Draft Environmental Impact Statement

Odessa Subarea Special Study

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. 10-12-006

October 2010

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.

United States Department of the Interior
BUREAU OF RECLAMATION
Columbia-Cascades Area Office
1917 Marsh Road
Yakima, Washington 98901-2058

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:

CCA-1100
PRJ-3.00

OCT 26 2010

To: Interested Individuals, Organizations, and Agencies

Subject: Odessa Subarea Special Study Draft Environmental Impact Statement, Grant, Adams, Walla Walla, and Franklin Counties, Washington

Dear Ladies and Gentlemen:

Enclosed for your review and comment is the Draft Environmental Impact Statement (Draft EIS) for the Odessa Subarea Special Study.

In response to public concern regarding groundwater decline, Congress provided funding to Reclamation to investigate the problem. The Washington Department of Ecology (Ecology) agreed to partner with Reclamation, providing funding and collaborating on various technical studies. This Draft 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 with Columbia Basin Project surface water. A No Action Alternative, four partial-replacement alternatives, and four full-replacement alternatives are evaluated.

This Draft 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 Draft EIS.

This Draft EIS is available for a 60-day public review period. Comments may be submitted orally, electronically, or by mail. Oral comments may be presented at the following public meetings:

November 17, 2010, 3-7 p.m.
Town of Coulee Dam City Hall
300 Lincoln Avenue
Coulee Dam WA 99116

November 18, 2010, 3-7 p.m.
Grant County ATEC Building 1800
Big Bend Community College
7611 Bolling Street NE
Moses Lake WA 98837

The public meeting facilities are physically accessible. Persons needing accessibility accommodations, including sign language interpreters or other auxiliary aids, may contact Mr. Chuck Carnohan, Study Manager, at 509-575-5848, ext. 603; by fax to 509-454-5650; or by email to odessa@usbr.gov. Requests should be made as early as possible to allow sufficient time to arrange for accommodation.

Requests to make oral comments at the public hearings may be made at each hearing. Comments will be recorded by a court reporter. Speakers will be called in the order of their request.

Comments may also be submitted electronically to the Bureau of Reclamation, Attention: Mr. Chuck Carnohan, Study Manager, at odessa@usbr.gov; by fax to 509-454-5650; or by mail to the above address, by December 31, 2010. You should be aware that your entire comment, including your personal identifying information, will be made publicly available in the Final EIS. While you may request in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

For further information regarding this document or to obtain additional copies in printed form or on compact disk (CD-ROM), please contact Mr. Carnohan. In addition, the Draft EIS is available for viewing on the Internet at http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html.

Sincerely,

William D. Gray
Area Manager
Columbia-Cascades Area Office
Bureau of Reclamation

Derek I. Sandison
Director
Office of the Columbia River
Washington Department of Ecology

Enclosure

Draft 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	Mr. Charles A. Carnohan 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 15 West Yakima Avenue, Suite 200 Yakima, Washington 98902-3401 509-454-7673

Cooperating Agency:

Bonneville Power Administration

This Draft Environmental Impact Statement (Draft 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, four partial replacement alternatives and four full replacement alternatives are evaluated.

This Draft 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 Draft EIS.

This Draft EIS is available for a 60-day public review period. Comments are due to the above Bureau of Reclamation address by December 31, 2010.

SEPA FACT SHEET

Project Title: Odessa Subarea Special Study

Brief Description of Proposal:

The Bureau of Reclamation (Reclamation) and Washington State Department of Ecology (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 eight action alternatives that address the Purpose and Need. The eight action alternatives fall within two categories:

- **Partial Replacement:** This group of delivery alternatives focuses on enlarging 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).
- **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 the East Low Canal. Lands north of I-90 would be served by constructing an East High Canal system.

The eight action alternatives consist of four partial replacement alternatives and four full replacement alternatives. The four alternatives within each of the two replacement alternative categories consist of variations in the water supply options that would be used. **Four supply options are being considered** that would use storage from Banks Lake, Lake Roosevelt, or a new Rocky Coulee Reservoir, either individually or in combination, 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 existing storage in Banks Lake and Lake Roosevelt, resulting in drawdowns from both reservoirs; **Option C—Banks Lake and Rocky Coulee Reservoir**, would use existing storage in Banks Lake, plus a new Rocky Coulee Reservoir; and **Option D—Banks Lake, Lake Roosevelt, and Rocky Coulee Reservoir**, would use a combination of all three storage facilities.

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
15 West Yakima Avenue, Suite 200
Yakima, Washington 98902-3401

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 no sooner than late 2015 and continue in a phased manner for about 10 years.

Agency Contacts:

Derek I. Sandison
Department of Ecology
Office of Columbia River
15 West Yakima Avenue, Suite 200
Yakima, Washington 98902-3401
509-454-7673

Charles A. Carnohan
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 would generally 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:

October 26, 2010

Public Comment Period:

In accordance with WAC 197-11-455 and the National Environmental Policy Act (NEPA), Ecology and Reclamation will conduct a 60-day public comment period from November 2, 2010, to December 31, 2010.

Submitting Comments:

Comments on the Draft EIS should be submitted to:

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

Public Hearings:

The public hearings will be held from 3:00 p.m. to 7:00 p.m. on November 17, 2010, at the Coulee Dam Town Hall, 300 Lincoln Avenue, Coulee Dam, Washington, 99116, and on November 18, 2010, at the Grant County Advanced Technologies Center (ATEC) Building 1800, Big Bend Community College, 7611 Bolling Street NE, Moses Lake, WA 98837. The hearing facility is physically accessible to people with disabilities.

Document Availability:

Requests for paper or CD copies of the Draft EIS may be made to 509-575-5848, ext. 603.

TTY users may dial 711 to obtain a toll free TTY relay.

Requests for sign language interpretation for the hearing impaired should be submitted to Charles Carnohan at 509-575-5848, extension 603, or mailed to him at the address in the Addresses section.

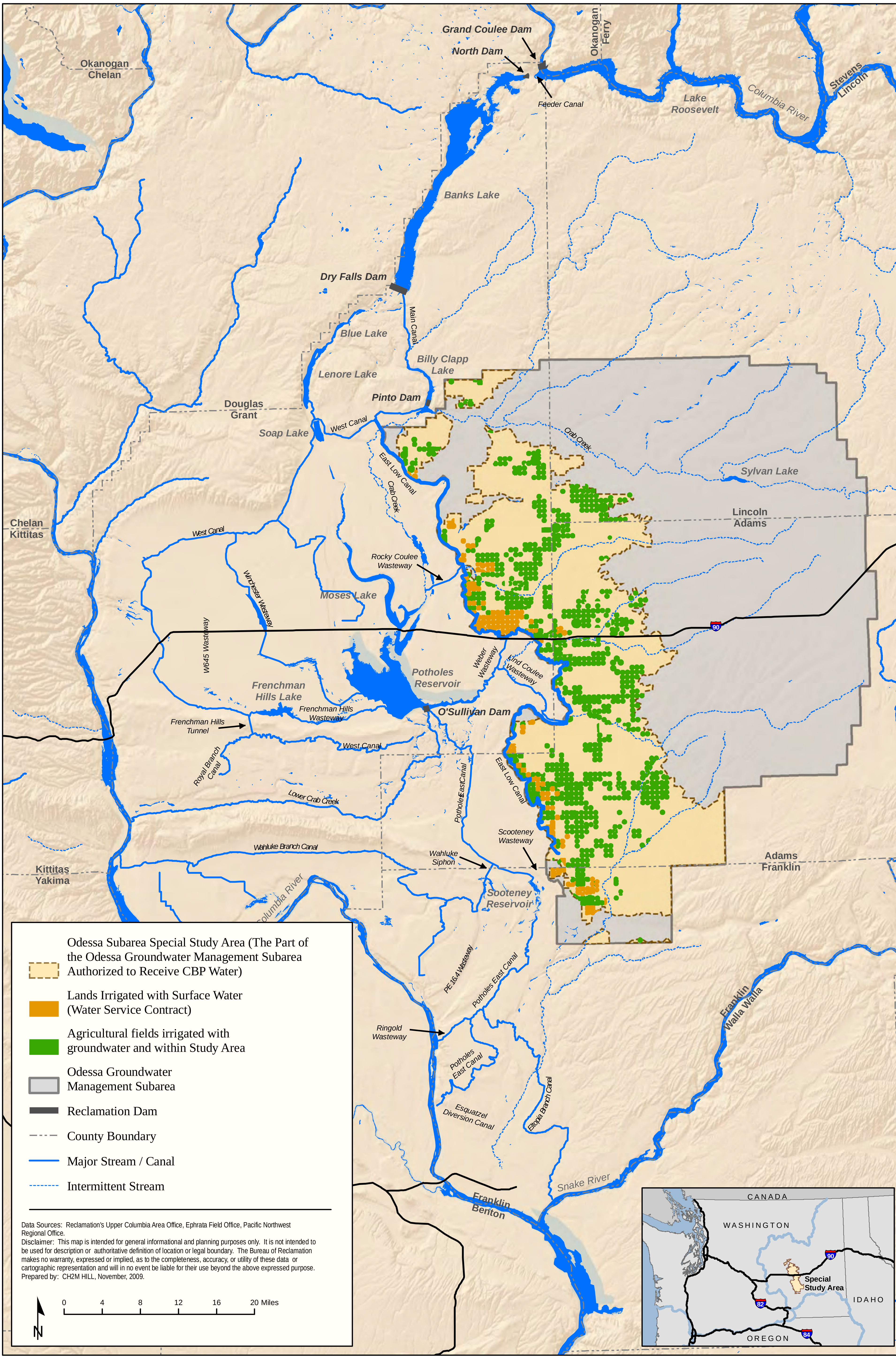
Spanish language interpretation requests should be made to Enedina Galvez at 509-575-5848. Si necesita usted interpretacion Español, llame por favor Enedina Galvez a 509-575-5848.

Location of Background Materials:

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

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

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



Odessa Subarea Special Study
Columbia Basin Project, Washington

Location Map

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ACRONYMS AND ABBREVIATIONS

Acronyms and Abbreviations

amsl	above mean sea level
aMw	average megawatts
APE	area of potential effect
ARPA	Archeological Resources Protection Act
ATV	all-terrain vehicle
BCA	benefit-cost analysis
BCR	benefit-cost ratio
bgs	below ground surface
BIA	Bureau of Indian Affairs
BMP	Best Management Practice
BO	Biological Opinion
BPA	Bonneville Power Administration
CBP	Columbia Basin Project
CBWA	Columbia Basin Wildlife Area
CFR	Code of Federal Regulations
cfs	cubic feet per second
CIG	Climate Impact Group
Corps	U.S. Army Corps of Engineers
CSRIA	Columbia Snake River Irrigator's Association
°C	degrees Celsius
°F	degrees Fahrenheit
dB	decibels
dBA	A-weighted decibel
DPS	District Population Segment
EC	electrical conductivity
ECBID	East Columbia Basin Irrigation District
Ecology	Washington State Department of Ecology
EDR	Environmental Data Resources, Inc.
EIS	Environmental Impact Statement
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
FERC	Federal Energy Regulatory Commission
FLIR	forward-looking infrared
FPPA	Farmland Protection Policy Act
FR	Federal Register
GHG	greenhouse gas
GIS	Geographic Information Systems
gpm	gallons per minute
GWMA	Columbia Basin Groundwater Management Area
HEP	Habitat Evaluation Procedures
HRFCPP	Hanford Reach Fall Chinook Protection Program
HSI	Habitat Suitability Index
I-	Interstate
IDC	interest during construction
IMPLAN	IMpact analysis for PLANning
ISAB	Independent Scientific Advisory Board
ITA	Indian trust asset
kcfs	thousand cubic feet per second
kWh	kilowatthours
Leq	equivalent sound pressure level
LRNRA	Lake Roosevelt National Recreation Area
LUST	leaking underground storage tank
µg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
µS/cm	microsiemens per centimeter
maf	million acre-feet
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
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
NPS	National Park Service
NR	not related
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 Groundwater 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
PSS	palustrine scrub-shrub wetlands
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
ROD	Record of Decision
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
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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EXECUTIVE SUMMARY

Executive Summary

Introduction

The U.S. Department of the Interior, Bureau of Reclamation (Reclamation) and Washington Department of Ecology (Ecology) are jointly preparing this Environmental Impact Statement (EIS) for the Odessa Subarea Special Study (Study). The purpose of the Study is to evaluate alternatives to deliver surface water from the Columbia Basin Project (CBP) to irrigated lands that currently rely on a declining groundwater supply from the Odessa Groundwater Management Subarea (Odessa Subarea, as shown on Figure 1). The CBP is a multipurpose water development project in the central part of the State of Washington (State), east of the Cascade Range. Lands within the Odessa Subarea that are eligible for surface water from the CBP comprise the Study Area for this EIS. The Study Area includes portions of Lincoln, Adams, Grant, and Franklin counties, as shown on Map 1, *Location Map*.

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 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, at an average decline rate of 6 to 8 feet per year, as shown on Map 2, *Groundwater Level Decline in Aquifers of the Odessa Subarea, 1981 to 2007*. 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.

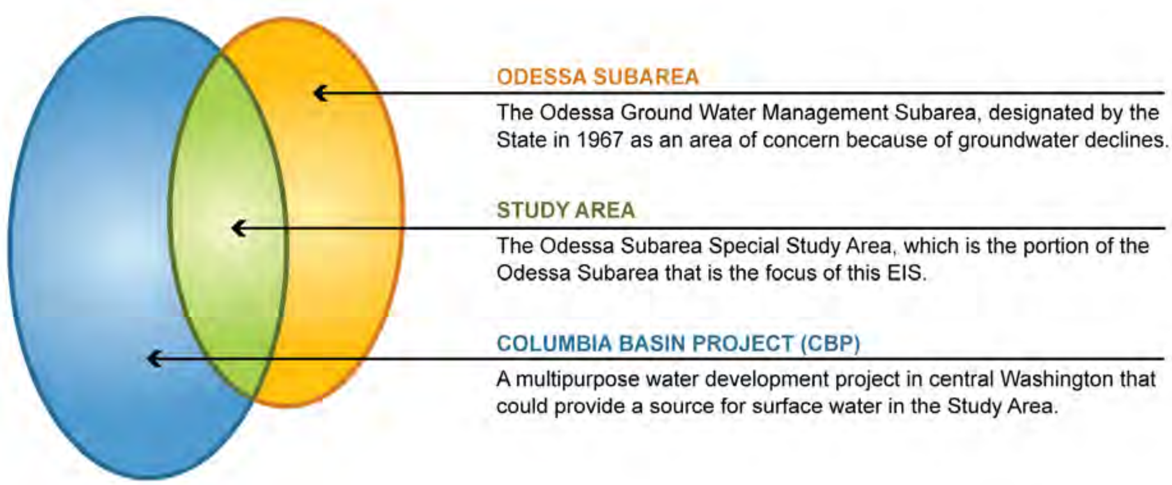


FIGURE 1
Common Terms Used in this EIS

Proposed Action

The proposed action is to replace groundwater 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.

The proposed action would deliver CBP water to the Study Area to replace groundwater under one of two scenarios:

- Partial groundwater replacement
- Full groundwater replacement

Partial replacement would deliver CBP water to irrigate approximately 57,000 acres of the 102,600 eligible acres in the Study Area. Partial replacement focuses on acreage located primarily south of Interstate Highway 90 (I-90) that can be served by the existing East Low Canal system (Map 1), although some modifications and expansion of the system would be required.

Full replacement would deliver CBP water to serve all or most of the approximately102,600 eligible acres in the Study Area. Full replacement would include the acreage south of I-90 (the same as partial replacement), plus remaining lands in the Study Area north of I-90 that would be served by constructing a new East High Canal system.

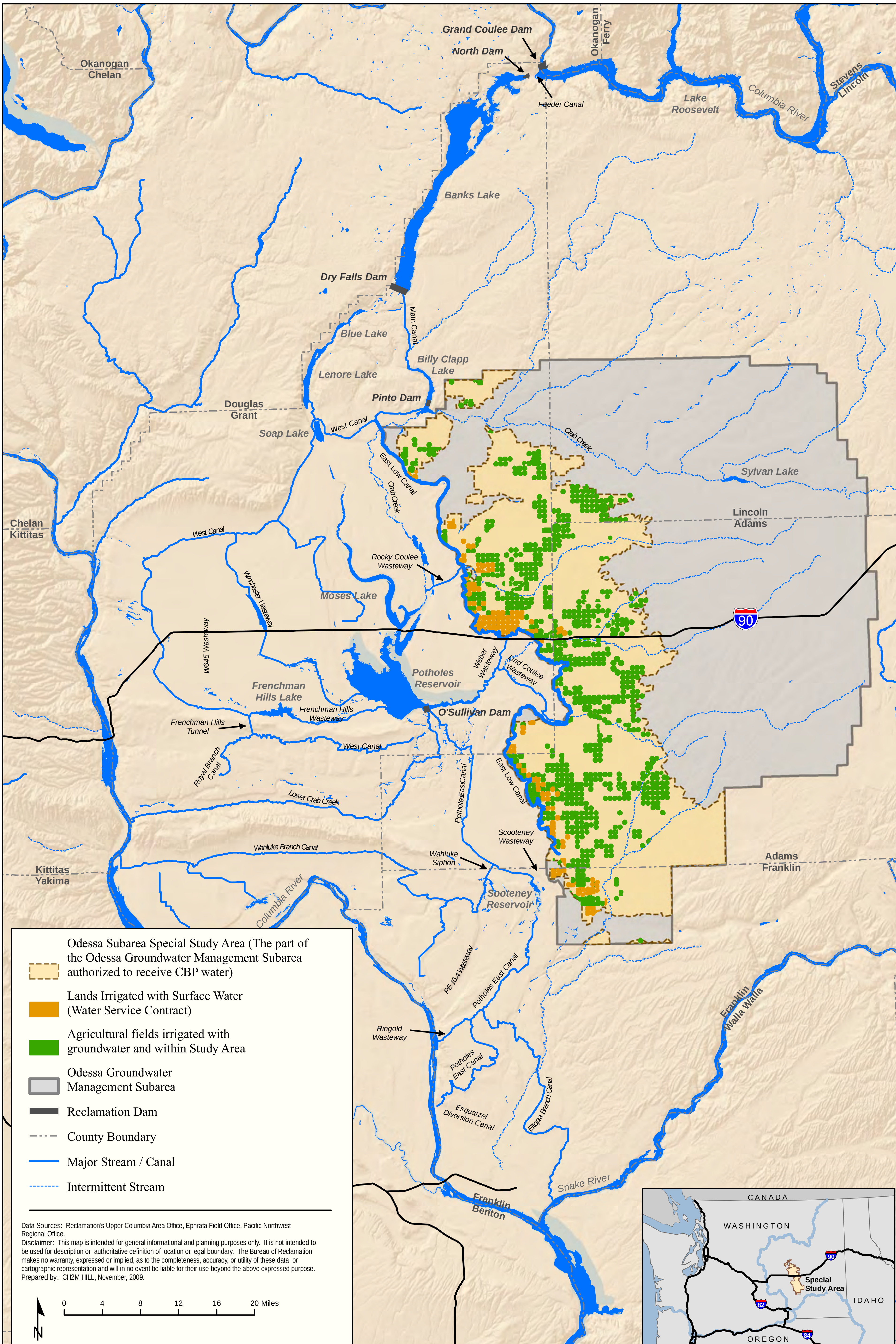
Either partial or full replacement would include construction of new or upgraded lateral canals and facilities, as well as the possible construction of new storage reservoirs. The types and extent of such construction would vary depending on the specific alternative selected.

Construction for either partial or full replacement is estimated to span a period of about 10 years. This work would be conducted in segments to allow the delivery system to be brought online in stages, as early and efficiently as possible.

What is Contained in the Draft EIS?

The purpose of the EIS is to analyze and disclose potential effects from the Proposed Action, and it contains the following information:

- *Executive Summary:* Summarizes the entire Draft EIS.
- *Chapter 1:* Describes the purpose of and need for the proposed action under the Study, and provides background information about water delivery in the CBP and Odessa Subarea.
- *Chapter 2:* Explains the process used to develop alternatives and describes the alternatives considered in this Draft EIS. Also, this chapter lists alternatives that were considered but eliminated, and compares the impacts of the alternatives and the consequences of not taking action.
- *Chapter 3:* Describes the current state of the environment and resources that could be affected by the proposed action and alternatives.
- *Chapter 4:* Analyzes and describes the impacts associated with each alternative considered in detail, and includes mitigation measures and environmental commitments.
- *Chapter 5:* Describes consultation and coordination activities with other Federal, Tribal, and State agencies and applicable laws and regulations.



Odessa Subarea Special Study
Columbia Basin Project, Washington

Map 1
Location Map

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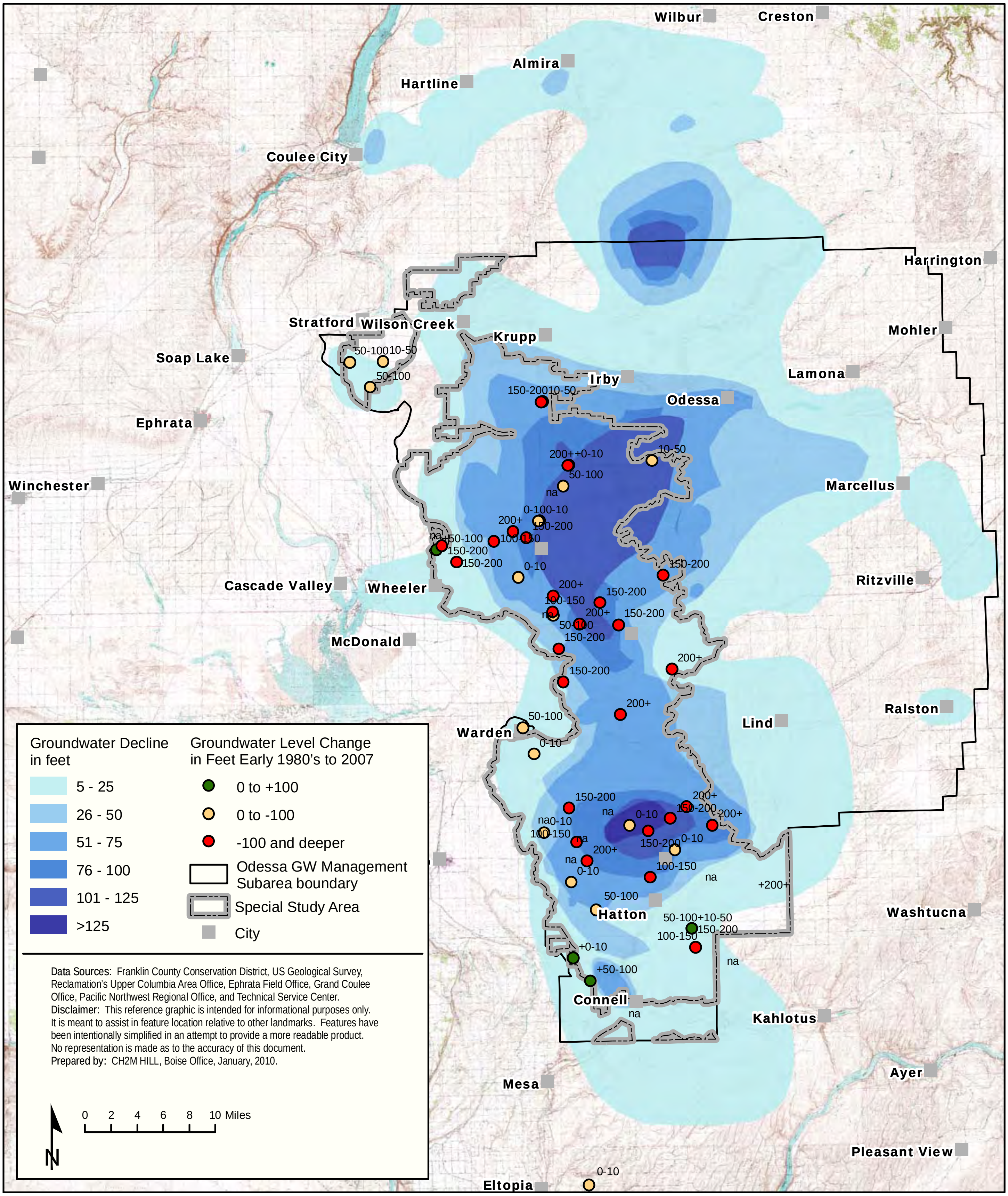

Odessa Subarea Special Study
Columbia Basin Project, Washington

Map 2

Groundwater Level Decline in Aquifers of the Odessa Subarea, 1981 to 2007

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

Purpose and Need

The purpose of the Study is to evaluate alternatives to replace groundwater supply with surface water to irrigate existing, groundwater-irrigated acres in the Odessa Subarea. This surface water would be provided as part of the continued phased development of the CBP, and would come from existing surface water rights in the Columbia River system. Reclamation can deliver water on up to approximately 102,600 acres authorized to receive CBP water in the Study Area.

Basis of Purpose

Measurements of groundwater levels in wells have shown a substantial decline in much of the Odessa Subarea since the 1980s, which are the earliest available measurements (Map 2). While not all wells have shown declines, the overall area of decline has spread and deepened over the past 30 years as wells have been drilled deeper. This has prompted public concern about the declining aquifers and associated economic and other effects, which resulted in a directive by the U.S. Congress and the Washington State legislature to investigate the problem.

Need

The Study is being conducted to evaluate and implement actions in response to four specific needs:

- Address declining groundwater supply for agriculture and other uses in the Study Area.
- Avoid significant economic loss to the region's agricultural sector because of continued decline of groundwater supply.
- Address environmental concerns and interests, including Columbia River seasonal flow objectives for salmon, steelhead, and habitats of importance to other sensitive species.
- Fulfill the commitment by Reclamation, the State, and CBP

irrigation districts to cooperatively conduct the Study.

Need—Address Declining Groundwater Supply for Agriculture and Other Uses

Groundwater decline in the Odessa Subarea has put the ability of farmers to irrigate their crops at risk. Domestic, commercial, municipal, and industrial users of groundwater are also affected. Declining groundwater supply has led to soil sodicity in parts of the Odessa Subarea by increasing use of deeper, older groundwater with high salinity and sodium content. Even those who irrigate from more shallow wells live with uncertainty about whether those wells will last. In the near term, the output from production wells in the Odessa Subarea will continue to steadily decrease. If no action is taken, it is estimated that, at the current rates of decline, about 70 percent of the production wells in the Odessa Subarea would cease production within 10 years.

Need—Avoid Significant 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 because of groundwater decline. Assuming that potato production and processing is lost from the region, the analysis estimated the regional economic impact would be a loss of about $630 million annually in regional sales, 3,600 jobs, and $211 million in regional income (Bhattacharjee and Holland 2005).

Since the publication of this purpose and need statement in the Federal Notice of Intent initiating the process for preparing this 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*.

Need—Address Environmental Concerns and Interests

The Study would address environmental concerns and interests, including Endangered Species Act (ESA) matters. For example, important objectives of the Study include ensuring that alternatives do not adversely affect the National Marine Fisheries Service's (NMFS) Columbia River seasonal flow objectives for salmon and steelhead, and that potential impacts are avoided or minimized to habitats of importance for other sensitive species.

Need—Fulfill Obligations to Improve Water Management and Delivery

This Study is needed to fulfill the commitment by Reclamation, the State, and CBP irrigation districts to cooperatively conduct the Study as stipulated in the Columbia River Initiative Memorandum of Understanding (MOU) in December 2004. The MOU promotes a cooperative process for activities to improve water management within the CBP. The Study implements Section 15 of the MOU, which states in part that, "[t]he parties will cooperate to explore opportunities for delivery of water to additional existing agricultural lands within the Odessa Subarea."

Photograph 2.
Dryland farming would likely replace irrigated agriculture if no action is taken, as shown in the background of this photo.

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 approved by Congress. These acts gave authority to the Secretary of the Interior (Secretary) to assess feasibility, approve plans, and build the CBP. Construction of the CBP was anticipated to occur in phases over a 70-year period to irrigate a total of 1.029 million acres.

To date, about 671,000 acres of currently-irrigated lands in the CBP have been developed. These acres were supplied with CBP water primarily in the 1950s and 1960s, with some additional acreage added sporadically until 1985. Prior studies examined the merits of continuing the incremental development of irrigated acreage in the CBP. However, for various reasons, additional development has not yet occurred.

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 it to be economically justified and financially feasible.

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. The State provided a cost-share through an Intergovernmental Agreement between Ecology and Reclamation in December 2005 to fund this Study.

In February 2006, the State legislature passed the Columbia River Water Resource Management Act (Management Act; Engrossed Substitute House Bill [ESHB] 2860). The Management Act authorizes 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 groundwater for agricultural users in the Odessa subarea aquifer." The Odessa Subarea is a high priority for the State (RCW 90.90.020, *Allocation and Development of Water Supplies*).

Scope

In general, the geographic scope of this EIS considers potential impacts on natural, social, and economic resources in the Study Area and the Odessa Subarea. The scope of the affected environment may vary for each resource and is explained in detail in EIS Chapter 3, *Affected Environment*.

In preparing this Draft EIS, **cumulative actions** are considered that include "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). The following cumulative actions are considered in EIS Chapter 4, *Environmental Consequences*:

- Potholes Supplemental Feed Route
- Lake Roosevelt Incremental Storage Releases Project
- Walla Walla Storage and Pump Exchange Study—only the aquifer storage and recovery portion
- Umatilla Basin Aquifer Recovery

Additional NEPA or SEPA processes may be conducted as detailed design is completed.

Alternatives

Reclamation and Ecology began with an appraisal-level investigation, completed in March 2008, that analyzed options for water delivery and supply that could provide replacement surface water to the Study Area (Reclamation 2008 Appraisal). Reclamation and Ecology also conducted public scoping meetings in September 2008 to obtain public input on the proposed Study, which helped formulate alternatives (Reclamation 2008 Scoping).

The alternatives considered in the Study include the No Action Alternative as required by NEPA and SEPA, and eight action alternatives that address the purpose and need. The action alternatives fall within the two categories of partial replacement or full replacement of surface water supply. The alternatives are shown on Map 3, briefly described in Table 1, and listed below:

1. No Action Alternative
2. Partial replacement alternatives:

    2A. Partial—Banks
    2B. Partial—Banks + FDR
    2C. Partial—Banks + Rocky
    2D. Partial—Combined

3. Full replacement alternatives:

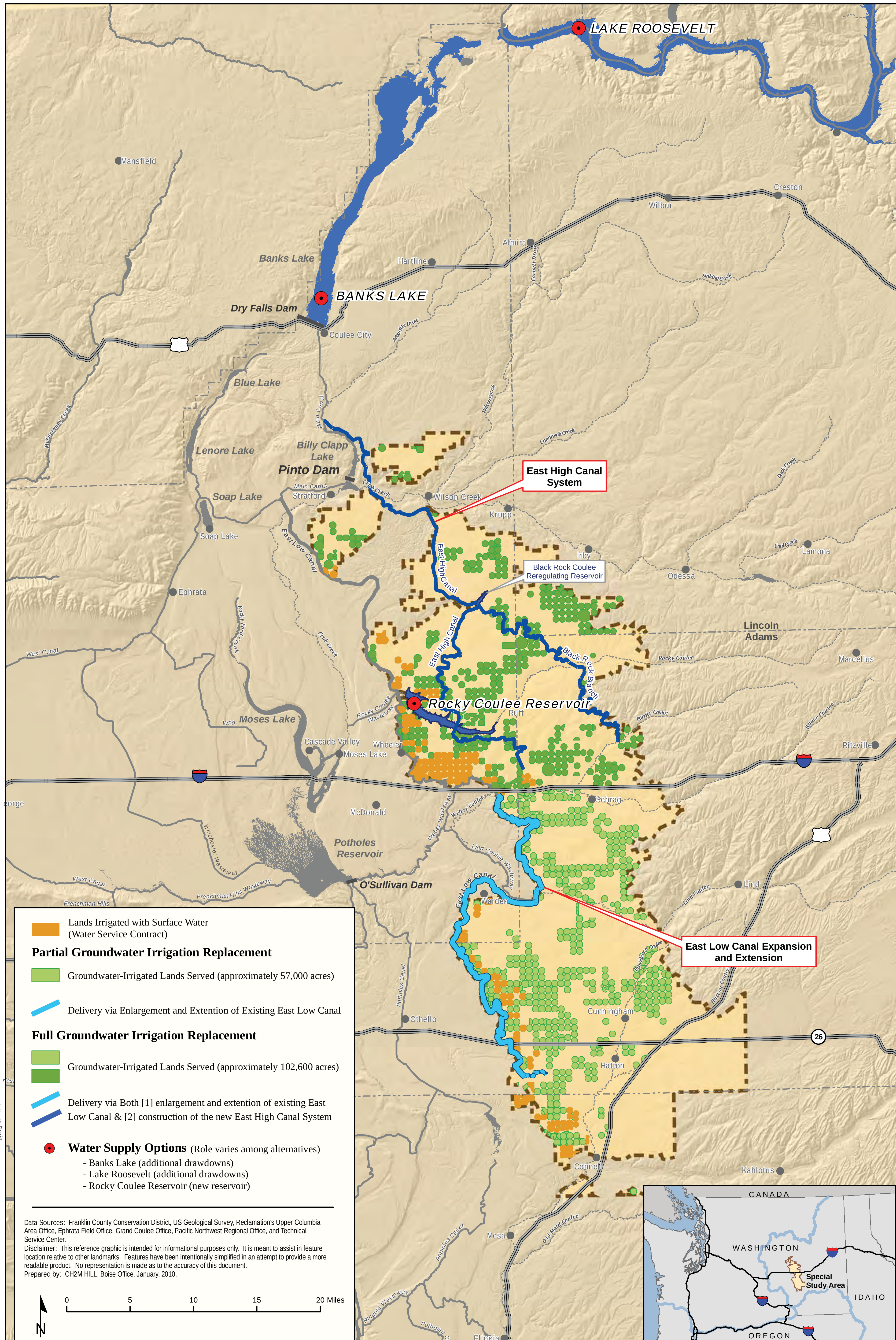
    3A. Full—Banks
    3B. Full—Banks + FDR
    3C. Full—Banks + Rocky
    3D. Full—Combined

TABLE 1

Key Features of the Study Alternatives

Delivery Alternative (see also Map 3)	Letter and Symbol*	Supply Alternative: Additional Drawdowns of Existing Reservoirs: Banks Lake	Supply Alternative: Additional Drawdowns of Existing Reservoirs: Lake Roosevelt (FDR)	Supply Alternative: New Rocky Coulee Reservoir
1 No Action • No CBP surface water provided to any additional groundwater-irrigated lands in the Odessa Subarea • No facility construction required • Current and ongoing Columbia River and CBP programs, commitments, and operations continue		Not Applicable		
2 Partial Groundwater Irrigation Replacement • Approximately 57,000 acres of groundwater-irrigated lands provided with CBP surface water • All lands supplied with surface water replacement would be south of I-90 • Water delivered by enlargement and extension of the existing East Low Canal and construction of a pressurized pipeline system • Current and ongoing Columbia River and CBP programs, commitments, and operations continue	2A	Yes	No	No
	2B	Yes	Yes	No
	2C	Yes	No	Yes
	2D	Yes	Yes	Yes
3 Full Groundwater Irrigation Replacement • Most groundwater-irrigated lands in the Study Area (approximately 102,600 acres) provided with CBP surface water (both north and south of I-90) • Water delivered south of I-90 by enlargement and extension of the existing East Low Canal and construction of a pressurized pipeline system • Water delivered north of I-90 by construction of a new East High Canal system, with an associated pressurized pipeline system • Current and ongoing Columbia River and CBP programs, commitments and operations continue	3A	Yes	No	No
	3B	Yes	Yes	No
	3C	Yes	No	Yes
	3D	Yes	Yes	Yes

*The symbol system shown on this table is used as an aid in identifying the alternatives. The center area shows the delivery alternative: partially or fully shaded to indicate partial or full replacement. The band surrounding the center shows the supply option. If a reservoir name is shown in black with white text, it is included in that alternative; the white, grayed-out reservoir is not included.



Map 3

Odessa Subarea Special Study
Columbia Basin Project, Washington

Overview of Action Alternatives:
Major Delivery and Supply Elements

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The Odessa Subarea Special Study Action Alternatives

Each of the eight action alternatives are composed of two aspects:

- **Delivery—**How much water is delivered to the Study Area, what lands would receive it, and facilities that would convey that water
- **Supply—**The combination of existing or new reservoirs that would provide stored water from the Columbia River

Half of the action alternatives would deliver water to *partially replace* the groundwater supply in the Study Area, and the other half would *fully replace* the groundwater irrigation supply. Within each of these two broad categories of partial and full replacement, four different *water supply options* are analyzed.

The four action alternatives within each of the two delivery categories vary in the water supply options that would be used. Supply options would use storage from Banks Lake, Lake Roosevelt, or a new Rocky Coulee Reservoir, either individually or in combination, as follows:

- **A: Partial—Banks**. Would use existing storage in Banks Lake, exclusively.
- **B: Partial—Banks + FDR**. Would result in drawdowns from both Banks Lake and Lake Roosevelt.
- **C: Partial—Banks + Rocky**. Would use existing storage in Banks Lake, plus a new Rocky Coulee Reservoir.
- **D: Partial—Combined**. Would use a combination of all three facilities.

Alternative Cost

Table 2 provides a summary of the estimated costs for the alternatives, including the total construction costs, interest during construction (IDC) costs, and the annual operation, maintenance, replacement, and power (OMR&P) costs. These costs are feasibility-level estimates developed for use only to compare alternatives. All the alternatives used the same assumptions and unit prices, so these are directly comparable from a cost standpoint.

Benefit-Cost Analysis

A benefit-cost analysis (BCA) was completed to compare the benefits of the 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.

Before comparisons can be made between costs and benefits, these must be converted to a common point in time. As is typical in Reclamation studies, the decision was made to measure all the costs and benefits at the end of the construction period. Since construction is divided into a series of phases, the end of the construction period was defined as the end of the last construction phase (year 2025). For more information about how the BCA was conducted, see Chapter 2, Section 2.8, *Benefit-Cost Analysis*.

Since all costs and benefits are estimated as changes from the No Action Alternative, a BCA was not developed for the No Action Alternative. The BCA for each of the action alternatives is shown on Table 3. The partial replacement alternatives have a more favorable BCR than the full replacement alternatives. Of the partial replacement alternatives, those that do not involve the additional costs of constructing Rocky Coulee Reservoir have an improved BCR. From a strictly economic perspective, Alternative 2A: Partial—Banks, and Alternative 2B: Partial—Banks + Rocky are the most favorable.

TABLE 2

Summary of Alternative Cost Estimates (millions of dollars)

Alternative	Construction Costs	IDC Costs	Total	Maximum Annual OMR&P Costs*
1: No Action	--	--	--	$3.3
2A: Partial—Banks	$728.3	$113.3	$841.6	$6.9
2B: Partial—Banks + FDR	$728.3	$113.3	$841.6	$6.9
2C: Partial—Banks + Rocky	$1,004.5	$160.4	$1,164.9	$7.9
2D: Partial—Combined	$1,004.5	$160.4	$1,164.9	$7.9
3A: Full—Banks	$2,582.4	$408.7	$2,991.1	$15.9
3B: Full—Banks + FDR	$2,582.4	$408.7	$2,991.1	$15.9
3C: Full—Banks + Rocky	$2,858.6	$455.8	$3,314.4	$17.0
3D: Full—Combined	$2,858.6	$455.8	$3,314.4	$17.0

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

TABLE 3

Results of BCA Based on Current Planning Rate of 4.375 Percent, Millions of Dollars

	Partial Replacement Alternatives				Full Replacement Alternatives			
Alternatives:	2A	2B	2C	2D	3A	3B	3C	3D
Total Benefits	1,170.2	1,170.2	1,170.2	1,170.2	1,820.5	1,820.5	1,820.5	1,820.5
Total Costs (including Lost Benefits)	1,276.7	1,276.7	1,726.1	1,726.1	4,148.6	4,148.6	4,597.9	4,597.9
Net Benefits (row 1 minus row 2)	-106.5	-106.5	-555.9	-555.9	-2,328.1	-2,328.1	-2,777.4	-2,777.4
Benefit-Cost Ratio (row 1 divided by row 2)	0.917	0.917	0.678	0.678	0.439	0.439	0.396	0.396

River and Reservoir Operational Changes Common to All Alternatives

Hydrologic modeling has been conducted to estimate the changes in river flows and reservoir operations (drawdown and refill patterns) that would accompany implementation of all Study alternatives. Throughout the EIS, potential future operations are analyzed in terms of representative water year scenarios, or hydrologic conditions, within the watershed:

- Wet condition: Only approximately 10 percent of years would be this wet or wetter
- Average condition: Half of years would be wetter and half drier

- Dry condition: Approximately 15 percent of years would be this dry or drier
- Drought condition: Only approximately 5 percent of years would be this dry or drier

Based on hydraulic modeling, none of the action alternatives would result in a significant change in Columbia River flows. All of the action alternatives would change the depth and timing of drawdowns beyond the No Action Alternative at Banks Lake. Drawdown patterns at Lake Roosevelt would also change in alternatives that use Lake Roosevelt storage. Such changes would not occur for Rocky Coulee Reservoir because it would be a new facility with no prior water supply commitments and no established or planned recreation or fishery values. Figures 2 and 3 illustrate the drawdowns for the partial and full replacement alternatives, compared to the No Action Alternative.

No Action Alternative (Alternative 1)

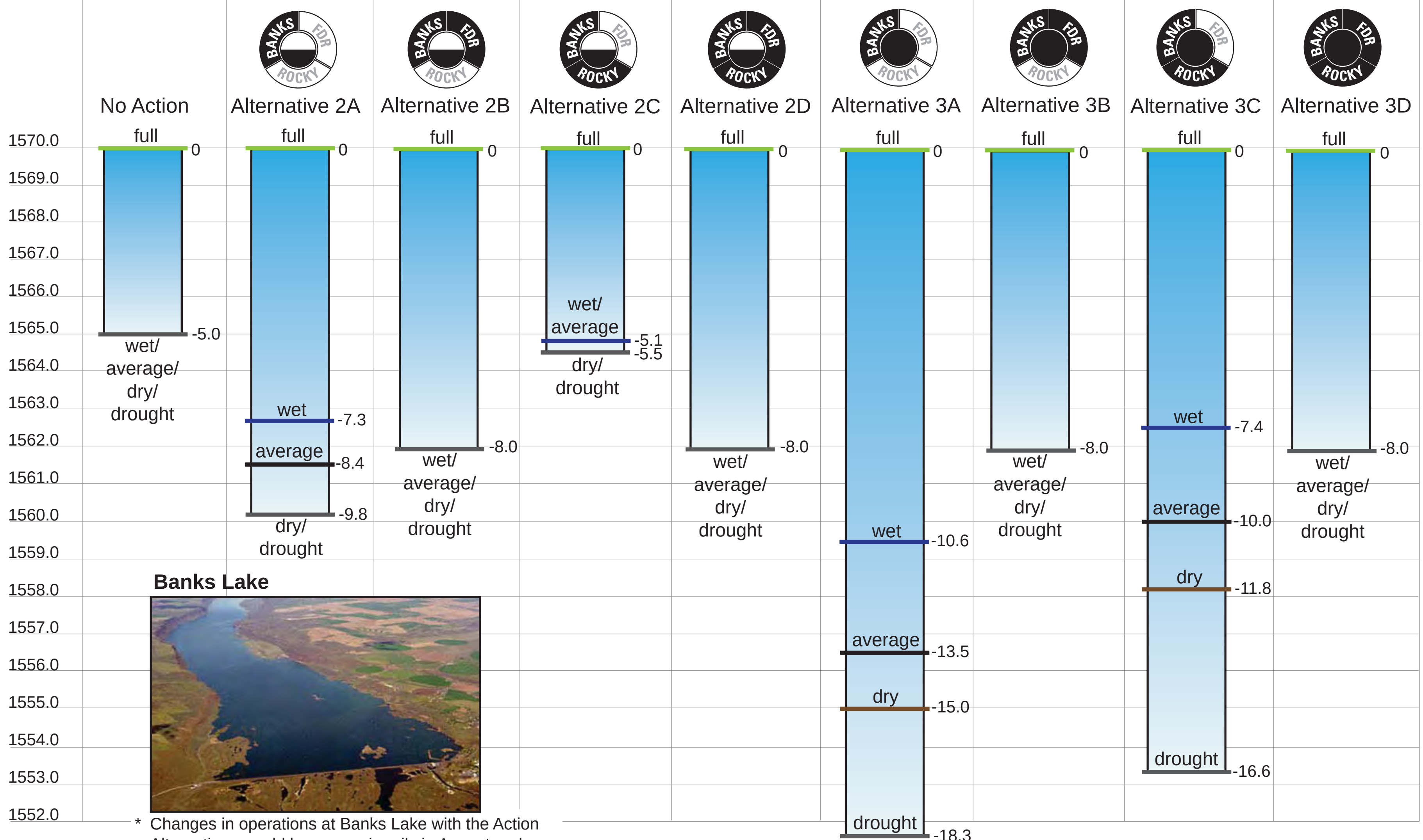
The No Action Alterative represents the foreseeable future if the proposed action is not implemented and groundwater levels continue declining in the Study Area aquifers. Under the No Action Alternative, no CBP facility expansion would occur to serve the Study Area, and irrigated agriculture that currently relies on groundwater would continue using that source of water. With continued groundwater pumping, aquifers would further decline, and well yield and irrigation capability, as well as the quality of water from the wells, would progressively diminish.

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

None of the Study's eight action alternatives would result in a significant change in Columbia River flows. Current instream flow requirements for the Columbia River would be met to protect the resource values associated with the mainstem of the Columbia River, including ESA-listed fish species in the river.

Instead, 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 four of the action alternatives. At both reservoirs, these changes would mean increased drawdowns—and therefore lower pool levels—when compared with the No Action Alternative. For the action alternatives, the increased drawdowns would cause the reservoirs to reach their lowest elevation at the end of August. The proposed Rocky Coulee Reservoir would be a working reservoir, filled and emptied each year exclusively to provide irrigation water supply.

Under the No Action Alternative, as groundwater levels continue declining, the percent of production wells in the Study Area that are permanently discontinued would increase from about 5 percent to 55 over the next 10 years (by approximately the year 2020). Over the same period, only about 15 percent of the production wells in the Study Area would continue to support irrigation for high-water crops, such as potatoes, compared to 35 percent under current conditions.



Banks Lake

* Changes in operations at Banks Lake with the Action Alternatives would be seen primarily in August and September, with the deepest drawdown seen generally on or near August 31 of each year. 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
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Figure 2
Banks Lake - End of August Drawdown*

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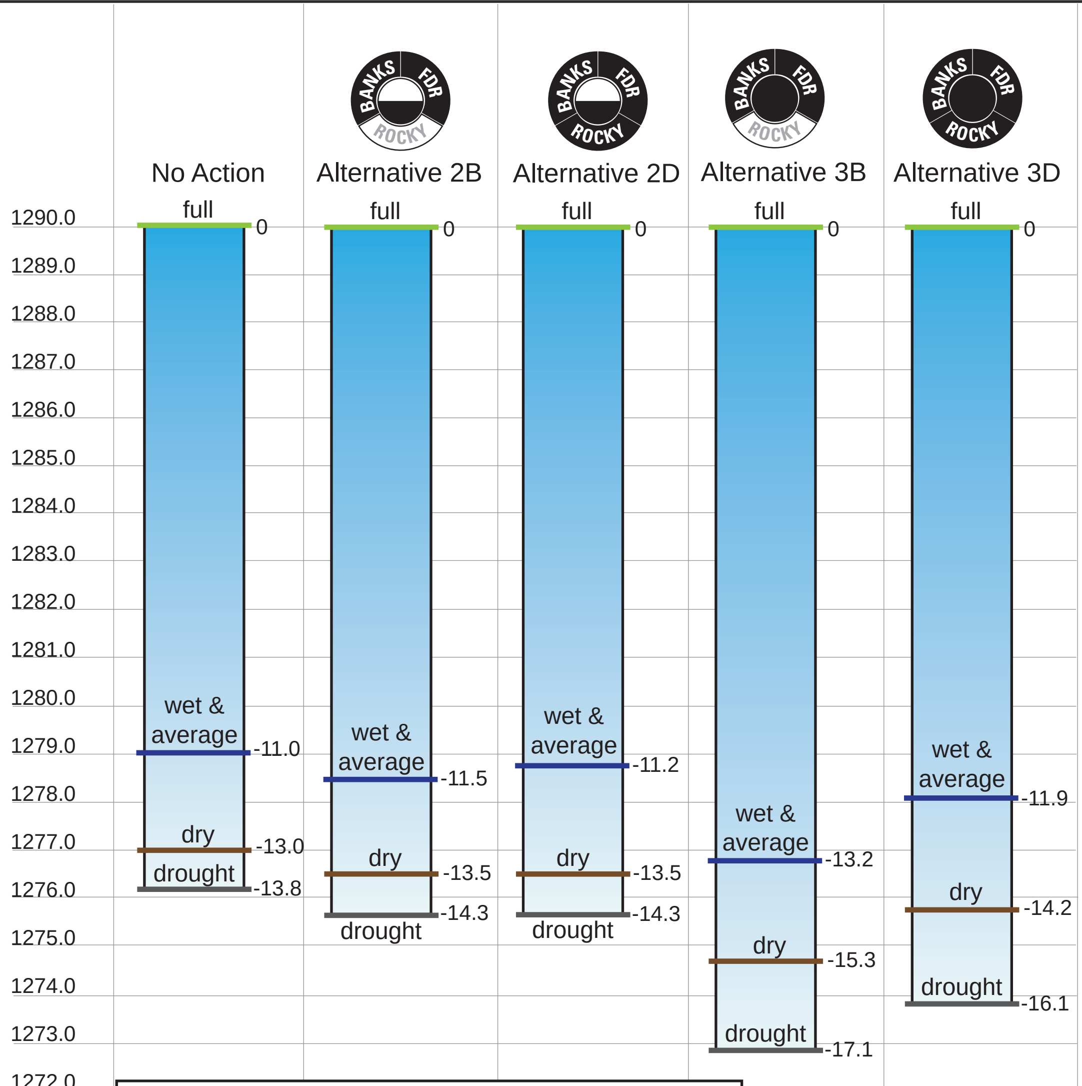

Modeled Representative Water Years

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

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.

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Figure 3
Lake Roosevelt - End of August Drawdown*

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High sodium concentrations in groundwater used for irrigation have caused soil sodicity conditions in parts of the Study Area. Soil sodicity can require application of soil amendments to maintain adequate surface soil structure and infiltration. Under the No Action Alternative, the need to apply soil amendments to maintain land in production would become more widespread if continued pumping of declining groundwater increases use of deeper, older groundwater of higher salinity and sodium content.

What is Soil Sodicity?

Soil sodicity can occur when soils accumulate high sodium concentrations through irrigation with groundwater containing high sodium content. Soils with high sodium concentrations may exhibit structural instability, which decreases water infiltration and inhibits plant growth. To maintain agricultural productivity, additives (often referred to as amendments) may have to be applied to neutralize the effects of high sodium concentrations.

Actions by the Columbia River Water Resource Management Program to pursue development of water supply alternatives to groundwater for agricultural users in the Odessa Subarea likely 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. As a result, the No Action Alternative would fail to meet this specific provision of Chapter 90.90 RCW.

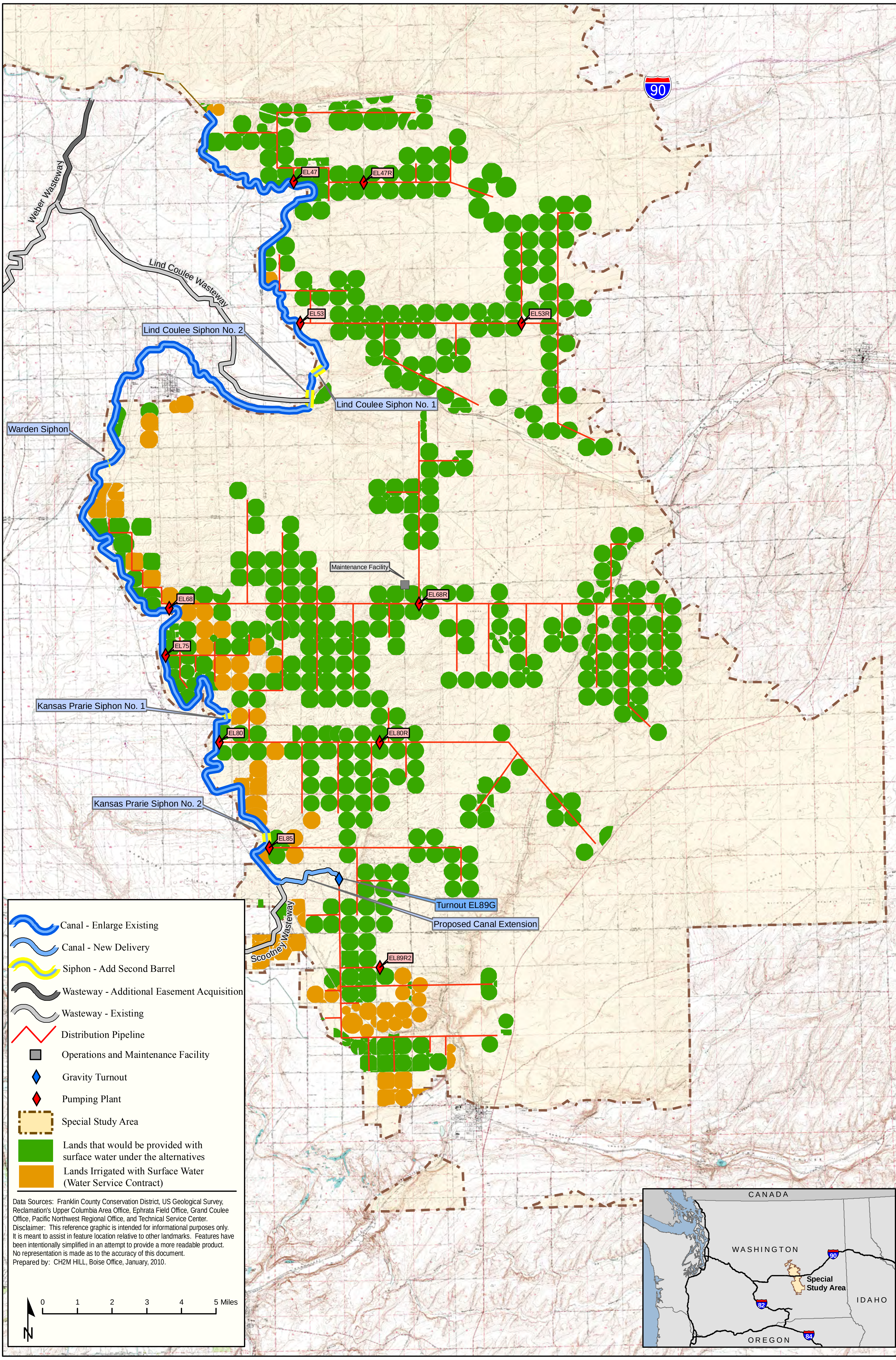
Under the No Action Alternative, operations at Lake Roosevelt and Banks Lake would continue to provide water supply to meet authorized CBP purposes, including water delivery for irrigation, fish management, municipal and industrial uses, and support of recreation. The Lake Roosevelt Incremental Storage 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. 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 use of groundwater for existing irrigation.

Partial Replacement Action Alternatives (Alternatives 2A through 2D)

Each of the four partial replacement alternatives would provide CBP surface water supply to approximately 57,000 acres of lands in the Study Area south of I-90, as shown on Maps 3 and 4. The total volume of water associated with partial groundwater replacement is estimated at 176,343 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.

The four partial replacement alternatives differ only in the combination of reservoirs used to provide the necessary water supply. As shown on Table 1, all four of these alternatives would use storage in Banks Lake. One alternative would use Banks Lake exclusively, two others would use Banks Lake in combination with either Lake Roosevelt or a new Rocky Coulee Reservoir, and the final alternative would use all three sources in combination.

As the surface water supply system is brought online and this water becomes available to eligible lands, the intent would be to quit using associated irrigation wells. Under current State regulations, the irrigation wells would not be decommissioned or abandoned. Instead, 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). However, the State is exploring the option of conducting a rulemaking process to require that these wells be fully decommissioned, at least in some areas or circumstances.



Map 4

Odessa Subarea Special Study
Columbia Basin Project, Washington

Partial Groundwater Irrigation Replacement Alternatives: Delivery System Facility Development & Modification

(Applicable to Alternatives 2A through 2D)

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Partial Replacement Delivery System Facility Requirements

Major facility development would be necessary to deliver CBP water for the four partial replacement alternatives. These facilities are shown on Map 4 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
- Extending the East Low Canal in an new 600 foot-wide easement
- Creating a pressurized pipeline distribution system to get the water to farmlands, consisting of buried pipelines, pumping plants, and transmission lines
- Building a new operations and maintenance facility
- 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

Rocky Coulee Reservoir (included in Alternatives 2C and 2D)

A new Rocky Coulee Reservoir would be built as part of partial replacement alternatives 2C: Partial—Banks + Rocky, and 2D: Partial—Combined. The location of the reservoir is shown on Map 3. This new facility would involve acquisition of an 8,960-acre site and would store 117,900 acre-feet of water delivered from the existing East Low Canal. The reservoir would be a fully "working" facility, emptied during the irrigation season and refilled from the Columbia River and Banks Lake in the fall.

Partial Replacement River and Reservoir Operational Changes

The additional drawdowns that would occur at Banks Lake with the four partial replacement alternatives are illustrated on Figure 2, in context with the No Action Alternative and the full replacement alternatives. Additional drawdowns at Lake Roosevelt under Alternatives 2B: Partial—Banks + FDR, and 2D: Partial—Combined are shown on Figure 3.

In both reservoirs, the additional drawdowns associated with the alternatives would reach their maximums at the end of August each year. These drawdowns in average years are summarized on Table 4.

TABLE 4

Partial Replacement Alternatives—Reservoir Drawdown Changes

	End-of-August Drawdowns*	
Alternative	**Total**	**Beyond No Action**
Banks Lake		
2A: Partial—Banks	8.4	3.4
2B: Partial—Banks + FDR	8.0	3.0
2C: Partial—Banks + Rocky	5.1	0.1
2D: Partial—Combined	8.0	3.0
Lake Roosevelt		
2B: Partial—Banks + FDR	11.5	0.5
2D: Partial—Combined	11.2	0.2

*Feet in average years

Photograph 3.
Native shrub steppe habitat in the northern part of the Study Area that would be impacted by the full replacement alternatives.

Full Replacement Action Alternatives (Alternatives 3A through 3D)

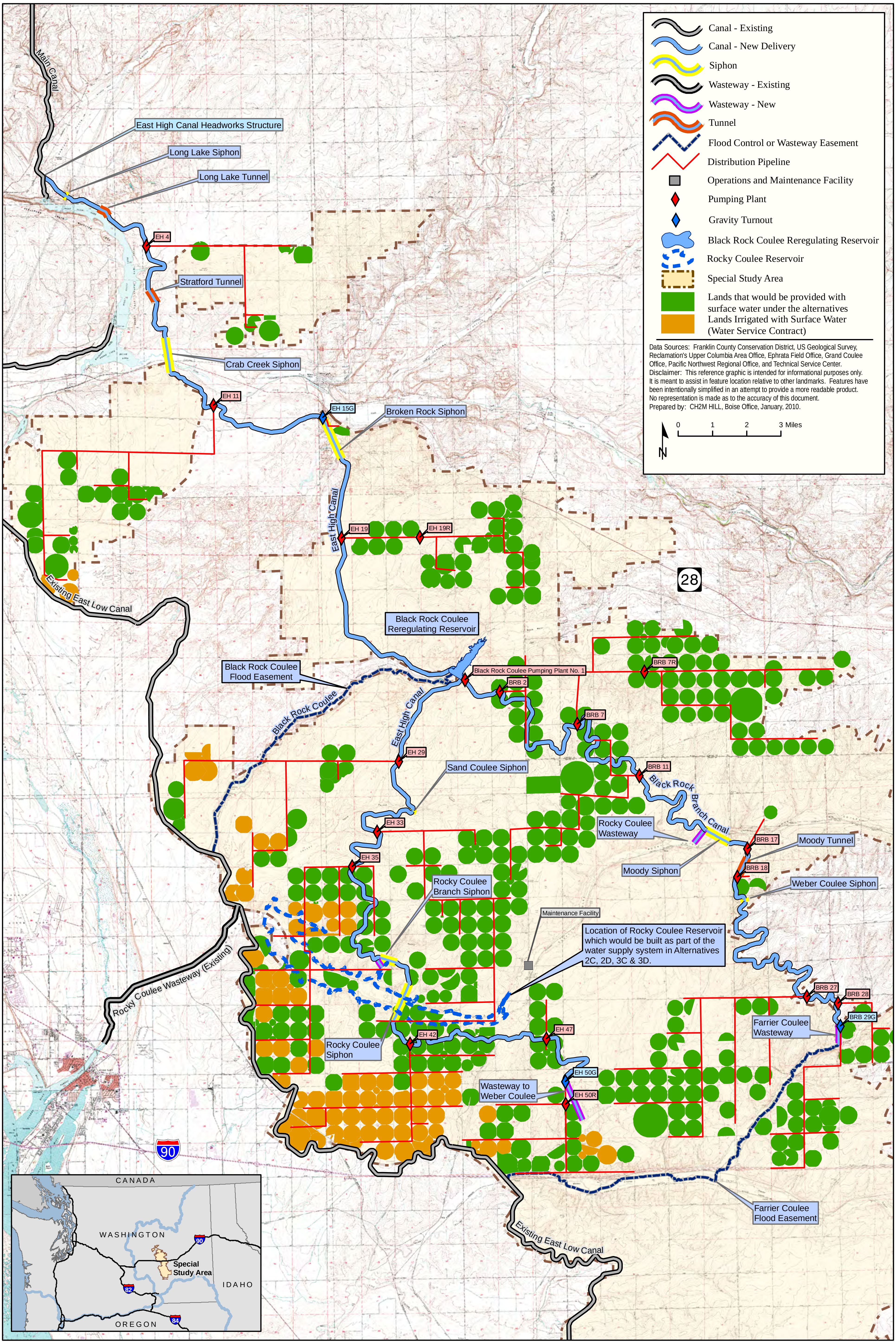
Each of the four full replacement alternatives would provide CBP surface water supply to replace existing groundwater supply for most lands in the Study Area now irrigated with groundwater (approximately 102,600 acres), both north and south of I-90. The total volume of water would be 347,137 acre-feet. As described for the partial replacement alternatives, the intent would be to cease operation of associated irrigation wells as the new surface supply comes online.

The four full replacement alternatives differ only in the combination of reservoirs used to provide the necessary water supply. As shown on Table 1, all four of these alternatives would use storage in Banks Lake. One alternative would use Banks Lake exclusively, two others would use Banks Lake in combination with either Lake Roosevelt or a new Rocky Coulee Reservoir, and the final alternative would use all three sources in combination.

Full Replacement Delivery System Facility Requirements

Major facility development would be necessary to deliver CBP water for the four full replacement alternatives. The following facilities are in addition to all the facilities described south of I-90 for the partial replacement alternatives, and would be located north of I-90, as shown on Map 5:

- Building the East High and Black Rock Branch canals, including associated siphons and tunnels, in a new 600-foot-wide easement
- Adding a headworks facility along the existing Main Canal to route water into the new East High Canal
- Building a reregulating reservoir in Black Rock Coulee, including a pumping plant to lift water to the Black Rock Branch Canal
- Creating four new wasteway channels for canal flow management in 600-foot-wide easements
- Creating a pressurized pipeline distribution system to get the water to farmlands, consisting of buried pipelines, pumping plants, and transmission lines
- Building a new operations and maintenance facility
- Gaining flood control easements along Black Rock and Farrier Coulees



Map 5

Odessa Subarea Special Study
Columbia Basin Project, Washington

Full Groundwater Irrigation Replacement Alternatives: Delivery System Facility Development & Modification

(Applicable to Alternatives 3A through 3D; Facilities shown are in addition to those required for Partial Replacement--See Map 4)

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Rocky Coulee Reservoir (included in Alternatives 3C and 3D)

A new Rocky Coulee Reservoir would be built as part of full replacement Alternatives 3C: Full—Banks + Rocky, and 3D: Full—Combined. All specifications of this facility, including site requirements, storage capacity, construction and operations would be the same as described under the partial replacement alternatives.

Full Replacement River and Reservoir Operational Changes

The additional drawdowns that would occur at Banks Lake and Lake Roosevelt with the four full replacement alternatives are illustrated on Figures 2 and 3, in context with the No Action Alternative and the partial replacement alternatives. 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. For the full replacement alternatives, these drawdowns in average years are summarized on Table 5.

TABLE 5

Full Replacement Alternatives—Reservoir Drawdown Changes

	End-of-August Drawdowns*	
Alternative	**Total**	**Beyond No Action**
Banks Lake		
3A: Full—Banks	13.5	8.5
3B: Full—Banks + FDR	8.0	3.0
3C: Full—Banks + Rocky	10.0	5.0
3D: Full—Combined	8.0	3.0
Lake Roosevelt		
3B: Full—Banks + FDR	13.2	2.2
3D: Full—Combined	11.9	0.9

*Feet in average years

Alternatives Considered But Not Carried Forward

Major delivery alternatives that were considered but eliminated included full replacement using only a new East High Canal system both north and south of I-90, and partial replacement using the existing capacity in the East Low Canal. The first of these was eliminated because of cost and environmental concerns, as compared to serving eligible lands by expanding the existing East Low Canal. The second was eliminated because it could only serve less than half of eligible lands and would not meet the purpose and need.

Major supply options considered but eliminated included the following:

- Raising Banks Lake—eliminated because of cost and environmental impact concerns
- Potholes Reservoir reoperation—eliminated due to elevation in the CBP system and conflicting flood control requirements
- Lake Roosevelt as sole supply—eliminated because of conflicts with existing water management programs and requirements, and high impact on recreation and shoreline resources
- New reservoirs in Dry Coulee and Lower Crab Creek—both eliminated because of high cost and environmental impact concerns

Summary of Environmental Consequences

The consequences of the alternatives, including the No Action Alternative, are fully described in Chapter 4 of the Draft EIS. Tables 6 and 7 give a brief overview of the consequences of the No Action Alternative and impacts of the partial and full replacement alternatives. Table 6, *Summary Benefits or Impacts from the Alternatives for Specific Areas within Affected Resource Topics,* provides a summary of the relative magnitude of benefits and adverse impacts expected under each of the nine alternatives. The table only includes resource topics, such as "Groundwater," "Vegetation," and "Land Use," where benefits and adverse impacts were determined in the analysis for this Draft EIS, as described in detail in Chapter 4, *Environmental Consequences*. Resource topics with no impacts or minimal impacts, such as "Air Quality" and "Geology," are not listed on this summary.

Table 7, *Overview of the Impacts and Benefits Associated with the No Action, Partial Replacement, and Full Replacement Alternatives*, compares the alternatives by resource areas.

In the remainder of this section, the resource areas with impacts or beneficial effects, as shown on Table 6, are described further. The following resource areas have no notable beneficial effects or adverse impacts, and are not discussed further after Table 7:

- Surface Water Quantity
- Water Rights
- Geology
- Soils
- Threatened and Endangered Species
- Air Quality
- Public Services and Utilities
- Public Health
- Indian Trust Assets
- Indian Sacred Sites
- Environmental Justice

How Do Most Alternatives Measure Up Against Each Other?

Both the adverse impacts and beneficial effects of the alternatives are directly related to how much land would receive CBP surface water to replace failing groundwater supplies.

For the No Action Alternative, the same beneficial effects and adverse impacts generally apply across the entire Study Area, because none of the lands would receive a replacement water supply. Similarly, the full replacement alternatives would have the same types of impacts and effects across the entire Study Area, because CBP water would be delivered throughout the Study Area.

For the partial replacement alternatives, effects and impacts tend to be the same as expected for the No Action Alternative on lands north of I-90 because these lands would not receive a replacement water supply. Effects and impacts on lands south of I-90 tend to be similar to those for the full replacement alternative in that portion of the Study area.

Groundwater Resources

The shallow and deep aquifer systems beneath the Study Area are the area's primary source of municipal, industrial, domestic, and irrigation water. The deep aquifers are being depleted within and beyond the Study Area as a result of large-scale pumping. Consequently, groundwater users must pump from greater and greater depths as wells dry up and require deepening. This may impact all groundwater users, including those in nearby towns.

TABLE 6
Summary Benefits or Impacts from the Alternatives for Specific Areas within Affected Resource Topics

↑↑	↑	◊	↓	↓↓
Beneficial Effect		↔		Adverse Impact

Resource Topic and Effect Area	No Action	Partial Replacement Alternatives				Full Replacement Alternatives			
		2A	2B	2C	2D	3A	3B	3C	3D
Groundwater: Depth and Quality Declines	↓↓	↓	↓	↓	↓	↑	↑	↑	↑
Municipal and Industrial Users	◊	◊	◊	◊	◊	↑	↑	↑	↑
Water Quality: Banks Lake Temperature and Dissolved Oxygen	◊	↓	↓	◊	↓	↓↓	↓	↓↓	↓
Lake Roosevelt Temperature and Dissolved Oxygen	◊	◊	◊	◊	◊	◊	↓	◊	◊
Salinity of Water Placed on Fields	◊	↑	↑	↑	↑	↑	↑	↑	↑
Vegetation and Wetlands: Native Plants	◊	↓	↓	↓	↓	↓↓	↓↓	↓↓	↓↓
Habitat Fragmentation	◊	◊	◊	◊	◊	↓↓	↓↓	↓↓	↓↓
Special Status Plants	◊	◊	◊	◊	◊	↓↓	↓↓	↓↓	↓↓
Habitat Restoration	◊	◊	◊	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓
Wetland Loss or Functional Decline	◊	◊	◊	◊	◊	↓↓	↓↓	↓↓	↓↓
Wildlife: Shrub-Steppe Habitat	◊	↓	↓	↓	↓	↓↓	↓↓	↓↓	↓↓
Wildlife Movement Barriers	◊	◊	◊	◊	◊	↓↓	↓↓	↓↓	↓↓
Special Status Species	◊	↓	↓	↓	↓	↓↓	↓↓	↓↓	↓↓
Habitat Fragmentation	◊	◊	◊	◊	◊	↓↓	↓↓	↓↓	↓↓
Fisheries and Aquatic Resources: Condition of Banks Lake Fishery	◊	◊	◊	◊	◊	↓↓	↓	↓↓	↓
Impact on Invertebrate Production	◊	↓	↓	◊	↓	↓↓	↓	↓↓	↓
Land Use and Shoreline Resources: Changes in Ownership and Status	◊	↓	↓	↓	↓	↓↓	↓↓	↓↓	↓↓
Protection of Irrigated Agriculture	↓↓	↑	↑	↑	↑	↑↑	↑↑	↑↑	↑↑
Structures and Land Uses Displaced	◊	↓	↓	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓
Consistency with Plans and Policies	↓↓	↑	↑	↑	↑	↑↑	↑↑	↑↑	↑↑
Recreation: Boating at Banks Lake*	◊	↓	↓	↓	↓	↓↓	↓	↓↓	↓
Fishing at Banks Lake	◊	◊	◊	◊	◊	↓↓	↓	↓↓	↓
Swimming at Banks Lake*	↓	↓	↓	↓	↓	↓↓	↓	↓↓	↓↓
Camping and Day Use at Banks Lake	◊	↓	↓	◊	↓	↓↓	↓	↓↓	↓
Irrigated Agriculture: Gross farm income	↓	↑	↑	↑	↑	↑	↑	↑	↑
Socioeconomics: Employment, and Regional Income and Sales	↓	↑	↑	↑	↑	↑	↑	↑	↑
Transportation: Roads and Crossings	◊	◊	◊	↓↓	↓↓	◊	◊	↓↓	↓↓
Energy: Change in regional availability	◊	↓	↓	↓	↓	↓↓	↓↓	↓↓	↓↓
Noise: Short-term Construction Noise	◊	↓	↓	↓	↓	↓	↓	↓	↓
Visual: Landscape-Level Change	↓↓	↓	↓	↓	↓	◊	◊	◊	◊
New Developed Facilities	◊	↓	↓	↓	↓	↓↓	↓↓	↓↓	↓↓
Reservoir Drawdown Changes	◊	↓	↓	◊	↓	↓↓	↓	↓↓	↓
Cultural Resources: Potential for Impact to Significant Resources	◊	↓	↓	↓	↓	↓↓	↓↓	↓↓	↓↓

***Prior to mitigation**

Resource Topics with No Notable Beneficial Effects or Adverse Impacts:

- Surface Water Resources
- Water Rights
- Geology
- Soils
- Threatened and Endangered Species
- Air Quality
- Public Services and Utilities
- Public Health
- Indian Trust Assets
- Indian Sacred Sites
- Environmental Justice

TABLE 7
Overview of the Impacts and Benefits Associated with the No Action, Partial Replacement, and Full Replacement Alternatives

Resource Topic	No Action	Partial Groundwater Irrigation Replacement Alternatives	Full Groundwater Irrigation Replacement Alternatives
Surface Water Resources	No impact	No or minimal impacts on instream flow requirements for the Columbia River and at Lake Roosevelt. Changes would occur throughout the Study Area on flows and to areas that receive water. Minimal impacts from additional Banks Lake drawdown in part or all of August and September. Minimal impact from inundation of Rocky Coulee Reservoir.	Same as partial replacement alternatives, plus minimal impact from inundation by Black Rock Coulee Reregulating Reservoir (Alternatives 3C and 3D).
Groundwater Resources	Significant impact as groundwater declines continue throughout the Odessa Subarea.	Groundwater declines continue north of I-90 (significant impact). Groundwater declines would stop south of I-90 (important beneficial effect). Minimal to important beneficial effect on municipal and industrial users south of I-90. No impact or minimal beneficial effect on shallow groundwater south of I-90.	Groundwater declines would stop throughout the Study Area (important beneficial effect). Minimal to important beneficial effect on municipal and industrial users throughout the Study Area. No impact or minimal beneficial effect on shallow groundwater throughout the Study Area.
Water Quality	No impact	No impact on temperature, dissolved oxygen, and heavy metals at Lake Roosevelt. Minimal impact on temperature and total dissolved gas in the Columbia River. No or minimal impact on turbidity at Banks Lake. Significant impact on temperature and dissolved oxygen at Banks Lake under alternatives 2A, 2B, and 2D. No or minor impacts or benefits on water quality within the rest of the analysis area.	Same as partial replacement alternatives, except an adverse impact on temperature at Lake Roosevelt. Significant impact on temperature and dissolved oxygen at Banks Lake under all alternatives.
Water Rights	No impact	No impact	No impact
Geology	No impact	No to minimal impact	No to minimal impact
Soils	The need to apply soil amendments to maintain land in production would become more widespread if continued pumping of declining groundwater increases use of deeper, older groundwater of higher salinity and sodium content.	Significant impact under the Farmland Protection Policy Act. Legal requirements would reduce impacts.	Significant impact, but legal requirements would reduce impacts.
Vegetation and Wetlands	No impacts on upland vegetation or wetlands.	Significant impacts on native plant communities. No or minimal impacts on other vegetation or wetlands for Alternatives 2A and 2B. Greater impacts on native plant communities and requirement for restoration of disturbed habitat for Alternatives 2C and 2D because of Rocky Coulee Reservoir.	Significant impacts because facilities would disturb a large area of native communities and cause fragmentation of native plant communities. Significant impacts on special status plants, habitat restoration requirements, and wetland loss for Alternatives 3A and 3B. Alternatives 3C and 3D would impact a larger area because of Rocky Coulee Reservoir.
Wildlife and Wildlife Habitat	Minimal impact on wildlife that use farm lands because wheat fields would be fallowed every other year.	Significant impacts on intact shrub-steppe habitat and several special status species, including migratory birds. No to minimal impacts from barriers to wildlife movement or habitat fragmentation.	Significant impacts over substantially larger areas of native shrub-steppe habitat than under the partial replacement alternatives. Canals would result in significant barriers to movement by wildlife, habitat fragmentation, and locally lower wildlife population viability on small isolated areas. Significant impacts on multiple special status species and migratory birds, involving substantially larger area of effect and a larger number of species than under the partial replacement alternatives.

TABLE 7
Overview of the Impacts and Benefits Associated with the No Action, Partial Replacement, and Full Replacement Alternatives

Resource Topic	No Action	Partial Groundwater Irrigation Replacement Alternatives	Full Groundwater Irrigation Replacement Alternatives
Fisheries and Aquatic Resources	No impact	No to minimal impacts on downstream migration of salmonid smolts, upstream migration of adult salmon and steelhead in the Columbia River, and on Chum salmon spawning below Bonneville Dam. No to minimal impacts on zooplankton production and the rainbow trout net pen program in Lake Roosevelt and kokanee salmon spawner access to San Poil River from Lake Roosevelt. No to minimal impacts on fish and zooplankton entrainment and the overall condition of the fishery at Banks Lake. Drawdowns that would occur under Alternatives 2A, 2B, and 2D would result in substantially more exposure of Banks Lake littoral habitat in some years and represent a significant impact on invertebrate production. Overall, the temporary dewatering of benthic macroinvertebrates is not expected to be sufficient enough to significantly affect fish populations in Banks Lake.	Same as partial replacement alternatives, except a significant impact on the overall condition of the fishery at Banks Lake in all water year conditions under Alternatives 3A and 3C. Under Alternatives 3B and 3D, the significant impact on the overall condition of the fishery at Banks Lake would only occur during drought water year conditions. Drawdowns that would occur under all full replacement alternatives would result in substantially more exposure of Banks lake littoral habitat in some years and represent a significant impact on invertebrate production. Overall, the temporary dewatering of benthic macroinvertebrates is not expected to be sufficient enough to significantly affect fish populations in Banks Lake.
Threatened and Endangered Species	No impact	No impacts on terrestrial species and no to minimal impacts on downstream migration of salmonid smolts, upstream migration of adult salmon and steelhead in the Columbia River, and on Chum salmon spawning below Bonneville Dam.	Same as partial replacement alternatives except for a potential minor beneficial effect on downstream migration of salmonid smolts under Alternative 3C.
Air Quality	No impact	Minimal impact	Minimal impacts, somewhat greater than those of the partial replacement alternatives.
Land Use and Shoreline Resources	Significant impact in the Study Area, centered on change from irrigated agriculture to dryland farming conditions and inconsistency with county plans for irrigated agriculture.	Significant impact similar to No Action on groundwater-irrigated lands north of I-90. South of I-90, important beneficial effect with continuation of irrigated agriculture and related support for county plans. However, significant land acquisition requirements and related impacts on existing land uses including residences, center pivot irrigation systems, and agricultural land in general. Number and acreage of land ownership and land use impacts would be substantially higher for alternatives that include Rocky Coulee Reservoir.	Important beneficial effect throughout the Study Area, with continuation of irrigated agriculture and related support for county plans. Significant land acquisition requirements and related impacts on existing land uses, including residences, center pivot irrigation systems, and agricultural land in general. Number and acreage of impacts with Alternatives 3A and 3B substantially greater than 2A and 2B, but also substantially less than 2C and 2D because Rocky Coulee Reservoir is not included. Impacts under Alternatives 3C and 3D would be the highest magnitude and extent of all the action alternatives.

TABLE 7
Overview of the Impacts and Benefits Associated with the No Action, Partial Replacement, and Full Replacement Alternatives

Resource Topic	No Action	Partial Groundwater Irrigation Replacement Alternatives	Full Groundwater Irrigation Replacement Alternatives
Recreation Resources	Significant impact on developed swimming areas for 2 weeks in late August in average years. Otherwise, no impact. Adverse impact to hunting and wildlife viewing throughout the Study Area due to loss of irrigated agriculture.	Significant impacts to reservoir-oriented facilities and activities in August and September at Banks Lake in average years: - Without mitigation, reduction in boat launch capacity and related impacts on fishing access, camping, and day use: o Alternative 2A—1 week in North and Steamboat sectors and 4 weeks in Middle and South sectors o Alternative 2B—5 weeks in Middle and South sectors o Alternative 2C—1 week in Middle and South sectors, and o Alternative 2D—5 weeks in Middle and South sectors Impact would be mitigated. - Without mitigation, loss of usability at developed swimming sites for 6 weeks with Alternatives 2A and 2B, 2 weeks with Alternative 2C, and 7 weeks with Alternative 2D. Impact would be mitigated. - Additional exposure of rocks and shoals and distance to shore impacts at recreation sites proportional to additional depth of drawdown. Impact would be mitigated through public information and education. - Adverse “distance to shoreline” impacts at camping and day use facilities. Impact would be proportional to depth of additional drawdown and is not subject to mitigation. Minimal impact to recreation resources and activities at Lake Roosevelt. Adverse impact to hunting and wildlife viewing in the Study Area north of I-90 due to loss of irrigated agriculture.	Significant impacts to reservoir-oriented facilities and activities in August and September at Banks Lake in average years: - Without mitigation, reduction in boat launch capacity and related impacts on fishing access, camping, and day use: o Alternative 3A—6 weeks in North and Steamboat sectors and 10 weeks in Middle and South sectors o Alternative 3B—5 weeks in Middle and South sectors o Alternative 3C--3 weeks in North and Steamboat sectors and 7 weeks in Middle and South sectors, and o Alternative 3D--7 weeks in Middle and South sectors Impact would be mitigated. - Without mitigation, loss of usability at developed swimming sites for up to 12 weeks with Alternative 3A, 6 weeks with Alternative 3B, and 9 weeks with Alternative 3C, and 8 weeks with Alternative 3D. Impact would be mitigated. - Additional exposure of rocks and shoals and distance to shore impacts at recreation sites proportional to additional depth of drawdown. Impact would be mitigated through public information and education. Minimal impact to recreation resources and activities at Lake Roosevelt.
Irrigated Agriculture	Adverse Impact: gross farm income in 2025 would be estimated at $42.7 million and would represent less than three percent of the approximately $1.6 billion total gross farm income for the four-county analysis area.	Beneficial effect: Increase in gross farm income would be estimated at $36.5 million in 2025 and would represent less than three percent of the approximately $1.6 billion total gross farm income for the four-county analysis area.	Beneficial effect: Increase in gross farm income would be estimated at $65.7 million in 2025 and would represent less than five percent of the approximately $1.6 billion total gross farm income for the four-county analysis area.
Socioeconomics	Minimal adverse impact: Four-county analysis area would see a small (less than 1 percent) net decrease in jobs, labor income, and sales	Minimal beneficial effects: Less than 2 percent increase in jobs, labor income, and regional sales for the four-county area compared to the No Action Alternative	Minimal beneficial effects: Less than 6 percent increase in jobs, labor income, and regional sales for the four-county area compared to the No Action Alternative

TABLE 7
Overview of the Impacts and Benefits Associated with the No Action, Partial Replacement, and Full Replacement Alternatives

Resource Topic	No Action	Partial Groundwater Irrigation Replacement Alternatives	Full Groundwater Irrigation Replacement Alternatives
Transportation	No impact	Significant impact on local circulation with Alternatives 2C and 2D resulting from road closures caused by Rocky Coulee Reservoir. Transportation Management Plan would keep other potential impacts to minimal levels.	Same as partial replacement alternatives for Rocky Coulee Reservoir. Additional adverse impact to local roads north of I-90 because of new canal crossings; Transportation Management Plan would minimize adverse impacts.
Energy	No impact	Short-term impacts to the regional energy surplus would be minimal. However, over the long term (10-year horizon), the reduction in regional energy availability would have an adverse impact. The net reduction in available energy relative to projected surplus by 2017 would be about 11 to 14 percent.	Short-term impacts to the regional energy surplus would be minimal. However, over the long term (10 year horizon), the reduction in regional energy availability would have significant impact. The net reduction in available energy relative to projected surplus by 2017 would be about to 23 to 31 percent.
Public Services and Utilities	No impact	No to minimal impacts on services or utilities.	Same as partial replacement alternatives
Noise	No impact	Localized adverse impact from short-term construction noise levels and minimal impact from long-term increases in noise levels near pumping plants.	Same as partial replacement alternatives
Public Health	No impact	Minimal impact	Same as partial replacement alternatives
Visual Resources	Significant impact in the Study Area with change from irrigated agriculture to dryland farming conditions; perception of whether impact is adverse would vary among viewers.	South of I-90, significant localized impacts because of visually prominent new infrastructure. North of I-90, same as the No Action Alternative. Adverse impact on visual quality in August and September at Banks Lake resulting from additional drawdowns under Alternatives 2A, 2B, and 2D.	Significant localized impacts throughout the Study Area from introduction of visually prominent new infrastructure. Significant impact on visual quality at Banks Lake in August and September from additional drawdowns in average years under Alternative 3A and in dry and drought years under Alternative 3C. Adverse impact in most years under Alternatives 3B and 3D.
Cultural Resources	No impact	Potential for adverse impact to significant resources with all alternatives as a result of facility construction and additional drawdowns at Banks Lake. Existing regulatory processes and consultation requirements would ensure appropriate surveys and impact avoidance or mitigation as part of implementing any action alternative.	Same as partial replacement alternatives
Indian Sacred Sites and Indian Trust Assets	No impact	No known impacts would occur to sacred sites or trust assets. Existing regulatory processes and consultation requirements would ensure appropriate surveys and impact avoidance or mitigation as part of implementing any action alternative.	Same as partial replacement alternatives
Environmental Justice	No impact	No disproportionate impacts to minority or low-Income populations.	Same as partial replacement alternatives

The No Action Alternative would have long-term significant impacts. 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, and increased pumping head and costs. At some point, using groundwater to grow high water demand crops would become uneconomical.

In the partial replacement alternatives, groundwater levels in the Study Area south of I-90 would be anticipated to stabilize, which would be an important beneficial effect for all users. Groundwater levels north of I-90 would continue to decline and be significantly impacted. In the full replacement alternatives, groundwater levels both south and north of I-90 would be anticipated to stabilize.

Surface Water Quality

Surface water quality issues associated with the Odessa Subarea Special Study alternatives consist of potential changes to temperature, dissolved oxygen, total dissolved gas, pH, nutrients, and heavy metals at Lake Roosevelt, Banks Lake, the Columbia River downstream of Grand Coulee Dam, and in the Study Area Irrigation Network. The No Action Alternative would have no impact on water quality in Lake Roosevelt, Banks Lake, or the Columbia River. The Study Area irrigation network would experience a minor beneficial effect because of decreased delivery of pesticides and fertilizers to the canal and drain system because of the switch to dryland agriculture conditions.

Lake Roosevelt water quality, in terms of temperature and dissolved oxygen, would generally experience only a minimal impact from any of the action alternatives. Banks Lake water quality, particularly temperature and dissolved oxygen, would be significantly impacted under all of the partial and full replacement alternatives except Alternative 2C: Partial—Banks + Rocky. The impacts of additional drawdown in Banks Lake on temperature and dissolved oxygen would be greatest in Alternative 3A: Full—Banks and Alternative 3C: Full—Banks + Rocky.

Water quality in the Columbia River downstream of Grand Coulee Dam, particularly temperature and total dissolved gas, would experience only a minimal impact from any of the action alternatives. Either no impacts or minimal beneficial effects to water quality in the irrigation network would be expected.

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. The following terms are used to describe the level of impact or effect within each of the alternatives:

- Neutral or Negative (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 established for each resource area
  - Significant impact: Violates one of the significance criteria
- Positive (from least to most effect):
  - Beneficial effect
  - Important beneficial effect

Vegetation and Wetlands

The action alternatives would impact both native upland vegetation and wetlands. No impacts to vegetation or wetlands are expected at Lake Roosevelt under any of the alternatives.

Photograph 4.
Wetlands have developed below seeps from the East Low Canal. This is one of several wetland mitigation options.

South of I-90, there would be loss of shrub steppe vegetation and wetlands adjacent to the East Low Canal. Impacts to wetlands surrounding Banks Lake would primarily shift the plant community composition and would not be significant. Additional long-term significant impacts to upland vegetation would occur with the construction of Rocky Coulee Reservoir under action alternatives that include this component.

Long-term impacts under the full replacement alternatives would be similar to the partial replacement alternatives, but would impact substantially larger areas. 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 Branch Canals. There would be significant impacts to Washington-listed rare or sensitive plant species under all of the full replacement alternatives. Significant wetland impacts would occur near the East Low and East High canals, and the area of the proposed Black Rock Coulee Reregulating Reservoir. Primary impacts to wetlands around Banks Lake would range from shifts in community composition to reduced area of wetlands, which constitute adverse to significant impacts.

Mitigation measures that Reclamation and Ecology have committed to for uplands include limiting construction disturbance to the rights-of-way, reseeding with local species where needed, conducting a weed inventory and controlling weeds, and developing detailed mitigation plans. For wetlands, the specific mitigation approach would be based on wetland permit terms and conditions, but would include enhancing or replacing wetlands lost as a result of new facility construction or operation.

Wildlife and Wildlife Habitat

Both native and non-native wildlife habitats would be impacted by the action alternatives. The extent of shrub steppe habitat in eastern Washington has declined dramatically, largely because of conversion to agriculture. Any further losses would be significant. The wildlife analysis is based on changes in the amount of available habitat identified in the vegetation studies, WDFW studies at the sites of major proposed facilities, and the effect of habitat fragmentation and movement barriers on wildlife.

A shift from irrigated agriculture to dryland farming under the No Action Alternative would cause minimal impacts to wildlife that use irrigated croplands.

Under all of the action alternatives, long-term significant impacts to wildlife would occur as a result of lost shrub steppe habitat. Additional long-term significant impacts would occur to special status species and migratory birds under all of the action alternatives as a result of drawdowns at Banks Lake and reduced nesting habitat. The extent of these impacts would be greater in duration and 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 and fragment native shrub steppe habitat, thereby isolating some segments of animal populations and reducing long-term local population viability.

Wildlife habitat impacts would be mitigated through the revegetation work planned to address impacts to upland vegetation. The extent to which impacted wildlife would reoccupy revegetated sites would depend on the success of the revegetation efforts, which would take 15 years or more. Expected wildlife use of the canal crossings would be increased by preserving a triangular shaped area of native vegetation on the approaches so that they match the surrounding habitat type. However, the effectiveness of these crossings for many species may be limited because of their narrow width and dual use as maintenance roads.

Fisheries

Potential impacts of the action alternatives on fisheries and aquatic resources were assessed in Lake Roosevelt, Banks Lake, and the Columbia River downstream of Grand Coulee Dam that provides essential habitat for anadromous salmonids.

Under the No Action Alternative, no short- or long-term impacts on fisheries and aquatic resources would occur. Since changes in the reservoir pool at Lake Roosevelt would not differ greatly from current conditions, no to minimal impacts are expected on the fishery in that reservoir.

Photograph 5.
High value wetland and riparian habitat borders several areas on the east side of Banks Lake.

For the Columbia River, the greatest reduction in flows would occur in September and October when adult fall Chinook salmon and steelhead trout are migrating up the lower and mid-Columbia River. However, no impacts to these adult migrating fish are anticipated. 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 not be impacted. During the salmonid smolt downstream migration season from mid-April through August, flows would either not change or the changes would be so small that no or non-measurable minimal impacts would be expected. Minimal impacts on salmonid smolt survival during the spring months would be expected in some years for the four alternatives that would not use Lake Roosevelt storage.

Projected summer water surface elevations in Banks Lake would be lower and would last for longer periods under the action alternatives compared to the No Action Alternative. Impacts may include the potential for reduced habitat availability for various life stages of fish, shifts in zooplankton production, and increased fish and zooplankton entrainment. Drawdowns that would occur under Alternatives 2A, 2B, and 2D would expose Banks Lake littoral habitat in August and significantly impact invertebrate production. Overall, the temporary dewatering of benthic macroinvertebrates is not expected to be sufficient enough to significantly affect fish populations in Banks Lake. Under the partial replacement alternatives, no to minimal long-term impacts to fisheries and aquatic resources would likely occur. Similar, but more extensive, drawdown effects on invertebrates would occur under each of the full replacement alternatives. However, significant impacts would be expected for fish populations and some other aquatic species because of the greater extent and duration of drawdowns, especially in dry years.

Land Use and Shoreline Resources

Concerns related to land use and shoreline resources focus on changes in land ownership, changes in existing land uses, and consistency with relevant plans, programs, and policies. No significant impacts to water bodies under the State Shoreline Management Act would occur with any of the alternatives.

Given that the exact location of facilities has not yet been determined, mitigation to avoid or minimize impacts could take place during detailed design. Such mitigation could include adjusting facility alignments to avoid displacing of residences, irrigation facilities, and agricultural uses to the extent feasible.

Land Ownership

The No Action Alternative would not involve major changes in land ownership in the Study Area. The action alternatives would require significant acquisition of land interests by Reclamation for water delivery systems. Land interests that would need to be acquired include easements for linear facilities such as canals, wasteways, pipelines and transmission lines, and fee title to sites for pumping plants, operations and maintenance facilities, and reservoirs. Acquisition requirements for the action alternatives are summarized in Table 8.

Photograph 6.
Shrub steppe and talus habitat types are important for wildlife.

Easement and fee title requirements for the full replacement delivery system would be much greater than those for the partial replacement alternatives. Also, fee title acquisition requirements are greater for alternatives that include Rocky Coulee Reservoir.

TABLE 8

Land Interest Acquisition Requirements of the Action Alternatives

	Easement Acquisition			Fee Title Acquisition		
	Acres	Private Land	Parcels Affected	Acres	Private Land	Parcels Affected
Alternatives 2A and 2B: Partial Replacement Alternatives without Rocky Coulee Reservoir	5,209	95%	327	85	95%	25
Alternatives 2C and 2D: Partial Replacement Alternatives with Rocky Coulee Reservoir	5,209	95%	327	9,023	96%	145
Alternatives 3A and 3B: Full Replacement Alternatives without Rocky Coulee Reservoir	19,689	95%	1307	1,525	99%	120
Alternatives 3C and 3D: Full Replacement Alternatives with Rocky Coulee Reservoir	19,689	95%	1307	10,463	96%	240

Most of the land involved in these acquisitions is private. The majority of public land involved is State Trust land administered by the Washington Department of Natural Resources (WDNR), with minor holdings by other state and local jurisdictions.

Land and Shoreline Use

The No Action Alternative would significantly change land use as irrigated agriculture transitions to dryland farming conditions. This same change would occur on groundwater-irrigated lands north of I-90 under all partial replacement alternatives.

Beyond these broad changes, land use impacts would center on development of the facilities needed for the action alternatives.

The categories of existing land use that would be significantly impacted include residences, center pivot irrigation systems, and irrigated agriculture in general. Other impacted land uses would include dryland agriculture and open space and habitat lands. The impacts of action alternatives are summarized on Table 9.

Impacts of the full replacement alternatives would be substantially higher in all categories than those under the partial replacement alternatives. Also, for both the partial and full replacement alternatives, impacts would be much higher for alternatives that include Rocky Coulee Reservoir, which is reflected in Tables 8 and 9.

TABLE 9

Land Use Impacts of the Action Alternatives

	Developed Use/Facility Impacts		**General Land Use Impacts**					
	Residences/ Occupied Structures	**Center Pivot Irrigation Systems**	**Irrigated Agriculture**		**Dryland Agriculture**		**Open Space**	
			Acres	**%**	**Acres**	**%**	**Acres**	**%**
Alternatives 2A and 2B: Partial Replacement Alternatives without Rocky Coulee Reservoir	4	8	1,975	46%	685	16%	1,668	38%
Alternatives 2C and 2D: Partial Replacement Alternatives with Rocky Coulee Reservoir	19	44	5,802	46%	955	8%	6,509	46%
Alternatives 3A and 3B: Full Replacement Alternatives without Rocky Coulee Reservoir	17	71	4,150	22%	3,624	19%	10,936	59%
Alternatives 3C and 3D: Full Replacement Alternatives with Rocky Coulee Reservoir	32	107	7,977	29%	3,894	14%	15,777	57%

Photograph 7.
The shoreline along Lake Roosevelt offers respite from the summer heat.

Relevant Plans, Programs and Policies

All involved counties designate land in the Study Area as agriculture and emphasize the importance of irrigated agriculture. Also, many of the State lands in the Study Area are leased for irrigated agriculture as a revenue source for State Trust beneficiaries. The No Action Alternative would be broadly inconsistent with this plan and program framework throughout the Study Area. The partial replacement alternatives reflect the same inconsistency north of I-90. Only the full replacement alternatives support this framework throughout the Study Area.

Recreation Resources

All action alternatives would have some degree of significant impact on water-oriented recreation facilities and uses at Banks Lake. No significant impact would occur to recreational resources at Lake Roosevelt or in the Special Study Area with any of the alternatives.

Impacts at Banks Lake would be due to the additional drawdowns of the reservoir pool beyond the No Action Alternative necessary to provide irrigation water supply to the Study Area. These drawdowns would make some boat ramps unusable periodically each year under all alternatives. Most developed swimming sites would also become unusable periodically each year under all alternatives. Developed and dispersed day use and camping sites would be adversely impacted in two ways:

- Loss of adjacent boat launches and swimming site capacity
- Additional distance to water caused by lower pool elevation

These impacts would greatest at the end of August each year, when drawdowns reach their maximum depth.

Generally, impacts at Banks Lake would be more widespread, impact more facilities, and last longer under the full replacement alternatives than under the partial replacement alternatives. Alternative 3A: Full—Banks and Alternative 3C: Full—Banks + Rocky would have the most widespread impacts, with use limitations averaging 2 months. Alternative 2C: Partial—Banks + Rocky would have the least widespread and shortest duration impacts.

Photograph 8.
Camping facilities at Banks Lake.

Impacts related to loss of boat ramp and swimming area availability would be mitigated by developing replacement facilities or redeveloping existing facilities. Mitigation would include building swimming pools near affected recreation sites to provide community swimming areas, and extension or redesign of high-capacity boat ramps. Impacts related to increased distance to the water's edge could not be mitigated.

Irrigated Agriculture and Socioeconomics

In the four-county area, adverse impacts to gross farm income under the No Action Alternative would represent less than 3 percent of the regional gross farm income. The partial replacement alternatives would represent a beneficial effect of less than 3 percent of the total gross farm income for the four-county analysis area. Under the full replacement alternatives, a beneficial effect of less than 5 percent of total gross farm income would be realized. The effects of the action alternatives, compared to No Action, are shown on Figure 4, *Comparison of Gross Farm Income under the No Action Alternative to the Action Alternatives*.

With respect to jobs, labor income, and sales in the four-county area, the analysis indicates that a minimal adverse impact would occur under the No Action Alternative. The net decrease would be less than 1 percent. Under the action alternatives, however, minimal beneficial effects would be expected, with a less than 1 percent increase in jobs, labor income, and sales in the four-county area.

Transportation

Transportation concerns focus on impacts to roads, highways, and railroads in the Study Area caused when construction of proposed facilities intersect these routes. No such concerns exist for the No Action Alternative, and no air or navigable waterway transportation systems would be affected by any of the alternatives.

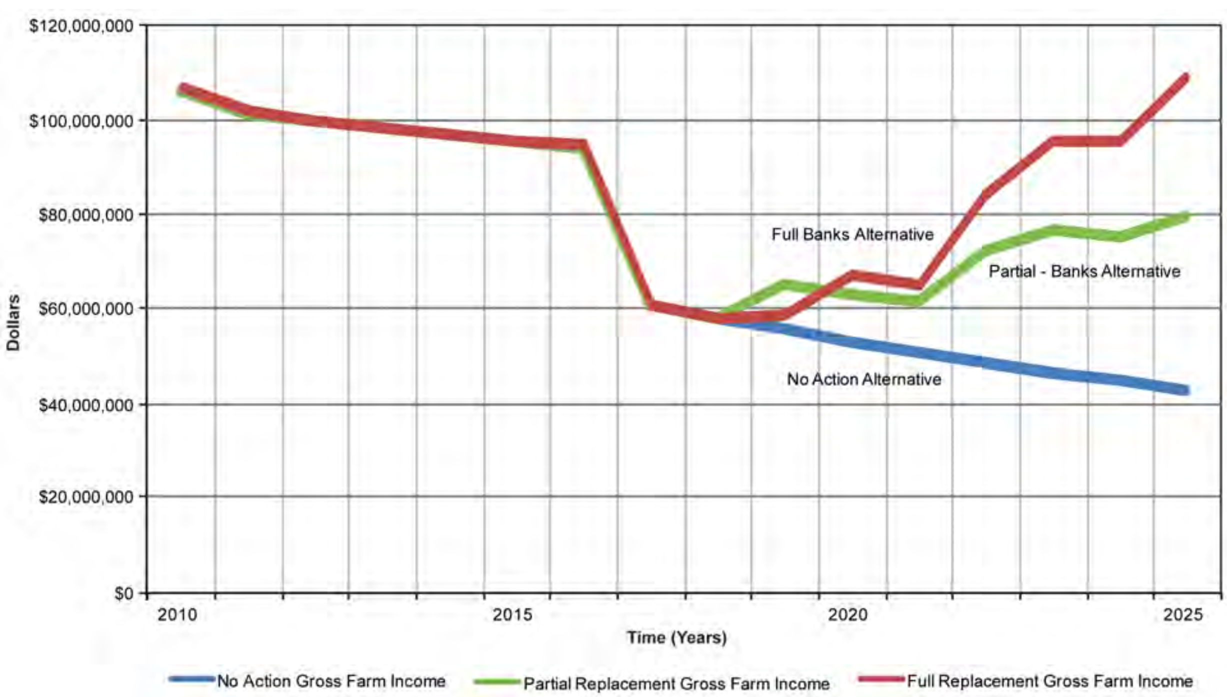


Figure 4
Comparison of Gross Farm Income under the No Action Alternative to the Action Alternatives

Photograph 9.
Boat docks at Banks Lake.

For all action alternatives, Reclamation and Ecology are committed to preparing a Transportation Management Plan in collaboration with affected counties and other agencies. The planning process would create a blueprint for avoiding short-term, construction-related impacts, and for assessing the best solution for resolving long-term impacts where facilities obstruct current routes.

Construction of the partial replacement alternatives delivery system would not significantly impact transportation. The full replacement delivery system north of I-90 would cross existing roadways more than 60 times, including one state highway, and one crossing of an active rail line by surface water conveyance facilities like canals. Through the transportation planning process, requirements for maintaining adequate transportation service would be defined and programmed, including bridges over the new conveyances or placing the facilities underground.

For action alternatives that include construction of Rocky Coulee Reservoir, locally significant long-term impacts to vehicular circulation would be unavoidable. This reservoir would inundate portions of local north-south through travel routes, including S Road NE and U Road NE.

Energy

Energy issues associated with the Study alternatives include the potential to alter regional and local energy balances. Additional withdrawals from the Columbia River would lead to lost hydroelectric generation potential and a possible reduction in regional energy supply and availability. Additional pumping requirements to deliver water through new or modified canal systems would increase the burden on local energy providers responsible for supplying energy resources and could affect regional energy demand.

Under the No Action Alternative, irrigators would require more energy to pump groundwater from greater depths, but local energy providers would experience minimal impacts because they would have sufficient capacity to supply all customers.

Regional energy availability would be impacted to some extent by all action alternatives. In the short term, even under critical water conditions, impacts to the regional total system energy surplus would be minimal. However, projecting the total system energy surplus out to a 10 year horizon, the reduction in regional energy availability would have an adverse impact for the partial replacement alternatives and a significant impact for the full replacement alternatives. The net reduction in available energy relative to projected surplus by 2017 would range from 11 percent for Alternative 2A: Partial—Banks and Alternative 2B: Partial—Banks + FDR, to 31 percent for Alternative 3C: Full—Banks + Rocky and Alternative 3D: Full—Combined. Current projections for the Critical Water year case indicate that there could be a regional system deficit by 2018.

Noise

Localized, short-term noise impacts would occur during construction of facilities associated with the action alternatives. Construction noise is exempt from state noise regulations. Nonetheless, BMPs would be employed to control and minimize construction noise to the extent practical, and no significant adverse short-term noise impacts are anticipated.

In the long term, ambient noise levels would increase near the pumping plants and operations and maintenance facilities associated with the action alternatives. These impacts would not be significant.

Visual Resources

Changes in visual character or quality would occur in the Study Area with all alternatives, including the No Action Alternative. Additional drawdowns at Banks Lake and Lake Roosevelt under the action alternatives also have potential adverse visual resource impacts.

In the Study Area, the No Action Alternative and the portion of the partial replacement alternatives north of I-90 would result in significant, broad-scale impacts caused by transition from irrigated agriculture to dryland conditions. Where lands would receive replacement water supply for irrigation under the action alternatives, broad-scale visual character would not be changed. However, development of water delivery system facilities would result in significant localized visual impacts associated with introduction of major new infrastructure. Some of the new facilities, such as canals, would be compatible with the irrigated agriculture environment. However, facilities such as regulating tanks up to 200 feet high would likely be seen as an adverse impact on visual quality.

Additional drawdowns at Banks Lake and Lake Roosevelt under the action alternatives would generally not result in significant adverse impacts on visual quality. The exceptions to this are Alternative 3A: Full—Banks, where drawdowns would be more than 8 feet lower than the No Action Alternative in average years and Alternative 3C: Full—Banks + Rocky, where similar, deep drawdowns would occur in dry and drought years. This extent of additional drawdown would have a significant adverse impact on visual quality at the reservoir for a period of time each year, creating a much larger “bathtub ring” effect where open, un-vegetated shoreline is exposed around the reservoir.

Cultural and Historic Resources

Cultural resources encompass a wide range of historic and prehistoric resources defined by State and Federal regulations.

The No Action Alternatives would not impact such resources. At the current level of project planning, assessment of potential for impact under the action alternative uses a predictive model to estimate the likelihood of significant resources being encountered for the sake of comparison among the alternatives. No surveys of potential facility sites have been conducted because of the scale and complexity of the alternatives.

All action alternatives involve development and operation of delivery system facilities in areas with high potential to contain significant cultural resources. These alternatives would also involve additional drawdowns at Banks Lake each year, exposing more shoreline with potential to contain significant resources. Generally, the partial replacement alternatives would have considerably less potential for adverse impact than the full replacement alternatives because fewer facilities would be built and these facilities would be located in less sensitive areas, and because additional drawdowns at Banks Lake would be less. For alternatives that include Rocky Coulee Reservoir, another large area with high potential for significant resources would be added.

Intensive field surveys to identify historic properties would be completed and all necessary consultation with the State Historic Preservation Officer and Tribes would be carried out if a decision is made to proceed with one of the action alternatives. Through this effort, appropriate impact avoidance and mitigation measures would be defined.

Cumulative Effects

No cumulative effects from the alternatives were identified.

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.

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. Table 10 lists the resource areas that include BMPs and legal requirements, and those that would have additional mitigation measures.

Consultation and Coordination

As explained in Chapter 5 of the Draft 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, and a Scoping Summary Report (Reclamation 2008 Scoping). Extensive coordination with agencies and organizations occurred prior to initiation of the NEPA process and during preparation of the Draft EIS. Bonneville Power Administration served as a cooperating agency throughout the process.

What Comes Next?

Public Review of the Draft EIS

The release of this Draft EIS was announced on Reclamation’s and Ecology’s websites and in local and regional newspapers. These announcements included the timeframe for public review and dates, times, and locations of public meetings. The public will have 60 days to review and provide comments on the Draft EIS.

TABLE 10

Applicable Legal Requirements and Environmental Commitments to Implement BMPs and Mitigation Measures by Resource Topic

	Legal Requirements	Best Management Practices	Mitigation Measures
Surface Water Resources	X	X	
Groundwater Resources	X	X	
Water Quality	X	X	
Water Rights	X		
Geology		X	
Soils	X	X	X
Vegetation and Wetlands	X	X	X
Wildlife and Wildlife Habitat	X	X	X
Fisheries and Aquatic Resources	X		
Threatened and Endangered Species	X		
Air Quality	X	X	
Land Use and Shoreline Resources	X		X
Recreation Resources			X
Irrigated Agriculture and Socioeconomics			
Transportation		X	
Energy			
Public Services and Utilities	X	X	
Noise	X	X	
Public Health	X	X	
Visual Resources		X	
Cultural and Historic Resources	X		
Indian Sacred Sites	X		
Indian Trust Assets	X		
Environmental Justice	X		X

Two public hearings will be held during the public review period, as described on the Fact Sheet. Participants will be encouraged to provide comments through several mechanisms—written comment cards, letters, e-mails, and oral comments at the meeting. All comments received on the Draft EIS, regardless of how submitted, will be given equal consideration and will be posted on the Odessa Study website at: http://www.usbr.gov/pn/programs/ucao_misc/Odessa/.

Preparation of the Final EIS

Reclamation and Ecology will carefully consider all comments received on the Draft EIS and will respond to substantive comments in the Final EIS by adjusting alternatives, supplementing or improving the analysis or making factual corrections.

Record of Decision

The NEPA process will be concluded with a Record of Decision (ROD) issued no sooner than 30 days after the Final EIS is completed. The ROD will identify Reclamation's and Ecology's decision on the proposed action, and will describe the basis for that decision.

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) are jointly preparing this Environmental Impact Statement (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 Groundwater 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 (Map 1-1, *Location Map*). The Odessa Subarea Special Study Area (Study Area) is shown on Map 1-1, as a smaller portion of the overall Odessa Subarea. These common terms are also shown in Figure 1-1.

The Study fulfills a commitment by Reclamation, the State, and CBP irrigation districts to cooperatively conduct the Study as stipulated in the Columbia River Initiative Memorandum of Understanding (MOU) in December 2004. The Columbia River Initiative MOU is provided on Ecology's web site at www.ecy.wa.gov/programs/wr/cri/images/pdf/cri_mou121704.pdf.

1.1.1 Study Approach

This 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 within this Study, and why it is needed. Taken together, the purpose and need for the proposed action provide the basis for identifying the alternatives to be considered in the EIS. Background information is provided on the Study. Additionally, the cooperating agencies, other actions and activities related to the study, the nature of decisions to be made, and the organization of this EIS are summarized.

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

1.1.2 Study Location

The CBP is located in the central part 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 CBP 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. The Odessa Subarea is in the eastern part of the CBP and overlaps the CBP boundaries. 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

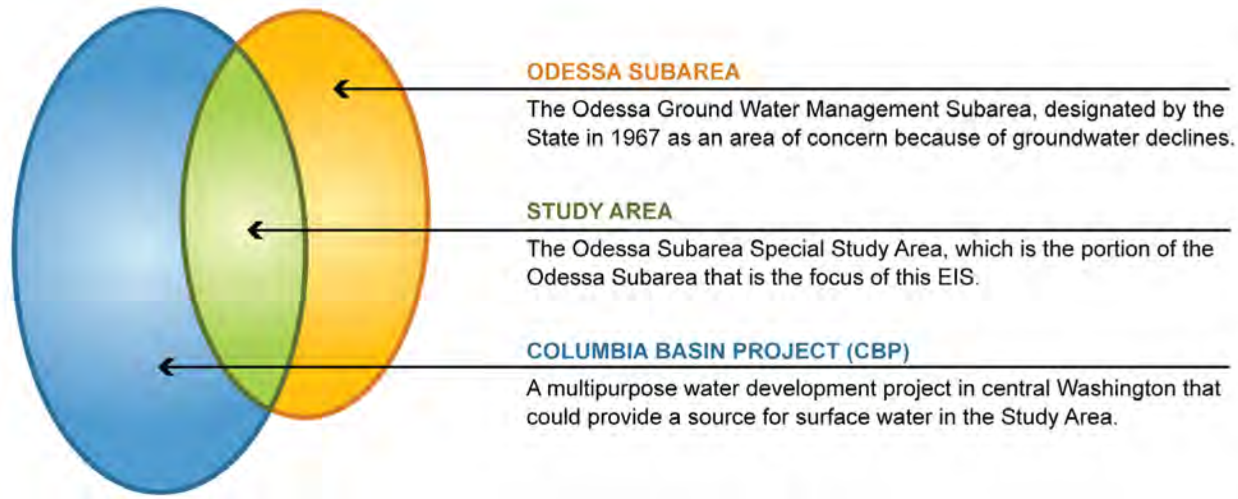


Figure 1-1
Common Terms Used in this EIS

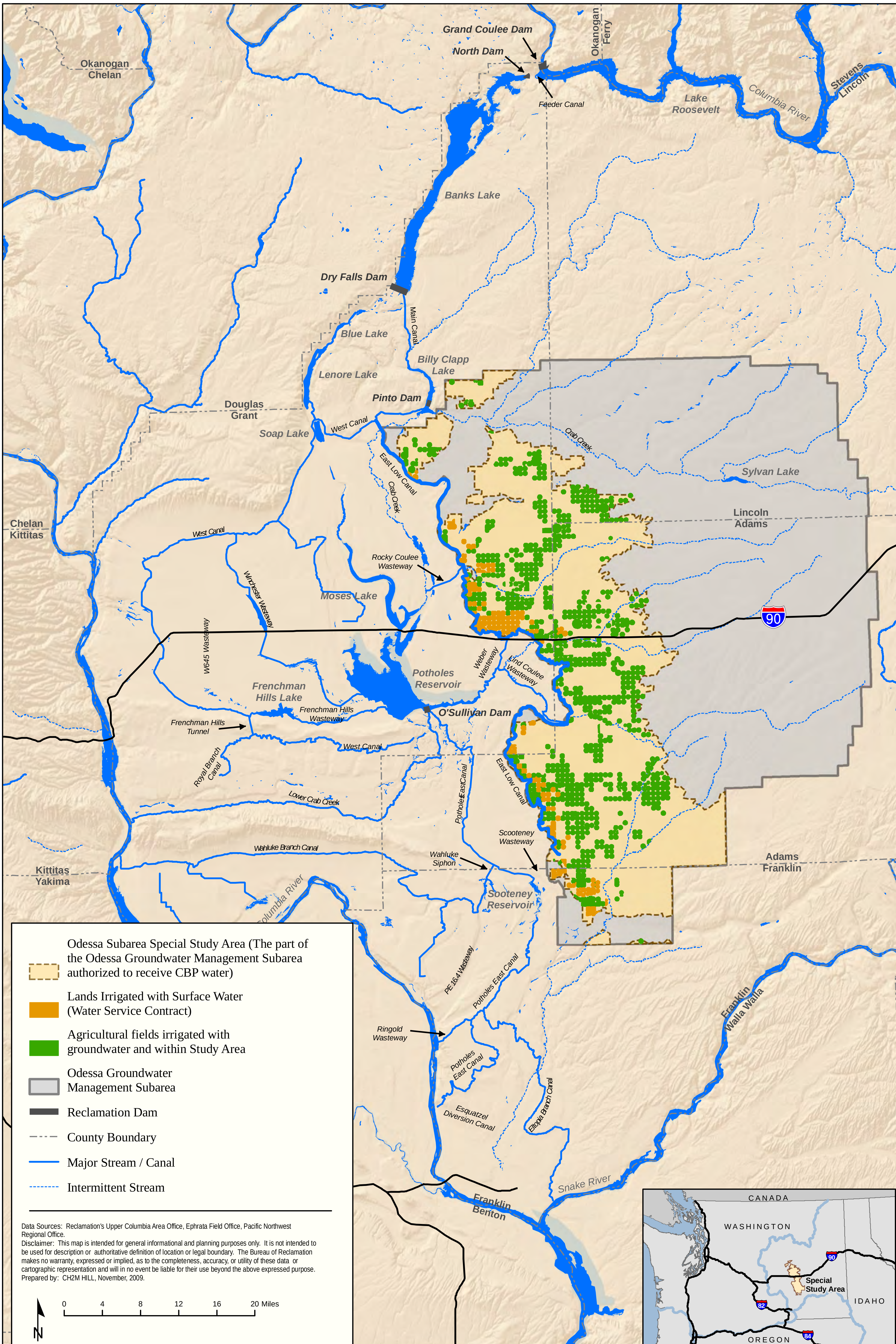
water. This surface water would be provided as part of the continued phased development of the CBP. The surface water would come from existing water rights in the Columbia River system.

The proposed Federal action would deliver CBP water to partially or fully replace groundwater used to irrigate eligible acres in the Odessa Study Area. Partial replacement would deliver 176,343 acre-feet of water annually to irrigate approximately 57,000 acres. Partial replacement focuses on surface water replacement for acreage located primarily south of Interstate Highway 90 that can be served by the existing East Low Canal (see Map 1-1), although the canal would require some modifications and expansion. Full replacement would deliver 347,137 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 the acreage located south of I-90 (as with partial replacement), plus remaining lands in the Study Area north of I-90 that would be served by constructing a new East High Canal system. Depending on the specific action alternative selected, other new or upgraded lateral canals, pump stations, and appurtenances, as well as possible construction of new reservoirs, would be required.

The duration of construction for either partial or full replacement is estimated to span a period of about 10 years, and may begin in 2015. Construction would be conducted in segments (that is, four segments for partial replacement and nine segments for full replacement) to allow the delivery system to be brought online in stages, as early and efficiently as possible.

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 (1990) states that the purpose and need "should briefly describe why the action is needed and what the action is designed to accomplish." Taken together, the purpose and need for a project establish the basic parameters for identifying the range of alternatives to be considered in an EIS.



Odessa Subarea Special Study
Columbia Basin Project, Washington

Map 1-1
Location Map

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1.3.1 Purpose

The purpose of the Study is to evaluate alternatives that would deliver surface water from the CBP to replace declining groundwater supply currently used for irrigation in the Odessa Subarea. This surface water would be provided as part of the continued phased development of the CBP, and would come from existing surface water rights in the Columbia River system. Reclamation can deliver water on up to approximately 102,600 acres authorized to receive CBP water in the Study Area.

1.3.1.1 Basis of Purpose

Measurements of groundwater levels in wells have shown a substantial decline since the 1980s, which are the earliest available measurements (Map 1-2). Figure 1-2 shows a continuous declining trend in measurements of groundwater levels of up to 180 feet over the past 30 years in three example wells (with best available data). While not all wells have shown declines, the overall area of decline has spread and deepened over the past 30 years as wells have been drilled deeper. This has prompted public concern about the declining aquifers and associated economic and other effects, which resulted in a directive by the U.S. Congress and the Washington State legislature to investigate the problem.

Ecology has been directed by the Washington State legislature to "focus its efforts to develop water supplies for the Columbia River Basin… (including) alternatives to groundwater for agricultural users in the Odessa subarea aquifer" (Revised Code of Washington [RCW] 90.90.020, *Allocation and Development of Water Supplies*).

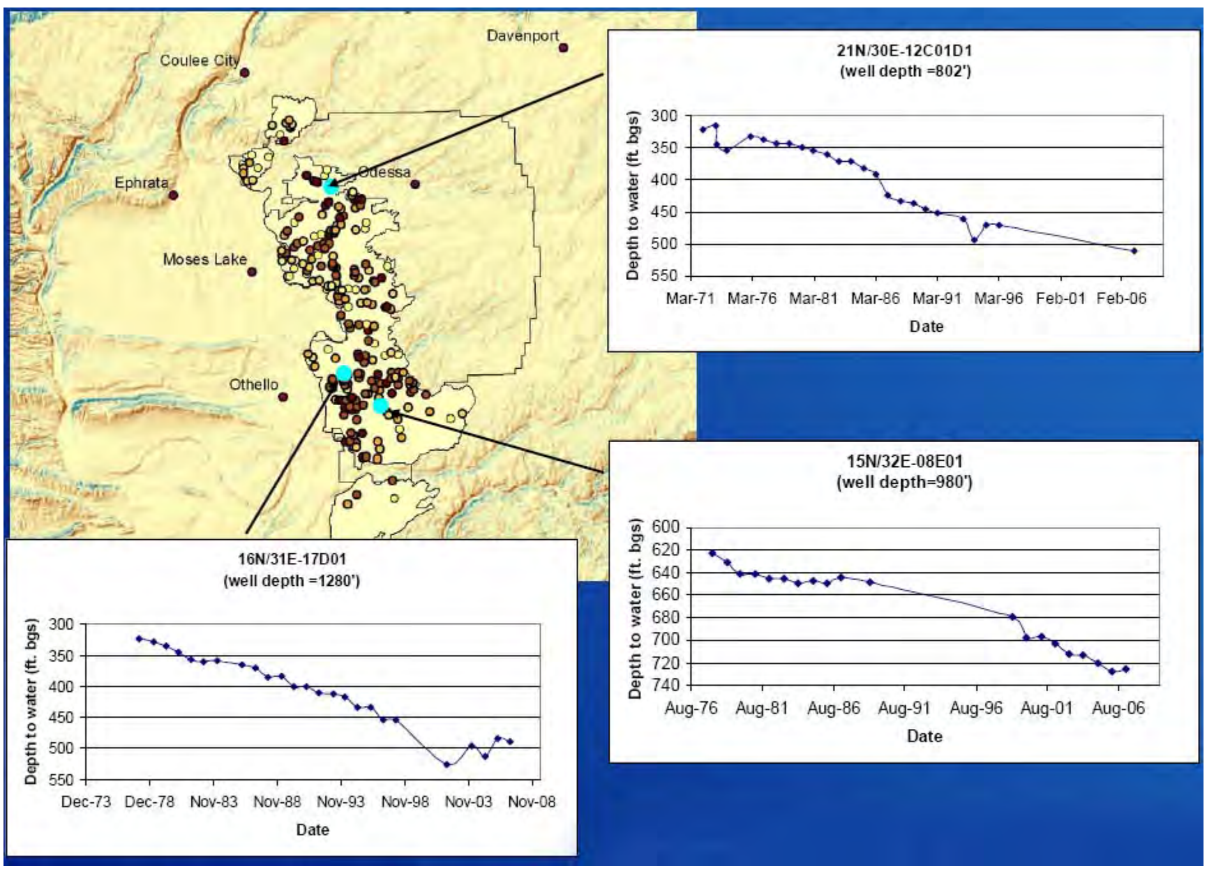
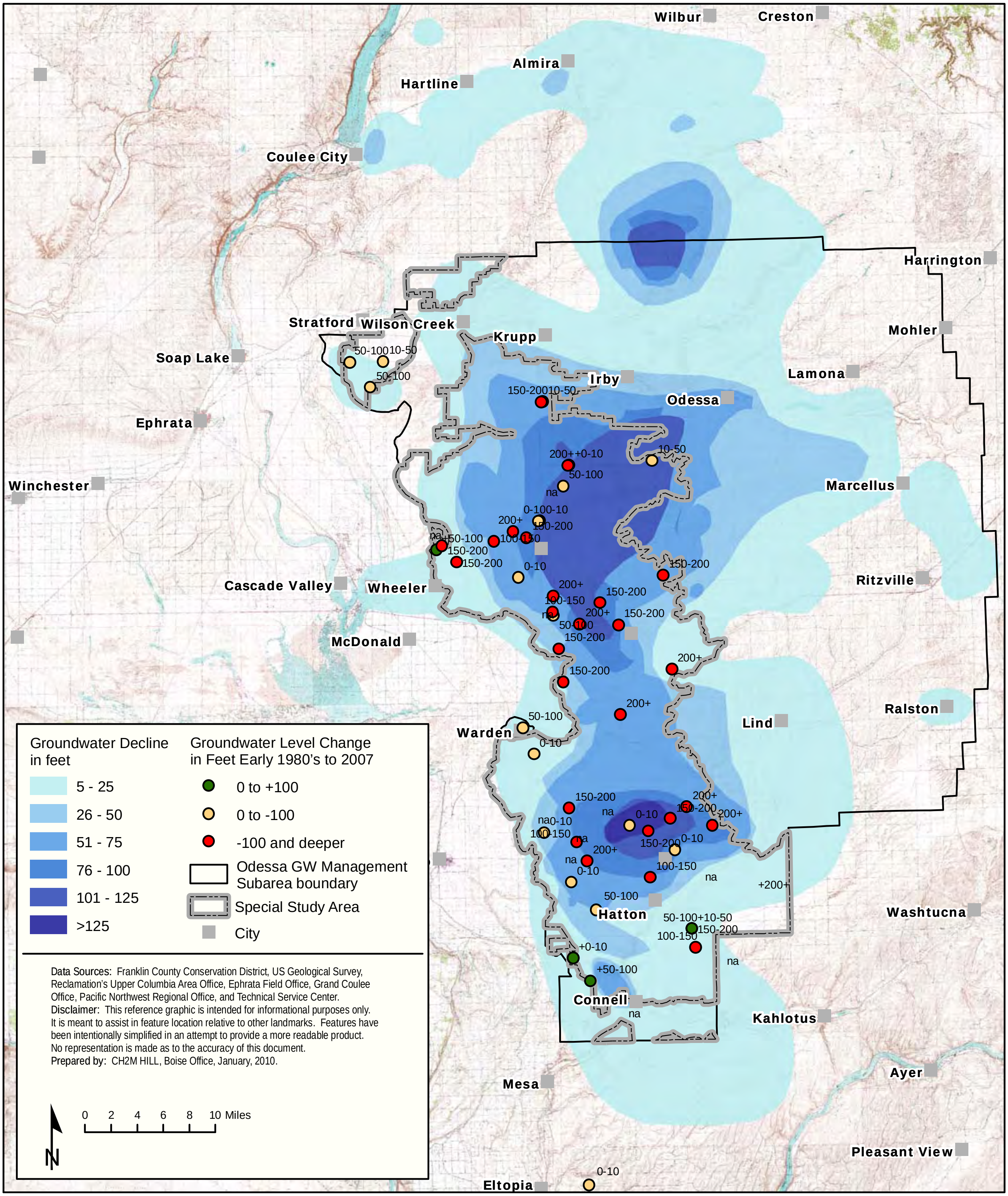


Figure 1-2
Declining Trend in Measurements of Groundwater Levels in Three Example Wells with Best Available Data.



Odessa Subarea Special Study
Columbia Basin Project, Washington

Map 1-2

Groundwater Level Decline in Aquifers of the Odessa Subarea, 1981 to 2007

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TABLE 1-1

Groundwater Replacement Range Considered in this EIS, Associated Surface Water Diversion Needs, and Estimated Construction Costs

Groundwater Replacement Range	Groundwater Acres to be Replaced with Surface Water	Additional CBP Surface Water Diversion Needed Annually (acre-feet)	Initial Estimate of Construction Cost (million $)*
Partial Replacement (based on enlarging and extending East Low Canal system south of Interstate 90)	Approximately 57,000	176,343	Approximately $840 to $1,200
Full Replacement (based on enlarging and extending East Low Canal system south of Interstate 90, and constructing a new East High canal system north of Interstate 90)	Approximately 102,600	347,137	Approximately $3,000 to $3,300

*Estimated construction costs are provided in present value terms (2010 dollars). These costs include non-contract costs, construction contract costs, and interest on these costs (as described in Section 2.7, *Estimated Cost of Alternatives*).

The Study is evaluating alternatives to replace groundwater supply with surface water to irrigate existing, groundwater-irrigated acres in the Odessa Subarea. Reclamation can only deliver water to lands authorized to receive CBP water. As such, up to approximately 102,600 groundwater-irrigated acres in the Study Area are eligible to receive CBP surface water.

The alternatives being evaluated are based on combinations of water delivery and water supply options. Water delivery options consist of expanding or using the existing East Low Canal system and potential construction of a new East High canal system (including canals, pumping plants, and laterals), or combinations of both. Water supply options that could store the replacement surface water supply for use in the Study Area consist of potential modification to the operations of existing CBP storage facilities, including Banks Lake and Lake Roosevelt, as well as the potential construction of a new Rocky Coulee Reservoir.

In 2008, Reclamation completed an initial appraisal-level investigation of various water delivery and water supply options[1], and public scoping for this EIS[2] (Reclamation 2008 Appraisal, 2008 Scoping). Based on the outcomes of these activities, Reclamation has determined to direct further Study actions at evaluating several specific water supply and delivery alternatives that consider either partial or full replacement of groundwater supply with surface water to irrigate eligible acres in the Study Area. The conditions assumed for the partial and full groundwater replacement scenarios are summarized in Table 1-1. These scenarios form the basis of the action alternatives as described in Chapter 2 of this EIS that are analyzed in subsequent chapters of this EIS.

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1 In March 2008, Reclamation completed appraisal-level investigations of water delivery alternatives and water supply options that could provide a replacement surface water supply. The investigation examined the engineering viability, developed preliminary cost estimates, and identified potential environmental and social issues. The recommendations from these appraisal-level investigations formed the basis of additional Study actions as evaluated in this EIS.

2 The public scoping process in support of this EIS was conducted in August and September 2008. The scoping was conducted to seek comments and information from the public to identify potential issues related to planned Study actions, and to help formulate the scope of the EIS analysis.

1.3.2 Need

The Study is needed to address declining groundwater supply in the Study Area, avoid economic loss to the region's agricultural sector, address environmental concerns and interests, and fulfill the commitment by Reclamation, the State, and CBP irrigation districts to cooperatively conduct the Study.

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 as much as 200 feet since 1981 (Map 1-2)[3]. Well drilling costs and pumping water from these depths have resulted in expensive power costs and water quality concerns, such as high water temperatures and sodium concentrations.

The high sodium concentrations in groundwater used for irrigation causes soil sodicity in parts of the Study Area. Soil sodicity can impair soil conditions, requiring application of soil amendments to maintain adequate soil structure and infiltration capacity. The need to apply soil amendments to maintain land in production would likely become more widespread in the future if continued pumping of declining groundwater increases use of deeper, older groundwater of higher sodicity.

What is Soil Sodicity?

Soil sodicity can occur when soils accumulate high sodium concentrations through irrigation with groundwater containing high sodium content. Soils with high sodium concentrations may exhibit structural instability, which decreases water infiltration and inhibits plant growth. To maintain agricultural productivity, additives (often referred to as amendments) may have to be applied to neutralize the effects of high sodium concentrations.

As a result of this groundwater decline, 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, even of shallower depth, live with uncertainty about future well production. In the near term, the output from production wells in the Odessa Subarea will continue to steadily decrease. If no action is taken, it is estimated that, at the current rates of decline, about 70 percent of the production wells in the Odessa Subarea would cease production within 10 years.

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 Notice of Intent initiating the process for preparing this EIS (published August 2008), additional economic studies have been

[3] The wells depicted in Map 1-2 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.

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*.

1.3.2.3 Address Environmental Concerns and Interests

The Study is needed to address environmental concerns and interests, including on Endangered Species Act (ESA) matters. For example, important objectives of the Study include ensuring that alternatives are consistent with the National Marine Fisheries Service (NMFS) Biological Opinion for salmon and steelhead, and potential impacts are avoided or minimized to habitats of importance to other sensitive species.

1.3.2.4 Fulfill Reclamation's and Ecology's Obligations in the Columbia River Initiative

The Study is needed to fulfill the commitment by Reclamation, the State, and CBP irrigation districts to cooperatively conduct the Study as stipulated in the Columbia River Initiative MOU in December 2004. The MOU promotes a cooperative process for activities to improve water management within the CBP. The Study implements Section 15 of the MOU, which states in part that, "[t]he parties will cooperate to explore opportunities for delivery of water to additional existing agricultural lands within the Odessa Subarea."

1.3.3 Study Authority for Reclamation

The Study is being conducted under the authority of the Reclamation Act of 1939 and the Columbia Basin Project Act of 1943, as amended. 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. Construction of the CBP was anticipated to occur in phases over a 70-year period.

Acting for the Secretary, Reclamation is authorized to implement additional development phases of the CBP as long as the Secretary finds it 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 effects, Congress funded Reclamation to investigate the problem. The State partnered with Reclamation by providing funding and collaborating on various technical studies.

As described above, Reclamation, the State, and CBP irrigation districts entered into the Columbia River Initiative MOU in December 2004 to promote a cooperative process for implementing important water management improvements within the CBP.

1.3.4 Study Authority for Ecology

Following the signing of the Columbia River Initiative MOU, the State legislature passed the Columbia River Water Resource Management Act (Management Act; Engrossed Substitute House Bill [ESHB] 2860) in February 2006. The Management Act 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 groundwater for agricultural users in the Odessa subarea aquifer."

The Management Act also created a Columbia River Basin development account.

Ecology's participation in this study is part of that program.

Ecology has been further directed by the State legislature to aggressively pursue new water supplies for instream and out-of-stream use. The Odessa Subarea is a high priority for the State, as it occurs first on the list of projects in the legislation concerning the allocation and development of water supplies (RCW 90.90.020, *Allocation and Development of Water Supplies*). In addition, Ecology is participating in the Study to provide support for state and local agency permit decisions that will likely be necessary to implement a water delivery project.

1.4 Background Information

The currently irrigated lands in the CBP were developed primarily in the 1950s and 1960s, with some acreage added sporadically 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 until the CBP was developed to provide surface water to these lands. The aquifer has now declined to such an extent that the ability of farmers to irrigate 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 to public concern about associated economic and other effects, 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.

The State has participated in and has partially funded investigation of CBP development to provide a replacement for current groundwater irrigation, as directed by the State legislature. The State, Reclamation, and the CBP irrigation districts signed the Columbia River Initiative MOU in December 2004 to promote a cooperative process for implementing activities to improve Columbia River water management and water management within the CBP. The Odessa Subarea Special Study implements Section 15 of the 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." The State provided a cost-share through an Intergovernmental Agreement between Ecology and Reclamation in December 2005 to fund this Study.

In February 2006, the State legislature passed the Columbia River Water Resource Management Act that directs Ecology to aggressively pursue development of water resources benefiting both instream and out-of-stream uses through storage, conservation, and voluntary regional water management agreements.

1.5 Cooperating Agencies

Reclamation and Ecology are responsible as joint lead agencies for developing the EIS, including a joint NEPA/SEPA process. The only cooperating agency on this project is the Bonneville Power Administration (BPA). 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

Photograph 1-1
Water conservation makes more efficient use of existing resources.

The Study is conducted within the framework of the Columbia River Basin Water Management Program (Management Program), which derived from the Management Act (ESHB 2860). In particular, the Management Program directs Ecology to seek alternatives to groundwater pumping in the Odessa Subarea for agricultural use. This 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, voluntary regional agreements, and other measures intended to meet the legislative mandate. The Management Program also includes administrative functions such as development of a project inventory, a water supply and demand forecast, and a data management system. Funding and management of a number of major projects have resulted from the Management Program.

The Management Program 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 stream flows
- New municipal, domestic, industrial, and irrigation water needs within the Columbia River Basin.

The Management Program Final Programmatic EIS (Ecology 2007) was developed by Ecology under SEPA as part of the Management Program development process. The Management Program EIS was prepared to assist in evaluating conceptual approaches to developing the Management Program and in describing the potential impacts that could be associated with components of the Management Program. Components evaluated included storage, conservation, voluntary regional agreements, instream resources, and policy alternatives for implementing requirements of the Columbia River Basin Water Management Act (ESHB 2860).

The study also evaluated potential impacts associated with implementation of the following three actions:

1. Storage releases from Lake Roosevelt

2. A supplemental feed route to supply Potholes Reservoir
3. The proposed Columbia-Snake River Irrigators Association Voluntary Regional Agreement

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

Reclamation is considering potential storage projects that may be approved for study and funding. One primary example is the ongoing Columbia River Mainstem Off-Channel Storage Options evaluation. These projects range from new large storage facilities, modification of existing storage facilities, and groundwater storage. Examples of potential storage projects include Black Rock reservoir, Wymer reservoir, reoperation of Banks Lake, the Crab Creek reservoir, and the City of Kennewick Groundwater Storage project. These projects are being investigated by the Management Program.

1.6.1.2 Conservation

Ecology has developed an inventory of more than 500 conservation projects and is currently developing, screening, and ranking criteria to determine which projects best meet the goals of the Management Program. Potential projects may address issues such as incentive payments to reduce water use and full or partial water banking, improvements to municipal water infrastructure, use of reclaimed water, improved water delivery efficiency at the irrigation district level and on-farm conservation, improved industrial infrastructure, and pump exchanges. Ecology would manage the use of conserved water.

1.6.1.3 Voluntary Regional Agreements

A voluntary regional agreement (VRA) is a legal agreement between the State and one or more Columbia River water users "for the purpose of providing new water for out-of-stream use, streamlining the application process, and protecting instream flow" (RCW 90.90.030, *Voluntary Regional Agreements*). Under this component, groups would be able to enter VRAs with Ecology to exchange a package of water projects for new water rights. All existing legislation governing new water rights would remain in place, and VRAs must meet minimum requirements to be approved by Ecology.

Ecology and the Columbia-Snake River Irrigators Association (CSRIA) have entered into a VRA as provided for in RCW 90.90.030. The purpose of this VRA is to provide new water for the issuance of drought permits to existing interruptible water rights holders and new water rights on the Columbia and Snake Rivers. This VRA provides that the issuance of these new water rights cannot reduce or negatively impact stream flows in the months of July and August (April through August for the Snake River). To meet this standard of protection, Ecology and CSRIA would pursue conservation, storage, acquisition, and other opportunities to provide new water to offset new withdrawals during the summer.

1.6.1.4 Instream Water

Ecology is pursuing a full range of options for augmenting instream resources. The Management Act (ESHB 2860) provides that one-third of the active storage in any new storage facility made possible with Management Program funding would be available for instream flows. Water for allocation to instream uses could be provided by a number of projects that Ecology is considering under the Management Program, including any new storage within the Study alternatives being addressed in this EIS.

1.6.1.5 Inventory and Demand Forecasting

The Management Act (ESHB 2860) 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.

1.6.1.6 Early Actions

Ecology has begun to implement the three early actions included in the Management Program:

- **Incremental Storage Releases from Lake Roosevelt.** The Lake Roosevelt Incremental Storage Releases Project involves releasing flows from Lake Roosevelt to improve municipal and industrial water supply, replace some groundwater use in the Odessa Subarea, enhance stream flows in the Columbia River to benefit fish, and provide water to interruptible water rights holders in drought years. Ecology issued the *Final Supplemental Environmental Impact Statement for the Lake Roosevelt Incremental Storage Releases Program* in August 2008, and Reclamation issued an Environmental Assessment and FONSI for the project in June 2009. Reclamation and Ecology began implementing the flow releases in September 2009. This activity is a cumulative impact that is analyzed along with the Study alternatives addressed in this EIS (see Section 1.8.1, *Actions within the Geographic Scope*).
- **Supplemental feed route for Potholes Reservoir.** The purpose of the supplemental feed route project is to increase the reliability of transporting water from Banks Lake to Potholes Reservoir. This activity has been identified as a cumulative impact that is analyzed along with the Study alternatives addressed in this EIS (see Section 1.8.1, *Actions within the Geographic Scope*).
  - Currently, the existing feed route transports water through the Main Canal, south through the East Low Canal to Rocky Coulee Wasteway, and then 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 demand have reduced the effectiveness of the existing feed route. The demand on Potholes is greater, and the amount of “unused” capacity in the East Low Canal has declined.
  - Reclamation prepared an Environmental Assessment (EA) and identified Alternative 2—Crab Creek and Frenchman Hills Wasteway, as the preferred alternative for a supplemental feed route (Reclamation 2007 EA). This would release feed water from Billy Clapp Reservoir through the Crab Creek channel, then into Moses Lake and Potholes Reservoir.
  - The supplemental feed route lies outside of the Odessa Ground Water Management Area and beyond the boundaries of the Study Area. The existing feed route in the Study Area would continue to be used as well. Reclamation received funding under the American Recovery and Reinvestment Act for work on the Crab Creek portion of the feed route and will initiate work in 2010.
- **Columbia-Snake River Irrigator’s Association VRA.** Under the VRA provision of the Management Program, Ecology signed a permit agreement with the CSRIA in July 2008. Under the agreement, the State would issue drought permits to irrigators who face shutoff during dry years. CSRIA would manage water savings and efficiency programs to create more efficient ways to use irrigation water.

1.6.2 Prior Investigations and Related Activities in the Columbia Basin Project

Table 1-2 lists the prior investigations and activities in the CBP, and their relationship to the Study. The two activities that most profoundly shape the alternatives considered for the current Study are as follows:

- The *Initial Alternative Development and Evaluation, Odessa Subarea Special Study* (Reclamation 2006 PASS). 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. Based on these results, Reclamation completed an appraisal-level study in March 2008 entitled *Appraisal-Level Investigation Summary of Findings* (Reclamation 2008 Appraisal).
- Federal Columbia River Power System (FCRPS) 2008 Biological Assessment and Opinion, which dictate numerous operational requirements at Grand Coulee Dam and Lake Roosevelt that affect the timing of water withdrawals considered in the Odessa Study.

TABLE 1-2

Relationship of Prior Investigations and Activities in the CBP to the Odessa Subarea Special Study

Activity	Summary Description	Relationship to the Odessa Study
Priest Rapids Hydroelectric Project Relicensing	The Federal Energy Regulatory Commission (FERC) issued a new 44-year license on April 17, 2008, for the operation of Priest Rapids and Wanapum hydroelectric dams. The license outlines operational requirements that cover a range of resources, including aquatic resources such as resident and anadromous fish that inhabit Priest Rapids Lake, the Hanford reach, or pass through the dam. Many of the requirements deal with the timing and magnitude of flows designed to protect anadromous fish.	ESA flow objectives, as defined in the 2008 Biological Opinion (NMFS 2008 BO), are set at Priest Rapids Dam, downstream of Lake Roosevelt, from which water would be withdrawn for the Odessa Subarea. Any additional withdrawals of water from the Columbia River for the Odessa Subarea would need to address these downstream flow objectives.
Federal Columbia River Power System 2008 Biological Assessment and Opinion	The CBP, which includes Grand Coulee Dam and Lake Roosevelt, is part of the 2008 consultation on the Federal Columbia River Power System (FCRPS). The FCRPS Biological Assessment included proposed reasonable and prudent alternatives to address impacts to ESA-listed species and thereby avoid jeopardy to the listed species (NMFS 2008 BO). Additionally, the Action Agencies entered into new agreements with four northwest Tribes and two States for a 10-year commitment to benefit fish—particularly Columbia River Basin salmon and steelhead stocks.	The reasonable and prudent alternatives dictate numerous operational requirements at Grand Coulee Dam and Lake Roosevelt that affect the timing of water withdrawals considered in the Odessa Study (see Table 1-3).
1989 Draft EIS Continued Phased Development	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. A No Action Alternative was also included.	Provides a basis for understanding the potential effects of continued development of the CBP, as contemplated in this Odessa Special Study Draft EIS.
1993 Supplemental Draft EIS (Fish Enhancement)	A Supplemental Draft EIS (Reclamation 1993) 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.	Same as 1989 Draft EIS above.

TABLE 1-2

Relationship of Prior Investigations and Activities in the CBP to the Odessa Subarea Special Study

Activity	Summary Description	Relationship to the Odessa Study
2001 Banks Lake Resource Management Plan (RMP) (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. For further information, please see <http://www.usbr.gov/pn/programs/rmp/bankslake/index.html>.	Management guidance for Banks Lake determines, in part, the types of mitigation measures anticipated for Recreation Resources.
2004 Banks Lake Drawdown EIS	The Final EIS (Reclamation 2004) describes and analyzes the environmental effects of lowering the August water surface elevation of Banks Lake annually to elevation 1560 feet (10 feet below the full pool elevation of 1570 feet).	This information was used to assess impacts on biological and recreation resources at Banks Lake.
2006 Plan of Study (POS)	The Odessa POS (Reclamation 2006 POS) provided the study background and purpose, described potential issues, outlined study steps and requirements, and identified required resources in the Odessa Subarea. Reclamation completed a pre-appraisal-level investigation through a PASS late in 2006. The investigation is documented in a report entitled, *Initial Alternative Development and Evaluation, Odessa Subarea Special Study* (Reclamation 2006 PASS).	The POS and the PASS provide the basis for the Odessa Study, and cover the same Study Area.
2008 Appraisal Summary	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 the Odessa DEIS. Four water delivery alternatives and six water supply options were evaluated.	Same as the POS and PASS documents above.
Walla Walla River Storage and Pump Exchange Studies	The U.S. Army Corps of Engineers (Corps), in conjunction with the Confederated Tribes of the Umatilla Indian Reservation, are focusing on the restoration and management of a viable ecosystem within the Walla Walla River Basin. Many factors have contributed to the decline and limited production of salmonids and lamprey in the Basin. To increase salmonid and lamprey production, several actions have been proposed for consideration, including ways to increase stream flows, improve water quality, and lower river water temperatures. Multiple measures were evaluated through the shallow aquifer. They include recharge, storage and recovery, and recharge for protection purposes only. The measure that was carried forward is recharge for protection purposes.	Potential for applying CBP surface water for other uses. This is a cumulative impact that is analyzed along with the Odessa Study alternatives (see Section 1.8.1, *Actions Within the Geographic Scope*).
Umatilla Basin Aquifer Recovery	The agricultural economy of Umatilla and Morrow counties is critically dependant on availability of water for irrigation. Because of overdraft of the groundwater aquifers in the area, the Oregon Water Resources Department (OWRD) designated four groundwater aquifers within the Umatilla Basin as Critical Groundwater Areas in the Umatilla Basin (OWRD 2003). To increase water availability in the Critical Groundwater Areas, OWRD has begun a technical assessment of the feasibility of storing water from the Columbia River, and other surface water sources, during high flow periods in shallow sediment and deep basalt aquifers for later recovery and use during the irrigation season. Surface water withdrawals from the Columbia and Umatilla Rivers that would occur during times that avoid impacts to listed fish species, and that would deliver water for storage in groundwater aquifers, are key to addressing the long-term water supply needs in the Umatilla Basin.	Illustrates the widespread nature of groundwater management issues in Washington and that surface water is considered for other areas beyond the Odessa Subarea. This is a cumulative impact that is analyzed along with the Odessa Study alternatives (see Section 1.8.1, *Actions Within the Geographic Scope*).

1.6.2.1 Project Alternative Solutions Study

In 2006, Reclamation completed a pre-appraisal-level investigation for the Study Area through a PASS based on the Reclamation 2006 Plan of Study (POS). 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, and groundwater irrigators. 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 engineers, a hydrogeologist, a watermaster, and irrigation district managers from Reclamation, Ecology, and the CBP irrigation districts. The Technical Team developed preliminary alternative concepts, 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 Project 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 Columbia Basin Project 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. The report identifies several water supply possibilities that could accommodate these restrictions. These options include relying on existing reservoirs within the Columbia Basin Project, adjusting current Project operations, or constructing new storage facilities.

1.6.2.2 Federal Columbia River Power System 2008 Biological Opinion

The FCRPS is a complex set of requirements and agreements that have the most profound effect on the timing for CBP water to move into the Odessa Subarea. Whenever a Federal action may adversely affect listed species, the ESA requires that the action agencies (U.S. Army Corps of Engineers [the Corps], BPA, and Reclamation) formally consult with NMFS and USFWS. The evaluation is contained in a Biological Opinion. The action agencies that operate the FCRPS had already concluded that hydropower projects would jeopardize listed species unless further mitigation was provided.

Table 1-3 lists the mitigation measures and associated constraints that are particularly applicable to the Study Area.

TABLE 1-3

Mitigation Measures and Constraints on the Odessa Subarea Special Study Imposed by the FCRPS Biological Opinion

Agreement	Summary Description	Constraints on Odessa Study
Actions 1 and 4*	Dictates 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 future evaluation and modeling (NMFS 2008 BO).	Numerous other operational requirements are in place at Lake Roosevelt: • Operate to be at the April 10 Upper Rule Curve (which means Reclamation cannot implement actions that would draft the reservoir lower than that elevation). • Refill to elevation 1290 feet by July 4 (Reclamation cannot implement actions that would prevent the reservoir from being full on July 4). • Operate for chum salmon flows (sometimes Reclamation must draft Lake Roosevelt to provide flows below Bonneville Dam from November through April 10). • Provide flows for Priest Rapids from April through June. • Refill to elevation 1283 feet by the end of September. • Draft an additional 1 to 1.8 feet by the end of August for the Lake Roosevelt Incremental Storage Releases Project.
Action 14*	Reasonable and prudent alternative Action 14 is for dry water year operations. Two of the specific elements within Action 14 call for the action agencies to convene a technical workshop to scope and investigate alternative strategies for dry water year operations, and to consider annual and future long-term agreements between the U.S. and Canada (NMFS 2008 BO).	The dry year study would look at shaping the Lake Roosevelt Incremental Storage Releases Project water in April, May, and June in the 20 percent driest water years. This may impact Reclamation’s ability to refill Lake Roosevelt.
Columbia Basin Fish Accords	On May 2, 2008, several Memorandums of Agreement (MOA), 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 (the Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes of the Warm Springs Reservation, Confederated Tribes and Bands of the Yakama Nation) and the Columbia River Inter-Tribal Fish Commission • The State of Idaho • The State of Montana	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 Biological Opinions for listed salmon and steelhead and improve their prospects for recovery, foster a partnership toward our 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 and States, and 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.

*Actions are from the 2008 Biological Opinion (NMFS 2008 BO)

1.7 Nature of Decisions to be Made

Reclamation and Ecology are responsible for determining if the Proposed Action might have significant effects to the human and natural environment under NEPA or SEPA. Congress authorized the Department of the Interior (through Reclamation), in collaboration with Ecology, to study options for using CBP water to replace groundwater for irrigation. Likewise, the Management Act (ESSB 2860) directs Ecology to aggressively pursue development of water supplies to benefit both instream and out-of-stream uses in the Columbia River Basin. Developing alternatives to replace groundwater for irrigation in the Odessa Subarea was identified as a priority under ESHB 2860. Following publication of this Draft EIS and public comment, Reclamation and Ecology will make a final decision about whether to implement one of the action alternatives. The decision must then be put before Congress for funding.

1.8 Scope of the EIS

The Council on Environmental Quality 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 Actions within the Geographic Scope

This EIS considers actions within the geographic scope of the Study that may be connected, cumulative, or similar. *Connected actions* are those that automatically trigger other actions that cannot, or will not, proceed unless other actions are taken previously or simultaneously. These actions could be interdependent parts of a larger action and depend on the larger action for their justification. *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*, which when viewed with other reasonably foreseeable or proposed agency actions, have similarities that provide a basis for evaluating their environmental consequences together, such as common timing or geography.

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

- Potholes Supplemental Feed Route (see Section 1.6.1.6, *Early Actions*, associated with the Management Program)
- Lake Roosevelt Incremental Storage Releases Project (see Section 1.6.2, *Prior Investigations and Related Activities in the Columbia Basin Project*)
- Walla Walla storage and pump exchange studies—only the aquifer storage and recovery portion of the study (see Table 1-2)
- Umatilla Basin Aquifer Recovery (see Table 1-2)

1.8.2 Actions Outside the Scope of This EIS

No known actions remain outside of the scope of this EIS. Supplemental NEPA or SEPA processes may be conducted related to proposed facilities that are not fully analyzed; for example, access roads and transmission lines.

1.8.3 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 eight action alternatives analyzed in this EIS are described in Chapter 2, *Alternatives*.

The eight action alternatives fall into two groups: four partial replacement alternatives, which would replace groundwater supplies south of I-90; and four full replacement alternatives, which would replace groundwater supplies throughout the Study Area, both north and south of I-90. Within each of those groups, the four alternatives evaluate various combinations of water supply sources from Banks Lake, Lake Roosevelt, or a proposed Rocky Coulee Reservoir.

1.8.4 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 a new reservoir discussed in Chapter 4, *Environmental Consequences*, could include direct impacts from inundating land, indirect impacts from creating water source for a potential fringe wetland, and cumulative impacts if another project is happening in the same area that would endanger rare plants.

The geographic area analyzed for possible impacts of the proposed action and alternatives for this EIS appears in Map 1-1. For some topics, the resource 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 Purpose of the EIS

Reclamation and Ecology have prepared this EIS in response to declining aquifer levels in the Odessa Subarea, as described in Section 1.3, *Purpose and Need*. The purpose of this document is to fully evaluate the potential environmental, socioeconomic, and cultural effects of various alternatives for replacing the groundwater supply with Columbia River surface water.

1.10 Relevant Concerns and Issues Related to the Proposed Action

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 input, which is summarized below.

Both formal and informal input has been encouraged and used in preparing this Draft 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*. The public was notified of scoping meetings in late August, and Study Updates were mailed to more than 240 recipients.

In addition to comments received at the scoping meetings, written comments were accepted through mid-September 2008. The *Scoping Summary Report* is available upon request or can be accessed from the Study Web site: http://www.usbr.gov/pn/programs/ucao_misc/odessa/.

Scoping comments can be grouped into five major categories. 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.

1.11 Related Permits, Actions, and Laws

To implement any alternative, Reclamation 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 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

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

1.12 Overview of the EIS

This EIS closely follows the format recommended by the Council on Environmental Quality. This Draft EIS is a companion volume to the *Odessa Subarea Special Study Report* (Study Report) that Reclamation completed and is available on the web at http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html.

- This Draft EIS fulfills the environmental compliance requirements as detailed in Chapter 5, *Consultation and Coordination*.
- The Study Report fulfills the requirements of the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&Gs). The Study Report presents 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 1 identifies the Proposed Action, the purpose and the need for action, and provides background information.

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 environmental impacts of the alternatives considered in detail in addition to identifying mitigation measures.

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

1.13 What Comes Next?

The release of this Draft EIS was announced in the *Federal Register*, on Reclamation's website, and in local and regional newspapers. These announcements included the timeframe for public review, as well as dates, times, and locations of formal public hearings. Ecology issued a Determination of Significance, published notices in local papers, and posted information on their website as well. The public will have 60 days to review and provide comments on the Odessa Draft EIS.

As described in Chapter 5, *Consultation and Coordination*, and in the letter at the beginning of this Draft EIS, a public meeting will be held during the public review period. Participants will be encouraged to provide comments through several mechanisms, such as written comment cards, letters, e-mails, or oral comments at the meeting. All comments received on the Draft EIS, regardless of how the comment is submitted, will be given equal consideration. All comments received on the Draft EIS will be posted on the Project website at http://www.usbr.gov/pn/programs/ucao_misc/odessa/.

1.13.1 Final EIS

Reclamation will carefully consider comments received on the Draft EIS and could respond to such comments by adjusting alternatives, adding new alternatives, supplementing or improving the analysis, or making factual corrections. Each substantive comment will be carefully considered and responses will be included in the Final EIS. The comments and responses will be published as an appendix to the Final EIS.

1.13.2 Record of Decision

In accordance with Federal guidelines, a Record of Decision (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 Environmental Protection Agency 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. Ecology's requirements state that an action can be taken 7 days after issuance of the Final EIS.

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, as follows:

- **Section 2.2:** Summary alternative descriptions, including related water resource management programs and activities.
- **Sections 2.3 through 2.5:** More detailed alternative descriptions, including how CBP water would be supplied (that is, which reservoirs would be involved), and the facilities required to deliver that water to groundwater-irrigated lands in the Study Area. Included with the description of required facilities is an overview of related construction timeframes and activities.
- **Section 2.6:** Alternatives formulation and selection process, and alternatives that were considered but eliminated from further study.
- **Section 2.7:** Estimated costs of the action alternatives.
- **Section 2.8:** Benefit-cost analysis of the action alternatives
- **Sections 2.9 and 2.10:** Summary of potential environmental consequences (details in Chapter 4).

2.2 Alternatives Overview and Water Management

Nine alternatives are considered for the Odessa Study, including the No Action Alternative as required by NEPA and SEPA. Because these alternatives must adhere to the same framework of management programs described in Chapter 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 nine alternatives analyzed in this Draft EIS. Then, Section 2.2.2, *River and Reservoir Operational Changes under the Action Alternatives*, describes what would change and how those changes are measured under different watershed conditions, such as average, wet, dry, and drought years.

Alternatives in the Odessa Study EIS

This DEIS analyzes eight action alternatives that meet the Study Purpose and Need to varying degrees, as well as a No Action Alternative. The eight action alternatives for the Odessa Study Area are composed of two aspects:

- Delivery—How much water is delivered to the Odessa Subarea, what lands would receive the water, and the conveyance facilities that would be used to provide that water
- Supply—The combination of existing or new reservoirs that would provide stored water from the Columbia River

Half of the action alternatives would provide water to partially replace the groundwater supply in the Study Area, and the other half would fully replace the groundwater irrigation supply. Within each of these two broad delivery categories of partial and full replacement, four different reservoir supply combinations are analyzed, as described in Section 2.2.1, *Overview of Alternatives*.

A number of existing, inter-related water management programs, actions, and activities in the study region 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 Area.

2.2.1 Overview of Alternatives

Nine alternatives are evaluated in this Draft EIS, including one No Action Alternative, four partial groundwater irrigation replacement alternatives, and four full groundwater irrigation replacement alternatives. The replacement alternatives differ in which reservoir(s) would supply most of the water:

1. No Action Alternative
2. Partial replacement alternatives:
   - 2A. Partial—Banks
   - 2B. Partial—Banks + FDR
   - 2C. Partial—Banks + Rocky
   - 2D. Partial—Combined
3. Full replacement alternatives:
   - 3A. Full—Banks
   - 3B. Full—Banks + FDR
   - 3C. Full—Banks + Rocky
   - 3D. Full—Combined

2.2.1.1 Delivery Alternatives

The action alternatives fall into two groups based on how much surface water is delivered and where it would be delivered to replace groundwater-irrigated acreage in the Study Area. Including the No Action Alternative, this creates three delivery alternatives with associated facilities, listed below:

- **Alternative 1—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. 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), which is part of the Management Program MOU and the Coordinated Conservation Program.

- **Alternative 2—Partial Groundwater Irrigation Replacement**: This group of delivery alternatives focuses on enlarging the existing East Low Canal and providing CBP surface water to approximately 57,000 acres currently using groundwater south of I-90 (Map 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 176,343 acre-feet.

  Major facility development necessary for the partial replacement alternatives would include expanding the capacity of 43.3 miles of the existing East Low Canal south of I-90, extending the canal by 2.1 miles, and developing a pressurized pipeline system to distribute water from the canal to the farmlands.

- **Alternative 3—Full Groundwater Irrigation Replacement**: This group of delivery alternatives 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, as shown on Map 2-1. The total CBP surface water supply needed for the full replacement alternatives would be 347,137 acre-feet.

In addition to the facilities described for the partial replacement alternatives, the full replacement alternatives would require construction of 71.6 miles of new canal, plus associated siphons, tunnels, wasteways, and a small re-regulating reservoir, as well as a pressurized pipeline distribution system.

2.2.1.2 Supply Options

All surface water supply for the delivery alternatives ultimately would come from the Columbia River using existing CBP water rights, but storage of that water in existing or new reservoirs would be needed. This allows water to be used from the reservoirs during the irrigation season, when less river flow is available. The reservoirs are then refilled during the fall and winter, when more river flow is available. Banks Lake and Lake Roosevelt could both be used for this storage. A new reservoir on Rocky Coulee in the Study Area is also possible. The locations of these three reservoirs are shown on Map 2-1.

Four supply options are considered for both the partial replacement and full replacement delivery alternatives. These use storage from Banks Lake, Lake Roosevelt, or the proposed Rocky Coulee Reservoir, either individually or in combination, to provide the necessary CBP water supply:

- **A: Partial—Banks**. Would use existing storage in Banks Lake, exclusively.
- **B: Partial—Banks + FDR**. Would result in drawdowns from both Banks Lake and Lake Roosevelt.
- **C: Partial—Banks + Rocky**. Would use existing storage in Banks Lake, plus a new Rocky Coulee Reservoir.
- **D: Partial—Banks + Rocky**. Would use a combination of all three facilities.

2.2.1.3 Action Alternatives—Delivery and Supply Combinations

Within each of the two broad delivery categories of partial and full replacement, the four different supply combinations are analyzed to create the action alternatives. These eight action alternatives are listed on Table 2-1 along with the No Action Alternative.

Alternative 1 is the No Action Alternative, which would not deliver additional CBP water to the Study Area and does not involve any facility construction.

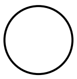
Alternatives 2A through 2D would each provide partial groundwater irrigation replacement to approximately 57,000 acres south of I-90 through an enlarged East Low Canal. The alternatives differ only in which of the four supply options would be used. Similarly, Alternatives 3A through 3D evaluate four different supply options that would each provide full groundwater irrigation replacement to approximately 102,600 acres, both north and south of I-90. These alternatives would use both an enlarged East Low Canal and a new East High Canal system.

2.2.2 River and Reservoir Operational Changes and Hydrology under the Action Alternatives

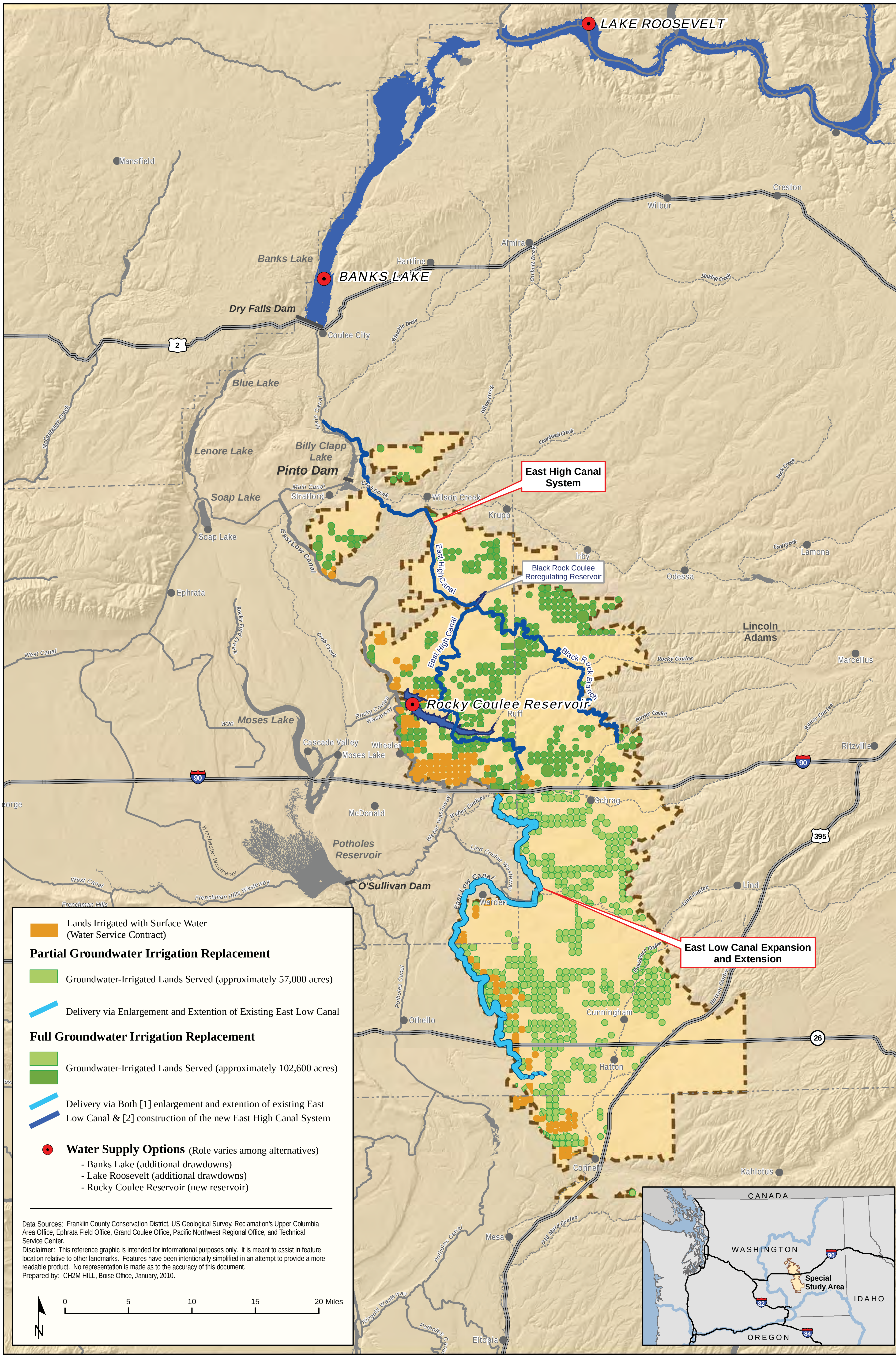
The Columbia River system would provide the surface water supply that would replace groundwater irrigation in the Study Area. Hydrologic modeling has been conducted to determine the potential changes in river flows or reservoir operations (drawdown and refill patterns) that would accompany implementation of the partial replacement alternatives (Alternatives 2A through 2D), the full replacement alternatives (Alternatives 3A through 3D), and the No Action Alternative.

TABLE 2-1

Alternatives Overview

	Delivery Alternative (see also Map 2-1)	Letter and Symbol*		Supply Alternative: Additional Drawdowns of Existing Reservoirs: Banks Lake	Supply Alternative: Additional Drawdowns of Existing Reservoirs: Lake Roosevelt (FDR)	Supply Alternative: New Rocky Coulee Reservoir
1	**No Action**  • No CBP surface water provided to any additional groundwater-irrigated lands in the Odessa Subarea • No facility construction required • Current and ongoing Columbia River and CBP programs, commitments, and operations continue			Not Applicable		
2	**Partial Groundwater Irrigation Replacement**  • Approximately 57,000 acres of groundwater-irrigated lands provided with CBP surface water • All lands supplied with surface water replacement would be south of I-90 • Water delivered by enlargement and extension of the existing East Low Canal and construction of a pressurized pipeline system • Current and ongoing Columbia River and CBP programs, commitments, and operations continue	**2A**		Yes	No	No
		2B		Yes	Yes	No
		2C		Yes	No	Yes
		2D		Yes	Yes	Yes
3	**Full Groundwater Irrigation Replacement**  • Most groundwater-irrigated lands in the Study Area (approximately 102,600 acres) provided with CBP surface water (both north and south of I-90) • Water delivered south of I-90 by enlargement and extension of the existing East Low Canal and construction of a pressurized pipeline system • Water delivered north of I-90 by construction of a new East High Canal system, with an associated pressurized pipeline system • Current and ongoing Columbia River and CBP programs, commitments, and operations continue	**3A**		Yes	No	No
		3B		Yes	Yes	No
		3C		Yes	No	Yes
		3D		Yes	Yes	Yes

*The symbol system shown on this table is used as an aid in identifying the alternatives. The center area shows the delivery alternative: partially or fully shaded to indicate partial or full replacement. The band surrounding the center shows the supply option. If a reservoir name is shown in black with white text, it is included in that alternative; the white, grayed-out reservoir is not included.



Map 2-1

Odessa Subarea Special Study
Columbia Basin Project, Washington

Overview of Action Alternatives: Major Delivery and Supply Elements

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

- Wet condition: Only approximately 10 percent of years would be this wet or wetter
- Average condition: Half of years would be wetter and half drier
- Dry condition: Approximately 15 percent of years would be this dry or drier
- Drought condition: Only approximately 5 percent of years would be this dry or drier

Using historical data to evaluate likely future hydrologic and system operation patterns assumes that future hydrologic conditions would be similar to those observed in the 1929 to 1998 period of record that was used as the basis for modeling. However, other wet, average, dry, and drought water years would not be identical to these four representative years. Section 4.2, *Surface Water Quantity*, describes the hydrologic record used for modeling, and the specific years within that record selected as representative.

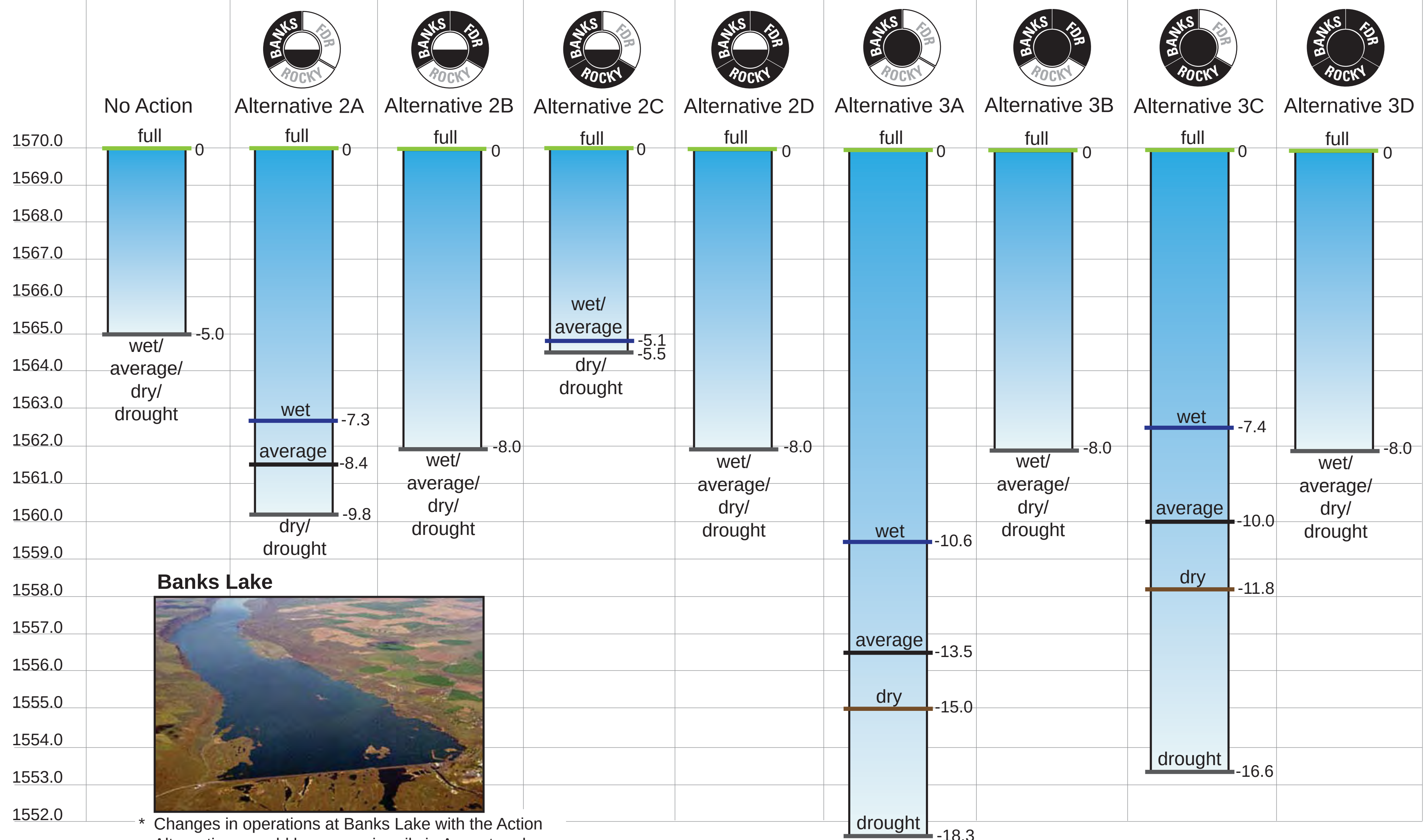
In all water year conditions, the most demand for surface water in the Study Area and, therefore, the greatest drawdown of reservoirs, would occur at the end of August during the height of the irrigation season. Figure 2-1 shows the end-of-August drawdowns and associated pool elevations projected for Banks Lake for the No Action Alternative and the eight action alternatives under wet, average, dry, and drought conditions. Figure 2-2 provides this same information at Lake Roosevelt for the four action alternatives that use Lake Roosevelt storage.

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

None of the Study's eight action alternatives would result in a significant change in Columbia River flows. Current instream flow requirements intended to protect resource values would continue to be met as a first priority in all hydrologic conditions. Water management programs and requirements are in place that establish minimum flows and levels for the Columbia River to protect the resource values associated with the main stem of the Columbia River, including ESA-listed fish species in the river.

Instead, 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, 2D, 3B, and 3D, as shown on Table 2-1. 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 increased drawdowns would reach their minimum elevations at the end of August. The Rocky Coulee Reservoir proposed in Alternatives 2C, 2D, 3C, and 3D would be a working reservoir, filled and emptied each year exclusively to provide irrigation water supply.

For example, as shown on Figure 2-1, the maximum irrigation-season drawdown of Banks Lake under Alternative 2A: Partial—Banks in a drought year (up to 5 percent of years) would be 9.8 feet. In more typical, average years, the end-of-August drawdown under this alternative would be 8.4 feet. For Alternative 2A: Partial—Banks, this would mean an additional drawdown beyond No Action conditions of 3.4 feet in an average year and 4.8 feet in a drought year.



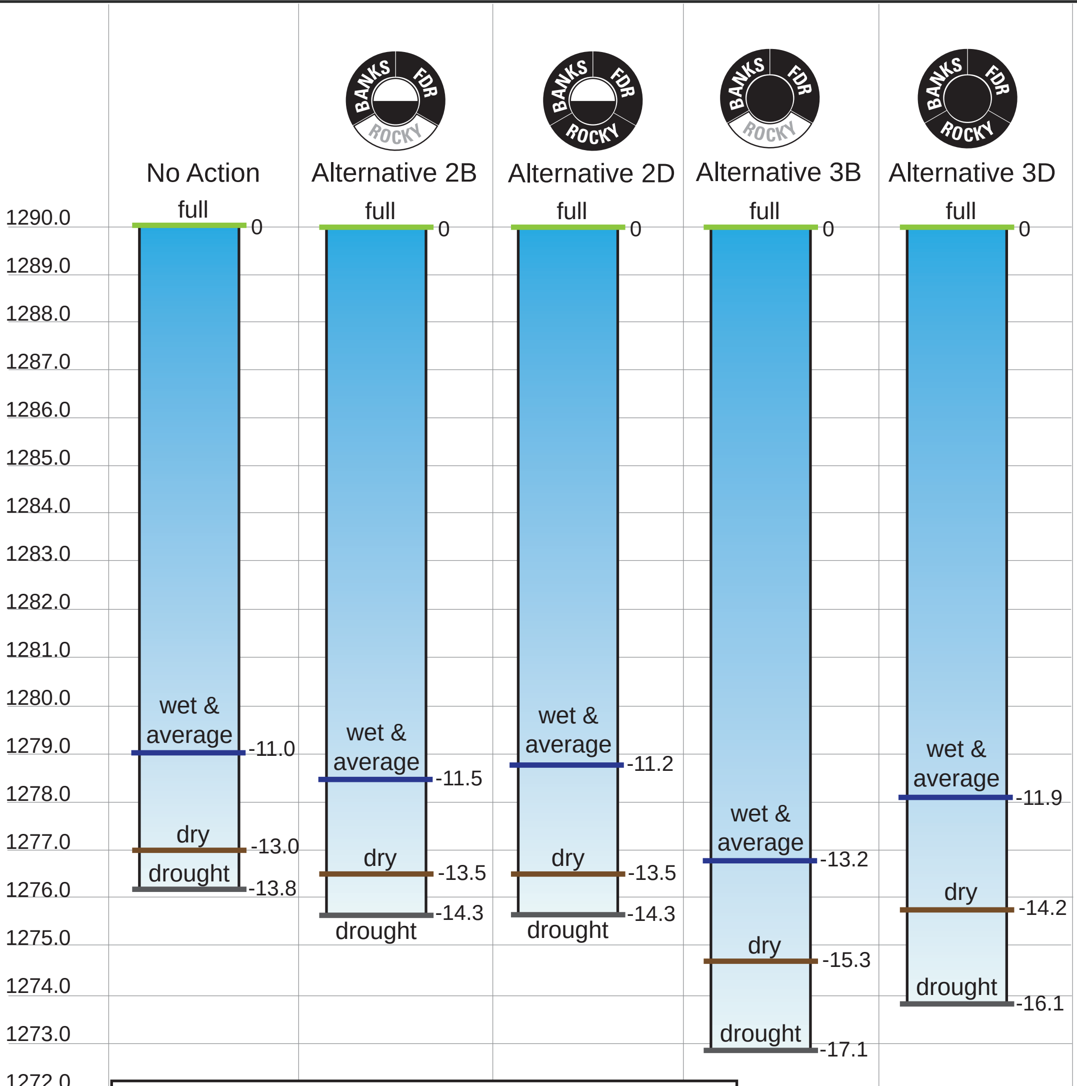
* Changes in operations at Banks Lake with the Action Alternatives would be seen primarily in August and September, with the deepest drawdown seen generally on or near August 31 of each year. Photo is not representative of drawdown conditions.

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

Figure 2-1
Banks Lake - End of August Drawdown*

WB082009003BOI



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

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.

Figure 2-2
Lake Roosevelt - End of August Drawdown*

Full-year depictions of the modeling results for Banks Lake and Lake Roosevelt for all alternatives are presented in Section 4.2, *Surface Water Quantity*. For the proposed new Rocky Coulee Reservoir that would accompany Alternatives 2C, 2D, 3C, and 3D, no modeling data is provided. This reservoir would exclusively be a working reservoir, completely filled and emptied each year to provide required irrigation water supply.

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, supply of flows in the Columbia River to support fish and environmental objectives and meet water rights, and flood control operations are all carefully timed throughout the year to meet numerous, inter-related 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 are listed below, with brief descriptions of each provided in the paragraphs following:

- 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 to the Grand Coulee Feeder Canal, which flows 1.6 miles to Banks Lake (Photograph 2-1). Banks Lake is a storage facility formed by two dams: North and Dry Falls, Photographs 2-2 and 2-3. Banks Lake is designed to serve as a re-regulation reservoir for the irrigation portion of the CBP, as well as the forebay for a pumped storage plant. Water is delivered to CBP lands through a low-head power plant and outlet works in Dry Falls Dam at the southern end of Banks Lake through the Main Canal (Photograph 2-4).

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 directly with Corps for flood control, with State and Federal fish and wildlife agencies for management and protection of fish resources, and with BPA for power production.

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. Lake Roosevelt receives large amounts of runoff from its tributaries with enough runoff to fill the reservoir several times in an average year. The minimum operating pool elevation of Lake Roosevelt is 1208 feet amsl.

Photograph 2-1. Grand Coulee 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 and Dry Falls Dam

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

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 2.3). The primary considerations that shape these operations are summarized in Table 2-2. Except where noted, these existing operations would continue unchanged under all Study alternatives.

TABLE 2-2

Lake Roosevelt Operations Common to All Alternatives

Operational Goal	Description
Flood Control	Lake Roosevelt is operated under a series of “rule curves” that regulate the amount of drawdown and fill. In late winter and early spring, flows are released from the reservoir to allow room to store upstream runoff and prevent downstream flooding. In an average 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 by the Fourth of July holiday.
ESA-Listed Fish	Grand Coulee Dam is operated to help shape streamflows downstream to support ESA-listed fish. In the Columbia River system, 13 anadromous fish species and 2 resident fish species are listed as threatened or endangered. As described in Chapter 1, NMFS and the U.S. Fish and Wildlife Service (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 is operated to help with chum salmon flows from November 1 to April 10 and for other listed salmon and steelhead from April 10 to August 31. Under the Lake Roosevelt Incremental Storage Releases Program, operation of Grand Coulee Dam is being modified to include additional instream flow augmentation. These releases would draw down Lake Roosevelt by an additional 1 foot in non-drought years and 1.8 feet during drought years by the end of August.
CBP Irrigation Supply	About 2.65 million acre-feet is currently pumped annually from Lake Roosevelt to Banks Lake to supply irrigation water, generally from March through October. All irrigation-related operations are conducted to comply with downstream flow objectives to avoid impacting ESA-listed species.
Hydropower	In addition to seasonal fluctuations, Lake Roosevelt fluctuates daily because of releases for hydropower production. Grand Coulee Dam has four power plants, including the pump/generation 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. 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 will go to the Study Area, 25,000 acre-feet to meet municipal and industrial needs, and 27,500 acre-feet to augment instream flows (82,500 acre-feet total). An additional 50,000 acre-feet will be 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, reconstruction of the Weber Siphon is the primary facility modification necessary to deliver the 30,000 acre feet of supply.
Secondary Considerations	Within these 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-listed fish is also a secondary consideration for the overall operation of the reservoir. For example, operations coordinated with involved fish and wildlife agencies are shaped to benefit and protect non-listed mid-Columbia Chinook salmon from November through June.

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.

For the most part, the Banks Lake water surface level has fluctuated in a narrow 2-foot range, from about elevation 1570 feet to elevation 1568 feet. Exceptions to this, historically, 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 management issues. For example, in September 1993, the water surface elevation was lowered 5 feet, to approximately 1565 feet amsl, for maintenance of canal gates at the dams. 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 to reduce an infestation of Eurasian milfoil.

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 has been, and will continue to be, reduced in August, to provide 133,600 acre-feet for summer fish flow augmentation. This results in a 5-foot drawdown of the reservoir level by the end of August. Refill occurs in September 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.

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 550,000 acres in the Columbia Basin. Other purposes of the CBP include power production, flood control, and recreation. 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 Map 2-2 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.

2.2.3.3 Columbia River Basin Water Management Program

Ecology was directed through the Management Act to aggressively 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 Odessa Special 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.

2.2.3.4 Coordinated Conservation Program

Under the broad umbrella of the Management Program, the ECBID, SCBID, QCBID, Ecology, and Reclamation are collaborating on a Coordinated Conservation Program to determine the potential for conservation efforts to create water savings in all three districts. This basin-wide conservation program would continue under all Special Study alternatives.

For example, in 2005 ECBID was contracted to deliver water to 2,361 acres of land (6,274 acre-feet of water) to replace groundwater supplies in the Study Area. This water was available as a result of water conservation associated with Ecology’s Referendum 38 funded pipeline and canal lining projects. The conservation also produced over 4,200 acre-feet of M&I and fish and wildlife water in the District. Water conservation has been achieved through such actions as lining ditches, improving control structures, and more efficient operational controls.

Some of the water conserved through this program could eventually be allocated to groundwater-irrigated lands in the Study Area. However, there are many issues and perspectives related to ownership and use of conserved water. Conserved water cannot be directly translated into reduced demand for groundwater irrigation. Primary considerations include impacts on stream flows, initiatives by those conserving water to irrigate new land that is not currently irrigated, and the fact that the SCBID system relies on return flows from irrigation in the ECBID and QCBID for a majority of its water supply.

2.3 Alternative 1: No Action Alternative

In this EIS, no action means that the proposed Federal action would not take place, and the resulting environmental effects from taking no action are compared with the effects of moving forward with an action alternative. 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 on Map 2-2.

The No Action Alterative represents the foreseeable future if an action alternative is not implemented and groundwater levels continue declining 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.

2.3.1 Conditions Under the No Action Alternative

2.3.1.1 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. Since the early 1980s, groundwater levels have dropped by 100 to 200 feet in nearly half of the production wells (see Chapter 1, Map 1-2), at an average decline rate of 6 to 8 feet per year. In many cases, wells have been drilled deeper to access water, or use of wells has been discontinued. Most of the groundwater wells currently are 800 to 1,000 feet deep, but some are as deep as 2,100 feet.

During the period from September to December 2009, the Columbia Basin Groundwater 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).

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 2-3. 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). On the other end of the spectrum, 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).

TABLE 2-3

Estimated Status of Wells in the Odessa Subarea Under Current Conditions and in the Future Under No Action

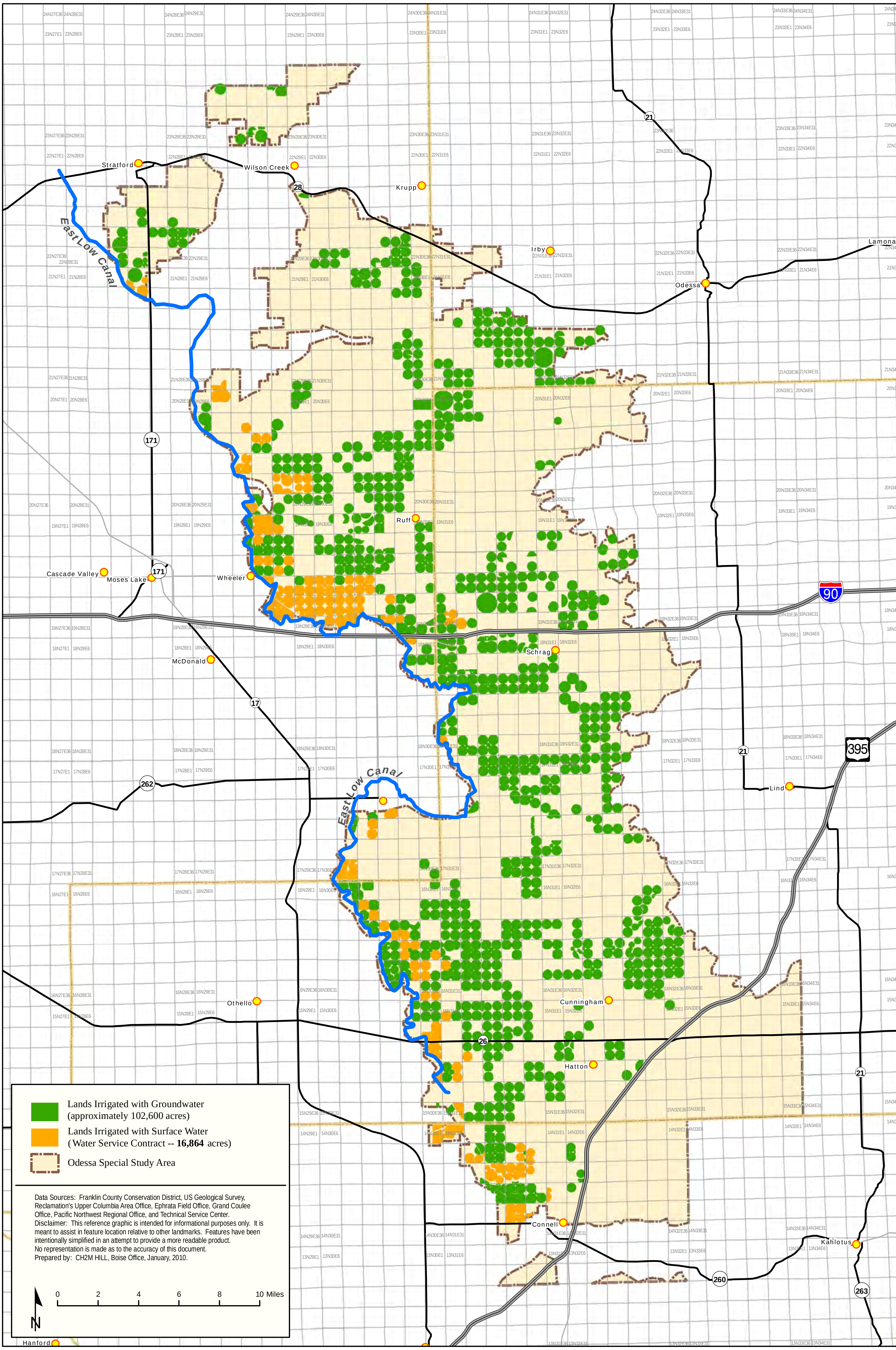
	Percent of Wells By Status Level	
Well Status Levels	Current [a]	Future: 10 Years (about 2020) [b]
Status Level 1: Full Permit Delivery	5	5
Status Level 2: Full Permit Delivery, But Requiring Modifications	30	10
Status Level 3: Partial Permit Delivery, But Still Supports Some High Water Crop Use	30	15
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.

[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*.

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.



Odessa Subarea Special Study
Columbia Basin Project, Washington

Map 2-2

Currently Irrigated Agriculture in the Odessa Subarea Special Study Area (Study Area)

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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*).

2.3.1.2 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 also 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[1] 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 this 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 in the next 10 years (Status Levels 1 and 2; Table 2-3). 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 2-3).

Under the No Action Alternative, 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.
- **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

[1] 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.

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[2].

2.3.1.3 Other Uses of Groundwater in the Study Area

Aquifers in the Odessa Subarea also supply commercial, domestic, municipal, 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 water would not be replaced with surface water, aquifers would continue to decline, and all current commercial, domestic, municipal, and industrial users would be affected in and near the Study Area.

2.3.1.4 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 CBP purposes, including water delivery for irrigation, municipal, and industrial uses, and recreation and fish management. Water from Lake Roosevelt to the CBP would be lifted via the Grand Coulee Feeder Canal to Banks Lake. Banks Lake would serve as a re-regulation reservoir for the irrigation portion of the CBP, and water would be delivered to CBP lands through the Dry Falls Dam outlet works at the southern end of Banks Lake.

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 Alternative, this adjustment would continue, whereby pumping from Lake Roosevelt to Banks Lake would be reduced in August to provide 133,600 acre-feet 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 Columbia River Water Resource Management Program (as described in Section 2.2.3, *Water Management Programs and Requirements Common to All Alternatives*), being implemented by Ecology, is to pursue the development of water supply alternatives to groundwater for agricultural users in the Odessa

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

Subarea, among other priorities (Section 90.90.020 of Chapter 90.90 RCW—Columbia River Water Management Act). 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) would continue to implement incremental storage releases from Lake Roosevelt to supplement water supplies to benefit both instream and out-of-stream uses. Each year, 82,500 acre-feet would be released, of which 30,000 acre-feet would go to the Study Area, 25,000 acre-feet to meet municipal and industrial needs, and 27,500 acre-feet to augment instream flows. The additional 30,000 acre-feet to the Study Area would remain limited to existing agricultural lands, with priority for lands irrigated under existing State groundwater permits. An additional 50,000 acre-feet would be released during drought years, with 33,000 acre-feet of that release directed at relief for interruptible water right holders and 17,000 acre-feet used for augmenting instream flows.

2.4 Partial Groundwater Irrigation Replacement Alternatives

The group of partial replacement alternatives would provide CBP surface water supply to approximately 57,000 acres of lands in the Study Area south of I-90 (see Maps 2-1 and 2-2). The total volume of water associated with partial groundwater replacement is estimated at 176,343 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, 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). However, the State is exploring the option of conducting a rulemaking process to require that these wells be fully decommissioned, at least in some areas or circumstances. Such rulemaking may be part of authorizing legislation for construction of the Odessa Subarea Special Study action alternative.

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 be incorporated into the delivery system. This action would increase system operational efficiency and improve ECBID’s ability to meet scheduled deliveries.

Each of the four partial replacement alternatives 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 pressurized pipeline system. The alternatives vary only in the option used to store and supply CBP water.

The four partial replacement alternatives are as follows:

- Alternative 2A: Partial replacement using the Banks Lake supply option (2A: Partial—Banks)
- Alternative 2B: Partial replacement using the Banks Lake and Lake Roosevelt (FDR) supply options (2B: Partial—Banks + FDR)
- Alternative 2C: Partial replacement using the Banks Lake and Rocky Coulee supply options (2C: Partial—Banks + Rocky)
- Alternative 2D: Partial replacement using the Banks Lake, FDR, and Rocky Coulee supply options combined (2D: Partial—Combined)

Each of these partial replacement alternatives is described below, including summaries of water supply aspects and more detailed information about required facility development.

2.4.1 Alternative 2A: Partial—Banks

The main aspects of Alternative 2A: Partial—Banks are illustrated on Figure 2-3. 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 of the East Low Canal south of I-90 and installation of a pressurized pipeline system to deliver the water from the canal to farmlands.

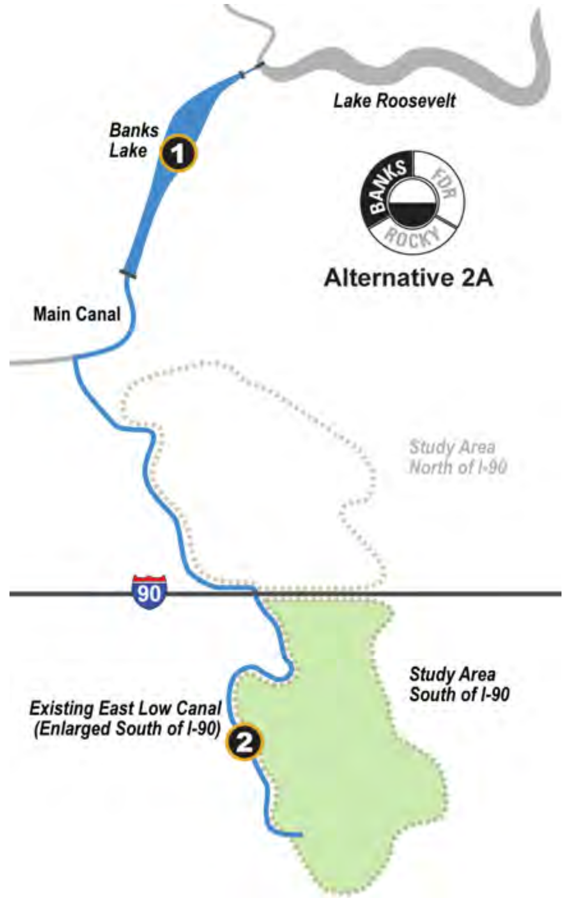


Figure 2-3
Diagram of Alternative 2A: Partial—Banks

2.4.1.1 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 3.4 feet 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 8.4 feet at the end of August (see Figure 2-1).

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.

2.4.1.2 Delivery System

Facility Descriptions

The water delivery system necessary for Alternative 2A: Partial—Banks and all of the other partial replacement alternatives is shown on Map 2-3. 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 (see Map 2-3)
- Additional easement width along the existing Weber wasteway
- New electric transmission lines to each pumping plant and the O&M facility

Each of these facilities is described below. Table 2-4 provides a summary listing, including information on facility quantities and land requirements.

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 DEIS 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 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.

TABLE 2-4

Partial Replacement Alternatives—Delivery System Facility Requirements

		Land Interest Acquisition Required	
Facility/Action*	**Quantity**	**Type**	**Quantity**
East Low Canal (ELC)			
- Enlargement	43.3 miles	*NA--Within existing easement*	
- Extension	2.1 miles	Easement	600 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 ELC)	6 Sites	Fee	7 acres each
(EL47, 53, 68, 75, 80 & 85)			
Relift Plants (EL47R, 53R, 68R, 80R, & 89R2)	5 sites	Fee	7 acres each
Gravity Turnout (EL89G)	1 site	Fee	2 acres
Distribution Pipeline	161.3 miles	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 ELC—Reconstruct	NA[d]	*NA—Within road easement and canal easement*	
- Road Crossings By New Canal [e]	1 location		
Operation and Maintenance Facility	1 site	Fee	7 acres each

[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.

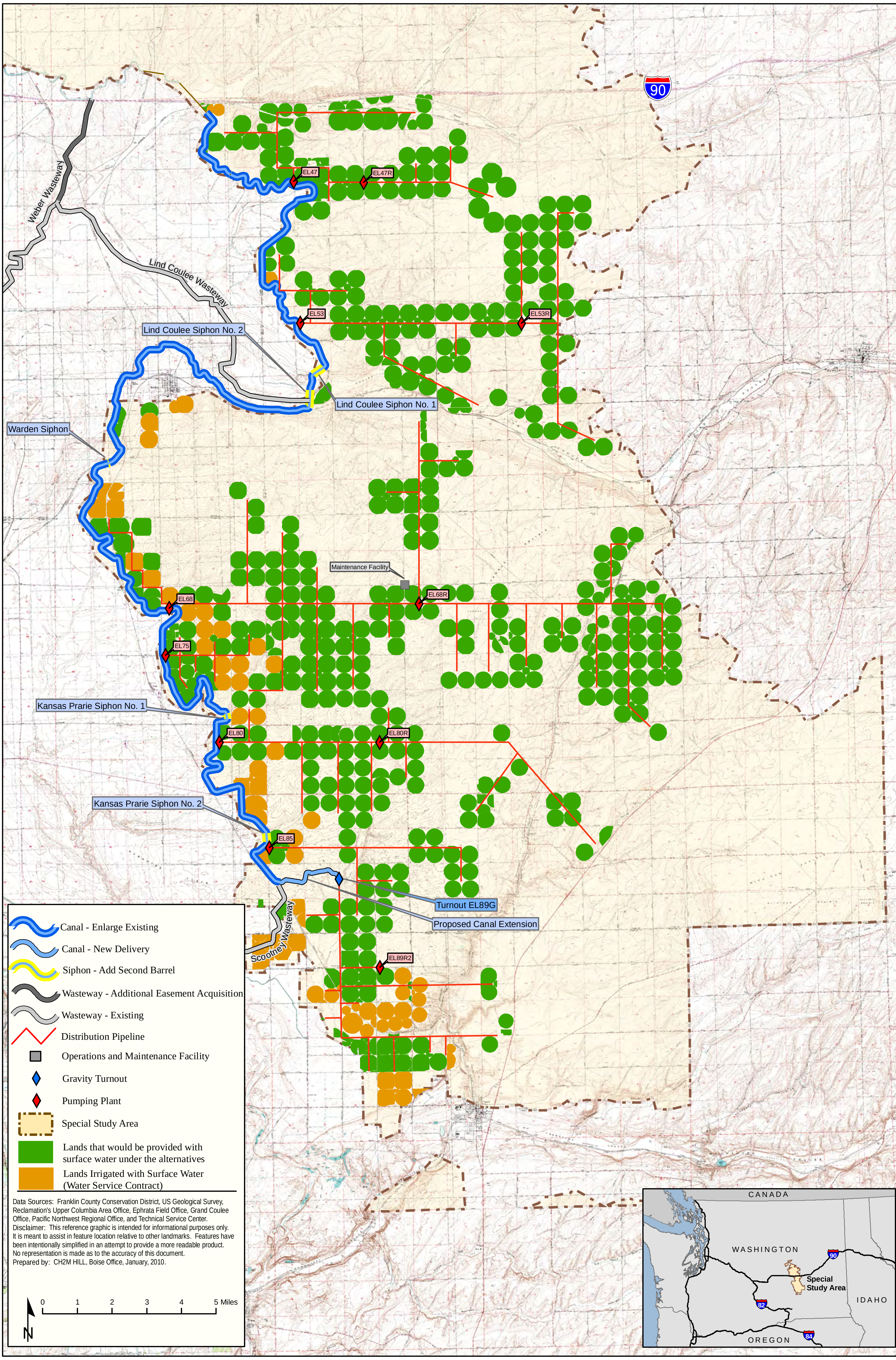
[c] Electric power supply would be needed at each pumping plant and the operations and maintenance facility. Supplying this power would require construction of new transmission lines. For the Partial Replacement alternatives, it is expected that power would be brought to facilities from the Moses Lake 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 ELC canal may need to be lengthened/reconstructed to accommodate ELC enlargement. Any such requirements would be defined during more detailed planning (see Transportation discussion in Section 4.16 of the DEIS).

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

NA: Not applicable

*Note: Some refinements in project facility design are occurring as part of engineering feasibility work. These refinements generally include limited adjustments to pumping plant locations and pipeline alignments (see Engineering Report, available for review at http://www.usbr.gov/pn/programs/ucao_misc/odessa/). As of the public distribution date of the DEIS and Study Report, these refinements would not result in meaningful changes in DEIS or PR analysis or conclusions.



Odessa Subarea Special Study
Columbia Basin Project, Washington

Map 2-3

Partial Groundwater Irrigation Replacement Alternatives: Delivery System Facility Development & Modification

(Applicable to Alternatives 2A through 2D)

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Actions required along the East Low Canal south of I-90 for Alternative 2A: Partial—Banks (and the other partial replacement alternatives) include the following:

- Widening the canal to increase its capacity. Figure 2-4 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 at29 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 2-5.

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 on Map 2-3, and a typical cross-section of the new canal is shown in Figure 2-6. Reclamation would acquire a 600-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.

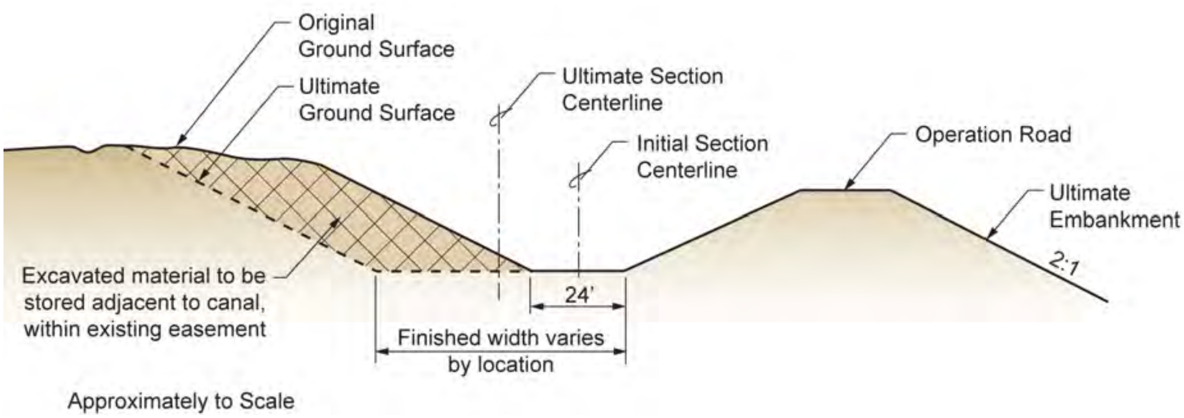


Figure 2-4
East Low Canal Enlargement—Typical Cross-Section

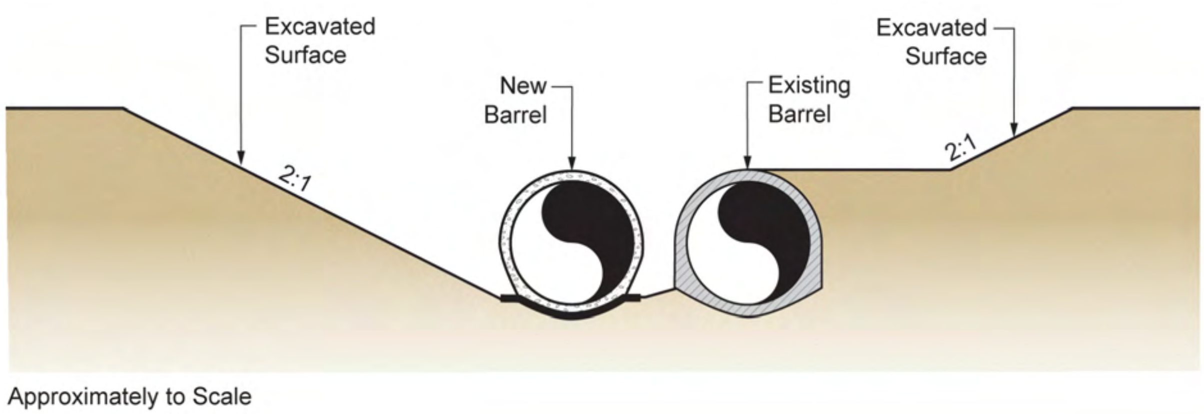


Figure 2-5
Siphon Second Barrel Addition—Typical Cross-Section

Figure 2-6
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 re-lift pumping plants, and one gravity feed turnout to achieve 5 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 Map 2-3, 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 re-lift pumping plants and equipment sites described below, agriculture or other non-structural 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 7 acres to accommodate the pumping plant equipment (no building/structure would be involved), a 6- 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- 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. Figures 2-7 and 2-8 provide a conceptual site and elevation, respectively, of these pumping plants.
- **Re-lift Pumping Plants**: Five re-lift 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 Map 2-3; Figure 2-9 provides a conceptual site plan. Each plant would require about 7 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.

- **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 involves one new crossing of a county road. No bridge or realignment is proposed for this road. Through traffic would be re-routed to other nearby facilities (see Section 4.16, *Transportation*).

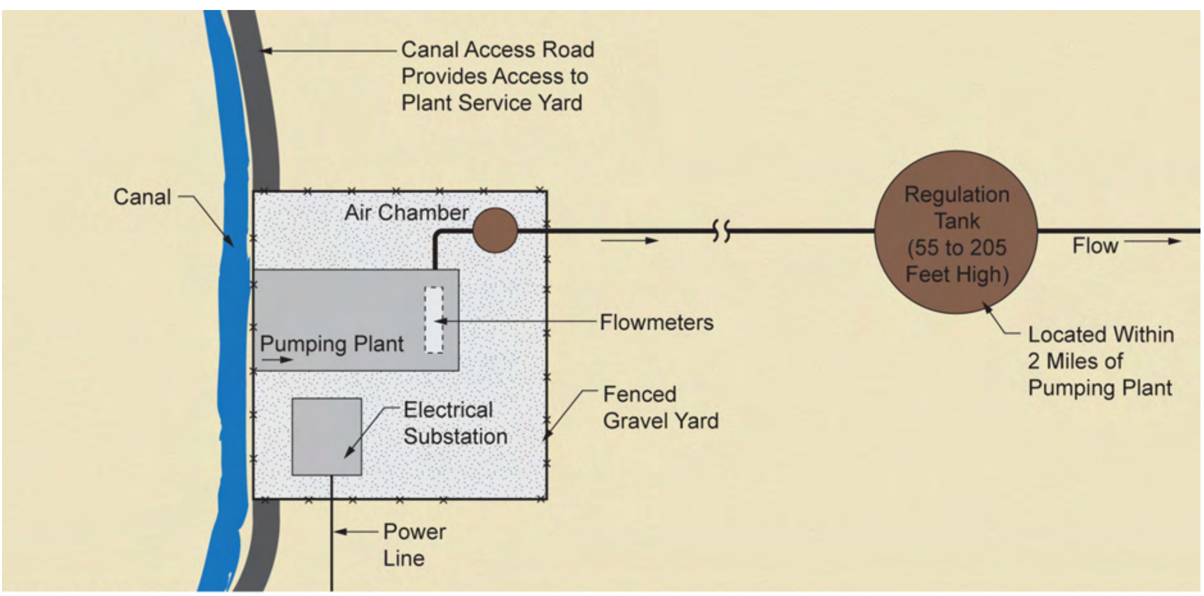


Figure 2-7
Canal-Side Pumping Plant Conceptual Site Plan

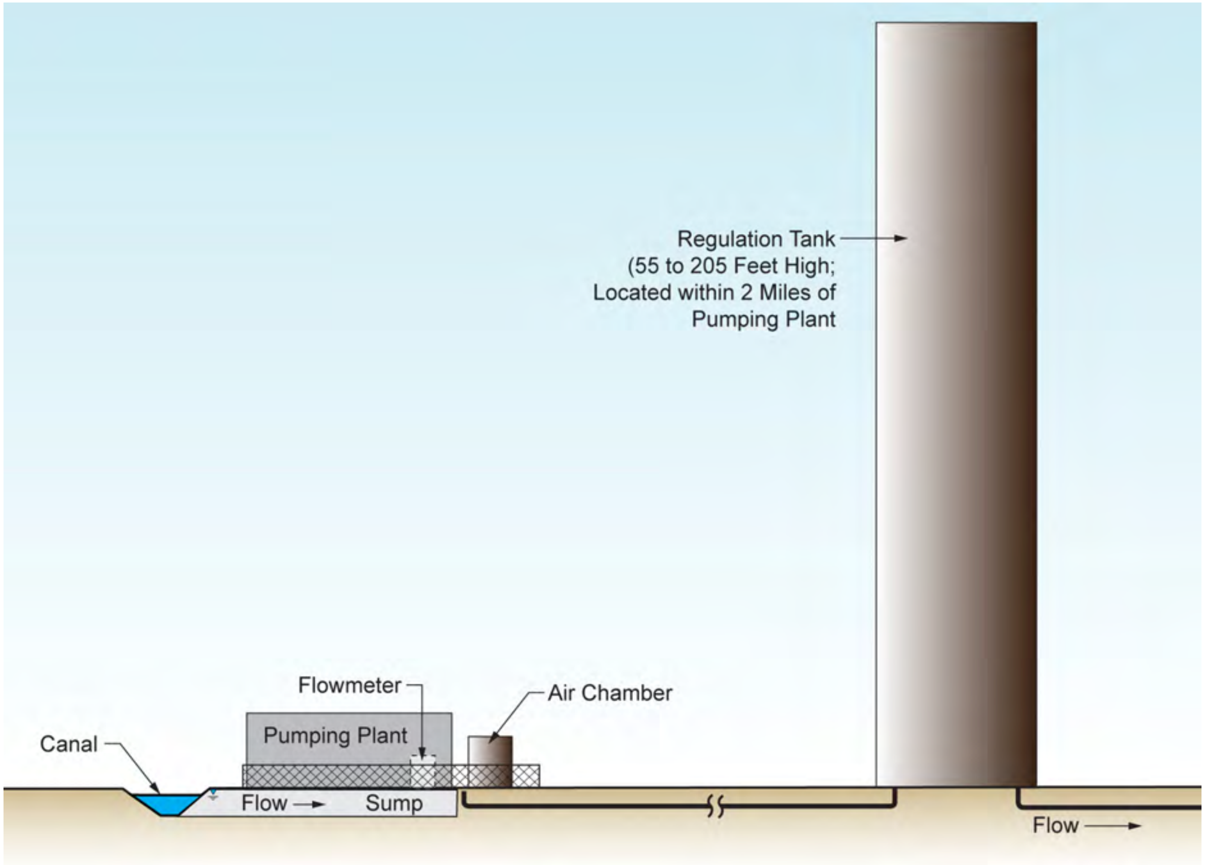


Figure 2-8
Canal-Side Pumping Plant Conceptual Elevation

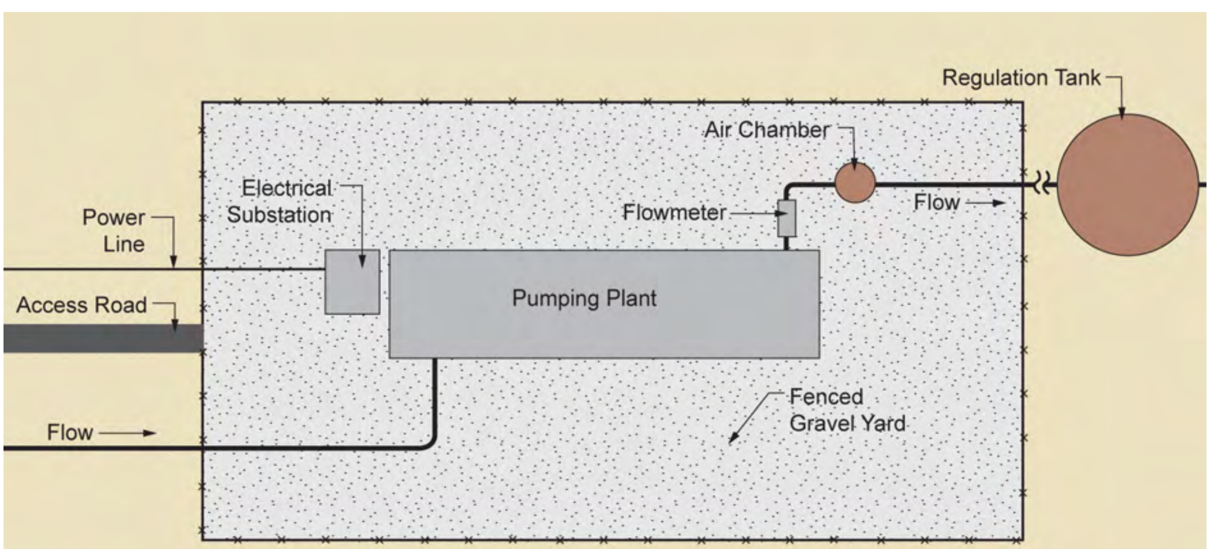


Figure 2-9
Relift Pumping Plant Conceptual Site Plan

- **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 2-10.

- **Additional Easement Width—Weber Wasteway**: The 3-mile-long constructed channel of the existing Weber Wasteway (shown on Map 2-3) has deteriorated over time. Rather than reconstruct the channel, Reclamation proposes to acquire additional easement width to accommodate continued operation. 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 (currently estimated at 34.5 kilovolt) electric power would need to be provided at each of the canal side and re-lift 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

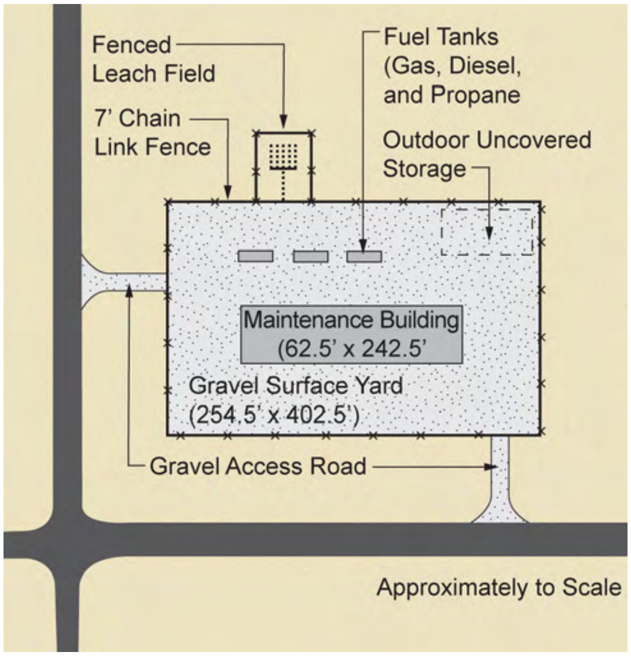


Figure 2-10
Operation and Maintenance Facility Conceptual Site Plan

power lines, roadways, railroads, or other existing linear infrastructure wherever possible. If needed, additional NEPA documentation would be provided to address transmission line development impacts as details of routing are defined.

- **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 canalside pumping plants and the gravity turnout facility. For the relift pumping plants and the O&M facility, locations with existing road access will be selected to the extent feasible. However, short distances of new access road may be needed for some relift plants, and additional NEPA documentation would be provided if needed to address these roads.

  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

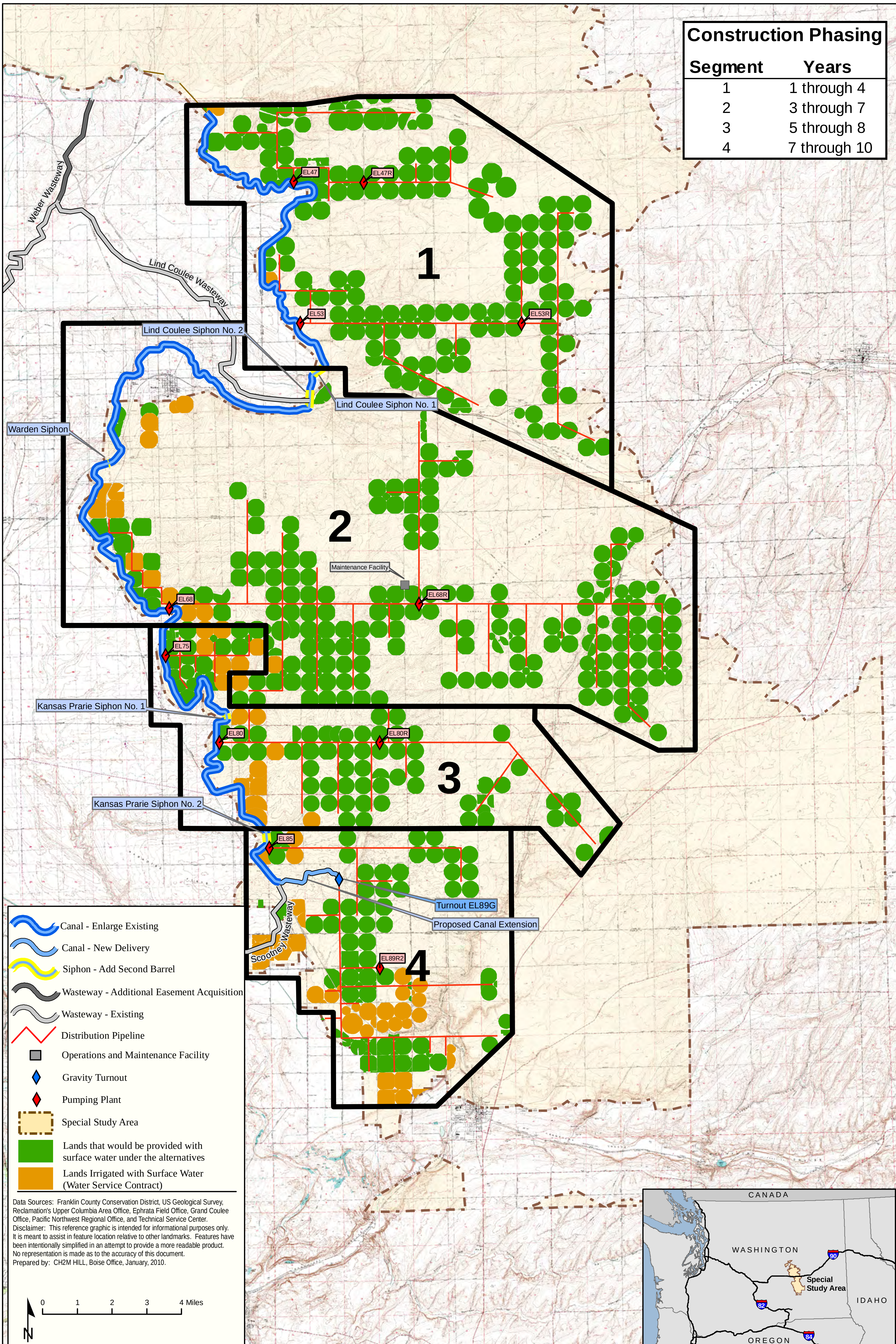
Duration and Phasing
Development of the delivery system for Alternative 2A: ParBtial—Banks (and the other partial replacement alternatives) would be divided into four segments, spanning a total of approximately 10 years, as shown on Map 2-4. Each construction segment would last 3 to 4 years, with work on two or more segments overlapping at times. Construction would be conducted in segments 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.

Construction Workforce, Activities, Equipment, and Other Requirements
The total workforce requirement for construction of the delivery system for Alternative 2A: Partial—Banks (and the other partial replacement alternatives) 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 segments.

Construction activity, and thus deployment of the workforce, would occur at multiple locations simultaneously in each segment, and move progressively through the segment area. Work sites would include the following:

- 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.



Odessa Subarea Special Study
Columbia Basin Project, Washington

Map 2-4

Partial Groundwater Irrigation Replacement Alternatives: Delivery System Construction Phasing

(Applicable to Alternatives 2A through 2D. *Note: Facilities and phasing are also part of the Full Replacement alternatives--see Section 2.4)*

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Access for facility construction would be primarily from existing public roads, Reclamation operations, and maintenance 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.

2.4.2 Alternative 2B: Partial—Banks + FDR

The primary elements of Alternative 2B: Partial—Banks + FDR are illustrated on Figure 2-11. 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 of the East Low Canal south of I-90 and installation of a pressurized pipeline system to deliver the water from the canal to farmlands.

Figure 2-11
Diagram of Alternative 2B: Partial—Banks + FDR

2.4.2.1 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 3 feet 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 at the end of August (See Figure 2-1).

The additional drawdown in an average year at Lake Roosevelt would be 0.5 feet at the end of August beyond the 11.0 feet with the No Action Alternative, bringing the total end-of-August drawdown to 11.5 feet (see Figure 2-2).

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.

2.4.2.2 Delivery System

Delivery system facility requirements, construction, and O&M for this alternative would be the same as those described in Section 2.4.1 for Alternative 2A: Partial—Banks.

2.4.3 Alternative 2C: Partial—Banks + Rocky

The main aspects of Alternative 2C: Partial—Banks + Rocky are illustrated on Figure 2-12. As shown on the diagram, these aspects include providing water supply from Banks Lake (1) and a new Rocky Coulee Reservoir (2), delivered through the East Low Canal (3), to currently groundwater-irrigated lands south of I-90. Major facility development would include Rocky Coulee Reservoir as well as the same East Low Canal enlargement and pressurized pipeline system described for Alternative 2A: Partial—Banks.

Figure 2-12
Diagram of Alternative 2C: Partial—Banks + Rocky

2.4.3.1 Water Supply

Water supply for Alternative 2C: Partial—Banks + Rocky would be provided from available Columbia River flows, minor additional drawdowns at Banks Lake, and storage in a new Rocky Coulee Reservoir. When Columbia River flows or storage in Banks Lake are being used, water would be released from Banks Lake into the Main Canal from Dry Falls Dam and diverted to the East Low Canal. Water from Rocky Coulee Reservoir would enter the East Low Canal directly though an inlet/outlet channel, as described and illustrated below.

Reservoir operation under this alternative would cause very little additional drawdown of Banks Lake. The additional drawdown at Banks Lake would be 0.1 feet 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 drawdown would average 5.1 feet at the end of August.

Rocky Coulee Reservoir would be nearly or fully emptied each year, with no continuing recreational or fish and wildlife values.

In terms of refill, water would be released from Banks Lake to fill Rocky Coulee Reservoir by the end of October each year, followed by any necessary refill of Banks Lake. Rocky Coulee Reservoir would need to be refilled first because of icing conditions in the Main and East Low Canals after November 1. Refill rates for the two reservoirs, in turn, would be subject to any constraints imposed by adherence to Columbia River instream flow or other operational requirements.

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

Required facility development for Rocky Coulee Reservoir is described below.

Rocky Coulee Reservoir

Facility Description

Rocky Coulee Reservoir would be formed by an earth-filled dam in Rocky Coulee, approximately 8 miles from the town of Moses Lake, Washington. The location of the reservoir is shown on Map 2-1, and the reservoir site plan is shown on Map 2-5. Data describing facility types, sizes, and capacities are shown on Table 2-5.

TABLE 2-5

Rocky Coulee Reservoir Data

Facility/Characteristic	Size/Quantity
Land Acquisition Requirement	8,960 acres
Reservoir	
Surface area at full pool	2,812 acres
Length at full pool	9 miles along center line
Active storage capacity	109,315 acre-feet
Maximum water surface elevation	1300.8 feet (Probable Maximum Flood)
Elevation top of active storage	1,291 feet
Dam	
Type	Zoned earth fill embankment
Crest elevation	1,305 feet
Crest width	30 feet
Crest length	3,100 feet
Inlet/outlet canal length and capacity	1.27 mile; 1,060 cfs. 600-foot easement outside of acquisition area
Pumping Plant	
Unit type	91.9 cfs horizontal split case centrifugal
Plant design flow capacity	735.4 cfs
Pump lift	88 feet

To fill the new Rocky Coulee Reservoir, water would flow by gravity through a newly constructed concrete-lined inlet/outlet channel from the existing East Low Canal to the right abutment of the proposed dam. The channel would tie into the existing East Low Canal immediately upstream of the existing Rocky Coulee Siphon. When needed to meet irrigation needs, water would be pumped back into the East Low Canal through a pumping plant located at the downstream toe of the dam. A lower outlet structure would also be constructed at the dam to evacuate the reservoir, if needed.

Construction
Rocky Coulee Reservoir, including all related facilities, would be constructed over a 4-year period. A workforce of approximately 120 personnel would be employed during construction.

Access to the reservoir site for construction personnel, materials, and equipment would be from existing public roads, and any necessary material or equipment staging areas would be located within the Reclamation acquisition area illustrated on Map 2-5.

Construction would require use of heavy equipment, including hydraulic excavators, large dozers, scrapers, graders, 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.

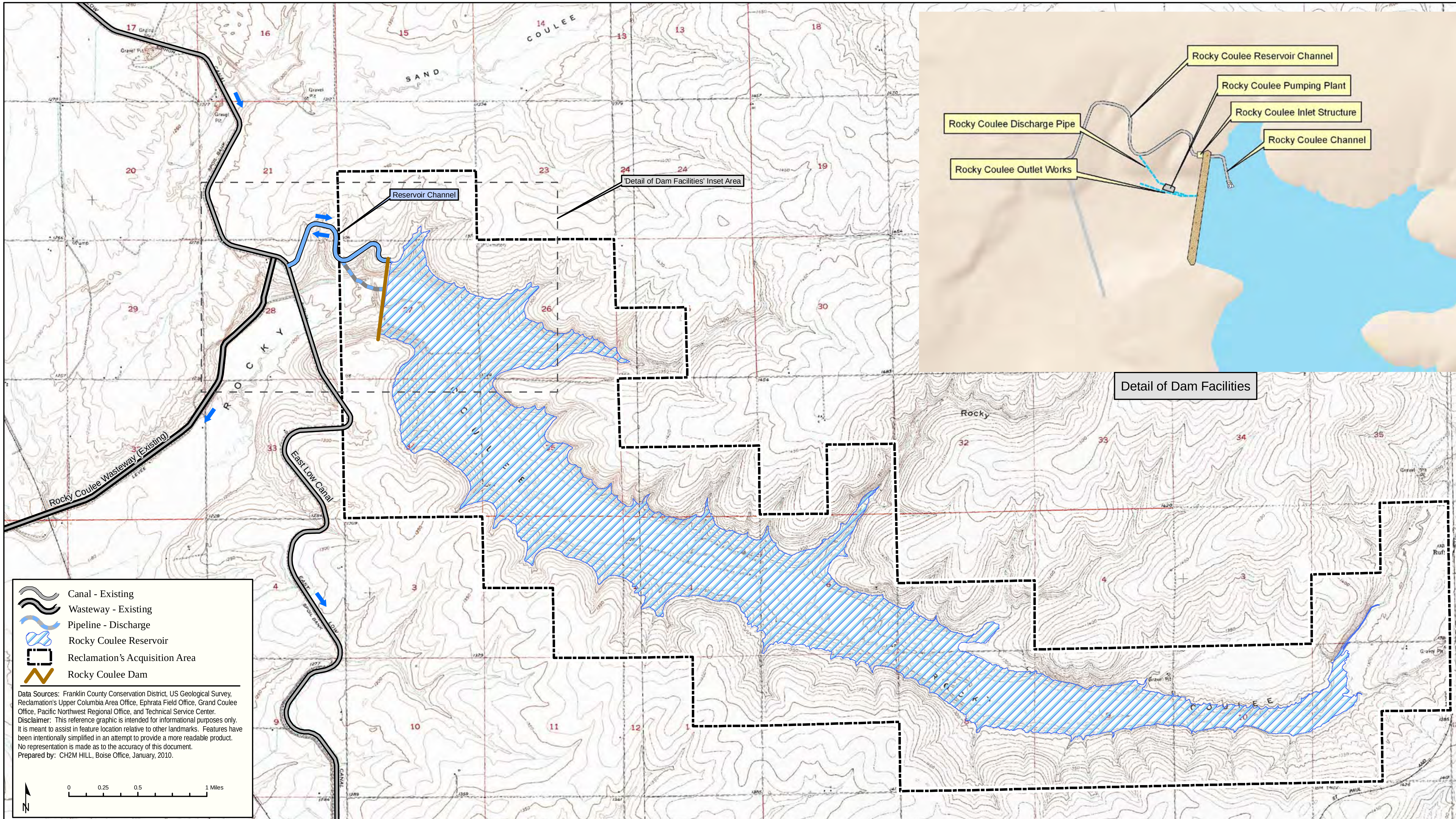
Based on preliminary geologic investigations, it is expected that all earth and rock material necessary for construction of the dam can be derived from within the reservoir inundation area or nearby, within the Reclamation acquisition area. As a result, all major material hauling activity would occur within the reservoir site.

No disposal sites for excavated material are expected to be needed. All material excavated for the inlet/outlet channel or other facilities would be used in dam construction or stockpiled onsite.

Operations and Maintenance
The dam and related facilities would require periodic maintenance, inspection, monitoring, and debris removal. Major maintenance of pumping plant equipment would take place on a 5-year cycle, with replacement of pumps and associated equipment occurring on a 20-year cycle. Collectively, these activities would not require a large workforce and only infrequent use of heavy equipment

2.4.3.2 Delivery System
Water delivery facility requirements, construction, and O&M for Alternative 2C: Partial—Banks + Rocky would be the same as those described in Section 2.4.1 for Alternative 2A: Partial—Banks.

2.4.4 Alternative 2D: Partial—Combined
The primary elements of Alternative 2D: Partial—Combined are illustrated on Figure 2-13. As shown on the diagram, these include providing water supply from Lake Roosevelt (1), Banks Lake (2) and a new Rocky Coulee Reservoir (3), delivered through the East Low Canal (4), to currently groundwater-irrigated lands south of I-90. Major facility development would include Rocky Coulee Reservoir (as described for Alternative 2C: Partial—Banks + Rocky), as well as the same East Low Canal enlargement and pressurized pipeline system described for Alternative 2A: Partial—Banks.



Odessa Subarea Special Study
Columbia Basin Project, Washington

Map 2-5
Rocky Coulee Reservoir

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Figure 2-13
Diagram of Alternative 2D: Partial—Combined

2.4.4.1 Water Supply

Water for this alternative would come from available Columbia River flows, additional drawdowns at Banks Lake and Lake Roosevelt, and storage in a new Rocky Coulee Reservoir. When Columbia River flows or storage in Banks Lake and Lake Roosevelt are being used, water would be released from Banks Lake into the Main Canal from Dry Falls Dam and diverted to the East Low Canal. Water from Rocky Coulee Reservoir would enter the East Low Canal directly through an inlet/outlet channel, as described and illustrated for Alternative 2C: Partial—Banks + Rocky (Section 2.4.3).

The average additional drawdown at Banks Lake under this alternative would be 3 feet beyond the 5 feet of drawdown for summer fish flow augmentation that is part of the No Action Alternative. The total drawdown would be 8 feet at the end of August (see Figure 2-1)

At Lake Roosevelt in an average year, drawdown in August would reach 11.2 feet, compared with 11.0 feet under No Action (that is, an increase in August drawdown of 0.2 feet—see Figure 2-2).

Rocky Coulee Reservoir would generally be filled and emptied each year.

Refill of the reservoirs would proceed as follows:

1. Water would be released from Banks Lake to fill Rocky Coulee Reservoir by the end of October each year because of icing conditions in the Main and East Low Canals during the winter.
2. Lake Roosevelt would be refilled to meet the requirement that it be at water surface elevation 1283 feet amsl by the end of September.
3. Refill of Banks would occur subject to these priorities and any other constraints imposed by Columbia River instream flow or other operational requirements.

No construction or modification of facilities is required at Lake Roosevelt or Banks Lake under Alternative 2D: Partial—Combined. Required facility development for Rocky Coulee Reservoir is described under Alternative 2C: Partial—Banks + Rocky, above.

2.4.4.2 Delivery System

Delivery system facility requirements, construction, O&M for Alternative 2D: Partial—Combined would be the same as described in Section 2.4.1 for Alternative 2A: Partial—Banks.

2.5 Full Groundwater Irrigation Replacement Alternatives

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 would be 347,137 acre-feet. As the surface water supply system would be brought online and this water would become 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, 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). However, the State is exploring the option of conducting a rulemaking process to require that these wells be fully decommissioned, at least in some areas or circumstances. Such rulemaking may be part of authorizing legislation for construction of an Odessa Subarea Special Study action alternative.

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 also be incorporated into the delivery system. Incorporating this acreage would increase system efficiency and improve ECBID’s ability to meet scheduled deliveries.

Each of the four 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 (see Map 2-1). Each of the full replacement alternatives vary only in the option used to store and supply CBP water.

The four full replacement alternatives include the following:

- Alternative 3A: Full replacement using the Banks Lake Supply option (3A: Full—Banks)
- Alternative 3B: Full replacement using the Banks Lake and Lake Roosevelt (FDR) supply options (3B: Full—Banks + FDR)
- Alternative 3C: Full replacement using the Banks Lake and Rocky Coulee supply options (3C: Full—Banks + Rocky)
- Alternative 3D: Full replacement using the Banks Lake, FDR, and Rocky Coulee supply options combined (3D: Full—Combined)

Each of these full replacement alternatives is described below, including summaries of water supply aspects and more detailed information about required facility development.

2.5.1 Alternative 3A: Full—Banks

The primary elements of Alternative 3A: Full—Banks are illustrated on Figure 2-14. As shown on the diagram, these include providing 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 small re-regulating reservoir, and an associated pressurized pipeline distribution network.

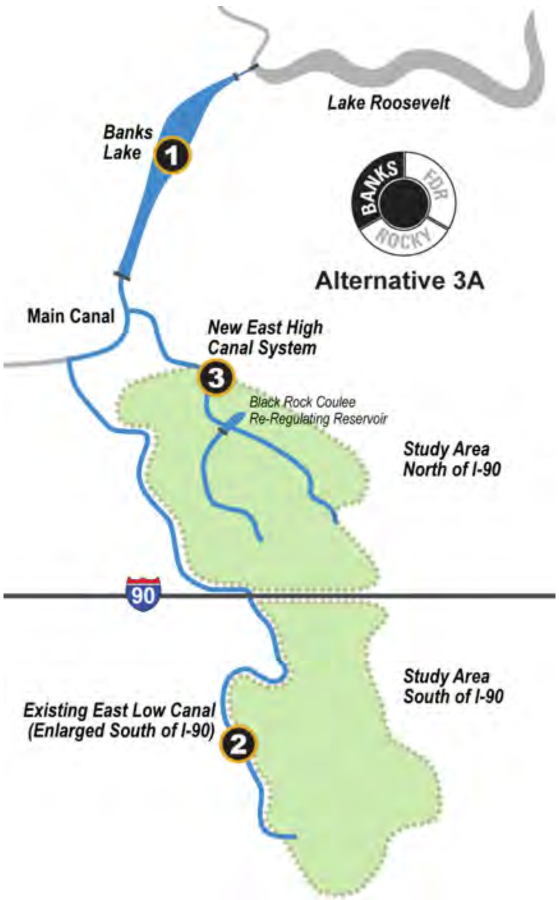


Figure 2-14
Diagram of Alternative 3A: Full—Banks

2.5.1.1 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 8.4 feet 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 13.5 feet at the end of August (see Figure 2-1).

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.

2.5.1.2 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 2.4.1) to serve acreage south of I-90. To serve acreage north of I-90, the following additional facilities would be developed (see Map 2-6):

- 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 re-regulating 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

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 (see Map 2-6)
- New electric transmission lines to each pumping plant and the O&M facility

Each of these facilities is described below. Table 2-6 lists the facilities, including information on quantities and land requirements.

Canals

Under Alternative 3A: Full—Banks, 71.6 miles of new canal would be required to serve groundwater-irrigated and water service contract lands north of I-90. This canal would be constructed in three main reaches: East High Canal north of the re-regulating reservoir (21.4 miles), East High Canal south of the re-regulating reservoir (23.4 miles), and Black Rock Branch Canal originating at the re-regulating 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 600-foot easement, with all material excavated for the canal deposited within the easement. A typical cross-section of the canal is shown in Figure 2-15.

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 project development. Instead, the canal would be built to approximately 15 percent of full capacity, which is the size necessary to serve groundwater-irrigated and existing water service contract 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 Map 2-6, with additional information provided below and on Table 2-6.

- **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 2-16. This facility would be constructed entirely within the existing easement of the existing Main Canal and the new 600-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.

TABLE 2-6
Full Replacement Alternatives—Delivery System Facility Requirements

Facility/Action	South of I-90 (See Map 2-3)	North of I-90 (See Map 2-6)	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	600 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	600 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	600 feet wide
- New Tunnels (3)	-	1.3 miles	1.3 miles	Easement	600 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	600 feet wide
- To Weber Coulee from EHC		1.3 miles			
- To Rocky Coulee from EHC		0.3 miles			
- To Rocky Coulee from BRBC		0.5 miles			
- To Farrier Coulee from BRBC		0.6 miles			
Drainage/Flowage Easements					
Black Rock Coulee		6.0 miles	6 miles	Easement	1,200 feet wide
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 BRBC)		1 site	1 site	*NA—Within reregulating reservoir acquisition area*	
Canalside Pumping Plants (distribution system)	6 sites	15 sites	21 sites	Fee	7 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	5 sites	3 sites	8 sites	Fee	7 acres each
- East Low Canal (EL47R, 53R, 68R, 80R, & 89R2)	5 sites		5 sites		
- East High Canal (EH19R, 50R)		2 sites	2 sites		

TABLE 2-6
Full Replacement Alternatives—Delivery System Facility Requirements

Facility/Action	South of I-90 (See Map 2-3)	North of I-90 (See Map 2-6)	Total	Land Interest Acquisition Required	
				Type	Quantity
- Black Rock Branch Canal (BRB7R)		1 site	1 site		
Gravity Turnout	1 site	3 sites	4 sites	Fee	2 acres
- East Low Canal (EL89G)	1 site		1 site		
- East High Canal (EH15G & EH50G)		2 sites	2 sites		
- Black Rock Branch Canal (BRB29G)		1 site	1 site		
Distribution Pipeline	161.3 miles	187.3 miles	348.6 miles	Easement	200 feet wide
East Low Canal	161.3 miles				
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 ELC--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]
Operation and Maintenance Facility	1 site	1 site	2 sites	Fee	7 acres each

[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.

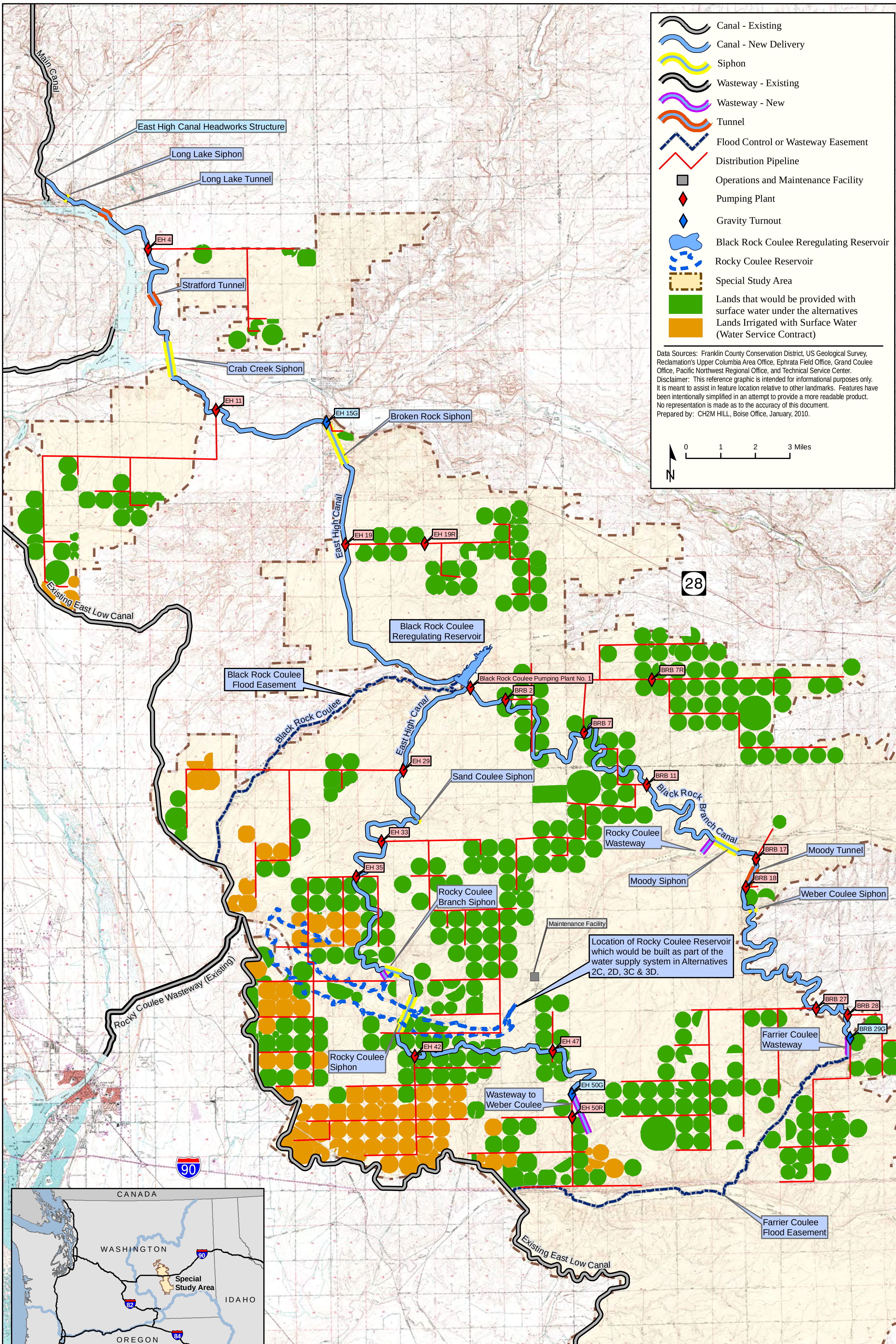
[d] To Be Determined: Some existing road bridges along the ELC canal may need to be lengthened/reconstructed to accommodate ELC expansion. Any such requirements would defined during more detailed planning (See Transportation discussion in Section 4.16 of the DEIS).

[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

*Note: Some refinements in project facility design are occurring as part of engineering feasibility work. These refinements generally include limited adjustments to pumping plant locations and pipeline alignments (see Engineering Report, available for review at http://www.usbr.gov/pn/programs/ucao_misc/odessa/). As of the public distribution date of the DEIS and Study Report, these refinements would not result in meaningful changes in DEIS or PR analysis or conclusions.



Map 2-6

Odessa Subarea Special Study
Columbia Basin Project, Washington

Full Groundwater Irrigation Replacement Alternatives: Delivery System Facility Development & Modification

(Applicable to Alternatives 3A through 3D; Facilities shown are in addition to those required for Partial Replacement--See Map 2-3)

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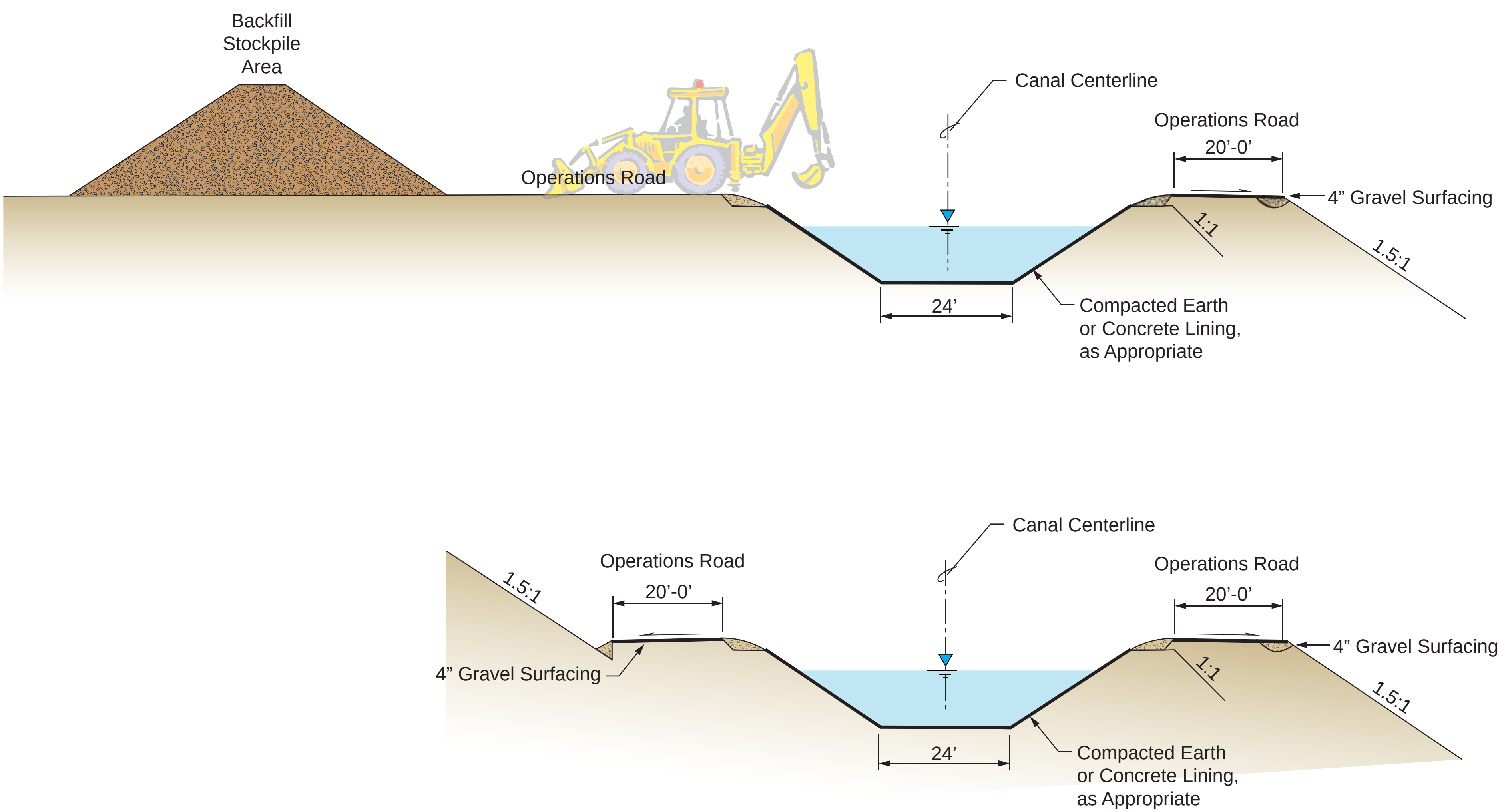

Approximately to Scale

Odessa Subarea Special Study
Columbia Basin Project, Washington

Figure 2-15
Typical Cross-Sections
East High and Black Rock Branch Canals

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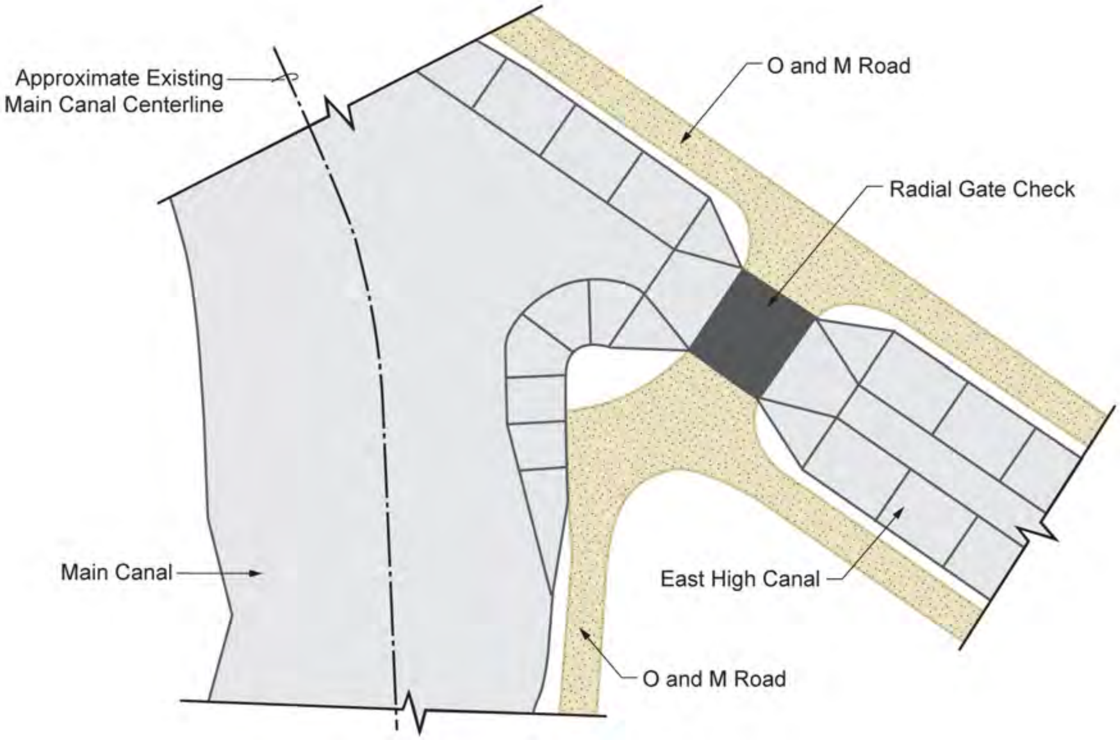


Figure 2-16
East High Canal Headworks Structure: Conceptual Site Plan

- **Siphons**: Three siphons would be constructed along the East High Canal north of the re-regulating 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 Map 2-6. All siphons would be constructed within a 600-foot easement with all material excavated for siphon installation deposited within this easement. Figure 2-17 illustrates a typical siphon cross-section.

- **Tunnels**: Two tunnel sections would be constructed as part of the East High Canal north of the re-regulating reservoir and one would be located along the Black Rock Branch Canal. The locations of these tunnels are shown on Map 2-6. The tunnel portals would be constructed within the 600-foot canal easement, and a 600-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

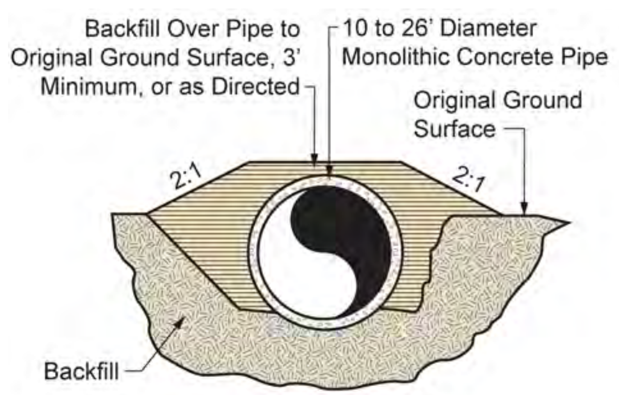


Figure 2-17
Typical Siphon Cross-Section

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 Map 2-6. 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 600-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 earth fill 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 Map 2-7.

In its role as a re-regulating 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 reservoir into the Black Rock Branch Canal, as shown on Map 2-7.

Reclamation would also acquire a 1,200-foot-wide easement along the channel of Black Rock Coulee downstream of the re-regulating 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.

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. Map 2-6 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 Map 2-6, 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 non-structural uses could generally continue once the pipeline is installed and operational.

- **Canal-Side Pumping Plants**: As shown on Map 2-6, 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 2.4.1.2, and illustrated in Figures 2-7 and 2-8.

- **Re-lift Pumping Plants**: Three re-lift 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 Map 2-6. 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 2.4.1.1, and illustrated on Figure 2-9.

- **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 Map 2-6 for the locations of these turnouts). Each facility would require a 2-acre site.

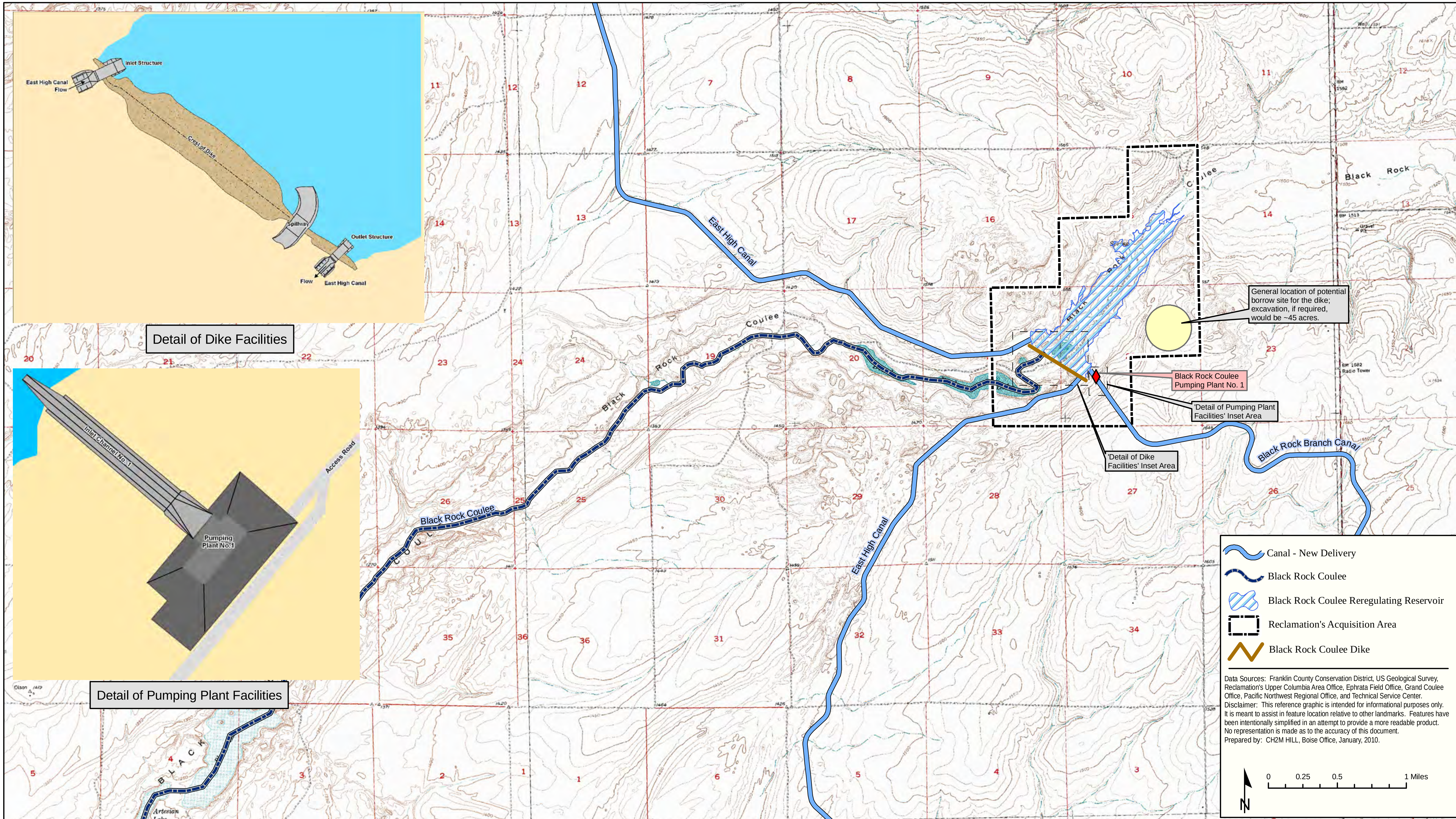
- **Meter Equipment Sites**: Metering equipment would be installed at numerous locations in the water distribution pipeline system. Most of these metering sites would be associated with the locations where landowners tap into the system. These sites would be approximately 2,500 square feet, be within 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.



Odessa Subarea Special Study
Columbia Basin Project, Washington

Map 2-7
Black Rock Coulee Reregulating Reservoir

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- **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 Re-Regulating 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. NEPA documentation would be provided for new roads if needed.

- **Wildlife Crossings and Escape Ramps**: As part of East High Canal development, 11 wildlife crossings would be installed over the East High Canal, nine along the reach north of Black Rock Coulee Reregulating Reservoir and two 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 2-18. Each would also include a road surface planted with low grasses and would be used for general O&M vehicle circulation along the canal. These features may change to better accommodate wildlife use during final design.

  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 2-19 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 Washington Department of Fish and Wildlife (WDFW).

- **Operations and Maintenance Facility**: A second O&M facility (in addition to the one described in Section 2.4.1.1) would be built at the northeast corner of

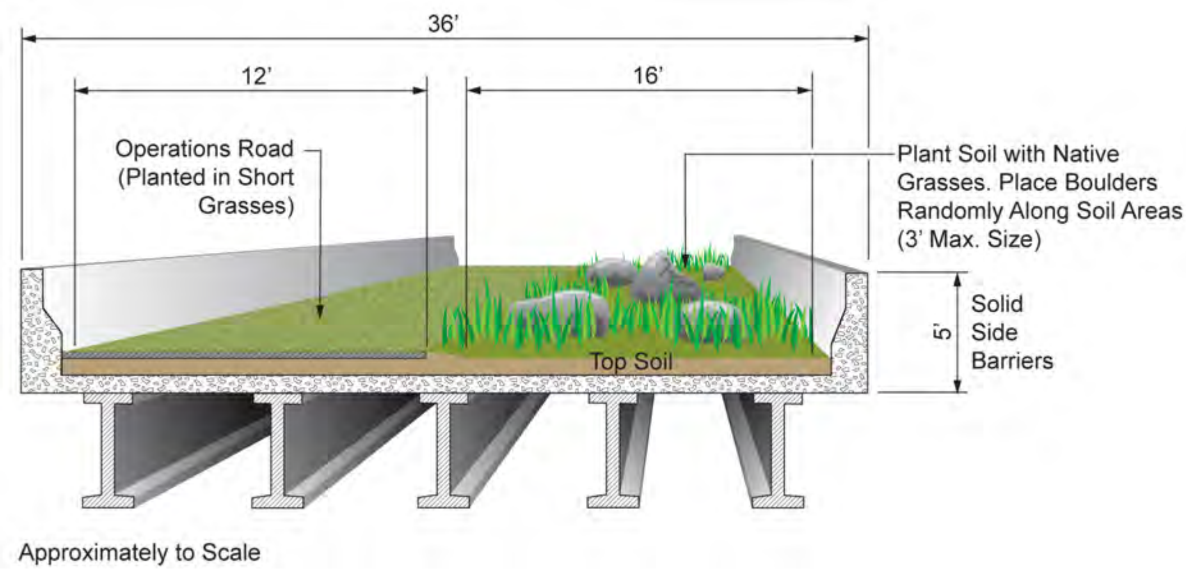


Figure 2-18
Wildlife and O&M Bridge Typical Cross-Sections

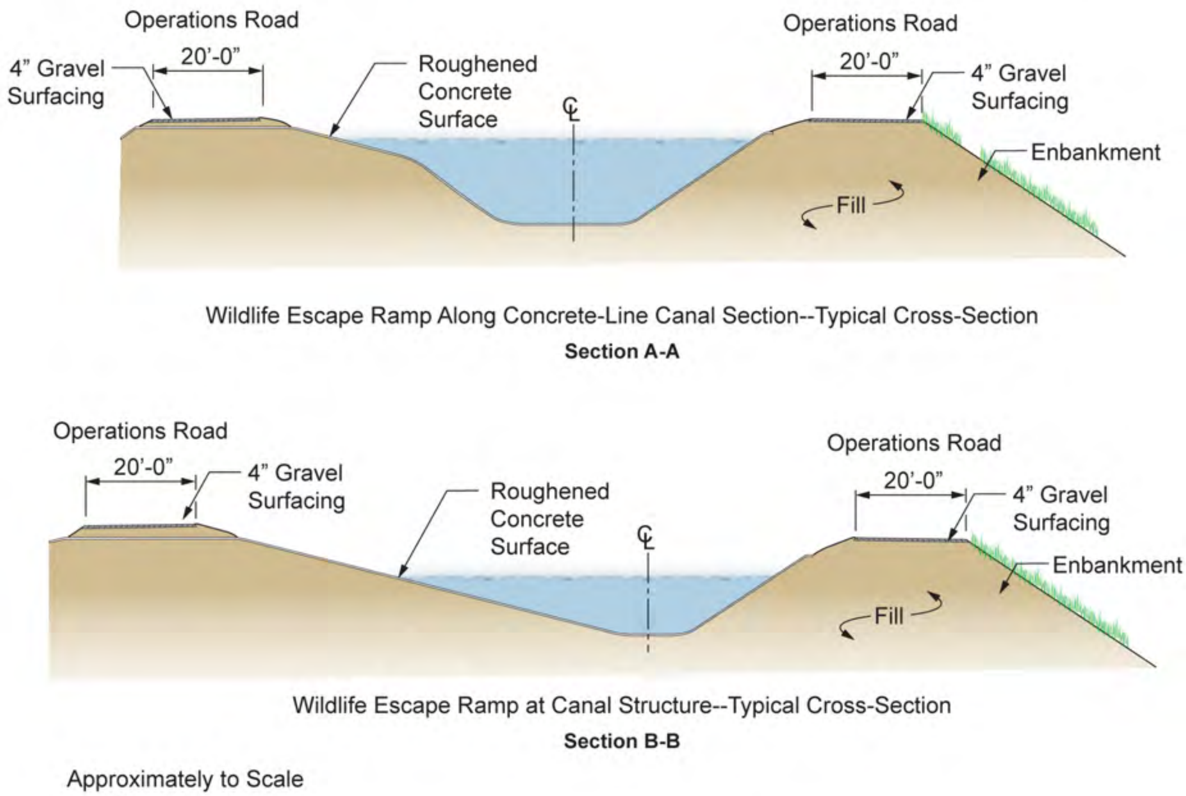


Figure 2-19
Wildlife Escape Ramps Typical Cross-Section

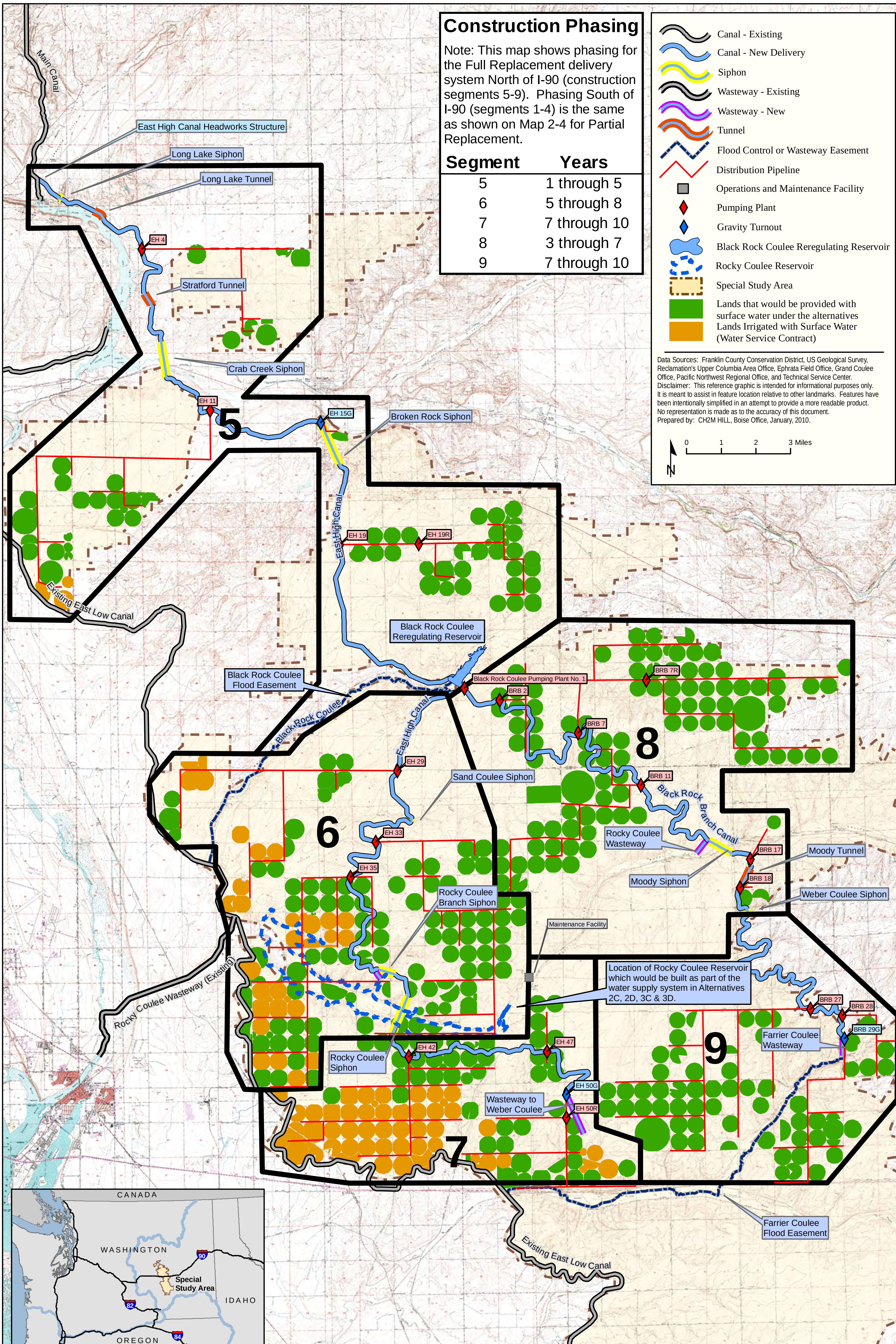
the intersection of Road 6 NE and Road W NE, approximately 0.25 mile north of Ruff, Washington. This facility would be the same as that described for location south of I-90 in Section 2.4.1.1 and illustrated in Figure 2-10.

- **Electric Transmission Lines**: High voltage 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 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. If needed, additional NEPA documentation would be provided as the details of transmission line development are defined.

Construction

Duration and Phasing

Development of the delivery system for the full replacement alternatives would be divided into nine segments, as shown on Maps 2-4 and 2-8 (showing phasing of facilities south and north of I-90, respectively). The total construction period is projected to be approximately 10 years, with segments being built simultaneously north and south of I-90. Construction within each segment would last 3 to 4 years.



Map 2-8

Odessa Subarea Special Study
Columbia Basin Project, Washington

Full Groundwater Irrigation Replacement Alternatives: Delivery System Construction Phasing

(Applicable to Alternatives 3A through 3D; map shows phasing of facilities North of I-90; see Construction Phasing notes above for reference to facilities south of I-90)

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Construction would be conducted in segments 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.

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 segments is occurring simultaneously.

Construction activity, and thus deployment of the workforce, would occur at multiple locations simultaneously in each segment and move progressively through the segment area. Primary work locations for facilities south of I-90 were listed in discussion of the partial replacement alternatives (Section 2.4.1.1); primary work locations for facilities north of I-90 would include the following:

- East High Canal Headworks structure (Segment 5 only)
- Black Rock Coulee Reregulating Reservoir (Segment 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
- Operations and maintenance 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 2.4.1.1.

2.5.2 Alternative 3B: Full—Banks + FDR

The main aspects of Alternative 3B: Full—Banks + FDR are illustrated on Figure 2-20. 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.

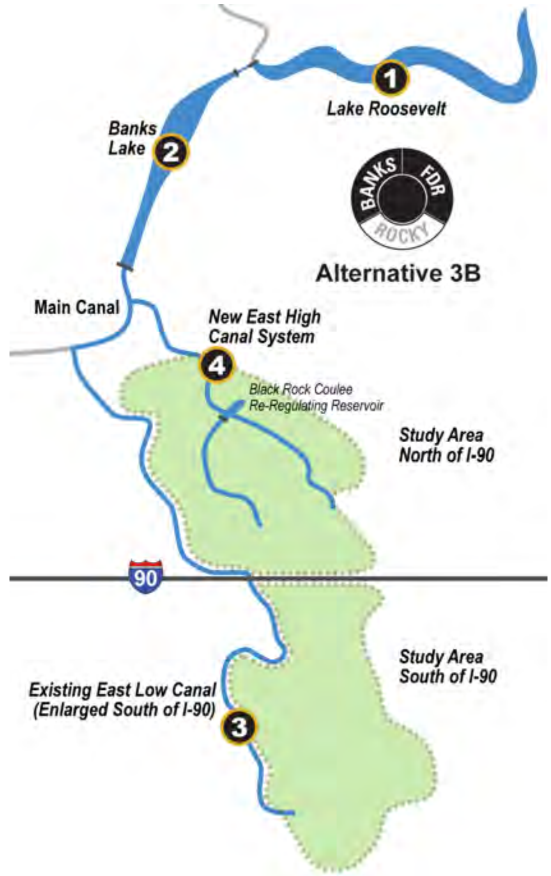

Figure 2-20
Diagram of Alternative 3B: Full—Banks + FDR

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 High and East Low Canals.

The additional drawdown of Banks Lake under this alternative would be 3 feet 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 at the end of August (See Figure 2-1).

The additional drawdown in an average year at Lake Roosevelt would be 2.2 feet at the end of August beyond the 11.0 feet with the No Action Alternative, bringing the total end-of-August drawdown to 13.2 feet (see Figure 2-2).

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. Under this alternative, Banks Lake would not be expected to completely refill in approximately 6 percent of years. Operations modeling indicates that Banks Lake would not refill in 4 out of 70 years under this alternative.

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

2.5.2.2 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 for Alternative 3A: Full—Banks.

2.5.3 Alternative 3C: Full—Banks + Rocky

The primary elements of Alternative 3C: Full—Banks + Rocky are illustrated on Figure 2-21. As shown on the diagram, these include providing water supply from Banks Lake (1) and a new Rocky Coulee Reservoir (2), delivered through the East Low Canal (3) and a new East High Canal system (4), to currently groundwater-irrigated lands north and south of I-90. Major facility development would include Rocky Coulee Reservoir as well as the same East Low Canal enlargement, East High Canal system, and pressurized pipeline networks described for Alternative 3A: Full—Banks.

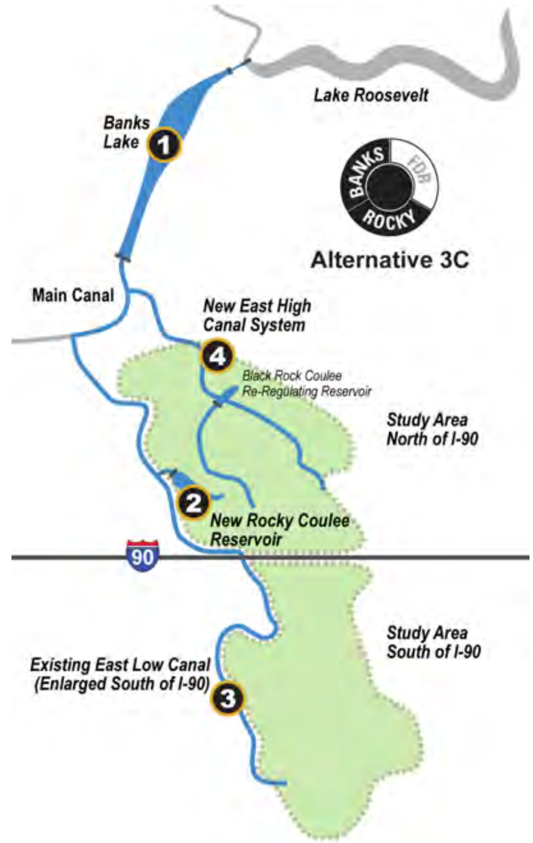

Figure 2-21
Diagram of Alternative 3C: Full—Banks + Rocky

2.5.3.1 Water Supply

Water supply for Alternative 3C: Full—Banks + Rocky would come from available Columbia River flows, additional drawdowns at Banks Lake, and storage in a new Rocky Coulee Reservoir. When Columbia River flows or storage in Banks Lake are being used, 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. Water from Rocky Coulee Reservoir would enter the East Low Canal directly though an inlet/outlet channel.

The additional drawdown at Banks Lake would be 5 feet 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 drawdown would average 10 feet at the end of August.

Rocky Coulee Reservoir would be nearly or fully emptied each year, with no continuing recreational or fish and wildlife values.

In terms of refill, water would be released from Banks Lake to fill Rocky Coulee Reservoir by the end of October each year, followed by any necessary refill of Banks Lake. Rocky Coulee Reservoir would need to be refilled first because of icing conditions in the Main and East Low Canals after November 1. Refill rates for the two reservoirs, in turn, would be subject to any constraints imposed by adherence to Columbia River instream flow or other operational requirements.

No construction or modification of facilities would be required at Banks Lake under this alternative. Required facility development for Rocky Coulee Reservoir would be the same as described for Alternative 2C: Partial—Banks + Rocky.

2.5.3.2 Delivery System

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

2.5.4 Alternative 3D: Full—Combined

The primary elements of Alternative 3D: Full—Combined are illustrated on Figure 2-22. As shown on the diagram, these include providing water supply from Lake Roosevelt (1), Banks Lake (2) and a new Rocky Coulee Reservoir (3), delivered through the East Low Canal (4) and a new East High Canal system (5), to groundwater-irrigated lands north and south of I-90. Major facility development would include Rocky Coulee Reservoir (as described for Alternative 2C: Partial—Banks + Rocky), as well as the same East Low Canal enlargement, East High Canal facilities, and associated pressurized pipeline systems described for Alternative 3A: Full—Banks.

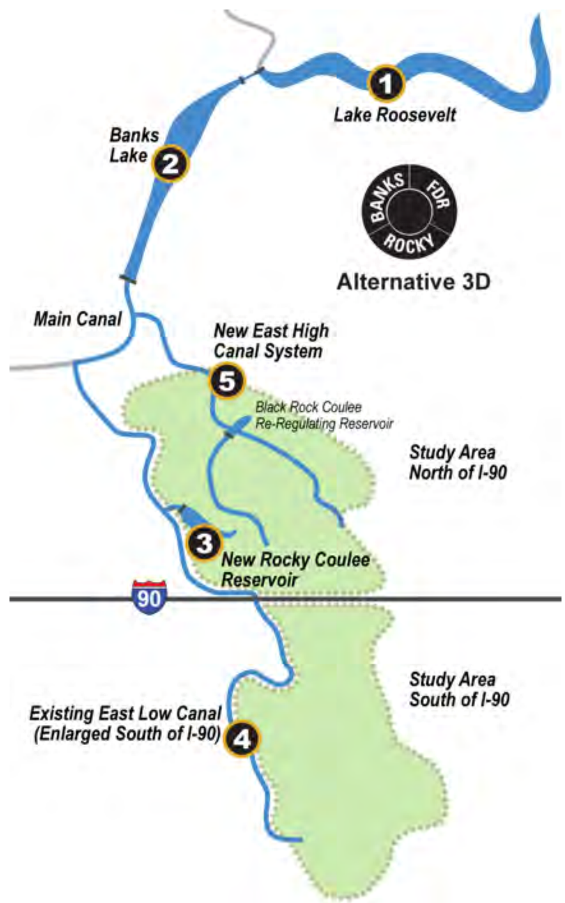

Figure 2-22
Diagram of Alternative 3D: Full—Combined

2.5.4.1 Water Supply

Water supply for Alternative 3D: Full—Combined would come from available Columbia River flows, additional drawdowns at Banks Lake and Lake Roosevelt, and storage in a new Rocky Coulee Reservoir. When Columbia River flows or storage in Banks Lake and Lake Roosevelt are being used, water from Banks Lake would be released into the Main Canal from Dry Falls Dam and diverted to the East Low and East High Canals. Water from Rocky Coulee Reservoir would enter the East Low Canal directly though an inlet/outlet channel, as described and illustrated for Alternative 2C: Partial—Banks + Rocky (Section 2.4.3).

The average additional drawdown at Banks Lake under this alternative would be 3 feet beyond the 5 feet of drawdown for summer fish flow augmentation that is part of the No Action Alternative. The total drawdown would be 8 feet at the end of August (see Figure 2-1).

At Lake Roosevelt in an average year, the additional drawdown would be 0.9 feet beyond the No Action Alternative drawdown of 11.0 feet, bringing the total end-of-August drawdown to 11.9 feet.

Rocky Coulee Reservoir would generally be filled and emptied each year.

Refill of the reservoirs would proceed as follows:

1. Water would be released from Banks Lake to fill Rocky Coulee Reservoir by the end of October each year because of icing conditions in the Main and East Low Canals during the winter.
2. Lake Roosevelt would be refilled to meet the requirement that it be at water surface elevation 1283 feet amsl by the end of September.
3. Refill of Banks would occur subject to these priorities and any other constraints imposed by Columbia River instream flow or other operational requirements.

Under Alternative 3D: Full—Combined, it is projected that Banks Lake would not completely refill approximately 7 percent of years (operations modeling indicates that Banks Lake would not refill in 5 out of 70 years under this alternative).

No construction or modification of facilities is required at Lake Roosevelt or Banks Lake under Alternative 3D: Full—Combined. Required facility development for Rocky Coulee Reservoir is described under Alternative 2C: Partial—Banks + Rocky, above.

2.5.4.2 Delivery System

Water delivery system facility requirements, construction and O&M for Alternative 3D: Full—Combined would be the same as those described in Section 2.5.1 for Alternative 3A: Full—Banks.

2.6 Alternatives Considered but Eliminated from Further Study

2.6.1 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.

The PASS identified four broadly-defined alternatives that combined various options for supply and delivery of surface water to replace groundBwater for irrigation use in the Study area, as shown on Table 2-7. These were carried forward through an appraisal-level investigation, the results of which were published in the March 2008 report titled, *Appraisal-Level Investigation Summary of Findings* (Reclamation 2008 Appraisal).

What Should Alternatives Accomplish?

According to criteria used historically in the PASS evaluation, a reasonable, potentially viable alternative should accomplish the following objectives:

- Replace all or a portion of 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.

In the appraisal-level study report, Reclamation and Ecology confirmed a decision to carry only delivery Alternative B into feasibility-level analysis (that is, the level represented by the current Study Report and this Draft EIS). However, for the purposes of evaluating a full range of alternatives under NEPA, partial replacement options are also evaluated in this Draft EIS. Supply options identified for further evaluation 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.

TABLE 2-7

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.
Supply Options	
Banks Lake Drawdown	Draw down 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

After the appraisal-level investigation, during the early work on the current feasibility-level studies, three adjustments were made to the range of supply options being considered. These included eliminating the Banks Lake Raise and the Potholes Reoperation options, and adding use of storage in Lake Roosevelt as an option. The two sections below summarize the delivery alternatives and supply options that were considered but eliminated from further study.

2.6.2 Delivery Alternatives Considered But Eliminated From Further Study

2.6.2.1 Appraisal Alternative A

Although it would provide full replacement, Alternative A was eliminated because it would involve substantially higher cost, longer implementation times, and greater potential for environmental impact when compared with Alternative B. These disadvantages arise 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.

2.6.2.2 Appraisal Alternative C

Alternative C was eliminated from consideration because it 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.

2.6.2.3 Appraisal Alternative D

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

2.6.3 Supply Options Considered But Eliminated From Further Study

2.6.3.1 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. However, this option was eliminated from consideration because of cost concerns and the potential for significant impact to lands, facilities, and environmental resources. Problems associated with raising the Banks Lake pool level would include the following:

- 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

2.6.3.2 Potholes Reservoir Reoperation

Use of storage in Potholes Reservoir is not a feasible option for providing CBP water to the Odessa Special Study Area for a number of reasons. Primary among these are (1) this reservoir is too low in the CBP system, and (2) 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.

2.6.3.3 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 would result in summer drawdown levels that conflict with other water management requirements at Grand Coulee Dam and Lake Roosevelt, and would result in adverse impacts to recreation and shoreline environmental resources managed by the National Park Service and the Tribes.

2.6.3.4 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 cost and environmental impact concerns, 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.

2.7 Estimated Cost of Alternatives

This section compares estimated costs of the alternatives. Costs were estimated by Reclamation engineers, as described in the Engineering Report available at http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html. These estimates were prepared for the action alternatives, and include costs of construction, interest during construction (IDC), 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.

The estimated construction costs include non-contract costs and field costs of construction contracts. Non-contract costs refer to work or services to support the project and other work that is of such a broad, non-specific 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 have been split into two categories: [1] Water supply and delivery facilities, as described in Sections 2.4 (Partial Groundwater Irrigation Alternatives) and Section 2.5 (Full Groundwater Irrigation Replacement Facilities), with phased construction occurring in the 2015 to 2025 timeframe, and [2] an allocation for irrigation water drainage systems[3].

The IDC costs are interest costs charged on the field costs of construction contracts and non-contract costs during the water supply/delivery facilities construction period. Non-contract costs incurred prior to the start of this construction period were aggregated into the first year of the construction period before calculating IDC costs.

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 the Benefit-Cost Analysis section of this chapter (Section 2.8) or with those presented in the national economic development (NED) benefit cost analysis presented in the Odessa Special Study Report, since they have not been adjusted (compounded or discounted) to the end of the canal construction period (year 2025).

2.7.1 Estimated Costs for Alternative 1 (No Action)

Under the No Action Alternative, no new facilities would be constructed and no construction costs would be incurred.

[3] Regarding allocation for irrigation water drainage facilities, the estimated costs are based on 20- to 30-year-old CBP design assumptions, which included new irrigation development, and were based on platted, concentrated farms using gravity flow and rill irrigation. These assumptions are no longer valid, because the current farms in the Study Area are spaced widely and use pressurized delivery systems. Although project design has not progressed to the point of addressing irrigation water drainage in detail, estimates of drainage system costs using the original CBP assumptions are included to ensure complete and conservative cost estimates. The proposed action alternatives being considered in this DEIS would simply replace current groundwater with surface water. No new land would be irrigated, and field application would not exceed historical water use. Further, under current conditions, no significant drainage issues or problems are evident in the Study Area. Given these factors, no substantial change in irrigation water drainage conditions is anticipated. As project design proceeds, there will be more detailed analysis. If drainage facilities are needed, appropriate supplementary NEPA analysis will be conducted and revised cost estimates prepared.

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.

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

Table 2-8 lists the estimated total construction costs and OMR&P costs (expressed in millions of dollars) for Alternatives 2A: Partial—Banks and 2B: Partial—Banks + FDR. 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: Partial—Banks and 2B: Partial—Banks + FDR. For a description of the specific features within each phase, see Section 2.4, *Partial Groundwater Replacement Alternatives*.

Table 2-8 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 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 2-8 reflects the sum of the field costs of construction contracts and the non-contract costs for all water delivery facilities as well as the above-noted allocation for drainage systems. The total column combines construction costs and associated IDC costs. OMR&P costs in Table 2-8 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 2125).

TABLE 2-8

Cost Estimates for Alternatives 2A: Partial—Banks and 2B: Partial—Banks + FDR (millions of dollars)

Feature	All Water Supply & Delivery System Facilities, (2015-2025) Construction Costs	IDC Costs	Total	Annual OMR&P Costs
Phase 1	194.3	25.4	219.7	2.0
Phase 2	288.9	45.8	334.7	2.6
Phase 3	108.0	14.1	122.1	1.2
Phase 4	97.5	12.8	110.3	0.9
Totals	688.7	98.1	786.8	6.6
Allocation for Drainage Systems				
Total	39.6	15.2	54.8	.27

2.7.3 Estimated Costs for Alternatives 2C: Partial—Banks + Rocky and 2D: Partial—Combined

Table 2-9 lists the estimated total construction costs and OMR&P costs (expressed in millions of dollars) for Alternatives 2C: Partial—Banks + Rocky and 2D: Partial—Combined. In addition to the total cost for each alternative, separate costs are presented for the four water delivery system construction phases, plus the addition of the Rocky Coulee Reservoir, applicable to Alternatives 2C: Partial—Banks + Rocky and 2D: Partial—Combined. For a description of the specific features within each phase, see Section 2.4, *Partial Groundwater Replacement Alternatives*.

Just like Table 2-8, the values shown in Table 2-9 contains a single set of cost values that apply to both Alternatives 2C: Partial—Banks + Rocky and 2D: Partial—Combined, because the source of water supply does not affect the estimated costs of the facilities needed to deliver water.

The estimated construction costs for Alternatives 2C: Partial—Banks + Rocky and 2D: Partial—Combined are higher than the estimated construction costs for Alternatives 2A: Partial—Banks and 2B: Partial—Banks + FDR because of the addition of the Rocky Coulee Reservoir. Similarly, the estimated OMR&P costs for Alternatives 2C: Partial—Banks + Rocky and 2D: Partial—Combined are higher than the estimated OMR&P costs for Alternatives 2A: Partial—Banks and 2B: Partial—Banks + FDR because of the addition of the Rocky Coulee Pumping Plant.

TABLE 2-9

Cost Estimates for Alternatives 2C: Partial—Banks + Rocky and 2D: Partial—Combined (millions of dollars)

Facility Construction Phase	All Water Supply & Delivery System Facilities, (2015-2025) Construction Costs	IDC Costs	Total	Annual OMR&P Costs
Phase 1	$194.3	$25.4	219.7	$2.0
Phase 2	$288.9	$45.8	334.7	$2.6
Phase 3	$108.0	$14.1	122.1	$1.2
Phase 4	$97.5	$12.8	110.3	$0.9
Rocky Coulee Reservoir	$276.2	$47.1	323.3	$1.0
Totals	$964.9	$145.2	$1,110.1	$7.7
Allocation for Drainage Systems				
Total	$39.6	$15.2	$54.8	$.27

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

Table 2-10 lists the estimated total construction costs and OMR&P costs (expressed in millions of dollars) for Alternatives 3A: Full—Banks and 3B: Full—Banks + FDR. In addition to the total cost for each alternative, separate costs are presented for the nine construction phases applicable to Alternatives 3A: Full—Banks and 3B: Full—Banks + FDR. For a description of the specific features within each phase, see Section 2.5, Full Groundwater Replacement Alternatives.

Table 2-10 contains a single set of cost values that apply to both Alternatives 3A:

Full—Banks and 3B: Full—Banks + FDR. 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: Full—Banks and 3B: Full—Banks + FDR 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)

Facility Construction Phase	All Water Supply & Delivery System Facilities, (2015-2025)			
	Construction Costs	IDC Costs	Total	Annual OMR&P Costs
Phase 1	$194.3	$25.4	$219.7	$2.0
Phase 2	$288.9	$45.8	$334.7	$2.6
Phase 3	$108.0	$14.1	$122.1	$1.2
Phase 4	$97.5	$12.8	$110.3	$0.9
Phase 5	$857.0	$135.9	$992.9	$2.2
Phase 6	$303.1	$39.8	$342.9	$1.8
Phase 7	$220.3	$28.9	$249.2	$1.2
Phase 8	$276.5	$43.8	$320.3	$2.3
Phase 9	$115.1	$15.6	$130.7	$0.8
Totals	$2,460.8	$362.1	$2,822.9	$15.0
	Allocation for Drainage Systems			
Total	$121.6	$46.6	$168.2	$.95

2.7.5 Estimated Costs for Alternatives 3C: Full—Banks + Rocky and 3D: Full—Combined

Table 2-11 lists the estimated total construction costs and OMR&P costs (expressed in millions of dollars) for Alternatives 3C: Full—Banks + Rocky and 3D: Full—Combined. In addition to the total cost for each alternative, separate costs are presented for the nine construction phases, plus the addition of the Rocky Coulee Reservoir, applicable to Alternatives 3C: Full—Banks + Rocky and 3D: Full—Combined. For a description of the specific features within each phase, see Section 2.5, *Full Groundwater Replacement Alternatives*.

Table 2-11 contains a single set of cost values that apply to both Alternatives 3C: Full—Banks + Rocky and 3D: Full—Combined. The estimated construction costs for Alternatives 3C: Full—Banks + Rocky and 3D: Full—Combined are higher than the estimated construction costs for Alternatives 3A: Full—Banks and 3B: Full—Banks + FDR because of the addition of the Rocky Coulee Reservoir. Similarly, the estimated OMR&P costs for Alternatives 3C: Full—Banks + Rocky and 3D: Full—Combined are higher than the estimated OMR&P costs for Alternatives 3A: Full—Banks and 3B: Full—Banks + FDR because of the addition of the Rocky Coulee Pumping Plant.

TABLE 2-11

Cost Estimates for Alternatives 3C: Full—Banks + Rocky and 3D: Full—Combined (millions of dollars)

Facility Construction Phase	All Water Supply & Delivery System Facilities, (2015-2025)			
	Construction Costs	IDC Costs	Total	Annual OMR&P Costs
Phase 1	$194.3	$25.4	$219.7	$2.0
Phase 2	$288.9	$45.8	$334.7	$2.6
Phase 3	$108.0	$14.1	$122.1	$1.2
Phase 4	$97.5	$12.8	$110.3	$0.9
Phase 5	$857.0	$135.9	$992.9	$2.2
Phase 6	$303.1	$39.8	$342.9	$1.8
Phase 7	$220.3	$28.9	$249.2	$1.2
Phase 8	$276.5	$43.8	$320.3	$2.3
Phase 9	$115.1	$15.6	$130.7	$0.8
Rocky Coulee Reservoir	$276.2	$47.1	$323.3	$1.0
Totals	$2,737.0	$409.2	$3,146.2	$16.0
	Allocation for Drainage Systems			
Total	$121.6	$46.6	$168.2	$.95

2.7.6 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)

	All Facilities Including Allocation for Drainage Systems			
Alternative	**Construction Costs**	**IDC Costs**	**Total**	**Maximum Annual OMR&P Costs (Year 2045+)***
1: No Action	--	--	--	$3.3
2A: Partial—Banks	$728.3	$113.3	$841.6	$6.9
2B: Partial—Banks + FDR	$728.3	$113.3	$841.6	$6.9
2C: Partial—Banks + Rocky	$1,004.5	$160.4	$1,164.9	$7.9
2D: Partial—Combined	$1,004.5	$160.4	$1,164.9	$7.9
3A: Full—Banks	$2,582.4	$408.7	$2,991.1	$15.9
3B: Full—Banks + FDR	$2,582.4	$408.7	$2,991.1	$15.9
3C: Full—Banks + Rocky	$2,858.6	$455.8	$3,314.4	$17.0
3D: Full—Combined	$2,858.6	$455.8	$3,314.4	$17.0

* Since the construction periods vary by phase, this maximum annual OMR&P cost does not occur until year 2045 after all construction phases are completed.

2.8 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.

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.

Before comparisons can be made between costs and benefits, these must be converted to a common point in time. As is typical in Reclamation studies, the decision was made to measure all the costs and benefits at the end of the construction period. Since construction is divided into a series of phases, the end of the construction period was defined as the end of the last construction phase (year 2025).

Starting from the end of the construction period in year 2025, a standard 100-year analysis period was used, resulting in a period of analysis from 2026 to 2125. Costs and benefits incurred after year 2025 are discounted (reduced) back to the end of the construction period using the Federal 2009 to 2010 water project planning rate of 4.375 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 Columbia Basin Project was initially authorized. Benefits associated with all phases prior to the last construction phase would begin at the end of each phase (not the end of the last construction phase), and end in year 2125. Thus, some of those benefits would accrue prior to the end of the canal construction period in year 2025. This implies that these benefits would need to be compounded (increased) to the end of the construction period.

These same discounting and compounding concepts are also applied to the costs incurred during the canal construction period and period of analysis. For example, canal construction costs were compounded (increased) to the end of canal construction period, whereas OMR&P costs were discounted (decreased) to the end of the canal construction period. Because all benefits and costs must be adjusted to the same point in time for the BCA, the unadjusted total costs presented in Section 2.7, *Estimated Cost of Alternatives*, do not agree with the costs presented within this section.

As described in Section 2.7, *Estimated Cost of Alternatives*, the cost components include canal, reservoir, and drainage system construction, IDC, 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.

2.8.1 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.

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

Alternatives 2A: Partial—Banks and 2B: Partial—Banks + FDR involve the same costs and benefits; therefore, they generate the same BCA results. Using the current 4.375 percent planning rate, total benefits were estimated at $1,170.2 million and total costs at $1,276.7 million, resulting in a negative net benefit of -$106.5 million and a 0.917 BCR. Alternatives 2A: Partial—Banks and 2B: Partial—Banks + FDR are the best of the proposed alternatives from an economic perspective, but still result in negative net benefits and a BCR of slightly less than one based on the quantified benefits and costs. As a result, these alternatives are not considered economically justified.

2.8.3 BCA for Alternatives 2C: Partial—Banks + Rocky and 2D: Partial—Combined

Alternatives 2C: Partial—Banks + Rocky and 2D: Partial—Combined involve the same costs and benefits; therefore, they generate the same BCA results. Using the current 4.375 percent planning rate, total benefits were estimated at $1,170.2 million and total costs at $1,726.1 million resulting in a negative net benefit of -$555.9 million and a 0.678 BCR. These two alternatives generate negative net benefits and would not be considered economically justified based on a comparison of the quantified benefits and costs.

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

Alternatives 3A: Full—Banks and 3B: Full—Banks + FDR involve the same costs and benefits and generate the same BCA results. Using the current 4.375 percent planning rate, total benefits were estimated at $1,820.5 million and total costs at $4,148.6 million, resulting in a negative net benefit of -$2,328.1 million and a 0.439 BCR. These two alternatives generate negative net benefits and would not be considered economically justified based on a comparison of the quantified benefits and costs.

2.8.5 BCA for Alternatives 3C: Full—Banks + Rocky and 3D: Full—Combined

Alternatives 3C: Full—Banks + Rocky and 3D: Full—Combined involve the same costs and benefits and generate the same BCA results. Using the current 4.375 percent planning rate, total benefits were estimated at $1,820.5 million and total costs at $4,597.9 million resulting in a negative net benefit of -$2,777.4 million and a 0.396 BCR. These two alternatives generate negative net benefits and would not be considered economically justified based on a comparison of the quantified benefits and costs.

The results in Table 2-14 were generated using the 3.0 percent planning rate originally authorized under the Columbia Basin Project Act of 1943. The use of the lower planning rate results in somewhat higher costs, but considerably higher benefits, thereby resulting in higher net benefits and BCRs for all partial and full replacement alternatives.

TABLE 2-13

Results of BCA Based on Current Planning Rate of 4.375 Percent, Millions of Dollars

	Partial Replacement Alternatives				Full Replacement Alternatives			
Alternatives:	**2A**	**2B**	**2C**	**2D**	**3A**	**3B**	**3C**	**3D**
1) Total Benefits:	1,170.2	1,170.2	1,170.2	1,170.2	1,820.5	1,820.5	1,820.5	1,820.5
a) Agriculture	1,153.3	1,153.3	1,153.3	1,153.3	1,800.7	1,800.7	1,800.7	1,800.7
b) Municipal	5.1	5.1	5.1	5.1	8.1	8.1	8.1	8.1
c) Industrial	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8
2) Total Costs (including Lost Benefits):	1,276.7	1,276.7	1,726.1	1,726.1	4,148.6	4,148.6	4,597.9	4,597.9
a) Canal & Reservoir Construction & IDC Costs	908.0	908.0	1,326.0	1,326.0	3,255.7	3,255.7	3,673.7	3,673.3
b) Canal & Reservoir OMR&P Costs	180.7	180.7	212.1	212.1	401.5	401.5	432.8	432.8
c) Drainage System Construction & IDC Costs	28.5	28.5	28.5	28.5	83.5	83.5	83.5	83.5
d) Drainage System OMR&P Costs	3.1	3.1	3.1	3.1	10.4	10.4	10.4	10.4
e) Lost Hydropower Benefits	156.4	156.4	156.4	156.4	397.6	397.6	397.6	397.6
3) Net Benefits (row 1 minus row 2)	-106.5	-106.5	-555.9	-555.9	-2,328.1	-2,328.1	-2,777.4	-2,777.4
4) Benefit-Cost Ratio (row 1 divided by row 2)	0.917	0.917	0.678	0.678	0.439	0.439	0.396	0.396

TABLE 2-14

Results of BCA Based on Original CBP Planning Rate of 3.0 Percent, Millions of Dollars

	Partial Replacement Alternatives				Full Replacement Alternatives			
Alternatives:	**2A**	**2B**	**2C**	**2D**	**3A**	**3B**	**3C**	**3D**
1) Total Benefits:	1,504.5	1,504.5	1,504.5	1,504.5	2,401.9	2,401.9	2,401.9	2,401.9
a) Agriculture	1,478.7	1,478.7	1,478.7	1,478.7	2,371.1	2,371.1	2,371.1	2,371.1
b) Municipal	9.3	9.3	9.3	9.3	14.3	14.3	14.3	14.3
c) Industrial	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
2) Total Costs (including Lost Benefits):	1,328.3	1,328.3	1,736.1	1,736.1	4,185.5	4,185.5	4,593.2	4,593.2
a) Canal & Reservoir Construction & IDC Costs	832.5	832.5	1,200.0	1,200.0	2,981.5	2,981.5	3,348.9	3,348.9
b) Canal & Reservoir OMR&P Costs	239.9	239.9	280.1	280.1	535.5	535.5	575.7	575.7
c) Drainage System Construction & IDC Costs	31.4	31.4	31.4	31.4	93.5	93.5	93.5	93.5
d) Drainage System OMR&P Costs	5.2	5.2	5.2	5.2	17.7	17.7	17.7	17.7
e) Lost Hydropower Benefits	219.3	219.3	219.3	219.3	557.3	557.3	557.3	557.3
3) Net Benefits (row 1 minus row 2):	+176.2	+176.2	-231.5	-231.5	-1,783.6	-1,783.6	-2,191.3	-2,191.3
4) Benefit-Cost Ratio (row 1 divided by row 2)	1.133	1.133	0.867	0.867	0.574	0.574	0.523	0.523

2.9 Consequences of No Action

The consequences of the No Action Alternative over the next 10 years—by approximately the year 2020—would include the following:

- 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 2.2.3).
- 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.

2.10 Comparative Evaluation of Alternatives

Table 2-15, *Summary Benefits or Impacts from the Alternatives for Specific Areas within Affected Resource Topics*, provides a simplified view of the magnitude of benefits and adverse impacts expected under each of the nine alternatives. The table only includes resource topics, such as "Groundwater," "Vegetation," and "Land Use," where benefits and adverse impacts were discovered in the analysis for this Draft EIS, as described in detail in Chapter 4, *Environmental Consequences*. Resource topics with no impacts or minimal impacts, such as "Air Quality" and "Geology," are not listed on this summary.

For a more in-depth look, Table 2-16, *Overview of the Benefits and Impacts from the Alternatives on All Resource Topics and Areas Assessed*, 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 is colored to show the relative magnitude of the effects of the alternatives, the same as shown on Table 2-15. If the impact is significant, that 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 reflected on Tables 2-15 and 2-16 do not reflect 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 4.29, *Environmental Commitments*.

TABLE 2-15
Summary Benefits or Impacts from the Alternatives for Specific Areas within Affected Resource Topics

↑↑	↑	◊	↓	↓↓
Beneficial Effect		↔		Adverse Impact

Resource Topic and Effect Area	No Action	Partial Replacement Alternatives 2A	2B	2C	2D	Full Replacement Alternatives 3A	3B	3C	3D
Groundwater: Depth and Quality Declines	↓↓	↓	↓	↓	↓	↑	↑	↑	↑
Municipal and Industrial Users	◊	◊	◊	◊	◊	↑	↑	↑	↑
Water Quality: Banks Lake Temperature and Dissolved Oxygen	◊	↓	↓	◊	↓	↓↓	↓	↓↓	↓
Lake Roosevelt Temperature and Dissolved Oxygen	◊	◊	◊	◊	◊	◊	↓	◊	◊
Salinity of Water Placed on Fields	◊	↑	↑	↑	↑	↑	↑	↑	↑
Vegetation and Wetlands: Native Plants	◊	↓	↓	↓	↓	↓↓	↓↓	↓↓	↓↓
Habitat Fragmentation	◊	◊	◊	◊	◊	↓↓	↓↓	↓↓	↓↓
Special Status Plants	◊	◊	◊	◊	◊	↓↓	↓↓	↓↓	↓↓
Habitat Restoration	◊	◊	◊	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓
Wetland Loss or Functional Decline	◊	◊	◊	◊	◊	↓↓	↓↓	↓↓	↓↓
Wildlife: Shrub-Steppe Habitat	◊	↓	↓	↓	↓	↓↓	↓↓	↓↓	↓↓
Wildlife Movement Barriers	◊	◊	◊	◊	◊	↓↓	↓↓	↓↓	↓↓
Special Status Species	◊	↓	↓	↓	↓	↓↓	↓↓	↓↓	↓↓
Habitat Fragmentation	◊	◊	◊	◊	◊	↓↓	↓↓	↓↓	↓↓
Fisheries and Aquatic Resources: Condition of Banks Lake Fishery	◊	◊	◊	◊	◊	↓↓	↓	↓↓	↓
Impact on invertebrate production	◊	↓	↓	◊	↓	↓↓	↓	↓↓	↓
Land Use and Shoreline Resources: Changes in Ownership and Status	◊	↓	↓	↓	↓	↓↓	↓↓	↓↓	↓↓
Protection of Irrigated Agriculture	↓↓	↑	↑	↑	↑	↑↑	↑↑	↑↑	↑↑
Structures and Land Uses Displaced	◊	↓	↓	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓
Consistency with Plans and Policies	↓↓	↑	↑	↑	↑	↑↑	↑↑	↑↑	↑↑
Recreation: Boating at Banks Lake*	◊	↓	↓	↓	↓	↓↓	↓	↓↓	↓
Fishing at Banks Lake	◊	◊	◊	◊	◊	↓↓	↓	↓↓	↓
Swimming at Banks Lake*	↓	↓	↓	↓	↓	↓↓	↓	↓↓	↓↓
Camping and Day Use at Banks Lake	◊	↓	↓	◊	↓	↓↓	↓	↓↓	↓
Irrigated Agriculture: Gross farm income	↓	↑	↑	↑	↑	↑	↑	↑	↑
Socioeconomics: Employment and Regional Income and Sales	↓	↑	↑	↑	↑	↑	↑	↑	↑
Transportation: Roads and Crossings	◊	◊	◊	↓↓	↓↓	◊	◊	↓↓	↓↓
Energy: Change in regional availability	◊	↓	↓	↓	↓	↓↓	↓↓	↓↓	↓↓
Noise: Short-term Construction Noise	◊	↓	↓	↓	↓	↓	↓	↓	↓
Visual: Landscape-Level Change	↓↓	↓	↓	↓	↓	◊	◊	◊	◊
New Developed Facilities	◊	↓	↓	↓	↓	↓↓	↓↓	↓↓	↓↓
Reservoir Drawdown Changes	◊	↓	↓	◊	↓	↓↓	↓	↓↓	↓
Cultural Resources: Potential for Impact to Significant Resources	◊	↓	↓	↓	↓	↓↓	↓↓	↓↓	↓↓

***Prior to mitigation.**

Resource Topics with No Notable Beneficial Effects or Adverse Impacts:

- Surface Water Resources
- Water Rights
- Geology
- Soils
- Threatened and Endangered Species
- Air Quality
- Public Services and Utilities
- Public Health
- Indian Trust Assets
- Indian Sacred Sites
- Environmental Justice

TABLE 2-16

Overview of the Benefits and Impacts from the Alternatives on All Resource Topics and Areas Assessed

Impacts assume that all legal requirements are followed and all BMPs are successfully implemented. Mitigation measures are not considered. Impact categories are defined as follows:

Important Beneficial Effect	Beneficial Effect	No Impact to Minimal Impact	Adverse Impact	Important Adverse Impact
A substantial beneficial effect	A minor beneficial effect	No impact; or influences the resource to a barely measurable degree	A negative impact to the resource	A substantial negative impact

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives				Full Groundwater Irrigation Replacement Alternatives			
		2A: Partial—Banks	2B: Partial—Banks + FDR	2C: Partial—Banks + Rocky	2D: Partial—Combined	3A: Full—Banks	3B: Full—Banks + FDR	3C: Full—Banks + Rocky	3D: Full—Combined
Surface Water Resources									
Instream flow requirements	No impact	Compliance achieved. No impact.	Compliance achieved. No impact.	Compliance achieved. No impact.	Compliance achieved. No impact.	Compliance achieved. No impact.	Compliance achieved. No impact.	Compliance achieved. No impact.	Compliance achieved. No impact.
Reduction of surface water elevations in Lake Roosevelt	No impact	No impact	Minimal additional drawdown in late August/early September. Minimal hydrologic impact.	No impact	Minimal additional drawdown in late August/early September. Minimal hydrologic impact.	No impact	Minimal additional drawdown in late August/early September. Minimal hydrologic impact.	No impact	Minimal additional drawdown in late August/early September. Minimal hydrologic impact.
Reduction of surface water elevations in Banks Lake	No impact	Additional drawdown in August and September. Minimal hydrologic impact.	Additional drawdown in August and September. Minimal hydrologic impact.	Additional drawdown in August and September. Minimal hydrologic impact.	Additional drawdown in August and September. Minimal hydrologic impact.	Additional drawdown in August and September. Minimal hydrologic impact.	Additional drawdown in August and September. Minimal hydrologic impact.	Additional drawdown in August and September. Minimal hydrologic impact.	Additional drawdown in August and September. 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	No impact	Inundation by Rocky Coulee. Minimal impact.	Inundation by Rocky Coulee. Minimal impact.	Inundation by Black Rock Coulee Reregulating Reservoir. Minimal impact.	Inundation by Black Rock Coulee Reregulating Reservoir. Minimal impact.	Inundation by Black Rock Coulee Reregulating Reservoir and Rocky Coulee Reservoir. Minimal impact.	Inundation by Black Rock Coulee Reregulating Reservoir and Rocky Coulee Reservoir. Minimal impact.
Changes to areas that receive water from the wasteways	No impact	Minimal impact	Minimal impact	Minimal impact in Rocky Coulee	Minimal impact in Rocky Coulee	Minimal impact in Black Rock Coulee	Minimal impact in Black Rock Coulee	Minimal impact in Black Rock Coulee and Rocky Coulee	Minimal impact in Black Rock Coulee and Rocky Coulee
Groundwater Resources									
Groundwater level declines	102,614 acres would still be irrigated by groundwater; declines continue	48,416 acres would still be irrigated by groundwater; declines continue	48,416 acres would still be irrigated by groundwater; declines continue	48,416 acres would still be irrigated by groundwater; declines continue	48,416 acres would still be irrigated by groundwater; declines continue	Full surface water replacement supply; groundwater not used	Full surface water replacement supply; groundwater not used	Full surface water replacement supply; groundwater not used	Full surface water replacement supply; groundwater not used
Recharge or seepage in Rocky Coulee	No impact	No impact	No impact	Local recharge to shallow groundwater from reservoir	Local recharge to shallow groundwater from reservoir	No impact	No impact	Local recharge to shallow groundwater from reservoir	Local recharge to shallow groundwater from reservoir
Recharge or seepage in Black Rock Coulee	No impact	No impact	No impact	No impact	No impact	Local recharge to shallow groundwater from reservoir	Local recharge to shallow groundwater from reservoir	Local recharge to shallow groundwater from reservoir	Local recharge to shallow groundwater from reservoir
Municipal and industrial users	No impact	Minimal beneficial effect south of I-90	Minimal beneficial effect south of I-90	Minimal beneficial effect south of I-90	Minimal beneficial effect south of I-90	Minimal beneficial effect throughout Study Area	Minimal beneficial effect throughout Study Area	Minimal beneficial effect throughout Study Area	Minimal beneficial effect throughout Study Area
Water Quality									
Temperature (FDR)	No impact	No impact	Minimal impact	No impact	Minimal impact	No impact	Adverse impact	No impact	Minimal impact
Dissolved oxygen (FDR)	No impact	No impact	Minimal impact	No impact	Minimal impact	No impact	Adverse impact	No impact	Minimal impact
Heavy metals (FDR)	No impact	No impact	Minimal impact	No impact	Minimal impact	No impact	Minimal impact	No impact	Minimal impact
Temperature (Banks)	No impact	Significant impact	Significant impact	Minimal impact	Significant impact	Significant impact but greater than 2A	Significant impact	Significant impact but greater than 2A	Significant impact
Dissolved oxygen (Banks)	No impact	Significant impact	Significant impact	Minimal impact	Significant impact	Significant impact but greater than 2A	Significant impact	Significant impact but greater than 2A	Significant impact
Turbidity (Banks)	No impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact
Temperature (Columbia)	No impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact
Total dissolved gas (Columbia)	No impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact
Temperature (Analysis)	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
pH (Analysis Area)	No impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact
Salinity (Analysis Area)	No impact	Minor beneficial effect	Minor beneficial effect	Minor beneficial effect	Minor beneficial effect	Minor beneficial effect	Minor beneficial effect	Minor beneficial effect	Minor beneficial effect

TABLE 2-16

Overview of the Benefits and Impacts from the Alternatives on All Resource Topics and Areas Assessed

Impacts assume that all legal requirements are followed and all BMPs are successfully implemented. Mitigation measures are not considered. Impact categories are defined as follows:

Important Beneficial Effect	Beneficial Effect	No Impact to Minimal Impact	Adverse Impact	Important Adverse Impact
A substantial beneficial effect	A minor beneficial effect	No impact; or influences the resource to a barely measurable degree	A negative impact to the resource	A substantial negative impact

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives				Full Groundwater Irrigation Replacement Alternatives			
		2A: Partial—Banks	2B: Partial—Banks + FDR	2C: Partial—Banks + Rocky	2D: Partial—Combined	3A: Full—Banks	3B: Full—Banks + FDR	3C: Full—Banks + Rocky	3D: Full—Combined
Nutrients (Analysis Area)	Potential minor beneficial effect	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
Water Rights									
Loss or curtailment of groundwater rights	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
Columbia River and Lake Roosevelt Tribal water rights	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
Geology									
Commitment of geologic resources	No impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact
Geologic hazards	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
Unique geologic features	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
Soils									
Farmland Protection Policy Act	No impact	Significant impact, but would be addressed through legal requirements	Significant impact, but would be addressed through legal requirements	Significant impact, but would be addressed through legal requirements	Significant impact, but would be addressed through legal requirements	Significant impact, but would be addressed through legal requirements	Significant impact, but would be addressed through legal requirements	Significant impact, but would be addressed through legal requirements	Significant impact, but would be addressed through legal requirements
Soil salinity and sodicity *Note: This is not a significance criteria in Chapter 4, but it is provided here to illustrate consequences of No Action*	The need to apply soil amendments to maintain land in production would become more widespread if continued pumping of declining groundwater increases use of deeper, older groundwater of higher salinity and sodium content.	The impact described under No Action would continue for lands north of I-90.	The impact described under No Action would continue for lands north of I-90.	The impact described under No Action would continue for lands north of I-90.	The impact described under No Action would continue for lands north of I-90.	No impact	No impact	No impact	No impact
Vegetation and Wetlands									
Impact on native plant communities	No impact	Significant impact on native plant communities.	Significant impact on native plant communities.	Significant impact on native plant communities, but greater impact on native plant communities from Rocky Coulee Reservoir.	Significant impact on native plant communities, but greater impact on native plant communities from Rocky Coulee Reservoir.	Significant impact over a large area of native communities, including Black Rock Coulee Reregulating Reservoir	Significant impact over a large area of native communities, including Black Rock Coulee Reregulating Reservoir	Significant impact over a large area of native communities, including Black Rock Coulee Reregulating Reservoir and Rocky Coulee Reservoir	Significant impact over a large area of native communities, including Black Rock Coulee Reregulating Reservoir and Rocky Coulee Reservoir
Fragmentation of native plant communities	No impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Significant impact due to construction of new canals	Significant impact due to construction of new canals	Significant impact due to construction of new canals	Significant impact due to construction of new canals
Impact on special status plants	No impact	No impact	No impact	No impact	No impact	Impact on rare plants would be significant	Impact on rare plants would be significant	Impact on rare plants would be significant	Impact on rare plants would be significant
Habitat restoration	No impact	Minimal impact	Minimal impact	Significant requirement for restoration of disturbed habitat over large areas	Significant requirement for restoration of disturbed habitat over large areas	Significant requirement for restoration of disturbed habitat over large areas	Significant requirement for restoration of disturbed habitat over large areas	Significant requirement for restoration of disturbed habitat over large areas	Significant requirement for restoration of disturbed habitat over large areas
Long-term loss of wetland area	No impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Significant impact at Banks Lake	Significant impact at Banks Lake	Significant impact at Banks Lake	Significant impact at Banks Lake
Long-term loss or degradation of wetland function	No impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal to adverse impact at Banks Lake depending on the water year	Minimal to adverse impact at Banks Lake depending on the water year	Minimal to adverse impact at Banks Lake depending on the water year	Minimal to adverse impact at Banks Lake depending on the water year

TABLE 2-16

Overview of the Benefits and Impacts from the Alternatives on All Resource Topics and Areas Assessed

Impacts assume that all legal requirements are followed and all BMPs are successfully implemented. Mitigation measures are not considered. Impact categories are defined as follows:

Important Beneficial Effect	Beneficial Effect	No Impact to Minimal Impact	Adverse Impact	Important Adverse Impact
A substantial beneficial effect	A minor beneficial effect	No impact; or influences the resource to a barely measurable degree	A negative impact to the resource	A substantial negative impact

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives				Full Groundwater Irrigation Replacement Alternatives			
		2A: Partial—Banks	2B: Partial—Banks + FDR	2C: Partial—Banks + Rocky	2D: Partial—Combined	3A: Full—Banks	3B: Full—Banks + FDR	3C: Full—Banks + Rocky	3D: Full—Combined
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	Significant impact	Significant impact	Significant impact	Significant impact	Significant impact over substantially larger area than under Alternatives 2A-2D	Significant impact over substantially larger area than under Alternatives 2A-2D	Significant impact over substantially larger area than under Alternatives 2A-2D	Significant impact over substantially larger area than under Alternatives 2A-2D
Barriers to unrestricted movement by wildlife	No impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	Significant impact from canal construction	Significant impact from canal construction	Significant impact from canal construction	Significant impact from canal construction
Impact on special status species, including migratory birds	No impact	Significant impact on multiple species	Significant impact on multiple species	Significant impact on multiple species, with increased area of effect due to Rocky Coulee Reservoir	Significant impact on multiple species, with increased area of effect due to Rocky Coulee Reservoir	Significant impact on multiple species, involving substantially larger area and a number of species than under Alternatives 2A-2D	Significant impact on multiple species, involving substantially larger area and a number of species than under Alternatives 2A-2D	Significant impact on multiple species, involving substantially larger area and a number of species than under Alternatives 2A-2D	Significant impact on multiple species, involving substantially larger area and a number of species than under Alternatives 2A-2D
Habitat fragmentation and population viability	No impact	No impact	No impact	No impact	No impact	Significant impact due to canal construction	Significant impact due to canal construction	Significant impact due to canal construction	Significant impact due to canal construction
Fisheries and Aquatic Resources									
Columbia River: Downstream migration of salmonid smolts	No impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact
Columbia River: Upstream migration of adult salmon and steelhead	No impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact
Columbia River: Chum salmon spawning below Bonneville Dam	No impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact
FDR: Zooplankton production	No impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact
FDR: Rainbow trout net pen program	No impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact
FDR: Kokanee salmon spawner access to San Poil River	No impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact
Banks Lake: Fish and zooplankton entrainment	No impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact
Surface areas of littoral habitat temporarily exposed during drawdowns	No additional impact	Significant impact on invertebrate production from greater drawdown but no long-term impact on fish populations.	Significant impact on invertebrate production from greater drawdown but no long-term impact on fish populations.	Minimal additional impact on invertebrate production from greater drawdown.	Significant impact on invertebrate production from greater drawdown but no long-term impact on fish populations.	Significant impact on invertebrate production from greater drawdown but no long-term impact on fish populations.	Significant impact on invertebrate production from greater drawdown but no long-term impact on fish populations.	Significant impact on invertebrate production from greater drawdown but no long-term impact on fish populations.	Significant impact on invertebrate production from greater drawdown but no long-term impact on fish populations.
Banks Lake: Overall condition of the fishery	No impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	No impact to minimal impact	Significant impact in all water year conditions is likely	Significant impact in drought years. Minimal impact in wet, average, or dry years.	Significant impact in all water year conditions is likely, but less severe than 3A.	Significant impact in drought years. Minimal impact in wet, average, or dry years.
Threatened and Endangered Species									
Pygmy rabbits	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
Downstream migration of salmonid smolts	No impact	Minimal impact	No impact	Minimal impact	No impact	Minimal impact	No impact	Potential minor beneficial effect	Minimal impact
Upstream migration of adult salmon, steelhead, and bull trout	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
Chum salmon spawning below Bonneville Dam	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact

TABLE 2-16

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Impacts assume that all legal requirements are followed and all BMPs are successfully implemented. Mitigation measures are not considered. Impact categories are defined as follows:

Important Beneficial Effect	Beneficial Effect	No Impact to Minimal Impact	Adverse Impact	Important Adverse Impact
A substantial beneficial effect	A minor beneficial effect	No impact; or influences the resource to a barely measurable degree	A negative impact to the resource	A substantial negative impact

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives				Full Groundwater Irrigation Replacement Alternatives			
		2A: Partial—Banks	2B: Partial—Banks + FDR	2C: Partial—Banks + Rocky	2D: Partial—Combined	3A: Full—Banks	3B: Full—Banks + FDR	3C: Full—Banks + Rocky	3D: Full—Combined
Air Quality									
Primary air quality standards	No impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact
Secondary air quality standards	No impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact
Attainment area classification	No impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact
Land Use and Shoreline Resources									
Changes in land ownership and land status	No acres acquired for facilities	5,294 acres acquired (easements and fee title)	5,294 acres acquired (easements and fee title)	14,232 acres acquired (easements and fee title)	14,232 acres acquired (easements and fee title)	21,214 acres acquired (easements and fee title)	21,214 acres acquired (easements and fee title)	30,252 acres acquired (easements and fee title)	30,252 acres acquired (easements and fee title)
Changes in land or shoreline uses: Protection of irrigated agriculture	Significant change from irrigated to dryland agriculture	57,000 acres of irrigated agriculture preserved	57,000 acres of irrigated agriculture preserved	57,000 acres of irrigated agriculture preserved	57,000 acres of irrigated agriculture preserved	102,600 acres of irrigated agriculture preserved	102,600 acres of irrigated agriculture preserved	102,600 acres of irrigated agriculture preserved	102,600 acres of irrigated agriculture preserved
Changes in land or shoreline uses: Occupied structures impacted	No structures impacted	5 structures impacted	5 structures impacted	20 structures impacted	20 structures impacted	17 structures impacted	17 structures impacted	32 structures impacted	32 structures impacted
Changes in land or shoreline uses: Center pivots impacted	No center pivots removed from operation	5 pivots removed from operation	5 pivots removed from operation	41 pivots removed from operation	41 pivots removed from operation	53 pivots removed from operation	53 pivots removed from operation	70 pivots removed from operation	70 pivots removed from operation
Changes in land or shoreline uses: Irrigated agriculture impacted	No acres removed from production	203 acres removed from production	203 acres removed from production	5,784 acres removed from production	5,784 acres removed from production	1,442 acres removed from production	1,442 acres removed from production	5,269 acres removed from production	5,269 acres removed from production
Consistency with relevant plans, policies and programs	Inconsistent with plans across 102,614 acres	Supports county comprehensive plans across 57,000 acres	Supports county comprehensive plans across 57,000 acres	Supports county comprehensive plans across 57,000 acres	Supports county comprehensive plans across 57,000 acres	Supports county comprehensive plans across 102,600 acres	Supports county comprehensive plans across 102,600 acres	Supports county comprehensive plans across 102,600 acres	Supports county comprehensive plans across 102,600 acres
Recreation Resources									
FDR: Loss of boating capacity	No impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact
FDR: Exposure of boating hazards	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
FDR: Loss of fishing opportunities	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
FDR: Loss of usability at developed swimming areas	No impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact
FDR: Decrease in usability or aesthetic quality at developed camping or day use facilities	No impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact
FDR: Dispersed recreation	No impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact
FDR: Loss of opportunity for hunting, wildlife viewing, hiking, etc. on lands surrounding the reservoirs	No impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Banks: Loss in boat launch capacity and related impacts on fishing access, camping, and day use	No impact	1 week in North and Steamboat sectors and 4 weeks in Middle and South sectors in an average year. Impact would be mitigated	5 weeks in Middle and South sectors in an average year. Impact would be mitigated	1 week in Middle and South sectors in an average year. Impact would be mitigated	6 weeks in Middle and South sectors in an average year. Impact would be mitigated	6 weeks in North and Steamboat sectors and 10 weeks in Middle and South sectors in an average year. Impact would be mitigated	5 weeks in Middle and South sectors in an average year. Impact would be mitigated	3 weeks in North and Steamboat sectors and 7 weeks in Middle and South sectors in an average year. Impact would be mitigated	6 weeks in Middle and South sectors in an average year. Impact would be mitigated
Banks: Exposure of boating hazards	Minimal impact	3.4 feet of drawdown beyond the No Action Alternative in an average year	3 feet of drawdown beyond No Action	0.1 feet of drawdown beyond No Action	3.4 feet of drawdown beyond No Action	8.5 feet of drawdown beyond No Action	3.4 feet of drawdown beyond No Action	5 feet of drawdown beyond No Action	3.4 feet of drawdown beyond No Action

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Impacts assume that all legal requirements are followed and all BMPs are successfully implemented. Mitigation measures are not considered. Impact categories are defined as follows:

Important Beneficial Effect	Beneficial Effect	No Impact to Minimal Impact	Adverse Impact	Important Adverse Impact
A substantial beneficial effect	A minor beneficial effect	No impact; or influences the resource to a barely measurable degree	A negative impact to the resource	A substantial negative impact

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives				Full Groundwater Irrigation Replacement Alternatives			
		2A: Partial—Banks	2B: Partial—Banks + FDR	2C: Partial—Banks + Rocky	2D: Partial—Combined	3A: Full—Banks	3B: Full—Banks + FDR	3C: Full—Banks + Rocky	3D: Full—Combined
Banks: Loss of fishing opportunities (because of impact on fishery; impact on fishing access reflected in boating capacity indicator)	No impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Significant impact likely in all water year conditions	Significant impact in drought years. Minimal impact in wet, average or dry years.	Significant impact likely in all water year conditions	Significant impact in drought years. Minimal impact in wet, average or dry years.
Banks: Loss of usability at developed swimming areas	2 weeks of loss of use at most sites in average years	6 weeks of loss of use at most sites in average years. Impact would be mitigated	6 weeks of loss of use at most sites in average years. Impact would be mitigated	2 weeks of loss of use at most sites in average years. Impact would be mitigated	7 weeks of loss of use at most sites in average years. Impact would be mitigated	12 weeks of loss of use at most sites in average years. Impact would be mitigated	6 weeks of loss of use at most sites in average years. Impact would be mitigated	9 weeks of loss of use at most sites in average years. Impact would be mitigated	8 weeks of loss of use at most sites in average years. Impact would be mitigated
Banks: Decrease in usability or aesthetic quality at developed camping or day use facilities	Minimal impact	3.4 feet of drawdown beyond the No Action Alternative in an average year	3 feet of drawdown beyond No Action	0.1 feet of drawdown beyond No Action	3.4 feet of drawdown beyond No Action	8.5 feet of drawdown beyond No Action	3.4 feet of drawdown beyond No Action	5 feet of drawdown beyond No Action	3.4 feet of drawdown beyond No Action
Banks: Decrease in usability of aesthetic quality at dispersed recreation sites	Minimal impact	3.4 feet of drawdown beyond the No Action Alternative in an average year	3 feet of drawdown beyond No Action	0.1 feet of drawdown beyond No Action	3.4 feet of drawdown beyond No Action	8.5 feet of drawdown beyond No Action	3.4 feet of drawdown beyond No Action	5 feet of drawdown beyond No Action	3.4 feet of drawdown beyond No Action
Banks: Loss of opportunity for hunting, wildlife viewing, hiking, etc. on lands surrounding the reservoirs	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
Loss of hunting and/or wildlife viewing opportunities in Odessa Special Study Area	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact
Irrigated Agriculture									
Gross Farm Income 2025 Study Area Compared to Four-County Analysis Area	Adverse long-term impact: less than three percent of analysis area Gross Farm Income	Beneficial long-term effect: less than three percent of analysis area Gross Farm Income	Beneficial long-term effect: less than three percent of analysis area Gross Farm Income	Beneficial long-term effect: less than three percent of analysis area Gross Farm Income	Beneficial long-term effect: less than three percent of analysis area Gross Farm Income	Beneficial long-term effect: less than five percent of analysis area Gross Farm Income	Beneficial long-term effect: less than five percent of analysis area Gross Farm Income	Beneficial long-term effect: less than five percent of analysis area Gross Farm Income	Beneficial long-term effect: less than five percent of analysis area Gross Farm Income
Socioeconomics									
Change in regional employment (number of jobs) within the four-county analysis area	Adverse long-term impact: less than one percent decrease in jobs	Short-term beneficial effects: less than one percent increase in jobs. Net long-term beneficial effects: less than one percent increase in jobs.	Short-term beneficial effects: less than one percent increase in jobs. Net long-term beneficial effects: less than one percent increase in jobs.	Short-term beneficial effects: less than two percent increase in jobs. Net long-term beneficial effects: less than one percent increase in jobs.	Short-term beneficial effects: less than two percent increase in jobs. Net long-term beneficial effects: less than one percent increase in jobs.	Short-term beneficial effects: less than four percent increase in jobs. Net long-term beneficial effects: less than one percent increase in jobs.	Short-term beneficial effects: less than four percent increase in jobs. Net long-term beneficial effects: less than one percent increase in jobs.	Short-term beneficial effects: less than four percent increase in jobs. Net long-term beneficial effects: less than one percent increase in jobs.	Short-term beneficial effects: less than four percent increase in jobs. Net long-term beneficial effects: less than one percent increase in jobs.
Change in regional labor income within the four-county analysis area	Adverse long-term impact: less than one-half of one percent decrease in labor income	Short-term beneficial effects: less than two percent increase in labor income. Net long-term beneficial effects: less than one percent increase in labor income.	Short-term beneficial effects: less than two percent increase in labor income. Net long-term beneficial effects: less than one percent increase in labor income.	Short-term beneficial effects: less than two percent increase in labor income. Net long-term beneficial effects: less than one percent increase in labor income.	Short-term beneficial effects: less than two percent increase in labor income. Net long-term beneficial effects: less than one percent increase in labor income.	Short-term beneficial effects: less than six percent increase in labor income. Net long-term beneficial effects: less than one percent increase in labor income.	Short-term beneficial effects: less than six percent increase in labor income. Net long-term beneficial effects: less than one percent increase in labor income.	Short-term beneficial effects: less than six percent increase in labor income. Net long-term beneficial effects: less than one percent increase in labor income.	Short-term beneficial effects: less than six percent increase in labor income. Net long-term beneficial effects: less than one percent increase in labor income.
Change in regional sales within the four-county analysis area	Adverse long-term impact: less than one-half of one percent decrease in sales	Short-term beneficial effects: less than one percent increase in sales. Net long-term beneficial effects: less than one percent increase in sales.	Short-term beneficial effects: less than one percent increase in sales. Net long-term beneficial effects: less than one percent increase in sales.	Short-term beneficial effects: less than one percent increase in sales. Net long-term beneficial effects: less than one percent increase in sales.	Short-term beneficial effects: less than one percent increase in sales. Net long-term beneficial effects: less than one percent increase in sales.	Short-term beneficial effects: less than four percent increase in sales. Net long-term beneficial effects: less than one percent increase in sales.	Short-term beneficial effects: less than four percent increase in sales. Net long-term beneficial effects: less than one percent increase in sales.	Short-term beneficial effects: less than four percent increase in sales. Net long-term beneficial effects: less than one percent increase in sales.	Short-term beneficial effects: less than four percent increase in sales. Net long-term beneficial effects: less than one percent increase in sales.

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Important Beneficial Effect	Beneficial Effect	No Impact to Minimal Impact	Adverse Impact	Important Adverse Impact
A substantial beneficial effect	A minor beneficial effect	No impact; or influences the resource to a barely measurable degree	A negative impact to the resource	A substantial negative impact

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives				Full Groundwater Irrigation Replacement Alternatives			
		2A: Partial—Banks	2B: Partial—Banks + FDR	2C: Partial—Banks + Rocky	2D: Partial—Combined	3A: Full—Banks	3B: Full—Banks + FDR	3C: Full—Banks + Rocky	3D: Full—Combined
Transportation									
Short- or long-term increases in traffic (general average daily and peak hour) on regional or local roads	No impact	Minimal Impact	Minimal Impact	Minimal Impact	Minimal Impact	Minimal Impact	Minimal Impact	Minimal Impact	Minimal Impact
Increases in large and/or heavy-load vehicle traffic on regional or local roads	No impact	Minimal Impact	Minimal Impact	Minimal Impact	Minimal Impact	Minimal Impact	Minimal Impact	Minimal Impact	Minimal Impact
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	Significant impact on local circulation from road closures necessary for Rocky Coulee reservoir	Significant impact on local circulation from road closures necessary for Rocky Coulee reservoir	Minimal impact given committed TMP	Minimal impact given committed TMP	Significant impact on local circulation from road closures necessary for Rocky Coulee reservoir	Significant impact on local circulation from road closures necessary for Rocky Coulee reservoir
Energy									
Change in net energy available in region	No impact	Adverse impact	Adverse impact	Adverse impact	Adverse impact	Significant impact	Significant impact	Significant impact	Significant impact
Capacity of local providers	No impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact
Public Services and Utilities									
Exceedance of service or utility capacity (long-term)	No impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
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	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	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	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	Minimal impact	Minimal impact
Public Health (Hazardous Materials)									
Hazardous sites	No impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact
Mosquito habitat	No impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact	Minimal impact
Visual Resources									
Landscape-level change: conversion from irrigated agriculture to dryland or fallow	102,614 acres would convert to dryland or fallow	48,416 acres would convert to dryland or fallow	48,416 acres would convert to dryland or fallow	48,416 acres would convert to dryland or fallow	48,416 acres would convert to dryland or fallow	Landscape appearance does not change	Landscape appearance does not change	Landscape appearance does not change	Landscape appearance does not change
Introduction of new developed facilities	No impact	Delivery and distribution system south of I-90 only	Delivery and distribution system south of I-90 only	Delivery and distribution system south of I-90 and Rocky Coulee Reservoir north of I-90	Delivery and distribution system south of I-90 and Rocky Coulee Reservoir north of I-90	Delivery and distribution system north and south of I-90	Delivery and distribution system north and south of I-90	Delivery and distribution system north and south of I-90, plus Rocky Coulee Reservoir	Delivery and distribution system north and south of I-90, plus Rocky Coulee Reservoir
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 at Banks Lake generally related to depth of additional drawdown	Minimal Impact	Adverse impact at Banks Lake generally related to depth of additional drawdown	Significant impact at Banks Lake in August and September of average years	Adverse impact at Banks Lake generally related to depth of additional drawdown	Significant impact at Banks Lake in August and September of dry and drought years	Adverse impact at Banks Lake generally related to depth of additional drawdown

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Important Beneficial Effect	Beneficial Effect	No Impact to Minimal Impact	Adverse Impact	Important Adverse Impact
A substantial beneficial effect	A minor beneficial effect	No impact; or influences the resource to a barely measurable degree	A negative impact to the resource	A substantial negative impact

Resource Indicator, Topic, or Measurement	No Action	Partial Groundwater Irrigation Replacement Alternatives				Full Groundwater Irrigation Replacement Alternatives			
		2A: Partial—Banks	2B: Partial—Banks + FDR	2C: Partial—Banks + Rocky	2D: Partial—Combined	3A: Full—Banks	3B: Full—Banks + FDR	3C: Full—Banks + Rocky	3D: Full—Combined
Cultural and Historic Resources									
Potential for construction to encounter and impact significant cultural resources									
Miles of new linear facilities	No impact	172 miles	172 miles	172 miles	172 miles	248 miles	248 miles	248 miles	248 miles
Acres of facility site acquisition	No impact	90 acres	90 acres	6,170 acres	6,170 acres	128 acres	128 acres	6,208 acres	6,208 acres
Additional acreage exposed by drawdowns at Banks Lake	No impact	780 acres	680 acres	30 acres	500 acres	2,310 acres	690 acres	1,170 acres	690 acres
Indian Sacred Sites									
Potential for facility development to impact known sacred sites	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
Indian Trust Assets									
Potential for facility development to impact known ITAs	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
Environmental Justice									
Disproportionate impact to minority or low-Income populations	No impact	No Impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact

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. It also portrays existing conditions under the No Action Alternative.

The analysis area is defined for each environmental resource or topic discussed in Chapter 3, and may be different from the Odessa Subarea or the Study Area. As shown on Map 1-1, the Odessa Subarea includes the entire Odessa Groundwater Management Area, which is where groundwater levels are declining. Within the western portion of the Odessa Subarea lies the Study Area, which is the focus of this Draft 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 action alternatives may occur. For example, the analysis area for fisheries includes the Odessa Subarea 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.

Photograph 3-1
Lands currently rely on a declining groundwater supply from the Odessa Groundwater Management Subarea (Odessa Subarea). This action would propose to deliver surface water within the Odessa Subarea Special Study Area (Study Area).

3.2 Surface Water Quantity

Surface water quantity issues associated with the Odessa Special 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 action alternatives (Lake Roosevelt and Banks Lake), and other surface water features in the Study Area. The Study Area is located within the multipurpose CBP, which provides irrigation, power production, flood control, municipal water supply, recreation, and fish and wildlife benefits. The Study Area is defined by those lands within the larger Odessa Groundwater Management Subarea eligible to receive CBP water (Map 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 covers an area about 260,000 square miles in the northwestern United States 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 approximately 1,214 miles. Numerous subbasins are formed by tributaries of the mainstem river, including the Kootenai, Flathead and Pend Oreille, Snake, and Willamette rivers. Map 3-1 shows the extent of the Columbia River Watershed.

Runoff from forested slopes of the Rocky Mountains in British Columbia, western Montana, and northern Idaho contributes the main portion of the Columbia Basin's water supply. Most of the annual precipitation occurs in the winter, with the largest share falling in the mountains as snow. Basin snowpack melts in the spring and early summer, resulting in heavy, prolonged flows during the summer months with the peak flow 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.

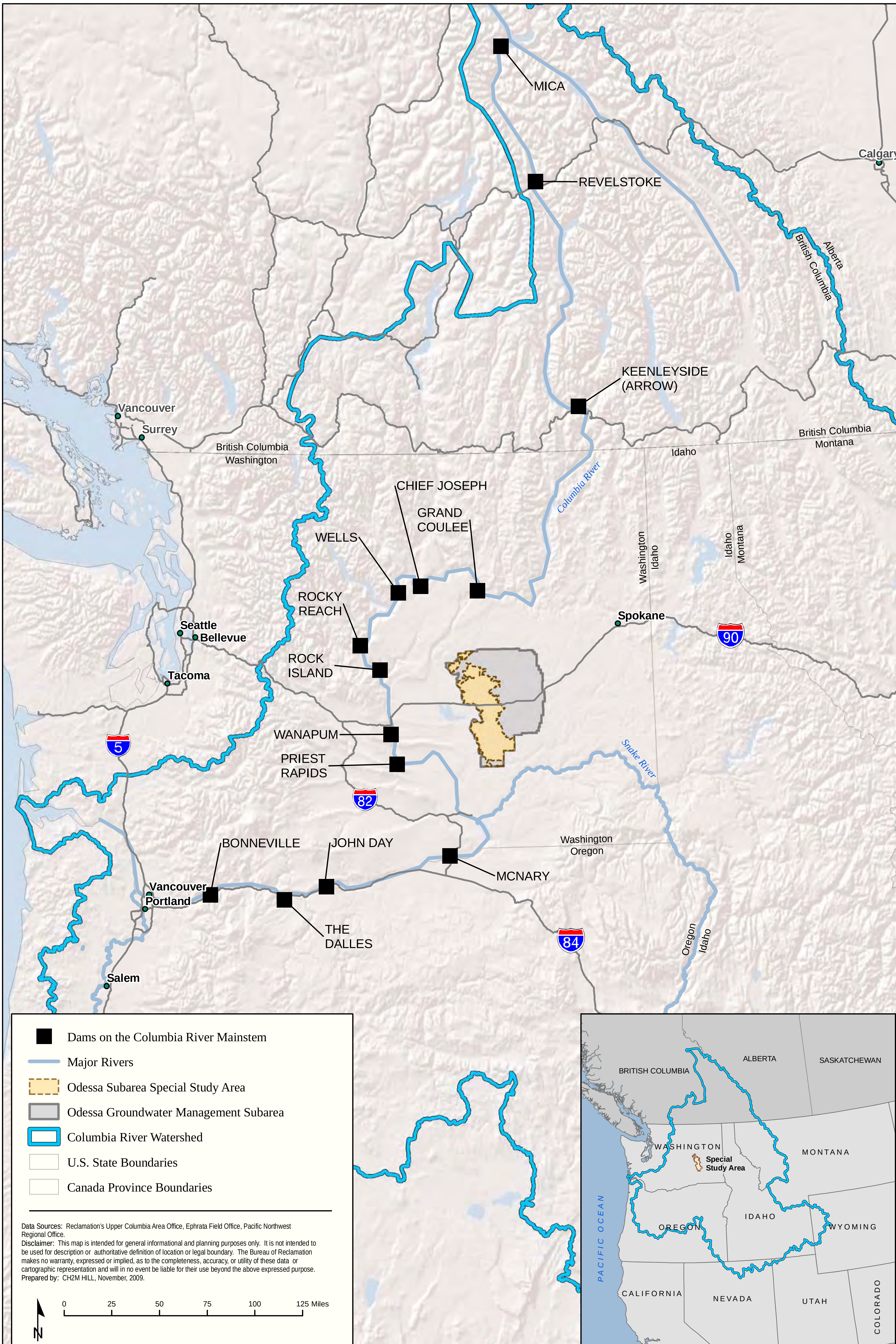
3.2.2.1 Columbia River Flows

Based on a 70-year period of record from 1929 through 2008, 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 3-1 presents data from USGS Gage 12436500 for the Columbia River at Grand Coulee Dam. This plot represents the regulated flow below the dam and does not illustrate the variability of natural flows upstream of Lake Roosevelt.

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 on the Columbia River basin rivers are the foundation of the Northwest's power supply and have a maximum capacity of 22,500 megawatts. 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 Map 3-1, there are 11 dams on the United States 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).



Odessa Subarea Special Study
Columbia Basin Project, Washington

Map 3-1
Columbia River System Overview

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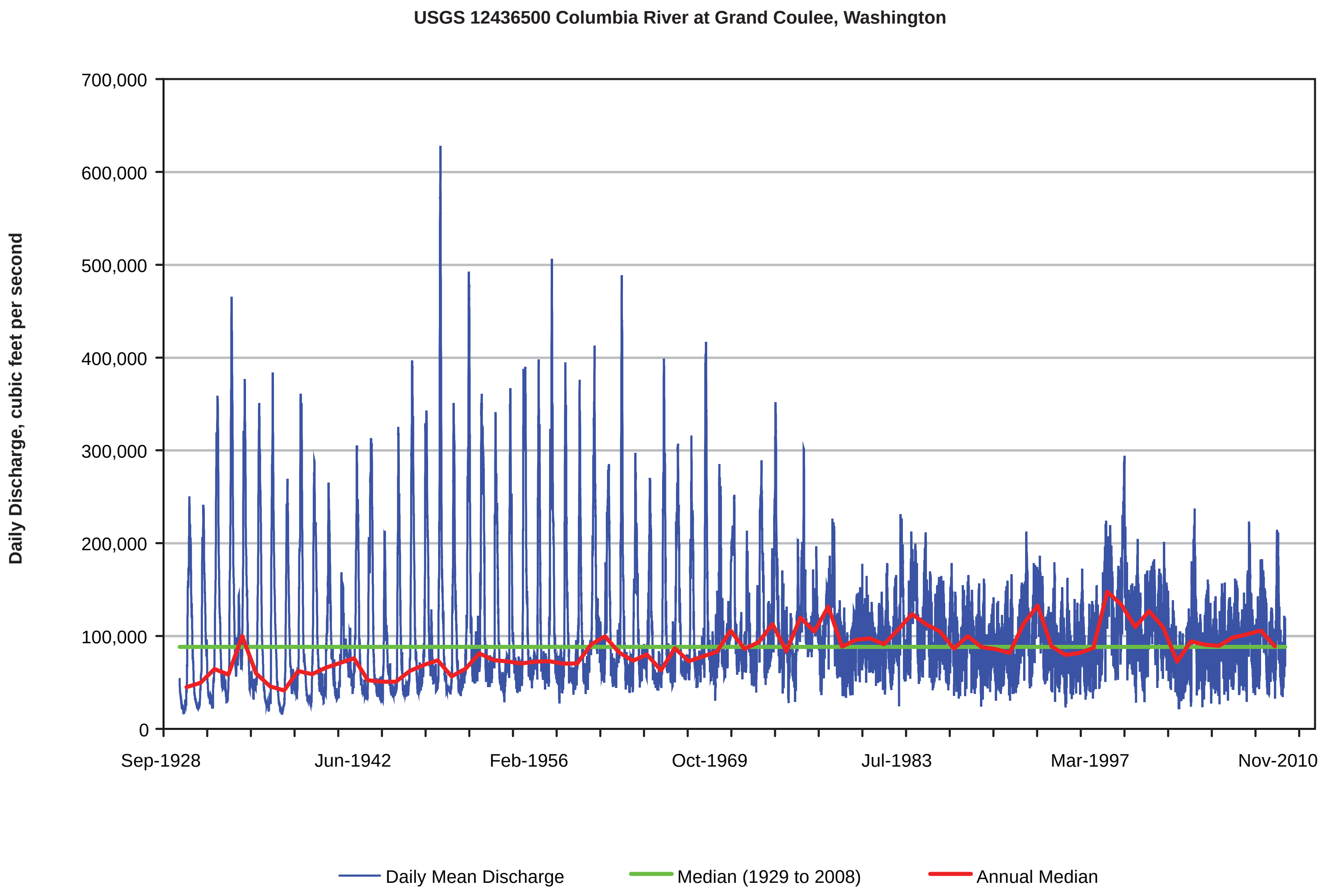

Odessa Subarea Special Study
Columbia Basin Project, Washington

Figure 3-1
Columbia River Flows at Grand Coulee, Washington

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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, and the project extends east 60 miles to near Odessa and Lind.

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. Up to 67 different crops are grown, with more than $1.4 billion of crop value each year, including alfalfa, potatoes, apples, and vegetables.

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

3.2.2.3 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 (see Figure 3-1). 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 fluctuates 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 3-2 illustrates historical drawdown in Lake Roosevelt. The deep drawdowns shown in 1969 and 1974 are due to construction of the third powerplant associated with the Grand Coulee Powerplant Complex.

Similarly, Banks Lake operates within established constraints to meet water delivery contractual obligations, ensure public safety, and protect property, while striving to allow for recreational use. Banks Lake drawdowns generally begin approximately 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 amsl) 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 3-3 illustrates historical drawdown in Banks Lake.

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 (see Map 1-1):

- **Feeder Canal.** Conveys pumped water (20,000 cfs capacity) 1.6 miles from Lake Roosevelt to Banks Lake.

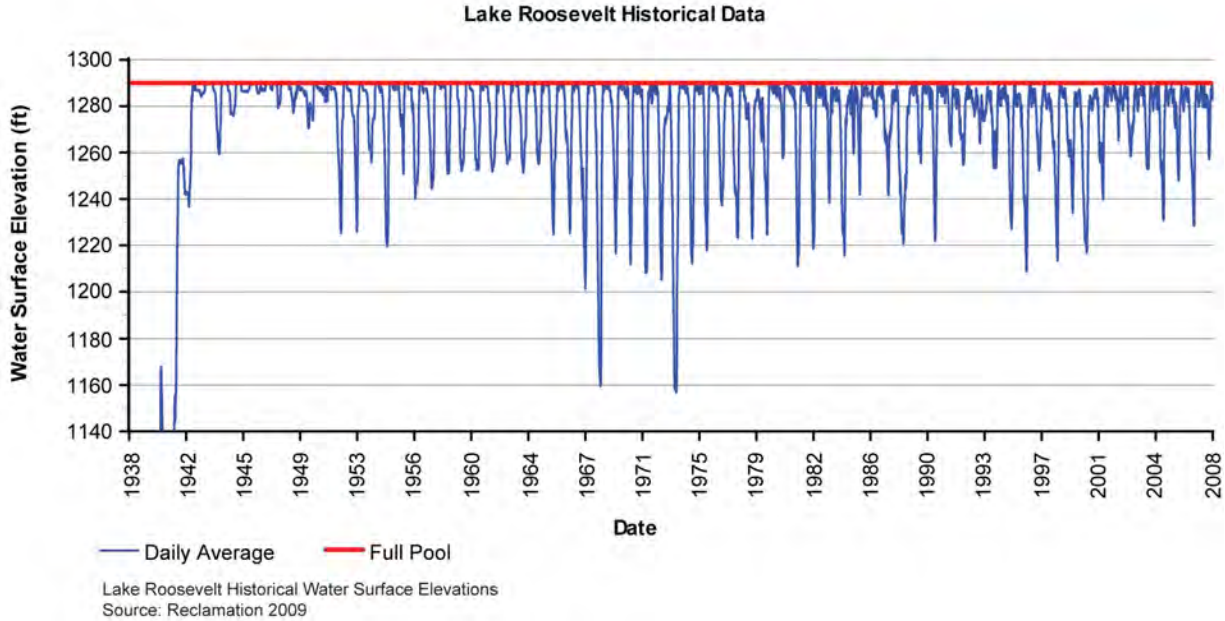


Figure 3-2
Lake Roosevelt Historical Water Surface Elevations (Source: Reclamation 2009)

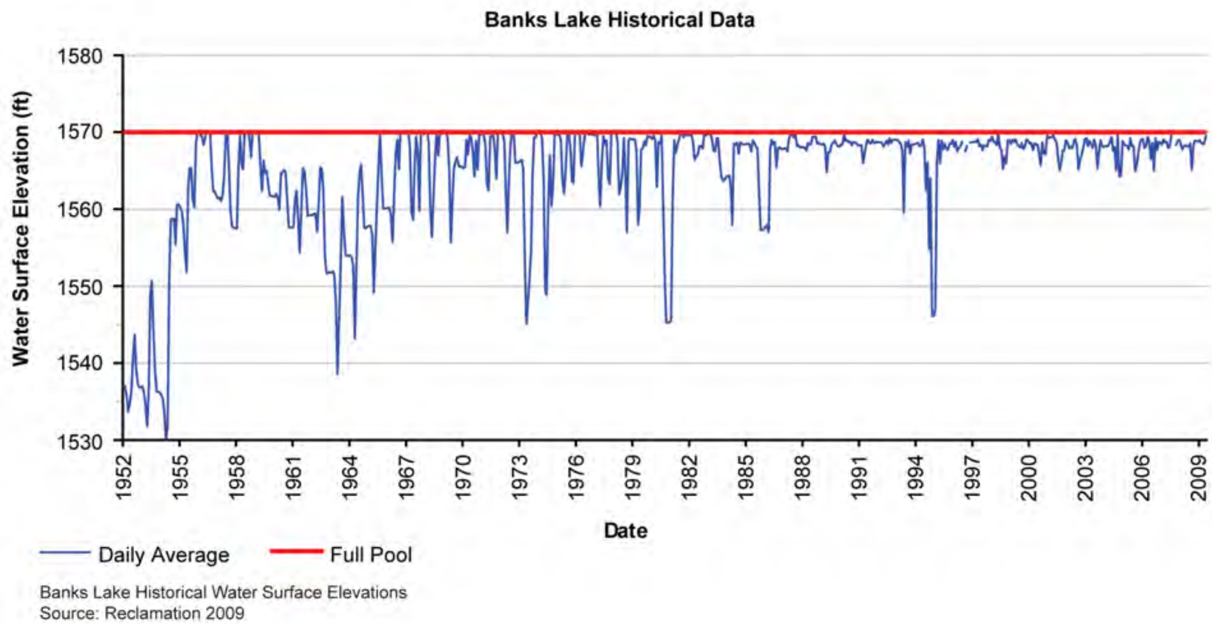


Figure 3-3
Banks Lake Historical Water Surface Elevations (Source: Reclamation 2009)

- **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. Other inflows to the reservoir include Winchester, Frenchman Hills, and Lind Coulee Wasteways.

- **Potholes Canal.** Conveys water (3,600 cfs capacity) 62.4 miles from Potholes Reservoir 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.

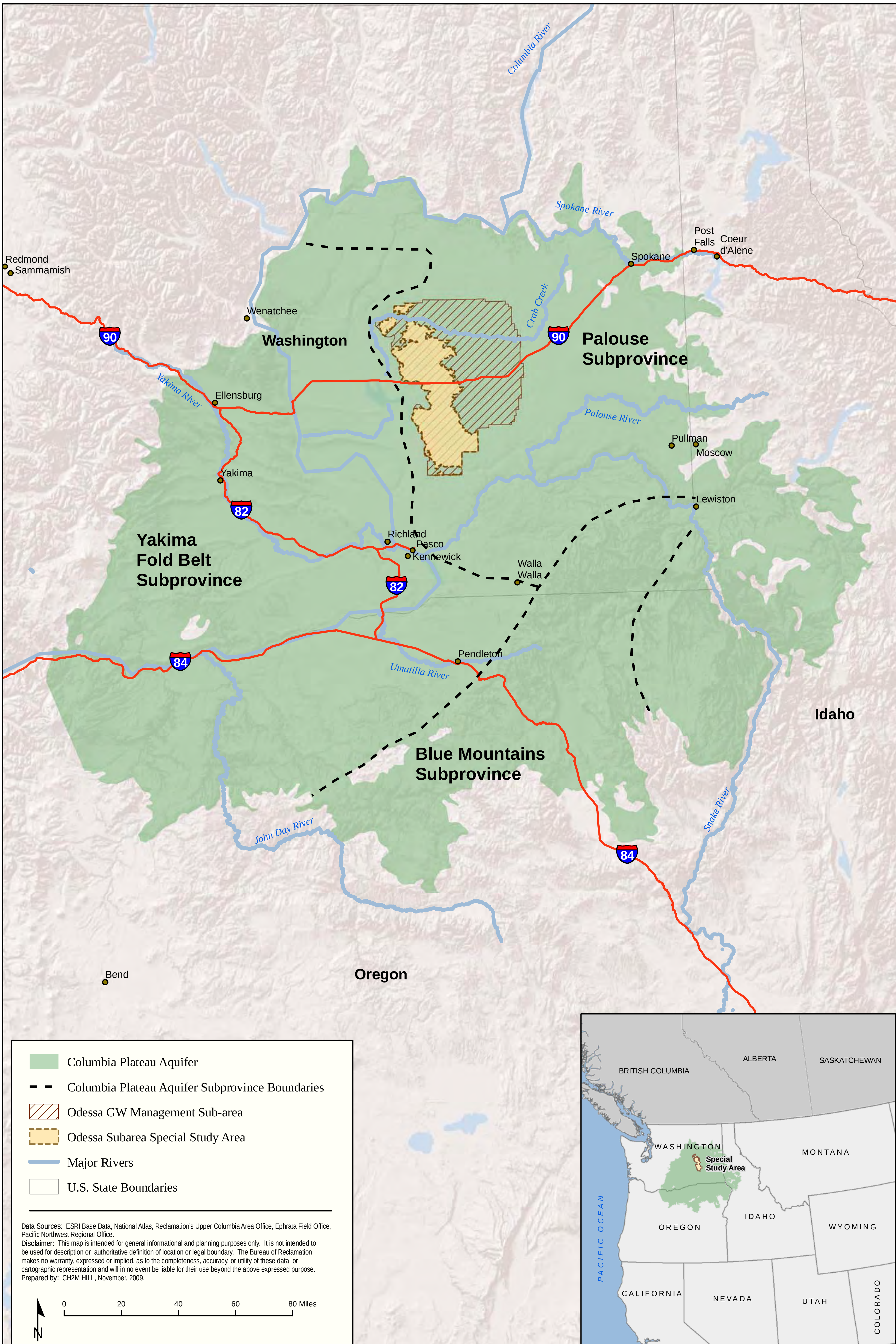
Photograph 3-2
Canals serve the region's agriculture.

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 has anticipated impacts on snowpack and runoff patterns. Recent research suggests that warmer temperatures across the basin are contributing to declines in total snow accumulations, and that the decline in the Cascade Mountains may be as much as 60 percent (Mote 2003). The implications are that the snowpack would melt earlier in the spring and reduce summer streamflow.

3.3 Groundwater Resources

The Odessa groundwater management subarea was designated by the Washington legislature in 1967 because groundwater levels had declined as a result of groundwater pumping. The aquifers underlying the Study Area for the Odessa Subarea Special Study Draft EIS are part of the larger Columbia Plateau aquifer system (Map 3-2). The aquifer system under the Study Area is the area's primary source of municipal, industrial, domestic, and irrigation water.



Odessa Subarea Special Study
Columbia Basin Project, Washington

Map 3-2
Regional Aquifer Context

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Crops that rely on groundwater for production include potatoes, wheat, corn, alfalfa, peas, grass seed, onions, and dry beans.

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 proposed Rocky Coulee Dam site, 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 (Vaccaro 1999 as cited in 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. 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 non-irrigation 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 (Cline 1984 as cited in 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 and 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 is 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 do 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, and a storage reservoir constructed in Rocky Coulee is part of alternative water supply options in either the full or partial replacement alternatives. The bedrock at the abutments of the proposed dams consists of Wanapum Basalt. It appears that the basalt bedrock in the sides and walls of the coulees where these dams would be built is unsaturated. When these reservoirs are full, water would move laterally and vertically into the walls and bottoms of the coulees 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. Hydraulic conductivity values at the Rocky Coulee dam site range from 0.02 to 4.12 feet per day. Borrow sites, particularly for fine-grained impervious fill near the Rocky Coulee Dam, would need to be dewatered prior to excavation (Reclamation 2007 Appraisal).

Shallow groundwater in the sediments surrounding the 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.

Adams County has 63,618 acres of groundwater-irrigated land; with 52,389 acres (82.4 percent) south of I-90 and 11,229 acres (17.7) percent north of I-90. Grant County's groundwater-irrigated acreage totals 28,487 acres, with 27,383 acres (96.1 percent) north of I-90 and 1,104 acres (3.9 percent) south of I-90. All of the groundwater-irrigated acres in Franklin County (3,575) are south of I-90. All the groundwater-irrigated acres in Lincoln County (6,932) are north of I-90.

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. 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.

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 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 (http://apps.ecy.wa.gov/welllog/), 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.

In addition, recent surveys conducted by GWMA provide a history of impacts to municipalities due to declining water levels (GWMA, 2010). 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 can not 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 to produce frozen foods such as potatoes and beans. These facilities are located primarily in Othello, Warden, and Moses Lake. 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 gallons per minute, but the larger, deeper wells produce up to 2,000 gallons per minute.

Several hundred domestic wells have been drilled in the Study Area and are used for household water supply. 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 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 alternatives consist of potential changes to temperature, dissolved oxygen, total dissolved gas, pH, nutrients, and heavy metals 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

The action alternatives would withdraw water from Lake Roosevelt, route the water through Banks Lake and the CBP for agricultural use, and discharge any return flows to the Columbia River through various natural and man-made drainageways. Impacts to surface water quality in Lake Roosevelt and Banks Lake may be propagated downstream through the Columbia River (Grand Coulee Dam to Bonneville Dam) and the CBP irrigation network. All of these lands and water bodies are part of the analysis area for water quality.

Available water quality data from the systems identified above were evaluated and compared to State standards. Adherence to State water quality standards is required, and is administered by Ecology and approved by the U.S. 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.

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 total dissolved gas 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.

3.4.2 Lake Roosevelt

Either no or minimal additional impacts on water quality in Lake Roosevelt would occur under any of the alternatives, as described in Section 4.4, *Surface Water Quality*. Therefore, existing water quality conditions (temperature, total dissolved gas, dissolved oxygen, and metals) in Lake Roosevelt are only briefly discussed here.

Lake Roosevelt is 303(d)-listed for temperature criteria exceedances (Ecology 2007a; Ecology 2007b). The Lake Roosevelt temperature standard is driven by 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) (Washington State Legislature [WSL] 2006). EPA is leading an effort to develop a temperature TMDL for the Columbia River system, but the TMDL has not been finalized.

A total dissolved gas TMDL, *Total Maximum Daily Load for Total Dissolved Gas in the Mid-Columbia River and Lake Roosevelt* (EPA et al. 2004), was developed for Lake Roosevelt to help achieve compliance with the state standard. The State's numeric total dissolved gas criteria for core summer salmonid habitat states that total dissolved gas shall not exceed 110 percent of saturation at any point during sampling (WSL 2006). Despite TMDL implementation, maximum total dissolved gas concentrations in excess of 110 percent saturation were observed from 2002 to 2005 at six locations throughout the reservoir (LRFEP, as cited in Ecology 2008).

Lake Roosevelt is on the 303(d) list for dissolved oxygen based on criteria exceedances 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 (LRFEP, as cited in Ecology 2008).

Lake Roosevelt has significant levels of zinc, lead, copper, arsenic, cadmium, and mercury contamination primarily as a result of the 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 higher-order organisms, like fish, that feed on them (Underwood et al. 2004). Upper Lake Roosevelt shows impairment for mercury on the 303(d) list (Ecology 2007a; Ecology 2007b).

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 their potential to be impacted by the action alternatives, the water quality parameters in Banks Lake examined in greater detail include temperature, dissolved oxygen, and turbidity. Water quality data for Banks Lake is sparse, although WDFW has collected data since 2002 and the 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 impairment, although data suggests that the water body exceeds standards for temperature and dissolved oxygen.

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
Total Dissolved Gas	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	N/A
Turbidity	N/A	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	N/A	N/A

Notes:

[a] The Columbia River at Bonneville Dam is subject to both Washington and Oregon state standards, and the criteria listed here are the controlling criteria.

[b] 1 hour maximum is 125 percent of saturation. If flows exceed the 7-day, consecutive low 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 applicable
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

MCL = maximum contaminant level
NO_2 = nitrogen
NO_3 = nitrate
TDS = total dissolved solids

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

TABLE 3-5

TMDLs for Total Dissolved Gas in Lake Roosevelt and the Columbia River Downstream of Grand Coulee Dam

Water Feature	Load Allocation for Total Dissolved Gas	TMDL Report
Lake Roosevelt*	72 mm Hg above saturation	*Total Maximum Daily Load for Total Dissolved Gas 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	*Total Maximum Daily Load for Total Dissolved Gas in the Mid-Columbia River and Lake Roosevelt* (Ecology et al. 2004)
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 Total Dissolved Gas* (Ecology and ODEQ 2002)

mm HG = millimeters of mercury

*Total dissolved gas 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

3.4.3.1 Temperature

Banks Lake summer temperature data suggest that the reservoir exceeds the state temperature standard of 17.5°C (63.5°F; WAC 173-201A, *Water Quality Standards for Surface Waters*), which 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 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 into the lake from FDR Lake. The cooler water mixes with the slightly warmer upper layers of the lake. This partly mixed lower part of the reservoir is very close to the same temperature below the zone heated by air temperature and the 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 basin becomes strongly stratified, and solar heating varies almost linearly from the surface to the lower mixed layers, with slightly more heat being accumulated in the near surface than in the deeper parts of the lake. During the fall of the year, the surface of the lake is cooled as the air temperature decreases and the temperature profile becomes nearly uniform as the near surface zone is cooled. However, Banks Lake normally does not mix throughout its depth in most years, and the surface zone can cool until ice forms on the surface during the winter.

During summer 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 thermocline is well defined by late summer. However, thermal characteristics sometimes vary from year to year. For example, the thermocline dropped to roughly 66 feet (20 meters) by late August in 2003 (Polacek et al. 2003), whereas the thermocline dropped to only half that depth by late August of 2005 (Polacek and Shipley 2005). Likewise, stratification sometimes begins to develop by May but in other years is not apparent until June. Figure 3-4 demonstrates the seasonal variability in temperature and dissolved oxygen concentrations based on data collected throughout the reservoir during 2008.

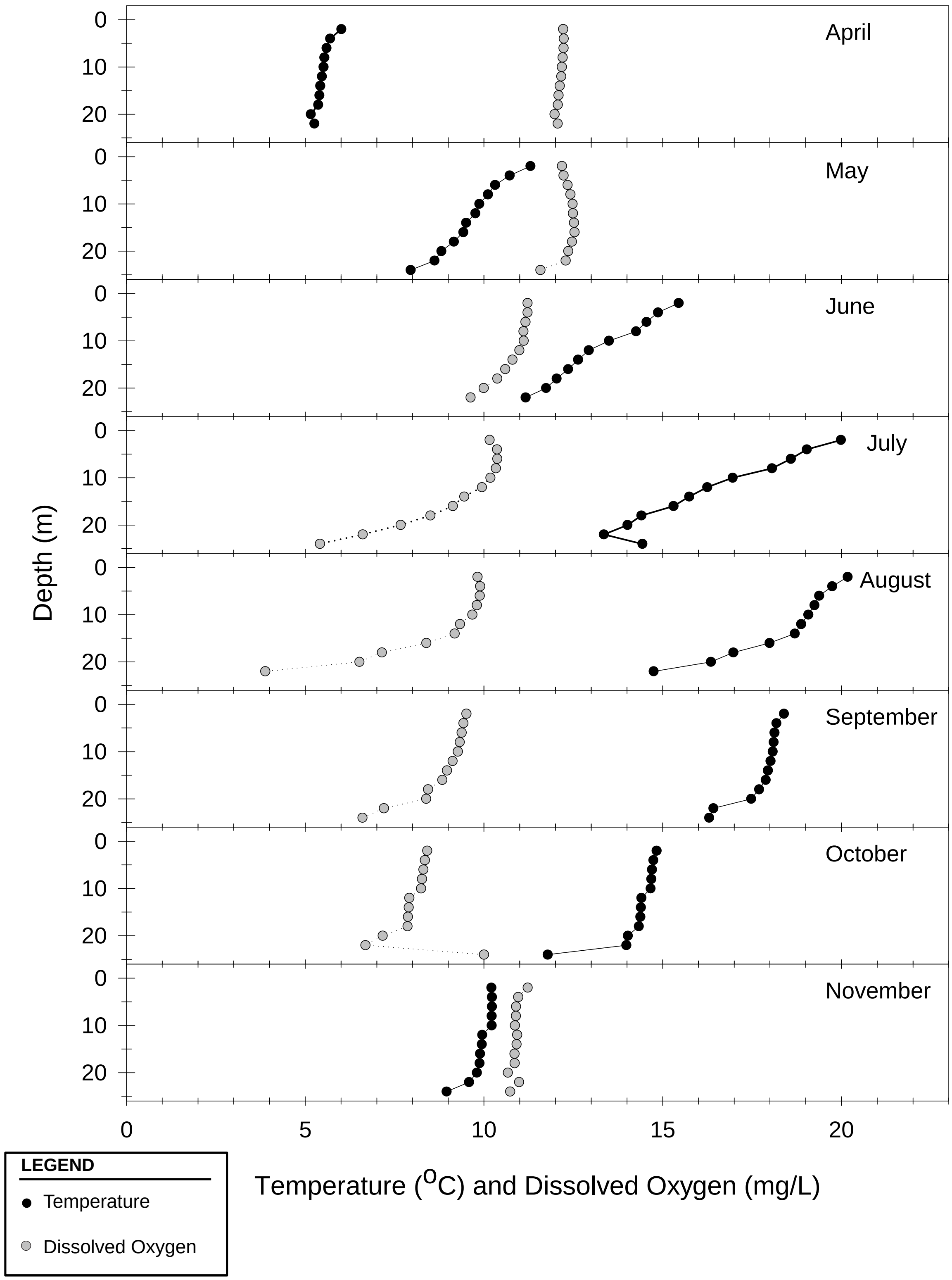
3.4.3.2 Dissolved Oxygen

WDFW data indicate that Banks Lake is not in compliance with the State's dissolved oxygen standard of 8.0 mg/L (WAC 173-201A, *Water Quality Standards for Surface Waters*), which is intended to be protective of salmonid spawning, rearing, and migration. Dissolved oxygen concentrations in Banks Lake have been measured by WDFW since 2002. Dissolved oxygen levels generally remained above 7 to 10 mg/L until mid-summer, but typically dropped to 5 mg/L (a critical level for fish) or less at depth greater than about 66 feet (20 meters) 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, dissolved oxygen 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 conditions (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.

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 described above to turbidity.



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 3-4
Banks Lake Mean Monthly Water Temperatures and Dissolved Oxygen Profiles

3.4.4 Columbia River Downstream of Grand Coulee Dam

Either no or minimal additional impacts on water quality in the Columbia River Downstream of Grand Coulee Dam would occur under any of the alternatives, as explained in Section 4.4, *Surface Water Quality*. Therefore, existing water quality conditions in Lake Roosevelt 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, the majority of water in the Study Area that is not consumed by agricultural practices (a portion of the original volume) is conveyed through the drain system to Crab Creek. Crab Creek runs through two reservoirs (Moses Lake and Potholes) before eventually returning to the Columbia River near Beverly, Washington. Other drainages in the Columbia Basin also collect irrigation water and return it to the Columbia River, but those drainages are generally outside the Study Area. Since the action alternatives would replace groundwater as the irrigation source with surface water delivered from Lake Roosevelt, the only reason water quality may be impacted is if the new surface water supply is of better or poorer quality than the existing groundwater source.

The action alternatives would not alter land use practices or the amount of water used on the farms for agricultural purposes, so return flow regimes (volume and timing) of the drains and Crab Creek are not anticipated to change. Therefore, this assessment presents data at sites that are representative of the water quality that could be expected from the new surface water supply. Groundwater quality data from the existing irrigation sources are also presented. The water quality parameters in the Study Area irrigation network that are examined in greater detail include temperature, pH, dissolved solids and specific conductance (surrogates for salinity), pesticides, and nutrients.

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.

Analysis area irrigation network target water quality parameters for surface water and groundwater are presented in Table 3-7. The following list highlights the relevance of the parameters presented in Table 3-7 and briefly reviews that status of those parameters in surface water and groundwater sources in the Study Area:

- Temperature
  - Impacts the survival and reproduction of fish and other aquatic species upon reaching variable upper limits.
  - Surface irrigation water temperature increases during summer when water flows through shallow channels or passes through relatively shallow reservoirs with large surface areas. Temperatures currently approach the state standard of 17.5 °C (63.5 °F) at some locations.
  - Groundwater extracted from deep aquifers is susceptible to geothermal heating in certain areas and also tends to approach the state surface water standard (applicable following surface application).

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
Groundwater [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 (also located at the Bifurcation) and CBP712 (located between Pinto Dam and the Bifurcation) measurements were generally collected April through October, while Bifurcation data was 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 United States Geological Survey (USGS) National Water Information System (NWIS).

Sources: Hoff and Cannon, Reclamation 2009 (CBP033 and CBP712); Jordan 2009 (Bifurcation); Whiteman et al. 1994 (groundwater); USGS 2009 (groundwater).

- 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.
- Salinity
  - Some crops cannot tolerate highly saline water.
  - TDS and specific conductance serve as indicators of salinity.
  - TDS levels in the surface water are much lower than in the groundwater.
  - 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 (Miles 1977, as cited in 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 streams.
  - 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.

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 because all alternatives must continue to meet minimum flow requirements and ESA target flows. Existing water rights and concerns relative to these were evaluated based on interviews with Reclamation and 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

A detailed description of water rights considerations within the Columbia River Basin is provided in the Programmatic EIS for the Management Program (Ecology 2007). 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 entitles 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 United States” (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 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. The out-of-stream uses 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 consist of 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 (2008):

> The funding doesn’t 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 non-use.

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 on Table 3-8.

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.

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.

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 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 right 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 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 by 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* (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.

Research conducted by Ecology using the Water Rights Tracking System did not reveal an existing claim, permit, or certificate for surface water occurring in Rocky Coulee. The only relevant records pertain to Reclamation's reservoir certificate for the Potholes Reservoir (Certificate No. R3-00013C, Priority Date April 22, 1943), which cites the source of water as Crab Creek (which contains Rocky Coulee) among the water sources. Potholes Reservoir serves to recapture and distribute return flows from the Columbia Basin project and the water right application "covers the unappropriated waters of Moses Lake, Crab Creek, Lind Coulee and all tributary channels leading thereto, withdrawn by the United States pursuant to RCW 90.40.030 by notice from the First Assistant Secretary of the Interior dated April 17, 1943."

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 the Odessa Special Study action alternatives.

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. Map 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. 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 rip rap and aggregate materials.

Photograph 3-3
Unique 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.

3.6.2.4 Rocky Coulee Reservoir

The bedrock foundation for the proposed Rocky Coulee Dam site consists of Roza and Frenchman Springs Members of the Wanapum Basalt. The valley fill alluvium in the exploratory hole drilled near the middle of the coulee at the dam site is about 76 feet thick and composed of soft to firm silty fines with fine sand. The water table recorded during drilling in May 2008 was about 14.5 feet bgs at the dam site. The depth to water at the abutments was not measured in test holes. The bedrock in the sides of the Coulee is not saturated. Irrigation activity in the vicinity probably contributes to the shallow water table. Borrow sites, particularly for fine-grained impervious fill near the proposed dam, would need to be dewatered prior to excavation. The reservoir rim areas are underlain by basalt bedrock with a surficial cover of colluvium and loess.

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. 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 (SSURGO) database and U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) county soil surveys.

Photograph 3-4
Pivot irrigation creates the agricultural base in the Study Area.

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 that 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 shows 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 (Richards 1954). 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 GWMA groundwater quality database between 1982 to 2008 reported SAR values greater than 6. All samples with an SAR greater than 6 also had 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 have been confirmed to not be 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 has been noted by growers to substantially reduce the yields of crops including wheat, corn, potatoes, and bluegrass seed (Personal communication with Heath Gimmestad). 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 (Personal communications with O. Johnson and E. Stahl).

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 (Reclamation 2004) found that exposed soils around the reservoir are susceptible to erosion. 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 drawdowns 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.

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 proposed dam sites and inundation areas. Upland plant communities adjacent to Banks Lake and Lake Roosevelt would not be impacted by greater summer drawdowns, and are therefore not discussed. No rare plant surveys were conducted along pipeline routes or access roads because their locations were not known at the time of the surveys.

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.

3.8.1.1 Wetland Analysis Methods

Existing wetland conditions for the Study Area were mapped using National Wetland Inventory (NWI) data, 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. No formal delineation was conducted at this time.

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 proposed reservoirs and dams. 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 non-native 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). At the ecosystem level, the Washington Department of Natural Resources (WDNR) has designated Priority Ecosystems for state lands. The WNHP provide 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 conversion of native vegetation agriculture is that several plant species endemic to the region now have restricted distributions and are listed as rare in Washington. Similarly, past fragmentation and disturbance of native plant communities have allowed or encouraged many non-native 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 also 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 and Rocky 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 (1998) 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 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 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.

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*, S*tipa*, and *Agropyron spp*.) and, in some areas, non-native cheatgrass (*Bromus tectorum*).

TABLE 3-11

Historic (Prior to 1977) and Current Recorded Occurrences of WNHP High Quality or Rare Plant Communities Occurring Within a 5-mile Radius of the Analysis Area

Scientific Name/Type	Common Name	Current WNHP Data (number of observed areas)	Historic WNHP Data (number of observed areas)	Types Found During Field Surveys
Artemisia rigida/Poa secunda Shrub Herbaceous Vegetation	Stiff Sagebrush/Sandberg's Bluegrass	1	-	Yes
Artemisia tridentata/Festuca idahoensis Shrub Herbaceous Vegetation	Big Sagebrush/Idaho Fescue	2	-	No
Artemisia tridentata Shrubland	Big Sagebrush Shrubland	-	1	Yes
Artemisia tridentata ssp. *wyomingensis/Pseudoroegneria spicata* Shrub Herbaceous Vegetation	Wyoming Big Sagebrush/ Bluebunch Wheatgrass	4	-	-
Hesperostipa comata Cover Type	Needle-and-thread Grassland	1	-	Yes*
Inter-Mountain Basins Active and Stabilized Dune	Dunes	1	-	-
Artemisia rigida/Poa secunda Shrub Herbaceous Vegetation	Stiff (Scabland) Sagebrush/ Sandberg's Bluegrass	-	-	Yes
Eriogonum thymoides/Poa secunda Dwarf Shrub Herbaceous Vegetation	Thymeleaf buckwheat/ Sandberg's bluegrass	-	-	Yes
Populus tremuloides Cover Type	Quaking aspen	-	-	Yes*
Distichlis spicata Herbaceous Vegetation	Saltgrass	-	-	Yes*
Sarcobatus vermiculatus / Distichlis spicata Shrubland	Greasewood/Saltgrass	-	-	Yes*

*Very rare in analysis area

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 sagebush—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 eight 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 nine 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. 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 3-5
View of Big Sagebrush-Bluebunch Wheatgrass vegetation type with Three-Tip Sagebrush in foreground. Note the high forb cover, including Carey's Balsamroot, Longleaf Phlox, 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. No wetland resources were identified in the Rocky Coulee Reservoir footprint. 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 non-tidal 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 486.8 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, 25.3 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 6 meters (20 feet) 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 balsmifera*), willow species, or at one location, quaking aspen (*Populus tremuloides*).

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 have been identified within the analysis area.

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 were dominated by saltgrass (*Distichlis spicata*) and in some cases dead fourwing saltbush (*Atriplex canescens*) in the shrub layer.

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 (Zedler 1987, as cited in 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.

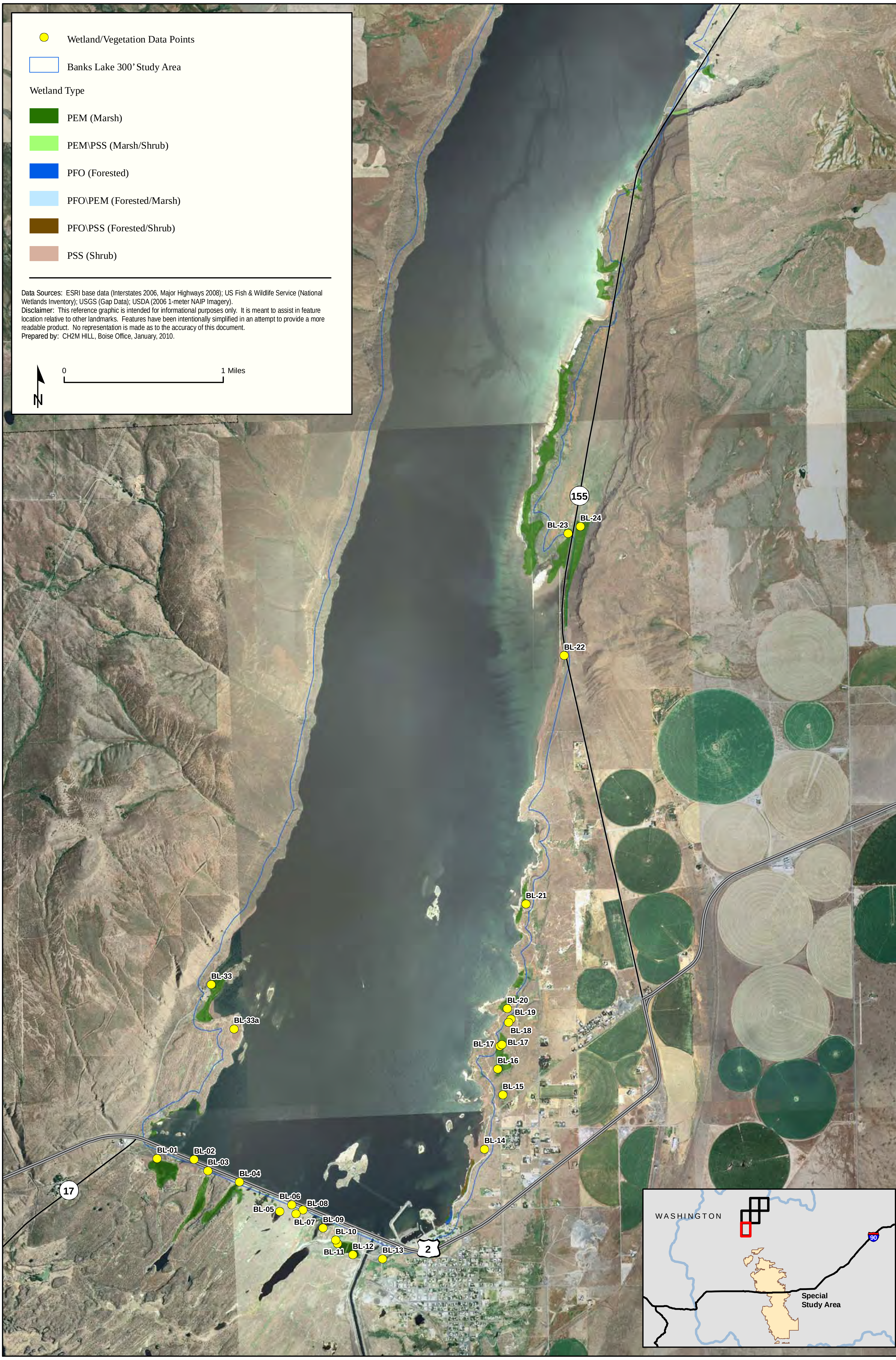
3.8.5 Wetland Locations
Wetland vegetation communities are described by wetland type for each major Odessa facility location within the analysis area. Those habitats with WDNR special status are noted.

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 does currently support areas of aquatic plants between 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 Maps 3-3a through 3-3e.

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 include 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*).



Map 3-3a

Banks Lake Fringe Wetlands, South

Odessa Subarea Special Study
Columbia Basin Project, Washington

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Odessa Subarea Special Study
Columbia Basin Project, Washington

Map 3.-3b
Banks Lake Fringe Wetlands, West Central

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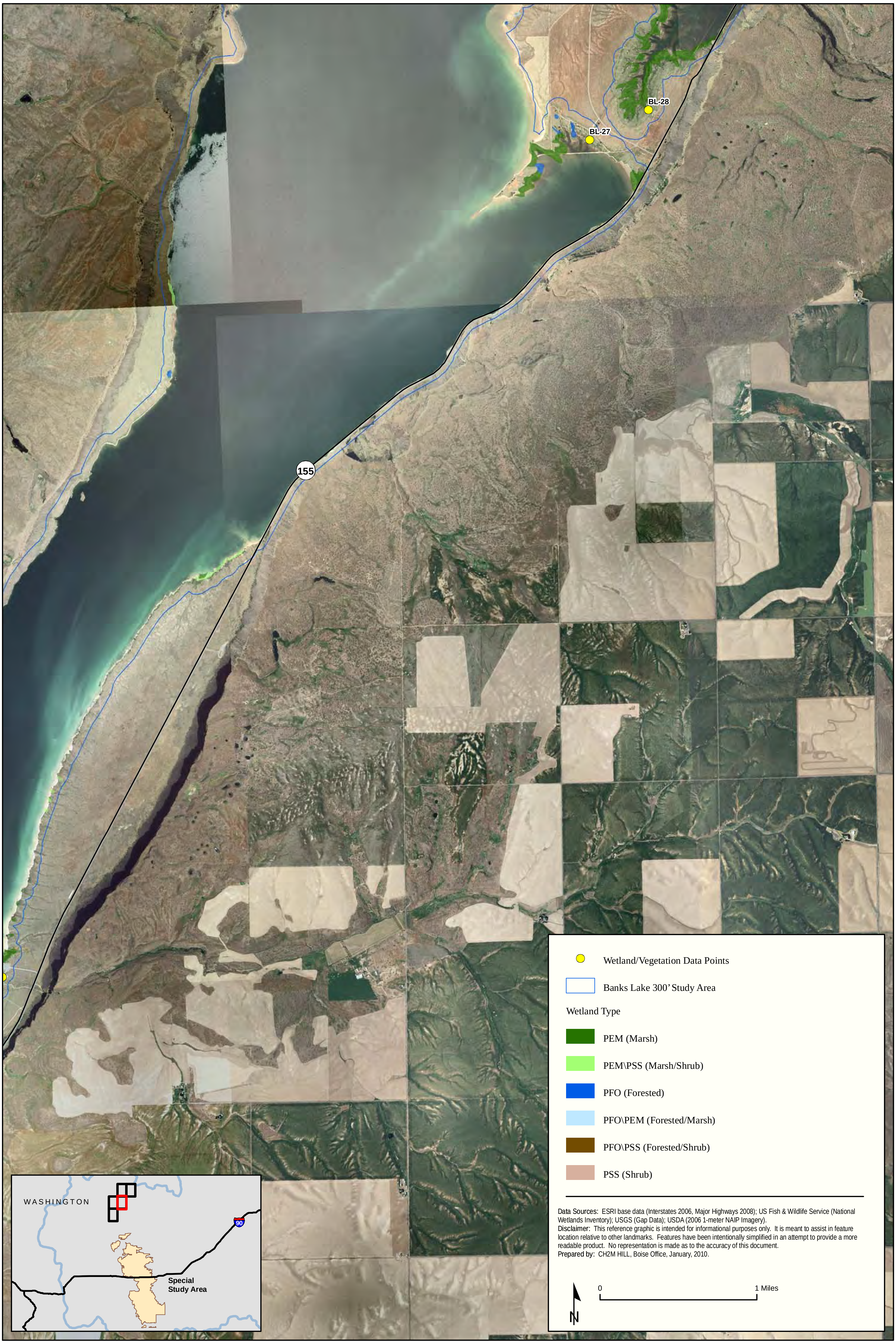

Map 3-3c

Banks Lake Fringe Wetlands, East Central

Odessa Subarea Special Study
Columbia Basin Project, Washington

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Map 3-3d

Odessa Subarea Special Study
Columbia Basin Project, Washington

Banks Lake Fringe Wetlands, Northwest

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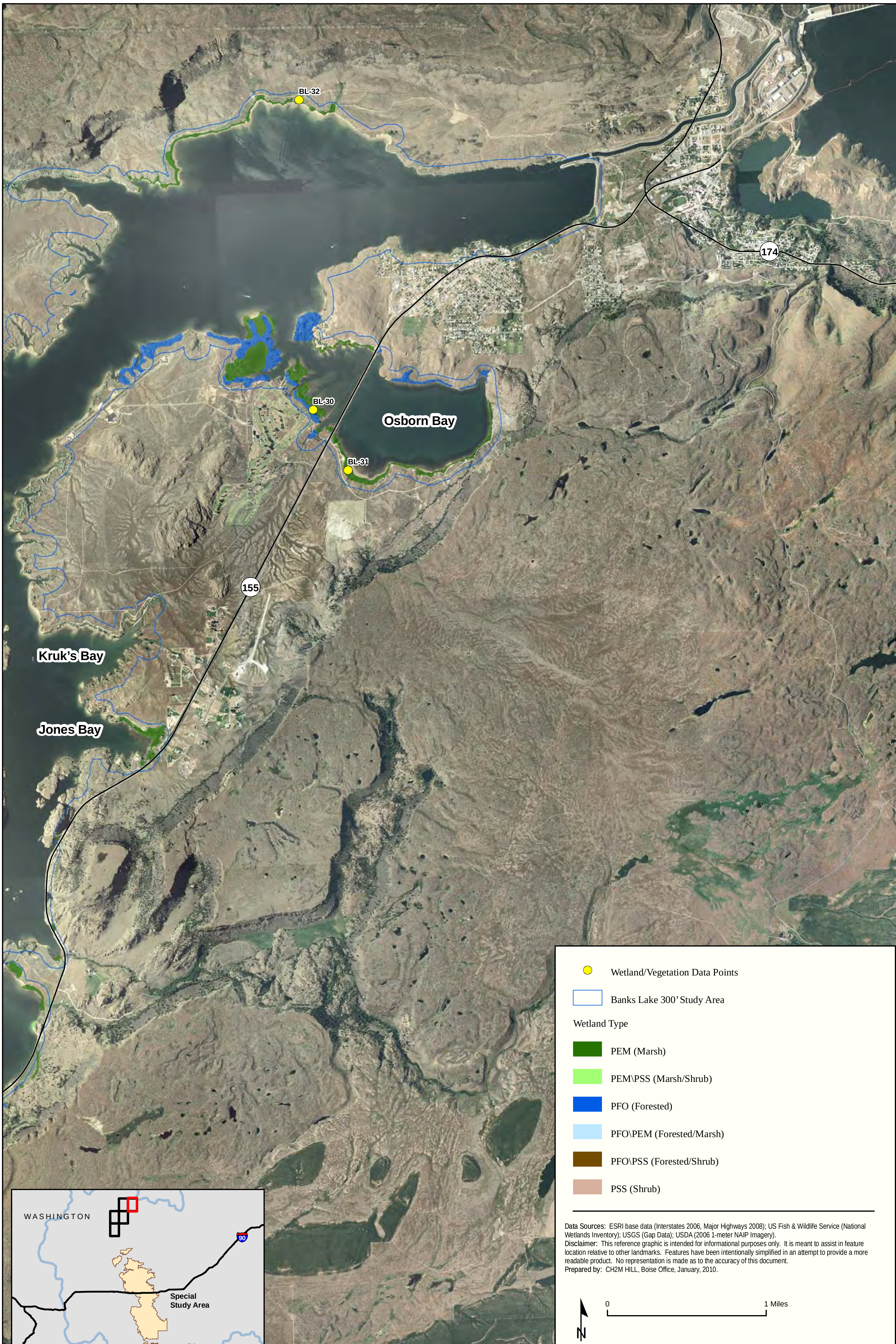

Odessa Subarea Special Study
Columbia Basin Project, Washington

Map 3-3e

Banks Lake Fringe Wetlands, Northeast

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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.

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 non-living 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 3-13

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)

TABLE 3-14

Wetland Function Descriptions

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, 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.

Source: Hruby 2007

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.

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 3-13 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.

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 (Hadfield and Magelssen 2004 as cited in 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 (Romme et al. 1997, as cited in 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 a 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).

TABLE 3-15

Study Area Wetland Categorization Based on Special Characteristics

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 (Zedler 1987 as cited in 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).

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. D*isjuncta*	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 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. 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 by 150 feet). The second occurrence was a very small population of 7 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 nonnative 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 water milfoil, 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 being evaluated by WDFW within the Study Area as part of this EIS. Field studies and habitat evaluations being conducted by the WDFW focus on five primary areas:

- Banks Lake
- East High Canal
- East Low Canal
- Black Rock Coulee Reregulating Reservoir
- Rocky Coulee Reservoir

The WDFW Banks Lake studies are focused on western grebes. Special status species presence and location data are being 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*, 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 additional inflow into Potholes Reservoir would result in less drawdown during August of some years under the full replacement alternatives. Changes during September would be very minor and no adverse impacts are expected. 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 Maps 3-3a through 3-3e. 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 Maps 3-3a through 3-3e.

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.

Reclamation (2004) noted nesting colonies of western grebes (*Aechmophorous occidentalis*) at Osborn Bay and Devils 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 Devils Punch Bowl. Tables 3-18 and 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 3-17

Wildlife of the Banks Lake Wetland and Riparian Zones and Reservoir Surface

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 (USFWS 2000 as cited in 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.
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 (USFWS 2000 as cited in 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.

Source: Reclamation 2004, WDFW 2010

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 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 very 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). Remaining 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 and Rocky Coulee.

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, RC, BRC, and BRC floodway.	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, RC, BRC, and BRC floodway. Expected to occur in suitable habitat.	2C, 2D, 3A, 3B, 3C, and 3D
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, RC, BRC, and BRC floodway. No formal surveys by WDFW. Expected to occur in suitable habitat.	2C, 2D, 3A, 3B, 3C, and 3D
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

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
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, RC, BRC, and BRC floodway.	2C, 2D, 3A, 3B, 3C, and 3D
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
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 BRC and Banks Lake.	All (Banks Lake)

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
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, BRC, and East Low Canal floodway portions of the Study Area.	All
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, 3C, and 3D
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 BRC flood storage have suitable nesting sites. Foraging habitat is available across the Study Area in sagebrush steppe.	3A. 3B, 3C, and 3D
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, BRC and East Low Canal portions of the Study Area. Suitable foraging habitat also exists in wetlands associated with Banks Lake.	All
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 BRC footprint.	3A. 3B, 3C, and 3D

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
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 BRC have suitable habitat.	Possibly 3A. 3B, 3C, and 3D
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 BRC aspen stand and treed areas along Banks Lake.	Low potential for all alternatives (Banks Lake)
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, RC, BRC, and BRC floodway 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, RC, East Low Canal and BRC floodway 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, 3C, and 3D

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
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)
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 BRC.	3A. 3B, 3C, and 3D
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 BRC floodway 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, RC, and BRC floodway portions of the Study Area. There is also suitable habitat in the BRC 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, BRC, and BRC floodway portions of the Study Area.	3A. 3B, 3C, and 3D
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

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
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, RC, East Low Canal, BRC, and BRC floodway 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, 2C, and 2D
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)
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 is present at a few areas along Banks Lake.	Very low potential for all alternatives (Banks Lake)

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
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. BRC 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 BRC 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 BRC. None were heard or observed, although survey conditions were marginal. Suitable breeding habitat occurs within the BRC footprint and in vegetated shallows around Banks Lake.	Potentially for 3A, 3B, 3C, and 3D (Black Rock Coulee)
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, RC, BRC, and BRC floodway.	2C, 2D, 3A, 3B, 3C, and 3D
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, RC, and BRC floodway segments.	All

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
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 BRC segments and marginal habitat occurs along the RC and the BRC floodway 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.

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://depts.washington.edu/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.

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 pre-settlement conditions. The WDFW 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 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 Odessa 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 Odessa 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 and 0.9 in Rocky Coulee. These values indicate 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 of 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 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

Non-vegetated 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 important to all of the snake species and about half of the lizard species of the Columbia Basin (Vander Haegen et al. 2001 cited in 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 Odessa 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 crop lands 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. The HSI value on agricultural lands in Rocky Coulee was 0.71. 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 Odessa 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 Odessa 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.

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 ground water 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 Odessa 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 Rocky Coulee and 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 Odessa analysis area are native shrub-steppe, especially in the northern part of the area.
Talus and Cliffs	Non-vegetated 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 non-breeding ranges such as mule deer moving between summer and winter range. 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, several of 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
- Proposed Rocky Coulee 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.

3.10.2 Columbia River

3.10.2.1 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 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 Biological Opinions 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 FCRPS Biological Opinion (NMFS 2008 BO), which dictates storage project operations. These actions are listed in Chapter 1, Table 1-3, *Mitigation Measures and Constraints on the Odessa Subarea Special Study Imposed by the FCRPS Biological Opinion*.

Considerable research has indicated that the benefit of flow augmentation for improving smolt survival is most evident in dry years. Consequently, NMFS has established minimum flow objectives from mid-April through August, as measured at several locations on the Columbia and Snake Rivers, to aid in the conservation of these anadromous salmonid populations (Table 3-22). The action alternatives were developed with the assumption that the anadromous fish flow objectives in the Columbia River (measured at Priest Rapids, McNary, and Bonneville Dams) would not be compromised.

The Federal agencies that operate the FCRPS, including Reclamation, BPA, and the Corps, are obligated under conditions outlined in the 2008 Biological Opinion (Reasonable and Prudent Alternative, Action 4, NMFS 2008 BO) to meet these flow objectives to the extent possible with available water storage. It is recognized, however, that these 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, it is anticipated that a Biological Assessment will be prepared for the preferred alternative.

3.10.2.2 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 3-22

Seasonal Flow Objectives and Planning 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

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
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: NOAA 2009

Steelhead Trout

Steelhead/rainbow 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, 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 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 Basin. There are many different seasonal "runs" or modes in adult Chinook salmon migration from the ocean to freshwater. Typically, spring Chinook spawn higher in the watersheds where they can gain access during the high snowmelt period. Fall Chinook generally spawn lowest in the watersheds.

In the upper Columbia River basin, spring Chinook typically spawn in August and September, summer Chinook in September and October, and fall Chinook in October and November. All spring Chinook spawn in upper tributaries of the Columbia River, most summer Chinook spawn in the mainstem Wenatchee, Methow and Okanogan rivers, and fall Chinook spawn primarily in the mainstem Columbia River. Most fall Chinook spawn in the free-flowing Hanford Reach of the Columbia River downstream of Priest Rapids Dam.

Upper Columbia River spring Chinook are ESA-listed as "endangered." Upper Columbia summer and fall Chinook 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 these Chinook populations 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 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).

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). 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 from either Lake Wenatchee or Lake Osoyoos in the Okanogan system. A much smaller number of sockeye 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 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. Coho salmon reintroduction efforts through hatchery planting have been attempted in the upper Columbia 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.

Prior to 2008, 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. However, The FCRPS agencies now use the 2008 Biological Opinion Reasonable and Prudent Alternative, Action 17 for chum salmon protection (NMFS 2008 BO). This alternative stipulates 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 extent 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.

3.10.2.3 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 Basin (Close et al. 1995). This species was petitioned for ESA listing in 2003. In December 2004, the USFWS determined that there is 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. 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 nearshore marine waters from Mexico through Canadian British Columbia. Aggregations of adult green sturgeon occur the Columbia River estuary and occasionally in the lower river up to Bonneville Dam primarily in the summer months (NMFS 2008 BO). 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, the National Marine Fisheries Service listed the Southern Distinct Population Segment (Mad River, California to Nass River, British Columbia) as a threatened species under the ESA (Federal Register Vol. 75, No. 52, March 18, 2010). 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 main-stem of the Columbia River has not been recorded upstream of 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).

3.10.2.4 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 non-native, and are of management concern because of their predation on juvenile salmonids, including those listed under ESA.

3.10.3 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 follows:

- 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 1,270 feet 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 follows:

- 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 follows:

- 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 follows:

- 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 2-5, *Lake Roosevelt Operations Common to All Alternatives*, lists operational goals for the reservoir, including for fish. Table 1-3, in Chapter 1, lists the mitigation measures and constraints imposed by the FCRPS Biological Opinion (NMFS 2008 BO). Water releases from the reservoir vary by water year type and are governed to a certain extent by biological flow objectives. These flow objectives have been established at downstream sites through various agreements and legal mandates to assist in the protection and recovery of anadromous fish populations in the Columbia River basin.

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*.

3.10.3.1 Fish Assemblage

Lake Roosevelt supports 30 species of fish (18 game and 12 non-game 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.

3.10.3.2 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
- Total dissolved gas 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.

3.10.4 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, 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.

3.10.4.1 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, 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 have been stocked every year since 1990 (Reclamation 2004). To date, this voluntary cooperative net-pen project has greatly improved angling success for rainbow trout, many of which are in the 2- to 3-pound range. Since 1996, kokanee also have been reared to fingerling and yearling size in net pens at Electric City and Coulee City.

3.10.4.2 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, non-vegetated 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 water line, 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. 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 3-6
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 nearshore 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. 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 3-7
Shallow unvegetated flats provide habitat for a variety of species at Banks Lake.

3.10.4.3 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 nearshore 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.

3.10.4.4 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, 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 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 entrained (17.8 percent of the total) compared to 1975 and 1976. In response to the relatively high entrainment rates, especially of adult kokanee, 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 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).

3.10.5 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 (slightly decreased drawdown), 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. No aquatic resources are present at the proposed Rocky Coulee Reservoir site.

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 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 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 listed salmonids entering the lower Columbia from the Willamette River and other estuarine tributaries, as well as the 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 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 Basin distinct population segment (DPS) of the pygmy rabbit as endangered (Federal Register [FR] 2001). The pygmy rabbit is the only 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 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 Basin pygmy rabbit population is genetically distinct and isolated from other pygmy rabbit populations in the Great Basin (FR 2003). Pygmy rabbit populations have declined severely in the Columbia 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 addendums (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 extensive 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). Surveys will be repeated by WDFW in 2010.

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.

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.

TABLE 3-24

Fish Species Listed Under the Endangered Species Act 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

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 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 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 non-anadromous *O. mykiss* co-occur with anadromous forms in the lower Columbia River tributaries (Busby et al. 1996). The relationship between non-anadromous 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 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, naturally 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 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 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. Typically, spring Chinook spawn higher in the watersheds where they can gain access during the high snowmelt period. Fall Chinook 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 are referred to as “stream-type” because the juveniles spend at least one full year rearing in freshwater before outmigrating as yearling smolts. Fall Chinook, 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 in the Snake River, however, are stream-type, and thus are often grouped with Snake River basin spring Chinook, 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 basin. Upper Columbia River basin spring Chinook typically spawn in August and September in upper tributaries. Spring Chinook smolts migrate seaward through the upper Columbia (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 was designated to include all river reaches accessible to 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 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 sub-basins: 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 sub-basins: 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 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 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 listed Snake River sockeye.

Sockeye 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 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 2008 Biological Opinion Reasonable and Prudent Alternative, Action 17 for chum salmon protection (NMFS 2008 BO). This alternative stipulates 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). The target elevation generally corresponds to a flow at Bonneville Dam of approximately 125,000 cfs, but subject to the other variables noted above. 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.

In February 2000, critical habitat for Columbia River chum was designated to include all river reaches accessible to 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 kilometer 144 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 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. The 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 Basin bull trout DPS throughout most of its range in 2005. The upper Columbia unit was included in the draft critical habitat designation in 2002 but was excluded in the 2005 final ruling.

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 gasses (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 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 [$PM_{2.5}$])). Primary and secondary NAAQS for these constituents are listed on EPA's web site (http://www.epa.gov/air/criteria.html). 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 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 ug/m^3 one time. No $PM_{2.5}$ exceedances have occurred. No PM_{10} data were available for this area.

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

TABLE 3-25

Maximum Measured Ambient Air Quality Monitoring Data in the Vicinity of the Analysis Area (µg/m3)

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
µg/m^3 = micrograms per cubic meter

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 Draft 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, *Alternatives Overview*). 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.

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.

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%
Percent of groundwater-irrigated land south of I-90 (to be provided with surface water under all action alternatives)	18%	96%	0%	100%
Percent of groundwater-irrigated land north of I-90 (to be provided with surface water under the full replacement alternatives 3A, 3B, 3C, 3D)	82%	4%	100%	0%

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 as follows:

- 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 non-agricultural 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.

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.

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 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 Supply Facilities (Rocky Coulee Reservoir—in Grant County and included in water supply options C and D for both Partial and Full Replacement alternatives)	43%	3%	54%

*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.

- **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 the following:

> *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 the following:

- *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

3.13.4.2 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 Ordinance 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 and Rocky Coulees (occurrences of wetlands and priority habitat).

3.13.4.3 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.

3.13.4.4 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 & Enhance Fish and Wildlife and Their Habitats.* Emphasis in the Plan is on State and Federal 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 effected 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 Resources

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 an overview of the types of reservoir-oriented recreation that take place at Banks Lake and Lake Roosevelt. It begins with a discussion of reservoir-oriented recreation within the middle and upper Columbia Basin, which illustrates the importance of Banks Lake and Lake Roosevelt within the regional network of reservoirs that provide water-oriented recreation. Following the regional overview is a description of the types of water-oriented recreational activities that take place at both Banks Lake and Lake Roosevelt.

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.

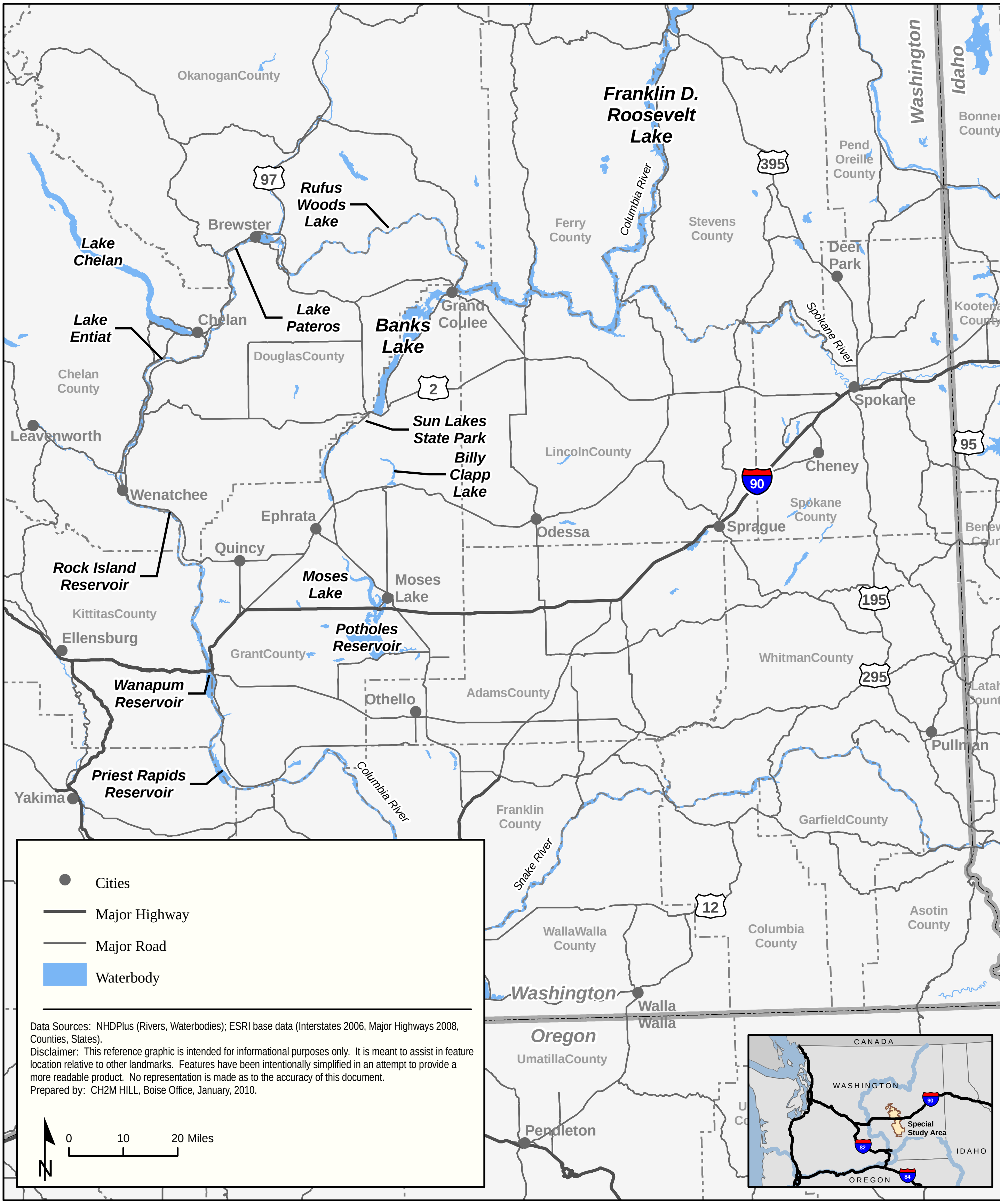
Map 3-4 and Table 3-28 show the major reservoirs and lakes in the mid- and upper Columbia region that provide recreational facilities. Recreation facilities and use patterns at these water bodies are fairly similar in that most provide boating access, many have developed camping and day use facilities 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 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 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.

Studies of reservoirs in the mid-Columbia 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 Banks Lake and Lake Roosevelt that are dependent upon access to water, or benefit from proximity to it, are 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).



Odessa Subarea Special Study
Columbia Basin Project, Washington

Map 3-4

Reservoirs That Provide Recreation Facilities in the Mid- and Upper Columbia Basin

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TABLE 3-28

Major Reservoirs and Lakes in the Mid- and Upper Columbia 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

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 water craft, 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 non-fishing 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.

Photograph 3-8
Boating docks at Banks Lake.

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 (Reclamation 2004). Low pool elevations have also resulted in areas off-shore 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.

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 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 gamefish 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 (both of which are stocked annually), burbot, and lake whitefish. The kokanee fishery has increased in popularity as the number of kokanee 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, Northup (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, Grand Coulee, or Coulee City).

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 drop offs 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 non-swimming 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 waters' 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 Draft EIS, sightseeing includes driving a vehicle, boating, and bicycle touring. These activities emphasize examining the scenery and take 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, Northup Point Access, Northup Canyon, and the Steam Boat 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 Draft 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 the WSPRC 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 Playground. 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: 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%)
September	42,734 (11%)
October	20,977 (5%)
November	25,501 (6%)
December	9,573 (2%)
Total	416,325

Source: Poplawski 2009

Reservoir-Oriented Recreation Facilities

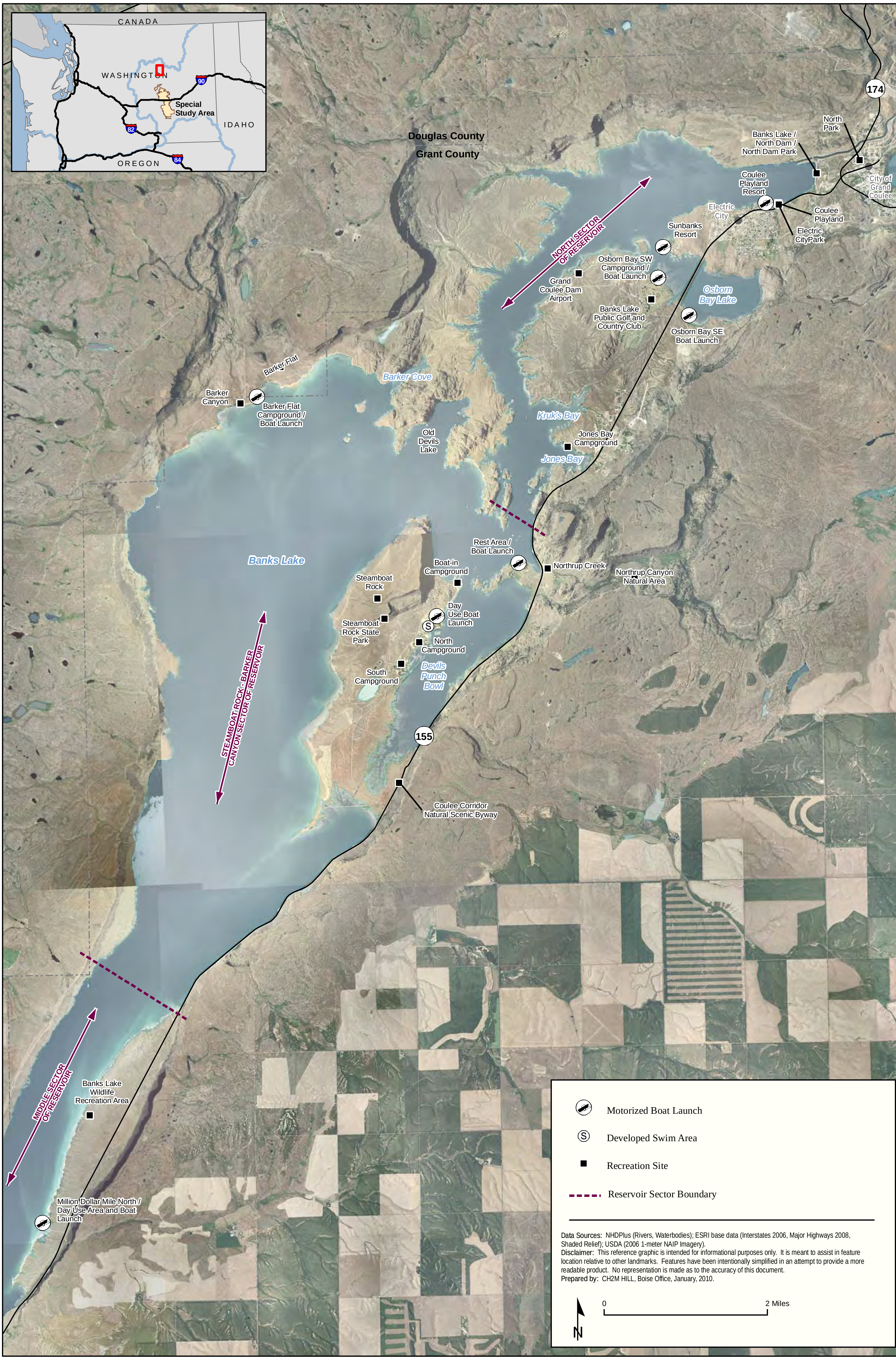
This section describes the recreation facilities that could be affected by the action alternatives. Some of the facilities are water-dependant and some are enhanced by a proximity to water. These facilities allow the general public and customers at privately managed recreational facilities to access and enjoy the waters and shoreline of Banks Lake. Table 3-31 provides information regarding these facilities and Maps 3-5 and 3-6 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 gravel
Million Dollar Mile North Boat Launch (WDFW)	Yes (1,565)	5%	No	No	Undefined sites		Launch ramp is graded
Steamboat Rocks/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 (WSPRC)	Yes (1,560)	10%	No	No			Launch ramp is 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



Odessa Subarea Special Study
Columbia Basin Project, Washington

Map 3-5
Banks Lake North, Recreation Facilities and Reservoir Sectors

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Odessa Subarea Special Study
Columbia Basin Project, Washington

Map 3-6
Banks Lake South, Recreation Facilities and Reservoir Sectors

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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 Maps 3-5 and 3-6. 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 SW 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 Maps 3-5 and 3-6:

- **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 SW 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 (Reclamation 2004) 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). 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.

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 Devils Lake/Lovers Lane, and along the Steamboat Rock peninsula's west shore (Reclamation 2004).

Photograph 3-9
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 water craft, 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 and white-tailed 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, beaver, muskrat, and rabbit are abundant. Developed trails in the Steamboat Rock State Park Recreation Area provide good wildlife viewing opportunities.

3.14.2.4 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 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 (FR 2004). 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 (FR 2004).

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 General Plan.

On lands owned by the Colville Confederated Tribes, recreation resources are managed under the Parks and Recreation Strategic Plan (Colville Tribes Department of Natural Resources 2009). Reservation recreation resources on the Spokane Tribe Reservation are managed by the Tribe's Department of Natural Resources (Colville Tribes Department of Natural Resources 2009).

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

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).

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

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 would be 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	

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
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	

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
Lower Columbia	--	--	--	--	6	Yes	
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 would function under all water years. In August, four would be usable and one (the Seven Bays Marina) would not be 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 can’t be used. By June, all swimming areas are generally functional, except in wet years when 7 of the 10 would be 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 would drop 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 non-camping 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.

3.14.3 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 sight-seeing 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 Study Area.

Because the vast majority of land in the Odessa Sub-Area 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 land owners and by the land owners 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; U.S. Department of Agriculture [USDA] 2010) for the state of Washington.

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. 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.

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.

TABLE 3-35

Census of Agriculture Number of Farms 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
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

TABLE 3-35

Census of Agriculture Number of Farms Data for the Four-County Analysis Area

	Adams	Franklin	Grant	Lincoln	Total
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: 1997, 2002, 2007 Census of Agriculture

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/acre. The average land value for Adams County was $745/acre in the 2002 Census of Agriculture, a 4.3 percent increase. In 2007, land values increased to $1,024/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: 1997, 2002, 2007 Census of Agriculture

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. 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.

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; however, GWMA disagreed with the results, finding that the published county-average yield for irrigated wheat, at 101.5 bushels per acre, was too low. This observation was confirmed by the Washington State University Farm Business Management Report EB2029E. Therefore, an average yield of 125 bushels per acre was used for irrigated wheat, based on GWMA's recommendation and substantiated by the published report. All other yields were used in the analysis, as reported in Table 3-38.

Prices received for the crops came from NASS (USDA 2010). The prices used for this analysis are in Table 3-39.

TABLE 3-37

Primary Irrigated Crop Acreages for the Four-County Analysis Area, 2004-2008

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

TABLE 3-38

Weighted County Average Yields by Crop, 2004-2008

Crop	Yield Unit	2004	2005	2006	2007	2008	Average
Irrigated Wheat	Bushels	91.6	108.3	102.4	103.6	N/A	101.5
Dryland Wheat	Bushels	32.9	28.9	43.6	35.6	N/A	35.3
Mixed Crops	Pounds	2,753.5	2,261.1	1,615.4	2,433.5	2,355.1	2,247.7
Potatoes	Cwt	590.4	626.2	588.7	624.2	627.6	611.4

Source: USDA 2010

TABLE 3-39

Prices Received by Crop, 2004-2008

		State Average Prices					
Crop	Yield Unit	2004	2005	2006	2007	2008	Average
Wheat	Bushel	$3.58	$3.21	$4.35	$7.51	$6.25	$4.98
Mixed Crops	Pounds	$0.245	$0.218	$0.229	$0.406	$0.308	$0.2812
Potatoes	Cwt	$4.90	$5.60	$6.00	$6.70	$7.95	$6.23

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 expected crop yield and irrigation wells. 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, that percentage split 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, came to 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.

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 3-40

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)

TABLE 3-41

The Four Representative Crops, the Combined GWMA 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 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 is 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.

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 $110.9 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 3-42
Well Levels, Acres Served by Each Well Level, and Rate of Decline by Well Level

Well 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%	

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%	15,495	611.4	$6.23	$59,020,796
Mixed Crops	38.2%	39,200	2,248	$0.2812	$24,779,794
Irrigated Wheat	41.7%	42,791	125	$4.98	$26,637,398
Dryland Wheat[1]	5.0%	5,131	35.3	$4.98	$451,000
Total		102,616			$110,888,988

The gross value of production for dryland wheat equals acres times price times yield times 0.5, because dryland wheat is only harvested on one-half the acres listed. The other half of the acres are 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.

3.15.2.2 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 IMPLAN (IMpact analysis for PLANning). 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 and discussed below.

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.

TABLE 3-44
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.

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.

3.16.2 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 Map 2-2 in Chapter 2. All interstate and state highways are under the jurisdiction of the WSDOT.

3.16.2.1 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).

3.16.2.2 State Highways

Two, two-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.

3.16.3 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. 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 3-10
Rural roads 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).

3.16.4 Railroads

Rail access to and within the Study Area is part of the Burlington Northern and 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 alternatives consist of the potential to alter regional and local energy balances. Additional withdrawals from the Columbia River may lead to lost hydroelectric generation potential and a possible reduction in regional energy supply and availability. Additional pumping requirements to deliver water through the new or modified canal system may increase the burden on local energy providers responsible for supplying energy resources.

3.17.1 Analysis Area and Methods

The analysis area for energy includes a higher-level examination of the Pacific Northwest region but focuses on the Study Area. Methods include providing an overview of regional energy management and surplus, and on creating an inventory of local energy providers and suppliers. Energy consumption data from a large groundwater pump test was also reported.

3.17.2 Energy Resources in the Pacific Northwest

Energy resources in the Pacific Northwest are managed by a variety of entities, including the BPA, Reclamation, the Corps, private suppliers, investor-owned utilities, and public utility districts. Water-derived energy is extremely important, as hydroelectric generation is estimated to provide approximately 81 percent of the total firm energy resources in the Federal system and 45 percent of the total firm energy resources in the Pacific Northwest. Firm energy is energy produced on a guaranteed basis. In hydroelectric generation, firm energy is the energy that can be reliably generated during the region's worst historical water conditions.

The regional supply and demand for energy in the Pacific Northwest is evaluated and summarized by the BPA in a document titled, Pacific Northwest Loads and Resources Study, commonly referred to as the "White Book." 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 2009 White Book provides a snapshot of both the Federal system and the Pacific Northwest region loads and resources for operating years 2010 through 2019. As a planning document, rather than an operations guide or revenue calculator, the White Book uses a conservative set of water data for Columbia River flows in projecting resource balance. A historic low water year (1937) is the base case used in the planning document, and for sensitivity analysis additional simulations are run using the averages of the lowest 10 percent, highest 10 percent, and middle 80 percent of years in the 70-year flow record (1929 to 1998). This approach is consistent in all planning years and is accepted by all participants in the Pacific Northwest energy planning process. In this energy evaluation, these energy industry standard scenarios are used rather than the wet, average, dry, and drought years used in remainder of the Draft EIS. Table 3-45 presents the projected total system surplus, determined by power studies performed by BPA, over the planning horizon under each flow scenario. These regional total surpluses are used to evaluate the impact of each of the alternatives. Where total system surplus under low water conditions is much larger than net energy demands from the various alternatives, it is unlikely that new generation would be added as a result. Thus, the impacts would be considered minimal. If net energy demands from the various alternatives are a substantial portion of the system surplus, and might require additional generating resources, the impacts would be considered adverse.

3.17.3 Energy Resources in the Study Area

3.17.3.1 Energy Supply

Energy is provided to customers in the Study Area by several different entities. Table 3-46 summarizes electrical service providers and their coverage areas.

TABLE 3-45
Summary of Regional Firm Energy Surplus (Average Annual Megawatts)

Operating Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Critical Low Water Conditions (1937)	2,968	2,375	2,289	1,778	1,553	1,218	1,142	680	626	277
Bottom 10% Water Conditions	2,998	2,403	2,317	1,807	1,581	1,247	1,170	708	655	306
Middle 80% Water Conditions	6,445	5,838	5,755	5,247	5,028	4,698	4,622	4,160	4,107	3,758
Top 10% Water Conditions	9,239	8,622	8,543	8,036	7,822	7,496	7,420	6,958	6,905	6,556

Source: BPA 2007

TABLE 3-46

Study Area Electrical Service Suppliers

County	Provider	Supplier	Notes
Adams	Avista	Grant County PUD Bonneville Power Administration (BPA) Portland General Electric (PGE) Avista owns eight hydroelectric projects located on the Spokane and Clark Fork Rivers, partial ownership of two coal-fired units in Montana, three natural gas-fired projects within its service territory, a natural gas-fired project in Oregon, and a biomass plant near Kettle Falls, Washington.	Avista expects an energy deficit beginning in 2011 (2014 with the Lancaster Plant).
Franklin	Big Bend Electric Cooperative	BPA	Big Bend Electric serves more than half the total area.
	Franklin County PUD	BPA Packwood Lakes Hydroelectric Project Columbia Storage Power Exchange	Franklin County PUD serves more than 80 percent of the population, and expects an energy surplus through 2013.
	Avista	BPA	
	Inland Power and Light	Primarily BPA, plus a small number of distributed generation facilities on its system.	
Grant	Grant County PUD	Grant County PUD, through the Electric System (Potholes East Canal and Quincy Chute Project), Priest Rapids Dam, and Wanapum Dam	
Lincoln	Avista	Grant County PUD BPA PGE Avista owns eight hydroelectric projects located on the Spokane and Clark Fork Rivers; partial ownership of two coal-fired units in Montana, three natural gas-fired projects within its service territory, a natural gas-fired project in Oregon, and a biomass plant near Kettle Falls, Washington.	Avista expects an energy deficit beginning in 2011 (2014 with the Lancaster Plant).
	Inland Power and Light	Primarily BPA, plus a small number of distributed generation facilities on its system.	

Sources: Avista Utilities 2007 Electric IRP; Inland Power & Light 2009; Franklin County 2008; Grant County 2009

3.17.3.2 Energy Consumption

In addition to residential, commercial, and industrial users, the suppliers listed in Table 3-46 also provide a large amount of energy to agricultural users who need energy to pump groundwater for irrigation. 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 was 0.000274 average megawatts (aMW) per acre.

3.18 Public Services and Utilities

Public services in the Odessa Special Study Area include law enforcement, fire protection, and emergency medical services. Utilities providers include electricity, natural gas, telecommunications, water supply (domestic and irrigation), 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 3-47 presents law enforcement, fire protection, and emergency medical services available in the Analysis Area.

TABLE 3-47

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 Lind Police Department Othello Police Department Ritzville Police Department Royal City Police Department	Ritzville Fire Department Royal City Fire Department Lind Town 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
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	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 service providers are listed in Table 3-46, *Study Area Electrical Service Suppliers*, in Section 3.17, *Energy Use*.

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 (L_{eq}), which is defined as the average noise level over a given period of time.

Table 3-48 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 3-48

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 area 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.

Another 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 final preferred alternative is selected and prior to construction. The potential of such discoveries was evaluated in this Draft EIS to compare the action alternatives.

3.20.2.1 Odessa Special Study Area

The agricultural environment of the Study Area, where project water delivery systems and the proposed 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, and 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 County Health District 2009).

3.20.2.2 Shoreline of Banks Lake

A database search for listed hazardous sites on lands adjacent to Banks Lake that would be exposed if the lake level elevation was lowered was conducted. 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 RMP (Reclamation 2001), a total of 12 leaking underground storage tanks (LUSTs) are present in the general area. All sites have contaminated soil, and only 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*, which was reviewed for this evaluation (Lake Roosevelt Forum 2009).

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 has contracted another study of 34 beaches from the Canadian Border to Grand Coulee Dam. Sampling began in September, 2009 and will continue in the spring of 2010. This study will address data gaps identified in previous studies and will be 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.

Risks from Airborne Sediments
Based on available data from the WSDOH, potential risks from inhalation of sediment-derived 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 is high during high wind conditions. WSDOH and USGS are continuing to conduct studies of 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, are 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 Map 1-1), 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 and 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 (for example, 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 Maps 3-5 and 3-6 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 is 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* (2001) and Grant County's *Shorelines Management Master Program* (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 are 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 man-made 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 Draft EIS alternatives. This Study Area encompasses approximately 278,300 acres.
- **Rocky Coulee Reservoir Site (included within the Study Area)**: Defined as the 8,960-acre area that Reclamation would acquire to develop, buffer, and manage the facility.
- **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 3-49.

TABLE 3-49

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
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 and Sharpe (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 include the Confederated Tribes of the Colville Reservation, the Spokane Tribe of Indians, the Confederated Tribes of the Umatilla Indian Reservation, the Coeur d'Alene Tribe, the Nez Perce Tribe, and the Yakama Nation. Although without a reservation, the Cowlitz Tribe also has traditional ties to lands in the area. Non-Federally recognized Tribes that have traditional ties to the area include the Wanapum Band and the Chinook Nation.

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).

Other Tribal Interests
Sections 3.23, *Indian Sacred Sites*, and 3.24, *Indian Trust Assets*, detail other Tribal interests in the analysis area.

3.22.2.2 Historic Setting
Euro-Americans began exploration of the Columbia Basin in 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 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 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 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 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, including the Rocky Coulee Reservoir Site

Existing data for the Study area at proposed water system features includes 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 only the Rocky Coulee Reservoir site contains a high probability for both pre-contact and 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, 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 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 by Stevens (1999, as cited in Reclamation 2004), Hamilton and Hicks (2000 and 2002, as cited in Reclamation 2004), and Engseth (2003, as cited in Reclamation 2004). There are 673 archaeological sites recorded on Reclamation-managed lands. Of that total, 66 pre-contact sites, 3 historic sites, and 2 multi-component 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 Land 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).

3.22.4 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. The site where Rocky Coulee Reservoir would be built in some alternatives is also included in the predictive model. Banks Lake and Lake Roosevelt are not 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 decision-making. 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.

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 or the Rocky Coulee Reservoirs would be sited.

As part of research for this Draft 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 the following:

- 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.
- The site of the Rocky Coulee Reservoir has a high potential for historic resources associated with agricultural farmsteads.

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 3-50. 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 3-50

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 Waste-way**	**Northern Study Area (North of I-90)**	**Southern Study Area (South of I-90)**	**Black Rock Coulee Reregulating Reservoir**	**Rocky Coulee 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	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	Moderate probability for pre-contact resources overall; localized high probability for 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	Localized small areas of high historic probability; otherwise, low probability for pre-contact & historic resources

TABLE 3-50

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 Waste-way**	**Northern Study Area (North of I-90)**	**Southern Study Area (South of I-90)**	**Black Rock Coulee Reregulating Reservoir**	**Rocky Coulee 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	Majority at low, western-most end at high, and eastern-most end at moderate probability for pre-contact and historic resources
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	Majority at 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	No data
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	High pre-contact and historic probabilities

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. 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.

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.

3.24 Indian Trust Assets

Indian Trust Assets (ITAs) are legal interests in property held in trust by the U.S. 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. 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 Nez Perce Tribe, and the Confederated Tribes of the Colville Indian. Additionally, the Wanapum, a non-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) and potential impacts to the Columbia River (Colville). Additionally, both tribes have cultural ties to the Columbia 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 project 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 project area does not include lands publically withdrawn or held in trust by the United States for tribes or individual allottees, nor does the project area include trust land. Reclamation owned property in the Columbia Basin was not withdrawn or ever considered open and unclaimed. Instead, property was purchased from private individuals for Columbia Basin Project 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 the following (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 decision making 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, low-income populations, and Native American tribes—could be impacted by the No Action Alternative or the action alternatives, either because of a decision to provide or not provide replacement irrigation supply, or resulting from facility development or modification.

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).

Environmental justice concerns were evaluated relative to the potential impacts that may be incurred by minority or low-income populations in the area as a result of implementing any of the action alternatives.

3.25.2 Race and Ethnicity for the Analysis Area

Table 3-51 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 3-51, none of the individual minority races for the four counties were above the 50 percent threshold in 2000, indicating a minority population pursuant 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.

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 3-52 provides income, poverty, unemployment, and housing data for the counties of Adams, Franklin, Grant, and Lincoln, as well as for the State.

TABLE 3-51

Race and Ethnicity in 2000 for the Counties of Adams, Franklin, Grant, and Lincoln, and the State of Washington

Parameter	Adams County	Franklin County	Grant County	Lincoln County	Washington State
Total population	16,428	49,347	74,698	10,184	5,894,121
Racial minorities					
Number	5,756	18,794	17,524	444	1,072,298
Percent	35.0	38.1	23.5	4.4	18.2
Hispanic or Latino (any race)					
Number	7,732	23,032	22,476	191	441,509
Percent	47.1	46.7	30.1	1.9	7.5

Source: U.S. Census Bureau 2000

As shown in Table 3-52, all four counties have a much lower median family income and 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 is much higher in Adams, Franklin, and Grant counties than in the State. These facts triggered a block group analysis to evaluate potential impacts.

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 therefore, potentially impacts to populations in poverty. Also, the action alternatives for both partial and full replacement would include this area, south of I-90.

TABLE 3-52

Income, Poverty, Unemployment, and Housing in 2000 for the Counties of Adams, Franklin, Grant, and Lincoln, and the State of Washington

Parameter	Adams County	Franklin County	Grant County	Lincoln County	Washington State
Median family income (1999)	$37,075	$41,967	$38,938	$41,269	$53,760
Per capita income (1999)	$13,534	$15,459	$15,037	$17,888	$22,973
Families below poverty level					
Number	566	1,807	2,458	249	110,663
Percent	13.6	15.5	13.1	8.4	7.3
Individuals below poverty level					
Number	2,951	9,280	12,809	1,260	612,370
Percent	18.2	19.2	17.4	12.6	10.6
Percent unemployed	8.7	10.8	11.7	6.2	6.2
Housing percent with 1.01 or more occupants per room	14.4	18.6	12.4	1.9	5.1
Housing percent lacking complete plumbing facilities	0.3	0.6	0.8	0.4	0.5

Source: U.S. Census Bureau 2000

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.

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.

What Area is Affected?

Distinct geographic areas are involved with analyzing the alternatives, as shown in Map 1-1, *Location Map*, and described in Figure 1-1, *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.

- **Impact Analysis.** Each alternative is evaluated in turn, as follows:
  - Alternative 1: No Action Alternative
  - Alternative 2A: Partial—Banks
  - Alternative 2B: Partial—Banks + FDR
  - Alternative 2C: Partial—Banks + Rocky
  - Alternative 2D: Partial—Combined
  - Alternative 3A: Full—Banks
  - Alternative 3B: Full—Banks + FDR
  - Alternative 3C: Full—Banks + Rocky
  - Alternative 3D: Full—Combined

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 4.26, *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: Violates 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.
- Cumulative Impacts (applicable only to the action alternatives): Perspectives on other actions in the analysis area that could have similar impacts and could add to those expected with action alternatives.

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 all partial replacement alternatives and are focused on expanding the East Low Canal. Likewise, all of the full replacement alternatives would involve development of the East High Canal system north of Interstate Highway 90.

Within these two broad groups of partial and full replacement alternatives, the alternatives vary only in the source of the water supply, such as Banks Lake, Lake Roosevelt, and potential construction of the Rocky Coulee Reservoir. Therefore, in many environmental topics, the impact analysis related to the water delivery system is presented only for Alternatives 2A: Partial—Banks, and 3A: Full—Banks, with discussions of other alternatives incorporating that analysis by reference. The same is true of alternatives that would involve construction of Rocky Coulee Reservoir. Alternatives 2C: Partial—Banks + Rocky, 2D: Partial—Combined, 3C: Full—Banks + Rocky, and 3D: Full—Combined, all include this new reservoir, so the related impact analysis is generally presented only under Alternative 2C: Partial—Banks + Rocky and referenced under the other three alternatives. In all cases, differences from previously described impacts are discussed.

Finally, beyond the 24 individual resource topics, this chapter includes the following discussions as required by NEPA and SEPA:

- 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, mitigation measures, and cumulative impacts 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
- Major reservoirs
- 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 Lake Roosevelt, flows would not change in the Columbia River, and Banks Lake operation would not change.

Changes in reservoir drawdowns under some of the action alternatives would affect surface water quantity. By themselves, these effects on water quantity are neither positive nor negative. However, reductions of reservoir water surface elevations because of additional drawdowns could impact several other 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*; and 4.14, *Recreation Resources*.

The Columbia River would experience slight 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 or August. Surface water quantity would be minimally impacted by all of the action alternatives. Instream flow requirements would not be impacted by any of the action alternatives.

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.

Climate change effects were investigated for all action alternatives. Under the four representative water year conditions (wet, average, dry, and drought), the two climate change scenarios resulted in no additional reservoir drawdown in Lake Roosevelt or Banks Lake for any of the action alternatives. The climate change scenarios would result in additional Columbia River flow changes, ranging from an increase or decreasing almost 3 percent, for Alternative 2D: Partial—Combined, as well as the full replacement alternatives.

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 Resources Impact Indicators and Significance Criteria

Impact Indicator	Significance Criteria
Instream flow requirements	Compliance with requirements 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*, and 4.14, *Recreation 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, threatened or endangered fish, recreation, vegetation, or wildlife habitat, are addressed in those sections of the Draft EIS. The impacts of changes in reservoir water surface elevations 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*, and 4.14, *Recreation Resources*. No further reference to those sections is made in this Chapter.

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.

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 Draft EIS, alternatives are compared based on four projected basin-wide precipitation conditions:

- **Wet year:** approximately 10 percent of years would be this wet or wetter (within the hydrologic record, 1982 was selected as being representative of these conditions)
- **Average year:** approximately 50 percent of years would be wetter and 50 percent drier (1995 was selected as the representative year)[1]
- **Dry year:** approximately 15 percent of years would be this dry or drier (1998 was selected as the representative year)
- **Drought year:** approximately 5 percent of years would be this dry or drier (1931 was selected as the representative year)

Use of historical hydrologic data to evaluate likely future hydrologic and system operation patterns relies on the assumption that future hydrologic conditions would be similar to those observed in the 1929 to 1998 period of record that was used as the basis for modeling. However, other water years would not be identical to these four representative years. These results are not predictions of hydrologic conditions over the life of the Odessa Special Study alternatives, but are indicative of likely patterns of water operations and hydrology assuming no major change occurs relative to historical hydrologic patterns. Given the length and variety of hydrologic conditions in the record, it is reasonable to use this information to make future predictions.

The representative years chosen for the analysis are different than years referenced in previous SEPA documents prepared by Ecology (2008, 2007), which reference representative years as recent as 2003. However, the analyses presented in this document are limited to data from 1929 through 1998 because additional information is not yet available from HYDSIM modeling.

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 watershed year for water supply.

[1] Under current (No Action) operations, Lake Roosevelt end of August draft is dependent on the water supply forecast at The Dalles. When the water supply forecast volume is 99 percent of average or higher (between 50 and 60 percent of water years), Lake Roosevelt is drafted 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 99 percent (approximately 40 to 50 percent of water years), Lake Roosevelt is drafted at least 13 feet from full.

Lake Roosevelt

A spreadsheet analysis used for comparison of alternatives considers the interaction of Lake Roosevelt, Banks Lake, and downstream Columbia River flows to determine the effects of each alternative on Lake Roosevelt. A difference in pumping to Banks Lake between the No Action Alternative and each action alternative was calculated. The differences in pumping were applied to the BPA's HYDSIM model for Lake Roosevelt storage under the No Action Alternative to determine the effects of providing water for each alternative. The effects were carried from year-to-year to determine the long-term effects of each alternative on Lake Roosevelt.

Columbia River

To determine when water could be diverted from the Columbia River, the 2006 PASS hydrologic model analysis was updated. The model analysis is based on the output data from BPA's HYDSIM model for the FCRPS and includes all major dams on the mainstem Columbia River and its major tributaries.

Hydraulic modeling of alternatives assumed that water from the Columbia River would not be diverted unless flows exceeded ESA flow objectives for anadromous fish identified by NMFS (NMFS 2008). Consistent with State water law, hydraulic modeling also assumed that no new diversions would occur in July and August without a replacement water supply.

To calculate when Columbia River flows exceed ESA flow objectives, HYDSIM model output and historic data were compared to the ESA flow objectives on the Columbia River at Priest Rapids, McNary, and Bonneville dams. Columbia River water available for diversion to the CBP was then calculated as the average monthly flow in excess of ESA flow objectives.

Banks Lake

The effect of each alternative on Banks Lake was calculated using a spreadsheet analysis. The difference between pumping from Banks Lake in the HYDSIM model under the No Action Alternative and the pumping from Banks Lake for each action alternative was calculated. This difference was used to determine the effects of each alternative's pumping scenario on the storage and surface elevation of Banks Lake.

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 inflow data set of available flows from the Columbia River for the period 1929 to 1998 in combination with Crab Creek inflows for the Irby gage 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.

The additional inflow into Potholes Reservoir would result in less drawdown during August of some years under the full replacement alternatives. Changes during September would be very minor and no adverse impacts are expected. Water levels and operations of Moses Lake would not be expected to change under the action alternatives. Therefore, those systems were not further evaluated.

Climate Change Analysis

The impacts analysis considers two separate modeling scenarios that represent conditions projected under climate change assumptions in the year 2040: “2040_A1B” and “2040_B1”. These climate change scenarios were supplied by the Climate Impact Group (CIG) at the University of Washington. A brief description of conditions associated with each scenario follows.

How Is Climate Change Evaluated for the Study Alternatives?

It is generally understood that climate change would impact reservoirs and the Columbia River. This analysis evaluates how impacts resulting from each of the action alternatives would be affected by climate change.

The 2040_A1 scenario family assumes very high economic growth, global population peaking at about middle of the 21st century and then declining, and energy needs being met by a balance of fossil fuels and alternative technologies. A1B (a subset of the A1 family) lies near the high end of the spectrum for future greenhouse gas (GHG) emissions, particularly through mid-century. A1B projects a future where technology is shared between developed and developing nations to reduce regional economic disparities.

The 2040_B1 scenario family lies near the lower limit of projected changes in GHG emissions. The B1 scenario assumes global population growth peaks by the middle of the 21st century and then declines, a rapid economic shift towards service and information economies, and the introduction of clean and resource-efficient technologies.

The projected change in climate was the average of multiple climate models run with these two emission scenarios in a monthly time step for the period 1929 through 1998. The results of the climate change scenarios (temperature and precipitation) were input to the University of Washington’s Variable Infiltration Capacity (VIC) hydrological model of the Columbia River to estimate watershed runoff. Watershed runoff for each scenario was used to determine inflows and local flows for the Columbia system.

These changes in inflows were input into CIG’s Columbia River reservoir model (ColSim), which emulates the regulation of reservoirs on the Columbia System. The ColSim model output included flows on the Columbia for a base case with no climate change and the flows of each for the two climate change scenarios (A1B and B1). Using the output from the ColSim model, spreadsheets were developed to quantify the change in flow between the climate change scenarios and the base case for Priest Rapids, McNary, and Bonneville dam outflows. The spreadsheets quantify the difference in projected flow at each of the three locations when comparing the climate change scenarios to the base case without climate change. The data sets include monthly values from 1917 to 2006.

Changes in Columbia River flows for scenarios A1B and B1 were applied to the HYDSIM model base case (no climate change) to quantify the HYDSIM flow rates with climate change at Priest Rapids, McNary, and Bonneville dams under each scenario. Flows in excess of target flows on the Columbia River at these locations are considered by the Agencies to be available for diversion from the river. Three time-series data sets define the volume of water available to pump from the Columbia River, and consist of the base case (no climate change) and the two climate change scenarios (A1B and B1).

For each of the Odessa Special Study alternatives (No Action Alternative and eight action alternatives), the three time series data sets for water supply from the Columbia River (base case, A1B, and B1) were evaluated to predict changes in flow in the Columbia River. Results from these analyses have been used to predict and compare the impacts of climate change on flows under the action alternatives. RiverWare modeling of surface water features in the CBP does not include any changes projected for the two climate change scenarios.

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 Requirements 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*. Seasonal flow objectives for the Columbia River to aid downstream juvenile salmonid passage and to accommodate returning adults are identified in the NMFS Biological Opinion for the FCRPS (NMFS 2008 BO). Additional Columbia River diversions require NEPA compliance and ESA consultation. VRAs, established in RCW 90.90.030, limit withdrawals during July and August to mitigate potential instream flow impacts.

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 4.29, *Environmental Commitments*.

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 Figures 4-1 and 4-2. These figures show representative wet, average, dry, and drought watershed conditions.

4.2.2.1 Short-Term Impacts

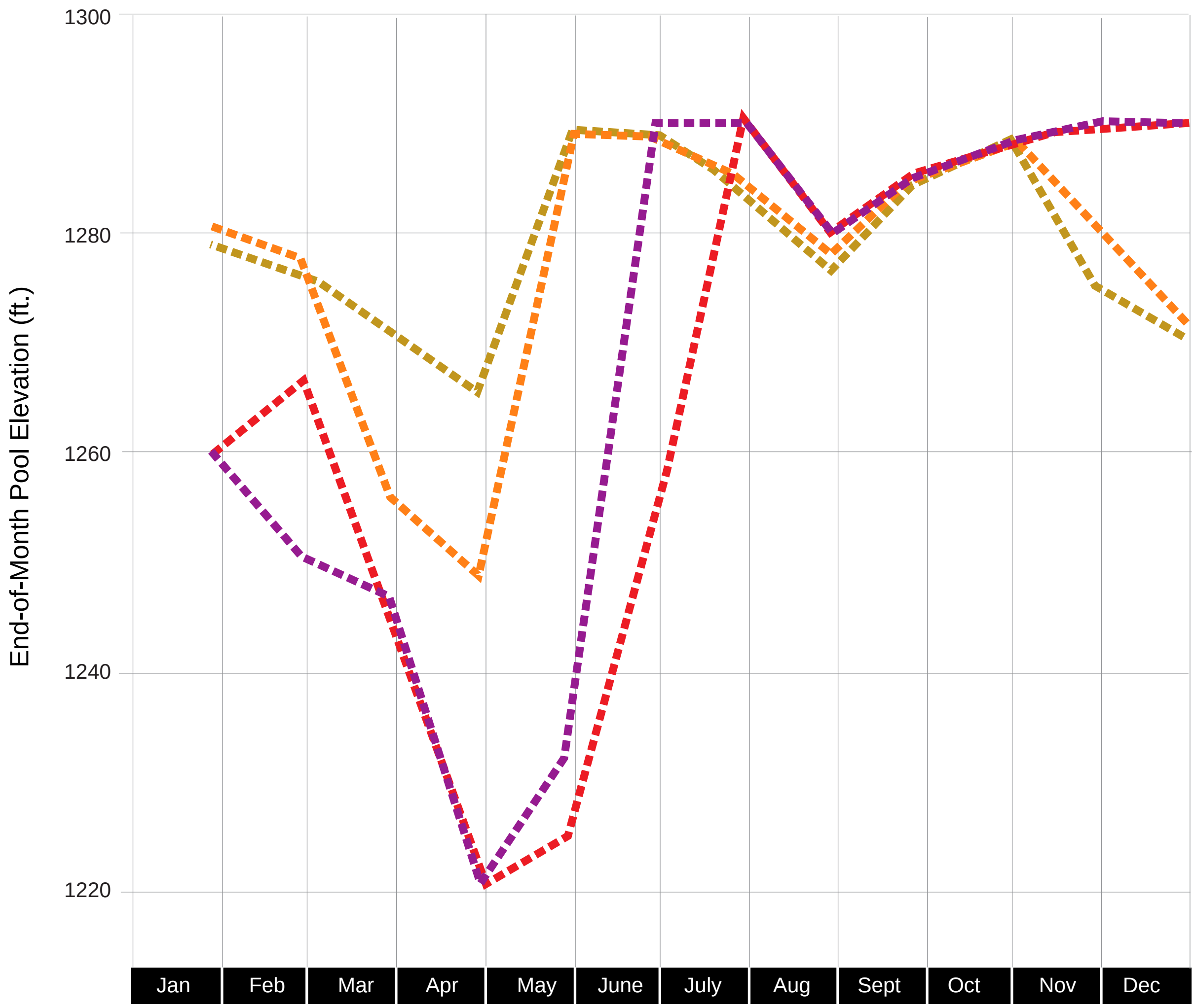
No short-term impacts are anticipated because no new facilities would be constructed under this alternative.

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

Figure 4-3 and Table 4-2 illustrate the annual drawdown pattern at Banks Lake for Alternative 2A: Partial—Banks in representative wet, average, dry, and drought conditions; data portraying how this pattern differs from No Action are also provided. As shown, Alternative 2A: Partial—Banks would result in an additional drawdown of 3.4 feet at Banks Lake 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 8.4 feet at the end of August.



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 December end points should not be expected to "match up" with the January 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.

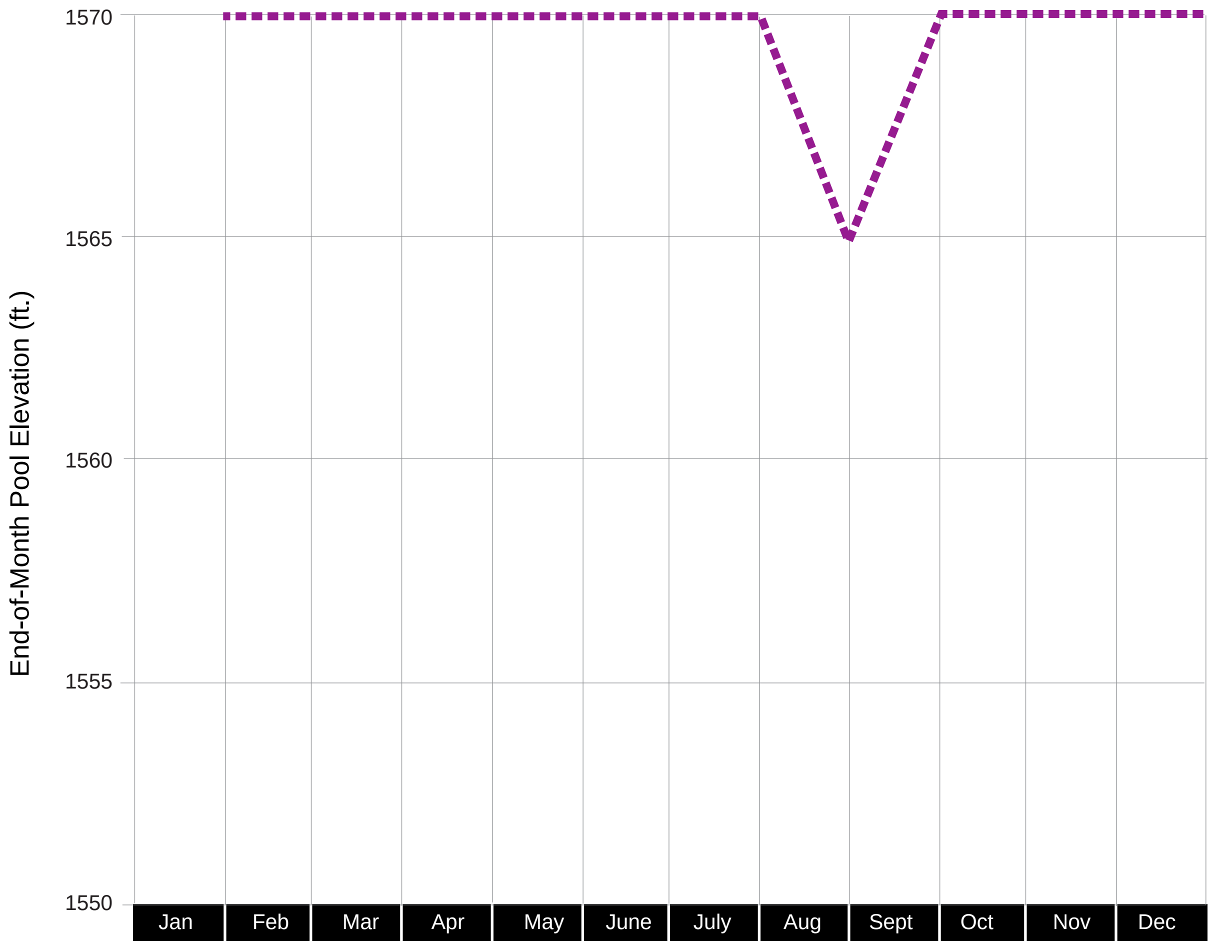
LEGEND

- No Action - Average Year
- No Action - Wet Year
- No Action - Dry Year
- No Action - Drought Year

Odessa Subarea Special Study
Columbia Basin Project, Washington

Figure 4-1
No Action Alternative
Lake Roosevelt Drawdown (feet)

WB082009003BOI



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 (described in Section 4.2.1.2); not all wet, average, dry or drought years would be the same as those shown.

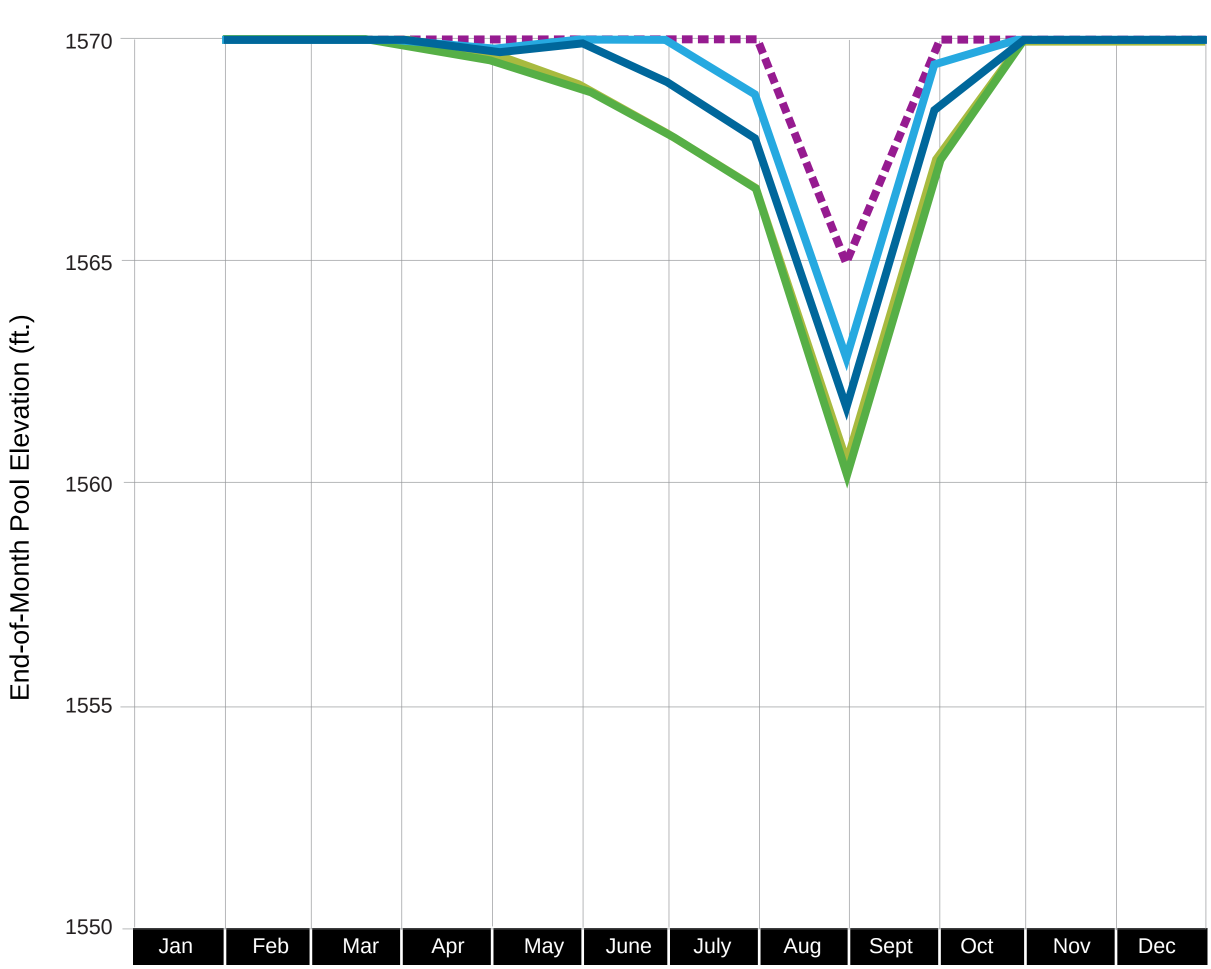
LEGEND

No Action - Average, Wet, Dry, and Drought Years

Odessa Subarea Special Study
Columbia Basin Project, Washington

Figure 4-2
No Action Alternative
Banks Lake Drawdown (feet)

WB082009003BOI



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 (described in Section 4.2.1.2); not all wet, average, dry or drought years would be 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

Figure 4-3
Banks Lake Drawdown (feet) for Alternative 2A: Partial - Banks

TABLE 4-2
Banks Lake Drawdown (feet) for Alternative 2A: Partial—Banks

Condition	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
No Action Alternative	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0
Wet Year												
Total Drawdown	0.0	0.0	0.0	0.2	0.0	0.0	1.2	7.3	0.6	0.0	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.2	0.0	0.0	1.2	2.3	0.6	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Average Year												
Total Drawdown	0.0	0.0	0.0	0.2	0.0	1.0	2.2	8.4	1.6	0.0	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.2	0.0	1.0	2.2	3.4	1.6	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Dry Year												
Total Drawdown	0.0	0.0	0.0	0.4	1.1	2.1	3.3	9.8	2.8	0.0	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.4	1.1	2.1	3.3	4.8	2.8	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Drought Year												
Total Drawdown	0.0	0.0	0.0	0.4	1.1	2.1	3.3	9.6	2.6	0.0	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.4	1.1	2.1	3.3	4.6	2.6	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*

Drawdowns represent end-of-month levels for all months.

4.2.3.1 Short-Term Impacts

No short-term impacts to Lake Roosevelt, the Columbia River, or Banks Lake are anticipated for this alternative, nor 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.
- Construction of new on-channel facilities would interrupt flow patterns in the various ephemeral drainages.

4.2.3.2 Long-Term Impacts

Columbia River

Implementation of this alternative would reduce flow in the Columbia River downstream of Lake Roosevelt. Reductions in flow are projected only when average monthly flow exceeds flow objectives set for the Columbia River. September flow reductions were limited to 1,000 cfs. October through June flow reductions were limited to 2,200 cfs. Table 4-3 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.

TABLE 4-3

Differences in Columbia River Flows for the Partial Replacement Alternatives Compared to the No Action Alternative

	Change in Average Monthly Flow Rate Compared to No Action Alternative for Modeled Representative Water Years (cfs)											
Alternative	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
2A: Partial—Banks												
Wet	-353	0	0	0	0	41	-76	-431	-459	0	0	-1000
Average	-1299	0	0	0	0	41	-75	-427	0	0	0	-1000
Dry	-1321	0	0	0	0	41	0	0	0	0	0	-1000
Drought	-1218	0	0	0	0	41	0	0	0	0	0	-1000
2B: Partial—Banks + FDR												
Wet	-1413	0	0	0	0	0	0	0	0	0	0	-885
Average	-1415	0	0	0	0	0	0	0	0	0	0	-880
Dry	-1418	0	0	0	0	0	0	0	0	0	0	-898
Drought	-1407	0	0	0	0	0	0	0	0	0	0	-840
2C: Partial—Banks + Rocky												
Wet	-1009	0	0	0	0	41	-30	-215	-459	4	2	-947
Average	-1439	0	0	0	0	41	-29	-214	3	4	2	-1000
Dry	-1443	0	0	0	0	41	3	14	3	4	0	-1000
Drought	-1408	0	0	0	0	41	12	27	3	4	1	-1000
2D: Partial—Combined												
Wet	-1212	0	-1051	0	0	0	0	0	0	0	0	-1000
Average	-1077	0	0	-1151	-189	0	0	0	0	0	0	-1000
Dry	-1540	0	0	0	0	-863	0	0	0	0	0	-1000
Drought	-1215	0	0	0	0	0	0	0	0	0	0	-1000

*Negative values indicate reduced flow.

Compared to the No Action Alternative, the maximum projected reduction in flow would occur in October. There would be no reduction in flow during July and August.

The difference in flow would be very small and represents 1.9 percent of the total Columbia River flow rate below Grand Coulee Dam during October. Flow rates would comply with instream flow objectives specified for the Columbia River. Minimal impacts would occur as a result of the projected reduction in flow in the Columbia River for any of the representative water year projections.

Banks Lake

Implementation of this alternative 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 on Figure 4-3 and Table 4-2.

Other Surface Water Features

Implementation of this alternative is 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 result from inundation, overtopping, or scour of an existing waterway, coulee, or other receiving water body that historically received much smaller or less frequent flows.
- 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 2 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, Potholes Canal, Lind Coulee Wasteway, 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.

Photograph 4-1.
Surface water features in the analysis area would be impacted to some extent by all of the action alternatives, and flows would increase in many of the major canals, diversions, channels, and wasteways.

Climate Change Analysis

Based on analysis of the four representative conditions (wet, average, dry, and drought), climate change scenarios A1B or B1 would not affect the water available for implementation of this alternative. Therefore, climate change would not result in additional reservoir drawdown in Lake Roosevelt and Banks Lake or additional flow reductions in the Columbia River for the years analyzed, and there would be no additional impact. Other surface water features in the CBP were not included in the climate change analysis.

4.2.3.3 Mitigation

Mitigation is not required because no impacts are expected.

4.2.3.4 Cumulative Impacts

No cumulative impacts are anticipated for the Columbia River, Lake Roosevelt, or Banks Lake under this alternative. The Lake Roosevelt Incremental Storage and Release Program (Ecology 2008) has already been assumed in the baseline (No Action Alternative) for the Odessa Subarea Special Study. Similarly, the Reasonable and Prudent Alternatives contained in the 2008 FCRPS Biological Opinion (NMFS 2008 BO), including the 5-foot Banks Lake drawdown and the Columbia River flow objectives, have been incorporated into the Study as part of the baseline or as constraints to the development of the action alternatives.

The Potholes Supplemental Feed Route project is designed to be water budget neutral, meaning there would be no impact on Columbia River flows. Elements of the Walla Walla River Storage and Pump Exchange Studies and the Umatilla Basin Aquifer Recovery would divert water from the Columbia River or its tributaries to improve local irrigation water supplies and instream flows, but these diversions would also be required to meet the Columbia

River flow objectives. Similarly, none of the VRAs would reduce or negatively impact Columbia River ESA flows during July and August. These actions would have to meet the Columbia River flow objectives as a constraint of their enactment, which assures that there would be no cumulative impacts on the Columbia River.

Surface water features in the analysis area, including Crab Creek, could experience cumulative impacts when the Potholes Supplemental Feed Route project is fully implemented in the near future. The Feed Route would use Crab Creek to convey water from Pinto Dam to Potholes Reservoir. Should large flows be introduced to Crab Creek, significant changes to the system's geomorphology and sediment transport capacity are possible. However, because the actions associated with Alternative 2A: Partial—Banks would only cause minor changes to Crab Creek flows, the relative contribution of potential alteration from this alternative is negligible. Any increase in return flows from the action alternatives of this Study would be offset by reduction in feed from Brook Lake. Any effects on Brook Lake are addressed in the Potholes Supplemental Feed Route EA (Reclamation 2007 EA).

4.2.4 Alternative 2B: Partial—Banks + FDR

Figures 4-4 and 4-5 illustrate the annual drawdown patterns at Banks Lake and Lake Roosevelt, respectively, for Alternative 2B: Partial—Banks + FDR in representative wet, average, dry, and drought conditions. Data portraying how these patterns differ from the No Action Alternative are also provided.

As shown on Table 4-4, Alternative 2B: Partial—Banks + FDR would result in an additional drawdown of 3 feet at Banks Lake 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 drawdown would be 8 feet at the end of August. The additional drawdown at Lake Roosevelt in August of an average year, as shown on Table 4-5, would be 0.5 feet beyond the No Action Alternative drawdown of 11.0 feet, bringing the total drawdown under Alternative 2B: Partial—Banks + FDR to 11.5 feet.

TABLE 4-4

Banks Lake Drawdown (feet) for Alternative 2B: Partial—Banks + FDR

Condition	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
No Action Alternative	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0
Wet Year												
Total Drawdown	0.0	0.0	0.0	0.4	1.1	2.1	3.0	8.0	3.0	0.0	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.4	1.1	2.1	3.0	3.0	3.0	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Average Year												
Total Drawdown	0.0	0.0	0.0	0.4	1.1	2.1	3.0	8.0	3.0	0.0	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.4	1.1	2.1	3.0	3.0	3.0	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*

TABLE 4-4

Banks Lake Drawdown (feet) for Alternative 2B: Partial—Banks + FDR

Condition	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Dry Year												
Total Drawdown	0.0	0.0	0.0	0.4	1.1	2.1	3.0	8.0	3.0	0.0	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.4	1.1	2.1	3.0	3.0	3.0	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Drought Year												
Total Drawdown	0.0	0.0	0.0	0.4	1.1	2.1	3.0	8.0	3.0	0.0	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.4	1.1	2.1	3.0	3.0	3.0	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*

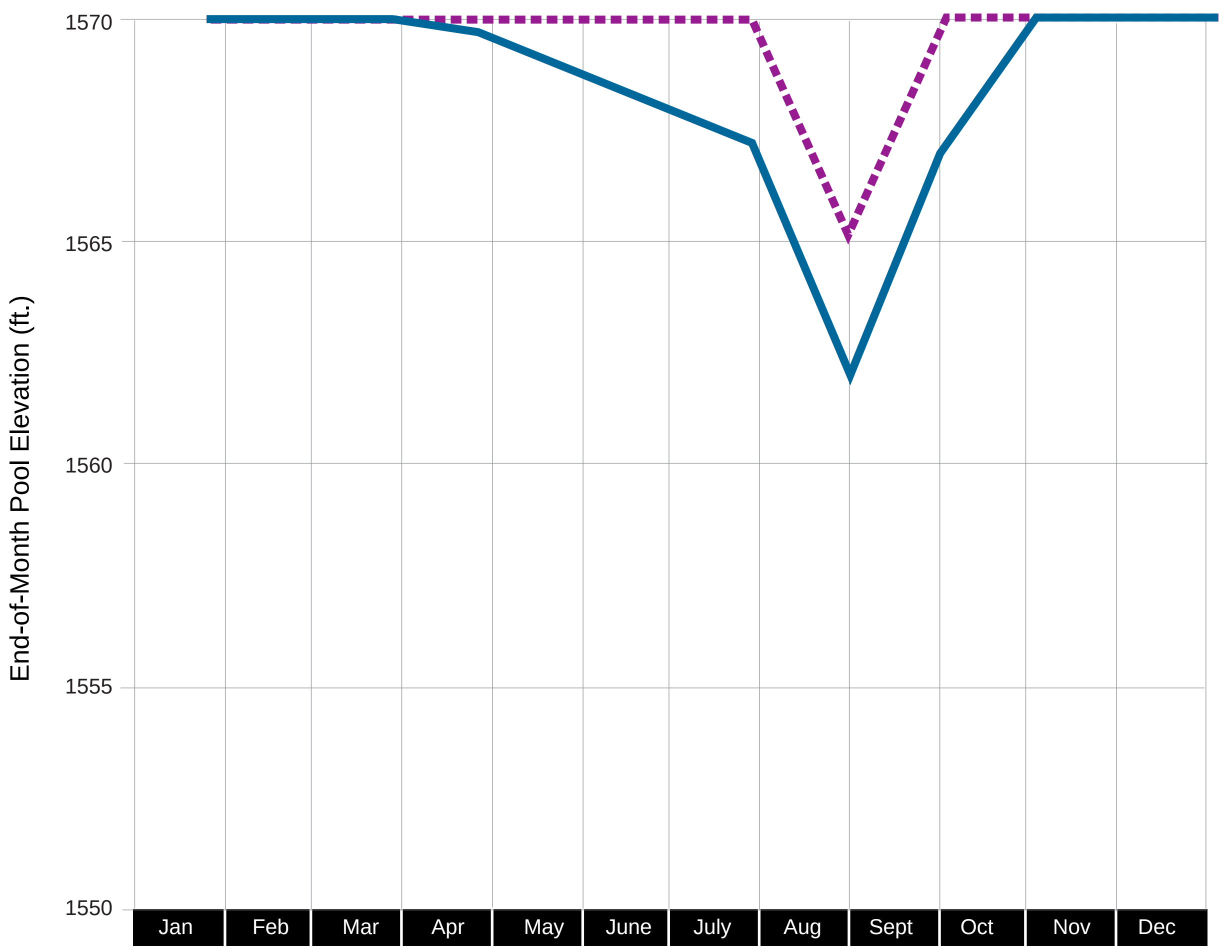
Drawdowns represent end-of-month levels for all months.

TABLE 4-5

Lake Roosevelt Drawdown (feet) for Alternative 2B: Partial—Banks + FDR

Condition	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Wet Year												
Total Drawdown with No Action Alternative	30.0	23.4	46.1	70.1	64.8	35.9	0.5	11.0	5.1	2.1	0.0	0.0
Total Drawdown with Alternative 2B	30.0	23.4	46.1	70.1	64.8	35.9	0.7	11.5	5.1	2.1	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	0.0	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Average Year												
Total Drawdown with No Action Alternative	29.2	40.0	4.38	70.1	57.5	0.3	0.5	11.0	5.1	2.1	0.0	0.0
Total Drawdown with Alternative 2B	29.9	40.0	43.8	70.1	57.5	0.3	0.7	11.5	5.1	2.1	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	0.0	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Dry Year												
Total Drawdown with No Action Alternative	10.1	12.6	35.0	41.5	1.5	0.6	5.8	13.0	5.1	2.1	10.4	18.6
Total Drawdown with Alternative 2B	10.1	12.6	35.0	41.5	1.5	0.6	5.9	13.5	5.1	2.1	10.4	18.6
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	0.0	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Drought Year												
Total Drawdown with No Action Alternative	11.1	13.3	19.0	24.7	1.3	1.1	6.3	13.8	5.1	2.1	15.1	20.3
Total Drawdown with Alternative 2B	11.1	13.3	19.0	24.7	1.3	1.1	6.4	14.3	5.1	2.1	15.1	20.3
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	0.0	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*

Drawdowns represent end-of-month levels for all months.



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 (described in Section 4.2.1.2); not all wet, average, dry or drought years would be the same as those shown.

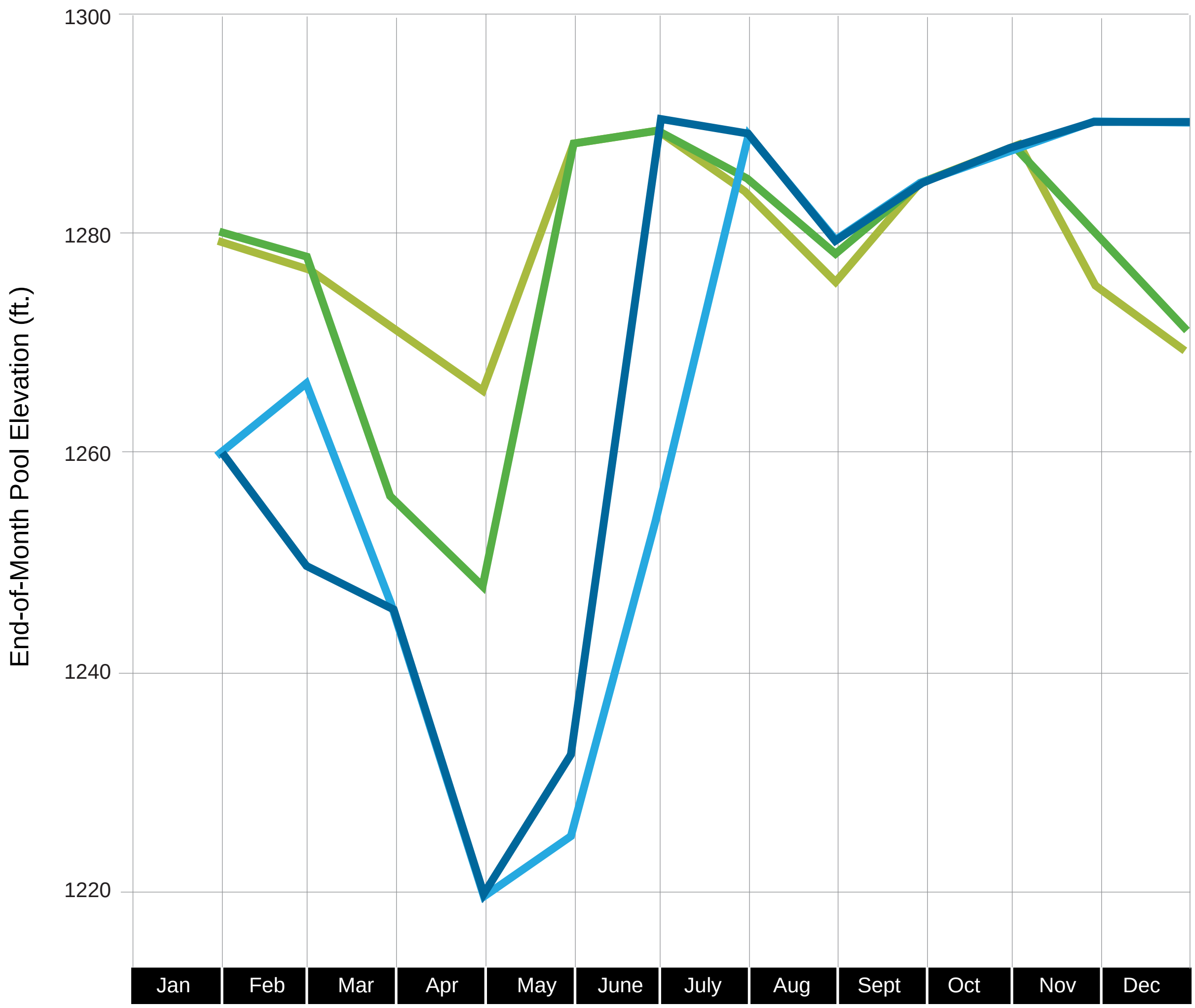
LEGEND

Alternative 2B - Average, Wet, Dry, and Drought Years

No Action - Average, Wet, Dry, and Drought Years

Figure 4-4

Banks Lake Drawdown (feet) for Alternative 2B: Partial - Banks + FDR



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 December end points should not be expected to "match up" with the January 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 - and No Action Average Year
- Alternative 2B - and No Action Wet Year
- Alternative 2B - and No Action Dry Year
- Alternative 2B - and No Action Drought Year

Figure 4-5
Lake Roosevelt Drawdown (feet) for Alternative 2B: Partial - Banks + FDR

Short-term impacts, mitigation measures, and cumulative impacts would be the same as those for Alternative 2A: Partial—Banks.

4.2.4.1 Long-Term Impacts

Lake Roosevelt

Implementation of this alternative would result in additional drawdown of Lake Roosevelt. Long-term minimal impacts from drawdown would be a minor reduction in water levels in the reservoir, as shown on Figure 4-5 and Table 4-5.

No significant long-term impacts from the drawdown would occur, because Lake Roosevelt would refill during the next spring runoff period. The reduction in flow would be very small, as the reservoir contains 5.2 million acre-feet of storage. A majority of the flow into Lake Roosevelt occurs during the spring runoff season lasting from April to July, which accounts for 65 to 70 percent of the total annual average inflow. The maximum volume pumped from the reservoir for irrigation would be a minor percent of the inflow passed through Grand Coulee to Lake Roosevelt during the spring runoff season.

Columbia River

Implementation of this alternative would reduce flow in the Columbia River downstream of Lake Roosevelt. Reductions in flow are projected only when average monthly flow exceeds flow objectives set for the Columbia River. September flow reductions were limited to 1,000 cfs. October through June flow reductions were limited to 2,200 cfs. Table 4-2 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.

Compared to the No Action Alternative, the largest reduction in flow would occur in October. There would be no reduction in flow during July and August.

The difference in flow would be very small and represents 2.0 percent of the total Columbia River flow rate below Grand Coulee Dam during October. Following withdrawal of this water, flow rates would comply with instream flow objectives specified for the Columbia River. Minimal impacts would occur as a result of the projected reduction in flow in the Columbia River for any of the representative water year projections.

Banks Lake

Implementation of this alternative would result in additional drawdown of Banks Lake, as shown on Figure 4-4 and Table 4-4.

Other Surface Water Features

Implementation of this alternative would result in the same long-term impacts as described for Alternative 2A: Partial—Banks.

Climate Change Analysis

Climate change effects would be the same as those described for Alternative 2A: Partial—Banks.

4.2.5 Alternative 2C: Partial—Banks + Rocky

Reservoir operation under Alternative 2C: Partial—Banks + Rocky would cause very little additional drawdown of Banks Lake beyond the No Action Alternative. Figure 4-6 and Table 4-6 illustrate the annual drawdown pattern at Banks Lake for this alternative in representative wet, average, dry, and drought conditions; data portraying how these patterns would differ from the No Action Alternative are also provided. As shown, Alternative 2C: Partial—Banks + Rocky would result in an additional drawdown of 0.1 feet at Banks Lake 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 drawdown would average 5.1 feet at the end of August.

No graph or table is included for Rocky Coulee Reservoir because it would be a fully working reservoir, essentially filled and emptied each year.

Mitigation measures and cumulative impacts would be the same as those for Alternative 2A: Partial—Banks.

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. In addition, this alternative could create temporary changes to flows, geomorphology, or connectivity resulting from inundation of the area occupied by the proposed Rocky Coulee reservoir.

4.2.5.2 Long-Term Impacts

Columbia River

Implementation of this alternative would reduce flow in the Columbia River downstream of Lake Roosevelt. Reductions in flow are projected only when average monthly flow exceeds flow objectives set for the Columbia River. Table 4-2 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.

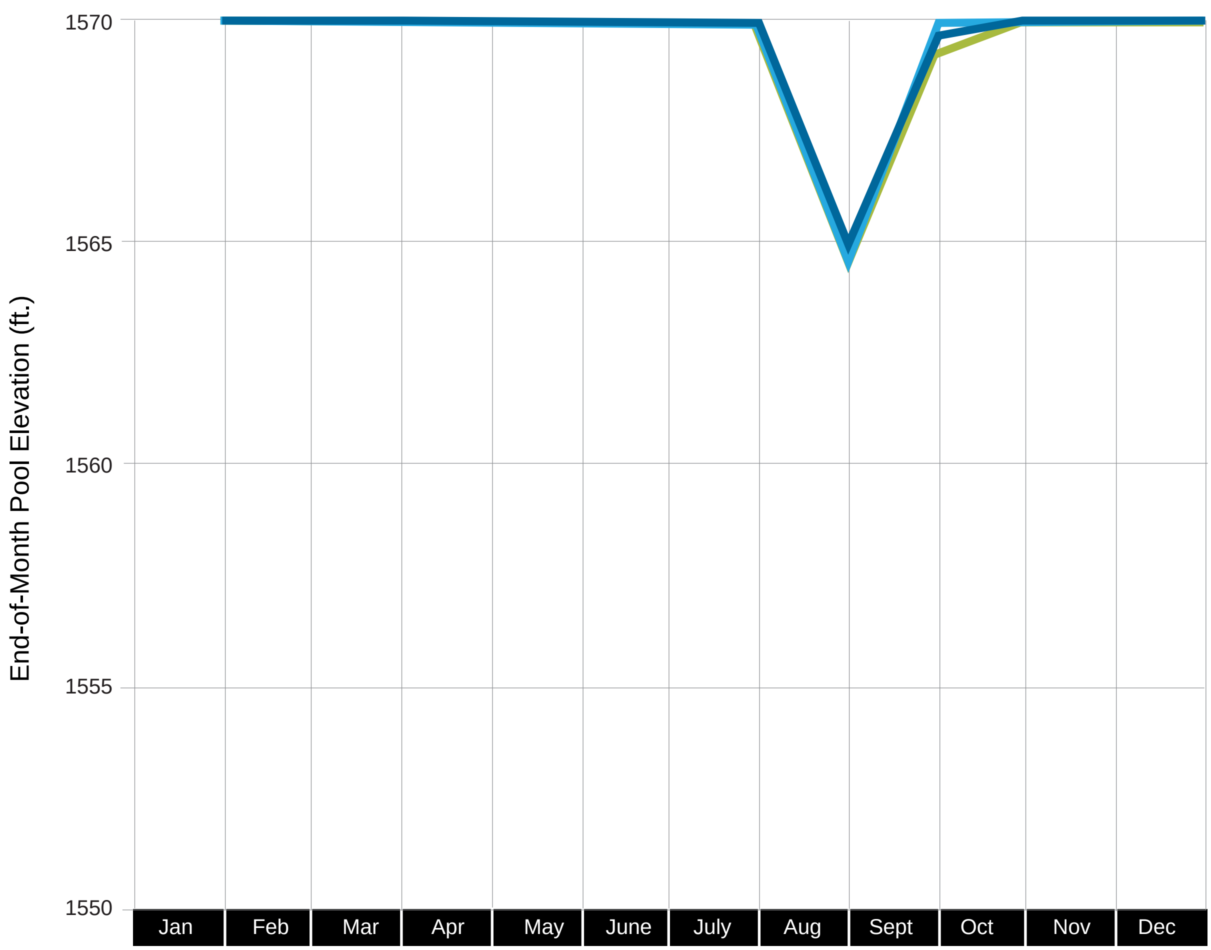
Compared to the No Action Alternative, the maximum projected reduction in flow would occur in October. A small reduction in flow would occur in the spring to meet irrigation demands. There would be no reduction in flow during July and August.

TABLE 4-6

Banks Lake Drawdown (feet) for Alternative 2C: Partial—Banks + Rocky

Condition	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
No Action Alternative	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0
Wet Year												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.1	0.0	0.0	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Average Year												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.1	0.4	0.0	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Dry Year												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	0.8	0.0	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.8	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Drought Year												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	0.8	0.0	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.8	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*

Drawdowns represent end-of-month levels for all months.



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 (described in Section 4.2.1.2); not all wet, average, dry or drought years would be the same as those shown.

LEGEND

- Alternative 2C - Average Year
- Alternative 2C - Wet Year; and No Action - Average, Wet, Dry, and Drought Years
- Alternative 2C - Dry and Drought YearsYear

Odessa Subarea Special Study
Columbia Basin Project, Washington

Figure 4-6
Banks Lake Drawdown (feet) for Alternative 2C: Partial - Banks + Rocky

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The differences in flow would be very small and represent 2.1 percent of the total Columbia River flow rate below Grand Coulee Dam during October. Following withdrawal of this water, flow rates would comply with instream flow objectives specified for the Columbia River. Minimal impacts would occur as a result of the projected reduction in flow in the Columbia River for any of the representative water year projections.

Banks Lake

Implementation of this alternative would result in additional drawdown of Banks Lake, as shown on Figure 4-6 and Table 4-6.

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 would be associated with the construction of Rocky Coulee Reservoir:

- Creation of the potential for the dam to breach, resulting in flooding downstream.
- An increase in evaporative losses from the irrigation system. These losses would be in proportion to the surface area of the reservoir.
- An increase in shallow groundwater recharge in the area associated with the footprint of the new reservoir.
- Permanent changes to flows, geomorphology, or connectivity resulting from inundation of the area under Rocky Coulee Reservoir. Although Rocky 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, East Low Canal, and 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 none to minimal.

Climate Change Analysis

Climate change effects would be the same as those described for Alternative 2A: Partial—Banks.

4.2.6 Alternative 2D: Partial—Combined

Figures 4-7 and 4-8 illustrate the annual drawdown patterns at Banks Lake and Lake Roosevelt, respectively, for Alternative 2D: Partial—Combined in representative wet, average, dry, and drought conditions. Data portraying how these patterns differ from the No Action Alternative are also provided.

As shown on Table 4-7, Alternative 2D: Partial—Combined would result in an average additional drawdown of 3 feet at Banks Lake each year, beyond the 5 feet of drawdown for summer fish flow augmentation that is part of the No Action Alternative. The total drawdown would be 8 feet at the end of August. Under Alternative 2D: Partial—Combined, an additional drawdown of 0.2 feet would occur in Lake Roosevelt in an average year, as shown on Table 4-8. No graph or table is included for Rocky Coulee Reservoir because it would be a fully working reservoir, essentially filled and emptied each year.

Mitigation measures and cumulative impacts would be the same as those for Alternative 2A: Partial—Banks.

4.2.6.1 Short-Term Impacts

Implementation of this alternative would result in the same short-term impacts as described for Alternative 2C: Partial—Banks + Rocky.

4.2.6.2 Long-Term Impacts

Lake Roosevelt

Figure 4-8 and Table 4-8 present a summary of seasonal changes in reservoir water surface elevation for this alternative relative to the No Action Alternative for representative wet, average, dry, and drought years. As shown in the tables, implementation of this alternative would result in an additional 0.2-foot drawdown in August of an average year compared to the No Action Alternative.

Columbia River

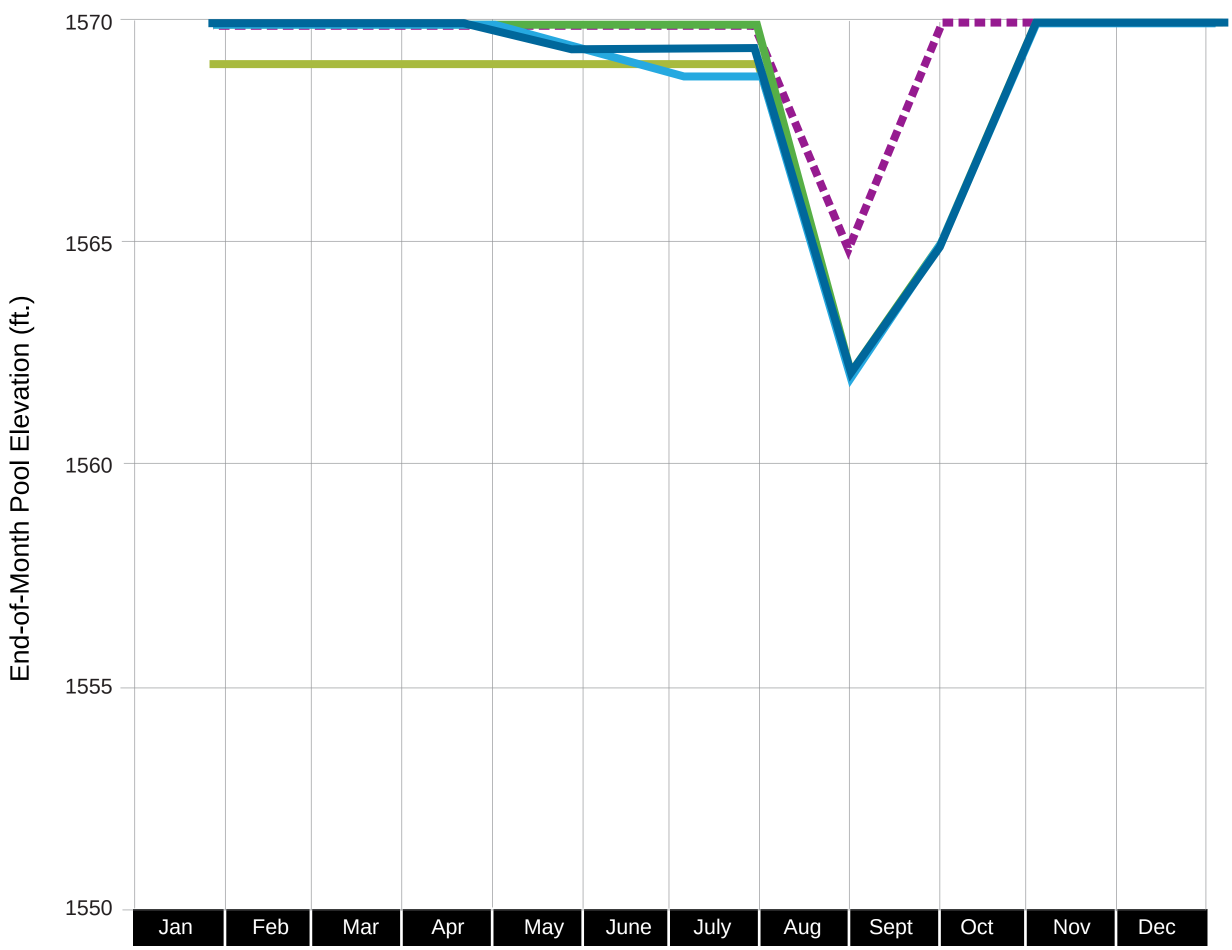
Implementation of this alternative would reduce flow in the Columbia River downstream of Lake Roosevelt. Reductions in flow are projected to occur during juvenile fish migration, only when flows exceed the flow objectives. Otherwise, they occur in September and October. September flow reductions were limited to 1,000 cfs. October through June flow reductions were limited to 2,200 cfs. Table 4-2 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.

TABLE 4-7

Banks Lake Drawdown (feet) for Alternative 2D: Partial—Combined

Condition	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
No Action Alternative	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0
Wet Year												
Total Drawdown	0.0	0.0	0.0	0.0	0.5	1.0	1.0	8.0	5.0	0.0	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.5	1.0	1.0	3.0	5.0	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Average Year												
Total Drawdown	0.0	0.0	0.0	0.0	0.5	0.5	0.5	8.0	5.0	0.0	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.5	0.5	0.5	3.0	5.0	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Dry Year												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	5.0	0.0	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	5.0	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Drought Year												
Total Drawdown	0.8	0.8	0.8	0.8	0.8	0.8	0.8	8.0	5.0	0.0	0.0	0.0
Additional Drawdown Beyond No Action	0.8	0.8	0.8	0.8	0.8	0.8	0.8	3.0	5.0	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*0.4*	*0.4*	*0.4*

Drawdowns represent end-of-month levels for all months.



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 December end points should not be expected to "match up" with the January 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 2D - Average Year
- Alternative 2D - Wet Year
- Alternative 2D - Dry Year
- Alternative 2D - Drought Year
- No Action - Average, Wet, Dry, and Drought Years

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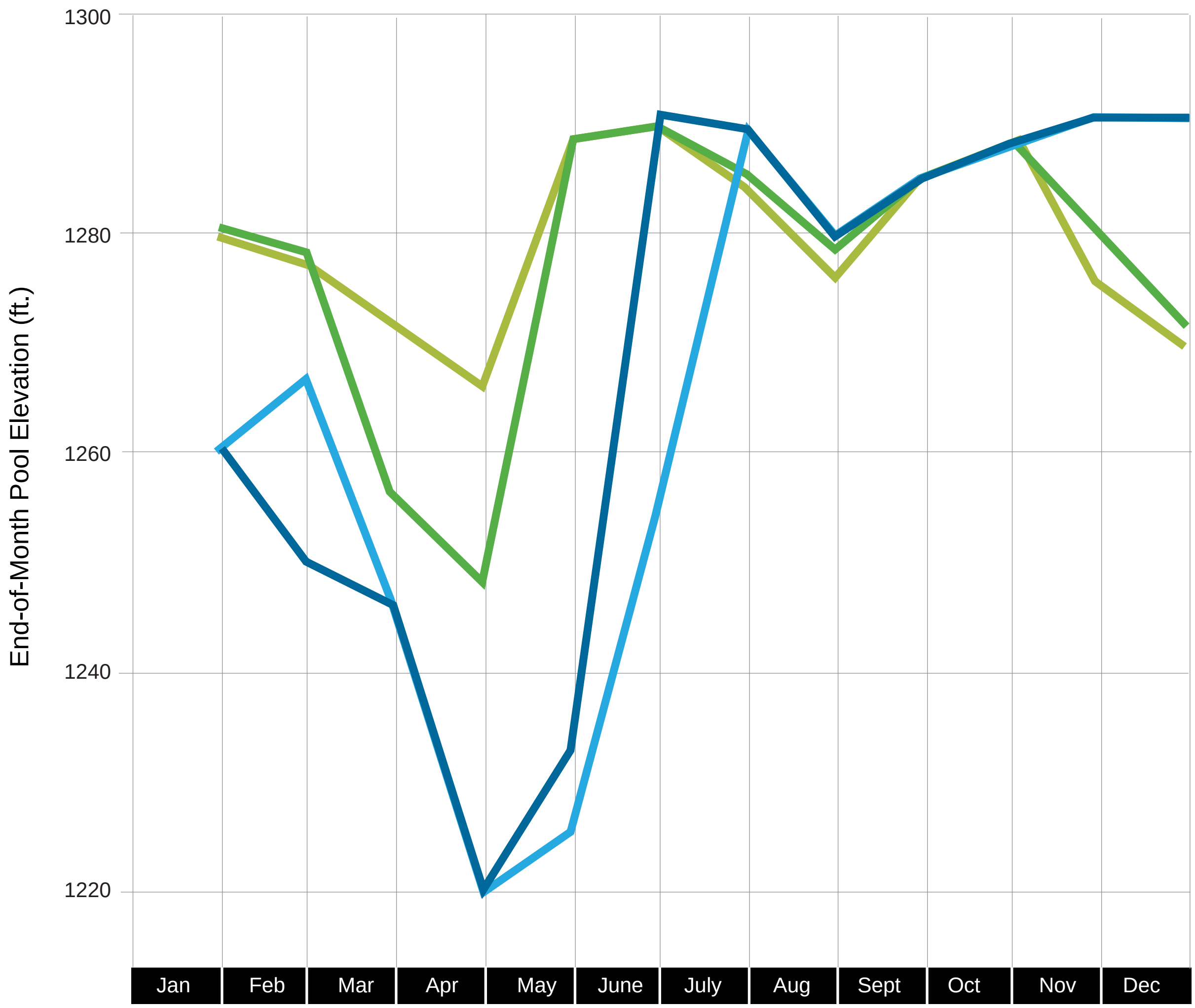
Figure 4-7
Banks Lake Drawdown (feet) for Alternative 2D: Partial - Combined

WB082009003BOI



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 December end points should not be expected to "match up" with the January 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 2D - and No Action Average Year
- Alternative 2D - and No Action Wet Year
- Alternative 2D - and No Action Dry Year
- Alternative 2D - and No Action Drought Year

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Figure 4-8

Lake Roosevelt Drawdown (feet) for Alternative 2D: Partial - Combined

WB082009003BOI

TABLE 4-8

Lake Roosevelt Drawdown (feet) for Alternative 2D: Partial—Combined

Condition	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Wet Year												
Total Drawdown with No Action Alternative	30.0	23.4	46.1	70.1	64.8	35.9	0.5	11.0	5.1	2.1	0.0	0.0
Total Drawdown with Alternative 2D	30.0	23.4	46.1	70.1	64.8	36.1	0.7	11.5	5.1	2.1	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.5	0.0	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Average Year												
Total Drawdown with No Action Alternative	29.2	40.0	4.38	70.1	57.5	0.3	0.5	11.0	5.1	2.1	0.0	0.0
Total Drawdown with Alternative 2D	29.9	40.0	43.8	70.1	57.5	0.3	0.5	11.2	5.1	2.1	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Dry Year												
Total Drawdown with No Action Alternative	10.1	12.6	35.0	41.5	1.5	0.6	5.8	13.0	5.1	2.1	10.4	18.6
Total Drawdown with Alternative 2D	10.1	12.6	35.0	41.5	1.5	0.6	5.8	13.5	5.1	2.1	10.4	18.6
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Drought Year												
Total Drawdown with No Action Alternative	11.1	13.3	19.0	24.7	1.3	1.1	6.3	13.8	5.1	2.1	15.1	20.3
Total Drawdown with Alternative 2D	11.1	13.3	19.0	24.7	1.3	1.1	6.3	14.3	5.1	2.1	15.1	20.3
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*

Drawdowns represent end-of-month levels for all months.

Compared to the No Action Alternative, the maximum projected reduction in flow would occur in October. There would be no reduction in flow during July and August.

The difference in flow would be very small and represents 2.2 percent of the total Columbia River flow rate below Grand Coulee Dam during October. Following withdrawal of this water, flow rates would comply with instream flow objectives specified for the Columbia River. Minimal impacts would occur as a result of the projected reduction in flow in the Columbia River for any of the representative water year projections.

Banks Lake

Implementation of this alternative would result in additional drawdown of Banks Lake, as shown in Figure 4-7 and Table 4-7.

Other Surface Water Features

Implementation of this alternative would result in the same long-term impacts as described for Alternative 2C: Partial—Banks + Rocky.

Climate Change Analysis

Climate change effects for Lake Roosevelt and Banks Lake would be the same as those described for Alternative 2A: Partial—Banks. However, implementation of this alternative would reduce flow in the Columbia River downstream of Lake Roosevelt. Based on analysis of the four representative conditions (wet, average, dry, and drought), climate change would affect the water available in the Columbia River for all conditions resulting in additional reductions in flow. As compared to Alternative 2D: Partial—Combined, without any consideration of climate change, both climate change scenarios (2040_A1B and 2040_B1) would further impact flow rates in the Columbia River as described below:

- Wet—Flow further reduced by 1.4 percent (B1) in October and increased by 1.1 percent (A1B and B1) in December
- Average—Flow further reduced by 1.6 percent (B1) in October, 2.3 percent (B1) in November, 2.8 percent (B1) in December, and increased by 1.5 percent (B1) in January
- Dry—Flow further reduced by 1.0 percent (B1) in October
- Drought—Flow further reduced by 1.4 percent (B1) in October

During November, December, and January, flow objectives specified in the Biological Opinion (NMFS 2008 BO) are still achieved with the flow reductions analyzed with climate change scenarios.

4.2.7 Alternative 3A: Full—Banks

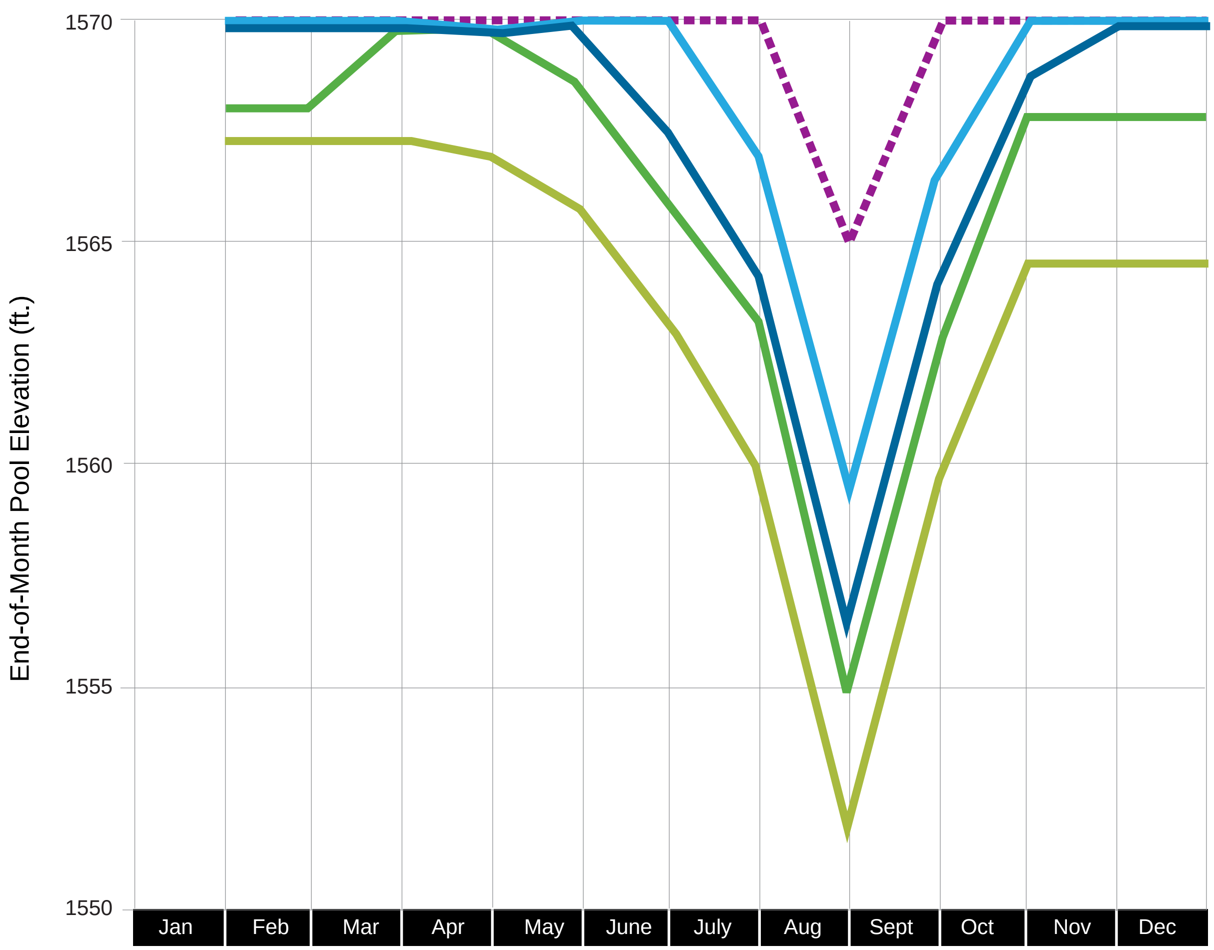
Figure 4-9 and Table 4-9 illustrate the annual drawdown pattern at Banks Lake for Alternative 3A: Full—Banks in representative wet, average, dry, and drought conditions. Data portraying how this pattern differs from No Action are also provided. As shown, Alternative 3A: Full—Banks would result in an average additional drawdown of 8.5 feet at Banks Lake each year, beyond the current 5 feet of drawdown for summer fish flow augmentation in the Columbia River, which is part of the No Action Alternative. The total drawdown in representative, average water years would be 13.5 feet at the end of August.

TABLE 4-9

Banks Lake Drawdown (feet) for Alternative 3A: Full—Banks

Condition	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
No Action Alternative	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0
Wet Year												
Total Drawdown	0.0	0.0	0.0	0.1	0.0	0.0	3.0	10.6	3.4	0.0	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.1	0.0	0.0	3.0	5.6	3.4	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Average Year												
Total Drawdown	0.0	0.0	0.0	0.1	0.0	2.6	5.7	13.5	6.1	1.3	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.1	0.0	2.6	5.7	8.5	6.1	1.3	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Dry Year												
Total Drawdown	1.9	1.9	0.0	0.3	1.4	4.0	7.1	15.0	7.3	2.1	2.1	2.1
Additional Drawdown Beyond No Action	1.9	1.9	0.0	0.3	1.4	4.0	7.1	10.0	7.3	2.1	2.1	2.1
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Drought Year												
Total Drawdown	2.7	2.7	2.6	2.9	4.1	6.9	10.1	18.3	10.5	5.4	5.4	5.4
Additional Drawdown Beyond No Action	2.7	2.7	2.6	2.9	4.1	6.9	10.1	13.3	10.5	5.4	5.4	5.4
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*

Drawdowns represent end-of-month levels for all months.



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 December end points should not be expected to "match up" with the January 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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Figure 4-9
Banks Lake Drawdown (feet) for Alternative 3A: Full - Banks

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Mitigation measures and cumulative impacts would be the same as those for Alternative 2A: Partial—Banks.

4.2.7.1 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.

4.2.7.2 Long-Term Impacts

Columbia River

Implementation of this alternative would reduce flow in the Columbia River downstream of Lake Roosevelt. Reductions in flow are projected only when average monthly flow exceeds flow objectives set for the Columbia River. Table 4-10 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.

Table 4-10 displays estimates based on actual hydrologic conditions recorded from the four water years selected to represent the wet (1982), average (1995), dry (1988), and drought conditions (1931). Not all wet, average, dry, and drought years are identical and the timing of reservoir refill would differ. For example, in the average year selected (1995), there was no water available in November or December, so water was not diverted. In other years, November flows would be high enough that the reservoir could be refilled in November.

Residual pool elevation in the fall depends upon conditions from the previous year. For example, the average year (1995) indicates pumping in January, which was necessary to refill the reservoir from the previous year (1994), a dry year.

Compared to the No Action Alternative, the maximum projected reduction in flow would occur in October. There would be no reduction in flow during July and August.

The difference in flow would be very small and represents 3.2 percent of the total Columbia River flow rate below Grand Coulee Dam during October. Following withdrawal of this water, flow rates would comply with instream flow objectives specified for the Columbia River. Minimal impacts would occur as a result of the projected reduction in flow in the Columbia River for any of the representative water year projections.

TABLE 4-10

Differences in Columbia River Flows for the Full Replacement Alternatives Compared to the No Action Alternative

	Change in Average Monthly Flow Rate Compared to No Action Alternative for Modeled Representative Water Years (cfs)											
Alternative	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
3A: Full—Banks												
Wet	-1610	0	0	0	0	8	72	-505	-1184	0	0	-1000
Average	-2200	0	0	-2020	0	8	61	-518	0	0	0	-1000
Dry	-2200	0	0	0	0	-849	0	0	0	0	0	-1000
Drought	-2200	0	0	0	0	0	0	0	0	0	0	-1000
3B: Full—Banks + FDR												
Wet	-2200	0	-1051	0	0	0	0	0	0	0	0	-1000
Average	-2200	0	0	-2200	-189	0	0	0	0	0	0	-1000
Dry	-2200	0	0	0	0	-863	0	0	0	0	0	-1000
Drought	-2200	0	0	0	0	0	0	0	0	0	0	-1000
3C: Full—Banks + Rocky												
Wet	-2200	0	-845	0	0	8	375	-273	-1174	0	0	-1000
Average	-2200	0	0	-2200	-835	8	342	-296	0	0	0	-1000
Dry	-2200	0	0	0	0	-1700	355	331	0	0	0	-1000
Drought	-2200	0	0	0	0	0	0	0	0	0	0	-1000
3D: Full—Combined												
Wet	-2200	0	-2013	0	0	0	0	0	0	0	0	-1000
Average	-2200	0	0	-2200	-707	0	0	0	0	0	0	-1000
Dry	-2200	0	0	0	0	-1745	0	0	0	0	0	-1000
Drought	-2200	0	0	0	0	0	0	0	0	0	0	-1000

*Negative values indicate reduced flow.

Banks Lake

Compared to all other action alternatives, Alternative 3A: Full—Banks results in the lowest projected water surface elevation, as shown on Figure 4-9 and Table 4-9.

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 flowrate would be within the channel capacity and the impacts associated with the increase would be minimal.

Climate Change Analysis

Climate change effects for Lake Roosevelt and Banks Lake would be the same as those described for Alternative 2A: Partial—Banks. However, implementation of this alternative would reduce flow in the Columbia River downstream of Lake Roosevelt. Based on analysis of the four representative conditions (wet, average, dry, and drought), climate change would affect the water available in the Columbia River for the drought and average conditions, resulting in additional reductions in flow.

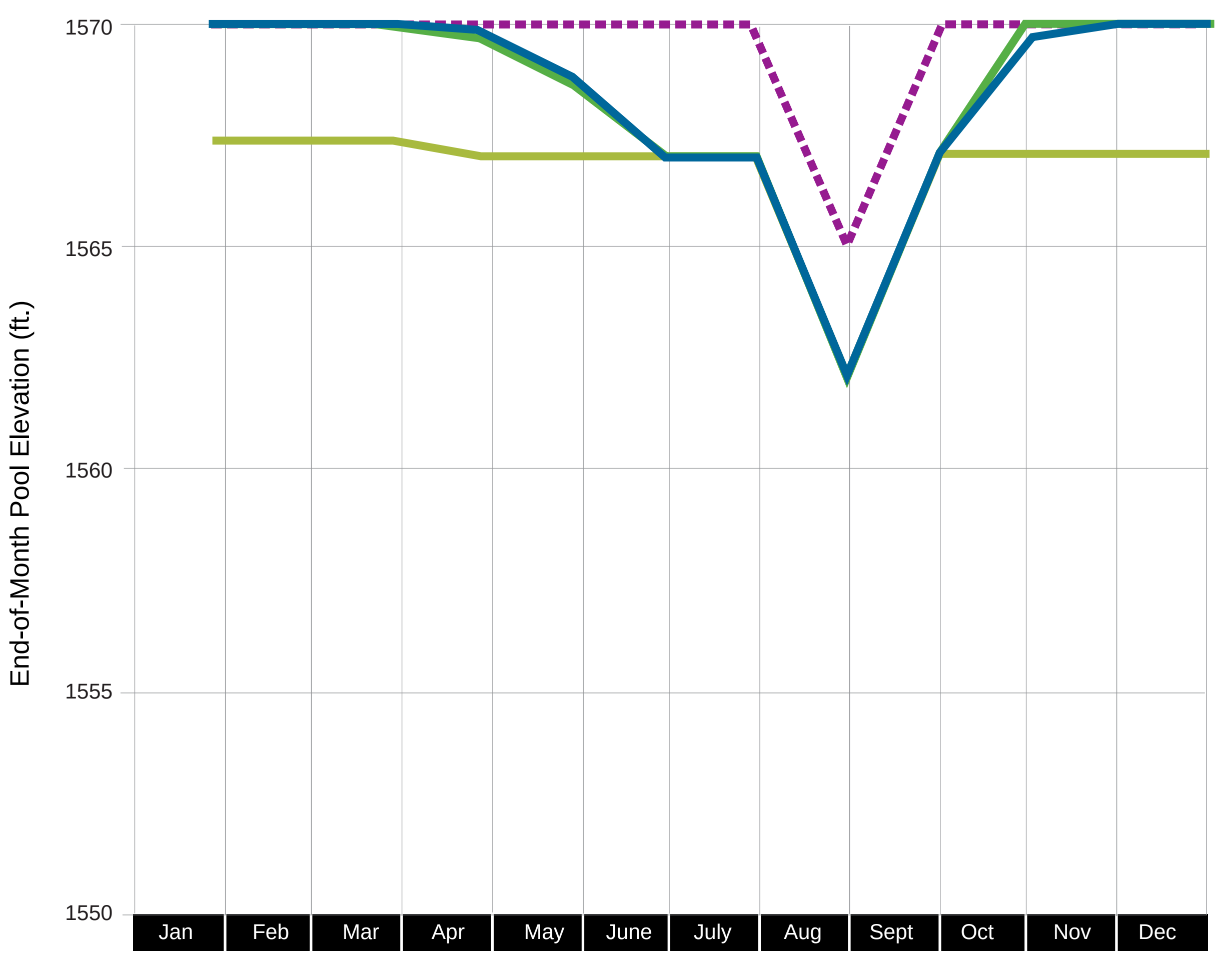
As compared to Alternative 3A: Full—Banks, without any consideration of climate change, both climate change scenarios (2040_A1B and 2040_B1) would further impact flow rates in the Columbia River as described below:

- Average—Flow further reduced by 1.2 percent (B1) in November, reduced by 1.3 percent (A1B) in December, and increased by 2.6 percent (A1B and B1) in January
- Drought—Flow further reduced by 1.3 percent (A1B and B1) in November

During November, December, and January, flow objectives specified in the Biological Opinion (NMFS 2008 BO) are still achieved with the flow reductions analyzed with climate change scenarios.

4.2.8 Alternative 3B: Full—Banks + FDR

Figures 4-10 and 4-11 illustrate the annual drawdown patterns at Banks Lake and Lake Roosevelt, respectively, for Alternative 3B: Full—Banks + FDR. Tables 4-11 and 4-12 specify the additional drawdown at the two reservoirs beyond the No Action Alternative.



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 December end points should not be expected to "match up" with the January 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, and Wet Years
- Alternative 3B - Dry Year
- Alternative 3B - Drought Year
- No Action - Average, Wet, Dry, and Drought Years

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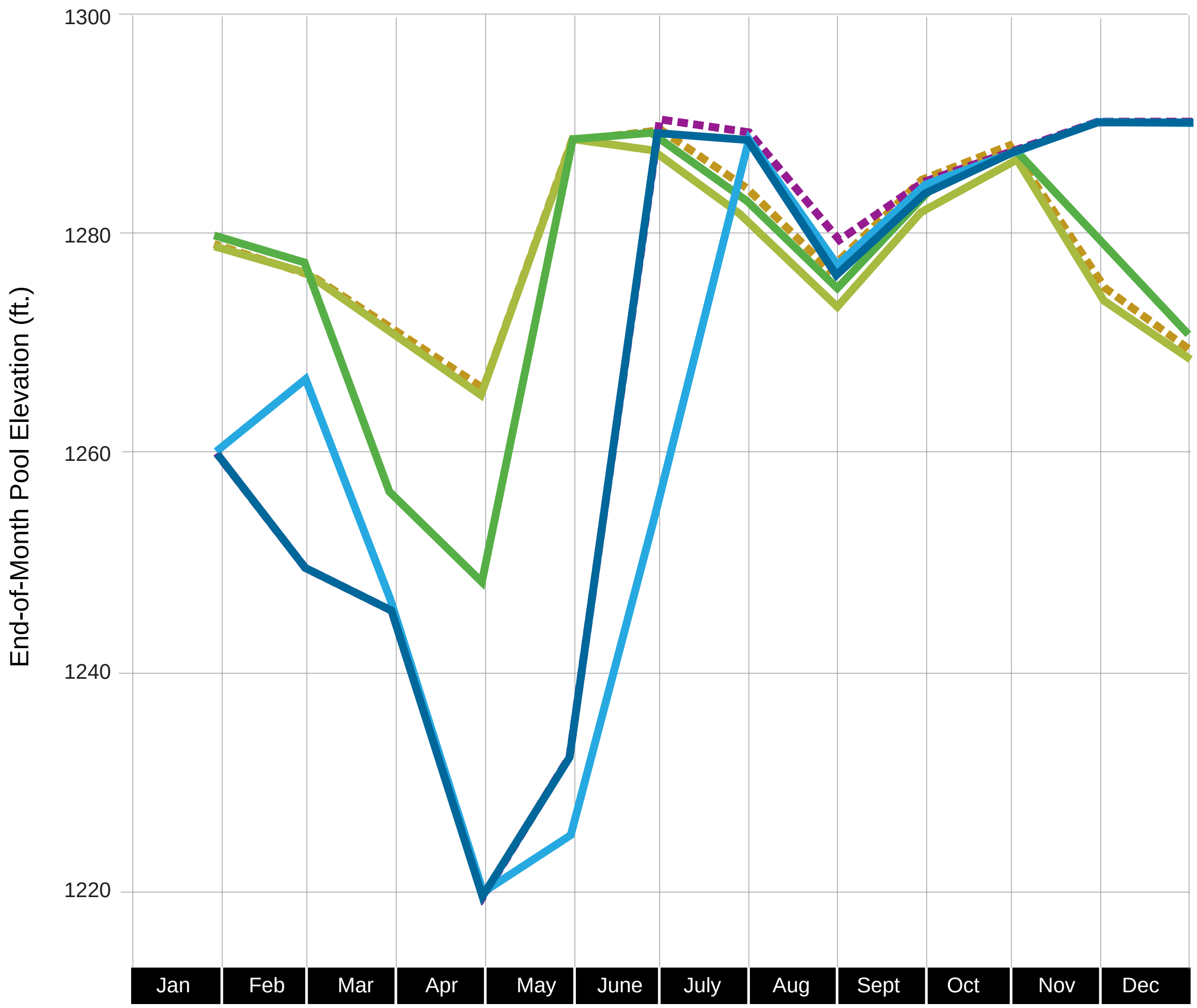
Figure 4-10
Banks Lake Drawdown (feet) for Alternative 3B: Full - Banks + FDR

WB082009003BOI



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 December end points should not be expected to "match up" with the January 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 - and No Action Wet Year
- Alternative 3B - and No Action Dry Year
- Alternative 3B - Drought Year
- No Action Average Year
- No Action Drought Year

Figure 4-11

Lake Roosevelt Drawdown (feet) for Alternative 3B: Full - Banks + FDR

Alternative 3B: Full—Banks + FDR would result in an average additional drawdown of 3 feet at Banks Lake during several months of each year, beyond the 5 feet of drawdown for summer Columbia River fish flow augmentation that is part of the No Action Alternative. The total drawdown would be 8 feet in August. The additional drawdown at Lake Roosevelt in August of a representative average water year would be 2.2 feet beyond the No Action Alternative drawdown of 10.8 feet, bringing the total drawdown under Alternative 3B: Full—Banks + FDR to 13.2 feet.

TABLE 4-11

Banks Lake Drawdown (feet) for Alternative 3B: Full—Banks + FDR

Condition	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
No Action Alternative	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0
Wet Year												
Total Drawdown	0.0	0.0	0.0	0.1	1.1	3.0	3.0	8.0	3.0	0.2	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.1	1.1	3.0	3.0	3.0	3.0	0.2	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Average Year												
Total Drawdown	0.0	0.0	0.0	0.1	1.2	3.0	3.0	8.0	3.0	0.2	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.1	1.2	3.0	3.0	3.0	3.0	0.2	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Dry Year												
Total Drawdown	0.0	0.0	0.0	0.3	1.4	3.0	3.0	8.0	3.0	0.1	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.3	1.4	3.0	3.0	3.0	3.0	0.1	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Drought Year												
Total Drawdown	2.7	2.7	2.7	3.0	3.0	3.0	3.0	8.0	3.0	3.0	3.0	3.0
Additional Drawdown Beyond No Action	2.7	2.7	2.7	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*

Drawdowns represent end-of-month levels for all months.

TABLE 4-12

Lake Roosevelt Drawdown (feet) for Alternative 3B: Full—Banks + FDR

Condition	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Wet Year												
Total Drawdown with No Action Alternative	30.0	23.4	46.1	70.1	64.8	35.9	0.5	11.0	5.1	2.1	0.0	0.0
Total Drawdown with Alternative 3B	30.0	23.4	46.1	70.1	64.8	36.2	1.8	13.2	6.5	2.1	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.3	1.2	2.2	1.4	0.0	0.0	0.0
Potential Influence of Climate Change	none	none	none	none	none	none	none	none	none	none	none	none
Average Year												
Total Drawdown with No Action Alternative	29.2	40.0	4.38	70.1	57.5	0.3	0.5	11.0	5.1	2.1	0.0	0.0
Total Drawdown with Alternative 3B	29.9	40.0	43.8	70.1	57.5	0.5	1.8	13.2	6.5	2.1	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.3	1.2	2.2	1.4	0.0	0.0	0.0
Potential Influence of Climate Change	none	none	none	none	none	none	none	none	none	none	none	none
Dry Year												
Total Drawdown with No Action Alternative	10.1	12.6	35.0	41.5	1.5	0.6	5.8	13.0	5.1	2.1	10.4	18.6
Total Drawdown with Alternative 3B	10.1	12.6	35.0	41.5	1.5	0.9	7.2	15.3	6.5	2.1	10.4	18.6
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.3	1.4	2.3	1.4	0.0	0.0	0.0
Potential Influence of Climate Change	none	none	none	none	none	none	none	none	none	none	none	none
Drought Year												
Total Drawdown with No Action Alternative	11.1	13.3	19.0	24.7	1.3	1.1	6.3	13.8	5.1	2.1	15.1	20.3
Total Drawdown with Alternative 3B	11.1	13.3	19.0	24.7	1.7	2.3	8.6	17.1	7.5	2.9	16.0	21.1
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.4	1.2	2.3	3.3	2.4	0.8	0.8	0.9
Potential Influence of Climate Change	none	none	none	none	none	none	none	none	none	none	none	none

Drawdowns represent end-of-month levels for all months.

Short-term impacts, mitigation measures, and cumulative impacts would be the same as those for Alternative 2A: Partial—Banks.

4.2.8.1 Long-Term Impacts

Lake Roosevelt

Long-term impacts from drawdown under this alternative would result in reduced water levels in the reservoir, as shown on Figure 4-11 and Table 4-12.

Columbia River

Implementation of this alternative would reduce flow in the Columbia River downstream of Lake Roosevelt. Reductions in flow are projected only when average monthly flow exceeds flow objectives set for the Columbia River. Table 4-3 presents seasonal changes in flow conditions for this alternative relative to the No Action Alternative for representative wet, average, dry, and drought years.

Compared to the No Action Alternative, the maximum projected reduction in flow would occur in October (wet, dry, and drought hydrologic conditions) and January (average hydrologic conditions). For the years shown, reduction in flow occurred in October and January because there was not water available that year in November or December. The reduction in flow in January in the average year selected is not representative of an average year but of the previous year (1994) which was a dry year. There would be no reduction in flow during July and August.

The difference in flow would be very small and represents 3.2 percent of the total Columbia River flow rate below Grand Coulee Dam during October. Following withdrawal of this water, flow rates would comply with instream flow objectives specified for the Columbia River. Minimal impacts would occur as a result of the projected reduction in flow in the Columbia River for any of the representative water year projections.

Banks Lake
Implementation of this alternative would result in additional drawdown of Banks Lake, as shown on Figure 4-10 and Table 4-11.

Other Surface Water Features
Implementation of this alternative would result in the same long-term impacts as described for Alternative 3A: Full—Banks.

Climate Change Analysis
Climate change effects for Lake Roosevelt and Banks Lake would be the same as those described for Alternative 2A: Partial—Banks. However, implementation of this alternative would reduce flow in the Columbia River downstream of Lake Roosevelt. Based on analysis of the four representative conditions (wet, average, dry, and drought), climate change would affect the water available in the Columbia River for the drought and average conditions resulting in additional reductions in flow.

As compared to Alternative 3B: Full—Banks + FDR, without any consideration of climate change, both climate change scenarios (2040_A1B and 2040_B1) would further impact flow rates in the Columbia River as described below:

- Average—Flow further reduced by 1.8 percent (B1) in November, reduced by 1.1 percent (B1) in December, and increased by 2.8 percent (B1) in January
- Drought—Flow further reduced by 1.3 percent (B1) in November

During November, December, and January, flow objectives specified in the Biological Opinion (NMFS 2008 BO) are still achieved with the flow reductions analyzed for climate change.

4.2.9 Alternative 3C: Full—Banks + Rocky

Under Alternative 3C: Full—Banks + Rocky (as with all action alternatives), water would typically be diverted from the Columbia River (Lake Roosevelt) into Banks Lake when supplies are available, outside of the juvenile fish migration season of April 10 through August 31. When flows are not available in the Columbia River, Banks Lake and the new Rocky Coulee Reservoir would be drawn down to provide surface water supply to the service area.

Figure 4-12 illustrates the annual drawdown patterns at Banks Lake for Alternative 3C: Full—Banks + Rocky. Table 4-13 specifies the additional drawdown at Banks Lake beyond the No Action Alternative.

Alternative 3C: Full—Banks + Rocky would result in an average additional drawdown of 5 feet at Banks Lake during one or more months of each year, beyond the 5 feet of drawdown for summer Columbia River fish flow augmentation that is part of the No Action Alternative. The total drawdown would be 10 feet in August. No graph or table is included for Rocky Coulee Reservoir because it would be a fully working reservoir, essentially filled and emptied each year.

Mitigation measures and cumulative impacts would be the same as those for Alternative 2A: Partial—Banks.

4.2.9.1 Short-Term Impacts
Implementation of this alternative would result in the same general short-term impacts as described for Alternative 3A:

Full—Banks. Short-term impacts associated with Rocky Coulee Reservoir would be the same as described for Alternative 2C: Partial—Banks + Rocky.

4.2.9.2 Long-Term Impacts

Columbia River

Implementation of this alternative would reduce flow in the Columbia River downstream of Lake Roosevelt. Reductions in flow are projected only when average monthly flow exceeds flow objectives set for the Columbia River. Table 4-3 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.

Compared to the No Action Alternative, the maximum projected reduction in flow would occur in October (all hydrologic conditions) and January (average hydrologic conditions). For the years shown, reduction in flow occurred in October and January because there was not water available that year in November or December. The reduction in flow in January in the average year selected is not representative of an average year but of the previous year (1994), which was a dry year. There would be no reduction in flow during July and August.

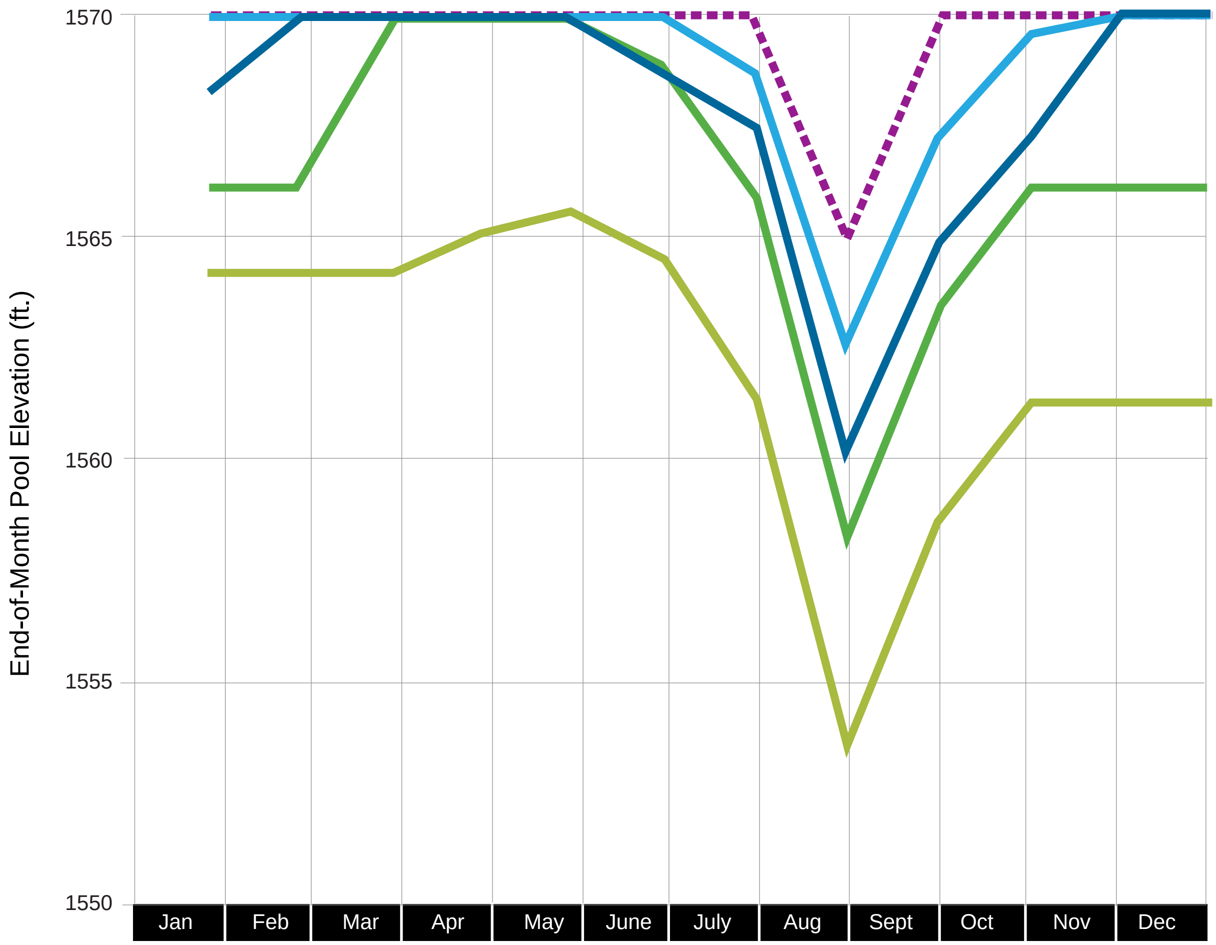
The difference in flow would be very small and represents 3.2 percent of the total Columbia River flow rate below Grand Coulee Dam during October. Following withdrawal of this water, flow rates would comply with instream flow objectives specified for the Columbia River. Minimal impacts would occur as a result of the projected reduction in flow in the Columbia River for any of the representative water year projections.

TABLE 4-13

Banks Lake Drawdown (feet) for Alternative 3C: Full—Banks + Rocky

Condition	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
No Action Alternative	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0
Wet Year												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	0.0	1.3	7.4	2.8	0.4	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	1.3	2.4	2.8	0.4	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*0.2*	*none*
Average Year												
Total Drawdown	1.7	0.0	0.0	0.0	0.0	1.0	2.4	10.0	5.2	2.8	0.0	0.0
Additional Drawdown Beyond No Action	1.7	0.0	0.0	0.0	0.0	1.0	2.4	5.0	5.2	2.8	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Dry Year												
Total Drawdown	3.9	3.9	0.0	0.0	0.0	1.1	4.1	11.8	6.6	3.8	3.8	3.8
Additional Drawdown Beyond No Action	3.9	3.9	0.0	0.0	0.0	1.1	4.1	6.8	6.6	3.8	3.8	3.8
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Drought Year												
Total Drawdown	5.8	5.8	5.8	4.9	4.3	5.5	8.6	16.6	11.5	8.8	8.8	8.8
Additional Drawdown Beyond No Action	5.8	5.8	5.8	4.9	4.3	5.5	8.6	11.6	11.5	8.8	8.8	8.8
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*

Drawdowns represent end-of-month levels for all months.



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 December end points should not be expected to "match up" with the January 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 3C - Average Year
- Alternative 3C - Wet Year
- Alternative 3C - Dry Year
- Alternative 3C - Drought Year
- No Action - Average, Wet, Dry, and Drought Years

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Figure 4-12
Banks Lake Drawdown (feet) for Alternative 3C: Full - Banks + Rocky

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Banks Lake

Compared to all other action alternatives, this alternative results in the second lowest projected water surface elevation, as shown on Figure 4-12 and Table 4-13.

Other Surface Water Features

Implementation of this alternative would result in the same general long-term impacts as described for Alternative 3A: Full—Banks. Long-term impacts associated with Rocky Coulee Reservoir would be the same as described for Alternative 2C: Partial—Banks + Rocky.

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 the East Low Canal, and would decrease in the Rocky Coulee Wasteway. In each case, the increased flowrate would be within the channel capacity and the impacts associated with the increase would be minimal.

Climate Change Analysis

Climate change effects for Lake Roosevelt and Banks Lake would be the same as those described for Alternative 2A: Partial—Banks. However, implementation of this alternative would reduce flow in the Columbia River downstream of Lake Roosevelt. Based on analysis of the four representative conditions (wet, average, dry, and drought), climate change would affect the water available in the Columbia River for the drought and average conditions resulting in additional reductions in flow.

As compared to Alternative 3C: Full—Banks + Rocky, without any consideration of climate change, both climate change scenarios (2040_A1B and 2040_B1) would further impact flow rates in the Columbia River as described below:

- Average—Flow further reduced by 1.8 percent (B1) in November, reduced by 2.4 percent (A1B) in December, and increased by 2.8 percent (A1B and B1) in January
- Drought—Flow further reduced by 1.5 percent (B1) in November

During November, December, and January, flow objectives specified in the Biological Opinion (NMFS 2008 BO) are still achieved with the flow reductions analyzed for climate change.

4.2.10 Alternative 3D: Full—Combined

Figures 4-13 and 4-14 illustrate the annual drawdown patterns at Banks Lake and Lake Roosevelt for Alternative 3D: Full—Combined in average and dry conditions. Maximum drawdown expected in very rare conditions is also shown. Tables 4-14 and 4-15 specify the additional drawdown at these reservoirs beyond the No Action Alternative.

Alternative 3D: Full—Combined would result in an average additional drawdown of 3 feet at Banks Lake each year, beyond the 5 feet of drawdown for summer fish flow augmentation that is part of the No Action Alternative. The total maximum drawdown at Banks would be 8 feet at the end of August. The additional drawdown at Lake Roosevelt in August of an average year would only be 0.9 feet beyond the No Action Alternative drawdown of 11.0 feet, bringing the total drawdown to 11.9 feet. Rocky Coulee Reservoir would be nearly or fully emptied each year.

TABLE 4-14

Banks Lake Drawdown (feet) for Alternative 3D: Full—Combined

Condition	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
No Action Alternative	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0
Wet Year												
Total Drawdown	0.0	0.0	0.0	0.0	0.6	3.0	3.0	8.0	5.0	2.6	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.6	3.0	3.0	3.0	5.0	2.6	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Average Year												
Total Drawdown	0.0	0.0	0.0	0.0	0.7	1.7	3.0	8.0	5.0	2.6	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.7	1.7	3.0	3.0	5.0	2.6	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Dry Year												
Total Drawdown	0.0	0.0	0.0	0.0	0.0	1.1	3.0	8.0	5.0	2.4	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	1.1	3.0	3.0	5.0	2.4	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Drought Year												
Total Drawdown	4.6	4.6	4.6	4.6	4.6	4.6	4.6	8.0	5.0	3.0	0.0	0.0
Additional Drawdown Beyond No Action	4.6	4.6	4.6	4.6	4.6	4.6	4.6	3.0	5.0	3.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*

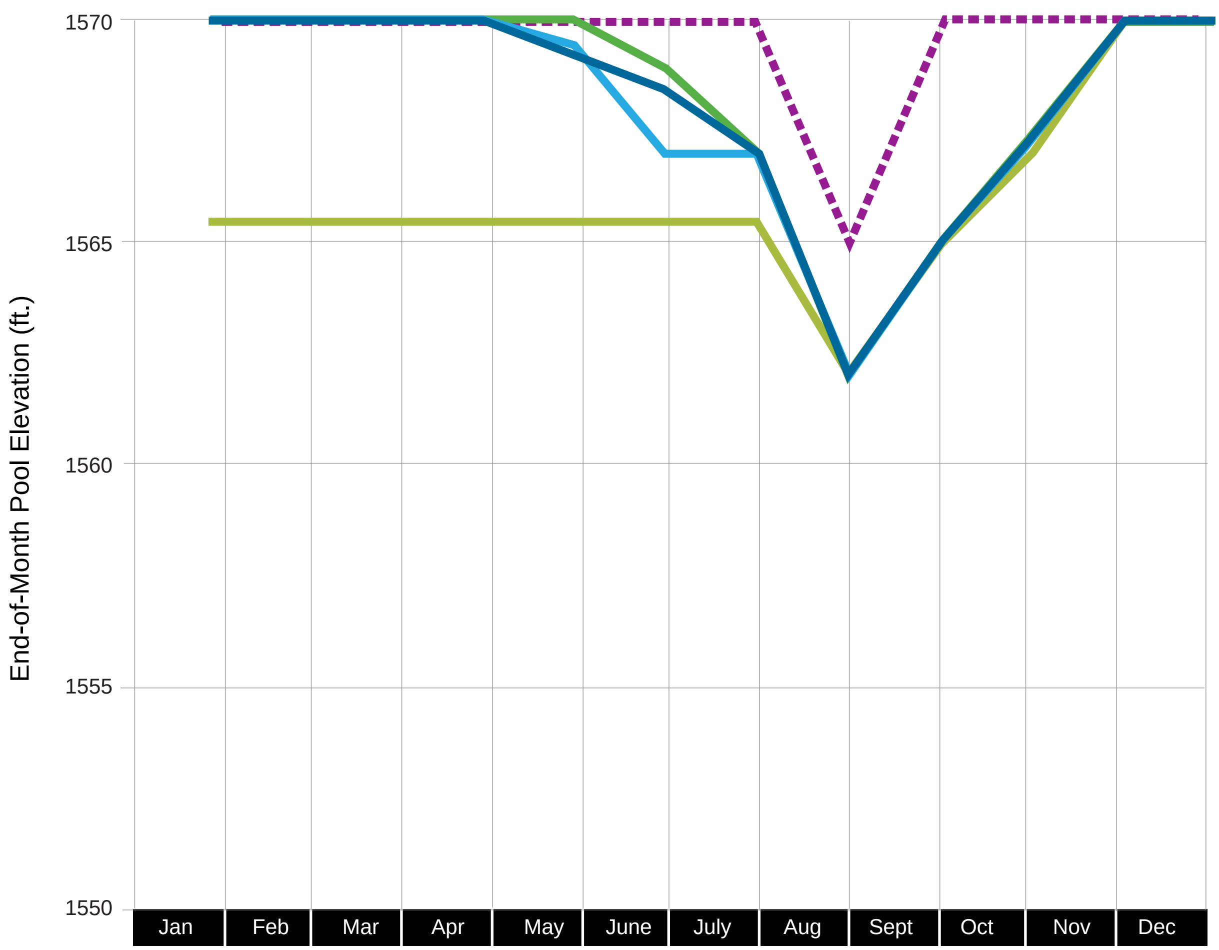
Drawdowns represent end-of-month levels for all months.

TABLE 4-15

Lake Roosevelt Drawdown (feet) for Alternative 3D: Full—Combined

Condition	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Wet Year												
Total Drawdown with No Action Alternative	30.0	23.4	46.1	70.1	64.8	35.9	0.5	11.0	5.1	2.1	0.0	0.0
Total Drawdown with Alternative 3D	30.0	23.4	46.1	70.1	64.8	36.0	1.0	11.9	5.5	2.1	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.1	0.5	0.9	0.4	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Average Year												
Total Drawdown with No Action Alternative	29.2	40.0	4.38	70.1	57.5	0.3	0.5	11.0	5.1	2.1	0.0	0.0
Total Drawdown with Alternative 3D	29.9	40.0	43.8	70.1	57.5	0.3	0.6	11.9	5.4	2.1	0.0	0.0
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.3	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Dry Year												
Total Drawdown with No Action Alternative	10.1	12.6	35.0	41.5	1.5	0.6	5.8	13.0	5.1	2.1	10.4	18.6
Total Drawdown with Alternative 3D	10.1	12.6	35.0	41.5	1.5	0.6	6.2	14.2	5.6	2.1	10.4	18.6
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.2	0.5	0.0	0.0	0.0
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*
Drought Year												
Total Drawdown with No Action Alternative	11.1	13.3	19.0	24.7	1.3	1.1	6.3	13.8	5.1	2.1	15.1	20.3
Total Drawdown with Alternative 3D	11.1	13.3	19.0	24.7	1.3	1.4	7.7	16.1	6.7	2.9	16.0	21.2
Additional Drawdown Beyond No Action	0.0	0.0	0.0	0.0	0.0	0.4	1.4	2.3	1.7	0.8	0.9	0.9
Potential Influence of Climate Change	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*	*none*

Drawdowns represent end-of-month levels for all months.



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 December end points should not be expected to "match up" with the January 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 3D - Average Year
- Alternative 3D - Wet Year
- Alternative 3D - Dry Year
- Alternative 3D - Drought Year
- No Action - Average, Wet, Dry, and Drought Years

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Figure 4-13
Banks Lake Drawdown (feet) for Alternative 3D: Full - Combined

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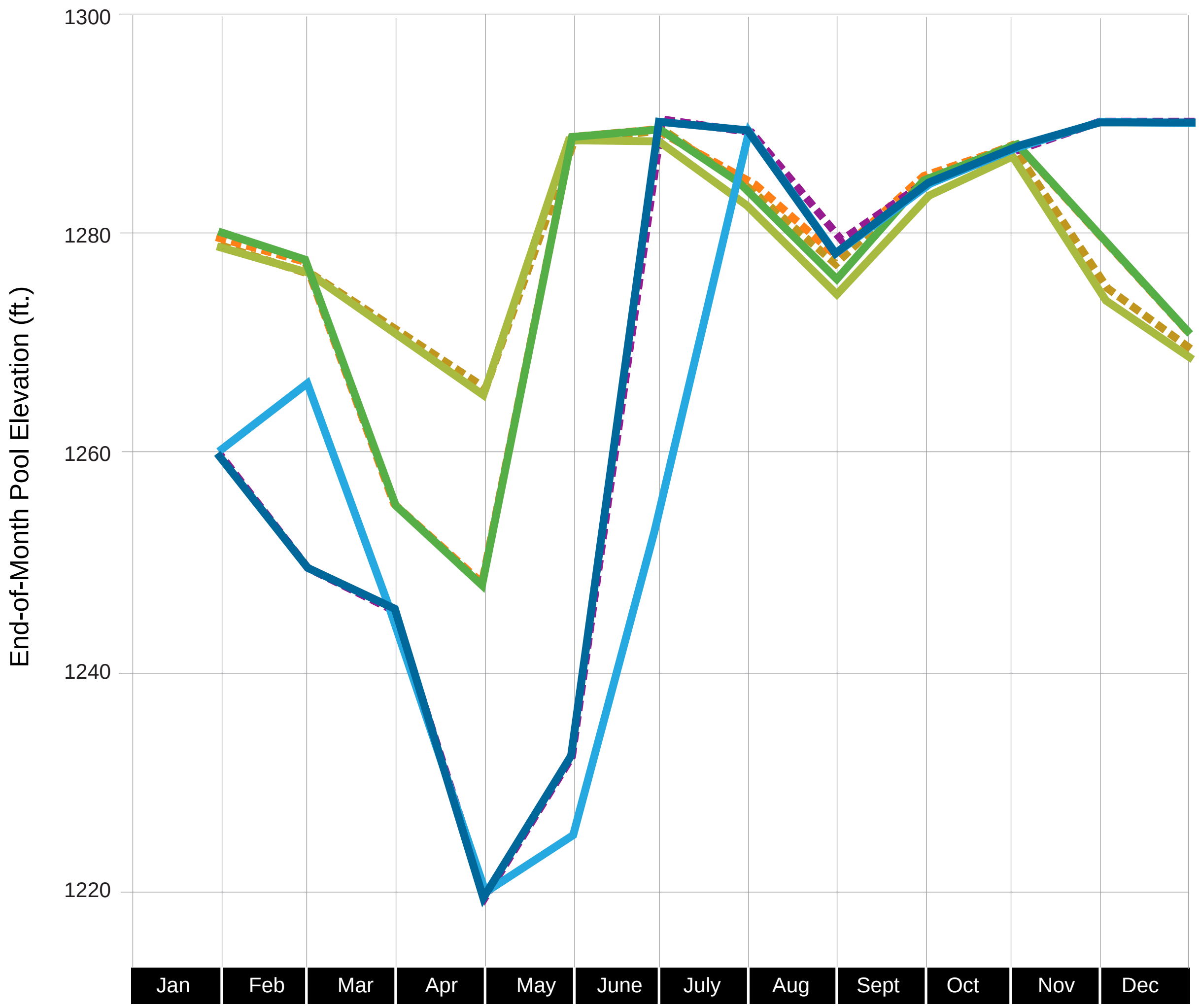

NOTES

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 December end points should not be expected to "match up" with the January 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 3D - Average Year
- Alternative 3D - and No Action Wet Year
- Alternative 3D - Dry Year
- Alternative 3D - Drought Year
- No Action Average Year
- No Action Dry Year
- No Action Drought Year

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Figure 4-14

Lake Roosevelt Drawdown (feet) for Alternative 3D: Full - Combined

WB082009003BOI

Mitigation measures and cumulative impacts would be the same as those for Alternative 2A: Partial—Banks.

4.2.10.1 Short-Term Impacts

Implementation of this alternative would result in the same short-term impacts as described for Alternative 3C: Full—Banks + Rocky.

4.2.10.2 Long-Term Impacts

Lake Roosevelt

Long-term impacts from drawdown under this alternative would be a reduction in water levels in the reservoir, as shown on Figure 4-14 and Table 4-15.

The projected water levels would still be within the normal operating range of the lake. Other long-term impacts are the same as those described for Alternative 2B: Partial—Banks + FDR. Long-term impacts are not considered significant.

Columbia River

Implementation of this alternative would reduce flow in the Columbia River downstream of Lake Roosevelt. Reductions in flow are projected only when average monthly flow exceeds flow objectives set for the Columbia River. Table 4-3 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.

Compared to the No Action Alternative, the maximum projected reduction in flow would occur in October (all hydrologic conditions) and January (average hydrologic conditions). For the years shown, reduction in flow occurred in October and January because there was not water available that year in November or December. The reduction in flow in January in the average year selected is not representative of an average year but of the previous year (1994) which was a dry year. There would be no reduction in flow during July and August.

The difference in flow would be very small and represents 3.2 percent of the total Columbia River flow rate below Grand Coulee Dam during October. Following withdrawal of this water, flow rates would comply with instream flow objectives specified for the Columbia River. Minimal impacts would occur as a result of the projected reduction in flow in the Columbia River for any of the representative water year projections.

Banks Lake

As shown on Figure 4-13 and Table 4-14, there would be seasonal changes in reservoir water surface elevation for this alternative relative to the No Action Alternative for representative wet, average, dry, and drought years.

Other Surface Water Features

Implementation of this alternative would result in the same long-term impacts as described for Alternative 3C: Full—Banks + Rocky.

Climate Change Analysis

Climate change effects for Lake Roosevelt and Banks Lake would be the same as those described for Alternative 2A: Partial—Banks. However, implementation of this alternative would reduce flow in the Columbia River downstream of Lake Roosevelt. Based on analysis of the four representative conditions (wet, average, dry, and drought), climate change would affect the water available in the Columbia River for the drought and average conditions resulting in additional reductions in flow.

As compared to Alternative 3D: Full—Combined, without any consideration of climate change, both climate change scenarios (2040_A1B and 2040_B1) would further impact flow rates in the Columbia River as described below:

- Average—Flow further reduced by 1.8 percent (B1) in November and 2.8 percent (B1) in December
- Drought—Flow further reduced by 1.5 percent (B1) in November and 2.4 percent (B1) in December

During November, December, and January, flow objectives specified in the Biological Opinion (NMFS 2008 BO) are still achieved with the flow reductions analyzed for climate change.

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. In 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. In 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. Municipal and industrial users would experience a beneficial effect in some areas from all action alternatives as groundwater declines decrease.

Groundwater quality would be anticipated to experience a beneficial effect in some areas from all action alternatives. As groundwater pumping ends in areas south of I-90 under all action alternatives and areas north of I-90 under the full replacement alternatives, overall groundwater quality would not degrade further.

Seepage and shallow groundwater recharge associated with the new reservoirs would occur in all action alternatives except Alternatives 2A: Partial—Banks, and 2B: Partial—Banks + FDR, because no new reservoirs are constructed under those alternatives. Construction of Rocky Coulee Reservoir or 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 4-16 presents impact indicators and significance criteria for groundwater resources in the Study Area.

TABLE 4-16

Groundwater Resources Impact Indicators and Significance Criteria

Impact Indicator	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 land owner 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 stages (see Maps 2-4 and 2-8 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 stages in the action alternatives, and are shown on Maps 2-4 and 2-8. 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 partial and full replacement 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 a few feet of additional drawdown in Banks Lake and temporary fluctuations in groundwater levels.

Local recharge to shallow groundwater in the coulee walls and floors surrounding Rocky Coulee and 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 4.29, *Environmental Commitments*.

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 and quality. 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. 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—by approximately the year 2020—would include the following:

- 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 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 under the No Action Alternative would vary among the by proposed construction stage areas that are delineated for the action alternatives within the Study Area.

Table 4-17 summarizes the percentage of wells estimated to become unusable; 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 4-17

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 Stage	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 stage, the depth to groundwater tends to vary on the order of 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.

Adverse groundwater quality impacts under the No Action Alternative include continued decline in groundwater quality in the Grande Ronde aquifer, such as increasing groundwater temperatures, increases in dissolved solids, and potential for increased nitrates because of downward infiltration of applied irrigation water.

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 4-18 shows the average water level at the end of construction of each stage, including both the partial replacement alternatives south of I-90, and the full replacement alternatives north of I-90.

For this and all partial replacement alternatives (encompassing construction stages 1 through 4), it is anticipated that groundwater decline rates in the Grande Ronde aquifer would decrease, and groundwater levels in the higher Wanapum aquifer have the potential to rise because of infiltration from percolating irrigation water.

TABLE 4-18

Anticipated Levels of Groundwater Stabilization Following Implementation of Action Alternatives

Alternative	Construction Stage	Years After Initial Construction Begins	Average Groundwater Depth at End of Construction (feet bgs)[a,b]
	South of I-90		
Partial Groundwater Replacement Alternatives (2A to 2D)	1	4	472
	2	7	600
	3	8	677
	4	10	597
	North of I-90		
Additional Area Included with Full Groundwater Replacement Alternatives (3A to 3D)	5	5	431
	6	8	536
	7	10	518
	8	7	595
	9	10	563

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

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 176,300 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.

4.3.3.3 Mitigation

No mitigation measures are feasible for Alternative 2A: Partial—Banks, nor for any of the other action alternatives.

4.3.3.4 Cumulative Impacts

No cumulative impact concerns are present for groundwater resources under Alternative 2A: Partial—Banks, nor for any of the other action alternatives.

4.3.4 Alternative 2B: Partial—Banks + FDR

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as those described for Alternative 2A: Partial—Banks.

4.3.5 Alternative 2C: Partial—Banks + Rocky

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as under Alternative 2A: Partial—Banks, with the exception of Rocky Coulee Reservoir.

Construction of Rocky Coulee 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. When Rocky Coulee Reservoir is full, water would seep from the reservoir into the coulee walls and floor and become shallow groundwater. Conversely, when the reservoir is lowered to provide irrigation water, the local groundwater would become perched and would then discharge from the walls of the coulee as springs and seeps.

4.3.6 Alternative 2D: Partial—Combined

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks, with the exception of Rocky Coulee Reservoir. Beneficial effects on shallow groundwater in the vicinity of Rocky Coulee Reservoir would be the same as under Alternative 2C: Partial—Banks + Rocky.

4.3.7 Alternative 3A: Full—Banks

Short-term and cumulative impacts, as well as mitigation measures, 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 south of I-90 would be reconstructed in stages 1 through 4, and those north of I-90 would be constructed in stages 5 through 9 under all full replacement alternatives. 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 stages 1 to 9, are anticipated to decrease in the deeper Grande Ronde aquifer because of the elimination of discharge through pumpage.

Table 4-18 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 deep groundwater would occur under this alternative, as up to 347,000 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 by the end of September, 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.

4.3.8 Alternative 3B: Full—Banks + FDR

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 3A: Full—Banks.

4.3.9 Alternative 3C: Full—Banks + Rocky

Short-term, long-term, and cumulative impacts, as well as mitigation measures, to groundwater resources would be the same as Alternative 3A: Full—Banks, except for Rocky Coulee Reservoir. Beneficial effects on shallow groundwater resources in the vicinity of Rocky Coulee Reservoir would be the same as Alternative 2C: Partial—Banks + Rocky.

4.3.10 Alternative 3D: Full—Combined

Short-term, long-term, and cumulative impacts, as well as mitigation measures, to groundwater resources would be the same as Alternative 3A: Full—Banks, except for Rocky Coulee Reservoir. Beneficial effects on shallow groundwater resources in the vicinity of Rocky Coulee Reservoir would be the same as Alternative 2C: Partial—Banks + Rocky.

4.4 Surface Water Quality

The surface water quality analysis addresses the potential effects on temperature, dissolved oxygen, total dissolved gas, pH, nutrients, and heavy metals in the following systems:

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

The No Action Alternative would have no impact on Lake Roosevelt, Banks Lake, or the Columbia River downstream of Grand Coulee Dam. The analysis area irrigation network would experience a beneficial effect from decreased delivery of pesticides and fertilizers to the canal and drain system if lands go out of agricultural production.

Lake Roosevelt water quality, particularly temperature, dissolved oxygen, total dissolved gas, and heavy metals, would generally experience only a minimal impact from any of the action alternatives. Additional drawdown in Lake Roosevelt would be greatest in Alternative 3B: Full—Banks + FDR, but even then, impacts to water quality would be minimal.

Banks Lake water quality, particularly temperature and dissolved oxygen, would be significantly impacted under all of the action alternatives except Alternative 2C: Partial—Banks + Rocky. The action alternatives would have a minimal impact on turbidity because erosive forces would be distributed over a range of bank elevations. Additional drawdown in Banks Lake, and its corresponding adverse impacts on temperature and dissolved oxygen, would be greatest in Alternative 3A: Full—Banks and Alternative 3C: Full—Banks + Rocky.

Water quality in the Columbia River downstream of Grand Coulee Dam, particularly temperature and total dissolved gas, would experience only a minimal impact from any of the action alternatives. Additional flow reductions in the Columbia River, and the potential for temperature and total dissolved gas to be impacted, would be greatest under Alternative 3A: Full—Banks, Alternative 3C: Full—Banks + Rocky, and Alternative 3D: Full—Combined.

Analysis area irrigation network water quality would not be impacted to a great extent by any of the action alternatives. No impacts would be anticipated for temperature or nutrients, a minimal impact would be anticipated for pH, and a beneficial effect would be anticipated for salinity. Resulting surface water quality differences between the different action alternatives would be negligible.

4.4.1 Methods and Assumptions

4.4.1.1 Impact Indicators and Significance Criteria

Table 4-19 presents impact indicators and significance criteria for water quality.

TABLE 4-19

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 substantial resource degradation, assumed to occur if the decrease in water column thickness exceeds 5 percent, is considered significant.
Columbia River: temperature and TDG	An exceedance of a state water quality standard or substantial resource degradation, assumed to occur if the decrease in summer flow temperature implications exceeds 5 percent or if an increase in flow at any time throughout the year exceeds 3 percent (TDG implications), is considered significant.
Analysis area irrigation network: temperature, pH, salinity, pesticides, nutrients	An exceedance of a state water quality standard is considered significant.

[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

A comprehensive water quality model has not been developed for Lake Roosevelt, so anticipated impacts resulting from the action alternatives were assessed in a qualitative fashion similar to the *Final Supplemental Environmental Impact Statement for the Lake Roosevelt Incremental Storage Releases Program* (Ecology 2008).

Hydrologic modeling results for wet, average, dry, and drought conditions are presented in greater detail in Chapter 2, Section 2.2.2, *River and Reservoir Operational Changes and Hydrology under the Action Alternatives*. This analysis focuses on the condition 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. Water volume and depth, which often dictate water quality in reservoirs, are directly correlated with drawdown. Differences in drawdown 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 metals).

Banks Lake

A comprehensive water quality model has not been developed for Banks Lake, so anticipated impacts resulting from the action alternatives were assessed in a qualitative fashion similar to the *Banks Lake Drawdown Final Environmental Impact Statement* (Reclamation 2004). Drawdown results from spreadsheet analyses were used to evaluate anticipated impacts to the Banks Lake target water quality parameters (temperature, dissolved oxygen, and turbidity).

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 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 from a representative average year were evaluated for this analysis.

Analysis Area Irrigation Network
The action alternatives would replace groundwater as the irrigation source with surface water delivered from Lake Roosevelt, through Banks Lake, to the facilities within the CBP. The action alternatives would not alter land use practices or the amount of water used on the farms for agricultural purposes, so return flow regimes (volume and timing) of the drains and Crab Creek are not anticipated to change. Consequently, the only reason water quality would be impacted 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, *Analysis Area Irrigation Network*.

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 4.29, *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 thoroughly explained in Chapter 3, Section 3.4, *Surface Water Quality*.

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 4.29, *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 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.

The analysis area irrigation network would be beneficially affected in the long term by the No Action Alternative if groundwater continues to be depleted at its current rate. If 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. Later, as groundwater supplies decline further, irrigated lands would be converted to dryland crops. Surface water quality in the analysis area irrigation network would improve slightly, a beneficial effect, because pesticides and fertilizers would not be as easily conveyed to the canal and drain system.

Water quality standards for some of the target parameters in Lake Roosevelt, Banks Lake, the Columbia River Downstream of Grand Coulee Dam, and the analysis area irrigation network are currently being exceeded under the existing condition. The No Action Alternative would not resolve these issues and exceedances would likely continue into the foreseeable 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 those features. Short-term impacts to the analysis area 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.

Banks Lake

Projected Banks Lake drawdowns for the No Action Alternative and the action alternatives are presented in Chapter 2 under each alternative description. Significant impacts on temperature and dissolved oxygen are anticipated to occur under this alternative. Only minimal impacts on turbidity would occur.

Alternative 2A: Partial—Banks would feature significantly greater drawdown than the No Action Alternative. Maximum drawdown would occur during August of the representative dry year simulation, when the projected drawdown would increase from 5.0 feet for the No Action Alternative to 9.8 feet for this alternative. The reservoir has an average depth of approximately 41 feet at full pool (Reclamation 2004), so average water column thickness during August would decrease from 36 feet for the No Action alternative to 31.2 feet for this alternative. This 13 percent decrease in water column thickness represents a significant decrease in reservoir volume that would likely result in elevated average temperatures, and the vertical temperature profile would shift downward an additional 4.8 feet (eliminating the bottom 4.8 feet from the No Action Alternative profile). By comparison, projected drawdown for the representative average water year condition would result in a relative decrease in the average water column thickness of 9 percent. Warming is especially likely to occur in shallow embayments that experience a greater relative decrease in water column thickness (that is, a bay with only 10 feet of water under the No Action Alternative would experience a relative decrease of nearly 50 percent of its thickness under this alternative during the drought condition).

Temperature stratification in the reservoir is driven by mixing processes, so the stratification regime observed under the No Action Alternative would not be likely to change if pumping (from Lake Roosevelt) and discharge (from Dry Falls Dam at the south end of Banks Lake) schedules remain the same. Temperature of the irrigation water sent to the CBP through a bottom release at Dry Falls Dam would not be likely to change significantly, despite the downward temperature profile shift, because water temperatures near the bottom of the reservoir tend to be fairly uniform.

Outflow from Banks Lake would be increased to supply irrigation water to the Study Area under this alternative, resulting in the greater drawdown described above. Increased outflow would reduce the hydraulic residence time and, relative to the No Action Alternative, would provide less time for the water to be warmed by solar radiation. Consequently, some of the warming caused by increased drawdown would be negated by decreased residence time, but the degree of offset would be difficult to predict.

Although Banks Lake is not currently listed as temperature-impaired by the State, apparent temperature criteria exceedances occur under existing conditions and would be expected to continue (refer to Section 3.4.3.1, *Temperature*). Significant temperature impacts for this alternative would be anticipated based on the established significance criteria (additional relative drawdown would exceed 5 percent).

Banks Lake is not currently listed as dissolved oxygen-impaired by the state, but apparent criteria exceedances occur under existing conditions and would be expected to continue (refer to Section 3.4.3.2, *Dissolved Oxygen*). Significant dissolved oxygen impacts for this alternative, beyond the No Action Alternative, would be anticipated because the temperature increase would further decrease dissolved oxygen concentrations and would likely cause additional standards exceedances.

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 only a minimal impact on turbidity because the drawdown for this alternative would be spread over several months and erosive forces would be distributed over a range of bank elevations.

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 very small reductions in flow are anticipated to have only minimal 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 an average increase of 41 cfs in March to an average decrease of 1,299 cfs in October for the average water condition, with no projected change to flows during the temperature-critical summer months. The largest flow change in flow would occur in October when flows from this alternative would decrease relative to the No Action Alternative flows, as follows for the average condition:

- 1.8 percent at Grand Coulee
- 1.8 percent at Chief Joseph
- 1.6 percent at Priest Rapids
- 1.3 percent at Bonneville

These small reductions in flow are anticipated to have a minimal impact on water temperature during the fall when air temperatures are relatively cool. The flow reductions resulting from this alternative would also have a minimal impact on TDG and may even decrease TDG concentrations by reducing the need for emergency dam spills. The potential impact 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 to be minimal at most and were not further evaluated.

Analysis Area Irrigation Network

Within the irrigation network, no impacts would be anticipated for temperature or nutrients, a minimal impact would be anticipated for pH, and a beneficial effect would be anticipated for salinity under this alternative.

This alternative would feature conversion of the irrigation water source from groundwater to surface water on lands south of I-90. Instead of being pumped from wells, surface water would be released from Banks Lake for distribution through the East Low Canal and a network of pipelines. The new irrigation water source would transform from groundwater quality characteristics (primarily from the deeper Grande Ronde aquifer) to the surface water quality characteristics presented in Chapter 3, Table 3-7, *Surface Water and Groundwater Quality in the Study Area*. 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 or flood methods, the water likely equilibrates with the environment as it percolates through the soil and eventually returns to the 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 (refer to Chapter 3, Table 3-4, *Target Parameter Water Quality Standards for the Analysis Area Irrigation Network*), 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 a minimal impact on 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 saline 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; Richards 1954, as cited in 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 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.

4.4.3.3 Mitigation

No water quality mitigation measures are recommended for Lake Roosevelt, the Columbia River downstream of Grand Coulee Dam, or the analysis area irrigation network for this or any of the alternatives because the long-term impacts were not considered significant. The long-term impacts to Banks Lake would be significant based on current standards, but mitigation measures intended to decrease temperatures and increase dissolved oxygen have limited effectiveness on a broad scale and are not recommended.

4.4.3.4 Cumulative Impacts

No cumulative impacts on water quality were identified.

Photograph 4-2.
Uses adjacent to waterways could potentially contribute to water quality issues in the study area irrigation network, but these impacts would be governed by State water quality regulations.

4.4.4 Alternative 2B: Partial—Banks + FDR

Short-term and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.4.4.1 Long-Term Impacts

Lake Roosevelt

Minor changes in the operation of Lake Roosevelt that would result in a small decrease in water column thickness would have a minimal impact on temperature, total dissolved gas, dissolved oxygen concentrations, and resuspension of heavy metals. 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 and other water quality parameters) would occur during August of the representative drought year simulation, when drawdown would increase from 13.8 feet for the No Action Alternative to 14.3 feet for this alternative. The vertical temperature profile would shift downward approximately 0.5 feet (eliminating the bottom 0.5 feet 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 column thickness 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 percent. For comparison, the representative dry and average water years would also be projected to have an additional 0.5 feet of drawdown, although the relative decrease in water column thickness would be negligibly smaller.

Additional re-suspension of sediment-bound metals (zinc, lead, copper, arsenic, cadmium, and mercury), which were primarily derived from 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 sediment would be exposed to erosive wave forces. Consequently, only a minimal impact from resuspension of sediment-bound heavy metals would occur.

Banks Lake

Water quality impacts at Banks Lake under this alternative would be significant. This alternative would feature maximum projected drawdown during August of the representative drought, dry, and average year simulations, when the average water column thickness would decrease by approximately 8 percent 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. However, because the relative additional drawdown is greater than 5 percent, temperature and dissolved oxygen impacts would still be considered significant.

Columbia River Downstream of Grand Coulee Dam

This alternative would feature maximum projected flow reductions ranging from 1.4 percent (at Bonneville) to 2.0 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.

Analysis Area Irrigation Network

Impacts and benefits would be the same as described in Alternative 2A: Partial—Banks.

4.4.5 Alternative 2C: Partial—Banks + Rocky

Short-term and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.4.5.1 Long-Term Impacts

Lake Roosevelt

No long-term impacts would be anticipated for this alternative because no additional water would be withdrawn from Lake Roosevelt during the critical summer months.

Banks Lake

The small decreases in water column thicknesses for the dry, drought, and average conditions would have a minimal impact on temperature, dissolved oxygen concentrations, and turbidity. This alternative would feature a decrease in the average water column thickness of 1.4 percent for the representative dry and drought water year simulations and 0.3 percent for the representative average year simulation relative to the No Action Alternative.

Columbia River Downstream of Grand Coulee Dam
This alternative would feature maximum projected flow reductions ranging from 1.4 percent (at Bonneville) to 2.0 percent (at Grand Coulee) for the representative average year compared to the No Action Alternative, and only minimal impacts would be anticipated for this alternative, as described for Alternative 2A: Partial—Banks.

Analysis Area Irrigation Network
Impacts and benefits would be the same as described in Alternative 2A: Partial—Banks.

4.4.6 Alternative 2D: Partial—Combined

Short-term and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.4.6.1 Long-Term Impacts

Lake Roosevelt
The 0.2 percent decrease in water column thickness relative to the No Action Alternative would have only a minimal impact on water quality.

Banks Lake
The impacts of this alternative would be the same as Alternative 2B: Partial—Banks + FDR during August, but drawdown (with its corresponding water quality impacts) for this alternative would be more prolonged through the spring and would be greater in September.

Columbia River Downstream of Grand Coulee Dam
This alternative would feature maximum projected flow reductions ranging from 0.8 percent (at Bonneville) to 1.5 percent (at Grand Coulee) for the representative average year compared to the No Action Alternative, and only minimal impacts would be anticipated for this alternative, as described for Alternative 2A: Partial—Banks.

Analysis Area Irrigation Network
Impacts and benefits would be the same as described in Alternative 2A: Partial—Banks.

4.4.7 Alternative 3A: Full—Banks

Short-term and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.4.7.1 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.

Banks Lake
Significant impacts on temperature and dissolved oxygen would occur during the August drawdown of Banks Lake. This alternative would feature maximum projected drawdown during August of the representative drought year simulation, when the average water column thickness would decrease by approximately 37 percent compared to the No Action alternative. Projected drawdown during the representative average year would result in a relative decrease of 24 percent.

Significant temperature impacts would be anticipated from the large drawdown associated with this alternative during representative drought, dry, and average years, and significant dissolved oxygen impacts would be anticipated because of the increase in temperature. Lower shoreline elevations would be exposed to erosive forces and some additional turbidity would be generated, but only minimal turbidity impacts would be anticipated because drawdown would occur over 12 months and the bank elevation subjected to erosion would vary.

Columbia River Downstream of Grand Coulee Dam
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 would be anticipated for this alternative, as described for Alternative 2A: Partial—Banks.

Analysis Area 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 south and north of I-90).

4.4.8 Alternative 3B: Full—Banks + FDR

Short-term and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.4.8.1 Long-Term Impacts

Lake Roosevelt
This alternative would feature a decrease in the average water column thickness of 3.3 percent during the representative drought year simulation and 2.1 percent during the representative average year simulation relative to the No Action Alternative during August. The decreases in water column thicknesses under both conditions would cause a slight increase in water temperature that subsequently causes a small decrease in dissolved oxygen concentrations. However, Lake Roosevelt is already 303(d)-listed for exceedances of the State's temperature and dissolved oxygen standards, and this alternative would not be anticipated to substantially degrade the resource. Furthermore, only a minimal impact on total dissolved gas would be anticipated and additional resuspension of sediment-bound metals would be unlikely, so although this alternative would adversely impact water quality in Lake Roosevelt, those impacts would not be anticipated to be significant.

Banks Lake
The impacts of this alternative would be the same as 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 be experienced throughout the rest of the year. Impacts outside of the critical summer months, when temperature and dissolved oxygen are most easily affected, would likely be minimal.

Columbia River Downstream of Grand Coulee Dam
This alternative would feature maximum projected flow reductions ranging from 1.6 percent (at Bonneville) to 2.7 percent (at Grand Coulee) for the representative average year compared to the No Action Alternative, and only minimal impacts would be anticipated for this alternative, as described for Alternative 2A: Partial—Banks.

Analysis Area Irrigation Network
Impacts and benefits would be the same as described for Alternative 3A: Full—Banks.

4.4.9 Alternative 3C: Full—Banks + Rocky

Short-term and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.4.9.1 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.

Banks Lake

This alternative would feature maximum projected drawdown during August of the representative drought year simulation, when the average water column thickness would decrease by approximately 32 percent compared to the No Action Alternative. Projected drawdown during the representative average year would result in a relative decrease of 14 percent. The temperature and dissolved oxygen impacts under this alternative would be significant dissolved oxygen for the drought, dry, and average conditions and would be similar to Alternative 3A: Full—Banks, except that drawdown (with its corresponding water quality impacts) for this alternative would be slightly less from June through August and greater throughout the remainder of the year.

Columbia River Downstream of Grand Coulee Dam

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 would be anticipated for this alternative, as described for Alternative 2A: Partial—Banks.

Analysis Area Irrigation Network

Impacts and benefits would be the same as described for Alternative 3A: Full—Banks.

4.4.10 Alternative 3D: Full—Combined

Short-term and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.4.10.1 Long-Term Impacts

Lake Roosevelt

Only minimal impacts on water quality are anticipated. This alternative would feature a decrease in the average water column thickness of 2.2 percent during the representative drought year simulation and 0.7 percent during the representative average year simulation relative to the No Action Alternative during August. The minimal impacts would likely be the same as those of Alternative 3B: Full—Banks + FDR, although temperatures would increase slightly less and dissolved oxygen concentrations would decrease slightly less because of slightly reduced drawdown in this alternative.

Banks Lake

This alternative would feature maximum projected drawdown during August of the representative dry, drought, and average year simulations, when the average water column thickness would decrease by approximately 8 percent compared to the No Action alternative. The impacts of this alternative would be the same as Alternative 3B: Full—Banks + FDR during August, but a greater amount of drawdown (with its corresponding water quality impacts) for this alternative would be experienced throughout most of the remainder of the year. Impacts outside of the critical summer months, when temperature and dissolved oxygen are most easily affected, would likely be minimal.

Columbia River Downstream of Grand Coulee Dam
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 would be anticipated for this alternative, as described for Alternative 2A: Partial—Banks.

Analysis Area Irrigation Network
Impacts and benefits would be the same as described for Alternative 3A: Full—Banks.

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 doesn't allow its use except in temporary emergency situations, as described below.

4.5.1 Methods and Assumptions

Anticipated impacts to water rights were evaluated in this Draft 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 water 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 4-20 lists the significance criteria for each of the study indicators.

TABLE 4-20

Water Rights Impact Indicators and Significance Criteria

Impact Indicator	Significance Criteria
Columbia River and Lake Roosevelt Tribal Water Rights	1) If minimum reservoir levels during the irrigation season make access infeasible 2) If additional drawdowns result in increased withdrawal costs
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 would be impacted (for example, pumping or intake locations). This analysis compares modeled water levels under each action alternative to the No Action Alternative during the representative dry year, since during drought periods the reservoir is typically held closer to full pool during much of the irrigation season. It is assumed that any additional drawdowns within approximately 2 feet of the No Action Alternative have a minimal impact on accessibility of the water.

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 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 no new facilities would be constructed under this alternative.

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 for 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 for 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 only 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 for 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. This alternative would only result in additional drawdowns of storage from Banks Lake, which has no competing senior water rights. Therefore, no significant impacts would be associated with water rights generating from the source of the water.

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. 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 doesn't allow its use.

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 surface irrigation water is provided, existing groundwater rights would be eclipsed by a superseding permit that provides new rules for use. 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 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 doesn't allow its use. This would not be considered to be a significant impact.

4.5.3.3 Mitigation

No mitigation measures would be required for Alternative 2A: Partial—Banks, nor for any of the other action alternatives.

4.5.3.4 Cumulative Impacts

No cumulative impact concerns are present for Water Rights under Alternative 2A: Partial—Banks, nor for any of the other action alternatives.

4.5.4 Alternative 2B: Partial—Banks + FDR

Short-term and cumulative 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. Under normal operations during average to wet years, Lake Roosevelt is typically held at lower levels (19 to 70 feet below full pool elevation) throughout the early 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 2C: Partial—Banks + Rocky

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as those described for Alternative 2A: Partial—Banks.

4.5.6 Alternative 2D: Partial—Combined

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as those described for Alternative 2A: Partial—Banks.

4.5.7 Alternative 3A: Full—Banks

Short-term and cumulative impacts, as well as mitigation measures, 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 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. As is the case with Alternative 2A: Partial—Banks, if surface irrigation water is provided, existing groundwater rights would be eclipsed by a superseding permit that provides new rules for use. 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. 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 doesn’t allow its use. This would not be considered to be a significant impact.

4.5.8 Alternative 3B: Full—Banks + FDR

Short-term and cumulative impacts, as well as mitigation measures, 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. Under normal operations during normal to wet years, Lake Roosevelt is typically held at lower levels (19 to 70 feet below full pool elevation) throughout the early irrigation season. 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.

4.5.9 Alternative 3C: Full—Banks + Rocky

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as those described for Alternative 2A: Partial—Banks.

4.5.10 Alternative 3D: Full—Combined

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as those described for Alternative 2A: Partial—Banks.

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 Rocky Coulee Reservoir Dam or 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 4-21 presents impact indicators and significance criteria for geological resources in the Study Area.

TABLE 4-21

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 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 4.29, *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 4.29, *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 (45 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.

4.6.3.3 Mitigation

Because the impacts to geologic resources are not anticipated to be significant, no mitigation measures are required.

4.6.3.4 Cumulative Impacts

No cumulative impacts for geology have been identified.

4.6.4 Alternative 2B: Partial—Banks + FDR

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.6.5 Alternative 2C: Partial—Banks + Rocky

Cumulative impacts and mitigation measures would be the same as Alternative 2A: Partial—Banks.

4.6.5.1 Short-Term Impacts

No short-term impacts to geologic resources because of canal expansion and extension are anticipated. However, construction of the Rocky Coulee Dam and Reservoir would require clearing and grubbing the dam footprint, excavating the abutments, and excavating and hauling materials to build the dam and facilities.

4.6.5.2 Long-Term Impacts

Borrow materials would be taken from the proposed Rocky Coulee Reservoir area, which would later be flooded. The reservoir would be formed by an earth-filled dam in Rocky Coulee, with a volume estimated to be approximately 4.5 million cubic yards. Construction of the dam would result in the consumption of raw materials as described under Alternative 2A: Partial—Banks. Construction materials are not anticipated to be in short supply. Borrow materials from the reservoir inundation area could be used to build the dam; with stockpile areas located within the reservoir acquisition area. Therefore, when the reservoir is full the impact of the excavations would be covered and would be minimal.

4.6.6 Alternative 2D: Partial—Combined

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2C: Partial—Banks + Rocky.

4.6.7 Alternative 3A: Full—Banks

Cumulative impacts and mitigation measures would be the same as Alternative 2A: Partial—Banks.

4.6.7.1 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.

4.6.7.2 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. The reservoir would be constructed to manage water delivery and distribute water. Construction of the dam would result in the consumption of raw materials as described under Alternative 2C: Partial—Banks + Rocky. 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 covered and would be minimal.

4.6.8 Alternative 3B: Full—Banks + FDR

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 3A: Full—Banks.

4.6.9 Alternative 3C: Full—Banks + Rocky

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 3A: Full—Banks. Short-term and long-term impacts associated with the construction of the Rocky Coulee Reservoir would be the same as described under Alternative 2C: Partial—Banks + Rocky.

4.6.10 Alternative 3D: Full—Combined

Long-term, short-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 3A: Full—Banks. Short-term and long-term impacts associated with the construction of the Rocky Coulee Reservoir would be the same as described under Alternative 2C: Partial—Banks + Rocky.

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. Long-term impacts would occur under the No Action Alternative, specifically related to a shift from irrigated farmland to dryland farming. These would be a minimal impact.

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 also 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 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, as a result 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 related to erosion would occur under all of the action alternatives. Consistent with short-term impacts, legal requirements, BMPs, and mitigation measures would minimize these impacts. State-important farmland and unique farmland would be permanently taken out of production under all of the action alternatives. The extent of this impact would vary, with more impact occurring under the full replacement alternatives. Additional land would be taken out of production for alternatives including Rocky Coulee Reservoir. 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. Table 4-22 presents the resource indicators and significance criteria that have been identified for soils.

TABLE 4-22

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 on soils are as follows:

- Site-specific spatial and soil characteristic data, including the SSURGO 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 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.
- Soil characteristics within the drawdown zones at Banks Lake were evaluated to determine if water or wind erosion would be an issue at those locations.
- Constraints of soil characteristics on construction or operation of facilities, including susceptibility to erosion and compaction, were identified. Soil constraints that would impede revegetation or result in excessive erosion were identified. Erosion susceptibility and estimates of erosion potential on currently irrigated lands under the No Action Alternative and partial replacement alternatives were identified.

Relatively high sodium levels occur in groundwater used for irrigation in parts of the study area, creating soil sodicity conditions that can impact soil productivity and crop yields. Although less of an issue under current conditions, relatively high salinity levels also occur within some groundwater sources in the study area, which can reduce crops yields to varying degrees depending upon crop selection and irrigation management. 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. Groundwater quality data were used to estimate the distribution and extent of potential soil sodicity issues within the study area. The possible significance of this issue could not be assessed because of the limited data availability.

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 4.29, *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 4.29, *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 Study complies with FPPA because it does not change the use of land from farmland to uses that are not compatible with agriculture, as described in Chapter 5, *Consultation and Coordination*.

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 4.29, *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 framing. 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 would impact surface water quality as more sediment is deposited into local water ways.

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 (Personal communications with H. Gimmestad, O. Johnson and E. Stahl). Therefore, yields could be reduced for a long period of time 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 4,023 acres of soil susceptible to wind or water erosion would be temporarily cleared during construction (Chapter 3, Table 3-9, *Acres of Soil with Potential Soil Limitations*). Application of erosion control BMPs would minimize offsite movement of sediment until new vegetation becomes established on temporarily disturbed lands. The land would be put back into production following construction. Approximately 2,500 of the 4,000 acres disturbed during construction is currently in irrigated or dryland agriculture. Most of this land could be returned to production when facilities (mostly pipelines) are installed.

Of the 2,500 acres of agricultural land temporarily taken out of production, approximately 1,216 acres and 79 acres are designated as state-important and unique farmland, respectively, and 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 588 acres of soil susceptible to wind or water erosion would be permanently impacted during construction (see Table 4-23). 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.

TABLE 4-23

Permanent and Temporary Soil Impacts Resulting from Implementation of Partial Replacement Action Alternatives

Impact Type	Alternatives/Impacted Acres over 10 Years							
	2A: Partial—Banks		2B: Partial—Banks + FDR		2C: Partial—Banks + Rocky		2D: Partial—Combined	
	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary
Erosion	588	4,023	588	4,023	777	3,365	777	4,026
Compaction	0	0	0	0	6	0	6	0
Productivity	168	267	168	267	946	267	946	267
State-important farmland	255	1,216	255	1,216	1,141	1,216	1,141	1,216
Unique farmland	56	79	56	79	1,368	79	1,368	79

Note: All impacts would occur incrementally over an estimated 10-year construction period.

Special Status Soil and Soil Productivity Loss

Approximately 255 and 56 acres of State-important farmland and unique farmland, respectively, would be permanently taken out of production (Table 4-23). Soil productivity would be lost when productive land is permanently removed from the agricultural land base. For purposes of this analysis, 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, 168 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, 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.

Photograph 4-3.
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. Based on grower interviews, yields of some crops under full irrigation would be improved without the sodium impacts currently experienced using high SAR groundwater.

4.7.3.3 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.

4.7.3.4 Cumulative Impacts

Construction of the Potholes Supplemental Feed Route facilities would result in similar short- and long-term impacts on soils. The cumulative impact would not be significant.

4.7.4 Alternative 2B: Partial—Banks + FDR

Long-term, short-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.7.5 Alternative 2C: Partial—Banks + Rocky

Improvements in soil productivity and crop yield, cumulative impacts and mitigation measures would be the same as Alternative 2A: Partial—Banks.

4.7.5.1 Short-Term Impacts

Short-term impacts are similar to those for Alternative 2A: Partial—Banks, although the magnitude varies (Table 4-23). Slightly less land susceptible to erosion would be bare under this alternative (3,365 acres).

4.7.5.2 Long-Term Impacts

Impacts as described under Alternative 2A: Partial—Banks would also occur under this alternative. In addition, impacts associated with the Rocky Coulee Supply option would be expected, as described in the next two sub-sections.

Special Status Soil

With the implementation of mitigation measures as required by FPPA, impacts to farmlands in association with the construction of Rocky Coulee Reservoir would be minimal. Considerably more valuable agricultural soil would be lost compared to Alternative 2A: Partial—Banks and Alternative 2B: Partial—Banks + FDR. Approximately 1,141 and 1,368 acres of state-important farmland and unique farmland, respectively, would be permanently taken out of production (Table 4-23).

Soil Productivity Loss

Approximately 946 acres of productive soil would be lost with implementation of this alternative. Although a higher amount of productive land within the facility footprint would be taken out of production compared to Alternative 2A: Partial—Banks and Alternative 2B: Partial—Banks + FDR (10 percent), the amount of lost land relative to that in the Columbia Basin is still quite small and would not be significant.

4.7.6 Alternative 2D: Partial—Combined

Short-term and long-term impacts on soils would be slightly higher than those described for Alternative 2C: Partial—Banks + Rocky (Table 4-23). Improvements in soil productivity and crop yield, cumulative impacts and mitigation measures would be the same as Alternative 2A: Partial—Banks.

4.7.7 Alternative 3A: Full—Banks

Improvements in soil productivity and crop yield, cumulative impacts and mitigation measures would be the same as Alternative 2A: Partial—Banks.

4.7.7.1 Short-Term Impacts

Approximately 7,400 acres of soil susceptible to wind or water erosion would be temporarily cleared during construction over 10 years (Table 4-24). Application of erosion control BMPs would minimize offsite movement of sediment until new vegetation becomes established. The land would be put back into production following construction.

Approximately 18 acres of soils susceptible to compaction would be impacted by construction. If growth-limiting compaction occurs because of equipment traffic, mitigation measures to reduce compaction would be implemented.

Approximately 3,586 acres and 945 acres of state-important and unique farmland would be temporarily taken out of production, respectively. 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 3A: Full—Banks would include all the impacts associated with Alternative 2A: Partial—Banks, plus impacts associated with implementation of the full replacement alternatives.

TABLE 4-24

Permanent and Temporary Soil Impacts Resulting from Implementation of Full Replacement Action Alternatives

Impact Type	Alternatives/Impacted Acres over 10 Years							
	3A: Full—Banks		3B: Full—Banks + FDR		3C: Full—Banks + Rocky		3D: Full—Combined	
	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary
Erosion	3,842	7,400	3,842	7,400	4,030	7,398	4,030	7,398
Compaction	245	18	245	18	251	18	251	18
Productivity	5,317	3,110	5,317	3,110	6,093	3,062	6,093	3,062
State-important farmland	1,386	3,586	1,386	3,586	2,272	3,564	2,272	3,564
Unique farmland	708	945	708	945	2,014	880	2,014	880

Note: All impacts would occur incrementally over an estimated 10-year construction period.

Erosion Potential

Approximately 3,842 acres of soil susceptible to wind or water erosion would be permanently impacted during construction of Alternative 3A: Full—Banks (Table 4-24). 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 1,386 and 708 acres of state-important farmland and unique farmland, respectively, would be permanently taken out of production (Table 4-24). Based on the soil limitations analysis, 5,317 acres of productive land (approximately 56 percent of productive land in the facility impact area) 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.

4.7.8 Alternative 3B: Full—Banks + FDR

Long-term, short-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 3A: Full—Banks. In addition, Lake Roosevelt would be lowered slightly less than under current conditions. Additional erosion would not be expected.

4.7.9 Alternative 3C: Full—Banks + Rocky

Improvements in soil productivity and crop yield, cumulative impacts and mitigation measures would be the same as Alternative 3A: Full—Banks.

4.7.9.1 Short-Term Impacts

Short-term impacts are similar to those for Alternative 3A: Full—Banks, although there is a very slight difference in magnitude (Table 4-24).

4.7.9.2 Long-Term Impacts

Impacts associated with Alternative 3C: Full—Banks + Rocky would be the same as for Alternative 3A: Full—Banks, but larger in magnitude. Impacts include an increase in loss of productive land by 776 acres, an increase in lost state important farmland by 886 acres, and the loss of 1,306 more unique farmland acres. As in Alternative 3A: Full—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 following full replacement alternatives.

4.7.10 Alternative 3D: Full—Combined

Long-term, short-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 3C: Full—Banks + Rocky.

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 alternatives, including the No Action Alternative.

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 lost shrub steppe vegetation south of I-90, and wetlands adjacent to the East Low Canal. Additional long-term significant impacts to upland vegetation would occur in the footprint of the proposed Rocky Coulee Reservoir, under all of the action alternatives that include this component. 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 all of the full replacement alternatives would be similar to the partial replacement alternatives, but to a substantially 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 all of the full replacement alternatives. Significant wetland impacts would occur adjacent to the East Low and East High canals, and in the area of the proposed Black Rock Coulee Reregulating Reservoir. 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 4-25.

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 3.8.1.2, *Upland Analysis Methods*.

TABLE 4-25

Vegetation and Wetlands Impact Indicators and Significance Criteria

Impact Indicator	Significance Criteria
Impacts on native plant communities	A long-term reduction in acres of high quality native plant communities would be significant
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

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 county-wide 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 bottom 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. 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 600 feet along the East High Canal, 150 feet along the east side of the East Low Canal expansion, and 200 feet along distribution pipelines.
- About 300 feet of the 600-foot easement along the East High Canal would be required for permanent facilities and disposal of excavated rock and soil. Where the East High Canal would cross native plant communities, the other 300 feet of the easement 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. If in-kind replacement cannot be done on private lands another suitable site would be found.
- 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 to be 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. 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.

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 4.29, *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 4.29, *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 also 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 4.29, *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 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 and extension of the East Low Canal. Direct short-term losses during pipeline construction are estimated as follows:

- 155 acres of sagebrush steppe
- 17 acres of steppe grassland
- 0.4 acres of scabland shrub land

Lands that would be impacted during construction, but that are not required for permanent facilities, are considered to be 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 adverse impacts on wetland resources as follows:

- 37.8 acres of the fringe of a PEM wetland that lines the left (east) inner wall of the East Low Canal
- Temporary construction impacts to PEM wetlands adjacent to the East Low Canal that would occur during excavation for pipe laying and canal expansion and extension.

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 likely 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.

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 of time 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.

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 4-15. 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 an average water year 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 4-26. Under dry year conditions, water levels are anticipated to exceed the 3-foot rooting depth and capillary fringe threshold for an additional 12 days, on average.

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 (Grace and Harrison 1986 as cited in 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 (Manning et al. 1989 and Stasiak 1994 as cited in 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. Basically, 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 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.

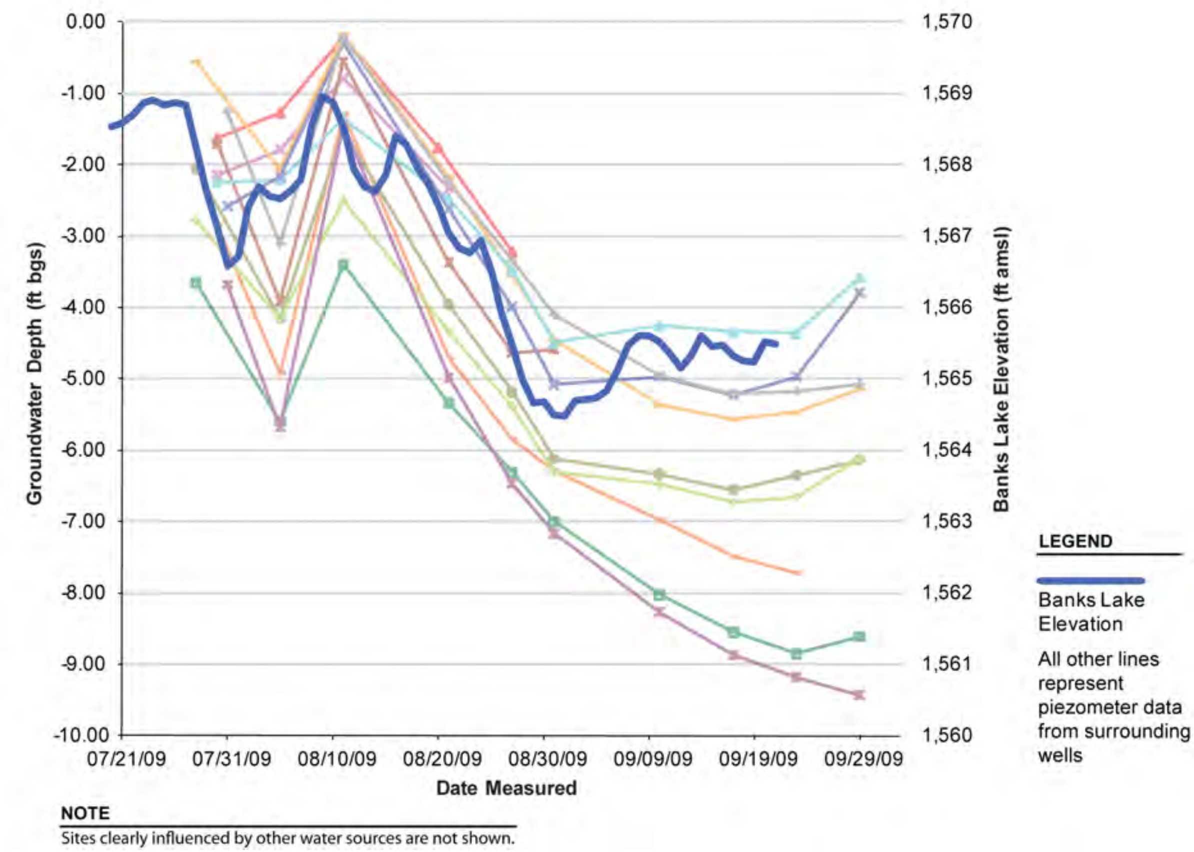


Figure 4-15
Groundwater Elevations of Banks Lake Fringe Wetlands During August 2009 Drawdown of the Reservoir

TABLE 4-26

Responses of Wetland Plants to Groundwater Drawdowns Near Banks Lake in Representative Average and Dry Watershed Conditions: 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	42 days	Survival without stress
2B: Partial—Banks + FDR	41 days	41 days	Survival without stress
2C: Partial—Banks + Rocky	22 days	24 days	Survival without stress
2D: Partial—Combined	31 days	31 days	Survival without stress

4.8.3.3 Mitigation

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:

- 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 in cooperation with WDFW. 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.

4.8.3.4 Cumulative Impacts

The Potholes Supplemental Feed Route would result in the loss of about 1,150 acres of shrub steppe along Crab Creek (Reclamation 2007 EA). This impact would be cumulative to the impacts to upland vegetation under this alternative. The Walla Walla Storage and Pump Exchange Studies could add water to local streams, which could benefit wetland and riparian communities.

4.8.4 Alternative 2B: Partial—Banks + FDR

Short-term, long-term, and cumulative impacts on native upland plant communities, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks. Impacts to wetlands would be similar to Alternative 2A: Partial—Banks and are shown in Table 4-26.

4.8.5 Alternative 2C: Partial—Banks + Rocky

4.8.5.1 Short-Term Impacts

Uplands

- No direct or indirect impacts to rare plant populations are expected under this alternative. The other significant impacts related to weeds and the loss of native upland plant communities described for Alternative 2A: Partial—Banks would also occur under this alternative.

Photograph 4-4.
View of bottom of black rock coulee with big sagebrush—Sandberg's bluegrass vegetation type along bottom.

Wetlands

Short-term wetland impacts along the East Low Canal would be the same as those described for Alternative 2A: Partial—Banks.

4.8.5.2 Long-Term Impacts

Uplands

About 147 acres of shrub-steppe habitat types would be lost during expansion and extension of the East Low Canal. Construction of Rocky Coulee dam and reservoir would result in the additional loss of large areas of shrub-steppe communities; a significant impact. This includes long-term direct losses from inundation of the following plant communities:

- 182 acres of steppe grassland along the upper slopes of Rocky Coulee would be lost. These areas are dominated by bottlebrush squirreltail, Sandberg's bluegrass, and several native forb species.
- 288 acres of sagebrush steppe habitat would be lost in the bottom of Rocky Coulee. This habitat is dominated by a diverse age group of big sagebrush, including large stature old sagebrush, which is very unique. The understory has been disturbed and is infested with non-native species.

The 470 acres at Rocky Coulee cannot be replaced at the locations where it would be removed because the canal, dam, and reservoir would occupy these areas.

Issues related to mitigation and the long-term success of restoration efforts as they relate to the loss of species diversity and biotic crusts would similar to those described for Alternative 2A: Partial—Banks. However, parts of the Rocky Coulee Reservoir footprint support higher quality stands of shrub-steppe. Full restoration of the higher species diversity and biotic crusts characteristic of higher quality shrub-steppe sites would likely not be achieved. These impacts, and the inability to fully restore higher quality shrub-steppe sites, would be significant.

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. Specific issues relate to the difficulty of controlling non-native invasive plants and the challenges associated with establishing a diverse community of native shrubs, grasses, and forbs in a harsh arid environment. Restoration actions under these conditions require years of regular monitoring and maintenance to be successful.

Wetlands

Impacts to wetlands would be similar to Alternative 2A: Partial—Banks and are shown in Table 4-26.

4.8.5.3 Mitigation

Uplands

Mitigation measures similar to those described for Alternative 2A: Partial—Banks would be implemented for this alternative. However, much larger areas would be required to mitigate the impacts to uplands because larger areas would be impacted. Limitations to fully restoring pre-construction conditions would be the same as those described for Alternative 2A: Partial—Banks.

Wetlands

Mitigation measures for wetlands would be the same as those for Alternative 2A: Partial—Banks.

4.8.5.4 Cumulative Impacts

Cumulative impacts would be the same as Alternative 2A: Partial—Banks for uplands and wetlands.

4.8.6 Alternative 2D: Partial—Combined

Short-term, long-term, and cumulative impacts on native upland plant communities and rare plants would be the same as Alternative 2C: Partial—Banks + Rocky. Impacts to wetlands would be similar to Alternative 2A: Partial—Banks, and are shown in Table 4-26. Mitigation measures for uplands and wetlands would be the same as Alternative 2A: Partial—Banks.

4.8.7 Alternative 3A: Full—Banks

4.8.7.1 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 4-27). Impacts would occur from constructing pipelines, the East Low Canal, the East High Canal, and Black Rock Coulee Reregulating Reservoir. Table 4-27 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 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 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 4-27

Short- and Long-term Impacts on Native Upland Plant Communities from Alternatives 3A: Full—Banks and Alternative 3B: Full—Banks + FDR

	Upland Vegetation Type and Acres Impacted					
Facility[a]	**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
Total Permanent Impacts	**-**	**52**	**2,406**	**1**	**4**	**4**
Additional Temporary[c] **Impacts During Construction – These Impacts May Be Mitigated In-place**						
Pipelines for the East Low Canal	-	17	155	-	-	-
East Low Canal	-	11	98	-	-	-
Pipelines for the East High Canal	24	17	374	-	-	-
East High Canal	-	14	1,107	-	2	-
Total Additional Temporary Impacts	**24**	**59**	**1,734**	**-**	**2**	**-**

[a]Permanent and temporary impacts do not include those from substations, transmission lines, and pump stations 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.

4.8.7.2 Long-Term Impacts

Uplands

As shown in Table 4-27, about 2,470 acres of native plant communities would be directly impacted by permanent facilities under Alternative 3A: Full—Banks; a significant impact. Another 1,819 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 to be 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 of time 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 4-28). Wetland resources in Black Rock Coulee Reregulating Reservoir are considered high quality wetlands (Category I; including PFO, alkali, and vernal pool wetland components). Detailed information specific to Black Rock Coulee Reregulating Reservoir wetland characteristics is in Section 3.8 *Vegetation and Wetlands*.

TABLE 4-28

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	3C	3D
East High Canal	5.2	PEM	IV	Long-term direct impact	X	X	X	X
Black Rock Coulee Reregulating Reservoir	21.6	PEM	I	Long-term direct impact	X	X	X	X
Black Rock Coulee Reregulating Reservoir	0.1	PEM	III	Long-term direct impact	X	X	X	X
Black Rock Coulee Reregulating Reservoir	3.6	PFO	I	Long-term direct impact	X	X	X	X
East Low Canal	37.8	PEM	IV	Short-term direct impact	X	X	X	X
East Low Canal	1.0	PEM	III	Long-term direct impact	X	X	X	X
East Low Canal	3.4	PEM	III	Temporary construction impacts	X	X	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, possible wetland loss and likely community composition shift.*	X		X	X
Banks Lake	Unquantified	PEM	III	Long-term indirect impact – *During drought year drawdown regime only, wetland loss and community composition shift*	X		X	X
East High Canal	Unquantified	PEM	IV	Long-term indirect impact - *Potential decrease in wetland function*	X	X	X	X

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 4-28 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 (Stromberg 1992 as cited in Reclamation 2004).

How Do Wetlands Respond To Drought Conditions?

Many wetland systems show great plasticity in response to drought events (Johnson et al. 2004 and Kentula et al. 2004 as cited in Touchette et al. 2008). This ability would be largely dependent upon the condition of underground rhizomes and roots, as well as seed bank composition (Mulhouse et al. 2005 as cited in 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 (Katovich et al. 2003; Mulhouse et al. 2005; Rejmankova et al. 1999; all as cited in Touchette et al. 2008). Conversely, some research indicates that short-term dry conditions would increase above-ground 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” (Hansen et al. 1988 as cited in Gucker 2008; Reclamation 2004).

Photograph 4-5.
PEM/PFO wetland / open water complex at the site of the Black Rock Coulee Reregulating Reservoir.

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, throughout much of the growing season, with the modeled dry and drought years having a lower starting elevation than for Alternative 2A: Partial—Banks.

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*, Figure 4-9, *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 4-29. 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 4-29

Responses of Wetland Plants to Groundwater Drawdowns Near Banks Lake in Representative Average and Dry Watershed Conditions: Full Replacement Alternatives

	Number of Days (on Average) the 3-foot rooting depth and capillary fringe threshold is exceeded		
Alternative	**Average Year**	**Dry Year**	**Plant Response and Notes**
No Action	30 days	30 days	Survival without stress
3A: Full—Banks	66 days	80 days	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
3C: Full—Banks + Rocky	39 days	44 days	Survival without stress. See note for a discussion of drought year effects on wetlands.
3D: Full—Combined	41 days	41 days	Survival without stress. See note for a discussion of drought year effects on wetlands.

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 and for all of the growing season for Alternatives 3C: Full—Banks + Rocky and 3D: Full—Combined (Figures 2-23, 2-26, and 2-27). 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. Successive years of drought would likely result in the near complete loss of PEM wetlands around Banks Lake under Alternatives 3C: Full—Banks + Rocky and 3D: Full—Combined. 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. 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 4-29). 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 4-6.
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 in regard to 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.

4.8.7.3 Mitigation

Uplands

The same types of mitigation measures described for Alternative 2A: Partial—Banks would be implemented for this alternative. However, much larger areas would be required to implement the mitigation.

Wetlands

The specific mitigation approach would change based on the final determination of impacts and Section 404 permit terms and conditions. Mitigation for unavoidable impacts to wetlands and riparian areas would require both passive and active measures and would be implemented at one or several of the following locations:

- East Low Canal (expansion of existing wetlands supported by canal seepage)
- East High Canal (development of new wetlands supported by canal seepage)
- Black Rock Reregulation Reservoir (development of new wetlands on the eastern extent of proposed reservoir footprint and/or down-gradient of proposed dam

East Low Canal

Enhancement areas would require planting of wetland shrub and tree species within existing wetland areas that currently lack vegetative structure. Creation of additional wetland acreage along the East Low Canal would include grading margins of existing seep wetlands to expand wetland acreage and include wetland plantings of shrub and tree species appropriate for existing or supplemented hydrology. Components of enhancing or creating wetland habitat along the East Low Canal would include hydrologic inputs from seepage or water turnouts from the irrigation delivery system, grading, wetland and riparian plantings, and hydrologic and vegetation monitoring. Wetland mitigation associated with canal leaks would not be subject to Section 404 regulations.

East High Canal
Creation of new wetlands along the East High Canal would involve active management to provide water to planned, created wetlands, as well as grading at the site of canal leaks to facilitate wetland development. Both options would require planting of preferred vegetation and hydrologic and vegetation monitoring. Wetland mitigation associated with canal leaks would not be subject to Section 404 regulations.

Black Rock Reregulation Reservoir
Wetlands could be developed around parts of the eastern side of the reservoir because the water level would be relatively constant. Wetlands could also be developed downstream of the reservoir through controlled releases of water. Both actions could create PEM, PSS, and PFO wetland communities and would require grading, planting, erosion control measures, and monitoring. Wetland hydrology would be established through surface or subsurface inundation of the wetland areas by reservoir levels, dam seeps, and/or inputs from the irrigation delivery system. Monitoring would aid in the identification of remedial actions needed to meet the stated goals at each site.

4.8.7.4 Cumulative Impacts

Cumulative impacts are the same as presented for Alternative 2A: Partial—Banks for uplands and wetlands.

4.8.8 Alternative 3B: Full—Banks + FDR

Alternative 3B: Full—Banks + FDR would have the same short-term, long-term, and cumulative impacts on native upland plant communities and rare plants as Alternative 3A: Full—Banks. For wetlands, short-term and cumulative 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 4-28, and the rooting depth and capillary fringe threshold exceedances shown in Table 4-29.

Mitigation measures for both upland vegetation and wetlands would be the same as described for Alternative 3A: Full—Banks.

4.8.9 Alternative 3C: Full—Banks + Rocky

4.8.9.1 Short-Term Impacts

Uplands
Impacts on native upland plant communities and rare plants would be similar to those described for Alternative 2A: Partial—Banks, and Alternative 3A: Full—Banks, but would occur over substantially larger areas under this alternative. The short- and long-term impacts of constructing pipelines, the East Low Canal, the East High Canal, Black Rock Coulee Reregulating Reservoir, and Rocky Coulee Reservoir are shown in Table 4-30, and apply to both Alternative 3C: Full—Banks + Rocky, and Alternative 3D: Full—Combined.

Wetlands
Alternative 3C: Full—Banks + Rocky would have the same short-term impacts as Alternative 2A: Partial—Banks.

4.8.9.2 Long-Term Impacts

Uplands
As shown in Table 4-30, about 2,940 acres of native plant communities would be

directly impacted by permanent facilities under Alternative 3C: Full—Banks + Rocky. Another 1,819 acres of native plant communities would be impacted during construction, but would not be occupied by permanent facilities. 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 ability to fully restore high quality shrub-steppe communities, and the long times required to mitigate the losses. Rural residential development expected to occur on private lands around Black Rock Coulee once the reservoir is filled would result in an additional indirect permanent loss of native shrub-steppe 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.

The same significant direct and indirect impacts on rare plant populations described for Alternative 3A: Full—Banks would occur under this alternative.

TABLE 4-30

Short- and Long-term Impacts on Native Upland Plant Communities of Alternatives 3C: Full—Banks + Rocky and 3D: Full—Combined

	Upland Vegetation Type and Acres Impacted					
Facility[a]	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 (under permanent facilities)	-	18	112	-	-	-
Black Rock Coulee Reregulating Reservoir	-	7	149	1	-	-
East High Canal	-	27	2,145	-	4	4
Rocky Coulee Reservoir	-	182	288	-	-	-
Total Permanent Impacts	**-**	**234**	**2,694**	**1**	**4**	**4**
Additional Temporary[c] Impacts During Construction – These Impacts May be Mitigated In-place						
Pipelines for the East Low Canal	-	17	155	-	-	-
East Low Canal	-	11	98	-	-	-
Pipelines for the East High Canal	24	17	374	-	-	-
East High Canal	-	14	1,107	-	2	-
Total Additional Temporary Impacts	**24**	**59**	**1,734**	**-**	**2**	**-**

[a] Permanent and temporary impacts do not include those from substations, transmission lines, and pump stations because their locations are not known at this time. The footprint of the dam at Black Rock Coulee Reregulating Reservoir is also not included. Transmission line construction would include 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.

[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
Long-term impacts on wetlands during average and dry years would be similar to those described for Alternative 3A: Full—Banks. Direct impacts would be the same as those described for Alternative 3A: Full—Banks, and as shown in Table 4-28, with differences in the indirect impacts shown as well. Dry year impacts would be similar to those identified under Alternative 3A: Full—Banks, since the 3-foot rooting depth and capillary fringe threshold would be exceeded in July, August, and September. Potential effects would include a shift in species composition and the potential loss of PEM fringe wetlands.

Based on the groundwater levels from Banks Lake piezometers, water levels under this alternative during a average water year would exceed the 3-foot rooting depth and capillary fringe threshold for an additional 9 days on average, as shown in Table 4-29. Under dry year conditions, water levels are anticipated to exceed the 3-foot rooting depth and capillary fringe threshold for an additional 14 days, on average (Table 4-29). These additional exceedances (9 days and 14 days) of 3-foot rooting depth and capillary fringe threshold are not anticipated to stress established wetland vegetation as additional exceedances would occur in October (average year) and in October, November, and December (dry year) when plants typically are in the dormant stage. Although the overall drawdown for Alternatives 3A: Full—Banks and 3C: Full—Banks + Rocky are similar, the sharp decline in the number of exceedance days for the 3-foot rooting depth and capillary fringe threshold under this alternative is because the dry year is modeled to be more similar to an average water year during the growing season (see Chapter 2, Figures 2-23 and 2-26, to compare the dry years). Additionally, drought year drawdowns would result in wetland acreage loss as groundwater levels would be below the rooting depth and capillary fringe threshold the entire growing season (March through October, as shown in Section 4.2, *Surface Water Quantity*, Figure 4-12, *Banks Lake Drawdown (feet) for Alternative 3C: Full—Banks + Rocky*). The loss of PEM wetlands during successive drought year conditions would be reversed over a period of several years by a series of average or wet watershed years. However, this recovery would require longer than under Alternative 3A: Full—Banks because of the season-long duration of the drought year drawdown under this alternative. Any changes in species composition toward more drought tolerant species would likely persist in spite of a return to average watershed conditions.

4.8.9.3 Mitigation

Uplands
The same types of mitigation measures described for Alternative 2A: Partial—Banks would be implemented for this alternative. However, much larger areas would be required to implement the mitigation.

Wetlands
Proposed wetland mitigation measures would be the same as those for Alternative 3A: Full—Banks.

4.8.9.4 Cumulative Impacts

Cumulative impacts are the same as described for Alternative 2A: Partial—Banks.

4.8.10 Alternative 3D: Full—Combined

Short-term, long-term, cumulative, and unavoidable adverse impacts on native upland plant communities and rare plants would be the same as Alternative 3C: Full—Banks + Rocky. For wetlands, short-term and cumulative impacts would be the same as described for Alternative 2A: Partial—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 4-28, and the rooting depth and capillary fringe threshold exceedances shown in Table 4-29. Representative drought year drawdowns would result in wetland acreage loss as groundwater levels would be below the rooting depth and capillary fringe threshold for the entire growing season (March through October), same as described for Alternative 3C: Full—Banks + Rocky.

Mitigation measures for both upland vegetation and wetlands would be the same as Alternative 3C: Full—Banks + Rocky.

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 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 4-31.

TABLE 4-31

Wildlife and Wildlife Habitat Impact Indicators and Significance Criteria

Impact Indicator	Significance Criteria
Impacts on intact 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 by 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

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 (2009 Species and 2009 Habitat) 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
- HEP 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 in the vicinity of 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 of time (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.

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 minimum viable population (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. 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, 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.
- Long-term impacts would persist for many years following construction, or would be realized over a longer time frame, 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 4.29, *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 4.29, *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 Draft EIS. At a Federal level migratory birds, as well as bald and golden eagles, are protected by international treaties.

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 4.29, *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. These herds would likely retain their current high numbers if irrigated agriculture changed to dryland farming.

Photograph 4-7.
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 253 acres of sagebrush steppe and 28 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 on 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 non-breeding season for wildlife. Therefore, while human activity and noise levels near construction would be high, the effects on wildlife would be relatively low compared to the effects if construction occurred during the breeding season. That said, wildlife in the vicinity of 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.

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 canarygrass 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 would be lost during 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; a significant 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 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 area evaluated during the HEP study that would be affected under Alternative 2A: Partial—Banks + Rocky 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, significant impacts related to conversion from irrigated crops to dryland crops would be the same as described under the No Action Alternative.

Banks Lake

On the basis of currently available data, 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. The overall impact on zooplankton abundance, and subsequently on the growth of plankton-eating fish, is being evaluated by WDFW and results will be available in late 2010.

Based on the analysis of piezometer data, the data presented in Table 4-26 (*Responses of Wetland Plants to*

Groundwater Drawdowns Near Banks Lake in Representative Average and Dry Watershed Conditions: Partial Replacement Alternatives) 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 song birds, 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 1565 feet amsl by August 31 (Section 4.2, Figure 4-3, *Banks Lake Drawdown (feet) for Alternative 2A: Partial—Banks*). 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 1565 feet amsl on 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.

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.

WDFW noted that operational changes (lower water levels) in Banks Lake during April 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 in the vicinity of 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, *Known or Potential Occurrence of Special Status Wildlife Species in the Odessa Analysis Area*, 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; a significant impact.

4.9.3.3 Mitigation Measures

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 4.29, *Environmental Commitments*. Full restoration of native shrub steppe habitats to pre-construction 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.

No known mitigation measures are available to compensate for the unavoidable impacts to grebes nesting at Banks Lake.

4.9.3.4 Cumulative Impacts

The Potholes Supplemental Feed Route preferred alternative would result in the loss of about 1,150 acres of shrub steppe along Crab Creek (Reclamation 2007 EA). This impact would be cumulative to the impacts to wildlife under this alternative. The Walla Walla Storage and Pump Exchange Studies could add water to local streams, which could improve wetland and riparian habitat, thereby benefiting associated wildlife.

4.9.4 Alternative 2B: Partial—Banks + FDR

Short-term, long-term, and cumulative impacts on shrub steppe habitats and associated wildlife 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

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 on May 15, 2 feet on July 1, and 3 feet on August 1 (Section 4.2, *Surface Water Quantity*, Figure 4-4, *Banks Lake Drawdown (feet) for Alternative 2B: Partial—Banks + FDR*). 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.

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 semi-annual 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) acknowledged that nesting waterfowl and breeding amphibians are currently impacted by the rapid springtime fluctuations of water levels.

Voeller (1993, cited in Ecology 2008) observed little aquatic plant community growth and low benthic macroinvertebrate assemblages because of the lack of stable littoral habitats at Lake Roosevelt. 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 0.5 to 3.2 feet lower at the end of August, and 1.3 to 1.9 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 semi-annual 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 shouldn’t 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 no to minimal 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.

4.9.5 Alternative 2C: Partial—Banks + Rocky

The short- and long-term impacts of constructing the East Low Canal expansion and extension and the associated pipelines would be the same as described for Alternative 2A: Partial—Banks. Impacts and mitigation measures described for this alternative are in addition to those impacts.

4.9.5.1 Long-Term Impacts

Banks Lake

The projected drawdown at Banks Lake would not differ from the drawdown under the No Action Alternative. Therefore, there would be no additional impacts on nesting grebes or other birds that use Banks Lake wetland or riparian habitats compared to the No Action Alternative.

Upland Vegetation Types and Species

In addition to the impacts of Alternative 2A: Partial—Banks, construction of Rocky Coulee Reservoir would result in the long-term loss of 288 acres of sagebrush steppe and 182 acres of steppe grassland habitat. Given the relatively large area of sagebrush steppe habitat that would be lost in Rocky Coulee, it is very unlikely that individuals of the more mobile species would be displaced would then be able to find suitable unoccupied habitat. Displaced animals would likely be lost as part of the local population over a period of a few years. Less mobile species occupying affected areas, such as small mammals and reptiles would drown. These impacts would be significant.

The areas evaluated during the HEP study that would be affected under Alternative 2C: Partial—Banks + Rocky include the East Low Canal and the Rocky Coulee Reservoir site. 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.

Special Status Species

Several special status species, in addition to those affected by Alternative 2A: Partial—Banks, would be impacted by implementation of this alternative. Additional special status species identified by WDFW during their surveys of the Rocky Coulee area included badger, grasshopper sparrow, loggerhead shrike, long-billed curlew, pygmy short-horned lizard, sage sparrow, Swainson's hawk, and Washington ground squirrel. Burrowing owls have also used this area in the past and suitable habitat is present. All of these species would likely be directly or indirectly impacted through loss of breeding and foraging habitat and displacement in response to noise, human activities, and drowning. Grasshopper sparrows, loggerhead shrikes, and sage sparrows would likely be impacted by the loss of shrub steppe habitats at Rocky Coulee more than the other species because of their dependence on these habitat types. Impacts on curlews and Swainson's hawks would consist of a loss of foraging habitat for both species and possible nesting habitat for curlews.

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 drown during filling or be lost during construction. Washington ground squirrels hibernate from late summer to late winter. Adults may emerge from hibernation from late January to early March and remain active until June. Juveniles are active until late June or early July. Pygmy short-horned lizards also hibernate in burrows during cold weather. Construction of the dam and flooding of the reservoir in areas occupied by these species would eliminate affected individuals.

Several other special status species listed in Chapter 3, Table 3-20, *Known or Potential Occurrence of Special Status Wildlife Species in the Odessa Analysis Area*, use shrub steppe habitats and would also be impacted by direct mortality or loss of habitat. Compared to Alternative 2A: Partial—Banks, there is a higher likelihood that the larger blocks of shrub steppe habitat in Rocky Coulee provide suitable habitat for some of these other special status species. All impacts on special status species would be significant.

4.9.5.2 Mitigation

The same types of mitigation measures and limitations described for Alternative 2A—Partial Banks and for vegetation and wetlands would likely be implemented to compensate for the loss of shrub steppe habitats. However, substantially larger areas would be required for restoration or enhancement of wildlife habitat values. Washington ground squirrels would be relocated to areas of suitable habitat to reduce long-term impacts on this species.

4.9.6 Alternative 2D: Partial—Combined

Short-term, long-term, and cumulative impacts on shrub steppe habitats and associated wildlife, including special status species, would be the same as Alternative 2C: Partial—Banks + Rocky. Impacts to wetland habitats and associated wildlife would be similar to Alternative 2A: Partial—Banks except as described below for fewer potential long-term impacts on grebes and other birds nesting in emergent wetlands at Banks Lake. Mitigation measures and limitations would be the same as those for Alternative 2C: Partial—Banks + Rocky.

4.9.6.1 Long-Term Impacts

Banks Lake

The drawdown of Banks Lake would not start any earlier during any of the representative water years than under the No Action Alternative. However, the drawdown rate would be faster. Because the drawdown would not start until August 1, impacts on nesting grebes would be minimal. Other birds that nest in emergent wetlands would likely not be impacted.

4.9.7 Alternative 3A: Full—Banks

Short-term, long-term, and cumulative impacts, as well as mitigation measures and limitations, would be the same as Alternative 2A: Partial—Banks + Rocky 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.

4.9.7.1 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 4-27, *Short- and Long-term Impacts on Native Upland Plant Communities from Alternatives 3A: Full—Banks and Alternative 3B: Full—Banks + FDR*). 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.

4.9.7.2 Long-Term Impacts

Banks Lake

Grebes nesting at Banks Lake would be significantly impacted by implementation of this alternative. Under Alternative 3A: Full—Banks, the reservoir would not fill during representative drought years and would be about 6 feet below full pool at the start of the grebe nesting season (Section 4.2, *Surface Water Quantity*, Figure 4-9, *Banks Lake Drawdown (feet) for Alternative 3A: Full—Banks*). All of the nesting areas used by the grebe colony would be dry throughout the entire nesting season, which would eliminate nesting in the existing colony at Banks Lake during representative drought years, a significant impact. Operational changes proposed for Banks Lake under Alternative 3A: Full—Banks during representative wet, average, and dry watershed years would begin to draw down the reservoir from 1 to 3 months earlier than under the No Action Alternative, respectively. Based on straight-line projections of modeled month-end elevations, the drawdowns under this alternative would reach 1565 feet amsl on about August 10 in a representative wet year, July 20 in a representative average water year, and July 10 in a representative dry year. These changes would remove all water from the nesting colonies 20 to 50 days earlier than under the No Action Alternative and would eliminate all nesting habitat, especially during representative average and dry years, a significant impact.

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 canarygrass. 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 canarygrass replaces existing emergent wetland plants.

On the basis of currently available data, significant impacts on Banks Lake fish populations are anticipated under this and the other full replacement alternatives. 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, is being evaluated by WDFW and results will be available in late 2010.

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 4-27). 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 non-linear 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) reported well over 100 individual observations of mule deer during their surveys. Many observations were all 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 these habitats for the neotropical 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 especially house cats, that would kill small birds, mammals, and reptiles. Fertilizer runoff from residential areas also presents a risk to wildlife. Weed infestations would likely increase in the vicinity of residential developments, further degrading shrub steppe habitat.

The results of the HEP analysis of the East Low Canal, East High Canal, and Black Rock Coulee Reregulating Reservoir site are presented in Figures 4-16, 4-17, 4-18, 4-19, and 4-20. The acreage of each cover type that would be impacted is constant for each location on each individual figure. For instance, all of the projected habitat unit losses on Figure 4-16 refer to the same number of acres of shrub steppe habitat at each location. Therefore, variation in the number of habitat units that would be impacted within a cover type is a reflection of the overall suitability of the cover type for each 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 4-32.

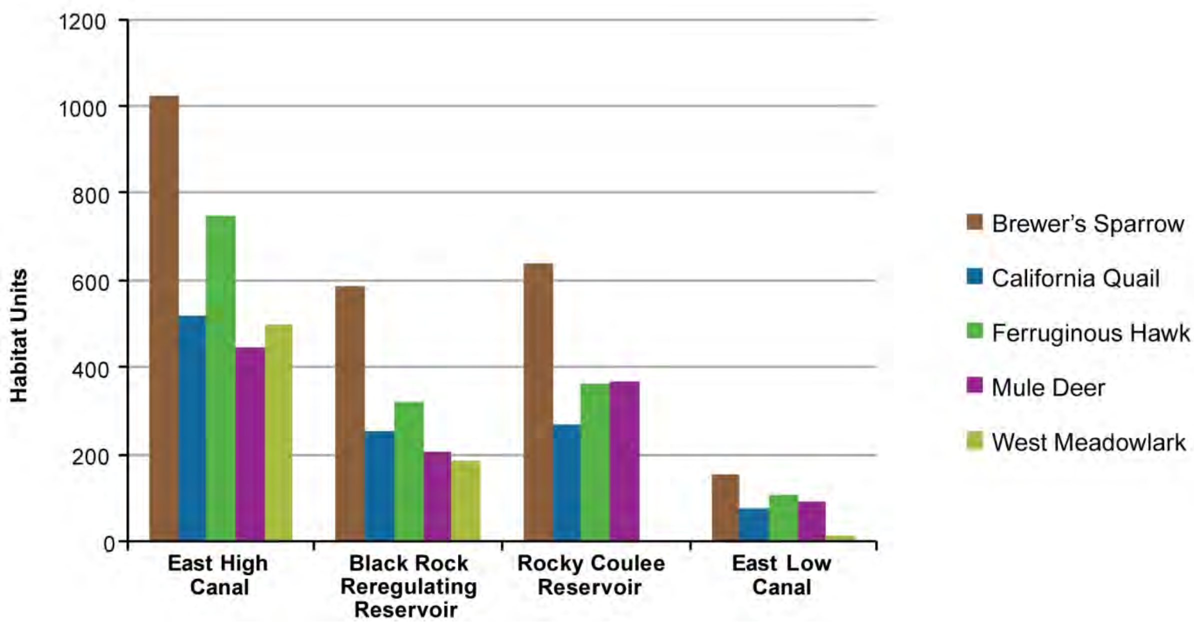


Figure 4-16
Habitat Evaluation Procedure Results for Shrub Steppe Evaluation Species

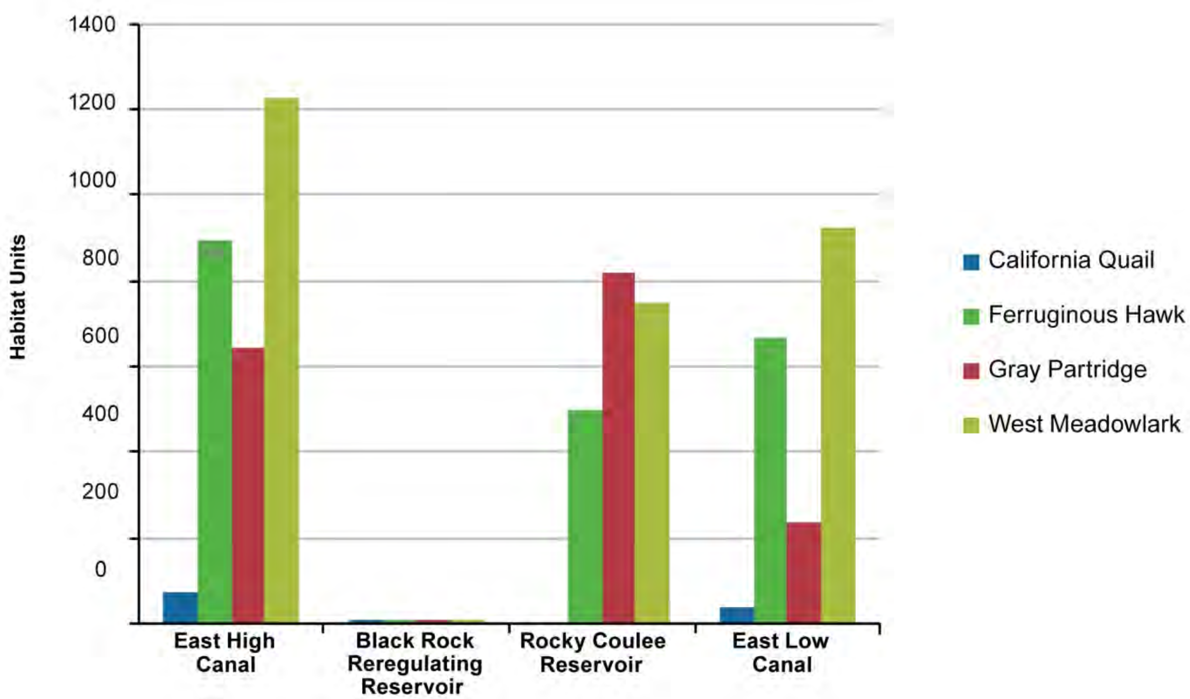


Figure 4-17
Habitat Evaluation Procedure Results for Grassland Evaluation Species

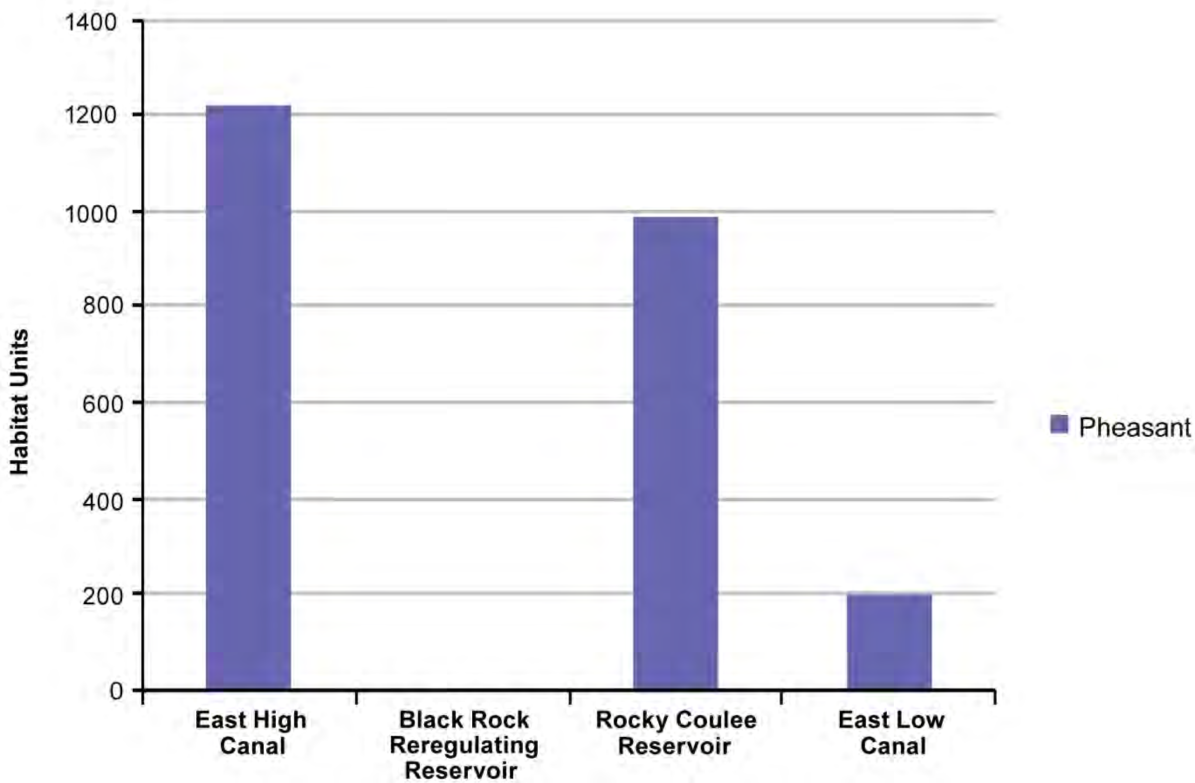


Figure 4-18
Habitat Evaluation Procedure Results for Agriculture Evaluation Species

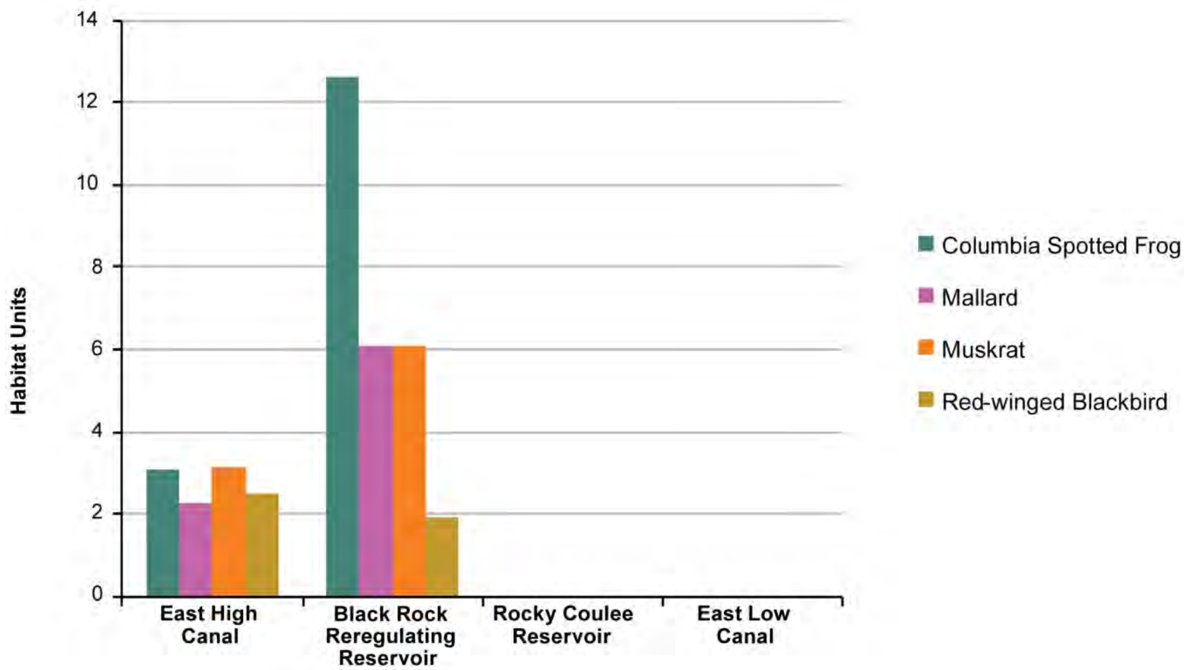


Figure 4-19
Habitat Evaluation Procedure Results for Emergent Wetlands Evaluation Species

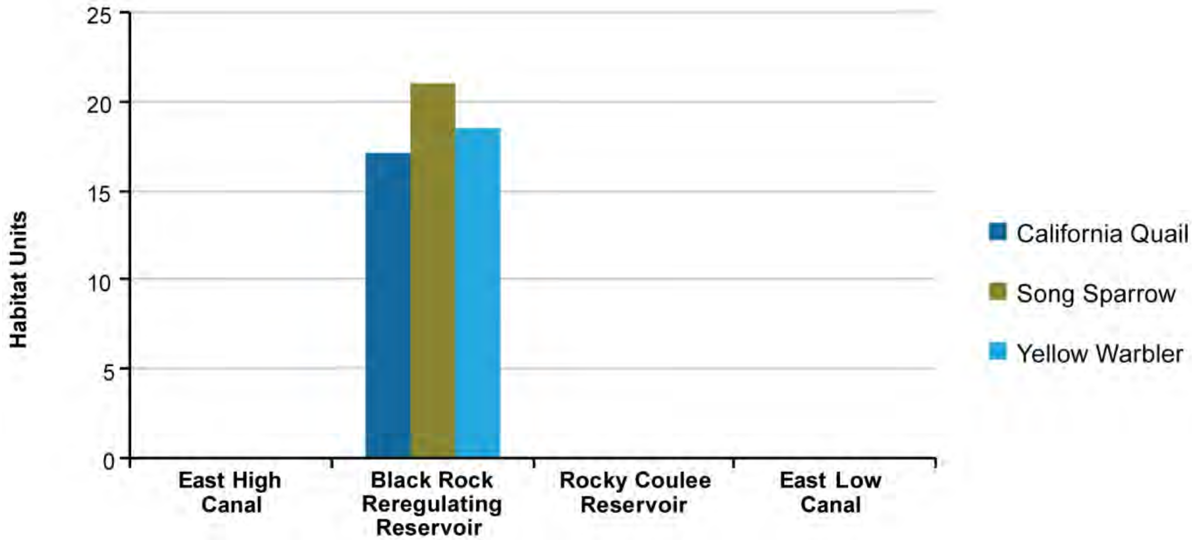


Figure 4-20
Habitat Evaluation Procedure Results for Scrub Shrub/Mesic Shrub/Riparian Forest Evaluation Species

TABLE 4-32

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			
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 downed during flooding or lost during construction. Construction in areas occupied by these species during their dormant periods would eliminate affected individuals.

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, *Known or Potential Occurrence of Special Status Wildlife Species in the Odessa Analysis Area*, 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: Partial—Banks, the larger blocks of shrub steppe habitat that would be affected under this alternative likely provide suitable habitat for some of these other special status species. These impacts on special status species would be significant and would occur under all of the other 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 are 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 two 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. 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 on one or the other side of the canals.

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, and they include a service road. Wildlife crossing structures are planned for every 2 miles along the East High Canal. A typical cross-section is shown in Chapter 2, Figure 2-18, *Wildlife and O&M Bridge Typical Cross-Sections*. 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 fairly 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 would 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 (Putman 1997; Bekker 1998; and Ng et al. 2004—all as cited in 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 (Evink 2002 as cited in 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 12-foot-wide maintenance road planted with short grass and a 16-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 of time 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. Clevenger et al. (2002 as cited in Crooks and Sanjayan 2006) observed that adaptation to large-scale landscape change, such as a new road, can 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 (Gerlach and Musolf 2000 as cited in 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. Dual-use of the proposed crossing structures for both maintenance vehicles and wildlife will also reduce their effectiveness for many species.

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 (Rosenzweig 1995 as cited in 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 4-33 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.

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 4-34. 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 4-33) 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 4-33

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

TABLE 4-34

Minimum Viable Population Analysis of Small Patches of Shrub Steppe and Steppe Grassland Habitats 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 (Beier 1993 as cited in Hilty et al. 2006; Mills 1996 as cited in 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 may 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. Water in Rocky Coulee Reservoir during the late fall, winter, and early spring would benefit migrating and wintering waterfowl unless it is frozen. 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.

4.9.7.3 Mitigation

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.
- The original design of wildlife crossings has been modified to increase their potential use. Instead of a maintenance road between two strips of vegetation the road has been moved to one side of the crossing, leaving a single wider strip of vegetation.
- Adaptive management actions would be implemented to improve the effectiveness of crossing structures.

4.9.8 Alternative 3B: Full—Banks + FDR

Except for Banks Lake, short-term, long-term, and cumulative impacts on shrub steppe habitats and associated wildlife would be the same as Alternative 3A: Full—Banks. Impacts to wetland habitats and associated wildlife would be similar to Alternative 3A: Full—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 3A: Full—Banks.

4.9.8.1 Long-Term Impacts

Banks Lake

Grebes nesting at Banks Lake would be significantly impacted by implementation of this alternative. Under Alternative 3B: Full—Banks + FDR, the reservoir would not fill during drought years and would be about 3 feet below full pool at the start of the grebe nesting season (Section 4.2, *Surface Water Quantity*, Figure 4-10, *Banks Lake Drawdown (feet) for*

Alternative 3B: Full—Banks + FDR). Based on the available bathymetry, about 60 percent of the area of the nesting colony would not have any standing water throughout the entire nesting season, and another 20 percent of the area would have less than the 12 inches required for successful nesting. This would eliminate most of the suitable grebe nesting habitat at Banks Lake during drought years; a significant impact.

Operational changes proposed for Banks Lake under Alternative 3A: Full—Banks during representative wet, average, and dry watershed years would begin to draw down the reservoir 3 months earlier than under the No Action Alternative. Based on straight-line projections of modeled month-end elevations, the drawdowns under this alternative would be 3 feet below full pool for July and reach 1565 feet amsl on about August 12 in representative wet, average, and dry years. These changes would remove all water from the nesting colonies about 19 days earlier than under the No Action Alternative and would significantly impact nest success by reducing the area of the colony that has at least 12 inches of standing water throughout the nesting season.

4.9.9 Alternative 3C: Full—Banks + Rocky

Except as described below, short-term, long-term, and cumulative impacts on shrub steppe habitats and associated wildlife would be the same as Alternative 3A: Full Banks. Impacts to wetland habitats and associated wildlife would be similar to Alternative 3A: Full Banks, except as described below for long-term impacts on grebes and other birds nesting in emergent wetlands at Banks Lake. These would all be significant impacts. Mitigation measures and limitations would be the same as those for Alternative 2C: Partial—Banks + Rocky, plus those proposed for Alternative 3A: Full—Banks.

4.9.9.1 Long-Term Impacts

Upland Vegetation Types and Species

In addition to the long-term impacts of Alternative 3A: Full—Banks, construction of Rocky Coulee Reservoir would result in the loss of 288 acres of sagebrush steppe and 182 acres of steppe grassland habitat for a total loss of about 2,940 acres, a significant impact.

The results of the HEP analysis of the East Low Canal, East High Canal, Black Rock Coulee Reregulating Reservoir site, and the Rocky Coulee Reservoir site were presented in Figures 4-2, 4-3, 4-4, 4-5, and 4-6. The acreage of each cover type that would be impacted is constant for a given type. Therefore, variation in the number of habitat units that would be impacted within a cover type is a reflection of the overall suitability of the cover type for each evaluation species.

Special Status Species

The significant impacts on special status species discussed under Alternatives 2A: Partial—Banks, 2C: Partial—Banks + Rocky, and 3A: Full—Banks would also occur under this alternative.

Banks Lake

Grebes nesting at Banks Lake would be significantly impacted by implementation of this alternative. Under Alternative 3C: Full—Banks + Rocky, the reservoir would not fill during representative drought years and would be about 5 feet below full pool at the start of the grebe nesting season (Section 4.2, Figure 4-12, *Banks Lake Drawdown (feet) for Alternative 3C: Full—Banks + Rocky*). All of the nesting areas used by the grebe colony would be dry throughout the entire nesting season, which would eliminate nesting in the existing colony at Banks Lake during representative drought years. Drawdowns would begin 2 months earlier during representative average and dry water years and 1 month earlier during wet years, compared to the No Action Alternative. Based on straight line projections of modeled month-end elevations, the drawdowns under this alternative would reach 1565 feet amsl on about August 18 in a representative wet year, August 10 in an average water year, and August 1 in dry years. These changes would begin to lower the water levels in the nesting colonies 1 to 2 months earlier. Standing water depths would drop below the 12-inch threshold within the shallowest parts of the colony as early as July 1 and within the entire colony about 1 to 4 weeks earlier than under the No Action Alternative. At best, nesting success would decrease, especially during representative dry and average years; a significant impact. At worst, useful nesting habitat would be eliminated during these years.

The effects of a single drought year on PEM wetland wildlife habitat would be similar to those described for Alternative 3A: Full—Banks. Successive years of drought would likely result in the near-complete loss of PEM wetlands around Banks Lake under Alternative 3C: Full—Banks + Rocky. Wildlife habitat values of Banks Lake PEM wetlands after a series of drought years could be completely eliminated until wetter conditions return. 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. Some 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 adverse impacts on wildlife because more drought tolerant species such as reed canarygrass provide lower quality habitat or support fewer invertebrates consumed by wildlife.

4.9.10 Alternative 3D: Full—Combined

Except as described in this section, short-term, long-term, and cumulative impacts on shrub steppe habitats and associated wildlife would be the same as Alternative 3A: Full—Banks. Impacts to wetland habitats and associated wildlife would be similar to Alternative 3A: Full—Banks except for long-term impacts on grebes and other birds nesting in emergent wetlands at Banks Lake. Mitigation measures and limitations would also be the same as those for Alternative 2C: Partial—Banks + Rocky, plus those proposed for Alternative 3A: Full—Banks.

4.9.10.1 Long-Term Impacts

Banks Lake

Grebes nesting at Banks Lake would be significantly impacted by implementation of this alternative. Under Alternative 3A: Full—Banks, the reservoir would be about 4.5 feet below full pool at the start of the grebe nesting season during drought years (Section 4.2, Figure 4-13, *Banks Lake Drawdown (feet) for Alternative 3D: Full—Combined*). About 90 percent of the nesting areas used by the grebe colony would be dry throughout the entire nesting season and the other portion would have about 6 inches of water until August 1, when the drawdown would begin. This would eliminate nesting in the existing colony at Banks Lake during drought years. Banks Lake would begin to be drawn down from 2 to 3 months earlier, depending on watershed conditions. Drawdowns would begin earlier in representative wet and average water years than in representative dry years. Based on straight line projections of modeled month-end elevations, the drawdowns under this alternative would reach 1565 feet amsl on about August 20 in representative wet, average, and dry water years. These changes would begin to lower the water levels in the nesting colony 2 to 3 months earlier than under the No Action Alternative and water levels in would drop below the 12-inch threshold as early as mid-June. These operational changes would significantly impact nesting success and may result in the complete loss of suitable nesting habitat.

The effects of one or more successive years of drought on PEM wetland habitat around Banks Lake under this alternative would be the same as those under Alternative 3C: Full—Banks + Rocky.

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 in water surface elevation at Lake Roosevelt would occur during the summer under the four alternatives that include Lake Roosevelt.

Impacts to fisheries and aquatic resources under the partial and full replacement alternatives would be similar; however, they would occur to a greater extent under the full replacement alternatives because of the greater amount of water involved. For Banks Lake, impacts would include the potential for reduced habitat availability for various life stages of fish, changes in fish distribution, shifts in zooplankton production, increase exposure of littoral zones, and increased fish and zooplankton entrainment. The greatest reductions in water surface elevations in Banks Lake would consistently occur in the late summer. Under the partial replacement alternatives, only minimal impacts to fisheries and aquatic resources would likely occur at Banks Lake because of the short term and relatively small extent of the drawdown. Under the full replacement alternatives, however, adverse, and in some cases significant, impacts would be expected for fish and some other aquatic species because of the greater extent and duration of drawdowns, especially in dry years.

For the Columbia River, the greatest reduction in flows would occur in September and October when adult fall Chinook salmon and steelhead trout are migrating up the lower and mid-Columbia River. However, no impacts to these adult migrating fish are anticipated. In November, when flows would be reduced in some years for some alternatives, fall Chinook spawn in the free-flowing Hanford Reach of the Columbia River and chum salmon spawn below Bonneville Dam. These slightly lower flows during the spawning season would be managed within the flexibility of FCRPS operations so as to not adversely impact spawning success. During the salmonid smolt downstream migration season from mid-April through August, flows would not change at all for the four alternatives that include the use of additional storage in Lake Roosevelt.

For the four alternatives that do not use Lake Roosevelt storage, only small changes in flow (positive and negative) would occur in the Columbia River during the spring, and no changes would occur in July or August. There would be no flow changes in those drier years when the flow objective at McNary Dam, established for ESA-listed salmonids, would otherwise not be met. Minimal non-measurable 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 4-35, 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 below the table.

TABLE 4-35

Fisheries and Aquatic Resources 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 is likewise delayed by reduced 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. 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	
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 exposed greater than 100 acres would significantly affect invertebrate production.
Overall condition of the fishery	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 from the base case are depicted using the same categories of water-year types used by NMFS in their recent Biological Opinions. These year-type categories, based on ranking of the annual water volume at The Dalles Dam, are described in Table 4-36. 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 4-36

Description of Water-Year Categories

Water-Year Category	January to July Water Volume Runoff at The Dalles Dam
Dry	Avg. of less than 72 MAF (8)
Dry-Average	Avg. of 73 - 100 MAF (21)
Wet-Average	Avg. of 101 - 120 MAF (26)
Wet	Avg. 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 occur.

MAF = million acre-feet.

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, which then predicted monthly average changes to Columbia River flows. These flow changes were assumed to be 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 eight 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 and August flow changes are not highlighted because it was assumed during alternative development that additional water could not be diverted during these 2 months.

Lake Roosevelt

The impact analysis for Lake Roosevelt is based on simulated monthly changes in water surface elevations derived with the RiverWare model for the action alternatives. 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. 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. In addition, annual studies conducted by WDFW since 2002 as part of the BPA-funded Banks Lake Fishery Evaluation Project provided descriptions of fish assemblages, angler catches, shoreline and littoral habitat, limnology, fish entrainment, and zooplankton populations. WDFW is continuing its studies to assess impacts of the Odessa alternatives. If a flow-entrainment relationship can be demonstrated at Dry Falls Dam for fish or zooplankton, changes in water particle retention time as dictated by lake level (volume) and water flow would be used to help determine any incremental change in fish and zooplankton entrainment compared to the No Action Alternative. A bioenergetics model, in conjunction with results of a hydrodynamic water quality model (CEQUALW2), would be used to determine if changes in water temperature and zooplankton density would impact fish growth potential for rainbow trout, kokanee salmon, and lake whitefish. Results of these WDFW studies are anticipated to be available in late 2010.

Overall Study Area and Broader Central Washington/CBP Area

Although no existing water bodies in the overall Study Area are anticipated to be impacted by the alternatives, inundation at the site of the proposed Black Rock Reregulating Reservoir would impact existing aquatic resources. Additionally, the extent to which a recreational fishery would become established at the new Black Rock Reregulating Reservoir is discussed below. The primary approach to addressing these concerns was based on reconnaissance-level field surveys of existing conditions in the areas of proposed inundation and identification of the spatial and temporal impacts that would likely to occur under the proposed alternatives.

No aquatic resources are present at the Rocky Coulee Reservoir site, and no recreational fishery would become established because of annual draining of the reservoir. Therefore, the proposed Rocky Coulee Reservoir site is not included in this analysis.

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 4.29, *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 2008 FCRPS Biological Opinion (NMFS 2008 BO). 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 4.29, *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

Alternative 2A: Partial—Banks is expected to result in either no impacts or minimal impacts on fish in the Columbia River downstream of Grand Coulee Dam. Anticipated impacts of this and the other action alternatives would be related to changes in Columbia River stream flows.

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 (Table 4-37). Flows in the other year-categories would be reduced from the base case a minor amount (range from 40 cfs to 482 cfs), with the greatest reductions in the wetter 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 only a minimal impact 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 greatest reductions in Columbia River flow for Alternative 2A: Partial—Banks, as well as for all alternatives, would consistently occur in September (up to 1,000 cfs) and October (up to 2,200 cfs), corresponding to the primary refill period for Banks Lake (Table 4-37). During this period, the peaks of the fall Chinook salmon and steelhead trout adult migrations occur in the lower and mid-Columbia River.

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. This was based on the hypothesis that more flow produced higher smolt survival as they migrated downstream. Current thinking is that the flow-survival relationship is manifested though other variables associated with flow, such as temperature, velocity, turbidity, and predation (Williams et al. 2005; Anderson 2002; ISAB 2003). Dam operations also affect fish passage and survival, including spillways, turbines, and fish screening and bypass systems, as well as efficiency of fish collection and transport systems. These variables differ by species and at different points in the migration period.

Basically, the flow-survival relationship is complicated by numerous physical and biological factors, and the simple hypothesis that more flow is always better is no longer valid. As stated by the Independent Scientific Advisory Board (ISAB 2003): "The prevailing flow-augmentation paradigm, which asserts that in-river smolt survival will be proportionally enhanced by any amount of added water, is no longer supportable. It does not agree with information now available."

Despite the complexities involved in the flow-survival relationship, considerable research indicates a positive relationship between flow and survival in years when river flows are lowest: the drier and drought years. The ambiguity in the flow-survival relationship at higher flows may result from other factors associated with high flows, such as elevated TDG or poorer performance of fish passage and protection systems. Fewer data are available from Chief Joseph to McNary Dams. Studies have not indicated a statistically significant link of flow to survival of juvenile salmonids (Giorgi et al. 1997). Studies have indicated that flow impacts migration speed for steelhead trout and sockeye salmon, but not for sub-yearling summer/fall Chinook or yearling spring Chinook smolt. A recent analysis of 10 years of PIT-tag data for steelhead survival between Rock Island Dam and McNary Dam indicate reduced survival on the low-flow year of 2001 (81 to 101 thousand cfs [kcfs]) but no apparent relationship for the other 9 years when flows ranged from 138 to 269 kcfs (FPC 2009). These results support the established flow target of 135 kcfs at Priest Rapids Dam in recent Biological Opinions.

It is not fully known why flow relates more strongly to survival during low-flow years. The most commonly referenced causative factors include water temperature (impacting predation rates, metabolic cost, and residualization), turbidity (impacting predation rates), and water velocity (impacting smolt travel time). Anderson et al. (2003) provides analysis indicating that water temperature, not flow, best fits the observed flow-survival relationship.

The fact that flows impact water travel time, which in turn can impact the rate of downstream fish migration, also may play a role in the survival of smolts after they reach the ocean. A protracted downstream migration, such as that observed in the drought year 2001, can result in suboptimal smolt development and reduced readiness for entry to salt water (Williams et al. 2005). Most clearly, steelhead studies indicate that exposure to warming in-river temperatures during a late out migration depresses the smoltification process and promotes recidivism when temperatures exceed 12 to 13°C. As noted by ISAB (2001), the cause may not matter in the larger view as long as the result of higher flows is higher survival.

The lower flows during September and October in the Columbia River resulting from the alternatives are not expected to cause any delay in the upstream migration of fall Chinook salmon or steelhead trout. 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).

The relatively minor flow reductions that would occur with any of the alternatives during the post-spawning period (November to April) would not impact the ability of Grant County PUD to meet its flow obligations outlined in the Hanford Reach Fall Chinook Protection Program (HRFCPP). 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 almost always 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 changes in daily average flow during November at Priest Rapids Dam associated with each alternative are shown in Table 4-37. Results are presented in ranked order based on November average flows for the base case. None of the partial replacement alternatives, except for Alternative 2D: Partial—Combined, would change November flows at all, and thus would not impact the ability to maintain target flows for Chinook 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.

TABLE 4-37

Average Differences in Columbia River Flows (cfs) from the No Action Alternative for the Partial Replacement Alternatives

Water Year Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr "1"	Apr "2"	May	Jun	Jul	Aug "1"	Aug "2"	Sep
Alternative 2A: Partial—Banks														
Dry	-751	0	0	0	0	30	0	0	0	0	0	0	0	-875
Dry-Average	-753	0	0	0	0	41	-28	-40	-164	-298	0	0	0	-952
Wet-Average	-597	0	0	0	0	41	-97	-87	-329	-456	0	0	0	-953
Wet	-616	0	-4	0	0	41	-145	-151	-328	-482	0	0	0	-1000
Alternative 2B: Partial—Banks + FDR														
Dry	-1454	0	0	0	0	0	0	0	0	0	0	0	0	0
Dry-Average	-1410	0	0	0	0	0	0	0	0	0	0	0	0	0
Wet-Average	-1411	0	0	0	0	0	0	0	0	0	0	0	0	-30
Wet	-1554	0	-4	-4	0	0	0	0	0	0	0	0	0	0
Alternative 2C: Partial—Banks + Rocky														
Dry	-1247	0	0	0	-124	-74	8	2	12	3	3	2	0	-875
Dry-Average	-1107	0	0	0	0	41	-2	-17	-78	-173	4	3	0	-948
Wet-Average	-1017	0	0	0	0	41	-30	-47	-169	-370	4	3	0	-927
Wet	-1075	0	-14	0	0	41	-53	-84	-197	-459	4	3	0	-939
Alternative 2D: Partial—Combined														
Dry	-1285	0	-281	-287	-172	-112	0	0	0	0	0	0	0	-633
Dry-Average	-1219	-169	-285	-309	-53	-144	0	0	0	0	0	0	0	-676
Wet-Average	-1127	-291	-554	-245	-7	-46	0	0	0	0	0	0	0	-681
Wet	-1134	-583	-453	-88	0	0	0	0	0	0	0	0	0	-695

Negative values indicate reduced flow. Water year types are those defined in the FCRPS 2008 Biological Opinion (NMFS 2008 BO).
April "1" and April "2" and Aug "1" and Aug "2" refer to the first and second halves of these months.

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-December spawning season or during the subsequent egg incubation months (see Table 4-37).

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 4-2, *Banks Lake Drawdown (feet) for Alternative 2A: Partial—Banks*.

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.

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 surface area of shallow-water littoral habitat that would be temporarily dewatered during drawdown under the various action alternatives compared to the No Action Alternative is presented in Table 4-38. Drawdowns that would occur under Alternative 2A: Partial—Banks would result in a maximum exposure of approximately 2,000 acres of littoral habitat in August (Central Washington University 2009). This would be approximately 780 acres more than that exposed under the No Action Alternative and represent a significant impact on invertebrate production. The three zones of littoral habitat that would be affected include the following:

1) Shallow aquatic macrophyte communities
2) Boulders, cobble and gravel
3) Shallow unvegetated flats

Based on the bathymetry of Banks Lake (Central Washington University 2009), temporary losses in boulder, cobble and gravel, as well as shallow unvegetated flats, would likely be replaced by similar habitats made available at lower water elevations. As a result, no substantial impacts are anticipated for fish and aquatic resources using these types of littoral zones. Kokanee use shallow cobble and talus rock substrate for spawning. However, the kokanee population in Banks Lake is more dependent on hatchery augmentation than on natural lake-shore spawning. Furthermore, the rising water levels in September and October would not be expected to adversely affect spawning or egg incubation for those kokanee that do spawn in the reservoir.

TABLE 4-38

Approximate Acres of Banks Lake Littoral Habitat Temporarily Dewatered Under the Action Alternatives and the No Action Alternative

Alternative	Average Water Year Drawdown (feet)	Area Exposed by Drawdown (acres)	Difference from No Action Alternative (acres)	Significant Impact Compared to No Action
No Action	5.0	1220		
Alternative 2A	8.4	2000	780	Yes
Alternative 2B	8.0	1910	690	Yes
Alternative 2C	5.1	1250	30	No
Alternative 2D	8.0	1910	690	Yes
Alternative 3A	13.5	3530	2310	Yes
Alternative 3B	8.0	1910	690	Yes
Alternative 3C	10.0	2390	1170	Yes
Alternative 3D	8.0	1910	690	Yes

Note: Some estimates are interpolated from results presented in the report because drawdown levels for all of the alternatives were not presented.

Source: Central Washington University 2009

During a drought year the drawdown would begin gradually in April and continue through August (see Chapter 2). Water levels at the end of May would remain about 1 foot below those just prior to the annual drawdown. This moderate drawdown would not be enough to affect the spawning success of those fish species (such as largemouth bass) that spawn at this time of year. This conclusion for drought years is reached for all other partial replacement alternatives as well.

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 September and 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 enough to significantly affect fish populations in Banks Lake.

Water level changes in Banks Lake, therefore, are not anticipated to impact zooplankton directly (Reclamation 2004). Direct impacts for the purposes of this study are recognized as being limited to either displacement or removal of zooplankton in association with a shortened water retention time. Greater displacement or removal of zooplankton through entrainment at Dry Falls Dam would result from the shortened water retention times that would occur in association with increased surface water discharge during drawdown with Alternative 2A: Partial—Banks. Based on the most recent available information, impacts to zooplankton communities would be minimal. In summer 2009, the density (organisms/m^3) of *Daphnia* (a key zooplankton) in the discharge at Dry Falls Dam was approximately ten-fold less than that observed in the lake (WDFW 2009). This finding is 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 September and October compared to the No Action Alternative. Final determinations of the overall impact on zooplankton abundance, and subsequently on the growth of plankton-eating fish, will be based on results of pending WDFW studies (available in late 2010).

Fish entrainment at Dry Falls Dam also continues to be assessed by WDFW. Preliminary results from 2009 (WDFW

2009 Fish) 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). Results and conclusions of these ongoing WDFW studies on fish entrainment will be available in late 2010.

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.

4.10.3.3 Mitigation

Only minimal impacts to anadromous fish are anticipated for the Columbia River and no impacts are anticipated for fish in Lake Roosevelt under Alternative 2A: Partial—Banks. Therefore, no mitigation measures are recommended.

No mitigation measures are recommended to address potential changes in aquatic macrophyte communities and benthic macroinvertebrate populations that would occur in Banks Lake as a result of increased drawdowns because changes are not anticipated to be sufficient to significantly impact fish populations in the long term.

These conclusions about mitigation would be the same for all action alternatives, and are therefore not discussed again in this analysis.

4.10.3.4 Cumulative Impacts

No cumulative impacts are anticipated for the Columbia River, Lake Roosevelt, Banks Lake or the Study Area and broader central Washington/CBP area under Alternative 2A: Partial—Banks. The Lake Roosevelt Incremental Storage and Release Program (Ecology 2008) has already been assumed in the baseline (No Action Alternative) for the Odessa Subarea Special Study. Similarly, the Reasonable and Prudent Alternatives contained in the 2008 FCRPS Biological Opinion, including the 5-foot Banks Lake drawdown and the Columbia River flow objectives, have been incorporated into the Odessa Subarea Special Study as part of the baseline or as constraints to the development of the alternatives (NMFS 2008 BO).

The Potholes Supplemental Feed Route project is designed to be water budget neutral, meaning there would be no impact on Columbia River flows. Elements of the Walla Walla River Storage and Pump Exchange Studies and the Umatilla Basin Aquifer Recovery would divert water from the Columbia River or its tributaries to improve local irrigation water supplies and instream flows. Diversions would be required to also meet the Columbia River flow objectives. Similarly, all Voluntary Regional Agreements cannot reduce or negatively impact stream flows during the months of July and August (April through August for the Snake River). The requirement that all of these actions would be required to meet the Columbia River flow objectives as a constraint to their enactment assures that there would be no cumulative impacts on fish in the Columbia River.

No other potential cumulative impacts on fisheries in the Columbia River basin have been identified. Also, no other projects have been identified that would be implemented during the same time period or in the same area that would potentially impact fish.

4.10.4 Alternative 2B: Partial—Banks + FDR

Short-term and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.10.4.1 Long-Term Impacts

Columbia River

No impacts on Columbia River fish are anticipated under this alternative. Of the eight action alternatives, four include the use of Lake Roosevelt storage to meet the Study Area water replacement needs (Alternatives 2B: Partial—Banks + FDR, 2D: Partial—Combined, 3B: Full—Banks + FDR, and 3D: Full—Combined). None these alternatives would have an impact on Columbia River flows during the mid-April through June downstream migration period (see Table 4-37). Therefore, Alternative 2B: Partial—Banks + FDR would have no impact on the survival of spring-migrant salmonid smolts.

Alternative 2B: Partial—Banks + FDR would not impact flows in the Columbia River during June, July, or August. Therefore, Alternative 2B: Partial—Banks + FDR would have no impact on the downstream migration survival of fall Chinook salmon originating in the Snake or Columbia Rivers. No adverse impacts on upstream migration or Hanford Reach fall Chinook would occur, as discussed for Alternative 2A: Partial—Banks.

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 during the November-December spawning season or during the subsequent egg incubation months (see Table 4-37).

Lake Roosevelt

None of the action alternatives would impact the extent of annual maximum drawdown during winter and spring. Furthermore, Alternative 2B: Partial—Banks + FDR would not be expected to increase the potential for fish entrainment at Grand Coulee Dam or at the nearby pump-generation station.

Entrainment of kokanee salmon and rainbow trout out of Lake Roosevelt through Grand Coulee Dam has been documented (Spotts et al. 2002 and 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: Partial—Banks + FDR would have no impact on lake elevations compared to the No Action Alternative from October through May in all year-types (Section 4.2, *Surface Water Quantity*, Table 4-5, *Lake Roosevelt Drawdown (feet) for Alternative 2B: Partial—Banks + FDR*). 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. The greatest water elevation changes would occur in July and August when the lake level is high, flows are low, and resulting water retention times are relatively long (greater than 45 days).

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.

Alternative 2B: Partial—Banks + FDR would draw down Lake Roosevelt slightly more than typical in the summer months (an additional 0.5 foot in August), but would not approach the level of annual drawdown that occurs in April. The capacity of the lake 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).

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 2A: Partial—Banks 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).

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 and this topic is not discussed under any of the remaining action alternatives.

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 the 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. Therefore, operation of the reservoir under the current rule curves attempts to achieve an elevation of 1283 feet amsl during September, when the kokanee first start attempting to migrate into the San Poil River. Other environmental factors such as water temperature and rainfall events also greatly influence initiation of upstream migration into the river.

Banks Lake

Impacts to shallow aquatic macrophyte communities (with reduced water surface elevations) under this alternative are anticipated to be the same as would occur under Alternative 2A: Partial—Banks 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. Projected Banks Lake monthly drawdowns under wet, average, dry and drought conditions for Alternative 2B: Partial—Banks + FDR are presented in Section 4.2, *Surface Water Quantity*, Table 4-4. Under this alternative, 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, July, and September. These drawdowns would be slightly less than those under Alternative 2A: Partial—Banks, but impacts to fish and aquatic resources are anticipated to be the similar. Drawdowns that would occur under Alternative 2B: Partial—Banks + FDR would result in approximately 1,910 acres of littoral habitat being dewatered in August (see Table 4-38). This would be approximately 690 acres more than the loss of littoral habitat that occurs currently under the No Action Alternative and represent a significant impact on invertebrate production.

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. However, WDFW is continuing its studies of the potential effects of zooplankton entrainment or fish growth.

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.

4.10.5 Alternative 2C: Partial—Banks + Rocky

Short-term and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.10.5.1 Long-Term Impacts

There would be only a minimal impact on any of the Columbia River salmonids migrating downstream in the spring and no impact on downstream summer smolt migration, upstream adult migration, lower river chum salmon, Hanford Reach fall Chinook salmon, or Lake Roosevelt fisheries under this alternative.

This alternative would have the least potential to impact fish and aquatic resources in Banks Lake and any impacts would be minimal. Projected Banks Lake monthly drawdowns under wet, average, dry, and drought conditions for Alternative 2C: Partial—Banks + Rocky are presented in Section 4.2, *Surface Water Quantity*, Table 4-6, *Banks Lake Drawdown (feet) for Alternative 2C: Partial—Banks + Rocky*. Banks Lake would be drawn down only slightly more than what is currently occurring under the No Action Alternative. The monthly water surface elevations in Banks Lake would be very similar to those under the No Action Alternative.

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 those described under Alternative 2A: Partial—Banks.

4.10.6 Alternative 2D: Partial—Combined

Short-term and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.10.6.1 Long-Term Impacts

There would be no impact on Columbia River downstream salmonid smolt migration, Hanford Reach fall Chinook, lower river chum salmon, or the Lake Roosevelt fishery under this alternative. The relatively minor flow reductions (see Table 4-37) that would occur under this alternative 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. Under this alternative, the November flow at Priest Rapids Dam would be reduced in 19 of the 70 years. However, the reduced-flow years tend to be those with a higher base flow. Therefore, there should be little or no impact on the ability of Grant County PUD (and other coordination parties) to provide the desired spawning conditions for fall Chinook below Priest Rapids Dam. If anything, the reduced flows on these otherwise high-flow years could help to maintain flows at desirable levels (albeit minor at approximately 1 percent).

Projected Banks Lake monthly drawdowns under wet, average, dry, and drought conditions for Alternative 2D: Partial—Combined are presented in Section 4,2, *Surface Water Quantity*, Table 4-7, *Banks Lake Drawdown (feet) for Alternative 2D: Partial—Combined*. Under Alternative 2D: Partial—Combined, drawdowns would be very similar to those for Alternative 2B: Partial—Banks + FDR, and impacts to fish and aquatic resources are anticipated to be the same.

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 those described under Alternative 2A: Partial—Banks.

4.10.7 Alternative 3A: Full—Banks

Short-term and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.10.7.1 Long-Term Impacts

Columbia River

The minimal impacts on downstream smolt migration in the Columbia River would be the same as Alternative 2A: Partial—Banks, and there would be no impact on upstream salmonid migration, lower river chum salmon spawning success, or the Lake Roosevelt Fisheries under this alternative.

The relatively minor flow reductions that would occur with Alternative 3A: Full—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 3A: Full—Banks would change November flows in the Columbia River in only 3 of the 70 years and only by 229 cfs to 591 cfs (Table 4-39). 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.

Banks Lake

Long-term impacts on fish in Banks Lake would probably be significant because of increased drawdowns in May, June, and July. Projected Banks Lake monthly drawdowns under wet, average, dry, and drought conditions Alternative 3A: Full—Banks are presented in Section 4.2, *Surface Water Quantity*, Table 4-9, *Banks Lake Drawdown (feet) for Alternative 3A: Full—Banks*. Banks Lake would be drawn down more under Alternative 3A: Full—Banks than under any of the other alternatives and represent a significant impact on invertebrate production. The types of potential aquatic resource impacts associated with this alternative would be similar to those types described for Alternative 2A: Partial—Banks for littoral habitat, macro-invertebrates, and zooplankton production, except the impacts would be greater because of the more extensive and longer-duration drawdowns with this alternative. The increased drawdowns in May, June, and July (see Chapter 2) would likely have a significant 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. The long-term impact on the fish community would therefore likely be significant.

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.

No impacts to fish in the area are anticipated under this alternative. Under Alternative 3A: Full—Banks, the Black Rock Reregulating Reservoir would flood a small pond that is currently fed by a perennial cold water spring. However, there is no known fishery in the existing pond, and no plans to stock fish in the proposed reservoir.

TABLE 4-39

Average Differences in Columbia River Flows (cfs) from the No Action Alternative for the Full Replacement Alternatives

Water Year Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr “1”	Apr “2”	May	Jun	Jul	Aug “1”	Aug “2”	Sep
Alternative 3A: Full—Banks														
Dry	-1789	0	-150	0	-172	-3	56	0	0	0	0	0	0	-875
Dry-Average	-1943	-11	-95	-98	0	-136	71	-17	-186	-594	0	0	0	-952
Wet-Average	-1856	-23	-132	-133	0	-75	84	-46	-380	-1025	0	0	0	-953
Wet	-1761	-38	-144	-27	0	9	44	-102	-431	-1211	0	0	0	-1000
Alternative 3B: Full—Banks + FDR														
Dry	-1650	0	-281	-320	-172	-165	0	0	0	0	0	0	0	-875
Dry-Average	-2200	-169	-285	-309	-53	-144	0	0	0	0	0	0	0	-952
Wet-Average	-1608	-291	-681	-286	-7	-85	0	0	0	0	0	0	0	-953
Wet	-1760	-583	-520	-136	0	0	0	0	0	0	0	0	0	-1000
Alternative 3C: Full—Banks + Rocky														
Dry	-2068	0	-282	-85	-275	-137	272	231	217	0	0	0	0	-875
Dry-Average	-2200	-67	-249	-223	-13	-258	406	342	104	-496	0	0	0	-952
Wet-Average	-2200	-121	-367	-238	-32	-75	286	260	-130	-923	0	0	0	-953
Wet	-2198	-271	-282	-132	0	9	220	146	-229	-1174	0	0	0	-1000
Alternative 3D: Full—Combined														
Dry	-1650	0	-328	-305	-275	-272	0	0	0	0	0	0	0	-875
Dry-Average	-2095	-106	-275	-236	-34	-173	0	0	0	0	0	0	0	-952
Wet-Average	-1862	-211	-623	-273	-115	-84	0	0	0	0	0	0	0	-953
Wet	-2200	-444	-391	-273	-121	0	0	0	0	0	0	0	0	-1000

Negative values indicate reduced flow. Water year types correspond to those defined in the FCRPS 2008 Biological Opinion (NMFS 2008 BO).
April “1” and April “2” and Aug “1” and Aug “2” refer to the first and second halves of these months.

4.10.8 Alternative 3B: Full—Banks + FDR

Short-term and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.10.8.1 Long-Term Impacts

Columbia River

Under Alternative 3B: Full—Banks + FDR there would be no impacts on Columbia River downstream salmonid smolt migration, adult upstream migration, lower river chum salmon spawning success, or on the Hanford Reach fall Chinook.

Lake Roosevelt

There would be no adverse impacts on fish entrainment, littoral habitats, zooplankton production, or the rainbow trout net pen program in Lake Roosevelt.

No long-term impacts on kokanee spawning success are expected under this alternative. Lake Roosevelt would not achieve refill to 1283 feet amsl in 12 of 70 years by the end of September compared to 1 of 70 for the No Action Alternative. For these additional 11 years that the September lake elevation would be less than 1283 feet amsl, the elevation would need to rise 0.1 to 0.5 feet to achieve the 1283 feet amsl target elevation. However, with water estimated to raise an average of 0.16 feet per day in October, the target elevation should be met 1 to 3 days after September 30. This would represent the extent of the kokanee migration delay for this alternative. While this delay in about 1 of 6 years would be viewed as a significant impact of this alternative, it is unlikely that a delay of 1 to 3 days at the beginning of the migration period during 1 of 6 years would adversely impact the long-term spawning success of San Poil River kokanee salmon.

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*, Table 4-11, *Banks Lake Drawdown (feet) for Alternative 3B: Full—Banks + FDR*. Banks Lake water levels would be drawn down 3 feet further than currently occurs in August in all water-year-types. This is the same maximum monthly drawdown expected to occur under Alternative 2B: Partial—Banks + FDR and impacts to fish and aquatic resources would be similar to those described for that alternative under wet, average, and dry conditions. Under drought conditions, drawdowns of approximately 3 feet further than what currently occurs would persist through all months of the year. In turn, impacts would likely be significant during drought years, but not in the long term.

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.

4.10.9 Alternative 3C: Full—Banks + Rocky

Short-term and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.10.9.1 Long-Term Impacts

Columbia River

There would be only minimal impacts on Columbia River downstream smolt migration, and no impacts on upstream adult migration, Hanford Reach fall

Chinook, lower river chum salmon, or Lake Roosevelt fisheries under this alternative.

Flows are projected to increase slightly during the driest years, suggesting a potential survival benefit to downstream migrant salmonids. However, these differences in flow would be too small to have a measurable impact on fish survival. Alternative 3C: Full—Banks + Rocky differs from all other alternatives in that average Columbia River flows during April (all year-type categories) and May (dry and dry-average year-types) would increase by 104 cfs to 406 cfs (see Table 4-39). These flow increases seen in the model output appear to be because of the drafting of Rocky Coulee Reservoir during the early irrigation season to meet some of the demand of the current CBP, thereby reducing the diversion from the Columbia River by a small amount.

Banks Lake

Impacts of Alternative 3C: Full—Banks + Rocky on fish and other aquatic resource in Banks Lake would be intermediate between those described above for Alternative 3A: Full—Banks and Alternative 3B: Full—Banks + FDR. Projected Banks Lake monthly drawdowns for Alternative 3C: Full—Banks + Rocky are presented in Section 4.2, *Surface Water Quantity*, Table 4-13, *Banks Lake Drawdown (feet) for Alternative 3C: Full—Banks + Rocky*. The extent of drawdowns under this alternative would be second in severity behind Alternative 3A: Full—Banks, and impacts would be similar. In an average year, August and September drawdowns would be approximately 5 feet more that what is currently occurring under the No Action Alternative. Lesser drawdowns would be expected in June (1.0 feet), July (2.4 feet) and October (2.8 feet). The additional drawdown would represent a significant impact on invertebrate production.

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.

4.10.10 Alternative 3D: Full—Combined

Short-term and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.10.10.1 Long-Term Impacts

There would be no adverse impacts on Columbia River downstream salmonid smolt migration, upstream adult migration, Hanford Reach fall Chinook, lower river chum salmon, or Lake Roosevelt fisheries under this alternative.

Banks Lake

Impacts of Alternative 3D: Full—Combined on fish and other aquatic resource in Banks Lake would be similar to those described for Alternative 3B: Full—Banks + FDR. Projected Banks Lake monthly drawdowns for Alternative 3D: Full—Combined are presented in Section 4.2, *Surface Water Quantity*, Table 4-14, *Banks Lake Drawdown (feet) for Alternative 3D: Full—Combined*. The drawdowns of Banks Lake would be very similar to those for Alternative 3B: Full—Banks + FDR. The maximum drawdown occurring in August would be 5 feet more that what is currently occurring under the No Action Alternative for all water-year types and represent a significant impact on invertebrate production.

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.

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 4-40, 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 4-40

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 eight action alternatives described above.

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 biological opinions 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 Columbia Basin Project*, 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 or their suitable habitat 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 or their suitable habitat 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 streamfows. As described in the *Fisheries and Aquatic Resources* portion of this Chapter, Section 5.10.3, *Alternative 2A: Partial—Banks*, there is little correlation between streamflows and fish survival when flows exceed the objectives identified in the 2008 Biological Opinion. 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. 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 (Table 4-2 in 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 only 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.

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 September (up to 1,000 cfs) and October (up to 2,200 cfs), corresponding to the primary refill period for FDR, Banks Lake, and Rocky Coulee Reservoir (see Tables 4-37 and 4-39 in 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 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). If anything, the reduced flows would facilitate faster upstream migration, although very slightly, based on the relatively small change in flow.

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 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 2: 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 (see Table 4-37).

4.11.3.3 Mitigation

No impacts to pygmy rabbits and only minimal non-measurable impacts (spring downstream migrants) or no impacts on ESA-listed fish species would occur under this alternative. Therefore, no mitigation measures are needed.

4.11.3.4 Cumulative Impacts

No cumulative impacts on pygmy rabbits are expected to occur under this or any of the action alternatives.

No cumulative impacts are anticipated for ESA-listed fish in the Columbia River, the Snake River, or Lake Roosevelt under Alternative 2A: Partial—Banks. The Lake Roosevelt Incremental Storage and Release Program (Ecology 2008) has already been assumed in the baseline (No Action Alternative) for the Study. Similarly, the Reasonable and Prudent Alternatives contained in the 2008 FCRPS Biological Opinion, including the 5-foot Banks Lake drawdown and the Columbia River flow objectives, have been incorporated into the Study as constraints to the development of the alternatives (NMFS 2008 BO). The Potholes Supplemental Feed Route project is designed to be water budget neutral, meaning there would be no impact on Columbia River flows.

Elements of the Walla Walla River Storage and Pump Exchange Studies and the Umatilla Basin Aquifer Recovery would divert water from the Columbia River or its tributaries to improve local irrigation water supplies and instream flows. Diversions would be required to also meet the Columbia River flow objectives. Similarly, all Voluntary Regional Agreements cannot reduce or negatively impact stream flows in the months of July and August (April through August for the Snake River). Since of these actions would be required to meet the Columbia River flow objectives as a constraint to their enactment, there would be no cumulative effects on fish in the Columbia River. No other potential cumulative impacts on fisheries in the Columbia River basin have been identified. Also, no other projects have been identified that would be implemented during the same time period or in the same area that would potentially impact fish.

4.11.4 Alternative 2B: Partial—Banks + FDR

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—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.

4.11.5 Alternative 2C: Partial—Banks + Rocky

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.11.6 Alternative 2D: Partial—Combined

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2B: Partial—Banks + FDR.

4.11.7 Alternative 3A: Full—Banks

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 extensive surveys within these areas of potentially suitable habitat that would be impacted by facilities during 2009 and no pygmy rabbits were detected (WDFW 2009). Surveys are to be repeated in 2010.

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. 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 to be 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.

There would be only minimal impacts on Columbia River downstream smolt migration during the spring, and no impacts on summer downstream migration, or 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: Partial—Banks. 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.

4.11.7.3 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.

4.11.7.4 Cumulative Impacts

As in Alternative 2A: Partial—Banks, no cumulative impacts on pygmy rabbits or ESA-listed fish are anticipated.

4.11.8 Alternative 3B: Full—Banks + FDR

Short-term, long-term, and cumulative impacts, as well as mitigation measures, 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.

4.11.9 Alternative 3C: Full—Banks + Rocky

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 3A: Full—Banks, with the exception of the Columbia River flows.

Very minor beneficial effects might occur downstream on the Columbia River because of slightly increased flows during some months of the driest years. Alternative 3C: Full—Banks + Rocky differs from all other alternatives in that average Columbia River flows during April (all year-type categories) and May (dry and dry-average year-types) would increase by 104 cfs to 406 cfs (see Table 4-39). These modeled flow increases appear to result from drafting Rocky Coulee Reservoir during the early irrigation season to meet some of the demand of the current CBP, thereby reducing the diversion, albeit minor, from the Columbia River. Because these flow increases would occur in the driest years suggests a potential survival benefit to downstream migrant salmonids. However, any effect on fish survival from these minor increases in flow would be too small to be meaningfully evaluated.

4.11.10 Alternative 3D: Full—Combined

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 3A: Full—Banks.

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 are 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. Although it is anticipated that no new generation will be required, to be conservative this analysis assumed a new gas-fired power source will be required to meet the net increase in power requirements. The alternatives would thus result in the generation of indirect GHG emissions from this power source. Indirect emissions refer to those that are a consequence of ongoing project activities that take place within the boundaries of the project area, but emissions occur at sources owned or controlled by another entity. Indirect GHGs emissions from this gas-fired power source are also considered in the evaluation.

Under the No Action Alternative, a decline in water availability and quality would cause some wells to be drilled deeper to maintain irrigated crop production. Activities associated with this would cause a very small and localized increase in air pollutants, fugitive dust, and GHGs and would not be considered significant over the short- or long-term.

Short- and long-term minimal impacts in association with construction vehicle exhaust, the release of fugitive dust, and GHGs under all partial replacement alternatives would occur. Similar impacts to air quality would occur under the full replacement alternatives, but to a greater degree. These impacts would also be considered minimal.

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 4-41 presents air quality impact indicators and significance criteria.

TABLE 4-41

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.

Indirect GHG emissions associated with a new natural gas-fired power source were calculated based on estimated increased annual electricity demand and emission factors relating GHGs to electricity requirements. Consistent with the draft SEPA GHG guidance, emission factors from the Climate Registry *General Reporting Protocol, Updates and Clarifications, 5/12/10, Table 14.1- U.S. Emission Factors for Grid Electricity by eGRID Subregion* were used in this analysis.

Typically, GHG emissions are reported on tons of carbon dioxide equivalent basis. To obtain tons of carbon dioxide equivalent emissions, the emissions of each GHG are multiplied by their associated global warming potential and then summed. The global warming potential 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 global warming potential of 21 and nitrous oxide has a global warming potential of 310. Global warming potentials from the Climate Registry Reporting Protocol were used to convert methane and nitrous oxide emissions to total carbon dioxide equivalent emissions.

Photograph 4-8.
Rural residents are accustomed to a clear airshed.

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 4.29, *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 4.29, *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

Only very minimal impacts on air quality, similar to current conditions, 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. Also, construction vehicle engine exhaust would result in an increase in localized air pollutants, as well as GHGs released into the atmosphere. Indirect GHG emissions would also occur as a result of increased electricity demand. Table 4-42 summarizes air pollutants that would be released into the atmosphere from engine exhaust during construction of the action alternatives as well as indirect GHG emissions from electricity usage.
Table 4-43 summarizes particulate matter emissions from the construction of each of the eight action alternatives. Adverse impacts from combustion byproducts and fugitive dust (PM_{10}) would be temporary in nature and minor. The construction activity best management practices 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.

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.

TABLE 4-42

Estimated Average Annual Air Pollutant Emission (ton/year)

		Alternatives 2A and 2B	Alternatives 2C and 2D	Alternatives 3A and 3B	Alternatives 3C and 3D
Fuel Usage (gal/year)		241,953	416,289	922,254	1,096,591
Criteria Pollutants	Carbon monoxide	54.29	73.45	183.97	203.13
	Nitrogen oxides	71.11	123.37	272.93	325.19
	Particulate matter	5.00	8.68	19.19	22.87
	PM_{10}	5.00	8.68	19.19	22.87
	Sulfur oxides	4.66	8.09	17.88	21.31
	Volatile organic compounds	7.62	12.26	28.12	32.76
Toxic Pollutants	Acetaldehyde	0.001	0.002	0.005	0.006
	Acrolein	0.002	0.003	0.005	0.006
	Benzene	0.015	0.026	0.050	0.061
	1,3-Butadiene	0.001	0.0009	0.0017	0.0021
	Formaldehyde	0.019	0.033	0.063	0.076
	Naphthalene	0.001	0.002	0.004	0.005
	Polyaromatic hydrocarbons	0.003	0.004	0.009	0.010
	Toluene	0.006	0.011	0.021	0.026
	Xylenes	0.005	0.008	0.015	0.019
Greenhouse Gas Pollutant	Carbon dioxide	2,692	4,640	10,271	12,219
	Methane	0.154	0.265	0.587	0.698
	Nitrous oxide	0.069	0.119	0.263	0.313
	Total carbon dioxide equivalents	2,717	4,682	10,365	12,331
Indirect GHG Pollutant	Carbon dioxide	123,297	154,516	254,497	285,716
	Methane	2.61	3.28	5.40	6.06
	Nitrous oxide	2.04	2.55	4.20	4.72
	Total carbon dioxide equivalents	123,983	155,376	255,913	287,306

Source: Estimated fuel use based on proposed facilities, materials required, and vehicles. GHG emission factors from Climate Registry 2008.

TABLE 4-43

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
2C: Partial—Banks + Rocky	52,358
2D: Partial—Combined	52,358
3A: Full—Banks	120,313
3B: Full—Banks + FDR	120,313
3C: Full—Banks + Rocky	121,515
3D: Full—Combined	121,515

Source: Analysis of facilities, equipment, and transportation requirements

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. Annual indirect emissions would also occur as a result of increased power demand under the action alternatives. However, any incremental impact on global climate change would occur over a longer time frame and also be part of the far greater global GHG emissions. Therefore, GHG emissions are considered to be a cumulative impacts issue and are addressed in that section for each alternative.

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. 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.

4.12.3.3 Mitigation

No mitigation measures are required.

4.12.3.4 Cumulative Impacts

GHGs contribute to air quality degradation and climate change by trapping heat in the atmosphere. All of the action alternatives represent a very minor fraction of the state and national GHG emissions. Though very small, any contribution of direct GHG emissions from construction of facilities as well as indirect emissions from increased power demand would persist as a long-term minimal impact.

In Washington, GHGs are not regulated pollutants. However, in 2007, the Governor signed an Executive Order to reduce GHGs. In 2008, the Legislature passed a bill requiring Ecology to adopt a mandatory GHG reporting rule. Therefore, to determine if reporting is required, an operations emissions estimate for the Study Area would be compared against the reporting thresholds. GHGs have been identified as a contributor to climate change and would be problematic for air quality during the summer months.

The draft reporting thresholds for annual GHG emissions are equal to or greater than either of the following:

- 2,500 metric tons from on-road motor vehicles
- 10,000 metric tons of all direct GHG emissions from a stationary source, a mobile source for transporting people or cargo, or a combination of these stationary and mobile sources

The CEQ draft guidance regarding how Federal agencies should analyze the environmental effects of GHG emissions and climate change indicates that if a proposed action would be reasonably anticipated to cause direct emissions of 25,000 metric tons or more of CO_2-equivalent GHG emissions on an annual basis, agencies should consider this an indicator that a quantitative and qualitative assessment may be meaningful to decision makers and the public. For long-term actions that have annual direct emissions of less than 25,000 metric tons of CO_2-equivalent, CEQ encourages Federal agencies to consider whether the action's long-term emissions should receive similar analysis.

CEQ does not propose this as an indicator of a threshold of significant effects, but rather as an indicator of a minimum level of GHG emissions that may warrant some description in the appropriate NEPA analysis for agency actions involving direct emissions of GHGs.

The CEQ guidance does not currently address methodologies and approaches for indirect GHG emissions.

The draft SEPA GHG guidance does not currently indicate a standard significance threshold for GHG emissions; however, the guidance indicates that other agencies, including CEQ, have developed thresholds to help determine whether more evaluation is required. SEPA recommends using these references for agencies interested in developing their own level of significance.

GHG emissions are appropriately considered a cumulative impacts issue, and the construction and operation of a new carbon dioxide source, including the proposed facilities, would comprise an incremental increase (albeit extremely small) to cumulative GHG emissions, unless the increase were offset by reductions from other sources.

It is possible to generally estimate the incremental contribution of carbon dioxide into the atmosphere from a large construction project. However, it is not possible to determine how relatively small incremental emissions from a single construction event might translate into specific physical impacts on the environment (for example, the impact on sea level rise, or snowpack levels). Given the complex interactions between various global and regional-scale physical, chemical, atmospheric, terrestrial, and aquatic systems that would result in the physical expressions of global climate change, it is not possible to discern whether or the extent to which the presence of carbon dioxide emitted by a given construction event would result in any specific altered conditions. Similarly, it is difficult to assess impacts from a relatively small increase in power demand. The impact of indirect GHG emissions may be reduced by the implementation of energy efficiency projects where the power is used (i.e. efficient lighting, motor controls, HVAC controls, etc.) and by the purchase of green power or renewable energy certificates. The decision to implement any of these energy efficiency measures would be made during final design.

Table 4-44 summarizes each alternative's estimated GHG emissions relative to other alternatives as well as estimated emissions for the State of Washington and for the U.S. Alternative 2A: Partial—Banks represents one of the two lowest emission alternatives. These projected direct GHG emissions are well below the CEQ's 25,000 metric ton direct emissions indicator that may warrant a quantitative analysis of GHG effects on climate change in NEPA.

4.12.4 Alternative 2B: Partial—Banks + FDR

Short- and long-term impacts and conclusions, mitigation measures, and cumulative impacts for air quality would be the same as Alternative 2A: Partial—Banks (Tables 4-42, 4-43, and 4-44).

TABLE 4-44

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)	
	Direct Construction	**Indirect from Power Usage**
Alternative 2A	2,500	112,476
Alternative 2B	2,500	112,476
Alternative 2C	4,200	140,956
Alternative 2D	4,200	140,956
Alternative 3A	9,400	232,163
Alternative 3B	9,400	232,163
Alternative 3C	11,000	260,642
Alternative 3D	11,000	260,642
State of Washington[a]	94,800,000	
United States[b]	7,260,000,000	

[a] Ecology et al. 2007
[b] EPA 2007

4.12.5 Alternative 2C: Partial—Banks + Rocky

4.12.5.1 Short-Term Impacts

Alternative 2C: Partial—Banks + Rocky includes the development of the Rocky Coulee Reservoir which represents nearly half of the construction effort for this alternative. Construction vehicle engine exhaust would result in an increase in air pollutants, as well as GHGs released into the atmosphere (Tables 4-42 and 4-43). Conclusions regarding PM_{10} emissions and the analysis area attainment status are the same as those of Alternative 2A: Partial—Banks.

4.12.5.2 Long-Term Impacts

Emissions resulting from maintenance activities are a fraction of the short-term impact emissions for Alternative 2C: Partial—Banks + Rocky. Therefore, no long-term emissions were estimated for this alternative.

4.12.5.3 Mitigation

No mitigation measures are required.

4.12.5.4 Cumulative Impacts

Though very small, any contribution of direct GHG emissions from construction of facilities and indirect GHG emissions from increased power demand would persist as a long-term minimal impact. Potential GHG impacts on climate change would be higher than those of Alternative 2A: Partial—Banks (Table 4-44). All of the alternatives represent a very minor fraction of the state and national GHG emissions. It is not possible to discern whether the presence of carbon dioxide emitted by a given construction event or small increase in power demand would result in any specific altered conditions.

4.12.6 Alternative 2D: Partial—Combined

Short- and long-term impacts and conclusions, mitigation measures, and cumulative impacts for air quality are the same as those presented for Alternative 2C: Partial—Banks + Rocky (Tables 4-42, 4-43, and 4-44).

4.12.7 Alternative 3A: Full—Banks

4.12.7.1 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 Tables 4-42 and 4-43.

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 3A: Full—Banks. Therefore, no long-term emissions were estimated for this alternative.

4.12.7.3 Mitigation

No mitigation measures are required.

4.12.7.4 Cumulative Impacts

The very small contribution of direct GHG emissions from construction of facilities and indirect GHG emissions from increased power demand would persist as a long-term minimal impact. Potential GHG impacts on climate change would be higher than those of the partial replacement alternatives (Table 4-44). All of the alternatives represent a very minor fraction of the state and national GHG emissions. It is not possible to discern whether the presence of carbon dioxide emitted by a given construction event or small increase in power demand would result in any specific altered conditions.

4.12.8 Alternative 3B: Full—Banks + FDR

Short- and long-term impacts and conclusions, mitigation measures, and cumulative impacts for air quality are the same as those presented for Alternative 3A: Full—Banks, and as shown in Tables 4-42, 4-43, and 4-44 in Alternative 2A: Partial—Banks.

4.12.9 Alternative 3C: Full—Banks + Rocky

4.12.9.1 Short-Term Impacts

Fugitive dust and vehicle exhaust emissions would be somewhat higher than those of Alternative 3A: Full—Banks, and as shown on Tables 4-43 and 4-44 in Alternative 2A: Partial—Banks. Conclusions regarding these emissions would be the same as those stated for Alternative 3A: Full—Banks.

4.12.9.2 Long-Term Impacts

Emissions that would result from maintenance activities are a fraction of the short-term impact emissions for Alternative 3C: Full—Banks + Rocky. Therefore, no long-term emissions were estimated for this alternative.

Though very small, any contribution of GHG emissions from construction of the facilities would persist as a long-term minimal impact.

4.12.9.3 Mitigation

No mitigation measures are required.

4.12.9.4 Cumulative Impacts

As stated for the other alternatives, the very small contribution of direct GHG emissions from construction of facilities and indirect GHG emissions from increased power demand would persist as a long-term minimal impact. Potential GHG impacts on climate change would be higher than those of Alternative 3A: Full—Banks (Table 4-44). All of the alternatives represent a very minor fraction of the state and national GHG emissions. It is not possible to discern whether the presence of carbon dioxide emitted by a given construction event or small increase in power demand would result in any specific altered conditions.

4.12.10 Alternative 3D: Full—Combined

Short- and long-term impacts and conclusions, mitigation measures, and cumulative impacts for air quality are the same as those presented for Alternative 3C: Full—Banks + Rocky (shown on Tables 4-42, 4-43, and 4-44).

4.13 Land Use and Shoreline Resources

The short- and long-term impacts, mitigation measures, and cumulative 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 would support irrigated agricultural uses in the long term on groundwater-irrigated lands in the Study Area south of I-90. 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 5,200 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 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. Nearly 20,000 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 42 percent is in agricultural use. As with the partial replacement alternatives, existing uses that would be disrupted or changed range from residences, through center-pivot irrigated farm parcels, to dryland farms and open land.

For the action alternatives that include construction of Rocky Coulee Reservoir, additional significant impacts would accompany the 8,900 acres of land acquired for that facility. Uses that would be impacted include several residences, irrigated agriculture operations, and dryland farms.

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 4-45 were used to evaluate land use and shoreline resources impacts.

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.

TABLE 4-45

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.

4.13.1.3 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

Photograph 4-9.
A developed recreation site at Lake Roosevelt.

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, *Partial 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 in Table 4-46 for easement acquisition, and Table 4-47 for fee title acquisition.

TABLE 4-46

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	3,632	288	Locations, land status, and parcels impacted undetermined	3,988	315
Public land	--	--	204	12		204	12
County and city land	--	--	6	1		6	1
School District	--	--	6	1		6	1
State land (WDNR)	--	--	198	11		198	11
Totals	**356**	**27**	**3,836**	**300**	**1,018**	**5,209***	**327**

*Includes totals above plus transmission line acreage at left.

TABLE 4-47

Partial Replacement Alternatives—Water Delivery System: Fee Title Acquisition Requirements

	Pumping plants, gravity turnout, O&M Facility	
	Acres	**Parcels Impacted**
Private land	81	24
Public land	4	1
State land (WDNR)	4	1
Totals	**85**	**25**

As shown in Tables 4-46 and 4-47, most land interest acquisition requirements would involve private land, reflecting the predominance of private ownership throughout the Study Area. A total of 4,192 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 4-48, 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 75 percent of this in irrigated lands and 25 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 4-48

Partial Replacement Alternatives—Water Distribution System: Land Use Impacts*

		Agriculture								Open Land
		Center Pivots		Other Irrigated Farm Parcels		Dryland Farm Parcels				
Proposed Feature County	**Occupied Structures (including residences and businesses) within New Easements or Acquisition**	**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**	**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)**
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 (200-foot easements)	**3**	**257**	**63**	**8**	**0**	**55**	**2**	**1,772**	**521**	**1,583**
Adams	2	221	50	5	0	49	1	1,577	440	1,364
Grant	0	6	3	0	0	0	0	9	0	61
Franklin	1	30	10	3	0	6	1	186	81	158
Pumping plants, gravity turnout, and O&M Facilities	**0**	**4**	**NA**	**0**	**NA**	**2**	**NA**	**20**	**16**	**60**
Adams	0	4	NA	0	NA	2	NA	20	16	52
Grant	0	0	NA	0	NA	0	NA	0	0	8
Totals	**5**	**262**	**66**	**8**	**12**	**60**	**3**	**1,975**	**685**	**1,668**

*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 39 percent of the land necessary for facility easements or fee-owned sites is currently open land. Parcels impacted range from section corners (the un-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

4.13.3.3 Mitigation

Land Ownership and Land Status

Land interest acquisition requirements are an unavoidable consequence of Alternative 2A: Partial—Banks. 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.

Existing Land Use and Shoreline Resources

To some extent, both short-term and long-term land use changes and impacts are unavoidable under Alternative 2A: Partial—Banks. 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).

Relevant Plans, Programs, or Policies

The fundamental inconsistencies of the Alternative 2A: Partial—Banks with the plans, programs, or policies of impacted counties and the WDNR related to groundwater irrigated land north of I-90 are unavoidable (as is the case with the No Action Alternative).

4.13.3.4 Cumulative Impacts

No cumulative impact concerns are present for Land Use and Shoreline under Alternative 2A, Partial—Banks, nor for any of the other action alternatives.

4.13.4 Alternative 2B: Partial—Banks + FDR

Short- and long-term impacts and conclusions, mitigation measures, and cumulative impacts would be the same as that presented for Alternative 2A: Partial—Banks.

4.13.5 Alternative 2C: Partial—Banks + Rocky

Impacts associated with this alternative would be the same as for Alternative 2A: Partial—Banks, except for additional impacts associated with the construction of the Rocky Coulee Reservoir.

4.13.5.1 Short-Term Impacts

No short-term impacts would occur to land ownership and land status, existing land use and shoreline resources, or relevant plans, programs, or policies. All impacts would be long term.

4.13.5.2 Long-Term Impacts

Land Ownership and Land Status

Reclamation would acquire fee title to a total of 8,938 acres of land for the development and long-term operation of Rocky Coulee Reservoir. The acreages of private and public land and involved numbers of parcels in this acquisition are shown in Table 4-49. Most of the land to be acquired is privately owned. About 4 percent of the total acres are State Trust lands, with 76 acres owned by Fire District 5 in Grant County.

TABLE 4-49

Rocky Coulee Reservoir: Fee Title Acquisition Requirements

	Acres	Parcels Impacted
Private land	8543	117
Public land	395	3
State land (WDNR)	319	1
Fire District 5	76	2
Totals	**8,938**	**120**

Existing Land Use and Shoreline Resources

Long-term land use impacts would derive directly from Reclamation acquisition of the land necessary for the reservoir. Impacts would include the following:

- Displacement of residences
- Removing land from agricultural production
- Introducing major irrigation system infrastructure in currently open land

In the first two of these categories, impacts would be significant. In cases where currently open land would be used, impacts would generally not be considered significant because none of the impacted open lands are formally designated as open space, recreation, or habitat.

As shown in Table 4-50, 15 residences would be displaced from within the reservoir acquisition area. Of the total area to be acquired, approximately 46 percent is in agricultural use (over 90 percent of which is irrigated). Seventeen center-pivot-irrigated fields would be taken out of production, and another 19 fields could have operations continue. All or portions of three dryland farm parcels are within the reservoir acquisition area, with parts of two are in the inundation zone.

Approximately 54 percent of the land to be acquired for Rocky Coulee Reservoir is currently open land. This includes all publicly-owned land noted in previous text. None of this land is formally designated as open space, recreation, or habitat. No waterbodies subject to the State Shoreline Management Act are within the area impacted by development of Rocky Coulee Reservoir.

TABLE 4-50

Rocky Coulee Reservoir: Land Use Impacts

	Agriculture								Open Land
	Center Pivots		Other Irrigated Farm Parcels		Dryland Farm Parcels				
Occupied Structures Within Easements or Acquisition Areas	All or Part within Inundation Zone	All or Part within Acquisition Area; Not in Inundation Zone	All or Part within Inundation Zone	All or Part within Acquisition Area; Not in Inundation Zone	All or Part within Inundation Zone	All or Part within Acquisition Area; Not in Inundation Zone	Total Irrigated Agriculture within Acquisition Area (acres)	Total Dryland Agriculture within Acquisition Area (acres)	Total Open Land within Acquisition Area (acres)
15	17	19	0	0	2	1	3,827	270	4,841

Relevant Plans, Programs, or Policies
All land within the Rocky Coulee Reservoir acquisition area is within the "irrigated" designation of the Grant County Comprehensive Plan. Thus, from the strict standpoint of land use designation, development of the reservoir would not be consistent with the Comprehensive Plan. From a broader perspective, if the reservoir is needed to preserve irrigated agriculture, it would be considered necessary agricultural infrastructure and would be consistent with the overall goals and objectives of the Grant County plan. However, the vast majority of irrigated lands in the Study Area that would be supplied with surface water in this alternative are not in Grant County.

Federal acquisition of 319 acres of State Trust land for the reservoir would remove this land from the State's inventory in terms of revenue planning for the trust beneficiaries.

Development of Rocky Coulee Reservoir would involve no inconsistencies with plans, programs, or policies related to the County's Critical Areas Ordinance, or the State Shoreline Management Act, and County Shoreline Master Program.

4.13.5.3 Mitigation

Land Ownership and Land Status
Land interest acquisition is an unavoidable consequence of Alternative 2C: Partial—Banks + Rocky. 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.

Existing Land Use and Shoreline Resources
To some extent, long-term land use changes and significant impacts are unavoidable within the acquisition area for Rocky Coulee Reservoir. This is true related to displacement of residences and impacts to agricultural land within the inundation or facility site zones of the reservoir. To the extent feasible, existing agricultural uses within the acquisition area, but not within the inundation or facility site zones, would be allowed to continue under permit after construction is completed.

Relevant Plans, Programs, or Policies
No mitigation measures are possible for the fundamental inconsistency of Rocky Coulee Reservoir with the underlying Grant County Comprehensive Plan land use designation.

4.13.6 Alternative 2D: Partial—Combined

Short- and long-term impacts and conclusions, mitigation measures, and cumulative impacts would be the same as those described for Alternative 2C: Partial—Banks + Rocky.

4.13.7 Alternative 3A: Full—Banks

Alternative 3A: Full—Banks 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: Partial—Banks, 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.

4.13.7.1 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.

4.13.7.2 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 Tables 4-51 for easement acquisition, and 4-52 for fee title acquisition. Total land ownership impact quantities, including facilities both north and south of I-90, are shown in Table 4-53 for easement acquisition, and Table 4-54 for fee title acquisition.

TABLE 4-51

Full Replacement Alternatives—Water Delivery System: Easement Acquisition Requirements North of I-90[a]

	Canals, Siphons, Wasteways		**Pipelines**		**Transmission Lines**	**Totals**	
	Acres	**Parcels Impacted**	**Acres**	**Parcels Impacted**	**Acres**	**Acres**	**Parcels Impacted**
Private land	8,101	337	4,171	575	Locations, land status, and parcels impacted undetermined	12,272	912
Public land	537	22	131	19		668	41
County and city land total	--	--	5	2		5	2
Adams County	--	--	1	1		1	1
Grant County	--	--	4	1		4	1
State land total	537	22	126	17		663	39
WDFW	89	6	--	--		89	6
WDNR	365	9	115	11		480	20
WSDOT	83	7	11	6		94	13
Totals	**8,638**	**359**	**4,302**	**594**	**1,540**	**14,480**[b]	**953**

[a] In addition to requirements south of I-90, described in Table 4-46 for the partial replacement alternatives
[b] Includes totals above plus transmission line acreage at left.

TABLE 4-52

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	130	41	1,299	51	1,429	92
Public	10	2	1	1	11	3
State land (WDNR)	10	2	1	1	11	3
Totals	**140**	**43**	**1,300**	**52**	**1,440**	95

* In addition to requirements south of I-90, described in Table 4-46 for the partial replacement alternatives

TABLE 4-53

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	8,074	889		16,531	1,253
Public land	537	22	340	32		877	54
County and city land total	--	--	16	4		16	4
School District 146	--	--	6	1		6	1
Warden			5	1	Locations, land status, and parcels impacted undetermined	5	1
Adams County			1	1		1	1
Grant County	--	--	4	1		4	1
State land total	537	22	324	28		861	50
WDFW	89	6	--	--		89	6
WDNR	365	9	313	22		678	31
WSDOT	83	7	11	6		94	13
Totals	**8,994**	**386**	**8,414**	**921**	**2,557**	**19,689***	**1,307**

* Includes totals above plus transmission line acreage at left.

TABLE 4-54

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	211	65	1,299	51	1,510	116
Public	14	3	1	1	15	4
State land (WDNR)	14	3	1	1	15	4
Totals	**225**	**68**	**1300**	**52**	**1,525**	**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 4 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:** 491 acres of land involving 23 parcels scattered throughout the area, necessary for new canals and pipelines.
- **WSDOT:** 94 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 19,689 acres of easements and 1,525 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 provided in Table 4-55. Table 4-56 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 36 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 64 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 4-55
Full Replacement Alternatives—Water Distribution System: Land Use Impacts North of I-90 [a,b]

		Agriculture								Open Land
		Center Pivots		Other Irrigated Farm Parcels		Dryland Farm Parcels				
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**	**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)**
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	0	8	4	0	0	6	2	210	49	0
Pipelines (200-foot easements)	**4**	**213**	**209**	**3**	**2**	**49**	**16**	**898**	**1,418**	**1,986**
Adams	0	42	45	1	0	12	4	189	147	781
Grant	2	145	130	1	2	29	12	623	922	1,116
Lincoln	2	26	34	1	0	8	0	86	349	89
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**	**5**	**NA**	**0**	**NA**	**6**	**NA**	**28**	**42**	**74**
Adams	0	0	NA	0	NA	4	NA	7	28	23
Grant	0	5	NA	0	NA	1	NA	21	7	44
Lincoln	0	0	NA	0	NA	1	NA	0	7	7
Black Rock Reregulating Reservoir	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**11**	**0**	**1,289**
Totals	**10**	**261**	**232**	**5**	**3**	**88**	**30**	**2,174**	**2,939**	**9,272**

[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 4-47 for the partial replacement alternatives.

TABLE 4-56

Full Replacement Alternatives—Water Distribution System: Land Use Impact Totals*

		Agriculture								Open Land
		Center Pivots		Other Irrigated Farm Parcels		Dryland Farm Parcels				
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**	**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)**
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**	**2,670**	**1,940**	**3,569**
Adams	2	263	95	6	0	61	5	1,766	587	2,145
Grant	2	151	133	1	2	29	12	632	922	1,177
Franklin	2	30	10	3	0	6	1	186	81	158
Lincoln	2	26	34	1	0	8	0	86	349	89
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**	**48**	**58**	**130**
Adams	0	4	0	0	0	6	0	4	44	73
Grant	0	5	0	0	0	1	0	21	7	50
Lincoln	0	0	0	0	0	1	0	0	7	7
Black Rock Reregulation Reservoir	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**11**	**0**	**1,289**
Totals	**17**	**523**	**298**	**13**	**15**	**148**	**33**	**4,150**	**3,624**	**10,936**

*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

4.13.7.3 Mitigation

Mitigation for land ownership and land status, existing land use and shoreline resources, and plans, programs, and policies would be the same as described for Alternative 2A: Partial—Banks.

4.13.8 Alternative 3B: Full—Banks + FDR

Short- and long-term impacts and conclusions, mitigation measures, and cumulative impacts would be the same as those described for Alternative 3A: Full—Banks.

4.13.9 Alternative 3C: Full—Banks + Rocky

Impacts associated with this alternative are the same as for Alternative 3A: Full—Banks, except for additional impacts associated with the construction of the Rocky Coulee Reservoir. Impacts from reservoir construction are the same as described in Alternative 2C: Partial—Banks + Rocky. The only difference with this alternative is that the inconsistency with the Grant County Comprehensive Plan land use designation for the reservoir site would be counter-balanced by support for continued irrigated agriculture in the portion of the Study Area within Grant County. In Alternative 2C: Partial—Banks + Rocky, the land supported by the reservoir is generally not in Grant County.

4.13.10 Alternative 3D: Full—Combined

Short- and long-term impacts and conclusions, mitigation measures, and cumulative impacts would be the same as those described for Alternative 3B: Full—Banks + FDR.

4.14 Recreation Resources

The short- and long-term impacts to recreation resources could potentially affect water-oriented recreation, as well as other recreation activities that use rural lands.

No significant short- or long-term impacts to recreation resources would occur under the No Action Alternative. The transition away from irrigated agriculture in the Study Area would result in a minimal impact on hunting and wildlife viewing opportunities in the Study Area.

Under all of the action alternatives, minimal short-term impacts on recreation resources would occur at Banks Lake, Lake Roosevelt, and in the Study Area, including at the proposed Rocky Coulee Reservoir site. Minor disruptions of hunting or wildlife viewing opportunities in the Study Area could occur during facility construction.

Long-term impacts to reservoir-oriented recreation resources under all the action alternatives, except Alternative 2C: Banks + Rocky, would be significant at Banks Lake. Impacts would be caused by increased drawdowns and would center on corresponding increases in the distance to shore from developed and dispersed campgrounds and day use sites. Generally, these impacts would be of higher magnitude or longer duration each year under the full replacement alternatives than under the partial replacement alternatives and would not be mitigable. Without mitigation, significant impacts would also occur relative to boat launch capacity, boating hazards, fishing opportunities, and developed swimming areas; however, these impacts would be mitigated. Under Alternative 2C: Partial—Banks + Rocky, there would be no significant impact on reservoir-oriented recreation at Banks Lake. Only minimal, if any, impacts would occur to land-based recreation near Banks Lake for any of the action alternatives.

The action alternatives would generally have minimal impact on recreation resources at Lake Roosevelt. Within the Study Area north of I-90, the partial replacement alternatives would involve the same impact on hunting and wildlife viewing described for the No Action Alternative.

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 4-57. 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 4-57
Recreation Resources 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 1% or more of capacity is lost during the recreation season.
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.
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. Impacts would be locally or individually significant to users focused on specific tracts of land, but not significant from a broader Study Area or regional perspective.

*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 Bank 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 over funding for that agency's fish and wildlife programs. However, this effect would apply only to anglers who use Banks Lake 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 as 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 4-10.

Photograph 4-10.
Illustration of a reservoir drawdown, or bathtub ring conditions. This is a representative illustration and does not depict either Banks Lake or Lake Roosevelt.

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), 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.

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 4.29, *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 the purpose of 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 (see Section 4.2, *Surface Water Quantity*, Figure 4-2, *Banks Lake Annual Drawdown Patterns—No Action Alternative*).
- 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 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 have the following impacts on recreation facilities and activities:

- Six of the 22 boat launch ramps and one of the four marinas in the National Park Service area become unavailable for 1 to 2 weeks. These ramps and marinas 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)
- 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. These changes would, however, 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 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

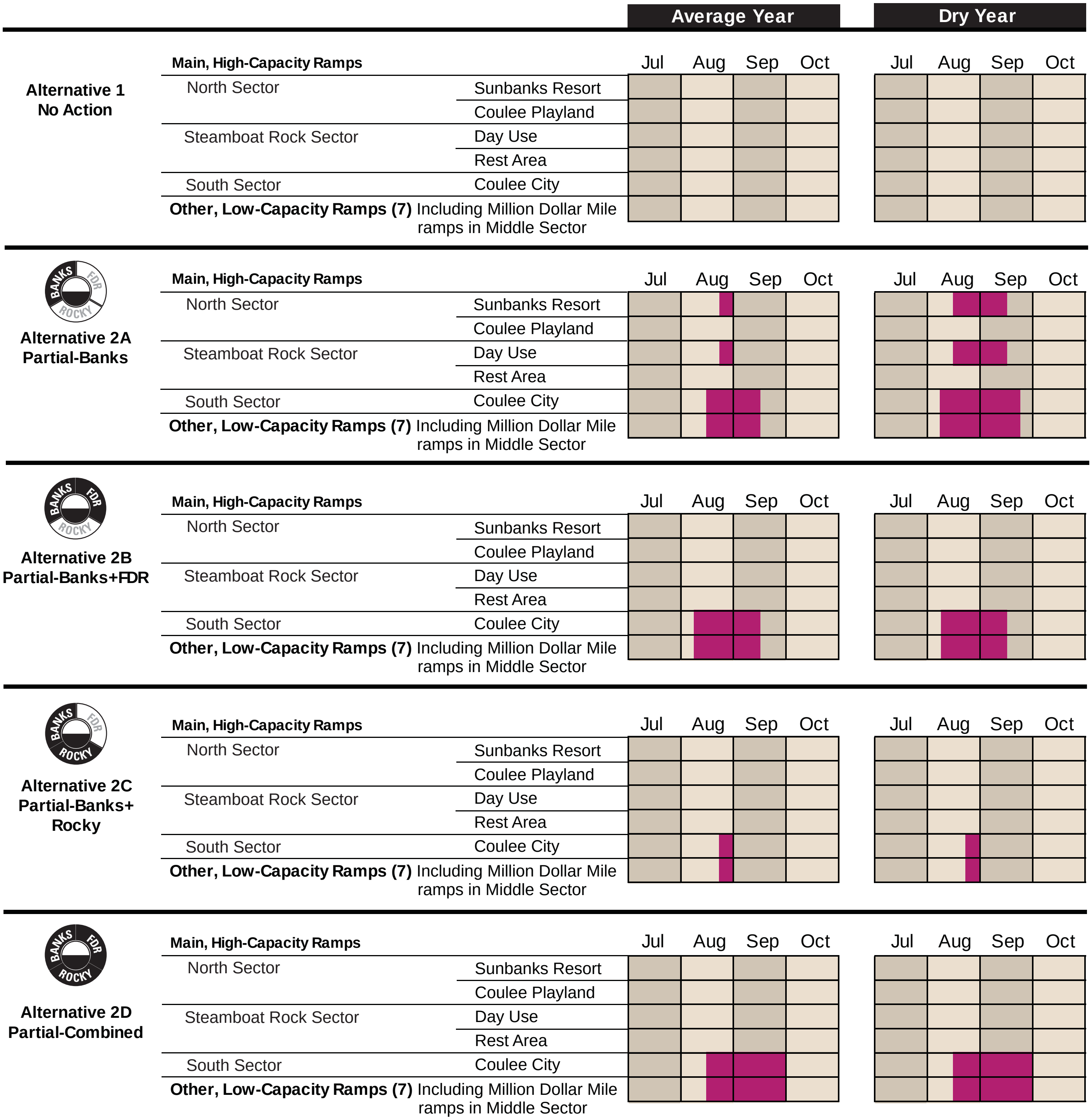
Boat Launch Capacity

Without mitigation, this alternative would result in the following significant impacts to boat launch capacity (see Figure 4-21):

- Three of the five developed boat ramps would become unusable for a period of time in August and September. Sunbanks Resort and SRSP Day Use would be unusable for approximately 1 week in average water years and 2 weeks in dry years. The Coulee City boat ramp would be unusable for approximately 4 weeks in average water years and 6 weeks in dry years. The seven remaining, low-use/capacity ramps would also be unusable for the same periods of time as the Coulee City facility. This compares with no periods in which ramps would be unusable under the No Action Alternative.
- During the same August and September time frame, two of the four geographic sectors of the reservoir (Middle and South; see Maps 3-5 and 3-6) would lose boat launch capability for approximately 4 weeks in average water years and 6 weeks in dry years. No launch ramps would be available during this period in the Middle and South sectors.

Boating Hazards

Reservoir drawdowns below 1564 feet amsl (the threshold for significant impact) would occur during both average and dry years during the same impact time frames as for boat ramps. Maximum drawdown would be to about 1562 feet amsl in average years and about 1560 amsl in dry years.



NOTES

* Potential for impact is July - October. No impacts would occur the remainder of the year for any alternative.

LEGEND

= Ramp in Service

= Ramp Not in Service

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Figure 4-21

Partial Replacement Alternatives - Banks Lake Boat Launch Ramp Impacts (July - October*)

WB082009003BOI

Fishing Opportunities
Fishing activity would be significantly restricted when boat ramps are unavailable. 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 (see Figure 4-22).

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. Tables 4-58 and 4-59 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, most locations where this distance would exceed 100 feet are located in the Middle and South sectors of the reservoir, with distances ranging from 300 to 900 feet in average years.

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.

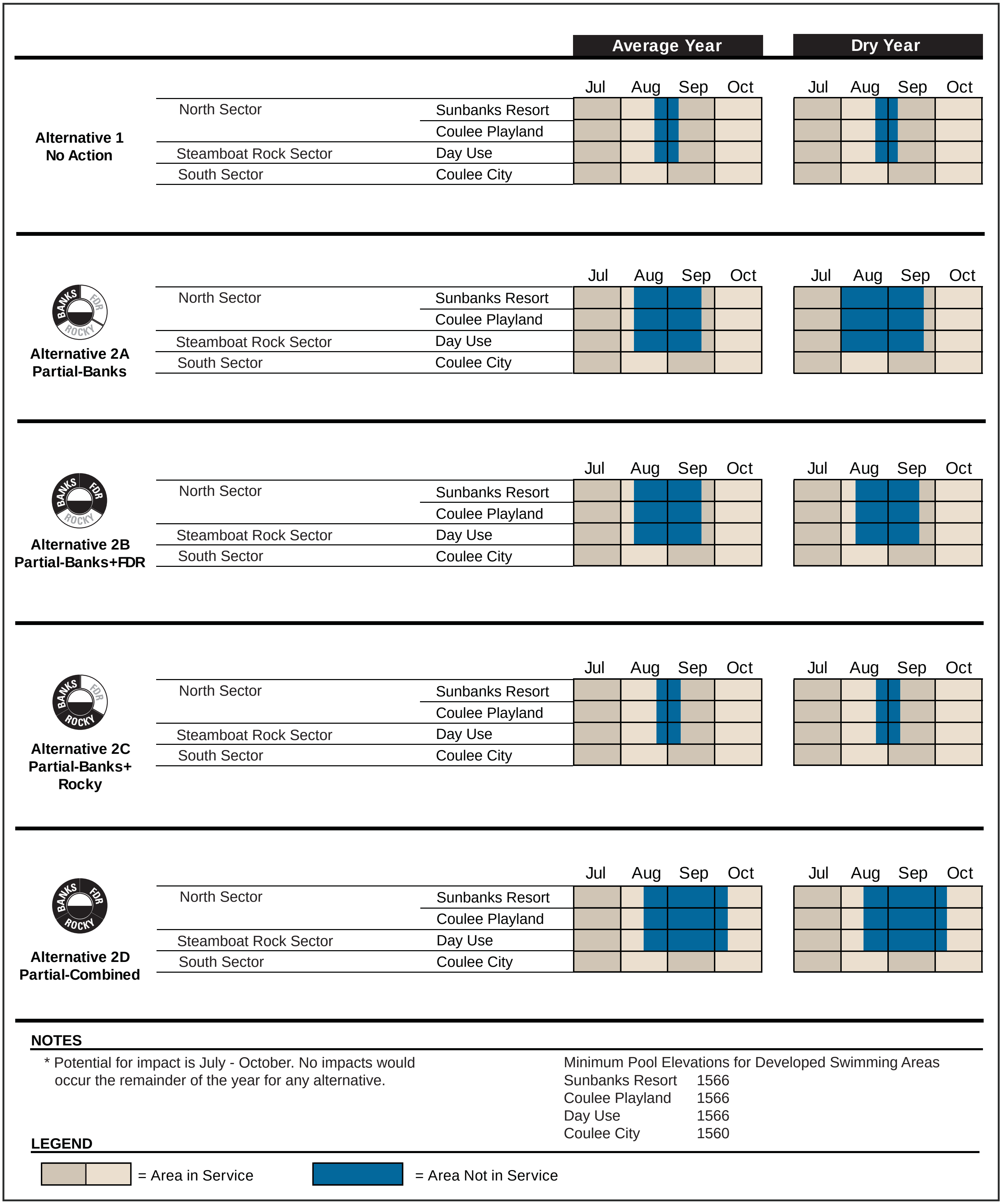
Upland Recreation (Lands Surrounding the Reservoir)
Reservoir operations under this alternative would have no to minimal impact on upland recreation around Banks Lake.

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.

4.14.3.3 Mitigation
Available mitigation measures for impacts at Banks Lake are described below. For impacts to land-based camping and day use sites at this reservoir, no mitigation measures are feasible and impacts are unavoidable.

Boat Launch Capacity
Restoration of full season-wide availability at all main, high-capacity ramps would be achieved by extension or other redevelopment of boat launch facilities at or near Sunbanks Resort, SRSP Day Use site, and Coulee City Community Park so that they remain usable at maximum reservoir drawdown.

Retention of season-wide boat access in all sectors of the reservoir would be achieved by extending either the north or south Million Dollar Mile ramp (Middle Sector), as well as the improving the Coulee City facilities noted above (South Sector).



Odessa Subarea Special Study
Columbia Basin Project, Washington

Figure 4-22
Partial Replacement Alternatives - Banks Lake
Developed Swimming Area Impacts (July - October)*

WB082009003BOI

TABLE 4-58

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 Max. Drawdown Level (feet)	No Action 1565 (-5.0)	2A 1561.6 (-8.4)	2B 1562 (-8.0)	2C 1564.9 (-5.1)	2D 1562 (-8.0)
North Sector					
Coulee Playland	< 25	50	50	25	50
Sunbanks Resort	75	100	100	75	100
Osborn Bay SW	50	75	75	50	75
Steamboat Rock—Barker Canyon Sector					
SRSP Day Use Site	50	75	75	50	75
SRSP Rest Area	50	75	75	50	75
Barker Flat	100	175	150	100	150
Middle Sector					
Million Dollar North	225	300	275	225	275
Million Dollar South	< 25	< 25	50	< 25	50
South Sector					
Coulee City Community Park	125	300	250	150	250
Dry Falls/Ankeny 2	175	400	350	200	350
Dry Falls/Ankeny 1	200	900	750	225	750

* Full pool is 1570 feet amsl
Note: Reflects approximate distance in feet, measured from full pool shoreline to the edge of the water.

TABLE 4-59

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 Max. Drawdown Level (feet)	No Action 1565 (-5.0)	2A 1561.6 (-8.4)	2B 1562 (-8.0)	2C 1564.9 (-5.1)	2D 1562 (-8.0)
North Sector					
Coulee Playland	< 25	100	50	25	50
Sunbanks Resort	75	100	100	75	100
Osborn Bay SW	50	100	75	50	75
Steamboat Rock—Barker Canyon Sector					
SRSP Day Use Site	50	75	75	50	75
SRSP Rest Area	50	75	75	50	75
Barker Flat	100	225	150	100	150
Middle Sector					
Million Dollar North	225	325	275	225	275
Million Dollar South	< 25	50	50	<25	50
South Sector					
Coulee City Community Park	125	350	175	150	175
Dry Falls/Ankeny 2	175	375	350	200	350
Dry Falls/Ankeny 1	200	900	750	225	750

* Full pool is 1570 feet amsl
Note: Reflects approximate distance in feet, measured from full pool shoreline to the edge of the water.

These mitigation measures would eliminate significant adverse impacts to boat launch capacity.

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 existing developed swimming areas, organized, protected swimming opportunities would be replaced by development of swimming pools near affected recreation sites. This measure, in context with the myriad opportunities for in-lake swimming that would remain outside of developed sites, would compensate for significant impacts to existing developed swimming sites.

4.14.3.4 Cumulative Impacts
No cumulative impact concerns have been identified for recreation resources involved with the Study alternatives.

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
Without mitigation, this alternative would result in the following significant impacts to boat launch capacity (see Figure 4-21):

- One of the five developed boat ramps (Coulee City), as well as the seven remaining, low-capacity/use ramps, would become unusable for approximately 5 weeks during late August and early September in both average and dry years.
- During the same late August and early September time frame, two of the four geographic sectors of the reservoir (Middle and South; see Maps 3-5 and 3-6) would lose boat launch capability.

Photograph 4-11.
Boat launching facilities at Banks Lake.

Boating Hazards
Reservoir drawdowns below 1564 feet amsl (the threshold for significant impact) would occur during both average and dry years at the same time as for boat ramps. Maximum drawdown would be to about 1562 feet amsl in all water years.

Fishing Opportunities
Same as Alternative 2A: Partial—Banks.

Swimming Areas
Three of the four developed swimming areas would be unusable for approximately 6 weeks during August and September in all water year types (see Figure 4-22).

Developed Campgrounds and Day Use Sites
Under Alternative 2B: Partial—Banks + FDR, 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, as described above, and increased distance to the water's edge. As shown in Tables 4-58 and 4-59, sites where the distance to the water's edge would exceed 100 feet are located predominantly in the Middle and South sectors of the reservoir, with distances ranging from 250 to 750 feet in average years.

Dispersed Recreation Sites
Impacts with this alternative would be generally the same as those described for Alternative 2A: Partial—Banks.

Upland Recreation

Same as Alternative 2A: Partial—Banks (no impact).

Lake Roosevelt
Alternative 2B: Partial—Banks + FDR, would not result in recreation impacts 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.

Photograph 4-12.
Docks and boat launch in Lake Roosevelt recreation area.

Study Area
Impacts would be the same as Alternative 2A: Partial—Banks.

4.14.4.3 Mitigation
Available mitigation measures for impacts at Banks Lake are described in the following text. For impacts to land-based camping and day use sites at this reservoir, no mitigation measures are feasible and impacts are unavoidable.

Boat Launch Capacity
Restoration of full, season-wide availability at all main, high-capacity ramps would be achieved by extension or other redevelopment of boat launch facilities at or near Coulee City Community Park so that they remain usable at maximum reservoir drawdown.

Retention of season-wide boat access in all sectors of the reservoir would be achieved by extension of either the north or south Million Dollar Mile ramp (Middle Sector), as well as the improvements Coulee City facilities noted above (South Sector).

These mitigation measures would eliminate significant adverse impacts to boat launch capacity.

Boating Hazards and Swimming Areas
Mitigation measures would be the same as those under Alternative 2A: Partial—Banks.

4.14.4.4 Cumulative Impacts
No cumulative impact concerns have been identified for recreation resources involved with the Study alternatives.

4.14.5 Alternative 2C: Partial—Banks + Rocky
Short-term and long-term impacts at Banks Lake would be comparable to the No Action Alternative, with no cumulative impacts identified. Exceptions to this

include a maximum 1 week loss of boat launch capacity at the same ramps, in the same reservoir sectors, and with the same mitigation described for Alternative 2B: Partial—Banks + FDR. This short-duration impact would have corresponding effects on fishing opportunities and shoreline recreation sites.

In the Study Area, impacts would generally be the same as those described for Alternative 2A: Partial—Banks, with the exception of Rocky Coulee Reservoir construction. Development of Rocky Coulee Reservoir would have a minimal, localized impact on current hunting or wildlife viewing in the immediate site of the reservoir. Further, since this new reservoir would be filled and emptied each year, it would not create new recreation opportunities.

4.14.6 Alternative 2D: Partial—Combined

Short-term and long-term impacts with this alternative would be the following:

- **At Banks Lake:** Comparable to Alternative 2B: Partial Banks + FDR, except that without mitigation the period of time in which the specified boat ramps (Coulee City and the seven low-use facilities) and three of the four developed swimming areas would be unusable would increase to 7 weeks and extend into early October. Impacts at developed and dispersed camping and day use sites would be the same as Alternative 2B: Partial—Banks + FDR.
- **At Lake Roosevelt:** The same as Alterative 2B: Partial—Banks + FDR.
- **In the Study Area:** The same as Alternative 2C: Partial—Banks + Rocky.

Mitigation and cumulative impacts overall would be the same as Alternative 2B: Partial Banks + FDR.

4.14.7 Alternative 3A: Full—Banks

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
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
Without mitigation, this alternative would result in the following significant impacts to boat launch capacity at Banks Lake (see Figure 4-23):

- All boat ramps would become unusable for a period of time during the recreation season. Related to the five main, high-capacity ramps:
  - Coulee Playland and SRSP Rest Area would become unusable approximately 4 weeks in late August and early September in average water years. This period would extend to 6 weeks in dry years.
  - Sunbanks Resort and SRSP Day Use would be unusable for approximately 6 weeks in August

and September in average years. This period would extend to 8 weeks in dry years.

- Coulee City and the remaining seven low-capacity ramps would become unusable in late July and remain unusable through early October, a period of about 10 weeks, in average years. This period of unavailability would extend for about 12 weeks from mid July through mid October in dry years.

- All four sectors of reservoir would lose boat launch capability as a result of the impacts listed above. The North and SRSP Sectors would lose boat access for a minimum of 4 weeks in average years and 6 weeks in dry years. No launch ramps would be available in the Middle and South sectors for about 10 weeks in average years and about 12 weeks in dry years.

Boating Hazards
Reservoir drawdowns below 1564 feet amsl (the threshold for significant impact) would occur during both average and dry years at the same time as for the boat ramps. Maximum drawdown would be to about 1557 feet amsl in average years and about 1555 feet amsl in dry years.

Fishing Opportunities
Fishing activity would be significantly restricted during the periods of time that boat ramps are unavailable, as specified above. In addition, the drawdown pattern of this alternative would result in a significant adverse impact on the fishery, as noted in Section 4.10, *Fisheries and Aquatic Resources*. 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 (see Figure 4-24). The least affected would be the site in Coulee City, which would be unusable for approximately 4 weeks during August and September in average water years, and approximately 6 weeks in dry years. The other three areas would be unusable for up to 12 weeks from mid July through mid October in average years, and 15 weeks in wet years from early July through late October.

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. Tables 4-60 and 4-61 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 would exceed 100 feet are located in all geographic sectors of the reservoir, with distances ranging from 150 to 1,150 feet in average years.

TABLE 4-60

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 Max. Drawdown Level (feet)	**No Action 1565 (-5.0)**	**3A 1556.5 (-13.5)**	**3B 1562 (-8.0)**	**3C 1560 (-10.0)**	**3D 1562 (-8.0)**
North Sector					
Coulee Playland	< 25	150	50	100	50
Sunbanks Resort	75	200	100	100	100
Osborn Bay SW	50	200	100	100	100
Steamboat Rock—Barker Canyon Sector					
SRSP Day Use Site	50	100	50	50	50
SRSP Rest Area	50	100	50	75	50
Barker Flat	100	350	150	225	150
Middle Sector					
Million Dollar North	225	400	325	350	325
Million Dollar South	< 25	50	25	50	25
South Sector					
Coulee City Community Park	125	650	175	350	175
Dry Falls/Ankeny 2	175	450	350	375	350
Dry Falls/Ankeny 1	200	1150	850	900	850

* Full pool is 1570 feet
Note: Reflects approximate distance in feet, measured from full pool shoreline to the edge of the water.

TABLE 4-61

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 Max. Drawdown Level (feet)	**No Action 1565 (-5.0)**	**3A 1556.5 (-13.5)**	**3B 1562 (-8.0)**	**3C 1560 (-10.0)**	**3D 1562 (-8.0)**
North Sector					
Coulee Playland	< 25	175	50	125	50
Sunbanks Resort	75	225	100	150	100
Osborn Bay SW	50	700	100	150	100
Steamboat Rock—Barker Canyon Sector					
SRSP Day Use Site	50	375	50	75	50
SRSP Rest Area	50	300	50	100	50
Barker Flat	100	400	150	300	150
Middle Sector					
Million Dollar North	225	425	325	375	325
Million Dollar South	< 25	75	25	50	25
South Sector					
Coulee City Community Park	125	900	175	500	175
Dry Falls/Ankeny 2	175	550	350	425	350
Dry Falls/Ankeny 1	200	1200	750	1000	750

* Full pool is 1570 feet
Note: Reflects approximate distance in feet, measured from full pool shoreline to the edge of the water.

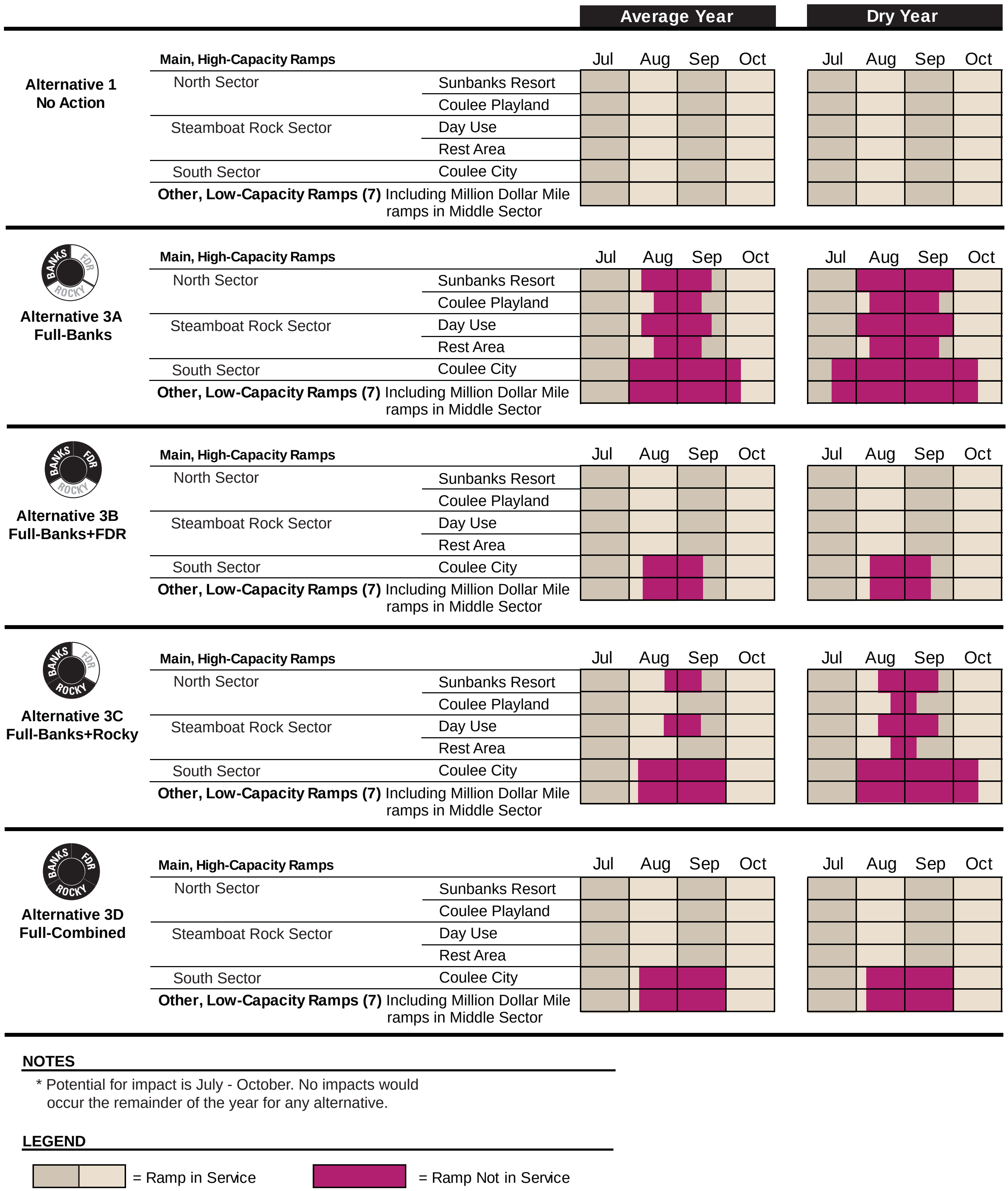
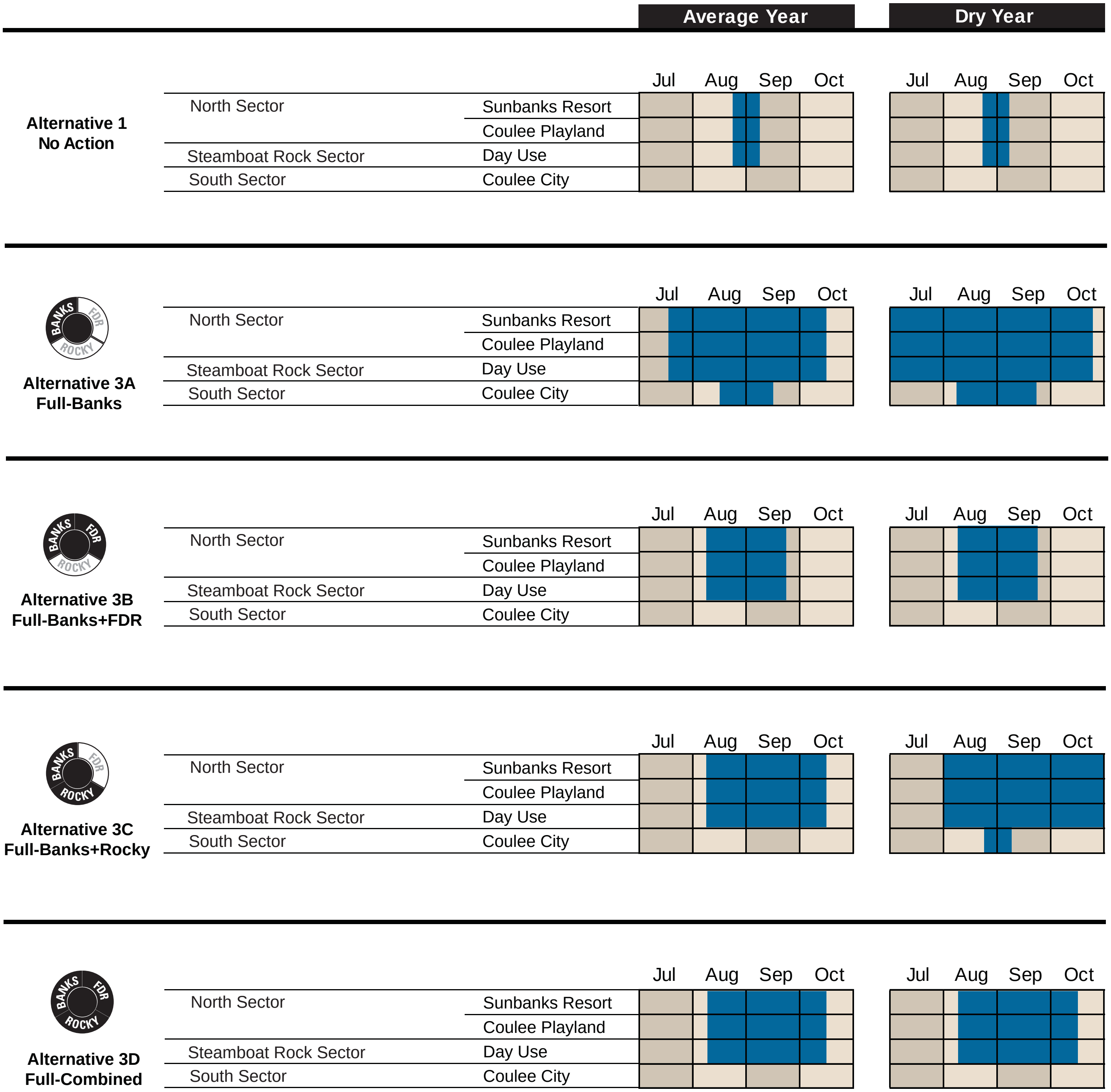


Figure 4-23

Partial Replacement Alternatives - Banks Lake Boat Launch Ramp Impacts (July - October*)

Odessa Subarea Special Study
Columbia Basin Project, Washington

WB082009003BOI



NOTES

* Potential for impact is July - October. No impacts would occur the remainder of the year for any alternative.

Minimum Pool Elevations for Developed Swimming Areas

Sunbanks Resort	1566
Coulee Playland	1566
Day Use	1566
Coulee City	1560

LEGEND

= Area in Service

= Area Not in Service

Odessa Subarea Special Study
Columbia Basin Project, Washington

Figure 4-24

Full Replacement Alternatives - Banks Lake
Developed Swimming Area Impacts (July - October)*

WB082009003BOI

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.

4.14.7.3 Mitigation
Available mitigation measures for impacts at Banks Lake are described below. 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

- Restoration of full, season-wide availability at all main, high-capacity ramps would be achieved by extension or redevelopment of ramps at all five main/high-capacity boat launch locations so that they remain usable at maximum reservoir drawdown.
- In addition to the ramp improvements noted above, either the north or south Million Dollar Mile ramp (Middle Sector) would be extended to provide boat access to all geographic sectors of the reservoir.

These mitigation measures would eliminate significant adverse impacts to boat launch capacity.

Boating Hazard and Swimming Areas
Mitigation measures would be the same as those under Alternative 2A: Partial—Banks.

4.14.8 Alternative 3B: Full—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. This alternative would also have a significant impact on the Banks Lake fishery in drought years.
- **In the Study Area:** The same as Alterative 3A: Full—Banks.

Mitigation and cumulative impacts would be the same as those under Alternative 2B: Partial Banks + FDR.

Related to Lake Roosevelt, there would be no short-term impacts.

4.14.8.1 Long-Term Impacts
Lake Roosevelt
Additional reservoir drawdown in late August at Lake Roosevelt would increase the period of time in which six of the 22 boat launch ramps and one of the four marinas would be unavailable when compared with the No Action Alternative. In average water years, these facilities would remain unusable for up to 1 week beyond No Action conditions. This impact represents less than one half of 1 percent of recreation-season capacity at the reservoir and would not be significant. The same extension of impact would occur to swimming areas, campgrounds, and day use sites.

As with Alternatives 2B: Partial—Banks + FDR, and 2D: Partial—Combined, this alternative would have no impact on upland recreation activities such as hunting and wildlife viewing.

4.14.8.2 Mitigation
Lake Roosevelt
Because impacts to boat launches, marinas, and swimming areas in this alternative are

relatively short extensions of impact already associated with the No Action Alternative, no mitigation is proposed. The additional impact to campgrounds and day use sites is not subject to mitigation.

4.14.9 Alternative 3C: Full—Banks + Rocky

No significant short-term or long-term impacts would occur related to the recreation resources in the Study Area or with development of Rocky Coulee Reservoir. No short-term impacts would occur related to Banks Lake. As with the other action alternatives discussed above, there are no cumulative impact concerns.

4.14.9.1 Long-Term Impacts

Banks Lake

Boat Launch Capacity

Without mitigation, this alternative would result the following significant impacts to boat launch capacity at Banks Lake (see Figure 4-23):

- All boat ramps would become unusable for a period of time during the recreation season. Related to the five main, high-capacity ramps.
  - Sunbanks Resort and SRSP Day Use would be unusable for approximately 3 weeks in late August and early September in average years, with this period extending to 5 weeks in dry years.
  - Coulee Playland and SRSP Rest Area would not be adversely affected in average water years, but would be unusable for approximately 2 weeks in late August and early September in dry years.
  - Coulee City and the remaining seven low-capacity ramps would become unusable in early August and remain unusable through September (for a period of about 7 weeks) in average years; this period of unavailability would extend to about 10 weeks in dry years, encompassing all of August and September and extending through mid-October.
- Two geographic sectors of reservoir would lose boat launch capability as a result of the above specified impacts. No launch ramps would be available in the Middle and South sectors for about 7 weeks in average years and about 10 weeks in dry years.

Boating Hazards

Reservoir drawdowns below 1564 feet amsl (the threshold for significant impact) would occur during both average and dry years during the impact time frames noted above for boat ramps. Maximum drawdown would be to about 1560 feet amsl in average years and about 1558 feet amsl in dry years.

Fishing Opportunities

Same as Alternative 3A: Full—Banks.

Swimming Areas

As shown in Figure 4-24, three of the four developed swimming areas would be unusable from early August through mid October (for a period of about 9 weeks) during average water years. In dry years, all four areas would be affected, with the Coulee City location unusable for two weeks and the remaining three areas not available for all of August, September and October (about 12 weeks).

Developed Campgrounds and Day Use Sites

Under Alternative 3C: Full—Banks + Rocky, 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, as described above, and increased distance to the water's edge. As shown in Tables 4-60 and 4-61, sites where the distance to the water's edge would exceed 100 feet are located predominantly in the Middle and South sectors of the reservoir, with distances ranging from 225 to 900 feet in average years.

Dispersed Recreation Sites
Similar to the developed sites discussed above, it can be expected that distances over 100 feet would be seen at some 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).

4.14.9.2 Mitigation
Mitigation measures would be the same as described for Alternative 2A: Partial—Banks.

4.14.10 Alternative 3D: Full—Combined
Short-term and long-term impacts and mitigation with this alternative would be as follows:

- **At Banks Lake:** Similar to Alternative 3B: Full Banks + FDR, except that the period of time in which the specified boat ramps (Coulee City and the seven low-use facilities) would be unusable in August and September would be lengthened from about 4 to 7 weeks and include all of September (see Table 4-60); and the time in which three of the four swimming areas would not be available would be extended from about 6 to 8 weeks. Mitigation would be the same as Alternative 3B: Full—Banks + FDR.
- **At Lake Roosevelt:** The same as Alterative 2B: Partial—Banks + FDR.
- **In the Study Area:** The same as Alternative 3C: Partial—Banks + Rocky, including the Rocky Coulee Reservoir site.

Cumulative impacts would be the same the other action alternatives.

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, and Alternative 3A: Full—Banks. As explained in Chapter 2 Alternatives, the action alternatives consist of four partial groundwater irrigation replacement alternatives and four full groundwater irrigation replacement alternatives. Each of 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.

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, dryland wheat/fallow rotation would replace irrigated crops.

Evaluation of 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 between 2015 and 2025 in phases. There would be four construction phases for partial replacement alternatives and nine phases for full replacement alternatives. Until 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 $36.5 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 $65.7 million more in gross farm income at the end of all nine construction phases. The analysis results are presented in Table 4-62.

The No Action Alternative gross farm income, $42.7 million, would be less than 3 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, $36.5 million, would be less than 3 percent, and the change under Alternative 3a: Full—Banks, $65.7 million, would be less than 5 percent.

TABLE 4-62

Comparison of the Difference in the 2025 Gross Farm Income Between the No Action Alternative and Alternative 2A: Partial—Banks and Alternative 3A: Full—Banks

	No Action Alternative	Partial Replacement Alternatives	Full Replacement Alternatives
Gross Farm Income in 2025			
Potato	$11,592,038	$37,969,627	$59,020,857
Wheat	$18,195,488	$21,416,085	$21,416,085
Mixed Crops	$12,951,198	$19,862,922	$23,124,445
Total	$42,738,724	$79,248,634	$108,467,377
Difference in Income Compared to the No Action Alternative			
Potato		$26,377,589	$47,428,819
Wheat		$3,220,597	$3,220,597
Mixed Crops		$6,911,724	$10,173,247
Total		$36,509,910	$65,728,653

4.15.1.1 Methods and Assumptions

Impact Indicators and Significance Criteria

Table 4-63 presents impact indicators and significance criteria for irrigated agriculture in the Study Area.

TABLE 4-63

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.

4.15.1.2 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 4-64, showing the beginning and ending acreages by well level for 2025.

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 are 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 acres lost during the year (the third column in Table 4-64) 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 $106,426,621. 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 $63,687,897, a 60 percent decrease.

TABLE 4-64

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	2025 Acres by Well Level (End of Year)
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

*The acres gained from the next highest well level are from the previous year in the model, not the current year.

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 4-25 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 4-65 along with the number of acres of each crop.

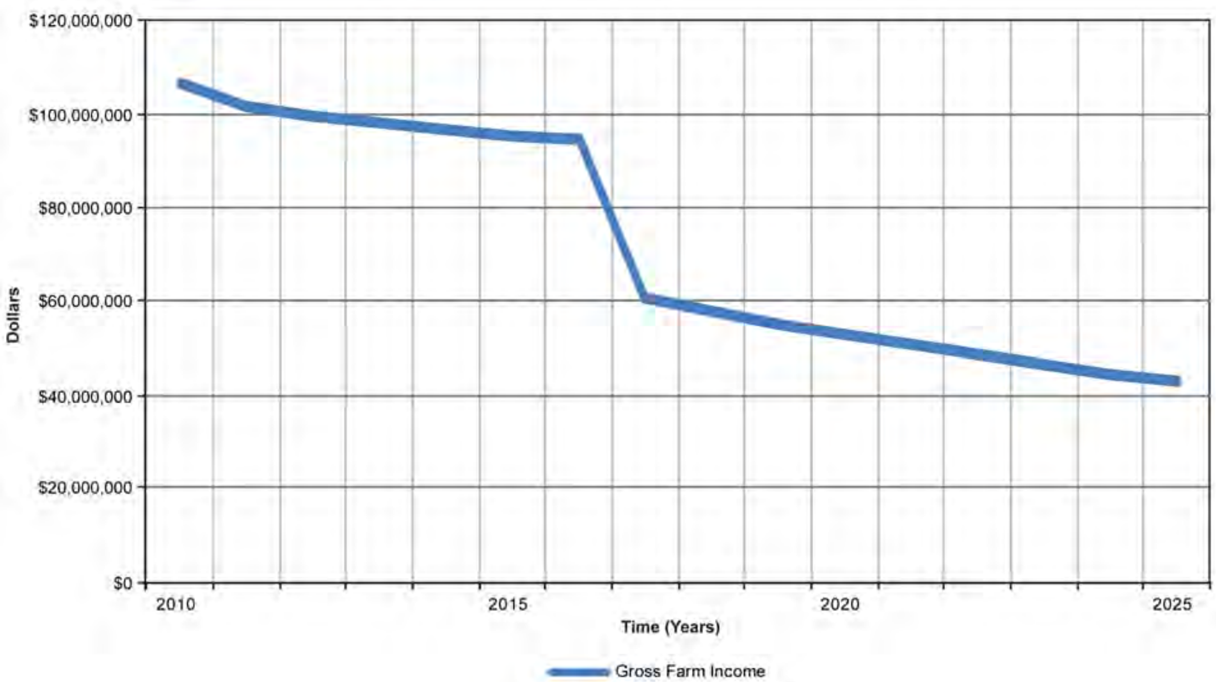


Figure 4-25
Total Gross Farm Income under the No Action Alternative from 2010 Until 2025

TABLE 4-65

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	15,495	$59,020,857	3,044	$11,592,038
Wheat	38,481	$19,450,991	27,454	$13,877,444
Mixed Crops	43,509	$27,503,791	20,488	$12,951,198
Dryland Wheat Produced	2,565	$450,982	24,563	$4,318,044
Fallow Acres in Rotation	2,566	$0	24,563	$0
Acres of Lost Production	0	$0	2,504	$0
Total	102,616	$106,426,621	102,616	$42,738,724

* 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.

4.15.1.3 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 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 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. Estimates of prices received and yields of crops were held constant over the period of analysis. Although prices vary annually and yields would change over the long run, reasonably forecasting changes in prices and yields of crops was not possible.

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 partial replacement alternatives and the No Action Alternative would be $106,426,621. 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 4-66 presents the number of acres for each of the four construction phases by well level that would receive surface water deliveries.

Alternative 2A: PartialBanks would supply replacement water to bring approximately 57,000 acres back into irrigated production. Table 4-67 shows that Alternative 2A: Partial—Banks had 9,968 acres of potatoes compared to 3,044 acres of potatoes under the No Action Alternative (in 2025). This is 6,924 more acres of potatoes. Irrigated wheat production under the two alternatives came to 27,454 acres and 33,587 acres, respectively in 2025, an increase of 6,133 acres of irrigated wheat due to Alternative 2A: Partial—Banks. Mixed crops increased 12,803 acres in 2025, and by 2025, acres of dryland wheat under the Alternative 2A: Partial—Banks had decreased by 12,234 acres compared to the No Action Alternative.

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.

TABLE 4-66

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 & Wells S of I-90	**57,070**	**2,854**	**17,121**	**34,240**	**2,854**

TABLE 4-67

Acreages by Crop for 2010 and 2025,Alternative 1: No Action 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	15,495	3,044	9,968	+6,924
Wheat	38,481	27,454	33,587	+6,133
Mixed Crops	43,509	20,488	33,291	+12,803
Dryland Wheat Produced	2,565	24,563	12,329	-12,234
Fallow Acres in Rotation	2,566	24,563	12,329	-12,234
Acres of Lost Production		2,504	1,112	-1,392
Total	102,616	102,616	102,616	

Figure 4-26 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.

Table 4-68 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 $36.5 million more in gross farm income.

Figure 4-27 compares gross farm income for the No Action Alternative and the Alternative 2A: Partial—Banks.

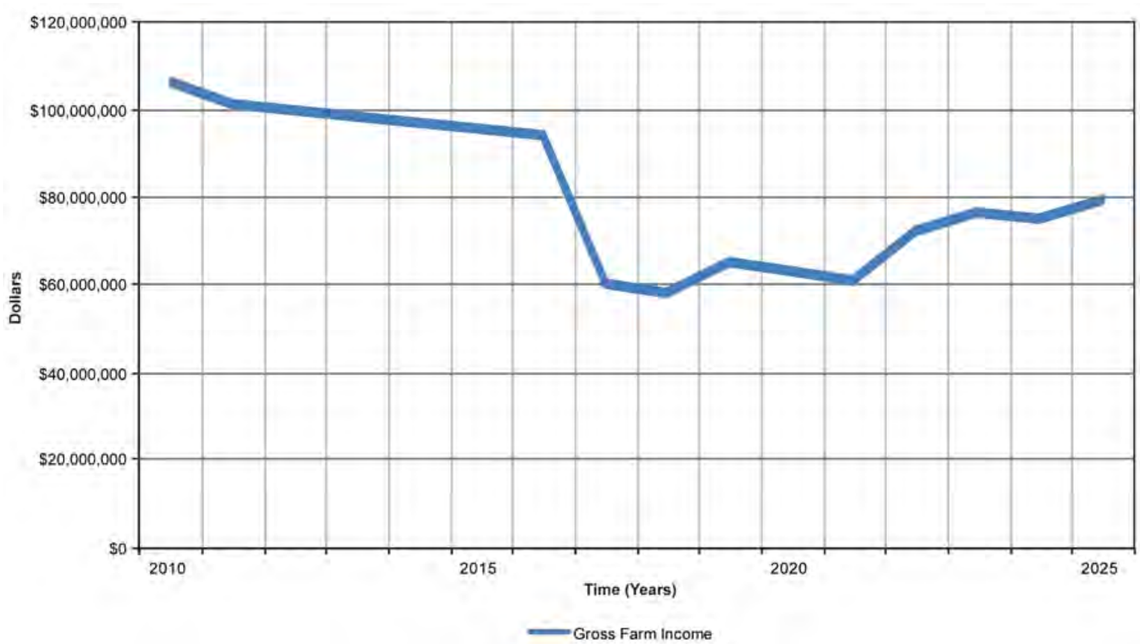


Figure 4-26
Total Gross Farm Income Alternative 2A: Partial—Banks

TABLE 4-68

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	$59,020,857	$11,592,038
Wheat	$19,901,973	$18,195,488
Mixed Crops	$27,503,791	$12,951,198
Total	**$106,426,621**	**$42,738,724**
Alternative 2A : Partial—Banks Gross Farm Income		
Potato	$59,020,857	$37,969,627
Wheat	$19,901,973	$21,416,085
Mixed Crops	$27,503,791	$19,862,922
Total	**$106,426,621**	**$79,248,634**
Difference in Income		
Potato	$0	+$26,377,589
Wheat	$0	+$3,220,597
Mixed Crops	$0	+$6,731,724
Total	**$0**	**+$36,509,910**

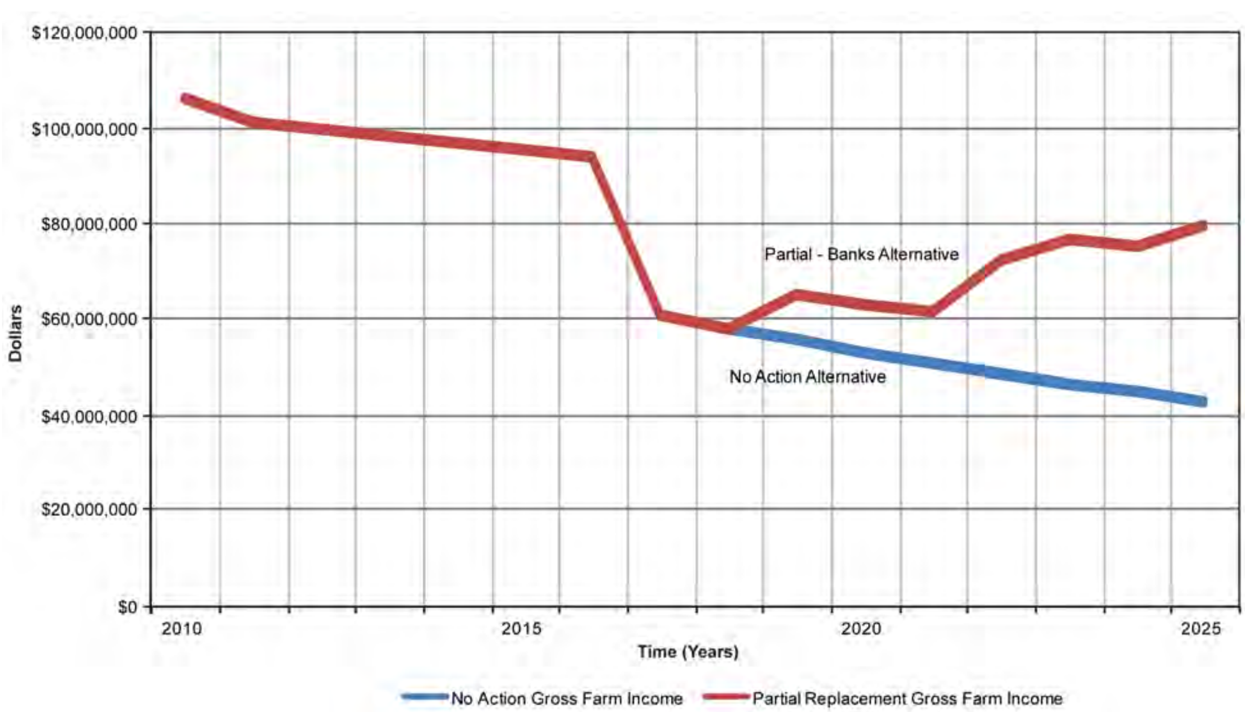


Figure 4-27
Comparison of Gross Farm Income Between the No Action Alternative and Alternative 2A: Partial—Banks

Mitigation and Cumulative Impacts

No mitigation measures or cumulative impacts have been identified for irrigated agriculture.

4.15.1.4 Alternative 2B: Partial—Banks + FDR

Short- and long-term impacts, mitigation measures, and cumulative impacts for irrigated agriculture are the same as those presented for Alternative 2A: Partial—Banks.

4.15.1.5 Alternative 2C: Partial—Banks + Rocky

Short- and long-term impacts, mitigation measures, and cumulative impacts for irrigated agriculture are the same as those presented for Alternative 2A: Partial—Banks.

4.15.1.6 Alternative 2D: Partial—Combined

Short- and long-term impacts, mitigation measures, and cumulative impacts for irrigated agriculture are the same as those presented for Alternative 2A: Partial—Banks.

4.15.1.7 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 15,495 acres of potatoes, 41,046 acres of irrigated wheat, and 46,075 acres of irrigated mixed crops annually; this crop mix provided the highest gross farm income that could be expected from the approximately 102,600 acres cropped acres.

Table 4-69 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.

Alternative 3A: Full—Banks would substantially increase the acres of irrigated crop production compared to the No Action Alternative. Table 4-70 shows that Alternative 3A: Full—Banks has 12,451 more acres of potatoes, 13,592 more acres of irrigated wheat, 25,587 more acres of mixed crops, 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. However, the crops grown on lands served by Level 1 wells would not change; potatoes and irrigated wheat, in the same amounts, were assumed to continue to be grown on those lands.

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. Potatoes were capped at the original number of acres, and the remaining lands were split between the mixed crops and the irrigated wheat in this analysis.

TABLE 4-69

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**

TABLE 4-70

Acreages by Crops for 2010 and 2025 Alternative1: 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	3,044	15,495	+12,451
Wheat	38,481	27,454	41,046	+13,592
Mixed Crops	43,509	20,488	46,075	+25,587
Dryland Wheat Produced	2,565	24,563	0	-24,563
Fallow Acres in Rotation	2,566	24,563	0	-24,563
Acres of Lost Production		2,504	0	-2,504
Total Income	**102,616**	**102,616**	**102,616**	

Figure 4-28 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.

Table 4-71 shows gross farm income estimates for 2010 and 2025 for Alternative 3A: Full—Banks. This alternative would provide $65.7 million more in gross farm income than the No Action Alternative.

Figure 4-29 compares gross farm income for the No Action Alternative and the Alternative 3A: Full—Banks Alternative.

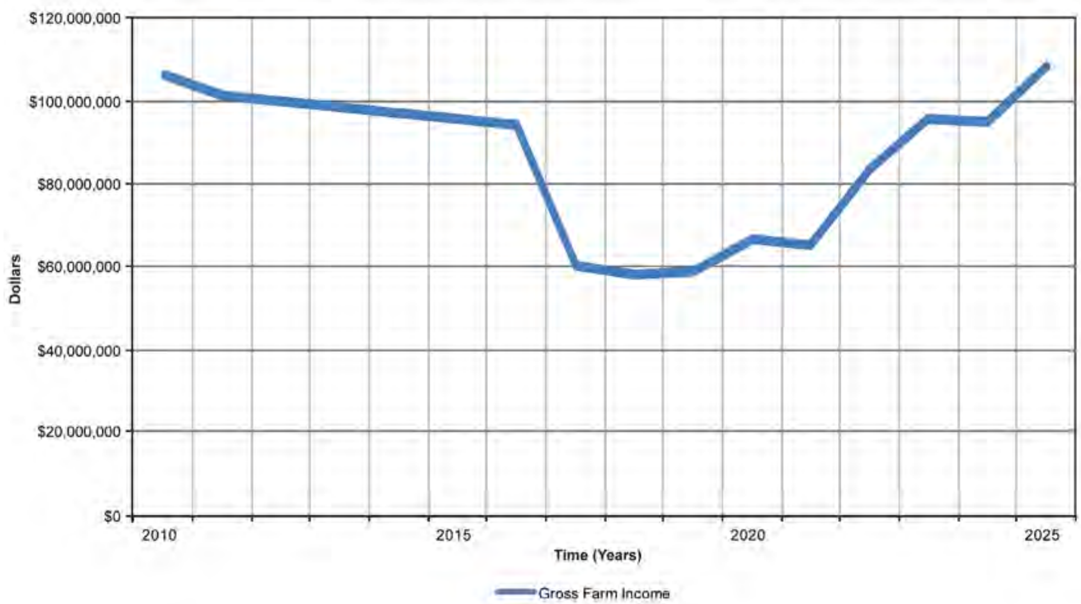


FIGURE 4-28
Total Gross Farm Income Alternative 3A: Full—Banks

TABLE 4-71
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	$59,020,857	$11,592,038
Wheat	$19,901,973	$18,195,488
Mixed Crops	$27,503,791	$12,951,198
Total	**$106,426,621**	**$42,738,724**
Alternative 3A: Full—Banks Gross Farm Income		
Potato	$59,020,857	$59,020,857
Wheat	$19,901,973	$21,416,085
Mixed Crops	$27,503,791	$23,124,445
Total	**$106,426,621**	**$108,467,377**
Difference in Income		
Potato	$0	+$47,428,819
Wheat	$0	+$4,928,957
Mixed Crops	$0	+$13,370,877
Total	**$0**	**+$65,728,652**

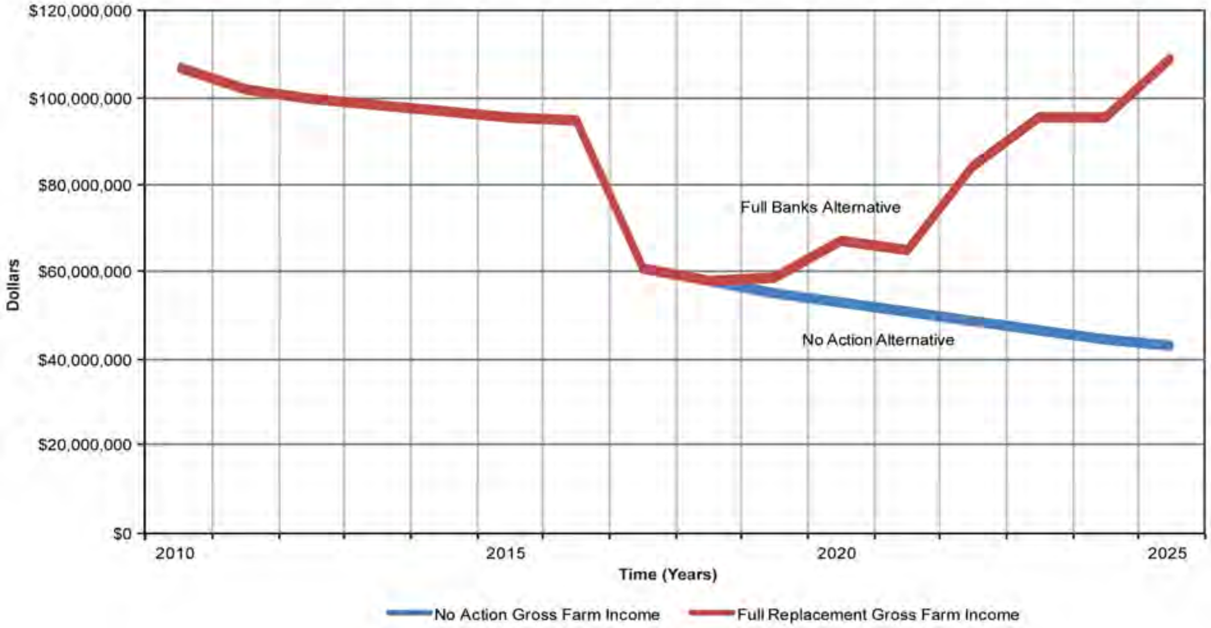


FIGURE 4-29
Comparison of Gross Farm Income Between the No Action Alternative and Alternative 3A: Full—Banks

Mitigation and Cumulative Impacts
No mitigation measures or cumulative impacts have been identified for irrigated agriculture.

4.15.1.8 Alternative 3B: Full—Banks + FDR

Short- and long-term impacts, mitigation measures, and cumulative impacts for irrigated agriculture are the same as those presented for Alternative 3A: Full—Banks.

4.15.1.9 Alternative 3C: Full—Banks + Rocky

Short- and long-term impacts, mitigation measures, and cumulative impacts for irrigated agriculture are the same as those presented for Alternative 3A: Full—Banks.

4.15.1.10 Alternative 3D: Full—Combined

Short- and long-term impacts, mitigation measures, and cumulative impacts for irrigated agriculture are the same as those presented for Alternative 3A: Full—Banks.

4.15.2 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 4-72, gross farm income, potato production, and O&M expenditures would increase with implementation of any of the partial or full 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.

4.15.2.1 Economics Context and Background

Chapter 1 of this Draft 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 significant economic loss to the region's agricultural sector because of continued decline of groundwater supply."

In the Notice of Intent published in the Federal Register on August 2008 that initiated preparation of this 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 Draft 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 4-72

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	2C: Partial—Banks + Rocky 2D: Partial—Combined	3A: Full—Banks 3B: Full—Banks + FDR	3C: Full—Banks + Rocky 3D: Full—Combined
Change in regional employment (number of jobs) within the four-county analysis area	Minimal long-term impact: less than one percent decrease in jobs	Short-term beneficial effects: less than one percent increase in jobs. Net long-term beneficial effects: less than one percent increase in jobs.	Short-term beneficial effects: less than two percent increase in jobs. Net long-term beneficial effects: less than one percent increase in jobs.	Short-term beneficial effects: less than four percent increase in jobs. Net long-term beneficial effects: less than one percent increase in jobs.	Short-term beneficial effects: less than four percent increase in jobs. Net long-term beneficial effects: less than one percent increase in jobs.
Change in regional labor income within the four-county analysis area	Minimal long-term impact: less than one-half of one percent decrease in labor income	Short-term beneficial effects: less than two percent increase in labor income. Net long-term beneficial effects: less than one percent increase in labor income.	Short-term beneficial effects: less than two percent increase in labor income. Net long-term beneficial effects: less than one percent increase in labor income.	Short-term beneficial effects: less than six percent increase in labor income. Net long-term beneficial effects: less than one percent increase in labor income.	Short-term beneficial effects: less than six percent increase in labor income. Net long-term beneficial effects: less than one percent increase in labor income.
Change in regional sales within the four-county analysis area	Minimal long-term impact: less than one-half of one percent decrease in sales	Short-term beneficial effects: less than one percent increase in sales. Net long-term beneficial effects: less than one percent increase in sales.	Short-term beneficial effects: less than one percent increase in sales. Net long-term beneficial effects: less than one percent increase in sales.	Short-term beneficial effects: less than four percent increase in sales. Net long-term beneficial effects: less than one percent increase in sales.	Short-term beneficial effects: less than four percent increase in sales. Net long-term beneficial effects: less than one percent increase in sales.

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 Subasin of Adams and Lincoln Counties*
- Entrix (2010), *Economic Contribution of Agriculture Irrigated by the Columbia Basin Project*

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 4-73.

TABLE 4-73
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 Sub-basin: Potato Production and Processing*		
Odessa Subarea defined as: Franklin, Adams, Grant, and Lincoln counties of WA 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 WA state
Holland and Beleiciks (2005). *The Economic Impact of Potatoes in Washington State*		
Washington State	Measure the economic contributions of the potato industry to WA state's economy.	Washington State, plus Morrow and Umatilla counties of OR state
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 WA state	Explore the regional economic impacts of the possible crop production losses and its associated processing in the Odessa Sub-area of Lincoln and Adams Counties as a result of possible irrigation-water shortages.	Lincoln and Adams counties of WA state
Entrix (2010). *Economic Contribution of Agriculture Irrigated by the Columbia Basin Project*		
Columbia Basin Project (CBP) defined as: 1) South Columbia Basin Irrigation District 2) Quincy Columbia Irrigation District 3) East Columbia Irrigation District	Evaluate the economic and fiscal impacts of CBP irrigated agriculture on the local, state, and national economies	Adams, Grant, and Franklin counties of WA state
Reclamation (2010). Odessa Subarea Special Study Draft 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 Draft EIS	Adams, Grant, Franklin, and Lincoln counties of WA state

4.15.2.2 Methods and Assumptions

Impact Indicators and Significance Criteria

Table 4-74 presents the indicators and associated criteria for determining potential significant socioeconomic impacts.

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.

TABLE 4-74

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

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 are 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 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 4-75.

TABLE 4-75

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.

4.15.2.3 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 below.

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 4-76, would result in 1,107 jobs (1.24 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 1,107 jobs to 449 jobs, which is 0.50 percent of the employment with in the four-county area, between 2010 and 2025. The job loss of 658 jobs in 2025 would be due to both losses in gross farm income and the Odessa potatoes supplied to local processors.

Labor income as a result of implementation of the No Action Alternative would equal $16 million (0.48 percent of the four-county area) and would drop to $7 million (0.22 percent of the four-county area) in 2025. Implementation of the No Action Alternative would result in $99 million (0.77 percent of the four-county area) of output in the four-county area. Output would decline to $54 million (0.42 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.

TABLE 4-76

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	No Action	1,107	1.24%	$16	0.48%	$99	0.77%
2025	No Action	449	0.50%	$7	0.22%	$54	0.42%
	Net Change	-658	-0.74%	-9.0	-0.26	-45.0	-0.35

[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.

4.15.2.4 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 4-77. 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.

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 4-78 summarizes the regional impacts stemming from total annual O&M activities after all the construction phases have been implemented.

TABLE 4-77

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.

TABLE 4-78

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 819 jobs (0.92 percent of total employment in the four-county area) in the four-county area compared to the No Action Alternative of 449 jobs in year 2025, as shown in Table 4-79. Compared to the No Action Alternative, a partial replacement alternative would result in a net change of 370 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.

Labor income in 2025 for a partial replacement alternative would equal $20 million (0.59 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 $13 million compared to year 2025 of the No Action Alternative.

Output in 2025 for a partial replacement alternative would equal $121 million (0.64 percent of total output in the four-county area). Implementation of a partial replacement alternative would create $67 million more in output compared to year 2025 of the No Action Alternative.

TABLE 4-79

Partial Replacement Alternatives: Regional Impacts Stemming from Changes in Gross Farm Income and Associated Potato Processing

		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	449	0.50%	$7	0.22%	$54	0.42%
2025	Partial	819	0.92%	$20	0.59%	$121	0.64%
	Net Change	370	0.42%	$13	0.37%	$67	0.22%

[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.

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.

Cumulative Impacts

Construction

No cumulative impacts have been identified for construction-related regional economic impacts.

O&M

No cumulative impacts have been identified for O&M related regional economic impacts.

Agriculture

No cumulative impacts have been identified for irrigated agricultural-based economic impacts.

4.15.2.5 Alternative 2B: Partial—Banks + FDR

Short and long-term impacts, mitigation measures, and cumulative impacts for construction, O&M, and agriculture would be the same as those presented for Alternative 2A: Partial—Banks.

4.15.2.6 Alternative 2C: Partial—Banks + Rocky

Short-Term Impacts

Alternative 2C: Partial—Banks + Rocky adds Rocky Coulee Dam and Reservoir, which were not included in Alternatives 2A: Partial—Banks and 2B: Partial—Banks + FDR; therefore, construction impacts would be slightly higher with this alternative. Like Alternatives 2A: Partial—Banks and 2B: Partial—Banks + FDR, construction expenditures spent within the analysis area would positively affect employment, labor income, and regional sales, as shown in Table 4-80. These short-term impacts would occur during the construction phases proportional to the expenditure levels during each year of construction. Because construction phases 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 apply to construction of this alternative.

Short-term impacts for agriculture would be the same as Alternative 2A: Partial—Banks.

Long-Term Impacts

Annual O&M expenditures would result in positive economic long-term impacts greater than the No Action alternative. Table 4-81 summarizes regional impacts stemming from total annual O&M activities after construction.

Long-term agricultural impacts, mitigation, and cumulative impacts would be the same as Alternative 2A: Partial—Banks.

TABLE 4-80

Total Regional Economic Impacts Stemming from Alternative 2C: Partial—Banks + Rocky Related to 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%
Rocky Coulee	$1,117	1.25%	$54.4	1.61%	$132.32	1.03%

[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.

TABLE 4-81

Total Regional Economic Impacts Stemming from Alternative 2C Partial—Banks + Rocky 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	35	Less than 1%	$2.2	Less than 1%	$4.3	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.

4.15.2.7 Alternative 2D: Partial—Combined

Short-term construction and long-term O&M impacts would be the same as Alternative 2C: Partial—Banks + Rocky. All of the other impacts and mitigation would be the same as Alternative 2A: Partial—Banks.

4.15.2.8 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 4-82. 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.

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 4-83 summarizes the regional impacts stemming from total annual O&M activities after all the construction phases have been implemented.

TABLE 4-82

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.

TABLE 4-83

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 1,115 jobs (1.25 percent of total employment in the four-county area) in the four-county area, as shown in Table 4-84. Implementation of a full replacement alternative would cause a net change of 666 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.

Labor income in 2025 for a full replacement alternative would equal $30 million (0.88 percent of total labor income in the four-county area) in 2025. Labor income would increase by $23 million, as compared the No Action Alternative, as a result of constructing a full replacement alternative.

Full replacement alternatives output would equal $174 million (1.35 percent of total output in the four-county area). Implementing a full replacement alternative would result in a net change of $120 of output compared to the No Action Alternative.

Mitigation and Cumulative Impacts

Cumulative impacts and mitigation would be the same as Alternative 2A: Partial—Banks.

4.15.2.9 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. Mitigation measures and cumulative impacts would be the same as Alternative 2A: Partial—Banks.

TABLE 4-84

Full Replacement Alternatives Regional Impacts Stemming From Changes in Gross Farm Income and Associated Potato Processing

		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	449	0.50%	$7	0.22%	$54	0.42%
2025	Full	1,115	1.25%	$30	0.88%	$174	1.35%
	Net Change	666	0.75%	$23	0.66%	$120	0.93%

[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.

4.15.2.10 Alternative 3C: Full—Banks + Rocky

Short-Term Impacts

Alternative 3C: Full—Banks + Rocky adds Rocky Coulee Dam and Reservoir, which were not included in Alternatives 3A: Full—Banks and 3B: Full—Banks + FDR; therefore, construction impacts would be slightly higher with this alternative. Like Alternatives 3A: Full—Banks and 3B: Full—Banks + FDR, construction expenditures spent within the analysis area would have a positive impact on employment, labor income, and regional sales, as shown in Table 4-85. These are short-term impacts that would occur during the construction phases and are proportional to the expenditure levels during each year of construction. During analysis when the phases were concurrent, constructions costs were combined to measure regional economic impacts. Additionally, because not all construction phases would be at the same time, economic impacts for each of the construction phases were not 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.

Short-term impacts to agriculture would be the same as Alternative 3A: Full—Banks.

Long-Term Impacts

Annual O&M expenditures required for this alternative would have a positive economic long-term impact greater than the No Action alternative. Table 4-86 summarizes regional impacts stemming from total annual O&M activities after all the construction phases have been implemented.

TABLE 4-85

Total Regional Economic Impacts Stemming from Alternative 3C: Full—Banks + Rocky 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%
Rocky Coulee	$1,117	1.25%	$54.4	1.61%	$132.32	1.03%

[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.

TABLE 4-86

Total Regional Economic Impacts Stemming from Alternative 3C: Full—Banks + Rocky 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	74	Less than 1%	$3.98	Less than 1%	$7.9	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.

Long-term impacts to agriculture would be the same as Alternative 3A: Full—Banks.

Mitigation and Cumulative Impacts

Mitigation and cumulative impacts would be the same as Alternative 2A: Partial—Banks.

4.15.2.11 Alternative 3D: Full—Combined

Short-term and long-term impacts from construction, O&M, and agriculture, would be the same as Alternative 3C: Full—Banks

+ Rocky. Mitigation measures and cumulative impacts would be the same as Alternative 2A: Partial—Banks.

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, except for those associated with the proposed Rocky Coulee Reservoir, which would involve some impact north 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 minimal for any of the action alternatives.

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 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.

For action alternatives that include construction of Rocky Coulee Reservoir, locally significant long-term impacts to vehicular circulation would be unavoidable. This reservoir would inundate portions of local north-south through travel routes, including S Road NE and U Road NE.

4.16.1 Methods and Assumptions

4.16.1.1 Impact Indicators and Significance Criteria

Table 4-87 presents the indicators and associated criteria for determining potential significance are used to evaluate transportation impacts.

TABLE 4-87

Transportation Resources Impact Indicators and 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

Broadly 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 4.29, *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 4.29, *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 Draft 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 4.29, *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 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 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, if 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 would 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, for this and the other partial replacement alternatives, the number of such vehicle movements should be low. Movements on public roads of equipment 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.

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.

Photograph 4-13.
Gravel road in the Study Area.

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.

4.16.3.3 Mitigation

No mitigation measures are proposed or necessary.

4.16.3.4 Cumulative Impacts

No cumulative impacts to transportation would occur for Alternative 2A: Partial—Banks, nor for any of the other action alternatives. Therefore, it is not discussed further in this analysis.

4.16.4 Alternative 2B: Partial—Banks + FDR

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.16.5 Alternative 2C: Partial—Banks + Rocky

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks, with the exception of the Rocky Coulee Reservoir.

4.16.5.1 Short-Term Impacts

Short-term transportation impacts related to Rocky Coulee Reservoir would focus on increases in local traffic during the construction period. Resulting impacts on the road system should be minimal for the following reasons:

- The construction workforce is expected be a maximum of approximately 120. Even if each worker arrived at the construction site in his or her personal vehicle, the additional traffic on local roads would be minimal.
- The dam would be a central core rockfill embankment. All earth materials needed for the embankment would be derived from within Reclamation's acquisition area for the reservoir. Therefore, no transport of such materials from outside sources would be needed.
- The channel connection from the embankment to the existing East Low Canal and the associated pumping plant are relatively small facilities and would not require large numbers of equipment and material delivery trips.

4.16.5.2 Long-Term Impacts

Construction of Rocky Coulee Reservoir would result in locally significant impacts to vehicular circulation. Considering both the footprint of reservoir (embankment and pool) and the larger area that Reclamation would acquire to manage and protect the facility, a number of local county road segments would be inundated or acquired. Of these, the most noteworthy would be S Road NE and U Road NE. Both roads are local north-south through travel routes. Neither is an existing or planned all-weather facility. If these roads were inundated by the reservoir, the shortest available alternative routes would involve an additional 4 to 8 miles of travel (4 miles for uses of U Road NE and 8 miles for users of S Road NE). Other roads that would be inundated by the reservoir or are on land that would be acquired by Reclamation are not through routes. Impacts to these facilities would be adverse, but not significant, from the standpoint of local vehicular circulation.

4.16.6 Alternative 2D: Partial—Combined

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.16.7 Alternative 3A: Full—Banks

Short- and long-term impacts south of I-90 as well as cumulative impacts overall would be the same as described for Alternative 2A: Partial—Banks.

4.16.7.1 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 if 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. 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 4.29, *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.

4.16.7.2 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 4-88 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 a siphons and pipelines at both of these crossings; thus impacts would be short-term and minimal.

TABLE 4-88

Road and Railroad Crossings by Major Facilities North of I-90

	East High Canal*		Black Rock Branch Canal*	Black Rock Coulee Reregulating Reservoir	Totals
	North of Reregulating Reservoir	South of Reregulating Reservoir			
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-Cities area 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 (that is, pipeline segments, transmission line poles and conductors). Little, if any, concrete or other construction material would be delivered.
- **Pumping Plants and O&M facility.** 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.

4.16.7.3 Mitigation

No mitigation measures are proposed or needed.

4.16.8 Alternative 3B: Full—Banks + FDR

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 3A: Full—Banks.

4.16.9 Alternative 3C: Full—Banks + Rocky

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 3A: Full—Banks, with the addition of the analysis and conclusions Related to Rocky Coulee Reservoir presented under Alternative 2C: Partial—Banks + Rocky.

4.16.10 Alternative 3D: Full—Combined

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 3C: Full—Banks + Rocky.

4.17 Energy

Energy issues associated with the Study alternatives include the potential to alter regional and local energy balances. Additional withdrawals from the Columbia River would lead to lost hydroelectric generation potential and a possible reduction in regional energy supply and availability. Additional pumping requirements to deliver water through new or modified canal systems would increase the burden on local energy providers responsible for supplying energy resources and could affect regional energy demand.

The No Action Alternative would result in continued groundwater level declines. Irrigators would require more energy to pump groundwater from greater depths, but local energy providers would experience minimal impacts because they would have sufficient capacity to supply all customers. The regional energy supply would be minimally impacted.

Regional energy availability would be impacted to some extent by all action alternatives. In the short term, even under critical water conditions, impacts to the regional energy surplus would be minimal. However, projecting the energy surplus out to a 10 year horizon, the reduction in regional energy availability would have an adverse impact for the partial replacement alternatives and a significant impact for the full replacement alternatives. The net reduction in available energy relative to projected surplus by 2017 would range from 11 percent for Alternative 2A: Partial—Banks and Alternative 2B: Partial—Banks + FDR, to 31 percent for Alternative 3C: Full—Banks + Rocky and Alternative 3D: Full—Combined. Current projections for the Critical Water year case indicate that there could be a regional system deficit by 2018.

The demand on local energy providers would be impacted minimally by all action alternatives. Additional surface water pumping would cause increased energy demand for all action alternatives, but local electric service providers would only be minimally impacted because the increase in demand is expected to be offset by the regional system surplus.

Although there is a regional system wide surplus of energy that can meet the increased demand, it comes from what is referred to as marginal resources, defined as the last resource brought on-line to supply power during a given time period. In the Northwest these marginal resources are made up primarily of combined cycle gas turbines. As such, these resources have an environmental impact when called on to meet additional demand. Due to the high percentage of hydro in the overall Northwest energy supply the average marginal CO_2 production is substantially higher than the average CO_2 production from all sources. CO_2 is a GHG and therefore has the potential to affect air quality and global warming as an indirect source. These impacts are addressed in the cumulative impact section of each alternative here, but are more fully described in Section 4.12, *Air Quality*.

4.17.1 Methods and Assumptions

4.17.1.1 Impact Indicators and Significance Criteria

Table 4-89 presents impact indicators and significance criteria for energy resources.

TABLE 4-89

Energy Impact Indicators and Significance Criteria

Impact Indicator	Significance Criteria
Change in net energy available in region	If the available energy decrease exceeds 20 percent of the existing surplus, the impact would be considered significant.
Capacity of local providers	If energy needed for system operations exceeds capacity of local providers, then it would be considered a significant impact.

4.17.1.2 Impact Analysis Methods

Changes in energy use that would occur under each of the alternatives are compared against the current conditions within the study area.

Energy issues associated with the Study alternatives have the potential to alter regional and local energy balances. Potential environmental impacts were evaluated by performing an energy balance on the net change in available energy associated with the alternatives. The following components factor into the energy balance:

- **Reduced Groundwater Pumping**. Consumption of energy from groundwater pumping would decrease with the conversion to surface water for irrigation. Records of pumping energy used per acre were obtained from utility providers and an average demand per acre calculated to be used for the entire affected area.

- **Lost Hydroelectric Generation**. Generation of hydroelectricity would decrease because water would be supplied from the Columbia River upstream of Grand Coulee Dam, which affects the power generation potential of 11 hydroelectric projects on the river downstream. BPA conducted a power analysis study for the system to project changes in total generation as a result of the various alternatives.

- **Additional Surface Water Pumping**. Consumption of energy would increase as surface water was conveyed to its final destination. Preliminary design by Reclamation provided the number of pump stations, total flow required, and total dynamic head. These numbers were used in standard pump sizing calculations to determine projected pumping demand for each alternative.

One of these component factors considered in energy associated with the alternatives was lost hydroelectric generation potential resulting from additional withdrawals from the Columbia River.

BPA conducted a power analysis study for the system to estimate changes in total generation as a result of the various alternatives. In performing this analysis, BPA's modeling of net energy change assumed additional withdrawals of 138,000 acre-feet for the partial replacement alternatives and 273,000 acre-feet for the full replacement alternatives. As described in Chapter 1, the total CBP surface water diversion under the proposed action would be 176,343 acre-feet for the partial replacement alternatives and 347,137 acre-feet for the full replacement alternatives.

Two factors explain the lesser water volume amounts assumed in the BPA analysis. First, an incremental release of 30,000 acre-feet of CBP water from Lake Roosevelt is currently used in the Study Area as part of the Management Program MOU and the Coordinated Conservation Program. This incremental release will continue with or without the proposed action (see Section 2.2.3, *Water Management Programs and Requirements Common to All Alternatives*). Second, BPA's modeling assumed that some of the seepage and return flow from Potholes reservoir and other CBP features would be reused under the action alternatives. This is based on Reclamation's observations of existing water reuse from seepage and return flow. A proportionately higher amount of such reuse was assumed for the full replacement alternatives as a result of the additional facilities to be constructed under those alternatives.

As an equation the energy balance is simplified as follows:

$$Net\ Energy\ Change = \begin{pmatrix} Reduced \\ Groundwater \\ Pumping \end{pmatrix} - \begin{pmatrix} Lost \\ Hydroelectric \\ Generation \end{pmatrix} - \begin{pmatrix} Additional \\ Surface \\ Water \\ Pumping \end{pmatrix}$$

Terms in the equation are expressed in 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.

Implementation of the action alternatives would result in increased demand on utilities because of the large amount of energy required to operate the pumping plants.

4.17.1.3 Impact Analysis Assumptions

No specific State or Federal statutes or BMPs apply and no mitigation measures are required.

4.17.2 Alternative 1: No Action Alternative

4.17.2.1 Short-Term Impacts

No short-term impacts to the net available energy on a regional basis would be expected because no changes would be made to the current irrigation or hydro generation scenarios.

4.17.2.2 Long-Term Impacts

Under the No Action Alternative, current groundwater pumping practices would continue with a long-term expectation that groundwater levels would decline. Although it is not possible to accurately quantify, continued decline of groundwater levels would likely result in the need to deepen wells and install larger pumps, or to create new wells with additional pumps, resulting in an increase in energy demand. This increase would only last as long as wells are operational. As wells are retired, energy demand would decrease. Local energy providers would likely have the capacity to continue supplying energy to all customers, so impacts from this alternative would be anticipated to be minimal.

4.17.3 Alternative 2A: Partial—Banks

4.17.3.1 Short-Term Impacts

No short-term impacts are expected from the construction of facilities required by this alternative, nor for any of the other action alternatives, so short-term impacts are not further discussed in this analysis.

4.17.3.2 Long-Term Impacts

This alternative would result in decreased groundwater pumping (positive change to the net available energy), lost hydro generation potential (negative change), and increased surface water pumping (negative change). Table 4-90 uses the average rate of energy consumed by groundwater pumping and the total area that would be converted to surface water irrigation under each action alternative to determine the total energy load conserved by shifting away from groundwater pumping.

Table 4-91 presents the anticipated monthly decrease in hydro generation as a result of the action alternatives diverting Columbia River water, which could otherwise be used by the 11 downstream hydroelectric projects to generate electricity.

The action alternatives would require a combination of additional storage and conveyance, and additional surface water pumping would be needed to serve the affected area. The surface water pumping load would be based on the number and size of the canal-side pumping plants and relift pumping plants, and, in the action alternatives featuring Rocky Coulee Reservoir (Alternative 2C: Partial—Banks + Rocky, Alternative 2D: Partial—Combined, Alternative 3C: Full—Banks + Rocky, and Alternative 3D: Full—Combined), the additional pumping requirements from the Rocky Coulee Pumping Plant. These parameters are summarized in Table 4-92.

The components of the energy balance were developed in Tables 4-90 for reduced groundwater pumping, 4-91 for lost hydroelectric generation, and 4-92 for additional surface water pumping. The net change in total energy for the No Action Alternative and each of the action alternatives incorporates those components and is presented in Table 4-93.

TABLE 4-90

Energy Conserved through Cessation of Groundwater Pumping

Alternative	Irrigated Acres	Annual Groundwater Pumping Energy (aMW/acre)	Conserved Annual Pump Energy (aMW)
Partial Replacement Alternatives (2A, 2B, 2C, and 2D)	57,069	0.000274	15.9
Full Replacement Alternatives (3A, 3B, 3C, and 3D)	102,614	0.000274	28.1

TABLE 4-91

Energy Lost through Reduced Hydro Generation

Alternative	Predicted Change in Hydro Generation* (aMW)														
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Apr	May	Jun	Jul	Aug	Aug	Sep	Avg
Partial Replacement Alternatives (2A, 2B, 2C, and 2D)	-74	0	0	0	0	3	-5	-5	-14	-12	0	0	0	-103	-17
Full Replacement Alternatives (3A, 3B, 3C, and 3D)	-238	-8	-28	-48	-28	-24	20	16	-3	-25	0	0	0	-103	-41

*Predicted values include reduced generation resulting from lower flow through the hydro system and added energy required to pump additional water from Lake Roosevelt to Banks Lake.

TABLE 4-92

Energy Consumed by Additional Surface Water Pumping

Alternative	Canal Side Pumping Plants	Relift Pumping Plants	Required Canal/Relift Energy [c] (aMW)	Rocky Coulee Pumping Plant [e] (aMW)	Black Rock Coulee Pumping Plant [d] (aMW)	Total Pump Load (aMW)
2A: Partial—Banks	7 [a]	6 [a]	30.1	0	0	30.1
2B: Partial—Banks + FDR	7 [a]	6 [a]	30.1	0	0	30.1
2C: Partial—Banks + Rocky	7 [a]	6 [a]	30.1	7.9	0	38.0
2D: Partial—Combined	7 [a]	6[a]	30.1	7.9	0	38.0
3A: Full—Banks	25 [b]	6 [a]	45.5	0	6.0	51.5
3B: Full—Banks + FDR	25 [b]	6 [a]	45.5	0	6.0	51.5
3C: Full—Banks + Rocky	25 [b]	6 [a]	45.5	7.9	6.0	59.4
3D: Full—Combined	25 [b]	6 [a]	45.5	7.9	6.0	59.4

Notes:
[a] All plants located on East Low Canal
[b] Includes 7 plants on the East Low Canal, 10 plants on the East High Canal, and 8 plants on Black Rock Branch Canal
[c] Based on standard calculations of pump size from head and flow information provided by Reclamation.
[d] Assumes 1 pump at 423 cfs against a head of 201 feet
[e] Assumes 8 pumps (91.9 cfs each) lifting 88 feet

TABLE 4-93

Net Change in Energy

Alternative	Reduced Groundwater Pumping (aMW)	Lost Hydroelectric Generation (aMW)	Additional Surface Water Pumping (aMH)	Net Change (aMW)
No Action Alternative	0	0	0	0
2A: Partial—Banks	15.9	-17.0	-30.1	-31.2
2B: Partial—Banks + FDR	15.9	-17.0	-30.1	-31.2
2C: Partial—Banks + Rocky	15.9	-17.0	-38.0	-39.1
2D: Partial—Combined	15.9	-17.0	-38.0	-39.1
3A: Full—Banks	28.1	-41.0	-51.5	-64.4
3B: Full—Banks + FDR	28.1	-41.0	-51.5	-64.4
3C: Full—Banks + Rocky	28.1	-41.0	-59.4	-72.3
3D: Full—Combined	28.1	-41.0	-59.4	-72.3

As demonstrated in Table 4-93, the reduction in groundwater pumping load for this alternative almost offsets the lost hydroelectric generation potential. Including the additional surface water pumping load, the net change in available energy is a reduction of 31.2 aMW. Compared to the system surpluses forecast in Chapter 3, Table 3-45, *Summary of Regional Firm Energy Surplus (Average Annual Megawatts)*, this reduction is anticipated to have a minimal impact in the short term (1 percent under critical water conditions in 2010) but over time would result in an adverse impact (the available energy reduction relative to surplus increases to 11 percent by 2017). It is assumed that a small amount of the regional surplus could be acquired as an offset for the additional energy consumed by this alternative and that no additional generating facilities would be needed.

Of the total change in available energy, about half (14.2 aMW for Alternative 2A: Partial—Banks, computed as the net increase between reduced groundwater pumping demand and increased surface water pumping demand) would be seen as additional demand on the electric service providers in the area. Since most of the providers obtain some if not all of their supply from the regional system, the local providers would be minimally impacted because they can obtain additional supply from the regional system surplus to offset the additional demand.

4.17.3.3 Mitigation
No mitigation measures are required for Alternative 2A: Partial—Banks, nor for any of the other action alternatives.

4.17.3.4 Cumulative Impacts
Cumulative impacts to energy resources would include lost downstream hydroelectric generation resulting from this alternative compounded by the additional small loss of downstream generation from the Lake Roosevelt Incremental Storage Releases Project. The extent of those compounding impacts would be minimal. There would also be some cumulative impact from additional indirect GHG

production, estimated at 123,983 CO_2 tons/year. Although very minor in terms of regional GHG emissions they would persist as long-term minimal impacts.

4.17.4 Alternative 2B: Partial—Banks + FDR

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.17.5 Alternative 2C: Partial—Banks + Rocky

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks, except that construction of the Rocky Coulee Pumping Plant would increase the additional surface water pumping load by approximately 6.0 aMW (see Table 4-92).

The net change in available energy for this alternative is a reduction of 39.1 aMW (see Table 4-93), or about 14 percent of the regional system surplus available in 8 years under critical water conditions (see Chapter 3, Table 3-45, *Summary of Regional Firm Energy Surplus*). Impacts to the regional surplus would be adverse.

The increased energy demand because of increased surface water pumping would have a minimal impact on local electric service providers.

The contribution to indirect regional GHG emissions is estimated at 155,376 CO_2 tons/year, which would persist as long-term minimal impacts.

4.17.6 Alternative 2D: Partial—Combined

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2C: Partial—Banks + Rocky.

4.17.7 Alternative 3A: Full—Banks

4.17.7.1 Long-Term Impacts

Long-term impacts are similar to those presented for Alternative 2A: Partial—Banks, except that more land would be converted to surface water irrigation (further reduced groundwater pumping, see Table 4-90). Also, more water would be diverted for surface water irrigation (resulting in additional lost hydroelectric generation; see Table 4-91). The proposed East High Canal, Black Rock Branch Canal, and Black Rock Coulee Reregulating Reservoir would require additional pumps for conveyance of surface water (see Table 4-92).

The net change in available energy for this alternative would be a reduction of 64.4 aMW (see Table 4-93), or about 23 percent of the regional system surplus available in 10 years under critical water conditions (see Chapter 3, Table 3-45, *Summary of Regional Firm Energy Surplus*). Impacts to the regional surplus would be considered significant.

Local electric service providers would only be minimally impacted because the increase in demand is expected to be offset by the regional system surplus.

4.17.7.2 Cumulative Impacts

Cumulative impacts are the same as those presented for Alternative 2A: Partial—

Banks, except that slightly more downstream hydroelectric generation would be lost under this alternative. Indirect GHG emissions would also increase to an estimated 255,913 CO_2 tons/year, which would persist as long-term minimal impacts.

4.17.7.3 Mitigation

As with Alternative 2A: Partial—Banks and all other action alternatives, no mitigation measures are required for Alternative 3A: Full—Banks.

4.17.8 Alternative 3B: Full—Banks + FDR

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 3A: Full—Banks.

4.17.9 Alternative 3C: Full—Banks + Rocky

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 3A: Full—Banks, except that construction of the Rocky Coulee Pumping Plant would increase the additional surface water pumping load by approximately 7.9 aMW (see Table 4-92).

The net change in available energy for this alternative is a reduction of 72.3 aMW (see Table 4-93), or about 26 percent of the regional system surplus available in ten years under critical water conditions (see Chapter 3, Table 3-45, *Summary of Regional Firm Energy Surplus*). Impacts to the regional surplus would be considered significant.

Local electric service providers would only be minimally impacted because the increase in demand is expected to be offset by the regional system surplus.

Estimated indirect GHG emissions would increase to 287,306 CO_2 tons/year, which would persist as long-term minimal impacts.

4.17.10 Alternative 3D: Full—Combined

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 3C: Full—Banks + Rocky.

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. 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 4-94 were used to evaluate public services and utilities impacts.

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

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 related BMPs listed in Section 4.29, *Environmental Commitments*. No mitigation measures are required.

TABLE 4-94

Public Services and Utilities Impact Indicators and 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.

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 4.29, *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 4.29, *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 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 Use*, concluded no net energy use change for the No Action Alternative; therefore, no impact on local electrical utilities would occur. A reduction in the demand for the other utilities could also result in a minimal impact on those other utilities.

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 4.29, *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 mobile 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 reduce the pumping load (thus reducing electricity demand). However, this alternative would also result in less energy being produced from hydroelectric generation and would require electricity to pump irrigation water to all areas within the Study Area that are eligible for water, as described in Section 4.17, *Energy*. This would result in a net energy loss. This loss is considered minimal because BPA has a system surplus that is capable of offsetting the additional demand.

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 land-line connections are available, they would be installed. If land-line connections are not available in select areas, wireless systems would likely be used. The few land-line 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 all facilities. When needed, they would be provided by independent onsite systems (for example, water supply wells, septic tanks, or other independent wastewater management systems). The few water and wastewater facilities that would be needed for the proposed facilities would not increase the burden on the suppliers of this service. No adverse impacts on the suppliers or their ability to provide services to other customers is expected.

4.18.3.3 Mitigation

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.

4.18.3.4 Cumulative Impacts

No cumulative impact concerns related to public services and utilities have been identified for this or any of the action alternatives.

4.18.4 Alternative 2B: Partial—Banks + FDR

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as that presented for Alternative 2A: Partial—Banks.

4.18.5 Alternative 2C: Partial—Banks + Rocky

Short-term, long-term, and cumulative impacts, as well as mitigation measures for all services and utilities except electricity, would be the same as that presented for Alternative 2A: Partial—Banks. With Alternative 2C: Partial—Banks + Rocky, more surface water pumping would occur than with Alternative 2A: Partial—Banks, resulting in a greater net electrical energy loss than with Alternative 2A: Partial—Banks. The increase in electricity demand is expected to be offset by the system surplus through BPA, resulting in no to minimal impact.

4.18.6 Alternative 2D: Partial—Combined

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as that presented for Alternative 2C: Partial—Banks + Rocky.

4.18.7 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, mitigation, and cumulative impacts 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 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.

4.18.8 Alternative 3B: Full—Banks + FDR

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as that presented for Alternative 3A: Full—Banks.

4.18.9 Alternative 3C: Full—Banks + Rocky

Short-term, long-term, and cumulative impacts, as well as mitigation measures for all services and utilities except electricity, would be the same as that presented for Alternative 3A: Full—Banks. With Alternative 3C: Full—Banks + Rocky, more surface water pumping would occur than with Alternative 3A: Full—Banks, resulting in a greater net electrical energy loss than with any of the other action alternatives, except for Alternative 3D: Full—Combined. The increase in electricity demand is expected to be offset by the system surplus through BPA, resulting in no to minimal impact.

4.18.10 Alternative 3D: Full—Combined

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as that presented for Alternative 3C: Full—Banks + Rocky.

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 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 and O&M facilities. The partial replacement alternatives would require a total of 14 facilities; the full replacement delivery alternatives would involve 28 such facilities. For alternatives that include Rocky Coulee Reservoir, one additional pumping plant would be built. 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 4-95 presents the indicators and significance criteria that have been identified for noise.

TABLE 4-95

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, as defined below) outside of daylight hours would be considered a significant short-term impact
Long-term increases in noise levels	Exceeding state noise standards

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 (L_{max}) based on the highest noise levels generated by the construction equipment and the equivalent noise level (L_{eq}) which is the average (on an acoustical energy basis), taking into account the usage factor.

4.19.1.3 Impact Analysis Assumptions

Broadly applicable legal requirements are described in Chapter 5, *Consultation and Coordination*. State of Washington Noise Regulations (WAC 173-60-040) are listed in Table 4-96. For the alternative impact analysis, it is assumed that all regulations would be followed, along with the BMPs listed in Section 4.29, *Environmental Commitments*. No mitigation measures are required.

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 4.29, *Environmental Commitments*.

TABLE 4-96

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)

TABLE 4-97

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

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 4-97 are expected to be representative. These data are illustrated in Figure 4-30.

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.

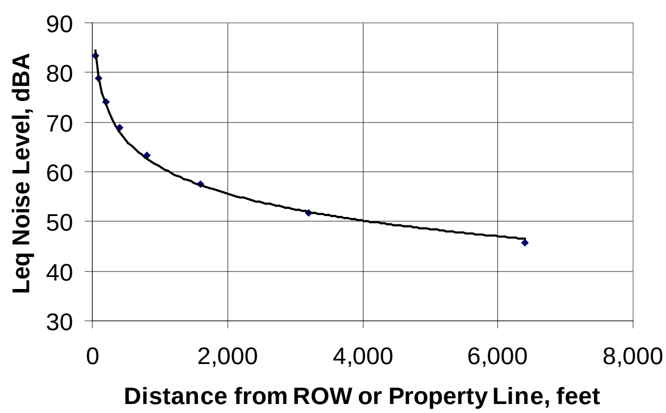


Figure 4-30
Estimated Construction Noise Levels

4.19.3.2 Long-Term Impacts

Noise levels would not increase significantly next to the pumping plants and the O&M facility. Thirteen pumping plants and one O&M facility would be located in remote areas. 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, Map 2-1, *Overview of Action Alternatives: Major Delivery and Supply Elements*). Vendor-specific noise information is not currently available for pumping plant or O&M facility 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.

4.19.3.3 Mitigation

Assuming full compliance with applicable State noise standards and application of BMPs, no additional mitigation measures are proposed or necessary, for this or any of the action alternatives.

4.19.3.4 Cumulative Impacts

Given the remote nature of the study area, distance between pumping plants and other facilities, and absence of other major construction projects in the study area, no cumulative noise impacts are anticipated, for this or any of the action alternatives.

4.19.4 Alternative 2B: Partial—Banks + FDR

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as that presented for Alternative 2A: Partial—Banks.

4.19.5 Alternative 2C: Partial—Banks + Rocky

Cumulative impacts and mitigation measures would be the same as that presented for Alternative 2A: Partial—Banks.

4.19.5.1 Short-Term Impacts

Short-term impacts would be the same as those described for Alternative 2A: Partial—Banks, with the addition of noise resulting from earthwork activities during construction of the Rocky Coulee Reservoir. Similar to Alternative 2A: Partial—Banks, construction activities would be exempt from State noise limits, but would be limited to daytime hours and subject to BMPs.

4.19.5.2 Long-Term Impacts

Long-term operational impacts would be the same as those described for Alternative 2A: Partial—Banks. One additional pumping plant would be constructed as part of the Rocky Coulee Reservoir. The nearest structure would be approximately 1,320 feet from the pumping plant. The noise reducing features discussed for Alternative 2A: Partial—Banks would also apply to the Rocky Coulee pumping plant to ensure compliance with State noise requirements.

4.19.6 Alternative 2D: Partial—Combined

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as that presented for Alternative 2C: Partial—Banks + Rocky.

4.19.7 Alternative 3A: Full—Banks

Cumulative impacts and mitigation measures would be the same as that presented for Alternative 2A: Partial—Banks.

4.19.7.1 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, and an additional O&M facility. 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.

4.19.7.2 Long-Term Impacts

As with the partial replacement alternatives, noise levels would increase slightly next to the pumping plants and O&M facilities. In addition to the 13 pumping plants and one O&M facility in the partial replacement alternatives, the full replacement alternatives would require another 19 pumping plants and a second O&M facility. 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, Map 2-6, *Full Groundwater Replacement Alternatives: Delivery System Development and Modification*). As discussed previously, all required facilities would be designed to incorporate noise control and reduction measures as necessary to comply with state noise standards.

4.19.8 Alternative 3B: Full—Banks + FDR

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as that presented for Alternative 3A: Full—Banks.

4.19.9 Alternative 3C: Full—Banks + Rocky

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as that presented for Alternative 3A: Full—Banks.

4.19.9.1 Short-Term Impacts

Short-term impacts would be the same as those described for Alternative 3A: Full—Banks, with the addition of construction noise resulting from earthwork activities during construction of the Rocky Coulee Reservoir. Similar to Alternative 3A: Full—Banks, construction activities would be exempt from state noise limits, but would be limited to daytime hours and subject to BMPs.

4.19.9.2 Long-Term Impacts

Long-term operational impacts would be the same as those described for Alternative 3A: Full—Banks. One additional pumping plant would be constructed as part of the Rocky Coulee Reservoir. The nearest structure would be approximately 1,320 feet from the pumping plant. As with all other pumping plants, noise reducing or control features would be included in facility design to ensure compliance with state noise standards.

4.19.10 Alternative 3D: Full—Combined

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 3C: Full—Banks + Rocky.

4.20 Public Health (Hazardous Materials)

The public health analysis addresses the potential for the Study alternatives to increase or reduce threats to human health from hazardous materials or mosquito-borne illness. No 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 from all of the action alternatives would be caused by encountering hazardous sites during construction that would require long-term clean-up or monitoring. Additional risk of impacts to public health relative to mosquitoes would occur under the action alternatives that include the construction of Rocky Coulee Reservoir. 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 4-98 were used to evaluate public health impacts.

TABLE 4-98

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 releases during construction. • Public exposure to contaminated sediments from drawdown of Lake Roosevelt.
Mosquito Habitat	Creation of large, new areas 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 alternatives are compared against the current conditions 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 resulting from construction, operation or 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, US 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 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 4.29, *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 to the Water Quality Act. This and other related Federal and State 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 ground in areas near a potential hazardous site. Reclamation and Ecology would implement the BMPs listed in Section 4.29, *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 potential for nitrogen and phosphorus to enter surface and groundwaters, would be progressively reduced as currently 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 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 of irrigation water on the soil.

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 of any of the action alternatives, fuels, oils, solvents, pesticides and other potentially hazardous materials may be introduced to surface water by 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 greater potential for temporary formation of mosquito habitat and increases in local mosquito populations during construction. These impacts would occur when rainwater accumulates in shallow pools or puddles caused by construction activities or associated with material and equipment staging. Response 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 could be caused by encountering hazardous sites during construction that would 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 impact 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 currently groundwater-irrigated lands south of I-90, it would be substantially reduced north of I-90 as groundwater-irrigated lands transition to dryland farming.

Shoreline of Banks Lake

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 areas 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 Study Area overall 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 on groundwater-irrigated lands 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. However, should mosquito populations increase unexpectedly under this alternative, regulations and BMPs would be implemented to reduce the impact to a minimal level.

4.20.3.3 Mitigation

No mitigation measures beyond the committed BMPs would be necessary for any of the public health impact indicators.

4.20.3.4 Cumulative Impacts

No cumulative impacts are associated with Alternative 2A: Partial—Banks.

4.20.4 Alternative 2B: Partial—Banks + FDR

With the single exception of long-term concerns related to contaminated sediment at Lake Roosevelt, short-term, long-term, and cumulative impacts, as well as mitigation perspectives, would be the same for this alternative as described above for Alternative 2A: Partial—Banks.

4.20.4.1 Long-Term Impacts

Shoreline of Lake Roosevelt

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 and the potential for windblown erosion and transport is increased. 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 at the reservoir would not change shoreline or mosquito habitat conditions appreciably from the No Action Alternative.

4.20.4.2 Mitigation

At Lake Roosevelt, the contaminated sediments issue is being studied separately by EPA and Teck Cominco. Reclamation would consider the results when they are available to determine if mitigation is required. If it is determined that the action alternatives cause re-entraining toxic materials into the air or water, Ecology and Reclamation would pursue development of appropriate mitigation measures and funding for implementation of these measures (Ecology 2008).

4.20.4.3 Cumulative Impacts

No cumulative impact concerns are associated with the contaminated sediment at Lake Roosevelt. The only recent or foreseen change in reservoir operations is associated with the Lake Roosevelt Incremental Storage Releases Project; this change is incorporated into the No Action Alternative.

4.20.5 Alternative 2C: Partial—Banks + Rocky

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as identified for Alternative 2A: Partial—Banks, except for any additional concern related to potential for mosquito habitat at Rocky Coulee Reservoir; any such concern would be addressed by the BMPs, which would be applied to keep any impacts at minimal levels.

4.20.6 Alternative 2D: Partial—Combined

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2B: Partial—Banks + FDR, with the addition of perspectives described for Rocky Coulee Reservoir under Alternative 2C: Partial—Banks + Rocky.

4.20.7 Alternative 3A: Full—Banks

All impact considerations and conclusions as well as mitigation perspectives 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 a replacement surface water supply. Thus, there would be no change in these impact indicators from existing conditions. The reductions in fertilizer and 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.

4.20.8 Alternative 3B: Full—Banks + FDR

Short-term, long-term, and cumulative impacts, as well as mitigation measures, 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.

4.20.9 Alternative 3C: Full—Banks + Rocky

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 3A: Full—Banks, with addition of the impact considerations associated with Rocky Coulee Reservoir described under Alternative 2C: Partial—Banks + Rocky.

4.20.10 Alternative 3D: Full—Combined

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 3B: Full—Banks + FDR, with the addition of impact considerations associated with Rocky Coulee Reservoir under Alternative 2C: Partial—Banks + Rocky.

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 the 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. For action alternatives that include construction of Rocky Coulee Reservoir, localized significant short- and long-term visual impacts would also occur near this new facility.

- **Banks Lake Drawdown under Alternative 3A: Full—Banks:** Average-year summer drawdowns would be more than 8 feet lower than under the No Action Alternative, which would create a significant adverse impact. Additional drawdowns at Banks Lake 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 4-99 presents the indicators and associated criteria for determining potential significant impacts to visual resources.

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.

Photograph 4-14.
Irrigated agriculture is a defining part of the landscape.

TABLE 4-99

Visual Resources 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.

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 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, 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 4.29, *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 4.29, *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 a 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 would occur.

4.21.3.2 Long-Term Impacts

Study Area

North of I-90, this alternative and the other partial replacement alternatives 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, pumping plants, and an O&M facility. 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 4-15.
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 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.

4.21.3.3 Mitigation
No mitigation measures are proposed or necessary.

4.21.3.4 Cumulative Impacts
There are no cumulative impact concerns related to visual resources.

4.21.4 Alternative 2B: Partial—Banks + FDR
Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as that presented for Alternative 2A: Partial—Banks. Regarding the Lake Roosevelt role in the this alternative, no short-term impacts would occur, and the small additional drawdown in August of each year would have a minimal visual impact.

4.21.5 Alternative 2C: Partial—Banks + Rocky
Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as that presented for Alternative 2A: Partial—Banks, except for the following:

- Only minimal impacts at Banks Lake from annual drawdowns
- Impacts associated with the proposed Rocky Coulee Reservoir

Development of Rocky Coulee reservoir would involve both short-term and long-term visual impacts to a relatively large local area. The reservoir would fill the bottom of Rocky Coulee and change the character of the area from a mix of agriculture and undeveloped areas (with a generally natural appearance) to that of a storage reservoir, which is filled and emptied each year. However, these impacts would generally not be visible to residents or motorists. All existing residents within the reservoir acquisition area would be relocated, and all public roads would be rerouted. Given these actions, the only visibility of the reservoir or its facilities would be from immediately downstream (to the west), where a small number of residents would be able to see portions of the dam and related facilities. For these local residents, introduction of the dam and facilities could be significant visual impact, to the extent that the new facilities are visible. No detailed line-of-sight analysis has been conducted for this Draft EIS.

4.21.6 Alternative 2D: Partial—Combined

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as that presented for Alternative 2A: Partial—Banks. Assessment and conclusions presented under Alternative 2B: Partial—Banks + FDR for Lake Roosevelt and Alternative 2C: Partial—Banks + Rocky for Rocky Coulee Reservoir also apply to this alternative.

4.21.7 Alternative 3A: Full—Banks

Cumulative impacts and mitigation measures would be the same as that presented for Alternative 2A: Partial—Banks.

4.21.7.1 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.

4.21.7.2 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 waterbody 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 significantly deeper and of longer duration, exposing considerably more shoreline, than would be the case with the No Action Alternative or any of the partial replacement alternatives. In August of average years, the drawdown would be approximately 14 feet, which is 9 feet deeper than the No Action Alternative. Also, drawdowns would begin earlier in the year in June or July instead of August.

At the drawdown levels projected with this alternative, the “bathtub ring” effect would be quite pronounced, and exposed shoreline would range from 100 to 1,000 feet larger than with the No Action Alternative (see Tables 4-60 and 4-61, which provide the distance to the water’s edge at Banks Lake 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 of all water years, and from June to September in drought years.

Photograph 4-16.
Rolling low hills characterize parts of the Study Area.

4.21.8 Alternative 3B: Full—Banks + FDR

Short-term, long-term, and cumulative impacts, as well as mitigation measures, 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.

4.21.9 Alternative 3C: Full—Banks + Rocky

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as presented for Alternative 3A: Full—Banks. Impacts associated with Rocky Coulee Reservoir would be the same as those described for Alternative 2C: Partial—Banks + Rocky.

For Banks Lake, significant impacts resulting from drawdown conditions would occur in dry and drought years when drawdowns would reach between 7 and 12 feet below those under the No Action Alternative.

4.21.10 Alternative 3D: Full—Combined

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as that presented for Alternative 3A: Full—Banks. Impacts at Lake Roosevelt would be the same as those described for Alternative 2B: Partial—Banks + FDR. Impacts associated with Rocky Coulee Reservoir would be the same as those described for Alternative 2C: Partial—Banks + Rocky.

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.

All action alternatives involve development and operation of facilities in areas with high potential to contain cultural or historic resources. All action alternatives would also involve additional drawdowns at Banks Lake each year, exposing more shoreline with potential to contain cultural resources.

Generally, the 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. Additional drawdowns at Banks Lake are also generally less for the partial replacement alternatives compared with the full replacement alternatives. Alternatives that include development of Rocky Coulee Reservoir create another large site with high potential for significant cultural resources.

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. If an action adversely affects a historic property, then it would significantly affect the quality of the human environment, as defined by NEPA, unless the effects can be reduced below the level of significance through mitigation measures. 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. These indicators are shown in Table 4-100.

TABLE 4-100

Cultural Resources Impact Indicators and Criteria

Impact Indicator	Significance Criteria
Miles of new linear facilities with high potential for encountering and impacting cultural resources Acres of facility site acquisition areas with high potential for encountering and impacting cultural resources Additional acreage exposed by drawdown changes at Banks Lake	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.

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.

Class II cultural resource investigations are not considered feasible or justified at the current level of planning. Class II cultural resource investigations include the archival research conducted for Class I investigations, as well as an intensive on-the-ground pedestrian inventory survey, and possibly subsurface testing and site significance evaluations (Reclamation 1998). 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 4.29, *Environmental Commitments*.

As noted above, detailed study and analysis of impact to cultural resources is 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 4.29, *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 NHPA, 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 NHPA is a part of Federal legislation that guides, instructs, and provides a way to implement the overall intent of the NHPA 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 NRHP.

Standard Procedures Pursuant to Regulatory Requirements

As the lead Federal agency for the undertaking, Reclamation, or Reclamation's designated lead agency, would define a formal APE through consultation with the Washington State Historic Preservation Office (SHPO; 36 CFR 800.4(a)(1)). 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. Using the cultural resource predictive model, areas containing high probability for cultural resources would be inventoried most intensively, with lower probability areas needing lesser investigation; however, it is recognized that cultural resources would likely be present even in low potential areas.

Once documented, cultural resource significance would be established using Determination of Eligibility forms. Determining a resource's significance would require subsurface testing, additional fieldwork, or additional research. Eligibility recommendations would be submitted on Determination of Eligibility 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, mitigation would be necessary.

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 would 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 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. This plan would include annual 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.
- If avoidance is not feasible, Determination of Eligibility would be conducted for potentially affected site(s). If this process results in SHPO concurrence, and the cultural property is confirmed eligible for inclusion in the NRHP or the Washington Heritage Register, then additional measures would be required to mitigate adverse effects. Mitigation would include additional historic research or subsurface testing, possible data recovery, large format black-and-white photographic documentation, or other measures.
- Prior to construction, Reclamation's archaeologists would also perform the following actions:
    - 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 be excluded from access to any cultural resources.
  - Place protective fencing and other exclusion measures around cultural resources to ensure their protection.

- For highly sensitive cultural resource areas or known historic properties that have a potential to be adversely impacted, conduct monitoring on an ongoing or 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.

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. However, the transition away from irrigated agriculture to dryland farming would have a corresponding indirect impact on the historic cultural environment.

Banks Lake and Lake Roosevelt

The No Action Alternative would have no impact on cultural and historic resources; 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). Potential impact to these resources associated with this and all action alternatives is considered long-term.

4.22.3.2 Long-Term Impacts

Odessa Subarea

Impacts to cultural and historic resources associated with this alternative could include either direct or indirect impacts. With any of the action alternatives in the Draft EIS, direct impacts could occur from such actions as physical destruction or inundation of all or portion of the resource. Indirect impacts to historic properties could result from fires caused by heavy equipment access in the area, human destruction caused by increased access to the area, ongoing degradation of subsurface deposits for historic and pre-contact archaeological resources caused over time by unstable or shifting soils, and changed agricultural production practices.

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 4-101. These impacts are the same for all of the partial replacement alternatives.

Banks Lake

The additional drawdown at Banks under this alternative, when compared with the No Action Alternative, would expose an additional 780 acres of land during an average water year, as shown in Table 4-102. 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.

4.22.3.3 Mitigation

No additional mitigation measures are required following application of the regulations and associated standard procedures.

4.22.3.4 Cumulative Impacts

No cumulative impact concerns related to cultural and historic resources are present for this or any of the action alternatives.

4.22.4 Alternative 2B: Partial—Banks + FDR

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as that presented for Alternative 2A: Partial—Banks. The only difference with this alternative is that 690 acres of land, beyond the No Action Alternative, would be exposed at Banks Lake, as shown in Table 4-102. Operations at Lake Roosevelt under this alternative would not involve drawdowns deeper than what currently occur over the course of the year.

TABLE 4-101

Potential for Water Delivery System Implementation to Result in Impacts to Significant Cultural and Historic Resources: Partial Replacement Alternatives

	High Potential	Moderate Potential	Low Potential
Miles of Linear Facilities [a]	172	16	28
Acres of Site Facilities [b]	90	1	7

[a] Includes East Low Canal enlargement and extension (44.1 miles) and distribution pipelines (172.7 miles); alignments of necessary transmission lines are not known and are not included.

[b] Includes pumping plants and O&M facility (totaling 98 acres)

Note: Locations of facilities are illustrated in Map 2-3 in Chapter 2

TABLE 4-102

Additional Acreage of Shoreline Exposed at Banks Lake: Partial Replacement Alternatives

Alternative	Total Dewatered Shoreline (acres)	Difference from No Action (acres)
No Action Alternative	1,200	0
2A: Partial—Banks	2,450	780
2B: Partial—Banks + FDR	1,700	690
2C: Partial—Banks + Rocky	1,450	30
2D: Partial—Combined	1,700	500

4.22.5 Alternative 2C: Partial—Banks + Rocky

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as that presented for Alternative 2A: Partial—Banks. The differences with this alternative are limited to the following:

- The additional acreage of land exposed at Banks Lake, beyond the No Action Alternative, would be 30 acres in an average water year, as shown in Table 4-102.
- Rocky Coulee Reservoir would be constructed. Of the 8,960 acres of land acquired by Reclamation for development and operation of this reservoir (see Chapter 2, Map 2-5), 6,080 acres (68 percent) have a high probability of containing cultural and historic resources. According to the cultural resource predictive model, 1,670 acres (2 percent) have a moderate probability of containing cultural and historic resources, and 1,210 acres (30 percent) have a low probability of containing cultural and historic resources.

4.22.6 Alternative 2D: Partial—Combined

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as that presented for Alternative 2A: Partial—Banks, plus the impacts disclosed for the proposed Rocky Coulee Reservoir under Alternative 2C: Partial—Banks + Rocky. Regarding Lake Roosevelt, this alternative would not involve drawdowns deeper than what currently occur over the course of the year.

4.22.7 Alternative 3A: Full—Banks

Cumulative impacts and mitigation measures would be the same as that presented for Alternative 2A: Partial—Banks.

4.22.7.1 Short-Term Impacts

As with all of the partial replacement alternatives, impacts to cultural and historic resources are generally not short term. Potential impact to these resources associated with this and all action alternatives is considered long-term.

4.22.7.2 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 4-103. These impacts are the same for all of the full replacement alternatives.

Banks Lake

The drawdown at Banks under this alternative, when compared with the No Action Alternative, would expose an additional 2,310 acres of land in an average water year, as shown in Table 4-104. This creates a high potential for encountering and enabling impacts to significant cultural resources.

TABLE 4-103

Potential for Water Delivery System Implementation to Result in Impacts to Significant Cultural and Historic Resources: Full Replacement Alternatives

	High Potential	Moderate Potential	Low Potential
Miles of Linear Facilities [a]	248	26	205
Acres of Site Facilities [b]	128	12	1392

[a] Includes East Low Canal enlargement and extension (47.1 miles), EHC (45 miles), BRBC 27.1 miles), and distribution pipelines (360.1 miles); alignments of necessary transmission lines are not known and are not included.

[b] Includes pumping plants & O&M facilities (totaling 231 acres, and Black Rock Coulee Reregulating Reservoir (1300 acres)

Note: Locations of facilities are illustrated in Maps 2-3 and 2-6 in Chapter 2.

TABLE 4-104

Additional Acreage of Shoreline Exposed at Banks Lake: Full Replacement Alternatives

Alternative	Total Dewatered Shoreline (acres)	Difference from No Action (acres)
No Action Alternative	1,200	0
3A: Full—Banks	4,400	2,310
3B: Full—Banks + FDR	1,700	690
3C: Full—Banks + Rocky	4,150	1,170
3D: Full—Combined	1,700	690

4.22.8 Alternative 3B: Full—Banks + FDR

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as that presented for Alternative 3A: Full—Banks. The only difference with this alternative is that 690 acres of land, beyond the No Action Alternative, would be exposed at Banks Lake, as shown in Table 4-104. Operations at Lake Roosevelt under this alternative would not involve drawdowns deeper than what currently occur over the course of the year.

4.22.9 Alternative 3C: Full—Banks + Rocky

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as that presented for Alternative 3A: Full—Banks. The differences with this alternative are limited to the following:

- Additional acreage of land exposed at Banks Lake, beyond the No Action Alternative, would be 1,170 acres in an average water year, as shown in Table 4-104.
- This alternative includes development of Rocky Coulee Reservoir, with impact potential the same as described for Alternative 2C: Partial—Banks + Rocky.

4.22.10 Alternative 3D: Full—Combined

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as that presented for

Alternative 3A: Full—Banks, plus the impacts disclosed for the proposed Rocky Coulee Reservoir under Alternative 2C: Partial—Banks + Rocky. The only difference with this alternative is that 780 acres of land, beyond the No Action Alternative, would be exposed at Banks Lake, as shown in Table 4-104. Regarding Lake Roosevelt, this alternative would not involve drawdowns deeper than what currently occur over the course of the year.

4.23 Indian Sacred Sites

To date, no sacred sites have been identified in the Study Area. Therefore, none of the alternatives would impact known sacred sites. However, if a Tribe identifies a sacred site within the area affected by the preferred alternative, Reclamation would promote accommodation of access and protect the physical integrity of the site.

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*.

4.24 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.

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 disproportionate impacts to 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, 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 4-105.

TABLE 4-105

Environmental Justice Impact Indicators and Significance Criteria

Impact Indicator	Significance Criteria
Disproportionate Impacts to Minority or Low-Income Populations	Examples of significant disproportionate impacts include construction immediately adjacent or within minority or low-income populations that surrounding populations are not experiencing.

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, the affected environment discussion for 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) and represents the extent of both 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 4.29, *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 4.29, *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 4.29, *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 water availability and of 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 water 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, 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 two population groups.

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 impacted.

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 be disproportionate. Therefore, no short-term environmental justice impacts would occur to these groups 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.

4.25.3.3 Mitigation

In the absence of significant environmental justice impacts, no associated mitigation measures are necessary.

4.25.3.4 Cumulative Impacts

No cumulative impacts would occur to minority or low-income populations.

4.25.4 Alternative 2B: Partial—Banks + FDR

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.25.5 Alternative 2C: Partial—Banks + Rocky

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.25.6 Alternative 2D: Partial—Combined

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 2A: Partial—Banks.

4.25.7 Alternative 3A: Full—Banks

Short-term, long-term, and cumulative 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.

4.25.8 Alternative 3B: Full—Banks + FDR

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 3A: Full—Banks.

4.25.9 Alternative 3C: Full—Banks + Rocky

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 3A: Full—Banks.

4.25.10 Alternative 3D: Full—Combined

Short-term, long-term, and cumulative impacts, as well as mitigation measures, would be the same as Alternative 3A: Full—Banks.

4.26 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:

- **Water Quality.** Significant impacts on temperature and dissolved oxygen at Banks Lake would occur under all alternatives, except Alternative 2C: Partial—Banks + Rocky.
- **Soils.** Impacts subject to the FPPA would be unavoidable.

- **Vegetation and Wetlands**. Alternatives 2C: Partial—Banks + Rocky, 2D: Partial—Combined, and the full replacement alternatives would have significant impacts on upland shrub steppe communities. Impacts from the full replacement alternatives would be substantially greater than those in the partial replacement alternatives. The full replacement alternatives would also have significant impacts on rare plants and wetland area and function.

- **Wildlife.** All alternatives would have significant impacts on shrub steppe habitat and special status species. Wildlife movement barriers created by canal construction under all full replacement alternatives would have significant impacts. Similarly, all 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.

- **Fisheries and Aquatic Resources.** Alternatives 3A: Full—Banks and 3C: Full—Banks + Rocky 3A would have significant impacts on the Banks Lake sport fishery during most water type years. Alternatives 3B: Full—Banks + FDR and 3D: Full—Combined would have significant impacts on the Banks Lake fishery during drought years.

- **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.

  - The Partial Replacement alternatives would result in major changes to land use in the Study Area north of I-90; it is expected that all eligible 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 that exclude Rocky Coulee Reservoir, consisting of Alternative 2A: Partial—Banks, and Alternative 2B: Partial—Banks + FDR
    2. Full replacement alternatives that exclude Rocky Coulee Reservoir, consisting of Alternative 3A: Full—Banks, and Alternative 3B: Full—Banks + FDR
    3. Partial replacement alternatives that include Rocky Coulee Reservoir, consisting of Alternative 2C: Partial—Banks + Rocky, and Alternative 2D: Partial—Combined
    4. Full replacement alternatives that include Rocky Coulee Reservoir, consisting of Alternative 3C: Full—Banks + Rocky, and Alternative 3D: Full—Combined

  - 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 that exclude Rocky Coulee Reservoir, consisting of Alternative 2A: Partial—Banks, and Alternative 2B: Partial—Banks + FDR
2. Partial replacement alternatives that include Rocky Coulee Reservoir, consisting of Alternative 2C: Partial—Banks + Rocky, and Alternative 2D: Partial—Combined
3. Full replacement alternatives that exclude Rocky Coulee Reservoir, consisting of Alternative 3A: Full—Banks, and Alternative 3B: Full—Banks + FDR
4. Full replacement alternatives that include Rocky Coulee Reservoir, consisting of Alternative 3C: Full—Banks + Rocky, and Alternative 3D: Full—Combined

- 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.

- **Recreation** (all impacts related to Banks Lake):
  - All action alternatives except 2C: Partial—Banks + Rocky 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.
  - Alternatives 3A: Full—Banks, and 3C: Full—Banks + Rocky, would have a significant impact on fishing because of the adverse impact on the fishery in all water years. Alternatives 3B: Full—Banks + FDR, and 3D: Full—Combined, would have the same adverse impact on fishing, but only during drought years.

- **Transportation:**
  - All alternatives involving Rocky Coulee Reservoir would involve significant long-term, local traffic circulation impacts from road closures forced by reservoir development (Alternatives 2C: Partial—Banks + Rocky, 2D: Partial—Combined, 3C: Full—Banks + Rocky, and 3D: Full—Combined).

- **Visual:**
  - The Partial Replacement alternatives 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, this impact would be limited to areas south of I-90; in the full replacement alternatives, the impact would occur both north and south of I-90.
  - Alternative 3A: Full—Banks 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. Alternative 3C: Full—Banks + Rocky would have similar adverse impacts during drought years (up to 15 percent of years).

- **Cultural:**
  - 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 compared with the Partial Replacement alternatives. This is because the Full Replacement alternatives would involve considerably more development of new linear and site facilities and deeper drawdowns of Banks Lake.

4.27 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 and full replacement alternatives would implement ground-disturbing activities that would produce short-term and long-term impacts. Impacts would be expected to Banks Lake water quality, soil, vegetation and wetlands, wildlife and habitat, the Banks Lake fishery, land use, recreation, transportation, and visual resources. However, the action alternatives would also provide the long-term benefit of reducing or eliminating use of groundwater pumping for irrigation.

4.28 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. Table 4-106 presents a summary of these irreversible commitments.

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 4-107 presents a summary of irretrievable commitments.

TABLE 4-106

Irreversible Commitments of Resources

	Alternatives			
	Partial Replacement Alternatives without Rocky Coulee	Partial Replacement Alternatives with Rocky Coulee	Full Replacement Alternatives without Rocky Coulee	Partial Replacement Alternatives with Rocky Coulee
Resources	**2A and 2B**	**2C and 2D**	**3A and 3B**	**3C and 3D**
Materials, labor, and energy needed to construct the project represented by total project cost	To be determined by Reclamation	To be determined by Reclamation	To be determined by Reclamation	To be determined by Reclamation
Materials, labor, and energy consumed in maintenance and operation of the project annually represented by total annual O&M cost	To be determined by Reclamation	To be determined by Reclamation	To be determined by Reclamation	To be determined by Reclamation
Flow uses during construction	Coffer dams and other temporary disturbances	Coffer dams and other temporary disturbances	Coffer dams and other temporary disturbances	Coffer dams and other temporary disturbances

TABLE 4-107

Irretrievable Commitments of Resources

	Partial Replacement Alternatives without Rocky Coulee	Partial Replacement Alternatives with Rocky Coulee	Full Replacement Alternatives without Rocky Coulee	Partial Replacement Alternatives with Rocky Coulee
	2A and 2B	**2C and 2D**	**3A and 3B**	**3C and 3D**
Direct land uses (total acreages for reservoirs, canals, pipelines, pumping plants, switchyards, and other above-ground features)	4,905	13,843	19,766	28,704
Indirect land uses (total acreages for borrow pits, fill disposal sites, excavation sites and other temporary construction features)	Temporary impacts during construction include 320 acres of native plant communities. Other impacts not known at this time.	Temporary impacts during construction include 320 acres of upland and native plant communities. Other impacts not known at this time.	Temporary impacts during construction include 1,772 acres of native plant communities. Other impacts not known at this time.	Temporary impacts during construction include 1,772 acres of native plant communities. Other impacts not known at this time.
Flow uses during operation	Flows would be diverted from the Columbia River	Flows would be diverted from the Columbia River	Flows would be diverted from the Columbia River	Flows would be diverted from the Columbia River

4.29 Environmental Commitments

Decisions subsequent to the Record of Decision or the need for specific permits would trigger the Washington SEPA process. Similarly, additional NEPA compliance activities would be conducted as needed to address changes or minor elements of the Alternatives that are not known at this time. Two examples would be assessing the effects of access roads and transmission lines because their specific locations are not known at this time.

The following list includes the environmental commitments made for the Study. These commitments are either in the form of BMPs or mitigation measures. BMPs are assumed to be included as part of the action alternatives. Mitigation measures are applied in addition to the alternatives to compensate for impacts that cannot be minimized through BMPs or other means. Reclamation and Ecology share the responsibility to ensure these commitments are met if an action is implemented.

4.29.1 Surface Water Quantity

Several procedures would be used as necessary to prevent and minimize erosion and siltation during construction and throughout the period needed to reestablish permanent vegetative cover on disturbed sites. Reclamation and Ecology would implement the following BMPs to further avoid or minimize water pollution during and after construction:

- Schedule land-clearing activities to minimize the exposure of soils. Initiate final erosion control and site restoration measures as soon as an area is no longer needed for construction, stockpiling, or access.
- Avoid placement of excavated materials near or on shorelines, streambanks, wetlands, or other watercourse perimeters where they could be washed away by high water or storm runoff, or encroach upon any sensitive areas.
- Avoid construction activities during wet periods of the year and use proper construction techniques and procedures to keep silt out of lakes and drainages.

4.29.2 Groundwater

At this time, the State can only require that the wells for lands that would receive surface water would go on standby status. These standby wells could only be used during temporary emergency situations, such as an interruption of the irrigation supply from the Federal delivery system. Restricting future well use to temporary emergency situations may further limit groundwater level declines and their impact on municipal and industrial users.

4.29.3 Surface Water Quality

Reclamation and Ecology would implement the following BMPs as part of their Storm Water Pollution Prevention Plan (SWPPP) to further avoid or minimize water pollution during and after construction in the study area irrigation network:

- Canal construction activities would be conducted outside of the irrigation season so that in-stream disturbances would be minimized.
- When crossing live streams, a water quality monitoring plan, including a quality assurance project plan (QAPP) following Ecology guidelines, would be established to ensure that construction activities did not result in state water quality standards exceedances. A protocol for addressing

standards exceedances (that is, what the contractor needs to do to avoid additional exceedances) would also be established prior to commencement of construction activities.

- A spill plan would be developed to implement containment of construction materials such as treated woods, concrete, concrete leachate, grout, and other substances that may be deleterious or toxic to fish and other aquatic organisms.
- Silt fences and settling ponds would be used to minimize construction site runoff to nearby receiving waters.
- Settling ponds or other measures would be used to prevent wastewater from dewatering, equipment washing, wet sawing, or other construction activities from being discharged directly into nearby receiving waters.
- Construction equipment would be equipped with environmental spill kits to contain petroleum products in the event of a leak.
- 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.
- Stockpiles of earthen materials would be strategically placed to minimize runoff into nearby receiving waters.

4.29.4 Geology

BMPs for geologic resources would include the following:

- Design facilities to minimize disturbance during construction.
- Utilized materials excavated within reservoir footprint for dam construction.
- Design and permit gravel pits and rock quarries with stable side slopes to ensure safety and minimize erosion. Reclamation and Ecology would also implement BMPs to avoid or minimize soil erosion during and after construction as stated in Section 3.7, *Soils*.

4.29.5 Soils

4.29.5.1 BMPs

BMPs for reducing impacts on soils include actions intended to minimize the amount of land disturbance at any given time to reduce adverse impacts on water quality from erosion.

- Soil temporarily disturbed during construction would be revegetated as soon as construction activities have ended in a particular area. This BMP is intended to reduce the potential for erosion by protecting the soil surface as soon as practicable. Areas that supported native vegetation before disturbance would be revegetated using native species as described in Section 4.8, *Vegetation and Wetlands*.
- Temporary erosion control structures such as wattles and silt fences would be installed as needed to protect surface water from sediment from soil erosion. The BMP would protect surface water by intercepting any sediment inadvertently eroded from construction areas. See Section 4.4, *Surface Water Quality*, for details.
- Stockpiling and reapplication of topsoil. The top 12 inches of topsoil should be removed from the surface of temporary excavations, such as pipeline trenches, and stockpiled. The stockpile soil would be protected from erosion until it is used. After construction is complete, the stockpiled topsoil would be spread

over the disturbed area and lightly compacted prior to revegetation.

This measure is very effective at providing a good seed bed for revegetation efforts. It also allows for quickly establishing new vegetation to prevent erosion and restore visual quality back to the landscape.

4.29.5.2 Mitigation Measures

When soil becomes compacted because of construction activity, the compaction could 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. The same mitigation measure would be applied to all action alternatives.

4.29.6 Vegetation and Wetlands

4.29.6.1 BMPs

BMPs described in Section 4.29.3, *Surface Water Quality*, would also help to prevent or minimize degradation of native upland, wetland, and riparian communities. Reclamation and Ecology would implement the following BMPs to further avoid or minimize the spread of noxious weeds:

- The contract administrator would ensure that the inventoried noxious weed populations are located and marked with temporary fencing prior to entry with equipment. The temporary fencing would keep vehicles from entering infested areas to prevent the spread of noxious weeds. Temporary fencing would also facilitate weed control efforts in accordance with local county, State, and Federal requirements.

- 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:

  – Install sediment barriers and other suitable erosion and runoff control devices prior to ground-disturbing activities at construction sites to minimize offsite sediment movement.

  – Clearly mark the buffer areas around wetland and riparian areas to avoid inadvertent impacts.

  – Minimize grading, clearing or other construction work in wetlands, riparian corridors, and native shrub-steppe. Do not permit use of these areas for construction staging, equipment or materials storage, fueling of vehicles, or related activities.

Lands impacted during pipeline construction would be seeded with local native species following construction with a goal of restoring the impacted community.

4.29.6.2 Mitigation

The following mitigation measures are intended to partially compensate for impacts that would not be avoided through adherence to legal requirements or BMPs. Legal requirements are described both in each resource section and in Chapter 5, *Consultation and Coordination.*

Partial Replacement Alternatives

Uplands

Actions that would be implemented along the East High Canal and other construction sites include the following:

- Construction staging areas would be located within portions of the the rights-of-way 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 grass, forb, and sagebrush species acclimated to site conditions.
- Restoration goals, success criteria, and monitoring protocols would be developed in cooperation with WDFW and the USFWS as part of an upland native habitat management plan. This plan would be developed during final design and before any ground disturbing activities. Monitoring will 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 49 acres of shrub-steppe during expansion and extension of the East Low Canal would be developed in cooperation with WDFW as part of an upland native habitat management plan. Mitigation may 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 State and Federal laws.

All revegetation or restoration efforts would likely require many years of reseeding and weed control to achieve the desired goals.

For alternatives that would propose to construct the Rocky Coulee Reservoir, much larger areas would be required to mitigate the impacts to uplands because larger areas would be impacted.

Wetlands
At the East High Canal, wetland mitigation would be the same as for the full replacement alternatives. All impacts to jurisdictional wetlands would be mitigated as determined during later consultation with the U. S. Army Corps of Engineers. It is described in more detail in that section because more acres are affected.

Banks Lake
No significant impacts at Banks Lake are anticipated. If the proposed action results in significant impacts, appropriate mitigation measures would be developed and implemented in consultation with WDFW.

Full Replacement Alternatives
Uplands
The same types of mitigation measures described for the partial replacement alternatives would be implemented. However, much larger areas would be required.

Wetlands
All impacts to jurisdictional wetlands would be mitigated as determined during later consultation with the U. S. Army Corps of Engineers. The specific mitigation approach would change based on the final determination of impacts and Section 404 permit terms and conditions. Mitigation for unavoidable impacts to wetlands and riparian areas would require both passive and active measures and would be implemented at one or several of the following locations:

- East Low Canal (expansion of existing wetlands supported by canal seepage)
- East High Canal (development of new wetlands supported by canal seepage)

- Black Rock Reregulation Reservoir (development of new wetlands on the eastern extent of proposed reservoir footprint and/or down-gradient of proposed dam

Enhancement areas at East Low Canal would require planting of wetland shrub and tree species within existing wetland areas that currently lack vegetative structure. Creation of additional wetland acreage along the East Low Canal would include grading margins of existing seep wetlands to expand wetland acreage and include wetland plantings of shrub and tree species appropriate for existing or supplemented hydrology. Components of enhancing or creating wetland habitat along the East Low Canal would include hydrologic inputs from seepage or water turnouts from the irrigation delivery system, grading, wetland and riparian plantings, and hydrologic and vegetation monitoring.

Creation of new wetlands along the East High Canal would involve active water management to provide water to planned created wetlands and grading at the site of canal leaks to facilitate wetland development. Both options would require planting of preferred vegetation and hydrologic and vegetation monitoring.

Wetland mitigation associated with canal leaks would not be subject to Section 404 regulations.

Wetlands could be developed around parts of the eastern side of the Black Rock Reregulation Reservoir because the water level would be relatively constant. Exclusionary fencing around the reservoir would be considered during final design. Wetlands could also be developed downstream of the reservoir through controlled releases of water. Both actions could create PEM, PSS, and PFO wetland communities and would require grading, planting, erosion control measures, and monitoring. Wetland hydrology would be established through surface or subsurface inundation of the wetland areas by reservoir levels, dam seeps, and/or inputs from the irrigation delivery system. Monitoring would aid in the identification of remedial actions needed to meet the stated goals at each site.

Banks Lake
If the proposed action results in significant impacts, appropriate mitigation measures would be developed and implemented in consultation with WDFW.

4.29.7 Wildlife and Wildlife Habitat

4.29.7.1 BMPs
BMPs described in Sections 4.29.3, *Surface Water Quality*, and 4.29.6, *Vegetation and Wetlands*, would prevent or minimize degradation of native upland, wetland, and riparian habitats. Reclamation and Ecology would implement the following BMPs to further avoid or minimize impacts on wildlife:

- Construction would be timed to avoid the breeding period of special status species.
- Incorporate standard, raptor-proof designs for all power lines as outlined in *Suggested Practice for Avian Protection on Power Lines: The State of the Art in 2006*. (Avian Powerline Interaction Committee, 2006).

4.29.7.2 Mitigation
The following mitigation measures are intended to partially compensate for impacts that would not be avoided through adherence to legal requirements or BMPs. Legal requirements are described both in each resource section and in Chapter 5, *Consultation and Coordination.*

Partial Replacement Alternatives
Mitigation measures described in Section 4.29.6, *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 may include measures in addition to those listed for vegetation and wetlands. An upland native habitat management plan would be developed in consultation with WDFW and the USFWS.

The success of revegetation efforts depends on a several factors and is not assured, as described in Sections 4.8, *Vegetation and Wetlands*, and 4.29, *Environmental Commitments*. Full restoration of native shrub steppe habitats to pre-construction 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.

No known mitigation measures are available to compensate for the unavoidable impacts to grebes nesting at Banks Lake.

For alternatives that involve the proposed construction of Rocky Coulee Reservoir, the same types of mitigation measures described in Section 4.29.6, *Vegetation and Wetlands*, would likely be implemented to compensate for the loss of shrub steppe habitats. Washington ground squirrels would be relocated to areas of suitable habitat to reduce long-term impacts on this species.

Full Replacement Alternatives

Mitigation measures described for the partial replacement alternatives 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 an offsite location.

The effectiveness of the wildlife crossing structures would likely be improved by the following actions:

- A triangular shaped area of native vegetation within the canal ROW on both sides of each wildlife crossing would preserved during construction. Each area would taper from 300 feet wide at the outside edge of the ROW to the width of the crossing structure. 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 ROW.

- The original design of wildlife crossings has been modified to increase their potential use. Instead of a maintenance road between two strips of vegetation the road has been moved to one side of the crossing, leaving a single wider strip of vegetation.

For alternatives that involve the proposed construction of Rocky Coulee Reservoir, the same types of mitigation measures described for the partial replacement alternatives would be implemented.

4.29.8 Air Quality

BMPs or reasonable precautions are typically used to control fugitive dust for preventing particulate matter from becoming airborne. Factors considered include the proximity of dust-emitting operations to human habitations and activities and atmospheric conditions that might impact the movement of particulate matter.

BMPs to reduce fugitive dust would focus on measures to stabilize soils during construction by applying water or environmentally friendly chemical binders to exposed soils in construction zones and contractor staging areas. Efforts would be made to minimize the amount of exposed soil at any given time. Disturbed areas would be reseeded at the earliest possible date following construction that is compatible with local growing conditions. This would likely be in the fall prior to the winter rainy season. This action would limit the land surface area exposed to wind erosion.

4.29.9 Land Use and Shoreline Resources

To some extent, both short-term and long-term land use changes and impacts are unavoidable. 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 and more detailed planning moves forward. Further, some facilities, particularly power transmission lines and access roads, have not yet been identified. Given the status of facility planning, the following measures should be taken to avoid or minimize and 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 (through permitting) existing agricultural uses within easement or acquisition areas that are not directly involved with facility operation and maintenance.

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 may 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). Any acquired lands would become Federal property.

4.29.10 Recreation Resources

Mitigation measures are described for Banks Lake. They are the same for all action alternatives, unless noted for boat launch capacity. For impacts to land-based camping and day use sites at Banks Lake, no mitigation measures are feasible and impacts are unavoidable. No mitigation measures are necessary for Lake Roosevelt or the Study Area.

4.29.10.1 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.

4.29.10.2 Developed Swimming Areas

While no mitigation is practical for impacts to existing developed swimming areas, organized, protected swimming opportunities would be replaced by development of swimming pools near affected recreation sites. This measure, in context with the myriad opportunities for in-lake swimming that would remain outside of developed sites, would reduce impact to less than significant levels.

4.29.10.3 Boat Launch Capacity

2A: Partial—Banks

Restoration of full season-wide availability at all main, high-capacity ramps would be achieved by extension or other redevelopment of boat launch facilities at or near Sunbanks Resort, SRSP Day Use site, and Coulee City Community Park so that they remain usable at maximum reservoir drawdown. Retention of season-wide boat access in all sectors of the reservoir would be achieved by extending either the north or south Million Dollar Mile ramp (Middle Sector), as well as the improving the Coulee City facilities noted above (South Sector).

2B: Partial—Banks + FDR

Restoration of full, season-wide availability at all main, high-capacity ramps would be achieved by extension or other redevelopment of boat launch facilities at or near Coulee City Community Park so that they remain usable at maximum reservoir drawdown. Retention of season-wide boat access in all sectors of the reservoir would be achieved by extension of either the north or south Million Dollar Mile ramp (Middle Sector), as well as the improvements Coulee City facilities noted above (South Sector).

2C: Partial—Banks + Rocky

Same as those under Alternative 2A: Partial—Banks.

2D: Partial—Combined

Same as Alternative 2B: Partial Banks + FDR.

3A: Full—Banks

Restoration of full, season-wide availability at all main, high-capacity ramps would be achieved by extension or redevelopment of ramps at all five main/high-capacity boat launch locations so that they remain usable at maximum reservoir drawdown. In addition to the ramp improvements noted above, extension of either the north or south Million Dollar Mile ramp (Middle Sector) would be needed to provide boat access to all geographic sectors of the reservoir.

3B: Full—Banks + FDR

Same as Alternative 2B: Partial Banks + FDR.

3C: Full—Banks + Rocky

Same as those under Alternative 2A: Partial—Banks.

3D: Full—Combined

Mitigation would be the same as Alternative 3B.

4.29.11 Transportation

Consistent with standard coordination procedures and requirements, and in recognition of the programmatic analysis contained in this Draft EIS, Reclamation is committed to working with WDOT, 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 below would guide preparation and implementation of the Transportation Management Plan.

4.29.11.1 Construction BMPs as part of the Transportation Management Plan

The following would be applied for construction:

- Identify roads that would be designated as transportation routes for construction equipment, materials, and construction workers.
- Assess construction assess routes to determine and plan for any necessary improvements or increased maintenance.
- Provide for detours around work sites, retaining access to all residences and businesses throughout the construction zones and throughout the construction period, and traffic management (for example, flaggers) to direct traffic at roadway locations that are potentially problematic.
- Consider the need for or desirability of scheduling work shifts, personnel arrival times, material/equipment delivery times or intervals, other measures to avoid conflicts with local traffic (including such traffic as school buses or emergency service vehicles) and to ensure smooth traffic flow patterns.

4.29.11.2 Short- and Long-Term BMPs as part of the Transportation Management Plan

Short- and long-term planning actions apply in these cases:

1. Major ground surface facilities such as canals, siphons or constructed wasteways cross existing roads
2. Discontinuities in the road network would be unavoidable because of reservoir construction/inundation.

In each instance, ensure the following occurs:

- Appropriate access is maintained to all impacted land parcels.
- Key through routes and all-weather routes are retained to extent feasible, or replaced if necessary,
- Public service (law enforcement, fire, emergency medical) response times are kept at levels consistent with established standards or otherwise acceptable to involved providers,
- Increases in local travel distances or travel times are not unacceptably increased.

4.29.12 Public Services and Utilities

To minimize disruption to emergency service providers, Reclamation would implement a Transportation Management Plan, as described in Section 4.29.12, which lists environmental commitments for transportation. Impacts on water quality would be minimized through the BMPs described in Section 4.29.3, which describes environmental commitments for water quality. 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.

4.29.13 Noise

Reclamation and Ecology would implement the following BMPs to further avoid or minimize noise impacts during and after construction:

- All construction and operations activities would be in compliance with noise regulations, to the extent practicable.
- Construction activities would be limited to daytime hours.

- Equipment and vehicle staging areas would be located as far from residential areas as possible.
- All construction equipment will be in good working order and maintained per manufacturer's recommendations.
- All construction equipment will be adequately muffled.
- Idling of construction equipment and vehicles will be minimized during the construction.
- Workers would be provided appropriate hearing protection, if necessary.
- Acoustical treatments would be incorporated into pumping plants and other facilities to ensure that operational noise complies with state noise requirements.

Through the use of BMP's during both construction and operation, additional mitigation measures would not be necessary.

4.29.14 Public Health (Hazardous Materials)

4.29.14.1 BMPs

Hazardous sites would be managed by being cautious in excavating or disturbing the ground in areas near a potential hazardous site. Reclamation and Ecology would implement the BMPs listed below to further manage hazardous materials, and to avoid or minimize water pollution during and after construction:

- Avoid contamination of surface and groundwater during construction and operations.
- Limit disturbed or exposed ground during construction
- Avoid contamination of stormwater by preplanning
- Avoid mismanagement of hazardous materials (such as pesticides, fuels, and solvents)
- Avoid or minimize spills and releases by preplanning

For chemical use, BMPs include applying pesticides correctly and educating farmers and Reclamation employees on proper use and management of agrichemicals.

BMPs for mosquito control would include the following:

- Conduct mosquito surveillance and control programs, including a monitoring program for mosquito larvae.
- Ensure facilities are designed in consultation with experts in mosquito biology and control to prevent as much mosquito production as possible and to facilitate proper functioning and maintenance in the future. Appropriate operations and maintenance provisions would include considerations for routine monitoring and control of mosquito populations.
- Consult and coordinate with local health departments and mosquito and abatement districts about mosquito control measures during the design, implementation, and operations phases.
- Prepare a mitigation monitoring plan to ensure that the proposed mitigation measures are implemented.
- Develop and implement mosquito abatement measures for control, including stormwater management, reducing opportunities for mosquito breeding habitats in construction materials and facilities, management of vegetation that would be conducive to mosquito habitat, site maintenance to prevent topographical depressions and ponding, monitoring, and adult mosquito control.

- Monitor access routes to detect formation of undrained depressions in tire ruts. Backfill access-related shallow depressions or incise narrow drainages so they do not impound small, sheltered areas of standing water.
- Ensure any artificial depressions capable of holding water for a period greater than 7 days are rectified by filling, draining, or other treatment to prevent the creation of mosquito-breeding sites.
- Optimize drainage, and keep discharge of test water to a practical minimum to prevent long-term pooling.
- Avoid water storage open to ingress of insects wherever possible. When open storage is necessary, the duration would be kept to a minimum and ensure proper mosquito-control equipment.
- Inform workers of the potential for increases in mosquito breeding populations and of the appropriate precautions to take to protect their health, including wearing long-sleeve shirts and long trousers and using insect repellent. Provide insect repellent.

4.29.14.2 Mitigation Measures

At Lake Roosevelt, the contaminated sediments issue is being studied separately by EPA and Teck Cominco. Reclamation will consider the results when they are available to determine if mitigation is required. If it is determined that the project causes re-entraining toxic materials into the air or water, Ecology and Reclamation would establish a working group to develop appropriate mitigation measures and pursue funding for mitigation *(Lake Roosevelt Incremental Storage Releases Project Final Supplemental EIS).*

4.29.15 Visual Resources

BMPs for visual resources generally involve designing new facilities to be compatible with the surrounding environment to the extent feasible, or screening incongruous or incompatible facilities from view. Compatibility includes both architectural and landscape design treatments, as applicable.

4.29.16 Cultural and Historic Resources

In consultation with SHPO and the affected Tribes, Reclamation and Ecology would define a formal APE based on the proposed action. The APE is defined as the area within which direct and indirect impacts to cultural resources may occur. Necessary input in defining the APE would be obtained from the Washington State Historic Preservation Officer and affected Tribes; and consultation with the SHPO and Tribes would be carried out for the duration of the project 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 may be present even in low potential areas. Once documented, cultural resource significance would be determined using Determination of Eligibility forms. Determining a resource’s significance may require subsurface testing, additional fieldwork, or additional research. Determinations of Eligibility would be submitted to SHPO for review and concurrence. If impacts to NRHP Eligible, significant resources cannot be avoided, mitigation may be necessary. To minimize potential impacts to significant cultural resources, the following measures would be implemented as appropriate:

- Because of the potential size of the APE, a comprehensive programmatic agreement (PA) may be necessary to establish a process to ensure protection, proper treatment, and management of all cultural resources, both documented and yet undiscovered. This PA may include annual 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 of the project. The PA may also describe the legal requirements and regulatory protocols to be followed if human remains are encountered during any phase of the project.
- To the extent feasible, project facilities would be selected, designed, or modified to avoid identified cultural resources.
- If avoidance is not feasible, sites will be evaluated to determine if they are eligible for the NRHP. If this process results in SHPO concurrence, and the cultural property is confirmed eligible for inclusion in the NRHP or the Washington Heritage Register, then additional measures may be required to mitigate adverse effects. Mitigation may include additional historic research or subsurface testing, possible data recovery, large format black-and-white photographic documentation, or other measures.
- Prior to the construction of project components, the following actions may occur:
  - Conduct informational cultural resource sensitivity training with construction and project personnel to alert them to the appropriate treatment and protocols for cultural resources encountered during project implementation.
  - Require that project 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, monitoring would be conducted on an ongoing or periodic basis during ground-disturbing project 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.
- Develop an inadvertent discovery plan to establish a protocol for responding if cultural resources are discovered during implementation.

Chapter 5
CONSULTATION AND COORDINATION

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 decisionmaking 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. Both formal and informal input has been encouraged and used in preparing this Draft 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 Web site (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 Water Storage Feasibility Study. The Notice of Intent, Determination of Significance, news releases, and meeting notice are attached to the *Scoping Summary Report* (Reclamation 2008 Scoping). 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.
- Determining the appropriate environmental documents to be prepared.

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 public 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 this Draft EIS on October 26, 2010, began a 60-day public review and comment period. Written comments can be submitted to Reclamation and Ecology throughout this period, which will end on December 31, 2010. Also during this period, Reclamation and Ecology will hold public hearings on November 17 and 18, 2010, to receive oral and written comments. Upon completion of the review period and as part of preparing a Final EIS, Reclamation and Ecology will respond to comments received. No Reclamation or Ecology decision will be made on the proposed action until a minimum of 30 days after release of the Final EIS. Following this 30-day period, Reclamation will complete its Record of Decision. Ecology's requirements state that an action can be taken 7 days after issuance of the Final EIS.

Details regarding how to provide comments on this Draft EIS, as well as the date and location of the planned public meeting, are provided on the Fact Sheet at the front of this document.

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
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

TABLE 5-1

Meetings Held with Interested Parties

Date of Meeting	Meeting With	Location
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

5.3 Agency Coordination and Consultation

5.3.1 Bonneville Power Administration

BPA is the only cooperating agency for this Study. In assuming this responsibility, BPA agreed participate in the NEPA/SEPA process, develop information and prepare environmental analyses for which BPA has specific expertise, and review the Draft and Final EIS documents

BPA information provides the basis for the energy analysis in this Draft EIS. The regional supply and demand for energy in the Pacific Northwest is evaluated and summarized by BPA in an annual 10-year forecast document called the "*Pacific Northwest Loads and Resources Study*" (commonly called the White Book). The White Book is prepared by BPA with input from other Pacific Northwest Federal agencies, public agencies, cooperatives, Reclamation, Corps, and investor-owned utilities. The current version is the 2009 White Book, which provides a snapshot of both the Federal system and the pacific northwest region loads and resources for Operating Years 2010 through 2019. The 2007 White Book was used as the baseline for evaluating the significance of net changes in energy from the various alternatives compared to regional totals.

5.3.2 National Marine Fisheries Service

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 web site. If an alternative is selected for implementation, appropriate consultation will be completed prior to seeking construction authorization.

5.3.3 State Historic Preservation Officer

The NHPA of 1966, 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 NHPA on specific undertakings.

To comply with Section 106 of 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 effect 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 seeking construction authorization.

5.3.4 U.S. Army Corps of Engineers

Reclamation has ongoing coordination activities with the Corps in conjunction with their interests and responsibilities for wetlands. Reclamation will make application to the Corps or petition them for an exemption under Section 404 of the Clean Water Act as stated in Chapter 4, Section 4.29, *Environmental Commitments*.

5.3.5 U.S. Department of Agriculture

The FPPA of 1981 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 NRCS 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 non-compatible use. The Project does not encourage non-agricultural uses and the proposed structures are designed to improve agricultural practices, subsequently encouraging continued agricultural practices.
- Alternative sites which 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

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 fresh-water 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 seeking construction authorization.

5.3.6.2 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (16 United States Code 661-667e, as amended) requires Federal agencies to coordinate with the 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. The recommendations (section IV) contained in the ongoing USFWS Draft Coordination Act Report, which has been made available online with the release of this DEIS, 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 are summarized in the Draft EIS. Additional study findings to be conducted by WDFW in 2010 will be included 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 United States 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 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.

5.5 Other Regulatory Compliance Requirements

In addition to the laws, Executive Orders, and regulations described above, Reclamation and Ecology has and will continue to comply with these 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 non-indigenous 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 non-listed birds receive additional protection. Compliance with these laws is assumed in the impact analysis for this 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 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 the Odessa Special Study Draft 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 and 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. 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

Indian trust assets 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 United States 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 are identified.

5.5.2.4 Native American Graves Protection and Repatriation Act

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 will consult with appropriate Tribe or Tribes and the SHPO. These consultations would aid in determining measures to mitigate adverse effects.

Reclamation will include in construction contracts a stipulation and protocol 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) prohibits 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 is selected for implementation, appropriate consultation will be completed prior to seeking construction authorization.

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

A Tribal Employment Rights Ordinance (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 (Colville), the Spokane Tribe of Indians (Spokane), and the Yakama Nation (Yakama). 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 AM and 10 PM 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 is 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 United States 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.

DISTRIBUTION LIST

Distribution List

This Draft EIS is available for information and review on Reclamation's Pacific Northwest Region Web site at www.usbr.gov. In addition, copies for information and review were sent to those who requested a copy.

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 Indian 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
Yakama Nation, Toppenish, Washington

Washington State Legislature

Representative Mike Armstrong, Olympia
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
Representative Bill Hinkle, Olympia
Senator Janéa Holmquist, Olympia
Senator Jim Honeyford, Olympia
Representative Brad Klippert, Olympia
Representative Joel Kretz, Olympia
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, Othello, Richland, Wenatchee
  Geological Survey, Tacoma; Columbia River Research Laboratory, Cook
  National Park Service, Coulee Dam

State and Local Government Agencies

State of Washington

Conservation Commission, Moses Lake, Okanagon, Yakima
  Franklin Conservation District, Pasco
  Warden Conservation District, Warden
Department of Agriculture, Yakima
  Livestock Nutrient Management
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
Potato Commission, Moses Lake
Recreation and Conservation Office, Olympia
State Parks and Recreation Commission, East Wenatchee, Olympia
Washington State Water Resources Association, Olympia

State of Oregon

Water Resources Department, Salem, Oregon

Local Agencies

Adams County
  City Council, Othello
  Commissioners, Ritzville
  Health Department, Othello
Chelan County
  Public Utility District No. 1, Wenatchee
City of Connell

City of Electric City
    Mayor, Electric City
City of Warden
Grant County
    Commissioners, Ephrata
    Fire District No. 4, Warden
    Planning, Ephrata
    Public Utility District, Ephrata
    Public Works Department, Ephrata
Klickitat County
    Commissioners, Goldendale
    Community Development Services, Ellensburg
Lincoln County
    Commissioners, Davenport
Stevens County
    Commissioners, Colville
Yakima County
    Commissioners, Yakima

Irrigation Districts

Black Sands Irrigation District, Ephrata
East Columbia Basin Irrigation District, Othello, Ritzville
Kennewick Irrigation District, Kennewick
Moses Lake Irrigation and Rehabilitation District, Moses Lake
Quincy Columbia Basin Irrigation District, Quincy
South Columbia Basin Irrigation District, Mesa, Pasco

Libraries

Big Bend Community College Library, Moses Lake
Columbia Basin College Library, Pasco
Basin City Branch, Mid-Columbia Library, Basin City
Benton-Franklin County Regional Law Library, Pasco
Connell Branch, Mid-Columbia Library, Connell
Coulee City Public Library, Coulee City
Ephrata City Library, Ephrata
Grant County Law Library, Ephrata
Kahlotus Branch, Mid-Columbia Library, Kahlotus
Moses Lake Community Library, Moses Lake
North Central Regional Library, Royal City Library, Royal City
North Central Regional Library, Warden Library, Warden
Odessa Public Library, Odessa
Othello Branch, Mid-Columbia Library, Othello
Pasco Branch, Mid-Colombia Library, Pasco
Quincy Public Library, Quincy
Ritzville Public Library, Ritzville
Seattle Public Library, Central Library, Seattle
Sprague Public Library, Sprague
Washington State Library, Olympia

Organizations

American Rivers, Seattle
American Whitewater, Seattle
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 & Policy, Seattle, Spokane
Citizens for a Clean Columbia, Wenatchee
Columbia Basin Development League, Moses Lake, Odessa, Olympia, Othello, Royal City, Warden, Wilson Creek; Riverside, California
Columbia Basin Ground Water Management Area, Othello
Columbia Basin Sand Commandos, Moses Lake
Columbia Institute for Water Policy, Spokane
Columbia River Intertribal Fish Commission, Portland, Oregon
Columbia Riverkeeper, Hood River, Oregon
Columbia-Snake River Irrigators Association, Kennewick, Moses Lake
Coulee Corridor Consortium, Grand Coulee
Grand Coulee Dam Area Chamber of Commerce, Grand Coulee
Grant County Economic Development Council, Moses Lake
Lower Columbia Basin Audubon Society, Pasco
National Wildlife Federation, Seattle
Need to Know
North Columbia Community Action Council, Moses Lake
Northwest Council of Governments and Associates, Soap Lake
Northwest Power and Conservation Council, Portland, Oregon
Northwest Women Fly Fishers
Okanogan Highlands Alliance, Tonasket
Port of Warden, Warden
P.O.W.E.R., Grand Coulee
Public Power Council, Portland, Oregon
Puget Sound Fly Fishers, Tacoma
Ritzville Area Chamber of Commerce, Ritzville
Sierra Club, Seattle
Sierra Club Upper Columbia River Group, Spokane
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
Water Policy Alliance, Olympia
Water Resource Inventory Area 43

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Dennis & Suzanne Franz Swinger, Jr., Lind
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Mark E. & Theresa Vanlandingham, Othello
Mario & Arlene Vedrich, Tucson, Arizona
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Rebecca Weber
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Ken & Jocelyn Weeks, Lyle
Patrick Welton
Weston Living Trust, Seattle
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David W. Wood, Spanaway
Byrdeen Worley, Moses Lake
Jerry Wraspir, Odessa
Tina Wynecoop, Colbert
Lewis Zundel, Marlin

Business Entities

77 Double Bar Ranch, Soap Lake
Air Ag
Anchor QEA, LLC, Richland
American Land & Ranches, Prescott, Arizona
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
Big Bend Electric Co-op, Ritzville
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
Claassen Farms, Inc., Marlin
D&R Stucky Properties, Shoreline; Carbondale, Illinois
Desert Grain Farms, Inc., Marlin
Desert Ridge Produce, Moses Lake
Emmerland Hills, Ritzville
Fink Aquia, Inc., Odessa
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
Hailey Co., Mesa
Hartland LLC, Connell
HDR Engineering, Lakewood
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
Jenkins Farms, Lind
Johnson Agriprises, Inc., Othello
J.R. Simplot Company, Moses Lake; Boise, Idaho
Kagele-Arlt Farms, Odessa
Kagele Family Farms, Inc., Odessa
Kelsey 5, Inc., Connell
Klindworth, Inc., Connell
L&L Farms, Echo, Oregon
Lyle Ranch & Land LLC, Othello
MAC Farms, Inc., Marlin, Moses Lake
Mar Don Resort, Othello
Melville Ranch, LLC, Lamont
Mikkelborg, Broz, Wells & Fryer, PLLC, Seattle
Montgomery Water Group, Kirkland
Northwest Food Processors Association, Moses Lake
O'Neal Farms, Connell
Phillips Ranch, Lind
Prior Farms, Othello
Royal Bluffs Ranch II, LLC
S&G Farms, Moses Lake
Stahl Farms, Ritzville
Strohmaier Law Office, Odessa
Suko Farms, Moses Lake
Sunbanks Resort
Union Elevator and Warehouse Co., Lind
US Bank, Spokane
V3, Inc., Odessa
Warden Hutterian Brethren, Warden
Washington Land and Ranches, Prescott, Arizona
Watershed, LLC, Vashon
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
Othello Outlook, Othello
Spokane Public Radio, Spokane
Star Newspaper, Grand Coulee
The Wenatchee World, Wenatchee
Tri-City Herald, Tri-Cities

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Gloria Beattie	M.S., Civil Engineering, University of Idaho B. S., Civil Engineering, Boise State University 19 years of experience in civil engineering and environmental and permitting services.	CH2M HILL	Surface Water
Roger Beieler	M.S., Civil Engineering, Washington State University B.S., Agricultural Engineering, Washington State University 35 years of experience designing and managing more than 50 projects involving canals, canal structures, pipelines, pumping plants, valve structures, river crossings, wells, and reservoirs. Familiar with planning, preparation of environmental documents, permitting, design, construction, and right-of-way acquisition.	CH2M HILL	Equipment and Work Force Analysis
Susan Black	B.A., Economics, St. Martin's University 26 years of experience in water resources planning, environmental compliance, social analysis, and public involvement.	Bureau of Reclamation	Socioeconomics
Chuck Blair	M.S., Wildlife Biology, South Dakota State University B.S., Wildlife Ecology, University of Wisconsin-Madison Certified senior ecologist with experience conducting over 150 wildlife, habitat, and botanical studies as well as preparing numerous impact assessments and mitigation plans.	CH2M HILL	Project Manager, Wildlife and Wildlife Habitat, and Threatened and Endangered Species
Levi Brekke	B.S., Civil Engineering, University of Iowa M.S., Environmental Science and Engineering, Stanford University Ph.D., Civil Engineering, University of California, Berkely 13 years of experience in environmental and water resources engineering	Bureau of Reclamation	Climate Change Advisor

Name	Education and Professional Experience	Affiliation	Contribution
Ken Carlson	M.S., Water Resources Engineering and Science, University of Washington B.A., Zoology, University of Washington 23 years of experience on a wide variety of projects involving natural resources assessment, management, and regulatory compliance. Extensive experience in planning and oversight of complex projects, consultation and permitting with regulatory agencies, and balanced approaches to solving technical and regulatory compliance issues.	CH2M HILL	Chapter 1 and Chapter 2 Contributor
Corey Carmack	M.S., Cultural Resource Management 10 years experience in tribal relations, permitting, and environmental compliance including NEPA, NHPA, NAGPRA.	Bureau of Reclamation	Indian Trust Assets and Sacred Sites
Charles A. Carnohan	M.S., Land and Water Resource Management, University of North Texas B.A., Anthropology, University of Texas, Austin 17 years experience in environmental planning, permitting, and project management.	Bureau of Reclamation	Project Manager
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Rob Davis	Ph.D., Agricultural Economics, Colorado State University M.S., Agricultural Economics, Utah State University B.S., Agricultural Business, Colorado State University 15 years experience agricultural economics	Bureau of Reclamation	Agricultural Economics
Raena DeMaris	B.A., Anthropology, Brigham Young University 10 years of experience in cultural resource management with a strong understanding of Federal, State, and local legislation.	CH2M HILL	Cultural and Historic Resources
Brian Drake	M.S., Environmental and Water Resources Engineering, University of Texas at Austin B.S., Civil Engineering, Washington State University Experience includes evaluating potential fish habitat and determining necessary passage at road crossings as well as assessing and designing numerous alternatives, including culverts, bottomless arches, and log weir retrofits.	CH2M HILL	Water Quality

Name	Education and Professional Experience	Affiliation	Contribution
Kayti Didricksen	B.S., Geology, Western Washington University M.S., Hydrogeology, Easter Washington University 32 years of experience in engineering geology and hydrogeology	Bureau of Reclamation	Contributed to groundwater analysis
Paula Engel	B.S., Animal Science, University of Idaho M.S., Agricultural Economics, University of Idaho 18 years of experience in resource economics.	Bureau of Reclamation	Socioeconomics
Ron Fehringer	M.S., Agricultural Engineering, Oregon State University B.S., Agricultural Engineering, Oregon State University 19 years experience serving as lead engineer, task manager, and project manager for a variety of conveyance system and fish passage design projects, as well as completing numerous studies focusing on water supply, water quality, irrigation, and drainage.	CH2M HILL	Surface Water
Judy Ferguson	M.S., Rangeland Ecology, University of Idaho B.S., Range Resources, University of Idaho B.S., Wildlife Biology, University of Idaho 11 years of experience conducting plant surveys, breeding bird surveys, small mammal surveys, habitat mapping, and wetland delineations.	CH2M HILL	Vegetation and Rare Plants
David Fornander	Ph.D., Geography, University of Arizona M.A., Biology, Boise State University B.S., Biology, Washington State University More than 13 years of experience in the physical, biological, and social components specific to aquatic ecosystem function.	CH2M HILL	Fisheries and Aquatic Resources
Mark Greenig	M.U.P., Urban Planning, Texas A&M University B.S., Landscape Architecture, California Polytechnic State University, San Luis Obispo Areas of technical expertise include visual assessment, land use, and project consistency with comprehensive plans and recreation.	CH2M HILL	Recreation and Visual Resources
Guy J. Gregory	M.S., Geology, University of Vermont B.S., Geology, Washington State University Technical Unit Supervisor and Senior Hydrogeologist at Ecology, with 22 years of experience.	Ecology	Groundwater studies and hydrogeology
Marlena Guhlke	B.A., Environmental Quality Measurement, Central Washington University Extensive experience with regulatory compliance, permitting processes, environmental evaluations, and public involvement.	CH2M HILL	Public health analysis (hazardous and toxic materials)

Name	Education and Professional Experience	Affiliation	Contribution
Teresa Hauser	M.S., Civil Engineering, Hydraulics and Hydrology, Washington State University B.S., Biology, University of Portland 7 years experience in hydraulics, hydrology, and water resource engineering.	Bureau of Reclamation	Hydraulic Modeling Resource Analysis
Wendy Haydon	M.S., Recreation Administration, California State University, Sacramento B.A., Environmental Studies, California State University, Sacramento More than 22 years of experience working on environmental documents meeting Federal and/or State requirements, including: environmental impact reports (EIRs), environmental impact statements (EISs), environmental assessments (EAs), initial studies (ISs), and mitigation plans.	CH2M HILL	Environmental Justice and Public Services and Utilities
Michelle Headley	B.S., Geography, University of North Carolina at Charlotte GIS analyst with experience in ArcGIS 8x/9x, ArcView, ArcINFO, AutoCAD, Microstation, SQL Server, and Oracle, as well as exposure to cartographic design, surveying, aerial photo interpretation, spatial analysis, and digital image processing.	Critigen	GIS
Gretchen Herron	M.S., Disturbed Land Restoration, Montana State University B.S., Environmental Science, Allegheny College Expertise in wetland delineation, wetland mitigation design, disturbed land restoration, plant identification, wetland permitting issues, and characterization of forested wetlands of the Pacific Northwest.	CH2M HILL	Wetlands
David Kaumheimer	B.S., Wildlife Ecology, University of Wisconsin M.S., Wildlife Management, University of Idaho 28 years of experience.	Bureau of Reclamation	Senior Review
Kim McCartney	B.S., Agricultural Engineering, South Dakota State University	Bureau of Reclamation	Study Manager (retired)
Rick McCormick	M.S., Environmental Engineering, University of Montana B.S., Biology, Montana State University More than 12 years of experience in environmental engineering, regulatory review, auditing, and air quality permitting.	CH2M HILL	Air Quality
Stephanie McMackin	M.S., Civil Engineering (Environmental Option), University of Dayton B.S., Engineering Management, Environmental Science Specialty, Miami University of Ohio Environmental engineer with more than 10 years of experience.	CH2M HILL	Climate Change

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Eric Oden	M.S., Education, Boise State University B.S., Education, Boise State University Experienced in preparation and editing of NEPA documentation including environmental impact statements and environmental assessments.	CH2M HILL	Editor
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Name	Education and Professional Experience	Affiliation	Contribution
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Mike Wirtz	B.S., Environmental Engineering, Oregon State University 8 years of experience specializing in the investigation and execution of environmental projects.	CH2M HILL	Air Quality

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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.
bank-full	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.
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 rate	The volume of water passing a given point per unit of time.
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.
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.
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 stream flows.

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.
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.
tipping points	For commodity processing industries—minimum acreage needed in a given crop such as potatoes to support processing facilities and transportation costs—a minimum acreage below which processing facilities would begin to reduce capacity or close.
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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