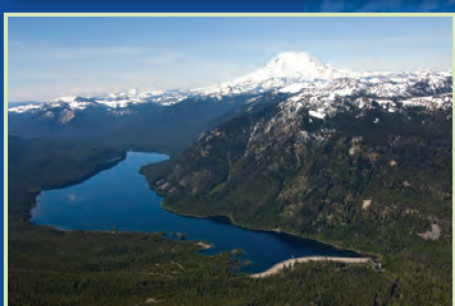
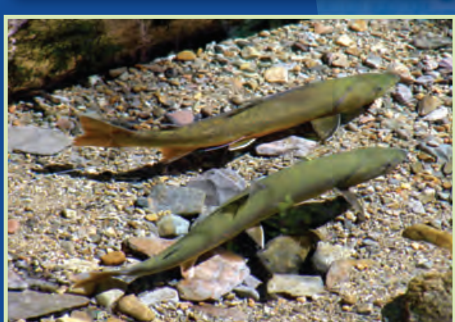
Yakima River Basin Integrated Water Resource Management Plan

Draft Programmatic Environmental Impact Statement

BENTON, KITTITAS, KLICKITAT AND YAKIMA COUNTIES





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

State of Washington
Department of Ecology
Central Regional Office
Yakima, Washington

Ecology Publication Number: 11-12-024

November 2011

Mission Statements

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

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

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

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

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To: Interested Individuals, Organizations, and Agencies

Subject: Yakima River Basin Integrated Water Resource Management Plan Draft Programmatic Environmental Impact Statement, Benton, Kittitas, Klickitat, and Yakima Counties, Washington

Dear Interested Parties:

Enclosed for your review and comment is the Draft Programmatic Environmental Impact Statement (Draft PEIS) for the Yakima River Basin Integrated Water Resource Management Plan (Integrated Plan), prepared jointly by the Bureau of Reclamation and Washington State Department of Ecology (Ecology). This Draft PEIS evaluates two alternatives to meet the water supply and ecosystem restoration needs in the Yakima River basin—the No Action Alternative and the Yakima River Basin Integrated Water Resource Management Plan Alternative.

Reclamation and Ecology, working with the Yakima River Basin Water Enhancement Project (YRBWEP) Workgroup (composed of representatives of the Yakama Nation; Federal, State, county, and city governments; environmental organizations; and irrigation districts), developed the proposed Integrated Plan as a comprehensive approach to address a variety of water resource and ecosystem problems affecting fish passage and habitat and agricultural, municipal, and domestic water supplies in the Yakima River basin. The Integrated Plan includes seven elements: reservoir fish passage, structural and operational changes to existing facilities, surface water storage, groundwater storage, habitat/watershed protection and enhancement, enhanced water conservation, and market reallocation. The environmental impacts of the Integrated Plan are evaluated at a programmatic level in this document.

This Draft PEIS was prepared in compliance with the National Environmental Policy Act (NEPA), Public Law 91-190, and the State of Washington Environmental Policy Act (SEPA), Chapter 43.21C RCW, and the SEPA Rules (Chapter 197-11 WAC). A joint NEPA and SEPA scoping process was held from April 2, 2011, to June 15, 2011.

Comments may be submitted orally, electronically, or by regular mail. Oral comments will be accepted at each of six meeting sessions. The meetings will be from 1:30 to 3:30 p.m. and 5 to 7 p.m. on the dates and locations listed below:

December 5, 2011
U.S. Forest Service Ranger Station
803 W. 2nd Street
Cle Elum, WA 98922

December 6, 2011
Hal Holmes Center
209 N. Ruby Street
Ellensburg, WA 98926

December 14, 2011
Yakima Arboretum
1401 Arboretum Drive
Yakima, WA 98901

Requests to provide comments orally at the public meetings will be handled on a first-come, first-served basis. Comments will be recorded into a transcript by a court reporter. In the interest of available time, each speaker will be asked to limit oral comments to 5 minutes. Longer comments should be summarized and submitted in writing either at the public meeting or identified as meeting comments and sent to Ms. Candace McKinley, Environmental Program Manager, no later than January 3, 2012, at the address below.

Also, comments may be submitted electronically to yrbwep@usbr.gov or by mail to the Bureau of Reclamation, Attention: Ms. Candace McKinley at the address below. Comments on this document must be postmarked by January 3, 2012, to ensure inclusion into the Final PEIS. You should be aware that your entire comment, including your personal identifying information, will be made publicly available in the Final PEIS. While you can ask us 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, please contact:

Ms. Candace McKinley
Environmental Program Manager
Bureau of Reclamation
Columbia-Cascades Area Office
1917 Marsh Road
Yakima, WA 98901-2058
Phone: 509-575-5848, ext. 613
Fax: 509-454-5650
Email: yrbwep@usbr.gov

The public meeting facilities are physically accessible. Persons who need accessibility accommodations, including sign language interpreters or other auxiliary aids, may contact Ms. McKinley. Requests should be made as early as possible to allow sufficient time to arrange for accommodation.

Those wishing to obtain the Draft PEIS in the form of a printed document or on compact disk (CD-ROM) or an Executive Summary of the Draft PEIS may contact Ms. McKinley at the address or phone number given above.

The Draft PEIS is available for viewing on the Internet at http://www.usbr.gov/pn/programs/yrbwep/2011integratedplan/index.html.

Sincerely,

William D. Gray
Area Manager
Columbia-Cascades Area Office
Bureau of Reclamation
1917 Marsh Road
Yakima, Washington 98901-2058

Derek I. Sandison
Director, Office of Columbia River
Department of Ecology
15 W. Yakima Ave, Suite 200
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Enclosure

Draft Programmatic Environmental Impact Statement
Yakima River Basin Integrated Water Resource Management Plan
Benton, Kittitas, Klickitat, and Yakima, Counties, Washington

Joint Lead Agencies:	**For further information contact**:
U.S. Department of the Interior Bureau of Reclamation	Ms. Candace McKinley Environmental Program Manager Columbia-Cascades Area Office 1917 Marsh Road Yakima, Washington 98901-2058 509-575-5848, ext. 613
State of Washington Department of Ecology	Mr. Derek I. Sandison Director, Office of Columbia River 15 W. Yakima Ave, Suite 200 Yakima, Washington 98902-3452 509-457-7120

Cooperating Agencies:

U.S. Department of Agriculture, U.S. Forest Service
U.S. Department of Energy, Bonneville Power Administration

This Draft Programmatic Environmental Impact Statement (DPEIS) for the Yakima River Basin Integrated Water Resource Management Plan (Integrated Plan) was prepared jointly by the Bureau of Reclamation and Washington State Department of Ecology. This DPEIS evaluates two alternatives to meet the water supply and ecosystem restoration needs in the Yakima River basin—the No Action Alternative and the Yakima River Basin Integrated Water Resource Management Plan Alternative. A preferred alternative has not been identified. The environmental impacts of the Integrated Plan have been evaluated at a programmatic level in this document.

This DPEIS was prepared in compliance with the National Environmental Policy Act (NEPA), Public Law 91-190, and the State of Washington Environmental Policy Act (SEPA), Chapter 43.21C RCW, and the SEPA Rules (Chapter 197-11 WAC).

The DPEIS will be available for a 45-day public comment period. Comments are due to the above Bureau of Reclamation address by January 3, 2012.

SEPA FACT SHEET

Brief Description of Proposal:

The Bureau of Reclamation (Reclamation) and the Washington State Department of Ecology (Ecology) have jointly prepared this Draft Programmatic Environmental Impact Statement (DPEIS) on the Yakima River Basin Integrated Water Resource Management Plan (Integrated Plan). This document was prepared in compliance with the National Environmental Policy Act (NEPA) and Washington State Environmental Policy Act (SEPA). Ecology is the SEPA lead agency for the proposal.

The Integrated Plan identifies a comprehensive approach to water resources and ecosystem restoration improvements in the Yakima River basin. The Integrated Plan includes seven elements: reservoir fish passage, structural and operational changes to existing facilities, surface water storage, groundwater storage, habitat/watershed protection and enhancement, enhanced water conservation, and market reallocation. The Integrated Plan was developed to address a variety of water resource and ecosystem problems affecting fish passage, fish habitat, and water supplies for agriculture, municipalities, and domestic uses.

Proponents and Contacts:

U.S. Department of the Interior, Bureau of Reclamation

Contact: Ms. Candace McKinley
Environmental Program Manager
Columbia-Cascades Area Office
1917 Marsh Road
Yakima, Washington 98901-2058
509-575-5848, ext. 613

State of Washington, Department of Ecology

Contact: Mr. Derek I. Sandison
SEPA Responsible Official
Director, Office of Columbia River
15 W. Yakima Ave, Suite 200
Yakima, Washington 98902-3452
509-457-7120

Permits, Licenses, and Approvals Required for Proposal:

To implement any component of the action alternative, Reclamation and Ecology would need to apply for any required permits and comply with various laws, regulations, and Executive Orders. The following are examples of those that may apply:

- National Environmental Policy Act
- Endangered Species Act
- Secretary's Native American Trust Responsibilities
- 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
- Section 401 Certification, Clean Water Act
- Section 402 Permit, Clean Water Act
- Section 404 Permit, Clean Water Act
- State Environmental Policy Act
- Washington Department of Natural Resources Permit
- Additional Points of Diversion Authorization
- State Trust Water Rights Program Participation
- Water use permit/certificate of water right
- Reservoir permit/aquifer storage and recovery
- Dam safety permit
- Shoreline conditional use permit or variance
- Water system plan approval
- Hydraulic project approval
- Critical areas permit or approval
- Floodplain development permit

Authors and Contributors:

A list of authors and contributors is provided following Chapter 6.

Date of Issue:

November 16, 2011

Public Comment Period:

The DPEIS will be available for a 45-day public comment period. Comments must be received or postmarked by 5 p.m. PST on January 3, 2012, and may be submitted orally, in writing via regular mail, or email to:

Ms. Candace McKinley
Environmental Program Manager
Columbia-Cascades Area Office
1917 Marsh Road
Yakima, Washington 98901-2058
Phone: 509-575-5848, ext. 613
Fax: 509-454-5650
Email: yrbwep@usbr.gov

Public Meetings:

Reclamation and Ecology will conduct six public meetings to receive comments on the DPEIS. The meetings will be held from 1:30 PM to 3:30 PM and from 5:00 PM to 7:00 PM on the following dates:

December 5, 2011
U.S. Forest Service Ranger Station
803 W. 2nd Street
Cle Elum, WA 98922

December 6, 2011
Hal Holmes Center
209 N. Ruby Street
Ellensburg, WA 98926

December 14, 2011
Yakima Arboretum
1401 Arboretum Drive
Yakima, WA 98901

Timing of Additional Environmental Review:

Reclamation and Ecology anticipate releasing the Final PEIS on the Integrated Plan in January or February 2012. This analysis is programmatic in nature and has been prepared to generally address probable significant adverse impacts associated with the Integrated Plan. Any individual projects that are carried forward will require additional, more detailed project-level environmental review prior to implementation. These projects and actions may require SEPA compliance, NEPA compliance, or both, depending on the implementing agency, source of funding, and/or types of permits required. If a decision is made to implement the Integrated Plan following the Final PEIS, some projects and actions could be advanced and ready for additional environmental review early in 2012; others could require several years before they would be advanced for implementation.

Document Availability:

The DPEIS for the Integrated Plan can be viewed online at: http://www.usbr.gov/pn/programs/yrbwep/2011integratedplan/index.html. The document may be obtained in hard copy or CD by written request to the SEPA Responsible Official listed above, or by calling 509-457-7120. To ask about the availability of this document in a format for the visually impaired, call the Office of Columbia River at 509-662-0516. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

Location of Background Materials:

Background materials used in the preparation of this DPEIS are available online at:

Yakima River Basin Water Enhancement Project

http://www.usbr.gov/pn/programs/yrbwep/2011integratedplan/index.html.

ACRONYMS AND ABBREVIATIONS

ACRONYMS AND ABBREVIATIONS

μg/L	micrograms per liter
μg/m^3	micrograms per cubic meter
ACHP	Advisory Council on Historic Preservation
AID	Ahtanum Irrigation District
ARE Reserve	Arid Lands Ecology Reserve
ASR	Aquifer Storage and Recovery
ATVs	all-terrain vehicles
BCAA	Benton County Air Authority
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BMPs	best management practices
BNSF	Burlington Northern Santa Fe
BPA	Bonneville Power Administration
CBSP	Columbia Basin System Planning
CESRF	Cle Elum Supplementation and Research Facility
CFO	Conditional Final Orders
CFR	Code of Federal Regulations
cfs	cubic feet per second
CHU	Critical Habitat Unit
CIG	Climate Impact Group
CO	carbon monoxide
CPOM	coarse-particulate-organic-matter
CRBG	Columbia River Basalt Group
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
CWA	Clean Water Act
DAHP	Department of Archaeology and Historic Preservation
DART	Data Access in Real Time
dB	decibels

dBA	A-weighted decibels
DDD	dichlorodiphenyl-dichloroethane
DDE	dichlorodiphenyl-dichloroethylene
DDT	dichlorodiphenyl-trichloroethane
DEIS	Draft Environmental Impact Statement
DPEIS	Draft Programmatic Environmental Impact Statement
DNR	Department of Natural Resources
DO	dissolved oxygen
DOT	Department of Transportation
DPS	distinct population segment
Ecology	Washington State Department of Ecology
EDNA	Environmental Designation for Noise Abatement
EDT	Ecosystem Diagnosis and Treatment
EIS	Environmental Impact Statement
ELJ	engineered log jam
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
ET	evapotranspiration
FAR	The IPCC's Fourth Assessment Report
FEIS	Final Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
FHA	Federal Highway Administration
FPHCP	Forest Practices Habitat Conservation Plan
FR	Forest Road
ft	feet
ft/d	feet per day
FTA	Federal Transit Administration
FWCA	Fish and Wildlife Coordination Act
FWIP	Future without Integrated Plan

g	acceleration of gravity
GHG	greenhouse gas
gpm	gallons per minute
HCP	Habitat Conservation Program
HPA	hydraulic project approval
I-82	Interstate 82
I-90	Interstate 90
ICC	Indian Claims Commission
ICTRT	Interior Columbia Technical Recovery Team
Integrated Plan	YRBWEP Integrated Water Resource Management Plan
IOP	Interim Comprehensive Basin Operating Plan for the Yakima Project
IPCC	Intergovernmental Panel on Climate Change
IWRMP	Integrated Water Resource Management Plan
KAF	thousand acre-feet
KCCD	Kittitas County Conservation District
KID	Kennewick Irrigation District
KRD	Kittitas Reclamation District
L_{dn}	day-night noise level
L_{eq}	hourly-equivalent sound pressure levels
LWD	large woody debris
maf	million acre-feet
MCR	Middle Columbia River
mg/L	milligrams per liter
MOA	Memorandum of Agreement
MOCA	Managed Owl Conservation Area
msl	mean sea level
MW	Megawatts
MWH	Megawatt hours
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act

NF	North Fork
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NO_x	nitrogen oxide
NPDES	National Pollutant Discharge Elimination System
NPCC	Northwest Power and Conservation Council
NRHP	National Register of Historic Places
NSR	New Source Review
NWI	National Wetland Inventory
OAQPS	Office of Air Quality Planning and Standards
PCB	Polychlorinated biphenyl
PHS	Priority Habitats and Species
$PM_{2.5}$	particulate matter 2.5 microns or less
PM_{10}	particulate matter 10 microns or less
PMOA	Programmatic Memorandum of Agreement
ppb	parts per billion
ppm	parts per million
PEIS	Programmatic Environmental Impact Statement
PR/EIS	Planning Report/Environmental Impact Statement
PSD	Prevention of Significant Deterioration
PUD	Public Utility District
RCW	Revised Code of Washington
Reclamation	Bureau of Reclamation
RM	River Mile
SAAQS	State Ambient Air Quality Standards
SASSI	Salmon and Steelhead Stock Inventory
SEPA	State Environmental Policy Act
Service	U.S. Fish and Wildlife Service
SF	South Fork

SHPO	State Historic Preservation Office
SIL	Scenic Integrity Level
SIP	State Implementation Plan
SMA	Shoreline Management Act
SMP	Shoreline Master Program
SOAC	System Operations Advisory Committee
SR	State Route
SRFB	Salmon Recovery Funding Board
ST-1	Scenic Travel 1 Visual Quality Objective
Storage Study	Yakima River Basin Water Storage Feasibility Study
TCPs	traditional cultural properties
THPO	Tribal Historic Preservation Office
TMDL	total maximum daily load
TSC	Technical Service Center
TWSA	Total Water Supply Available
USFWS	U.S. Fish and Wildlife Service
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
VOC	volatile organic compound
VQO	Visual Quality Objective
VSP	viable salmonid population
WAC	Washington Administrative Code
Watershed Council	Yakima River Watershed Council
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WIP	Wapato Irrigation Project
Workgroup	YRBWEP Workgroup
WSDOT	Washington State Department of Transportation
WTWG	Water Transfer Working Group
Yak-RW	Yakima Project RiverWare

YBFWRB	Yakima Basin Fish and Wildlife Recovery Board
YKFP	Yakima/Klickitat Fisheries Project
YRBWEP	Yakima River Basin Water Enhancement Project
YRCAA	Yakima Regional Clean Air Agency
YTAHP	Yakima Tributary Access and Habitat Program
YTC	Yakima Training Center

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Introduction

The Bureau of Reclamation (Reclamation) and the Washington Department of Ecology (Ecology) have prepared a Draft Programmatic Environmental Impact Statement (DPEIS) on the Yakima River Basin Integrated Water Resource Management Plan (Integrated Plan). The Integrated Plan identifies a comprehensive approach to water resources and ecosystem restoration improvements in the Yakima River basin. The Integrated Plan includes seven elements: reservoir fish passage, structural and operational changes to existing facilities, surface water storage, groundwater storage, habitat/watershed protection and enhancement, enhanced water conservation, and market reallocation. The Integrated Plan was developed to address a variety of water resource and ecosystem problems affecting fish passage and habitat, and agricultural and municipal and domestic water supplies.

Purpose and Need for the Action

The current water resources infrastructure of the Yakima River basin has not been capable of consistently meeting aquatic resource demands for fish and wildlife habitat, dry-year irrigation demands, and municipal water supply demands. Specific problems that the Integrated Plan is proposed to address include:

- Anadromous and resident fish populations are seriously depleted from historic levels due to the following major factors:
    - Dams and other obstructions block fish passage to upstream tributaries and spawning grounds;
    - Riparian habitat and floodplain functions have been degraded by past and present land use practices; and
    - Irrigation operations have altered streamflows, resulting in flows at certain times of the year that are too high in some reaches and too low in others to provide good fish habitat.
- Demand for irrigation water significantly exceeds supply in dry and drought years, leading to severe prorationing[1] for proratable, or junior, water rights holders;
    - A water supply of 70 percent of proratable water rights during a drought year would provide a minimally acceptable supply to prevent severe economic losses to farmers. This number was reached following

[1] Prorationing refers to the process of equally reducing the amount of water delivered to junior ("proratable") water right holders in water-deficient years based on Total Water Supply Available (TWSA).

extensive discussions with stakeholders regarding the lowest level of water supply that could be accommodated without catastrophic losses to crops, assuming aggressive water management techniques were employed. This 70 percent threshold is similar to the State of Washington's definition of a drought condition contained in RCW 43.83B.400, which recognizes a drought when water supply for a significant portion of a geographic area falls below 75 percent of normal and is likely to cause undue hardship for various water uses and users.

- Demand for municipal and domestic water supplies is difficult to meet because of the following factors:
  - Water rights in the basin are fully appropriated, making it difficult to acquire water rights to meet future municipal and domestic water demand;
  - Pumping groundwater for irrigation and municipal uses may reduce surface water flows in some locations, which may affect existing water rights; and
  - Hydraulic continuity between groundwater and surface water in the basin creates uncertainty over the status of groundwater rights and permit exempt wells within the basin's appropriative water rights system ("first in time, first in right"), potentially making groundwater use junior to nearly all surface water use.
- Climate change projections indicate that there will be changes in runoff and streamflow patterns, increasing the need for prorationing and reducing flows for fish.

These problems have created a need to restore ecological functions in the Yakima River system and to provide more reliable and sustainable water resources for the health of the riverine environment, and for agricultural, municipal, and domestic needs. These problems should be addressed in a way that anticipates increased water demands and changes in water supply related to climate change.

The purposes of the Integrated Plan are to:

- Implement a comprehensive program of water resource and habitat improvements in response to existing and forecast needs of the Yakima River basin; and
- Develop an adaptive approach for implementing these initiatives and for long-term management of basin water supplies that contributes to the vitality of the regional economy and sustains the health of the riverine environment.

Alternatives

Development and Analysis of Alternatives

The Integrated Plan presented in this DPEIS is the result of 30 plus years of study and proposals to improve water supply and fish habitat in the Yakima basin, including elements and projects identified in Reclamation's Yakima River Basin Water Storage Feasibility Study Planning Report/EIS (Reclamation, 2008g) and Ecology's Final EIS on Yakima River Basin Integrated Water Resource Management Alternative (Ecology, 2009). The Yakima River Basin Water Enhancement Project (YRBWEP) Workgroup further evaluated these elements and projects. The result is an Integrated Plan of actions to address water supply and fish needs in the basin.

The combination of projects and actions included within the Integrated Plan has been optimized during nearly three years of discussion with the YRBWEP Workgroup and other stakeholders to achieve the objectives outlined in the Purpose and Need statement. Extensive modeling and analyses completed during the Yakima River Basin Study (April 2011) determined that the Integrated Plan Alternative represents the only combination of programs, projects and resource allocations that could feasibly meet the objectives outlined in the Purpose and Need statement. Therefore, only one action alternative is presented in this DPEIS.

During implementation of the Integrated Plan, individual components may be modified as new information becomes available or conditions change. Should these modifications result in substantial changes to the components, supplemental programmatic environmental evaluations will be conducted. Additional information may also become available during project-level review for individual components. Any new information that could result in substantial reshaping of the program or project under consideration would be subject to additional environmental review.

No Action Alternative

Under the No Action Alternative, Reclamation and Ecology would not carry out the Integrated Plan Alternative. Reclamation and Ecology would not develop new water storage in the Yakima River basin or expand programs to protect or enhance fish habitat. In addition, Reclamation and Ecology would not implement enhanced water conservation, market reallocation, or groundwater storage. Although Reclamation and Ecology would not implement these actions as an integrated program, various agencies and other entities would likely continue to undertake individual actions to accomplish some water resource improvements. These actions could include small water storage projects, artificial fisheries supplementation programs, fish passage, habitat improvements, water conservation, and water quality improvements. Reclamation would continue to study fish passage options at its major reservoirs in accordance with its Mitigation Agreement with the Washington Department of Fish and Wildlife (WDFW) and its Settlement Agreement with the Yakama Nation. These actions, although beneficial, would only provide slow and partial progress in addressing the water resource problems of the basin. With the No Action Alternative, existing problems with water availability and habitat quality would likely worsen with increased population and climate change.

The No Action Alternative is intended to represent the most likely future expected in the absence of implementing the proposed action. For the purposes of this DPEIS, Reclamation and Ecology consider the No Action Alternative to include projects that are ongoing and ready for implementation. These are projects, actions, and policies that:

- Have been planned and designed through processes outside the Integrated Plan;
- Are authorized and have identified funding for implementation; and
- Are scheduled for implementation.

Several entities in the Yakima River basin, including the Yakama Nation, Reclamation, the Bonneville Power Administration (BPA), U.S. Fish and Wildlife Service (Service), National Marine Fisheries Service (NMFS), Ecology, WDFW, county and municipal governments, local conservation districts, nonprofit organizations, and other landowners and managers throughout the basin have been actively involved in storage modification, supplementation, and fish enhancement projects in the past 30 years. Projects, actions, and policies developed by these entities that meet the ready for implementation criteria described above are considered part of the No Action Alternative.

Integrated Water Resource Management Plan Alternative

The Integrated Water Resource Management Plan Alternative (Integrated Plan) represents a comprehensive approach to water management in the Yakima River basin. It is intended to meet the need to restore ecological functions in the Yakima River system and to provide more reliable and sustainable water resources for the health of the riverine environment and for agriculture and municipal and domestic needs. The Integrated Plan is also intended to provide the flexibility and adaptability to address potential climate changes and other factors that may affect the basin's water resources in the future.
The Integrated Plan includes three components of water management in the Yakima basin—Habitat, Systems Modification, and Water Supply. The intent of the Integrated Plan is to implement a comprehensive program that will incorporate all three components using seven elements to improve water resources in the basin:

- Reservoir Fish Passage Element (Habitat Component);
    - Provide fish passage at the five major Yakima River basin dams – Cle Elum, Bumping Lake, Tieton, Keechelus, and Kachess – as well as Clear Lake Dam.
- Structural and Operational Changes Element (Systems Modification Component);
    - Cle Elum Pool Raise,
    - Kittitas Reclamation District Canal Modifications,
    - Keechelus-to-Kachess Pipeline,

    - Subordinate Power at Roza Dam and Chandler Powerplants, and
    - Wapatox Canal Improvements.
- Surface Water Storage Element (Water Supply Component);
    - Wymer Dam and Pump Station,
    - Kachess Reservoir Inactive Storage,
    - Bumping Lake Reservoir Enlargement, and
    - Study of Columbia River Pump Exchange with Yakima Storage.
- Groundwater Storage Element (Water Supply Component);
    - Shallow Aquifer Recharge, and
    - Aquifer Storage and Recovery.
- Habitat/Watershed Protection and Enhancement Element (Habitat Component);
    - Targeted Watershed Protections and Enhancements, and
    - Mainstem Floodplain and Tributary Enhancement Program.
- Enhanced Water Conservation Element (Water Supply Component);
    - Agricultural Conservation, and
    - Municipal and Domestic Conservation Program.
- Market Reallocation Element (Water Supply Component).

Reclamation and Ecology worked with the YRBWEP Workgroup to develop a package of projects to meet the goals of the Integrated Plan. These projects are described individually; however, Reclamation, Ecology and the YRBWEP Workgroup intend that the Integrated Plan would be implemented in a comprehensive manner, incorporating all elements of the proposed plan. Implementing the different elements of the Integrated Plan as a total package is intended to result in greater benefits than implementing any one element alone.

Resource Analysis

Following is a narrative summary of the environmental elements with the potential to have the most substantive impacts, based on current evaluations. Table ES-1 at the end of this Executive Summary presents a summary of impacts on all resources evaluated in this DPEIS.

Earth

No Action Alternative

Erosion and sediment delivery to streams likely would continue to occur at about the same rates as under existing conditions or could increase in the future, as past trends have indicated.

Integrated Plan Alternative

Short-term impacts to Earth would be related to construction activities that may result in erosion and sedimentation. Long-term impacts would include a combination of effects, including loss of earth-related resources, permanent landscape modifications, new roads, and changes in stream channel and floodplain conditions. Implementation of the Surface Water Storage Element of the Integrated Plan would result in increased disruption of the natural sedimentation process downstream of new or expanded storage facilities, as the reservoirs trap and hold sediments. Implementation of the Integrated Plan would also likely result in a decrease in erosion potential as floodplains are reconnected, channel scouring is reduced, and as conservation areas are created and land use practices are modified to benefit the watershed as a whole.

Surface Water Resources

No Action Alternative

The No Action Alternative includes conservation measures through YRBWEP and other programs that may impact surface water. These impacts could include a slight increase in Total Water Supply Available (TWSA) and streamflow in various Yakima River reaches and tributaries.

Integrated Plan Alternative

The Integrated Plan Alternative would benefit instream flows and improve the reliability of water supply for agriculture and municipal and domestic uses. Short-term impacts would be minor but could affect water deliveries to water users, streamflows, flood control operations, or TWSA or cause a surface water body to be temporarily diverted from its typical location. Long-term improvements in water supply would be reflected in increases in TWSA, end-of-season reservoir storage, and annual diversions compared to the No Action Alternative. In dry years, the increases in annual diversions would be substantial.

Groundwater

No Action Alternative

Under the No Action Alternative, the existing activities, programs, and trends in the Yakima River basin would continue. Deficiencies in water availability from surface water sources may increase demand on groundwater. In general, groundwater recharge from irrigation is expected to decrease, and this would result in lowered water tables, reduced water levels in area wells, and reduced discharges to rivers, creeks and wetlands.

Integrated Plan Alternative

Short-term impacts of groundwater are limited to potential reduced usability of wells in the immediate vicinity of construction sites. Impacts would be temporary and are likely to be minor. Long-term groundwater levels and quantity are expected to increase through additional recharge from irrigation deliveries made from storage facilities, groundwater recharge enhancement, riparian enhancements, wetland and wet meadow construction, and from floodplain enhancements. Decreases in recharge are expected from enhanced conservation (improving conveyance facilities and increasing application efficiencies). No impacts to groundwater quality are anticipated.

Water Quality

No Action Alternative

Under the No Action Alternative, the existing activities, programs, and trends in the Yakima River basin would continue. Operation, maintenance, and construction associated with these projects could have impacts to water quality.

Integrated Plan Alternative

The Integrated Plan is designed to provide an overall net benefit to water quality conditions by improving streamflow conditions, riparian areas, and floodplain habitat in the basin. Localized impacts to water quality may occur, particularly with regard to temperature conditions in late summer and early fall immediately downstream of surface water storage projects. In addition there is some potential for existing contamination of soils in some locations to affect water quality if floodplain restoration projects are carried out in those areas.

Hydropower

No Action Alternative

The No Action Alternative is not expected to have long-term impacts on hydropower because no changes in flow through hydroelectric facilities are currently proposed.

Integrated Plan Alternative

Short-term impacts are not anticipated. In the long-term, the Integrated Plan would result in a combination of effects including a reduction of hydroelectric generation at the Roza and Chandler powerplants and at the Drop 2 and Drop 3 powerplants in the Wapato Irrigation Project. A slight reduction in hydroelectric generation at dams along the Columbia River would occur when a new reservoir is refilling after the irrigation portion of the water stored is used during a drought year. While power recovery facilities are not included in the Integrated Plan, they could be constructed at several facilities in the future if economic conditions are favorable.

Fish

No Action Alternative

Various agencies and other entities would likely continue to undertake individual actions to accomplish some water resource improvements. These actions could include small water storage projects, artificial fisheries reintroduction and supplementation programs, fish passage, habitat improvements, water conservation, and water quality improvements. These actions, although beneficial, would provide slow and partial progress in addressing the water resource problems of the basin. With the No Action Alternative, existing problems with water availability and habitat quality would likely worsen with increased population and climate change.

Integrated Plan Alternative

Given implementation of the combined elements, the Integrated Plan would contribute to more flow conditions resembling natural flows and the creation of habitat conditions more capable of supporting salmonid populations in the Yakima River basin. In particular, the Surface Water Storage Element would improve flow conditions throughout the basin. The Habitat/Watershed Protection and Enhancement Element, the Structural and Operational Changes element, and the Reservoir Fish Passage Element, would also benefit fish and help meet fish production and survival targets.

Vegetation

No Action Alternative

Some of the individual actions proposed under the No Action Alternative involve improvement of vegetation communities such as riparian areas or wetlands. This includes projects for water storage, artificial supplementation programs, and fish passage and habitat improvements. The projects would likely include removal of nonnative vegetation and planting with native plants. Some projects could reduce the amount of shrub-steppe vegetation.

Integrated Plan Alternative

Although there would be some negative impacts to vegetation, particularly shrub-steppe and old-growth in the areas of new or expanded reservoirs, the overall long-term impact of the Integrated Plan is expected to be positive. The Habitat/Watershed Protection and Enhancement Element would improve degraded habitat and protect large areas of intact habitat, including threatened shrub-steppe and old-growth habitats. The integrated implementation of the Habitat/Watershed Protection and Enhancement element and streamflow improvements provided by the Structural and Operational Changes, Surface Water Storage, and Groundwater Storage elements would provide greater benefits to riparian and wetland vegetation in comparison to a program that implements the elements separately. Thus, integrated management approaches are more likely to achieve systemwide benefits for vegetation.

Wildlife

No Action Alternative

Some of the individual actions proposed under the No Action Alternative involve riparian vegetation improvement or alteration of wildlife habitats and species using those habitats. This includes projects for water storage, artificial supplementation programs, and fish passage and habitat improvements. The projects would likely include removal of nonnative vegetation and planting with native plants. Improved riparian vegetation would result in increased habitat for terrestrial wildlife species. Some projects could reduce the amount of shrub-steppe vegetation.

Integrated Plan Alternative

The overall impact of the Integrated Plan is expected to be positive for wildlife. Although there would be some negative impacts to wildlife habitat, particularly to shrub-steppe and old-growth in the areas of new or expanded reservoirs, the combined effect of the proposed elements would result in improved fish and wildlife habitat over time. Many of the proposed projects under the Enhanced Conservation and Structural and Operational Changes elements would not impact habitat because they would be located in previously disturbed areas. However, they would provide flow benefits to fish and other aquatic species. Fish passage facilities would open up new territory for anadromous fish and help restore ecosystems upstream of the dams. The Habitat/Watershed Protection and Enhancement Element would improve degraded habitat and protect large areas of intact habitat, including declining shrub-steppe and old-growth habitats.

Threatened and Endangered Species

No Action Alternative

Some of the individual actions proposed under the No Action Alternative involve riparian vegetation improvement or alteration of wildlife habitats and species using those habitats. This includes projects for water conservation, artificial supplementation programs, and fish passage and habitat improvements. The projects would likely include removal of nonnative vegetation and planting with native plants. Improved riparian vegetation would result in increased habitat for terrestrial wildlife species. Some projects could reduce the amount of shrub-steppe vegetation.

Integrated Plan Alternative

Impacts would be positive for listed species along the mainstem and tributaries in the Yakima River basin. Construction associated with structural and operational changes to existing facilities is not expected to result in impacts because it would occur in previously disturbed areas or built environments. In addition, they would provide flow benefits to Middle Columbia River (MCR) steelhead, bull trout and other aquatic species. Fish passage facilities would open up new territory for MCR steelhead and help restore ecosystems upstream of the dams. The Habitat/Watershed Protection and Enhancement Element would improve degraded habitat and protect large areas of intact habitat, including threatened shrub-steppe and old-growth habitats critical for greater sage-grouse and northern spotted-owl, respectively. The integrated implementation of fish habitat enhancement projects and the streamflow improvements provided by the Structural and Operational Changes, Surface Water Storage, Groundwater Storage, and Habitat/Watershed Protection and Enhancement elements would provide greater benefits to listed fish and wildlife species in comparison to a program that implements the elements separately. Thus, integrated management approaches are more likely to achieve systemwide benefits for listed species.

However, the integrated elements would result in negative impacts to listed fish and wildlife using the area of a new reservoir or the proposed reservoir expansion adjacent to Bumping Lake.

Climate Change

No Action Alternative

Changes in precipitation, snowmelt, and runoff that may occur as a result of climate change could affect projects included in the No Action Alternative. There may be changes in water availability for irrigation, fish, and municipal uses. Without a comprehensive, integrated management program, projects would be completed in a piecemeal fashion, reducing the potential for coordination and increased efficiencies in implementation. An uncoordinated approach may reduce the potential to adapt water management strategies and adjust to changing climatic conditions. Depending on its severity, climate change could cause existing water supply shortages and adverse effects on streamflows and fish in the basin to become significantly worse under the No Action Alternative.

Integrated Plan Alternative

As an integrated package, this alternative would provide multiple benefits to water supply, agriculture, and fish while improving the ability of water managers to adapt to future climate changes. Approaching management on a basinwide level could provide additional consistency in water management. Additional water storage and improved irrigation operations would provide a more reliable water supply for agriculture during dry periods. Improved streamflows and fish habitat, along with access to upper river tributaries, would produce enhanced fish populations that would be better able to withstand habitat changes caused by climate change.

Recreation

No Action Alternative

The No Action Alternative would not result in long-term impacts to recreation in the Yakima River basin. This alternative includes storage modification, supplementation, and fish enhancement projects that would likely be implemented by other agencies and special interest groups. Recreational activities would be expected to continue as they are currently occurring. These projects could provide minor benefits to recreation by improving fishing opportunities.

Integrated Plan Alternative

Implementation of most of the projects and elements of the Integrated Plan would result in short-term disruptions to facilities due to access limitations during construction; however, many of these impacts will be resolved following completion of construction. Long-term impacts to recreational resources could occur associated with land acquisition for habitat protection, which could limit some recreational uses. Designation of areas as Wilderness or Wild and Scenic Rivers could limit some recreational uses such as motorized vehicles or mountain biking. Recreational facilities at Bumping Lake Reservoir would be significantly impacted by eliminating shoreline recreational facilities and access to trails. It is anticipated that some of the recreational facilities that would be eliminated could be replaced over time. However, it may not be possible to replace all impacted facilities at or near Bumping Lake Reservoir. Reclamation would coordinate with the U.S. Forest Service (USFS) to determine appropriate mitigation for impacted recreational facilities. Many of the proposed projects in the Integrated Plan would improve riparian and fish habitat. This would have a beneficial impact on recreation by improving fishing and wildlife viewing opportunities.

Land and Shoreline Use

No Action Alternative

The No Action Alternative could result in long-term land use impacts in the Yakima River basin if projects require property acquisition. This alternative includes water conservation, artificial fish supplementation, and fish enhancement projects that would be implemented by other agencies and entities.

Integrated Plan Alternative

The Cle Elum Dam pool raise, Keechelus-to-Kachess pipeline, Bumping Lake enlargement, and Kachess Reservoir inactive storage projects would require acquisition of land or easements, but are not anticipated having a significant impact on land use. Approximately 4,000 acres of private land would need to be purchased for the Wymer Dam project and changed from Forest and Rangeland to water storage, which could be a significant impact to land use. Habitat enhancement projects could require acquisition of property or easements, but they would be located on property owned by willing participants to the extent possible and would be compatible with existing land uses. Even with willing sellers, some land use impacts could occur. Additionally, land use impacts could occur associated with habitat enhancement projects if acquisition results in more restrictive land uses. In particular, logging or other relatively high intensity activities would likely be curtailed on these acquired properties. Market Reallocation could result in changes in land use as water rights are transferred from one area and land use to another.

Cultural Resources

No Action Alternative

Under the No Action Alternative many water supply and habitat enhancement projects would be independently undertaken. Long-term impacts to cultural resources under the No Action Alternative would include ground-disturbing activities, erosion of cultural deposits, and increased vandalism of cultural resources. The net impact to cultural resources is expected to be lower under the No Action Alternative because fewer large-scale projects are likely to be constructed.

Integrated Plan Alternative

Projects undertaken as part of the Integrated Plan have the potential to cause long-term impacts to cultural resources located within the footprint of any new ground-disturbing construction activities. Many of the impacts to cultural resources would occur during ground-disturbing activities related to construction; although these impacts are construction related they would be permanent; therefore, they are considered long-term impacts. Construction impacts would include access and staging areas as well as any off-site mitigation areas. The main non-construction long-term impact for most elements would be erosion of cultural deposits. Potential impacts to cultural resources would be evaluated through site-specific studies and consultation with the Department of Archaeology and Historic Preservation and affected Tribes to develop appropriate mitigation measures.

Cumulative Impacts

The Integrated Plan has been developed with the intention of addressing some of the cumulative impacts associated with past projects in the Yakima River basin, including past impacts caused by dam construction, land use actions, inefficiencies in irrigation systems, and other impacts. There are cumulative impacts that could occur associated with implementation of the Integrated Plan. Cumulative construction impacts could occur if projects within the basin are constructed concurrently, including impacts to water quality, vegetation, and local transportation and access. These cumulative construction-related impacts would be further compounded if other present and reasonably foreseeable projects such as wind power development, expansion of the Department of Army's Yakima Training Center, potential hydropower at existing dams, and areawide ongoing developments are constructed concurrently with Integrated Plan projects.

The long-term cumulative impacts of the Integrated Plan are expected to be beneficial, although some localized impacts could occur associated with individual projects. Expanding existing reservoirs or building new water storage facilities would add to existing impacts on fisheries in a river basin that has already been extensively dammed, and has been impacted by development, climate change, and other modifications to the system. Additional storage facilities could exacerbate the impacts of existing facilities, including the potential to create additional impediments to fish passage, increased migration times, and impaired downstream water quality. However, these storage projects will also contribute to improving instream flows. Hydropower facilities could be expanded in the future by utilities as well as private developers, resulting in water quality impacts, altered reservoir operations, and other detrimental effects that could affect fisheries. The Integrated Plan has been developed in a comprehensive manner to offset these cumulative impacts, by including new fish passage, and retrofitting existing reservoirs with improved fish passage, and by including measures to enhance habitat, maintain flows, reduce water temperatures, and offset climate change-induced impacts. Land acquisition and wilderness designations associated with habitat/watershed protection and enhancement components have the potential to cumulatively affect and/or be affected by the USFS Okanogan-Wenatchee Forest Plan Revision Process.

There are projects and programs outside the Yakima River basin that could potentially cumulatively affect or be affected by the Integrated Plan, including the Odessa Subarea Special Study, Lake Roosevelt Incremental Storage Releases, Walla Walla Pump Exchange, Sullivan Lake Water Supply Project, Umatilla Aquifer Recharge project in Oregon, and potential renegotiation or termination of the Canadian Treaty, among others. Some of these projects would improve streamflows, most represent increased demand for water in the Columbia River. All these projects include opportunity costs. The Integrated Plan is an effort to evaluate the full range of impacts on a systemwide basis, to avoid both short term and long term adverse cumulative impacts.

Environmental Commitments

Reclamation has the primary responsibility to ensure that environmental commitments are met if any action is implemented. Because this a programmatic environmental review of the Integrated Plan elements, specific mitigation measures have not been developed for specific project actions at this time. The type of actions that Reclamation would undertake to minimize short-term construction impacts include erosion and sediment control, mitigation for construction impacts, evaluation of existing habitat, additional studies, property acquisition. For long-term impacts Reclamation would develop measures to address impacts to surface water and habitat, earth, groundwater, hydropower, visual resources, air quality, climate change, property acquisition, and cultural resources. Additional measures would be developed during project-specific review for each project action carried forward.

Public Involvement

On April 5, 2011, Reclamation published a Notice of Intent (NOI) to prepare a Draft Programmatic EIS in the *Federal Register*. Reclamation and Ecology issued a joint press release to local media on April 6, 2011, announcing the scoping meetings and a meeting notice was mailed to interested individuals, Tribes, groups, and Government agencies which described the project, requested comments, and provided information about the public scoping meeting. On May 3, 2011 Reclamation and Ecology held two scoping meetings at the Hal Holmes Center in Ellensburg, Washington, one in the afternoon and one in the evening; 45 individuals attended the two meetings. On May 5, 2011, two public scoping meetings were held at the Yakima Arboretum in Yakima, Washington; one in the afternoon and one in the evening; 26 individuals attended the two meetings. At the meetings, the proposed Integrated Plan was described and attendees were given the opportunity to comment on the proposal, the National Environmental Policy Act (NEPA)/State Environmental Policy Act (SEPA) process, and resources being evaluated in the DPEIS.

Reclamation and Ecology received 79 written comments during the scoping period which were used in the preparation of the DPEIS. The *Scoping Summary Report* (Reclamation and Ecology, 2011m) is available upon request or can be accessed from the YRBWEP 2010 Integrated Plan Web Site:
http://www.usbr.gov/pn/programs/yrbwep/2011integratedplan/index.html.

Consultation and Coordination

Reclamation has conferred with the U.S. Fish and Wildlife Service (Service) and National Marine Fisheries Service (NMFS) and the agencies have reached agreement that Reclamation will not conduct consultation under Section 7 for the PEIS. Reclamation will carry out compliance in accordance with the Endangered Species Act, National Historic Preservation Act (NHPA) of 1966, and Clean Water Act Consultation for individual projects that are carried forward under the Integrated Plan in the future. Reclamation will initiate Government-to-Government consultation with the Confederate Tribes of the Yakama Nation, Confederated Tribes of the Umatilla Indian Reservation, and Bureau of Indian Affairs regarding cultural resources, Indian trust assets, and Indian sacred sites. Most of this consultation will take place when individual projects proposed under the Integrated Plan are carried forward to implementation.

Reclamation and Ecology were responsible as joint lead agencies for developing this joint NEPA/SEPA DPEIS. BPA and USFS are cooperating agencies.

Summary of Impacts

Table ES-1 summarizes impacts associated with the No Action and Integrated Plan Alternatives.

Table ES-1. Comparison of Impacts for Alternatives

Resource	No Action Alternative	Integrated Plan Alternative
Earth	Erosion and sediment delivery would continue or increase.	Short-term: Construction-related erosion and sedimentation. Long-term: Loss of earth-related resources, permanent landscape modifications, and changes in stream channel and floodplain conditions. Disruption of sedimentation downstream of storage facilities. Decrease in erosion potential in conservation areas.
Surface Water Resources	Conservation measures through other projects could result in a slight increase in water supply and increases in streamflows in various reaches and tributaries. Overall goals and objectives of the Integrated Plan would not be achieved.	Short-term: Potential disruption during construction. Long-term: Increased TWSA, end-of-season reservoir storage, annual diversions, and improved streamflow.
Groundwater	Groundwater recharge is expected to decrease and demand on groundwater may increase.	Short-term: Temporary reduction of usability of wells in the immediate vicinity of construction sites. Long-term: Groundwater levels and quantities would increase with potential decreases near canal lining sites.
Water Quality	Construction projects could result in water quality impacts, localized benefits from habitat enhancement projects. Net benefits to water quality unlikely to occur.	Short-term: Risk of erosion and contaminants from construction. Long-term: Net benefit to water quality by improving streamflow conditions, riparian areas, and floodplain habitat.
Hydropower	Hydroelectric generation would continue to operate as under current patterns and trends.	Short-term: No impact. Long-term: Reduction of hydroelectric generation at Roza and Chandler Powerplants and the Drop 2 and Drop 3 powerplants in the Wapato Irrigation Project.
Fish	Habitat quality would likely worsen with increased population and climate change, although proposed projects could produce localized improvements.	Short-term: Temporary habitat disturbance, construction-related impacts. Long-term: Overall benefits from fish passage facilities, improved streamflows and habitat/watershed protection and enhancement projects.

Resource	No Action Alternative	Integrated Plan Alternative
Vegetation	Some vegetation removal from construction projects. Some projects could reduce the amount of shrub-steppe vegetation. Minor improvements from habitat enhancement projects. Current patterns and trends would likely continue into the foreseeable future.	Short-term: Temporary disruption of vegetation, including shrub-steppe and old-growth vegetation Long-term: Negative impacts, including habitat loss, from expanded reservoirs, but an overall positive impact due to habitat/watershed protection and enhancement. Permanent impact on shrub-steppe and old-growth vegetation.
Wildlife	Temporary dislocations during construction. Some vegetation removal or alteration of wildlife habitat from construction projects. Some projects could reduce the amount of shrub-steppe vegetation and habitat. Minor improvements to habitat from enhancement projects. Current patterns and trends would likely continue into the foreseeable future.	Short-term: Temporary disruption of habitat during construction. Substantial habitat impact could occur if replacement habitat is unavailable. Short term impacts for some species could be substantial at Wymer Dam and expansion of Bumping Lake Reservoir. Long-term: Negative impacts to habitat from new or expanded reservoirs. Overall positive impact for wildlife from habitat/watershed protection and enhancement. Permanent impact on shrub-steppe and old-growth vegetation.
Threatened and Endangered Species	Construction projects would likely include alteration of wildlife habitats. Some projects could reduce the amount of shrub-steppe vegetation. Minor improvements to habitat may provide limited benefits to listed species. Current patterns and trends would likely continue into the foreseeable future.	Short-term: Temporary disruption of habitat during construction, including reduction of shrub-steppe and old-growth habitat. Long-term: Negative impacts to species that may be displaced from the area of a new or expanded reservoir. Overall positive impacts from fish passage facilities, improved streamflows, and habitat/watershed protection and enhancement projects. Permanent impact on shrub-steppe and old-growth vegetation.
Visual Resources	Projects could alter visual resources. Individual actions would have varying levels of long-term visual impacts.	Short-term: Construction equipment and activities would be visible. Long-term: Visual impacts would be primarily of local scale and are not expected to be significant with the potential exception of new and expanded reservoirs.
Air Quality	Construction projects would likely cause minor increases in fugitive dust and vehicle emissions. Individual projects may cause long-term impacts from emissions if they include stationary pollutant sources such as pumping equipment driven by diesel, natural gas, or other fossil fuels.	Short-term: Minor dust and emissions associated with construction and traffic. Long-term: Some projects may cause long term impacts from emissions associated with stationary pollutant sources, although impacts are not expected to be significant.

Resource	No Action Alternative	Integrated Plan Alternative
Climate Change	Water supply shortages and adverse effects on streamflows and fish could become significantly worse. Limited ability to respond to climate change-induced impacts.	Short-term: Increases in greenhouse gas emissions associated with construction of individual projects. Long-term: Multiple benefits to water supply, agriculture, and fish, improving the ability of water managers to adapt to future climate change.
Noise	Increased construction noise. Individual projects have the potential to generate noise during long-term operation.	Short-term: Increased construction noise. Long-term: Some equipment or vehicles may be audible in the vicinity of projects.
Recreation	Temporary access restrictions or nuisance dust and noise during construction projects. Current patterns and trends impacting recreation facilities would likely continue into the foreseeable future.	Short-term: Temporary access restrictions or nuisance dust and noise. Long-term: Recreational facilities and resources at Bumping Lake Reservoir would be eliminated and it may not be possible to relocate. Many projects would improve fishing and wildlife viewing opportunities. Recreational opportunities such as motorized vehicle use would be restricted in areas acquired for conservation or designated as Wild and Scenic or Wilderness.
Land and Shoreline Use	Temporary access restrictions during construction. Individual projects could result in long-term land use impacts from property or easement acquisitions. Current patterns and trends impacting land use would likely continue into the foreseeable future.	Short-term: Temporary access restrictions caused by construction. Long-term: Property and easement acquisitions, shift from Forest and Rangeland to water storage in Wymer Reservoir area, potential land use changes due to market reallocation. Logging and other uses would be restricted in areas acquired for conservation or given special designations.
Utilities	Potential temporary disruptions during construction.	Short-term: Potential temporary disruption during construction. Long-term: Reduced electrical supply of electricity due to power subordination and increased demand from new equipment.
Transportation	Potential temporary traffic delays and possible detours associated with individual projects. Long term transportation not likely to be affected.	Short-term: Temporary traffic delays and possible detours, in some cases for up to 3 to 5 years for major projects. Long-term: Bumping Lake Enlargement would eliminate some Forest Roads, reducing access to recreation sites.
Cultural Resources	Ground disturbance, erosion, and increased vandalism of cultural resources. Potential impacts to historic structures.	Short-term: Construction could cause permanent impacts to cultural resources. Long-term: Ground disturbance, erosion, and increased vandalism of cultural resources. Potential impacts to historic structures.

Resource	No Action Alternative	Integrated Plan Alternative
Socioeconomics	Current economic patterns and trends would likely continue into the foreseeable future. Climate change and population increases would impact the relation between natural resources and the economy in the basin.	Short-term: Project-related funding would likely have short-term impacts positive on jobs and incomes and uncertainty and risk. Long-term: Potential increase in the value of goods and services derived from the basin's water and related resources in the long term. Reduction in uncertainty and risk.
Environmental Justice	Most projects would not be expected to cause disproportionate impacts to environmental justice communities.	Most projects are not expected to cause disproportionate impacts to environmental justice communities. Additional environmental justice analysis would be required during project-level analysis.

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Chapter 1

INTRODUCTION AND BACKGROUND

CHAPTER 1.0 INTRODUCTION AND BACKGROUND

1.1 Introduction

The Bureau of Reclamation (Reclamation) and the Washington Department of Ecology (Ecology) have prepared this Draft Programmatic Environmental Impact Statement (DPEIS) on the Yakima River Basin Water Enhancement Project (YRBWEP) Integrated Water Resource Management Plan (Integrated Plan). The Integrated Plan identifies a comprehensive approach to water resources and ecosystem restoration improvements in the Yakima River basin. The Integrated Plan includes seven elements: reservoir fish passage, structural and operational changes to existing facilities, surface water storage, groundwater storage, habitat/watershed protection and enhancement, enhanced water conservation, and market reallocation. The Integrated Plan was developed to address a variety of water resource and ecosystem problems affecting fish passage and habitat, and agricultural, municipal, and domestic water supplies.

The goals of the Integrated Plan are to:

- Provide opportunities for comprehensive ecological restoration and enhancement addressing instream flows, aquatic habitat, and fish passage;
- Improve water supply reliability during drought years;
- Develop a comprehensive approach for efficient management of water supplies for irrigated agriculture, municipal and domestic uses, and power generation;
- Improve the ability of water managers to respond and adapt to potential effects of climate change; and
- Contribute to the vitality of the regional economy and sustain the riverine environment.

The Integrated Plan was developed collaboratively with the YRBWEP Workgroup (composed of a diverse group of stakeholders plus the Yakama Nation) using information from past studies and environmental analyses conducted by Reclamation and Ecology. The Workgroup evaluated and recommended potential actions to address these needs, which resulted in the Integrated Plan that is evaluated in this DPEIS.

The sections in this chapter include descriptions of:

- The National Environmental Policy Act (NEPA) and State Environmental Policy Act (SEPA) environmental analysis;
- The purpose and need for the proposed action;
- Federal and State authority for the Integrated Plan;
- Background on ecological and water resources issues in the Yakima basin; and
- Documents that have been adopted under SEPA.

1.2 National and State Environmental Policy Act Review Process

This DPEIS is a combined NEPA and SEPA Programmatic EIS. It meets the requirements of both NEPA and SEPA with Reclamation and Ecology as joint leads in its preparation.

This DPEIS is prepared at a programmatic level. A programmatic EIS evaluates the effects of broad proposals or planning-level decisions that include any or all of the following:

- A wide range of individual projects;
- Implementation over a long timeframe; and/or
- Implementation across a large geographic area.

The programmatic EIS does not evaluate site-specific issues such as precise project footprints or specific design details that are not yet ready for decision at the planning level. Typically, a programmatic EIS will require subsequent project-level, or site-specific, environmental reviews. This stepwise approach to analysis and decisionmaking is called "tiering." Tiering of environmental impact statements refers to the process of addressing a broad, general program, policy, or proposal in an initial programmatic EIS, and analyzing a narrower site-specific proposal related to the initial program, plan, or policy when that proposal is ready to be carried forward.

1.3 Purpose and Need for the Action

The current water resources infrastructure of the Yakima River basin has not been capable of consistently meeting aquatic resource demands for fish and wildlife habitat, dry-year irrigation demands, and municipal water supply demands. Specific problems that the Integrated Plan is proposed to address include:

- Anadromous and resident fish populations are seriously depleted from historic levels due to the following major factors:
    - Dams and other obstructions block fish passage to upstream tributaries and spawning grounds;
    - Riparian habitat and floodplain functions have been degraded by past and present land use practices; and
    - Irrigation operations have altered streamflows, resulting in flows at certain times of the year that are too high in some reaches and too low in others to provide good fish habitat.

- Demand for irrigation water significantly exceeds supply in dry and drought years, leading to severe prorationing[1] for proratable, or junior, water rights holders;
    - A water supply of 70 percent of proratable water rights during a drought year would provide a minimally acceptable supply to prevent severe economic losses to farmers. This number was reached following extensive discussions with stakeholders regarding the lowest level of water supply that could be accommodated without catastrophic losses to crops, assuming aggressive water management techniques were employed. This 70 percent threshold is similar to the State of Washington's definition of a drought condition contained in RCW 43.83B.400, which recognizes a drought when water supply for a significant portion of a geographic area falls below 75 percent of normal and is likely to cause undue hardship for various water uses and users.
- Demand for municipal and domestic water supplies is difficult to meet because of the following factors:
    - Water rights in the basin are fully appropriated, making it difficult to acquire water rights to meet future municipal and domestic water demand;
    - Pumping groundwater for irrigation and municipal uses may reduce surface water flows in some locations, which may affect existing water rights; and
    - Hydraulic continuity between groundwater and surface water in the basin creates uncertainty over the status of groundwater rights and permit exempt wells within the basin's appropriative water rights system ("first in time, first in right"), potentially making groundwater use junior to nearly all surface water use.
- Climate change projections indicate that there will be changes in runoff and streamflow patterns, increasing the need for prorationing and reducing flows for fish.

These problems have created a need to restore ecological functions in the Yakima River system and to provide more reliable and sustainable water resources for the health of the riverine environment, and for agricultural, municipal, and domestic needs. These problems should be addressed in a way that anticipates increased water demands and changes in water supply related to climate change.

[1] Prorationing refers to the process of equally reducing the amount of water delivered to junior ("proratable") water right holders in water-deficient years based on Total Water Supply Available (TWSA).

The purposes of the Integrated Plan are to:

- Implement a comprehensive program of water resource and habitat improvements in response to existing and forecast needs of the Yakima River basin; and
- Develop an adaptive approach for implementing these initiatives and for long-term management of basin water supplies that contributes to the vitality of the regional economy and sustains the health of the riverine environment.

1.4 Integrated Plan Authority

Reclamation and Ecology share authority for developing the Integrated Plan and preparing this DPEIS. Federal authority is through the YRBWEP legislation and State authority is through the Columbia River Water Supply legislation and State Capital Budget as discussed below.

1.4.1 Federal Authority

Congress authorized Reclamation to conduct a feasibility study to address the water resource needs of the Yakima River basin in the Act of December 28, 1979 (93 Stat. 1241, Public Law 96-162, Feasibility Study - Yakima River Basin Water Enhancement Project).

Other authorities relevant to the YRBWEP are:

- Hoover Power Plant Act of 1984, which authorizes Reclamation to install fish passage facilities on Reclamation dams; and
- Yakima River Basin Water Enhancement Project Act of 1994, described in Section 1.7.2.

1.4.2 Washington State Authority

Authority for the State of Washington is provided by Chapter 90.90 RCW, the Columbia River Basin Water Supply legislation approved by the Washington State Legislature in 2006, which states:

> *(1) The legislature finds that a key priority of water resource management in the Columbia river basin is the development of new water supplies that includes storage and conservation in order to meet the economic and community development needs of people and the instream flow needs of fish.*
>
> *(2) The legislature therefore declares that a Columbia river basin water supply development program is needed, and directs the department of ecology to aggressively pursue the development of water supplies to benefit both instream and out-of-stream uses.*

In 90.90.010 RCW, the legislature created the Columbia River basin water supply development account in the state treasury. The account may be used to:

> *Assess, plan and develop new storage, improve or alter operations of existing storage facilities, implement conservation projects, or any other actions designed to provide access to new water supplies within the Columbia river basin for instream and out-of-stream uses.*

Additional authority for the State of Washington is contained in the 2011 to 2013 Capital Budget, *Yakima Basin Integrated Water Management Plan Implementation (30000278) C 49, L 11, E1, Sec 3033.* Under this provision, funding is provided to implement the Integrated Water Resource Management Plan identified as a result of the Yakima River Basin Water Storage Feasibility study. Projects proposed for inclusion with this first phase address storage, including the Wymer Reservoir and Bumping Lake expansion projects, and fish passage at Cle Elum Dam.

1.5 Background

This section provides background information about the need to develop the Integrated Plan. It also briefly describes ecological and major water resource issues in the basin.

1.5.1 Basin Fisheries

The Yakima River historically supported large runs of anadromous salmonids, with estimated runs of 300,000 to 960,000 fish per year in the 1880s (Natural Resource Law Center, 1996). These numbers have declined drastically, and three salmon species have been extirpated (eliminated) from the basin – sockeye, summer Chinook, and coho.

Pre-European settlement estimates of returning steelhead salmon alone (a subset of the total basin fish population) range from 20,800 to 100,000 (YBFWRB, 2009). Between 1981 and 1990, the average annual return of all anadromous salmonids to the Yakima River was only 8,000. For the period from 2001 to 2010, the following counts were recorded:

- Combined Chinook past Prosser Dam: 5,425 to 25,783[2];
- Coho: 818 to 9,091; and
- Steelhead: 1,537 to 6,793 (YKFP, 2011; Columbia River DART, 2011).

Native summer Chinook and coho salmon and sockeye were extirpated from the Yakima basin. Reintroduction of coho began in the mid-1980s and summer Chinook reintroduction is currently being undertaken. The numbers of spring and fall Chinook and summer steelhead have been seriously reduced. In response to declining fish numbers, steelhead were listed as threatened under the Endangered Species Act (ESA) in 1999.

[2] Counts are past Prosser and do not represent a total count for fall Chinook.

The causes for the declines and extirpations are many, including the following:

- In the 1900s, crib dams on the four natural glacial lakes (Cle Elum, Kachess, Keechelus, and Bumping) contributed to the extirpation of sockeye.
- Construction of Reclamation's five storage dams eliminated access to previously productive spawning and rearing habitat for sockeye, spring Chinook, coho, and steelhead salmon.
- Irrigation operations have altered streamflows, resulting in flows at certain times of the year that are too high in some reaches and too low in others to provide good fish habitat. This problem is worse during drought years.
- Land development, including road construction, diking, gravel mining, and agriculture, has degraded riparian habitat and increased sediment in streams and rivers.
- Irrigation diversions have reduced flows and created fish passage barriers in tributary streams.
- Conditions outside the Yakima River basin also affected Yakima River anadromous fish populations, including Columbia River dams and historic commercial fishing in the Columbia River and Pacific Ocean.

The adverse conditions for anadromous species described above also affect bull trout populations and habitat, and bull trout were listed as threatened in 1998. The historic abundance of bull trout in the basin is not well defined, but its historic distribution was likely broader with many distinct populations. The basin was recently designated as critical bull trout habitat, and there is a need to reinstitute year-round connectivity of bull trout habitat between lakes and reservoirs and mainstem rivers, including the Yakima River.

While still well below historic levels, in more recent years anadromous fish populations have improved through a combination of fisheries management, habitat and facility improvements, hatchery supplementation, and reintroduction efforts. Habitat conditions are improving for steelhead. Reintroduction efforts by the Yakama Nation, beginning in the 1980s, used hatchery fish to reestablish naturally reproducing coho salmon. The Yakama Nation and Washington Department of Fish and Wildlife (WDFW) have begun reintroduction of sockeye and summer Chinook salmon. While progress has been made, substantial additional effort is needed to provide for sustainable fisheries in the basin.

1.5.2 Irrigation Water Supply

Approximately 450,000 acres are currently irrigated from the Yakima Project (Figure 1-1). This irrigation has enabled the production of high-value orchard crops, wine grapes, and hops in addition to grains, vegetables, and dairy products. Irrigation has created a strong agricultural economy in the basin which has been called "one of the most productive agricultural areas in the West" (Natural Resources Law Center, 1996).

The Yakima Project's surface water supply comes from the Yakima River and its tributaries, irrigation return flows, and releases of stored water from the five major reservoirs in the basin. (See Section 1.6 for additional information on the Yakima

Project.) Only 30 percent of the average annual runoff can be stored in the storage system. The Yakima Project depends heavily on the timing of spring and summer runoff from snowmelt and rainfall. The spring and early summer runoff flows supply most river basin demands through June in an average year. The majority of spring and summer runoff is from snowmelt; as a result, the snowpack is often considered a "sixth reservoir." In most years, the five major reservoirs are operated to maximize storage in June, which typically coincides with the end of the major runoff. The reservoirs have a combined storage capacity of about 1.07 million acre-feet (maf).

Demand for water from the Yakima River cannot always be met in years with below-average runoff. Though all of the entitlement holders do not call on their full entitlement volume every year, the existing surface water supply does not presently meet all water needs in dry years. A dry year results in prorationing during the irrigation season. In addition, reduced summer and early fall streamflows may affect migrating, spawning, and rearing conditions for anadromous fish.

1.5.3 Municipal and Domestic Water Supply

Residential development and population have been increasing in the Yakima River basin in the last two decades. Resort and second-home developments have also increased, particularly in the areas around Cle Elum and Roslyn. Because surface water rights are fully appropriated, at least seasonally, in the Yakima basin, acquiring year-round water rights for growing municipalities and for housing developments is difficult. Many of the housing developments rely on permit exempt wells for domestic water supplies.

Groundwater and surface water in the Yakima River basin are interconnected. Groundwater pumping can diminish streamflows, affects nonproratable (senior) surface water rights, and can reduce the amount of water available for maintaining legally required flows for fish. In 2007, water rights holders in Kittitas County petitioned Ecology to place a temporary moratorium on new groundwater wells. In response, Ecology issued a series of Emergency Rules to manage groundwater in Kittitas County. In December 2010, Ecology issued a Ground Water Rule (Chapter 173 -539A WAC) that withdraws from appropriation all groundwater in upper Kittitas County with the exception of uses for structures for which a building permit was granted and vested prior to July 16, 2009, and uses determined to be "water budget neutral." To assist homeowners and developers in acquiring water rights to meet the water budget neutral determination, Ecology has established the Kittitas Water Exchange to help water users locate or sell water available for transfer.

Although the Ground Water Rule only affects Kittitas County, there is a potential for similar problems in other parts of the Yakima River basin. This creates a need for improving the water supply of municipal and domestic water users in the basin.

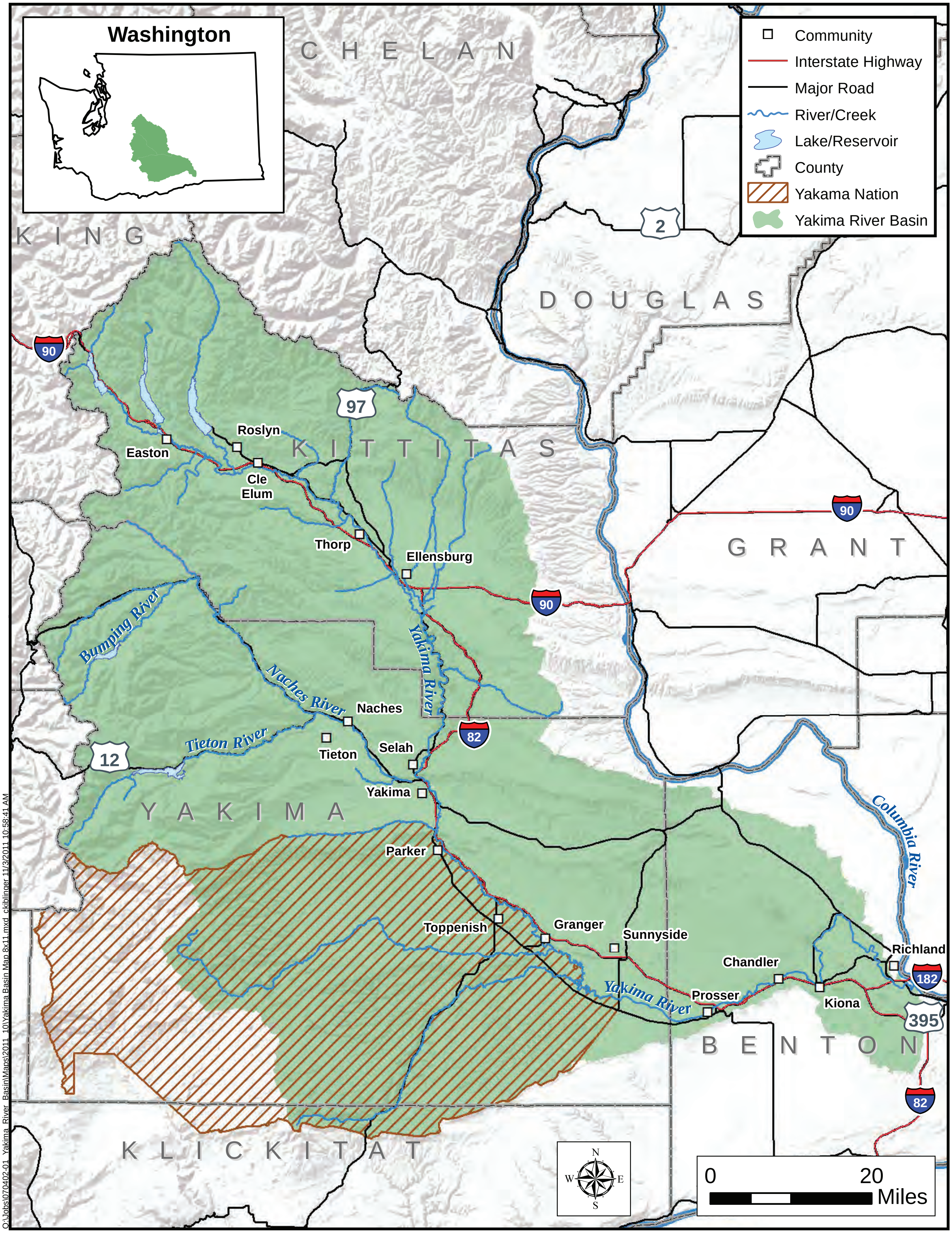


Figure 1-1. Yakima Basin Map

1.5.4 Effects of Climate Change

Climate change studies for the Yakima River basin include those conducted by the Climate Impacts Group (CIG) at the University of Washington, working with the U.S. Fish and Wildlife Service (Service) and other Federal agencies. For development of the Integrated Plan, climate change effects were modeled using the Yakima Project RiverWare model. Additional information on climate change in the basin can be found in Section 3.13 of this DPEIS.

Changes in runoff in the Yakima River basin caused by climate change are projected to be significant. Generally, the projected increased air temperatures would cause some precipitation to fall as rain instead of snow, which would increase winter and early spring runoff and reduce the volume of runoff from snowpack that occurs in the late spring and early summer. Additionally, projected higher air temperatures would cause runoff from snowpack to begin earlier, shifting the peak runoff period earlier in the season. Spring and summer runoff is projected to decrease (ranging from 12 to 71 percent of existing runoff) and fall and winter runoff is projected to increase (ranging from an increase of 4 to 74 percent of existing runoff). Fall and winter inflow to reservoirs would increase, and the reservoir system may not be able to capture and hold the increased flow for release during the high-demand period (spring and summer). Additionally, a decrease in spring and summer supply would cause water stored in reservoirs to be depleted at a faster rate to meet demand. The combined effects would likely cause a decrease in overall supply during the high-demand period.

Climate change is expected to result in a decline in the quantity of freshwater habitat for salmonid populations across Washington State (Mantua et al., 2010). The Yakima River basin is a transient watershed, one that is dominated by a mix of direct runoff from fall rain and spring snowmelt. Simulations predict that this type of watershed would be most affected by climate change, with accompanying impacts to fisheries. Specific impacts to fish are expected to include:

- Increased air temperature would increase water temperature, negatively impacting fish habitat;
- Elevated stream temperatures would increase thermal barriers to migration;
- Increased winter flood frequency and intensity would cause a negative effect on juvenile coho, Chinook, and steelhead survival and reduction of survival rates for incubating eggs and rearing parr;
- Reduced spring snowmelt and summer and fall streamflows would impact summer-run steelhead, sockeye, and summer Chinook migrations; and
- Diminished flows in combination with increased water temperatures would increase pre-spawn mortality for summer-run and stream-type salmonids.

1.5.5 Statutory Constraints on the Water Supply

Reclamation operates the Yakima Project to achieve specific purposes: irrigation water supply; flood control; power generation; and instream flows for fish, wildlife, and recreation. Irrigation operations and flood control management have been historical priorities for reservoir operations. The Yakima Project's authorization and water rights, issued under Washington State water law, and the *1945 Consent Decree* (Section 1.6.4.2) are statutory constraints for water resources. Reclamation must operate the Yakima Project divisions and storage facilities in a manner that avoids injury to water users within this framework.

Project operators use a number of control points to monitor the river system. The primary control point for operation of the upper Yakima Project is the Yakima River near the Parker stream gage. Legislation in 1994 provided that an additional purpose of the Yakima Project shall be for fish, wildlife, and recreation, but that this additional purpose "shall not impair the operation of the Yakima Project to provide water for irrigation purposes nor impact existing contracts." Since April 1995, the Yakima Project has been operated as required by the 1994 legislation to maintain target streamflows downstream from Sunnyside Diversion Dam, as measured at the Yakima River near the Parker stream gage. These flows, based on the estimated water available, range from 300 to 600 cubic feet per second (cfs) between April 1 and October 31.

Reclamation's *Yakima River Basin Water Enhancement Project, Washington, Final Programmatic Environmental Impact Statement* (Reclamation, 1999) presents a more complete description of statutory constraints for managing water resources in the Yakima Project.

1.6 Yakima River Basin Background and History

1.6.1 Location and Setting

The Yakima River basin is located in south-central Washington, bounded on the west by the Cascade Range, on the north by the Wenatchee Mountains, on the east by the Columbia River drainage, and on the south by the Horse Heaven Hills. The Yakima River originates in the Cascade Mountains near Snoqualmie Pass and flows southeasterly for about 215 miles to its confluence with the Columbia River near Richland, Washington. The Yakima River basin encompasses about 6,155 square miles and includes portions of Benton, Kittitas, Klickitat, and Yakima Counties (Figure 1-1).

The basin varies considerably from the higher mountain altitudes (elevation 8,184 feet in the Cascades) to the semiarid lower Yakima Valley (elevation 340 feet at the Yakima River confluence with the Columbia River). The western and northern mountains receive about 140 inches of precipitation annually. The lower valley often receives less than 10 inches of precipitation per year. The higher elevation, northern and western areas are mostly forested and used for timber harvest, cattle grazing, fish and wildlife habitat, and recreation. About one-fourth of this area is designated as wilderness. The middle elevations are primarily used for dry-land and irrigated agriculture, cattle grazing, wildlife management, and military training. The lower elevations in the eastern and southern portions of the basin are primarily used for irrigated agriculture. Agriculture is the main economy of the basin.

The Yakima River and its tributaries are the primary sources for surface water in the basin. Major tributaries include the Kachess, Cle Elum, Teanaway, and Naches Rivers.

The Naches River, which joins the Yakima River at the city of Yakima, has several tributaries, including the American, Bumping, and Tieton Rivers.

1.6.2 Yakima Project

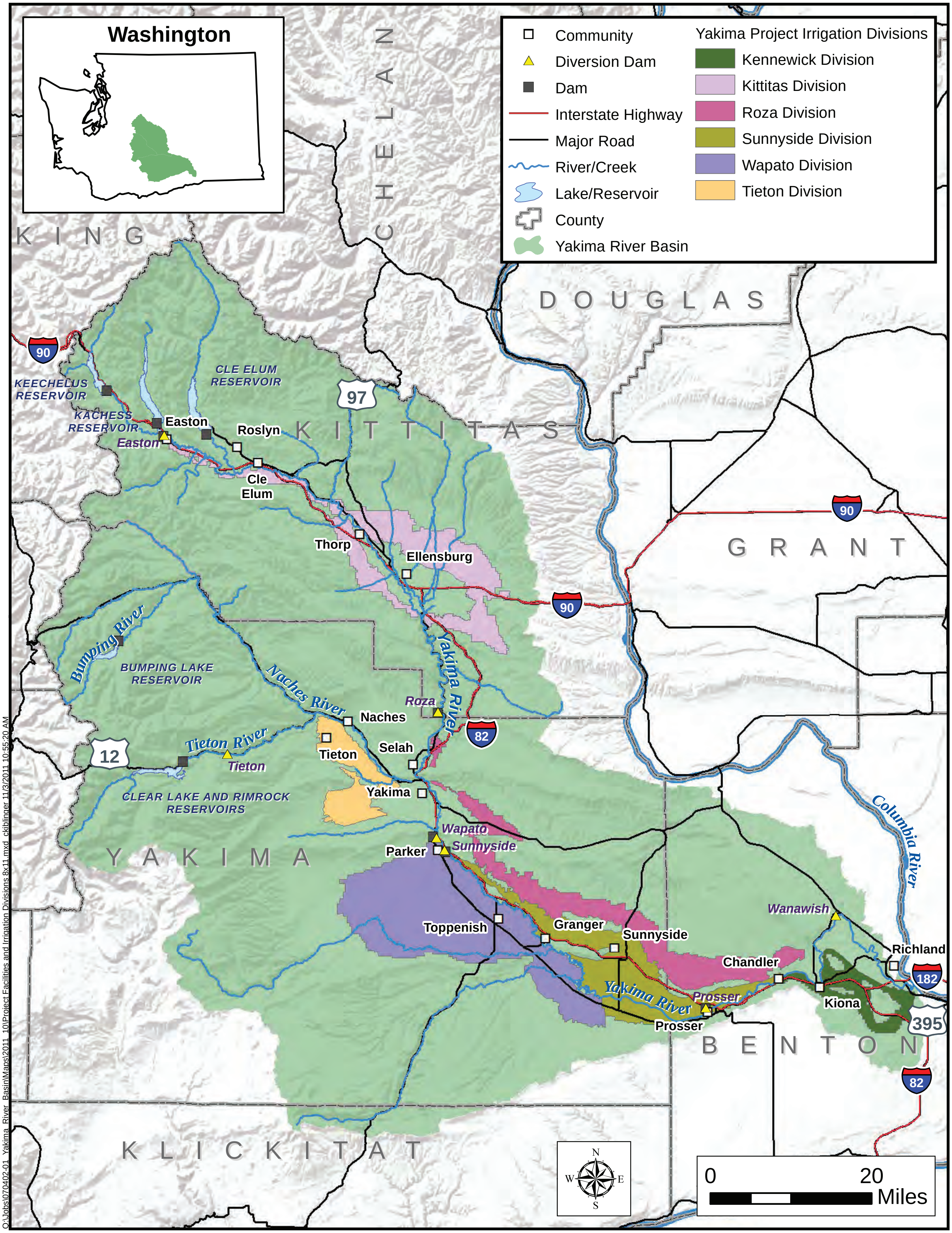
The Yakima Project is composed of seven divisions: six irrigation divisions (Kittitas, Roza, Tieton, Wapato, Sunnyside, and Kennewick), and a storage division (Figure 1-2). The six irrigation divisions provide water to about 450,000 irrigated acres of the Yakima Project and represent about 70 percent of the total diversions of major entities in the Yakima River basin. The remaining 30 percent are made up of other irrigation entities which are mainly nonproratable water right holders. The storage division is composed of the five major reservoirs with a total capacity of about 1,065,400 acre-feet. A sixth reservoir, Clear Lake, has a capacity of 5,300 acre-feet and is used primarily for recreational purposes.

The five major reservoirs—Bumping, Kachess, Keechelus, Rimrock (Tieton Dam), and Cle Elum Lakes—store and release water to meet irrigation demands, flood control needs, and instream flow requirements. Other project features include 5 diversion dams, 420 miles of canals, 1,697 miles of laterals, 30 pumping plants, 144 miles of drains, 2 federally owned powerplants, plus fish passage and protection facilities constructed throughout the project (Reclamation, 2002).

The Kittitas, Roza, Tieton, and Kennewick Divisions each contain a single irrigation district that is responsible for the operation and maintenance of the facilities within its division. The Wapato Division is located within the exterior boundary of the Yakama Nation Reservation and is operated by the Bureau of Indian Affairs (BIA) in consultation with the Yakama Nation and the Wapato Irrigation Project. The Sunnyside Division contains four irrigation districts in addition to two ditch companies and three cities. The Sunnyside Division Board of Control has responsibility for operating and maintaining the joint facilities of the Sunnyside Division (primarily the Sunnyside Main Canal), with Sunnyside Valley Irrigation District operating these facilities on behalf of the Board of Control.

Reclamation operates the six dams and reservoirs of the Storage Division as well as the Roza Powerplant (part of the Roza Division) and the Chandler Pumping and Generating Plant (part of the Kennewick Division). The five major reservoirs are operated as a pooled system with no reservoir or storage space designated for a specific area, division, or entity. Stored water that is not used is carried over to the next year to the benefit of all water users.

Table 1-1 provides information on the six irrigation divisions and the physical sources of the stored water supply.



O:\Jobs\070402-01_Yakima_River_Basin\Maps\2011_10\Project Facilities and Irrigation Divisions 8x11.mxd ckiblinger 11/3/2011 10:55:20 AM

Figure 1-2. Project Facilities and Irrigation Divisions

Table 1-1 Yakima Project Irrigation Divisions and Stored Water Sources

Division	Location (subarea)	Diversion river mile	Stored water source	Operating entity
Kittitas	Upper Yakima	Yakima River RM 202.5	Keechelus and Kachess Reservoirs	Kittitas Reclamation District
Roza	Middle Yakima	Yakima River RM 127.9	Keechelus, Kachess, and Cle Elum Reservoirs	Roza Irrigation District
Tieton	Naches	Naches River RM 14.2	Rimrock Reservoir	Yakima-Tieton Irrigation District
Wapato	Middle Yakima	Yakima River RM 106.7	All reservoirs	BIA and Wapato Irrigation Project
Sunnyside	Middle Yakima	Yakima River RM 103.8	All reservoirs	Sunnyside Division Board of Control
Kennewick	Lower Yakima	Yakima River RM 47.1	Unregulated and return flows	Kennewick Irrigation District

1.6.3 History of Water Management in the Yakima River Basin

Development of irrigation in the Yakima River basin began as early as the 1850s. By 1902, an estimated 122,000 irrigated acres were served by natural flows in the rivers and tributaries. However, even at that time, the natural flow was inadequate to assure a dependable water supply. A petition dated January 28, 1903, from citizens of Yakima County to the Secretary of the U.S. Department of the Interior, requested United States involvement in irrigation. Further irrigation development was not possible unless two things occurred: (1) existing water users had to agree to limit their water use during the low-flow periods of late summer and early fall; and (2) water storage was necessary to capture early season runoff for supplying irrigation water throughout the growing season.

The limitation on water use was accomplished by "limiting agreements" with more than 50 appropriators on the Yakima and Naches Rivers.[3] The development of storage was made possible by the Washington Legislature in March 4, 1905, by granting to the United States the right to exercise eminent domain in acquiring lands, water, and property for reservoirs and other irrigation works. Under this law, a withdrawal of the unappropriated waters of the Yakima River and its principal tributaries was filed by the United States on May 10, 1905. These actions led to the authorization of the Yakima Project on December 12, 1905.

[3] Not all appropriators signed "limiting agreements," and some appropriators' water claims were modified as "heretofore recognized rights."

1.6.4 Related Legal Decisions

A number of legal decisions affect how water is allocated in the Yakima River basin. The major decisions include the following.

1.6.4.1 May 10, 1905, Withdrawal

Using the provisions of Chapter 90.40 RCW, the Secretary of the Interior withdrew all the unappropriated waters of the Yakima River and tributaries for benefit of the proposed Yakima Reclamation Project. The withdrawal was effective from its May 10, 1905, initiation to its December 31, 1951, expiration. In that span of 45 years, water rights were established under Washington law for the developed project facilities.

1.6.4.2 1945 Consent Decree

Disputes over water use from the Yakima River during years of low runoff resulted in litigation in the Federal court. In 1945, the District Court of Eastern Washington issued a decree under Civil Action No. 21 called the *1945 Consent Decree*. The *1945 Consent Decree* is a legal document pertaining to water distribution and water rights in the basin. It established the rules under which Reclamation should operate the Yakima Project system to meet the water needs of the irrigation districts that predated the Yakima Project, as well as the rights of divisions formed in association with the Yakima Project.

The *1945 Consent Decree* determined water delivery entitlements for all major irrigation systems in the Yakima River basin, except for lower reaches of the Yakima River near the confluence with the Columbia River. The *1945 Consent Decree* states the quantities of water to which all water users are entitled (maximum monthly and annual diversion limits) and defines a method of prioritization to be placed in effect during water-deficient years. The water entitlements are divided into two classes—nonproratable and proratable. Nonproratable entitlements are generally held by preproject water users, and these entitlements are to be served first from the total water supply available (TWSA). The *1945 Consent Decree* also spelled out the concept of TWSA, which is defined as: "That amount of water available in any year from natural flow of the Yakima River, and its tributaries, from storage in the various Government reservoirs on the Yakima River watershed and from other sources, to supply the contract obligations of the United States to the Yakima River and its tributaries, heretofore recognized by the United States." The TWSA estimate has an important role in determining operations of the Yakima Project and is estimated using forecasted runoff, forecasted return flows, and storage contents.

All other Yakima Project water rights are proratable, which means they are of equal priority. Any shortages that may occur are shared equally by the proratable water users.

The Federal projects within the basin were constructed to manage water supplies to serve the proratable water users in the basin. The contractors for this water supply repay the Yakima Project storage construction costs and the annual operation and maintenance costs allocated to the irrigation purpose. However, nonproratable entitlements are met first from the TWSA, which includes stored water.

1.6.4.3 Water Right Adjudication

The *1945 Consent Decree* controlled distribution of Yakima Project water in the Yakima River basin between 1945 and 1977. In the spring of 1977, with a drought imminent, Reclamation predicted the proratable water users would receive only 15 percent of their normal water supply. Some proratable water users brought action in the U.S. District Court for the Eastern District of Washington to modify the *1945 Consent Decree* and make all water right holders proratable. The Yakama Nation sought to intervene and also filed a separate action in U.S. District Court to have its treaty-reserved water rights determined. In light of this dilemma, United States District Judge Marshall Neill suggested a State court general adjudication to finally determine water rights in the Yakima River basin.

On October 12, 1977, Ecology filed an adjudication of the Yakima River system in the Superior Court of Yakima County naming the United States and all persons claiming the right to use the surface waters of the Yakima River system as defendants. The purpose of this adjudication was to determine all existing surface water rights within the basin, and to correlate each right in terms of priority with all other rights. At about the same time, the Yakama Nation filed an action in U.S. District Court to determine the priority and water rights of the Yakama Nation under the Treaty of 1855. The Federal case was remanded to the State case, and the filing by the Yakama Nation did not proceed.

An order of the Superior Court was entered on July 17, 1990, regarding the rights of the Yakama Nation. This Partial Summary Judgment defined the treaty-reserved rights of the Yakama Nation, and the rights to flow in the mainstem Yakima River were unanimously affirmed by the Washington Supreme Court on appeal. The treaty rights were divided into separate rights for fish and agriculture.

The Court determined that various acts of Congress, agency actions, and decisions of various tribunals had defined and limited the treaty irrigation rights of the Yakama Nation. This right translated into existing nonproratable irrigation rights with an 1855 priority date, and proratable irrigation rights with a priority date of 1905.

The treaty right for fish had likewise been limited by various acts of the Congress and agency actions and had been compensated in the proceeding before the Indian Claims Commission (ICC), Docket No. 147. The flow right was held to be the "specific minimum instream flow necessary to maintain anadromous fish life in the river, according to the annual prevailing conditions as they occur and determined by the Yakima Field Office Manager in consultation with the Yakima River Basin System Operations Advisory Committee, Irrigation Districts and Company managers and others." This decision was later extended to include all tributaries that support fish at the Yakama Nation's usual and accustomed fishing locations. The priority date for the treaty fishing right is "time immemorial."

The relationship of the *1945 Consent Decree* to the State's adjudication proceeding was addressed by the Superior Court in 1993 (Memorandum Opinion Re: Threshold Issues). The Court held that the *1945 Consent Decree*, in and of itself standing alone, did not establish any water rights. However, it did "memorialize the appropriations thereto made" (pre-1945). Water right claimants had the burden of addressing changes in the appropriations after 1945. The Court further stated, "Once this case is concluded . . . the final judgment herein would supersede that (1945) Decree."

The Superior Court has issued most of the Conditional Final Orders (CFO) which confirm the surface water rights for the Yakima River basin. The Court is proceeding to prepare the *Final Decree*. The United States has been issued its CFO, including the water rights for the Yakima Project. These are the surface water rights upon which any water rights changes under the Integrated Plan will be based.

1.6.4.4 February 17, 1981, Withdrawal

In a February 13, 1981, letter to Ecology, referenced *Withdrawal of Waters for Yakima River Basin Water Enhancement Study*, Reclamation filed notice that it ". . . intends to make examinations and surveys for the utilization of the unappropriated waters of the Yakima River and its tributaries for multipurpose use under the Federal Reclamation laws."

Reclamation certified on January 16, 1982, that the project was feasible and that investigations would be made in detail. Pursuant to RCW 90.40.030, this certification of feasibility continued the withdrawal until January 18, 1985. Reclamation has continuously renewed this withdrawal, and it remains active.

The current withdrawal of Yakima River basin unappropriated surface water is for benefit of the Yakima River Basin Water Enhancement Project (YRBWEP).

1.7 Prior Investigations and Activities in the Yakima Basin

This section highlights the more recent investigations and activities to develop additional water supplies in the Yakima River basin, beginning with the 1976 *Bumping Lake Enlargement—Joint Feasibility Report* (Reclamation and Service, 1976).

1.7.1 Bumping Lake Enlargement

The *Bumping Lake Enlargement Joint Feasibility Report* was prepared in 1976 by Reclamation and the Service. The purpose of this feasibility study, authorized by the Act of September 7, 1966 (Public Law 89–56), and the Fish and Wildlife Coordination Act (FWCA), was to address the water-related problems and needs of the Yakima River basin. A preliminary feasibility report was completed in March 1968 on construction of a new dam about 1 mile downstream from the existing Bumping Lake Dam on the Bumping River, a tributary in the Naches River drainage.[4] The report was forwarded to the Secretary of the Interior for consideration. During this process, the compatibility of

[4] The proposed capacity of the enlarged Bumping Lake was about 458,000 acre-feet, including the existing 33,700 acre-feet of the existing reservoir, which would be inundated.

recreation development with the Cougar Mountain (William O. Douglas) Wilderness Area then under consideration became a concern. It was determined that the recommended plan should be reevaluated and modified.

Following appropriations for the reevaluation work in 1974, the revised feasibility report was resubmitted to the Commissioner of Reclamation and the Director, U.S. Fish and Wildlife Service, in 1976. It was approved by the Secretary of the Interior in 1979. Reclamation filed the *Proposed Bumping Lake Enlargement, Final Environmental Impact Statement* with the Council on Environmental Quality on August 23, 1979 (Reclamation, 1979). Bills were introduced in Congress in 1979, 1981, and 1985 to authorize construction of the Bumping Lake enlargement, but Congress did not take action.

1.7.2 Yakima River Basin Water Enhancement Project

The 1977 drought in the Yakima River basin prompted legislative action for additional water supply. In 1979, the Washington Legislature provided $500,000 for ". . . preparation of feasibility studies related to a comprehensive water supply project designed to alleviate water shortage in the Yakima River basin." Also in 1979, Congress authorized, provided funds for, and directed the U.S. Department of the Interior to ". . . conduct a feasibility study of the Yakima River Basin Water Enhancement Project in cooperation with the State" (Act of December 28, 1979, Public Law 96–162).

Under the Yakima River Basin Water Enhancement Project (YRBWEP) legislation, some 35 potential storage sites outside of the Yakama Reservation have been evaluated since the 1980s. Two sites, Bumping Lake enlargement[5] and Wymer dam and reservoir[6], emerged as the preferable storage sites. The enlarged Bumping Lake Reservoir had previously been studied at the feasibility level. Wymer Reservoir was brought to a feasibility level of evaluation in 1985.

As planning was underway for YRBWEP, some early implementation actions were identified. These actions resulted in a cooperative Federal, State, Tribal, and local undertaking to construct "state-of-the-art" fish ladders and fish screens at water diversion points throughout the Yakima River basin. This is commonly referred to as Phase I of the YRBWEP and was initiated in the early 1980s. Fish ladders and fish screens have been completed at diversions on the Yakima and Naches Rivers and at tributary diversions.

In 1987 and 1988, considerable effort was made by the Washington congressional delegation to structure a comprehensive solution to the water needs of the Yakima River

[5] Bumping Lake enlargement capacities considered were 250,000, 400,000, and 450,000 acre-feet (including the existing 33,700-acre-foot capacity).

[6] The Wymer Dam and Reservoir Alternative is an off-channel site adjacent to the Yakima River, about 6 miles upstream of Roza Diversion Dam. The Wymer Reservoir capacity was about 142,000 acre-feet.

basin in lieu of continuing with the adjudication. The impetus for this effort was the desire to reach a mutual water right settlement by means of Federal-State comprehensive legislation providing for further development of water resource facilities and stipulating the Yakima River basin's surface water rights among the parties. However, in the fall of 1988, this effort was abandoned with the decision of some of the off-reservation irrigators to pursue the adjudication process rather than a stipulated settlement.

Subsequently, in the early 1990s, there was renewed interest in continuing the YRBWEP study process. As a result, Title XII of the Act of October 31, 1994, Public Law 103–434 (commonly referred to as Phase II of the YRBWEP), was enacted. This legislation authorized implementation and study of primarily nonstorage components for YRBWEP. The study and implementation results were to be the basis for future YRBWEP Phase III legislation which was expected to include elements such as construction of water storage features that would be needed for a complete YRBWEP plan to meet habitat, agricultural, municipal, and industrial needs of the basin. The actions that evolved from Title XII are discussed below.

1.7.2.1 Yakima River Basin Water Conservation Program

The Yakima River Basin Water Conservation Program (the centerpiece of the Title XII legislation) is a voluntary program structured to provide economic incentives with cooperative Federal, State, and local funding to stimulate the identification and implementation of structural and nonstructural agricultural water conservation measures in the Yakima River basin. Improvements in the efficiency of water delivery and use will result in improved, reach-specific streamflows for aquatic resources and improve the reliability of water supplies for irrigation.

The *Basin Conservation Plan*, prepared by the Yakima River Basin Conservation Advisory Group (1998)[7], was submitted to the Secretary of the Interior in 1998 and published and distributed in October 1999. The *Basin Conservation Plan* sets forth the mechanism for implementing water conservation measures, including eligibility requirements for Federal- and State-sponsored grants, standards for the scope and content of water conservation plans, criteria for evaluating and prioritizing conservation measures for implementation, and administrative procedures.

1.7.2.2 Yakima River Basin Water Enhancement Project, Washington, Final Programmatic Environmental Impact Statement

In January 1999, Reclamation prepared the *Yakima River Basin Water Enhancement Project, Washington, Final Programmatic Environmental Impact Statement* (Reclamation, 1999). A Record of Decision was signed in 1999. As specific actions

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[7] Chartered under the Federal Advisory Committee Act and appointed by the Secretary of the Interior.

authorized by Title XII are pursued, NEPA compliance was and will continue to be developed as appropriate and to a great extent will be "tiered" from the 1999 EIS.

1.7.2.3 Report on Biologically Based Flows

The System Operation Advisory Committee (SOAC) consists of Yakima River basin biologists representing Federal, State, Tribal, and irrigation agencies and entities. The SOAC provides information, advice, and assistance to Reclamation on aquatic-related issues concerning operation of the Yakima Project. Pursuant to Title XII, SOAC was directed to assess the target flows included therein "for the purpose of making a report with recommendations to the Secretary and the Congress evaluating what is necessary to have biologically based flows." This report was provided to the Secretary of the Interior in May 1999.

The purpose of the SOAC report was to review the factors affecting anadromous fish resources in the Yakima River basin and to recommend processes and procedures required to determine biologically based flows for increasing the abundance of salmon and steelhead. The SOAC suggested that river management should embrace the concept of a normative flow regime and that effects of flow management could be evaluated with such indicators as anadromous fish early life stage survival, smolt production, and habitat quality indices.[8] The SOAC provided nine recommendations as a part of a comprehensive program designed to recover the aquatic ecosystem and the anadromous salmonid populations that depend on it.

1.7.2.4 The Reaches Project: Ecological and Geomorphic Studies Supporting Normative Flows in the Yakima River Basin

The SOAC report recommended a comprehensive review and synthesis of available data on Yakima River flow management, water quality, habitat condition, land use activities, and biological communities. The purpose was to identify areas in the watershed where changes in water management or Yakima Project operations offer the greatest potential to recover the aquatic ecosystem. This activity was led by Jack Stanford of the University of Montana's Flathead Lake Biological Station in conjunction with Reclamation and the Yakama Nation. Results are documented in *The Reaches Project: Ecological and Geomorphic Studies Supporting Normative Flows in the Yakima River Basin, Washington* (Stanford et al., 2002).

The report concludes that the distribution and concentration of algae, macro-invertebrates, and fish on the five major floodplain reaches of the Yakima River basin system clearly demonstrate the importance of off-channel habitat and indicates these floodplains have significant potential for restoration. It also suggests the Yakima River

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[8] The SOAC defined a normative flow regime as one that represents historic flow conditions to the greatest extent possible given the cultural, legal, and operational constraints associated with river basin development.

system could be restored to a normative condition and that the floodplain reaches retain some ecological integrity but are substantially degraded. Because of this degradation, these reaches cannot sustain enhanced runs of salmon and steelhead without restoration of more normative flows throughout the mainstem Yakima and Naches Rivers.

1.7.2.5 Interim Comprehensive Basin Operating Plan for the Yakima Project

The *Interim Comprehensive Basin Operating Plan for the Yakima Project* (*IOP*) was completed by Reclamation in 2002. The preparation of the IOP was mandated by Title XII to provide a general framework within which the Yakima Project is operated. The IOP presents a historical context of the Yakima Project and its current operation. It describes the Yakima Project's legal and institutional aspects, articulates the impacts of Yakima Project operation on the natural resources of the basin, analyzes various operational alternatives, and recommends strategies and operational changes to address the goals of Title XII.

1.7.3 Yakima River Watershed Council

The Yakima River Watershed Council (Watershed Council) was formed in March 1994 as a nonprofit organization. Its membership included more than 800 individuals representing water-based interests in the Yakima River basin. A primary objective of the Watershed Council was to develop strategies and a plan to provide consistent and adequate water to meet the economic, cultural, and natural environmental needs in the Yakima River basin.

The first activity of the Watershed Council toward developing a plan was to issue a report in July 1996, called the *State of the Water Resources of the Yakima River Basin.* This was an assessment of problems and needs from the perspective of water supply, water quality, and water management.

Following development of planning goals, the Watershed Council prepared the draft plan, *A 20/20 Vision for a Viable Future of the Water Resource of the Yakima River Basin* (1997). A review and comment period followed, and the council issued a revised plan dated June 9, 1998. This included a critique of the storage sites considered in the YRBWEP investigations.

During this same timeframe, the Tri-County Water Resources Agency was formed (1995), and the Washington Legislature enacted the State of Washington Watershed Management Act (1997). Subsequently, the Tri-County Water Resources Agency received a Washington State planning grant for Yakima River basin watershed planning. Due to these actions, the Yakima River Watershed Council terminated its activities in July 1998 and did not finalize the draft report.

1.7.4 Watershed Assessment and Watershed Management Plan, Yakima River Basin

The Yakima River Basin Watershed Planning Unit was formed in 1998 to develop a comprehensive watershed management plan for the Yakima River basin. The Yakima River Basin Watershed Planning Unit represented local governments, citizens and landowners, irrigation districts, conservation districts, State agencies, and others. With the assistance of the Tri-County Water Resources Agency (currently known as the Yakima Basin Water Resources Agency), a *Watershed Assessment, Yakima River Basin* (2001) and *Watershed Management Plan, Yakima River Basin* (2003) were completed. The *Watershed Management Plan, Yakima River Basin* covers the entire Yakima River basin with the exception of the Yakama Nation Reservation.

The *Watershed Management Plan, Yakima River Basin* provides a "road map" for maintaining and improving the Yakima River basin's economic base, planning responsibility for expected growth in population, managing water resources for the long-term, and protecting the basin's natural resources and fish runs. Seven goals for a balanced management of water resources were addressed. The following four goals are directly related to the management of surface water:

- Improve the reliability of surface water supply for irrigation use;
- Provide for growth in municipal, rural, domestic, and industrial demand;
- Improve instream flows for all uses with emphasis on improving fish habitat; and
- Maintain economic prosperity by providing an adequate water supply for all uses.

The Plan included evaluations of water resource needs and supplies. Alternatives for improving water supplies for aquatic resources and future municipal needs and to meet dry-year irrigation deficiencies were identified and evaluated.

1.7.5 Yakima Subbasin Plan

The Yakima Subbasin Fish and Wildlife Planning Board (renamed the Yakima Basin Fish and Wildlife Recovery Board [http://www.YBFWRB.org]) completed a draft *Yakima Subbasin Plan* in May 2004. This plan was part of the Northwest Power and Conservation Council's (NPCC) process to guide the selection of projects funded by the Bonneville Power Administration (BPA) for the protection, restoration, and enhancement of fish and wildlife affected by the Federal hydropower system. Further clarification of the draft *Yakima Subbasin Plan* was requested by NPCC before consideration for adoption into its Fish and Wildlife Program. The *Supplement*, dated November 26, 2004, was then prepared.

The *Supplement* identifies the key factors limiting the biological potential of representative ("focal") species, the biological objectives to address each limiting factor, and management strategies to achieve success for each objective. The *Yakima Subbasin Plan and Supplement* was adopted by NPCC into its Fish and Wildlife Program.

1.7.6 Yakima Steelhead Recovery Plan

In 1999, the National Marine Fisheries Service (NMFS) classified Middle Columbia River steelhead as a threatened species under the Endangered Species Act. In 2006, NMFS revised its listing to apply only to the anadromous (ocean-going) form of *Onchorynchus mykiss*, commonly known as steelhead. This listing applies to steelhead that spawn in a large portion of central and eastern Washington and Oregon. The Yakima Basin Fish and Wildlife Recovery Board, a locally based organization governed by representatives of Yakima, Benton, and Kittitas Counties, the Yakama Nation, and cities in the basin, prepared the 2007 *Yakima Steelhead Recovery Plan* for those listed Middle Columbia River steelhead that spawn in the Yakima River basin.

The 2007 *Yakima Steelhead Recovery Plan* was incorporated into the NMFS *Columbia Steelhead Recovery Plan*, which was released in draft form on September 24, 2008, and released in final in September 2009.

1.8 Fish Recovery Efforts

A number of Federal, State, local, and private efforts have been working to improve fish habitat and fish populations in the Yakima River basin. The major fish recovery efforts are summarized in this section. Many other efforts in the basin, such as the YRBWEP Phase II conservation program described above, support fish recovery efforts.

1.8.1 Reclamation Improvements to Existing Facilities

Reclamation plans and constructs improvements to existing facilities when funding and priorities under existing programs allow. These projects benefit both water supply and fish passage. One such completed project was the Roza Dam roller gate improvements. Roza Dam was built with two 110-foot-wide roller gates that allow for the passage of Yakima River flow in excess of Roza Canal diversion requirements. During normal operation, the roller gates lift up to discharge water underneath the gates. Instead of opening a gate to let excess water flow underneath the gate, the roller gate can be lowered beyond the closed position to allow water to spill over the top of the gate. This process of lowering the roller gates past the closed position is known as “tucking.” The roller gates currently hinder smolt outmigration unless “tucked” periodically to allow surface spill. When no surface spill occurs at Roza Dam, downstream migrating fish must either navigate through the fish screen bypass which is located in slackwater with poor attraction flows, or swim deep and encounter high pressures and velocities to pass through a small slot near the bottom of the dam structure. The passage obstacle at Roza Dam increases overall travel time for migrants, prolongs exposure to predation in the dam pool, and may physically harm passing fish. Reclamation modified the spill gates to allow some surface spill to be maintained under all conditions.

1.8.2 Yakima River Side Channels Project

This project was initiated in 1997 and is ongoing. It is comanaged by the Washington Department of Fish and Wildlife (WDFW) and the Yakama Nation under the

Yakima/Klickitat Fisheries Project (YKFP). The Yakima River Side Channels Project is funded on a biennial basis through the NPCC Fish and Wildlife Program administered by BPA. Objectives include habitat protection and restoration in the most productive reaches of the Yakima River basin. The geographic focus includes Easton, Ellensburg, Selah, and Union Gap reaches on the Yakima River and the Gleed reach in the lower Naches River. These areas were identified through the Reaches Project (Stanford et al., 2002). See Section 1.7.2.4 of this document for additional information on the Reaches Project. Active habitat restoration actions include reconnecting structurally diverse alcoves and side channels, introducing large woody debris, fencing, and revegetating riparian areas.

1.8.3 Yakima Tributary Access and Habitat Program

The Yakima Tributary Access and Habitat Program (YTAHP) is a multiparty effort to restore fish passage to Yakima River tributaries that historically supported salmon and to improve habitat in areas where fish access is restored. BPA has funded the program since 2001, with additional funding for individual projects coming from BPA and other sources, including the Salmon Recovery Funding Board (SRFB), Ecology’s Water Infrastructure Program, the Community Salmon Fund, and other local, State, and Federal programs. Funded participants include Kittitas and North Yakima County Conservation Districts, WDFW, Yakama Nation, and South Central Washington Resource Conservation and Development. Other partners include the Kittitas Conservation Trust, Mid-Columbia Regional Fisheries Enhancement Group, Benton Conservation District, and Ecology. Projects funded through YTAHP are primarily fish screening and fish passage improvements, but also include riparian plantings, fencing, and irrigation system improvements that improve fish habitat conditions.

1.8.4 Yakima/Klickitat Fisheries Project

The Yakima/Klickitat Fisheries Project (YKFP) is a joint project of the Yakama Nation and WDFW, and is sponsored in large part by BPA with oversight and guidance from the NPCC. The YKFP is committed to salmon reintroduction through supplementation and habitat protection and restoration. It is designed to use artificial propagation in an attempt to maintain or increase natural production while maintaining long-term fitness of the target population and keeping ecological and genetic impacts to non-target species within specified limits. The YKFP is also designed to provide harvest opportunities. The purposes of the YKFP are to enhance existing stocks of anadromous fish in the Yakima and Klickitat River basins while maintaining genetic resources; reintroduce stocks formerly present in the basins; and apply knowledge gained about supplementation throughout the Columbia River Basin.

Species currently being enhanced by the YKFP and the Yakama Nation Fisheries Program include spring, summer and fall Chinook salmon, coho salmon, sockeye salmon, and steelhead trout. A fall Chinook salmon supplementation program began in the Yakima basin in 1983 (Yakama Nation, 2007). Spring Chinook supplementation has been occurring since 1997. Coho supplementation in the Yakima basin began in 1995 (Dunningan et al., 2002; Yakama Nation, 2004); however, the Yakama Nation has been releasing hatchery coho in the basin since the mid 1980s. The Yakama Nation has been conducting an interim fish reintroduction program since 2005 at Cle Elum Reservoir. The reintroduction includes coho salmon and sockeye starting in 2010.

1.8.5 Kittitas Conservation Trust

The Kittitas Conservation Trust implements conservation actions along the mainstem Yakima River and its tributaries. Funding sources include cost share matches such as the SRFB and YTAHP. Projects funded include the Swauk Creek Water Storage Study, the Currier Creek Barrier Removal, Taneum Creek Fish Passage Improvements, and North Fork Teanaway River Conservation Easements.

1.8.6 Salmon Recovery Funding Board Supported Projects

In 1999, the Legislature created the SRFB to administer State and Federal funds to protect and restore salmon habitat in Washington State. Funding comes from the sale of State general obligation bonds and the Federal Pacific Coastal Salmon Recovery Fund, and grants are awarded annually based on a public, competitive process. The Yakima Basin Fish and Wildlife Recovery Board (YBFWRB) is the lead entity responsible for coordinating SRFB grant applications in Yakima, Benton, and Kittitas Counties. Funding has been used for projects such as providing fish passage and screening at small irrigation diversions, planting riparian areas, acquiring and protecting land with high-priority fish habitat, restoring natural stream channel functions, and promoting fish-friendly agricultural practices.

1.8.7 Yakima County Comprehensive Flood Hazard Management Plans

As part of its Comprehensive Flood Hazard Management Plans, the Yakima County Flood Control Zone District (District) is currently implementing habitat restoration projects. These projects were identified in the Upper Yakima Comprehensive Flood Hazard Management Plan which was completed in 2007. The Plan includes the floodplain of the mainstem Yakima River from the mouth of Yakima Canyon to Union Gap and the Naches River from its mouth to Twin Bridges. Actions currently being implemented under the Comprehensive Flood Hazard Management Plan include floodplain restoration projects at several locations in the lower Naches River and in the Gap-to-Gap reach of the Yakima River. The District is presently working on the Comprehensive Flood Management Plan for Ahtanum and Wide Hollow and also plans to develop a plan for the lower Yakima River. Some actions are being implemented in Ahtanum Creek ahead of completion of the plan. The District is also implementing a study of stream channel functions and how infrastructure has altered the functions of the Yakima River “gaps” which are geologic control points in the river.

1.8.8 Washington State Department of Transportation Programs

The Washington State Department of Transportation (WSDOT) has various programs focused on meeting its stewardship goals of avoiding and minimizing environmental and habitat disturbance. Ongoing projects include wetlands mitigation, maintenance of habitat connectivity, and fish passage restoration. In Yakima and Kittitas Counties, WSDOT has funded over $2 million for fish passage barrier projects. The WSDOT 10-year fish passage project funding plan (2007-2019) includes funding for a project at Silver Creek, along Interstate 90 at mile post 70.9. Through its habitat connectivity and wetlands mitigation programs, WSDOT will continue to contribute funding to the Cascade Land Conservancy, the Kittitas Conservation Trust, YKFP, and other entities for land acquisition and conservation easements aimed at maintaining wildlife movement corridors and improving floodplain habitat function. WSDOT also funds restoration projects through its Chronic Environmental Deficiencies Program which identifies areas of State highways that are subject to chronic repair needs associated with impacts from stream channel erosion and flooding.

1.8.9 Conservation Projects by Private Organizations

Private conservation groups such as the Cascade Conservation Partnership, the Mountains to Sound Greenway Trust, and the Cascade Land Conservancy purchase and protect land for wildlife habitat and public benefit. Groups such as the Washington Water Trust and the Washington Rivers Conservancy have been actively purchasing or leasing water rights to improve instream flow in the Yakima River basin. These groups depend on a variety of public and private funding and have been successful in acquiring and protecting property from development activities.

A recent project was the acquisition of water rights in Manastash Creek. The water rights purchase program is part of the Manastash Creek Restoration Project Instream Flow Enhancement Implementation Plan. This project is part of a Memorandum of Understanding between the Manastash Creek Irrigators, BPA, WDFW, Kittitas County Conservation District (KCCD), and Washington Environmental Council (WEC).

In fall 2008, KCCD, Washington Rivers Conservancy, and Ecology conducted a reverse auction to purchase water rights on Manastash Creek. As a result of the auction, approximately 3 cfs will be left in the stream during the first half of the irrigation season until June 30, and approximately 1.5 cfs will be left in the stream until the end of the season on October 31.

1.8.10 Yakima Storage Dam Fish Passage Study

Reclamation is leading a cooperative investigation with the Yakama Nation, State and Federal agencies, and others to study the feasibility of providing fish passage at the five large storage dams of the Yakima Project. These dams—Bumping Lake, Kachess, Keechelus, Cle Elum, and Tieton—were never equipped with fish passage facilities. Four of the five reservoirs were originally natural lakes and historically supported Native American fisheries for sockeye salmon and other anadromous and resident fish (Reclamation, 2003).

The *Cle Elum Dam Fish Passage Facilities and Fish Reintroduction Project Final EIS* was issued in April 2011 (Reclamation and Ecology, 2011c). The *Final Planning Report Cle Elum Dam Fish Passage Facilities* was also completed in April 2011 (Reclamation, 2011b). The NEPA Record of Decision (ROD) issued on August 12, 2011, recommended a preferred alternative for upstream and downstream fish passage.

1.9 Recent Activities that Led to Development of the Integrated Plan

Actions leading to development of the Integrated Plan are displayed in Figure 1-3 which illustrates the timeline of YRBWEP activities.

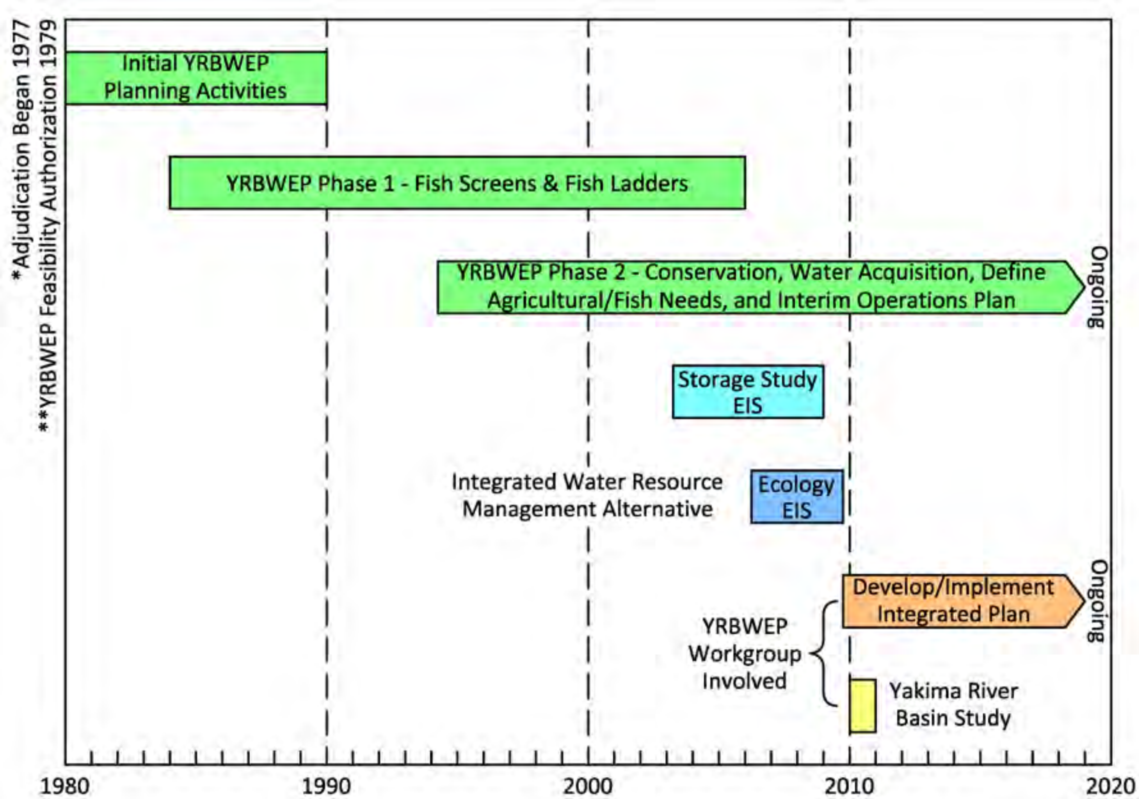

Figure 1-3 Yakima River Basin Water Enhancement Project Timeline

1.9.1 Yakima River Basin Water Storage Feasibility Study Planning Report and EIS (Storage Study)

In 2003, Congress directed Reclamation to conduct a feasibility study of options for additional water storage in the Yakima River basin. The authorization for the study is contained in Section 214 of the Act of February 20, 2003 (Public Law 108-7). The authorization states that the study will place "… emphasis on the feasibility of storage of Columbia River water in the potential Black Rock Reservoir and the benefit of additional storage to endangered and threatened fish, irrigated agriculture, and municipal water supply."

Reclamation began the Storage Study in May 2003. The State of Washington joined Reclamation in that effort after funding was provided in the State's 2003-2005 capital budget.

In 2007, Reclamation and Ecology initiated environmental review for the Storage Study. The Draft Planning Report/EIS was prepared as a combined NEPA and SEPA document, entitled the *Yakima River Basin Water Storage Feasibility Study Draft Planning Report/EIS* (Reclamation and Ecology, 2008).

Reclamation believed that the congressional authorization for the 2003 Storage Study limited the range of alternatives that it could consider in the EIS to the Black Rock Reservoir and other potential storage facilities in the Yakima River basin. The alternatives considered by Reclamation were:

- No Action Alternative;
- Black Rock Reservoir Alternative;
- Wymer Dam and Reservoir Alternative; and
- Wymer Dam Plus Yakima River Pump Exchange Alternative.

These storage facilities were referred to as the “Joint Alternatives” in the January 2008 Draft Planning Report/EIS. Under its SEPA authority, Ecology determined that both storage and nonstorage means of achieving the congressional objectives needed to be evaluated. Thus, the January 2008 Draft Planning Report/EIS considered three “State Alternatives” in addition to the Joint Alternatives:

- Enhanced Water Conservation Alternative;
- Market-Based Reallocation of Water Resources Alternative; and
- Groundwater Storage Alternative.

Reclamation and Ecology held a public comment period on the January 2008 Draft Planning Report/EIS from January 29 to March 31, 2008. A number of the comments received asserted that Reclamation and Ecology had failed to evaluate an adequate range of reasonable alternatives, and that the alternatives that had been evaluated were analyzed outside of the context of fish habitat and passage needs for the Yakima River basin. Ecology consulted with Reclamation concerning whether additional alternatives should be evaluated. Ecology concluded that the scope of the EIS should be expanded; however, Reclamation determined that its congressional authorization precluded it from expanding its analysis under NEPA. Therefore, Ecology decided to separate from the joint NEPA/SEPA process for the study and to pursue completion of a stand-alone SEPA EIS (see Section 1.9.2). Ecology continued to act as a cooperating agency for Reclamation’s NEPA process while Reclamation acted in a similar capacity for the SEPA process. Reclamation pursued completion of the Final Planning Report/EIS for the Storage Study, while Ecology prepared a SEPA Supplemental Draft EIS and a Final EIS.

Reclamation released its Final Planning Report/EIS on December 29, 2008. The Final Planning Report/EIS included only the storage facilities in the Joint Alternatives and responses to comments on the Joint Alternatives. The Final Planning Report/EIS concluded that none of the storage features by themselves met Federal criteria for an economically and environmentally sound water project and recommended the No Action

Alternative as the Preferred Alternative. On April 3, 2009, Reclamation, in a concluding letter, announced that it had concluded the Yakima River Basin Water Storage Feasibility Study.

A brief summary of the findings of the Final Planning Report/EIS is presented below. The Final Planning Report/EIS should be consulted for details on the environmental analysis.

The Final Planning Report/EIS determined that the Black Rock Reservoir Alternative would have the following major benefits and impacts:

- Add 1.3 million acre-feet of active storage capacity to the basin;
- Meet the dry-year proratable irrigation water supply goal of a minimum of 70 percent in all years;
- Meet municipal water supply needs;
- Increase streamflows in the Yakima River in all seasons;
- Provide increased streamflows in the Yakima River which would generally benefit anadromous fish;
- Increase anadromous fish stocks by 21 to 61 percent and steelhead stocks by 51 percent;
- Cause groundwater to seep toward and through the Hanford Nuclear Reservation, increasing groundwater flow and complicating cleanup efforts at the site, although Reclamation concluded that the seepage could be intercepted;
- Have no negative impacts on water quality in the Columbia or Yakima Rivers if seepage toward the Hanford Site were intercepted;
- Inundate approximately 3,850 acres of shrub-steppe habitat and affect sage-grouse populations;
- Require the acquisition of 13,000 acres of private property and the relocation of a State highway;
- Alter habitat conditions in the Arid Lands Ecology Reserve through construction of seepage mitigation features;
- Cost $4.95 billion to $7.73 billion (2007 dollars) with annual operating costs of $60.2 million ($50 million for energy pumping); and
- Have a benefit-cost ratio of 0.13.

The Final Planning Report/EIS determined that Wymer Dam and Reservoir Alternative would have the following major benefits and impacts:

- Add 162,500 acre-feet of active storage capacity to the basin;
- Meet the dry-year proratable irrigation water supply goal of a minimum of 70 percent in 2 of 6 years;

- Meet municipal water supply needs;
- Increase streamflows in the Yakima River, but not to the extent of Black Rock Reservoir;
- Increase anadromous fish stocks by 1 to 3 percent and steelhead stocks by 1 percent;
- Improve overwintering habitat for juvenile salmonids in the Cle Elum River, but provide no other changes in salmonid habitat;
- Provide cooling in the Yakima River downstream of the discharge point during summer and fall, but cause a slight warming during dry years;
- Adversely impact bighorn sheep wintering habitat and core habitat for mule deer;
- Require the acquisition of 4,000 acres of private property;
- Cost $867 million to $1.34 billion (2007 dollars) with annual operating costs of $3 million ($1.9 million for energy pumping); and
- Have a benefit-cost ratio of 0.31.

The Final Planning Report/EIS determined that Wymer Dam Plus Yakima River Pump Exchange Alternative would have similar impacts to the Wymer Dam and Reservoir Alternative in addition to the following:

- Improve aquatic habitat by leaving water in the river that otherwise would have been diverted by Roza and Sunnyside Irrigation Districts;
- Increase anadromous fish stocks by 11 to 35 percent and steelhead stocks by 24 percent;
- Improve water quality in the middle and lower river because of higher summer flows;
- Require the acquisition of 110 acres of private property in addition to the 4,000 acres required for the dam and reservoir;
- Cost $4.07 billion with annual operating costs of $38 million ($20 million for energy pumping); and
- Have a benefit-cost ratio of 0.07.

1.9.2 Ecology's SEPA Analysis

Based upon comments from the Yakama Nation and Roza Irrigation District, along with other stakeholders, Ecology determined that the alternatives in the PR/EIS were too narrowly focused. The comments recommended that Reclamation and Ecology should consider a wider range of alternatives and that the alternatives should include an integrated approach to benefit all resources including fish passage and habitat improvements in addition to improved storage. In response to those comments, Ecology prepared a separate SEPA Supplemental DEIS, released December 10, 2008, that evaluated an integrated approach to water management in the Yakima River basin. The Integrated Water Resource Management Alternative proposed seven elements for improving water supplies for agricultural and municipal needs and to improve habitat for anadromous and resident fish. The seven elements are fish passage, structural and operational improvements, new or expanded storage reservoirs, groundwater storage, fish habitat improvements, enhanced water conservation, and market-based reallocation of water resources. Ecology prepared its EIS at a programmatic level. The FEIS was issued in June 2009. It presents an integrated package of opportunities to address water resource problems in the Yakima River basin.

1.9.3 YRBWEP Workgroup Process

Following completion of its separate environmental analyses, Reclamation and Ecology decided to continue the process of evaluating options to improve water resources in the Yakima Basin through the YRBWEP process. In April 2009, the two agencies initiated the YRBWEP Workgroup to develop a proposal for an Integrated Water Resource Management Plan that incorporated studies and information developed during more than 30 years of work on water issues in the Yakima River basin. The Workgroup is composed of representatives of the Yakama Nation; Reclamation; the Service; NMFS; Ecology; WDFW; Washington Department of Agriculture; Benton, Kittitas, and Yakima Counties; City of Yakima; American Rivers; Yakima-Tieton Irrigation District; Kittitas Reclamation District; Kennewick Irrigation District; Sunnyside Valley Irrigation District; Roza Irrigation District; Yakima Basin Fish and Wildlife Recovery Board; and Yakima Basin Storage Alliance. Representatives from the Washington State congressional delegations were also invited to participate. The first meeting of the Workgroup was held in Yakima on June 30, 2009. Regular meetings have continued to the present time.

1.9.3.1 Development of Preliminary Integrated Plan

The Workgroup determined that a proposal for a comprehensive and integrated plan should include the seven elements outlined in Ecology's FEIS. The Workgroup developed a preliminary Integrated Plan, and at the end of 2009 agreed to move forward with it. This plan included as part of the seven elements a list of potential water supply actions for surface and groundwater, proposed modifications to existing operations, fish passage at existing reservoirs, a proposed fish habitat enhancement program, and actions related to market reallocation. Hydrologic and fish habitat benefits and funding requirements were also estimated, and a preliminary implementation approach and schedule were outlined. The preliminary Integrated Plan is available at: http://www.usbr.gov/pn/programs/yrbwep/reports/iwrmp/index.html

In early 2010, the Workgroup members supported further evaluation and analysis of the Integrated Plan under funding from the Department of Interior's WaterSMART Basin Study Program. The Basin Study was jointly conducted in 2010 by Reclamation and Ecology.

Through the Basin Study and associated interaction with the Workgroup and its subcommittees, basin needs were specified in greater detail, and actions were further defined, evaluated, and updated. Expected hydrologic, fish habitat, fisheries, and economic effects for the Integrated Plan and the Future without Integrated Plan (FWIP) were also further characterized.

Potential impacts of future climate change were evaluated and factored into the instream and out-of-stream projections for future water availability and demands. Storage and flow projections were modeled for plan elements based on accepted climate change projections.

During preparation of the preliminary Integrated Plan and the Basin Study, Workgroup subcommittees provided input on the Integrated Plan and the supporting technical work. Parallel with subcommittee efforts, potential actions for inclusion in the Integrated Plan were characterized through engineering analyses to refine available information and consider alternative project configurations. Analysis results, along with cost estimates, assessments of barriers and risks, and potential economic effects from the Integrated Plan, were presented at Workgroup meetings during the summer and fall of 2010. Work products were then updated based on Workgroup feedback. The Integrated Plan and supporting technical work are located on Reclamation's web site at: http://www.usbr.gov/pn/programs/yrbwep/2011integratedplan/index.html.

1.9.3.2 Integrated Plan Summary Support Document

An Integrated Plan summary support document was compiled for Workgroup deliberation in the fall of 2010. The summary included proposed Integrated Plan elements and actions, instream and out-of-stream water needs, water supply and fisheries benefits, and a preliminary schedule identifying plan implementation timing, implementation sequence, and triggers for adjusting the plan. It also outlined an approach for plan review and future adaptations, including principles to guide future plan adjustments.

While the Workgroup was preparing to take action on the summary support document, a supplemental effort was underway to strengthen the ecosystem protection and restoration portions of the plan. A group of natural resource conservation community stakeholders developed a proposal for watershed enhancements and a broadly structured program to further enhance the plan's watershed, water supply and ecological restoration goals. The findings from this process were accepted by the Workgroup and incorporated into the Integrated Plan.

In March 2011, after 21 months of meetings, modeling and studies, the Workgroup unanimously agreed to endorse the Integrated Plan Summary Support Document, recommending the elements and actions to include in the Integrated Plan. The Workgroup's proposal is intended for further consideration by Reclamation and Ecology as they proceed with preparing a programmatic EIS which will comply with NEPA and SEPA.

1.10 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. The following major permits, actions, and laws may apply to each alternative:

- National Environmental Policy Act
- Endangered Species Act (ESA)
- Secretary's Native American Trust Responsibilities
- National Historic Preservation Act (NHPA)
- Executive Order 11988: Floodplain Management
- Executive Order 11990: Protection of Wetlands
- Executive Order 12898: Environmental Justice
- Executive Order 13007: Indian Sacred Sites
- Section 401 Certification, Clean Water Act
- Section 402 Permit, Clean Water Act
- Section 404 Permit, Clean Water Act
- State Environmental Policy Act
- Washington Department of Natural Resources Permit
- Additional Points of Diversion Authorization
- State Trust Water Rights Program Participation
- Water use permit/certificate of water right
- Reservoir permit/aquifer storage and recovery
- Dam safety permit
- Shoreline conditional use permit or variance
- Water system plan approval
- Hydraulic project approval
- Critical areas permit or approval
- Floodplain development permit

1.11 Public Involvement

Formulating alternatives to water resource issues 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 YRBWEP Workgroup process. The degree of participation ranged from providing viewpoints and general observations to contributing directly to plan formulation. Chapter 6 summarizes additional public outreach efforts and public input.

1.12 Documents Adopted under SEPA

Pursuant to provisions of the SEPA Rules (WAC 197-11-630), Ecology is adopting the following documents as part of this PEIS to meet a portion of Ecology's responsibilities under SEPA:

- Yakima River Basin Water Storage Feasibility Study Final Planning Report/EIS (Reclamation, 2008g)
- Yakima River Basin Integrated Water Resource Management Alternative Final EIS (Ecology, 2009)
- Lake Roosevelt Incremental Storage Releases Final Supplemental EIS (Ecology, 2008a)
- Columbia River Water Management Program Final EIS (Ecology, 2007b)
- Cle Elum Dam Fish Passage Facilities and Fish Reintroduction Project Final EIS (Reclamation and Ecology, 2011c)

The Yakima River Basin Water Storage Feasibility Study Final Planning Report/EIS addresses impacts associated with water storage proposals in the Yakima River basin, including Wymer Reservoir. Ecology's Yakima River Basin Integrated Water Resource Management Alternative Final EIS evaluated the impacts of an integrated approach to provide water for agriculture, municipal and domestic uses, and fish benefits which formed the basis for the Integrated Plan. The Cle Elum Dam Fish Passage Facilities and Fish Reintroduction Project Final EIS evaluated the impacts of installing fish passage at the dam. These NEPA and SEPA documents are adopted and incorporated by reference to document the potential impacts of water storage, integrated water management, and fish passage facilities. The Lake Roosevelt Incremental Storage Releases EIS and the Columbia River Water Management Programmatic EIS are adopted to document cumulative impacts to water demand in the Columbia River Basin.

The Notice of Adoption for these documents is included as Appendix A.

1.13 How to Read this Document

This DPEIS is organized into seven chapters:

- Chapter 1 provides background information on the YRBWEP Integrated Plan, the purpose and need for the action, study authorities, relevant background information on the study area, history of water management in the Yakima River basin, prior studies and activities dealing with local water management issues, and a brief description of public involvement.
- Chapter 2 presents a description of the Integrated Plan alternatives. The chapter also summarizes how the alternatives were developed and describes alternatives considered but not carried forward to full evaluation.
- Chapter 3 describes the affected environment.

- Chapter 4 evaluates the short-term or construction impacts and proposed mitigation measures associated with the Integrated Plan along with potential cumulative impacts.
- Chapter 5 describes the potential long-term or operational impacts and proposed mitigation measures of the Integrated Plan. In Chapter 5, the potential impacts are evaluated first for the individual elements of the Integrated Plan. This is followed by a discussion of the positive or negative impacts of implementing the elements as an integrated package. A discussion of cumulative impacts is also included in Chapter 5.
- Chapter 6 describes the consultation and coordination that has occurred with various entities in developing this EIS.

The references used in the document follow Chapter 6. Appendices to accompany information presented in this DPEIS are attached at the end of the document.

Chapter 2

ALTERNATIVES

CHAPTER 2.0 ALTERNATIVES

2.1 Introduction

This DPEIS evaluates two alternatives to meet the water supply and ecological restoration needs in the Yakima River basin—the No Action Alternative and the Integrated Water Resource Management Plan (Integrated Plan) Alternative. The Integrated Plan includes a set of comprehensive elements intended to address water resource and ecosystem needs—fish passage and habitat/watershed protection and enhancement to improve conditions for fish; and structural and operational changes, surface water storage, groundwater storage, enhanced conservation, and market reallocation to improve water supply for agriculture, municipal and domestic uses, and streamflows. Reclamation and Ecology, working with the YRBWEP Workgroup, have identified a mix of projects to meet the goals of the Integrated Plan. The environmental impacts of the Integrated Plan are evaluated at a programmatic level in this document, using the identified mix of projects. It is possible that other or additional projects would be developed during implementation of the Integrated Plan; however, those projects are not included in this DPEIS because they have not been developed. All individual projects included in the Integrated Plan would undergo project level NEPA and/or SEPA analysis, as needed, as they are carried forward to implementation.

This chapter describes the two alternatives and the process used to develop them. For the Integrated Plan, the projects that are proposed to meet the goals of the plan are described. This chapter also includes a discussion of alternatives that were considered but eliminated from further study, as well as a summary comparison of the environmental impacts of the two alternatives.

The combination of projects and actions included within the Integrated Plan has been optimized during nearly three years of discussion with the YRBWEP Workgroup and other stakeholders to achieve the objectives outlined in the Purpose and Need statement. Extensive modeling and analyses completed during the Yakima River Basin Study (April 2011) determined that the Integrated Plan Alternative represents the only combination of programs, projects and resource allocations that could feasibly meet the objectives outlined in the Purpose and Need statement. Therefore, only one action alternative is presented in this DPEIS.

During implementation of the Integrated Plan, individual components may be modified as new information becomes available or conditions change. Should these modifications result in substantial changes to the components, supplemental programmatic environmental evaluations will be conducted. Additional information may also become available during project-level review for individual components. Any new information that could result in substantial reshaping of the program or project under consideration would be subject to additional environmental review.

2.2 Alternative Development Process

The Integrated Plan presented in this DPEIS is the result of years of study and proposals to improve water supply and fish habitat in the Yakima basin, including elements and projects identified in Reclamation's Yakima River Basin Water Storage Feasibility Study Planning Report (PR)/EIS (Storage Study) (Reclamation, 2008g) and Ecology's Final EIS on Yakima River Basin Integrated Water Resource Management Alternative (Ecology, 2009). Figure 2-1 illustrates the Supplemental EIS process undertaken by Reclamation and Ecology in 2008 and 2009. The YRBWEP Workgroup further evaluated these elements and projects in the process described in Section 1.9. The result of the Workgroup process is an Integrated Plan of actions to address water supply and fish needs in the basin. This section explains how the Integrated Plan elements and projects were selected. Figure 2-2 illustrates the planning process in developing the Integrated Plan.

2.2.1 Reclamation's Storage Study Planning Report/EIS

As described in Section 1.9, Ecology and Reclamation originally undertook the Storage Study to evaluate alternatives that would provide benefits to irrigated agriculture, future municipal needs, and anadromous fish as part of a joint NEPA/SEPA EIS. Under Reclamation's authority for performing the Storage Study, Reclamation was limited to evaluating a proposed Black Rock Reservoir and other storage options in the Yakima River basin. The storage-only alternatives included Black Rock Reservoir and two options for a Wymer Reservoir. These storage alternatives were jointly considered by Reclamation and Ecology and were referred to as "Joint Alternatives" in the January 2008 Draft Planning Report/EIS (Reclamation and Ecology, 2008). Ecology viewed its responsibility under SEPA to evaluate reasonable alternatives as requiring it to consider alternatives in addition to storage options to meet the State's study objectives. These additional alternatives were described and evaluated separately as "State Alternatives" in the January 2008 Draft Planning Report/EIS. The "State Alternatives" were: Enhanced Water Conservation, Market-based Reallocation of Water Resources, and Groundwater Storage.

Based on comments received on the Draft Storage Study PR/EIS, Ecology began a separate SEPA evaluation of an alternative solution to the Yakima basin's water problems, including consideration of aquatic habitat and fish passage needs. Reclamation completed its NEPA evaluation of the storage alternatives, evaluating only the "Joint Alternatives," and released its Final Storage Study PR/EIS in December 2008.

2.2.2 Ecology's Separate SEPA Analysis

Ecology released a Draft Supplemental EIS in December 2008 that evaluated an Integrated Water Resource Management Alternative. The alternative included the State Alternatives from the Draft Storage Study PR/EIS and additional water management and habitat improvement approaches composed of seven major elements: fish passage, structural/operational changes, surface storage, groundwater storage, fish habitat enhancements, enhanced water conservation, and market-based reallocation of water resources. The Final EIS was released in June 2009. The framework of the Integrated Water Resource Management Alternative provided the basis for the YRBWEP Workgroup development of the Yakima River Basin Study and Integrated Plan described below.

2.2.3 YRBWEP Workgroup Process

In 2009, Reclamation and Ecology convened the YRBWEP Workgroup to more thoroughly review studies and information produced over the past 30 years, including the Storage Study and Ecology's FEIS, with the intent to formulate a comprehensive and integrated solution for the basin's water resource problems, including the basin's related ecosystem needs. The Workgroup is composed of representatives of the Yakama Nation, Federal and State agencies, local governments, an environmental organization, and irrigation districts. Staff representing the State's congressional delegation also attended regularly to observe Workgroup discussions. The Workgroup reached a consensus in December 2009 to move forward with finalizing a proposal for a Preliminary Integrated Plan under the Yakima River Basin Study (Figure 2-2).

The Workgroup continued in 2010 to develop a Basin Study for the Yakima River under funding from the Department of Interior's WaterSMART Basin Study Program. The Basin Study built on the proposed Preliminary Integrated Plan and prior studies and provided additional analysis of water needs as well as a robust analysis of climate change impacts. The Integrated Plan proposal and Basin Study form the basis of the Integrated Plan Alternative evaluated in this DPEIS. Section 1.9.3 of this DPEIS provides additional information on the Workgroup's involvement in developing the alternative.

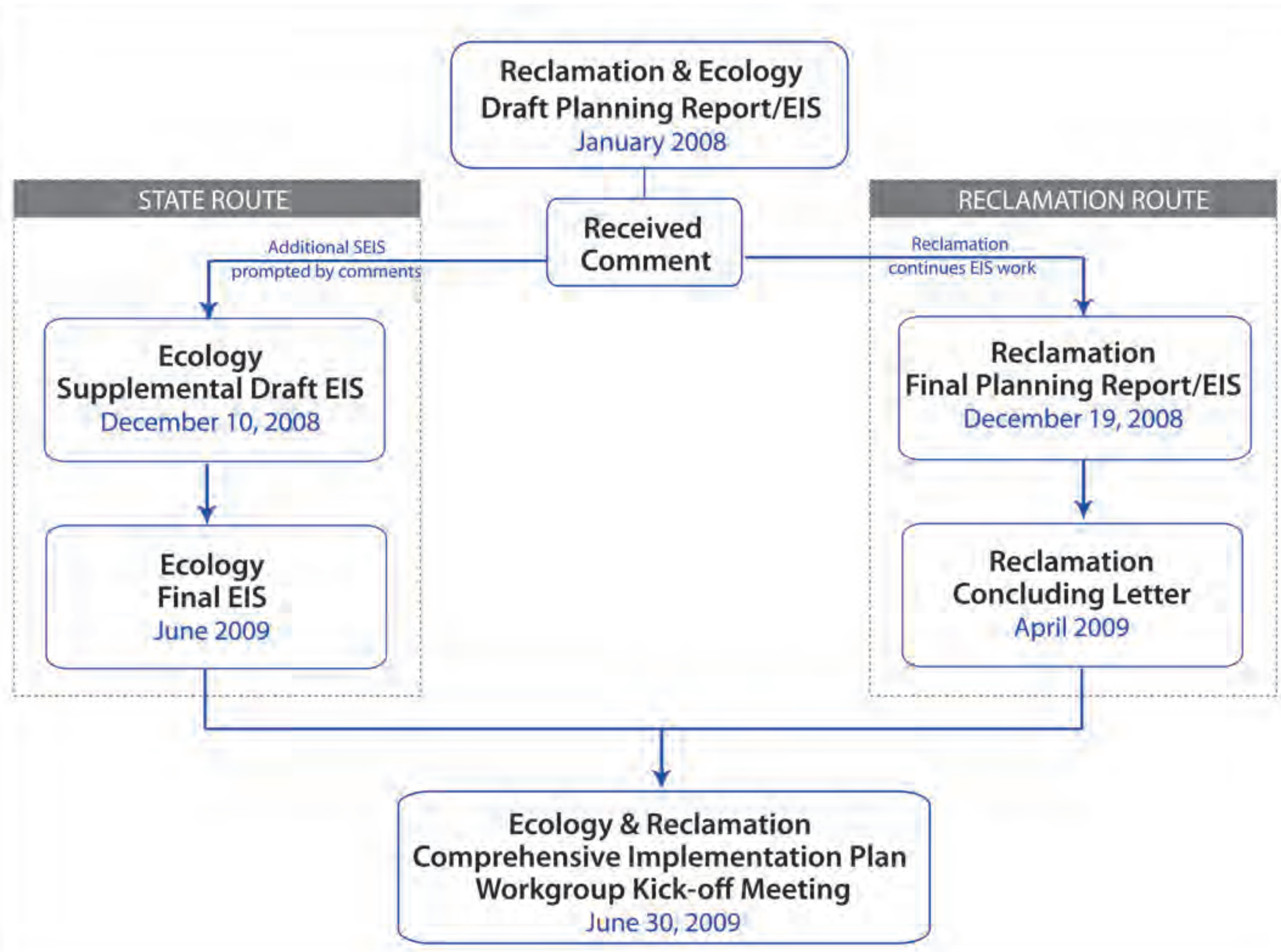

Figure 2-1. Supplemental EIS Process

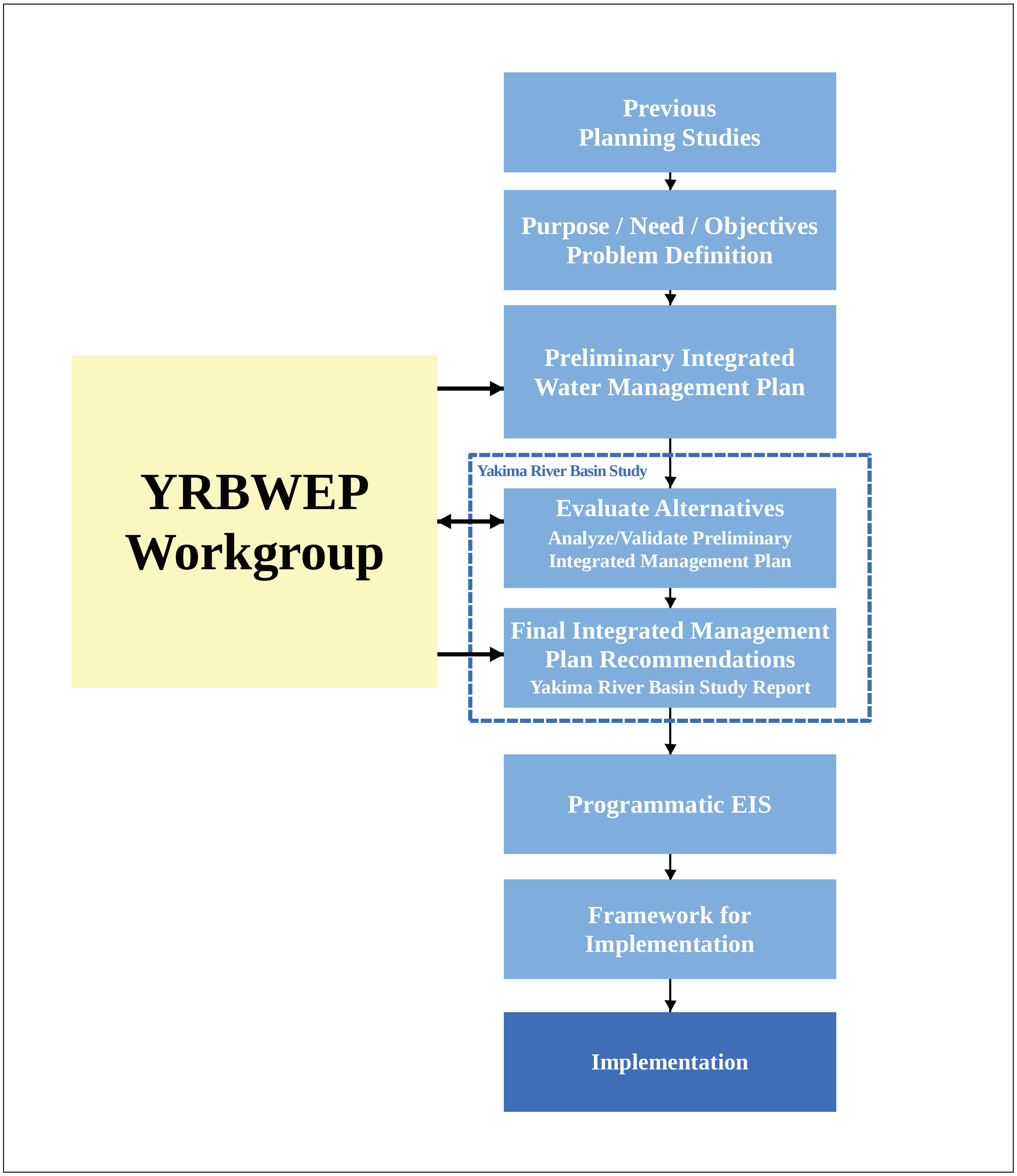

Figure 2-2. Integrated Water Resource Management Planning Process

2.3 No Action Alternative

Under the No Action Alternative, Reclamation and Ecology would not carry out the Integrated Plan Alternative. Reclamation and Ecology would not develop new water storage in the Yakima River basin or expand programs to protect or enhance fish habitat. In addition, Reclamation and Ecology would not implement enhanced water conservation, market reallocation, or groundwater storage. Although Reclamation and Ecology would not implement these actions as an integrated program, various agencies and other entities would likely continue to undertake individual actions to accomplish some water resources improvements. These actions could include small water storage projects, artificial fisheries supplementation programs, fish passage, habitat improvements, water conservation, and water quality improvements. Reclamation would continue to study fish passage options at its major reservoirs in accordance with its Mitigation Agreement with WDFW and its Settlement Agreement with the Yakama Nation. These actions, although beneficial, would only provide slow and partial progress in addressing the water resource problems of the basin. With the No Action Alternative, existing problems with water availability and habitat quality would likely worsen with increased population and climate change.

The No Action Alternative is intended to represent the most likely future expected in the absence of implementing the proposed action. For the purposes of this DPEIS, Reclamation and Ecology consider the No Action Alternative to include projects that are ongoing and ready for implementation. These are projects, actions, and policies that:

- Have been planned and designed through processes outside the Integrated Plan;
- Are authorized and have identified funding for implementation; and
- Are scheduled for implementation.

Several entities in the Yakima River basin, including the Yakama Nation, Reclamation, BPA, U.S. Fish and Wildlife Service (Service), National Marine Fisheries Service (NMFS), Ecology, WDFW, county and municipal governments, local conservation districts, non-profit organizations, and other landowners and managers throughout the basin have been actively involved in storage modification, supplementation, and fish enhancement projects in the past 30 years. Projects, actions, and policies developed by these entities that meet the ready for implementation criteria above described above are considered part of the No Action Alternative.

2.3.1 Ongoing Projects

A number of projects to improve water supply and benefit fish are ongoing in the basin. To the extent that these projects are authorized, funded, and scheduled for implementation, they are considered part of the No Action Alternative.

2.3.1.1 Yakima River Basin Water Enhancement Project

The Yakima River Basin Water Enhancement Project Act of 1994, commonly referred to as YRBWEP Phase 2, provides for a water conservation program with joint Federal and State funding coupled with local matches. The program provides economic incentives to implement structural and nonstructural water conservation measures. As required by YRBWEP Phase 2, a Conservation Advisory Group and Reclamation completed a Basin Conservation Plan in 1999, and implementation of conservation measures identified in the plan is ongoing. This No Action Alternative includes those conservation measures currently being implemented. The Basin Conservation Plan also includes limited provisions to acquire land and water rights on a permanent and temporary basis to improve instream flows. For additional information on YRBWEP, see Section 1.7.2 of this document.

2.3.1.2 Reclamation Improvements to Existing Facilities

Reclamation is responsible for the operation and maintenance of the Yakima Project. Under this responsibility, Reclamation intermittently plans and constructs minor improvements to existing facilities when allowed by funding and priorities under existing programs. These activities sometimes benefit both irrigation supply and fish habitat including passage. Section 1.8.1 explains a recent example of an activity that provided both agricultural and fish passage benefits.

2.3.1.3 Yakima River Side Channels Project

The WDFW and the Yakama Nation are continuing to implement Yakima/Klickitat Fisheries Project (YKFP) projects with funding for the 2011-2012 biennium from BPA. See Section 1.8.2 for additional information on the program. The projects include habitat protection and restoration with a focus on the Easton, Ellensburg, Selah, and Union Gap reaches on the Yakima River and Gleed reach in the lower Naches River. Project types include reconnecting side channels, introducing large woody debris, fencing, and revegetating riparian areas.

2.3.1.4 Yakima Tributary Access and Habitat Program

The YTAHP fish screening and fish passage improvements, riparian plantings, fencing, and irrigation system improvements that improve fish habitat conditions will continue under the No Action Alternative. For additional information on YTHAP, see Section 1.8.3.

2.3.1.5 Yakima/Klickitat Fisheries Project

The Yakama Nation and WDFW are continuing salmon reintroduction efforts through YKFP including reintroductions at Cle Elum Dam as part of fish passage feasibility studies. See Section 1.8.4 for additional information on the project. The YKFP will continue as part of the No Action Alternative.

2.3.1.6 Kittitas Conservation Trust

The Kittitas Conservation Trust will continue to implement conservation actions in the Yakima River basin under the No Action Alternative. See Section 1.8.5 for more information on the projects.

2.3.1.7 Salmon Recovery Funding Board Supported Projects

Under the No Action Alternative, the Yakima Basin Fish and Wildlife Recovery Board (YBFWRB) will continue to implement SRFB funded projects in the Yakima River basin. Funding will provide fish passage and screening at small irrigation diversions, planting of riparian areas, acquiring and protecting land with high priority fish habitat, restoring natural stream channel functions, and promoting fish-friendly agricultural practices. Section 1.8.6 provides more information on the SRFB.

2.3.1.8 Yakima County Comprehensive Flood Hazard Management Plans

Yakima County will continue to implement habitat restoration projects under the No Action Alternative as part of its Comprehensive Flood Hazard Management Plans. See Section 1.8.7 for additional information on the plans. These projects are expected to benefit fish habitat as well as provide improved flood management.

2.3.1.9 Washington State Department of Transportation Programs

The WSDOT programs to improve fish habitat are described in Section 1.8.8. These projects, including wetland mitigation, maintenance of habitat connectivity, and fish passage restoration, will continue under the No Action Alternative.

2.3.1.10 Conservation Projects by Private Organizations

Under the No Action Alternative, private conservation groups such as the Cascade Conservation Partnership, the Mountains to Sound Greenway Trust, the Cascade Land Conservancy, the Washington Water Trust, and Washington Rivers Conservancy are expected to continue their efforts to purchase and protect land and water rights for wildlife habitat and public benefit. Information on recent activities by these groups is located in Section 1.8.9.

2.4 Integrated Water Resource Management Plan Alternative

2.4.1 Introduction

The Integrated Water Resource Management Plan Alternative (Integrated Plan) represents a comprehensive approach to water management in the Yakima River basin. It is intended to meet the need to restore ecological functions in the Yakima River system and to provide more reliable and sustainable water resources for the health of the riverine environment and for agriculture and municipal and domestic needs. The Integrated Plan is also intended to provide the flexibility and adaptability to address potential climate changes and other factors that may affect the basin's water resources in the future.

The Integrated Plan includes three components of water management in the Yakima basin—Habitat, Systems Modification, and Water Supply. The intent of the Integrated Plan is to implement a comprehensive program that will incorporate all three components using seven elements to improve water resources in the basin:

- Habitat Component:
    - Reservoir Fish Passage Element (Section 2.4.3); and
    - Habitat/Watershed Protection and Enhancement Element (Section 2.4.7).
- Systems Modification Component:
    - Structural and Operational Changes Element (Section 2.4.4).
- Water Supply Component:
    - Surface Water Storage Element (Section 2.4.5);
    - Groundwater Storage Element (Section 2.4.6);
    - Enhanced Water Conservation Element (Section 2.4.8); and
    - Market Reallocation Element (Section 2.4.9).

Reclamation and Ecology worked with the YRBWEP Workgroup to develop a package of projects to meet the goals of the Integrated Plan. These projects are described individually below for each element; however, Reclamation, Ecology and the YRBWEP Workgroup intend that the Integrated Plan would be implemented in a comprehensive manner, incorporating all elements of the proposed plan. Implementing the different elements of the Integrated Plan as a total package is intended to result in greater benefits than implementing any one element alone.

Reclamation and Ecology intend to use an adaptive approach to implement the Integrated Plan (Section 2.4.10). As the Integrated Plan is being implemented, projects will be monitored and studies will be undertaken to determine the need for modifying and/or adding projects to the plan. It is anticipated that new projects may be identified or existing projects modified that better meet the overall objectives of the Integrated Plan. Proposals that would substantially alter the Integrated Plan would be subject to supplemental programmatic environmental review and, as noted above, all projects would undergo project-level environmental review.

Reclamation and Ecology anticipate that the Integrated Plan would be implemented over a period of time ranging from two to 20 years. The exact timeline for implementation would be largely dependent on the availability of funding. Reclamation and Ecology would work with the Yakama Nation, other water and fish managers, and local governments in the Yakima River basin to develop a more precise timeline as funding becomes available.

Most of the adverse impacts associated with the Integrated Plan elements are construction-related and there would be few long-term adverse effects excepting habitat losses and shoreline recreational losses at the enlarged Bumping Lake Reservoir and new Wymer Reservoir. Modeling indicates that implementation of the Integrated Plan's water supply elements would benefit irrigation and municipal and domestic uses and streamflows for fish, meeting the targets for both. Fish passage and habitat/watershed enhancements would provide further benefits for fish and wildlife in the basin. The Habitat/Watershed Protection and Enhancement Element would help protect substantial areas of existing habitat from future losses due to development-related habitat impacts. The Groundwater Storage, Enhanced Conservation, and Market Reallocation Elements provide opportunities to improve the reliability of water supplies without requiring surface storage. However, additional surface storage is needed to provide adequate water to meet the long term instream and out-of-stream needs of the Yakima basin. Overall, the Integrated Plan would provide long-term benefits to water supplies for agricultural and municipal and domestic uses and improve habitat conditions for resident and anadromous fish.

2.4.2 Benefits of an Integrated Approach

Many studies have indicated that ecosystem-level resource management provides greater opportunities for efficiency, synergy, and cooperation between stakeholders which then result in greater overall benefits. For example, providing fish passage at existing reservoirs would open up new habitat for fish, which would benefit fish populations. By also implementing fish habitat improvements and improving flows basin-wide through additional storage and other actions, fish would have improved conditions for survival generally, contributing to increased abundance and productivity. If fish habitat enhancements are implemented without providing fish passage at existing reservoirs and improving flows, the habitat enhancements would have more limited benefits to fish.

Additional storage would provide additional flows for fish and allow existing reservoir operations to be modified to benefit fish. New storage projects would also provide water to reduce irrigation supply shortages and help meet future municipal and domestic needs. Enhanced water conservation would provide opportunities to reduce water demand and improve water supply. Market reallocation would provide flexibility to meet the water needs of fish, irrigators, and especially domestic water users. These combined elements would improve the reliability of water supply in drought years and reduce the amount of new storage needed. Groundwater storage presents an opportunity to develop storage to improve water supply and flows without the traditional impacts associated with above-ground storage.

An integrated approach that includes water storage and facility improvement projects that also meet fish management needs will have the highest likelihood of being implemented and being successful over the long-term. The combined elements presented in this Integrated Plan would provide Yakima River basin water users and fish managers with the variety of tools needed to meet water supply needs and significantly improve conditions for fish.

2.4.3 Reservoir Fish Passage Element (Habitat Component)

Under this element of the Integrated Plan Alternative, fish passage would be provided at the five major Yakima River basin dams—Cle Elum, Bumping Lake, Tieton (Rimrock Reservoir), Keechelus, and Kachess. None of these dams currently have provisions for fish passage. In addition, the blockage to bull trout passage at Clear Lake Dam would be eliminated. Providing unimpeded fish migration past these dams would increase anadromous species abundance and spatial distribution, allow reintroduction of sockeye runs, and provide for genetic interchange for listed bull trout and other native fish. This would also help fish to cope with potential future climate change impacts by providing access to high-quality habitat at higher elevations if lower elevation habitat is no longer suitable for supporting fish life stages at certain times of year.

Reclamation studied opportunities for providing fish passage at the five Yakima River basin reservoirs in its *Yakima Dams Fish Passage Phase I Assessment Report* (Reclamation, 2005a) and in the *Draft Cle Elum and Bumping Lake Dams Fish Passage Facilities Planning Report* (Reclamation, 2008a). These studies were undertaken as part of the 2002 Settlement Agreement with the Yakama Nation to resolve litigation between the Yakama Nation and Reclamation. The Settlement Agreement calls for Reclamation to study anadromous fish passage at Yakima Project storage dams.

Construction and operation of fish passage would be constrained by the following:

- Fish passage facilities would be designed and operated within existing operational considerations and constraints outlined in the *Interim Comprehensive Basin Operating Plan* (Reclamation 2002), or subsequent Operation Plans.
- Operations would continue to serve existing Reclamation contracts.
- Potential operational changes would be considered that might enhance passage without adversely impacting existing contracts or irrigation water supply.

The following sections provide a general description of proposed fish passage options at the five Yakima River basin reservoirs, based on potential fish benefits as well as engineering feasibility. Information on existing conditions at the reservoirs is provided in Chapter 3 and further evaluation of the benefits of providing fish passage is provided in Chapters 4 and 5.

2.4.3.1 Cle Elum Dam

Cle Elum Dam impounded and enlarged a natural lake. Lack of fish passage at the dam blocked access to the lake and upstream habitat for anadromous salmonids, eliminating one of the largest sockeye salmon runs in the Columbia River Basin from the Yakima River basin. Lack of passage also prevents fish in the reservoir such as bull trout from moving throughout the basin.

Fish passage facilities and fish reintroduction at Cle Elum Dam were evaluated by Reclamation and Ecology in the *Cle Elum Dam Fish Passage Facilities and Fish*

Reintroduction Project FEIS (Reclamation and Ecology, 2011c) and *Final Planning Report Cle Elum Dam Fish Passage Facilities* (Reclamation, 2011b). Reclamation selected a preferred alternative in the FEIS and in the Record of Decision issued August 12, 2011. The environmental review for the project has been completed, but there is no funding for implementation; therefore, it is included in the Integrated Plan.

The downstream fish passage facility for the selected alternative would consist of a multilevel intake structure with gated openings that would operate at reservoir elevation 2,190 feet and above (from about 50 percent full to full pool) (Figure 2-3). The intake structure would be located against and accessed from the right bank abutment of the dam (i.e., the right-hand side, to an observer facing downstream). A juvenile bypass conduit located on the right bank would be installed to carry passage flows from the upstream intake structure to discharge fish into the spillway stilling basin. For upstream passage, a trap-and-haul adult fish passage facility would be located on the right bank and would include a fish ladder and a collection facility.

2.4.3.2 Bumping Lake Dam

Construction of Bumping Lake Dam in 1910 impounded and enlarged a natural glacial lake, blocking passage to an area that historically supported anadromous Chinook, summer steelhead, coho, and sockeye salmon and bull trout (McIntosh et al., 2005; Haring, 2001). Currently, the Bumping River supports anadromous spring Chinook and steelhead below the dam, and bull trout above the dam (Haring, 2001).

Fish passage at Bumping Lake Dam would make available habitat in the reservoir as well as high-quality migration, spawning, and rearing habitat in the Bumping River and its tributaries. Upstream and downstream fish passage would be installed at Bumping Lake Dam as part of the proposed Bumping Lake enlargement action described below as part of the Surface Water Storage Element (Section 2.4.5). Fish passage facilities at Bumping Lake Dam are expected to be similar to those proposed at Cle Elum Dam.

2.4.3.3 Tieton, Keechelus, and Kachess Dams

Upstream and downstream fish passage would be installed at Tieton, Keechelus, and Kachess Dams. Passage facilities at these three dams have not yet been designed; therefore, limited detail is available on the proposed facilities. The facilities are likely to be similar to those proposed at Cle Elum Dam.

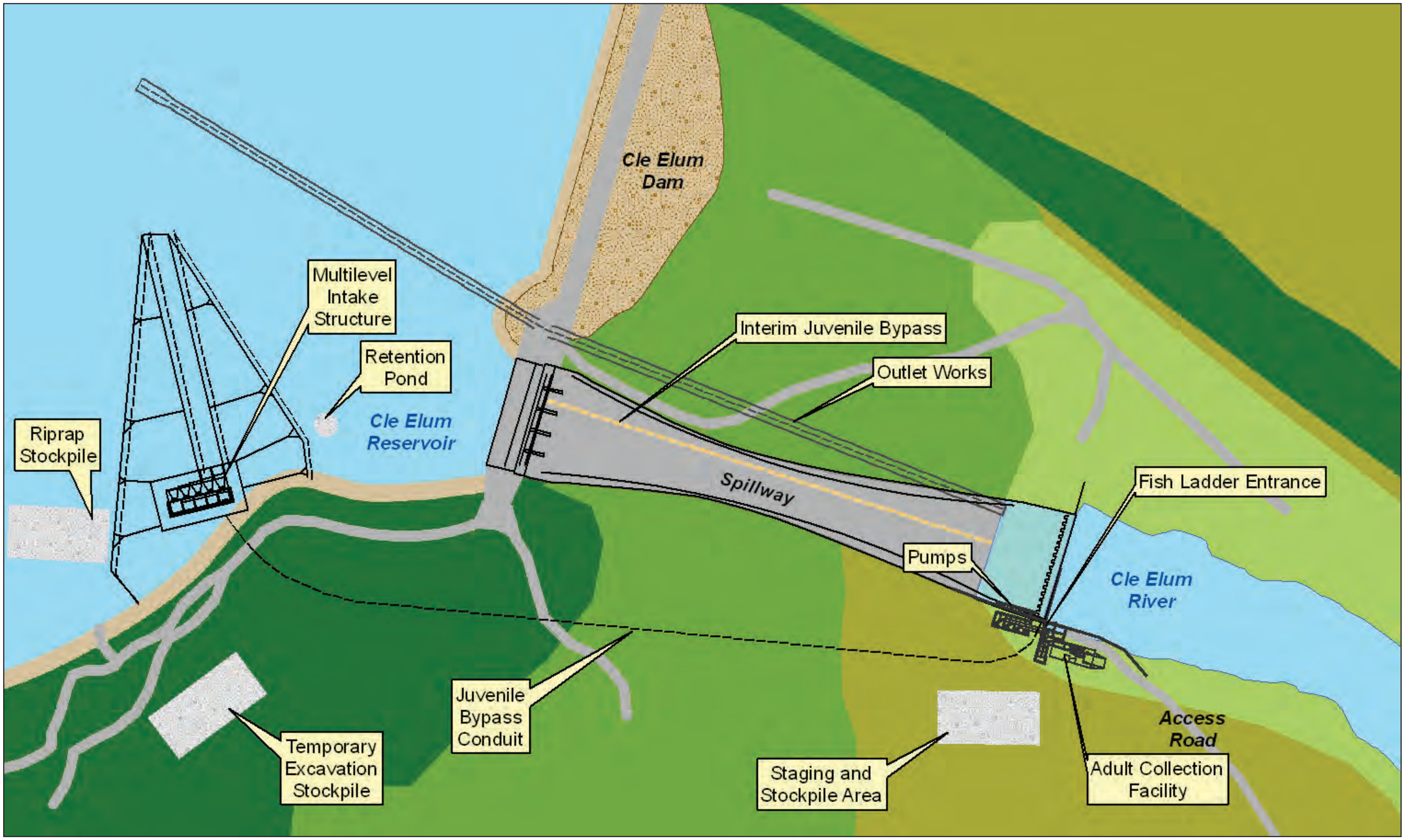

Figure 2-3. Cle Elum Dam Fish Passage Facilities

2.4.3.4 Clear Lake Dam

Clear Lake Dam is a small water storage facility located upstream from Rimrock Reservoir on the Tieton River. The dam includes a fish ladder intended to provide passage, but the location of the ladder entrance and high water temperatures at the outlet limit fish use. This prevents fish such as bull trout from moving throughout the basin above the dam.

Entrance to the existing fish ladder is located approximately 1,000 feet downstream from the dam outlet, in a shallow cove at the confluence of the emergency spillway and the river. During periods of low pool water levels, the fish ladder's water supply is substantially warmer than river water discharging from the dam outlet. Upstream migrating fish appear to stage where the colder water is released from the dam outlet works. Fish passage facilities proposed under the Integrated Plan would consist of a new pool/weir fish ladder located on the left abutment of the dam to provide both upstream and downstream fish passage.

2.4.4 Structural and Operational Changes Element (System Modifications Component)

The structural and operational changes included in the Integrated Plan provide opportunities to benefit fish by improving flows in some reaches and reducing mortality of smolts at some facilities. Structural changes include increasing storage in existing reservoirs, modifying fish bypass systems and canals, and moving points of diversion to increase flows in reaches of the Yakima River. Operational changes include reducing the amount of water diverted for power generation at the Roza and Chandler Powerplants in spring to increase instream flow and improve smolt out-migration. The structural and operational changes are intended to make existing facilities more efficient, reduce impediments to fish passage, and improve water supply and flows for fish.

2.4.4.1 Cle Elum Pool Raise

Under the Integrated Plan the level of Cle Elum Lake would be raised by 3 feet (from 2,240 feet to 2,243 feet above mean sea level) to increase the volume of available storage in Cle Elum Reservoir by approximately 14,600 acre-feet. The 3-foot raise would be accomplished by modifying the spillway gates on the existing dam. Raising the pool level would inundate additional land around the reservoir for approximately three to ten weeks per year (average of seven weeks). The higher water levels would typically occur between April and August. The project would impact approximately 56 acres that would either be seasonally inundated or used for shoreline protection measures. This includes portions of approximately 33 privately owned parcels. The effects would occur along a relatively narrow strip of shoreline fronting each parcel. The project includes measures to protect the shoreline from potential erosion caused by higher water levels.

2.4.4.2 Kittitas Reclamation District Canal Modifications

The Kittitas Reclamation District (KRD) diverts water from the Yakima River at Lake Easton at River Mile 202.5, near the town of Easton. The KRD system delivers irrigation water to approximately 55,500 acres in the Kittitas Valley. KRD currently augments flows in tributaries to the Yakima River with operational spills from the canal system. KRD also conveys and discharges excess water at spill locations when requested by Reclamation, but only when excess capacity is available in the system. The KRD system includes approximately 37 open-ditch laterals that distribute irrigation water from the Main Canal and South Branch Canal to KRD water users. Water is currently lost through seepage from these open-ditch laterals.

The Integrated Plan includes modifications to laterals of KRD's Main and South Branch Canals to reduce seepage losses and allow greater flexibility in KRD supply management. The water saved or transferred would be used to enhance instream flows in tributaries to the Yakima River, including Taneum Creek, Manastash Creek, Big Creek, Little Creek, Tillman Creek, Spex Arth Creek, and others that cross the KRD Main Canal. Specific actions would include:

- Piping of irrigation laterals along the KRD Main Canal and South Branch Canal;
- Construction of a re-regulation reservoir to capture KRD operational spills at Manastash Creek; and
- Construction of a pump station on the Yakima River to deliver flows to Manastash Creek water users.

Tributary flow improvements would be coordinated with habitat/watershed protection and enhancement actions (Section 2.4.7.2) to target improved fish passage at KRD canal crossings. It is estimated that these projects would reduce seepage losses by 5,300 acre-feet and increase flows in Manastash Creek by approximately 4,300 acre-feet.

2.4.4.3 Keechelus-to-Kachess Pipeline

This proposed project involves conveying water from Keechelus Reservoir to Kachess Reservoir to reduce flows and improve habitat conditions during high flow releases below Keechelus Reservoir and provide more water storage in Kachess Reservoir for downstream needs. The pipeline would also help Kachess Reservoir refill after using inactive storage as proposed below in the Surface Water Storage Element (Section 2.4.5).

The pipeline between the Keechelus outlet and the existing Kachess Reservoir high-water shoreline would be approximately 5 miles long. The outfall pipe would extend into Kachess Reservoir to discharge below a proposed future minimum water lake surface elevation of approximately 2,110 feet.

Efforts would be made to coordinate construction of the pipeline crossing of Interstate 90 (I-90) with the ongoing WSDOT I-90 construction project, which includes installation of wildlife crossings in the area.

2.4.4.4 Subordinate Power at Roza Dam and Chandler Powerplants

Water diversions for power generation would be further subordinated at Roza Dam and Chandler Powerplants under the Integrated Plan. Power subordination occurs when some or all of the water that could otherwise be diverted for power production is instead left in the river to provide instream flow benefits for fish. A substantial level of subordination has been undertaken for several decades. However, additional subordination at key time periods would support out-migration of steelhead, Chinook, sockeye, and coho juveniles. Subordination would be pursued subject to the development of acceptable agreements on the level and timing of subordination, mitigation for power losses, and approval by Reclamation, BPA and Roza or Kennewick Irrigation Districts, as applicable.

The Roza Powerplant is a conventional hydroelectric powerhouse with a single turbine, having a capacity of 12.9 megawatts (MW). The plant produces average annual energy of approximately 61,000 megawatt hours (MWH). The Chandler Powerplant is a 12 MW powerhouse with two turbines. The Chandler Powerplant includes two 6.0 MW, 4,160-volt hydropower generators. When water is not required for irrigation, the turbines can generate additional energy for revenue.

The intent of the Integrated Plan is that the Roza Powerplant would not be used to produce power in April and May, and the Chandler Powerplant would not be used to produce power in April, May, and June. Based on the historical data supplied by Reclamation, this would represent a power reduction of approximately 25,000 MWH annually.

2.4.4.5 Wapatox Canal Improvements

The Wapatox Canal, which is owned and operated by Reclamation, diverts water from the lower Naches River at RM 17.1, northwest of the town of Naches. The canal is more than 8 miles long and was originally constructed to deliver water to two powerplants. Reclamation purchased the power water right from PacifiCorp in March 2003 and discontinued operation of the powerplants with the intention of using as much of the water right as possible to increase flows in the lower Naches River. Reclamation retained responsibility under preexisting contracts for delivering approximately 50 cfs to Wapatox Ditch Company and some individual small water users who are supplied irrigation water from the Wapatox Canal.

Reclamation has not been able to use as much of the water right to increase flows because it typically has to divert as much as 130 to 140 cfs from the lower Naches River to deliver the approximately 50 cfs to water users along the Wapatox Canal. The excess water diverted (called “carriage water”) is conveyed through the entire length of the canal and discharged back to the lower Naches River below the Wapatox Powerplant.

Under the Integrated Plan piping and/or replacing the lining along portions of the existing Wapatox Canal would reduce or eliminate the amount of carriage water needed to supply Wapatox Ditch Company water users. The project would include one of the following:

- Installing new canal lining from the fish screen midway down the canal and replacing the existing canal downstream from that point with a pipeline: or
- Installing pipe to replace the entire length of the existing canal downstream from the fish screen.

This project could include consolidation of other diversions into the Wapatox Canal such as the Naches-Selah Irrigation District, the City of Yakima water treatment plant, and the Gleed Ditch to provide additional fish benefits. However, the benefits of consolidating those diversions need further evaluation because they may not be sufficient compared to the cost, and those water users may choose not to participate in the project. Therefore, these benefits are not evaluated in this DPEIS.

2.4.5 Surface Water Storage Element (Water Supply Component)

Reclamation, Ecology, and the YRBWEP Workgroup have determined that additional storage is needed in the Yakima River basin to meet the purpose and need of the project, especially to reduce the amount of prorationing and to improve streamflows. The proposed projects reflect a focus on in-basin solutions to address water supply and aquatic resource problems; however, study of an out-of-basin option is included in the Integrated Plan. The projects described below were included in the preliminary analysis conducted for the Basin Study. Each of the projects would require additional studies before being carried forward.

Collectively, these projects represent just over 450,000 acre-feet of additional storage for managing instream and out-of-stream uses in the basin. If one or more of the in-basin projects does not receive necessary permits and approvals for implementation, the YRBWEP Workgroup would recommend a replacement project (or projects) that would supply at least the equivalent quantity of water. With each of these projects, power generation opportunities would also be evaluated.

A portion of the additional supply would be made available for future municipal and domestic needs. This portion of supply should be allocated, in part, to serve needs in each of the three counties of the Yakima basin. It is intended that one-half of the municipal and domestic supply would be allocated by county based on projected growth. The other half would remain unallocated and available to municipal and domestic users anywhere in the basin on a first-come, first-served basis after the allotted county portions are used.

2.4.5.1 Wymer Dam and Reservoir

Wymer Dam and Reservoir would be constructed under the Integrated Plan to create a new off-channel storage facility in the intermittent stream channel of Lmuma Creek, which enters the Yakima River approximately 8 miles upstream of the Roza Diversion Dam. The storage capacity of the reservoir would be approximately 162,500 acre-feet (Figure 2-4). The reservoir area is currently under private ownership.

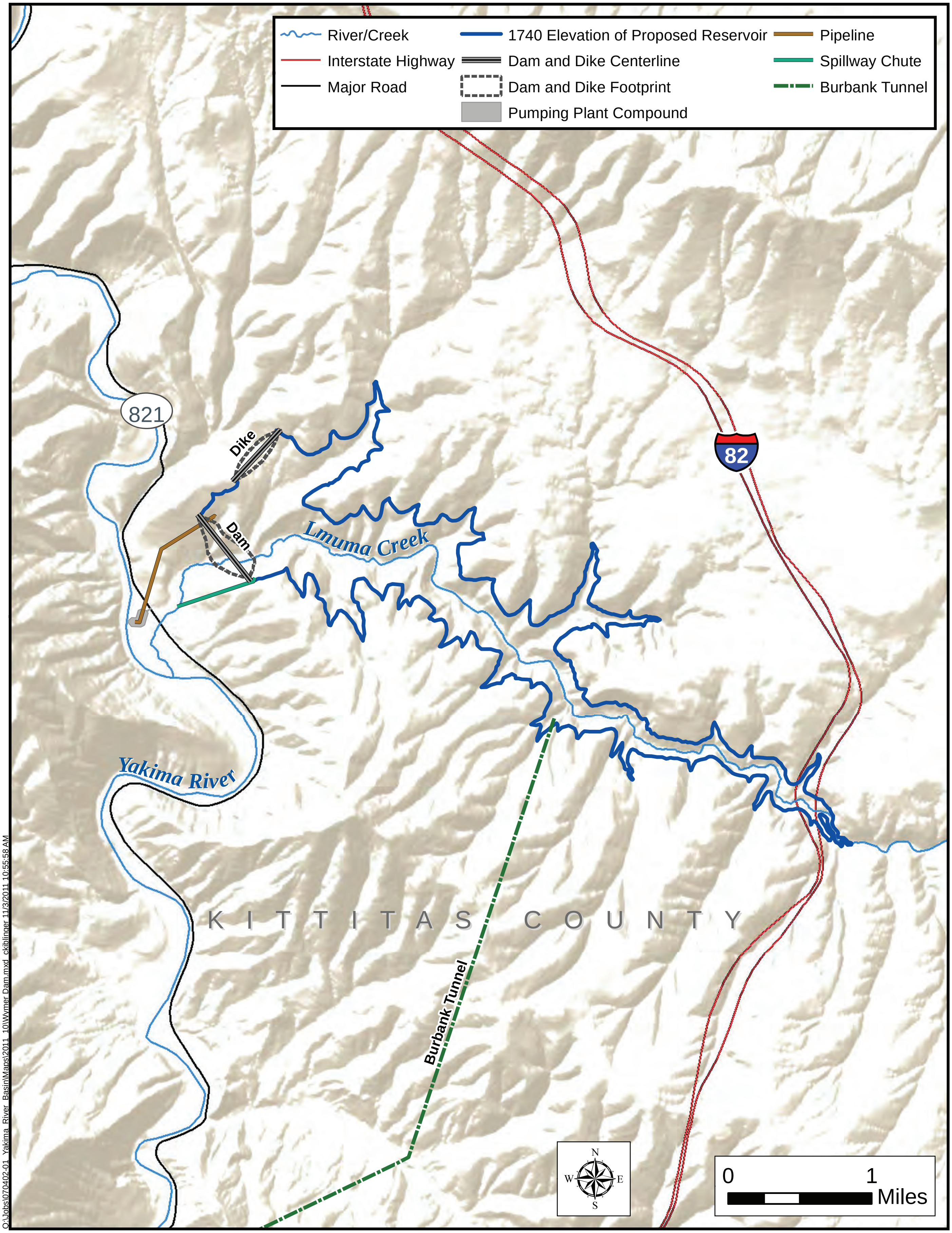

Figure 2-4. Wymer Dam and Reservoir

The dam would be a concrete-faced rockfill embankment approximately 450 feet high with a full-pool elevation of approximately 1,730 feet. A 180-foot-high central core rockfill dike would be constructed in a saddle on the north side of the reservoir. Rockfill dams and dikes have the ability to safely accommodate large seismic event loadings. A spillway and stilling basin would be located on the south abutment of the dam to discharge water into Lmuma Creek. Outlet works on the south dam abutment, sized for approximately 1,600 cfs, would return flow to Lmuma Creek and the Yakima River. The reservoir would be filled by a pumping plant with a capacity of approximately 400 cfs that would withdraw water from the Yakima River. A screened 200-foot intake channel on the Yakima River would carry water to the pumping plant.

Water would be pumped into the reservoir from the Yakima River during winter, spring, and potentially summer, during high-flow periods and times when upstream reservoirs are releasing water specifically for filling the reservoir. The facility would allow for increases in winter flows and decreases in summer flows in the upper Yakima River to benefit fish. On average 82,500 acre-feet of the storage capacity would be used annually to improve instream flows upstream and downstream of the reservoir. The remaining storage capacity would be used for carryover or drought relief storage.

2.4.5.2 Kachess Reservoir Inactive Storage

The Kachess Reservoir is located just east of Interstate 90 near Easton, Washington. The project would modify the outlet to Kachess Reservoir to allow it to be drawn down approximately 80 feet lower than the current outlet. This would provide the ability to withdraw another 200,000 acre-feet of water from the lake, when needed, for downstream uses during drought conditions.

Two options have been identified to withdraw the additional water from Kachess Reservoir, both starting from a new lake tap outlet in the Kachess Dam about 80 feet deeper than the existing outlet at the southeast end of the lake. Additional design is needed to select the preferred option.

Option 1 would use a gravity-flow tunnel that would discharge into the Yakima River approximately 4.6 miles southeast of the Kachess Dam. Option 2 would withdraw water from the outlet and use a pump station near the lake shoreline to pump through a pipeline to a discharge to the Kachess River just downstream of the dam. Either option would include fish passage improvements at Box Canyon Creek to improve fish passage for bull trout.

2.4.5.3 Bumping Lake Reservoir Enlargement

Bumping Lake Dam is located on the Bumping River, a tributary of the Naches River, approximately 40 miles northwest of Yakima. Bumping Lake Dam was constructed in 1910 and created a reservoir with a capacity of 33,700 acre-feet at elevation 3,425 feet.

Enlargement of Bumping Lake Reservoir includes construction of a new dam and fish passage facilities about 4,500 feet downstream from the existing Bumping Lake Dam

(Figure 2-5). The reservoir would be enlarged to a total active capacity of approximately 190,000 acre-feet at approximate elevation 3,490 feet. The existing dam would be breached following construction to allow full use of the existing pool.

The enlarged reservoir would inundate an additional 1,900 acres of land for a total inundation area of 4,120 acres. The reservoir would extend approximately 5 miles upstream from the dam and create approximately 14 miles of shoreline. The site of the proposed new dam and the lands that would be inundated by the expanded reservoir are contained entirely within the area reserved by Reclamation for the purposes of the Yakima project. The lands are located within the Okanogan-Wenatchee National Forest.

2.4.5.4 Study of Columbia River Pump Exchange with Yakima Storage

As the three in-basin surface storage projects described above are implemented, appraisal and, potentially, feasibility-level studies would commence on other water supply enhancements, including the potential for an interbasin transfer from the Columbia River. Because the Columbia River Pump Exchange proposal is a study and not a proposed project at this time, it is not analyzed in this DPEIS. An EIS would be prepared as part of the feasibility-level planning report (Step 2) if the YRBWEP Workgroup decides to move forward with a Columbia River pump exchange project in the future.

During implementation of the Integrated Plan, an adaptive approach will be used periodically to assess progress towards meeting the identified instream flow objectives, the 70 percent proratable supply goal for irrigation, and goals for other out-of-stream needs (Section 2.4.10). The need for additional water supply enhancements would depend on the effectiveness of projects that are implemented as part of the Integrated Plan, how the Yakima basin economy develops over time, and the timing of and manner in which climate changes affect water supply availability.

The evaluation of a Columbia River Pump Exchange would involve an initial screening step (Step 1) and subsequent feasibility study (Step 2). Step 2 would be conducted only if the initial screening in Step 1 demonstrates that an interbasin transfer is a viable option.

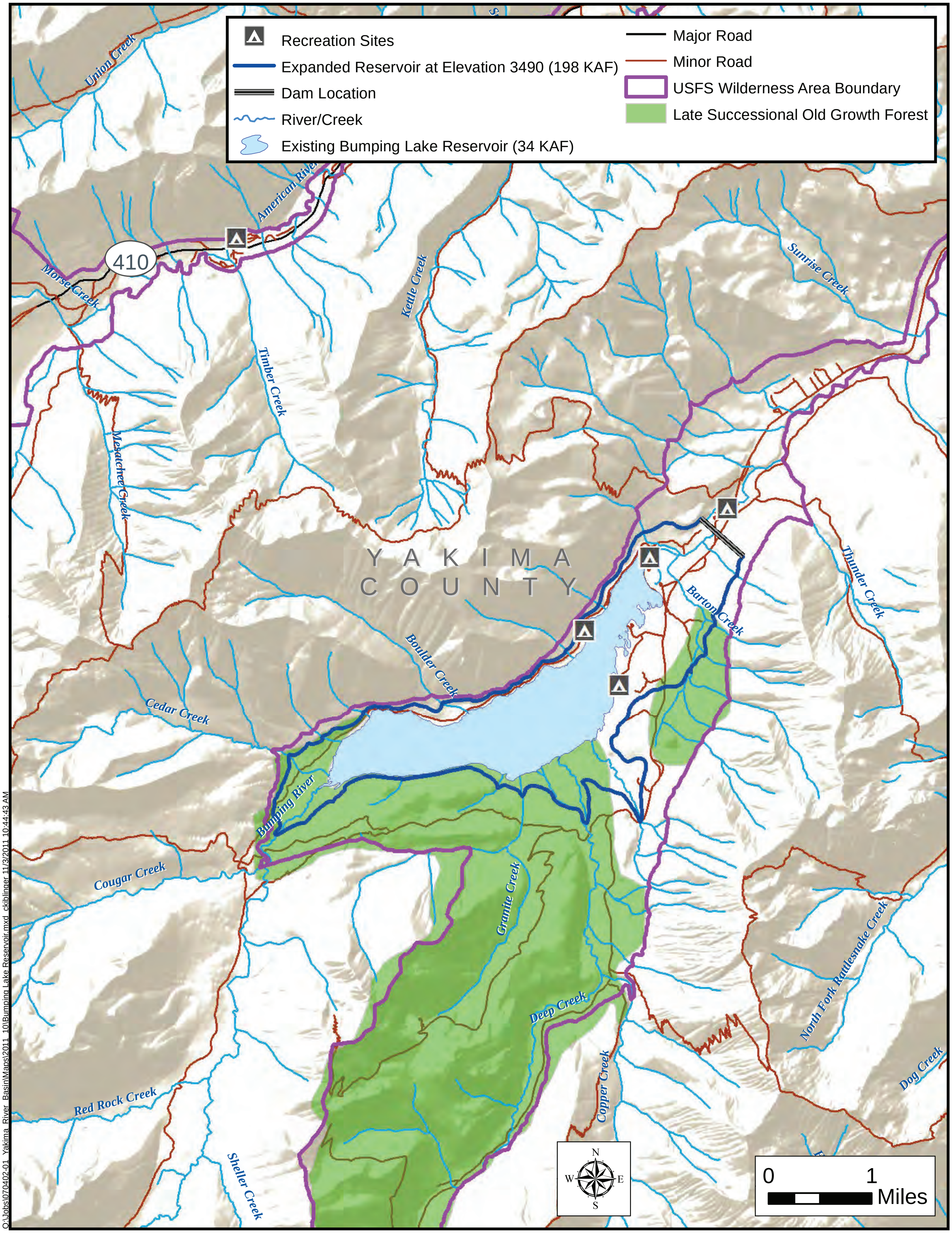

Figure 2-5. Bumping Lake Reservoir

2.4.6 Groundwater Storage Element (Water Supply Component)

The Groundwater Storage Element of the Integrated Plan would use surface water to recharge (replenish) underground rock formations that store groundwater (aquifers) and use the natural storage capacity of those aquifers to store water for later recovery and use. Typically aquifers would be recharged with surface water during high flow periods. The stored water would be used to supply out-of-stream uses, increase streamflows through increased groundwater discharge, and/or replenish depleted groundwater storage. The source water is expected to be surface water from the Yakima River or one of its tributaries. Water right permits would be required to divert, store, and use water in a reservoir, including an underground geologic formation (Revised Code of Washington (RCW) 90.03.370). New or existing infrastructure (canals or pipelines) would be used to convey water to the recharge site. The availability of water would be a function of seasonal timing and location within the Yakima River basin.

Two proposed groundwater storage actions—shallow aquifer recharge and aquifer storage and recovery (ASR)—would use surface water to recharge aquifers and store water for later withdrawal and use. Both of these actions are new concepts in the Yakima River basin and would initially be implemented as pilot studies to determine their feasibility. The water yield from a fully implemented program is estimated to be 5,000 to 10,000 acre-feet per year.

2.4.6.1 Shallow Aquifer Recharge

The first groundwater storage action involves groundwater infiltration. This would be accomplished by diverting water into designed infiltration systems (ponds, canals, or spreading areas) prior to storage releases from Yakima Project reservoirs in early spring. Water users would then withdraw the infiltrated water instead of using reservoir releases early in the irrigation season, allowing water to be retained longer in reservoir storage. Infiltration systems would also be located to provide returns directly back to surface waters through passive recharge (without pumping). The timing and scale of surface water diversions would be designed to allow continuation of natural high-flow events that provide biologic and channel configuration benefits. Infiltration could also provide cooler water to the lower Yakima River in the summer when the cooler groundwater discharges to the river.

It is anticipated that the groundwater infiltration program would be implemented in two phases:

- Pilot-scale infiltration testing in two study areas, followed by
- Full-scale implementation in the study areas and/or other locations.

Initially, a limited pilot study would be conducted to verify the scope and general design features of groundwater infiltration systems. The two proposed pilot-testing areas would be located in the KRD in the Badger Pocket area south of Ellensburg and in the Wapato Irrigation Project near Wapato and Toppenish. Two pilot-scale infiltration systems, approximately 1 to 2 acres in size, would be constructed in each study area. The pilot tests would result in recommendations for implementation at these locations or other suitable locations in the basin.

At full-scale implementation, it is anticipated that between 160 and 500 acres of infiltration area would be necessary to achieve a total infiltration capacity of at least 100,000 acre-feet. This volume was selected for preliminary modeling conducted as part of the Basin Study and does not necessarily reflect actual volumes that would be infiltrated. Total infiltration volumes may vary from year to year, depending on snowpack conditions and reservoir refill requirements. During the pilot phase, policy and legal protocols would be developed to ensure water stored through infiltration is not captured by unauthorized users.

2.4.6.2 Aquifer Storage and Recovery

The second groundwater storage action involves a municipal ASR system. The City of Yakima would divert approximately 5,000 to 10,000 acre-feet of water from the Naches River during the winter months and treat it at the City's existing water treatment plant. It would then be injected through wells and later pumped out for use by the City's residents and businesses during summer months when demand for water is highest. The City has proposed this project and the Integrated Plan would provide funding for implementation.

ASR could also be viable for other cities in the Yakima basin. These projects would require a water treatment facility, one or more wells that could hold treated water, and a pump station for retrieving stored water.

2.4.7 Habitat/Watershed Protection and Enhancement Element (Habitat Component)

This element includes projects and programs to protect and enhance habitat for anadromous and resident fish. The element would benefit fish in addition to the improved flows and fish passage included in other Integrated Plan elements. Fish would benefit from habitat/watershed protection such as land acquisition and protection of watershed functions and habitat enhancements such as reconnecting floodplains, reestablishing side channels, and restoring natural river and riparian conditions. This element of the Integrated Plan includes habitat protection in the basin watersheds and habitat enhancements on both mainstem rivers and tributaries in the Yakima River basin. Many of the proposed habitat enhancements have been identified in studies such as the Yakima Subbasin Plan (YBFWRB, 2005) and the Yakima Steelhead Recovery Plan (YBFWRB, 2009). The Integrated Plan would provide funding to complete the actions identified in those plans.

2.4.7.1 Targeted Watershed Protections and Enhancements

The Watershed Protection and Enhancement program includes two aspects. Under the Integrated Plan, key properties would be acquired to protect watersheds. The YRBWEP Workgroup also recommends that areas should be designated for wilderness and Wild and Scenic Rivers protection.

Land Acquisition Program

The watershed, water supply, and ecological restoration goals of the Integrated Plan would be furthered through the protection and restoration of key landscapes.

The primary lands that enhance other components of the Integrated Plan are large tracts of privately owned land in the Yakima and Naches watersheds that provide high potential for ecosystem and species conservation and restoration both within and outside of the immediate riparian corridor. Acquisition of conservation areas would complement the overall goals of the Integrated Plan by helping to maintain or improve water supply and quality, protecting sources of cold water and cold water habitat, providing (or providing linkages to) bull trout, salmon, and steelhead habitat and spawning grounds, and providing additional floodplain restoration opportunities.

The targeted goals for watershed protections and enhancements include:

- 45,000 acres as a Conservation Target for High Elevation Watershed Enhancement;
- 15,000 acres as a Conservation Target for Shrub-Steppe Habitat Enhancement; and
- 10,000 acres as a Conservation Target for Forest Habitat Enhancement.

The YRBWEP Workgroup has targeted three key areas in the Yakima and Naches River watersheds for land acquisition actions that would help achieve the watershed, water supply, and ecological restoration goals of the Integrated Plan. Protection and restoration of these key areas offer ecosystem, species conservation, and restoration potential both inside and outside the immediate riparian corridor by linking upper and lower watersheds. If these sites cannot be acquired, a combination of alternative sites of equivalent conservation value would be selected as long as alternatives collectively meet the target goals. The targeted acquisitions include:

- 45,000 acres in the middle and lower Teanaway River basin composed of mid- to high-elevation mixed conifer forest and lower elevation grand fir and Ponderosa pine forest. The Teanaway River flows into the Yakima River and provides fish passage and connectivity to high elevation colder water. Protecting this area would provide major ecosystem, water quality and quantity, and species benefits that would complement the habitats and species protected by the Plum Creek Central Cascades Habitat Conservation Program (HCP), adjacent to the western portion of the proposed area. The Ponderosa pine forests are particularly significant due to their limited range and vulnerability to climate change. The area is important for maintaining high water quality, protecting salmon and steelhead spawning grounds, and potential bull trout recovery. In addition, conservation of the Teanaway landscape fits well into the overall strategy of acquiring and protecting non-Federal lands to ensure successful landscape-scale linkages envisioned by the Integrated Plan.

- 15,000 acres in the Yakima River canyon, including the valley bottom and eastern slopes, from the Yakima River to Interstate 82 (I-82). The area is composed primarily of basalt cliffs and shrub-steppe vegetation, a critical habitat type. In addition, the Yakima Canyon riparian area provides salmon, steelhead, and resident rainbow trout habitat.
- 10,000 acres at the headwaters of the Little Naches River and lands surrounding the headwaters of Taneum and Manastash Creeks. Private lands in these watersheds are intermingled with National Forest land, generally in a checkerboard pattern. The land is primarily middle to upper elevation conifer forest, and the Little Naches is near Bumping Lake Reservoir. Most of the area has been logged and replanted, but some areas of old-growth forest remain. The upper reaches of the Naches River and Taneum and Manastash Creeks are important for water quality and maintaining cool temperatures for bull trout protection and restoration. They also protect water supply and provide current or potential salmon and steelhead spawning grounds.

Recommendations for Wilderness Area and Wild and Scenic River Designations

The YRBWEP Workgroup found that in addition to acquiring the targeted conservation lands identified above, protection of some lands under the Federal Wilderness Area and Wild and Scenic River designations is consistent with values and objectives and would further the purposes of the Integrated Plan. The YRBWEP Workgroup recommends the designation of additional lands that are eligible or have already been recommended for designation through the Northeastern Washington Forest Plan Revision process (Forest Service, 2011a, 2011b). These designations are consistent with the objectives of the Integrated Plan because they would protect cold water habitat, spawning and rearing grounds and migration corridors for salmon, steelhead, and bull trout, and would help protect important natural sources of water supply and are consistent with the objectives of the Integrated Plan.

Recommendations for designation include the following:

- Wilderness designation should be pursued for the land around Bumping Lake that is not inundated by the reservoir expansion.
- Wilderness or other appropriate designation should also be sought for roadless areas in the Teanaway, in the area between Kachess and Cle Elum Reservoirs, and in the upper reaches of Manastash and Taneum Creeks in order to protect headwater streams, snow pack, and forests.
- Wild and Scenic River designation should be sought for the American, Upper Cle Elum, and Waptus Rivers. The American River runs into the Bumping River downstream of Bumping Lake, and the Upper Cle Elum and Waptus Rivers would receive increasing numbers of salmon and steelhead as fish passage is completed at Cle Elum Dam. Other rivers determined eligible and recommended for designation in future Forest Plans should also be considered for designation.

The recommended Wild and Scenic River designations were included as recommendations in the Wenatchee National Forest 1990 Forest Plan and have been listed in preliminary documents related to the ongoing Forest Plan revision (Forest Service, 1990, 2011a). Wilderness designation for roadless areas in the Teanaway has also been recommended in preliminary planning documents (Forest Service, 2011b). Designations would require congressional action that would likely occur separately from the Integrated Plan. Designations would include additional public involvement and environmental review specific to each area proposed for designation.

2.4.7.2 Mainstem Floodplain and Tributary Fish Habitat Enhancement Program

The Integrated Plan includes an extensive fish habitat enhancement program that would address mainstem floodplain and tributary habitat restoration priorities through habitat enhancement, flow restoration, fish barrier removal, and screening diversions. Habitat enhancement would supplement the projects to provide fish passage and improved stream flows to create comprehensive improvements for fish. These actions would significantly improve prospects for recovering fish populations to levels that are resilient to catastrophic events and the potential impacts of climate change. They would accelerate ongoing efforts to protect existing high value habitats, improve fish passage, enhance flows, improve habitat complexity and functions, and reconnect side channels and off-channel habitat to stream channels.

Fish habitat enhancement actions would help create improved spawning, incubation, rearing, and migration conditions for all salmonid species in the Yakima basin; implement key strategies described in the Yakima Subbasin Plan (YBFWRB, 2005); and complete most of the actions described in the Yakima Steelhead Recovery Plan (YBFWRB, 2009). Mainstem floodplain improvements could include channel and habitat restoration in the Yakima River near Ellensburg and between Selah and Union Gap, and on the lower Naches River. Tributary program actions could include completing screening and passage at diversions in the middle and upper Yakima basin, bull trout habitat improvements and management actions, and implementing the Toppenish Creek Corridor restoration project. Tributary habitat enhancements would primarily occur on tributaries to the Yakima and Naches Rivers in the middle and upper parts of the basin, and on the Yakama Reservation.

The approach to implementation would be tailored to utilize existing organizations to review processes and plans, as applicable. Reclamation and Ecology may choose to establish an advisory group similar to the YRBWEP Conservation Advisory Group (see Section 1.9.3) to help develop a more detailed approach for project funding and scheduling.

2.4.8 Enhanced Water Conservation Element (Water Supply Component)

The Enhanced Water Conservation Element is an aggressive program of water conservation measures that would improve basin water supply and instream flows. The element includes conservation measures for irrigation district infrastructure improvements, on-farm conservation and irrigation efficiency improvements, municipal and domestic conservation, and commercial and industrial conservation. The scope of the element is not a duplication of the conservation activities to be funded under YRBWEP Phase 2.

2.4.8.1 Agricultural Conservation

Agricultural water conservation measures include lining or piping existing canals, automating canals, constructing re-regulating reservoirs on irrigation canals, improving water measurement and accounting systems, installing on-farm water conservation improvements, and other measures. A preliminary list of projects was developed as part of modeling conducted for the Basin Study, which estimated that the agricultural water conservation program would conserve up to approximatley170,000 acre-feet of water in good water years.

Projects that would actually be implemented under this program would be selected through detailed feasibility studies and evaluation by the existing YRBWEP Conservation Advisory Group. Entities eligible for project funding include federally and non-federally-served irrigation districts, private irrigators, and individual landowners.

Consumptive versus Nonconsumptive Use of Water

Consumptive and nonconsumptive uses are important considerations in water conservation programs, water transfers, and water markets and banking. For a water use involving a diversion from a source, a portion of the water withdrawn is consumed or lost to further use, primarily through evaporation (Figure 2-6). Examples of consumptive use within irrigation delivery systems include evaporation from open canals and drains, and evapotranspiration from vegetation growing along canal banks. For on-farm water use, consumptive use includes crop evapotranspiration, evaporation of water sprayed into the air (spray evaporative loss), evaporation from the plant canopy (canopy loss), and water blown off of the irrigated property (wind drift) (Ecology, 2005a).

A nonconsumptive use is defined by Ecology regulation as water that is not diverted from a source or that is diverted and used without diminishment of the source. Examples of nonconsumptive uses include seepage and return flow from an irrigation canal and percolation from farmlands where water in excess of ET is applied to fields. An example of a nonconsumptive use when water is not removed from the source is hydroelectric generation at a dam.

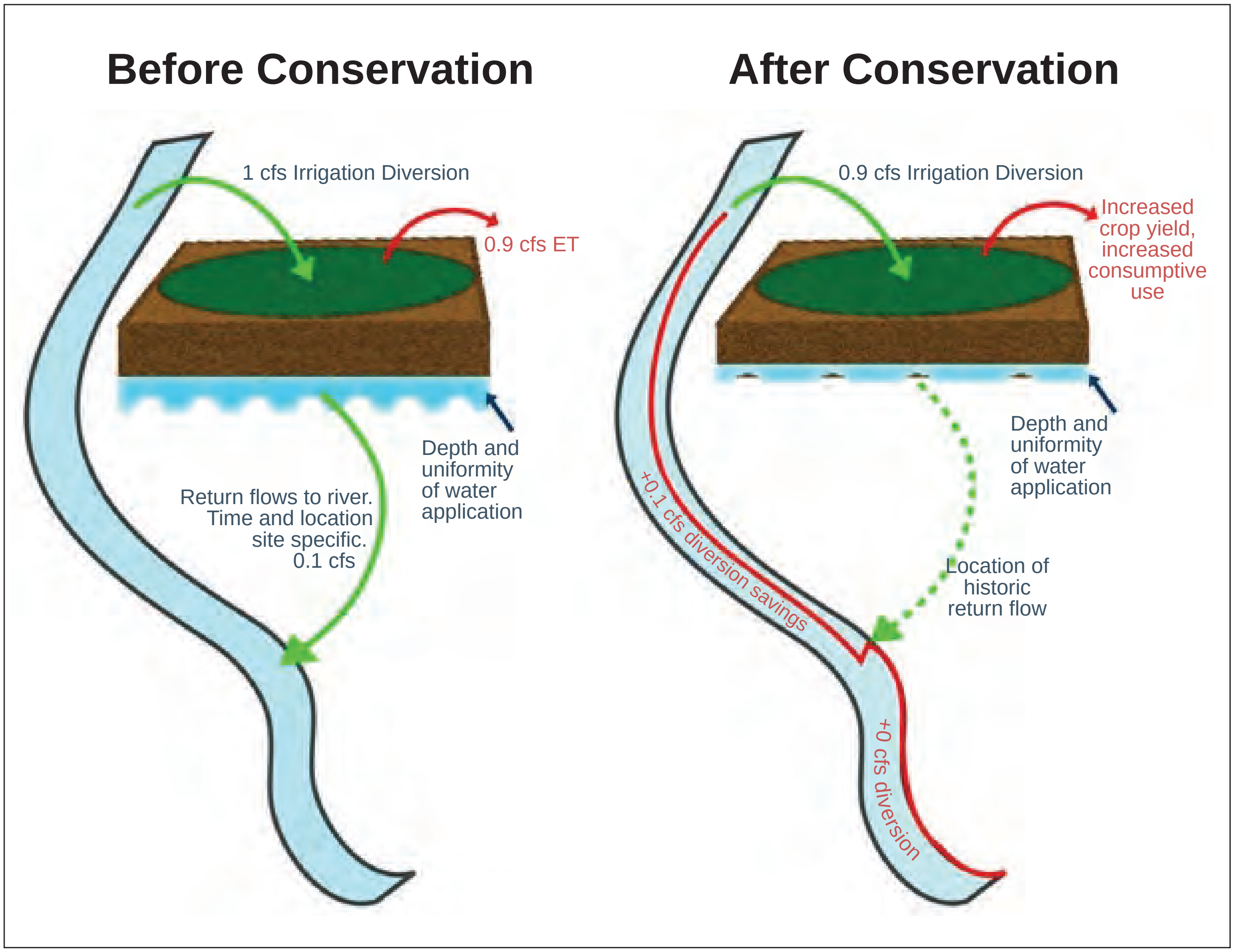

Figure 2-6. Consumptive versus Nonconsumptive Use

A water use may also be consumptive to a specific reach of a stream when water is diverted, used, and returned to the same source at a point downstream that is not in proximity to the point of diversion. The segment of the stream between the point of withdrawal and the point of discharge is called the bypass reach. An example is a hydroelectric project that diverts the source into a canal that carries the water to a generating station, and then returns it to the source some distance downstream.

The consumptive and nonconsumptive portions of a water right are important when determining how much water can be transferred or reallocated from a water conservation or water transfer project. Ecology has published guidance on determining irrigation efficiency and crop consumptive use (Ecology, 2005a). Typically the consumptive use portion of a water right can be transferred or reallocated from one water user to another within the Yakima River basin with conditions as to the location of transfers, effect on stream flow, and operations of the Yakima Project.

Transfers of the nonconsumptive portion of a water right are more difficult because each must be “water budget” neutral, that is, it must not increase consumptive use (unless offset by other water provided). In addition, each transfer cannot impair water rights, including instream flow water rights, in the bypass reach between the locations of the original and new points of diversion.

Most of the projects proposed for the Enhanced Water Conservation Element of the Integrated Plan involve reducing seepage and return flow which are nonconsumptive uses of water when viewed in terms of the entire river basin. They are consumptive uses when viewed reach by reach. Only a small amount of the water that will be conserved can be attributed to consumptive uses. However, the Yakima Project has some flexibility in its operation and can allow some redistribution of water within the basin. The challenge is balancing the reduced seepage and return flow from conservation projects with the potential effects on downstream water users and instream flows. The reduction in return flow will reduce the supply downstream and require water released from storage.

2.4.8.2 Municipal and Domestic Conservation Program

The Municipal and Domestic Conservation Program would promote efficient use of municipal and domestic water throughout the Yakima basin using voluntary, incentive-based actions that focus on landscape irrigation and other consumptive uses. Municipal and domestic usage includes water that is delivered by public systems regulated by the Washington State Department of Health, used by individual homeowners served by permit exempt wells, used by commercial or industrial facilities, and water delivered by irrigation entities for outdoor landscape irrigation in developed areas of the basin. It includes residential, commercial, industrial, and urban recreational uses of water such as parks, ball fields, and golf courses.

A multi-stakeholder advisory committee on municipal and domestic water conservation (including local and environmental stakeholders) would be convened to organize outreach to local elected officials and provide liaison with Reclamation, Ecology, and the

Washington State Department of Health. The advisory committee would focus on the following key efforts:

- Implementing education, incentives, and other measures to encourage residential and commercial users to improve landscape irrigation efficiency where the source of supply is agricultural irrigation canals or ditches.
- Improving the efficiency of consumptive uses (i.e., water that evaporates or is otherwise consumed and does not return to surface streams or groundwater through wastewater treatment plants, septic systems or surface infiltration).
- Establishing best practice standards for accessing the new supply developed through the Integrated Plan and dedicated to municipal use and municipal/domestic mitigation (mitigation refers to water that is used to offset the increased water usage from new housing or businesses). The standards would be based on review of evolving practices in similar communities and similar climate zones of the western United States.
- Determining conditions for accessing the new supply that would apply to homeowners or developers seeking mitigation water for consumptive water use for homes supplied by individual household wells.

2.4.9 Market Reallocation Element (Water Supply Component)

Under this part of the Integrated Plan, water resources would be reallocated through a "water market" and/or "water bank," where water rights would be bought, sold, or leased on a temporary or permanent basis, to improve water supply and instream flow conditions in the Yakima basin. This effort would include recommendations to:

- Increase the overall value of the goods and services derived from the basin's water resources, by reallocating water from low-value to high-value uses;
- Reduce the delay and cost of transactions that reallocate water resources; and
- Ensure that, before transactions are completed, appropriate consideration is given to the potential impacts on third parties.

These improvements to the water transfer process are intended to facilitate transfers to improve irrigation water supply and instream flows. The proposal includes two phases: a near-term effort to build on the existing water market programs, and a longer term effort that requires more substantial changes to existing laws and policies.

The near-term program would continue existing water marketing and banking activities in the basin that involve water users and Ecology, but take additional steps to reduce barriers to water transfers. The long-term program would focus on facilitating water transfers between irrigation districts. This would allow an irrigation district to fallow land inside the district and lease water rights for that land outside the district.

To facilitate this process, agricultural conservation program funding (Section 2.4.8.1) would also be made available to non-Federal irrigation entities to upgrade conveyance infrastructure to improve their operational flexibility and their ability to lease water to other irrigation districts, including federally-served districts.

2.4.10 Adaptive Approach

The Integrated Plan has seven elements and some of these include multiple projects. Implementation is expected to extend at least over a 20 year period. During this period plan adjustments may be necessary due to evolving and changing conditions that are likely to occur, but are unknown at this time as well as new information that becomes available, or other factors. To effectively identify and make such adjustments in a timely way, Reclamation and Ecology would use an adaptive approach to implementing the Integrated Plan. This would include:

Periodic Review. Review of progress on implementing the Integrated Plan will occur annually for the first five years and at five year intervals after that. The five year interval is consistent with Ecology's statutory requirement for preparing supply and demand forecasts for the state legislature. The review will include:

- Status of securing authorization and funding for implementation.
- Progress in establishing programmatic elements (e.g., water marketing, water conservation, habitat/watershed restoration; floodplain restoration).
- Progress in constructing structural improvements (e.g., reservoirs, canal lining, groundwater infiltration facilities, etc).
- Assessment of outcomes for water supply and fish production, including improvements in water supply, improvements in streamflow, improvements in other fish habitat conditions, and trends in salmon, steelhead and bull trout population metrics.
- Effectiveness of Reclamation's reservoir operating rules based upon identified goals for meeting instream and out-of-stream needs (including future revisions to operating rules).
- Significant changes, if any, in the underlying drivers for the Integrated Plan, such as listing status of aquatic species; changes in the Basin's population and economy; changes in climate, snowpack, streamflows and seasonal timing of runoff; major shifts in cropping patterns, irrigation practices or diversions; and changes in water needs.
- Formulation of any recommendations for adjustments to the Integrated Plan or implementation schedule.

Adaptive Adjustments: If the review described above indicates a need for significant changes to the Integrated Plan, then the following principles would be applied:

- Adjustments made to the Integrated Plan will reflect the overarching and balanced objectives to advance both water supply improvements and ecosystem enhancements.

- If particular projects or programs encounter insurmountable obstacles to implementation or are found unable to deliver the expected benefits, then substitutes for those projects should be pursued to achieve similar outcomes.

This adaptive approach would be formalized with written protocols and standards in an Adaptive Approach document, to be developed within the first three years of implementation.

2.5 Alternatives Eliminated from Detailed Study

Numerous additional projects were identified through the scoping process for this DPEIS. Some of the same projects were initially considered by Reclamation and Ecology for inclusion in the Integrated Plan. The projects described below were identified but not carried forward for further evaluation because they are not able to meet the objectives and goals identified in the Purpose and Need for the Integrated Plan. The reasons for eliminating these projects from detailed study are described below.

2.5.1 Black Rock Reservoir

Interest continues in developing Black Rock Reservoir as either an alternative to the Integrated Plan or as a storage project in the Integrated Plan. Reclamation and Ecology have thoroughly considered the Black Rock Reservoir. Reclamation concluded in its December 2008 Final Planning Report/EIS that the benefits of Black Rock, when compared to the impacts and costs, did not justify moving forward with it (see Section 1.9.1 of this document).

Ecology agreed with that conclusion in its 2009 Final EIS and included additional reasons for determining that Black Rock is not feasible in the near term. Black Rock does not solve some of the major aquatic resource problems in the Yakima basin, including fish passage and degraded habitat. The project lacks significant support from the end users of the water. Both the financial and the social opportunity cost of the Black Rock project are high and far outweigh the economic benefits that might accrue from the project. There is also significant environmental uncertainty associated with the impacts of groundwater seepage toward the Hanford site and the reliability of measures to control that seepage (Ecology, 2009).

2.5.2 Other Storage Projects

A number of other reservoir sites have been suggested and reviewed by Reclamation, but were not carried forward to a feasibility-level study for further analysis. A listing of those projects is provided in Table 2-1, along with Reclamation's reasons for not further studying each project (Reclamation, 1984).

Ecology also evaluated an offstream reservoir along Ahtanum Creek (Ecology, 2005b). Pine Hollow Reservoir was not carried forward in this document because its benefits would be limited primarily to the Ahtanum basin. Pine Hollow Reservoir would increase total water supply available (TWSA) by less than 0.1 percent, an amount that would not be measurable by Reclamation. The Yakama Nation was a partner in the development of the Ahtanum Creek Watershed Restoration Program. The Tribe has indicated that it does not support moving the project forward at this time because of lack of consensus among the Yakama Nation, Ahtanum Irrigation District, and other basin stakeholders to proceed with the project.

Table 2-1 Potential Storage Sites Considered

Name	Stream	Location	Maximum Capacity (acre-feet)	Reason for Not Carrying Forward
Bakeoven	Tieton River, South Fork	1.5 miles NE of Grey Creek Campground	35,000	Cost
Casland	Teanaway River, North Fork	3 miles north of Casland	63,000	Cost
Cle Elum Lake Enlargement	Cle Elum River	Existing Cle Elum Dam	485,000 (50,000 new)	Not listed
Cooper Lake	Cooper River	Cooper Lake outlet		Cost, wilderness impacts
Cowiche	Cowiche Creek, South Fork	6 miles west of Cowiche	16,000	Cost
Dog Lake	Clear Creek	Dog Lake outlet		Cost, limited water supply
East Selah	Yakima River	Gravel pits at Selah	3,000	Cost
Forks	Teanaway River	1 mile downstream of North and West Forks junction	390,000	Cost, geology
Hole in the Wall	Dry Creek	2 miles NW Hwy 97 crossing	25,000	Cost
Horseshoe Bend	Naches River	3 miles upstream of Tieton River	80,000	Cost, geology, block anadromous fish
Hyas Lake	Cle Elum River	Hyas Lake outlet	Not listed	Cost, limited water supply, wilderness impacts
Little Rattler	Rattlesnake Creek	1 mile upstream Naches River	112,000	Cost, inundates big game winter range and high-quality resident fishery
Lost Meadow	Little Naches River	1 mile NW Naches Pass Forest Camp	30,000	Cost
Lower Canyon	Yakima River	Mouth of Yakima Canyon	350,000	Railroad relocation cost, block anadromous fish, other adverse impacts

Name	Stream	Location	Maximum Capacity (acre-feet)	Reason for Not Carrying Forward
Manastash	Manastash Creek	7 miles west of Ellensburg	50,000	Cost
Mile Four	Rattlesnake Creek	4 miles upstream from Nile	45,000	Inundates big game winter habitat and resident fishery
Minnie Meadows	Tieton River, South Fork	1 mile SW of Grey Creek Campgrounds	35,000	Cost
Naneum	Naneum Creek	10 miles north of Ellensburg	40,000	Cost
Pleasant Valley	American River	Near Thunder Creek Campground	150,000	Block anadromous fish, impact recreation
Rattlesnake	Naches River	Immediately below Rattlesnake Creek	85,000	Block anadromous fish, social effects problem
Rimrock Lake Enlargement	Tieton River	Existing Tieton Dam	270,000 (172,000 new)	Engineering concerns
Satus	Satus Creek	8 miles west of Satus	175,000	Yakama Nation site
Simcoe	Simcoe Creek – Toppenish Creek (require other sources to fill)	4 miles west of White Swan	95,000	Yakama Nation site
Soda Springs	Bumping River	At Soda Springs Campground	360,000	Alternative to Bumping Lake enlargement, higher costs, adverse impacts
Swauk	Swauk Creek	0.5 miles upstream from Yakima River	75,000	Wildlife impacts
Tampico	Ahtanum Creek	7 miles west of Wiley City	72,000	Yakama Nation site
Toppenish	Toppenish Creek	9 miles SW of White Swan	125,000	Cost
Upper Canyon	Yakima River	0.5 miles upstream from Swauk Creek	190,000	Major barrier to anadromous fish
Wapatox	Naches River	0.5 miles below Tieton River	100,000	Block anadromous fish
Waptus Lake	Waptus River	Waptus Lake outlet	Not listed	Cost, wilderness impacts

2.5.3 Operational Changes at Existing Reservoirs

Ecology received several suggestions that the "flip-flop"[1] regime should be eliminated or altered to benefit fish. This option was considered during development of the Integrated Plan, but it was determined that the regime could not be eliminated because of Reclamation's obligations to provide irrigation water and meet fish target flows. However, hydrologic modeling conducted for the Basin Study found that it would be possible to modify the "flip-flop" regime to reduce the adverse impacts associated with the practice. Those modifications are included in the Integrated Plan proposal.

2.5.4 Reliance on Conservation and Water Marketing

Reclamation and Ecology have received comments that no additional storage should be constructed in the Yakima basin and that conservation and water marketing could provide enough water to meet the needs in the basin. Comments have suggested that the Integrated Plan not include storage components. Hydrologic modeling conducted for the Integrated Plan estimates the Enhanced Conservation Element would save approximately 170,000 acre-feet of water largely for instream uses during average years. During drought years, water savings are substantially less; about 30,000 acre-feet of water savings is realized during a single drought year and less than 10,000 acre-feet of water savings is realized during the third year of a 3-year drought. The amount of water that could be exchanged by the Market Reallocation Element is estimated to be in the range of 30,000 to 60,000 acre-feet per year. However even when combined with the 170,000 acre-feet of potential conservation savings, the combined total would not meet instream and out-of-stream needs. Both elements are expected to improve water supply, especially in specific reaches of the basin, but would not provide enough water to meet the purpose and need of the Integrated Plan, nor would they provide the operational flexibility to respond to varying flow conditions within the Yakima basin.

2.6 Summary Comparison of Environmental Impacts of Alternatives

Table 2-2 compares the impacts associated with the two alternatives. The phrase "short-term" refers to impacts associated with construction activities. The phrase "long-term" refers to impacts following the construction period. Additional information on the impacts is found in Chapters 4 and 5.

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[1] To accommodate irrigation needs and prevent the dewatering of redds, the Yakima Field Office manages the basin using what has become known as the "flip-flop" flow regime. The strategy involves a reduction in flows in the upper Yakima throughout the spawning period (Sept.-Oct.) and a ramping up of flows in the Naches River.

Table 2-2 Comparison of Impacts for Alternatives

Resource	No Action Alternative	Integrated Plan Alternative
Earth	Erosion and sediment delivery would continue or increase.	Short-term: Construction-related erosion and sedimentation. Long-term: Loss of earth-related resources, permanent landscape modifications, and changes in stream channel and floodplain conditions. Disruption of sedimentation downstream of storage facilities. Decrease in erosion potential in conservation areas.
Surface Water Resources	Conservation measures through other projects could result in a slight increase in water supply and increases in streamflows in various reaches and tributaries. Overall goals and objectives of the Integrated Plan would not be achieved.	Short-term: Potential disruption during construction. Long-term: Increased TWSA, end-of-season reservoir storage, annual diversions, and improved streamflow.
Groundwater	Groundwater recharge is expected to decrease and demand on groundwater may increase.	Short-term: Temporary reduction of usability of wells in the immediate vicinity of construction sites. Long-term: Groundwater levels and quantities would increase with potential decreases near canal lining sites.
Water Quality	Construction projects could result in water quality impacts, localized benefits from habitat enhancement projects. Net benefits to water quality unlikely to occur.	Short-term: Risk of erosion and contaminants from construction. Long-term: Net benefit to water quality by improving streamflow conditions, riparian areas, and floodplain habitat.
Hydropower	Hydroelectric generation would continue to operate as under current patterns and trends.	Short-term: No impact. Long-term: Reduction of hydroelectric generation at Roza and Chandler Powerplants and the Drop 2 and Drop 3 powerplants in the Wapato Irrigation Project.
Fish	Habitat quality would likely worsen with increased population and climate change, although proposed projects could produce localized improvements.	Short-term: Temporary habitat disturbance, construction-related impacts. Long-term: Overall benefits from fish passage facilities, improved streamflows and habitat/watershed protection and enhancement projects.

Resource	No Action Alternative	Integrated Plan Alternative
Vegetation	Some vegetation removal from construction projects. Some projects could reduce the amount of shrub-steppe vegetation. Minor improvements from habitat enhancement projects. Current patterns and trends would likely continue into the foreseeable future.	Short-term: Temporary disruption of vegetation, including shrub-steppe and old-growth vegetation Long-term: Negative impacts, including habitat loss, from expanded reservoirs, but an overall positive impact due to habitat/watershed protection and enhancement. Permanent impact on shrub-steppe and old-growth vegetation.
Wildlife	Temporary dislocations during construction. Some vegetation removal or alteration of wildlife habitat from construction projects. Some projects could reduce the amount of shrub-steppe vegetation and habitat. Minor improvements to habitat from enhancement projects. Current patterns and trends would likely continue into the foreseeable future.	Short-term: Temporary disruption of habitat during construction. Substantial habitat impact could occur if replacement habitat is unavailable. Short term impacts for some species could be substantial at Wymer Dam and expansion of Bumping Lake Reservoir. Long-term: Negative impacts to habitat from new or expanded reservoirs. Overall positive impact for wildlife from habitat/watershed protection and enhancement. Permanent impact on shrub-steppe and old-growth vegetation.
Threatened and Endangered Species	Construction projects would likely include alteration of wildlife habitats. Some projects could reduce the amount of shrub-steppe vegetation. Minor improvements to habitat may provide limited benefits to listed species. Current patterns and trends would likely continue into the foreseeable future.	Short-term: Temporary disruption of habitat during construction, including reduction of shrub-steppe and old-growth habitat. Long-term: Negative impacts to species that may be displaced from the area of a new or expanded reservoir. Overall positive impacts from fish passage facilities, improved streamflows, and habitat/watershed protection and enhancement projects. Permanent impact on shrub-steppe and old-growth vegetation.
Visual Resources	Projects could alter visual resources. Individual actions would have varying levels of long-term visual impacts.	Short-term: Construction equipment and activities would be visible. Long-term: Visual impacts would be primarily of local scale and are not expected to be significant with the potential exception of new and expanded reservoirs.
Air Quality	Construction projects would likely cause minor increases in fugitive dust and vehicle emissions. Individual projects may cause long-term impacts from emissions if they include stationary pollutant sources such as pumping equipment driven by diesel, natural gas, or other fossil fuels.	Short-term: Minor dust and emissions associated with construction and traffic. Long-term: Some projects may cause long term impacts from emissions associated with stationary pollutant sources, although impacts are not expected to be significant.

Resource	No Action Alternative	Integrated Plan Alternative
Climate Change	Water supply shortages and adverse effects on streamflows and fish could become significantly worse. Limited ability to respond to climate change-induced impacts.	Short-term: Increases in greenhouse gas emissions associated with construction of individual projects. Long-term: Multiple benefits to water supply, agriculture, and fish, improving the ability of water managers to adapt to future climate change.
Noise	Increased construction noise. Individual projects have the potential to generate noise during long-term operation.	Short-term: Increased construction noise. Long-term: Some equipment or vehicles may be audible in the vicinity of projects.
Recreation	Temporary access restrictions or nuisance dust and noise during construction projects. Current patterns and trends impacting recreation facilities would likely continue into the foreseeable future.	Short-term: Temporary access restrictions or nuisance dust and noise. Long-term: Recreational facilities and resources at Bumping Lake Reservoir would be eliminated and it may not be possible to relocate. Many projects would improve fishing and wildlife viewing opportunities. Recreational opportunities such as motorized vehicle use would be restricted in areas acquired for conservation or designated as Wild and Scenic or Wilderness.
Land and Shoreline Use	Temporary access restrictions during construction. Individual projects could result in long-term land use impacts from property or easement acquisitions. Current patterns and trends impacting land use would likely continue into the foreseeable future.	Short-term: Temporary access restrictions caused by construction. Long-term: Property and easement acquisitions, shift from Forest and Rangeland to water storage in Wymer Reservoir area, potential land use changes due to market reallocation. Logging and other uses would be restricted in areas acquired for conservation or given special designations.
Utilities	Potential temporary disruptions during construction.	Short-term: Potential temporary disruption during construction. Long-term: Reduced electrical supply of electricity due to power subordination and increased demand from new equipment.
Transportation	Potential temporary traffic delays and possible detours associated with individual projects. Long term transportation not likely to be affected.	Short-term: Temporary traffic delays and possible detours, in some cases for up to 3 to 5 years for major projects. Long-term: Bumping Lake Enlargement would eliminate some Forest Roads, reducing access to recreation sites.

Resource	No Action Alternative	Integrated Plan Alternative
Cultural Resources	Ground disturbance, erosion, and increased vandalism of cultural resources. Potential impacts to historic structures.	Short-term: Construction could cause permanent impacts to cultural resources. Long-term: Ground disturbance, erosion, and increased vandalism of cultural resources. Potential impacts to historic structures.
Socioeconomics	Current economic patterns and trends would likely continue into the foreseeable future. Climate change and population increases would impact the relation between natural resources and the economy in the basin.	Short-term: Project-related funding would likely have short-term impacts positive on jobs and incomes and uncertainty and risk. Long-term: Potential increase in the value of goods and services derived from the basin's water and related resources in the long term. Reduction in uncertainty and risk.
Environmental Justice	Most projects would not be expected to cause disproportionate impacts to environmental justice communities.	Most projects are not expected to cause disproportionate impacts to environmental justice communities. Additional environmental justice analysis would be required during project-level analysis.

Chapter 3

AFFECTED ENVIRONMENT

CHAPTER 3.0 AFFECTED ENVIRONMENT

3.1 Introduction

This chapter describes environmental resources potentially affected by implementation of the Integrated Plan. The level of detail varies; more information is provided for those resources with a potential to be affected at a more substantive level. For all of the environmental resources in this chapter, information is provided at a planning level of detail consistent with a programmatic analysis of potential effects. Additionally, more detailed evaluation will be conducted during subsequent project-level NEPA and SEPA review prior to implementing specific Integrated Plan actions, or projects.

The project team reviewed and consulted several documents to obtain the information for the majority of this chapter. These documents include: Integrated Water Resources Management Alternative EIS (Ecology, 2009), Storage Study EIS (Reclamation, 2008g), the Cle Elum Fish Passage EIS (Reclamation and Ecology, 2011c), the Wymer Damsite geologic assessment (Reclamation, 2008d) and *Habitat Limiting Factors, Yakima River Watershed* (Haring, 2001). Unless otherwise noted, these documents are the sources of information for this chapter.

3.2 Earth

This section summarizes the geologic and geomorphic setting for the Yakima River basin. The focus of the discussion is the potential for erosion and sedimentation. The Yakima River basin encompasses approximately 6,150 square miles (EES, 2003). Figure 3-1 shows the simplified geologic and structural features of the basin (USGS, 2006). Figure 3-2 shows the groundwater basins (USGS, 2006). The headwaters of the basin start in the Middle Cascades in the Cascade Mountain Range and generally flow southeast to join the Columbia River. The basin ranges in elevation from 8,200 feet in the Cascades to 350 feet at the Columbia River confluence.

The western half of the basin is located in the Middle Cascades and the eastern half is located within the Columbia Plateau basalt (Kinnison and Sceva, 1963). The Middle Cascades include igneous, sedimentary, and metamorphic rocks of many ages. The Columbia Plateau is primarily made of numerous Tertiary-age basalt flows. These flows in the western portion of the Plateau have created a series of southeast-trending ridges and valleys, known as the Yakima Fold Belt (Reclamation, 1979).

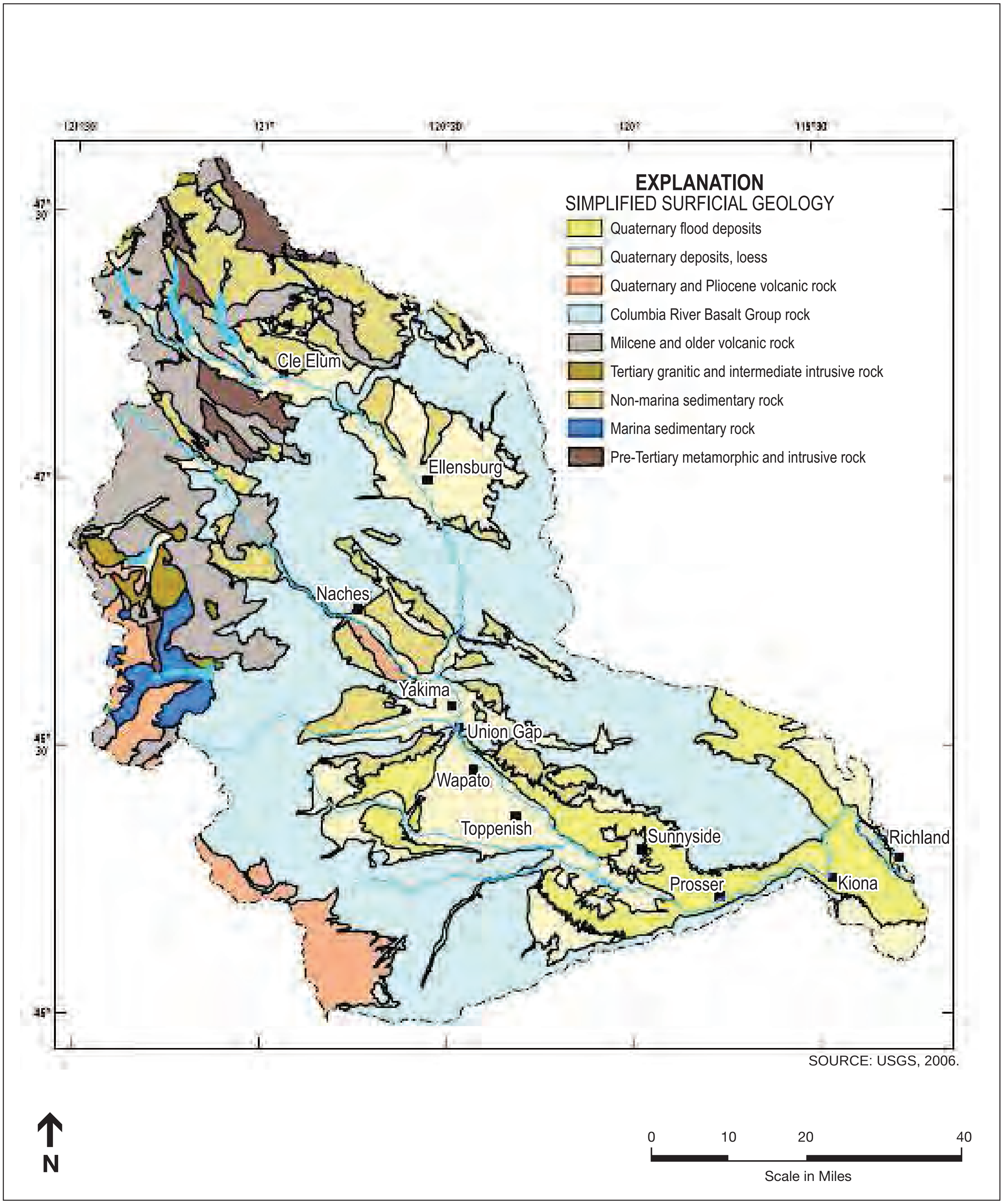

Figure 3-1. Simplified Surficial Geology

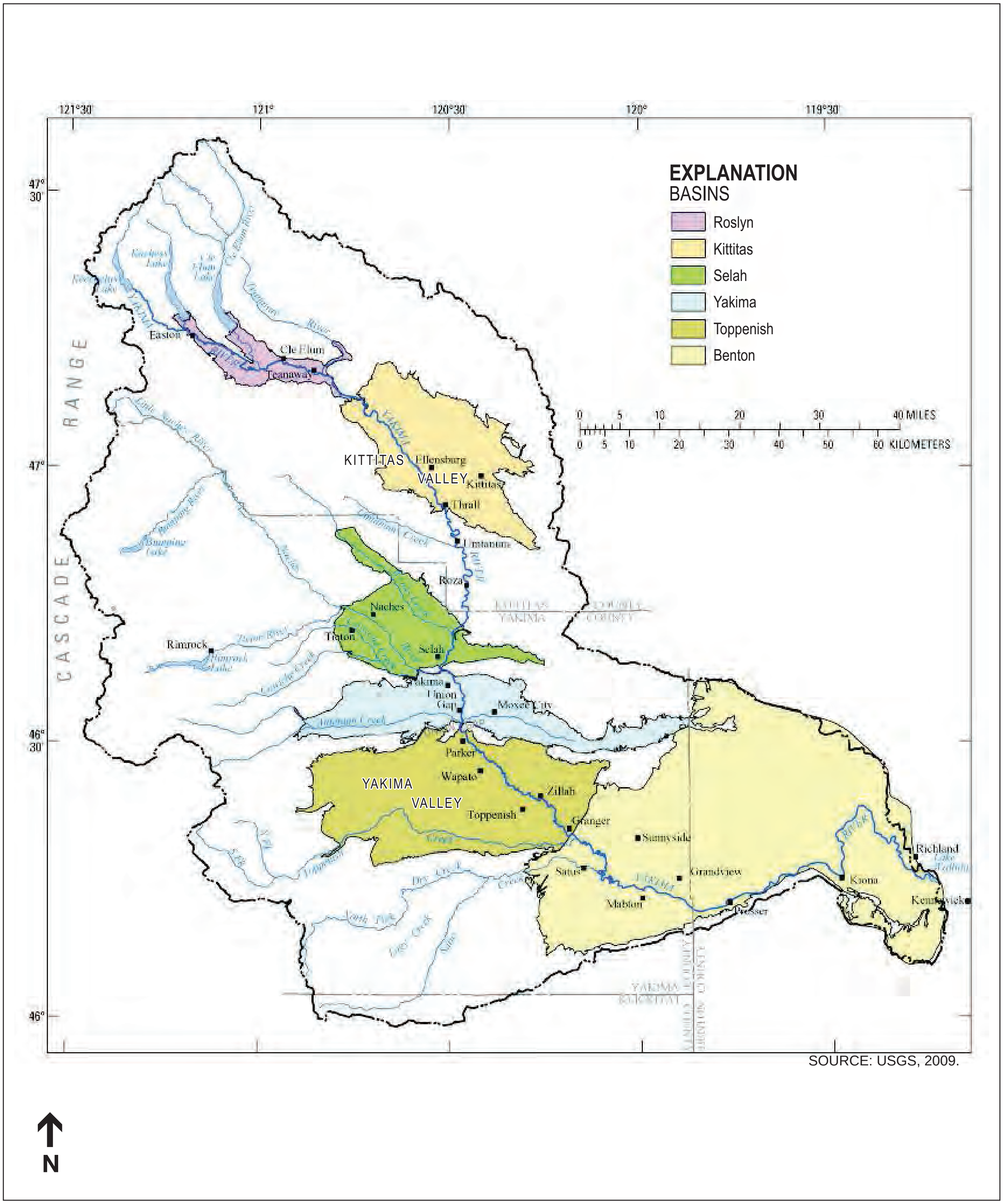

Figure 3-2. Groundwater Basins

This type of geology has an important impact on sediment transport, as the river flows from alluvial valleys through bedrock canyons and gaps. It has been stated that the Yakima River has a low sediment discharge for a river of its size (Dunne and Leopold, 1978), which might be attributed to the lack of available sediment in the canyon reaches and bedrock control at many locations, or to the reservoirs on the river that trap incoming sediment and substantially restrict sediment availability downstream of the dams. Intensive flow regulation and levee construction have affected the transport of sediment and channel morphology since the early part of the 20th century.

Yakima River floodplains were likely historically important in providing fish habitat (Snyder and Stanford, 2001), but these areas are now degraded (Stanford et al., 2002). Historically, the erosion and deposition of sediments, channel movement, and groundwater recharge from flooding events shaped the floodplain, creating a shifting mosaic of physical channel attributes and habitats. Maintaining this shifting mosaic depends on the ability of the river to move freely over the historic floodplain, and on the balance between channel movement and sediment erosion and deposition. Native aquatic species have evolved to these ongoing changes, and their alteration is likely to impact salmonids. A sufficient supply of sediment is also needed to build new bars and islands, prevent channels from becoming incised, and maintain connections between surface water and groundwater (Stanford et al., 2002).

The geology and groundwater of the Yakima basin have been extensively documented by the U.S. Geological Survey (Vaccaro et al., 2009) in a study undertaken as part of an agreement between Ecology, Reclamation, and the Yakama Nation. In its study, the USGS divides the Yakima River basin into groundwater basins separated from one another by anticlinal or monoclinal ridges. Refer to Section 3.4, Groundwater, for further discussion of the groundwater basins.

3.2.1 Roslyn Basin

The Roslyn basin includes the Cle Elum River and reservoir, Kachess and Keechelus Reservoirs, the Teanaway River, and Swauk Creek. It is located in the northwest portion of the Yakima River basin, in an area dominated by Mesozoic metamorphics and Tertiary volcanic deposits. In the valley floor, basin-fill deposits consist predominantly of alluvial, lacustrine, and glacial deposits.

3.2.1.1 Cle Elum Dam

Cle Elum Reservoir and Cle Elum Dam are located in a U-shaped valley formed by multiple glaciers during the Pleistocene period. A moraine deposited by the last glacial advance blocked the valley and formed a natural dam, impounding the lake. The moraine was subsequently breached, and a deep channel was incised through the moraine and outwash deposits, forming the outlet of the glacial lake. In 1933, Reclamation completed an earthfill dam, which blocks the deep channel that had worn through the moraine materials (Kinnison and Sceva, 1963).

The glacial materials near the dam range in size from rock flour to boulders. The bedrock has not been reached during investigations at the dam. Bedrock is expected to be composed of volcanic and sedimentary units (Reclamation, 2008b).

3.2.1.2 Keechelus and Kachess Dams

Keechelus Lake was a natural lake originally created by a moraine impoundment following the last glaciations (Kinnison and Sceva, 1963). Construction of Keechelus Dam, an earthfill dam, was completed by Reclamation in 1920 (Kinnison and Sceva, 1963). Beginning in 2003, the dam was reconstructed for safety modifications. The dam provides 157,900 acre-feet of active storage over the natural lake. The surface geology near Keechelus Dam is primarily composed of glacial materials. Lacustrine deposits and peat soils have been found adjacent to the lake (WSDOT and FHA, 2005).

Lake Kachess was also originally a natural lake impounded by a glacial till moraine. The till includes a heterogeneous mix of clays, silts, sands, gravels, cobbles, and boulders. The moraine ranges in depth from 45 to 100 feet and may be up to 200 feet deep beneath the dam (Reclamation, 2008e). Bedrock in the area includes basalts, metamorphic rocks, and other formations believed to have low permeability and porosity (Kinnison and Sceva, 1963).

3.2.2 Kittitas Basin

The Kittitas basin includes Taneum, Wilson, Naneum, and Manastash Creeks (Figure 3-2). It is located in the north-northeast part of the Yakima basin, an area of basalt terrain in the uplands and alluvial fill deposits in the lower segments of the basin.

The Teanaway River flows through the southern edge of the valley in Quaternary fill containing sand and coarse gravel alluvium. The southern valley slope is formed of Columbia River Basalt. The valley floor is underlain by a sand and gravel alluvium (Kinnison and Sceva, 1963).

Swauk Creek and Taneum Creek, located northwest of Thorp, flow through canyons composed of Columbia River Basalt. The canyon floors are filled with a coarse gravel alluvium of unknown depth (Kinnison and Sceva, 1963).

3.2.3 Selah Basin

The Selah basin, located in the central part of the Yakima River basin, extends to the Cascade Range Crest and headwaters of the Naches and Bumping Rivers (Figure 3-2). The basin includes the Bumping and Tieton Rivers, Bumping Lake, Rimrock Lake, and Cowiche Creek. The western portion of the basin contains Miocene volcanic rocks and Tertiary intrusives, while the middle portion contains the western margins of the Columbia River Basalt Group. The lower portion of the basin contains alluvial basin fills.

3.2.3.1 Bumping Lake Dam

Bumping Lake Dam is located in a deep, steep-walled canyon, formed in part by glacial activity. The canyon is formed of volcanic flow rocks and the valley is covered by glacial till and outwash overlain by mudflow materials. Outwash materials include silts, sand, gravels, cobbles, and boulders (Reclamation, 1979). Mudflow materials contain silty sand with gravels and cobbles. The material includes organic debris blended with volcanic ash (Reclamation, 2008a).

3.2.3.2 Tieton Dam

Tieton Dam is an earthfill dam set in a basin of basalt flows overlaying shale and sandstone sediments. Volcanic flows partially filled sections of the canyons with andesite. The canyons were cut by stream erosion and partially filled with Quaternary-age fills (Kinnison and Sceva, 1963). Glacial materials are present on the valley floor and occasionally on the valley walls (Reclamation, 2008d).

3.2.4 Yakima Basin

The Yakima basin is a long, narrow, east-west trending basin in the central part of the Yakima River basin (Figure 3-2). The western portion of the basin contains Miocene volcanic rocks of the Columbia River Basalt Group, while the middle and eastern portions contain Quaternary deposits (Figure 3-1).

3.2.5 Toppenish Basin

The Toppenish basin is in the south-central part of the Yakima River basin. It is underlain by Columbia River Basalt in the upland areas and alluvial basin fills in the lowland areas (Figure 3-2). The basin is bisected by the Wapato Syncline.

3.3 Surface Water Resources

This section provides information on water bodies that could be affected by the Integrated Plan. These water bodies are illustrated in Figure 3-3. They include all Yakima Project reservoirs, certain reaches of the Yakima, Kachess, Cle Elum, Naches, Tieton and Bumping Rivers, and many smaller tributaries.

Potential effects include changes in streamflow (both in quantity and in timing) in the mainstem Yakima River and its tributaries, storage capacities in reservoirs, total water supply available, and water diverted to water users. These key indicators were characterized by analyzing data and utilizing existing studies on water bodies that may be affected by the Integrated Plan.

3.3.1 Yakima River Basin Hydrology

Hydrology in the Yakima River basin is characterized by high precipitation in the Cascades and low precipitation in the lower Yakima River basin. Most of the annual precipitation occurs from October to March, and mainly falls in the form of snow during this period. During the late spring and early summer, precipitation changes to rain and temperatures increase to produce snowmelt runoff. A portion of this runoff is captured in the five major Yakima River basin reservoirs for storage and release during the summer and fall at times of higher water demand and lower natural precipitation. This operation causes streamflows that are higher than natural in the summer and fall and lower than natural in the winter and spring.

3.3.2 Yakima River Basin Reservoirs

The five main water storage facilities used to supplement the unregulated flow from the Yakima River are Keechelus, Kachess, Cle Elum, Rimrock, and Bumping Reservoirs. The five major storage reservoirs store runoff during the winter and spring/summer seasons for later release to supply irrigation demands during the summer/fall low-flow runoff periods. The total storage of the five major storage reservoirs is slightly more than 1 million acre-feet. These reservoirs are operated in a coordinated manner to supply the needs of the system as a whole. Releases from each reservoir are balanced to meet system-wide demands in conjunction with natural runoff and return flow available in the basin. No single reservoir is designated to supply the needs of one particular area, irrigation district, or division. Other water storage is provided through snowpack (often called the “sixth reservoir”) and Clear Lake Dam, a small lake above Rimrock Reservoir mostly used for recreation. These reservoirs are described in more detail in the sections below. A summary of the system storage capacity, average annual runoff, and historical storage on September 30 (end of irrigation season) for the five main Yakima Project reservoirs is presented in Table 3-1.

Table 3-1 Yakima Project System Storage Summary (Period of Record: 1920-1999)

Reservoir	Reservoir Drainage Area (square miles)	Depth (feet)	Active Storage Capacity (acre-feet)	Average Annual Runoff (acre-feet)	Ratio of Runoff to Capacity	Sept 30 Minimum Historical Storage (acre-feet)	Sept 30 Average Historical Storage (acre-feet)	Sept 30 Maximum Historical Storage (acre-feet)
Keechelus	54.7	Max- 310 Mean - 96	157,800	244,764	1.5:1	4,800	40,500	126,900
Kachess	63.6	Max - 430	239,000	213,398	0.9:1	20,100	107,200	227,200
Cle Elum	203.0	Max - 258 Mean - 109	436,900	672,200	1.5:1	12,900	118,000	359,500
Bumping	70.7	Max - 117 Mean - 45	33,700	209,492	6.2:1	2,400	7,900	24,600
Rimrock	187.0	174[a]	198,000	367,966	1.8:1	200	74,500	145,100
System Total	**579.0**		**1,065,400**	**1,707,820**	**1.6:1**	**51,700**	**357,500**	**660,200**

Source: Reclamation, 2002.

[a] FERC (1990) did not specify whether this is a maximum or mean depth.

Reclamation operates Hydromet, a hydrologic data collection system that records streamflow and reservoir levels for Reclamation projects, including the Yakima Project. Data on reservoir levels and discharge from the reservoirs are available at http://www.usbr.gov/pn/hydromet/ and will not be summarized in this document.

3.3.2.1 Sixth Reservoir (Snowpack)

Only 30 percent of the average annual total natural runoff can be stored. Therefore, the Yakima Project depends heavily on the timing of spring/summer runoff (snowmelt and rainfall). The early spring/summer natural flow is utilized to supply most river basin demands through June in an average year. The majority of spring/summer runoff is from snowmelt: therefore, snowpack is often called the sixth reservoir. In most years, the five major reservoirs are maintained at peak storage in June (average mid-June, period of record 1940-1999), around the same time the major natural runoff ends.

3.3.2.2 Clear Lake Reservoir

Clear Lake Reservoir is a small, 5,300-acre-foot lake located above Rimrock Reservoir. Although the lake has little capacity to supplement water supply, in short water years it is possible to provide some benefit to downstream storage demands to offset minimum storage requirements in Rimrock Reservoir for irrigation and fisheries.

3.3.3 Yakima River and Main Tributaries

Reaches along the Yakima River and its main tributaries that are affected by the operation of the Yakima Project and which may be affected by the Integrated Plan are listed in Table 3-2. Figure 3-3 shows the location of these reaches and tributaries.

Table 3-2 Yakima River Reaches

Reach Name*	Yakima River Mile Location	Length (miles)
Upper Yakima River	**214.5 to 127.9**	**86.6**
Yakima River from Keechelus Dam to Easton	214.5 to 202.5	12.0
Kachess River from Kachess Dam to Yakima River	*203.5*	*0.9*
Yakima River from Easton to Cle Elum River	202.5 to 185.6	16.9
Cle Elum River from Cle Elum Dam to Yakima River	*185.6*	8.2
Yakima River from Cle Elum River to Roza Dam	185.6 to 127.9	57.7
Middle Yakima River	**127.9 to 47.1**	**80.8**
Yakima River from Roza Dam to Naches River	127.9 to 116.3	11.6
Naches River (details in Table 3-3)	*116.3*	*44.6*
Yakima River from Naches River to Roza Powerplant Return	116.3 to 113.3	3.0
Yakima River from Roza Powerplant Return to Wapato Diversion Dam	113.3 to 106.7	6.6
Yakima River from Wapato Diversion Dam to Sunnyside Diversion Dam	106.7 to 103.8	2.9
Yakima River from Sunnyside Diversion Dam to Marion Drain	103.8 to 82.8	21.0
Yakima River from Marion Drain to Prosser Dam	82.8 to 47.1	35.7
Lower Yakima River	**47.1 to 0.0**	**47.1**
Yakima River from Prosser Dam to Chandler Canal Return	47.1 to 35.8	11.3
Yakima River from Chandler Canal Return to Columbia River	35.8 to 0.0	35.8

* Italicized entries are tributaries of the Yakima River

Major reaches within the Naches River basin that are currently affected by the operation of the Yakima Project and which may be affected by the Integrated Plan are listed in Table 3-3. These reaches are shown in Figure 3-3.

Table 3-3 Naches River Reaches

Reach Name	Naches River Mile Location	Length (miles)
Bumping River from Bumping Dam to Little Naches River	44.6	16.6
Upper Naches River from Bumping River to Tieton River	44.6 to 17.5	27.1
Tieton River from Tieton Dam to Naches River	17.5	21.3
Lower Naches River from Tieton River to Yakima River	17.5 to 0.0	17.5

Streamflow data for these reaches are available from Reclamation's Hydromet system at http://www.usbr.gov/pn/hydromet/ and will not be summarized in this document.

A description of the operations of the Yakima Project and its effect on existing river reaches is provided in Section 3.3.5.

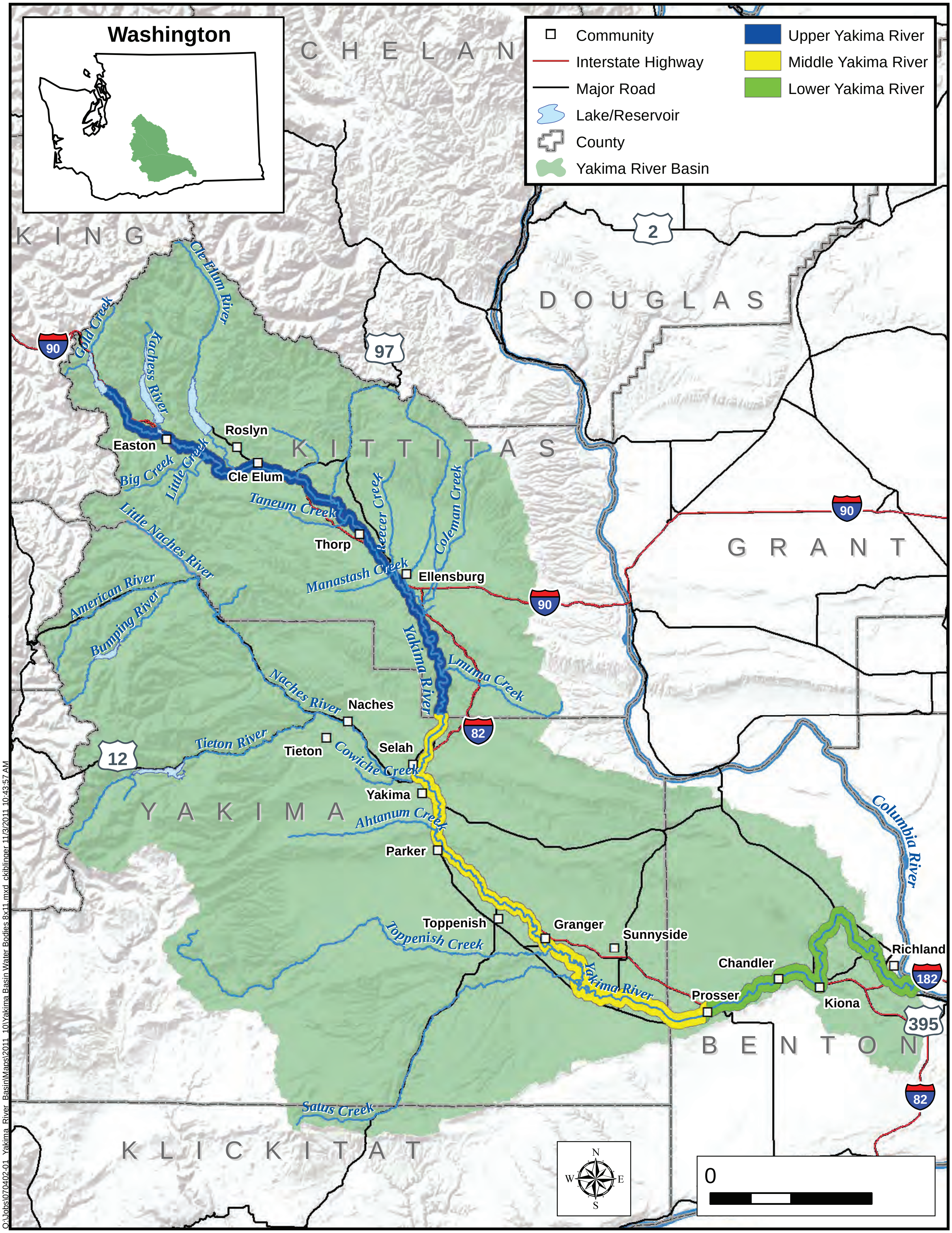

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Figure 3-3. Yakima Basin Water Bodies

3.3.4 Other River Reaches and Tributaries

The other river reaches and tributaries that may be affected by the Integrated Plan are described in the following sections.

3.3.4.1 Gold Creek above Keechelus Reservoir

Gold Creek flows into Keechelus Reservoir at the head of the Yakima River. Flows in Gold Creek have been affected by low rainfall, Gold Creek Pond, timber harvest, and road and residential developments (Haring, 2001). Keechelus Dam is currently a barrier to fish passage.

3.3.4.2 Kachess River and Box Canyon Creek above Kachess Reservoir

The Kachess River has a drainage area of 81 square miles of forested land. Streamflow above Kachess Reservoir is unregulated. Box Canyon Creek is one of the tributaries to the Kachess River. High streamflows occur through the winter, spring, and early summer, and low streamflows occur through late summer and fall (Haring, 2001). Kachess Dam is currently a barrier to fish passage.

3.3.4.3 Cle Elum River Basin above Cle Elum Reservoir

The Cle Elum River watershed has over 500 miles of streams and drains 231 square miles, with a vast majority occurring above Cle Elum Reservoir. Major rivers include the Cle Elum and Waptus Rivers, both of which are proposed for Wild and Scenic River designation. Streamflow in the Cle Elum River above Cle Elum Reservoir is unregulated (Haring, 2001). Cle Elum Dam currently presents a barrier to fish passage.

3.3.4.4 South Side Kittitas Valley Tributaries

South Side Kittitas Valley Tributaries include Big Creek, Little Creek, Tillman Creek, Spex Arth Creek, Taneum Creek, and Manastash Creek. These creeks are summarized in Table 3-4.

Table 3-4 South Side Kittitas Valley Tributaries

Creek	Surface Water Rights (acre-feet)	Flow Issues
Big	1,464[1]	Reductions due to irrigation diversions and seepage loss to groundwater[2]
Little	462[1]	Summer and early fall low flow[3]
Tillman	NA	Low summer and early fall flow
Spex Arth	NA	Low summer and early fall flow
Taneum	11,834[1]	Minimum instream flows met less than 5% of time[2]
Manastash	26,000[1]	Diversions create low flows/dewatered reaches[4]

Sources: [1] CH2M Hill, 2001 [2] Ecology, 2005b [3] Haring, 2001 [4] Yakama Nation and BPA, 2002

3.3.4.5 Teanaway River Basin

The Teanaway River has a drainage area of 244 square miles and flows into the Yakima River at river mile (RM) 176.1. Although in the past there were problems with low flows during the summer and fall in the lower mainstem and in the Middle and West Forks, flows in the lower mainstem have been addressed. Although Middle and West Fork flows are low, they do not go dry and are passable (Johnston, personal communication, 2008b). High flow variation also exists naturally and has increased due to extensive logging in the upper watershed. Water uses include diversions for seasonal irrigation, stock water, and domestic water supply. Low flows in the later summer and early fall do not allow access for salmon spawning most years. Summer flows are adequate for 15 miles of the North Fork and 9 miles of the Middle Fork of the Teanaway River (Haring, 2001). Jack Creek is a tributary to the North Fork of the Teanaway River.

Irrigation systems have been modified to reduce diversions and increase streamflow in the Teanaway River. However, residential development and drilling of permit exempt wells have increased. These wells may be in continuity with the river, which may affect the instream flow improvement efforts associated with modifications to the irrigation system (Haring, 2001).

The Teanaway River has two active gages that measure streamflow as part of Reclamation’s Hydromet network described in Section 3.3.2.

3.3.4.6 Swauk Creek

Swauk Creek has a drainage area of 100 square miles and flows into the Yakima River at RM 169.9. Precipitation in the basin is low, and therefore, unregulated summer flows are low. Lower Swauk Creek has naturally low streamflow during the late summer and early fall, but this is also partly caused by historic mining and channel alterations. There are also a number of diversions on Swauk Creek and its tributaries that may cause the creek to have very low or intermittent flow up to RM 6. Some diversions on Swauk and First Creeks have been dedicated to instream flow purposes through acquisition from the Mountain Star Resort.

Ecology operated a stream gage on Swauk Creek at RM 5 from February 2005 to February 2009. Flow data at the mouth of Swauk Creek for July to October 2001 ranged from being dry in August and September to a flow of 3 cubic feet per second (cfs) in mid-October 2001 (Montgomery Water Group, 2002).

3.3.4.7 North Side Kittitas Valley Tributaries

North Side Kittitas Valley Tributaries include Reecer Creek and the Wilson/Naneum Creeks system.

Reecer Creek flows into the Yakima River at RM 153.7. The headwaters of Reecer Creek flow year-round, but surface flow is intermittent during the late summer from the canyon base to the Highline Canal. Dry reaches also occur downstream. Irrigation water is delivered to Reecer Creek through KRD canals, Cascade canals, Town Ditch, and Reed-Mill Ditch (Haring, 2001).

Streamflow measurements are available for July to October 2001 upstream of Dolarway Road. During that year, flow in Reecer Creek at this location ranged from 6 cfs in October to 32 cfs in August (Montgomery Water Group, 2002).

Wilson Creek has a drainage area of 408 square miles and flows into the Yakima River at RM 147. Naneum and Cherry Creeks are major tributaries to Wilson Creek, draining into Wilson Creek at RM 20 and RM 0.5, respectively. Coleman Creek is a smaller tributary of Wilson Creek. The Wilson Creek drainage area includes much of the Kittitas Valley agricultural area. The KRD irrigation system adds high amounts of flow (several hundred cfs) during the irrigation season through delivery spills, return flows, and groundwater augmentation from flood/rill irrigation. Flows in Wilson Creek and its tributaries are typically highest in April and May and lowest in August and September (Haring, 2001).

3.3.4.8 Lmuma Creek

Lmuma Creek is a small tributary to the middle Yakima River. It enters the Yakima River at RM 135 approximately 10 miles south of Kittitas. The Lmuma Creek drainage basin is approximately 104 square miles (Reclamation, 2007c).

3.3.4.9 Bumping River and Deep Creek above Bumping Lake Reservoir

Bumping River is a tributary to the Naches River. Bumping Lake Dam is currently a barrier to fish passage (Reclamation, 2005a). Deep Creek is a tributary to the Bumping River above Bumping Lake. During low water years, the lower one-half mile of Deep Creek goes subsurface (Haring, 2001).

3.3.4.10 North Fork, South Fork Tieton River above Rimrock Reservoir

The North and South Forks of the Tieton River are located above Rimrock Reservoir and their confluence is inundated by the reservoir. Clear Creek and Indian Creek are tributaries of the North Fork. The North Fork, Clear Creek, and Indian Creek provide 47 percent of the total flow to the Tieton River and the South Fork provides 36 percent. Flow is largely unregulated for the Tieton River above Rimrock Reservoir.

3.3.4.11 Other Naches River Tributaries

Other tributaries to the Naches River that may be affected by the Integrated Plan are the American River, Crow Creek, Little Naches River, Rattlesnake Creek, and Cowiche Creek.

The American River flows down the east side of the Cascade Range, through the Okanogan-Wenatchee National Forest and the William O. Douglas Wilderness. It flows into the Bumping River at RM 3.5. The American River has a drainage area of 78.9 square miles. A USGS stream gage on the river has recorded a long-term average flow of 233 cfs.

Crow Creek is a small tributary that flows into the Little Naches River at RM 3.2. Rattlesnake Creek flows into the Naches River at RM 27.8. It has a drainage area of 134 square miles.

Cowiche Creek enters the lower Naches River at RM 2.7. It has a drainage area of 120 square miles. The South Fork and the mainstem portions of Cowiche Creek are suitable for salmonid rearing, even with irrigation withdrawals that occur. The North Fork of Cowiche Creek is intermittent between the mouth and the town of Cowiche except during spring runoff and operational spills from French Canyon Dam (Haring, 2001; Tayer, 2009).

Major irrigation diversions are operated by the Ahtanum Irrigation District (AID) and the Wapato Irrigation Project (WIP). The AID diverts surface water for irrigation from March until July 10. In 2002, the average diversion ranged from 14 cfs in March to 30 cfs in May. The WIP currently diverts water mostly during the late spring and early summer (Ecology, 2005b).

3.3.4.12 Toppenish Creek

Toppenish Creek, with a drainage area of 612 square miles, flows into the Yakima River at RM 80.4 (YBFWRB, 2005). Toppenish Creek has historically been dry from mid-June to mid-October due to irrigation diversions at the Toppenish Lateral Canal at RM 44.2. Recently, instream flows of 10 cfs have been adhered to, but natural seepage into the Toppenish Creek/Mill Creek alluvial fan has been as much as 18 cfs, resulting in a dry reach for several miles until WIP return flows enter Toppenish Creek (YBFWRB, 2009).

3.3.4.13 Satus Creek

Satus Creek has a drainage area of 625 square miles, approximately 10 percent of the Yakima River basin area (YBFWRB, 2005). It flows into the Yakima River at RM 69.6. Streamflow in Satus Creek is essentially unregulated, and previous irrigation diversions have been shut down since 1991 to protect instream flows. However, Satus Creek can still dry up in dry summers within the alluvial reach upstream of the confluence with Logy Creek at RM 23.6 (YBFWRB, 2009).

3.3.5 Yakima Project Operations

3.3.5.1 Total Water Supply Available

Total water supply available (TWSA) is defined in the 1945 Consent Decree as:

> That amount of water available in any year from natural flow of the Yakima River, and its tributaries, from storage in the various Government reservoirs on the Yakima watershed and from other sources, to supply the

> contract obligations of the United States to deliver water and to supply claimed rights to the use of water on the Yakima River and its tributaries, heretofore recognized by the United States.

Reclamation interprets the above to mean:

> . . . the total water supply available for the Yakima River Basin above PARW (the United States Geological Survey (USGS) gage at Parker referred to as “Parker gage”, located below Union Gap and the Sunnyside Diversion Dam), for the period April through September.

This is expressed in a mathematical formula, reading as follows:

	April 1 through July 31 forecast of runoff
+	August 1 through September 30 projected runoff
+	April 1 reservoir storage contents
+	Usable return flow upstream from Parker gage
=	TWSA

TWSA provides an estimated total water volume available for use in determining the instream flow targets for each year in accordance with the operating criteria of the YRBWEP legislation. The total demand to be placed against this TWSA for irrigation, regulation, and flows passing Parker gage averages 2.7 million acre-feet (including Title XII target flows) in a normal year.

Return flows resulting from irrigation diversions above Sunnyside Dam are an integral part of the TWSA estimate. The amount of return flow depends on the quantity and location of diversion and loss, which is also controlled by amount, time, and availability of runoff. Return flow will vary from year to year, but the usable portion is a fairly uniform base flow that is generated by fairly stable upstream diversion rates. The return flow volume projected to be usable is 400,000 acre-feet in high runoff years; 375,000 acre-feet in average years; and 300,000 to 350,000 acre-feet in low runoff years, depending upon the severity of drought.

Each year Reclamation develops monthly runoff forecasts beginning in January and typically ending in July. Early forecasts (January and February) are primarily used in flood-control operations. By March, forecasts become more suitable for TWSA estimation. The forecasts are made for anticipated precipitation levels of 50 percent, 100 percent, and 150 percent of normal. Table 3-5 lists historical TWSA estimates.

Table 3-5 Historical April 1 TWSA Estimates

Year	Total (acre-feet)
1977	2,037,000
1978	2,678,000
1979	2,657,000
1980	3,147,000
1981	2,367,000
1982	3,256,000
1983	3,392,000
1984	2,786,000
1985	3,111,000
1986	2,668,000
1987	2,559,000
1988	2,253,000
1989	3,071,000
1990	3,268,000
1991	2,962,000
1992	2,422,000
1993	1,974,000
1994	2,016,000
1995	3,044,000
1996	2,872,000
1997	4,542,000
1998	2,982,000
1999	4,198,000
2000	3,305,000
2001	1,678,000
2002	3,316,000
2003	2,644,000
2004	2,553,000
2005	1,717,000

Sources: Reclamation 2002; Reclamation 2008f.

3.3.5.2 Yakima River Flow and Diversions – Parker Gage

The average annual unregulated flow of the Yakima River basin at Parker gage totals approximately 3.4 million acre-feet, ranging from a high of 5.6 million acre-feet (1972) to a low of 1.5 million acre-feet (1977). The surface water entitlements above the Parker gage total 2.41 million acre-feet. Of that total, the five Yakima Project divisions diverting above the Parker gage have 1.94 million acre-feet of entitlements. The average diversions of the five Yakima Project divisions above Parker total 1.77 million acre-feet (period of record, 1990 through 2009) and have declined since the early 1990s. The average diversion in the last five nondrought years has totaled 1.6 million acre-feet.

The diversions in drought years are less: 1.21 million acre-feet in 2001 and 1.25 million acre-feet in 2005 (Reclamation and Ecology, 2011o). These volumes do not include other requirements for water in the basin, such as small irrigation districts and individual diversions, instream flows, and municipal and industrial uses.

3.3.5.3 Current Operations

Operational Objectives

The operational objectives of the current Yakima Project include the following:

- Store as much water as possible up to the reservoir system's full active capacity (approximately 1 million acre-feet) following the end of the irrigation season through early spring.
- Provide target flows and diversion entitlements downstream from the dams, meeting Title XII flows (described below) at Sunnyside and Prosser Diversion Dams.
- Provide reservoir space for flood control operations.

Meeting Irrigation Demands

The irrigation season starts around April 1. During the initial part of the irrigation season through late June, irrigation diversion demands and the Title XII target instream flows at Sunnyside Diversion Dam are generally adequately met by: (1) unregulated runoff from tributaries downstream from the five reservoirs; (2) incidental releases from the reservoirs (for target flows and flood control); and (3) irrigation return flows. Once these flows fail to meet diversion demands and Title XII instream target flows, reservoir releases are made, resulting in depletions in the stored water supply. This is commonly referred to as the beginning of the storage-control period. The storage-control period typically begins around June 24.

From the beginning of the storage-control period until early September, releases from Cle Elum Reservoir are used in coordination with releases from Keechelus and Kachess Reservoirs to meet mainstem Yakima River water entitlements from the Cle Elum River confluence (RM 179.6) to Sunnyside Diversion Dam (RM 103.8). These entitlements amount to approximately 1.46 million acre-feet to supply diversions, mostly from Roza Diversion Dam downstream, including Roza Division, Wapato Irrigation Project, and Sunnyside Division. A peak of approximately 3,600 cfs for irrigation is moved through this area.

On or prior to September 1, Cle Elum Reservoir releases are reduced substantially over a 10- to 20-day period, and releases from Rimrock Reservoir are increased substantially to meet the September and October irrigation demands downstream from the confluence of the Naches and Yakima Rivers. This is referred to as the "flip-flop" operation, which was instituted to encourage spring Chinook to spawn at a lower streamflow that requires less stored water to be released during the egg incubation period to protect spawning nests (redds). Affected spring Chinook spawning reaches are the Yakima River downstream from the Cle Elum River to the City of Ellensburg and the Cle Elum River downstream from the dam.

A similar operation, referred to as “mini flip-flop,” is performed between Keechelus and Kachess Reservoirs in years of sufficient water supply for similar reasons. Irrigation releases from Keechelus Reservoir are greater than from Kachess Reservoir from June through August. In September and October, irrigation releases from Keechelus Reservoir are decreased and correspondingly increased from Kachess Reservoir. The affected reach for the spring Chinook spawning reaches are the Yakima River from Crystal Springs downstream to the Cle Elum River confluence.

Carryover Storage

Conserving water during the summer/fall period of operations helps maximize carryover storage at the end of the irrigation season (October 21). The Yakima Basin storage system is designed to store only the current year’s spring/summer runoff and deliver it as needed to meet irrigation demands from April through October. If only minimal storage (52,000 acre-feet) is left on October 21, the upcoming water year’s operations are more likely to require lower base river flows and a tighter control over reservoir releases. In general, more rather than less carryover storage in the system reservoirs on October 20 leads to better flow and water supply conditions in the subsequent water year, particularly if the subsequent year turns out to be a dry year. The impacts of the drought year of 1977 were reduced because of favorable carryover storage from 1976. The 1994 drought was devastating to water users because there was virtually no carryover after the drought years of 1992 and 1993. A good carryover also helps assure sufficient spring Chinook incubation flow below the upper Yakima mainstem dams.

Irrigation Entitlements

The total of April through September “entitlement diversions” (existing contractual obligations) is approximately 2.41 million acre-feet. October entitlements total approximately 120,000 acre-feet. To date, entitlement in March is not completely quantified; however, some irrigation entities have rights that include flood water use. Entitlement diversions represent only the irrigation water entitlements stipulated in the 1945 Consent Decree for the mainstem Yakima River and do not include irrigation diversions on tributaries or adjudicated streams such as Big Creek, Little Creek, Teanaway River, Taneum Creek, Manastash Creek, Wenas Creek, Cowiche Creek, Ahtanum Creek, and others. Table 3-6 lists the irrigation entitlements recognized by the 1945 Consent Decree.

Table 3-6 April to September Irrigation Entitlements Recognized by 1945 Consent Decree

Month	Monthly Total (acre-feet)	Accumulated Total (acre-feet)
April	254,830	254,830
May	415,100	669,930
June	440,390	1,110,320
July	457,840	1,568,160
August	443,880	2,012,040
September	297,430	2,309,470

Source: Reclamation 2002

Some major entities, such as the Roza Irrigation District and KRD, have no natural flow rights and thus their entire water supply is contracted. Other entities needing a supplemental supply are furnished contract water under terms of the Federal Warren Act of February 21, 1911, which authorized Reclamation to contract for the sale of supplemental water from available supplies. These contracts specify the annual and monthly entitlements (nonproratable and proratable).

Table 3-7 lists the Yakima Project irrigation districts and their Yakima Project water rights divided into nonproratable water rights (priority date prior to May 10, 1905) and proratable water rights (priority date of May 10, 1905).

Table 3-7 Yakima Project Irrigation District Water Rights (acre-feet per year)

District	Nonproratable Water Rights	Proratable Water Rights	Total Water Rights
Wapato Irrigation Project	305,613	350,000	655,613
Sunnyside Division	289,646	157,776	447,422
Roza Irrigation District	0	393,000	393,000
Kittitas Reclamation District	0	336,000	336,000
Yakima-Tieton Irrigation District	75,865	30,425	106,290
Kennewick Irrigation District	18,000	84,674	102,674

Source: Ecology 2010b

Prorationing and Drought Response

Prorationing is necessary when the TWSA is not adequate to meet all irrigation entitlements. Historically, the prorationing period has not started until the date of storage control. The amount of proration is determined monthly, biweekly, or as needed, by project operations and this information is provided to water-using entities at manager meetings. The nonproratable users can divert their full irrigation entitlements, which are deducted from the water supply available for irrigation, with the remainder available for proratable irrigation entitlements.

Prorationing has been imposed an average of once every four years in the last 20 years. Table 3-8 lists the recent proration years.

Table 3-8 Yakima Project Proration Years and Percentages

Water Year	Proration Percentage
1992	58
1993	67
1994	37
2001	37
2005	42

Source: Reclamation, 2008g

Historically, Reclamation has followed a specific framework when faced with below-average years. The basic concepts of this policy are as follows:

- Share flood water and return flow during the main runoff period.
- Discourage storage releases during the tail end of the main runoff period (when runoff is unable to meet full demand).
- Allow water users to shape, via requests in advance, their estimated water supply use pattern during the period of heavy reservoir release (after the main runoff period).
- Maintain control during end-of-season (October) operations.

An emergency drought relief provision, established under Chapter 173-166 WAC, authorizes Ecology to determine when water supply conditions are expected to be 75 percent of the normal supply and cause undue hardship to water users. This definition was established by the Washington State Legislature in 1989 (RCW 43.83B.400). Following governor approval, Ecology can issue a drought condition order. This order:

- Allows water users to obtain water from alternate groundwater and surface water sources;
- Allows temporary water transfers and transactions; and
- Provides funding assistance to public bodies for projects and measures designed to help alleviate drought conditions relating to agriculture and fisheries.

During the water-short years of 1994, 2001, and 2005, emergency water right transfers were authorized for the declared drought condition. These transfers were intended to alleviate hardships, reduce burdens on water users (irrigation), and increase efficient and maximum use of the water supply during drought conditions.

In 1994, in anticipation of water shortages for irrigation within the Yakima basin, Reclamation proposed an emergency interdistrict water transfer program and developed criteria for the transfers. These transfers were voluntary between willing lessees and lessors and only for temporary water supply during the 1994 water year. The transfers were consistent with appropriate State and Federal law, and had the concurrence of the irrigation districts in which they occurred. The rights of other water users (third parties) were not to be impaired.

Such transfers were limited to lands that had legal water rights and were being irrigated in full compliance with applicable laws, regulations, and contracts (including the Reclamation Reform Act). These legal responsibilities were not to be diminished by the transfers. Transfers had to be within the capability of Reclamation to deliver, and were considered on a first-come, first-served basis. Transfers were subject to Reclamation's responsibility to protect and maintain resources (including water, fisheries, wildlife, and cultural) held in trust by the United States for the Yakama Nation.

In the 2005 drought, a similar process was used, resulting in seasonal transfers of 39,654 acre-feet of water (Ecology, 2005d).

3.3.5.4 Target Flows

Historical Target Flows Developed through System Operation Advisory Committee

Target flows for the Yakima basin have been developed through a System Operation Advisory Committee (SOAC) established by Reclamation. The SOAC consists of fishery biologists, with one each representing the U.S. Fish and Wildlife Service, Yakama Nation, Washington Department of Fish and Wildlife (WDFW), and irrigation entities represented by the Yakima Basin Joint Board. Reclamation also provides a fishery biologist as a liaison to the committee.

Since 1981, the SOAC has provided information, advice, and assistance to Reclamation on fish-related issues associated with the operation of the Yakima Project. Historical target flows from the 2002 Interim Comprehensive Basin Operating Plan for the Yakima Project (IOP) are presented in Table 3-9. The target flows have been modified in some reaches based upon input from Reclamation (Lynch, 2011).

Table 3-9 Historical Yakima Project Target Flows

River Reach	Fall Target Flow and Dates	Winter Target Flow and Dates[1]
Keechelus Reservoir Outflow	60-100 cfs – Sep 1-Oct 20	15-100 cfs – Oct 21-Mar 31
Yakima River – Crystal Springs to Lake Easton	60-100 cfs – Sep 1-Oct 20	30-100 cfs – Oct 21-Mar 31
Kachess Reservoir Outflow	Not Applicable (NA)	5-50 cfs – Oct 21-Mar 31
Yakima River – Easton Dam to Cle Elum River	150-300 cfs – Sep 10-Oct 20	80-300 cfs – Oct 21-Mar 31
Cle Elum Reservoir Outflow	150-650 cfs – Sep 10-Oct 20	60-300 cfs – Oct 21-Mar 31
Yakima River – Cle Elum River to Teanaway River	400-800 cfs – Sep 10-Oct 20	200-325 cfs – Oct 21-Mar 31
Yakima River – Roza Dam to Wenas Creek	200-300 cfs minimum – Jul 1-Oct 20	400 cfs – Power subordination target – all year
Bumping Reservoir Outflow	NA	50-120 cfs – Oct 21-Mar 31
Rimrock Reservoir Outflow	NA	15-50 cfs – Oct 21-Mar 31
Yakima River at Parker	NA	300-600 cfs minimum – Mar 15-Oct 21 (spring and summer target flow)

[1] – Winter target flow would be carried past March 31 if supplemental flows are still needed to reach target.
Source: Reclamation 2002 modified by Lynch, 2011.

Title XII Target Flows

One of the purposes of the YRBWEP is to implement water conservation measures to reduce out-of-stream irrigation water diversions from the Yakima River and its tributaries. Savings achieved through improvements to water delivery systems and changes in operation and management would result in more water remaining in the stream to improve flows for fish and wildlife and the reliability of the irrigation water supply.

Phase II of the YRBWEP was authorized by Title XII of the Act of October 31, 1994 (108 Stat. 4550, Public Law 103-434). Title XII established new instream flow targets to be maintained past the Sunnyside and Prosser Diversion Dams using criteria based on TWSA. The streamflow targets range from 300 cfs to 600 cfs, depending on the estimate of TWSA. Reclamation interprets the requirement for target flows as being subject to reasonable fluctuations due to project operations, not instantaneous flows to be uniformly maintained at all times. However, for any period exceeding 24 hours, flows cannot fall below 65 percent of target flow at the Sunnyside Diversion Dam (Parker gage) or more than 50 cfs below target flow at Prosser Diversion Dam. Target flows are listed in Table 3-10.

Table 3-10 Title XII Target Flows

TWSA (million acre-feet)				Parker and Prosser Flows (cfs)	Title XII Minimum Flow Past Parker Gage July-September Demand (acre-feet)
Apr-Sept	May-Sept	Jun-Sept	Jul-Sept		
3.20	2.90	2.4	1.9	600	117,000
2.90	2.65	2.2	1.7	500	100,000
2.65	2.40	2.0	1.5	400	84,000
Less than above TWSA				300	68,000

Source: Reclamation 2008g

Phase II of the YRBWEP also provides that, as conservation measures are implemented under the conservation program and irrigation water demands are thereby reduced, the target flows will be increased by 50 cfs for each 27,000 acre-feet of diversion reduction during nonprorated water years. Such increases, however, may not lower the volume of water that otherwise would have been delivered in years when the water supply is prorated. During those years, the target flows obtained through water conservation would be increased above 300 cfs only where irrigation return flows previously entered the Yakima River downstream of Parker gage. Although diversion reductions would be accounted for, a "block of water" would not be set aside under TWSA for maintaining target flows at Parker gage. Title XII target flows (supplemented by conserved water) would continue to be met from TWSA the same way irrigation demands are met under the 1945 Consent Decree. Water entitlements stipulated in the decree are not changed by Title XII.

3.3.6 Yakima River and Tributary Flow Issues

The management of water supply in the Yakima River basin has changed the flow regime, with effects on anadromous and resident fish. Table 3-11 compares the current flow regime to an unregulated or natural flow regime for upper Yakima River reaches, middle Yakima River reaches, and lower Yakima River reaches. In general, spring flows in the middle and lower Yakima River reaches are not sufficient to optimize survival of out-migrating smolts. Summer flows downstream of Sunnyside Dam are less than ideal for salmonid habitat and proper riparian function. High flows also persist during the summer in the upper Yakima River reaches, affecting juvenile salmonid rearing habitat (Reclamation, 2008g). The annual later summer “flip-flop” operation disrupts salmonid habitat spatially and has impacts on aquatic insect populations, while winter flows in the upper Yakima and Cle Elum Rivers are low, potentially impacting survival of overwintering juvenile salmonids (Reclamation, 2008g).

Flow conditions above the reservoirs are typically more natural, notwithstanding effects on flow from forest practices, roads, grazing, fire suppression, and other influences. The natural variations in flow are supported by the geographic surroundings and persistent flows contributed by springs and smaller drainages. Streams that have experienced flow alterations include Gold Creek, which drains to Keechelus Reservoir, and tributaries to the Kachess River, which become dewatered due to low flows or go subsurface as reservoirs are drawn down (Haring, 2001). Land use practices may be responsible for the flow alterations at Gold Creek; however, those alterations have not been quantified.

Table 3-11 Comparison of Current Stream Flow Regime to Unregulated Stream Flow Regime – Upper, Middle, and Lower Yakima River

Season	Upper Yakima River															
								Cle Elum River Basin								
	Above Dam	Mainstem Reach	Above Dam	Mainstem Reach		Tributaries		Above Dam	Mainstem Reach	Mainstem Reach	Tributaries					
	Above Keechelus Dam	Keechelus Dam to Lake Easton	Above Kachess Dam	Kachess River	Yakima River from Easton to Cle Elum River	Big Creek	Little Creek	Above Cle Elum Dam	Cle Elum River	Yakima River from Cle Elum River to Roza Dam	Teanaway River	Swauk Creek	Taneum Creek	Manastash Creek	Naneum Creek	Wilson Creek
Winter (Oct-March)	Flow is unregulated	Flow is reduced and is less variable	Flow is unregulated	Flow is reduced and is less variable	Flow is reduced	Flow is unregulated	Flow is unregulated	Flow is unregulated	Flow is reduced	Flow is reduced	Flow peaks are higher	Flow is unregulated	Flow is unregulated	Flow is unregulated	Flow is unregulated	Flow is unregulated
Spring (April-June)	Flow is unregulated	Flow is reduced	Flow is unregulated	Flow is reduced	Flow is reduced	Flow is slightly reduced	Flow is slightly reduced	Flow is unregulated	Flow is reduced	Flow is reduced	Flow peaks are higher	Flow is slightly reduced	Flow is reduced	Flow is reduced	Flow is reduced	Flow is reduced
Summer (July-Sept)	Flow is unregulated	Flow is greatly increased until early Sept flip-flop	Flow is unregulated	Flow is greatly increased, especially during mini flip-flop	Flow is increased until early Sept flip-flop	Flow is greatly reduced and dry in some areas	Flow is unknown, but likely reduced	Flow is unregulated	Flow is greatly increased until early Sept flip-flop	Flow is greatly increased until early Sept flip-flop	Flow is reduced	Flow is reduced and dry in some areas	Flow is greatly reduced	Flow is greatly reduced	Flow is dependent on KRD return	Flow is dependent on KRD return

Season	Middle Yakima River from Roza Dam to Prosser Dam																Lower Yakima River from Prosser Dam to the Columbia River	
		Naches River Basin																
	Mainstem Reach	Above Dam	Mainstem Reach		Above Dam	Mainstem Reach		Tributary	Mainstem Reach		Tributary	Mainstem Reach		Mainstem Reach	Tributaries		Mainstem Reach	Mainstem Reach
	Yakima River from Roza Dam to Confluence with Naches River	Above Bumping Dam	Bumping River from Bumping Dam to the Little Naches River	Upper Naches River from Bumping River Confluence to Confluence of Naches and Tieton Rivers	Above Rimrock Dam	Tieton River from Tieton Dam to Confluence with Naches River	Lower Naches River from Naches/Tieton Confluence to Yakima River	Cowiche Creek	Yakima River from Naches River to Roza Power Plant Return	Yakima River from Roza Power Plant Return to Wapato Diversion Dam	Ahtanum Creek	Yakima River from Wapato Diversion Dam to Sunnyside Diversion Dam	Yakima River from Sunnyside Diversion Dam to Marion Drain	Yakima River from Marion Drain to Prosser Dam	Toppenish Creek	Satus Creek	Yakima River from Prosser Dam to Chandler Canal Return	Yakima River from Chandler Canal Return to Columbia River
Winter (Oct-March)	Flow is reduced	Flow is unregulated	Flow is regulated	Flow is mostly unregulated	Flow is unregulated	Flow is reduced	Flow is reduced	Flow is unregulated	Flow is greatly reduced	Flow is reduced	Flow is reduced	Flow is reduced	Flow is reduced	Flow is reduced	Flow is unregulated	Flow has higher peaks	Flow is reduced	Flow is reduced
Spring (April-June)	Flow is reduced	Flow is unregulated	Flow is reduced	Flow is mostly unregulated	Flow is unregulated	Flow is reduced	Flow is reduced	Flow is reduced	Flow is reduced	Flow is reduced	Flow is reduced	Flow is reduced	Flow is reduced	Flow is reduced	Flow is reduced	Flow is unregulated	Flow is reduced	Flow is reduced
Summer (July-Sept)	Flow is greatly increased	Flow is unregulated	Flow is increased	Flow is mostly unregulated	Flow is unregulated	Flow is increased starting early Sept for flip-flop	Flow is increased starting early Sept for flip-flop	Flow is reduced	Flow is increased but moderated by RID diversions	Flow is increased	Flow is greatly reduced	Flow is slightly increased	Flow is reduced to target flow at Parker	Flow is reduced	Flow is reduced	Flow is reduced	Flow is greatly reduced	Flow is reduced

3.4 Groundwater

For this section, the description of groundwater resources focuses on the areas that would be affected by the Integrated Plan. Those areas include the vicinities of the five storage reservoirs, the groundwater recharge areas, and some of the Yakima River tributaries. Information used in developing this groundwater section comes from the *Yakima Basin Groundwater Infiltration Appraisal-Level Study Report* (Reclamation and Ecology, 2011e), *Yakima River Basin Groundwater and Hydrogeologic Framework of the Yakima River Basin Aquifer System 2009–5152* (Vaccaro et al., 2009), or *Hydrogeologic Framework of Sedimentary Deposits in Six Structural Basins, Yakima River Basin, Washington: U.S. Geological Survey Scientific Investigations Report 2006-5116* (Jones et al., 2006).

In cooperation with Reclamation, Ecology, and the Yakama Nation, the U.S. Geological Survey (USGS) completed a study of the groundwater system in the Yakima River basin and how it interacts with rivers and streams in the basin (Vaccaro et al., 2009). The USGS documented the hydrogeologic framework of the basin/aquifer system, collected well levels and pumping records, performed seepage studies of 155 stream reaches, and made simulation runs of a detailed groundwater flow model of the basin.

Groundwater is the principal source of drinking water in the Yakima River basin and supplies about 330,000 people, or about 80 percent of the population, in a three-county area. At least 45,000 wells withdraw water in the basin. Irrigation of cropland is the largest use of groundwater, with more than 300,000 acre-feet pumped annually from about 2,300 irrigation wells (Vaccaro and Sumioka, 2006).

3.4.1 Groundwater Setting

3.4.1.1 Geology Overview

Basaltic rocks beneath most of the Yakima River basin are part of the larger Columbia River Basalt Group (CRBG). The CRBG comprises more than 300 individual basalt flows that erupted from fissures in the eastern part of the Columbia Plateau during the Miocene Epoch (6–17 million years ago). The CRBG hosts multiple aquifers in various layers and formations that are collectively called the Columbia Plateau Aquifer System. The Columbia Plateau Aquifer System underlies about 63,000 square miles in central and eastern Washington, north-central and eastern Oregon, and a small portion of northwestern Idaho. Additional information on the geology of the Yakima basin is included in Section 3.2 and in the *Yakima Basin Groundwater Infiltration Appraisal-Level Study Technical Memorandum*.

The most important hydrogeologic formation with respect to groundwater is the Ellensburg Formation, a set of volcaniclastic and fluvial sediments occurring throughout the Yakima Basin. The confined aquifer consists of consolidated deposits of the Ellensburg Formation and similar undefined continental sedimentary deposits. The thickness of the Ellensburg Formation ranges from zero to 2,040 feet with localized differences, depending on subbasin. Within the Yakima basin, interbedded sediments found between some of the large basalt formations of the CRBG are typically part of the Ellensburg Formation.

Folding, faulting, and other large-scale geologic deformation can affect regional groundwater flow direction, influence hydraulic gradients, and create flow conduits or barriers. At least some of the faults in the Yakima Fold Belt are proven hydraulic barriers. Others appear to be conductive and may connect deep basaltic formations with shallower formations and surface springs. Folding increases the occurrence of fractures on the anticlinal ridges and tends to enhance aquifer hydraulic conductivity.

3.4.1.2 Groundwater Occurrence

Groundwater within the basalts is controlled primarily by the physical characteristics of the rock units, the geometry and relationship between rock units, and the geologic structure. The physical characteristics of the basaltic flows (density and texture, fractures, and internal structures) are important in determining their hydraulic properties. Internal structures found in the flows may influence both the ease of water movement and direction of flow through the formation. Individual basalt flows typically exhibit features that are formed from the emplacement and cooling of the flow.

The thickness and extent of basalt flows and the occurrence or absence of fine-grained sedimentary interbeds also influence groundwater movement. At the distal ends of the basalt flows or where erosion has interrupted the continuity of flows, interbedded sediments are able to commingle and may serve as a vertical conduit between previously separated flow systems.

Groundwater in the different hydrogeologic units occurs under perched, unconfined, semiconfined, and confined conditions (Vaccaro et al., 2009). Groundwater flow is generally from the ridges toward the streams and rivers in the valleys. Shallow groundwater flow is usually vertically downward from the surface to the underlying basalt units. However, because of the geologic structure of the basins, there are a number of areas that have upward flow and artesian wells in the lower valleys.

3.4.1.3 Aquifer Recharge and Discharge

Recharge refers to refilling of groundwater aquifers, as water from the land surface percolates downward into geologic units. Discharge refers to water leaving the groundwater system to enter surface lakes, rivers, or wetlands.

Local-, intermediate-, and regional-scale groundwater flow systems within the Yakima River basin are recharged by various mechanisms. Local and intermediate flow systems are recharged through basalts that are exposed to precipitation at the ground surface on the anticlinal ridges and through groundwater exchange with other basins and formations. On a regional scale, basaltic units are recharged along the western margin of the Columbia Plateau where the basalts merge with rocks and sediments at higher elevations in the Cascade Range.

Much of the natural recharge (from precipitation) occurs in the upper basin and is not available to the bedrock aquifers where most pumping takes place (Vaccaro and Olsen, 2007). The lower, arid portion of the Yakima River basin generally receives about 6 to 10 inches of precipitation annually, and most groundwater recharge is from application and distribution of irrigation water (Vaccaro and Olsen, 2007).

About 45 percent of the water diverted for irrigation is eventually returned to the river system as surface water inflows and groundwater discharge (Reclamation, 1999). Irrigation return flows to the lower Yakima River account for about 75 percent of the late-summer streamflow downstream from the Parker gage (Vaccaro and Sumioka, 2006).

Aquifer discharge occurs principally to major surface drainage systems (i.e., Yakima and Columbia Rivers) and through irrigation well pumping. Annual pumping in the Yakima River basin increased almost 270 percent from 1960 to 2000 (Vaccaro and Sumioka, 2006). About 312,000 acre-feet was pumped in 2000, with the majority of the pumping going to irrigation, and smaller quantities for a range of uses including municipal and commercial. The annual quantity appropriated in State water right certificates and permits is about 529,231 acre-feet (Vaccaro et al., 2009).

3.4.1.4 Groundwater Quality

Groundwater quality concerns in the Yakima basin generally are related to the impacts of agricultural operations on drinking water wells (Ecology, 2010a). Quality issues involve excess nitrate levels and bacterial contamination, particularly in the lower portions of the Yakima basin. Many residents in the lower basin rely upon shallow wells that are particularly vulnerable to contamination. According to an Ecology study, “approximately 12 percent of domestic well users are exposed to nitrate levels in their drinking water that exceed the health-based standard of 10 mg/L.”

3.4.2 Groundwater Recharge Pilot Projects

The Integrated Plan lists two agricultural areas for consideration as enhanced groundwater storage test sites. The KRD and WIP groundwater recharge areas will be investigated as part of the pilot testing program recommended in the Integrated Plan.

3.4.2.1 Kittitas Basin Recharge Area

The proposed KRD groundwater recharge pilot project is expected to be sited in the Kittitas basin, a broad, roughly southeast-northwest trending valley within the Yakima River basin, which covers an area of approximately 270 square miles in the central portion of Kittitas County (Jones et al., 2006; Vaccaro et al., 2009). The most promising general locations for infiltration in the KRD are in the vicinity of Naneum Creek and Badger Pocket.

Most of the wells in the subbasin are completed in basalt or basalt-derived deposits, with the remaining wells completed in gravels, cemented gravels, sandstone, or a mixture of clay, silt, sand, and gravels. The highest well yields (60 to 100 gallons per minute or gpm) were reported for wells completed in basalt. Overall, the range in well yield for basalt was 7 to 100 gpm; the overall range in well yield for a nonbasalt well was 2.5 to 45 gpm.

Depth to groundwater in the valley ranges from less than 20 feet to more than 200 feet below ground surface. Groundwater elevations range from over 2,200 feet above mean sea level to less than 1,450 feet above mean sea level. The groundwater flow paths in the Kittitas subbasin converge in the area where the Yakima River flows out of the valley and into the Yakima subbasin just north of Umtanum. Based on available specific capacity data and yield information, the basin-fill material and basalt in the north KRD area is of moderate to low permeability.

3.4.2.2 Toppenish Basin Recharge Area

The proposed WIP groundwater recharge pilot project is expected to be sited on the west side of the Yakima River in the Toppenish subbasin. This subbasin is a broad, east-west trending valley within the Yakima River basin that covers approximately 440 square miles in the Yakima Valley (Jones et al., 2006; Vaccaro et al., 2009). An area between the WIP Main Canal and Marion Drain has been preliminarily delineated for further study, based on groundwater flow directions recently published by the USGS.

The Yakima River enters the Yakima Valley from the north through the Union Gap in Rattlesnake Ridge and flows southeast near the Town of Zillah before leaving the valley and entering the Benton subbasin near the Town of Granger. Toppenish Creek is a significant tributary to the Yakima River; it enters the Yakima Valley from the southwest and flows generally east to west, eventually meeting the Yakima River to the east of Granger in the Benton subbasin.

Based on well logs, the basin-fill deposits in the Toppenish subbasin increase in thickness to the south to over 200 feet, but decrease in thickness to the north with an estimated average thickness of less than 100 feet.

About 61 percent of the wells examined in the subbasin were completed in loose, unconsolidated sands and gravels. Most of the remaining wells were completed in sandstone. Unlike the Kittitas recharge area, many of the wells in the Toppenish subbasin are completed with screens, since the basin-fill deposits within the upper 200 feet of this subbasin are loose and unconsolidated. This suggests that the basin-fill deposits in the Toppenish subbasin are not as “tight” as the basin-fill deposits in the Kittitas subbasin and would likely have higher infiltration rates. It is also possible that the presence of screens is a result of the wells being constructed more recently and according to State standards.

Drains, tile drains, and streams are locations where the groundwater discharges from the basin-fill deposits (Vaccaro et al., 2009). Drains are unlined canals or laterals that can capture groundwater when the water table intersects the bottom of the drain. A number of drains on the east side of the study area may passively capture groundwater as the water table rises with surface infiltration.

Flow originating in the area south of Union Gap moves to the south-southeast, discharging to the Yakima River. Flow originating along the Main Canal area, however, discharges in a more southerly direction toward Marion Drain and the Toppenish Creek. Flow originating in the far western portion of the subbasin generally discharges in the upper reaches of the Toppenish Creek.

3.5 Surface Water Quality

3.5.1 Regulatory Setting

The Clean Water Act (CWA), passed in 1972, aims to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. The CWA also establishes the basic structure for regulating pollutant discharges to regulated waterways.

Ecology has established water quality standards to protect public health and welfare and the quality of waters in Washington. Section 303(d) of the CWA requires Washington to develop a list of water bodies that do not meet water quality standards. When water quality fails to meet State water quality standards, Ecology determines the sources of pollutants and sets the maximum amount of pollutants that each source can discharge to a water body, called Total Maximum Daily Loads (TMDLs).

3.5.2 Reservoir Water Quality

Reservoir water quality is measured using limnological studies (a study of the biological, chemical, meteorological, and physical aspects).

There are five major reservoirs within the Yakima River basin. Keechelus Reservoir is the only one that has been included on Washington's 303(d) list as water-quality limited. It had 303(d) listings for dioxin and polychlorinated biphenyls (PCBs) in 2004 and 2008.

The Bumping Lake, Cle Elem, Keechelus, Kachess, and Rimrock Reservoirs have low concentrations of nutrients to support a diverse ecology and are thus considered oligotrophic (Lieberman and Grabowski, 2007; Rector, 1996; FERC, 1990). Thermal stratification (layers of water with different temperatures) is exhibited in Bumping Lake, Cle Elem, Keechelus, Kachess, and Rimrock Reservoirs (Service, 2002).

The maximum water temperatures in Bumping Lake and Cle Elem Reservoirs typically occur in July, exceeding 16°C to a depth of about 20 feet and 50 feet, respectively (Lieberman and Grabowski, 2007). Monitoring conducted in 1993 indicated that the upper 30 feet of Keechelus Reservoir had a temperature of about 16°C and dissolved oxygen of about 10 milligrams per liter (mg/L) (Rector, 1996). The upper layer (epilimnion) of Rimrock Reservoir exceeds the temperature standard in the summer, and then the reservoir undergoes turnover in mid-September.

Minimum dissolved oxygen concentrations in Bumping Lake and Cle Elem Reservoirs have ranged between 2 and 6.5 mg/L near the bottom (Lieberman and Grabowski, 2007), while Keechelus Reservoir has a dissolved oxygen concentration of about 10 mg/L

(Rector, 1996). Rimrock Reservoir dissolved oxygen is generally at or above saturation in the reservoir, although dissolved oxygen has not always met the State standards near the bottom, at the location of the intake (FERC, 1990).

3.5.3 Tributary Water Quality

Major tributaries within the Yakima River basin are listed in Table 3-12. Most of the tributaries are on Washington's 303(d) list as water-quality limited for temperature (Table 3-12). Additional 303(d) listings are described in the following sections.

3.5.3.1 Upper Yakima Tributaries

Although water quality in the upper Yakima River basin is generally much better than in the lower basin, irrigation effluents and flow regulation have adversely affected some areas (Joy, 2002; Joy and Patterson, 1997 as cited in YBFWRB, 2009). The upper Yakima and Cle Elum Rivers, as well as tributaries to the Yakima River in the Kittitas Valley (Cherry, Cooke, Manastash, Taneum, and Wilson Creeks), have 303(d) listings (Table 3.7-2 in Ecology, 2008b).

Stream temperature data collected in the Teanaway River basin during the early 1990s showed numerous excursions above the State numeric temperature criteria, resulting in eight stream segments in the Teanaway basin being included on Washington State's 1996 and 1998 303(d) lists (Irle, 2001). Development of a temperature TMDL in 2003 resulted in removal of the basin's streams from the 303(d) list (Table 3.7-2 in Ecology, 2008b).

The Cle Elum River is 303(d) listed for water temperatures that are higher than the standard acceptable levels for fish immediately above the reservoir and immediately downstream of the reservoir (Ecology, 2008b). The temperature criterion for the Cle Elum River is aquatic life for summer salmonid habitat which is not to exceed 16°C (WAC 173-201A).

Downstream from the dam, higher water temperatures may be a result of dam impoundment and surrounding forest practices. However, above Cle Elum Reservoir higher water temperature in the upper reach of the Cle Elum River is more likely a result of water flowing slowly through warm, shallow Tucquala Lake (Reclamation, 2007b). Both the Cooper River and Thorp Creek, tributaries to the upper Cle Elum River, are also on the 303(d) list for temperature.

Table 3-12 Yakima River Basin Tributary 303(d) Listings

Tributary	Water Quality Parameters			
	1996	1998	2004	2008
Ahtanum Creek	None	None	Fecal Coliform	Fecal Coliform Temperature
Ahtanum Creek (N.F.)	None	None	None	Temperature
Ahtanum Creek (S.F.)	None	None	None	Temperature
Bumping River	Temperature	Temperature	Temperature	Temperature
Cherry Creek	None	None	None	pH
Cle Elum River	Temperature	Temperature	Temperature	Temperature
Cooke Creek	Temperature	Temperature	Dissolved Oxygen Temperature	Dissolved Oxygen Temperature
Cooper River	Temperature	Temperature	Temperature	Temperature
Cowiche Creek	Fecal Coliform Temperature	Fecal Coliform Temperature	4,4'-DDE Fecal Coliform Temperature	4,4'-DDE Dissolved Oxygen Fecal Coliform PCB pH Temperature
Manastash Creek	None	None	None	Dissolved Oxygen Fecal Coliform pH
Manastash Creek (S.F.)	Temperature	Temperature	Temperature	Temperature
Naneum Creek	Temperature	Temperature	Temperature	pH Temperature
Satus Creek	None	None	None	None
Swauk Creek	Temperature	Temperature	Temperature	Temperature
Taneum Creek	Temperature	Temperature	Temperature	Dissolved Oxygen Fecal Coliform Temperature
Taneum Creek (S.F.)	Temperature	Temperature	Temperature	Temperature
Teanaway River	Temperature	Temperature	None	None
Thorp Creek	Temperature	Temperature	Temperature	Temperature
Tieton River	None	None	None	Temperature
Toppenish Creek	None	None	None	None
Wilson Creek	Fecal Coliform Temperature	Fecal Coliform Temperature	Fecal Coliform Temperature	pH Temperature

Source: Ecology, 2011b

3.5.3.2 Naches River Basin Tributaries

Several streams in the Naches River basin are included on the 303(d) list for high temperatures (Table 3-12). For most of these streams, Ecology (2005c) identified forest practices, agriculture, riparian modification, and grazing as contributing nonpoint sources to high temperatures. In addition, industrial point sources were identified as contributors for four Cowiche Creek basin 303(d) temperature listings. Cowiche Creek also has been included on the 303(d) list for five other parameters. Generally, the water quality of the Bumping River is very good except for the elevated water temperatures (WSDOT and FHA, 2005).

Several streams within the Okanogan-Wenatchee National Forest were included on Washington's 303(d) list for temperature (Table 3-12). In 2001, the U.S. Forest Service conducted a monitoring effort to evaluate stream temperatures throughout the Okanogan-Wenatchee National Forest. During the 2001 study, temperatures of greater than 16°C, the applicable temperature criterion at the time, were measured in several streams including Bumping River, Taneum Creek, North Fork Taneum Creek, and South Fork Tieton River (Whiley and Cleland, 2003).

3.5.3.3 Middle and Lower Yakima River Tributaries

Ahtanum Creek and its North and South Forks are included on the 2008 303(d) list due to high temperature. Although neither Toppenish nor Satus Creeks are included on the 303(d) lists, temperatures have exceeded 20°C in both of these creeks. In lower Toppenish, Simcoe, and Agency Creeks (also not 303(d) listed), high water temperatures have resulted from diversion of annual spring flooding, draining of wetlands, riparian degradation, and the large volume of warm irrigation returns routed from the Wapato Irrigation Project down Simcoe and Toppenish Creeks (YBFWRB, 2009). Stream temperatures increase with proximity to the mouth of Toppenish Creek, with the highest weekly average temperature among four locations in 2004 approaching 24°C at a point 10 miles upstream from the mouth. Data from the summer of 2007 indicate some cooling below this location may be related to groundwater upwelling. Temperatures in Marion Drain are moderated (about 6°C cooler in the summer and 5°C warmer in the winter than the mainstem) because of the drain intercepting groundwater.

Most of the Satus Creek watershed is undeveloped and is not exposed to agricultural, industrial, or domestic effluents. However, maximum weekly average temperatures can exceed 26°C in the reach of Satus Creek between Logy Creek and Wilson Charley Creek because of riparian impacts and low flow. Logy Creek may cool Satus Creek for a few miles downstream from their confluence (YBFWRB, 2009). Although water quantity increases as Satus Creek flows through the WIP in its lowermost 8 miles, water quality suffers in this reach (YBFWRB, 2009).

3.5.4 Yakima River

Water quality in headwater streams and the upper Yakima River is good but degrades downstream to the mouth. This degradation is caused both by natural processes and by the impacts from human activities, including both point and nonpoint sources (Reclamation, 1999). The Yakima River is on Washington's 303(d) list as water-quality limited for multiple parameters (Table 3-13).

Table 3-13 Yakima River 303(d) Listings

River	Water Quality Parameters			
	1996	1998	2004	2008
Yakima River	4,4'-DDD 4,4'-DDE DDT Dieldrin Dissolved Oxygen Endosulfan Fecal Coliform PCB pH Temperature	4,4'-DDD 4,4'-DDE DDT Dieldrin Dissolved Oxygen Endosulfan Fecal Coliform PCB pH Temperature	4,4'-DDD 4,4'-DDE 4,4'-DDT Alpha-BHC Chlordane Dieldrin Dioxin Dissolved Oxygen Endosulfan Fecal Coliform PCB pH Temperature	4,4'-DDD 4,4'-DDE 4,4'-DDT Alpha-BHC Chlordane Dieldrin Dioxin Dissolved Oxygen Endosulfan Fecal Coliform PCB pH Temperature

Source: Ecology, 2011b

Surface water quality standards for water temperature, dissolved oxygen, pH, dichlorodiphenyl-trichloroethane (DDT), and other pesticides, as well as fecal coliform bacteria, are not met. The USGS has reported that the effects of agricultural return flow, urban runoff, and point source discharges on dissolved oxygen are noticeable in the lower Yakima Valley (Morace et al., 1999).

Nutrient (phosphorus and nitrogen) concentrations are conducive to eutrophication in the lower Yakima River. Eutrophication is the process by which a body of water becomes enriched in dissolved nutrients that stimulate the growth of aquatic plant life, usually resulting in the depletion of dissolved oxygen.

The primary factors affecting water temperatures are streamflow (river morphology and slope); air temperature; rate of vertical mixing; time of travel; and the temperature of inflowing water from natural tributaries (including groundwater discharge), canals, wasteways, and agricultural drains. Water in the upper basin is cold but warms as the river flows to the lower basin. In the lower portion of the basin, water temperatures in the late summer tend to be similar to those of agricultural return flows. This is attributed to the fact that a high percentage of the river flow in the late summer consists of return flow from agriculture (Reclamation, 1999).

3.6 Hydropower

Seven small hydroelectric powerplants are located in the Yakima River basin. Two of the plants are owned and operated by Reclamation (Roza and Chandler Powerplants), two are owned and operated by the Yakima-Tieton Irrigation District, two are owned and operated by Yakama Power in the Wapato Irrigation Project (WIP), and one is owned and operated by Tieton Hydropower LLC (at Tieton Dam). The general locations of the existing facilities are shown on Figure 3-4.

The two Reclamation powerplants are located on the Roza Main Canal and the Chandler Power Canal. The Roza Powerplant was built in 1958 and the Chandler Powerplant in 1956. These two powerplants are integral parts of the Roza Irrigation District and Kennewick Irrigation District. Both were originally conceived, in part, as a means of paying for the infrastructure making up the Roza and Kennewick Irrigation District combined facilities and making them economically viable for the future. When power is being generated at Roza Powerplant, there is a minimum flow target of 400 cfs below Roza Diversion Dam and 450 cfs below Prosser Diversion Dam. Power generation is terminated when the subordination flow target cannot be met with the plant operating.

The Roza Powerplant is located about 3 miles northeast of Yakima, adjacent to Reclamation’s offices. Water is diverted into the canal at Roza Diversion Dam about 11 miles north of Roza Powerplant and returns to the river below the powerplant. The Roza Powerplant is a conventional hydroelectric powerhouse with a single Francis wheel-style turbine, having a capacity of 12.9 megawatts (MW). The plant is rated at 158 feet of head, and produces an average of approximately 61,000 megawatt-hours of energy (based on Reclamation power records from 1988 through 2005), under current subordination practices.

The hydropower generation at Roza Powerplant is primarily used to supply at-cost power to pumps for irrigation water delivery to Roza Irrigation District (Roza) water users and the Reclamation project offices. When the power generated by Roza Powerplant exceeds the Roza power demand, the excess power is marketed through Bonneville Power Administration (BPA) under the Federal Columbia River Power System. During the irrigation season, when Roza’s demand for power exceeds the power supply available from Roza Powerplant, the district receives additional power from BPA. This annual exchange of power is accomplished through an agreement between Reclamation and BPA (Reclamation, 2002).

The Chandler Power and Pumping Plant is located in Benton County about 10 miles east of Prosser. The Chandler Plant uses water diverted down the Chandler Main Canal (capacity is 1,500 cfs) at Prosser Diversion Dam to operate two Francis turbine-driven generators and two turbine-driven pumps.

The two Francis turbine generators are rated at 6 MW each and power is supplied to the BPA grid. Water not required for irrigation is used to produce power for revenue. The turbines operate at net heads between 106 feet and 122 feet. At 6 MW, a generator uses about 735 cfs of water.

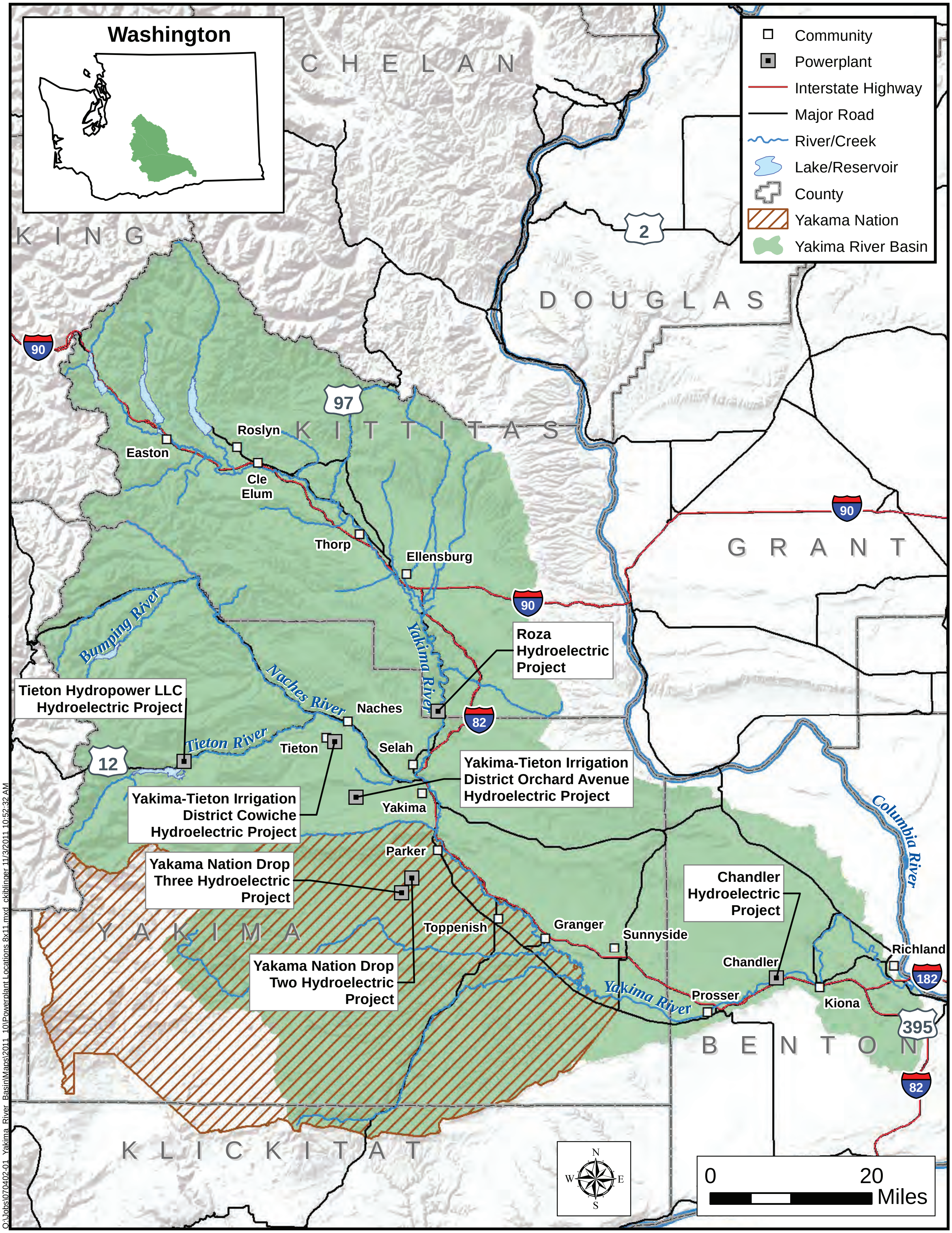


Figure 3-4. Powerplant Locations

The two Francis turbine pumps are rated with a discharge of 167 cfs each at net heads between 103 feet and 122 feet. Directly connected to each of the pump turbines is a vertical shaft centrifugal pump. The pumps are designed to operate under total heads from 104 feet to 112 feet. Water is pumped from the Chandler Main Canal, through the pumps, under the Yakima River and up to the Kennewick Irrigation Main Canal.

Power production is subordinated to various flows throughout the year. In the spring, the subordination target is 1,000 cfs over Prosser Diversion Dam through the end of June. During the remainder of the season, the subordination target is 450 cfs or the YRBWEP Title XII flow, whichever is higher.

Two of the powerplants owned by the Yakima-Tieton Irrigation District are in-line plants that take advantage of an all piped system with excess pressure head. The operations of the plants are incidental to the operations of the irrigation district. The water is not diverted specifically for power generation, but whatever water is diverted for irrigation is used for power. The two powerplants operated by Yakama Power take advantage of canal drops in the gravity irrigation canal system. The operations of the plants are incidental to the operations of the canals.

The Tieton Hydroelectric Project is a run-of-river facility located at the base of a Reclamation dam on the Tieton River, in Yakima County approximately 40 miles west of Yakima. The operations of the power plant are incidental to the operation of Tieton Dam.

3.7 Fish

This section describes the fish and aquatic resources in the Yakima River basin that could be affected by the Integrated Plan. The status of anadromous and resident fish species is described along with habitat conditions affecting those fish. The distribution and habitat conditions for aquatic invertebrates are also described. Information on Federal and State listed endangered species is provided in Section 3.10.

3.7.1 Anadromous Fish

The area potentially affected by the Integrated Plan includes the water bodies described in Section 3.3, Surface Water Resources. Anadromous fish are those that hatch in fresh water, migrate to salt water where they mature, and return to the same fresh water body to spawn.

3.7.1.1 Distribution of Steelhead and Salmon

Anadromous steelhead and salmon were historically widespread in the Yakima, Naches, and Tieton drainages. Spring and fall Chinook, coho, and steelhead currently reside in the Yakima River basin, while summer Chinook and sockeye have been extirpated (became locally extinct). Coho were extirpated in the 1970s but were reintroduced in the mid-1980s. Spring Chinook spawn and rear as juveniles in the Bumping, American, Little Naches, upper Yakima, and Naches Rivers. Fall Chinook generally spawn and rear as juveniles in the Yakima River, downstream from the Naches River to the mouth of the Yakima River. Steelhead spawn and rear as juveniles in many of the tributaries to the Yakima and Naches Rivers, including the mainstem of the Naches and upper Yakima Rivers (upstream of Roza Diversion Dam). Coho (reintroduced) spawn and rear primarily in the Wapato and Ellensburg reaches of the Yakima River and in the lower Naches River downstream from the Tieton River. Some coho spawning and rearing is known to occur in Ahtanum, Cowiche, Taneum, Wilson, Reecer, and Big Creeks in the Yakima River basin. Coho spawning and rearing also occur in the Nile and Pileup Creeks and the North Fork of the Little Naches River in the Naches River subbasin (Reclamation and Ecology, 2008).

Until recently, barriers blocked anadromous steelhead or salmon from reaching the tributary habitat upstream from Reclamation's reservoirs. However, beginning in 2006, the Yakama Nation introduced coho above Cle Elum and Bumping Lake Dams, and they have also reintroduced sockeye into Cle Elum Reservoir (Reclamation and Ecology, 2011c). Resident bull trout are also present above all of Reclamation's dams. Salmon and steelhead are present in the other tributaries up to the point of barriers, either natural or manmade. The upstream extent of anadromous salmonids is provided in Table 3-14.

Table 3-14
Upstream Extent of Anadromous Salmonid Passage in the Affected Area

Stream	Upstream Extent
Naches River Tributaries	
Bumping River	To Bumping Dam; otherwise, upstream at natural falls
Tieton River	To Tieton Dam; otherwise, entire mainstem; North Fork Tieton to RM 17.40 at toe of alluvial fan.
Yakima River Tributaries	
Cle Elum River	To Cle Elum Dam; otherwise, RM 9 at natural steep cascades
Keechelus River	To Keechelus River; otherwise, none on mainstem
Kachess River	To Kachess Dam; otherwise, none on mainstem
Teanaway River	Entire mainstem
Swauk Creek	Entire creek
Taneum Creek	To RM 2.0 at Bruton Diversion* (provides partial passage)
Jack Creek	To culvert near stream mouth*
Indian Creek	To culvert near stream mouth*
Manastash Creek	To RM 1.6 at barrier at West Side Canal
Naneum Creek	To barrier close to mouth
Reecer Creek	To 100 feet upstream of mouth of stream at diversion; also, in winter, the alluvial fan reach of the creek dries and prevents upstream winter movement by parr and sub-adults.
Wilson/Naneum Creeks Systems[1]	To RM 1.9 at irrigation diversion barrier Cherry Creek: To within 1-2 miles of Wilson Creek confluence at diversion Coleman Creek: To 0.5 mile upstream of Naneum Creek confluence at diversion
Ahtanum Creek[2]	To RM 8.0 at Wapato Irrigation Project Diversion near Tampico Wide Hollow Creek: RM 0.6 at old mill dam (adults can pass)
Toppenish Creek	To RM 4.8 at Durham Diversion
Cowiche Creek	Entire mainstem (partial barriers do exist)
Little Naches River	Entire mainstem

Table Notes:

* May not be completely impassable barrier, but extremely difficult fish passage.

[1] Includes Wilson, Naneum, Coleman, and Cherry Creeks, which are all interconnected.

[2] Includes North and South Forks and Wide Hollow Creek.

Source: Haring, 2001; Appendix A of Haring 2001; EES, 2001; YBFWRB, 2005; Conley, 2009; and Hubble, 2008. The sources contains information for the other smaller tributaries that flow to these creeks not listed here.

3.7.1.2 Anadromous Fish Status

Anadromous salmonids currently using the Yakima basin include the Mid Columbia River Evolutionarily Significant Unit (ESU) steelhead (federally listed as threatened), spring and fall Chinook, and coho (reintroduced). There is only one nonsalmonid anadromous fish species currently using the Yakima basin—the Pacific lamprey, which is a Federal species of concern. Listed species are discussed in Section 3.10, Threatened and Endangered Species.

Spring Chinook

The upper Yakima, Naches River basin, and American River spawning groups compose the Yakima River basin spring Chinook population. About 60 to 70 percent of the spring Chinook population returns to the upper Yakima River (Keechelus Dam to Ellensburg) and Cle Elum River annually. Adult spring Chinook return to the Yakima River beginning in late April through June, and spawning occurs from August to September. Juveniles migrate downstream from the time of emergence through summer and fall. After spending 1 year in fresh water, spring Chinook begin their seaward migration, with the majority passing Prosser Diversion Dam (RM 47) in April. Returning adults spend from 1 to 3 years in the ocean before returning to spawn. Variability in run timing is influenced by high and low flows. Run timing for spawning runs of all salmon and steelhead is delayed during years of high flow and accelerated in years of low flow (Reclamation, 2008f).

Over the 10-year period from 1997 to 2006, spring Chinook basin-wide escapement averaged 10,264 fish, ranging from 1,903 in 1998 to 23,265 in 2001 (Reclamation and Ecology, 2008).

Fall Chinook

Fall Chinook inhabit approximately 100 miles of the lower Yakima River from Sunnyside Dam to the Columbia River confluence. In some years, fall Chinook have been documented spawning in the reach between Union Gap and Selah and in the lower Naches River downstream of the City of Naches. The Yakama Nation has been acclimating and releasing fall Chinook into the Naches River at Gleed for several years. The Yakama Nation and WDFW plan to transition the releases upstream of Union Gap from fall to summer Chinook salmon as part of their plans to reintroduce extirpated summer Chinook to the middle Yakima River and lower Naches River. There is also a self-sustaining fall Chinook population in Marion Drain. Typically, the mainstem Yakima spawning run begins in early September, peaks in late September, and concludes by the second week of November. Typical emergence timing for Yakima River fish occurs from late March through May. Marion Drain fish spawn at the same time as Yakima River fish, but because of warmer water temperatures, they emerge in mid-February to late March.

Over the 10-year period from 1997 to 2006, fall Chinook basin-wide escapement averaged 2,830 fish, ranging from 1,120 in 1997 to 6,241 in 2002 (Reclamation and

Ecology, 2008). It is estimated that the Prosser count represents approximately 30 to 40 percent of the total count, since the majority of spawning occurs downstream of Prosser Dam (Hubble, personal communication, 2008). Marion Drain escapement fell sharply after 1988 (Haring, 2001) and remains relatively low.

Coho

Although endemic coho were extirpated (became locally extinct) from the Yakima River basin in the early 1980s, natural reproduction of hatchery-reared coho is now occurring in both the Yakima and Naches Rivers. Factors contributing to the extirpation of coho salmon from the Yakima basin include the construction of dams on the Columbia River and overharvest of wild stocks. The Yakama Nation releases approximately 1 million coho smolts in the Yakima basin annually (Newsome, personal communication, 2009).

The majority of coho spawning and rearing occurs in the upper Wapato reach below Parker Dam, in the lower Naches River between Cowiche Dam and the City of Naches, and in the upper Yakima River in the vicinity of Ellensburg. Spawning has also been documented in several tributaries (e.g., Ahtanum, Tanuem, lower Satus, Cowiche, and Nile Creeks) as the Yakama Nation expands its supplementation program into historic areas.

Currently, coho salmon enter the Yakima River in the fall. Spawning occurs soon afterward; the eggs incubate over the winter and hatch in the spring. After the fry emerge from the gravel, the juveniles rear in the stream until the following spring when they outmigrate as 1-year-old smolts (Reclamation, 2008f).

Over the 10-year period from 1997 to 2006, coho basin-wide escapement averaged 3,438 fish, ranging from 818 in 2002 to 6,216 in 2000 (Reclamation and Ecology, 2008).

Sockeye

The four natural glacial lakes in the Yakima River basin historically supported sockeye salmon. Sockeye salmon runs in the Yakima River basin were historically larger than any other runs in the Columbia River Basin in terms of numbers (Reclamation, 2008f). The construction of crib dams at the outlet of the lakes contributed to the extirpation of the species from the basin in the early 1900s. The reintroduction of sockeye salmon into Cle Elum Reservoir began in 2009 with the release by the Yakama Nation of 500 pairs of adult sockeye (Wenatchee and Lake Osoyoos stocks) trapped at Priest Rapids Dam (Reclamation and Ecology, 2011c).

Pacific Lamprey

In eastern Washington, Pacific lamprey historically occurred in the Yakima River basin and in numerous other Columbia River basins, including the Spokane River and Asotin Creek (Wydoski and Whitney, 1979). Current knowledge of Pacific lamprey in the Yakima River basin is limited to incidental observations of approximately five adults annually at the Prosser adult fish passage facility since 1985 (Johnston, 2009). Pacific lamprey are very rare in the Yakima River basin and little is known about their life history, historic distribution, or current limiting factors; therefore, the Yakama Nation considers reintroduction of this species a long-term objective. The Yakama Nation is conducting studies of lamprey in the basin and the potential for providing passage for lamprey at existing dams.

Data from Columbia River dams suggest that, although annual numbers fluctuate widely, there is a decreasing trend in the number of adult Pacific lampreys counted at each project (U.S. Federal Register, 2004). Data indicate that large declines occurred during the late 1960s and 1970s, and that current counts continue to be well below historical levels (Close et al., 1995; BioAnalysts, Inc., 2000).

3.7.1.3 Habitat Conditions for Anadromous Fish

Flows, temperature, sediment, large woody debris (LWD), channel condition, and habitat alterations all affect salmonid growth and survival in the basin. The following sections summarize fish habitat conditions in the Yakima and Naches River mainstem and tributaries.

Flow Conditions

Yakima and Naches Rivers

Under current conditions, river flows are altered substantially to meet water entitlements, primarily for irrigation (see Section 3.3, Surface Water Resources, for additional detail on existing water management conditions). In some areas of the basin, flows are higher and in other areas flows are lower than would naturally occur, affecting anadromous and resident fish habitat conditions at different life stages. The results of other studies suggest that the natural, unregulated flow regime of the Yakima River and its tributaries encouraged the distribution and abundance of riverine species and sustained the ecological integrity of the ecosystem (Leopold et al., 1964; Schlosser, 1985; Resh et al., 1988; Allan, 1995; Power et al., 1995; Stanford et al., 1996; Poff et al., 1997).

Flow variability provides ecological benefits to floodplain ecosystems and the terrestrial and aquatic organisms that depend upon them (Williams and Hynes, 1977; Chapman et al., 1982; Poff and Ward, 1989; Closs and Lake, 1996). The natural timing of variable flows provides numerous environmental cues for fish to spawn, hatch eggs, rear, move to off-channel floodplain habitats for feeding or reproduction, and migrate upstream or downstream (Seegrist and Gard, 1972; Montgomery et al., 1983; Nesler et al., 1988; Junk et al., 1989; Welcomme, 1992; Naesje et al., 1995; Sparks, 1995; Trepanier et al., 1996; Poff et al., 1997).

In general, spring flows in the middle and lower Yakima River reaches are not sufficient to optimize survival of out-migrating smolts. Flows steadily increase downstream of Sunnyside Dam in the summer as a result of irrigation return flows from groundwater sources and surface drains and the increase in flows becomes more pronounced between Zillah to Granger (river mile 88 to 83). Salmonid habitat conditions generally improve downstream throughout the Wapato reach as a consequence of increasing stream flow.

High flows also persist during the summer in the upper Yakima River reaches that affect juvenile salmonid rearing habitat (Reclamation, 2008g). The annual later summer “flip-flop” operation disrupts salmonid habitat spatially and impacts aquatic insect populations, while winter flows in the upper Yakima and Cle Elum River are low, potentially impacting survival of over-wintering juvenile salmonids (Reclamation, 2008g). Table B-1 in Appendix B provides additional detail about existing flow conditions and effects on anadromous species on the Yakima and Naches River mainstem and tributaries.

Temperature Conditions

Dams, riparian vegetation removal, water withdrawal and regulation, irrigated agriculture, channel engineering (e.g., straightening, channelization, diking, revetments, etc.), urbanization, increasing impervious surfaces, and floodplain development alter the factors that drive stream temperature (Poole and Berman, 2001). All of these factors occur in the Yakima River basin to some extent and have altered the temperature regime from the predevelopment, natural condition. Water temperature, especially in the lower Yakima River, has consistently been acknowledged as a factor affecting salmonids, especially during some life stages. High temperatures at the mouth of the Yakima River may affect anadromous fish, including migrating smolts and adults. In the upper parts of the basin, bottom-draw release structures, like those used at Keechelus, Kachess, Cle Elum, Tieton, and Bumping Lake Dams, provide thermally homogeneous, cold discharge to the Yakima, Kachess, Cle Elum, Tieton, and Bumping Rivers. This may interfere with certain aspects of salmonid ecology in the Yakima River basin (e.g., migration cues, spawn timing, and growth).

Instream and Riparian Habitat Conditions

Instream and riparian habitat conditions in the affected area have been significantly altered from historic conditions. Alterations include fish passage barriers caused by water diversions and culverts, channel modifications, road construction and logging, wetland disturbance, and other development in the watershed.

Channel Conditions

There are no constructed barriers above the reservoirs. However, degraded channel conditions have resulted from the slowing of flow as streams approach the reservoirs, the loss of LWD, and the reduction of riparian vegetation in the upper watersheds. Other stream alterations stem from logging practices and an associated reduction in canopy cover along the stream corridor.

Irrigation diversions are one of the most widespread alterations to instream habitat conditions. In many cases, diversions are associated with low-flow conditions, stream channelization, and sedimentation. Low flows cause reduced fish passage, while sedimentation and channelization negatively impact spawning success.

Erosion is affected by natural processes and land use practices. Natural slide events contribute significant quantities of sediment to streams. Erosion from bank disturbance and bank cutting also contributes fine sediments. In the upper watershed, road construction associated with timber harvest and off-road vehicle use leads to increased sedimentation (USFS, 1997). In recent years, many stream crossings in off-road recreational areas have been improved or eliminated to help reduce sedimentation. Other sources of sedimentation include grazing, and in the lower stream reaches, development for residential and recreational activities. Heavy loads of suspended sediments directly impact salmonids through their avoidance of impacted habitats, mortality (in extreme cases), a skewed distribution of prey species within the habitat, reduced feeding and growth, and reduced tolerance for disease (Waters, 1995). Fine sediment also fills the spaces between gravels, which affects habitat quality by reducing the flow of oxygenated water around incubating or fertilized eggs. This results in reduced survival.

The disconnection of rivers from their floodplains has resulted in a loss of habitat complexity, including connectivity between off-channel and mainstream habitats. These changes impact the ability of the ecosystem to support salmonid populations, including steelhead and bull trout. Construction of flood control dikes, levees, railroads, and highways has contributed to the loss of these historical connections (Eitemiller et al., 2002). Channel conditions vary significantly within a particular stream and between streams.

Some streams in the forested areas generally exhibit good stream channel conditions with high-quality gravels and gradients for salmonid spawning and rearing. These areas also have more functional riparian corridors and cover (CBSP, 1990). Some stream reaches have poor riparian cover (Plum Creek Timber Company, 1996). Lower in the watershed, streams are lower in gradient and often have confined reaches.

In the lower reaches, habitat quality is degraded by water management and land use, resulting in reduced habitat complexity, including straightened and incised stream channels, lower pool frequency, reduced or perched riparian vegetation and associated reduced LWD recruitment, and poorer water quality.

Large Woody Debris Conditions

LWD is abundant in the upper portions of the Cle Elum, Tieton, and Bumping River systems. Upper stream segments serve as the main source of instream LWD for these river systems, the material moving downstream during high flow events, settling in low-gradient, unconfined channel reaches. However, where forest harvest practices are common in the upper watershed, LWD is lacking in the streams (USFS, 1998). LWD recruitment to lower stream reaches is also interrupted by reservoirs (and prior to dam construction the naturally occurring lakes) where LWD washes up on the shores or becomes waterlogged and sinks.

In many Yakima River tributaries, LWD that enters the lower reaches is actively removed to avoid damaging or disrupting irrigation diversion and delivery systems. When LWD is sparse, habitat complexity is reduced and problems related to channel stability and bed scour become more frequent.

3.7.2 Resident Fish

The affected environment for resident fish is the same as described for anadromous fish in Section 3.7.1 of this document. Resident fish do not migrate to salt water but spend their entire life cycles in the same water body.

3.7.2.1 Description and Distribution

Resident native salmonids in the Yakima River basin include the Columbia River Distinct Population Segment (DPS) bull trout, westslope cutthroat trout, rainbow trout, kokanee, mountain whitefish, and pygmy whitefish (Pearsons et al., 1998; Service, 1998). Eastern brook trout, a nonnative (introduced) salmonid, is also present. Of these species, those of special concern include bull trout (federally threatened) and pygmy whitefish (State sensitive). Bull trout are discussed in Section 3.10.

Thirty-seven resident nonsalmonid species are present in the Yakima River basin (Pearsons et al., 1998). The most abundant of these in the upper Yakima River basin are speckled dace, longnose dace, redside shiners, northern pikeminnow, largescale suckers, bridgelip suckers, and sculpins. Burbot is present in Keechelus, Kachess, and Cle Elum Lakes (Bonar et al., 2000). Another less abundant species of special concern is the mountain sucker (State candidate). For a complete fish species list for the Yakima River basin, refer to Pearsons et al. (1998).

3.7.2.2 Habitat Conditions for Resident Fish

Habitat conditions for native resident fish in the river segments downstream from the storage dams are identical to those discussed in Section 3.7.1 Anadromous Fish. Unlike anadromous fish, resident fish are also present in the storage reservoirs, which are part of the area affected by the alternatives. Reservoir operations may affect resident fish by altering their food base and by affecting access from the reservoir to tributary spawning streams.

3.7.3 Aquatic Invertebrates

The affected environment for aquatic invertebrates is the same as described for anadromous fish in Section 3.7.1 of this document. Invertebrate responses to regulated river systems are often complex and variable. Invertebrates are a major source of food for fish, and changes in invertebrate communities may result in changes in condition of fish communities (Waters, 1982; Bowlby and Roff, 1986; Wilzbach et al., 1986). Invertebrates, like other aquatic organisms, respond to changes in water quality, food abundance, and other habitat parameters (Ward, 1976; Armitage, 1984; Armitage et al., 1987). Key conditions that influence the aquatic invertebrate communities include flow controls and the presence of organic matter in the system (Reclamation and Ecology, 2008; Reclamation, 2005b).

Aquatic invertebrates appear to be adapted to flow fluctuations within a range of what can be considered normal conditions. For example, Morgan et al. (1991) found that invertebrate density doubled if flows were generally held within a range of about one to three times the base flow. However, under extreme flood conditions, benthic biomass can be significantly reduced (Moog, 1993).

Artificially high flows at unseasonable times may have a major effect on benthic composition. The length of time that invertebrates are exposed to high flows also likely plays a role in biological community resiliency, with short-term (pulse) alterations being less damaging than long-term alterations.

Arango (2001) determined that the flip-flop operation affected the insect community in an upper Yakima River riffle near the City of Ellensburg. It appeared that some insects were stranded as the water level was lowered in the Yakima River, while other insects entered the drift. The study suggested that a major portion of the invertebrate community is successful in moving down the drying bank and back into the wetted area.

Backwaters in natural systems often function as areas for macroinvertebrates to take refuge from extreme flows. Backwaters accumulate macroinvertebrates during sudden flood events (Negishi et al., 2002). Floodplain production of invertebrates can be orders of magnitude greater than that produced in the river channel (Gladden and Smock, 1990) and result in enhanced growth and survival of salmonids (Sommer et al., 2001). Extreme high flows can flush out backwaters and reduce macroinvertebrate production, while low flows can also dewater areas and reduce production (Reclamation, 1998g; Stanford et al., 2002). Reduced productivity in benthic invertebrates caused by flow alterations are likely to impact the quality of food for salmonids.

The presence of coarse particulate organic matter (CPOM) is positively correlated with aquatic invertebrate biomass in upstream portions of the Yakima River basin (Nelson, 2005). CPOM is associated, to a large degree, with riparian trees, particularly black cottonwoods. Leaf fall in the autumn provides a large input of CPOM both directly to the main channel and through connection with side channels and floodplains.

3.8 Vegetation

The following discussion focuses on the areas where vegetation would be directly impacted or where changes to vegetation communities and species over time are anticipated as a result of the Integrated Plan. Vegetation issues of concern involve the loss of forest and shrub-steppe communities associated with the development of facilities under some of the elements, and effects on riparian and wetland habitat in the basin as a result of changed conditions. The affected area for vegetation includes the following:

- The location of proposed fish passage facilities at the five major reservoirs (Keechelus, Kachess, Cle Elum, Bumping, and Rimrock Lakes) and Clear Lake Dam;
- The areas of additional inundation and drawdown for proposed water storage at existing reservoirs (Cle Elum Lake, Bumping Lake Reservoir, and Lake Kachess);
- The location of new pipeline, canal improvements, pump stations, and transmission lines associated with proposed structural and operation changes on the KRD canals, Keechelus-to-Kachess pipeline, and Wapatox Canal;

- The area of inundation for water storage at the proposed Wymer off-channel reservoir;
- The location of new infrastructure associated with proposed groundwater recharge sites and infiltration systems;
- The location of pipeline, canal improvements, re-regulating reservoirs or other measures associated with proposed agricultural water conservation and market reallocation projects; and
- The location of land acquisitions to protect watershed functions, forest habitat, and shrub-steppe habitat. These include lands in the Teanaway, Taneum and Manastash Creek basins, as well as lands adjacent to the Yakima River canyon.

Proposed flow increases in the mainstem and tributary streams could also result in alteration or creation of riparian plant communities over time, so these areas are described below.

The 2005 Yakima Subbasin Plan (YBFWRB, 2005) contains comprehensive descriptions of plants and wildlife in the basin as well as Federal and State listed species. Lists of WDFW-designated priority habitats and species records in the vicinity of the proposed action areas are presented in Appendix C of this document. Threatened and endangered plant species are discussed in Section 3.10.

3.8.1 Upper Yakima River Basin

The Yakima River originates at the Keechelus Dam at 2,450 feet, which is within the ponderosa pine community zone (Franklin and Dyrness, 1988). This zone currently extends from the headwaters to the confluence with the Teanaway River. Mixed conifer stands occur in the vicinity of Cle Elum, Keechelus, and Kachess Lakes. Habitat is characterized by Douglas fir, grand fir, and young ponderosa pine with an understory of bitterbrush and kinnikinnick. Lodgepole pine is also present as well as black cottonwood along downstream rivers. Near the confluence of the Teanaway River, vegetation communities transition toward agricultural areas and grasslands.

Riparian areas are associated with backwaters, sloughs, and oxbows as well as the main river channel. Vegetation is dominated by black cottonwood, red alder, Pacific willow, and red-osier dogwood. Wetlands in the basin are located along the mainstem of the Yakima River and especially in the Kittitas Valley. In the upper basin, wetlands are found along smaller tributaries, at seeps and springs, at high-elevation wet meadows, and along the shorelines of natural lakes.

Site-specific studies of vegetation were conducted at the Cle Elum Reservoir, river, and tributaries for the *Cle Elum Dam Fish Passage Facilities and Fish Reintroduction Project Final EIS* (Reclamation and Ecology, 2011c). No site-specific studies are available for Keechelus or Kachess Reservoirs, but vegetation communities are likely similar due their proximity and similar elevation, topography, and climate. Site-specific studies would be conducted for projects that are carried forward. Mixed conifer forests surround Cle Elum Reservoir, Cle Elum River, and their tributaries. The forest habitat is dominated by ponderosa pine and Douglas fir, with serviceberry, hazelnut, bitterbrush, snowberry, Oregon grape, kinnikinnick, balsamroot, lupine, strawberry, and a variety of native grasses in the understory. Within the rocky reservoir and river riparian areas, woody vegetation includes black cottonwood, red alder, vine maple, big-leaf maple, rose, and spirea.

3.8.2 Lower Yakima River Basin

The lower Yakima River flows through a more arid landscape than the upper basin and includes mixed conifer forests similar to those previously described, as well as shrub-steppe, wetlands, riparian areas dominated by black cottonwood, and grassland communities. Wetlands are present throughout the lower basin and are primarily associated with the mainstem and tributaries of the Yakima River. In semiarid environments, wetlands are important to many species of wildlife as they provide some of the best vegetative growth for food and cover, invertebrate production, and water. The National Wetlands Inventory classification system (Cowardin et al., 1979) identified 43,695 acres of wetlands within the entire Yakima River basin, the majority of which are found in the lower basin. This includes 20,040 acres of herbaceous or emergent wetlands; 20,044 acres of scrub-shrub and forested wetlands; and 3,611 acres of unvegetated wetlands. Riparian areas are also present throughout the lower basin. Black cottonwood is the dominant plant species in lowland riparian forests and plays a key role in the integrity of Yakima River riparian systems (Reclamation, 2008g).

Shrub-steppe communities were historically a dominant vegetation type in eastern Washington and have been extensively studied (YSRB, 2004). 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). Environmental factors such as elevation, aspect, soil type, proximity to water, and others contribute to an individual site's vegetation diversity potential. For example, at higher elevations and on north-facing slopes, three-tip sagebrush and Idaho fescue may dominate; on ridge tops with shallow soils, rigid sage-brush and Sandberg's bluegrass and/or bluebunch wheatgrass may dominate (YBFWRB, 2005). Rabbitbrush may be common on recently burned sites. Other grasses and shrubs that may be scattered throughout dominant stands of Wyoming big sagebrush and bluebunch wheat-grass include needle and thread, Thurber's needle grass, Indian rice grass, squirreltail, Cusick's bluegrass, short-spine horsebrush, antelope bitterbrush, spiny hopsage, and basin sagebrush (Crawford and Kagan, 2001). More alkaline sites may support black greasewood, basin wild rye, and inland saltgrass (Daubenmire, 1970). Estimates of historic vegetation cover on undisturbed sites range from 5 to 30 percent shrub cover and from 69 to 100 percent bunchgrass cover. The proposed Wymer Reservoir site contains shrub-steppe vegetation.

Agricultural, residential, and urban development over the past century has changed the landscape drastically, resulting in large losses of shrub-steppe habitat. The further loss of habitat and the degradation of remaining shrub-steppe can be attributed to increased fragmentation, varying fire management practices, competition with exotic and invasive species, overgrazing from livestock, off-road vehicle use, and overall conversion and development (Crawford and Kagan, 2001). In the Yakima River basin, three large properties remain that continue to support large blocks of shrub-steppe: the Yakima Training Center (YTC); a portion of the Yakama Reservation; and the ALE Reserve, located on Hanford Reach National Monument and managed by the U.S. Fish and Wildlife Service (YBFWRB, 2004). More detailed treatment of this vegetation type is found in the *Yakima Subbasin Plan* (YBFWRB, 2004).

3.8.3 Naches River Basin

The Naches River begins near Naches Pass at 5,860 feet elevation. The mainstem of the Naches River upstream of the Bumping River confluence is known as the Little Naches River. The river flows 75 miles through mixed conifer forest and irrigated agricultural land until its confluence with the Yakima River northwest of Yakima. The large drop in elevation between the headwaters and the confluence (approximately 4,700 feet) results in a significant change of vegetation communities, from alpine habitats to arid lower valleys. Conifer forests are dominated by Douglas fir, western red cedar, western white pine, ponderosa pine, and western hemlock. Riparian areas in the lower basin are dominated by scrub-shrub vegetation such as black cottonwood, wild rose, willow, and alder.

According to the Limiting Factors Inventory, riparian forests along the Naches River have undergone a significant decline as a result of direct removal for construction of dikes and roads from the mouth to the confluence of the Tieton River (Haring, 2001). Direct removal of forest along the Naches River has been a significant mechanism of loss of floodplain. The area available for inundation and groundwater recharge decreased dramatically as forests were removed for agricultural expansion and road construction. The loss is estimated at over 57 percent since the 1900s (Haring, 2001). Additionally, changes in flow regime coupled with floodplain constriction appear to have decreased recruitment of cottonwood trees (the keystone riparian tree in the lower Naches River basin) and may be impacting the health of existing trees. With existing mature forest size reduced and recruitment of younger trees declining, forest size and health along the lower Naches River are continuing to decline (GeoEngineers, 2003). A more detailed discussion of black cottonwoods in the Yakima River basin is provided below.

Bumping Reservoir lies at 3,400 feet elevation and is surrounded by mixed conifer forest characterized by Douglas fir, western larch, lodgepole pine, western white pine, black cottonwood, grand fir, western red cedar, and Engelmann spruce (Reclamation, 2008a). The shrub layer includes red-osier dogwood, red alpine blueberry, wild rose, Oregon grape, mountain alder, Douglas maple, kinnikinnick, and snowberry. Herb species include bunchberry, twinflower, pipsissewa, vanilla leaf, and strawberry. In forest openings and meadows, sedges and rushes are present.

Rimrock Reservoir is surrounded by conifer forest similar in character to those adjacent to Bumping Lake. Dominant trees include ponderosa and lodgepole pine, western white pine, and Douglas fir. Understory vegetation consists of small shrubs, such as snowberry and vine maple, and perennial grasses. Narrow riparian areas along the Tieton River are dominated by black cottonwood, quaking aspen, water birch, mountain alder, and red-osier dogwood.

3.8.4 Yakima River Tributaries

Riparian habitat along many tributaries in the Yakima River basin is currently degraded due to flow diversions and excessive livestock grazing. Wetlands are common along Toppenish and Satus Creeks due to their low gradient and braided channels. As in other Yakima River basin areas, most emergent wetland habitat along these streams has been removed through draining and land leveling; however, the Yakama Nation has undertaken extensive wetland restoration efforts in the area.

3.8.5 Naches River Tributaries

Vegetation along the Bumping River is characterized by intact and mature mixed conifer forest. Dominant species include Douglas fir, western red cedar, ponderosa pine, and black cottonwood, with alder and willow present near the banks. Scrub-shrub and forested wetlands are present on the south side of the river near Goose Prairie and Soda Springs and near the confluence with the Naches River.

The Tieton River flows from the dam at Rimrock Lake through mature forest dominated by ponderosa pine before entering a columnar basalt canyon. Riparian vegetation includes black cottonwood, quaking aspen, willow, and dogwood. Oak woodlands dominated by Oregon white oak also occur in the corridor.

3.9 Wildlife

The following discussion focuses on the areas where wildlife would be directly impacted or where changes to vegetation communities that could affect wildlife habitats and species over time are anticipated with implementation of the Integrated Plan. Wildlife issues of concern involve the loss of forest and shrub-steppe habitats and alterations to movement corridors for some species with the development of some of the facilities. The affected area for wildlife includes the following:

- The location of proposed fish passage facilities at the five major reservoirs (Keechelus, Kachess, Cle Elum, Bumping, and Rimrock Lakes) and Clear Lake Dam;
- The areas of additional inundation and drawdown for proposed water storage at existing reservoirs (Cle Elum Lake, Bumping Lake Reservoir, and Lake Kachess);
- The location of new pipeline, canal improvements, pump stations, and transmission lines associated with proposed structural and operational changes on the KRD canals, Keechelus-to-Kachess pipeline, and Wapatox Canal;
- The area of inundation for water storage at the proposed new Wymer off-channel reservoir;

- The location of new infrastructure associated with proposed groundwater recharge sites and infiltration systems;
- The location of pipeline, canal improvements, re-regulating reservoirs or other measures associated with proposed agricultural water conservation and market reallocation projects; and
- The location of land acquisitions to protect watershed functions, forest habitat and shrub-steppe habitat. These include lands in the Teanaway, Taneum and Manastash Creek basins, as well as lands adjacent to the Yakima River canyon.

Proposed flow increases in the mainstem and tributary streams could also result in alteration or creation of riparian plant communities over time, so those areas are described below. However, the modification of existing structures and operations to increase instream flows is not anticipated to affect wildlife species as the areas of construction are already disturbed.

The 2005 Yakima Subbasin Plan (YBFWRB, 2005) contains comprehensive descriptions of plants and wildlife in the basin as well as Federal and State listed species. Lists of WDFW-designated priority habitats and species records in the vicinity of the proposed action areas are presented in Appendix C of this document. Threatened and endangered plant species are discussed in Section 3.10.

3.9.1 Upper Yakima River Basin

The Yakima River originates at the Keechelus Dam at 2,450 feet, within coniferous forest that extends from the headwaters to the confluence with the Teanaway River. Mixed coniferous and deciduous forest stands occur in the vicinity of Cle Elum, Keechelus, and Kachess Lakes. Conifer forests are used by elk and deer, small mammals, raptors, owls, grouse and a wide range of songbird species. WDFW priority species in the upper basin include fisher, northern goshawk, and pileated woodpecker (WDFW, 2008) (see Appendix C).

Near the confluence of the Teanaway River, vegetation communities transition toward agricultural areas and grasslands. Riparian areas are associated with backwaters, sloughs, and oxbows as well as the main river channel. Riparian areas are noted for having highly diverse plant and animal communities (Kauffman et al., 2001). Approximately 85 percent of Washington's terrestrial vertebrate species use riparian habitat for essential life activities, and the density of wildlife in riparian areas is comparatively high (Knutson and Naef, 1997). Riparian habitats along the mainstem of the Yakima River are highly productive and used by a diverse number of wildlife species including deer, elk, heron, waterfowl, and many amphibian species and cavity-nesting birds. Good riparian habitat is generally found along some forested headwater reaches, whereas degraded riparian habitat is concentrated in the valleys and frequently associated with agriculture, grazing, and fluctuating, regulated streamflow.

Wetlands in the basin are located along the mainstem of the Yakima River and especially in the Kittitas Valley. In the upper basin, wetlands are found along smaller tributaries, at seeps and springs, at high-elevation wet meadows, and along the shorelines of natural lakes. Many wetlands are designated as WDFW priority habitats, as well as open water areas that support high concentrations of waterfowl (WDFW, 2009) (see Appendix C).

3.9.2 Upper Basin Reservoirs

Site-specific studies were conducted at the Cle Elum Reservoir, river, and tributaries for the *Cle Elum Dam Fish Passage EIS* (Reclamation and Ecology, 2011c). No site-specific studies are available for Keechelus or Kachess Reservoirs, but wildlife species are likely similar due similarities in vegetation communities and degree of disturbance and human activity. Site-specific studies will be conducted for all projects if they are carried forward. The forest and riparian habitat areas surrounding Cle Elum Reservoir and Cle Elum River are relatively undisturbed and provide high-quality habitat for a variety of native wildlife species (Appendix C).

Riparian areas are used by many species including bear, deer, elk, heron, waterfowl, small mammals, reptiles, amphibians, cavity-nesting birds, raptors, and a variety of songbirds. Invertebrate species are also important in the Cle Elum River basin food web, for nutrient cycling, and as a food source for fish and wildlife species.

3.9.2.1 Lower Yakima River Basin

The lower Yakima River flows through a more arid landscape than the upper basin and includes riparian habitats similar to those previously described, as well as shrub-steppe habitat and grassland habitats.

Shrub-Steppe Habitat

An abundance of diverse wildlife inhabits and utilizes shrub-steppe communities in the region including the proposed Wymer Dam and reservoir sites. The Service lists core habitat for the following species within the Wymer site vicinity: bighorn sheep, Townsend ground squirrel, golden eagle, ferruginous hawk, short-eared owl, long-billed curlew, loggerhead shrike, sage sparrow, Brewer’s sparrow, sage thrasher, greater sage-grouse, black-tailed jackrabbit, Merriam’s shrew, mule deer, pallid bat, and small-footed myotis (Reclamation, 2007a). Peripheral habitat exists for the white-tailed jackrabbit. Other species within the affected areas include the coyote, badger, western kingbird, western meadowlark, mourning dove, western rattlesnake, Great Basin spadefoot toad, and northern sagebrush lizard (Service, 2007b).

Appendix C presents a list of the known wildlife species within the affected area of the Wymer Reservoir, as well as a partial list of potential wildlife species that may occur in the vicinity (from Reclamation and Ecology, 2008).

Wetlands and Riparian Habitats

Wildlife in wetlands and riparian areas in the lower Yakima River basin include deer, bats, raptors, owls, herons, waterfowl, pheasant, quail, and many songbird species. Unlined canals and drains provide habitat (nesting, brood rearing, feeding and thermal escape and cover) for upland game, waterfowl, furbearers, and many songbird species (Yakama Nation, 1992). Priority species in the lower basin include bald eagle, western grebe, and sage-grouse (WDFW, 2008) (see Appendix C).

3.9.2.2 Naches River Basin

Wildlife species in the Naches River basin include those found in the adjacent Yakima River basin. Riparian areas in the lower basin are dominated by scrub-shrub vegetation such as black cottonwood, wild rose, willow, and alder. Wildlife that use the riparian areas in the lower basin include deer, coyote, rabbit, small rodents, raptors, owls, waterfowl, and a variety of small reptiles and songbirds. WDFW priority species include fisher, northern goshawk, and pileated woodpecker (WDFW, 2008) (see Appendix C).

Bumping Lake and Rimrock Reservoirs

Bumping and Rimrock Reservoirs support a variety of terrestrial mammals including elk and deer, though winter use is marginal due to snow depths (Reclamation, 2008a). Mountain goats occur on American Ridge, adjacent to Bumping Lake, and on Nelson Ridge to the south. Aquatic mammals include beaver, river otter, muskrat, and mink. Small mammals likely include snowshoe hare, northern flying squirrel, golden-mantled ground squirrel, Douglas squirrel, yellow-bellied marmot, and yellow pine chipmunk.

A variety of reptiles and amphibians are present as well as raptors, owls, waterfowl, and many songbird species. Osprey tend to nest along the lakeshore. Principal waterfowl species nesting in lake-fringe habitats include mallard and green-wing teal, and cavity-nesting ducks that may occur in the area include wood duck and Barrow’s goldeneye. Amphibian species include Cascades frog, Pacific tree frog, western toad, northern long-toed salamander, and western skink. Reptile species include northern alligator lizard, rubber boa, and garter snake.

Priority species in the vicinity of Bumping Lake include lynx, wolverine, western toad, northern goshawk, and common loon (WDFW, 2009) (see Appendix C).

3.9.2.3 Yakima River Tributaries

Riparian habitat along many tributaries in the Yakima River basin is currently degraded due to flow diversions and excessive livestock grazing. Overhanging vegetation and large woody debris have also been removed to improve flows, eliminating many miles of channels and creeks for use by nesting waterfowl. Although current land use practices limit riparian habitat development, the remaining vegetation provides nesting cover for many species of waterfowl and songbirds. Waterfowl use the canals and drains of irrigation facilities and areas of undisturbed wetland habitat. Spring burning of canal banks is generally followed by herbicide applications through the summer (Reclamation, 2002). Late spring burning has decreased active waterfowl and pheasant nesting (Oakerman, 1979; Oliver, 1983).

Wetlands are common along Toppenish and Satus Creeks due to their low gradient and braided channels. As in other Yakima River basin areas, most emergent wetland habitat along these streams has been removed through draining and land leveling; however, the Yakama Nation has undertaken extensive wetland restoration efforts in the area. Remaining areas are heavily grazed during spring and summer months, decreasing wildlife habitat. However, flooded areas are heavily used by migratory waterfowl such as Canada goose. Refuges along Toppenish Creek provide important habitat for migratory and wintering waterfowl.

3.9.2.4 Naches River Tributaries

Vegetation along the Bumping River is characterized by intact and mature mixed conifer forest. Wildlife species described previously are likely to use mixed conifer forest as well as several bird species including common merganser, harlequin duck, and American dipper.

Wildlife species in the vicinity of the Tieton River include elk, bighorn sheep, mule deer, black bear, and cougar. Golden eagles are known to use cliffs for nesting, and spotted owls occupy adjacent conifer forest. Multiple woodpecker species are also present, including white-headed, Lewis' and acorn, which are uncommon across much of the state. Several priority species occur in the Tieton River drainage, including western gray squirrel, peregrine falcon, and white-headed and Lewis's woodpeckers (WDFW, 2009).

3.9.2.5 Movement Corridors in the Yakima River Basin

Valleys are often used as movement corridors by numerous land animals. This is especially true for species with relatively large home ranges such as deer and elk. The following discussion of movement corridors was provided as part of the *Yakima River Basin Water Storage Feasibility Study* (Reclamation, 2008g) and applies generally to the proposed infrastructure or habitat alterations described in this EIS.

Movement corridors are crucial to wildlife and may be seasonal, depending on the species. The primary function of a corridor is to connect two areas of habitat and encourage migration and dispersal into these areas. Wildlife movement is essential to healthy wildlife populations because it does the following:

- Provides connectivity and, thereby, genetic variation and biodiversity between differing populations and habitats, connects isolated habitats, and may allow recolonization of extirpated species;
- Provides varying habitats for migration patterns (e.g., foraging, nesting, brood-rearing, wintering, and mating); encourages plant propagation; and allows populations to move in response to habitat changes such as fires; and
- Can provide habitat for "corridor dwellers," species that live within corridors for extended periods (Beier and Loe, 1992).

The Yakima Training Center supports a small population of elk that migrate northwest from the ALE Reserve and south from the Colockum and Quilomene Wildlife Areas.

Neither the Yakima nor the Colockum herds have been observed within the Wymer area or in the areas directly east of the Yakima River (Stephenson, 2007).

3.10 Threatened and Endangered Species

The following discussion focuses on the areas where wildlife and plant species that are federally or State listed as threatened or endangered would be directly impacted. The affected area includes the following:

- The location of proposed fish passage facilities at five major reservoirs (Keechelus, Kachess, Cle Elum, Bumping, and Rimrock Lakes) and Clear Lake Dam;
- The areas of additional inundation and drawdown for proposed water storage at existing reservoirs (Cle Elum Lake, Bumping Lake Reservoir, and Lake Kachess);
- The location of new pipeline, canal improvements, pump stations, and transmission lines associated with proposed structural and operational changes on the KRD canals, Keechelus-to-Kachess pipeline, and Wapatox Canal;
- The area of inundation for water storage at the proposed new Wymer off-channel reservoir;
- The location of new infrastructure associated with proposed groundwater recharge sites and infiltration systems;
- The location of pipeline, canal improvements, re-regulating reservoirs or other measures associated with proposed agricultural water conservation and market reallocation projects;
- The location of land acquisitions to protect watershed functions, forest habitat and shrub-steppe habitat. These include lands in the Teanaway, Taneum and Manastash Creek basins, as well as lands adjacent to the Yakima River canyon;
- The location of public lands receiving a higher degree of protection through Federal wilderness designation; and surface waters designated as Wild and Scenic Rivers; and
- The location of habitat improvements implemented under the mainstem floodplain and tributary fish habitat enhancement program.

Proposed flow changes in the Yakima River mainstem and tributary streams could result in alteration or creation of riparian plant communities over time, which could affect habitat for listed or priority species. However, the modification of existing structures and operations to increase instream flows is not anticipated to affect listed species as the areas of construction are already disturbed.

The Yakima Subbasin Plan (YBFWRB, 2005), developed to support protection and restoration of fish and wildlife, contains a detailed list of known rare plant occurrences and rare plant communities in the basin. According to the Yakima Subbasin Plan, the Yakima River basin contains at least 67 rare plant species and 52 inventoried rare or high-quality plant communities. Approximately 8 percent of the rare plant communities are associated with grassland habitat, 28 percent with shrub-steppe habitat, 56 percent with upland forest habitat, and 8 percent with riparian habitat (YBFWRB, 2005). In terms of wildlife, there are 26 bird species, 16 mammal species, 11 amphibian species, and 5 reptile species listed as endangered, threatened, or candidate by Federal and/or State agencies.

Table 3-15 shows the wildlife species listed under the Federal Endangered Species Act (ESA) and State threatened and endangered species. The WDFW Priority Habitats and Species (PHS) database was also reviewed for occurrences in the vicinity of the affected areas of the proposed Integrated Plan elements and actions (WDFW, 2009).

Table 3-15 Federally and State-Listed Endangered, Threatened, Sensitive and Candidate Species that May Occur in the Yakima River Basin

Species	Scientific name	Federal Status*	State Status*
Federally Listed and Candidate Species			
bull trout	*Salvelinus confluentus* – Columbia River DPS	T, CH	C
steelhead	*Oncorhyncus mykiss* – Middle Columbia River DPS	T, CH	C
gray wolf	*Canis lupus*	C	T
grizzly bear	*Ursus arctos horribilis*	T	E
Canada lynx	*Lynx canadensis*	T	T
fisher	*Martes pennati* – West Coast DPS		E
western gray squirrel	*Sciurus griseus*	SC	T
ferruginous hawk	*Buteo regalis*	SC	T
greater sage-grouse	*Centrocerus urophasianus*	C	T
northern spotted owl	*Strix occidentalis caurina*	T, CH	E
Ute ladies'-tresses	*Spiranthes diluvialis*	T	E
State Designated and Federal Species of Concern			
Townsend's big-eared bat	*Corynorhinus townsendii*	SC	C
wolverine	*Gulo gulo*	SC	C
bald eagle	*Haliaeetus leucocephalus*	SC	S
northern goshawk	*Accipiter gentilis*	SC	C
peregrine falcon	*Falco peregrinus*	SC	S
Rocky Mountain tailed frog	*Ascaphus montanus*	SC	C
western toad	*Bufo boreas*	SC	C
sharp-tailed snake	*Contia tenuis*	SC	C
Larch Mountain salamander	*Plethodon larselli*	SC	S
black-backed woodpecker	*Picoides arcticus*		C
flammulated owl	*Otus flammeolus*		C
golden eagle	*Aquila chrysaetos*		C
Lewis' woodpecker	*Melanerpes lewis*		C
merlin	*Falco columbarius*		C
pileated woodpecker	*Dryocopus pileatus*		C
white-headed woodpecker	*Picoides albolarvatus*		C
great blue heron	*Ardea herodias*		M
common loon	*Gavia immer*		S
Thompson's chaenactis	*Chaenactis thompsonii*		S
western ladies'-tresses	*Spiranthes porrifolia*		S

*E = Endangered; T = Threatened; C = Candidate; CH = Critical habitat has been designated for this species; S = Sensitive; SC = Species of Concern; M = monitor species.

3.10.1 Listed Fish and Wildlife in Yakima River Basin

The Federal species lists were obtained from the Service and NMFS, and the State species lists were obtained from WDFW in September 2011 (NMFS, 2011 and Service, 2011a). Listed fish species include bull trout and Middle Columbia River (MCR) steelhead. Listed wildlife species identified by WDFW as occurring in the affected areas include gray wolf, grizzly bear, Canada lynx, fisher, ferruginous hawk, greater sage-grouse, and northern spotted owl (WDFW, 2008). Other priority bird species, such as bald eagle, white-headed woodpecker, pileated woodpecker, great blue heron, and common loon, are also known to occur in the Yakima River basin. WDFW-designated priority habitats in the project area include riparian zones, old growth, shrub-steppe, and wetlands (WDFW, 2008).

The following sections discuss the listed species and their occurrence in the vicinity of the affected areas. Appendix C of this document presents a summary of the information received from WDFW on priority habitats and species in the vicinity of the affected areas.

3.10.1.1 Bull Trout

In June 1998, the Service listed the Columbia River Basin “distinct population segment” (DPS) of bull trout as threatened under the ESA (63 FR 31647). The Service identified eight subpopulations in the Yakima River basin. Bull trout require cold, clear water with stable channels and adequate cover (Thurow, 1987; Ziller, 1992). Critical habitat for bull trout was designated in 2005 and revised in 2010 and includes reaches within the affected area.

Bull trout occurred historically throughout most of the Yakima River basin. Today, however, they are fragmented into relatively isolated populations. Although bull trout were probably never as abundant as other salmonids in the basin—due in part to their requirements for cold, clear water—they were likely more abundant and more widely distributed than they are today (WDFW, 1998).

Three bull trout life history forms are present in the Yakima River basin: adfluvial (migrate to lakes), fluvial (migrate to rivers), and resident. Adfluvial and fluvial fish reside in lakes and mainstem rivers, respectively, during part of the year. Fry and juveniles rear in their natal streams for 1 to 4 years before migrating downstream into lakes or mainstem river systems. Adults migrate back into tributary streams to spawn, after which they return to the lake or river. The resident life history form resides in a particular stream for its entire life cycle.

An adfluvial population could still be present in Cle Elum Reservoir; however, no spawning population has been documented in the upper Cle Elum basin. Adfluvial bull trout may have been replaced by nonnative lake trout, which have been naturally reproducing in Cle Elum Reservoir since being stocked in the 1920s. A fluvial population is present in the mainstem Yakima River, although few bull trout have been recorded in the mainstem above Roza Diversion Dam. Bull trout are late summer/early fall spawners and most spawning activity in the Yakima River basin, irrespective of life history form, occurs from early September through early October. However, spawning may occur as early as August or as late as mid-October to early November. For the migratory life history forms, the spawning migration can begin as early as mid-July when adults move upstream to hold in deep pools, or it may occur just prior to spawning.

The primary downstream migration period for juvenile bull trout from their natal tributaries into lakes or rivers occurs from June through November. The early summer migration appears to be in response to increased flows and may correspond with a switch in prey from invertebrates to fish. The fall migration appears to be primarily in response to decreasing water temperatures and the need to find suitable overwintering habitat (Fraley and Shepard, 1989; Murdoch, 2002).

Additional information on the presence of bull trout in the Cle Elum vicinity is available in the *Cle Elum Dam Fish Passage Facilities and Fish Reintroduction Project EIS* (Reclamation and Ecology, 2011c).

The WDFW Salmon and Steelhead Stock Inventory (SASSI) program characterizes bull trout stocks in the Yakima River basin. Stocks upstream of Rimrock Reservoir are characterized as healthy; Bumping Lake Reservoir bull trout stock are characterized as depressed; Yakima River, Ahtanum Creek, North Fork Teanaway, Kachess Reservoir, and Keechelus Reservoir stocks are characterized as critical; and Cle Elum Reservoir bull trout stocks are characterized as unknown (WDFW, 1998). Bull trout in the Naches River fluvial group are characterized as depressed in Rattlesnake Creek and in the American River, and critical in Crow Creek (WDFW, 1998). There are only a few historical catch records that indicate the presence of bull trout in Yakima River tributaries; relatively few fish were noted in these records (Haring, 2001).

The Service has recently revised designated critical habitat areas in the Yakima River basin (Service, 2010). The Yakima River is within critical habitat unit (CHU) 11 and includes the mainstem and tributaries. The majority of the critical habitat area remains the same as previously designated with some additional tributary habitat added.

3.10.1.2 Middle Columbia River Steelhead

The steelhead population in the Yakima River basin is a component of the Middle Columbia River (MCR) DPS steelhead that was listed as threatened in 1999 (64 FR 14517). Four genetically distinct spawning populations of wild steelhead have been identified in the Yakima River basin, one of which spawns in the upper Yakima River and its tributaries (Phelps et al., 2000). Critical habitat was designated for the MCR steelhead and includes portions of the affected area.

Steelhead are found throughout the basin, which includes the Satus, Toppenish, Naches, upper Yakima, and Ahtanum watersheds (YBFWRB, 2009). Steelhead enter the Yakima River in greatest numbers in September through November and then again in February through April (Haring, 2001). Steelhead hold in the mainstem until moving into tributaries throughout the basin to spawn. Adults spawn February through June, mostly in tributaries, and fry emerge from the gravel from May into July. Overall, most spawning occurs between March and May (Hockersmith et al., 1995), although WDFW personnel have observed steelhead spawning as late as July in the Teanaway River (RM 176.1), a tributary to the upper Yakima River.

Steelhead spend from 1 to 3 years in fresh water before beginning to migrate to the ocean in spring, with the majority of out-migrants passing Prosser Dam (RM 47) in April. Juvenile steelhead utilize tributary and mainstem reaches throughout the Yakima River basin as rearing habitat and use faster and deeper water as they grow. Some downstream movement begins in November, but the peak of the smolt out-migration occurs between mid-April and May. As with other salmon species, steelhead rely on spring freshets to move them successfully downriver through the Yakima River into the Columbia River (Reclamation and Ecology, 2008).

Over the 10-year period from 1997 to 2006, steelhead basin-wide escapement has averaged 2,339 fish, ranging from 1,070 in 1998-1999 to 4,525 in 2001-2002 (Reclamation and Ecology, 2008). The run is dominated by wild fish. The run also contains a hatchery component of 8 percent over the period of record and 3 percent between 1999 and 2007 (YBFWRB, 2009). The hatchery component is attributed to strays originating from outside the basin (WDFW, 2009).

3.10.1.3 Gray Wolf

The gray wolf is a Federal endangered and State endangered species. The Federal listing covers only the western half of Washington, including all of the Yakima basin. The gray wolf is a wide-ranging carnivore, using a variety of habitats. Its primary prey includes deer and elk. Historic habitat for this species occurs in the affected areas of the upper Yakima River basin. In July 2011 a gray wolf pack was confirmed in the Teanaway region of the basin (WDFW, 2011b). Since 2008, five wolf packs have been identified and confirmed by WDFW in the State of Washington. The other four packs occur in north-central and northeast Washington in Okanogan, Chelan, and Pend Oreille Counties. In response to the return of wolves to Washington, WDFW prepared the *Wolf Conservation and Management Plan for Washington* (WDFW, 2011a), which is currently under review by the Washington Fish and Wildlife Commission. Adoption of the final management plan is expected by December 2011.

Wolves tend to move away from areas with high road densities (Mech et al., 1988; Mech and Boitani, 2003). High road densities, present throughout much of the affected areas, reduce the likelihood of this species occurring on a regular basis.

3.10.1.4 Grizzly Bear

The grizzly bear is a Federal threatened and State endangered species. Grizzly bears are wide-ranging and feed on roots, berries, ants, grubs, carrion, small mammals, ungulates, and salmon. Suitable habitat existed in the upper Yakima River basin historically, but fairly high road densities, development, and increased human use have decreased the quality of the habitat in the area. Grizzly bear observations have been recorded in the vicinity of Cle Elum Reservoir (WDFW, 2009). Small numbers of this species may also be found in other areas of the Cle Elum River basin.

3.10.1.5 Canada Lynx

In March 2000, the Service listed the Canada lynx as threatened under the ESA. Canada lynx are known to occur in several western and northern tier states including Washington. The life history and habitat requirements of Canada lynx are described in detail in the *Endangered and Threatened Wildlife and Plants: Determination of Threatened Status for the Contiguous U.S. Distinct Population Segment of the Canada Lynx and Related Rule; Final Rule* (Service, 2000) and are summarized in the following paragraph.

In Washington, resident lynx populations were historically found in the northeast and north-central regions and along the east slope of the Cascade Mountains. In the West, the distribution of the lynx is associated with subalpine coniferous forest. Within these general forest types, lynx are most likely to persist in areas that receive deep snow, for which the lynx is highly adapted. Most of the lynx occurrences are in the 4,920- to 6,560-foot elevation class. The WDFW PHS data do not indicate any documented occurrences of Canada lynx in the affected areas (WDFW, 2009). If present in the Yakima River basin, they are most likely to occur at higher elevations.

3.10.1.6 Fisher

The fisher is a State endangered and Federal candidate species that feeds on a variety of small- to medium-sized mammals, birds and carrion. It inhabits dense coniferous forest with extensive and continuous canopy, using riparian areas and ridgelines as movement corridors. Fisher populations have declined because of overtrapping, predator control, and habitat alteration. There are several sightings on record in the Naches Ranger District to the southwest (USFS, 2006).

3.10.1.7 Western Gray Squirrel

The western gray squirrel is the largest tree squirrel native to the Pacific Northwest and is most frequently associated with pine and oak trees that provide nesting cover and seeds for food. In Washington, they also use stands of Douglas fir trees when a component of oak or pine is present. Western gray squirrels require mature stands of trees with sufficient canopy cover to allow arboreal travel and provide secure nest sites, and sufficient complexity of vegetation to provide a multitude of food resources.

Once common in suitable habitat on both sides of the Cascade Mountains, western gray squirrels in Washington have declined over the last century and their range has diminished due to losses of suitable habitat. Distribution of western gray squirrels in Washington currently is limited to only three locations: south Puget Trough, the North Cascades (Chelan and Okanogan Counties), and south-central Washington (primarily Klickitat County). Additional threats to western gray squirrels in Washington include fragmentation of oak woodlands, invasion of oak woodlands by nonnative plants like Scot's broom, diseases such as mange, and potential competitors such as the introduced eastern gray squirrel.

While once hunted in Washington, the western gray squirrel has been protected since 1944 and was listed as threatened by the WDFW in 1993. A species recovery plan was completed in 2007 (Linders and Stinson, 2007).

3.10.1.8 Ferruginous Hawk

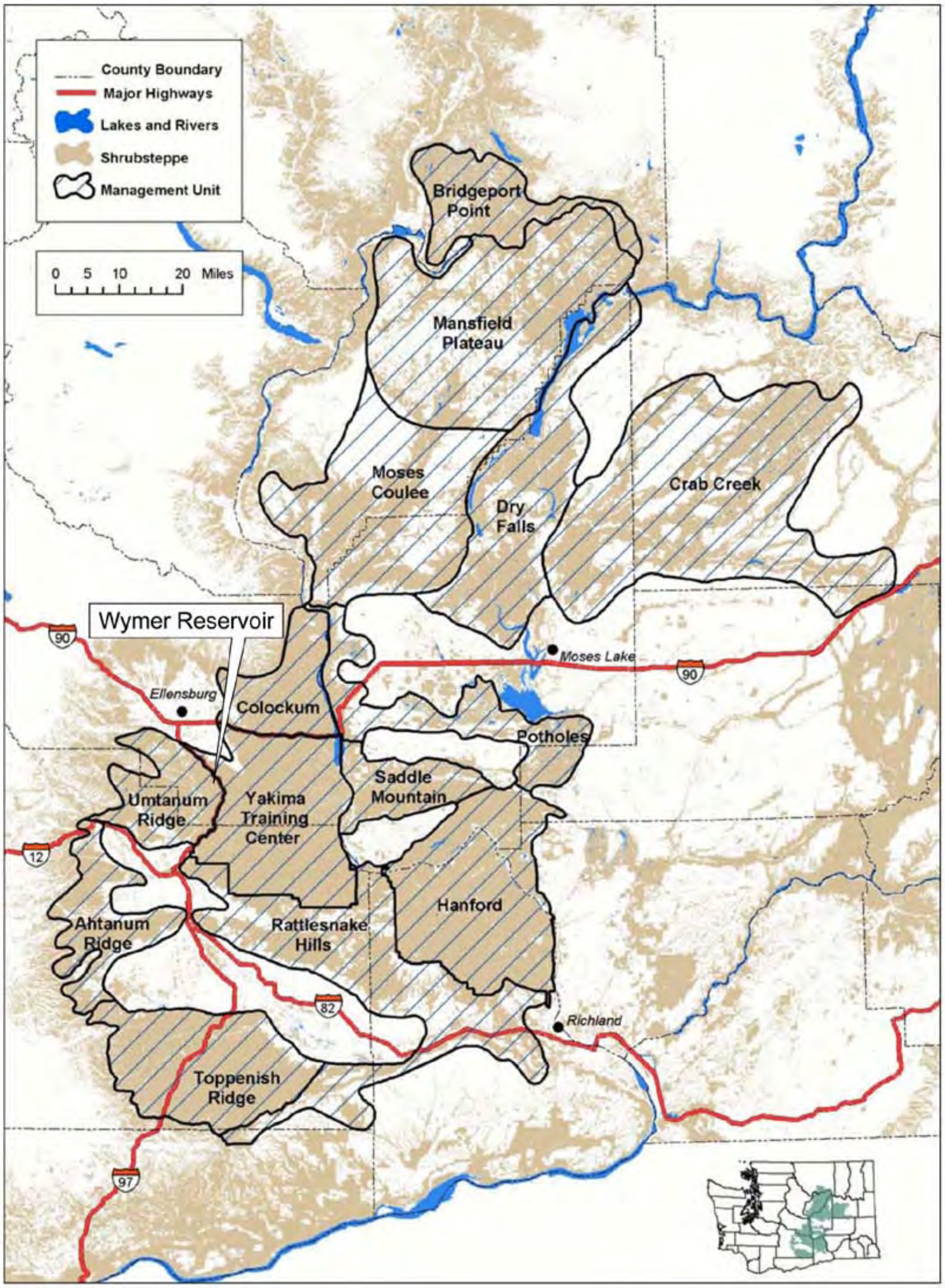
The ferruginous hawk is a Federal species of concern and a State threatened species. This large hawk inhabits dry, open country of the plains, prairies, grassland, shrub-steppe, and deserts, especially in those areas with native bunchgrasses. Ferruginous hawks nest on rocky cliff ledges, utility towers, or nest platforms. They have declined in recent years across the continent, including Washington, with the greatest concentration in Franklin and Benton Counties. They can also be seen in shrub-steppe habitats in the Yakima basin. Threats to the population in Washington include increased human disturbance and habitat destruction (specifically shrub-steppe). The Conservation Reserve Program and other shrub-steppe conservation programs may help protect and restore habitat for ferruginous hawks.

3.10.1.9 Greater Sage-Grouse

The greater sage-grouse is State-listed as threatened and is a Federal candidate for listing under the ESA. In Washington, sage-grouse formerly ranged from the Columbia River north to Oroville, west to the foothills of the Cascade Range, and east to the Spokane River. Sage-grouse in Washington currently are restricted to three isolated populations. The largest (estimated at about 600 birds) is located on mostly private land in Douglas and Grant Counties. A second population of 300 to 400 sage-grouse is on the Yakima Training Center in Kittitas and Yakima Counties adjacent to the proposed Wymer Reservoir site, and a third population of 25 to 30 sage-grouse occurs within the Yakama Reservation (Stinson et al., 2004).

Data from radio-tagged sage-grouse found that they use habitat in the Wymer Reservoir site. The shrub-steppe habitat in the project area is within the Umtanum Ridge Management Unit identified by the State as a potential expansion and reintroduction area for greater sage-grouse (see Figure 3-5) (Stinson et al., 2004).

Preferred habitat for greater-sage-grouse includes areas with greater than 10 percent cover of sagebrush, with moderate bunchgrass understory. Typical home-range size is 0.8 to17 square miles in Washington (Stinson et al., 2004). Males gather at leks, mating and displaying locations, returning to the same lek annually. Females choose nest sites then travel to leks to select mates. Females were found to nest approximately 0.5 to 12 miles from leks on the Yakima Training Center (Stinson et al., 2004).



SOURCE: Stinson et al. 2004.

Figure 3-5 Shrub-Steppe Habitat Management Units

3.10.1.10 Northern Spotted Owl

The northern spotted owl was listed as a threatened species by the Service in 1990, primarily due to widespread habitat loss and inadequate protective mechanisms. It is listed by the State as endangered due to its sharp decline in recent years in Washington State. Spotted owls generally rely on older forested habitats because such forests contain the structures and characteristics required for nesting, roosting, and foraging. Features that support nesting and roosting typically include a moderate-to-high canopy closure (60 to 90 percent); a multilayered, multispecies canopy with large overstory trees (with diameter at breast height of greater than 30 inches); a high incidence of large trees with various deformities (large cavities, broken tops, mistletoe infections, and other evidence of decadence); large snags; large accumulations of fallen trees and other woody debris on the ground; and sufficient open space below the canopy for spotted owls to fly (Thomas et al., 1990). Forested stands with high canopy closure also provide thermal cover (Weathers et al., 2001) and protection from predators. Spotted owls forage on wood rats, mice, bats, and occasionally small birds, moths, crickets, and large beetles.

The Service has recently released the *Revised Recovery Plan for the Northern Spotted Owl* (Service, 2011b). The 2008 recovery plan established a network of Managed Owl Conservation Areas (MOCAs) across the range of the northern spotted owl. As described in the *Yakima River Basin Water Storage Feasibility Study* (Reclamation, 2008g), the northern half of Cle Elum Reservoir lies within a proposed MOCA and the southern half lies within a proposed Conservation Support Area (CSA) under the previous plan. Bumping Lake and the surrounding forests to the south and northeast are within spotted owl Critical Habitat Unit (CHU) Number 6: Southeast Washington Cascades (Service, 2008). However, based on scientific peer review comments on the recovery plan, the Service is not incorporating the previously recommended MOCA network or CSAs and critical habitat designations into the revised recovery plan. The revised recovery plan states that northern spotted owl critical habitat will be updated in the future by the Service and that in the interim, land managers should continue to implement the standards and guidelines of the Northwest Forest Plan as well as fully considering other recommendations in the revised recovery plan (Service, 2011b).

3.10.2 Listed Plant Species in Yakima River Basin

3.10.2.1 Ute Ladies'-tresses

Ute ladies'-tresses is a species within the orchid family that was federally listed as a threatened species on January 17, 1992 (50 CFR Part 17) due to habitat loss or modification, small population size, and low reproductive rate (Service, 1992). Ute ladies'-tresses are found in moist soils near riparian areas, lakes, moderately moist (mesic) to wet meadows, river meanders, and perennial spring habitats. This plant generally occurs within an elevation range between 1,500 and 7,000 feet, with the lower elevations in the western part of its range. The orchid generally occurs below montane forests, in open areas of shrub or grassland, or in transitional zones. It is considered a lowland species, typically occurring near streams and rivers. This species tends to occupy grass, rush, sedge, and willow sapling dominated openings.

Ute ladies'-tresses were discovered in Washington State for the first time in Okanogan County in 1997. It was also found near the Chief Joseph Dam in Chelan County (Service, 2009b). At present, there are no known populations of Ute ladies'-tresses within the project area at Cle Elum Reservoir (WDNR, 2008; 2009); however, potential habitat for this species is present and potential habitat is likely to exist at other Integrated Plan project sites.

3.10.3 State Sensitive and Candidate Species

In addition to the Federal- and State-listed species discussed above, several other wildlife species that occur in the Yakima River basin are State sensitive and candidate species (Appendix C). Priority species in the upper basin include fisher, northern goshawk, and pileated woodpecker. In the Kittitas Valley, wetlands along the mainstem of the Yakima River support high concentrations of waterfowl and bald eagles. In the lower basin, riparian areas and freshwater lakes provide habitat for western grebe and other waterfowl. Habitats in the Naches River basin, including Bumping Lake Reservoir, support fisher, northern goshawk, and pileated woodpecker. Priority species in the vicinity of Rimrock Reservoir include gray wolf, marten, and pileated woodpecker. The Wymer Reservoir area provides core habitat for a number of large and small mammals and bird species, including greater sage-grouse, ferruginous hawk, sage sparrow, Brewer's sparrow, bighorn sheep, and mule deer.

3.11 Visual Quality

This section describes the visual setting of the areas where visual quality would likely be affected by the Integrated Plan elements. These areas include the following:

- Yakima River basin reservoirs (Keechelus, Kachess, Cle Elum, Bumping, Rimrock, and Clear Lake);
- Yakima and Naches River and their tributaries, including:
    - Middle and lower Teanaway River basin (for land acquisition);
    - Yakima River canyon (between Yakima River and I-82) (for land acquisition);
    - Little Naches River, Taneum and Manastash Creeks headwaters (for land acquisition);
    - Lands surrounding Bumping Lake (for Wilderness Area designation);
    - Roadless area in Teanaway, between Kachess and Cle Elum Reservoirs, and upper reaches of Manastash and Taneum Creeks (for Wilderness Area designation); and
    - America, Upper Cle Elum, and Waptus Rivers (for Wild and Scenic River Designation).
- Rural/agricultural areas of Kittitas, Benton and Yakima Counties; and
- Urban/suburban areas of the City of Yakima.

3.11.1 Regulatory Setting

Federal land management agencies such as the Bureau of Land Management (BLM) and U.S. Forest Service (USFS) have developed systems specifically designed to inventory, evaluate and manage for scenic (visual) resources on public lands. To evaluate scenic resources under BLM jurisdiction and to develop management objectives for those resources, the BLM developed the Visual Resource Management (VRM) system, which utilizes a Visual Resource Inventory (VRI). The VRI consists of three data components: scenic quality, visual sensitivity, and distance zones (BLM, 2011). Together, these three elements comprise a final VRI class that reflects the current physical condition of the visual resource within a geographic area. The lands around the proposed Wymer Dam are managed by BLM and would be subject to BLM's VRM system for evaluating visual impacts.

The USFS has a parallel system, known as the Scenery Management System (SMS). The primary components of the SMS are similar to BLM's VRM system (e.g., BLM's scenic quality versus the SMS inherent scenic attractiveness; visual sensitivity/public concern levels; and distance zones/seen areas and distance zones). In addition, the USFS provides management directions for scenic viewsheds containing dams and reservoirs, described in terms of Visual Quality Objective (VQO). Under this system, there are five VQO categories: Preservation, Retention, Partial Retention, Modification, and Maximum Modification. VQOs are established based on an evaluation of the following:

- Sensitivity Level (the public's concern for scenic quality – High, Moderate, and Low);
- Variety Class (the diversity of natural features – Distinctive, Pleasing but Common, and Dull or Monotonous); and
- Distance Zones (Foreground, Middleground, and Background).

These terms are from the Visual Management System (USFS, 1974 in Reclamation, 2008a) and the National Forest Landscape Management handbooks.

The VQOs for the Yakima River basin reservoirs are considered Scenic Travel 1 (ST-1)-Retention VQO (Jackson, 2008 in Reclamation, 2008a). Under Retention VQO, activities may only repeat form, line, color, and texture which are frequently found in the characteristic landscape. Changes in their qualities of size, amount, intensity, direction, pattern, etc., should not be evident. Immediate reduction in visual contrast (form, line, color, and texture) should be accomplished either during construction or immediately after.

Under USFS's Scenic Management System (SMS), Scenic Integrity Levels (SILs) are established for each Management Area, ranging from Very High, meaning the landscape is unaltered, to Low, meaning moderate alterations are apparent on the landscape. The SIL for lands around the reservoirs is High, meaning the landscape appears intact (Reclamation, 2008f). The visual resource analysis in this EIS references both the VQO and the SIL of the study area. Table 3-16 describes the relationship between VQOs and SIL as contained in the Scenic Management System (USDA, 1995).

Table 3-16 Relationship between Visual Quality Objectives and Scenic Integrity Levels

SIL/VQO	Condition	Perception, Degree of Deviation
High/Retention	Appears Unaltered	Not Evident. Deviations may be present but must repeat form, line, color, and texture of characteristic landscape in scale.

Source: USDA 1995, 2-4.

The lands around Keechelus, Kachess, Cle Elum, Bumping, Rimrock, and Clear Lake Reservoirs are within the Okanogan-Wenatchee National Forest. Individual projects proposed in these areas would be subject to the USFS's SMS system for evaluating visual impacts. This area is managed by the USFS principally as scenic viewsheds. The USFS manages these lands according to its 1990 Land and Resource Management Plan (Forest Plan) (USFS, 1990).

The lands around Keechelus, Kachess, and Cle Elum Reservoirs are part of the Mountains to Sound Greenway National Scenic Byway, which is also designated as a Washington State Scenic and Recreational Highway. State Route (SR) 182 through Yakima River canyon is similarly designated. This designation is based on the route's outstanding scenic character and environmental experiences, establishing a high level of sensitivity to visual quality for any action considered within the corridor. An overall goal of the Washington State Scenic and Recreational Highways Strategic Plan 2010-2030 is to: " Plan for, protect and preserve resources associated with the State's Scenic and Recreational Highways" (WSDOT, 2010).

3.11.2 Visual Setting: Reservoirs

All the reservoirs in the Yakima River basin share the characteristic of being drawn down during the summer. The reservoirs are generally full in late spring and early summer, but are drawn down for irrigation starting in June. The reservoirs do not refill until the following spring. This leaves large areas of exposed shorelines from late summer through the winter. Stumps from trees that were logged before the dams were raised or constructed are exposed. In dry years, the reservoirs may not completely fill and the upper portions of the reservoir are exposed year-round. In some reservoirs, such as Keechelus, shrubby vegetation has grown up in the exposed shorelines. That vegetation is green during the summer.

The visual settings of Keechelus, Kachess, Cle Elum, Bumping, Rimrock, and Clear Lake Reservoirs are described below.

3.11.2.1 Keechelus Reservoir

The visual setting for Keechelus Reservoir provides a perceived “natural” landscape, contrasting with a developed eastern shore—the I-90 corridor. Because of its proximity to I-90, Keechelus Reservoir is viewed by more people than any other Yakima River basin reservoir. The John Wayne Pioneer Trail is the principal development on the western shore of the lake.

The dominant landscape character is openness with dramatic contrasts of rock rising sharply to the east and water immediately adjacent to I-90 to the west, which curves around the eastern shore of the lake. Background views to the west are generally forested, with views of distant hills and mountains beyond. Douglas fir trees dominate the vegetation.

Foreground views to the west at the southern end of Keechelus Reservoir are dominated by I-90 and its concrete Jersey barrier. The middleground view is of grasses between the road and the lake. The earth-filled Keechelus Dam can be seen in the background, as well as the mountains in the far distance. Beyond the dam, the Yakima River flows to the south. The dam’s low profile relative to the surrounding landscape allows it to blend with the landscape, but it is visible and noticeable from I-90.

The John Wayne Pioneer Trail follows the western shoreline of Keechelus Reservoir. The view from the trail on the north end of the lake is very natural, with Gold Creek and native vegetation in the foreground, and stumps in the middle ground. To the south, views from the trail are dramatic and sweeping. The foreground is occupied by vegetation along and below the trail. Additional background views are of distant peaks. Evidence of development is limited to the narrow band of the highway, which is obscured by trees.

3.11.2.2 Kachess Reservoir

The visual setting for Kachess Reservoir provides a perceived “natural” landscape with limited development along the shores. Viewers of the lake are primarily recreationists and seasonal residents. Kachess Reservoir is located between the north-south trending Keechelus Ridge to the west and Kachess Ridge to the east. Background views are forested, with views of valley walls, ridges, and mountains beyond. Douglas fir forests dominate the vegetation. Development is generally limited to USFS roads on both the east and west shores, boat launches, other recreational facilities, and increasing residential development on the south and west shore.

Kachess Dam is located on the southern end of the lake and is approximately 115 feet tall and 1,400 feet in length with a gated spillway.

3.11.2.3 Cle Elum Reservoir

The visual setting for Cle Elum Reservoir provides a perceived “natural” landscape with limited development along the shores. Viewers of the lake are primarily recreationists and seasonal residents. Background views are forested with patches of logged hillsides, valley walls, ridges, and mountains beyond. Pine and Douglas fir trees dominate the vegetation. Development adjacent to the reservoir is generally limited to USFS roads on the east and west shore, boat launches, campgrounds, and cabins. Year-round residences and resorts are more common south of the reservoir.

Cle Elum Dam is located on the southern end of the lake and is approximately 165 feet tall and 1,800 feet in length with a gated spillway. Public views of the downstream side of the dam are limited by steep topography and restricted access.

3.11.2.4 Bumping Lake Reservoir

The visual setting for Bumping Lake Reservoir provides a perceived "natural" landscape, with relatively limited development in evidence. Development at the lake includes Bumping Lake Dam, USFS campgrounds and day use area (south shore), recreational residences, the Bumping Lake Marina (north shore), and USFS roads and trailheads. The existing dam is 61 feet tall and 2,925 feet in length, with an outlet from a 1,300-acre glacial lake in the floor of Bumping River valley. The dam site is a deep, steep-walled canyon. Glacial deposits dominate the valley floor. Mixed-conifer forests surround the lake. Viewers are primarily boaters and hikers, summer residents, and Goose Prairie residents.

The William O. Douglas Wilderness Area is located approximately 1 mile from the north and south shores of Bumping Lake Reservoir and is managed in a natural state.

3.11.2.5 Rimrock Reservoir

The visual setting at Tieton Dam/Rimrock Reservoir provides a perceived "natural" setting characterized by extremely rugged terrain. Tieton Dam is located in a steep-sided, mountainous valley, carved by the Tieton River. Background views are forested with valley walls, ridges, and mountains beyond. Pine and Douglas fir trees dominate the vegetation. Development adjacent to the reservoir is generally limited to USFS roads, boat launches, and campgrounds. The valley area is forested. Tieton Dam is visible from Highway 12. The downstream face of the dam generally does not support vegetation and the spillway channel is generally barren, solid rock and concrete channels. Because of the attractive combination of the forested valley and the lake, visual quality is generally high.

3.11.2.6 Clear Lake Reservoir

The visual setting at Clear Lake Reservoir provides a perceived "natural" setting characterized by extremely rugged terrain. Clear Lake Dam is located in a steep-sided, mountainous valley, with an outlet to the 5,300-acre lake. Clear Lake Reservoir is located above Rimrock Lake and has a similar visual setting. Development adjacent to the reservoir is generally limited to USFS roads, campgrounds, a day use area, and a boat launch. Because of the attractive combination of the forested valley and the lake, visual quality is generally high.

3.11.3 Visual Setting: Yakima and Naches River Tributaries

The landscape in which structural and operational changes (canal modifications), surface water storage (Wymer Dam and Pump Station), habitat/watershed protection and enhancements, and targeted watershed protections and enhancements would take place is both the mainstem and tributaries of the Yakima River and the Naches River. This is a large area with varied landscapes, but is most commonly characterized by irrigated agricultural lands and other large-lot rural development. Agricultural lands are a mix of orchards, vineyards, and row/field crops. Agricultural infrastructure (canals and appurtenant facilities) is strongly in evidence. Structures are generally residential and farm-oriented.

Typical foreground and middleground views are of valley agricultural lands, rangeland, and rolling hills of sagebrush. Background views are of mountains and sky. The visual character and quality are also defined by dispersed residential areas, existing transmission and generation facilities, and the way topography and vegetation relate to the sky and the changing patterns of light throughout the day and year. All of these factors contribute to the area's visual interest and perceived visual quality. Viewers would typically be residents of the low-density, scattered valley homes, dispersed recreationists, and motorists on highways and on rural roads in the area.

The landscape in which the Wymer Dam would be established is primarily the Yakima River canyon, along SR–821, north of Selah and south of Ellensburg. It is only within the Yakima River canyon where facilities associated with this alternative would be visible to the public. While the dam and reservoir would be located in the Lmuma Creek basin (tributary to the Yakima River canyon to the east), that entire basin is privately owned with no public access, no existing residents, and very limited public viewpoints from surrounding areas (Reclamation, 2008g).

The Yakima River canyon is generally narrow and meandering, with the Yakima River dominating the canyon bottom and steep to gently rolling basalt hills rising high on both sides. Much of the canyon is undeveloped, presenting a natural desert canyon landscape with riparian vegetation along the river and low-growing scrubland/grassland on the hillsides. Evidence of human development is present, including SR-182, the railroad, Roza Diversion Dam and associated infrastructure, instances of irrigated agriculture (with associated residences and other buildings), large-lot residential area north of the proposed Wymer Dam, and canyon-oriented recreational sites and businesses (for example, a river rafting company) where the canyon widens. SR–821 through the canyon is designated a National Scenic Byway and a State Scenic and Recreational Highway (Reclamation, 2008g).

Public viewpoints in the canyon are from the highway and the river (i.e., rafters, anglers, and kayakers) (Reclamation, 2008g).

3.11.4 Visual Setting: Rural/Agricultural Kittitas, Benton, and Yakima Counties

The setting of the proposed outlet and distribution facilities/systems under the Structural and Operational Changes Element and agricultural conservation projects under the Enhanced Water Conservation Element is characterized largely by irrigated agriculture and other large-lot rural residential development. Local agriculture includes a mixture of orchards, vineyards, and row/field crops. Agricultural infrastructure (canals and appurtenant facilities) is strongly in evidence. Structures are generally residential and farm-oriented.

Public viewpoints from which the locations of facilities would be visible are generally along local roads, residences, and farms. Relevant views in this setting generally are dominated by surrounding agriculture, often with open hillsides as a backdrop.

3.11.5 Visual Setting: Urban/Suburban Yakima

The visual setting of the municipal (Yakima) aquifer storage and recovery system, part of the Groundwater Storage Element, is typical of moderate- sized cities. The “cityscapes” where a water treatment facility, wells, and a pump station could be located include residential developments of varying densities, commercial sites and complexes, limited industrial development, and associated infrastructure (e.g., road systems, utility lines). Where the facilities would be sited in this setting, public views of the facilities would likely be short-range from adjacent roadways, residences, and businesses.

3.12 Air Quality

This section describes the area studied for the air quality analysis as well as the regulatory and environmental setting. The regulatory setting is described in terms of Federal, State, and local requirements. The environmental setting is described in terms of air pollutant sources and existing concentrations. Air quality changes over time as economic development occurs and regulatory programs affect the emissions from sources. The following discussion provides a general picture of air quality in the Yakima River basin which includes all or parts of Kittitas, Yakima, Klickitat, and Benton Counties where the proposed projects would be located.

3.12.1 Regulatory Setting

The Federal Clean Air Act has set National Ambient Air Quality Standards (NAAQS) that define levels of air quality necessary to protect the public health (primary standards) and the public welfare (secondary standards). The Clean Air Act requires States to classify air basins as either attainment or nonattainment with respect to these air pollutants. Counties or regions designated as nonattainment areas for one or more pollutants must prepare a State Implementation Plan (SIP) 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, or permits or approves any activity to demonstrate that the action conforms to the applicable SIP required under Section 110(a).

According to EPA guidance, before any approval is given for a proposed action, the regulating Federal agency must determine the regional significance of the action and its general conformity on a pollutant-by-pollutant basis. If the emissions are determined to be *de minimis* (minimal), no further analysis is required. However, if the conformity regulations apply, then an evaluation must be conducted.

Ecology has identified State ambient air quality standards (SAAQS) for total suspended particulates, lead, particulate matter, sulfur dioxide, carbon monoxide, ozone, and nitrogen dioxide.

Historically, the City of Yakima has experienced exceedances of the NAAQS for particulate matter and carbon monoxide. Through actions taken in the SIP, ambient air concentrations of these pollutants were brought into line with the NAAQS.

Today, portions of the City of Yakima are designated as maintenance areas for particulate matter and carbon monoxide. All other areas within the Yakima basin study area are currently in attainment for regulated pollutants.

The EPA has designated some areas of Washington as Class 1 Federal wilderness areas where visibility is an important factor (40 CFR 81.410, 81.425, and 81.434). SIPs must also address visibility within federally designated Class I areas, where good air quality is deemed to be of national importance (Section 162 Clean Air Act, August, 1977, defines Class I areas).

The Alpine Lakes Wilderness Area, at the headwaters of the Cle Elum River, and the Goat Rocks Wilderness, just east of Clear Lake, are both listed as Class I areas (WAC 173-400-030). WAC 173-400-117 sets forth requirements for projects in Class I areas. The WAC regulations apply to a permitting action where a project requires a permit application for a new major stationary source or a major modification; or the submittal of a notice of construction application for a major stationary source or a major modification to a stationary source in a nonattainment area, as defined in WAC 173-400-720.

Projects that require earthwork or otherwise have the potential to create fugitive or windborne dust are required to use best management practices (BMPs) to control dust at the project site. According to WAC 173-400-030, fugitive air emissions are emissions that “do not and which could not reasonably pass through a stack, chimney, vent, or other functionally equivalent opening.” These emissions include fugitive dust from unpaved roads, construction sites, and tilled land. Fugitive emissions are considered in determining the level of air permitting required only for a certain subset of sources, not including this type of proposed project. However, pursuant to WAC 173-400-040(8)(a): “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.”

Several subsections of WAC 173-400-040, *General Standards for Maximum Emissions*, would apply to construction activities. These include subsections (1) Visible emissions, (2) Fallout, (3) Fugitive emissions, (5) Emissions detrimental to persons or property, and (8) Fugitive dust sources.

3.12.2 Current Air Quality Environment

Various agencies including Ecology, the Yakima Regional Clean Air Agency, the Benton County Air Authority, and the Yakama Nation collect ambient air quality data in the project area.

Air quality in the Yakima basin is well within most of the standards for pollutants. Sources of regulated air pollutants in the Yakima basin include transportation sources (such as cars, buses, trucks, trains, boats, and aircraft), urban sources (including wood smoke, emissions from commercial operations, and gas-powered residential equipment), reintrained dust (naturally occurring particulate matter that is resuspended into the atmosphere through natural processes such as wind including from drawdown activities at regional reservoirs), agricultural practices (including field burning, reintrainment of dust from practices such as plowing, and emissions from farm equipment), and wildfires. These types of sources occur, to varying degrees, throughout the study area. Historical exceedances have occurred due to windblown dust from area agricultural fields (BCAA, 1996) followed by windblown dust from open lands, outdoor and agricultural burning, woodburning stoves and fireplaces, wildfires, industrial sources, and motor vehicles (BCAA, 2003).

3.13 Climate Change

Climate change has the potential to affect water resources in the Yakima River basin. The Integrated Plan has the potential to alter how water resources are affected by climate change.

For this analysis, the project team used data from hydrologic modeling studies conducted during the development of the Integrated Plan. These studies are documented in the *Modeling of Reliability and Flows Technical Memorandum* and the Secure Water Act Addendum to the Integrated Plan (Reclamation and Ecology, 2011k; Reclamation and Ecology, 2011a). Original data used were developed and documented in *Climate and Hydrology Datasets for Use in the RMJOC Agencies' Longer-Term Planning Studies Parts I, II, and III* (RMJOC, 2010; Reclamation, 2011a), or in *The Washington Climate Change Impacts Assessment* by the Climate Impacts Group at the University of Washington (CIG, 2009).

3.13.1 Regulatory Setting

In March 2009, Congress passed the Secure Water Act (Public Law 111-11, Subtitle F). Congress found that adequate and safe water supplies are fundamental to the health, economy, security and ecology of the United States. Additionally, global climate change poses a significant challenge to the protection and use of water resources in the United States due to an increased uncertainty with respect to the timing, form, and geographical distribution of precipitation, which may have a substantial effect on the supplies of water for agriculture, hydroelectric power, industrial, domestic uses, and environmental needs.

Federal agencies conducting water management and related activities are directed to take a lead role in assessing the risks to water resources of the United States, including the risks posed by global climate change, and to develop strategies to mitigate the potential impacts of these risks.

The Yakima River basin is part of the Columbia River system, which is subject to Public Law 111-11(12)(A) Section 9503, Reclamation Climate Change and Water Program. Section 9503 requires the Secretary of the Interior to establish a climate change adaptation program to assess the effect of and risk resulting from global climate change with respect to water resources. Reclamation has documented how the Integrated Plan complies with Section 9503; this evaluation can be viewed at http://www.usbr.gov/pn/programs/yrbwep/2011integratedplan/plan/addenvol1.pdf.

3.13.2 Global Climate Change

Global climate change has the potential to impact water resources in the Yakima River basin. Potential impacts relate to changes in future temperatures and precipitation patterns, and the resulting implications for stream runoff rate and timing, water temperatures, and reservoir operations.

3.13.3 Climate Change Effects in Yakima River Basin

3.13.3.1 Risks to Water Supply

The Yakima River basin is dominated by a mix of direct runoff from fall rain and spring snowmelt. Simulations predict that this type of watershed will be most affected by climate change (Mantua et al., 2010). Recent climate change studies to assess the risks to water supply in the Yakima River basin include those conducted by the Climate Impacts Group (CIG) at the University of Washington, working with the U.S. Fish and Wildlife Service and other Federal agencies. The study results were included in Addendum A to the *Yakima River Basin Study, Proposed Integrated Water Resource Management Plan*, which addresses requirements of Public Law 111-11, Subtitle F – Secure Water Act, http://www.usbr.gov/pn/programs/yrbwep/2011integratedplan/plan/addenvol1.pdf

For development of the Integrated Plan, climate change effects were modeled using the Yakima Project RiverWare (Yak-RW) model. Four scenarios were used to analyze climate change effects. The first scenario, called “No Regulation No Irrigation” (NRNI), represents current or historical hydrologic conditions. The other three scenarios are derived from climate-specific hydrologic modeling conducted by the University of Washington’s CIG. The three selected climate-impacted scenarios use a range of assumptions about future greenhouse gas emissions and a range of different global climate models (RMJOC, 2010). The selected scenarios represent “less adverse,” "moderately adverse," and "more adverse" climate change conditions that may occur during the 2040s (Reclamation and Ecology, 2011k). Table 3-17 summarizes the climate change scenarios.

Table 3-17 Summary of Climate Change Scenarios

Scenario	Climate Model Used	Descriptive Label	Average Temperature Change	Average Precipitation Change	Average Annual Reservoir Inflow (1.000 Acre-Feet)
NRNI (Existing or Historical)	Historically Based	Historic	0	0	1,660
Less Adverse	CGCM3.1	2040s Less Warming/ Wetter	1.8 ºC average increase	13.4% increase	1,860
Moderately Adverse	HADCM	2040s Central Change	1.7 ºC average increase	3.7% increase	1,480
More Adverse	HADGEM1	2040s More Warming, Drier	2.8 ºC average increase	2.5% decrease	1,380

Source: Reclamation and Ecology 2011k (page 42).

The following sections present changes to water supply under different climate change scenarios as related to the Yakima River basin.

Changes in Snowpack

Increased air temperatures from climate change would cause more precipitation to fall as rain rather than snow in the Cascade Mountains. This would reduce snowpack in the headwaters of the Yakima River system. Also, higher air temperatures would cause snowpack to melt earlier than under current conditions (Reclamation and Ecology, 2011a).

Studies have shown that the Yakima River basin is likely to have a 12 percent decrease in snowmelt volume given a 1^{o} C rise in air temperature, and a 27 percent decrease in snowmelt volume given a 2^{o} C rise (Vano et al., 2010).

Snowpack is considered the "sixth reservoir" in the Yakima River basin because most demands in the spring and early summer are met from runoff that comes from melting snowpack. Only 30 percent of the average annual total natural runoff can be stored in the current Yakima River basin reservoir storage system (Reclamation and Ecology, 2011q). Because of this, the water supply of the Yakima River basin is susceptible to changes in snowpack due to climate change.

Changes in Quantity and Timing of Runoff

To analyze changes in runoff due to climate change, total inflow into the five major reservoirs (Keechelus, Kachess, Cle Elum, Bumping Lake, and Rimrock) for the climate change scenarios discussed above in Section 3.13.3.1 were compared. Figures 3-6, 3-7, and 3-8 compare the modeling results of runoff into the five major reservoirs of the

NRNI scenario (historically-based) and the Less Adverse (CGCM3.1 model), Moderately Adverse (HADCM model), and More Adverse scenarios (HADGEM1 model), respectively.

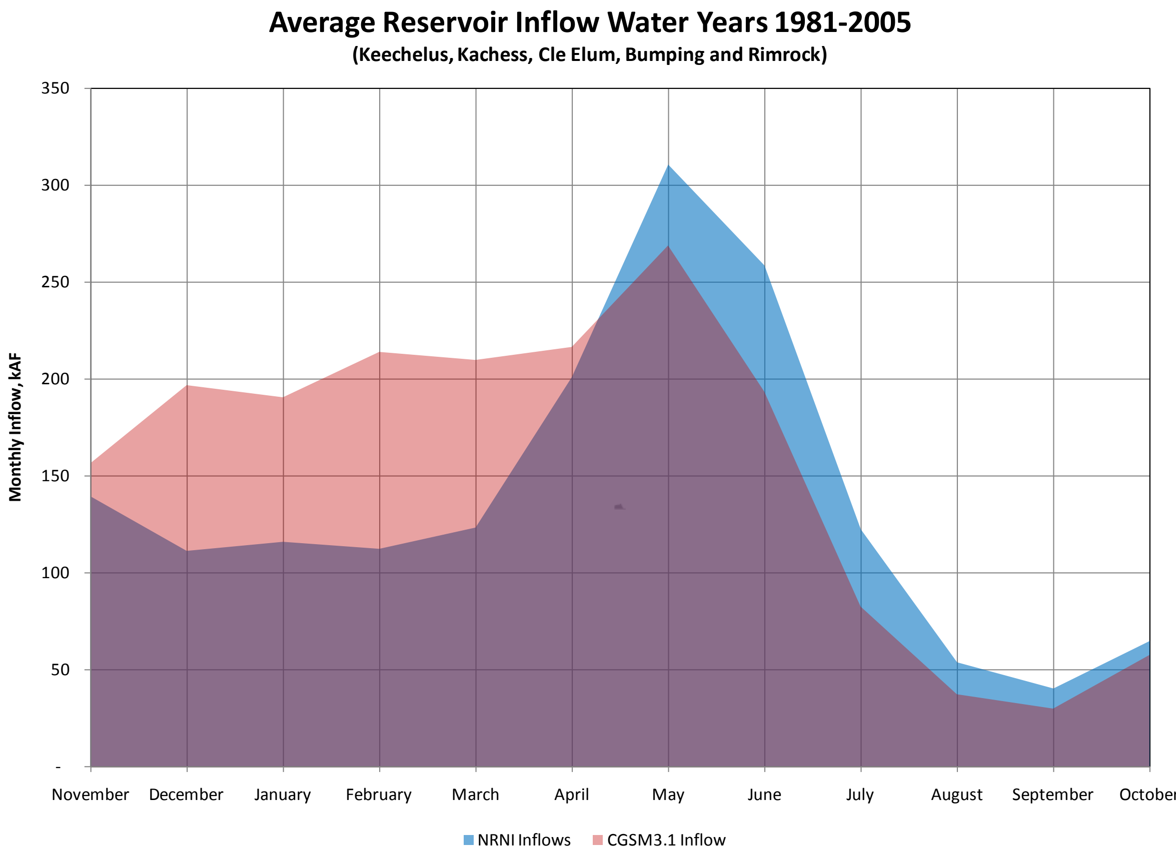


Figure 3-6 Comparison of Average Monthly Reservoir Inflows between Historically Based (NRNI) and Less Adverse scenario (Source: Reclamation and Ecology 2011k)

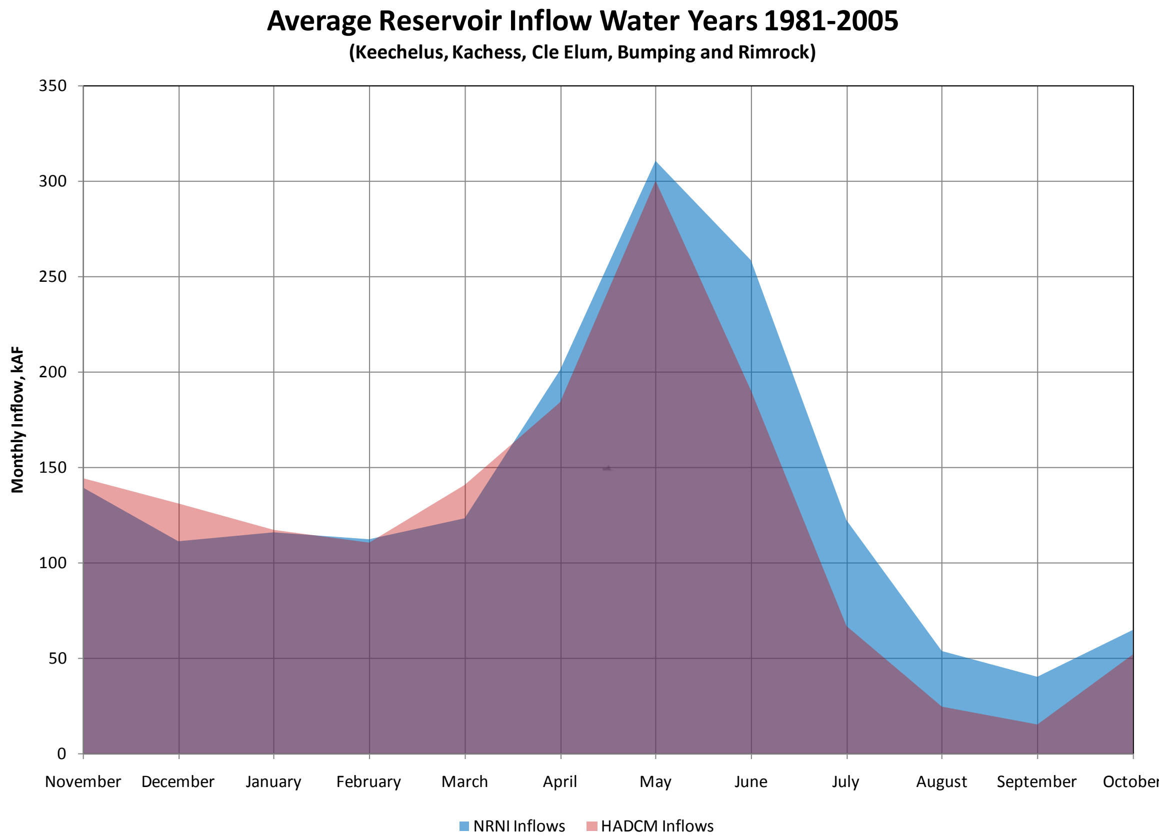


Figure 3-7 Comparison of Average Monthly Reservoir Inflows between Historically Based (NRNI) and Moderately Adverse scenario (Source: Reclamation and Ecology 2011k)

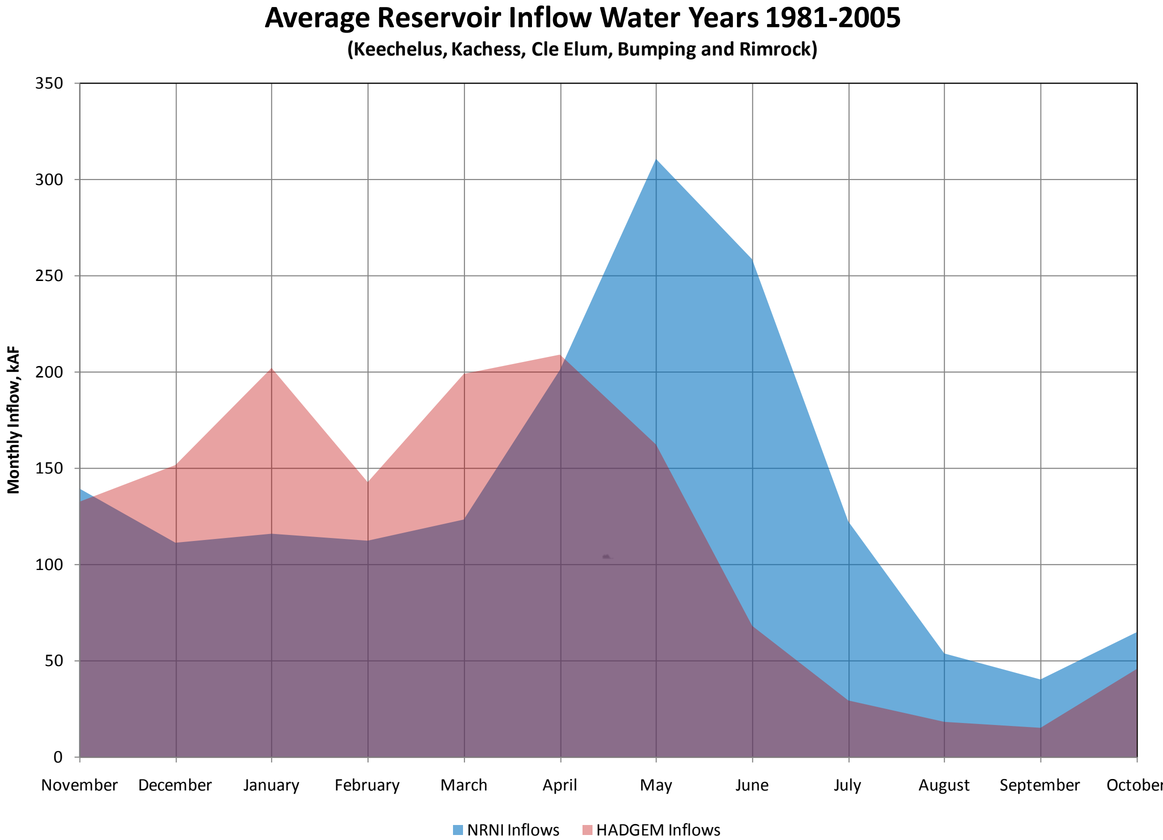


Figure 3-8 Comparison of Average Monthly Reservoir Inflows between Historically Based (NRNI) and More Adverse scenario (Source: Reclamation and Ecology 2011k)

Table 3-18 compares the climate change scenarios for seasonal inflow into the five major reservoirs from the model results.

Table 3-18 Comparison of Average Seasonal Inflows into Keechelus, Kachess, Cle Elum, Bumping, and Rimrock Reservoirs for the Climate Change Scenarios (Results in Thousands of Acre-Feet)

Scenario	Fall (October-December)	Winter (January-March)	Spring (April-June)	Summer (July-September)	Total
NRNI (Existing or Historical)	316	353	771	217	1,657
Less Adverse	412 (+30.4%)	615 (+74.2%)	679 (-11.9%)	151 (-30.4%)	1,856 (+12.0%)
Moderately Adverse	328 (+3.8%)	369 (+4.5%)	675 (-12.5%)	108 (-50.2%)	1,480 (-10.7%)
More Adverse	330 (+4.4%)	544 (+54.1%)	440 (-42.9%)	64 (-70.5%)	1,378 (-16.8%)

Based on the model results, changes in runoff in the Yakima River basin due to climate change are expected to be significant. For the three climate change scenarios modeled as part of the Yakima River Basin Study, the average annual change in reservoir inflow ranges from a decrease of 17 percent to an increase of 12 percent compared to the existing or historically based scenario. For all three climate change scenarios, spring and summer runoff is expected to decrease (ranging from 12 to 71 percent of existing runoff) and fall and winter runoff is expected to increase (ranging from 4 to 74 percent of existing runoff).

The shifts in runoff quantity and timing shown in the model results would cause significant risks to water supply. Fall and winter inflow will increase, but the reservoir system may not have sufficient capacity to be able to capture and hold enough winter and spring flow for release to meet needs during the high-demand and lower inflow period of the summer. Additionally, a decrease in spring and summer flow will cause water stored in reservoirs to be depleted at a faster rate to meet demand. The combined effects will likely cause a decrease in overall supply during the high-demand period.

3.13.4 Changes in Groundwater Recharge and Discharge

Changes in groundwater due to climate change have not specifically been studied in the Yakima River basin. However, the surface and groundwater systems of the basin are interconnected (Reclamation and Ecology, 2011a). Therefore, effects on surface water (such as runoff) due to climate change would also have an effect on groundwater. As such, risks in the water supply relating to changes in groundwater discharge and recharge are similar to those described above in Section 3.13.3.1, Changes in Timing and Quantity of Runoff.

Groundwater aquifers would likely be affected by a reduction in groundwater recharge through surface soils because of an increase in evapotranspiration (ET) from a warmer climate. Evapotranspiration is the combination of water that evaporates from the earth's surface and water released to the atmosphere by plants. As ET increases, more water is consumed by plants, and less precipitation and possibly less irrigation water may infiltrate to groundwater aquifers. In addition, riparian areas would consume more water due to increased ET, reducing groundwater outflows to surface water and surface water inflows to groundwater. Some of the increased ET may be offset by increased precipitation, although the timing of the precipitation will be an important factor.

The reduction in runoff quantity and change in timing described in previous sections would also impact groundwater recharge generated by application of surface water to farmland. As less water is available for irrigated agriculture, less recharge of aquifers would result, reducing groundwater discharge to surface water bodies such as the Yakima River. A smaller surface water supply reduces the amount of return flow available for water supply.

3.13.5 Changes in Related Resources

Climate change may also affect water-related resources in the Yakima River basin, including flood control, hydropower, fish and wildlife, and surface water quality.

With or without offsetting precipitation increases, studies indicate that winter runoff increases under regional warming could motivate adjustments to Yakima River flood control strategies.

Climate change may also affect existing and proposed hydroelectric power generation facilities in the Yakima River basin by altering the volume or timing of flow available for generating energy. Reductions in spring and summer flow caused by climate change could affect hydropower generation by reducing the flow available to be diverted through the existing facilities below historical levels. Increases in flow caused by climate change could affect hydropower generation by increasing the flow available to be diverted, but if the historical flow is already above the plant capacity, climate-caused increases in flow would not be usable to increase generation.

The availability of water-related recreation in the Yakima River basin could be affected by a number of climate change-related factors, including changes in snowpack and changes in the timing and quantity of streamflow. Climate change is expected to result in a decline in the quantity and quality of freshwater habitat for salmonid populations across Washington State (Mantua et al, 2010). Studies have predicted increasing water temperatures and thermal stress for salmonids in eastern Washington that are minimal for the 2020s but increase considerably later in the century (Mantua et al, 2010).

Based on projections for the 2040s, climate change may significantly alter the temperature, amount and timing of runoff and fish habitat in the Yakima River basin. Average annual air temperature is expected to increase, with accompanying increased water temperatures, according to the Climate Impact Group (CIG), and more precipitation is expected to fall as rain rather than snow. These temperature changes could affect fish in the Yakima River basin, including two federally listed threatened fish species, Middle Columbia River steelhead and Columbia River bull trout.

Climate change would have a direct impact on water temperature and probably dissolved oxygen. In general, an increase in air temperature due to climate change will cause water temperatures to increase. In the upper Yakima River, climate change models predict that the number of weeks when average water temperatures exceed 21^{o}C may rise from less than 5 weeks in historic conditions to over 10 weeks in the 2040s (Mantua et al, 2009). Warmer water can hold less dissolved oxygen than cooler water, so dissolved oxygen will decrease as air and water temperatures increase due to climate change (Karl et al, 2009).

3.14 Noise

Noise is generally defined as unwanted sound. Noise is measured in terms of the sound pressure level expressed in decibels (dB). The number of fluctuation cycles or pressure waves per second of a particular sound is the frequency of the sound. The human ear is less sensitive to higher and lower frequencies than to mid-range frequencies. Therefore, sound level meters used to measure environmental noise generally incorporate a filtering system that discriminates against higher and lower frequencies in a manner similar to the human ear to produce noise measurements that approximate the normal human perception of noise. Measurements made using this filtering system are termed "A-weighted decibels," abbreviated as dBA. Noise levels referred to in this EIS are stated as hourly-equivalent sound pressure levels (L_{eq}) in terms of dBA.

Noise levels decrease with distance from a noise source. The L_{eq} noise level from a line source, such as a road, will decrease by 3 to 4.5 dBA for every doubling of distance between the source and the receiver. The L_{eq} noise level from a point source, such as a generator, will decrease by approximately 6 dBA for every doubling of distance between the source and the receiver. Subjectively, a 10 dBA change in noise levels is perceived by most people to be approximately a twofold change in loudness (e.g., an increase from 50 dBA to 60 dBA causes the perceived loudness to double). Generally, 3 dBA is the minimum change in outdoor sound levels that can be perceived by a person with normal hearing.

General ambient environmental noise is often described using the day-night noise level (L_{dn}). The L_{dn} is a community noise metric which describes a receiver's cumulative noise exposure from all events over a full 24 hours, with events between 10 p.m. and 7 a.m. increased by 10 decibels to account for people’s greater nighttime sensitivity to noise.

Sound levels produced by common noise sources and expected in common types of environments are shown in Table 3-19. The affected environment is characterized in these general terms, because of the broad range of environments and geography involved in the Integrated Plan.

Table 3-19 Sound Levels of Common Sources and Noise Environments

Noise Sources (Distance from the Receiver)	Sound Level (dBA)	Subjective Evaluations	Possible Effects on Humans
Human threshold of pain Carrier jet takeoff (50 feet)	140	Deafening	Continuous exposure can cause hearing damage
Siren (100 feet) Jackhammer, power drill	130		
Loud rock band Auto horn (3 feet)	120		
Busy video arcade Baby crying	110		
Lawn mower (3 feet) Noisy motorcycle (50 feet)	100	Very Loud	
Heavy truck at 40 mph (50 feet) Shouted conversation	90		
Kitchen garbage disposal (3 feet) Busy urban street, daytime	80	Loud	
Normal automobile at 65 mph (25 feet) Vacuum cleaner (3 feet)	70		Speech interference
Large air conditioning unit (20 feet) Normal conversation (3 feet)	60	Moderate	
Suburban area (daytime) Light auto traffic (100 feet)	50		Sleep interference
Library Quiet home Suburban area (nighttime)	40	Faint	
Soft whisper (15 feet) Rural area (nighttime)	30		
Broadcasting studio	20	Very Faint	
Threshold of human hearing	0-10		

Source: U.S. EPA, 1971.

Note: Both subjective evaluations and physiological responses are continuous, without true threshold boundaries. Consequently, there are overlaps among categories of response that depend on the sensitivity of the noise receptors.

3.14.1 Regulatory Setting

3.14.1.1 Federal Noise Control Standards

The Federal Noise Control Act of 1972 established a requirement that all Federal agencies administer their programs to promote an environment free of noise that would jeopardize public health or welfare.

3.14.1.2 State and Local Noise Control Standards

The Washington Administrative Code (WAC) imposes limits on the allowable environmental noise levels from a variety of sources in any 1-hour period (WAC 173-60, *Maximum Environmental Noise Levels*). The maximum allowable levels depend on the classification of the property receiving the noise and the noise source. The classification system is called the Environmental Designation for Noise Abatement (EDNA) and is generally based on a property's use.

The WAC 173-60-040 establishes maximum permissible environmental noise levels. There are three EDNA designations (WAC 173-60-030), which generally correspond to residential, commercial/recreational, and industrial/agricultural uses:

- 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); and
- Class C: Lands where economic activities are of such a nature that higher noise levels are anticipated (such as industrial/agricultural).

Table 3-20 summarizes the maximum permissible levels applicable to noise received at the three EDNAs.

Table 3-20 Maximum Allowable Noise Levels

Environmental Designation for Noise Abatement of Noise Source	Environmental Designation of Noise Abatement of Receiving Property		
	Class A (dBA)	Class B (dBA)	Class C (dBA)
Class A (residential/recreational)	55	57	60
Class B (commercial)	57	60	65
Class C (industrial)	60	65	70

WAC 173-60-050 identifies noise sources or activities that are exempt from the noise limits described in the above table:

- Sounds created by traffic on public roads;
- Sounds created by warning devices (i.e., back-up alarms); and

- Sounds from blasting and from construction equipment are exempt from the standards during the day (7:00 a.m. to 10:00 p.m. weekdays and from 9:00 a.m. to 10:00 p.m. on weekends) in rural and residential districts.

For the purpose of this evaluation, construction activities associated with the project elements would be considered either maintenance of an essential utility service or a temporary construction activity. Thus, noise would be exempt from regulation between 7 a.m. and 10 p.m. per WAC 173-60-050(1)(e) and (3)(a).

There are no local county noise ordinances in Kittitas, Yakima, or Benton County that would be applicable.

3.14.2 Current Noise Environment

The study area for noise is defined as the immediate vicinity of the proposed project-related activity within the Yakima River basin. The study area is primarily rural and includes project construction areas as well as nearby agricultural, commercial, industrial, recreational, and residential areas. Existing noise sources are likely to include isolated industrial facilities, train and boat operation, small airports, highways, and agricultural activities.

3.15 Recreation

Washington provides a variety of recreation settings from designated wilderness areas to urban greenways. Within the Yakima River basin, recreation opportunities are found in both developed and rural natural settings. The recreational areas most likely to be affected by the projects analyzed in this document are those associated with the reservoirs and the mainstem and tributaries of the Yakima River, and land acquisitions under the targeted watershed protection and enhancement program. The five primary rivers within the basin that supply recreation opportunities are the Yakima, Naches, Tieton, Cle Elum, and Bumping Rivers. The many tributaries of these rivers also provide additional areas for outdoor recreation. Lands affected by the Integrated Plan include lands in the Teanaway, Manastash and Taneum Creek basins and the Little Naches River basin. Rivers affected by the proposed Wild and Scenic River designations include the American, upper Cle Elum, Waptus, and Teanaway Rivers.

Recreationists are attracted to the basin by the quality of the scenery and water, and by the variety of recreation opportunities. Primary recreation activities include fishing the reservoirs and rivers for cold-water species; whitewater boating and kayaking; motorized boating; and other related activities such as camping, hiking, picnicking, and wildlife viewing. Public demand for access to rivers, streams, and reservoirs continues to increase yearly.

3.15.1 Recreational Setting

The Yakima River has a national reputation for its high-quality fly fishing, one of the fastest growing activities on the river. The Yakima River is also considered a “blue ribbon" trout stream (Yakima Valley Visitors and Convention Bureau, 2011). The prime periods for fishing the river are February through May and September and October, although fishing occurs on the river throughout the year. There are camp sites along the Yakima River mainstem near the Keechelus, Kachess, and Cle Elum Reservoirs, in the Yakima River canyon between the City of Ellensburg and Roza Dam, and in the City of Yakima. All of these sections of the Yakima River are also popular for swimming during summer months, and rafting is popular in the Yakima River canyon.

Cle Elum, Kachess, and Keechelus Reservoirs are located in the Okanogan-Wenatchee National Forest. Cabins, camping, swimming, boating, picnicking, and fishing for some species, primarily for trout and freshwater ling, are available at all three reservoirs, with Kachess having the highest amount of recreational visitation.

Primary recreation activities in the Cle Elum River area include fishing the reservoir and rivers for cold-water species; boating and kayaking; whitewater rafting; motorized boating; and other related activities such as camping, swimming, hiking, hunting, horseback riding, picnicking, and wildlife viewing. In the winter, recreation activities include cross-country skiing, snowshoeing, and snowmobiling. Recreation opportunities are largely found along the eastern shore of Cle Elum Reservoir, and both downstream and upstream of the reservoir along the Cle Elum River and its tributaries. The Cle Elum River does not provide the quality of fishing found in the Yakima River because of more limited access, swift water, and the amount of woody debris. The Cle Elum River has regionally acclaimed whitewater rafting (American Whitewater, 2009).

The Naches River provides high-quality trout fishing opportunities. In particular, the upper Naches River, above the confluence with the Tieton River, provides good fishing opportunities for wild westslope cutthroat, rainbow trout, and mountain whitefish (Jeff Tayer, personal communication, 2009). Although drift-boat access is limited, there is public access to substantial sections of the Naches River for wading and bank fishing from the SR-410 right-of-way, as well as for inflatable watercraft.

Bumping Lake, Rimrock, and Clear Lake Reservoirs are in the Okanogan-Wenatchee National Forest. The rugged mountain terrain, surrounded by coniferous forests, creates magnificent scenic settings. Bumping Lake has high recreational use and includes developed facilities for camping, boating and fishing, as well as having privately-owned cabins. Much of the shoreland at Clear Lake is reserved for group camp use. Clear Lake Reservoir is primarily used for recreational boating.

The Tieton River below Tieton Dam does not provide high-quality fishing opportunities, mainly due to poor quality habitat and low channel complexity. This river has been highly altered and regulated so that it is no longer able to support a quality wild trout fishery (Jeff Tayer, personal communication, 2009).

The Tieton River has regionally acclaimed whitewater rafting during a three-week period in September when water from Rimrock Lake is released to enhance available irrigation in the Yakima valley. The rapids during that time are rated as Class III (Osprey Rafting

Company, Inc., 2008). There is very little rafting on the Naches River, because of limited access due to private ownership of adjacent lands.

Rimrock Reservoir is used intensively by fishermen and other recreationists. There are private cabins and several campgrounds in the area. Good fishing is available in the reservoir for rainbow and other trout, and in the stream below the dam for rainbow trout and whitefish.

The larger Yakima River basin as a whole also has a Pacific Northwest regional reputation for motorized recreation opportunities associated with trail bikes, all-terrain vehicles (ATVs), and snowmobiles, primarily on U.S. Forest Service lands. In particular, the areas around the I-90 reservoirs and Rimrock Lake are popular recreation sites with trails for motorized vehicles.

3.15.2 Recreation Visitation

Table 3-21 presents the estimated annual visitation to the key reservoirs and rivers in the Yakima River basin (Reclamation, 2008g).

Table 3-21 Estimated Annual Visitation to Key Reservoirs and Rivers in the Yakima River Basin (2006)

Reservoir	Number of annual visitors
Keechelus Lake	660
Kachess Lake	17,292
Cle Elum Lake	6,996
Rimrock Lake	10,824
Clear Lake	4,620
Bumping Lake	7,524
Lake Easton	19,260
River	**Number of annual visitors**
Yakima River	18,000
Tieton River	8,844
Naches River	3,696
Bumping River	5,016
Cle Elum River	5,280

3.16 Land and Shoreline Use

This section addresses land use and shoreline resources within the study area and describes current land uses, land ownership/land status, and governing policies for the Yakima River basin.

3.16.1 Federal, Tribal, State and Local Land Use Regulations and Policies

Federal, Tribal, State, and local land use regulations and policies apply to implementation of the Integrated Plan. At the Federal level, the Wilderness Act, the National Forest Management Act and others are relevant to land use practices in the basin. At the Tribal level, land use is governed by Tribal laws and policies. At the State level, these include the State Shoreline Management Act and the Forest Practices Act. Local land use regulations include zoning, comprehensive land use planning, and sensitive areas ordinances. These are described briefly below.

3.16.1.1 Regulation of Federal Lands

The Federal Government controls and manages a substantial portion of the land in the project area, including forests, rangeland, a national park, the Army's Yakima Training Center, and other lands. Federal activities on these lands are not subject to the local regulations or State regulations, but Federal policies generally direct that activities of the Federal Government should be consistent with local regulations to the extent feasible within the mission of each agency.

Wilderness Act, 1964

The Wilderness Act (16 U.S.C. §§ 1131-1136) established the National Wilderness Preservation System. The purpose of the act is "to assure that an increasing population, accompanied by expanding settlement and growing mechanization, does not occupy and modify all areas within the U.S. and its possessions, leaving no lands designated for preservation and protection in their natural condition."

The Wilderness Act works in conjunction with establishment and administration of national forests and units of national parks and national wildlife refuge systems. Each agency administering any wilderness area is responsible for preserving the area's wilderness character. Federally designated wilderness areas in the Yakima River basin include the Alpine Lakes Wilderness Area in the headwaters of the Cle Elum River, William O. Douglas Wilderness Area adjacent to Bumping Lake Reservoir, and Goat Rocks Wilderness Area adjacent to Clear Lake Reservoir. As part of the Integrated Plan, wilderness designations would be proposed for the land around Bumping Lake that would not be inundated by reservoir expansion, for the roadless areas in the Teanaway, in the area between Kachess and Cle Elum Reservoirs, and in the upper reaches of Manastash and Taneum Creeks.

Wild and Scenic Rivers Act, 1968

This Act (16 U.S.C. §§ 1271-1287) establishes a National Wild and Scenic Rivers System for the protection of rivers that have important scenic, recreational, fish and wildlife, and other resources. The system protects the designated river and an adjacent corridor of land. Rivers are classified as wild, scenic or recreational. The Act contains procedures and limitations for control of lands within the system that are administered by Federal agencies. The Federal agencies are required to assist other regional and local agencies, political subdivisions, landowners, private organizations, and individuals to plan, protect, and manage river resources.

No U.S. department or agency may assist by loan, grant, license or any other means in the construction of a water resources project that would have a direct and adverse effect on the values for which a river is designated as an actual or potential Wild and Scenic River. This does not preclude developments below or above an actual or potential wild, scenic or recreational river area, or on a stream tributary which will not invade the area or diminish the scenic, recreational and fish and wildlife values of the area. (§ 1278.; (http://wildlifelaw.unm.edu/fedbook/wildrive.html)

There are currently no designated Wild and Scenic Rivers in the Yakima River basin. However, the Integrated Plan recommends that the American, upper Cle Elum, and Waptus Rivers should be designated as Wild and Scenic Rivers under the Habitat/Watershed Protection and Enhancement Element.

National Forest Management Act, 1976

The National Forest Management Act requires every national forest or grassland managed by the U.S. Forest Service to develop and maintain a Land Management Plan (also known as a Forest Plan). The process for the development and revision of the plans, along with the required content of plans, is outlined in the planning regulations, or planning rule. Individual forests and grasslands then follow the direction of the planning rule to develop a Land Management Plan specific to their unit. The Forest Plan for the Wenatchee National Forest was adopted in 1990 and is currently being revised and updated as the Okanogan-Wenatchee Forest Plan.

3.16.1.2 Regulation of Tribal Lands

Substantial portions of the project area, over 1,500 square miles, are lands reserved under treaty with the Yakama Nation. These areas are not subject to any State regulations. Each Tribe or confederation of Tribes enacts its own laws to control land use and protect natural resources on lands within the reservation. Although the Integrated Plan would have very little effect on Tribal land, some programs would provide an overall benefit to the system, including resources on Tribal lands, such as improved water reliability. Water conservation funding would also be available to the Tribes.

3.16.1.3 Regulation of State Lands

Washington Shoreline Management Act, 1972

Many of the activities that would emerge from the Integrated Plan have the potential to impact shorelines that are governed under shoreline master programs developed under the authority of the State's Shoreline Management Act (SMA) (Chapter 90.58 RCW, WAC 173-18). Local shoreline master programs, which must be approved by Ecology, are intended to protect shoreline ecology, public access, and water-dependent uses and to require mitigation of impacts where appropriate.

The streams and lakes within the project area that are regulated by the SMA are listed in Appendix D.

3.16.1.4 Washington Forest Practices Act

Forest practices on all non-Federal and non-Tribal lands in Washington are regulated by means of the Forest Practices Act (Chapter 76.09 RCW). The Washington Forest Practices Board (the Board) governs the industry in order to protect the state's public resources while maintaining a viable timber industry. The rules adopted by the Board are implemented and enforced by the Washington Department of Natural Resources. These rules require the maintenance and restoration of aquatic and riparian habitat. Through the Forest Practices Habitat Conservation Plan, the State of Washington seeks to provide long-term conservation of covered species, support an economically viable timber industry, and create regulatory stability for landowners.

3.16.2 Current Land Use

Land use in the Yakima River basin is diverse, ranging from designated wilderness to intensive agriculture to areas of urban development. Private ownership totals 32 percent or over 1.2 million acres of the 4 million acres in the Yakima River basin (YBFWRB, 2005). However, the single largest landowner is the U.S Government with 1.5 million acres, or 38 percent, of the land area. Most of the Federal land is within the Okanogan-Wenatchee National Forest in the upper portion of the Yakima River basin, on the eastern slopes of the North Cascade Range. The national forest area is managed for multiple uses, including water, wildlife, recreation, and commercial timber production. Private forest lands are also common in these mountainous areas. In addition to the Cascade Range to the west and northwest, the basin is also flanked by the Stuart Range on the north and northeast.

Other large Federal land holdings include the U.S. Army Yakima Training Center (YTC), a portion of the Hanford Nuclear Reservation, and Bureau of Land Management (BLM) lands. Other public ownership (State, county, and local governments) totals over 400,000 acres.

The Yakama Nation Reservation covers 1,573 square miles (1,371,918 acres) in southern Yakima County and a smaller part of Klickitat County. The Yakama Nation and its members have over 880,000 acres held in trust; only a small portion is deeded land (YBFWRB, 2005).

Less than 60 square miles (1 percent) of the 6,150 square miles of the Yakima River basin has been converted to urban/suburban development. Significant urban areas include Cle Elum, Ellensburg, Selah, Yakima/Union Gap, Toppenish, Sunnyside, Grandview, and Prosser. These urbanized areas host much of the basin’s population, as well as its manufacturing, commercial, and service industry base.

Rangelands (2,900 square miles) are primarily used and managed for grazing, military training, wildlife habitat, and Tribal cultural activities. The 2,200 square miles of forested areas in the northern and western portions of the basin are primarily used and managed for timber harvest, water quality, fish and wildlife habitat, grazing, Tribal cultural activities, and recreation. About one-fourth of the forested area is designated as wilderness. The 1,000 square miles of irrigated agriculture includes pasture, orchards, grapes, hops, and field crops (see Figure 3-9). Diverse recreational activities, including hunting, fishing, and camping, occur across much of the project area (YBFWRB, 2005).

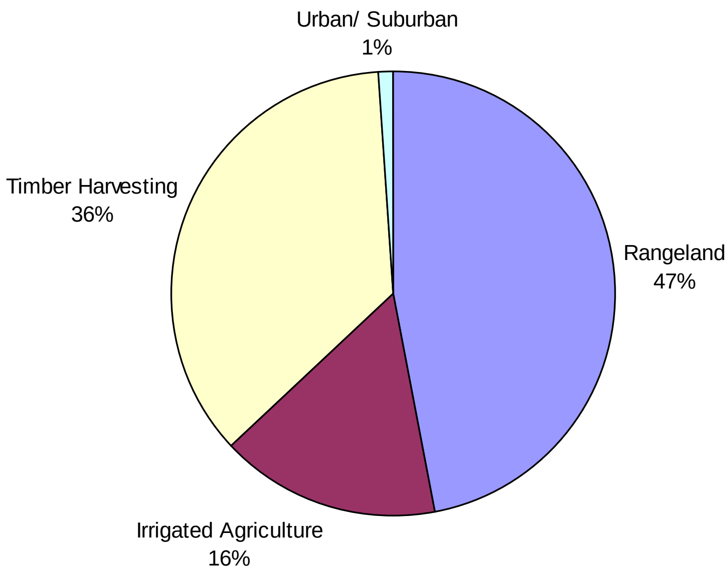


Figure 3-9 General land use types and percent distribution within the project area (YBFWRB, 2005).

3.17 Utilities

Public utilities in the Yakima River basin are provided by a combination of Tribal, county, city, special purpose districts, and private suppliers. Wastewater and solid waste utilities are provided by counties and cities. In some cases wastewater treatment is provided by private treatment facilities serving individual developments outside urban areas. In most rural areas, wastewater treatment is provided through individual private septic systems. Electricity is provided by the private utilities Puget Sound Energy and PacifiCorp, and public utility districts Kittitas County P.U.D. No. 1 and Benton Rural Electric Association. Section 3.6 describes hydropower facilities within the basin.

Potable water supply is provided by public and private water systems and individual wells. Within the basin, approximately 325,900 people are served by public water systems and domestic wells (Reclamation, 2011o). There are more than 20,000 wells in the basin, over 70 percent of which are shallow (10 to 250 feet deep) domestic wells (Vaccaro et al, 2009).

3.18 Transportation

This section addresses road/highway and railroad transportation facilities in and serving the areas where the Integrated Plan elements would be located. No air or navigable waterway transportation system or facilities would be involved or impacted by any of the alternatives. Information sources used to identify existing transportation facilities include mapping from the Washington State Department of Transportation (WSDOT) and county geographic information systems.

Major highways in the Yakima River basin include Interstates 90 and 82, Federal Highways 97 and 12, and State and local Highways 10, 821, 410, 24, 240, and 241 (Figure 3-10). In addition, local and Forest Service roads serve the rural areas of the basin.

The Burlington Northern Santa Fe (BNSF) Railroad runs through the basin. The rail route is generally parallel to Interstate 90 in the upper basin east of Easton, west of the Yakima River through the Yakima River canyon (parallel to SR-821), and parallel to Interstate 82 toward the Tri-Cities area.

The following projects of the Integrated Plan are likely to temporarily affect transportation facilities: new or expanded surface water storage at Wymer Reservoir, Kachess Reservoir, and Bumping Lake Reservoir; structural changes to existing facilities at Cle Elum Dam; construction of the Keechelus-to-Kachess pipeline; installation of fish passage facilities at all reservoirs; and floodplain restoration. The transportation facilities at these sites are described below.

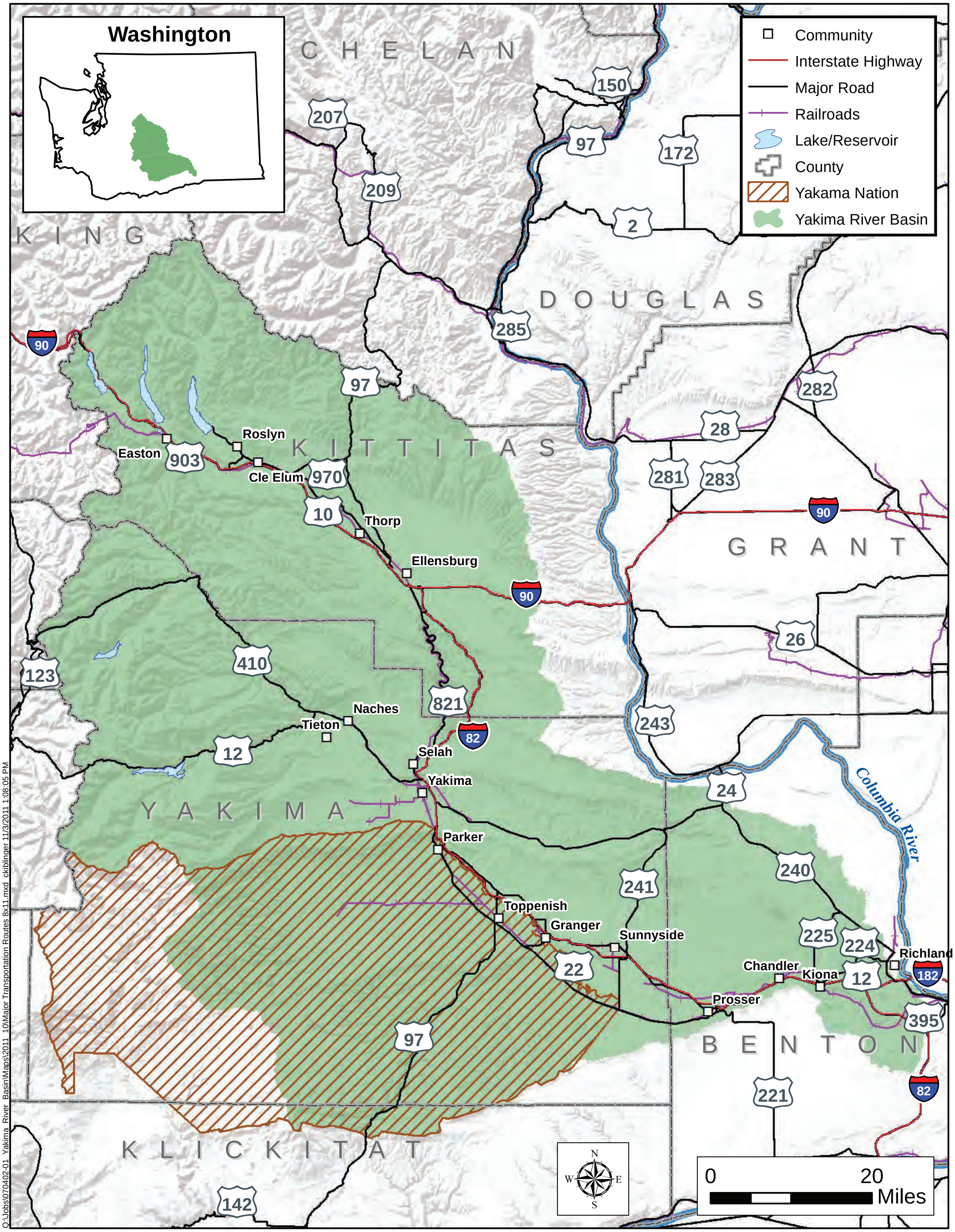


Figure 3-10. Major Transportation Routes

3.18.1 Reservoir Sites

Regional and local access to the proposed Wymer Reservoir site, as well as sites and alignments of associated facilities, would be exclusively via SR-821, a two-lane roadway in the Yakima River canyon in southern Kittitas County. The easternmost extent of the reservoir pool at high water would pass under I–82, but no access to project facilities is proposed from this location, either for construction or long-term operation. There are no public roads or rail facilities in the Lmuma Creek basin where the proposed Wymer Reservoir would be built. The only access present is an unpaved, private ranch road. The pumping plant would be built west of and adjacent to SR–821, and the pipeline to Wymer Reservoir would cross this road. SR-821 between Ellensburg and Yakima is designated by WSDOT as the Yakima River Canyon Scenic Byway, and is notable for views of geological features that define the region and access to the Yakima River for recreation.

Regional and local access to the Kachess Reservoir and associated facilities would be via I-90 and local roads. Under Option 1, the proposed gravity flow tunnel would roughly parallel 1-90 east of the Yakima River.

Regional and local access to the proposed Bumping Lake Reservoir expansion site and associated facilities would be via SR-410, a two-lane roadway extending northwest from Yakima in northwest Yakima County to Forest Road (FR) 1800. Forest Service roads serve the Bumping River basin where Bumping Lake would be expanded. There are no rail facilities where Bumping Lake would be expanded. The only access is a forest road that is closed in the winter. Several forest roads near Bumping Lake provide access to trailheads into the surrounding area, including the William O. Douglas Wilderness.

3.18.2 Cle Elum Dam

Regional and local access to Cle Elum Dam is via SR-903/Salmon La Sac Road, a two-lane roadway extending northwest from the town of Cle Elum to FR 4330. Access to Tucquala Lake is provided by FR 4330 (also known as Cle Elum Valley Road or Salmon La Sac Road). Access to the left abutment of the dam is provided by SR-903 and County Road 25010 (Cle Elum Lake Dam Road). Access to the right abutment of the dam is from Bull Frog Road, a Kittitas County road.

3.18.3 Keechelus-to-Kachess Pipeline

From Keechelus Lake Reservoir, the Keechelus-to-Kachess pipeline would cross I-90 just west of the interchange near I-90 Milepost 62. Reclamation intends to coordinate this project with construction of a new wildlife crossing of I-90 planned by WSDOT. The pipeline would continue east until it intersects Kachess Lake Road, following the road to the northeast until it diverges to continue down the lakeshore slope to Kachess Lake Reservoir.

3.18.4 Fish Passage Elements

Fish passage elements of the Integrated Plan involve “trap and haul” activities, where fish are transported on local roads around reservoir fish passage barriers. Fish “hauling” activities would vary by season, location, and timing of fish migration.

3.18.5 Floodplain Restoration

Throughout the basin, roads and bridges (interstate, State, county, city, and private) currently constrict floodplain functions. Floodplain restoration projects potentially implemented under the Integrated Plan could involve modifications to roads and bridges in some areas.

3.19 Cultural Resources

Human occupation in the project area dates to 11,500 years ago based upon the discovery of a Clovis-style projectile point along the pre-reservoir shoreline of Cle Elum Lake. These earliest peoples were likely pursuing large game animals such as mammoth. The human occupants during the subsequent Windust and Vantage Phases (11000 to 4500 BC) were nomads and occupied temporary camps. Windust Phase peoples relied on hunting mammals and birds, and the gathering of wild plants. The Vantage Phase showed an increased reliance on riverine resources such as fish. After 5200 BC, the pattern towards fish, smaller game and plant resources continued. Beginning about 3000 BC, people were starting to live in shallow pithouses and re-occupying locations for salmon harvesting while continuing to occupy fishing and hunting camps. After 1900 BC, populations in the area had increased and widespread use of pithouses indicates a heavy reliance on fishing. By at least 1000 AD, large winter villages consisting of semi-subterranean pithouses and larger longhouses had been established along the major rivers. People were heavily reliant on salmon runs. The architecture and layout of winter villages became even more permanent with the introduction of the horse in the early 1700s.

The federally recognized Yakama Nation consists of 14 Tribes and Bands that were combined socially and politically following the Walla Walla Treaty of June 9, 1855. The areas affected by the Integrated Plan are in the territory ceded in the 1855 Treaty. The Yakama Nation governing Tribal Council, located at the Yakama Nation Reservation headquarters at Toppenish, speaks for and manages the interests of the constituent 14 Tribes and Bands.

At least as early as 11,500 years ago, the ancestral inhabitants of today’s Yakama Nation, Confederated Tribes of the Colville Reservation, Confederated Tribes of the Umatilla Indian Reservation, and the Wanapum Band, developed a thriving economy based on the natural richness and bounty of the Columbia Plateau. Thousands of years prior to the arrival of European and Euro-American explorers, the Yakama and neighboring groups consisted of small, politically autonomous, yet closely related bands, which lived in permanent winter villages located on major watercourses. The villages were essentially autonomous, although each group as a whole shared a common culture, maintained intervillage kinship ties, shared subsistence resources, and were engaged in frequent social interactions.

Settlement centered on winter villages located in sheltered areas along the shores of rivers. The largest of these villages among the Kittitas and Yakama people could have as many as 500 residents housed in circular-shaped houses with conical roofs. About 2,000 people typically inhabited one village of the lower Yakima, known as *tsíkik* or 'spring.' From these villages, subsistence forays extended into the surrounding areas to fish, gather, and hunt. The foods processed from these subsistence activities were stored at the villages for the winter. In addition to residential structures, villages also contained menstrual huts, sweat huts, food caches, and burial grounds.

Today the Yakama people continue to have access to their "usual and accustomed places" within the Yakima River basin for a variety of traditional uses, including areas outside of the reservation boundaries. Additionally, within the boundaries of the reservation, the Yakama Nation and its Tribal Historic Preservation Office manage cultural resource concerns including traditional cultural properties, sacred sites, hunting and gathering locations, archaeological resources, historic resources, places related to legends, and ancestral sites.

By the early 19th century, Euro-American explorers and fur traders arrived, later followed by the military and missionaries. By the late 19th century, Euro-American towns were settled such as Yakima City in 1883. Agricultural development flourished following irrigation infrastructure projects; much of this infrastructure remains in use and is now historic in age. Today agriculture and ranching continue to be important industries in the area.

The State Historic Preservation Office is responsible for overseeing cultural resource compliance on non-reservation lands including Native American sites and historic properties related to Euro-American use of the landscape. These might include dams, logging or mining camps and associated infrastructure, railroads, agriculture, ranching, and recreational cabins. Other stakeholders include landowners such as the U.S. Forest Service, Reclamation, and State, county, and municipal agencies.

Information about the full range of cultural resources is not always accessible without detailed background research, which is outside the scope of the current programmatic level of evaluation. As a result, the discussion of cultural resources in this document is general in nature. Once more specific plans are developed, more intensive evaluation of cultural resources at project sites would be required.

The affected environment for the Integrated Plan elements would be the footprint of any ground disturbance, including construction access and staging areas, offsite mitigation areas, reservoirs, dams, canals, and other infrastructure. The affected environment could also include historic structures in the viewshed of the Integrated Plan elements. Additionally, the affected environment could include Traditional Cultural Properties (TCPs) near the Integrated Plan project sites, where projects affect the characteristics that provide the integrity of setting, feeling or association.

Some of the areas in the Integrated Plan, such as Cle Elum Dam, have been subject to previous cultural resource investigations, while others have not been extensively surveyed although cultural resources are likely present. In cases where recorded cultural resources are present in a project area, most of these have not yet been evaluated for eligibility to the National Register of Historic Places (NRHP). Sites that have not yet been evaluated are considered eligible to the NRHP. Prior to project implementation, all resources within a project's Area of Potential Effects (APE) must be evaluated for eligibility and, for any eligible sites, adverse effects would require mitigation.

The limited review of records and known historic resources for the Integrated Plan indicate that there is a high potential for historic resources (Reclamation, 2008g; Reclamation and Ecology, 2011c; Reclamation and Ecology, 2011d). The individual size of each of the Integrated Plan elements and associated impacts, the relationship of these alternatives to the Yakima River and Indian ceded lands, the Holocene geomorphology, the historic character of the existing water storage and delivery features, and the high site density in nearby locales are indicators of a high level of complexity in the cultural and historic resources. In addition, these factors predispose the Integrated Plan elements to a high level of interest and scrutiny from Indian Tribes, State, and Federal partners and reviewers, the professional historic preservation community, and the public.

3.20 Indian Sacred Sites

Executive Order 13007, Indian Sacred Sites (May 24, 1996), directs Federal agencies to accommodate access to, and ceremonial use of, Indian sacred sites by Indian religious practitioners and to avoid adversely affecting the physical integrity of such sacred sites on Federal lands. The agencies are further directed to ensure reasonable notice is provided for proposed land actions or policies that may restrict future access to or ceremonial use of, or adversely affect the physical integrity of, sacred sites. The Executive Order defines a sacred site as 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."

Sacred Sites may include ceremonial areas and natural landmarks which are religious or symbolic representations. No sacred sites have yet been identified that are associated with elements of the Integrated Plan. However, the Yakama Nation has expressed concern in the past about other projects in the Yakima River basin which impact their religious activities.

3.21 Indian Trust Assets

Indian Trust Assets (ITAs) are legal interests in property held in trust by the United States 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 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. Government.

As stated in the 1994 memorandum *Government-to-Government Relations with Native American Tribal Governments*, Reclamation is responsible for the assessment of project effects on Tribal trust resources and federally recognized Tribal Governments. Reclamation is tasked to actively engage and consult federally recognized Tribal Governments on a Government-to-Government level when its actions affect ITAs.

The U.S. Department of Interior (DOI) Departmental Manual Part 512.2 delegates the responsibility for ensuring protection of ITAs to the heads of bureaus and offices (DOI, 1995). The DOI is required to "protect and preserve ITAs from loss, damage, unlawful alienation, waste, and depletion" (DOI, 2000). Reclamation is responsible for determining if a proposed project has the potential to affect ITAs.

3.22 Socioeconomics

The Integrated Plan might affect five distinct components of socioeconomic conditions in Washington State:

- The value of water-related goods and services;
- The level and composition of jobs and incomes;
- The distribution among different groups of the costs and benefits resulting from management of water resources;
- The socioeconomic structure; and
- Economic uncertainty and risk.

3.22.1 Value of Goods and Services

Water and related resources in the Yakima River basin are economically important when, as part of an ecosystem, they produce goods and services that benefit people, impose costs on them, or both (U.S. EPA, 2009; National Research Council, 2004). The Integrated Plan would affect socioeconomic conditions in the basin by increasing or decreasing the supply and, hence, the value of individual goods and services derived from the basin's water-related ecosystems. There exists no overall accounting of the value of the goods and services that the Integrated Plan might affect, but studies of the larger Columbia River Basin demonstrate the potential value of marginal (incremental) changes in the supply of water to produce some crops and a few other goods and services (Huppert et al, 2004). Layton, Brown, and Plummer (1999) estimate the value of changes in goods and services associated with potential increases in the regional population of salmon and steelhead. The marginal value of water that produces other goods and services could be substantial, but reliable estimates are not available. With some exceptions, the demand for water-related goods and services would likely increase if the population grows and becomes wealthier, and if the economy expands.

3.22.2 Jobs and Incomes

Water and related resources of the Yakima River basin influence jobs and incomes through the following three mechanisms:

- Providing goods and services that are inputs to commercial activities;
- Producing goods and services that create a quality of life that influences the location decisions of households and businesses; and
- Providing other valuable ecosystem goods and services.

Impacts on jobs and incomes would materialize in the context of the two distinct regional markets for labor and local commerce that split the Yakima River basin, with Kittitas County connected more closely to the Seattle-Tacoma metropolitan centers, and the rest of the basin connected more closely to the Kennewick-Richland-Pasco centers (Johnson and Kort, 2004).

Between 2006 and 2009, farm income and employment have followed mixed trajectories. In general, farm income in the three counties increased between 2006 and 2008 and declined in 2009. Exceptions were Benton County, which experienced a decrease in income in both 2008 and 2009, and Kittitas County, whose farm income decreased between 2006 and 2008 but increased in 2009. During the same period of time, farm employment increased in all three counties. In 2009, farm employment represented 14 percent of the total employment in the Yakima County, 7 percent in Kittitas County, and 5 percent in Benton County (U.S. Department of Commerce, 2011).

An estimate of agricultural employment in the Columbia River Basin provides a context for anticipating the potential impacts of changes in water use in the Yakima River basin. Permanently shifting 1,000 acre-feet of water into (or out of) irrigation would increase (or decrease) employment directly linked to the agricultural industry by about 18 jobs, and related statewide employment by about 45 jobs (Huppert et al, 2004). Any such increases or decreases in employment probably would be accompanied by tradeoffs in jobs associated with alternative uses of water, such as water-related recreation, especially if the economy is operating at full employment. Additional research is needed to determine the full impacts on jobs and incomes associated with changes in water use in the Yakima River basin.

Quality-of-life impacts materialize when amenities, such as water-related recreational opportunities, induce households and businesses to locate nearby or increase the consumer surplus of the households already located in the region. Some water-related goods and services can influence jobs and incomes even though they are not direct inputs for commerce or amenities for households. Wetlands and floodplains, for example, can influence the risk of flood damage and, therefore, the cost of living and doing business in downstream communities (Daily, 1997).

3.22.3 Distribution of Costs and Benefits

The costs and benefits of implementing the Integrated Plan would likely fall unevenly on different groups. This distribution can have important consequences not just for the groups themselves, but also for the overall perception of the Integrated Plan's fairness, and the functioning of social institutions and relationships. Impacts on salmon and steelhead, for example, can have important distributional effects governed by treaties, laws, and regulations (Independent Economic Analysis Board, 2005). If those who enjoy the benefits of a good or service resulting from the Integrated Plan do not bear the full costs of its production, the beneficiaries may consume the goods and services beyond optimal levels (U.S. Army Corps of Engineers, 1991).

3.22.4 Socioeconomic Structure

Many aspects of economic activity and social organization in the basin have long been tied directly to water. Harvest of salmon and steelhead has provided a cultural focus and the basis for much economic activity for the members of Tribal groups, commercial fisheries, and recreational fisheries (Fluharty, 2000). Irrigation has enabled the expansion of agriculture, and water for municipal and industrial uses supports urban development and economic activity.

An important element of the socioeconomic structure is the State's water right system, which gives priority on a first-come basis, rather than to the highest and best use. The basin has seen several efforts to shift water from uses with a lower value to uses with a higher value. The voluntary transfer of water—through donation, conservation, lease, or purchase—from one place, type, and time of use to another has long been seen as necessary to reduce the economic damage from drought, offset the adverse impacts of water withdrawals on streamflows, increase water-related economic benefits and jobs, and provide water for new demands. It also is possible for a private or public entity to purchase land to gain control over the appurtenant water right, and then redirect the water to another type of use (Reclamation and Ecology, 2011j). Full realization of the potential efficiency gains from market-based reallocation of water will entail overcoming several barriers, such as uncertainty about water rights, and the limited capabilities resulting from efforts to date to provide an information clearinghouse, brokerage, technical support, verification, conveyance, and mitigation for third-party effects.

3.22.5 Uncertainty and Risk

Uncertainty exists when the outcome of taking an action (including no action) remains unknown. Risk exists when uncertainty includes one or more possible outcomes that would have an undesired effect or significant loss. Uncertainty and risk are economically undesirable, and, all else equal, decisions that reduce them are preferred over those that do not. Major concerns about risk and uncertainty have been expressed regarding habitat for salmon and steelhead, especially during critical times and conditions, and for irrigators, especially during times of drought for those who have invested in orchards and other perennial crops (Huppert et al, 2004; National Research Council, 2004). The greatest risk occurs during periods of drought.

Additional uncertainty and risk accompany anticipated changes in climate, which some research indicates may diminish runoff in spring and summer in the Yakima River basin, reducing the availability of water to meet the demands for irrigation, especially to proratable water rights holders, instream flows, and other uses (Vano et al., 2010). Such findings indicate there may be increased risks associated with droughts, and particularly the risks associated with high-value water uses, such as instream flows to provide habitat for at-risk fish and other aquatic species, and irrigation to sustain perennial crops. As these risks rise, the potential gains from transferring water from lower value uses to higher value uses in an expeditious manner, via conservation, groundwater storage, and/or market-based reallocation of water, may also rise.

3.23 Environmental Justice

Sources of information for this section include the U.S. Census Bureau (2010) and the American Community Survey (2009).

Environmental justice addresses the fair treatment of people of all races and incomes with respect to actions affecting the environment. Fair treatment implies that no group should bear a disproportionate share of negative impacts. Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," dated February 11, 1994, requires agencies to identify and address disproportionately high and adverse human health or environmental effects of their actions on minorities and low-income populations and communities, as well as the equity of the distribution of the benefits and risks.

Table 3-22 provides the numbers and percentages of population by racial category for Yakima basin counties and the State of Washington. The information is based on the 2010 U.S. Census data, the most recent consistent source of information for the basin.

In comparison to the State of Washington, Kittitas and Benton Counties have a smaller percentage of total racial minority and ethnic (Hispanic or Latino) populations, while Yakima County has a higher percentage. Additional potentially affected minority populations include members of the Yakama Nation and downstream Indian Tribes. While census data are available for recognized Indian reservations, specific data for Tribal members are not. Tribal members may be affected regardless of whether or not they reside on their reservations.

Table 3-22 Race and Ethnicity

	Kittitas County Number (%)	Yakima County Number (%)	Benton County Number (%)	State of Washington Number (%)
Total Population	40,915 (100%)	243,231 (100%)	175,177 (100%)	6,724,540 (100%)
One race	39,669 (97.0%)	234,122 (96.3%)	168,955 (96.4%)	6,411,614 (95.3%)
White	36,544 (89.3%)	155,056 (63.7%)	144,418 (82.4%)	5,196,362 (95.3%)
Black or African American	364 (0.9%)	2,320 (1.0%)	2,221 (1.3%)	240,042 (3.6%)
American Indian and Alaska Native	394 (1.0%)	10,568 (4.3%)	1,574 (0.9%)	103,869 (1.5%)
Asian	810 (2.0%)	2,560 (1.1%)	4,691 (2.7%)	481,067 (7.2%)
Native Hawaiian and Other Pacific Islander	57 (0.1%)	204 (0.1%)	253 (0.1%)	40,475 (0.6%)
Some other race	1,500 (3.7%)	63,414 (26.1%)	15,798 (9.0%)	349,799 (5.2%)
Two or more races	1,246 (3.0%)	9,109 (3.7%)	6,222 (3.6%)	312,926 (4.7%)
Racial Minority	4,371 (10.7%)	88,175 (36.3%)	30,759 (17.6%)	1,528,178 (22.7%)
Hispanic or Latino (of any race)	3,121 (7.6%)	109,470 (45.0%)	32,696 (18.7%)	755,790 (11.2%)
Minority[1]	5,071 12.4%	127,207 52.3%	44,740 25.5%	1,847,736 27.5%

Source: US Census Bureau, 2010
[1] The total Minority calculation includes all respondents who selected a race other than white as well as all respondents who selected both white and Hispanic or Latino.

Table 3-23 provides income, poverty, unemployment, and housing information for the same geographic area. Information in this table is from the 2009 American Community Survey. Low-income populations are identified by several socioeconomic characteristics. Specific characteristics include income (median family and per capita), percentage of the population below poverty (families and individuals), unemployment rates, and substandard housing. Median family income and per capita income for all three counties is less than the State. Compared to the State, the Yakima basin counties have greater percentages of families and individuals below the poverty level.

Table 3-23 Income, Poverty, Unemployment, and Housing

	Kittitas County	Yakima County	Benton County	Washington
Income				
Median household income	$41,025	$41,854	$55,253	$56,384
Per capita income	$22,451	$18,562	$26,250	$29,320
Percent below poverty level				
Families	11.0	15.7	9.4	7.8
Individuals	22.8	20.8	12.4	11.8
Percent unemployed	6.9	10.2	6.7	7.0
Percent of Housing				
1.01 or more occupants per room	2.2	6.3	2.7	2.3
Lacking complete plumbing facilities	0.6	0.5	0.1	0.5

Source: American Community Survey, 2009

Other measures of low income, such as unemployment and substandard housing, also characterize demographic data in relation to environmental justice. The 2009 unemployment rate for Yakima County was higher than the State's, but Kittitas and Benton Counties' were lower. Substandard housing units are overcrowded and lack complete plumbing facilities. The Census definition of "lacking complete plumbing facilities" is the lack of any of the following within the housing unit: hot and cold piped water; bathtub or shower; and flush toilet. The percentage of occupied housing units with 1.01 or more occupants per room in Kittitas County was lower than the percentage for the State, but the percentages in Yakima and Benton Counties were higher. When compared to the State, the percentage of housing units lacking complete plumbing facilities was higher in Kittitas County, equal in Yakima County, and lower in Benton County.

Chapter 4

SHORT-TERM IMPACTS AND MITIGATION MEASURES

CHAPTER 4.0 SHORT-TERM IMPACTS AND MITIGATION MEASURES

4.1 Introduction

This chapter describes the short-term impacts of the Integrated Plan elements and projects proposed in this DPEIS. Short-term impacts refer to those that are construction related or expected to last less than 4 years. Possible mitigation measures for the impacts are also discussed. Because this EIS is programmatic, the details of construction and project implementation are not known for many elements, projects, and actions. Thus, short-term impacts are discussed commensurate with the level of detail used to describe the proposed element, project, or action. Reclamation and Ecology expect that projects or actions included as features of the Integrated Plan would be subject to subsequent project-level environmental review under NEPA and SEPA before being approved for implementation should the Integrated Plan Alternative move forward. The subsequent NEPA project-level reviews could include any combination of EIS(s), supplemental EIS(s), environmental assessment(s), and/or categorical exclusion(s) along with corresponding SEPA reviews, as appropriate, depending on the proposed action, phasing of implementation, and potential for adverse impacts.

Impacts are evaluated for the No Action Alternative and the Integrated Plan. The Integrated Plan includes seven main elements—fish passage, structural and operational changes, surface water storage, groundwater storage, habitat/watershed protection and enhancement, enhanced water conservation, and market reallocation. The focus of the impacts analysis is on potential impacts anticipated for the Integrated Plan elements. The discussion includes impacts associated with specific projects for which there is sufficient detail. Short-term cumulative impacts are presented at the end of this chapter. Long-term impacts are described in Chapter 5.

4.2 Earth

Short-term earth impacts are based on the soil area that would be temporarily disturbed for any construction project and the duration of soil exposure. This includes associated stockpile or staging areas or temporary access roads. Short-term impacts are considered more substantial where extensive areas of soil are exposed for long periods of time, thus increasing the erosion potential and minor when small areas of soil are exposed for relatively short periods of time.

4.2.1 No Action Alternative

Under the No Action Alternative, various entities and agencies would undertake individual actions that could result in short-term impacts on earth resources. Construction associated with these actions has the potential to disturb the ground and increase the potential for erosion and delivery of sediments to the Yakima River system.

Any resulting impacts would be evaluated separately. These projects would not be part of an integrated water resource management approach.

4.2.2 Integrated Water Resource Management Alternative

Short-term impacts of the individual elements would be primarily related to construction activities that may result in erosion and sedimentation. These elements are discussed in the following sections.

4.2.2.1 Reservoir Fish Passage Element

Construction activities related to installing fish passage facilities would require ground disturbance that could increase the potential for sediment delivery to the nearby stream systems. Construction activities may include adult fish upstream collection and transportation facilities, temporary cofferdams, new spillways, multilevel gated intake structures, and/or construction of spawning channels or riffles. Because all of the proposed fish passage elements would occur on or near streams, they have the potential to increase the delivery of sediment to surface waters. Temporary increases in turbidity are likely.

Impacts for fish passage facilities at Cle Elum, Tieton, Keechelus and Kachess Dams are expected to be similar. Impacts at Clear Lake Dam would be less because the project is smaller in scale and some fish passage facilities would be located on existing dam structures.

4.2.2.2 Structural and Operational Changes Element

Modifications requiring construction activities would cause short-term impacts similar to those discussed in Section 4.2.2.1. Construction could include structural changes to existing water supply facilities such as modification of spill gates, outfalls, and canal/piping systems, and the installation of pump systems for pipe pressurization.

Changes to operations, such as subordination of power at Roza and Chandler powerplants, would not require construction or increase erosion or sediment entering surface waters.

Short-term impacts to earth resources are not anticipated from construction to raise the level of Cle Elum Dam because flashboards would be installed on the existing dam and would require no ground disturbance. Ground disturbance would occur when shoreline protection measures are installed. These activities would result in increased erosion and slope stability impacts at the shoreline, but impacts are expected to be limited because the total amount of shoreline protection would be limited to approximately 1 mile and construction would be done in dry conditions.

Construction activities for KRD and Wapatox Canal improvements would include excavation of canals that could cause increased erosion and slope stability impacts. The potential for sedimentation in nearby surface waters is limited because of the small areas that would be disturbed. Construction would occur in the dry season and best management practices (BMPs) would be used to minimize erosion.

Construction to install the approximately 5-mile-long Keechelus-to-Kachess buried pipeline has the greatest potential to increase erosion and cause slope stability impacts because of the length of the pipeline. Construction would require disturbance of a 75-foot-wide area along the length of the pipeline. The potential for increased sedimentation of surface waters would be greatest near stream crossings.

4.2.2.3 Surface Storage Element

The surface storage element would have the highest potential for short-term impacts to earth resources. Creating new or expanded storage reservoirs, such as Wymer Dam and Reservoir or Bumping Lake Reservoir, would involve clearing and excavating large areas for access roads, creating borrow areas, excavating along the shoreline, and constructing new dams or modifying existing dams. Excavation and fill activities would increase the potential for erosion during construction, although erosion could be minimized through the use of BMPs. Erosion during construction would contribute to turbidity in downstream waters, but would not have a long-term impact on downstream water quality. Construction of a pump station for Wymer Dam could cause increased erosion in the Yakima River. Site-specific geologic studies to determine slope stability problems would be conducted as part of further project-specific environmental review.

Construction of the tunnel or the pump station and pipeline for the Kachess Reservoir inactive storage project could result in short-term erosion and slope stability impacts. Construction activities would result in an increased potential for sedimentation in nearby surface waters. Site-specific geologic studies would be conducted as part of further project-specific environmental review.

4.2.2.4 Groundwater Storage Element

Groundwater storage projects involving construction activities would cause short-term erosion impacts. Construction activities for this element could include water treatment facilities, wells, conveyance facilities, and/or infiltration basins.

The pilot study for shallow aquifer recharge would have minor impact areas (less than 5 acres in two locations) which would result in a small potential for erosion. If the projects are developed at full scale, they would have larger impact areas (estimated 160 to 500 acres), resulting in a larger potential for erosion. Construction of surface recharge ponds also requires the removal of vegetation and scraping of the soil. Development of transmission infrastructure would also disturb soil. Site-specific geologic studies would be conducted as part of further project-specific environmental review.

Few impacts are expected from aquifer storage and recovery (ASR) projects which would mostly use existing infrastructure. Short-term impacts would be minimal for the City of Yakima proposal. A new well would be drilled to pump water during the summer months. Well drilling would result in limited disturbance and impacts to earth resources.

If new treatment facilities are required for ASR projects in other cities, additional soil disturbance would occur.

4.2.2.5 Habitat/Watershed Protection and Enhancement Element

Fish habitat enhancement projects could include reconnecting side channels, floodplains, and off-channel habitat to streams; restoring natural channels, riparian areas, and wet meadows; relocating infrastructure; and replanting and restoring riparian areas on the Yakima River and many of its tributaries. Enhancement-related construction activities may include placement of large woody debris and engineered log jams in streams, bank reshaping, channel reconstruction, and construction of fish passage facilities. These projects are expected to have limited impacts because they would involve short sections of streams and BMPs would be employed. Project areas would be tested for contamination prior to construction, and contaminated soils would be removed.

The land acquisition included in this program would not directly affect earth resources. Management of the lands could include enhancement projects, which would have impacts similar to those described above.

4.2.2.6 Enhanced Water Conservation Element

Construction of canal lining, pipelines, pump stations, reregulating reservoirs, or on-farm irrigation improvements could disturb soils and temporarily increase soil erosion. Most individual projects would be small scale and constructed during the dry season, using BMPs to minimize impacts.

Short-term impacts are not anticipated for the Municipal and Domestic Water Conservation Element because no construction activities would occur.

4.2.2.7 Market Reallocation Element

No impacts on earth resources are anticipated because no construction is expected under the water rights transfer programs.

4.2.3 Mitigation Measures

Large projects such as new surface storage would require site-specific geotechnical studies to identify subsurface issues, unstable slopes, and other local factors that could contribute to slope instability and increase erosion potential. These studies would be used in the design of project-specific BMPs and temporary erosion and sediment control plans in accordance with Federal, State, or local requirements. Requirements for each construction project would be defined through review by State and local regulatory agencies. The following measures could be included to minimize the potential for sediment production and delivery to stream channels:

- Timing construction activities to avoid disturbing soils during wet weather;

- Using straw bales, silt fencing, or other suitable sedimentation control devices;
- Washing truck tires to reduce tracking of sediments from construction sites;
- Covering exposed soil stockpiles and exposed slopes;
- Using straw mulch and erosion control matting to stabilize graded areas where appropriate;
- Retaining vegetation where possible to minimize soil erosion;
- Seeding or planting appropriate vegetation on exposed areas as soon as possible after work is completed;
- Constructing temporary sedimentation ponds to detain runoff waters where appropriate;
- Installing and operating dewatering facilities to eliminate the potential for slope stability impacts associated with excavation;
- Using berms and other onsite measures to prevent soil loss;
- Monitoring downstream turbidity during construction to document the effectiveness of implemented measures; and
- Visually monitoring for signs of erosion and for correct implementation of control measures.

4.3 Surface Water Resources

Short-term impacts on surface water resources were evaluated by analyzing potential changes to flows caused by the construction or initial implementation of the alternatives. For this section, impacts are defined as affecting water deliveries to water users, streamflows, flood control operations, or TWSA, or causing a surface water body to be temporarily diverted from its typical location.

4.3.1 No Action Alternative

Several projects in the No Action Alternative may have a short-term impact on surface water. For example, YRBWEP water conservation projects would require construction of canal lining, pipelines, pump stations, and other irrigation district improvements. Habitat restoration efforts would require construction of off-channel areas, removal of fish passage barriers, placement of large woody debris, and other actions. Potential short-term impacts could include an interruption in water service during construction of irrigation system improvements and diversion of surface water around work areas during dewatering and construction. If the No Action Alternative projects trigger NEPA or SEPA compliance, they would be evaluated separately.

4.3.2 Integrated Water Resource Management Plan Alternative

4.3.2.1 Reservoir Fish Passage Element

Impacts for fish passage facilities at Tieton, Keechelus, and Kachess Dams are expected to be similar to those identified for Cle Elum Dam (Reclamation and Ecology, 2011d). Construction would be coordinated to allow flow releases from the dams to remain unchanged. During the first year of construction, there could be a minor loss of storage due to the intake structure cofferdam. Approximately 30 to 40 acre-feet could be lost, but this is not expected to affect water delivery contracts, TWSA, or flood control operations (Reclamation and Ecology, 2011c).

Fish passage facilities at Bumping Lake Dam would be included with the enlarged reservoir (Section 4.3.2.3). No impacts to surface water are expected for the Clear Lake Dam facilities because construction would not affect releases from downstream Rimrock Reservoir.

4.3.2.2 Structural and Operational Changes Element

This element may require revisions to reservoir operations that may impact outflows and flood control operations. Work for project elements would be planned to minimize impacts on operations and flows.

Construction in the Cle Elum Pool Raise project would be scheduled during a lower pool elevation period (late summer to winter). Short-term impacts on surface water would be unlikely.

Installing a pump station on the Yakima River for the Manastash Pump portion of the KRD Canal Modifications project would require the construction area to be dewatered but would not affect flows. Other portions of the KRD Canal Modifications and the Wapatox Canal Improvements projects would not likely cause short-term impacts to surface water because construction is not expected to occur during the irrigation season.

Constructing the new outlet tunnel bifurcation on the existing Keechelus outlet works could require special operations and outflows. This work would be scheduled and planned to minimize impacts on normal operations and streamflows.

Power subordination at Roza and Chandler powerplants would not require construction or result in short-term impacts on surface water. Recurring seasonal effects on streamflows in the Yakima River are discussed in Chapter 5.

4.3.2.3 Surface Storage Element

This element may require short-term changes in reservoir storage and outflows as well as bypassing streams around construction areas. Impacts to surface water would be dependent on construction timing.

Lmuma Creek would need to be bypassed around the construction area of Wymer Dam during the construction of the dam and outlet works. Flows into the Yakima River are not expected to be impacted. Installing the pump station on the Yakima River would require the construction area to be dewatered or isolated but would not affect flows. For the Bumping Lake Enlargement project, the Bumping River would need to be bypassed around the construction area. This bypass would last the duration of the construction project. Bumping Lake Reservoir may need to be temporarily drawn down to allow removal of a portion or all of the existing dam. This may reduce storage volume during construction and may affect the ability to achieve minimum target flows in the Bumping River. The actual amount of storage loss would be dependent on construction timing. Construction would be scheduled to minimize impacts on storage loss and target flows.

During the first fill of Wymer Dam and the enlarged Bumping Reservoir, flows in the Yakima River downstream of Lmuma Creek, the Bumping River, and Naches River would be reduced from existing conditions. The amount of flow reduction would depend on the runoff and rate of fill of Wymer Reservoir and the runoff, rate of fill, and agreed minimum flows to be released from Bumping Reservoir.

Construction of the Kachess Reservoir Inactive Storage project may require a temporary drawdown in reservoir levels. This may decrease the amount of storage and reduce the chance of being able to refill the reservoir for the following irrigation season. Actual storage lost would depend on construction timing, runoff during the following season, and scheduling of other projects that may mitigate this risk. The drawdown would be scheduled to reduce effects on water delivery contracts, TWSA, or flood control operations.

4.3.2.4 Groundwater Storage Element

This element may result in temporary, construction-related impacts to surface waters. Areas near the construction site may be dewatered. These impacts are not expected to affect streamflow or deliveries to water users because construction of this element is expected to be scheduled outside of the irrigation season.

4.3.2.5 Habitat/Watershed Protection and Enhancement Element

The process of acquiring and protecting properties in the basin is not expected to affect surface water. Fish habitat enhancement projects may have short-term impacts on surface water in the Yakima River and its tributaries at construction locations. When enhancing fish habitat, there is the possibility of construction occurring instream, which may require dewatering, isolating the construction area from the stream, or bypassing the stream around the construction area. Construction would be scheduled to minimize impacts on flows.

4.3.2.6 Enhanced Water Conservation Element

Agricultural water conservation projects are not expected to have short-term impacts on surface waters because projects would be constructed outside of the irrigation season. The municipal and domestic conservation program is not expected to have a short-term impact on surface water because no construction is anticipated.

4.3.2.7 Market Reallocation Element

No short-term impacts on surface water are anticipated because there would be no construction associated with market reallocation.

4.3.3 Mitigation Measures

Specific mitigation measures would be developed as part of future environmental analysis if projects are carried forward and proposed for implementation. To mitigate short-term disruptions in surface water irrigation supply due to construction activities, the irrigation districts would coordinate with water users and construction personnel to ensure that construction activities are scheduled to minimize disruptions. To the extent possible, conveyance construction would occur outside the irrigation season. Mitigation for stream bypasses would be negotiated with regulatory agencies as part of permitting for individual projects. Reservoir drawdowns would be scheduled to minimize effects on salmon and bull trout and on water supplies for that year and the following year.

4.4 Groundwater

Groundwater impacts described in this section are limited to the effects of dewatering during construction, which would occur in the immediate vicinity of the construction sites. If groundwater wells are located near construction sites, drawdown associated with dewatering could temporarily reduce the usability of those wells. Impacts would be temporary (limited to the period of active construction) and are likely to be minor, given the rural character of the area surrounding the proposed projects and the expected absence of wells in these immediate areas. Potential impacts on groundwater quality would be minimized by the dispersed, rural location of the projects and the use of construction BMPs.

4.4.1 No Action Alternative

Construction associated with the ongoing efforts of the agencies and groups identified in Section 2.3--and included in the No Action Alternative--has the potential to result in temporary groundwater impacts in the Yakima River basin. Those impacts largely relate to the need for dewatering of construction areas. Any resulting impacts would likely be minor and the agencies or entities implementing the projects would undertake separate NEPA or SEPA evaluation as appropriate.

4.4.2 Integrated Water Resource Management Alternative

Construction dewatering may cause temporary, localized reductions in groundwater levels and availability. The amount of necessary groundwater withdrawals and the disposal method would be determined on a site-specific basis. Should dewatering be required, it would be conducted in accordance with Ecology requirements.

4.4.2.1 Reservoir Fish Passage Element

If construction dewatering occurs at Cle Elum, Tieton, Keechelus, or Kachess Dams, a minor and short-term impact on groundwater quantity in the immediate area of the site may occur. No impacts on groundwater quality are anticipated.

Fish passage facilities at Bumping Lake Dam would be constructed as part of the enlargement of the reservoir (Section 4.4.2.2). Impacts to groundwater at Clear Lake Dam would be similar to those described above, but this project is less likely to require dewatering because the weir and fish ladder are expected to be located on the existing dam.

4.4.2.2 Structural and Operational Changes

Modifying existing structures may impact groundwater quantity in the short term if construction dewatering occurs. Any impacts are expected to be localized within the immediate vicinity of the project and to be completed within a relatively short time period. No impacts to groundwater quality are anticipated.

Raising the existing dam for the Cle Elum Pool Raise project would not require dewatering, and no dewatering is likely to be required to install shoreline protection during the dry season. No short-term groundwater impacts are expected during canal lining or piping associated with the KRD and Wapatox projects. The Keechelus-to-Kachess pipeline would likely require a large amount of construction dewatering along the pipeline route. However, groundwater use within this area is minor and impacts would be temporary and relatively brief in any one location. No construction is involved for power subordination at Roza and Chandler Powerplants; therefore, there would be no impacts on groundwater.

4.4.2.3 Surface Storage Element

During excavation for pumping plants, tunnels, and appurtenant structures associated with storage options, dewatering may be necessary in some areas. The amount of dewatering necessary would depend on the site-specific conditions and the final design details of each project. Some provision for dewatering and disposal of pumped water would be necessary. No impacts on groundwater quality are anticipated from any of the projects.

Construction activities for an expanded reservoir at the Wymer site would have limited impact on groundwater resources. The pumping plant to supply Wymer Reservoir would be located along the Yakima River, and construction of the plant would require dewatering. The pumped water would need to be treated or allowed to settle to remove turbidity and suspended sediments prior to discharging the water back to the river. There are no private wells in the immediate area that would be affected by the dewatering. Dewatering also would be required during construction of the dam foundation. No impacts to groundwater quality are anticipated. Construction of the new dam at Bumping Lake Reservoir would also require substantial dewatering, which would be evaluated as part of future project-specific review.

Construction of the pumping plant and intake or tunnel to allow drawdown of Kachess Reservoir below its current minimum active storage level would require dewatering within the vicinity of the construction. Because of the greater underground depth of the construction activities near Kachess Reservoir, dewatering activities may be larger and more prolonged than for the other project elements. Impacts on water users are expected to be minor because of the absence of private wells within the area.

4.4.2.4 Groundwater Storage Element

The impacts of the Groundwater Storage Element were described in the *Groundwater Infiltration Appraisal-Level Study Technical Memorandum* (Reclamation and Ecology, 2011e). The initial projects would be constructed as pilot studies including site-specific groundwater studies and monitoring.

Construction of the new facilities to allow additional surface infiltration of Yakima River flow may require some dewatering for the shallow aquifer recharge projects. Limited impacts to groundwater could occur. However, in some locations, the depth of excavation during construction may not extend to the groundwater table and thus no dewatering would be required. No impacts to groundwater quality are anticipated.

The ASR projects are expected to have impacts similar to the shallow aquifer recharge projects except construction would be on a smaller scale and use existing facilities to the extent possible. Limited impacts on groundwater could occur during construction of the facilities necessary to treat water prior to injection. However, the depth of excavation during construction is not expected to extend to the groundwater table, and dewatering would probably not be required. Impacts on groundwater quality due to the construction of treatment facilities and groundwater wells for injection and extraction are expected to be minor because permitting requirements and construction BMPs would be designed to prevent groundwater contamination.

4.4.2.5 Habitat/Watershed Protection and Enhancement Element

No adverse groundwater impacts are expected from construction activities related to habitat restoration. Habitat/watershed protection and enhancement activities are in natural areas away from private wells. Construction BMPs would limit discharges of sediment-laden water.

4.4.2.6 Enhanced Water Conservation Element

Construction associated with conservation projects is not expected to affect groundwater. Construction of facilities would be limited, not requiring extensive excavation or dewatering. The municipal and domestic water conservation program does not involve construction, so no short-term effects are anticipated.

4.4.2.7 Market Reallocation Element

Market reallocation would not cause short-term impacts to groundwater because there would be no construction.

4.4.3 Mitigation Measures

The following measures could be used to reduce the potential for construction-related impacts on groundwater:

- Conduct site-specific hydrogeological studies prior to construction to determine impacts on short-term groundwater levels and quantity from dewatering activities.
- Treat groundwater withdrawn for dewatering prior to release to surface waters or groundwater to reduce impacts on water quality.
- Schedule construction during the dry summer months, when possible, to reduce the need for dewatering and the potential for generating stormwater that could enter groundwater.

In addition, all dewatering would be conducted in accordance with Federal, State, and local requirements.

4.5 Water Quality

Short-term impacts on water quality are most likely to occur during construction in or near water bodies. Construction activities can increase the risk of erosion and the introduction of contaminants. Appropriate mitigation measures, such as obtaining necessary construction and operational permits and implementing appropriate BMPs, can reduce these risks. While short-term impacts on water quality can occur, the long-term purpose of the projects includes an overall improvement in water quality. Taking actions to improve the long-term water quality of the region should provide benefits that offset these potential temporary impacts.

4.5.1 No Action Alternative

Existing and ongoing projects are considered part of the No Action Alternative as identified in Chapter 2. Construction of these projects has the potential to result in water quality impacts in the Yakima River basin, including sedimentation, increased turbidity, changes in temperature, and contamination from spills or construction activities. These projects would undergo separate NEPA or SEPA evaluation as appropriate and would comply with applicable permits.

4.5.2 Integrated Water Resource Management Plan Alternative

Instream work may cause local, temporary increases in turbidity during installation and removal of cofferdams. These increases would likely be most intense near the construction activity itself and would decrease over time and distance. Construction equipment in or near waterways could temporarily disturb the streambanks or streambed. These disturbances could temporarily degrade nearby water quality (for example, by increasing suspended sediments in the water). This could be mitigated by restricting in-water access to periods of low flows.

Short-term impacts on water quality could also result from near-stream soil disturbance; inadvertent release of fuel, oil, or other construction equipment-related fluids; dewatering; and cast-in-place concrete work. Both sediment and contaminants can increase turbidity and affect other water quality parameters such as dissolved oxygen.

4.5.2.1 Reservoir Fish Passage Element

The construction of juvenile fish passage facilities would be done behind cofferdams. Construction of cofferdams would be performed during normal reservoir drawdown. Construction of fish passage structures would be within the area of the dewatered cofferdams. Sedimentation and turbidity would occur during construction and removal of the cofferdam.

Increases in turbidity and sedimentation are likely to occur during construction of the adult fish upstream collection and transportation facilities, temporary cofferdams, new spillways, multilevel gated intake structures, or spawning channels or riffles. Fish passage projects have the potential to increase the delivery of sediment to surface waters on which they are located. Temporary increases in turbidity are likely.

There is a potential for soil disturbance and accidental spills of contaminants (such as fuel, oil, grease, antifreeze, and hydraulic fluids) associated with the use of heavy equipment during construction. Contamination is also possible during use of concrete or grout. Construction impacts would be controlled through the proper implementation of BMPs.

Impacts for installing fish passage facilities at Cle Elum, Tieton, Keechelus, and Kachess Dams are expected to be similar. Impacts at Clear Lake Dam would be similar, but of a lesser magnitude because of the smaller scale of the project. Bumping Lake Dam fish passage facilities would be included in the reservoir expansion project (Section 4.5.2.3).

4.5.2.2 Structural and Operational Changes Element

Construction to modify existing structures and facilities would cause short-term water quality impacts. Increases in sedimentation and turbidity could occur. There is a potential for soil disturbance and accidental spills of contaminants (such as fuel, oil, grease, antifreeze, and hydraulic fluids) associated with the use of heavy machinery during construction. Contamination is also possible during use of concrete or grout.

Raising the level of Cle Elum Dam is not expected to directly cause water quality impacts because all construction would take place on the existing dam. Water quality impacts could occur along the shoreline when erosion protection measures are installed. Excavation activities near the lake could impact water quality if sediments are allowed to enter the lake.

Construction activities to improve irrigation facilities for the KRD or Wapatox projects outside of the irrigation season are not anticipated to impact water quality.

The Keechelus-to-Kachess pipeline route would cross at least six streams and require work along portions of the Yakima River, Swamp Lake area, and Lodge Creek. Construction activities have the potential to degrade water quality, particularly at stream crossings.

Power subordination does not involve any construction activities; therefore, there would be no short-term impacts on water quality.

4.5.2.3 Surface Storage Element

Construction of new storage project such as Wymer Dam and Reservoir and Bumping Lake Reservoir enlargement could have short-term water quality impacts. During dam construction, a cofferdam and bypass channels may be required to route the flowing water away from construction activity. Filling reservoirs would inundate new areas, and cause decaying vegetation to increase the availability of nutrients in the reservoir and downstream waters. Constructing reservoirs in new locations would generally cause more extensive water quality impacts than modifying existing facilities. Construction activities related to a new reservoir and its associated water conveyance facilities would increase the potential for erosion and contamination over large areas and therefore have the potential to cause substantial short-term water quality impacts. There is also a potential for spills of hazardous materials used in the construction equipment. Pollutants could include gasoline, oil, hydraulic fluids, and sediments.

The Kachess Reservoir inactive storage project would require work on the reservoir bed, potentially disturbing sediments and causing increased erosion and sedimentation. However, work would be conducted when the reservoir is drawn down, minimizing potential impacts.

4.5.2.4 Groundwater Storage Element

The construction of groundwater storage projects could transport sediments into surface waters or result in spills of hazardous materials used in the construction equipment. Pollutants could include gasoline, oil, hydraulic fluids, and sediments. If not captured and treated through stormwater BMPs, these constituents could contribute to water quality degradation of surface water or groundwater.

4.5.2.5 Habitat/Watershed Protection and Enhancement Element

Construction of habitat enhancements is expected to impact water quality on a short-term basis. Impacts would include potential sediment deposition from construction operations. Excavation activities in or near surface water bodies could impact water quality by increasing erosion and sedimentation.

Degradation of surface and groundwater quality could also result if floodplain restoration projects inundate lands with contaminated soils. The levels of contaminants in inundated lands would largely be determined by historical land use practices. Agricultural areas are likely to have elevated levels of nutrients, pesticides and herbicides, and areas near roads are likely to have elevated levels of metals and petroleum products. Project areas would be tested for contamination prior to construction, and contaminated soils would be removed.

4.5.2.6 Enhanced Water Conservation Element

This approach to conserving water would include numerous small-scale improvements, which would require construction activities. Construction associated with these improvements could increase sedimentation and turbidity in water bodies.

The municipal and domestic conservation program does not involve construction activities; therefore, no short-term water quality impacts would occur.

4.5.2.7 Market Reallocation Element

Market reallocation would not involve construction and therefore is not expected to alter water quality.

4.5.3 Mitigation Measures

Mitigation measures would be performed to achieve compliance with Federal, State and local water quality regulations. Mitigation measures, such as applying BMPs to control stormwater runoff, erosion, and fluids from construction equipment, would be used to address short-term impacts on water quality. Contracts for construction projects would include language to protect water quality during construction. Contractors would be required to prepare and implement a spill prevention, control, and countermeasure plan and develop and implement a temporary erosion and sediment control plan. Turbid or contaminated dewatering water would be treated prior to discharge as necessary to comply with the requirements of the Washington Administrative Code, construction NPDES permit, and/or the local grading permit. Appropriate measures for handling and storing construction materials, fuels, and solvents would also be required. During construction, impacts to water bodies or other sensitive areas would be limited by selecting in-river equipment routes that minimize the disturbance. Necessary permits and BMPs to protect water quality will be identified before starting any project. Section 4.2.3 lists additional mitigation measures to minimize erosion and sedimentation impacts.

4.6 Hydropower

4.6.1 No Action Alternative

Short-term impacts on hydropower production are not expected to occur under the No Action Alternative because no change in flow through a hydroelectric facility would occur.

4.6.2 Integrated Water Resource Management Alternative

4.6.2.1 Reservoir Fish Passage Element

The fish passage element is not expected to have short-term impacts on hydropower because the projects would not cause changes in streamflows. None of the dams proposed for fish passage facilities include hydropower production.

4.6.2.2 Structural and Operational Changes Element

Construction associated with changes to existing facilities would not change streamflows or cause short-term impacts on hydropower. Cle Elum, Keechelus, and Kachess Dams do not currently include hydropower facilities.

Power subordination at Roza and Chandler powerplants would not require any construction activity; therefore no short-term impacts would occur. Long-term impacts from power subordination are discussed in Section 5.6.

4.6.2.3 Surface Storage Element

The construction of the surface water storage projects is not expected to have short-term impacts on hydropower because minimal changes in flow would occur during construction. Neither Bumping Lake Dam nor Kachess Dam includes hydropower facilities that could be affected by construction.

4.6.2.4 Groundwater Storage Element

There would be no construction impacts on hydropower from the Groundwater Storage Element because construction would not change flows through any hydroelectric facilities.

4.6.2.5 Habitat/Watershed Protection and Enhancement Element

The habitat/watershed protection and enhancement element is not expected to have short-term impacts on hydropower. Construction of habitat enhancement projects would not change flows through existing hydroelectric facilities.

4.6.2.6 Enhanced Water Conservation Element

Improvements to irrigation facilities under the enhanced water conservation element are not expected to have short-term impacts on hydropower because no changes in flow through existing hydroelectric facilities would occur. The municipal and domestic conservation program does not involve construction and would have no impacts.

4.6.2.7 Market Reallocation Element

Market reallocation would not require construction or result in short-term impacts on hydropower.

4.6.3 Mitigation Measures

Because no short-term impacts on hydropower are anticipated, no mitigation measures are proposed.

4.7 Fish

4.7.1 No Action Alternative

Under the No Action Alternative, various agencies and other entities would continue to undertake individual actions to restore and enhance fish and aquatic resources in the Yakima River basin. These actions would likely result in short-term impacts such as dewatering of instream habitat, disturbance of juvenile salmonids and resident species, disturbance of shoreline habitat, increased water temperatures, sedimentation, fish passage obstruction, and potential for accidental spills of hazardous materials (i.e., cement, fuel, hydraulic fluid). Additionally, Reclamation would remove the temporary wooden fish passage flume at Cle Elum Dam before it fails, which would stop the fish reintroduction efforts that have begun in the basin (Reclamation and Ecology, 2011c). Piecemeal implementation of individual projects may result in localized improvements; however, broader restoration and enhancement goals are less likely to be achieved than with the Integrated Plan. Short-term impacts would be minimized and mitigated according to applicable local, State, and Federal environmental review and permit requirements.

4.7.2 Integrated Water Resource Management Plan Alternative

Individual water storage and fish enhancement projects would be implemented over a period of years to decades as part of a comprehensive, integrated set of actions. These actions are intended to provide overall benefits to fish and aquatic resources. Short-term impacts would occur only during periods of active construction and would be temporary and localized. These impacts are described below for the individual elements. Short-term impacts could be mitigated by planting and sediment control measures during and immediately following construction activities to return the site to preproject conditions. The threshold for significance is whether or not the impact would exceed permit criteria during construction (i.e., water quality criteria or area of impacts). Avoidance and minimization measures would be identified and implemented consistent with State and Federal environmental review and permitting requirements.

4.7.2.1 Reservoir Fish Passage Element

Short-term impacts could include dewatering of instream habitat, disturbance of juvenile salmonids, disturbance of shoreline habitat, increased water temperatures, sedimentation, fish passage obstruction, and potential for accidental spills of hazardous materials (i.e., cement, fuel, hydraulic fluid).

Construction of fish passage facilities may require temporary dewatering of stream channels to isolate work areas. The method typically involves placing cofferdams in the stream channel and dewatering the work area within the cofferdams. The rest of the stream channel outside of the cofferdams continues to receive flows and function as fish habitat. Little sedimentation or turbidity is expected during cofferdam installation or removal, and this would be managed through the use of best management practices, as applicable. Effects of increased turbidity from placing and removing the cofferdams would not likely extend more than 200 feet downstream of the site at any time during the construction period. The timing and duration of the disturbance would be limited to instream work windows established by permitting agencies to avoid and minimize impacts on fish and aquatic habitat. Permit conditions typically allow an instream work window of a few months in late spring and late summer, but are dependent on site-specific conditions. Methods of fish isolation seek to avoid impacts to stream channels, returning the work area to preconstruction conditions with mitigation for unavoidable impacts, as applicable.

Construction within riparian buffers or stream channels could temporarily disturb salmonids that are resting, rearing, or migrating in the vicinity of the work area. Timing of activities would be scheduled to reduce overlap with fish use, and alteration of shoreline and aquatic habitats would be minimized. Construction activities could require clearing along streambanks and grading of soils. The removal of shoreline vegetation has the potential to increase water temperatures, but because of the limited area that would be disturbed, this is unlikely. If there were a measureable change in water temperature, it would be localized and limited to the period of the day when the water surface may be exposed to direct sunlight if stagnant water conditions existed.

Soils disturbed by grading could result in potential erosion and slope stability impacts, and increased sedimentation and turbidity in the channel if not properly managed during construction activities and stabilized following the restoration activity. A moderate increase in sedimentation and turbidity may cause some downstream displacement of juvenile salmon as they instinctively avoid turbid water. Sediment screens and other runoff and erosion control BMPs would be implemented to avoid sedimentation of streams and to minimize erosion during construction. The short-term impacts of soil disturbance generally extend until the following growing season when vegetation can be reestablished on disturbed surfaces. Until that time, erosion control mats and sediment screens would remain in place.

Impacts for installing fish passage facilities are expected to be similar for all major dams. Impacts at Clear Lake Dam would be similar, but of lower magnitude because of the smaller scale of the project.

4.7.2.2 Structural and Operational Changes

There are no anticipated short-term impacts associated with installing flashboards on the existing dam for the pool raise at the Cle Elum Reservoir. Limited ground disturbance activities (e.g., clearing along streambanks, grading of soils) would occur when shoreline protection is installed. This could result in short-term erosion and slope instability, and disturbance of riparian habitat and streambanks. Isolation of the work area may be required, depending on the shoreline protection actions.

Construction of the Keechelus-to-Kachess pipeline would temporarily disturb aquatic habitats and shorelines utilized by juvenile salmonids. Subordination of power at Roza and Chandler Powerplants does not involve construction that could result in short-term impacts to fish.

4.7.2.3 Surface Storage Element

Short-term impacts from Wymer Dam construction would occur on both Lmuma Creek and the Yakima River and would be similar to impacts described above for the Fish Passage Element. Specifically, impacts would be associated with disturbance related to constructing and removing cofferdams, constructing within riparian buffers and stream channels, and disturbing soils within the construction footprint.

Short-term impacts from the Bumping Lake enlargement project would be similar to those outlined for the Fish Passage Element and as described for Wymer Dam.

Short-term impacts from construction of the Kachess Reservoir Inactive Storage project would be similar to those described above for the Fish Passage Element. Impacts would include disturbance of riparian buffers and shorelines of the Kachess and Yakima Rivers for construction of inlet structures. Disturbance associated with the construction of an outlet at Lake Kachess could include isolation of the work area in the bed of the lake and disturbance to riparian habitat and shorelines associated with staging of materials related to construction.

4.7.2.4 Groundwater Storage Element

Short-term impacts associated with construction of intakes within stream channels could include those outlined above for the Fish Passage Element. Most infiltration and injection facilities would be located away from streams. However, screened intakes and infrastructure to convey water from the Yakima River to the groundwater storage site would be located within riparian buffers and along shorelines, causing disturbances to fish and fish habitat.

4.7.2.5 Habitat/Watershed Protection and Enhancement Element

Short-term impacts could include those outlined for the Fish Passage Element. In addition, construction projects associated with the Habitat/Watershed Protection and Enhancement Element could disturb streambed materials. Disturbance of these materials might cause a decrease in prey production or otherwise influence fish to avoid these habitats in the short term.

Habitat enhancement work would entail construction along shorelines within riparian buffers and stream channels where salmonids may be present, requiring isolation of the work areas. Construction activities may include placement of large woody debris and engineered log jams in streams, bank reshaping, channel reconstruction, and construction of fish passage facilities (e.g., small-scale fishways and culvert replacement). Enhancements requiring ground disturbance may result in erosion and slope stability impacts, increasing sedimentation and turbidity in the receiving waters.

4.7.2.6 Enhanced Water Conservation Element

Short-term impacts would be minimal, temporary, and localized, and would be similar to those outlined for Structural and Operational Changes.

4.7.2.7 Market Reallocation Element

Market reallocation would not require construction or result in short-term impacts on fish.

4.7.3 Mitigation Measures

Appropriate mitigation measures would be identified through Federal, State, and local environmental review and permitting processes and would therefore be project-specific. In addition to mitigation measures described to protect water quality (Section 4.6), typical mitigation measures to protect fish include:

- Working within appropriate instream fish work windows to avoid critical periods (i.e., breeding/spawning, migration);
- Following Washington Department of Fish and Wildlife (WDFW) guidelines for fish removal if stream dewatering is required;
- Implementing erosion control plans to prevent the delivery of silt-laden water to stream channels during ground disturbing activities;
- Stabilizing the work area during any significant breaks in work;
- Isolating the work area to protect water quality during construction below the ordinary high water line;

- Screening water intakes used for the project, including pumps used to dewater work isolation areas, and operating and maintaining them according to NMFS fish screen criteria, to prevent fish entrainment;
- Treating all discharge water created by construction to avoid degrading water quality or impacting flows;
- To the extent possible, avoiding entering stream channels with heavy equipment and using vegetable oil for equipment hydraulic systems when conducting in-water or bank work;
- Implementing native plant species revegetation/enhancement plans to mitigate potential impacts to sensitive areas, including streams, buffers, and wetlands and restore disturbed areas to the maximum extent possible, and
- Maintaining fish passage around work areas.

All of these measures are consistent with WDFW Stream Habitat Restoration guidelines (WDFW, 2004).

4.8 Vegetation

Short-term vegetation impacts are based on the area that would be temporarily disturbed for any construction project and subsequently revegetated with native species following construction. This includes any associated stockpile or staging areas or temporary access roads. Short-term impacts are considered more substantial where extensive areas of rare or intact vegetation communities are present. Impacts are considered minor where areas have been previously disturbed or contain invasive species.

4.8.1 No Action Alternative

Under the No Action Alternative, continued project implementation would occur under programs described in Chapter 2. Some of the individual actions undertaken by various entities and agencies that are currently funded and have a schedule for implementation could require removal of vegetation. This includes projects for water conservation, artificial supplementation programs, and fish passage and habitat improvement. These projects would undergo separate NEPA or SEPA analysis, if appropriate, and would comply with permitting requirements.

4.8.2 Integrated Water Resource Management Plan Alternative

Under the Integrated Plan, the extent of vegetation removal is unknown for the majority of elements. Site-specific studies would be conducted to evaluate impacts to vegetation as part of future environmental review if the projects are carried forward and proposed for implementation. Vegetation impacts would be minimized to the extent possible during facility siting and construction. Disturbed areas would be revegetated after project construction is completed.

4.8.2.1 Reservoir Fish Passage Element

Construction of fish passage facilities could disturb vegetation at the existing reservoirs. Approximate areas of disturbance for facilities located at Cle Elum Dam are available (Reclamation and Ecology, 2011c), but no similar detailed information is available for Kachess, Keechelus, or Tieton Dams or for Clear Lake Dam. In general, impacts on vegetation for all these projects would be similar, except vegetation removal at Clear Lake Dam would be less because of the smaller scale of the project and the location of most fish passage facilities on the existing dam.

In general, construction areas would be adjacent to existing spillways or dam abutments and embankments, where vegetation is limited to grasses or is nonexistent. Staging and stockpile areas, access roads, and dam crossings would be located in already disturbed areas to the extent possible. Conifer removal would be minimized to the extent possible.

Installation of fish passage facilities at the Cle Elum Dam would result in short-term impacts to vegetation communities during the three-year construction period. On the west side of Cle Elum Dam, approximately 4.5 acres of forest consisting of young Douglas fir, Ponderosa pine, and bitterbrush would be temporarily replaced by a stockpile and staging area (Reclamation and Ecology, 2011c). The fish passage conduit would temporarily disturb about 15 acres of Douglas fir, black cottonwood, lodgepole pine, and chokecherry along with the dirt roadway adjacent to the existing spillway facilities. The majority of disturbed areas would be revegetated after construction is completed. Short-term impacts to vegetation would likely be minor at Cle Elum Dam based on the limited amount of intact vegetation removal for facility construction and the proposed replanting of disturbed areas.

Installation of fish passage facilities at the Bumping Lake Dam would occur at the same time as expansion of the reservoir. Impacts of the construction project are described in Section 4.8.2.3.

4.8.2.2 Structural and Operational Changes Element

The majority of the proposed modifications would result in no impacts to vegetation because construction would take place in disturbed areas or agricultural lands. Some projects could result in the temporary disturbance of vegetation associated with staging and stockpile areas.

Raising the pool level behind Cle Elum Dam would inundate approximately 56 acres of additional land around the reservoir for approximately 3 to 10 weeks per year (average of 7 weeks). Short-term impacts from inundation could be possible where vegetation is present. Some species may tolerate being inundated, but spring growth could be affected for some species because the higher water levels would typically occur between April and August. Short-term impacts on vegetation would likely be minor due to the narrow area of additional inundation and limited amount of vegetation along portions of the shoreline.

For the KRD and Wapatox Canal modifications, construction activities could require removal of vegetation where present. The extent of vegetation removal is unknown at this time because facilities have not yet been designed. Because the project is located along canals in a previously disturbed agricultural area, few impacts to vegetation are anticipated.

Construction of the Keechelus-to-Kachess pipeline would require removal of vegetation where present, including forest areas, along the 5-mile corridor. Assuming a 75-foot-wide area of disturbance for the pipeline corridor, approximately 40 to 50 acres of vegetation would be removed. Much of the area would be revegetated with native vegetation and some would be permanently removed. Permanent impacts are discussed in Section 5.8. Additional temporary impacts on vegetation could also occur if stockpile or staging areas are needed during construction.

No short-term impacts on vegetation are anticipated from power subordination because there would be no construction requiring vegetation disturbance or removal.

4.8.2.3 Surface Storage Element

New storage facilities would include the construction of new access roads, staging and stockpile areas, and other work requiring the removal of vegetation. Some of the disturbed areas would be used only during construction and replanted with appropriate native vegetation after construction is complete. Other areas would be permanently impacted by new reservoirs. Permanent impacts on vegetation are discussed in Section 5.8. This element has the greatest potential to cause short-term impacts on vegetation.

Construction of Wymer Dam and Reservoir would likely require removal of vegetation where present in areas identified for temporary access roads, staging or stockpiling. To the extent possible, these areas would be located in the reservoir footprint area to minimize the area of permanent vegetation disturbance or removal. The Wymer location is an area of relatively undisturbed shrub-steppe habitat, and short-term vegetation removal could further reduce shrub-steppe habitat in the Yakima River basin. It is expected that disturbed areas would likely take several years to decades to reestablish the current vegetation after revegetation.

Construction of a new dam downstream of the existing Bumping Lake Dam would likely require access roads that could result in vegetation removal. Short-term impacts would be similar to those described above for the Wymer Dam. Bumping Lake is surrounded by second-growth conifer forest supporting a canopy of lodgepole pine, western hemlock, western red cedar, Englemann spruce, and a dense shrub understory. Some of this forest is late successional (old-growth) and vegetation removal for construction facilities could further reduce old-growth habitat in the Yakima River basin. It is expected that disturbed areas would likely take many decades to reestablish the current vegetation after revegetation. A more precise estimate would likely be determined during site-specific studies of vegetation as part of future environmental review if the projects are carried forward and proposed for implementation.

The Kachess Reservoir Inactive Storage project would likely require removal of vegetation where present in areas that would be disturbed for the gravity flow tunnel or temporary access roads, staging and stockpile areas. Vegetation removal may include forested areas and previously disturbed areas. It is expected that disturbed areas would likely take several years to decades to reestablish the current vegetation after revegetation.

4.8.2.4 Groundwater Storage Element

Most of the proposed groundwater storage would not affect native vegetation because the projects would likely be located in already disturbed areas, would rely mostly on existing infrastructure, and would require minimal construction. Some projects would require construction that would disturb or remove vegetation.

Shallow aquifer recharge projects would require the construction of infiltration systems such as ponds, canals, or spreading areas. The infiltration systems would be less than 5 acres in size and would require additional stockpile or staging areas during construction. Vegetation removal in the stockpile and staging areas would be considered short-term impacts, and the areas would be revegetated following construction.

Municipal ASR projects would require an existing water treatment facility and the construction of injection wells, a pump station, and conveyance lines. Short-term impacts on vegetation would be the same as described above for shallow aquifer recharge projects except on a smaller scale.

4.8.2.5 Habitat/Watershed Protection and Enhancement Element

Construction of some habitat restoration projects could result in short-term impacts on existing vegetation. Habitat enhancement projects on the mainstem of the Yakima River and its tributaries that involve streambank reshaping, channel reconstruction, and restoration of fish passage at manmade barriers would likely remove existing vegetation. These projects would also likely include the removal of nonnative vegetation, which would provide long-term benefits. Habitat restoration projects are intended to provide improved native plant species diversity, and temporarily disturbed areas would be revegetated after construction.

4.8.2.6 Enhanced Water Conservation Element

Construction of some of the conservation projects could result in short-term impacts on vegetation. However, many projects would be located in already disturbed areas and some would not require any construction. Agricultural water conservation projects could include lining canals or replacing them with piping. Short-term impacts on vegetation could occur if stockpile or staging areas are needed during construction.

4.8.2.7 Market Reallocation Element

The Market Reallocation Element does not require construction and no short-term impacts on vegetation would occur.

4.8.3 Mitigation Measures

Short-term impacts on vegetation caused by the development of the required facilities and infrastructure would be mitigated through site and facility design to minimize the need for vegetation removal to the extent possible. Facilities, access roads and staging areas should be located in areas of disturbed vegetation. If intact vegetation is present, the footprint of the facility should be minimized and situated to minimize disturbance. Where possible, vegetation that is removed for construction should be replaced with appropriate native plant species. Habitat restoration projects are expected to be an overall benefit to vegetation.

4.9 Wildlife

Short-term impacts are based on the temporary disturbance of wildlife in the vicinity of any construction project due to noise and human activity. Short-term impacts are considered more substantial when construction periods span multiple years or occur in rare or high-quality habitats. Impacts are considered minor where construction occurs over a short duration or in previously disturbed habitats.

4.9.1 No Action Alternative

Under the No Action Alternative, agencies and entities in the basin would continue to implement projects to improve water supply and fish habitat. Some of these projects could result in temporary displacements of wildlife due to noise and disturbance during construction. This includes projects for water conservation, artificial supplementation programs, and fish passage and habitat improvement. To the extent that NEPA or SEPA analysis would be required for these actions, appropriate documentation of the impacts from construction would be the responsibility of the project proponent, separate from this EIS.

4.9.2 Integrated Water Resource Management Alternative

Under the Integrated Plan, short-term impacts on wildlife are based on the degree of disturbance to wildlife in the vicinity of the project elements as a result of noise and human activity. Site-specific studies would be conducted to evaluate impacts on wildlife as part of future environmental review if the projects are carried forward and proposed for implementation.

4.9.2.1 Reservoir Fish Passage Element

Installation of fish passage facilities at the Cle Elum Dam would result in short-term impacts on wildlife and their habitats during construction. Wildlife species that inhabit riparian and upland forests in the project vicinity would be disturbed or displaced during the three years of project construction. Riparian areas are used by many species including bear, deer, elk, heron, waterfowl, small mammals, reptiles, amphibians, cavity-nesting birds, raptors, and a variety of songbirds. Short-term impacts on wildlife would likely be minor at Cle Elum Dam based on the availability of adjacent intact habitats that could be used by displaced wildlife. Some losses of individual animals could occur if there is not sufficient unoccupied habitat in the adjacent areas during construction. This would be offset somewhat by the relatively small areas disturbed. Construction-related noise impacts on wildlife at Cle Elum Dam are discussed in detail in the *Cle Elum Dam Fish Passage Facilities and Fish Reintroduction Project Final EIS* (Reclamation and Ecology, 2011c). In summary, the types of equipment that would be used during construction would produce noise above background levels up to approximately 2.4 miles from the construction site. This is a conservative estimate and the actual distance is likely to be much less due to topography, dense vegetation, and wind in the project area.

Short-term impacts on wildlife at Tieton, Keechelus, and Kachess Dams are expected to be similar to Cle Elum Dam. Bumping Lake Dam fish passage facilities would be constructed as part of the reservoir enlargement discussed in Surface Storage Element below. Impacts at Clear Lake Dam are expected to be of a lesser extent because of the more limited area of disturbance and the one-year construction period.

4.9.2.2 Structural and Operational Changes Element

Most of the proposed changes would result in minimal short-term impacts on wildlife during construction. Wildlife in the vicinity of the construction areas could experience noise and human activity and would likely avoid the area during construction periods. Site-specific studies would be conducted to evaluate impacts on wildlife as part of future environmental review if the projects are carried forward and proposed for implementation.

Short-term impacts associated with raising the pool level behind Cle Elum Dam would be related to disturbance from modifying the spill gates and installing shoreline protection for private residences. Both activities are expected to have little or no impacts on wildlife in the vicinity because they would be located in developed areas that provide limited habitat for wildlife.

Human activity and noise associated with the canal modifications proposed for KRD and the Wapatox Canal would result in short-term impacts on wildlife in the vicinity. Wildlife would likely avoid the area during construction periods. Both projects are located in areas that have been disturbed for agriculture and provide limited habitat for wildlife. Therefore, impacts are expected to be minimal.

Impacts on wildlife associated with construction of the Keechelus-to-Kachess pipeline are expected to be greater because of the higher likelihood of wildlife in the forested habitat. No short-term impacts are anticipated from the power subordination projects because no construction would occur.

4.9.2.3 Surface Storage Element

New storage facilities would include the construction of new access roads, dams, and other construction activities that would introduce noise and human activity. Wildlife in the vicinity would likely avoid the area during construction periods. This element has the greatest potential for short-term impacts on wildlife because of the long duration and large scale of construction. Long-term impacts on wildlife due to the additional area of inundation are discussed in Chapter 5.

The proposed Wymer Reservoir would affect approximately 1,055 acres of shrub-steppe wildlife habitat used by birds, reptiles, and small and large mammals. Many species of migratory and resident birds would be affected during construction, such as sage thrasher, western meadowlark, loggerhead shrike, and long-billed curlew. Nests and eggs on the ground and in shrubs would be destroyed if construction activities and reservoir filling occurred during the breeding season(s) for wildlife. The new reservoir may effect on the movement of elk, though there is little evidence that herds use Wymer area (see section 3.9), bighorn sheep, and mule deer. Bighorn sheep may avoid the area during the winter if construction occurs at that time. Based on the scarcity of similar habitat in the vicinity that could be used by wildlife within the Wymer Reservoir footprint combined with the extended construction period, short-term impacts on wildlife could be potentially substantial.

Construction of a new dam downstream of the existing Bumping Lake Dam would require access roads, staging areas, and the dam site in a forested area. Construction would cause temporary displacement of wildlife. Removal of riparian vegetation would affect wildlife using the habitat during construction. Some losses of individual animals could occur if there is not sufficient unoccupied habitat in the adjacent areas during construction. Long-term impacts to wildlife, such as permanent habitat removal and inundation in an area designated as habitat for northern spotted owl, are described in section 5.9.2.3 and in 5.10.2.3 with regards to threatened and endangered species.

Construction of the gravity flow tunnel or the pump station (whichever option is selected) for the Kachess Reservoir inactive storage would also displace wildlife which would likely avoid the area during construction periods. Impacts would be on a smaller scale than the Bumping and Wymer projects.

4.9.2.4 Groundwater Storage Element

Construction of the proposed groundwater storage projects would include the construction of new infiltration or recovery systems that would introduce noise and human activity. Wildlife would likely avoid the location of infiltration ponds and other structures during construction periods. Because the potential locations of the aquifer recharge facilities are in agricultural areas with disturbed habitats, few wildlife species are expected to be impacted. Short-term impacts would be similar for the shallow aquifer recharge projects and the ASR projects, but the ASR projects would be smaller in scale.

4.9.2.5 Habitat Enhancement and Protection Element

Both the targeted watershed protection and enhancement and mainstem floodplain and tributary habitat enhancement programs would include construction of habitat restoration projects that could result in temporary impacts on wildlife in the vicinity. Projects on the mainstem and tributaries of the Yakima River that involve streambank reshaping, channel reconstruction, and restoration of fish passage at manmade barriers would likely alter existing habitats through removal of vegetation. Habitat restoration projects are intended to provide improved habitat for wildlife in the long term. Wildlife in the vicinity of the restoration project may be temporarily displaced by noise and construction activities. Impacts are expected to be minor for projects that involve a few hundred feet of streambank and greater for larger projects.

4.9.2.6 Enhanced Water Conservation Element

Construction of some of the conservation projects could result in short-term impacts on wildlife during construction. Human activity and noise associated with construction of conservation projects would result in short-term impacts on wildlife in the vicinity. Wildlife would likely avoid the location of canals or ditches proposed for piping during construction periods. However, most projects would be located in already disturbed areas and some would not require any construction. Because most areas provide poor habitat for wildlife, few impacts are anticipated.

4.9.2.7 Market Reallocation Element

The Market Reallocation Element would not require construction or result in short-term impacts on wildlife.

4.9.3 Mitigation Measures

No specific mitigation is proposed for the temporary displacement of wildlife because this is expected to be a minor impact. Wildlife is likely to return following construction, except in the area that would be inundated by a new or expanded reservoir. Those impacts are considered long term and are discussed in Section 5.9. Where possible, vegetation that is removed for construction would be replaced with appropriate native plant species. Measures to reduce noise and limit human activity should be incorporated for project activities that are near high-quality habitats such as old-growth or riparian zones. Habitat restoration projects are expected to be an overall benefit.

4.10 Threatened and Endangered Species

Short-term impacts on listed species would be associated with any land or in-water construction that would affect suitable habitat or result in noise and human activity. Short-term impacts are considered more substantial when construction periods span multiple years or occur in rare or high-quality habitats. Impacts are considered minor where construction occurs over a short duration or in previously disturbed habitats.

4.10.1 No Action Alternative

Under the No Action Alternative, projects that are currently funded and have a schedule for implementation would be undertaken by various entities and agencies as described in Chapter 2. These projects could result in temporary displacements of listed wildlife due to noise and disturbance during construction. To the extent that NEPA or SEPA analysis would be required for these actions, appropriate documentation of the impacts from construction would be the responsibility of the project proponent, separate from this EIS.

4.10.2 Integrated Water Resource Management Alternative

Under the Integrated Plan, short-term impacts on listed species are based on the degree of disturbance resulting from any land or in-water work. Short-term impacts on bull trout and steelhead are expected to occur with some of the elements where in-water work would occur and temporary fish removal would be necessary. Impacts on northern spotted owl could occur with some of the elements that would produce increased noise and human activity during construction. Site-specific studies would be conducted to evaluate impacts on listed species as part of future environmental review if the projects are carried forward and proposed for implementation.

4.10.2.1 Reservoir Fish Passage Element

At Cle Elum Dam, habitat for listed fish species, including bull trout and Middle Columbia River steelhead, would be temporarily affected by construction of the fish ladder and adult collection facility. Individual fish would be affected by temporary removal during construction. Other short-term impacts include increased potential for erosion, sedimentation, or contamination from vehicle oil or gas spills. Reclamation will comply with the Essential Fish Habitat Conservation Recommendations provided by NMFS in its concurrence letter for Endangered Species Act consultation on the Cle Elum Dam project (Reclamation and Ecology, 2011c).

Other listed wildlife species may occur in the vicinity, such as gray wolf, fisher, grizzly bear, and Canada lynx. These species occur rarely in the project vicinity and would likely avoid the area during the three-year construction period. Short-term impacts on listed wildlife would likely be minor at Cle Elum Dam based on the availability of adjacent intact habitats that could be used by displaced wildlife. If listed species are present in the area and may be affected by the proposed action, identified conservation measures would be followed.

Impacts on threatened and endangered species are expected to be similar for construction of fish passage facilities at Rimrock, Keechelus, and Kachess Dams. Steelhead are found in specific areas of the Yakima River basin and bull trout are found upstream of Rimrock Reservoir and in both the Keechelus and Kachess Reservoirs. Impacts would be similar at Clear Lake Dam, but would be of lesser magnitude because of the smaller project scale and shorter construction period. At the Bumping Lake Dam, fish passage facilities would be constructed as part of the proposed reservoir enlargement (impacts are described in the Surface Water Storage Element).

4.10.2.2 Structural and Operational Changes Element

Raising the pool level behind Cle Elum Dam is not expected to affect listed fish species because all work would take place on top of the existing dam. Other listed wildlife in the vicinity would likely avoid the area during construction (similar to the impacts described for Cle Elum Dam fish passage). Installation of shoreline protection measures would also generate noise and activity that would displace wildlife. No Middle Columbia River steelhead are located above the dam. Isolated populations of bull trout are located above the dam and the area is critical habitat for bull trout. Short-term impacts are anticipated to be minor due to the limited extent of habitat that could be affected.

Modifications to the KRD and Wapatox Canals are not expected to affect listed species because most work would take place along existing canals which do not provide fish habitat. Construction of the pump station for Manastash Creek would occur in the Yakima River which provides habitat for Middle Columbia River steelhead and bull trout. Short-term impacts on listed fish would be similar to those described for Cle Elum Dam. Individual fish would be affected by temporary removal during construction and there would be increased potential for erosion, sedimentation, or contamination from vehicle oil or gas spills. Other listed wildlife are not likely to occur in the vicinity because of the lack of suitable habitat.

For the Keechelus-to-Kachess pipeline, short-term impacts on listed fish species would be associated with the installation of the pipeline at the Keechelus Dam outlet. Similar to the impacts described for Cle Elum Dam, individual fish would be affected by temporary removal and there would be increased potential for erosion, sedimentation, or contamination. Short-term impacts on listed wildlife species, such as gray wolf, fisher, grizzly bear, and Canada lynx, could occur due to the presence of suitable habitat for these species. Human activity and noise associated with construction of the Keechelus-to-Kachess pipeline could result in displacement of listed wildlife in the vicinity during construction periods.

No construction is associated with the power subordination project. All fish species would immediately benefit from the additional subordination due to the improvement in out-migration flows.

4.10.2.3 Surface Storage Element

New storage facilities would include the construction of new access roads, dams, and other construction activities that would introduce noise and human activity or require in-water work. In-water work and ground disturbance would be conducted in accordance with species-specific construction timing windows for breeding or spawning season avoidance and other mitigation measures to reduce short-term impacts.

Construction at Wymer Dam would occur in habitat for greater sage-grouse, a Federal candidate species, and the threatened Middle Columbia River steelhead and bull trout in the Yakima River. Human activity and noise associated with construction of new access roads, the reservoir and dam, and water conveyance facilities would disturb or displace listed wildlife such as sage-grouse in the vicinity. Construction of the pump station near the mouth of Lmuma Creek would result in short-term impacts on listed fish species. Individual fish would be temporarily affected during removal from the stream during construction, and the potential for erosion, sedimentation and contamination of stream habitats would be increased. Based on the known presence of listed wildlife in the vicinity and the extended construction period, short-term impacts on listed fish and wildlife could be potentially substantial. However, a moderate level of human activity and noise in the vicinity is present due to an existing state highway, human use of the river corridor, and existing agricultural uses.

Short-term impacts on listed fish and wildlife associated with enlargement of the Bumping Lake Reservoir would be similar to those described for Wymer Dam. Habitat for listed fish species, including bull trout and Middle Columbia River steelhead, would be temporarily affected by construction of the new dam. Individual fish would be affected by temporary removal during construction. Other short-term impacts include increased potential for erosion, sedimentation, or contamination from vehicle oil or gas spills. Based on the known presence of listed wildlife in the vicinity, including northern spotted owl, short-term impacts on listed fish and wildlife could be potentially substantial.

Short-term impacts on listed fish and wildlife for the Kachess Reservoir inactive storage project would be similar to those described for Cle Elum Dam fish passage. Human activity and noise associated with construction of the fish ladder and adult collection facility may disturb wildlife in the vicinity. Fish would be exposed to an increased potential for erosion, sedimentation, or contamination from vehicle oil or gas spills.

4.10.2.4 Groundwater Storage Element

Shallow aquifer recharge projects would require the construction of infiltration ponds, canals, and other facilities. The projects would be located in agricultural areas and, therefore, are expected to have limited impacts on listed species which are not likely to be present in the area. Most municipal ASR facilities would be located in urban areas with no habitat for listed species. Water diversions from the Yakima River could impact habitat for listed fish species. Short-term impacts on listed species would be similar to those described for the Manastash pump station in the Structural and Operational Changes Element unless an existing diversion is used.

4.10.2.5 Habitat/Watershed Protection and Enhancement Element

Construction of some habitat restoration projects could result in temporary impacts on listed fish and wildlife in the vicinity. Projects on the mainstem and tributaries of the Yakima River that involve streambank reshaping, channel reconstruction, and restoration of fish passage at manmade barriers would likely alter existing habitats through removal of vegetation and in-water work. It is anticipated that both small and large projects would be proposed under this element. Short-term impacts on listed fish, such as bull trout and Middle Columbia River steelhead, would be associated with those projects where in-water work is required. Such short-term impacts would likely be similar to other ongoing habitat/watershed protection and enhancement projects in the Yakima River basin, which have been documented as not adversely affecting listed fish species.

4.10.2.6 Enhanced Water Conservation Element

Construction of some the conservation projects could result in short-term impacts during construction. However, most projects would be located in already disturbed areas and some may not require any construction. Short-term impacts on listed species would be the same as described above for Shallow Aquifer Recharge projects. No short-term impacts are anticipated with the municipal and domestic conservation program because no construction would occur.

4.10.2.7 Market Reallocation Element

The Market Reallocation Element would not require construction or result in short-term impacts on listed fish and wildlife.

4.10.3 Mitigation Measures

The impacts on listed species caused by the development of the required facilities and infrastructure would be mitigated through site and facility design to minimize the need for habitat removal and construction activity. The design should incorporate an evaluation of existing wildlife habitats and species in the vicinity and a rare-plant survey. Habitat that is determined to be of significant importance (e.g., presence of listed species) should be preserved to the greatest extent possible. Facilities, access roads and staging areas should be located in areas of disturbed vegetation. If intact vegetation is present, the footprint of the facility should be minimized and situated to result in the least amount of disturbance. Where possible, vegetation that is removed for construction would be replaced with appropriate native plant species. Habitat restoration projects are expected to provide an overall benefit to listed fish and wildlife.

Mitigation for listed fish and wildlife species would be associated with conservation measures identified during future Endangered Species Act consultation.

4.11 Visual Quality

This section analyzes the short-term impacts on visual quality resulting from implementation of the Integrated Plan and the No Action Alternative. The analysis primarily entails the identification and description of changes to visual resources in the landscape during construction. Short-term impacts relate to the presence of construction activity and equipment and its effect on the visual landscape and the sensitivity of viewers.

4.11.1 No Action Alternative

Under the No Action Alternative, some of the individual actions undertaken by various entities and agencies that are currently funded and have a schedule for implementation could require construction, resulting in short-term visual resource impacts. Short-term impacts could include the presence of construction activities, fugitive or uncontrolled dust, heavy equipment, and other temporary structures at varying intensities and durations during the construction period for individual projects. Views of the construction sites would generally create an unattractive visual setting during the construction period. To the extent that NEPA or SEPA analysis would be required for these actions, appropriate documentation of the visual resource impacts from construction would be the responsibility of the project proponent, separate from this EIS.

4.11.2 Integrated Water Resource Management Plan Alternative

4.11.2.1 Reservoir Fish Passage Element

Construction activities, fugitive dust, heavy equipment, cofferdams, and other temporary structures would be in evidence at varying intensities and durations during the construction period for individual projects. Views of the construction sites would generally create an unattractive visual setting during the construction period. Viewpoints are generally limited to local roads, highways, and public access areas along the rivers and reservoirs. In areas with nearby residences, residents may also have views of the construction area.

4.11.2.2 Structural and Operational Changes

Modifications to spill gates, fish bypass systems, and canals would create short-term, minor, localized, and temporary visual impacts during the construction period of individual projects. Because access to and views of these facilities are limited, few people would notice the construction. The power subordination project does not require construction and would have no impacts on visual resources.

For the Keechelus-to-Kachess pipeline project, construction equipment and activities would be visible to residents and recreationists in the area, and in places to vehicles travelling on I-90, a National Scenic Byway and a Washington State Scenic and Recreational Highway. Travelers on this highway could have a heightened sensitivity to visual intrusions, so construction may result in visual impacts to highway drivers.

4.11.2.3 Surface Storage Element

Visual impacts during construction of new storage facilities would be extensive during the construction period. Construction would require clearing, stump removal and grading of the reservoir area, and construction of an earthfill or other dam. All of these activities would change existing landscapes, possibly block existing views, and create a potentially interesting, but unattractive visual intrusion. These activities could last several years. The extent of impacts would depend on how visible the construction site would be to the public, the extent to which the scenic quality of the existing landscape has already been modified, the sensitivity of the viewing public, and the viewers' expectations based upon the visual character of the setting in which the alterations to views is taking place.

Because the Wymer Dam site is relatively isolated from public areas, there would be limited views of construction activity and equipment. The public would have limited views of the dam construction site, with the only views being brief glimpses from SR 821, the Yakima River Canyon which is designated a State Scenic Byway. Construction associated with the pump station on the Yakima River would be visible to travelers on the highway as well as recreationists on the river. Travelers on this highway could have a heightened sensitivity to visual intrusions and there has been relatively little modification of the scenic quality of the landscape, so construction may result in visual impacts to highway drivers. It is likely that the Bureau of Land Management (BLM) Visual Resource Inventory management objectives would not be met in the short term (four years) at certain locations. A more detailed analysis of potential impacts on visual resources from Wymer Dam construction would be completed in accordance with the methods described in BLM visual assessment guidelines as part of future project-level environmental review.

Because of Bumping Lake's location in a popular recreation area, visual impacts during construction could be significant. Construction equipment and activities would be visible to recreationists and residents of the area. Viewpoints around the reservoir construction area would primarily be from USFS roads and adjacent trails. Seasonal residences and recreation facilities along the existing reservoir would be permanently removed during construction. Users of wilderness areas typically have a heightened sensitivity to visual intrusions associated with construction activities. Except for the reservoir and recreational facilities, there has been relatively little modification of the scenic quality of the Bumping Lake landscape. It is likely that the USFS Visual Quality Objectives and Scenic Integrity Levels would not be met in the short term (three to five years) at certain locations. A more detailed analysis of potential impacts to visual resources at Bumping Lake would be completed in accordance with the methods described in the USFS Scenic Management System as part of future project-level environmental review.

Construction equipment and activities associated with the Kachess Reservoir Inactive Storage project would be visible to residents and recreationists on Kachess Reservoir and in the area of the new tunnel. The impact would be minor because of the limited duration of construction at any one location and limited views of the construction area.

4.11.2.4 Groundwater Storage Element

No significant changes to visual resources are anticipated during construction of the groundwater storage element projects. Construction equipment and activities for shallow aquifer recharge would be visible in agricultural areas and from adjacent roadways. For ASR projects, most construction would occur at existing treatment facilities and generally would not be visible to the public. Impacts during construction would be minor.

4.11.2.5 Habitat/Watershed Protection and Enhancement Element

Construction of enhancement projects involving streambank reshaping, channel reconstruction, and restoring fish passage at manmade barriers would have the greatest temporary visual impacts of the fish habitat enhancement projects. Potential impacts would be related to the intensity of construction activities, presence of heavy equipment, and temporary impacts on vegetation. Construction areas could be visible from adjacent areas and to boaters and recreationists on the rivers. Visual impacts would be minor and temporary because of the small scale of the projects and short construction periods. In project areas where vegetation is removed or banks graded, the area would appear different until new vegetation is established. This visual impact could last approximately three years.

4.11.2.6 Enhanced Water Conservation Element

Conservation projects would consist of improvements to existing irrigation systems in rural areas. No changes to visual resources are anticipated with most conservation projects. Construction equipment and activities would be visible from surrounding agricultural areas and roadways. No short-term impacts on visual quality are anticipated for the municipal and domestic conservation program since it involves no construction.

4.11.2.7 Market Reallocation Element

No construction is associated with market reallocation; therefore, there would be no short-term impacts on visual resources.

4.11.3 Mitigation Measures

Specific mitigation measures would be developed for individual construction projects if they are advanced for implementation. Typical mitigation measures include the following:

- Limiting the area of ground disturbance through site and facility design;
- Locating temporary construction access roads and staging areas within previously disturbed areas or colocating them with proposed project activities;
- Utilizing flat, nonreflective earth-tone colors on heavy equipment that will be present onsite for 6 months or longer within visually sensitive areas; and

- Removing and restoring temporary access roads and other temporarily affected areas to their appropriate native vegetation following construction.

4.12 Air Quality

Short-term air quality impacts from construction activities within the Yakima River basin study area would be exempt from air quality permitting requirements. However, construction contractors would be required to comply with WAC 173-400-040 which sets forth various standards for construction equipment, methods, and best practices to minimize effects of construction-related emissions. The requirements under WAC 173-400-040 are not impact thresholds as such, but requirements for construction activities that specific projects must incorporate. As such, these regulations are not used to determine the significance of temporary air quality impacts in a programmatic EIS of this type. Rather, the general types of anticipated emissions from different construction elements under the alternatives are discussed qualitatively.

Compliance with the national and state ambient air quality standards, and with visibility goals within federally designated Class I areas, are addressed regionally through the Washington State Implementation Plans and are not addressed at a project level. Therefore, these standards and regulations, although important for regional air quality and conformity purposes, are not used to determine the significance of impacts for the specific actions discussed below. However, these regulations are included in the qualitative discussion for each project element, where applicable, to provide some additional context for understanding the likely impact of each proposed element on general air quality.

4.12.1 No Action Alternative

Under the No Action Alternative, Reclamation and Ecology would not carry out the Integrated Plan. However, various agencies and other entities would likely continue to undertake individual actions to accomplish some water resources improvements (Section 2.3). Short-term construction-related air quality impacts under the No Action Alternative would largely result from emissions resulting from the transit and operation of equipment used for construction of projects. In addition, construction activities have the potential to create windblown particulate matter (dust), particularly during the clearing and grading of land, and from the transport and placement of excavation material, soils and other materials.

Overall, because existing air quality in the study area is currently in attainment with the national standards for criteria pollutants, and due to the relatively limited scope of construction in any one location, and the BMPs required by the WAC for construction activities, short-term air quality construction impacts would be expected to be temporary, relatively minor, and not likely to cause exceedances of the national standards.

4.12.2 Integrated Water Resource Management Plan Alternative

Short-term construction-related air quality impacts under the Integrated Plan would largely result from emissions from transporting and operating construction equipment. In addition, construction activities have the potential to create windblown particulate matter (dust), particularly during the clearing and grading of land, and from the transport and placement of excavation material, soils and other materials.

The amount of dust emissions from construction activities would depend on meteorological conditions (particularly wind speeds), soil types and moisture content, and the surface area of soils or sediments exposed.

The level of short-term construction emissions from the various projects would depend on the amount of material moved and the number of pieces of equipment used in the peak day and peak year of construction activity. The major sources of volatile organic compounds, carbon monoxide, and nitrogen oxide emissions are expected to be the onsite construction equipment and haul trucks. The projects would require varying levels of construction with heavy machinery and equipment. Typical construction activities would include excavation, earthwork, trenching, tunneling, and concrete work. Most trenching work would involve little stationary equipment and would be complete at any one location within a few weeks.

Construction emissions from construction sites would be exempt from air quality permitting requirements. However, contractors would be required to comply with WAC 173-400-040 through the use of BMPs to minimize construction-related emissions. Construction emissions would vary from day to day, depending on the timing and intensity of construction. Dust emissions may be noticeable by recreational users and nearby residents.

Overall, because existing air quality in the study area is currently in attainment with the national standards for criteria pollutants, the relatively limited scope of construction in any one location, and the BMPs required by the WAC for construction activities, short-term air quality construction impacts would be temporary, relatively minor, and not likely to cause exceedances of the national standards.

4.12.2.1 Reservoir Fish Passage Element

Air quality impacts from the construction of fish passage facilities would be similar to the general impacts described above. Cle Elum, Tieton, Keechelus, and Kachess Dams would require similar levels of construction activity and would generate similar amounts of construction emissions and dust. The Clear Lake Dam project is of a smaller scale and shorter duration and would produce lesser air quality impacts. Bumping Lake Dam fish passage facilities would be installed as part of reservoir expansion and impacts are included in the Surface Storage Element below.

Short-term air quality construction impacts associated with constructing fish passage facilities would be temporary, relatively minor, and not likely to cause exceedances of the national standards. The primary type of air pollution during construction would be combustible pollutants from equipment exhaust and small dust particles from disturbed soils becoming airborne. Short-term emissions from construction sites are exempt from air quality permitting requirements. Construction emissions would vary from day to day, depending on the timing and intensity of construction. Dust emissions would be noticed by recreational users and residents near the dams.

4.12.2.2 Structural and Operational Changes

Soil disturbances during construction have the potential to create windblown particulate matter (dust), particularly during clearing and grading, and during the transport of vehicles and materials. Short-term construction impacts from the Cle Elum Dam pool raise project would result from emissions from mechanized construction equipment used for modifying the spillway gates at the Cle Elum Dam and to construct shoreline protection measures around the reservoir. Canal modifications for the KRD and Wapatox projects would generate emissions from mechanized construction equipment. Short-term construction impacts would result from emissions from mechanized construction equipment used to install pipelines to convey water from Keechelus Reservoir to Kachess Reservoir.

Overall, the air quality impacts of the Structural and Operational Changes Element are expected to be similar to those for the Fish Passage Facilities Element due to the relatively limited scope of construction in any one location.

No short-term air quality impacts are anticipated from operational changes associated with the subordination of power at the Roza Dam and Chandler Powerplants.

4.12.2.3 Surface Storage Element

Short-term construction impacts would result from emissions from mechanized construction equipment used to build Wymer Dam and associated structural features, build a new Bumping Lake Dam and expand Bumping Lake Reservoir, and construct the facilities needed for the Kachess Reservoir inactive storage project. Soil disturbances during construction have the potential to create windblown particulate matter (dust), particularly during clearing and grading, and during the transport of vehicles and materials. Short-term air quality impacts are expected to be similar to those described for the Fish Passage Element, but construction of reservoirs at Wymer and Bumping Lake would cause air quality impacts for a longer time period due to the larger size of the facilities. Overall, the impacts from projects are expected to be temporary, minor, and not likely to cause exceedances of the National Ambient Air Quality Standards (NAAQS).

4.12.2.4 Groundwater Storage Element

Short-term construction impacts from the Groundwater Storage Element are expected to be temporary and relatively minor. Existing air quality in the study area is currently in attainment with the national standards for criteria pollutants, the scope of construction in any one location is relatively limited, and BMPs would be required by the WAC for construction activities.

4.12.2.5 Habitat/Watershed Protection and Enhancement Element

Construction projects associated with the Habitat/Watershed Protection and Enhancement element would be relatively small in scale and are expected to have short-term air quality impacts similar to the Fish Passage Element, but of a shorter duration.

4.12.2.6 Enhanced Water Conservation Element

Due to existing air quality in the study area, the relatively limited scope of the agricultural conservation projects, and the BMPs required by the WAC, short-term impacts are expected to be temporary and minor.

No short-term air quality impacts are anticipated from the municipal and domestic conservation program because no construction would be required.

4.12.2.7 Market Reallocation Element

No short-term air quality impacts are anticipated from efforts to reduce barriers to water trading between water users because no construction is required.

4.12.3 Mitigation Measures

BMPs that could be used to reduce construction impacts for all alternatives include the following:

- Complying with applicable dust control policies and plans;
- Spraying dry soil with water to reduce dust;
- Minimizing idling of equipment when not in use;
- Covering dirt and gravel piles; and
- Sweeping paved roadways to reduce mud and dust.

If future NEPA documentation of specific projects included in the Integrated Plan predicts that emissions are anticipated to exceed the general conformity *de minimis* thresholds, additional mitigation may need to be applied to the emission sources. Such mitigation could include the following:

- Use of emulsified or aqueous diesel fuel;

- Use of equipment with engines that incorporate exhaust gas recirculation systems;
- Installation of a lean nitrogen oxide catalyst in the engine exhaust system;
- Wet suppression and soil stabilization;
- Wind fencing around the active area;
- Paving of onsite roadways;
- Truck wheel washing facilities at site exits on public roadways; and
- Maintaining minimal truck bed freeboard or covering haul truck beds.

4.13 Climate Change

Projects proposed as part of the Integrated Plan could both affect and be affected by climate change. Projects could affect climate change by increasing carbon emissions that contribute to global warming. Ecology guidance suggests that increased carbon emissions of less than 25,000 metric tons per year are presumed not to be significant (Ecology, 2011a). As noted in Section 3.13, climate change could affect precipitation, snowmelt and runoff in the Yakima River basin, affecting water management in the basin. For purposes of this Draft Programmatic EIS, the effects of proposed projects on climate change are discussed as short-term impacts. The effects of climate change on the projects are discussed as long-term impacts (Section 5.13).

4.13.1 No Action Alternative

The No Action Alternative would result in a continuation of currently planned actions, implementation of which would occur independently. Some of these actions may help to reduce effects associated with climate change, while others may worsen the effects. Piecemeal implementation would likely result in a continuation of current trends. To the extent that NEPA or SEPA analysis would be required for these actions, appropriate documentation of the impacts from construction would be the responsibility of the project proponent, separate from this EIS.

4.13.2 Integrated Water Resource Management Plan Alternative

For all the elements of the Integrated Plan that involve construction activities, greenhouse gas emissions would be generated during construction. Information is not currently available to estimate whether construction of the Integrated Plan elements would exceed the Ecology guidance level of 25,000 metric tons. The amount of emissions generated would depend on the amount of heavy construction and the duration of construction for specific projects, as well as the timing of construction of the multiple elements. Potential greenhouse gas emissions from construction projects would be estimated and potential impacts analyzed separately when specific project details are available. In general, the increased emissions are not expected to cause appreciable impacts on climate change because they would be small compared with local, national, and global levels of emissions.

4.13.2.1 Reservoir Fish Passage Element

Construction work for fish passage projects would last two to three years at each site. Most of the heavy construction work would last only a few months out of that time period. During the remainder of the construction period, increased emissions would primarily be limited to worker vehicles accessing the sites. Because potential fish passage sites are in relatively remote areas, workers would likely have to drive 20 to 50 miles to access the sites. Heavy construction equipment would be needed for excavating intake structures, cofferdam placement and removal, hauling materials, concrete pouring, and similar activities. The increased emissions are not expected to cause appreciable impacts because they would be relatively small.

4.13.2.2 Structural and Operational Changes

Construction associated with raising the level of Cle Elum Reservoir includes installing flashboards on the dam and shoreline protection around the reservoir. Construction is expected to last three years, but actual work would likely be complete at one given location within a few weeks. Construction equipment would produce greenhouse gas emissions, but the project is not expected to cause appreciable impacts because it would be small compared with local, national, or global emissions.

Most of the modification for the KRD and Wapatox projects would be completed at one given location within a few weeks, with overall construction lasting a few months. Emissions would be generated by worker vehicles, trenching equipment, concrete pouring, hauling materials, and similar activities. Construction equipment would generate increased greenhouse gas emissions, but the increased emissions are not expected to cause appreciable impacts because they would be small compared with local, national, or global emissions.

The Keechelus-to-Kachess pipeline project would have similar climate change impacts to those of the KRD Canal Modifications project, except this larger construction project would produce more greenhouse gas emissions.

Subordinating power at Roza Dam and Chandler Powerplants is not expected to generate increased greenhouse gas emissions since there would be no construction.

4.13.2.3 Surface Storage Element

The Surface Water Storage Element has the greatest potential for generating greenhouse gas emissions because of the duration and intensity of construction.

Construction would last three to five years at Wymer and Bumping Lake Dams and would require extensive use of heavy machinery. Equipment would be required for excavation and grading, hauling materials, access road construction, vegetation removal from areas planned for inundation, and similar activities. Because the sites are in relatively remote areas, workers would likely have to drive 20 to 50 miles to access the site. Although these large construction projects would produce greenhouse gas emissions, none of the increased emissions are expected to cause appreciable impacts because they would be small compared with local, national, or global emissions.

Climate change impacts from the Kachess Reservoir inactive storage project would be similar to those described for Wymer Dam and pump station except on a smaller scale because much less construction and clearing would be required.

4.13.2.4 Groundwater Storage Element

Construction activities for the shallow aquifer recharge projects could last from a few weeks to several months. The increased emissions are not expected to cause appreciable impacts because they would be relatively small. Impacts of the ASR projects would be similar to the Shallow Aquifer Recharge projects but smaller in scale because less excavation and equipment would be required.

4.13.2.5 Habitat/Watershed Protection and Enhancement Element

Construction associated with habitat enhancement projects would likely generate a limited amount of emissions. Most construction work for fish habitat enhancement would be completed at any one location within a few weeks or months. Heavy equipment would be limited to that needed for excavation and grading. Many of the areas where enhancements would occur are closer to populated areas, limiting worker vehicle miles. The increased greenhouse gas emissions are not expected to cause appreciable impacts because they would be relatively small.

4.13.2.6 Enhanced Water Conservation Element

Construction required for the agricultural water conservation program is not expected to cause appreciable impacts because it would be relatively small. The municipal and domestic conservation program of education and incentives is not expected to generate increased greenhouse gas emissions because no construction is involved.

4.13.2.7 Market Reallocation Element

Market reallocation would not require construction and therefore would not generate greenhouse gas emissions.

4.13.3 Mitigation Measures

Emissions from construction vehicles could be reduced by following BMPs such as maintaining engines in good working order and minimizing trip distances. Other measures to minimize emissions include coordinating project planning, combining workers' trips, and using local materials.

4.14 Noise

This section uses standard information about noise levels from typical construction equipment to present a generalized, qualitative discussion of short-term changes in noise during construction. Construction and blasting noise is exempt from regulation if conducted between 7 a.m. and 10 p.m. (daytime hours) per WAC 173-60-050. In addition, noise created by traffic (including heavy construction vehicles) on public roads is exempt from regulation under WAC 173-60-050. Therefore, there are no applicable standards to determine the significance of short-term noise impacts from construction activities.

4.14.1 No Action Alternative

Projects that would be implemented under the No Action Alternative have the potential to generate noise during construction. Those impacts would be evaluated separately from this EIS by the agencies or entities implementing the projects.

4.14.2 Integrated Water Resource Management Plan Alternative

Short-term noise impacts resulting from the Integrated Plan would be associated with transporting and operating mechanized construction equipment, as well as the potential for blasting under certain conditions.

The increase in short-term noise resulting from construction would be temporary and limited to the construction period. Construction noise conducted between 7 a.m. and 10 p.m. (daytime hours) and traffic noise from public roads are exempt from regulation under the Washington Administrative Code as described above.

4.14.2.1 Reservoir Fish Passage Element

Short-term noise impacts would result from construction activities associated with building fish passage structures. Short-term construction impacts would be similar at each proposed site and, more specifically, would result from transporting and operating mechanized construction equipment. For reference, noise levels of typical construction equipment at 50 feet from the source of the noise are shown in Table 4-1.

Table 4-1 Construction Equipment Average Maximum Noise Level (L_{max})

Equipment	Examples	Actual Measured Average L_{max}[a] at 50 ft in Decibels
Earth Moving	Compactors	83
	Front End Loader	79
	Backhoe	78
	Tractors	84
	Graders	89
	Pavers	77
Materials Handling	Concrete Mixer Truck	79
	Concrete Pump Truck	81
	Crane	81
Stationary	Pumps	81
	Compressors	78
	Generators	81
Hauling	Dump Truck	76
Impact Equipment	Pile drivers	110
Impact Tools	Jackhammers	81
	Rock Drills	81
	Pneumatic Tools	85

Source: FHWA, 2006.
[a] L_{max} is the maximum value of a noise level that occurs during a single event.

Depending on the activity, peak noise levels from equipment shown in Table 4-1 would range from 69 to 110 A-weighted decibels (dBA) at 50 feet from the source. However, noise levels decrease with distance from the source at a rate of approximately 6 to 7.5 dBA per doubled distance. For example, noise levels from construction equipment would range from approximately 57 to 98 dBA at a distance of 200 feet; from 51 to 92 dBA at 400 feet; and from 45 to 86 dBA at 800 feet.

The increase in noise would be temporary, localized, and limited to daytime hours. People recreating in the area adjacent to the dams would be subject to construction noise. These users may choose to recreate in other areas of the reservoirs during the construction period.

Although not regulated, short-term construction noise can be disruptive during certain activities. Some of the construction equipment that would be used to install the fish passage facilities would operate at noise levels high enough to cause hearing damage at very short distances (less than 50 feet). Because the noise levels would quickly dissipate below those levels, the only people likely to be exposed to damaging noise levels would be construction workers and other workers at the dam. Those workers would wear hearing protectors to prevent hearing damage. Noise impacts at Clear Lake Dam would be similar to those described for the major reservoirs; however, the duration of construction would be much shorter.

4.14.2.2 Structural and Operational Changes Element

Short-term construction impacts would result from noise associated with transporting and operating mechanized construction equipment. Equipment used for the construction of new structural and operational elements would be similar to that described in Table 4-1. The magnitude of short-term construction impacts in each case would depend on specific types of equipment used and the distance between construction activities and the nearest noise-sensitive property. However, overall construction noise impacts are likely to be relatively minor, localized, and limited to daytime hours.

The Keechelus-to-Kachess pipeline may require the use of blasting or impact tools and equipment to construct the pipeline. That would result in higher levels of construction noise.

No short-term noise impacts are anticipated from operational changes associated with the subordination of power at the Roza Dam and Chandler Powerplants because there would be no construction.

4.14.2.3 Surface Storage Element

Short-term noise impacts at Wymer and Bumping Lake Dams would be of greater intensity than other Integrated Plan projects because of the larger scale and longer duration of the projects. The projects are likely to require impact tools and equipment that generate more noise (Table 4-1).

Wymer Dam is located in an isolated canyon with few residents, but it is close to the heavily used recreation corridor through the Yakima River Canyon. Recreational users would be exposed to construction noise. Noise from the dam site would be moderated by the distance to the river area. Construction noise associated with the pump station would be more evident, but would be of shorter duration and require less noisy equipment than dam construction. Bumping Lake Dam is located in the Okanogan-Wenatchee National Forest adjacent to the William O. Douglas Wilderness. Construction noise may disturb recreational users and may detract from the wilderness experience (the William O. Douglas Wilderness is located approximately 0.1 mile from the shore of Bumping Lake Reservoir). Although the Wilderness Act of 1964 generally prohibits the use of motor vehicles and motorized equipment within federally designated wilderness areas, the Act does not set forth any restrictions from noise created outside the wilderness area boundaries. Therefore, there are no noise standards applicable at Bumping Lake in relation to the adjacent wilderness area.

For the Kachess Reservoir inactive storage project, short-term construction impacts would result from noise associated with transporting and operating mechanized construction equipment and potentially the blasting needed to construct the gravity-flow tunnel, conveyance channel, and fish passage facilities; or to construct the pump station, conveyance pipeline, discharge structure, and fish passage facilities under the second option. Equipment used for the construction of inactive storage elements would be similar to that described in Table 4-1.

4.14.2.4 Groundwater Storage Element

Short-term construction impacts would result from noise associated with transporting and operating mechanized construction equipment used to construct specific infiltration systems, such as ponds, canals, or spreading areas. Equipment used for the construction of shallow aquifer recharge structural elements and ASR facilities would be similar to that described in Table 4-1.

4.14.2.5 Habitat/Watershed Protection and Enhancement Element

Short-term construction impacts are expected to be relatively minor because equipment would be limited to earth moving and hauling (Table 4-1) and projects would last from a few weeks to a few months.

4.14.2.6 Enhanced Water Conservation Element

Short-term noise impacts from agricultural water conservation projects are expected to be similar to those described for habitat/watershed protection projects. No short-term impacts are anticipated from the municipal and domestic conservation program.

4.14.2.7 Market Reallocation Element

No short-term noise impacts are anticipated from efforts to reduce barriers to water trading between water users.

4.14.3 Mitigation Measures

Construction noise impacts could be mitigated by limiting construction hours, using equipment with mufflers or noise control, and situating noise-generating equipment away from houses. Projects located within city limits would comply with applicable construction noise hours. Where blasting is required, a blasting noise mitigation plan may be prepared depending on the anticipated location of blasting and the presence of surrounding noise-sensitive land uses.

4.15 Recreation

Short-term recreation impacts are those things that could temporarily alter the ability to use the recreational resource. For example, if construction activities block access to a facility or recreational area, this would be considered a short-term impact until access is restored. Short-term impacts may also include a reduced ability to enjoy the resource due to disturbances such as construction noise or changes in scenic views due to the presence of construction equipment.

4.15.1 No Action Alternative

Some of the individual actions undertaken by various entities and agencies under the No Action Alternative could result in temporary construction impacts due to access limitations. If these actions trigger NEPA or SEPA compliance, appropriate documentation of the recreational resource impacts from construction would be the responsibility of the project proponent, separate from this EIS.

4.15.2 Integrated Water Resource Management Alternative

Recreation activities that could be impacted include fishing, boating, hiking, camping, sightseeing, wildlife viewing, hunting, and similar activities. Short-term impacts would be primarily related to construction activities that may result in temporary access restrictions or nuisance dust and noise. These potential impacts are discussed in the following sections.

4.15.2.1 Reservoir Fish Passage Element

Construction activities, heavy equipment, and temporary structures would be in evidence at varying intensities and durations during the construction period for individual projects. Access to and from some recreational facilities, such as parks, boat launches, trails, and campgrounds near the reservoirs, may be limited during this time.

One of the primary effects on recreation users with construction of the Cle Elum Dam fish passage project would be disruption caused by construction traffic (Reclamation and Ecology, 2011c). Construction would occur during the prime recreation season for up to three years; however, the intensity of construction traffic would vary and would be light during some periods. Equipment deliveries would be limited to weekdays. Worker traffic would mostly occur outside peak recreation times. Therefore, construction traffic is not expected to cause significant delays for most recreationists.

Recreationists within sight and sound of the construction area could experience disruption or impairment of their recreational experience because of noise and dust. The magnitude of the impact would be directly related to the distance from the project area. The project would not affect recreation facilities such as established campgrounds, boat ramps, or trailheads. Reservoir users would be able to move to areas of the reservoir where disruption would be minimal.

These short-term impacts from construction activities would be temporary and limited in area. They are not expected to have a significant impact on recreational use of Cle Elum Reservoir.

Short-term impacts to recreation are expected to be similar at Tieton, Keechelus, and Kachess Dams although those reservoirs have fewer developed recreation areas. The

Clear Lake Dam area has several recreational sites for camping and picnicking on the southeast end of the lake and between Clear Lake and Rimrock Lake. Impacts associated with fish passage facilities at Clear Lake Dam would be similar to those for Cle Elum Dam, except the magnitude would likely be less as construction is expected to be somewhat shorter.

The Bumping Lake Dam fish passage improvements are included in the reservoir enlargement project described in Surface Water Storage below.

4.15.2.2 Structural and Operational Change Element

Modifications requiring construction activities would cause short-term impacts similar to those discussed above for the fish passage element. Construction activities for this element could, however, be larger in scale, such as for the lateral piping projects. Impacts to access at nearby recreational facilities could last longer, but would still be localized and temporary.

Construction for the Cle Elum Pool Raise project would be limited to the area surrounding the dam spillway gates. For this reason, the short-term impacts would be similar to those described above for the Fish Passage Element. Shoreline protection measures would be installed around the lake where erosion could occur from the higher level of inundation. Recreational areas could be affected by access limitations and increased construction traffic. Those impacts are expected to last a few weeks and would not cause major impacts to recreation.

Short-term impacts from the KRD and Wapatox Canal modifications would vary depending on the location and timing of construction. Most of the projects are not located near recreation areas. The exception is the Manastash Creek pump station in the Yakima River. Construction activities could disrupt recreational use of that section of the river, but would be limited to the area needed for placement of a cofferdam and would last for less than one year. This limited disruption would not be considered a significant impact to recreational use of the river.

The proposed Keechelus-to-Kachess pipeline alignment would not pass near any developed recreation facilities. However, the area is generally used for dispersed recreation activities such as fishing, hiking, wildlife viewing, and boating. Construction activities could temporarily alter access to and from the dispersed recreation activities along the pipeline corridor.

No short-term impacts are expected to occur with implementation of the power subordination projects because no construction would be involved.

4.15.2.3 Surface Storage Element

Recreationists within sight and sound of the construction areas for new and expanded reservoirs could experience impairment of their recreational experience because of construction traffic, noise, and dust. Construction would last several years; however, these short-term impacts from construction activities would be temporary and limited in area.

Recreational uses at the proposed Wymer dam and reservoir site are limited to hunting on private property. Hunting on portions of the reservoir site acquired for public use would be restricted during and following construction. The nearby Yakima River and Yakima River Canyon provide water access, camping, wildlife viewing, and fishing opportunities. SR 821, which parallels the Yakima River, is a designated Washington State Scenic Byway. Recreationists are expected to be able to move to areas of the river and canyon where disruption would be minimal if space allows; although their experience could be compromised due to increased crowding. No public recreation areas or access are expected to be closed. Construction activities and traffic may result in inconveniences and traffic-related slowdowns, but are not anticipated to prohibit access to recreational uses in the area.

Construction associated with the proposed Bumping Lake expansion would be extensive and the area has many recreation facilities and opportunities. In addition to the recreational uses that would be inundated by the expansion of Bumping Lake (described in Section 5.15), access to other recreational facilities outside of the direct impact area would likely be limited or blocked during the approximate three- to five-year construction period. Reservoir users and users of the adjacent William O. Douglas Wilderness within sight and sound of the construction area could experience disruption or impairment of their experience because of noise, dust, and visual intrusion. The magnitude of the impact would be related to the distance from the project area.

At some point during construction, recreational facilities around the existing lakeshore would be demolished to allow for inundation of the expanded reservoir. Access roads to trailheads and the wilderness area would also be permanently blocked. Reclamation would coordinate the demolition and access blockages with the U.S. Forest Service. Specific impacts to recreation and appropriate mitigation strategies would be developed as part of the project-level environmental analysis if the project is carried forward to implementation.

There are no developed recreational facilities along the proposed Lake Kachess Inactive Storage tunnel alignment. However, portions of the alignment are included in the Okanogan-Wenatchee National Forest which is used for dispersed recreation such as hiking and wildlife viewing. If the pump station option is chosen, dispersed recreation along the lakeshore and that vicinity would be temporarily disrupted.

Short-term impacts from this project would be similar to those described for the Kachess to Keechelus pipeline project, except the magnitude of recreational access limitations may be slightly less because there are fewer recreational opportunities in the vicinity.

4.15.2.4 Groundwater Storage Element

The specific areas proposed for shallow aquifer recharge have not yet been selected. However, the projects would be located in agricultural areas and are not likely to be in or adjacent to existing recreational facilities. Therefore, few impacts on recreation are anticipated. The short-term impacts from ASR projects are expected to be similar to those for shallow aquifer recharge.

4.15.2.5 Habitat/Watershed Protection and Enhancement Element

The greatest temporary impacts on recreational resources associated with this element would result from construction of habitat enhancement projects on rivers and tributaries. These impacts would be related to the intensity of construction activities and access limitations that would likely occur. The primary types of recreation affected would be streamside activities such as fishing and wildlife viewing. These construction impacts would be temporary and localized to the vicinity of construction. Changes in recreational use of the acquired properties are considered a long-term impact and are described in Section 5.16. Construction activities could temporarily limit access to and from adjacent recreational facilities and resources; however, the short-term impacts are not known.

4.15.2.6 Enhanced Water Conservation Element

Agricultural conservation efforts are not expected to have any substantial impact on recreational uses. Improvements to irrigation systems would be confined to lands already designated for agriculture. Construction associated with these projects would be temporary and unlikely to adversely affect surrounding recreational uses. The municipal and domestic conservation program would not involve any construction, and as such, would not have any short-term impacts on recreational uses.

4.15.2.7 Market Reallocation Element

There would be no short-term impacts to recreation because the Market Reallocation Element does not require construction.

4.15.3 Mitigation Measures

Access to and from recreational facilities may be temporarily closed, or limited, during construction. To the extent possible, alternate access routes would be provided. To minimize the negative impact to users, informational signage and alternate directions would be posted along access routes, at the recreational sites, and on agency websites. Construction BMPs would be implemented to minimize the impact on recreation facilities and their patrons from nuisance dust, noise, and conflicts with construction traffic during temporary construction activities. Recreation would coordinate with the U.S. Forest Service to determine appropriate mitigation for recreation impacts at Bumping Lake Reservoir.

4.16 Land and Shoreline Use

Short-term land use impacts are those things that could temporarily alter the current use of the project site and surrounding area. For example, if construction activities block access to an area that is normally accessible, it would be considered a short-term impact until access is restored.

4.16.1 No Action Alternative

Some of the projects included in the No Action Alternative could result in temporary construction impacts due to access limitations. If the projects trigger NEPA or SEPA compliance, appropriate documentation of the land and shoreline use impacts from construction would be the responsibility of the project proponent, separate from this EIS.

4.16.2 Integrated Water Resource Management Plan Alternative

Short-term impacts to land use would be primarily related to temporary access restrictions as discussed below. Individual construction projects would be subject to the regulations and permitting requirements of the presiding jurisdiction, which may include NEPA and/or SEPA compliance, permits required under the Shoreline Management Act, and local building permits

4.16.2.1 Reservoir Fish Passage Element

Construction activities, heavy equipment, and temporary structures could limit access to and from adjacent properties. Potential impacts to land use associated with the construction of fish passage facilities would be minor, localized, and temporary.

Land surrounding Cle Elum Reservoir is primarily in public ownership with areas of private ownership. The Federal Government is the primary landowner in areas to the west, east, and north of the reservoir.

Construction activities associated with the fish passage facilities at Cle Elum Dam could disrupt access to some surrounding land uses. These include recreational uses, as described in Section 4.15, and some residential uses. Construction would occur from mid-April through November for three years; however, the intensity of construction traffic would vary and would be light during some periods. Access to surrounding areas may be delayed at times. Equipment deliveries would be limited to weekdays, and worker traffic would mostly occur outside the peak use times. Therefore, construction traffic is expected to cause only limited delays for land uses in the area. For these reasons, short-term impacts from the fish passage facilities at Cle Elum Dam would be minimal.

Impacts of constructing fish passage facilities at Tieton, Keechelus, and Kachess Dams are expected to be similar to those for Cle Elum Dam. Impacts at Clear Lake Dam would also be similar to those for Cle Elum Dam, except the magnitude would likely be less as the duration of construction is expected to be shorter. Because fish passage is included in the Bumping Lake Reservoir enlargement project, those potential land use impacts are described in Surface Water Storage Element below.

4.16.2.2 Structural and Operational Changes Element

Modifications requiring construction activities would cause short-term impacts similar to those discussed in the Fish Passage Element, and would be subject to the same regulatory requirements. Construction activities for this element could, however, be larger in scale, such as for the lateral piping projects. Impacts to access to adjacent properties could last longer, but would still be temporary.

Most construction for the Cle Elum pool raise project would be limited to the area surrounding the dam spillway gates. For this reason, the short-term impacts would be similar to those described under the Fish Passage Element at Cle Elum Dam. However, shoreline protection measures would require construction activities in the shoreline area of the reservoir,. which would require acquisition of easements from property owners.

Most of the KRD and Wapatox Canal modifications projects are unlikely to cause short-term land use impacts because it is expected that all construction would occur within existing rights-of-way for the canals. The Manastash Creek pump station in the Yakima River would require a shoreline substantial development permit.

The land along the proposed Keechelus-to-Kachess pipeline alignment is primarily owned by private parties, with a smaller portion owned by the Federal government and the Kittitas Conservation Trust. Construction would require the acquisition of temporary construction easements and a permanent easement for the pipeline corridor.

No short-term impacts are expected with implementation of the power subordination projects because no construction would occur.

4.16.2.3 Surface Storage Element

Short-term land use impacts at all potential storage sites would be localized and temporary and would be subject to the same regulatory requirements as described in Section 4.16.2.1.

The land surrounding the Wymer Dam site is entirely privately owned by one family. Land uses in this area are primarily open space and rangeland, with some residential use near SR 821/Canyon Road. Construction of the dam would require acquisition of the private property. This is considered a permanent impact and is discussed in Section 5.16.

The land surrounding Bumping Lake Reservoir is federally owned, so no land acquisition would be required. The lands are within the Okanogan-Wenatchee National Forest and jointly managed by the U.S. Forest Service and the Bureau of Reclamation. The new damsite and all the area proposed for inundation is under joint jurisdiction by both agencies and Reclamation has reserved an area around the existing reservoir for expansion. No portion of the inundation area would be within the William O. Douglas Wilderness Area. Reclamation would coordinate with the U.S. Forest Service on the expansion of the reservoir and appropriate mitigation. Leased recreational properties, such as the marina and summer cabins, would be inundated. Impacts to these properties are considered a long-term impact which is discussed in Section 5.16

The land along the proposed Kachess Reservoir Inactive Storage tunnel alignment is primarily owned by private parties, with a smaller portion owned by the Federal Government. Construction would require the acquisition of 100-foot temporary construction easements for the pipeline corridor. Permanent easement acquisition is discussed in Section 5.16. If the pump station option is chosen, the pipeline alignment would be shorter, requiring fewer easements, but would also require a larger area of disturbance near the lake for construction of the pump station.

4.16.2.4 Groundwater Storage Element

The specific areas proposed for shallow aquifer recharge have not yet been selected. The proposed pilot projects involve two areas less than 5 acres in size in the Badger Pocket and Toppenish areas. Construction easements may be required to access the sites of the infiltration ponds and other facilities. Property acquisition may be required for the infiltration pond sites. This impact is discussed in Section 5.16 as a long-term impact. The short-term impacts from ASR projects would be similar in nature to those described for shallow aquifer recharge but lower in magnitude because the project sites would be smaller.

4.16.2.5 Habitat/Watershed Protection and Enhancement Element

The acquisition areas for the targeted watershed protection program have not yet been identified. Targeted watershed protection measures would include the purchase of land for conservation, which would not result in short-term impacts. Properties would be acquired from willing sellers. Conservation efforts may constitute long-term changes in land use, which is covered in Section 5.16. The habitat enhancement projects on mainstem and tributary streams, especially floodplain restoration projects, may require the acquisition of property or easements. Short-term construction activities and access restrictions may preclude use of these areas, such as for recreational purposes, but would only be temporary. The duration of construction would vary, depending on the size and location of the project.

4.16.2.6 Enhanced Water Conservation Element

Agricultural conservation efforts are not expected to have any substantial impact on land use. Improvements to irrigation systems would be confined to lands already designated for agriculture, and many would take place within existing canal rights-of-way. The municipal and domestic conservation program would not have any short-term impacts on land use.

4.16.2.7 Market Reallocation Element

There would be no short-term impacts associated with market reallocation because there would be no construction.

4.16.3 Mitigation Measures

Property acquisition and temporary and permanent easements would be required for most projects. Properties impacted would likely be a mix of public and private lands supporting a variety of uses. To the extent possible, alternate access routes would be provided, and access to private property would be maintained at all times. If individual projects that require the acquisition of land or easements are advanced for implementation, appropriate compensation would be required in accordance with applicable Federal or State regulations.

4.17 Utilities

Short-term impacts are based on the temporary disturbance of utilities affected by or located near construction. Impacts are considered minor when construction occurs over a short duration and can be coordinated with local services and utilities and scheduled to minimize impacts.

4.17.1 No Action Alternative

The No Action Alternative includes conservation-oriented water supply system improvements, including pumping plants and pipelines, at various locations in the Yakima Valley region (Kittitas, Yakima, and Benton Counties). These improvements are associated with existing approved programs and primarily existing facilities. To the extent that NEPA or SEPA analysis is required for these actions, appropriate documentation of the directly affected public services or utilities would be the responsibility of the project proponent, separate from this EIS.

4.17.2 Integrated Water Resource Management Alternative

4.17.2.1 Reservoir Fish Passage Element

Construction activities at Cle Elum Dam would take place on and near the existing dam and are not expected to disrupt any utilities. New electric lines would be needed for the fish intake facilities and the roller gates on the dam. These lines would connect to existing power lines at the dam and are not expected to affect existing utilities. Construction impacts for Tieton, Keechelus, and Kachess Dams are anticipated to be similar to those at Cle Elum Dam. Bumping Lake Dam fish passage facilities would be installed as part of the reservoir expansion project and are described in the Surface Water Storage Element below. Construction activities at Clear Lake Dam would be minor and are not anticipated to disrupt utilities.

4.17.2.2 Structural and Operational Changes Element

Construction activities on the Cle Elum Dam for the pool rise are not anticipated to disrupt utilities. The installation of shoreline protection measures would take place in a narrow strip on the reservoir shoreline and it is unlikely that any utilities would be impacted.

For the KRD Canal modifications project, construction of a re-regulation reservoir and pump station could cause minor temporary interruptions to electrical services when the facilities are brought online. However, with planning and coordination between the construction activities and the utility providers, such impacts could likely be avoided. The Wapatox project pipeline and pump station construction could cause minor temporary disruption of utilities, but could be coordinated with local services and utilities and scheduled to minimize impacts.

Construction associated with the Keechelus-to-Kachess pipeline could cause minor temporary disruption of utilities, and some utilities may require relocation. Relocations would be coordinated with local services and utilities and scheduled to minimize impacts.

The power subordination projects would not require construction or result in short-term impacts to utilities. Impacts to power generation are discussed in Section 5.6.

4.17.2.3 Surface Storage Element

New or enlarged storage reservoirs could cause short-term impacts to utility services (e.g., temporary service interruptions and requirements for infrastructure relocation). At Wymer Dam, the one local resident in the immediate project area could experience temporary disruptions. However, with proper construction-phase planning, such impacts likely could be avoided. Impacts to utilities at Bumping Lake Reservoir would be of greater magnitude due to the greater amount of existing infrastructure in the area. Power lines may need to be relocated in the dam site area. Utilities that serve recreation facilities and cabins at the reservoir would need to be relocated or removed. This would include power lines, propane tanks, and septic tanks. The relocations and removals would be coordinated with local services and utilities and scheduled to minimize impacts.

4.17.2.4 Groundwater Storage Element

Construction associated with building infiltration ponds, injection wells, and conveyance infrastructure could cause minor temporary disruption of utilities, but could be coordinated with local services and utilities and scheduled to minimize impacts. Pumps would require connection to electrical power.

4.17.2.5 Habitat/Watershed Protection and Enhancement Element

Construction for restoration projects could cause minor temporary disruption of utilities, but could be coordinated with local services and utilities and scheduled to minimize impacts.

4.17.2.6 Enhanced Water Conservation Element

Construction along roadways associated with irrigation improvements under the agricultural conservation program could cause minor temporary disruption of utility services. However, any disruptions would be coordinated with local services and utilities and would be scheduled to minimize impacts. The municipal and domestic conservation program is not expected to have a short-term impact on utilities because no construction is anticipated.

4.17.2.7 Market Reallocation Element

Market reallocation would not require construction or result in any construction-related impacts on utilities.

4.17.3 Mitigation Measures

The following measures could be used to avoid impacts to utilities during construction:

- Provide public notification of proposed construction activities, including the timing of construction, to all local service providers and schools within the immediate vicinity of any facilities or infrastructure projects.
- Coordinate with local utility service providers to assist in utility locations, if applicable, and to identify specific mitigation measures to minimize impacts to utility purveyors.
- Coordinate with local utility purveyors to identify other specific mitigation measures to minimize impacts.

Mitigation planning for utilities should also include close coordination with involved service providers, as well as with potentially impacted local residents and landowners. Where local utility system connections or installations would be impacted by construction activities, plan for and implement alternative or relocated connections and facilities prior to construction (i.e., avoid service disruptions).

4.18 Transportation

Construction activities would typically involve the movement of heavy equipment to and from the project site, as well as the commute by workers during construction.

4.18.1 No Action Alternative

Under the No Action Alternative, other agencies and entities would implement projects that could result in temporary construction impacts. To the extent that NEPA or SEPA analysis would be required for these actions, appropriate documentation of the transportation impacts from construction would be the responsibility of the project proponent, separate from this EIS.

4.18.2 Integrated Water Resource Management Plan Alternative

4.18.2.1 Reservoir Fish Passage Element

Construction of the various fish passage elements would have minor, short-term impacts on highways and roads in the Yakima River basin. Construction of fish passage facilities would temporarily increase traffic on roadways with worker traffic, equipment, and deliveries. All the fish passage facilities are located in areas served by local roads and Reclamation access roads that carry low volumes of traffic. Traffic would increase and may be slowed by the transport of construction equipment. No roadways would be closed by the construction projects. Standard safety procedures would be followed for transport of heavy equipment to project sites.

4.18.2.2 Structural and Operational Changes Element

Construction of the various structural changes to existing facilities could have minor, short-term impacts on highways in the Yakima River basin. Where canals or other delivery systems are located adjacent to roadways, there could be temporary disruptions of traffic. Piping of canals could require that culverts be installed or replaced under roadways, resulting in temporary closures or detours around affected areas. There would be increased traffic on roadways with worker traffic, equipment, and deliveries. The degree of impact depends, in part, on the current level of service on potentially affected roads.

The Keechelus-to-Kachess pipeline project includes installing approximately 5 miles of large-diameter pipe with a crossing of I-90 just east of Keechelus Reservoir. To the extent possible, the pipeline crossing would be coordinated with the ongoing reconstruction of I-90 and associated plans for wildlife crossings. Pipeline crossings of existing roads would have temporary and moderate adverse impacts on affected roadways.

No impacts on the transportation system would occur from the power subordination projects.

4.18.2.3 Surface Storage Element

Construction of new storage facilities would have an adverse impact on transportation facilities for the duration of the three to five-year construction period. Construction would cause increased traffic on roadways with worker traffic and equipment and materials hauling.

SR 821 provides the only access to the proposed Wymer Dam. SR 821 is a designated State Scenic Byway (see Section 3.18), and disruption by construction traffic would have a temporary adverse effect on traffic using this roadway. Impacts would include intermittent delays, increased trucks and heavy equipment on a roadway that is narrow and winding in places, and changes in the views of the surrounding landscape or access to the Yakima River (see Sections 4.11 and 4.15 for additional impacts to the Scenic Byway). In addition, construction of the proposed discharge and intake pipelines under SR 821 would have direct, short-term adverse effects, including temporary closure of the highway. Notification and signed detours of the closure would reduce the effects on travel. Detours would likely involve diverting traffic to I-82, which would cause some out-of-direction travel for users of SR 821. Road closure would adversely affect access to the Yakima River at points along SR 821. Average daily traffic on SR 821 in the vicinity of the proposed Wymer Dam is approximately 1,300 vehicles per day (WSDOT, 2011). Temporary diversion of SR 821 traffic to I-82 would be unlikely to have a substantial adverse effect on I-82 traffic (average daily traffic on I-82 is approximately 20,000 vehicles per day) (WSDOT, 2011).

Wymer Reservoir would inundate the piers supporting the I-82 bridges over Lmuma Creek. The piers would be reinforced and protected to prevent adverse effects from inundation. Construction to reinforce the bridge piers would not affect travel on I-82 and would protect the stability of the structures and the highway.

Construction activities occurring over the three to five-year construction period at Bumping Lake Dam would have short-term impacts to SR 410 and Forest Road 18, which would provide access to the proposed site of the new dam. Portions of Forest Road 18 may be closed during certain periods of the construction project, blocking access to recreational areas and trailheads in the immediate vicinity of the dam.

Construction associated with the inactive storage project would have minor, short-term impacts on local roads in the vicinity of Kachess Reservoir. It would temporarily increase traffic on roadways with worker traffic, equipment, and deliveries.

4.18.2.4 Groundwater Storage Element

The construction of infiltration and injection facilities for groundwater storage projects would temporarily increase trips by worker vehicles, construction equipment, and material delivery on adjacent roadways. If treatment facilities are required for injection facilities, construction would generate more traffic. Depending on the location of the infiltration and injection facilities, new access roads may need to be constructed.

Conveyance facilities would be required to convey water from the Yakima River to the injection or infiltration site. Where groundwater is actively recovered, pipelines would also be required to convey the water from the recovery well to the municipal supply system. In some cases, these conveyance facilities may cross existing roads. The conveyance lines would typically be installed by a cut-and-cover method that would require temporary lane closures.

4.18.2.5 Habitat/Watershed Protection and Enhancement Element

Land management and property acquisition under the habitat program would not affect transportation. The construction of the various fish habitat enhancement projects could have minor, short-term impacts on highways and roads in the Yakima River basin in the immediate vicinity of these projects. There would be increased traffic on roadways with worker traffic, equipment, and deliveries. Throughout the basin, roads and bridges (Interstate, State, county, city, and private) currently constrict floodplain functions. Floodplain restoration projects potentially implemented under the Integrated Plan could involve construction activity with short-term effects on use of roads and bridges in some areas.

4.18.2.6 Enhanced Water Conservation Element

Construction of facilities to improve agricultural water conservation would have minor, short-term impacts on roads in the Yakima River basin. Where canals or other delivery systems are located adjacent to or pass under roadways, there would be temporary disruptions of traffic. Piping of canals could require that culverts be installed or replaced under roadways. There would be increased traffic on roadways with worker traffic, equipment, and deliveries. The degree of impact depends, in part, on the current level of service on potentially affected roads. Because most irrigated lands are located on local, rural roads with limited traffic, only minor impacts are anticipated.

Municipal and domestic conservation programs involve promoting improved efficiencies in uses of water, and would not affect transportation.

4.18.2.7 Market Reallocation Element

The Market Reallocation Element would not affect transportation because there would be no construction.

4.18.3 Mitigation Measures

Mitigation measures to reduce short-term construction impacts on transportation would include maintaining access to properties, installing signs, marking detour routes, flagging, and providing information to the public, including notifications in advance of construction activities.

For elements with substantial impacts on roads or highways, such as new dam construction, short-term traffic and road impacts would be unavoidable. Specific mitigation measures would be developed in the design phase for these elements. Reclamation would coordinate with the Washington State Department of Transportation, U.S. Forest Service, and Federal, local, and Tribal transportation authorities to review plans, establish specific mitigation actions, and obtain necessary permits if the actions are carried forward.

4.19 Cultural Resources

Short-term impacts on historic structures, traditional cultural properties, or sacred sites may include increased dust, vibration, noise, or construction activity. Impacts on archaeological sites would be permanent and are addressed as long-term impacts in Chapter 5.

Short-term impacts to cultural resources were considered based on the level of ground disturbance anticipated and knowledge about general patterns of Native American and Euro-American land use throughout time. Because the exact locations of many elements are not known, and the inventory of cultural resources (particularly TCPs) is not complete, specific impacts are not yet identified. Significance of the impacts is based on the criteria for inclusion on national, State, or local historic registers.

4.19.1 No Action Alternative

Short-term impacts on cultural resources are possible under the No Action Alternative, including impacts from ground disturbing activities associated with stream restoration, irrigation improvements, and structural improvements to historic structures. To the extent that NEPA or SEPA analysis would be required for these actions, appropriate documentation of the impacts from construction would be the responsibility of the project proponent, separate from this EIS.

4.19.2 Integrated Water Resource Management Alternative

4.19.2.1 Reservoir Fish Passage Element

Short-term impacts on cultural resources could include modification of historic dams and their appurtenances; while the actions would occur in the short term, these impacts would be permanent. All dams are historic in age, although not all have been evaluated for significance. Measures to avoid affecting cultural resources would be employed prior to construction to minimize these potential impacts.

Short-term impacts to cultural resources could include noise and disturbance at Traditional Cultural Properties (TCPs). If TCPs are present, these impacts could substantially affect the characteristics (such as isolation or resource access) which provide the integrity of setting, feeling or association. No short-term impacts on buried cultural resources are anticipated because any impacts would be permanent (see Chapter 5).

Impacts for all fish passage projects would be similar. Impacts at Clear Lake Dam would be on a smaller scale. Bumping Lake Dam fish passage facilities would be installed as part of the reservoir enlargement project and are described in the Surface Storage Element below.

4.19.2.2 Structural and Operational Changes Element

Short-term impacts on cultural resources could include noise and disturbance of TCPs. If TCPs are present, these impacts could substantially affect the characteristics (such as isolation or resource access) which provide the integrity of setting, feeling or association. Flashboards added to the Cle Elum Dam would be permanent additions used seasonally but might not be used each year. The potential for permanent impacts on buried cultural resources is described in Chapter 5. The canal modifications and other facilities for the KRD and Wapatox projects could affect TCPs if present. However, all construction would take place in previously disturbed agricultural lands; therefore, the potential to encounter undisturbed cultural resources is low. The Keechelus-to-Kachess pipeline has a moderate potential to encounter TCPs. Excavation in the 5-mile pipeline corridor could temporarily disrupt access to and use of TCPs. No short-term impacts to cultural resources are anticipated with the power subordination projects because no construction is associated with the projects.

4.19.2.3 Surface Storage Element

Construction for new storage at Wymer and Bumping Lake Dams could adversely impact access to TCPs, traditional use areas, and sacred sites if present. At Bumping Lake Reservoir, historic recreational cabins eligible or listed on the National Register of Historic Places would be relocated or demolished; relocation can be an adverse impact since it impacts the setting and feeling of a historic property. The Kachess Reservoir inactive storage project could also affect TCPs, if present, and limit access to those areas in the short term. Construction at Kachess Dam could affect the historic dam structure; the extent of any impacts is not yet known. No short-term impacts to buried cultural resources are anticipated because any impacts would be permanent, therefore long term (see Chapter 5).

4.19.2.4 Groundwater Storage Element

Construction for groundwater storage could adversely impact access to TCPs and traditional use areas if present. However, based on the types of landforms selected for groundwater storage, these areas may have a lower likelihood for cultural resources. If alternative site locations are feasible, then complete avoidance of significant cultural resources may be possible. No short-term impacts on buried cultural resources are anticipated because any impacts would be permanent (see Chapter 5).

4.19.2.5 Habitat/Watershed Protection and Enhancement Element

Short-term impacts to cultural resources could include noise and disturbance at TCPs. If TCPs are present, these impacts could substantially affect the characteristics (such as isolation or resource access) which provide the integrity of setting, feeling or association. No short-term impacts on buried cultural resources are anticipated because any impacts would be permanent.

4.19.2.6 Enhanced Water Conservation Element

Short-term impacts to cultural resources could include noise and disturbance at TCPs. If TCPs are present, these impacts could substantially affect the characteristics (such as isolation or resource access) which provide the integrity of setting, feeling or association. However, the potential for TCPs may be lower because the Enhanced Water Conservation projects would be located in active agricultural lands.

4.19.2.7 Market Reallocation Element

No impacts to cultural resources are anticipated from the Market Reallocation Element as this project consists primarily of transfer of water rights and not actual transfer of water to new uses. In cases where additional water is transferred for agricultural uses, it is assumed the land will already be in agriculture.

4.19.3 Mitigation Measures

Additional cultural resources review including field investigations would be required once specific locations for project elements are identified. These inventory investigations would determine if any archaeological sites, historic structures, or TCPs would be affected. Once the inventory and evaluation is complete, then mitigation measures could be determined.

The first level of mitigation is to design the project to avoid or minimize impacts on cultural resources. This would be particularly valuable for designs that altered the exterior of the historic dams. If a project cannot avoid or minimize impacts, it is assumed a permanent impact would result and mitigation is addressed in Chapter 5.

Mitigation measures for short-term impacts to TCPs would need to be determined in consultation with the appropriate cultural group. Because TCPs contribute to the maintenance of a culture, mitigation efforts may include documentation of the significance of the place through oral histories or recording traditional storytellers. It is not always possible to come to agreement with the appropriate cultural group on how to mitigate adverse effects on TCPs.

Construction contracts would require that if any archaeological material is encountered during construction, construction activities in the immediate vicinity would halt, and the Department of Archaeology and Historic Preservation and a professional archaeologist would be contacted for further assessment prior to resuming construction activity in that area. Construction contracts may also include specific requirements for working around historic dams.

4.20 Indian Sacred Sites

Because details of specific Integrated Plan projects have not yet been identified, Reclamation has not begun consultation with the Yakama Nation to identify Indian Sacred Sites. Reclamation will consult with the Yakama Nation to determine the presence of sacred sites as part of project-level environmental review when specific projects are carried forward to implementation. The process for consultation is described in Chapter 6. Short-term impacts to sacred sites are expected to be those in which access to sacred sites, if they are extant, is being temporarily denied to Tribal members because of construction-related activities.

4.21 Indian Trust Assets

Because details of specific projects have not yet been identified, Reclamation has not begun consultation with affected Tribes to identify Indian Trust Assets. Reclamation would consult with affected Tribes and the Bureau of Indian Affairs to determine the presence of Indian Trust Assets as part of project-level environmental review when specific projects are carried forward to implementation. The process for consultation is described in Chapter 6.

4.22 Socioeconomics

The assessment of short-term socioeconomic impacts considers potential effects on the supply and value of goods and services derived from the basin's water and related resources, resource-related jobs and incomes, resource-related uncertainty and risk, the distribution of resource-related costs and benefits, and the structure of the economy. This assessment examines the Integrated Plan from a programmatic perspective. As specific projects are carried forward to implementation in the Integrated Plan, they would undergo a detailed determination of the potential socioeconomic effects, including the assessments required by the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementations Studies* (U.S. Water Resources Council, 1983).

4.22.1 No Action Alternative

Under this alternative, the current patterns and trends in the relationship between the basin's natural resources and the regional, State, and national economies would likely continue over the short term.

4.22.2 Integrated Water Resource Management Alternative

Some of the individual elements of the Integrated Plan might have discernible short-term effects on the supply and value of some goods and services derived from the basin's water-related ecosystem. Project-related funding mechanisms and expenditures would likely have short-term impacts on jobs and incomes, the distribution of resource-related costs and benefits, and the structure of the economy. Project-related activities might trigger short-term changes in uncertainty and risk.

4.22.2.1 Reservoir Fish Passage Element

Short-term impacts for the Fish Passage Element would occur relating to the value of goods and services, jobs and incomes, uncertainty and risk, distribution of costs and benefits, and socioeconomic structure. These impacts are discussed below.

Value of Goods and Services

Projects to construct fish passage facilities would require financial resources, volunteer resources, land, construction equipment, and other resources, making these resources unavailable for use elsewhere. However, the projects are not likely to have a discernible effect—across the regional, State, and national economies—on the value of the goods and services associated with these resources.

Jobs and Incomes

Short-term expenditures associated with projects to construct the fish passage facilities would generate jobs and incomes for the workers directly associated with these activities and as businesses, governments, and households respend the initial amounts. The impacts would be dampened, however, to the extent that expenditures on these activities draw funding, labor, or other resources away from other activities.

In its assessment of proposed fish passage expenditures, Reclamation (2008a) estimated that the projects would create local jobs at the rate of about one job per every $102,900 of total construction expenditures for fish passage facilities at Cle Elum Dam, of which $64,000 would be spent locally. The analysis predicted that fish passage construction at Cle Elum Dam would result in 937 direct and indirect jobs. The 600 construction jobs represent 5 percent of the total construction jobs in the three Yakima basin counties in 2009, the most recent year for which data exist. The same direct employment represents 0.3 percent of the counties' total nonfarm employment in 2009 (Washington Employment Security Department, 2011b). The analysis also estimated that the local expenditure of $1 on construction would generate about $0.28 to $0.37 of local labor income. These estimates do not, however, account for second-order effects that could significantly reduce the overall impacts on jobs and income. Such effects would materialize, for example, if fish passage projects would secure the services of some local construction firms and workers only by attracting them away from other projects, so that the net short-term impact on the overall level of local construction would be smaller than the fish passage projects in isolation.

Uncertainty and Risk

Projects proposed under the fish passage element likely would not affect a large enough portion of the basin's water and related resources for a long enough time to have a discernible effect on resource-related risk and uncertainty. The projects might have additional effects, to the extent that a decision to proceed with them would signal to private and public entities potential changes in the demand for and supply of related goods and services. Such signals might convince households and businesses that the risk and uncertainty associated with related investments have diminished, and induce them to make investments that otherwise would not occur.

Distribution of Costs and Benefits

In general, projects associated with the fish passage element would involve costs, concentrated in the short term, aimed at producing long-term benefits. Therefore, the short-term impacts on the distribution of costs and benefits would be determined by each project's impacts on its source of funding for the project, and on the types of land and other nonfinancial resources it would consume. Overall, these projects would likely have a minor short-term effect on the distribution of costs and benefits.

Socioeconomic Structure

The fish passage element would involve expenditures on construction and related activities that otherwise would not occur, but these likely would be too small to cause discernible changes in the overall regional, State, and national economies.

4.22.2.2 Structural and Operational Changes Element

Implementation of the Structural and Operational Changes Element would cause short-term socioeconomic effects generally similar to but smaller in scale than those discussed in Section 4.22.2.1 for fish passage. The power subordination projects do not involve construction and therefore would not cause short-term economic impacts. Long-term impacts associated with reduced power generation are discussed in Section 5.22.

4.22.2.3 Surface Storage Element

The Surface Storage Element would generally have the same types of short-term, socioeconomic impacts as those described for the Fish Passage Element, with the magnitude depending on the scale of the individual projects.

Jobs and Incomes

In its assessment of proposed construction expenditures at Wymer Dam and Reservoir, Reclamation (2008c) estimated the project would create an average of about 570 annual jobs over three to five years, the expected duration of construction. Of the total, 255 average annual jobs represent onsite and offsite labor directly related to construction. The estimated direct jobs represent 2 percent of the three counties' total construction employment in 2009 and 0.1 percent of the total nonfarm employment (Washington Employment Security Department, 2011b). Construction expenditures at Bumping Lake Reservoir are expected to be similar to those at Wymer Dam while those for the Kachess inactive storage project would be smaller due to the smaller scale of the project and shorter construction period.

Uncertainty and Risk

Projects to develop new surface water storage likely would have minor short-term effects on risk and uncertainty associated with the basin's water and related resources, similar to those described in Section 4.22.2.1.

Distribution of Costs and Benefits

Projects to develop new surface water storage likely would have minor short-term effects on the distribution of costs and benefits, similar to those described in Section 4.22.2.1.

Socioeconomic Structure

The overall socioeconomic structure of the regional, State, and national economies likely would not change in the short term in response to the surface water storage element of the Integrated Plan.

4.22.2.4 Groundwater Storage Element

Implementation of the Groundwater Storage Element would have short-term socioeconomic impacts similar in type, but potentially different in scale, than those described for the Fish Passage Element depending on the size of individual projects.

4.22.2.5 Habitat/Watershed Protection and Enhancement Element

The scope and design of specific habitat enhancement projects would determine their costs, benefits, and net benefits (or net costs); their impacts on jobs and income; the distribution of costs and benefits; their interaction with the structure of the economy; and the levels of risk and uncertainty they would generate for affected parties. Short-term impacts of habitat enhancement projects that involve construction would likely be similar to those described in Section 4.22.2.1, but on a smaller scale. The acquisition of properties for watershed protection likely would have little, if any, short-term effect on the management of these resources and, therefore, few socioeconomic effects other than those associated with the funding mechanisms used for the acquisition.

4.22.2.6 Enhanced Water Conservation Element

The scope, design, and level of expenditures for specific agricultural water conservation projects would determine their costs, benefits, and net benefits (or net costs); their impacts on jobs and income; the distribution of costs and benefits; their interaction with the structure of the economy; and the levels of risk and uncertainty they would generate for affected parties. Short-term, socioeconomic impacts of agricultural water conservation projects that require construction would likely be similar to, but smaller in scale than, those described in the Fish Passage Element section. The expenditure of funds on conservation projects would generate some jobs and incomes in the region, but these would be offset, regionally, State-wide, or nationally, to the extent that the funds would not be spent on other things in the basin, State, or nation. The municipal and domestic water conservation program would not include construction and therefore would have no short-term, construction-related socioeconomic impacts.

4.22.2.7 Market Reallocation Element

There would be no construction involved with this element; therefore, there would be no short-term, construction-related impacts. Some short-term impacts, such as the creation of new job opportunities, likely would accompany expenditures to establish procedures, activities, or institutions to facilitate market reallocation. The overall regional, State, or national impacts likely would not be discernible.

4.22.3 Mitigation Measures

Because no significant short-term socioeconomic impacts are anticipated, no mitigation is proposed.

4.23 Environmental Justice

Environmental justice issues arise when a project disproportionately impacts minority or low-income populations. If significant impacts are anticipated, demographic information for the project area is compared to the Yakima basin as a whole and the State of Washington to determine if minority populations would be disproportionately impacted.

4.23.1 No Action Alternative

Under the No Action Alternative, projects could be undertaken that could have environmental justice impacts. If those projects trigger NEPA compliance, the agencies and entities implementing the projects would conduct environmental justice analyses separate from this EIS.

4.23.2 Integrated Water Resource Management Alternative

4.23.2.1 Reservoir Fish Passage Element

Short-term impacts associated with the installation of fish passage facilities at Cle Elum Dam would be minor, temporary, and construction related. The immediate geographic area potentially affected has lower percentages of minority and low-income populations than the Yakima basin counties or the State of Washington. There would be no disproportionate adverse impact to those populations resulting from the project (Reclamation and Ecology, 2011c).

Environmental justice impacts for Tieton, Keechelus, Kachess, and Clear Lake Dams are expected to be similar to those at Cle Elum Dam. Bumping Lake Dam fish passage facilities would be installed as part of the reservoir enlargement project and are described in the Surface Water Element below.

4.23.2.2 Structural and Operational Changes Element

The projects proposed for the Structural and Operational Changes Element would not have disproportionate impacts on minority or low-income populations.

4.23.2.3 Surface Storage Element

New and expanded storage projects have the potential to generate major construction impacts such as impaired air quality, increased noise, and traffic delays. Those impacts could be mitigated using standard measures and are not expected to be significant. Therefore, there would be no disproportionate adverse impacts to low-income or minority populations. In addition, all three of the proposed storage projects are located in remote areas with expectedly small populations of minority and low-income people (U.S. Census Bureau, 2010).

4.23.2.4 Groundwater Storage Element

The shallow aquifer recharge projects are not expected to cause disproportionate adverse impacts on minority and low-income populations.

4.23.2.5 Habitat/Watershed Protection and Enhancement Element

Construction of enhancement projects under this element is not expected to create disproportionate adverse impacts to minority and low-income populations.

4.23.2.6 Enhanced Water Conservation Element

Agricultural water conservation projects would not generate disproportionate adverse impacts to minority or low-income populations. There would be no construction associated with the municipal and domestic conservation program and thus no short-term impacts.

4.23.2.7 Market Reallocation Element

There would be no construction associated with market reallocation so there would be no short-term impacts.

4.23.3 Mitigation Measures

None of the elements are expected to create short-term environmental justice impacts; therefore, no mitigation is expected to be required.

4.24 Overall Short-term Impacts and Benefits of Integrated Plan

Construction of the Integrated Plan elements would cause short-term construction-related impacts, including erosion and sedimentation, water quality, increased dust, noise and traffic disruptions. Access to recreation areas could be restricted and recreationists could be disrupted by noise and dust. Cultural resources could be exposed during construction and access to traditional areas could be limited. All these impacts would be temporary, limited to the expected three to five-year construction schedules. Implementation of BMPs and required permitting conditions would minimize construction impacts.

Implementation of the Integrated Plan includes a large number of projects throughout the Yakima River basin. Because of funding and the need for additional design and environmental review, implementation of the projects would be phased over time. As a result, construction impacts from the various projects would not occur at the same time.

The Integrated Plan includes several large scale construction projects, such as projects proposed in the Surface Water Storage Element. Those projects would have more substantial construction impacts and would last longer. Short-term impacts of these large scale projects are expected to be greater than anything proposed under the No Action Alternative.

Many of the proposed projects, such as water conservation and habitat enhancement, are similar to those proposed under the No Action Alternative and would have similar impacts. Implementing all of the projects under an Integrated Plan could further reduce short-term impacts by developing a coordinated plan for construction. This could be especially important for resources such as cultural resources for which a coordinated approach could reduce impacts through coordinate cultural resource studies.

Short-term impacts of the Integrated Plan may be somewhat greater than those that would occur under the No Action Alternative because of the number and scale of projects. In particular, construction associated with the new and expanded surface storage projects would be much larger in scale that projects in the No Action Alternative. All construction-related impacts would be temporary and mitigated by implementing BMPs. Development of a coordinated construction plan for the Integrated Plan projects could further reduce those impacts.

4.25 Cumulative Impacts

Cumulative impacts are the effects that may result from the incremental impact of an action when added to other past, present and reasonably foreseeable future actions (40 CFR 1508.7). "Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7). Generally, an impact can be considered cumulative if: a) effects of several actions occur in the same locale; b) effects on a particular resource are similar in nature; and c) effects are long-term in nature. Potential areas where short term cumulative impacts might occur as a result of implementation of the Integrated Plan are discussed below. Long term cumulative impacts associated with implementation of the Integrated Plan are discussed in Section 5.25.

The Integrated Plan is intended to address some of the cumulative impacts associated with past projects in the Yakima River basin, including fish passage projects to open up habitat blocked by dam construction, fish habitat enhancement projects to restore habitat damaged by past land use actions, structural and operation changes to improve fish migration and the efficiency of existing irrigation facilities, and new surface and groundwater storage to improve streamflows and water supplies. These improvements are considered long-term cumulative impacts and are described in Section 5.25.

The Integrated Plan includes a number of projects which could generate cumulative construction impacts if they were constructed concurrently. Cumulative construction impacts could include potential impacts to receiving water quality with accompanying effects on fisheries, impacts to vegetation associated with clearing and grading, and transportation issues associated with construction haul routes. Residents along construction haul routes could experience increased dust, noise, and traffic delays.

Potential cumulative impacts to recreational facilities could occur, if facilities are constructed that restrict access to recreational locations. These impacts could result in the need for individuals to travel farther for recreational opportunities for up to five years during the construction window for some projects. This could result in increased crowding at alternate facilities that are not subject to disruption. The potential for inadvertent discovery of cultural sites and artifacts during construction could occur associated with any of the proposed projects and this potential would increase as the number of projects increases.

These cumulative construction-related impacts would be further compounded if other present and reasonably foreseeable projects are constructed concurrently with Integrated Plan projects. These projects would include those identified for the No Action Alternative (Section 2.3), such as conservation projects under YRBWEP Phase II, fish habitat enhancement projects, Yakima County floodplain reconnection projects, and others. Other projects proposed in the basin that are not part of the No Action Alternative include activities that could compound short-term impacts associated with the Integrated Plan. These include wind power development ongoing throughout the area; ongoing activities and facility expansion at the Department of Army's Yakima Training Center; potential hydropower development at existing dams; and ongoing residential, commercial, and agricultural development in the basin, which has been planned for as part of regional land use planning. If construction of these projects occurs concurrently with Integrated Plan projects, short-term construction impacts could be compounded. The Integrated Plan, especially the Keechelus-to-Kachess pipeline project, could also compound cumulative construction impacts in combination with the WSDOT improvements to I-90 in the Snoqualmie Pass area.

Although there could be cumulative construction-related impacts if Integrated Plan and other reasonably foreseeable projects are constructed concurrently, construction impacts are generally expected to be minor, localized, and temporary. Required BMPs and compliance with permitting requirements would minimize potential cumulative impacts. In addition, projects associated with the Integrated Plan would undergo additional project-level environmental analysis under NEPA and/or SEPA, as would other projects proposed in the Yakima and Columbia River Basins. This would identify specific project impacts and cumulative impacts, as well as appropriate mitigation measures. Implementing the Integrated Plan in a comprehensive manner would allow for better coordination of construction scheduling of projects included in the plan and with other proposed projects. This would help minimize potential cumulative impacts of construction.

In addition to projects and programs within the Yakima River basin, there are several water resource programs and/or projects within the Columbia River Basin with the potential to cumulatively affect or be affected by the Integrated Plan. These include the Odessa Subarea Special Study, Lake Roosevelt Incremental Storage Releases, Walla Walla Pump Exchange, Sullivan Lake Water Supply, and Umatilla Aquifer Recharge projects. As described above, there may be cumulative short-term impacts if construction for these projects if scheduled concurrently or occurs in close proximity; however, these projects are scattered across eastern Washington and Oregon reducing the potential for short-term cumulative impacts. Overall, the potential for short-term cumulative impacts associated with implementation of these projects is very low. Refer to Section 5.25 for a discussion of potential long term cumulative impacts.

4.26 Unavoidable Adverse Impacts

Unavoidable significant adverse impacts are defined as environmental consequences of an action that cannot be avoided, either by changing the nature of the action or through mitigation if the action is undertaken. Construction-related impacts to water quality have been identified for many of the project elements; however, while some level of impact is unavoidable it is anticipated that mitigation measures would reduce these impacts to an insignificant level.

4.27 Relationship between Short-Term Uses 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). This occurs when short-term negative effects are counterbalanced by a long-term positive effect (and vice-versa). Implementation of the Integrated Plan would involve construction activities that would cause some short-term adverse impacts to water quality, fish, vegetation, wildlife, air quality, noise, transportation, and recreation. These short-term impacts are counterbalanced by long term benefits to fish, threatened and endangered species, vegetation, and ecosystem productivity.

4.28 Environmental Commitments

This section discussed the short-term environmental commitments made in this DPEIS. Reclamation has the primary responsibility to ensure these commitments are met if an action is implemented. Because this a programmatic environmental review of the Integrated Plan elements, specific mitigation measures have not been developed for specific project actions at this time. Additional measures would be developed during project-specific review for each project action carried forward. Below is a summary of the type of actions that would be undertaken to minimize short-term construction-related impacts.

4.28.1 Erosion and Sediment Control

Construction best management practices (BMPs) would be employed, and temporary erosion and sediment control plans would be prepared in accordance with Federal, State or local requirements, for any construction site to minimize the potential for sediment production and delivery to stream channels. Measures would include timing construction activities to avoid earth disturbances during periods of high precipitation; using appropriate sedimentation control devices; covering exposed soil stockpiles and exposed slopes; retaining vegetation where possible, and replanting as soon as possible following construction to minimize soil erosion; among other measures.

4.28.2 Construction Practices

Measures would be implemented as appropriate to minimize dust from construction sites and haul routes. Emissions from construction vehicles could be reduced by following BMPs to minimize emissions, such as maintaining engines in good working order and minimizing trip distances. Other measures to minimize emissions include coordinating project planning, combining workers' trips, and using local materials.

Construction noise impacts could be mitigated by limiting construction hours, using equipment with mufflers or noise control, and situating noise-generating equipment away from houses or other sensitive receivers.

Mitigation measures to reduce short-term construction impacts to transportation would include maintaining access to properties, installing signs, marking detour routes, flagging, and providing information to the public, including notifications in advance of construction activities. Access to and from recreational facilities may be temporarily closed, or limited, during construction. To the extent possible, alternate access routes would be provided.

Mitigation planning related to utility disruption should include coordination with involved service providers, as well as with potentially impacted local residents/landowners.

4.28.3 Habitat

Project design should incorporate an evaluation of existing wildlife habitats and species in the vicinity and a rare plant survey. Habitat that is determined to be of significant importance (e.g., presence of listed species) should be preserved to the greatest extent possible. Facilities, access roads, and staging areas should be located in areas of disturbed vegetation to minimize the disturbance of intact vegetation as much as possible. Where possible, vegetation that is removed for construction would be replaced with appropriate native plant species. Habitat restoration projects are expected to provide an overall benefit to listed fish and wildlife.

To minimize impacts to fish, construction activities with in-water components should work within appropriate instream fish work windows to avoid critical periods (i.e., breeding/spawning, migration);

Measures to reduce noise and limit human activity should be incorporated for project activities that are near high quality habitats such as old-growth or riparian zones. Habitat restoration projects are expected to be an overall benefit to wildlife.

4.28.4 Water Supply

To mitigate short-term disruptions in surface water irrigation supply due to construction activities, Reclamation and Ecology would coordinate with water users and construction personnel to ensure that construction activities are scheduled to minimize disruptions. To the extent possible, conveyance construction would occur outside the irrigation season. Mitigation for stream bypasses would be negotiated with fish agencies as part of permitting for individual projects. Reservoir drawdowns would be scheduled to minimize effects on water supplies and fish.

4.28.5 Additional Studies

Large projects such as new surface storage would require site-specific geotechnical studies to identify subsurface issues, unstable slopes, and other local factors that can contribute to slope instability and increase erosion potential. These studies would be used in the design of project-specific BMPs and temporary erosion and sediment control plans in accordance with Federal, State, or local requirements. Requirements for each construction project would be defined through review by State and local regulatory agencies.

Conduct site-specific hydrogeological studies prior to construction to determine impacts to short-term groundwater levels and quantity from projects that may require dewatering activities.

Additional cultural resources review including field investigations would be required once specific locations for project elements are identified. These inventory investigations would determine if any archaeological sites, historic structures, or TCPs would be affected. Once the inventory and evaluation was complete then mitigation measures could be determined. Mitigation measures for short-term impacts to TCPs would need to be determined in consultation with the appropriate cultural group. Construction contracts would require that if any archaeological material is encountered during construction, construction activities in the immediate vicinity would halt and DAHP and a professional archaeologist would be contacted for further assessment prior to resuming construction activity in that area. Construction contracts may also include specific requirements for working around historic dams.

4.28.6 Property Acquisition

Property acquisition and temporary and permanent easements would be required for most projects. Properties impacted would likely be a mix of public and private lands supporting a variety of uses. To the extent possible, alternate access routes would be provided, and access to private property would be maintained at all times. If individual projects that require the acquisition of land or easements are advanced for implementation, appropriate compensation would be required in accordance with applicable Federal or State regulations.

Chapter 5

LONG-TERM IMPACTS AND MITIGATION MEASURES

CHAPTER 5.0 LONG-TERM IMPACTS AND MITIGATION MEASURES

5.1 Introduction

This chapter describes the long-term impacts that could result from the alternatives proposed in this DPEIS. Long-term impacts are those that would occur as a result of implementing an element, project, or action. Possible mitigation measures for the impacts are also discussed.

Because this is a Programmatic EIS, the details of project implementation are not well known for many projects and actions. Thus, long-term impacts are discussed based on the level of detail available. Reclamation and Ecology expect that projects or actions included as features of the Integrated Water Resource Management Plan would be subject to subsequent project-level environmental review under NEPA and SEPA before being approved for implementation should the Integrated Water Resource Management Plan alternative move forward. The subsequent NEPA project-level reviews could include any combination of EIS(s), supplemental EIS(s), environmental assessment(s), and/or categorical exclusion(s) along with corresponding SEPA reviews, as appropriate, depending on the proposed action, phasing of implementation, and potential for adverse impacts.

Impacts are evaluated for the No Action Alternative and the Integrated Water Resource Management Plan. The Integrated Water Resource Management Plan includes seven elements—fish passage, structural and operational changes, surface water storage, groundwater storage, habitat/watershed protection and enhancement, enhanced water conservation, and market-based reallocation of water resources. Impacts associated with the elements are presented first. Because the Integrated Plan would be implemented as a coordinated package phased over time, the effects of the combination of all elements functioning together as a comprehensive plan also are presented. Long-term cumulative impacts are presented at the end of this chapter. The discussion of short-term impacts is presented in Chapter 4.

5.2 Earth

5.2.1 No Action Alternative

Under the No Action Alternative, the existing activities, development patterns, and land use trends in the Yakima River basin would continue. Erosion and sediment delivery to streams likely would continue to occur at about the same rates as under existing conditions or could increase in the future, as past trends have indicated. Any projects undertaken by other agencies or individuals would undergo separate NEPA or SEPA evaluation, as appropriate, to determine impacts on earth resources.

5.2.2 Integrated Water Resource Management Plan Alternative – Impacts of Individual Elements

Under the Integrated Plan Alternative, long-term impacts on earth resources are based on the long-term erosion potential associated with each proposed project.

5.2.2.1 Reservoir Fish Passage Element

No major long-term earth impacts are expected from the Fish Passage Element. Some of the fish passage structures would likely provide a limited source of organic materials for downstream beds, banks, and vegetation; however, the potential for impact is minor. Site-scale stream channel erosion and channel modifications are also possible. No major long-term earth impacts are expected from the operation of fish passage facilities because earth disruption would be minimal and the operational changes would not result in increased exposure of sediments.

5.2.2.2 Structural and Operational Changes Element

Earth-related impacts are expected to be minimal during operation of the modified facilities after construction activities have been completed, with the possible exception of erosion and shoreline changes at Cle Elum Reservoir following the pool raise. Increasing the pool elevation at Cle Elum by 3 feet would increase the shoreline erosion for some period as the new shoreline is established. Shoreline protection measures would be installed to minimize potential erosion to less-than-significant levels. A long-term borrow source could be required in order to perform future maintenance of the shoreline protection features. The rock borrow source and haul road could be a long-term sediment source.

Earth-related impacts are expected to be minimal during operation of the modified KRD facilities, the modified Wapatox Canal, and the Keechelus-to-Kachess pipeline once construction activities and revegetation have been completed. No impacts are expected from subordination of the Roza and Chandler Powerplants.

5.2.2.3 Surface Storage Element

The Surface Storage Element has the greatest potential to cause impacts on earth resources over the long term. Storage facilities, including the expansion of Bumping Lake, have the potential to alter the downstream transport of sediments, resulting in increased deposition in the reservoir and reduced sediment loads to downstream waters. Shoreline erosion may occur along the new shorelines at the proposed Wymer Dam and Bumping Lake Reservoirs. Detailed earth-related impacts for storage facilities would be described in future site-specific geologic investigations. This information would be used to develop facility designs that minimize the potential for earth-related impacts and develop appropriate mitigation measures.

5.2.2.4 Groundwater Storage Element

The shallow aquifer recharge infiltration ponds and conveyance infrastructure are not expected to cause impacts on earth resources once construction is completed. Periodic maintenance of the ponds would be required to maintain infiltration. Erosion control measures would be employed to ensure this maintenance would not increase erosion. The surface infiltration ponds would be dry during some periods of the year and the pond area would be exposed. Because the ponds would be surrounded by berms, the potential for longer term erosion is minor. The ASR facilities are not expected to cause increased erosion following construction because no water would flow over the soil surface.

5.2.2.5 Habitat/Watershed Protection and Enhancement Element

Restoring natural functions to riparian areas and streams would stabilize floodplain function and potentially reduce bank erosion and sedimentation to streams. Changing development patterns on frequently flooded areas could restrict earth-moving and disturbance activities within these areas, lessening the sedimentation caused during periodic flooding. Protecting headwater areas would also lessen the potential for erosion by preventing or limiting land uses such as logging and road building. In general, the Habitat/Watershed Protection and Enhancement Element would likely result in beneficial effects on earth resources by reducing the potential for erosion.

5.2.2.6 Enhanced Water Conservation Element

The Enhanced Water Conservation Element is expected to have similar earth impacts as the No Action Alternative. This alternative would involve changes in conservation practices by State entities, irrigation districts, and end users, as well as physical changes to some infrastructures elements, such as lining of irrigation ditches. Minimal landscape changes from facility upgrades and piping projects could result in localized soil instability, but this potential would be evaluated in subsequent site-specific investigations. Increased flows in some reaches of the Yakima River would increase transport of sand size material, but channel morphology would not be impacted. Where water conservation results in reduced return flows from irrigated areas, sediment transport to streams through irrigation drains would be reduced.

Long-term impacts on earth resources are not anticipated as a result of the municipal and domestic conservation program.

5.2.2.7 Market Reallocation Element

Reallocation of water resources through water transfers or water banking could potentially cause changes in land use from irrigated cropland to less water-intensive crops, fallowed land, or urban uses. Those land use changes could result in changes in erosion and sediment delivery to streams. Reduced soil erosion could occur if source areas are converted to dryland crops or fallowed land, or if areas are paved or landscaped for urban uses.

5.2.3 Integrated Water Resource Management Plan Alternative – Impacts of Integrated Plan

Implementing the elements as an integrated package would result in a combination of effects including loss of earth-related resources, permanent landscape modifications, new roads, and changes in stream channel and floodplain conditions. Because the Integrated Plan elements would be implemented in a comprehensive, systemic manner, these effects are expected to be less than if the elements or projects were implemented individually. Increased coordination of project elements could help minimize overall impacts by enhancing efficiency in design, construction, and monitoring of projects.

Implementation of the Integrated Plan would disrupt the natural sedimentation process downstream of storage facilities, as the reservoirs trap and hold sediments. Implementation of the Habitat/Watershed Protection and Enhancement Element would also likely reduce erosion potential as floodplains are reconnected and channel scouring is reduced. The protection of lands under the Habitat/Watershed Protection and Enhancement Element could reduce erosion in the watershed as a whole, as land use practices such as logging and grazing are modified to benefit the watershed.

5.2.4 Mitigation Measures

Mitigation measures to reduce sedimentation are largely related to construction and were included in Section 4.2.3. Dam safety inspections and monitoring of slopes and hydrostatic pressures would help document management strategies that are effective and identify any needed changes over the long term. Managing recharge volumes and pressures in groundwater storage aquifers to limit seepage, inventorying slopes in the project area, and monitoring pressures in slope areas during recharge and storage would minimize potential slope instability.

Constructing facilities in accordance with applicable design requirements and monitoring to ensure that potential impacts do not develop during operation would minimize the potential for impacts. Implementation of habitat/watershed protection and enhancement projects would help to mitigate earth-related impacts throughout the basin.

5.3 Surface Water Resources

This section analyzes potential changes in timing and/or quantity of streamflows in the mainstem Yakima River and its tributaries, changes in reservoir storage and refill, and changes in deliveries to water users. The impacts were characterized using previous analyses completed as part of the Yakima River Basin Study.

One major aspect of the analysis is the use of the RiverWare model to compare results between the alternatives. RiverWare software was developed by the Center for Advanced Decision Support for Water and Environmental Systems at the University of Colorado. The software is a general river basin modeling tool that simulates operations of complex river and reservoir systems such as the Yakima Project. The software uses an object-oriented modeling approach where objects represent features in the Yakima Project such as reservoirs, streams, river reaches, diversions, and canals. Each object has its own processes and data. The objects are connected in a network that represents water flow between objects. The model is controlled by a set of prioritized rules (Reclamation, 2008g).

The Yak-RW model of the Yakima basin (which uses the RiverWare software) was originally developed as part of the Watershed and River Systems Management Program by the Yakima Field Office and Upper Columbia Area Office (now the Columbia Cascades Area Office) and has been subsequently adapted and used in the Yakima River Basin Water Storage Feasibility Study, completed from 2006 through 2008. The specific version of the model used in the Yakima River Basin Study was obtained from Reclamation's Technical Service Center (TSC), where it had been modified slightly for use in evaluating the effects of potential climate change. HDR Engineering, Inc. further modified the TSC model to incorporate the planned water conservation measures and water demand increases anticipated for the basin. This model was used to estimate water supplies, streamflows, and reservoir levels for water years 1981-2005 associated with scenarios titled "Future without Integrated Plan" (FWIP), which is synonymous with the No Action Alternative, and the "Integrated Water Resource Management Plan" (Integrated Plan).

Additional details regarding RiverWare modeling for this study are described in the *Yakima River Basin Study Modeling of Reliability and Flows Technical Memorandum* (Reclamation and Ecology, 2011k).

5.3.1 No Action Alternative

The No Action Alternative includes conservation measures through YRBWEP (described in Section 2.3) and other programs that may impact surface water. These impacts could include a slight increase in total water supply available (TWSA) and increases in streamflow in various Yakima River reaches and tributaries. Basin-wide objectives for surface water resources, as outlined in the Purpose and Need for the Action, would not be met under the No Action Alternative. Improvements to instream flow include an increase in April to September flows at Parker by approximately 73,000 acre-feet, which is an average flow of about 200 cfs. That would be accomplished through water conservation measures on irrigation districts and pump exchange projects to move diversions downstream of Parker. Other projects included in the No Action Alternative could also affect surface water. If those projects trigger NEPA or SEPA compliance, the implementing agencies or entities would evaluate potential impacts in separate environmental analyses.

5.3.1.1 RiverWare Modeling Results

The No Action Alternative scenario provides a baseline condition against which the effects of the planned projects can be compared. Table 5-1 summarizes the water resources conditions under this alternative in million acre-feet (maf) (Reclamation and Ecology, 2011g).

Table 5-1 No Action Alternative Modeling Results

Resource Indicator	No Action Alternative
Average for water years 1981-2005 (maf)	
April 1 total water supply available (TWSA)	2.79
April-September Parker flow volume	0.64
April-September diversion	1.61
September 30 reservoir contents	0.23
Irrigation proration level	80%
1993 dry-year (maf)	
April 1 total water supply available (TWSA)	2.06
April-September Parker flow volume	0.36
April-September diversion	1.42
September 30 reservoir contents	0.04
Irrigation proration level	44%
1994 dry-year (maf)	
April 1 total water supply available (TWSA)	1.74
April-September Parker flow volume	0.31
April-September diversion	1.23
September 30 reservoir contents	0.05
Irrigation proration level	21%
2001 dry-year (maf)	
April 1 total water supply available (TWSA)	1.76
April-September Parker flow volume	0.25
April-September diversion	1.29
September 30 reservoir contents	0.06
Irrigation proration level	32%
2005 dry-year (maf)	
April 1 total water supply available (TWSA)	1.71
April-September Parker flow volume	0.25
April-September diversion	1.25
September 30 reservoir contents	0.08
Irrigation proration level	28%

5.3.2 Integrated Water Resource Management Plan Alternative – Impacts of Individual Elements

An introduction to RiverWare modeling completed for this study was presented in the introduction to Section 5.3. The elements of the Integrated Plan that were modeled together are as follows:

- Structural and Operational Changes Element;
- Surface Storage Element;
- Groundwater Storage Element; and
- Enhanced Water Conservation Element.

5.3.2.1 RiverWare Modeling Results

Table 5-2 summarizes the water resources conditions under the Integrated Plan (Reclamation and Ecology, 2011g). Detailed RiverWare model results are included in Appendix E. The critical conclusions related to water supply are as follows:

- Average April total water supply available would be 3.00 maf, an increase of 0.22 maf;
- Average April to September diversion would be 1.69 maf, an increase of 0.09 maf;
- Average September 30 reservoir storage would total 0.78 maf, an increase of 0.55 maf (includes all reservoirs and Kachess inactive storage); and
- Average prorationing level would be 92 percent, an increase of 12 percentage points.

For the four dry years studied, the worst conditions occurred in the third year of a three-year drought (1994). The critical conclusions related to water supply for this situation are as follows:

- Minimum April total water supply available would be 2.22 maf, an increase of 0.48 maf;
- Minimum April to September diversion would be 1.52 maf, an increase of 0.29 maf;
- Minimum September 30 reservoir storage would total 0.13 maf, an increase of 0.08 maf (includes all reservoirs and Kachess inactive storage); and
- Minimum prorationing level would be 70 percent, an increase of 49 percentage points.

Table 5-2 Integrated Plan Alternative Modeling Results

Resource Indicator	Integrated Plan Alternative	Change from No Action Alternative
Average for water years 1981-2005 (maf)		
April 1 total water supply available (TWSA)	3.00	0.22
April-September Parker flow volume	0.60	-0.04
April-September diversion	1.69	0.09
September 30 reservoir contents	0.78[1]	0.55
Irrigation proration level	92%	12%
1993 dry-year (maf)		
April 1 total water supply available (TWSA)	2.24	0.18
April-September Parker flow volume	0.30	-0.06
April-September diversion	1.57	0.15
September 30 reservoir contents	0.46	0.42
Irrigation proration level	70%	26%
1994 dry-year (maf)		
April 1 total water supply available (TWSA)	2.22	0.48
April-September Parker flow volume	0.25	-0.07
April-September diversion	1.52	0.29
September 30 reservoir contents	0. 13[1]	0.08
Irrigation proration level	70%	49%
2001 dry-year (maf)		
April 1 total water supply available (TWSA)	2.45	0.69
April-September Parker flow volume	0.20	-0.05
April-September diversion	1.55	0.27
September 30 reservoir contents	0.42[1]	0.36
Irrigation proration level	70%	38%
2005 dry-year (maf)		
April 1 total water supply available (TWSA)	2.32	0.61
April-September Parker flow volume	0.18	-0.06
April-September diversion	1.53	0.28
September 30 reservoir contents	0.32[1]	0.24
Irrigation proration level	70%	42%

[1] – Inactive storage pool in Lake Kachess (200,000 acre-feet) is accounted for in this quantity.

The Integrated Plan Alternative includes reservoir releases to meet reach-specific target flows. During the development of the Integrated Plan, the YRBWEP Workgroup formed a subcommittee with representation from Yakima River basin fisheries interests to recommend instream flows for specific reaches of rivers and streams affected by the operation of the Yakima Project. The subcommittee recommended flow objectives for those reaches and recommended which of the reaches are the highest priority for flow modification (Reclamation and Ecology, 2011f).

The Integrated Plan operational modeling did not include all of the flow objectives prepared by the subcommittee. The Integrated Plan model also does not use all of the water stored in new and expanded reservoirs. Increased carryover storage is provided, which would allow flexibility in operations to meet instream flow objectives. It is understood that significant additional instream benefits could be achieved by resource managers, working with Yakima Project operators, to optimize reservoir operations for both instream and out-of-stream purposes.

High-Priority Reach Results

Table 5-3 summarizes the flow objectives for the high-priority reaches and evaluates the level of success achieved in the modeled outcome from the Integrated Plan scenario. The level of success in meeting flow objectives has been characterized as: significant improvement, minor improvement, no significant change, or could worsen.

The Yakima River tributaries are not represented in the RiverWare model, and flow improvements for the tributaries could not be modeled. Reaches with significant improvement are shown in shading. The tributaries are shown as unshaded, even though the Integrated Plan would potentially improve flow conditions and passage.

Table 5-3 Yakima River Basin High-Priority Instream Flow Needs and Modeled Outcomes by Reach

<table>
<tr><th>River Reach</th><th>Desired Flow Objectives and Modeled Outcomes of Integrated Plan Alternative</th><th>Priority</th><th>Level of Success</th></tr>
<tr><td rowspan="2">Yakima River, Keechelus Dam to Lake Easton</td><td>Flow Objectives:
• Reduce flows to 500 cfs during July
• Ramp flows down from 500 cfs at August 1 to 120 cfs at the first week of September
• Increase base flow to 120 cfs year-round
• Provide one pulse flow (500 cfs peak) in early April</td><td>High</td><td>No Significant Change</td></tr>
<tr><td colspan="2">Modeled Outcome: Flows are reduced below 500 cfs in July with the Integrated Plan projects. Flows are also ramped down from about 500 cfs to 120 cfs at the first week of September. From that time through March, 120 cfs is exceeded 99.6 percent of the time under the Integrated Plan compared to 20.2 percent under the No Action Alternative. Winter/Spring pulse flows would be available in most years because Keechelus Reservoir carryover storage is increased by 39,000 acre-feet on average.</td><td>Significant Improvement</td></tr>
<tr><td rowspan="2">Yakima River, Easton Reach</td><td>Flow Objectives:
• Increase September and October spawning flows to 220 cfs
• Increase minimum flows to 250 cfs all other times for rearing which provides connection to side channels</td><td>High</td><td>No Significant Change</td></tr>
<tr><td colspan="2">Modeled Outcome: November-to-March flows are above 250 cfs 98.6 percent of the time (average = 462 cfs) under the Integrated Plan compared to 64.9 percent under the No Action Alternative (average = 407 cfs). Spawning flows are held at 220 cfs from October 1-10 in 21 out of 25 years under the Integrated Plan (the other 4 years are above 220 cfs) compared to 10 out of 25 years under the No Action Alternative.</td><td>Significant Improvement</td></tr>
</table>

River Reach	Desired Flow Objectives and Modeled Outcomes of Integrated Plan Alternative	Priority	Level of Success
Cle Elum River	*Flow Objectives:* • Increase minimum flow to 500 cfs (previous analyses performed for Integrated Water Resource Management Alternative: Final EIS [Ecology, 2009] indicated 300 cfs could be provided so 300-500 cfs would be tested in the hydrologic modeling) • Decrease flows by 1,000 cfs beginning the first of August	High	No Significant Change
	Modeled Outcome: Average fall/winter flows (October-March) increased from 325 cfs for the No Action Alternative to 436 cfs with the Integrated Plan. Higher fall/winter releases up to 500 cfs minimum were tested; however, storage was depleted in most years and a minimum release of 300 cfs was used in the final model runs. Average summer (July-August) flows have decreased from 2,779 cfs in the No Action Alternative to 2,280 cfs under the Integrated Plan. The flow reduction starts earlier (July) than the objective stated by the Subcommittee. Other flow benefits of the Integrated Plan include providing spring pulse flows in nondrought years. Additional pulse flows or flow variability would be available in most years with the Integrated Plan as Keechelus and Kachess reservoir carryover storage is increased by 39,000 acre-feet (not including Kachess Inactive Storage) and Cle Elum Reservoir carryover storage is increased by 84,000 acre-feet on average.		Significant Improvement
Yakima River, Cle Elum to Teanaway River	*Flow Objective*: • Ramp flows down starting July 1 to 1,000 cfs flow rate by August 31	High	No Significant Change
	Modeled Outcome: Average flow in August has been reduced from 4,016 cfs under the No Action Alternative to 3,005 cfs under the Integrated Plan. Average flow on August 31 has been reduced from 3,142 cfs under the No Action Alternative to 2,174 cfs under the Integrated Plan. A flow rate of 1,000 cfs could not be attained under the Integrated Plan, but summer flows are significantly reduced.		Significant Improvement
Yakima River, Teanaway River to Roza Dam (Ellensburg Reach)	*Flow Objectives*: • Reduce flow by 1,000 cfs beginning July 1 • Reach a flow of 1,000 cfs by August 31	High	No Significant Change
	Modeled Outcome: Average summer (July-August) flows have been reduced from 3,204 cfs under the No Action Alternative to 2,471 cfs under the Integrated Plan. Summer flows are significantly reduced, but the objective of reaching 1,000 cfs could not be attained.		Significant Improvement
Yakima River, Roza Dam – Naches River	*Flow Objectives*: • Increase flows in the spring to a minimum of 1,400 cfs • Increase flows in the fall and winter to between 1,000 and 1,400 cfs	High	No Significant Change
	Modeled Outcome: Some small flow benefits accrue to this reach because of increased flow in upstream reaches. However, flows in this reach are primarily affected by diversions for hydropower. Subordination of hydropower was not modeled in this study. Additional flow would be provided and flow objectives met if subordination of Roza Powerplant flows is adopted.		Minor Improvement

River Reach	Desired Flow Objectives and Modeled Outcomes of Integrated Plan Alternative	Priority	Level of Success
Tieton River	*Flow Objective:* • Increase minimum flows to 125 cfs from late October to April 1	High	No Significant Change
	Modeled Outcome: The high priority flow objective of 125 cfs in winter (November to March) was met 99.8 percent of the time under the Integrated Plan compared to 28.3 percent under the No Action Alternative.		Significant Improvement
Lower Naches River	*Flow Objectives*: • Increase minimum flow rate to 550 cfs from June 1 to November 1 • Change the ramping rates from spring to summer flows to a more gradual decline • Reduce September flows as much as possible	High	No Significant Change
	Modeled Outcome: Compared to the No Action Alternative, the average summer (July and August) flow has decreased by approximately 157 cfs, resulting in an average flow of 867 cfs under the Integrated Plan. However, since the lower Naches River was not targeted by reservoir operation rules the outcome of reduced summer flow appears to be a result of the model not being able to properly balance storage and flows well in that reach. Carryover storage in Rimrock and Bumping Lake Reservoirs is increased by about 207,000 acre-feet on average which would provide operational flexibility. It is expected that some of the carryover storage could be used to change the ramping rate and increase summer instream flows greater than shown in the model. The objective of reducing September flows (through changing flip-flop operations) was not achieved.		Could Worsen
Yakima River from Parker to Toppenish Creek (Wapato Reach)	*Flow Objectives*: • Provide a spring pulse of 15,000 to 20,000 acre-feet in early May in dry years • Change ramping rate at end of high flows that occur in June-July in average to wet years	High	No Significant Change
	Modeled Outcome: Pulse flows in dry years were not modeled, but system carryover storage is increased by 330,000 acre-feet on average. The additional storage could be used to provide pulse flows during dry years as well as flow to change ramping rates in average to wet years. In addition, storage in Wymer Reservoir is available for fisheries purposes, some of which can be used for pulse flows, although Wymer is lower in the river system. The hydrologic modeling also indicates average spring flow has increased from 3,377 cfs in the No Action Alternative to 3,578 cfs in the Integrated Plan, an increase of 201 cfs.		Minor Improvement
Manastash, Taneum, Cowiche	*Flow Objectives:* • Replace current diversions with Yakima or Naches River water; deliver water directly to tributaries if supply replacement is not feasible. No specific flow objectives were identified.	High	No Significant Change

River Reach	Desired Flow Objectives and Modeled Outcomes of Integrated Plan Alternative	Priority	Level of Success
	Modeled Outcome: Tributary flows were not addressed in the model at this time, but the KRD South Branch project included in the Integrated Plan could provide 27 cfs in Manastash and Taneum Creeks. Cowiche Creek is not addressed in the projects at this time.		No Significant Change
Ahtanum Creek	*Flow Objective*: • No flow objectives or augmentation alternatives were identified by the subcommittee; however summer and early fall flow issues are noted.	High	No Significant Change
	Modeled Outcome: Tributary flows were not addressed in the model at this time. No significant change in flow is anticipated in Ahtanum Creek under the Integrated Plan.		No Significant Change

The results in Table 5-3 show that the Integrated Plan would help meet high-priority flow objectives in eight of nine mainstem reaches, including substantial improvement in six of these reaches. While not modeled, it would also significantly improve flows in Taneum and Manastash Creeks. Appendix E contains figures showing flows under Integrated Plan conditions compared to No Action Alternative conditions. In some reaches, unregulated flow hydrographs are available and are plotted with the Integrated Plan and No Action Alternative hydrographs to illustrate the difference between regulated and unregulated conditions.

Lower Priority Reach Results

Flow objectives that are not high priority are shown in Table 5-4 along with a generalized evaluation of the level of success achieved in the modeled outcome from the Integrated Plan scenario. As for Table 5-3, reaches anticipated to have significant improvement in meeting flow objectives are shaded.

Table 5-4 Yakima Basin Lower-Priority Instream Flow Needs and Modeled Outcomes by Reach

River Reach	Desired Flow Objectives and Modeled Outcomes of Integrated Plan Alternative	Priority	Level of Success
Kachess River	*Flow Objective:* • No change proposed – Kachess River is a lesser priority for improving river flow because of other objectives	Lower	No Significant Change
Yakima River, Easton Reach	*Flow Objective:* • Provide spring pulse of 1,000 cfs for 48 hours during dry years, occasionally augment spring flow for channel maintenance (5 years for riparian recruitment – bankfull during wet years)	Medium	No Significant Change
	Modeled Outcome: Spring pulse flows are provided in 18 of 25 years under the Integrated Plan compared to 12 out of 25 years under the No Action Alternative. Additional storage is available in most years to provide additional pulses; in wet years, sufficient storage should be available to provide channel maintenance flows if not provided in winter.		Significant Improvement

River Reach	Desired Flow Objectives and Modeled Outcomes of Integrated Plan Alternative	Priority	Level of Success
Yakima River, Cle Elum to Teanaway River	*Flow Objectives:* • Provide channel shaping flows about every 5 years • Provide flow variability; see Cle Elum River	Medium	No Significant Change
	Modeled Outcome: Additional September 30 carryover storage of 123,000 acre-feet in upper Yakima reservoirs (Keechelus, Kachess and Cle Elum), on average (not including Wymer Reservoir or Kachess Inactive Storage), would allow additional pulse flow or increases in flow variability. In wet years sufficient storage should be available to provide channel maintenance flows if not provided in winter.		Significant Improvement
Yakima River, Teanaway to Roza Dam	*Flow Objectives:* • Provide channel shaping flows about every 5 years • Provide flow variability, time pulses to match natural events	Medium	No Significant Change
	Modeled Outcome: Pulse flows are provided from upstream reservoirs. Additional system carryover storage of 123,000 acre-feet in upper Yakima basin reservoirs would allow additional pulse flow or increases in flow variability. In wet years sufficient storage should be available to provide channel maintenance flows if not provided in winter.		Significant Improvement
Yakima River, Roza Dam to Naches River	*Flow Objective:* • Provide flow variability	Lower to Medium	No Significant Change
	Modeled Outcome: Subordination was not modeled, so increased flow variability could be provided when desired if subordination of Roza Powerplant flows is adopted.		Minor Improvement
Bumping River, Bumping Dam to Naches River	*Flow Objective:* • Reduce flows by 70-100 cfs from August through October	Medium	No Significant Change
	Modeled Outcome: Average daily flow from August through October decreased from 189 cfs under the No Action Alternative to 165 cfs under the Integrated Plan.		Minor Improvement
Tieton River	*Flow Objective:* • Reduce September flows to as close as possible to unregulated conditions	Medium	No Significant Change
	Modeled Outcome: Average flow in September decreased from 1,534 cfs under the No Action Alternative to 1,166 cfs under the Integrated Plan. Flip-flop could not be eliminated.		Significant Improvement
Yakima River, Naches River to Parker	*Flow Objective:* • Reduce high summer flows as much as possible	Lower	No Significant Change
	Modeled Outcome: The average summer flow under the Integrated Plan has decreased by approximately 215 cfs, resulting in an average flow of 3,185 cfs.		Minor Improvement

River Reach	Desired Flow Objectives and Modeled Outcomes of Integrated Plan Alternative	Priority	Level of Success
Yakima River from Parker to Toppenish Creek (Wapato Reach)	*Flow Objective:* • Link to habitat needs	No priority assigned	No Significant Change
Yakima River: Toppenish Creek to Prosser Dam	*Flow Objective:* • See Wapato Reach	See Wapato Reach	No Significant Change
Yakima River-Prosser Dam to Chandler Powerplant	*Flow Objectives:* • Need greater than 1,000 cfs in September • Although some subordination occurs to provide 1,000 cfs, need more flow in Spring	Lower	No Significant Change
	Modeled Outcome: Average September flow has decreased from 650 cfs under the No Action Alternative to 492 cfs under the Integrated Plan. Average flow in July increased from 682 cfs under the No Action Alternative to 758 cfs under the Integrated Plan. Average spring flows have increased by 188 cfs, resulting in an average spring flow of 2,490 cfs under the Integrated Plan. Subordination of Chandler Powerplant was not modeled and additional spring flow would occur if subordination is adopted. Additional storage is available for Spring pulse flows (see high priority flow objective for Wapato Reach) and possibly September flow.		Minor Improvement
Lower Yakima River (Chandler Powerplant to mouth)	*Flow Objectives:* • See Wapato Reach for spring flow objective • Link summer flow objective to habitat needs	Lower	No Significant Change
	Modeled Outcome: Pulse flows in dry years were not modeled, but system carryover storage increased by 330,000 acre-feet on average. The additional storage could be used to provide pulse flows during dry years. In addition, storage in Wymer Reservoir is available for fisheries purposes including pulse flows.		Minor Improvement
Big, Little, Tillman, Spex Arth and Peterson Creeks	*Objective:* Increase summer and early fall flows	Medium	No Significant Change
Ahtanum Creek	*Objective:* Increase summer and early fall flows	Medium	No Significant Change
Wenas Creek	*Objective:* Increase summer and early fall flows	Lower	No Significant Change
North Side Kittitas Valley Tributaries	*Objective:* Improve passage	Lower	No Significant Change

River Reach	Desired Flow Objectives and Modeled Outcomes of Integrated Plan Alternative	Priority	Level of Success
	Modeled Outcome: Tributary flows were not addressed in the model at this time. The KRD South Branch project could improve instream flow in Big, Little and other south side creeks; however, the flow available is also needed to increase flow in Taneum and Manastash creeks, which were rated a higher priority. No change in flow is anticipated in Ahtanum or Wenas Creek with projects under the Integrated Plan. The North Branch Canal has potential to improve flow conditions and passage in the north side Kittitas Valley tributaries by restoring flow or removing irrigation water conveyance through creeks and removing diversion structures.		No Significant Change

The results in Table 5-4 show the Integrated Plan would help meet medium- and lower-priority objectives in 9 of 11 mainstem reaches, and improve flows in some Kittitas County tributaries. In addition, approximately 330,000 acre-feet of additional water left in September 30 carryover storage beyond the No Action Alternative carryover (on average, not including Wymer Reservoir or Kachess Reservoir inactive storage) could be used to provide additional improvement in flows, if desired.

In two reaches, the Yakima River between Roza Dam and the Naches River, and the Yakima River between Prosser Dam and Chandler Powerplant, diversions for hydropower would affect flow in the Yakima River. Flow objectives for those two reaches could be met through additional subordination of hydroelectric generation. Section 5.3.2.3 covers effects on surface water due to power subordination at these two diversions.

5.3.2.2 Reservoir Fish Passage Element

Surface water resource impacts are not expected in the long term as a result of the fish passage facilities, assuming the reservoirs would be operated in the same general manner as they are currently. Some slight modifications to the timing of storage fills and releases may be required to accommodate upstream or downstream fish passage. However, the project is not expected to affect water delivery contracts, TWSA, or flood control operations.

5.3.2.3 Structural and Operational Changes Element

Cle Elum Dam Pool Raise

Raising the pool at Cle Elum Dam is included in the Integrated Plan modeling efforts, and effects on surface water are described in Section 5.3.2.1.

Kittitas Reclamation District Canal Modifications

Lateral piping in the Kittitas Reclamation District (KRD) would conserve water by eliminating seepage and evaporation loss within the laterals (Reclamation and Ecology, 2011h). In addition, pressurized laterals would reduce the volume of water spilled at the end of the laterals, and allow the previously spilled water to be conveyed to Kittitas Valley tributaries through existing infrastructure where flow is needed.

Ecology's EIS (2009) estimated that seepage losses would be reduced by 5,312 acre-feet per year (14.9 cfs) by piping five laterals along the South Branch Canal and five laterals along the Main Canal. The estimated seepage loss reductions represent the water that would be used to supplement flows in tributaries or supplant supply to users that divert water from tributaries. The KRD diversion would not be reduced; the water saved would be conveyed through the KRD system to the water users or tributaries through existing structures. KRD currently has the structures in place to supplement flow to Taneum Creek (via the Taneum Chute) and Manastash Creek (via the Manastash Spill); therefore, no additional structures would be required at these locations.

A reregulating reservoir at Manastash Spill or other site would capture spill and increase the flow in Manastash Creek by several cfs. Pumping water directly to water users or Manastash Creek would increase flows in Manastash Creek by several cfs also.

Wapatox Canal Improvements

Improvements to the Wapatox Canal would allow for reduced diversions from the Naches River by reducing the amount of carriage water diverted to the canal (Reclamation and Ecology, 2011n). While diversions have been reduced from peak flow rates when the canal was used for power generation, records indicate that diversions to the canal (approximately 110 to 130 cfs) still exceed the 50 cfs delivered to ditch users. The current ditch configuration requires carriage water to be diverted and conveyed through the entire length of the canal and discharged at the downstream end to maintain deliveries to irrigators. The project is intended to reduce carriage water diverted to the Wapatox Canal, reduce or eliminate other canal losses, and provide sufficient capacity to allow for consolidation of other surface water diversions with the Wapatox Canal diversion. The improvements would result in reduced diversions from the lower Naches River, increased flows in the river, and opportunities for restoration of floodplain areas.

Keechelus-to-Kachess Pipeline

The Keechelus-to-Kachess pipeline project is included in the Integrated Plan modeling efforts, and effects on surface water are described in Section 5.3.2.1.

Subordinate Power at Roza Dam and Chandler Powerplants

Subordination of Roza Powerplant diversions from April to May would affect surface water. This element of the Integrated Plan Alternative would allow water to remain in the 15-mile Yakima River reach between Roza Canal and the Roza Powerplant return from April to May, the time of spring out-migration of juvenile salmonids. The amount of flow that would remain in the Yakima River is not yet determined, but recommendations for flow subordination would likely be provided by an adaptive management team each spring. The management team would consist of representatives from Reclamation, the Yakama Nation, major irrigators, and fish agencies. Reclamation would then be responsible for implementing the flow changes.

Subordination of Chandler Powerplant diversion during the spring (April to June) would also affect surface water. This element of the Integrated Plan Alternative would allow additional water to remain in the 11-mile Yakima River reach between the Prosser Diversion Dam and the Chandler Canal return when flow in the Yakima River below Prosser Diversion Dam is below a flow threshold that is yet to be determined. The amount of flow required below Prosser Diversion Dam from April through June is currently set at 1,000 cfs. The flow increase has not yet been determined, and recommendations would be provided each spring by an adaptive management team as described above for the Roza Powerplant subordination.

5.3.2.4 Surface Storage Element

Adding surface storage through Wymer Dam, Bumping Lake Dam, and the Kachess Reservoir inactive storage projects is included in the Integrated Plan modeling efforts. Effects on surface water are described in Section 5.3.2.1 and Appendix E, which contains RiverWare modeling results showing reservoir storage volumes and levels for a long-term simulation period.

5.3.2.5 Groundwater Storage Element

Shallow aquifer recharge is included in the Integrated Plan alternative modeling efforts, and effects on surface water are described in Section 5.3.2.1.

Aquifer storage and recovery would impact flow in the Naches River from the City of Yakima water treatment plant diversion location at RM 9.7 to its confluence with the Yakima River, and in the Yakima River from its confluence with the Naches River to the mouth.

During the winter months when demand for water is low, approximately 5,000 to 10,000 acre-feet per year would be diverted, causing a reduction in the affected reaches. If it is assumed that the diversions would occur from November to March (150 days), the estimated average decrease in flow in the affected reaches is 17 to 34 cfs.

During the summer months when demand for water is highest, the water stored through aquifer storage and recovery would be recaptured for use in the City of Yakima. The amount of water recovered would reduce the amount of water the City of Yakima needs to divert, and could result in an increase in flow in the amount of the decreased diversion in the affected reaches.

5.3.2.6 Habitat/Watershed Protection and Enhancement Element

This program contains a number of projects that may improve flow conditions in the mainstem Yakima and Naches Rivers and tributaries by providing a more natural floodplain and increased habitat complexity. The projects may reduce flood peaks by providing additional floodplain storage, and reduce velocities in stream channels by providing additional off-channel conveyance areas.

5.3.2.7 Enhanced Water Conservation Element

Agricultural conservation is included in the Integrated Plan Alternative modeling efforts, and effects on surface water are described in Section 5.3.2.1.

The potential water savings from the municipal and domestic conservation program is 16,000 acre-feet per year in 2030 and 24,100 acre-feet per year in 2060 (Reclamation and Ecology, 2011l). The reduction in demand could result in a slight increase in surface water flow downstream of the point of diversion, for both diversions from mainstem rivers and withdrawal from wells. The effect of the municipal and domestic conservation program was incorporated into long-term demands placed into the RiverWare model. The effects on surface water are described in Section 5.3.2.1.

5.3.2.8 Market Reallocation Element

The water marketing element is designed to facilitate the transfer of existing water rights to help alleviate shortfalls in water supply for both irrigation and municipal uses. No increases in the overall water supply for the Yakima Project would result. Hydrologic conditions described for the No Action Alternative would also represent the overall hydrologic conditions for this element. The operations of the Yakima Project and individual irrigation districts or companies would constrain the amount and location of water transferred. For example, the Yakima Project operates reservoirs in both the upper Yakima River basin and in the Naches River basin. Water supply from both locations feeds the major nonproratable water users in Yakima (Sunnyside Valley Irrigation District, Wapato Irrigation Project). Water cannot be transferred from water users in one arm (i.e., the Naches River) to water users upstream in the Kittitas Valley.

Water supply conditions for certain farmers, irrigation districts, or municipal users could improve with this element. It is assumed with this element that the increase in water supply for some water users and a decrease for others would have a positive economic benefit because farms with higher-value crops or municipal users would want to purchase water from farms with lower-value crops, with the payment covering the foregone revenue from the farms with lower-value crops.

Initially the water reallocation element would continue existing water marketing and banking strategies that involve water users and Ecology, and reduce barriers to water transfers (Reclamation and Ecology, 2011j). When combined with the other elements in the Integrated Plan, approximately 30,000 acre-feet of water would be traded within districts. This could slightly increase surface water flow in the mainstem Yakima River between the point of diversion for the seller and the buyer. The relative effect on flows would be small. If the seller is located on a tributary, the relative effect on surface water could be much greater and beneficial to instream resources on the tributary.

If trading between districts is allowed, it is estimated that 60,000 acre-feet of water would be traded within districts and 60,000 acre-feet of water would be traded between districts.

In one scenario described in the *Market-Based Reallocation of Water Resources Technical Memorandum* (Reclamation and Ecology, 2011j), Roza Irrigation District would receive about 20,000 acre-feet from KRD and about 38,000 acre-feet from Sunnyside Valley Irrigation District. If it is assumed that the trading occurs for 60 days during August and September, an additional 168 cfs of water would be in the Yakima River between RM 202.5 (KRD Main Canal diversion) and RM 127.9 (Roza Canal diversion), and a reduction of 633 cfs of water in the Yakima River would occur between RM 127.9 (Roza Canal diversion) and RM 103.8 (Sunnyside Canal diversion). Other water marketing efforts would result in effects similar to those described for the near-term effort.

5.3.3 Integrated Water Resource Management Plan Alternative – Impacts of Integrated Plan

The major surface water impacts of the Integrated Plan were described in Section 5.3.2. Improvements in water supply are reflected in increases in TWSA, end-of-season reservoir storage, and annual diversions compared to the No Action Alternative. In dry years, the increases in annual diversions are substantial. A prorationing level of 70 percent was achieved throughout an extended drought lasting three years, such as the 1992 to 1994 drought. The Integrated Plan would help meet high-priority flow objectives in eight of nine mainstem reaches, and provide substantial improvement in six of these reaches. Instream flows in 9 of 11 other reaches that are not high priority would improve. Significant improvement in flows in Taneum and Manastash Creeks would also result. Other smaller tributaries would also benefit from increases in instream flow.

5.3.4 Mitigation Measures

More detailed, site-specific studies of the alternatives are required to better determine their impacts and benefits and the amount of mitigation that might be required. Those studies would include:

- Seepage studies on irrigation canals that would be lined or piped;
- Operational studies on irrigation facilities to determine the amount of water that could be conserved;
- Groundwater studies to better characterize the amount of water that would return to surface water from the Groundwater Storage Element; and
- Studies to better estimate the potential for large-scale water transfers to benefit irrigation water supply for some water users.

Additional RiverWare modeling would also be required to better understand the impact on Yakima Project operations. Studies of the impact on return flow from irrigation conservation measures are also recommended to assist Reclamation in modeling the impact of conservation measures.

No additional mitigation measures are proposed because the impacts are not expected to be significant and would be offset by the benefits of the elements within the Integrated Plan.

5.4 Groundwater

Impacts on groundwater quantity could result from changes in recharge to groundwater aquifers, or increased groundwater pumping. Impacts could be significant if they change groundwater levels in aquifers used for agricultural or municipal supply wells enough to change the usability of the wells or the amount of pumping energy needed. Impacts could also be significant if they greatly increase or reduce the amount of return flows from groundwater to streams. Impacts on groundwater quality could occur if poorer quality water enters groundwater aquifers being used for municipal or domestic supply, particularly if the levels of nitrates or bacterial contamination change.

5.4.1 No Action Alternative

Under the No Action Alternative, the existing activities, programs, and trends in the Yakima River basin would continue. Deficiencies in irrigation water availability from surface water sources may increase pressure for demand on groundwater. An increase in conversion from agricultural irrigation to residential use may result in a net decrease in total water use (since municipal and domestic use is typically lower than agricultural use, on a per acre basis). However, increased rural residential development may cause an increase in new permit exempt wells, resulting in additional use of groundwater. Continued issuance of permits for emergency use of groundwater wells in drought years could also result in overuse of groundwater. Existing groundwater levels would likely continue to decline. Implementation of agricultural projects under YRBWEP Phase 2 would lead to changes in the timing and volume of irrigation recharge and subsequent groundwater return flow. In general, groundwater recharge from irrigation is expected to decrease, and this would result in lowered water tables, reduced water levels in area wells, and reduced discharges to local rivers, creeks and wetlands.

5.4.2 Integrated Water Resource Management Plan Alternative – Impacts of Individual Elements

Long-term impacts on groundwater may occur during the operation of constructed facilities. More groundwater recharge due to increased water supply deliveries may raise aquifer levels, thus increasing discharge to streams and resulting base flows. Reducing groundwater irrigation withdrawals and increasing infiltration may also increase groundwater levels. Enhanced water conservation systems (including lining canals, converting canals to pipelines, converting to sprinkler irrigation systems, and increasing operational efficiency) would reduce applied irrigation water and reduce groundwater infiltration and shallow groundwater levels. Overall impacts on groundwater at the project scale may be positive or negative, depending on the specific details of the projects. The groundwater impacts for specific projects would be described in detail in future site-specific investigations.

5.4.2.1 Reservoir Fish Passage Element

No long-term impacts on groundwater are expected from the operation of constructed fish passage facilities because the facilities would not change the amount of water released from reservoirs or streamflows. Therefore, there would be no change in groundwater recharge.

5.4.2.2 Structural and Operational Changes Element

Releasing additional volumes for streamflow augmentation during dry seasons would have a limited long-term impact on regional groundwater conditions. Shallow groundwater in close connection with streamflows could be improved by streamflow augmentation. Improvements in irrigation conveyance facilities would reduce seepage from canals and decrease localized groundwater recharge and shallow groundwater interception, with a resulting decrease in groundwater levels. No significant impacts on groundwater quality are anticipated as a result of the operation of structural changes.

The increased pool elevation at Cle Elum Dam would likely increase seepage locally and slightly raise groundwater elevations in the immediate vicinity of the reservoir. This is not expected to create adverse effects since the change would be small (3 feet) and there are no known high groundwater issues in the immediate vicinity.

Efficiency improvements in KRD canals would reduce leakage that provides recharge to aquifers immediately underlying the canal system. Ancillary effects may include lowered water levels in local wells, and reduced groundwater discharge to local wetlands and creeks. It is anticipated that streamflow impacts would be offset in those creeks that receive enhanced flows.

Efficiency improvements to the Wapatox Canal would reduce leakage that provides recharge to aquifers immediately underlying the canal system. This may result in lowered water levels in local wells and reduced groundwater discharge to local rivers, wetlands and creeks.

No long-term effects on groundwater are expected from the Keechelus-to-Kachess pipeline or power subordination projects because changes would be small compared with the overall water balance in the vicinity of these projects.

5.4.2.3 Surface Storage Element

Operating new storage would permanently increase groundwater levels near new reservoirs. Increased infiltration beneath the reservoir would likely occur. The magnitude of impacts on water levels would depend on the size and depth, the hydraulic head created, and local hydrogeologic characteristics. Additionally, use of borrow material for construction could locally increase seepage or infiltration rates in the borrow areas. Higher groundwater levels could occur in the immediate vicinity of the reservoir, and larger scale changes in groundwater flow patterns are possible.

Based on geologic testing conducted at the Wymer Dam site, the high permeability of the surficial rock layers and sediments could result in large amounts of seepage to groundwater. Grouting or importation and lining with clay materials may be necessary to avoid excessive infiltration of stored reservoir water. More detailed hydrogeologic studies would be required to estimate the extent of impacts on local groundwater.

The Kachess inactive storage project would result in overall lower water levels in the reservoir during certain years, potentially causing less infiltration of stored water and local groundwater level impacts. More detailed hydrogeologic studies would be required to estimate the extent of impacts on local groundwater.

Because new storage would result in additional surface water deliveries, especially during dry years, increased infiltration and reduced demand on groundwater for irrigation may also increase groundwater levels in certain irrigated areas of the Yakima River basin. However, most large irrigation wells are completed in the deeper basalt aquifer. Therefore, reduced pumping of groundwater would not likely affect shallow aquifer groundwater levels. No significant impacts on groundwater quality are anticipated as a result of the new storage facilities, although increased recharge from higher irrigation deliveries could result in slightly higher return flows and contribute additional, cooler groundwater return flow to streams, especially during dry years.

5.4.2.4 Groundwater Storage Element

Changes in groundwater elevations and groundwater flow directions in shallow aquifers could result from surface infiltration associated with both shallow aquifer recharge and (to a lesser extent) ASR. Groundwater elevations near the surface infiltration sites would have the largest near-term, seasonal change. The impact of these changes would be generally positive, with an increase in shallow groundwater discharge to streams and wetlands. Negative impacts could include waterlogged soils or unwanted shallow groundwater and seepage. Long-term groundwater level changes could result from interannual return flows that are stored in the aquifer for a longer period of time. These changes would accrue slowly from year to year, depending on the cumulative amount of water infiltrated to shallow aquifers and the ability of the aquifer to discharge that infiltration to the stream in a given year. Because the quality of the surface water being infiltrated is generally good, no significant impacts on groundwater quality are anticipated as a result of the new storage facilities, although increased seepage could contribute additional cooler water to streams near the storage projects, improving surface water quality. Site-specific investigations conducted as part of the pilot studies would determine the potential for impacts on groundwater.

5.4.2.5 Habitat/Watershed Protection and Enhancement Element

Watershed protection and habitat protection could have a slight positive impact on groundwater resources (quantity and quality) in the immediate area of the affected lands. Projects such as stream channel protection and restoration, wetlands and wet meadows construction, and floodplain enhancements would allow natural riparian functions to return, with resulting improvements in shallow groundwater quantity and quality. Mainstem and tributary enhancement projects could alter floodplain and off-channel storage connectivity, potentially resulting in long-term changes to groundwater interaction with streams. In general, improvements to fish habitat would also improve near-channel groundwater interaction and connectivity between stream channels and shallow/hyporheic groundwater. Slight, positive impacts on groundwater quality are also likely.

5.4.2.6 Enhanced Water Conservation Element

The impacts from irrigation conservation and improved efficiency would include changes in the timing and volume of irrigation recharge and subsequent groundwater return flow. In general, groundwater recharge from irrigation is expected to decrease, and this would result in lowered water tables, reduced water levels in area wells, and reduced discharges to local creeks and wetlands. No impacts on groundwater quality are anticipated.

Impacts from the municipal conservation program would depend on whether total consumptive use is changed and whether future groundwater demand is changed. Ultimately, it is likely that the same amount of municipal and domestic groundwater would be used (up to existing water rights), but conservation efforts may, for example, increase the relative magnitude of consumptive use compared to the current condition. In the near term, water conservation could tend to stabilize groundwater levels in the deeper producing aquifers. No impacts on groundwater quality are anticipated.

5.4.2.7 Market Reallocation Element

Market reallocation could result in less agricultural irrigation in areas transferring water and more irrigation in areas receiving water, especially during drought years when transfers are expected to be the most active. This would reduce groundwater recharge in those years in some areas, and increase recharge in other areas. Market transfers may also reduce the need for emergency pumping of groundwater in some irrigated areas by providing improved access to surface water supply in proratable districts.

5.4.3 Integrated Water Resource Management Plan Alternative – Impacts of Integrated Plan

Groundwater levels and quantity are expected to increase through additional recharge from irrigation deliveries made from storage facilities, groundwater recharge enhancement, riparian enhancements, wetland and wet meadow construction, and floodplain enhancements. Decreases in recharge are expected from enhanced conservation (improving conveyance facilities and increasing application efficiencies). No impacts on groundwater quality are anticipated.

5.4.4 Mitigation Measures

Long-term impacts on groundwater could be avoided or mitigated by conducting hydrogeological studies and using the knowledge gained in the design, construction, and implementation of projects. The benefit of these studies would depend on the type and magnitude of projects and the extent of study.

The timing of operational activities could be used to reduce the impact on groundwater. Additionally, the use of artificial recharge or withdrawal could be considered as part of the impact management strategy. Monitoring during operations would document the effectiveness of management strategies.

Where local water supply wells are affected by lowered water tables due to conservation projects, mitigation measures could include extending wells to greater depths.

5.5 Water Quality

Long-term potential impacts on water quality were evaluated based on an understanding of local, State, and Federal permits and requirements for regulating water quality in Washington. The Integrated Plan is designed, in part, to improve streamflows in various parts of the Yakima River basin. Improved streamflows generally are expected to improve water quality conditions. However, in localized areas some of the projects included in the Integrated Plan could potentially impair water quality.

5.5.1 No Action Alternative

Under the No Action Alternative, the existing activities, programs, and trends in the Yakima River basin would continue. Operation, maintenance, and construction associated with projects funded and scheduled under the No Action Alternative could affect water quality. These projects are subject to previous environmental analyses and existing permits, or they would undergo separate NEPA or SEPA evaluation as appropriate.

5.5.2 Integrated Water Resource Management Plan Alternative – Impacts of Individual Elements

Components of the Integrated Plan are intended to provide net water resource and water quality benefits. However, some impacts on water quality could occur. Potential water quality impacts include: modification of water surface and groundwater quality, migration of contaminated soils located in newly inundated areas to surface or groundwater, and leaching and migration of subsurface natural and artificial contaminants.

In general, the Integrated Plan is not expected to affect 303(d) listings (Table 3-12). Habitat/watershed protection and enhancement projects and increased streamflows may improve stream temperatures. New reservoirs may increase temperatures of water released from the dams; however, the reservoirs will be operated to minimize temperature impacts.

5.5.2.1 Reservoir Fish Passage Element

Seasonal operation of the constructed fish passage elements is unlikely to result in significant changes in water quality because this element simply routes water through the fish passage facility rather than the existing facilities. Because of this, operation of the bypass facilities is not likely to have any direct effect upon water quality.

Increases in nutrient concentrations could result if fish populations increase and more nutrients are released from decaying fish carcasses. These nutrient releases are anticipated to be beneficial, but excessive releases could have negative impacts. Fish carcasses are an important source of nutrient inputs to streams and increase the biomass available to the benthic invertebrate community. Adult fish carcasses and associated nutrients are beneficial for juvenile salmonid productivity and consistent with the beneficial uses that the surface water quality standards are designed to attain. .

However, the introduction of adult salmon above the reservoir would, as intended, indirectly increase the nutrient content of the water, thereby increasing primary productivity. This may ultimately influence water quality characteristics such as water clarity and contribute to algal growth, especially within the reservoir. The decay of algae may reduce dissolved oxygen levels within the reservoir.

None of the other 303(d) water quality parameters are expected to substantially change. New spill gates and outflow structures could potentially influence the entrainment of air into the water and thereby affect total dissolved gas levels.

5.5.2.2 Structural and Operational Changes Element

One of the objectives of the proposed structural and operational changes is to maintain or improve water quality. These projects are designed to improve streamflows in the Yakima River and its tributaries, and they are unlikely to negatively impact stream temperatures and associated dissolved oxygen concentrations. The magnitude of changes to water quality has not been quantified, but would be a function of the location and seasonal timing of flows released as a result of the changes. Minor changes to turbidity, organic debris, sediment, and nutrients may occur, although these changes would reflect an increase in natural system processes.

The Cle Elum pool raise project may increase nutrients and sediment load in the reservoir. However, the shoreline protection measures included in the project and the limited duration of the increased inundation would reduce those impacts.

Keechelus Reservoir is listed on the State’s 303(d) list for dioxins and PCBs. The Keechelus-to-Kachess pipeline would transfer water possibly containing these pollutants to Kachess Reservoir and may impact aquatic communities and fisheries. It is anticipated that the amount of water piped to Kachess Reservoir via this pipeline would be a relatively minor contribution to the overall reservoir water volume; thus the impacts to water quality are expected to be minimal.

5.5.2.3 Surface Storage Element

The extent of impacts associated with new storage would depend on the size and location of the facility. Long-term impacts could include seasonal increases in downstream sediment loading, decreased downstream turbidity, increased or decreased downstream temperature, and increased pollutant accumulation in the impounded water.

Water quality can be affected by the impoundment of water, the depth from which water is withdrawn from reservoirs, modifications to the flow regime, and other changes to the natural hydrology. Impounding water tends to increase water temperatures and can reduce dissolved oxygen levels. These adverse effects may be transported downstream. Release of water taken from near the surface of a reservoir tends to transport warm, well oxygenated water downstream. The release of water taken from deeper in the reservoir can transport cooler, low dissolved oxygen water downstream depending on reservoir conditions.

The Wymer Dam project is intended to improve instream flows in the Yakima River and provide drought relief storage. Water would be pumped into the reservoir from the Yakima River during winter, spring, and potentially summer, during high-flow periods from upstream reservoir releases. If water is released from the reservoir to the Yakima River in the winter, spring, or early summer, it is unlikely that the water quality of the Yakima River would be significantly impacted because flows in the river are high and temperature in the river is less of an issue at these times. Releases in the later summer or early fall may have an impact on the temperature of the Yakima River, depending on the quantity and temperature of the flow from the reservoir relative to that of the Yakima River. Since flows from Wymer Dam have the potential to be warmer than downstream Yakima River water, particularly in late summer and fall, the operation of the dam would need to be mitigated through operational strategies and multiple flow release elevations. A small release of water to Lmuma Creek would occur to maintain streamflow and habitat between Wymer Dam and the Yakima River. The impacts on stream temperature would be similar to that described for the Yakima River.

If water from Wymer Reservoir is conveyed through pipelines to the Roza Canal headworks, then effects on Lmuma Creek and/or the Yakima River would be avoided or greatly reduced.

Enlargement of Bumping Lake Reservoir would inundate up to 4,120 acres of land, of which 1,300 acres are in the existing reservoir. The reservoir would extend approximately 5 miles upstream and create approximately 14 miles of shoreline. The overall operation of the reservoir would be maintained, with most of the drawdown occurring in the fall irrigation season. The enlarged reservoir has the potential to cause warmer surface water temperatures in the late summer and fall because of the increased surface area exposed to solar warming and the potentially longer residence time of the impounded water. The majority of the lake volume (middle and deep layers) would probably not warm to a significant level because its decreased density would prevent mixing into the deeper and more dense water strata. The potential impacts of increased temperature of the water released downstream could be mitigated with dam design and operational practices.

The Kachess Reservoir inactive storage project would modify the outlet to Kachess Reservoir to allow it to be drawn down approximately 80 feet lower than the current outlet. This additional drawdown would only be used during drought conditions. If the inactive storage drawdown occurs late in the irrigation season, the additional exposure of the lake surface to solar warming would presumably result in warmer water being released downstream into the Kachess and Yakima Rivers. Turbidity may increase in reservoir surface waters during inactive storage drawdown from wind-driven entrainment or sloughing of sediments into shallow surface waters. These potential impacts to lake water quality could be transmitted to the Kachess and Yakima Rivers. However, reservoir operation, intake location, flow pattern changes, and the depth of water withdrawn from the reservoir have the potential to mitigate these potential impacts. Furthermore, these potential impacts are only relevant during drought years that would necessitate the use of Lake Kachess inactive storage.

Recreational boating use, if allowed, on the new or enlarged reservoirs could also add oils and greases from watercraft, nutrients, or invasive aquatic species introduced by boats.

5.5.2.4 Groundwater Storage Element

The different types of groundwater storage elements would have different effects on water quality. Potential maintenance activities would require the use of machinery and would increase the potential for spills of hazardous materials including fuel and oils, although these risks could be minimized by conducting maintenance and fueling of the equipment offsite. Additionally, potential ground disturbances would impact water quality.

With shallow aquifer recharge, surface water would be infiltrated in groundwater aquifers for storage and later release. Some potential projects would contribute to shallow aquifers that may seep into the Yakima River, its tributaries, and the canal system. Changes in groundwater quality in affected shallow aquifers could occur from water from the Yakima River that is infiltrated to groundwater. Although specific locations and sizes of surface ponds have not been identified, a study was done to evaluate the potential effects of using this approach (Ecology, 2007a). The results indicated that the recharge water would tend to increase the concentrations of nitrates along with other water quality constituents, and the magnitude of these increases would depend on the ratio of the seepage rate to streamflow. The temperature of infiltrated water would affect the shallow aquifer groundwater temperatures. The pilot studies would be coordinated with Ecology to ensure no impacts occur to groundwater quality.

With ASR projects, potable water would be pumped into a deep confined aquifer and recovered later by pumping. Since this approach should have negligible effects on the groundwater table outside of the confined aquifer, it should have few effects on water quality beyond the confined area. Aquifer storage recovery studies indicate that metal concentrations could increase slightly while the water is stored in the deep basalt geologic formation, and that the concentration of coliform bacteria, an indicator of human pathogens, could be occasionally increased (Ecology, 2007a).

5.5.2.5 Habitat/Watershed Protection and Enhancement Element

Riparian and wetland habitat enhancements would help remove instream contaminants and cool the water. Conversely, inundation of lands for habitat restoration, wetland or wet meadow creation, and floodplain connectivity could result in the introduction of chemical constituents to surface waters. Contaminated lands would be remediated to protect water quality.

5.5.2.6 Enhanced Water Conservation Element

The primary focus of this element would be improving the efficiency of irrigation systems in the Yakima River basin. It is possible that the entire amount of conserved water would remain in the source streams during noncritical years. However, much of the conserved flow would be used by parties with proratable water rights during critical years. The amount of water that can be conserved in critical years is less than in noncritical years. Water conservation could increase nutrient concentrations in drains and wasteways as less water is discharged to those drains and wasteways, reducing dilution that currently occurs. Nutrient loading would remain the same or slightly decrease as some of the conservation measures could include on-farm reductions in the volume of water applied, thereby reducing return flow from farms. Less flow in drains and wasteways could also reduce bank erosion, reducing the amount of sediment transported to the Yakima River.

Water quality impacts from the municipal and domestic conservation program are expected to be minimal. Flow pattern changes resulting from municipal and domestic conservation are expected to have minimal effects on water quality because overall changes in surface and groundwater hydrology are expected to be relatively small.

5.5.2.7 Market Reallocation Element

Implementation of water markets or water banks could alter the use of water and thereby affect water quality in the basin. The water quality effects would depend on the volume of water and its uses and locations. Generally:

- Increases in municipal uses could increase the potential for water quality degradation by supporting increased urban development. The extent and location of any degradation would depend on the type and location of use.
- Increases in instream flows would tend to modify water quality including water temperature, dissolved oxygen, and turbidity. Effects would depend on the location, volumes, and sources of increased instream flows.

5.5.3 Integrated Water Resource Management Plan Alternative – Impacts of Integrated Plan

The Integrated Plan is designed to provide an overall net benefit to water quality by improving streamflow conditions, riparian areas, and floodplain habitat in the basin. Coordinating these activities under the Integrated Plan would facilitate better overall management of water quality.

Localized impacts on water quality may occur, particularly with regard to temperature conditions in late summer and early fall immediately downstream of surface water storage projects. In addition, contamination of soils in some locations could affect water quality if floodplain restoration projects are carried out in those areas.

5.5.4 Mitigation Measures

Local long-term effects on water quality are possible for some of the elements, but they would be mitigated with both local measures and net benefits from changes in the operations of the system. Water quality impacts could further be mitigated through evaluations that consider site-specific characteristics to aid in design and selection of individual projects.

In most cases, the potential for water quality impacts would be mitigated by following the permit requirements for the construction and operation of the project. Project design and permitting would occur within the existing total maximum daily load (TMDL) implementation framework.

Monitoring reservoir and downstream water quality would document the effectiveness of water quality management strategies. Long-term adaptive management plans and monitoring would be beneficial for maintaining and enhancing water quality. Reservoir operational practices related to the timing and volume of storage releases can be structured to mitigate water quality impacts. All long-term operational activities that relate to individual projects would require monitoring and approval to meet local, State, or Federal regulatory requirements for water quality. Ecology is the lead agency in charge of administering and enforcing the various rules and regulations governing water use and water quality in the State of Washington. Ecology's Water Quality Program is responsible for reviewing plans before construction to ensure all State and local water quality standards and requirements are met.

5.6 Hydropower

5.6.1 No Action Alternative

The No Action Alternative is not expected to have long-term impacts on hydropower because no changes in flow through hydroelectric facilities are currently proposed for the programs listed in Section 2.3.

5.6.2 Integrated Water Resource Management Plan Alternative – Impacts of Individual Elements

5.6.2.1 Reservoir Fish Passage Element

The fish passage element is not expected to have long-term impacts on hydropower because no changes in flow through existing hydroelectric facilities would occur.

5.6.2.2 Structural and Operational Changes Element

The only proposed project that would affect hydropower is the subordination of power at the Roza Dam and Chandler Powerplants. The other projects would not affect the amount of flow through any hydroelectric facility.

Water is currently diverted from the Yakima River to produce power at Roza and Chandler Powerplants. Power subordination occurs when some or all of the water that could otherwise be diverted for power production is instead left in the river to provide instream flow benefits for fish. Reclamation's Yakima Field Office Manager is responsible for operation of the Yakima Project including the timing and amounts of water released from the Project's storage reservoirs. The Project manager consults with basin interests to determine the appropriate level of power subordination that is needed to maintain adequate fish and aquatic habitat in the Yakima River system. The Integrated Plan includes a proposal for more power subordination to provide instream flow benefits for fish. The level of this additional subordination is under discussion.

Further power subordination of the Roza and Chandler Powerplants must be assessed relative to the economic and operational impacts for the Roza and Kennewick Irrigation Districts, Reclamation, and the Bonneville Power Administration (BPA). Reduction of power production at the Chandler Powerplant affects the amount of power available for distribution in the power grid, and could affect operation and maintenance of the pump turbines used to deliver water to the Kennewick Irrigation District. The implications for reduction of power production at the Roza Powerplant could include changes in the amount of power being provided from the Roza Powerplant for irrigation district pump stations, and less power available in determination of the irrigation district power rates.

Based on data supplied by Reclamation for power production at both powerplants from 1988 to 2010, which generally represents the current level of subordination, an average of approximately 107,000 megawatt-hours (MWH) of energy is being produced each year. The Roza Powerplant contributes approximately 61,000 MWH to this total and the Chandler Powerplant supplies the remaining 46,000 MWH.

Further subordination for biological benefits would involve reduced operation of the Roza and Chandler Powerplants in the spring. Specifically, Roza would not be used to produce power in April and May, and Chandler would not be used to produce power in April, May, and June.

Based on the historical data supplied by Reclamation, this would result in an average of approximately 82,000 MWH of annual power production from the Roza and Chandler

Powerplants – with Roza contributing 47,000 MWH and Chandler contributing 35,000 MWH to that total. This would represent a reduction of 25,000 MWH annually from current conditions. However, a plan for further subordination has not been agreed to by the stakeholders, and the estimate of power production may change based on the final operation schedule for the powerplants, the ability to schedule maintenance or replacement activities (that have historically interrupted power production at other times of the year) during the selected time, and the need for power at the plants while they are not producing power (i.e., the plants become a power consumer rather than a power producer).

The following assumptions were used to determine the amount of subordination required. For subordination at the Chandler Powerplant, target flows in the Yakima River at the Prosser gauging station are as follows:

- April 1 through June 30 – 1,000 cfs
- June 30 through October 20 – 450 cfs
- October 20 through April 1 – 800 cfs

For subordination of the Roza Powerplant, target flows in the Yakima River immediately below the Roza Diversion are as follows:

- Minimum flow – 400 cfs
- Spring flows – 1,200 cfs (the exact timing of this requirement is subject to review and change depending on flow conditions in a specific year)

Table 5-5 provides a summary of the estimated average annual energy production for the Roza and Chandler Powerplants with and without additional subordination.

Table 5-5 Estimated Energy Production for Roza and Chandler Powerplants

Location	Average Head (ft)	Average Flow (cfs)	Max Flow (cfs)	Average Annual MW Hours
Roza Powerplant	158	N.A.	1077	61,000
Chandler Powerplant	118	N.A.	1470	46,000
Total				107,000
Roza Powerplant (without April and May production)	158	N.A.	1077	47,000
Chandler Powerplant (without April, May and June production)	118	N.A.	1470	35,000
Total				82,000

The level of subordination summarized in Table 5-5 may make continued operation of the Roza and Chandler powerplants more costly. The current production costs are approaching market rates for power and could affect the plants' competiveness for capital improvement funds from the BPA. Any further subordination may cause the cost of production to exceed that.

5.6.2.3 Surface Storage Element

The Surface Storage Element could create additional opportunities for hydropower generation in the Yakima River basin at the new Wymer Reservoir, the expanded Bumping Lake Reservoir, the Kachess inactive storage site (if the tunnel option is used), and the Keechelus-to-Kachess pipeline. However, at this time construction of power recovery facilities at these sites is not included as part of the Integrated Plan. It is anticipated the projects would be constructed in a way that allows future addition of power recovery facilities.

Use of increased storage capacity in the basin would result in increased releases of stored water during some years and seasons, and diversion or retention of water to refill the reservoirs during some years and seasons. This would alter flows somewhat in river reaches downstream of the new storage facilities, including the Kachess, Yakima, Bumping, and Naches Rivers. Alteration of flows could potentially change the flows available for power production at some hydropower facilities, increasing the flows at some times and decreasing them at other times. Since refilling of the new reservoir capacity would offset releases from storage, the net effect over time within the Yakima basin would essentially be zero.

The increased water supply deliveries that occur within the Yakima River basin could cause a slight reduction in the amount of hydropower generated at dams on the Columbia River below the confluence of the Yakima River—McNary, John Day, The Dalles, and Bonneville Dams. Modeling conducted during development of the Integrated Plan indicated that Yakima River flow at the river mouth would decline less than 1 percent on average. Also, because the Yakima River is much smaller than the Columbia River, this average flow change would be insignificant in the context of Columbia River flows. Any impacts due to timing changes would depend on the operation of the new storage, but hydropower generation could decrease slightly in the winter and spring as new reservoirs are filled, and increase slightly in the summer as flow is released out of storage to improve streamflow. Streamflow releases may be higher in dry years, in which case hydropower generation increases would be higher in dry years as well. If the water stored for irrigation is only used during drought years, a reduction in hydroelectric generation may only occur in years when the reservoir is refilling after being used for irrigation water supply. These changes are expected to be small compared to the current amount of hydropower generation occurring at these four dams.

5.6.2.4 Groundwater Storage Element

The Groundwater Storage Element would not have long-term impacts on hydropower because no changes in flow through existing hydroelectric facilities would occur.

5.6.2.5 Habitat/Watershed Protection and Enhancement Element

This project would not have long-term impacts on hydropower as the project would not change flow through any existing hydroelectric facility.

5.6.2.6 Enhanced Water Conservation Element

The operations of the existing hydropower plants in the Yakima River basin may be slightly affected by agricultural water conservation. The potential effects could be a reduced amount of power generation at the powerplants in the Wapato Irrigation Project (WIP) in most years, if water conservation measures reduce the flow in the canals and through the powerplants. If flow rates in the canals are maintained at the levels prior to conservation, then no change in power generation would result. A slightly increased amount of power generation could result at those powerplants during drought years as the reliability of water supply increases with agricultural conservation, and higher flows could occur in the canals.

The municipal and domestic conservation program would have a minimal effect on hydropower. Total municipal savings under the Integrated Plan are approximately 22,000 acre-feet annually, which is less than 1 percent of the annual yield of the Yakima River basin. In addition, municipal and domestic water use is minimally consumptive, and most of the flow returns to the river relatively quickly.

5.6.2.7 Market Reallocation Element

The long-term impacts of increased market reallocation would depend on the location of the lessor and lessee of water. If the transfer of water is to farmers in the WIP during drought years, some increase in hydropower generation is possible for those years. Otherwise, the impacts would not likely be different than the No Action Alternative or the current operation.

5.6.3 Integrated Water Resource Management Plan Alternative – Impacts of Integrated Plan

Implementing the elements under the Integrated Plan Alternative as an integrated package would result in a combination of effects including a reduction of hydroelectric generation at the Roza and Chandler Powerplants and at the Drop 2 and Drop 3 powerplants in the WIP. A slight reduction in hydroelectric generation at dams along the Columbia River would occur when a new reservoir is refilling after the irrigation portion of the water stored is used during a drought year. While power recovery facilities are not included in the Integrated Plan, they could be constructed at several facilities in the future if economic conditions are favorable.

5.6.4 Mitigation Measures

Further power subordination at the Roza and Chandler Powerplants would substantially impact the amount of energy produced by hydropower in the Yakima basin. This reduction in hydropower generation in the basin would likely have substantial economic and operational impacts on the Roza and Kennewick Irrigation Districts, Reclamation, and BPA. Mitigation measures may be required to compensate for these impacts, such as purchase of power to replace the lost power and/or financial compensation to the affected parties. In addition, any changes in hydropower generation would be coordinated with BPA, Reclamation, and other affected agencies.

5.7 Fish

5.7.1 No Action Alternative

The No Action Alternative would not carry out the Integrated Plan Alternative. Reclamation and Ecology would not develop new water storage in the Yakima River basin or expand programs to protect or enhance fish habitat. In addition, Reclamation and Ecology would not implement enhanced water conservation, market reallocation, or groundwater storage. Although Reclamation and Ecology would not implement these actions as an integrated program, various agencies and other entities would likely continue to undertake individual actions to accomplish some water resources improvements. These actions could include small water storage projects, artificial fisheries supplementation programs, fish passage, habitat improvements, water conservation, and water quality improvements. These actions, although beneficial, would provide slow and partial progress in addressing the water resource problems of the basin. With the No Action Alternative, existing problems with water availability and habitat quality would likely worsen with increased population and climate change.

5.7.2 Integrated Water Resource Management Plan Alternative – Impacts of Individual Elements

This section describes the long-term impacts that could be associated with implementation of the Integrated Plan. Projects implemented under this alternative would require additional environmental review depending on the extent of Federal or State funding or permitting.

5.7.2.1 Reservoir Fish Passage Element

Providing fish passage at Cle Elum, Bumping, and Clear Lake Dams would contribute to the recovery of Yakima basin steelhead and bull trout populations listed under the Endangered Species Act, and to the reestablishment of sockeye salmon in the Yakima River basin. It would also provide significant benefits to Yakima basin Chinook and coho salmon, which are not ESA listed (YBFWRB, 2009). Additionally, this element includes fish passage at Tieton, Keechelus, and Kachess Dams subject to future studies. There are currently no upstream or downstream fish passage facilities at any of the dams. Section 2.4.3 provides a general description of fish passage options and potential benefits at each of these five Yakima River basin reservoirs. Restoring connectivity among presently isolated populations of bull trout would allow for dispersal of fish among local populations, providing a mechanism for supporting weaker populations or restarting those that might become extirpated. It would also allow for gene flow among populations, which would prevent the loss of genetic variation, ensure survival in variable environments, and reduce the probability of local extirpations.

5.7.2.2 Structural and Operational Changes Element

Modifying existing water diversion structures and operations would provide opportunities to improve water supply for irrigation while providing benefits to fish. Improving instream flow conditions and restoring more natural streamflows would enhance habitat restoration benefits in tributary reaches that have been negatively impacted by diversion withdrawals or system operations. This would benefit adult and juvenile salmonid survival by reducing travel times, and decreasing predation exposure, physical injury, and stress at facilities, thereby reducing smolt mortality.

Increasing the Cle Elum Reservoir pool level by 3 feet would provide increased water storage, with the highest water levels typically occurring between April and August. Additional water, if made available during the low-flow fall and winter months downstream of Cle Elum Dam, could be used to improve overwintering conditions in the lower Cle Elum River for juvenile salmonids. Raising the water level is not expected to adversely affect bull trout spawning in tributaries to the reservoir since bull trout spawning has not been documented in the Cle Elum system. The effect on sockeye productivity, once the species is reintroduced, from an increase in the pool elevation would need to be evaluated as part of future site-specific evaluations. There would be some loss and change in aquatic and shoreline habitats as a result of land inundation and fluctuating water levels.

KRD canal modifications would benefit most life stages of spring Chinook, coho, and steelhead in Taneum and Manastash Creeks; adult and juvenile coho and steelhead in Big and Little Creeks; and rearing spring Chinook in Big and Little Creeks. These benefits would result from allowing greater opportunity to augment streamflows in these affected tributaries to the Yakima River during migration, spawning, and rearing periods. The estimated savings of approximately 15 cfs throughout the irrigation season would help address streamflow and water temperature quality problems that negatively affect fish passage and survival in the affected reaches from July to the end of the irrigation season in October. The option of placing a pump station with a pressurized system at the lowest end of the KRD South Branch Canal would provide a slightly greater flow to augment the affected tributaries, thereby further contributing to improved flow conditions. Piping canals would result in the loss of some temporary ponds and wetlands that may have been formed and supported by irrigation seepage and leaks.

Modifying the water conveyance system for the Wapatox Project would free up water owned by Reclamation to augment flow in approximately 7 miles of the lower Naches River. This would benefit adult spring Chinook, coho, and steelhead migration and spawning and juvenile rearing in this reach of the Naches River. If summer Chinook salmon are reintroduced to the basin, they would also benefit because they are expected to use this reach for spawning and rearing.

Transferring water from Keechelus Reservoir to Kachess Reservoir by pipeline would improve rearing conditions for steelhead and spring Chinook by reducing artificial summertime high flows downstream of the Keechelus Reservoir during summertime releases of flow. The improvement of summertime rearing conditions for juvenile steelhead and spring Chinook would contribute to improving survival and productivity. Additional water in the Kachess Reservoir could improve bull trout migration into reservoir tributary streams, and improve instream flow and habitat quality for salmonids in downstream areas. The effects of changes in operations on bull trout and salmon species downstream of both storage facilities would need to be evaluated as part of future site-specific evaluations.

Flows diverted to generate power at Roza Dam would instead remain in the Yakima River between Roza Dam and the discharge location 11 miles downstream, benefitting fish use in this mainstem reach. Increasing minimum flows in the reach of the Yakima River affected by operations at the Chandler Powerplant would contribute to improved streamflows in the lower river from Prosser Dam to the powerplant return located 12 miles downstream. Current operations divert water to run the Chandler Powerplant and maintain minimum flows of 1,000 cfs in this reach. An increase in minimum flows in the Yakima River from April through June would contribute to improved Chinook, sockeye, and coho smolt survival and outmigration in this lower river reach.

5.7.2.3 Surface Storage Element

The Surface Storage Element of the Integrated Plan includes expanding existing water storage facilities or constructing new facilities. New storage would support increased flows for anadromous and resident fish passage and survival during drought years, while improving water supply for irrigation and future municipal growth.

Construction and operation of Wymer Reservoir would provide additional storage to assist in meeting high-priority instream flow goals in the upper Yakima River above Lmuma Creek and in the Cle Elum River. It would help meet goals for winter instream flow increases in some upstream reaches and also slightly reduce summer flows in some upstream reaches, which may benefit fish. Long-term operation impacts of a pump station in the Yakima River just upstream of Lmuma Creek would be avoided by including fish screens and ensuring unimpeded upstream and downstream migration for all salmonids. Some shoreline habitat may be unavoidably lost from construction of a pump station on the Yakima River, but this could be mitigated by the enhancement of native vegetation in the reach.

Expanding storage at Bumping Lake Reservoir would contribute to improvements in the Bumping, Naches, and Yakima Rivers by allowing fisheries managers to time the releases from the reservoir and increase spring flows in drought years. The inundation associated with the enlargement of Bumping Lake Reservoir would result in the permanent loss of shoreline habitat, although the loss would be offset by the creation of new shoreline habitat along the new operating elevation. The inundation would result in the loss of approximately 18 to 20 percent of redds found annually in Deep Creek (Service, 2009a). Deep Creek supports the only identified Yakima basin population upstream of Bumping Lake and is designated critical habitat for bull trout (USFWS, 2002). The new dam would include fish passage facilities, thereby providing connectivity between spawning populations for bull trout and other resident salmonid species. The bull trout population previously isolated upstream of the dam would benefit from the reestablishment of historic connectivity to other habitats and from an increased gene flow among other populations in the Yakima basin (USFWS, 2001).

The increase in storage capacity of the Kachess Reservoir of an additional 200,000 acre-feet of water for downstream beneficial uses would have both beneficial and detrimental effects on salmonids. Detrimental impacts are largely related to the drawdown of as much as 80 feet in the pool elevation, which would only occur during drought years. Additional impacts would include the loss and alteration of some shoreline and aquatic habitats resulting from inundation, water level fluctuations, and construction of a new lake outlet. The drawdown may also permanently change the character and function of shoreline habitats in the event of successive drought years. During drought years, the drawdown has the potential to negatively affect water temperatures and associated dissolved oxygen levels, affecting rearing bull trout, and sockeye, if reintroduced into the reservoir. If fish passage is reestablished at the dam, migration of adults or juveniles may be negatively affected if reservoir levels are kept at low operating elevations during the migration periods.

Bull trout rearing habitat in the reservoir would be reduced during drawdown, and access into spawning tributaries would be lost during drought years, although passage into tributaries would likely be improved during most years at nondrought operating elevations. Passage into the mouth of Box Canyon during higher operating levels would likely be improved and may also be improved at lower operating elevations with associated fish passage improvements.

5.7.2.4 Groundwater Storage Element

In the long term, groundwater storage has the potential to benefit aquatic organisms within the Yakima River system. Water injected or infiltrated into area aquifers may become part of the natural groundwater system that would potentially seep back into the river (surface) system through groundwater seeps. Groundwater seeps are often associated with geological structures, such as faults or fold structures. Recharge of cold surface water during the winter at certain geologic structures may increase cold water entering streams at existing areas of groundwater discharge. The water quality of return flows is expected to be better (i.e., cooler and cleaner) than ambient conditions. This would benefit cold-water fish and other organisms, like salmonids, that utilize the Yakima River system. In addition, groundwater storage may be used to offset surface water diversions and delay reservoir releases early in the irrigation season.

Creating a groundwater storage supply using infiltrated water diverted from the Yakima River in the late winter and early spring (prior to storage control) into designed infiltration systems could contribute to improved instream flows in the affected Yakima River reaches. The concept would be tested in two study areas, the Kittitas Reclamation District near Ellensburg and the Wapato Irrigation Project near Toppenish.

The development of an ASR system would potentially reduce diversions from the Naches River from spring through fall by approximately 5,000 to 10,000 acre-feet. All salmonid species impacted by a municipal surface water diversion would benefit from an ASR system which could contribute to improved instream conditions during low-flow periods.

5.7.2.5 Habitat/Watershed Protection and Enhancement Element

Historically, fish habitat in the Yakima River basin has been significantly altered. The Habitat/Watershed Protection and Enhancement Element would accelerate ongoing efforts to protect existing high-value habitats, improve fish passage, enhance flows, improve habitat complexity, and reconnect side channels and off-channel habitat to stream channels. The proposed habitat actions are expected to improve prospects for recovering ESA-listed fish populations to levels that are resilient to catastrophic events and the potential impacts of climate change. Fish habitat enhancement actions would help create improved spawning, incubation, rearing, and migration conditions for all salmonid species in the Yakima River basin; implement key strategies described in the Yakima Subbasin Plan (YBFWRB, 2005); and complete most of the actions described in the Yakima Steelhead Recovery Plan (YBFWRB, 2009). Habitat enhancement actions would provide greater benefits when integrated with the flow and fish passage improvements described in previous sections.

Benefits to Anadromous Fish and Bull Trout Effects

Habitat/watershed protection and enhancement projects would benefit different life history stages of anadromous salmonids. These benefits would improve the growth, survival, productivity, and abundance of salmonids in various ways (McElhaney et al., 2000). For all anadromous salmonids and bull trout, incubating eggs and juveniles would benefit from reduced fines in the stream and cooler water temperatures afforded by ample streamside vegetation and stable banks. Rearing juveniles would benefit from the increased prey availability (terrestrial insects) and increased organic matter input resulting from improvements in riparian vegetation. Growth and survival of juveniles would benefit from increased habitat in reconnected side channels. In addition, juvenile survival would benefit from large woody debris (LWD) or boulder complexes that provide refuge areas, and the increase in quality and quantity of pool habitats formed by these structures.

Survival of all adult life stages would benefit because of increased quality and quantity of holding habitat (pools) for spawners created by in-channel LWD and boulders. These structures would also benefit spawning adults because they tend to trap and retain spawning-sized gravels in the reach. Off-channel spawners would benefit from an increase in floodplain and off-channel habitats. In addition, spawner condition would benefit from riparian vegetation enhancement and the related cooler water temperatures.

Habitat enhancement in the upper Yakima River basin from Keechelus Dam to Roza Diversion would benefit spring Chinook, coho, and steelhead, which all migrate, spawn, incubate, and rear in this reach or its tributaries. It would also benefit migrating adult and juvenile bull trout and migrating adult and juvenile sockeye, once reintroduced. In the middle Yakima basin from Roza Diversion to Prosser Dam, spring Chinook, fall Chinook, coho, and steelhead, all of which spawn, migrate, incubate, and/or rear in this reach or its tributaries, would benefit. As in the upper Yakima River basin, migrating adult and juvenile bull trout and adult and juvenile sockeye, once reintroduced, would benefit. For the lower Yakima River from Prosser Dam to the Columbia River confluence, habitat enhancement would benefit fall Chinook which migrate, spawn, incubate, and rear in this reach. It would also benefit spring Chinook, coho, and steelhead, which migrate through as adults and/or rear there as juveniles. Migrating adult and juvenile sockeye, once reintroduced, would also benefit from habitat enhancements in the lower Yakima River.

In the upper Naches River basin from Bumping Dam to the Tieton River confluence, fish habitat enhancement would benefit spring Chinook, coho, steelhead, and bull trout because adult migration, spawning, incubation, and rearing all occur in this reach or its tributaries. Spawning and migrating adult sockeye and sockeye smolts would also benefit from habitat enhancements in this reach. In the lower reach encompassing the Tieton River confluence to the Yakima River confluence, habitat enhancement would benefit spring Chinook, coho, steelhead, and bull trout because adult migration, spawning, incubation, and/or rearing all occur in this reach or its tributaries. Sockeye adults would also benefit because upstream migration and smolt out-migration occur there.

Benefits were estimated quantitatively for anadromous fish with qualitative effects analysis provided for bull trout. The anadromous fish habitat enhancement program was evaluated using the following tools:

- 2004 Ecosystem Diagnosis and Treatment (EDT) model (Reclamation, 2010),
- All H Analyzer (AHA) (Reclamation 2010) ("All H" refers to four conditions that strongly affect fish: habitat, hatcheries, harvest, and hydropower), and
- The Euphotic Zone Depth model (sockeye only) (Ackerman et al., 2002).

Model results characterized improved habitat conditions that could result from implementing the habitat program and how this may increase fish production for anadromous fisheries in the basin, including spring, summer and fall Chinook, steelhead, coho, and sockeye. Improvements would also help with Endangered Species Act (ESA) recovery efforts for steelhead by increasing both production and spatial distribution. A qualitative effects analysis was conducted by Yakima Basin fisheries managers to characterize both positive and negative effects on bull trout populations, also listed under the ESA. Any potential negative effects on bull trout would require appropriate mitigation measures.

Modeling results show significant benefits for spring, summer and fall Chinook, steelhead, coho, and sockeye comparing the baseline to three scenarios. The baseline represents existing habitat conditions and fish population levels in the Yakima basin, and the three scenarios are described below:

- Future without Integrated Plan (FWIP) – Represents fish population increases from habitat improvements that would continue under current programs and funding levels. This represents an average of 18-percent improvement for fish populations over baseline conditions.
- Restoration – Represents fish population increases from habitat improvements that would result from implementing the fish habitat enhancement program. The actions identified in the Yakima Steelhead Recovery Plan were used as a surrogate in the modeling effort to characterize habitat improvements that would result from the Integrated Plan fish habitat enhancement program. (YBFWRB, 2009).
- Restoration with Fish Passage (Integrated Plan) – Represents fish population increases from the Habitat Restoration scenario plus providing fish passage at Cle Elum, Keechelus, Kachess, Bumping, and Tieton dams.

The model results described below and listed in Table 5-6 summarize the expected outcomes under the Integrated Plan for the following anadromous species, both individually and combined, without sockeye. Table 5-7 lists sockeye results. The values provided in these two tables are “recruitment” population values. Recruitment population values are an estimate of the ocean population at the mouth of the Columbia River. Ocean harvest was not included because it was either minimal or not applicable to the species. Other model results for species, such as harvest and escapement, are provided later in this section.

The reason for including results with and without sockeye is due to the large effect sockeye results have on the total estimated population increases that would result from the Integrated Plan. Projected sockeye population increases represent more than 70 percent of the total improvement for all anadromous species and are dependent on the proposed fish passage improvements at the five major reservoirs.

- **Spring Chinook –** Spring Chinook show benefits under both scenarios, with average run sizes increasing 56 percent from FWIP for Restoration, and increasing 87 percent for Restoration with Passage.
- **Steelhead –** For steelhead populations, natural production is not bolstered by hatchery production like spring Chinook in the Yakima Basin. However, steelhead run sizes for the Restoration scenario increased 90 percent from FWIP, and for the Restoration with Passage scenario, the average run size more than doubled the FWIP run size.
- **Coho –** Coho also show improvements in run sizes for modeled scenarios, with a 20-percent average run size increase from FWIP data for Restoration and 26 percent increase under the Restoration with Passage scenario.
- **Fall Chinook –** Fall Chinook runs increased approximately 51 percent from FWIP for both the Restoration and Restoration with Passage scenarios. There was no difference in the abundance numbers between the Restoration and Restoration + Passage scenarios. This is because fall Chinook complete their entire freshwater life cycle downstream of the five Reclamation storage dams and

are not affected by the provision of fish passage, which is the only difference in restoration/passage actions between these two scenarios.

- **Summer Chinook –** Summer Chinook show a significant benefit from FWIP to the Restoration and Restoration with Passage scenarios, more than doubling the average run sizes for both. There was no difference in the abundance numbers between the Restoration and Restoration + Passage scenarios. This is because summer Chinook complete their entire freshwater life cycle downstream of the five Reclamation storage dams and are not affected by the provision of fish passage, which is the only difference in restoration/passage actions between these two scenarios.

All Species Combined (without sockeye) – All species combined show benefits with average run sizes increasing 51 percent from FWIP for the Restoration scenario and increasing 65 percent for Restoration with Passage.

Table 5-6 All Species Combined Population Improvements (Without Sockeye)

Species		Baseline	Future Without Integrated Plan	Restoration	Restoration + Passage (Integrated Plan)
Spring Chinook	Max.[1]	33,653	38,434	59,949	72,058
	Ave.	10,153	11,494	17,909	21,503
	Min.[2]	5,109	5,748	9,149	10,905
Steelhead	Max.	8,995	11,954	23,868	27,904
	Ave.	2,871	3,699	7,041	8,198
	Min.	1,263	1,589	3,207	3,646
Coho	Max.	27,926	38,098	46,648	48,791
	Ave.	8,806	11,983	14,396	15,069
	Min.	4,686	6,414	7,671	8,026
Fall Chinook	Max.	29,857	31,082	47,259	47,259
	Ave.	8,385	8,724	13,170	13,170
	Min.	3,198	3,300	4,920	4,920
Summer Chinook	Max.	10,692	11,775	24,877	24,877
	Ave.	3,308	3,694	7,390	7,390
	Min.	1,464	1,529	2,372	2,372
All Species Combined (w/o Sockeye)	Max.	111,122	131,343	202,601	220,899
	Ave.	33,523	39,593	59,906	65,329
	Min.	15,719	18,581	27,318	29,868

(1) Represents the highest recruitment value in a 100 generation simulated run generated by the AHA model.
(2) Represents the lowest recruitment value in a 100 generation simulated run generated by the AHA model.

Sockeye were evaluated through a separate modeling effort. The approach provided a range of potential increases in population abundance from reintroduction efforts associated with passage and restoration actions in the Integrated Plan. This approach relies on the late summer reservoir pool size to estimate reservoir smolt production

(Ackerman et al., 2002) and a low and high smolt-to-adult survival rate (NMFS, 2009; NW Fishletter, 2010) to estimate the potential range in adult sockeye abundance. The "low" abundance estimate was based upon median late summer reservoir volume, a 43 percent smolt-to-smolt survival rate and a 3.5 percent smolt-to-adult survival rate. The "high" abundance estimate was based upon median late summer reservoir volume, a 43 percent smolt-to-smolt survival rate and an 8 percent smolt-to-adult survival rate. The low and high sockeye abundance estimates were 170,000 and 380,000 fish, respectively. The mathematical mid-point between the low and high estimates was used to represent medium sockeye abundance.

Table 5-7 Increase in Sockeye Population Abundance from Reintroduction Associated with Integrated Plan Actions

Scenario	Low	Medium	High
Restoration + Passage			
Recruitment	170,000	275,000	380,000
Columbia R. Harvest	13,599	21,999	30,399
Yakima River Mouth	139,400	225,499	311,599
Columbia R. Migration Loss	17,000	27,499	37,999
Yakima R. Harvest	20,910	33,825	46,740
Yakima R. Migration Loss	6,970	11,275	15,580
Escapement	111,519	180,399	249,279
Scenario	**Low**	**Medium**	**High**
Restoration + Passage			
Recruitment	170,000	275,000	380,000
Columbia R. Harvest	13,599	21,999	30,399
Yakima River Mouth	139,400	225,499	311,599
Columbia R. Migration Loss	17,000	27,499	37,999
Yakima R. Harvest	20,910	33,825	46,740
Yakima R. Migration Loss	6,970	11,275	15,580
Escapement	111,519	180,399	249,279

All Species Combined (with sockeye*)* **–** Table 5-8 summarizes results for all species by each of these categories. In addition to the recruitment population increases provided in the tables above, additional categories are also characterized in this table to provide a more complete depiction of modeled results:

- **Columbia River Harvest –** Includes Columbia River commercial, sport and Tribal harvest, but not migratory losses.

- **Yakima River Harvest –** Includes Yakima River sport and Tribal harvest but not migratory losses.
- **Yakima River Mouth –** Population that returns to the mouth less Columbia River harvest and migratory losses.
- **Broodstock Removal –** Fish taken for the Yakama Nation hatchery programs for spring, fall and summer Chinook and coho.
- **Sockeye Columbia River Migratory Loss –** Assumed 10 percent loss of the sockeye recruitment estimate.
- **Sockeye Yakima River Migratory Loss –** Assumed 5% loss of population estimate at the Yakima River mouth.
- **Total Escapement –** Population that returns to Yakima River spawning grounds after harvest and migratory losses.

These improvements would likely result in a range of total adult salmon recruitment between 200,000 during low survival years and more than 600,000 adults in years of high survival. Harvest would be as much as seven times greater than the FWIP. The number of fish reaching Yakima Basin spawning grounds would grow from a maximum return of 132,000 adults if the plan were not implemented to over 400,000 if the Integrated Plan is implemented.

Table 5-8 All Species Combined Results by Scenario

Scenario	Minimum	Average	Maximum
Baseline			
Recruitment	15,719	33,523	111,122
Columbia R. Harvest	3,443	7,472	24,893
Yakima River Mouth	12,277	26,051	86,229
Yakima R. Harvest	993	2,238	7,610
Broodstock Removal	1,047	1,214	2,030
Escapement	10,236	22,599	76,589
FWIP			
Recruitment	18,581	39,593	131,343
Columbia R. Harvest	4,035	8,739	29,016
Yakima River Mouth	14,545	32,201	106,619
Yakima R. Harvest	1,118	2,546	8,802
Broodstock Removal	1,288	1,480	2,297
Escapement	12,139	26,828	91,580
Restoration			
Recruitment	27,318	59,906	202,601
Columbia R. Harvest	5,671	13,032	44,204
Yakima River Mouth	21,647	46,875	158,397
Yakima R. Harvest	1,884	4,164	14,621
Broodstock Removal	1,330	1,491	2,297
Escapement	18,433	41,220	141,479
Restoration + Passage (Integrated Plan)			
Recruitment	199,868	340,329	600,889
Columbia R. Harvest	36,874	62,917	112,687
Sockeye Columbia R. Migration Loss	15,786	28,556	45,376
Yakima River Mouth	162,995	277,412	488,201
Yakima R. Harvest	28,903	50,804	85,499
Sockeye Yakima R. Migration Loss	6,472	11,708	18,604
Broodstock Removal	1,876	1,258	1,549
Escapement	132,215	225,350	401,154

Minimum values include sockeye low values.
Average values include sockeye medium values.
Maximum values include sockeye high values.

Bull trout were not addressed through the EDT model approach. Instead, a matrix and accompanying narrative was developed discussing population status, limiting factors and current impacts, changes to populations, actions completed in recent years, and information gaps. Additional bull trout management actions were identified for the habitat enhancement program recommendations (Section 3.1.5), focused on further mitigating existing operational impacts and potential impacts from surface water storage actions included in the Integrated Plan.

The following identifies the Yakima basin fisheries managers' expected changes in bull trout population viability with the Integrated Plan. In most cases, the plan would improve habitat conditions and increase available habitat. For Deep and Box Canyon creeks, and for the Bumping and Kachess rivers, the Integrated Plan would result in adverse impacts without commensurate mitigation. As previously stated, any potential adverse effects on bull trout would require appropriate mitigation.

Table 5-9 Bull Trout Benefits and Impacts

Stream	Integrated Plan
Ahtanum	+
Indian Creek	++
South Fork Tieton	+++
North Fork Tieton	+++
American	+
Crow Creek	+
Rattlesnake Creek	+
Deep Creek	-
Bumping River	-
Kachess River	-
Box Canyon Creek	-
Gold Creek	+++
Cle Elum/Waptus	+
Upper Yakima	++
Teanaway	+

- = Negative impact (would require mitigation)
+ = Some benefit from habitat actions or Bull Trout Task Force
++ = Additional benefit, either re-connectivity as dam passage is addressed, or another project that addresses a specific limiting factor for a population (e.g. SF Tieton falls, Gold Creek Hydrological Assessment).
+++ = Multiple passage or population specific projects

Benefits to Resident Fish and Aquatic Invertebrates

Resident fish and aquatic invertebrate communities would receive long-term benefits from habitat enhancement. Aquatic invertebrate communities are dynamic and adaptive to changing environmental conditions. High-quality resilient invertebrate communities exist in the upper Yakima River basin under the altered flow regimes associated with flip-flop operations (Cuffney et al., 1997; Stanford et al., 2002; Nelson, 2004; Reclamation, 2008g). The restoration of more normative habitat and flow conditions resulting from habitat/watershed protection and enhancement efforts would likely benefit aquatic invertebrate communities within the Yakima River basin. However, due to the many environmental factors that influence these communities, no definitive impacts can be quantified with available information.

Benefits to fish populations would be improved through the protection and restoration of key landscapes. The Integrated Plan would protect and enhance tracts of land in the basin that provide a high potential for ecosystem and species conservation and restoration, both within and outside of the immediate riparian corridor. The mainstem floodplain and tributary fish habitat enhancement program would significantly improve fish productivity, abundance, and survival to levels that are resilient to catastrophic events and the potential impacts of climate change. They would accelerate ongoing efforts to protect existing high-value habitats, improve fish passage, enhance flows, improve habitat complexity and functions, and reconnect side channels and off-channel habitat to stream channels. The program could also reduce flood risk.

Fish habitat enhancement actions would help create improved spawning, incubation, rearing, and migration conditions for all salmonid species in the Yakima River basin; implement key strategies described in the Yakima Subbasin Plan (YBFWRB, 2005); and complete most of the actions described in the Yakima Steelhead Recovery Plan (YBFWRB, 2009).

5.7.2.6 Enhanced Water Conservation Element

Long-term impacts of water conservation are anticipated to be beneficial to fish, potentially resulting in reduced water use and/or more efficient diversion practices with the potential to improve streamflows. Depending on the timing and location of the water savings, benefits to salmonids and resident fish species would be similar to those outlined in Section 5.7.2.5.

Lining canals or piping ditches could result in the loss of some ponds and wetlands supported by leakage. There could also be a reduction in return flows down drainages and into other topographic low areas that might support fish. Such changes are considered a shift toward natural conditions, not a significant impact at the population scale.

The municipal and domestic water conservation program would have impacts on fish similar to those of the agricultural conservation program.

5.7.2.7 Market Reallocation Element

Water rights transfers associated with market reallocation are not expected to have a substantial impact on fish populations or aquatic resources within the Yakima River basin. Any effects would be similar to those described in Section 5.7.2.1. Depending on the timing and location of the increased streamflows, anadromous and resident fish species could benefit from water transfers between irrigation districts. Higher flows would likely improve aquatic habitat conditions for fish and other organisms by increasing overall habitat area and improving water quality conditions (e.g., temperature and dissolved oxygen).

5.7.3 Integrated Water Resource Management Plan Alternative – Impacts of Integrated Plan

Given implementation of the combined elements, the Integrated Plan would contribute to more normative flow conditions and the creation of habitat conditions more capable of supporting salmonid populations in the Yakima River basin. In particular, the Surface Water Storage Element would improve flow conditions throughout the basin. However, even in combination with modifying existing water diversion structures and operations, these actions are likely not sufficient to support the restoration of sustainable ESA-listed populations and healthy, functional ecosystems in the Yakima River basin. Habitat/watershed protection and restoration actions, coupled with restoring fish passage into historic habitat, will be a necessary component for meeting fish production and survival targets.

Effects for specific river reaches are characterized below, based upon hydrologic modeling results for instream flows resulting from implementation of water storage and structural and operational changes (Reclamation and Ecology, 2011f). Not all effects were modeled. The Integrated Plan would generally increase carryover storage, providing more flexibility in operations to meet instream flow needs for anadromous species. Additional opportunity for optimizing reservoir operations could yield additional beneficial effects beyond those described for the various geographic areas below.

High summer flows and associated high flow velocities in the Yakima River from Keechelus Dam to Lake Easton would be substantially reduced from July through early September to improve rearing conditions for juvenile Chinook and steelhead (and potentially coho if reestablished). The improved juvenile salmonid rearing conditions would occur in all years, with benefits most significant in wet years. Low winter flows would be increased to improve juvenile rearing and overwintering habitat conditions. Winter and spring flow pulses could be provided in most years to mimic natural conditions, stimulating juvenile steelhead and smolts to move down lower in the basin to rear or out-migrate. All anadromous salmonids would benefit from increased base flows by improved spawning conditions.

Flow pulses would be provided in the Easton Reach to improve out-migration for spring Chinook, steelhead, sockeye, and coho. Increased flows in the fall and winter would improve the amount of available spawning, rearing, and overwintering habitat for all salmonid species.

Summer flows in the Cle Elum River would be reduced, improving the amount of suitable rearing habitat through reduced water velocities for juvenile Chinook and steelhead (and potentially coho if reestablished). Average fall and winter flows would increase, providing additional flow variation and access to available side channels when juvenile spring Chinook and steelhead (and potentially coho) are rearing in this reach. Spring pulse flows could also be provided in nondrought years to more closely mimic natural conditions and support juvenile out-migration.

Summer and early fall flows would be reduced on the Yakima River between Cle Elum and Lmuma Creek, improving rearing conditions for juvenile spring Chinook, steelhead, and coho. The improved juvenile salmonid rearing conditions would occur in all years, with benefits most significant in wet years.

Spring flows on the Yakima River from Roza Dam to Naches River would be improved for anadromous salmonid smolt out-migrants as a result of pulse flows and power subordination. On the Tieton River, winter flows would be increased to improve spring Chinook and steelhead rearing, and early adult steelhead migrants. In the fall, flows would still be high as a result of flip-flop operations (reducing flows in the upper arm of the Yakima River and increasing flows in the Naches River with increased water releases from Rimrock Reservoir).

On the lower Naches River, summer and fall flows could be lower than current conditions, negatively affecting rearing conditions for steelhead, coho, and spring Chinook. Lower flows also could affect available spawning habitat. August-September flows in the lower Naches would still be subject to the negative effects of the flip-flop operation which would be disruptive to juvenile rearing salmonids.

High summer flow conditions would be slightly improved (a reduction in flow) in the Yakima River from the Naches River to Parker, when juvenile Chinook, steelhead, and coho are rearing. Increased carryover storage would provide additional flexibility to provide flow pulses in this reach and lower Yakima reaches, to improve out-migration for all salmonid smolts produced upstream in the basin (spring and fall Chinook, steelhead, coho, and sockeye).

5.7.4 Mitigation Measures

As discussed in Sections 5.7.2 and 5.7.3, one of the goals of the Integrated Plan is to provide improved habitat and water conditions for fish and aquatic species. The long-term impacts on fish and aquatic species would primarily be beneficial. Specific projects would be evaluated through applicable environmental review and permitting processes. This evaluation may include review by Federal or local scientific review panels and Tribal Councils as required by the applicable regulatory processes, and depending on funding source requirements. These requirements may stipulate that actions implemented under this alternative should be consistent with the Federal, Tribal, and regional salmon and steelhead recovery planning and watershed planning efforts. Thus, it is expected that specific mitigation measures would be identified that pertain to long-term impacts from specific proposed activities.

As noted above, impacts associated with storage facilities would in some cases be substantial. The following items are generally considered ways to minimize the influence of dams and reservoirs on local environments:

- Seasonal restrictions on surface water withdrawals from supply reservoirs to the period with the least influence on key species;
- Adult and juvenile fish passage provisions an all in-channel storage sites;
- Construction techniques that minimize work activity and the seasonal timing within the OHWM and in compliance with applicable state and federal permit provisions;
- Diversion screens for reservoir withdrawal;
- Fish barriers in discharge canals;

- Ramping rates for diversions and for initiating or terminating downstream releases to minimize water level fluctuations and adverse effects on aquatic species; and
- Monitoring, periodic review, and adaptive management. For example, one area to focus monitoring efforts would be on improving the understanding between flow releases and smolt outmigration survival rates.

5.8 Vegetation

5.8.1 No Action Alternative

Some of the individual actions proposed under the No Action Alternative involve improvement of vegetation communities such as riparian areas or wetlands. This includes projects for water storage, artificial supplementation programs, and fish passage and habitat improvements. The projects would likely include removal of nonnative vegetation and planting with native plants. Some projects could reduce the amount of shrub-steppe vegetation. If the projects trigger compliance with NEPA or SEPA, appropriate documentation of the vegetation impacts would be the responsibility of the project proponent, separate from this EIS.

5.8.2 Integrated Water Resource Management Plan Alternative – Impacts of Individual Elements

Under the Integrated Plan Alternative, long-term impacts on vegetation are based on the amount of vegetation that would be permanently removed and replaced with project facilities. Some of the elements would improve vegetation communities through activities such as the enhancement of riparian areas or wetlands.

5.8.2.1 Reservoir Fish Passage Element

Construction of fish passage facilities would result in permanent removal of vegetation where it is present at existing reservoirs. Structures placed in the drawdown zone of the lakes would not result in vegetation impacts. Facilities would be located adjacent to existing spillways or dam abutments and embankments, where vegetation is nonexistent or limited to grasses.

The fish passage conduit at Cle Elum Lake would permanently replace about 7,600 square feet of Douglas fir, black cottonwood, lodgepole pine, and chokecherry along with the dirt roadway adjacent to the existing spillway facilities (Reclamation and Ecology, 2011c). The adult fish collection facility downstream, adjacent to the Cle Elum River, would permanently eliminate about 23,700 square feet of riparian and second-growth Douglas fir, black cottonwood, lodgepole pine, and chokecherry. About 2,600 feet of existing access roads would be upgraded and 550 feet of new road would be constructed. Based on the limited amount of permanent vegetation removal for facility construction, long-term impacts on vegetation would likely be minor at Cle Elum Dam.

Based on the current level of disturbance at Tieton, Keechelus, and Kachess Dams and the minimal loss of vegetation for fish passage facility construction, impacts on vegetation communities are anticipated to be minimal at these dams. In general, impacts are expected to be similar to those at Cle Elum Dam. The new fish passage facility at Clear Lake Dam would be located mostly on existing infrastructure and is unlikely to result in the removal of much vegetation. Installation of fish passage facilities at the Bumping Lake Dam would occur at the same time as expansion of the reservoir. Impacts of the construction project are described in Section 5.8.2.3.

5.8.2.2 Structural and Operational Changes Element

Most of the proposed modifications would result in no long-term impacts on vegetation because construction would take place in already disturbed areas. Some projects would result in the permanent loss of vegetation associated with the placement of project facilities.

Raising the pool level behind Cle Elum Dam would inundate approximately 60 acres of additional land around the reservoir for approximately 3 to 10 weeks per year (average of 7 weeks). In areas that are inundated, vegetation communities that are present may change over the long term. Where bank protection is installed beyond the inundation zone, minor impacts to vegetation could occur as wind and wave patterns may be altered. Impacts would occur along a relatively narrow strip of shoreline, portions of which lack vegetation; therefore, impacts are expected to be minor.

Canal improvements at the KRD and Wapatox projects could result in the loss of some temporary ponds and wetlands that may have formed along the irrigation canals and ditches. The loss of water could cause a shift of species composition toward upland or more arid plant community types, but this would be a change toward more natural conditions and would not be considered a substantial impact. Permanent losses of vegetation could also occur depending on the footprint of the Manastash Creek re-regulating reservoir and pump station, but these are expected to be minor because most facilities would be located in a previously disturbed agricultural area.

The Keechelus-to-Kachess pipeline would result in removal of vegetation (where present) along the 5-mile-long corridor. Assuming a 75-foot-wide pipeline corridor, approximately 40 to 50 acres of vegetation would be removed. Most of these impacts would be temporary because the area would be replanted with native vegetation and allowed to regenerate as grassland and shrub communities. Trees would not be planted within the corridor to avoid damage to the pipe from deep roots. Some areas would need to be maintained for pipeline access, resulting in permanent vegetation impacts. The exact area of impact would be determined when the pipeline corridor and alignment are designed.

No long-term impacts are anticipated from the power subordination projects because no vegetation would be disturbed or removed.

5.8.2.3 Surface Storage Element

The proposed new storage areas would result in long-term impacts where vegetation is permanently inundated or replaced by project facilities. This element has the highest potential for negative vegetation impacts because of the scale of the proposed projects.

The Wymer Reservoir would permanently remove vegetation for access roads and dam facilities. It would inundate substantial areas that contain shrub-steppe (approximately 80 percent), grassland (approximately 15 percent), riparian (approximately 5 percent), and forest (less than 1 percent) vegetation communities (Reclamation, 2008g). The Wymer location is an area of relatively undisturbed shrub-steppe habitat, and permanent vegetation removal would further reduce shrub-steppe habitat in the Yakima basin. The impact of vegetation removal would be offset by habitat/watershed protection and enhancement efforts, but could still represent a substantial impact. Site-specific studies of existing vegetation in the proposed reservoir area would be conducted prior to facility design and construction to minimize impacts.

Areas of palustrine (freshwater) wetlands would be permanently eliminated as habitat (Service, 2007). The Lmuma Creek channel would be modified to allow passage of higher flows from the dam, making it unlikely that riparian areas could be established. Fluctuations in the water level in Wymer Reservoir would not be conducive to the growth of a water-dependent shoreline plant community. Thus, no viable lakeshore fringe habitat could be expected around the perimeter of the reservoir (Reclamation, 2008g).

Construction of a new rock-fill dam downstream of the existing Bumping Lake Dam, including fish passage facilities, and enlargement of the reservoir would result in the flooding of forested communities above the current level of Bumping Lake Reservoir. The expansion would increase the current 1,300-acre reservoir to 4,120 acres. The forest communities surrounding the lake are second-growth conifer forest supporting a canopy of lodgepole pine, western hemlock, western red cedar, Englemann spruce, and a dense shrub understory. Some of this forest is late successional (old-growth) habitat. Preliminary estimates developed for the Integrated Plan indicate that impacts on terrestrial habitat would include approximately 980 acres of old-growth habitat. This represents approximately 1.5 percent of remaining old-growth habitat in the Naches River basin. While habitat protection and enhancement components of the Integrated Plan would be expected to offset some of this impact, loss of old-growth habitat would further reduce available habitat for the Northern Spotted and could represent a substantial impact.

Forest communities within the expansion zone of Bumping Lake would be cleared during construction or lost over time due to prolonged inundation and replaced by open water. The majority of impacts would occur to forested communities east of the lake and within the Deep Creek drainage area designated Areas. Impacts on vegetation are likely to be substantial.

Minor permanent impacts on vegetation are anticipated under the Kachess Reservoir inactive storage project. Construction of either the tunnel or pump station alternative would likely require some permanent vegetation removal depending on the location of the facility and the size of the construction footprint, which would be determined during site-specific studies if the project is carried forward.

5.8.2.4 Groundwater Storage Element

Most of the proposed groundwater storage projects would result in limited impacts on vegetation because the projects would likely be located in already disturbed areas, would rely mostly on existing infrastructure, and would require minimal construction. Some projects would result in the permanent loss of vegetation associated with the placement of project facilities.

For the shallow aquifer recharge projects, permanent losses of vegetation would occur at the infiltration ponds. The initial pilot study would require less than 5 acres of land. To achieve the infiltration capacity goal of at least 100,000 acre-feet, it is anticipated that between 160 and 500 acres of infiltration area would be necessary with infiltration ponds ranging from 2 to 10 acres. Ponds and other elements would be located in already disturbed areas to minimize long-term impacts to the extent possible. Site-specific studies of existing vegetation in the proposed infiltration areas would be conducted prior to facility design and construction.

Municipal ASR projects would require a water treatment facility and the construction of injection wells, a pump station, and conveyance lines. Long-term impacts on vegetation would be similar to those for shallow aquifer recharge projects.

5.8.2.5 Habitat/Watershed Protection and Enhancement Element

Long-term impacts of the habitat restoration projects are expected to be beneficial to plants and vegetation communities.

Beneficial impacts are anticipated with the acquisition of lands and the protection of large areas. The acquisition of lands containing old-growth forest or shrub-steppe offer greater protection of these high-quality habitats. Old-growth forests are uncommon in the Yakima River basin and shrub-steppe habitat has been significantly reduced.

The proposed habitat/watershed protection, restoration, and enhancement projects on the mainstem and tributaries of the Yakima River would improve native plant diversity. The creation of off-channel habitats, stabilization of streambanks, and restoration of riparian areas would revegetate portions of the Yakima River over the long term.

5.8.2.6 Enhanced Water Conservation Element

Most of the conservation projects would result in no permanent impacts on vegetation because the projects would likely be located in already disturbed areas. Some projects would result in the permanent loss of vegetation associated with the placement of project facilities.

Many of the agricultural water conservation projects include lining canals or replacing them with piping, which could result in the loss of some temporary ponds and wetlands that exist because of leakage from irrigation canals and ditches. Lining or piping the canals would remove the water source of these wetlands and could result in a shift of species composition toward upland or more arid plant community types. This shift would be toward more natural conditions and is not considered a substantial impact.

No long-term impacts are anticipated with this element because no vegetation would be disturbed or removed.

5.8.2.7 Market Reallocation Element

No long-term vegetation impacts are anticipated for the Market Reallocation Element because this element generally does not require removal of vegetation. If water transfers involve the fallowing of land, there is the potential for noxious weeds to invade the fallowed areas. The Market Reallocation Element would include measures to require replanting of fallowed areas to prevent this impact.

5.8.3 Integrated Water Resource Management Plan Alternative – Impacts of Integrated Plan

Although there would be some negative impacts on vegetation, particularly in the areas of new or expanded reservoirs, the overall impact of the Integrated Plan is expected to be positive. Many of the proposed projects under the Enhanced Conservation and Structural and Operational Changes Elements would not impact vegetation because they would be located in previously disturbed areas. The Habitat/Watershed Protection and Enhancement Element would improve degraded habitat and protect large areas of intact habitat, including threatened shrub-steppe and old-growth habitats. The integrated implementation of fish habitat enhancement projects and the streamflow improvements would provide greater benefits to riparian and wetland vegetation in comparison to a program that implements the elements separately. Thus, integrated management approaches are more likely to achieve systemwide benefits for vegetation.

5.8.4 Mitigation Measures

The impacts on vegetation caused by the development of the required facilities and infrastructure would be mitigated through site and facility design to minimize the need for vegetation removal. Specific mitigation measures would be developed as part of future project-level environmental analysis. In general, the design should incorporate an evaluation of existing wildlife habitats and species in the vicinity and a rare-plant survey. Habitat that is determined to be of significant importance (e.g., presence of listed species) should be preserved to the greatest extent possible. Facilities, access roads, and staging areas should be located in areas of disturbed vegetation if possible. If intact vegetation is present, the footprint of the facility should be minimized and situated to result in the least amount of disturbance.

Removal of mature trees should be avoided where possible in all construction areas. Staging and stockpile areas should be revegetated after construction. Native plant species appropriate for the vegetation community (e.g., riparian areas) should be used for all proposed restoration. Vegetation communities, particularly shrub-steppe, should be created, restored, or protected elsewhere in the Yakima River basin to compensate for habitat losses. Land acquisition and habitat enhancement components included in the Integrated Plan are intended to offset habitat losses by protecting and enhancing existing high value habitat areas within the Yakima basin.

5.9 Wildlife

5.9.1 No Action Alternative

Some of the individual actions proposed under the No Action Alternative involve riparian vegetation improvement or alteration of wildlife habitats and species using those habitats. This includes projects for water storage, artificial supplementation programs, and fish passage and habitat improvements. The projects would likely include removal of nonnative vegetation and planting with native plants. Improved riparian vegetation would result in increased habitat for terrestrial wildlife species. Some projects could reduce the amount of shrub-steppe vegetation, but that impact is expected to be minor because most areas are already disturbed. If the projects trigger NEPA or SEPA compliance, appropriate documentation of the wildlife impacts would be the responsibility of the project proponent, separate from this EIS.

5.9.2 Integrated Water Resource Management Plan Alternative – Impacts of Individual Elements

Under the Integrated Plan Alternative, long-term impacts on wildlife are based on the area needed for project facilities. Impacts include the amount of wildlife habitat that would be permanently removed and replaced with project facilities. Some of the elements would result in the improvement of vegetation communities such as riparian areas or wetlands and are considered beneficial for wildlife.

5.9.2.1 Reservoir Fish Passage Element

Construction of fish passage facilities could result in displacement of wildlife. However, some of the facilities would be located on existing dam facilities and would not disturb vegetation. Minor effects on habitat could occur through the removal of a few mature Douglas firs or other conifers for construction of the adult fish collection facilities and access roads. Conifer removal would be minimized to the extent possible.

Fish passage would provide anadromous fish access to historic territories and would have overall long-term ecosystem benefits by restoring food web interactions between invertebrates, fish, and mammals. Migrating, spawning and juvenile fish are a vital forage base for many birds, mammals, and other fish. Spawned fish carcasses and eggs are also an important source of nutrients to streams and increase the biomass available to the benthic invertebrate community. In general, this element is anticipated to have beneficial impacts on wildlife.

The fish passage conduit at Cle Elum Reservoir would permanently replace about 7,600 square feet of mixed conifer and deciduous forest along with the dirt roadway adjacent to the existing spillway facilities (Reclamation and Ecology, 2011c). The adult fish collection facility downstream, adjacent to the Cle Elum River, would permanently eliminate about 23,700 square feet of riparian and second-growth forest. About 2,600 feet of existing access roads would be upgraded and 550 feet of new road would be constructed, resulting in some habitat losses. Based on the limited amount of permanent habitat removal for facility construction, long-term impacts on wildlife would likely be minor at Cle Elum Dam.

Based on the current level of disturbance at Tieton, Keechelus, and Kachess Dams and the minimal loss of vegetation for fish passage facility construction, impacts on wildlife are anticipated to be minimal at these dams, similar to Cle Elum Dam. Impacts on wildlife would be minor at Clear Lake Dam because the fish passage facility would be attached to existing dam facilities and is not likely to affect wildlife habitat. Fish passage facilities for Bumping Lake Dam would be installed as part of the reservoir enlargement process. Impacts are described in Section 5.9.2.3.

5.9.2.2 Structural and Operational Changes Element

Most of the proposed modifications would result in minimal long-term impacts on wildlife because they are located in areas already disturbed and developed. Some projects could result in permanent removal of wildlife habitat and displacement of wildlife.

Raising the pool level behind Cle Elum Dam would inundate approximately 60 acres of additional land around the reservoir for approximately 3 to 10 weeks per year (average of 7 weeks). Long-term impacts from inundation could be possible where foraging or nesting habitat is present along undisturbed portions of the shoreline. Impacts would occur along a relatively narrow strip of shoreline, and some of the affected areas do not contain vegetation or provide wildlife habitat.

Canal modifications at the KRD and Wapatox projects could result in the loss of some temporary ponds and wetlands that may have formed along the irrigation canals and ditches. These artificial wetlands may provide habitat for amphibians, birds, and other wildlife. The loss of water could cause a shift of species composition toward upland or more arid plant community types, but this would be a change toward more natural conditions and would not be considered a substantial impact.

The Keechelus-to-Kachess pipeline would result in alteration of wildlife habitat where present within along the 5-mile-long corridor. Some forest communities would be removed and replaced by shrub communities, and more edge habitat would be present. This would result in the displacement of wildlife to adjacent suitable habitats and the immigration of other wildlife species. The extent of permanent wildlife habitat removal is unknown at this time because facilities have not yet been designed.

No long-term impacts are anticipated with the power subordination project because no wildlife habitat would be disturbed or removed.

5.9.2.3 Surface Storage Element

The proposed new storage areas have the greatest potential for long-term negative impacts on wildlife due to the extent of wildlife habitat removal for the placement of facilities.

Wymer Dam and Reservoir would have permanent impacts on shrub-steppe vegetation and wildlife within the Lmuma Creek drainage. Impacts include the inundation of shrub-steppe habitat, impacts to movement corridors, possible exotic plant species invasion, possible increase in fire susceptibility, and indirect impacts associated with the construction of facilities.

Shrub-steppe communities in the proposed reservoir area provide core habitat for a number of species, including greater sage-grouse, ferruginous hawk, sage sparrow, Brewer’s sparrow, bighorn sheep, mule deer, and numerous other birds and small mammals (Reclamation, 2008g). Approximately 1,000 acres of shrub-steppe would be permanently inundated. Varying amounts of grassland (150 to 175 acres) and riparian habitats (40 to 60 acres) would also be inundated. These impacts, while offset by land acquisition and habitat enhancement efforts included in the Integrated Plan, could contribute to regional declines in these wildlife communities.

Indirect impacts could occur at the site as a result of some increase in activity associated with operations and maintenance. Indirect adverse effects could include degradation of habitat adjacent to the site through introduction of nonnative invasive plants and increased fire danger. Currently, there is a fairly high level of recreational use occurring in the Yakima River Canyon just downstream from the damsite. Given the existing level of recreational use in the area, these indirect impacts are not expected to be substantial.

Elk movements within the Wymer reservoir vicinity would not be affected. There is migration southward from the Colockum and Quilomene elk herds, but there is little evidence that these herds move into the Wymer area. WDFW has identified the Wymer reservoir site as core wintering habitat for bighorn sheep and core habitat for mule deer. Based on this, Wymer dam and reservoir could have an effect on movement of these species of wildlife.

The expanded Bumping Lake Reservoir would permanently inundate forest communities and displace wildlife. Construction of a new rock-fill dam downstream of the existing Bumping Lake Dam and enlargement of the reservoir would result in the flooding of forested communities above the current level of the reservoir. Preliminary estimates developed for the Integrated Plan indicate that approximately approximately 980 acres of old-growth habitat, would be inundated if Bumping Lake were enlarged to a capacity of 198,300 acre-feet (Reclamation and Ecology, 2011d).

Habitats at the lake edge used by wildlife for nesting or foraging would be lost, but could be replaced in the long term once vegetation at the new lake edge stabilizes. Mobile wildlife species would be permanently displaced to adjacent suitable habitats. Some losses of individual animals could occur if there is not sufficient unoccupied habitat in the adjacent areas. Travel corridors for wildlife would also be impacted by the change in lake level, likely resulting in adverse effects on elk, deer, and small mammals. Loss of forest communities surrounding Bumping Lake could also adversely affect some listed and priority species known to occur in the vicinity, including wolverine, western toad, common loon, and northern spotted owl (Section 5.10). Additional site-specific studies to document wildlife species in the area and potential impacts on those species would be conducted prior to facility design and construction.

Wildlife using wetland habitats along the Kachess Reservoir shoreline are currently affected by existing drawdown operations. The proposed inactive storage drawdown would only occur when the lake levels are already reduced and wildlife are unable to use wetland habitats along the shoreline. Site-specific studies of existing wildlife species using the reservoir area would be conducted prior to facility design and construction.

5.9.2.4 Groundwater Storage Element

Most of the proposed groundwater storage projects would result in minimal impacts on wildlife because projects would likely be located in already disturbed areas, would rely mostly on existing infrastructure, and would require minimal areas for project facilities. Some projects would result in the permanent loss of wildlife habitat associated with the placement of project facilities.

Because the potential locations of the aquifer recharge facilities would be in agricultural or urban areas with disturbed habitats, few wildlife species are expected to be impacted.

5.9.2.5 Habitat/Watershed Protection and Enhancement Element

Long-term impacts of the habitat restoration projects are expected to be beneficial to wildlife habitat and wildlife. Substantial beneficial impacts are anticipated with the acquisition of lands and the protection of large areas of wildlife habitat. The acquisition of lands containing old-growth forest or shrub-steppe habitat would protect areas of these high-quality habitats that otherwise could be lost due to development under existing ownership. Old-growth forests are uncommon in the Yakima River basin, and shrub-steppe habitat has been significantly reduced.

The proposed habitat/watershed protection, restoration, and enhancement projects on the mainstem and tributaries of the Yakima River would improve native plant diversity and habitat for wildlife in the long term. Projects that reconnect side channels or create off-channel habitats would increase breeding habitat for amphibians. Stabilizing streambanks and restoring riparian areas would provide functioning habitats for many species of large and small mammals and birds. The extent of construction is unknown at this time because the projects have not yet been designed, and therefore the magnitude of impact is difficult to characterize at this stage. It is anticipated that both small and large projects would be proposed under this element.

5.9.2.6 Enhanced Water Conservation Element

Most of the water conservation projects would be located in already disturbed areas and would not permanently impact wildlife. Some projects would result in the permanent displacement of wildlife associated with the placement of project facilities.

No long-term impacts are anticipated with the municipal and domestic conservation program because no wildlife habitat would be disturbed or removed.

5.9.2.7 Market Reallocation Element

No long-term wildlife impacts are anticipated for the Market Reallocation Element because this element does not generally require construction.

5.9.3 Integrated Water Resource Management Plan Alternative – Impacts of Integrated Plan

The overall impact of the Integrated Plan is expected to be positive for wildlife. Although there would be some negative impacts on wildlife habitat, particularly in the areas of new or expanded reservoirs, the combined effect of the proposed elements would result in improved fish and wildlife habitat over time. Many of the proposed projects under the Enhanced Conservation and Structural and Operational Changes Elements would not impact habitat because they would be located in previously disturbed areas. However, they would provide flow benefits to fish and other aquatic species. Fish passage facilities would open up new territory for anadromous fish and help restore ecosystems upstream of the dams. The Habitat/Watershed Protection and Enhancement Element would improve degraded habitat and protect large areas of intact habitat, including threatened shrub-steppe and old-growth habitats.

The integrated implementation of fish habitat enhancement projects and the streamflow improvements would provide greater benefits to riparian and wetland habitats in comparison to a program that implements the elements separately. Thus, integrated management approaches are more likely to achieve systemwide benefits for fish and wildlife.

5.9.4 Mitigation Measures

The impacts on wildlife caused by the development of the required facilities and infrastructure would be mitigated through site and facility design to minimize the need for wildlife habitat removal. Mitigation measures for wildlife habitat are expected to be the same as those described for vegetation in Section 5.8.4.

5.10 Threatened and Endangered Species

5.10.1 No Action Alternative

Some of the individual actions proposed under the No Action Alternative involve riparian vegetation improvement or alteration of wildlife habitats and species using those habitats. This includes projects for water storage, artificial supplementation programs, and fish passage and habitat improvements. The projects would likely include removal of nonnative vegetation and planting with native plants. Improved riparian vegetation would result in increased habitat for terrestrial wildlife species. Some projects could reduce the amount of shrub-steppe vegetation, but that impact is expected to be minor because most areas are already disturbed. To the extent that NEPA or SEPA analysis would be required for these actions, appropriate documentation of the wildlife impacts from construction would be the responsibility of the project proponent, separate from this EIS.

5.10.2 Integrated Water Resource Management Plan Alternative – Impacts of Individual Elements

Under the Integrated Plan Alternative, long-term impacts on listed species are based on the amount of habitat for listed fish or wildlife species that would be permanently removed and replaced with project facilities. Some of the elements would result in the improvement of streamflows, riparian areas, forest communities, or wetlands and are considered beneficial for listed species.

5.10.2.1 Reservoir Fish Passage Element

Construction of fish passage facilities could result in displacement of listed fish and wildlife. Minor effects on habitat could occur through the removal of a few mature Douglas firs or other conifers for construction of the adult fish collection facilities and access roads. Conifer removal would be minimized to the extent possible.

Fish passage would provide anadromous fish access to historic territories. The reintroduction of anadromous fish would have overall long-term ecosystem benefits by restoring food web interactions between invertebrates, fish, and mammals. Migrating, spawning, and juvenile fish are a vital forage base for many birds, mammals, and other fish. Spawned fish carcasses and eggs are also an important source of nutrient inputs to streams and increase the biomass available to the benthic invertebrate community. In general, this element is anticipated to have beneficial impacts on listed fish and wildlife species.

Most threatened and endangered species present in the Cle Elum River basin are expected to benefit from the project. Overall, bull trout would benefit from an increased prey base, unrestricted access to available upstream spawning and rearing habitat, and connection to downstream populations that were previously isolated by the dam. Other listed species that may occur in the area, such as gray wolf, grizzly bear, and Canada lynx, would likely benefit from increased ecosystem productivity. A small amount of wildlife habitat would be removed for facility construction at the dam, but long-term impacts on listed wildlife are anticipated to minor. Most listed wildlife species are not likely to use the area adjacent to the dam because of the presence of people and roads.

Impacts on threatened and endangered species are expected to be similar at all the other reservoirs. Fish passage facilities at Bumping Lake Dam would be constructed as part of the proposed enlargement project and impacts are described in Section 5.9.2.3.

5.10.2.2 Structural and Operational Changes Element

The KRD and Wapatox projects are not anticipated to cause long-term impacts on listed species because no fish or wildlife habitat suitable for listed species would be disturbed or removed.

The Keechelus-to-Kachess pipeline could result in permanent removal of wildlife habitat where present along the 5-mile-long corridor. If listed species are present, this would result in the displacement of wildlife to adjacent suitable habitats. Because the pipeline corridor is near an existing road, it is unlikely that listed species use the area. The extent of permanent wildlife habitat removal is unknown at this time because facilities have not yet been designed. The pipeline would improve rearing conditions for steelhead downstream of the Keechelus Reservoir by reducing artificial summer high flows.

The change in operations for the power subordination projects would not cause negative impacts on listed species. Middle Columbia River steelhead would benefit from improved river flows during juvenile migration.

5.10.2.3 Surface Storage Element

Construction of new storage facilities has the greatest potential for impacts on listed fish and wildlife. A new reservoir would permanently remove vegetation and displace wildlife from the reservoir area. The size and location of the facility would determine the degree of alteration to habitats used by threatened or endangered species. Site-specific studies of listed fish and wildlife species using the reservoir area would be completed prior to facility design and construction.

The Wymer Dam would have permanent impacts on shrub-steppe vegetation and listed wildlife within the Lmuma Creek drainage. As discussed in Section 5.8, over 1,000 acres of shrub-steppe habitat would be inundated (Reclamation, 2008g). Greater sage-grouse, a Federal candidate species, use shrub-steppe and, to a lesser extent, grassland and agricultural areas. Loss of this habitat at the Wymer site would exacerbate ongoing losses in the area resulting in potentially substantial impacts to this species.

Movement corridors and habitat for the greater sage-grouse would be affected directly by Wymer Reservoir. A movement corridor runs north to south through the Yakima River Canyon that is about 14 miles wide. The reservoir lies east of the canyon and is oriented east and west so it would obstruct very little of the greater sage-grouse movement corridor. Sage-grouse moving west from the Yakima Training Center to the canyon would be required to migrate to the north or south of the reservoir which would further fragment greater sage-grouse populations (Reclamation, 2008g).

Shrub-steppe habitat in eastern Washington has been altered significantly by agricultural, residential, and urban development over the past century. Most recently, areas of shrub-steppe have been developed for wind energy. Three large areas of shrub-steppe remain in the Yakima River basin; two are on public land (the Yakima Training Center and the Hanford Reach National Monument); the third is on the Yakama Reservation. These large blocks are protected from future residential and urban development.

Management efforts are being implemented at these three remaining sites to preserve, restore, and increase shrub-steppe habitat and connectivity. The South-Central Washington Shrub Steppe/Rangeland Conservation Partnership and Washington's Greater Sage-Grouse Recovery Plan seek to implement these objectives for the remaining tracts of shrub-steppe (Stinson et al., 2004). Outside of these larger protected areas, residual shrub-steppe habitat continues to be threatened by urban and residential development and habitat fragmentation. The Habitat/Watershed Protection and Enhancement Element of the Integrated Plan would acquire large tracts of shrub-steppe habitat to reduce the threat to residual habitat.

The northern spotted owl was federally listed as a threatened species in 1990 because of widespread habitat loss and degradation and a lack of effective regulations to conserve the species. The major causes of the species' decline are considered to be timber harvesting; catastrophic natural events such as fire, volcanic eruption and wind storms; and competition from barred owls (USFWS, 2009b). Northern spotted owls generally rely on mature and old-growth forests that provide the habitat structures and characteristics required for nesting, roosting, and foraging (USFWS, 2008).

Expansion of the Bumping Lake Reservoir would permanently inundate forest communities downstream of the existing dam and above the current level of Bumping Lake. This could adversely affect listed species and their habitats known to occur in the vicinity, such as the northern spotted owl. Previous habitat mapping efforts (WDFW, 2010) have identified northern spotted owl habitat within the area of proposed expansion as well as late successional (old-growth) forest habitat (WDFW, 2010). Site-specific studies of wildlife using the area would be conducted prior to facility design and construction, in particular the presence of threatened and endangered species.

Fish passage facilities are expected to benefit listed fish and wildlife that depend on these fish above Bumping Lake dam. While bull trout populations would experience increased competition from introduced fish, they are expected to benefit from an increased prey base and connection to downstream populations.

The Kachess Reservoir inactive storage project is not expected to affect listed species using the shoreline. The area is already subject to substantial drawdowns and is not used by listed species during drawdown periods; however, bull trout would continue to be present. Drawdown during drought years would further reduce habitat available in Kachess Reservoir for bull trout and make two tributary streams at the northern end of the lake inaccessible. However, it is anticipated that the Keechelus-to-Kachess pipeline project would increase water levels in the Kachess Reservoir most years and improve bull trout passage during drawdown in drought years. The project includes improving bull trout passage into Box Canyon Creek which would expand and improve available bull trout habitat. Long-term displacement could also occur due to permanent changes to the character and function of the shoreline during successive drought years. Site-specific studies of existing wildlife species using the reservoir area would be conducted prior to facility design and construction.

5.10.2.4 Groundwater Storage Element

Most of the proposed groundwater storage projects would be located in already disturbed areas that do not provide habitat for listed species. The infiltration of cooler groundwater into the Yakima River or its tributaries could benefit fish including listed bull trout and Middle Columbia River steelhead.

5.10.2.5 Habitat/Watershed Protection and Enhancement Element

Long-term impacts of the habitat restoration projects are expected to be beneficial to habitat for listed fish and wildlife.

Beneficial impacts are anticipated with the acquisition of lands and the protection of large areas. The acquisition of lands containing old-growth forest or shrub-steppe habitat would offer greater protection from loss of these high-quality habitats. Old-growth forests are uncommon in the Yakima River basin, and shrub-steppe habitat has been significantly reduced, impacting these species.

Mainstem and tributary habitat enhancement projects would also benefit listed fish species. Historically, fish habitat in the Yakima River basin has been significantly altered. The Habitat/Watershed Protection and Enhancement Element would accelerate ongoing efforts to improve fish passage, protect existing high-value habitats, enhance flows, improve habitat complexity, and reconnect side channels and off-channel habitat to stream channels. The proposed habitat actions are expected to improve prospects for recovering ESA-listed fish populations to levels that are resilient to catastrophic events and the potential impacts of climate change. Fish habitat enhancement actions would help create improved spawning, incubation, rearing, and migration conditions for all salmonid species in the Yakima River basin; implement key strategies described in the Yakima Subbasin Plan (YBFWRB, 2005); and complete most of the actions described in the Yakima Steelhead Recovery Plan (YBFWRB, 2010). Specific benefits of the Habitat/Watershed Protection and Enhancement Element for both anadromous and resident fish, including steelhead and bull trout, are previously discussed in Section 5.7.2.5.

5.10.2.6 Enhanced Water Conservation Element

Most of the conservation projects would be located in already disturbed areas that do not provide suitable habitat for listed species.

5.10.2.7 Market Reallocation Element

Water rights acquisitions targeted at instream flow improvements could benefit listed species. Depending on the timing and location of the increased streamflows that could occur, steelhead and bull trout could benefit from water transfers. Higher flows would likely improve aquatic habitat conditions for fish and other organisms by increasing overall habitat area and improving water quality conditions (e.g., temperature and dissolved oxygen).

5.10.3 Integrated Water Resource Management Plan Alternative – Impacts of Integrated Plan

The overall impact of the Integrated Plan is expected to be positive for listed species. The Integrated Plan elements would result in negative impacts on listed fish and wildlife using the area of a new reservoir or the proposed reservoir expansion adjacent to Bumping Lake, including the loss of approximately 980 acres of old-growth habitat and more than 1,000 acres of shrub-steppe habitat. Overall, impacts would be positive for listed species along the mainstem and tributaries in the Yakima River basin. Operational and structural changes to existing facilities are not anticipated to result in negative impacts because construction associated with these elements would generally occur in previously disturbed areas or built environments. In addition, they would provide flow benefits to fish and other aquatic species. Fish passage facilities would open up new territory for anadromous fish and help restore ecosystems upstream of the dams. The Habitat/Watershed Protection and Enhancement Element would improve degraded habitat and protect large areas of intact habitat, including threatened shrub-steppe and old-growth habitats critical for greater sage-grouse and northern spotted-owl, respectively. The integrated implementation of fish habitat enhancement projects and the streamflow improvements would provide greater benefits to listed fish and wildlife species in comparison to a program that implements the elements separately. Thus, integrated management approaches are more likely to achieve systemwide benefits for listed fish and wildlife.

5.10.4 Mitigation Measures

The impacts on listed fish and wildlife caused by the development of the required facilities and infrastructure would be mitigated through site and facility design to minimize the need for vegetation removal. The design should incorporate an evaluation of existing wildlife habitats and species in the vicinity and a rare-plant survey. Habitat that is determined to be of significant importance (e.g., presence of listed species) should be preserved to the greatest extent possible. If intact vegetation is present, the footprint of the facility should be minimized and situated to result in the least amount of disturbance. Mitigation for listed fish and wildlife species would be associated with conservation measures identified during future ESA consultation.

5.11 Visual Quality

This section analyzes the long-term impacts on visual quality from implementation of the Integrated Plan and the No Action Alternative. The visual quality analysis conducted as part of this EIS involved a review of existing documents and aerial photos to identify issues relevant to the existing landscape character of the sites, and a determination of the potential for visual impacts that would result from the major components. In determining the magnitude of visual impacts, the scale, extent, and sensitivity of viewers was considered.

5.11.1 No Action Alternative

The No Action Alternative includes individual actions that could affect visual resources. These actions could include small water storage projects, artificial fisheries supplementation programs, fish passage, habitat improvements, water conservation, and water quality improvements. The individual actions would have varying levels of long-term visual impacts. Overall, impacts would likely be minor where the actions would modify an existing facility. Habitat improvements would likely have a beneficial impact on the visual resource settings. If the projects trigger NEPA or SEPA consultation, visual quality impacts would be evaluated separately from this EIS by the agencies or entities sponsoring the project.

5.11.2 Integrated Water Resource Management Plan Alternative – Impacts of Individual Elements

5.11.2.1 Reservoir Fish Passage Element

The proposed Fish Passage Elements would be located in landscape settings where the overall visual character and scenic quality are high. However, the fish passage facilities would be located at existing dams where human activities have reduced the visual character and scenic quality. It is often a challenge to blend or design compatible facilities in such settings without creating a substantial change in visual character or reducing scenic quality. The capacity to visually absorb development is primarily dependent on vegetation cover, landform, and existing structures.

Lake and reservoir shorelines generally have a low ability to visually absorb new development due to the availability of uninterrupted views across water (Reclamation, 2008g). However, a major factor influencing the potential visual impact is the level of visual contrast between the proposed new development and the existing elements in the landscape. The existence of Cle Elum, Bumping Lake, Tieton, Keechelus, Kachess, and Clear Lake Dams, and their related structures, would make new visual intrusions related to implementing fish passage less apparent. Distance is also a strong influence on potential visual impact, and the intrusion often is reduced if the project is viewed from a distance.

At viewpoints above the dams, and on or adjacent to reservoirs, additional intake structures and conduits for fish passage may be visible. Typical viewpoints are from highways, local roads, shoreline campgrounds, and residences adjacent to or overlooking the reservoirs.

At viewpoints below dams, additional outlets for downstream fish passage and structures for upstream fish passage (barrier, fish ladder, loading slab, building, fish lock, and holding pool) would be visible. Typical viewpoints are from highways, local roads, and riverbanks, where public access exists. The views would generally be fleeting for motorists, and inconsequential relative to the existing dams and structures.

Many of the new and modified facilities would be visible from viewpoints, but would be subordinate in character to the dams. In some cases they would be indistinguishable; in other cases they would be more pronounced. Exterior surfaces would be designed to blend with the surrounding landscape. Reclamation has determined that for Cle Elum and Bumping Lake Dams, the upstream fish passage facilities will be indistinguishable from existing dam features (Reclamation, 2008g). At Cle Elum Dam, the downstream barrier may be visible from the riverbank. At Bumping Lake Dam, the top of the fish handling facility building may be visible from the adjacent Forest Road.

Removal of some second-growth conifer forest and riparian vegetation would be necessary to construct fish collection facilities at some dam sites, which would create a more open setting and potentially increase views into the sites. Development of access roads to new trap-and-haul facilities would also have the potential to increase views into the sites. For the most part, the new facilities would be introduced into a visual environment already containing several similar facilities; therefore, long-term visual impacts would be minor.

The visual impact caused by the removal of second-growth forest for construction would gradually be reduced over time as replanted trees reach maturity. Permanent fish passage facilities that would be visible upstream of the dam include the intake structure and access bridge. The intake structure would consist of a multilevel gated structure and concrete intake tower located about 500 feet upstream of the dam. Depending on the elevation of the reservoir, the intake structure would be partially or entirely visible above water.

Permanent fish passage facilities that would be visible downstream from the spillway include the barrier dam and collection facility. Visual impacts of downstream facilities would be minimal given the limited viewpoints of this area.

In general, the fish passage facilities would have minimal visual impacts, remaining subordinate to the existing dam and associated structures.

The fish passage facilities at Tieton, Keechelus, and Kachess Dams are expected to be similar to those at Cle Elum Dam and would similarly alter views of the existing dam. The facilities would be visible to residents and recreationists in the immediate vicinity of Kachess Dam, but largely hidden from view from most visitors because of limited access to the dam area. The facilities at Keechelus and Tieton Dams would be visible to motorists on I-90 and Highway 410, respectively. Keechelus Dam is visible from the

Mountains to Sound Greenway. At both dams, the fish passage facilities would have minimal visual impacts because they would be subordinate to the existing dam. The Clear Lake Dam fish passage facilities would be located on the downstream side of the existing dam and would not be visible to most visitors.

A more detailed analysis of potential impacts on visual resources at the reservoirs would be completed in accordance with the methods described in USFS Scenic Management System (SMS) as part of the future project-level environmental review.

Fish passage facilities at Bumping Lake Dam would be constructed as part of the reservoir enlargement. Impacts are evaluated in the Surface Storage Element section below.

5.11.2.2 Structural and Operational Changes Element

The proposed modifications would have varying levels of long-term visual impacts. Overall, impacts would likely be minor because the modifications would occur to existing facilities at a local scale.

For the Cle Elum Dam pool raise project, flashboards installed on top of the dam would modify its appearance. The flashboards would protrude above the spillway of the historic dam and would be visible to residents and recreationists in the immediate area. It is likely that the flashboards would blend in with the overall dam structure and would not substantially modify views. Shoreline protection measures, such as riprap and bioengineering measures, would alter the appearance of the shoreline on a small portion of the lake shore. The shoreline protection measures would be designed to blend in with the surrounding shoreline and would likely not be noticeable once vegetation is established around them. Land around the reservoir would be inundated to a higher level for 3 to 10 weeks per year. The increased reservoir level would be noticeable during the high water periods, but would only be 3 feet higher than current high water elevations.

Once construction is completed for the KRD and Wapatox projects, there would be little visual difference from current conditions. The open canals would be replaced with pipes. Because they would be located in the same canal rights-of-way, there would be limited views of the pipes. Additional water in the tributary streams during otherwise dry conditions could improve visual quality. The re-regulating reservoir at Manastash Creek and pump station on the Yakima River would be visible to residents of the area and people driving through or boating on the Yakima River. These impacts could be mitigated by careful siting and screening of the facilities.

Keechelus-to-Kachess Pipeline

The Keechelus-to-Kachess pipeline corridor would be visible to visitors, including motorists on the Mountains to Sound Greenway. The pipeline corridor would be vegetated, but would have no trees, similar to powerline corridors and road rights-of-way in the area. Although viewers from the Greenway may be more sensitive to unnatural views, the views in the vicinity of the pipeline corridor have been previously disturbed by roads and powerlines. The outfall pipe at Kachess Reservoir would be visible to residents and recreationists during low lake levels.

The power subordination projects at Roza Dam and Chandler Powerplants would not cause any changes to visual quality.

5.11.2.3 Surface Storage Element

Construction of new storage facilities would result in substantial long-term visual impacts. The magnitude of the impact would depend on the proposed location of the facility, the existing character of the surrounding landscape, the scale of the project, how visible the construction site would be to the public, the extent to which the scenic quality of the existing landscape has already been modified, the sensitivity of the viewing public, and viewers' expectations based upon the visual character of the setting in which the alterations to views is taking place. The reservoirs would inundate large areas of land and change the landscape from shrub-steppe or forested to open water. Reservoirs would be drawn down during summer months creating a "bathtub ring" of mud and stumps where forested areas are inundated. Rivers below the dam would have altered flows during some seasons.

The new dam and reservoir at Wymer would introduce substantial new manmade facilities in the predominantly undeveloped Yakima River Canyon. The most prominent of the facilities would include the pumping plant (approximately 40 feet high) and the switchyard (which would include towers approximately 80 feet in height). These facilities would be on agricultural land east of SR–821 and the river. The outlet channel from the dam would modify the existing Lmuma Creek channel and crossing under SR–821 to the Yakima River. The creek is intermittent and the area near SR-821 is trampled by cattle and bare of vegetation (Reclamation, 2008g).

These facilities, at least prior to mitigation, would represent a substantial visual impact in the context of the largely undeveloped, scenic Yakima River Canyon corridor. While the new facilities may be somewhat similar in character to those at Roza Diversion Dam (located 5 miles to the south), they would be more prominent, visible, and concentrated (Reclamation, 2008g).

Related to the dam and reservoir, the top of 450-foot-high Wymer Dam would be visible to motorists along an approximately 0.5-mile stretch of SR–821, a State Scenic Byway. The view of the dam would be fleeting (available for less than a minute) and would be noticed only if motorists look eastward up Lmuma Creek immediately opposite the site of the pumping plant complex. The dam would be concrete-faced and would be visible to viewers as something distinct and in contrast to the surrounding shrub-steppe vegetation and basaltic cliffs. The only other location from which portions of this alternative would be seen is I-82, where the narrow, easternmost arm of the reservoir pool would be crossed by the highway and would be visible to motorists. The dam would not be visible from any recreation sites or businesses. Nonetheless, this visibility of the dam would add to the intensity of impact on the Yakima River Canyon corridor (Reclamation, 2008g). It is possible the Bureau of Land Management (BLM) Visual Resource Inventory management objectives would not be met at certain locations. A more detailed analysis of potential impacts on visual resources from Wymer Dam construction would be completed in accordance with the methods described in BLM visual assessment guidelines as part of future project-level environmental review.

The Bumping Lake expansion would increase the current 1,300-acre reservoir to approximately 4,120 acres. The new dam structure would be located approximately 4,500 feet downstream from the existing dam and would likely be taller than the existing dam. The new dam location is currently an area of mature conifer forest with a free flowing (but controlled) river flowing through it. The new dam and expansion of Bumping Lake would substantially affect the visual character of the Bumping Lake valley by removing trees and flooding the area behind the new dam. It is possible the U.S. Forest Service Visual Quality Objectives and Scenic Integrity Levels would not be met at certain locations. A more detailed analysis of potential impacts to visual resources at Bumping Lake would be completed in accordance with the methods described in the U.S. Forest Service Scenic Management System as part of future project-level environmental review.

The new dam and expanded reservoir would be visible from existing viewpoints and from new viewpoints that would be provided surrounding the reservoir. Changes to the reservoir would be particularly evident along the east and southeast areas of the reservoir from the new Bumping Lake Dam, south to the Deep Creek drainage area. This area would be inundated and would change from a low-lying, forested upland lake fringe to open water. During low water levels, a larger area of mud flats and tree stumps would be visible.

These changes would be perceived as either neutral or positive by some and as adverse by others. The degree of positive versus negative viewer reaction would likely vary by the type of user. For example, to boaters and fishermen the sight of the expanded reservoir may be viewed favorably; however, those who prefer an unaltered natural view would likely react negatively. The dam and expanded reservoir would also be visible to trail users from a number of obstructed viewpoints (filtered views through trees) and unobstructed viewpoints in the William O. Douglas Wilderness. Viewpoints include trails and lookout points on American Ridge (north of the lake), Nelson’s Ridge (south of the lake), and Miner’s Ridge (west of the lake). Many of these trail users are in the Wilderness area because they value natural settings, and they may view the new dam and expanded reservoir as negative.

A more detailed analysis of potential impacts on visual resources at Bumping Lake would be completed in accordance with the methods described in USFS Scenic Management System (SMS) as part of the future project-level environmental review.

Under one option for the Kachess Reservoir inactive storage project, the outlet channel and discharge structure from the Yakima River portal to the river would be visible to river users. Under the other option, the pump station at the dam would modify the views of the dam, but would fit with the character of other dam structures. The outlet pipe would be visible in the area downstream of the dam. Because other dam facilities are located in the downstream area, river users are not likely to view them negatively. The inactive storage project would cause the reservoir to be drawn down to a lower level during drought years. This may be viewed negatively by recreationists and residents. However, the reservoir currently is drawn down and the lower level may not be noticeable to most people. Long-term impacts at Kachess would likely be minor since the new facilities do not represent a substantial change.

5.11.2.4 Groundwater Storage Element

Groundwater storage facilities would change the visual landscape in their immediate areas, but would likely result in only minor long-term impacts given the limited facilities and local scale of visual changes. Infiltration sites would change from dry areas to basins that hold water. Injection facilities would be housed in pump houses similar to wells and have minimal visual impacts. Infiltration ponds, pump stations, and other equipment would be visible, but would likely blend into the surrounding landscape of agricultural uses.

The ASR infrastructure would be located at existing treatment facilities and would generally not be visible to the public. Most conveyance lines would be underground. However, the intake lines would require pump facilities adjacent to the water source. This would consist of a pump house, power supply, and intake pipe. The facilities would be fenced. Depending on the location, the intake facilities could be visible from adjacent roadways and recreational areas, such as the Naches River for the Yakima ASR project. All impacts would be localized and would affect a limited number of individuals, largely those people who live in or travel through the local area. As a result, long-term impacts would likely be minor.

5.11.2.5 Habitat/Watershed Protection and Enhancement Element

The targeted watershed protection program would preserve lands from development, likely protecting existing visual resources in a natural or nearly natural appearing condition. The program would not change the visual appearance of the acquired lands.

Habitat enhancements, including levee setbacks and riparian plantings, would improve the condition of riparian vegetation and change views of the rivers and creeks. These enhancements would create a more natural streambank condition, which would improve visual resources in the immediate area overall.

5.11.2.6 Enhanced Water Conservation Element

Some conservation facilities such as re-regulating reservoirs would be visible in the area, but would likely blend in with surrounding agricultural facilities. Open water canals would be converted to enclosed pipes in some areas, likely drying up adjacent vegetation and riparian-like areas that are facilitated by leakage from the irrigation system. This would change the visual character of the area, but the change would be a return to more natural arid conditions.

No impacts on visual quality are anticipated from the municipal and domestic conservation program.

5.11.2.7 Market Reallocation Element

The Market Reallocation Element would have no direct effects on visual resources. However, reallocation could result in land use changes that would alter visual landscapes. Water right transfers could result in expanding irrigation to new areas, changing agricultural uses to urban or domestic uses, or fallowing some fields. All would result in changes to the visual landscape, which some people may view as negative. Irrigated agriculture could be expanded into areas that are zoned for agriculture. Visual changes would be limited to changes in crop types and the addition of irrigation facilities, but the overall visual landscape would not be altered. Water transferred to urban or domestic uses would also be applied in areas that are designated for those uses. Some people may view a fallow field as potential wildlife habitat, while others may feel that such areas are unkempt and overgrown. The program would include provisions requiring weed control on fallowed fields.

5.11.3 Integrated Water Resource Management Plan Alternative – Impacts of Integrated Plan

Because the visual impacts of the facilities would be primarily of local scale, no increase or lessening of impacts as a result of the integrated elements is expected. Further, considering the similarity in appearance with existing structures and the fact that the overall complex of facilities at individual project sites would be viewed mainly from a distance, the overall long-term visual resource impact is not expected to be significant.

5.11.4 Mitigation Measures

Involving an architect in project design would ensure that new facilities and restored areas would meet BLM’s Visual Resource Inventory management objectives and the prescribed USFS Visual Quality Objective of Retention and corresponding Scenic Integrity Level of High (see Section 3.11) to the extent practicable.

Disturbed areas below the fish passage facilities would be contoured to blend with adjacent areas to the extent practicable and revegetated with appropriate native plant species. The visual impacts of fish handling facilities would be reduced using the appropriate paint color to blend with the natural landscape. New or modified canals, ditches, tunnels, siphons, and appurtenant facilities would be located to reduce their visibility from public areas.

5.12 Air Quality

Because project details are not known at this time, potential air quality impacts are discussed qualitatively based on the general types of emissions anticipated from different stationary sources proposed for the Integrated Plan elements. This section does not discuss compliance with Federal or State regulations because specific levels of emissions from permanent stationary sources cannot be determined at this time. Additional analysis would be undertaken during project-level review of projects carried forward to implementation.

5.12.1 No Action Alternative

Under the No Action Alternative, Reclamation and Ecology would not carry out the Integrated Plan Alternative; however, various agencies and other entities would likely continue to undertake individual actions to accomplish some water resources improvements. In some cases, these projects may cause long-term impacts from emissions if they include stationary pollutant sources such as pumping equipment driven by diesel, natural gas, or other fossil fuels. In general, small water resources projects would likely fall below WAC stationary source permit requirements. If the scale or number of pumps triggers permitting requirements, they would be required to incorporate additional emissions controls. Therefore, long-term air quality impacts from the operation of pumping equipment would be relatively minor and unlikely to exceed the National Ambient Air Quality Standards (NAAQS) or Class 1 visibility standards.

5.12.2 Integrated Water Resource Management Plan Alternative – Impacts of Individual Elements

5.12.2.1 Reservoir Fish Passage Element

Long-term impacts for all proposed fish passage projects included under this alternative (i.e., those at Clear Lake Dam, Cle Elum Dam, Bumping Lake Dam, Tieton Dam, Keechelus Dam, and Kachess Dam) would result from emissions from internal combustion engine vehicles used to transport fish upstream in the case of trap-and-haul fish passage programs at the Cle Elum Dam, and at other sites where such programs are implemented.

Long-term air quality impacts from the operation of the fish passage facilities or trap-and-haul programs would not trigger permit requirements and would be minor due to the small number of annual trips required at any one reservoir.

5.12.2.2 Structural and Operational Changes Element

No long-term air quality impacts are anticipated from structural and operational changes at Cle Elum Dam. No new emissions would be generated by operation of the flashboards at the dam or the shoreline protection measures.

The operation of equipment such as pumps or compressors used to pressurize pipes for the KRD and Wapatox Canal modifications could result in long-term emissions if the equipment is driven by diesel, natural gas, or other fossil fuels. The operation of the new pump station used to increase flows to Manastash Creek water users or directly to Manastash Creek could also cause emissions if the pump station is driven by diesel, natural gas, or other fossil fuels. Pump facilities may trigger air quality permitting on a project-by-project basis depending on equipment specifications. In general, facilities would either not trigger permitting thresholds or would incorporate emissions controls and conditions to minimize annual emissions. As a result, long-term air quality impacts from the operation of this equipment are not expected to cause exceedances of air quality standards.

No long-term air quality impacts are anticipated from structural and operational changes associated with the Keechelus-to-Kachess pipeline or power subordination at Roza Dam and Chandler powerplants because the projects would not generate any emissions.

5.12.2.3 Surface Storage Element

Electric pumps are anticipated to be used at the new pump station that would be used to fill Wymer Reservoir, and at the new pump station that could be used to withdraw water from inactive storage in Kachess Reservoir under one of the Kachess Inactive Storage options. Power supply would come from the regional power grid; therefore, air quality effects are not anticipated in the Yakima River basin. The regional power grid draws power from hydropower sources and from some fossil fuel powered electricity generation facilities, so there may be minor air quality effects at other locations where power is generated. However, any additional air quality emissions resulting from the generation of electricity using fossil fuels to run the pump stations under this element would be very minor in the context of the overall emissions from such a power plant. Additionally, facility emissions controls would maintain emissions rates within the limits set under the plant's air quality operating permits. Since pumping for both of these projects would occur only during intermittent periods when Wymer Reservoir is being filled or Kachess Inactive Storage is being used, any air quality effects would also be intermittent.

Emissions of dust and other airborne particulates originating from the drawdown zone of the reservoirs may increase PM_{10} levels in some cases. The Wymer Dam site is slightly more than 10 miles north of the PM_{10} maintenance area boundary, and because of the distance, not likely to cause PM_{10} compliance issues. There are no requirements for conformity analyses for sources outside the boundary, and therefore no additional mitigation measures required beyond standard dust control practices.

5.12.2.4 Groundwater Storage Element

No long-term air quality impacts are anticipated from the Groundwater Storage Element. Any increases in PM_{10} levels are expected to be minor and would occur outside the City of Yakima maintenance area boundary.

5.12.2.5 Habitat/Watershed Protection and Enhancement Element

No permanent stationary sources of air pollutants are anticipated to result from the proposed Habitat/Watershed Protection and Enhancement Elements. Therefore, no long-term air quality impacts are anticipated.

5.12.2.6 Enhanced Water Conservation Element

No long-term impacts are anticipated from the municipal and domestic conservation program because no emissions would be generated.

5.12.2.7 Market Reallocation Element

If the market-based water reallocation results in fallow fields, dust emissions could increase. The program would include requirements that fallow fields must be vegetated to control dust.

5.12.3 Integrated Water Resource Management Plan Alternative – Impacts of Integrated Plan

Long-term air quality impacts associated with the Integrated Plan would be relatively minor and unlikely to cause exceedances of the NAAQS or Class 1 visibility standards.

5.12.4 Mitigation Measures

Dust control plans could be developed to mitigate the impacts of increased dust from fallow fields and dry infiltration basins. Measures to reduce dust could include installing plantings around the infiltration basins and planting drought-tolerant plants in fallow areas.

In some cases, air quality permits may be required for use of non-electric pumping, injection, or treatment equipment. Where permits are required, mitigation in the form of control technology and permit conditions would reduce emissions to acceptable levels. No mitigation measures are required for the temporary emissions from backup generators.

5.13 Climate Change

For purposes of this DPEIS, the effect of climate change on proposed projects is discussed as a long-term impact. The potential for proposed projects to generate greenhouse gas emissions was discussed as a short-term impact in Section 4.13.

5.13.1 No Action Alternative

Changes in precipitation, snowmelt, and runoff that may occur as a result of climate change could affect projects included in the No Action Alternative. There may be changes in water availability for irrigation, fish, and municipal uses, as discussed in Section 3.13. Without a comprehensive, integrated management program, projects would be completed in a piecemeal fashion, reducing the potential for coordination and increased efficiencies in implementation. An uncoordinated approach may reduce the potential to adapt water management strategies and adjust to changing climatic conditions. The three climate change scenarios evaluated would each affect the projects included in the No Action Alternative or the Integrated Plan Alternative differently. Two of the three scenarios show that climate change could cause existing water supply shortages and adverse effects on streamflows and fish in the basin to become significantly worse under the No Action Alternative.

5.13.2 Integrated Water Resource Management Plan Alternative – Impacts of Individual Elements

As discussed in Section 3.13, the effects of climate change could alter temperature and precipitation in the Yakima River basin and affect water management throughout the region. Changes in runoff and precipitation would require Ecology, Reclamation, and other agencies to adapt water management to respond to changing conditions as they occur.

Improvements to storage, water supply, and fish habitat that are proposed under the Integrated Plan Alternative are expected to improve the ability of water agencies, the agriculture sector of the economy, and fish and wildlife to better withstand and adapt to changing conditions, including the changes associated with climate change.

5.13.2.1 Reservoir Fish Passage Element

Current predictions of the effects of climate change in the Yakima River basin indicate a potential increase in winter streamflow and decline in snowpack and spring and summer streamflow, with resulting changes in reservoir storage. Reservoir inflow to Cle Elum is predicted to increase in winter months, but decrease in summer months.

The predicted changes in runoff and reservoir storage could affect operation of the Yakima Project. Specifically, it could affect how the fish passage facilities at Cle Elum Dam are operated. The downstream passage facilities would allow release of fish passage flows any time the reservoir water surface is in the upper 50 feet (2,190 feet at the forebay) of full pool (about 224 thousand acre feet (KAF) or 51 percent full). The proposed downstream fish passage facilities were designed to maximize passage for the majority of the season when smolts are migrating in early March to June. The combined climate change modeling results for the Integrated Plan show that average maximum Cle Elum Reservoir levels under the Moderately Adverse scenario are 65,000 acre-feet (16.5 percent) lower than under historically based hydrology. Three additional years out of 25 fail to reach the minimum level for fish passage release. To the extent less water is available in Cle Elum Reservoir throughout the migration period, fish passage facility operations could be adversely affected.

Increased temperatures are predicted to affect fish by interfering with salmon migration, elevating the risk of disease, and increasing mortality. Fish passage facilities at Cle Elum Dam would expand the habitat available to anadromous fish, increasing the abundance and productivity of fish. The changes produced by the passage facilities (improved health of fish populations and access to cooler tributary streams above the reservoirs) should help fish withstand the impacts of climate change, including lower flows and warmer temperatures in the spring and summer.

Fish passage facilities for Tieton, Keechelus, Kachess, and Clear Lake Dams have not yet been designed. It is anticipated that climate change impacts on the projects would be similar to those for Cle Elum Dam, although individual differences could be notable due to hydrologic and operational differences between the reservoirs.

Fish passage facilities for Bumping Lake Dam would be constructed as part of the reservoir enlargement project. Impacts from climate change are discussed in the Surface Storage Element below.

5.13.2.2 Structural and Operational Changes Element

Modifying existing structures and facilities would allow the Yakima Project to be operated in a more efficient manner that would improve irrigation deliveries and reduce impacts on fish. These improvements could improve the adaptability of the system to future climate changes. The potential impacts of climate change on the proposed Structural and Operational Changes projects (in combination with the other elements of the Integrated Plan Alternative) have been estimated using hydrologic modeling.

The predicted changes in snowpack and runoff would alter Cle Elum Reservoir operation by producing larger and more frequent drawdowns, and would result in more frequent years (five out of 25) when the reservoir fails to re-fill completely. These changes could reduce the effectiveness of the pool raise project somewhat. However, the changes associated with climate change would increase water supply shortages and thereby increase the need for the extra storage produced by the proposed Cle Elum pool raise project. In this way, some of the effects of the potential reduction in operational effectiveness would be offset.

Based on the hydrologic modeling conducted for the combined Integrated Plan Alternative, minor impacts due to climate change are expected for deliveries through KRD and Wapatox canals, flows through the Keechelus to Kachess pipeline, and operation of the Roza Dam and Chandler Powerplants, because of the relatively small size of these projects or their flexibility to respond to hydrologic variations.

5.13.2.3 Surface Storage Element

Predicted climate changes are estimated to have an adverse effect on irrigation deliveries and streamflows (in the summer). However, the reservoir storage improvements could improve the adaptability of the system to future climate changes by providing a more reliable water supply for proratable irrigation districts and improving streamflows for fish.

To a major extent, the effectiveness of the storage projects under climate change conditions depends on the ability of the projects to refill, as well as the relationship between the volume of increased storage and the volume of increased water supply needs. The proposed storage facilities would not be as full under climate change conditions compared to conditions without climate change. For example, the average maximum spring storage in the combination of all five reservoirs under climate change is 290,000 acre-feet (23.5 percent) less than under historically based hydrology. Nevertheless, even with climate change, the storage projects would still be effective in improving water available for irrigation and instream flows. Specific quantitative results provided here represent the Moderately Adverse climate change scenario. More detailed results, and results for the other climate change scenarios, are included in the *Modeling of Reliability and Flows Technical Memorandum* (Reclamation and Ecology, 2011k).

Operation of the proposed Wymer Dam has been simulated under the effects of potential climate change using hydrologic modeling. The modeling results show that, when combined with the other proposed elements associated with the proposed Integrated Plan, the project would still deliver approximately 82,500 acre-feet per year of streamflow augmentation during all years, and approximately 80,000 acre-feet of irrigation water supply during heavily prorationed water supply years, just as it would without climate change effects. The difference is that there would be more years needing supply augmentation under climate change, because of reduced snowpack and runoff.

Hydrologic modeling of the proposed Bumping Lake enlargement project shows that, when combined with the other proposed elements of the Integrated Plan Alternative, the project would be needed to make major water supply deliveries in an additional 10 out of 25 years, compared with operations not impacted by climate change.

Modeling results for the proposed Kachess inactive storage project indicate that, when combined with the proposed Integrated Plan elements, the reservoir would be drawn down below the existing minimum pool level in an additional 10 out of 25 years, compared with operations not impacted by climate change.

5.13.2.4 Groundwater Storage Element

As described in Sections 5.3, 5.5, and 5.7, groundwater storage could improve streamflow, improve water supplies, and provide beneficial impacts for aquatic organisms. Groundwater storage could be used to store higher winter flows which would be subsequently pumped from wells or allowed to discharge naturally to offset some of the effects of lower summer flows predicted under climate change scenarios. Enhanced groundwater storage could provide a reliable supply of water for municipalities and residential developments. Stored groundwater that returns to surface water through seeps would provide a source of cooler water to benefit water quality and fish and other organisms. These benefits would likely be localized, but would improve the ability to adapt to climate change.

The operation of the proposed shallow aquifer recharge project (in combination with the other elements of the Integrated Plan Alternative) has been simulated under the effects of potential climate change using hydrologic modeling. Because of the earlier snowmelt under warmer, climate-impacted conditions, it is likely that somewhat more water would be available for infiltration compared with historically based hydrologic conditions. Additional hydrologic analysis would be required during subsequent study of this element of the Integrated Plan.

The operation of the ASR project was not included in the hydrologic simulations performed to estimate the effects of climate change. This is because the volume of water used in the ASR project would be small compared with the available water supply in the

Yakima system. Climate change would not be expected to affect the operation of the ASR project.

5.13.2.5 Habitat/Watershed Protection and Enhancement Element

Fish habitat enhancements would create a healthier habitat for fish in the Yakima River basin by reconnecting and reestablishing floodplains and side channels, enhancing and restoring riparian habitat conditions, and increasing channel complexity. This should improve the growth, survival, and abundance of both anadromous and resident fish and help the populations withstand the impacts of climate change.

Acquisition and protection of watersheds would also benefit anadromous and resident fish by providing improved habitat conditions. This should help them withstand the impacts of climate change.

5.13.2.6 Enhanced Water Conservation Element

The effects of the Enhanced Water Conservation Element on surface water, groundwater, and anadromous and resident fish are described in Sections 5.3, 5.4, and 5.7 respectively. The expected small improvements in streamflow that would result from enhanced water conservation could improve the ability to adapt to climate change.

The proposed agricultural water conservation program (in combination with the other elements of the Integrated Plan Alternative) has been simulated under the effects of potential climate change using hydrologic modeling, but no element-specific results are available. Climate change is estimated to increase future agricultural water demands by approximately 8 percent (Reclamation and Ecology, 2011o). As water demands increase, water conservation is generally more important in balancing needs with supplies. When combined with the other elements of the Integrated Plan Alternative, agricultural conservation would help provide additional water supply for instream flows and a more reliable water supply to individual users.

The operation of the municipal and domestic conservation program was not included in the hydrologic simulations performed to estimate the effects of climate change. This is because the volume of water affected by this program would be small compared with the available water supply in the Yakima system. However, climate change is estimated to increase municipal and domestic water demands by 5 percent, making conservation even more critically important (Reclamation and Ecology, 2011o). Climate change is not expected to affect the operation of the municipal and domestic conservation project, although depending on the severity of climate change, it could make the water savings more important. The conservation program project would help ensure the reliability of municipal and domestic supplies under climate change conditions.

5.13.2.7 Market Reallocation Element

A market reallocation system could improve the flexibility to adapt to climate change by allocating water where it is needed to improve water supplies, streamflows, and conditions for fish. The water supply fluctuations predicted to result from climate change may increase the need for and benefits from the Market Reallocation Element.

5.13.3 Integrated Water Resource Management Plan Alternative – Impacts of Integrated Plan

As an integrated package, the Integrated Plan would provide multiple benefits to water supply, agriculture, and fish while improving the ability of water managers to adapt to future climate changes. Approaching management on a basin-wide level could provide additional consistency in water management. Additional water storage and improved irrigation operations would provide a more reliable water supply for agriculture during dry periods. Improved streamflows and fish habitat, along with access to upper river tributaries, would produce healthier fish populations that would be better able to withstand habitat changes caused by climate change. This alternative embodies many of the methods for adapting to the adverse effects of climate change that are recommended in the University of Washington Climate Impacts Group and University of Oregon studies discussed in Section 3.13.

5.13.4 Mitigation Measures

Changes in water availability in the Yakima River basin would require the managing agencies to adaptively manage the river to respond to changing conditions. Ecology and Reclamation would coordinate with other water, fish, agriculture, energy, forest and public health managers to adapt to climate change. The Integrated Plan on the whole would improve the ability of water and fisheries managers to mitigate the effects of climate change.

5.14 Noise

The State imposes limits on the allowable environmental noise levels from a variety of sources in any 1-hour period (WAC 173-60, *Maximum Environmental Noise Levels*). The maximum allowable levels depend on the classification of the property receiving the noise and the noise source. The classification system is called the Environmental Designation for Noise Abatement (EDNA) and is used to assess long-term impacts from stationary noise sources associated with the Integrated Plan elements.

5.14.1 No Action Alternative

Projects that would be implemented under the No Action Alternative have the potential to generate noise during long-term operation. Those impacts would be evaluated separately from this EIS by the agencies or entities implementing the projects.

5.14.2 Integrated Water Resource Management Plan Alternative – Impacts of Individual Elements

Under State regulations, the maximum allowable noise levels from sources associated with activities under the Integrated Plan would depend on the classification of the property receiving the noise and the noise source (see Section 3.14.3).

5.14.2.1 Reservoir Fish Passage Element

Long-term noise impacts would be minor and similar at each site (Cle Elum, Bumping, Tieton, Keechelus, and Kachess Dams). Minor noise impacts would result from the one to two additional onroad vehicles trips per day to transport fish upstream in the case of trap-and-haul fish passage programs at the Cle Elum Dam and at other sites where such programs are implemented. No trap-and-haul system would be used at Clear Lake Dam. Noise created by traffic (including trap-and-haul vehicles) on public roads is exempt from regulation under WAC 173-60-050.

5.14.2.2 Structural and Operational Changes Element

No long-term noise impacts are anticipated from structural and operational changes at the Cle Elum Dam, Keechelus to Kachess pipeline, or Wapatox projects. Beneficial long-term impacts would result from lower noise emissions from turbines and centrifugal pumps at the Roza Powerplant in April and May, and at the Chandler Powerplant in April, May, and June when power is subordinated.

The KRD canal modifications could require equipment, such as pumps or compressors and the new pump station used to increase flows to Manastash Creek water users or directly to Manastash Creek. Pumping would involve smaller pumping facilities (likely up to a maximum of approximately 8 cfs) than would be required under other project elements, which would produce relatively less noise, and the units would be contained within a pumphouse structure. Pumps would be operated primarily in the summer months, when required to provide water to local creeks during low-flow periods.

The facilities would be located in a rural area outside of Ellensburg, about 4,000 feet from the nearest existing developed part of the city, but within a few hundred feet of some rural residents. Other ambient sources of noise in the vicinity include I-90, which is approximately 3,000 feet from the site. Facility equipment selected for use under this alternative would be required to comply with WAC 173-60. Long-term impacts are anticipated to be localized and minor provided the standards in WAC 173-60 are met.

5.14.2.3 Surface Storage Element

Long-term impacts would result from noise from the new pump station used to pump water from the Yakima River to the new Wymer Reservoir. Equipment to provide pumping capacity of up to 1,000 cfs to skim high flows during the winter and spring would be selected for use under this alternative, and would be required to comply with WAC 173-60 at the nearest regulated land use. Pump facilities at Wymer Reservoir would be housed within a pumphouse structure which would reduce noise levels outside the pump station. This pump facility would have the largest capacity of all the Integrated Plan pump facilities elements.

The location of the proposed Wymer Dam pump station is a rural area in the Yakima River Canyon. Other sources of ambient noise in the vicinity include the Yakima River and SR-821. Long-term impacts are anticipated to be localized and minor provided the standards in WAC 173-60 are met. However, these noise effects may be audible within the area designated as a Scenic Byway during periods of operation where visitors typically value the absence of mechanized noise.

No noise effects would result from the operation of an enlarged Bumping Lake Reservoir.

Long-term impacts would result from noise emissions under the new pump station option of the Lake Kachess inactive storage project. Pumping operations would be active primarily during the irrigation season (typically April through September) in drought years only. An enclosed pump station structure would contain up to six 200 cfs pumps and would be required to comply with WAC 173-60 at the nearest regulated land use.

5.14.2.4 Groundwater Storage Element

Groundwater storage projects could cause increased noise emissions from pumping equipment used to pump water used for infiltration by water users and groundwater during the irrigation season. Specifications for pumping equipment for use under this alternative have not been determined, but would be required to comply with WAC 173-60. Precise locations for pump facilities would be determined at a later date, but would likely be in rural areas with limited residential use. Long-term impacts are anticipated to be localized and minor provided the standards in WAC 173-60 are met. Pumps for municipal ASR projects would be enclosed in a structure and would have noise characteristics similar to other urban utility pump stations in the Yakima area.

5.14.2.5 Habitat/Watershed Protection and Enhancement Element

No long-term noise impacts are anticipated from habitat/watershed protection or enhancement projects because no noise would be generated after construction.

5.14.2.6 Enhanced Water Conservation Element

Long-term impacts would result from noise emissions associated with non-electric equipment, such as pump stations, used to facilitate specific water conservation projects. Facility equipment would be selected for use under this alternative at a later date on a project-by-project basis, and would be required to comply with WAC 173-60. Long-term impacts are anticipated to be localized and minor provided the standards in WAC 173-60 are met. The surrounding environment includes mechanized agricultural activity during seasons when pumping equipment would be used.

No long-term impacts are anticipated from the municipal and domestic conservation program.

5.14.2.7 Market Reallocation Element

No long-term noise impacts are anticipated from the transfer of water rights.

5.14.3 Integrated Water Resource Management Plan Alternative – Impacts of Integrated Plan

Long-term noise impacts associated with proposed elements of the Integrated Plan would result from the use of vehicles for trap-and-haul programs and from stationary equipment, such as pumps or compressors, used for moving water. WAC 173-60-050 exempts sounds created by traffic on public roads. Stationary equipment would need to meet the requirements of WAC 173-60 and would therefore not create noise impacts at the nearest adjacent properties. In some cases, equipment such as pumps may be audible in the vicinity of specific project sites and may change ambient noise levels, especially where isolated areas have low existing ambient levels.

5.14.4 Mitigation Measures

Facility equipment selected for use would be required to comply with WAC 173-60. Assuming that specifications for selected equipment allow the standards set forth in WAC 173-60 to be met, no additional mitigation would be required.

5.15 Recreation

5.15.1 No Action Alternative

The No Action Alternative would not result in long-term impacts on recreation in the Yakima River basin. This alternative includes storage modification, supplementation, and fish enhancement projects that would likely be implemented by other agencies and special interest groups. Recreational activities would be expected to continue as they are currently occurring. These projects could provide minor benefits to recreation by improving fishing opportunities. If the projects trigger NEPA or SEPA compliance, appropriate documentation of the recreational resource impacts would be the responsibility of the project proponent, separate from this EIS.

5.15.2 Integrated Water Resource Management Plan Alternative – Impacts of Individual Elements

5.15.2.1 Reservoir Fish Passage Element

In general, the goal of all projects proposed as part of the Fish Passage Element is to increase the amount of habitat available to fish species within the Yakima River basin by providing passage into areas currently blocked. This, in turn, could benefit recreational resources by increasing the number of areas available for fishing, as well as improving the amount of stock available within the basin. This would be a long-term beneficial impact.

5.15.2.2 Structural and Operational Changes Element

Although elevated water levels resulting from the Cle Elum Dam pool raise project would only occur 3 to 10 weeks out of the year, this is considered a long-term impact because it would reoccur from year to year for the foreseeable future. Recreational facilities on the east bank of the reservoir could be affected by the increased reservoir elevation. Higher reservoir levels could flood dispersed camping and fishing access areas. However, the increased inundation would be of limited duration and would occur in the spring when recreational use is lower. Therefore, no major impacts are anticipated.

Modification of the KRD and Wapatox irrigation facilities would be located in agricultural areas and not near any public facilities. The exception would be the new Manastash Creek pump station located along the Yakima River shoreline. The pump station would be visible to recreational users on the river; however, no major impacts on recreation are anticipated.

The Keechelus-to-Kachess pipeline and subordination of power at Roza Dam and Chandler powerplants are not expected to cause long-term impacts on recreation.

5.15.2.3 Surface Storage Element

The only recreation currently occurring at the Wymer Dam and reservoir site is hunting on private land. The reservoir would displace this activity, but is not expected to be a major impact on recreation because of the limited current use. No long-term impacts are expected to occur in the vicinity of the pump station on the Yakima River. Reclamation does not plan to provide recreation facilities at the completed Wymer Dam.

The proposed Bumping Lake Reservoir expansion would eliminate all of the current shoreline recreational facilities and restrict access to trails upstream of the dam. All of the lakeshore access and associated facilities (e.g., boat launches and parking), several developed and dispersed campsites, leased summer cabins, trails and trailheads, access roads, and other recreational facilities would be inundated by the expansion of the lake. This would be a significant adverse impact.

New recreational facilities would be constructed where possible, but it is unlikely that comparable replacement locations for the residences and the marina could be provided on Bumping Lake Reservoir, given the steepness of the topography on the north and the proximity of the William O. Douglas Wilderness. Replacing recreation facilities such as the campground and boat launch would cause additional impacts on forest habitat and plant and wildlife communities that could further adversely affect the listed and priority species and habitats known to occur in the vicinity.

The project would also eliminate approximately 11 miles of roads that provide access to recreational sites and facilities above Bumping Lake. Opportunities to construct new access roads to trailheads would be limited. Reduced access would complicate the USFS ability to provide fire protection in the affected area. Reclamation would coordinate with the USFS to determine appropriate mitigation for the impacts on recreation facilities.

The Kachess Reservoir inactive storage project would allow lower drawdown of Kachess Reservoir in drought years. This could affect recreational use, including fishing and boating. However, the reservoir is currently drawn down annually, and the additional drawdown would have little additional impact on recreation.

5.15.2.4 Groundwater Storage Element

No long-term impacts on recreation resources are expected as a result of groundwater storage because it is not anticipated that the groundwater facilities would be located in recreational use areas.

5.15.2.5 Habitat/Watershed Protection and Enhancement Element

Fish habitat enhancement projects would be designed to increase overall habitat area and fish survival rates within the affected reaches. This could be a long-term beneficial impact on recreational fishing opportunities.

Some of the proposed fish habitat enhancement projects would require the acquisition of land, or the placement of land in restrictive easements. This would not necessarily preclude the use of these lands for public access or recreational uses; however, the specific uses allowed within each area would be defined as conditions of project implementation.

The targeted watershed protection and enhancement program would acquire property for watershed and habitat protection and place that land in protective management. Specific properties have not been identified nor have specific management objectives or restrictions. Habitat protection could affect some current recreation uses of the lands. Specific management guidelines would be developed in coordination with local governments and interests including recreationists.

Recommendations for Wilderness Area and Wild and Scenic River designations would be implemented through processes separate from the Integrated Plan (Section 2.4.7.1). The proposals would undergo separate environmental analysis by the administering Federal agency (likely the USFS) to determine impacts on recreation and other environmental considerations. Because these designations include restrictions on uses of the areas, it is possible that recreational uses would be limited. For example, no motorized recreation or bicycles are permitted in Wilderness Areas, although hunting, fishing, and hiking are permitted. Management plans would be developed for any designated Wild and Scenic River area by the administering agency to determine appropriate uses of the river corridor. These could change how the land is managed along the river corridor. Those plans are often developed with input from local interests to determine appropriate uses, including recreational use.

5.15.2.6 Enhanced Water Conservation Element

The Enhanced Water Conservation Element is not expected to appreciably affect recreational opportunities because the facilities would be located away from recreational areas. Conservation may result in minor increases in streamflows in some reaches, but it is not expected to affect streamflows to the extent that boating or shoreline recreation would be impacted. Depending on the timing and volume of increased streamflows, they may improve the health of streams and riparian zones and provide increased opportunities for wildlife watching. Increased flows may also improve fish habitat and increase fishing opportunities. Municipal water conservation projects could benefit municipal recreation facilities, for example, by providing additional water for irrigating playfields.

5.15.2.7 Market Reallocation Element

Because the extent and location of water transfers is unknown, it is not possible to quantitatively evaluate changes in streamflows. However, water transfers are not expected to result in streamflow changes that would affect recreation.

5.15.3 Integrated Water Resource Management Plan Alternative – Impacts of Integrated Plan

Implementation of most of the projects and elements of the Integrated Plan would not result in long-term impacts on recreational resources. The exception is recreational facilities at Bumping Lake Reservoir, which would be significantly impacted. It is anticipated that some of the recreational facilities that would be eliminated could be replaced over time. However, it may not be possible to replace all impacted facilities at or near Bumping Lake Reservoir. Reclamation will coordinate with the USFS to determine appropriate mitigation for impacted recreational facilities.

Many of the proposed projects in the Integrated Plan would improve riparian and fish habitat. This would have a beneficial impact on recreation by improving fishing and wildlife viewing opportunities.

5.15.4 Mitigation Measures

Since most projects under the Integrated Plan would have no long-term impacts on recreation, no mitigation measures are required for those projects. Recreational facilities at Bumping Lake Reservoir would be relocated or replaced to the extent possible. Mitigation for impacts at Bumping Lake Reservoir, including for those facilities that could not be replaced, would be coordinated between Reclamation and the USFS.

5.16 Land and Shoreline Use

5.16.1 No Action Alternative

The No Action Alternative could result in long-term land use impacts in the Yakima River basin if projects require property acquisition. This alternative includes storage modification, supplementation, and fish enhancement projects that would be implemented by other agencies and entities. If the projects trigger NEPA or SEPA compliance, appropriate documentation of the long-term land use impacts of these projects would be the responsibility of the project proponent, separate from this EIS.

5.16.2 Integrated Water Resource Management Plan Alternative – Impacts of Individual Elements

5.16.2.1 Reservoir Fish Passage Element

All of the fish passage facilities at Cle Elum Dam would be constructed on Federal land, so there is no need to acquire property. Some vegetated riparian areas would be converted to fish collection facilities or other fish passage facility use. The area that would be converted is small and the uses are compatible with other uses of the dam. Because all land involved with the project is Federal, local zoning regulations do not apply; however, the project would be compatible with the existing land uses.

Because the Cle Elum River and Reservoir are regulated under the Shoreline Management Act (SMA), shoreline permits may be required from Kittitas County. While the construction of new fish passage facilities would require alteration of a small area of natural habitat, the benefits of providing additional fish habitat in Cle Elum Lake and the upstream segments of the Cle Elum River would be consistent with the intent of the shoreline master program (SMP) Conservancy designation.

For the reasons described above, the proposed fish passage facilities at Cle Elum Dam would not have significant long-term impacts on land use.

The fish passage facilities for Tieton, Keechelus, Kachess, and Clear Lake Dams have not yet been designed. However, it is not expected that land acquisition would be necessary for any of them. Long-term impacts on land use from these fish passage projects are expected to be similar to those for Cle Elum Dam.

Because fish passage is included in the enlarged Bumping Lake Reservoir project, those potential land use impacts are described in the Surface Storage Element section below.

5.16.2.2 Structural and Operational Changes Element

The Cle Elum Dam pool raise project would require an approximately 300-foot strip of land surrounding the entire reservoir to be available for the 3-foot rise in water level and for shoreline protection measures. Much of the land surrounding the reservoir is owned by the Okanogan-Wenatchee National Forest where property acquisition would not be required. Reclamation would coordinate the project with the USFS to determine what permits or actions are required for temporarily inundating the shoreline. There is additional privately-owned land that would need to be acquired fee simple or by easement. Property or easement acquisition would be conducted on a case-by-case basis, with negotiations occurring between Reclamation and the individual property owners according to Federal or State law.

The property required for acquisition or easement is within Kittitas County's shoreline jurisdiction. In addition, Cle Elum Reservoir is a Shoreline of Statewide Significance under the State of Washington's Shoreline Management Act (RCSW 90.58.030(2)(e). The Shoreline Management Act determined that the interest of all people of the state should be considered in the management of Shorelines of Statewide Significance. In these designations, specific priority uses are preferred.. Any potential change in land use resulting from property acquisition or encumbrance by an easement would not be considered significant because it does not substantially alter the nature of existing land use around the reservoir.

The KRD and Wapatox Canal modifications projects have not yet been designed. However, the canal modification would not constitute a change in land use from existing conditions. No long-term impacts on land use are expected to result from these projects.

Property acquisition and permanent or temporary easements would be required for the Keechelus-to-Kachess pipeline. Preliminary estimates conducted as part of the Integrated Plan recommended a 50-foot permanent easement and a 100-foot temporary construction easement in open areas, and a 25-foot temporary easement on each side of the road and no permanent easements where parcels run parallel to Kachess Lake Road (Reclamation and Ecology, 2011g). Easement acquisition would be conducted on a case-by-case basis, with negotiations occurring according to Federal or State law. Because the area is not currently developed, the acquisition of easements and construction of the pipeline would not constitute a significant impact on land use.

No long-term impacts on land use are expected to result from projects that would only change the flows to the powerplants.

5.16.2.3 Surface Storage Element

The Wymer Dam project would require the acquisition of approximately 4,000 acres of private land, with negotiations occurring between Reclamation and the individual property owners. The pump station would affect the Yakima River which is a Shoreline of Statewide Significance. Reclamation would comply with all applicable existing and future regulatory requirements for the property acquisition and shoreline use.

This project would entail a change in land use from open habitat and rangeland to water storage and associated infrastructure. The area that would be converted constitutes approximately 14 percent of the area zoned as Forest and Rangeland in Kittitas County. This conversion of land would be a potentially significant impact on land use. However, in addition to Forest and Rangeland, there are currently almost 500,000 acres of land zoned for other agricultural uses in Kittitas County (Kittitas County, 2010). Land use trends in the Yakima River Canyon have been toward recreation and residential uses in recent years.

It is estimated that the enlarged Bumping Lake Reservoir would inundate up to 4,120 acres of land, of which 1,300 acres are in the existing reservoir. The reservoir would extend approximately 5 miles upstream from the new dam and create a total of 14 miles of shoreline (Reclamation and Ecology, 2011b). The area needed for reservoir expansion has been reserved for Reclamation for the purpose of expanding the reservoir; therefore, no property would have to be acquired. Reclamation would comply with all applicable existing and future regulatory requirements for locating the reservoir.

Although the change in land use may be evident in most areas around the lake after completion of the project, it would conform to the designations and uses of Yakima County and the USFS. Therefore, no long-term land use impacts would be expected from the Bumping Lake enlargement project.

The Kachess Reservoir inactive storage project would require property and easement acquisition. Preliminary estimates for the Integrated Plan recommended a 50-foot permanent easement and a 100-foot temporary construction easement on parcels where the pipeline or tunnel would cross open space. The conceptual alignment for the pipeline and pump station would require easements from private landowners and coordination with the Okanogan-Wenatchee National Forest (Reclamation and Ecology, 2011i). Long-term impacts from this project would be similar to those described for the Kachess to Keechelus pipeline project, except the permanent change in land use may be slightly greater in magnitude due to the greater amount of development in this area.

5.16.2.4 Groundwater Storage Element

The specific areas proposed for shallow aquifer recharge have not yet been selected. As such, the potential long-term impacts on existing land uses cannot be determined at this time. The projects would require land for infiltration. The land or easements would be purchased from willing sellers or obtained through acquisition following applicable State and Federal regulations. Long-term impacts on land use would not be expected from the pilot study projects which would require less than 5 acres for infiltration areas. If the project proves feasible and is implemented on a larger scale, additional land would be required. The larger project could cause long-term land use impacts, but the impacts would be minor since the land would represent a small fraction of agricultural land in the Yakima basin and would not cause a change in land use from agriculture.

Impacts for ASR projects would be similar to those for shallow aquifer recharge except on a smaller scale. Most ASR projects would use existing city facilities to the extent possible, thus minimizing the need for property acquisition.

5.16.2.5 Habitat/Watershed Protection and Enhancement Element

The targeted watershed enhancement program would require the acquisition of property. The agencies sponsoring the individual enhancement projects could also work with property owners to place all or portions of their property in conservation easements. The land would be purchased on a case-by-case basis from willing sellers or obtained through acquisition following applicable State and Federal regulations.

Both acquisition and placement of property in easements would likely constitute a change in land use. It is anticipated that land would be taken out of current uses, which in most cases would be logging, and placed into designations that would be more restrictive on property use. These changes in land use, although not specifically known at this time, could constitute a substantial impact.

This program also recommends Wilderness and Wild and Scenic River designations. Those designations could result in restrictions on activities such as logging and development. Recommendations for Wilderness Area and Wild and Scenic River designations would be implemented through processes separate from the Integrated Plan. The proposals would undergo separate environmental analysis by the administering Federal agency (likely the USFS) to determine impacts on recreation and other environmental considerations. Management plans would be developed for any designated Wild and Scenic River area by the administering agency to determine appropriate uses of the river corridor. Those plans are often developed with input from local interests to determine appropriate uses, including recreational use.

Habitat enhancement projects would be located on property owned by willing participants to the extent possible; however, some property acquisition or easements may be required. The enhancement projects are expected to be compatible with existing land uses.

5.16.2.6 Enhanced Water Conservation Element

Although conservation may allow the irrigation of additional lands, those lands are expected to be in areas that are zoned agricultural. Some existing irrigation facilities may be demolished and replaced. By increasing the reliability of irrigation supplies, it is expected that enhanced water conservation would improve the viability of existing agricultural operations and reduce the potential conversion of agricultural land to other uses.

Some new or replaced irrigation facilities such as intakes and conveyance infrastructure may be located within shoreline areas and could require shoreline permits from counties or cities. The long-term impacts are not anticipated to be substantial.

No long-term land use impacts are anticipated from the municipal and domestic conservation program.

5.16.2.7 Market Reallocation Element

In the long term, transfers of water rights may result in changes in land use, both in the areas where the water rights originated and in the recipient areas. These transfers may influence development in urban and rural areas and contribute to the conversion of farm uses to urban or domestic uses. Transfers of water from agricultural lands may increase fallow lands that otherwise would have supported irrigated crops and accelerate their conversion to more developed uses. On the other hand, transfers that improve the reliability of an irrigation water supply may help keep some properties in agricultural use that otherwise would be converted to other uses. Transferred water rights may be used to irrigate different areas and expand agricultural land uses. This expansion is expected to occur in areas already designated for agricultural use.

5.16.3 Integrated Water Resource Management Plan Alternative – Impacts of Integrated Elements

Implementation of the elements under the Integrated Plan Alternative would result in long-term impacts on land use in some cases. However, the integrated projects are not expected to have disproportionately larger land use impacts than the individual projects described above.

5.16.4 Mitigation Measures

If individual projects that require the acquisition of land or easements are advanced for implementation, appropriate compensation would be required in accordance with applicable State or Federal regulations.

5.17 Utilities

Long-term impacts on utilities were determined by estimating the amount of power or other utilities that would be required by a project once it is in operation and comparing the amount to overall power demand in the basin. Impacts are considered minor if the increased demand would not affect regional supplies.

5.17.1 No Action Alternative

The No Action Alternative includes conservation-oriented water supply system improvements, including pumping plants and pipelines, at various locations in the Yakima Valley region (Kittitas, Yakima, and Benton Counties). These improvements are associated with existing approved programs and orient predominantly to existing facilities; none are being or would be constructed under the auspices of the Integrated Plan. To the extent that NEPA or SEPA analysis would be required for these actions, appropriate documentation of the directly affected utilities would be the responsibility of the project proponent, separate from this EIS.

5.17.2 Integrated Water Resource Management Plan Alternative – Impacts of Individual Elements

5.17.2.1 Reservoir Fish Passage Element

Electricity would need to be provided on the right side of the Cle Elum dam for the fish ladder and adult collection facilities. Power poles would most likely be used to supply electricity to these two structures. Power would be provided to the intake structure via a buried cable. The minor increased demand for power would not affect regional power supplies. No other increases in utilities would be required.

Impacts of installing fish passage facilities at the other dams are anticipated to be similar to those described for the Cle Elum Dam. Since Bumping Lake fish passage facilities would be installed as part of the reservoir enlargement project, those impacts are described in the Surface Storage Element below.

5.17.2.2 Structural and Operational Changes Element

Operation of the Cle Elum Dam after modifications would not require an increase in electricity or other utilities.

Power would need to be provided to new pump stations for the KRD and Wapatox projects. The minor increased demand for power would not affect regional power supplies.

The Keechelus-to-Kachess pipeline would require power for new elements, including self-cleaning fish screens, motor-operated butterfly control valves, and metering and controls. The pipeline would be gravity operated and no power would be needed to pump water through the pipeline. The increased power demand is expected to be minor and is not expected to affect regional power supplies.

The reduction in regional power supplies caused by subordinating power at Roza Dam and Chandler powerplants could be substantial and is covered in Section 5.6, Hydropower.

5.17.2.3 Surface Storage Element

Development of the Wymer Dam and Reservoir would result in a long-term increase in demand for electrical power, associated with the pumping plant and other intake/outlet facilities along the Yakima River. Power supply to these facilities, including the pump station, is expected to be drawn directly from an existing BPA transmission line. No constraint on the availability of necessary power has been recognized to date (Reclamation, 2008g).

Other perspectives on long-term utility service demand at or from Wymer facilities include the following:

- Telecommunication system connections would be required at facility sites. Where land-line connections are not readily available, wireless systems could be used.
- Water supply and wastewater management would be via independent, onsite systems (e.g., water supply wells, septic tank/leach field, or other independent wastewater management system).
- If gas energy is needed, onsite systems (i.e., propane) would be used (Reclamation, 2008g).

Impacts on utilities at Bumping Lake Reservoir would be similar to those described for Wymer Dam, except no power would be required for pumping water to fill the reservoir. Additionally, if utilities are inundated by the expanded reservoir, they would be relocated in coordination with local utility companies and the USFS.

Under the Kachess Reservoir inactive storage project option that includes a pump station, increased electrical power would be required, but the increase would be minor and would not affect regional power supplies.

5.17.2.4 Groundwater Storage Element

Additional power would be required for pumping, injection, and treatment, but this minor increase would not affect regional power supplies. Groundwater storage may provide a source of water to increase the reliability of public water supplies.

5.17.2.5 Habitat/Watershed Protection and Enhancement Element

No impacts on utilities are anticipated from projects to protect and enhance habitat.

5.17.2.6 Enhanced Water Conservation Element

Conservation measures could reduce energy consumption in some areas over time by reducing the volume of water that needs to be pumped to irrigate a given area. However, some of the conservation measures entail construction of new pumping plants to allow water to remain instream in the Yakima River. Those plants would increase the overall amount of energy consumed.

On-farm conservation measures would have minimal impacts on utilities. Some measures, such as conversion to sprinkler irrigation or automated systems, may consume additional electricity. Conservation measures, such as more efficient irrigation application rates that result in less return flow, could reduce water reaching lakes and rivers as return flow, which could affect other water users' ability to provide adequate water.

The municipal and domestic conservation program could require additional investments by local utilities and increased rates in the short term. However, over the long term, conservation programs could reduce costs of providing municipal water as the cost of new water supplies increases. Enhanced water conservation may improve the reliability of public water supplies.

5.17.2.7 Market Reallocation Element

Transfers from irrigation uses to domestic uses may cause increased demands for municipal services if development increases. Water right transfers may create a source to improve the reliability of public and domestic water supplies.

5.17.3 Integrated Water Resource Management Plan Alternative – Impacts of Integrated Plan

Though many elements of the Integrated Plan would cause an increased demand in electricity, only power subordination at the Roza and Chandler Powerplants would cause a substantial impact on the supply of electric power. If subordination of power were to be implemented as part of the Integrated Plan, the increase in demand for electricity would add to the deficit caused by power subordination and potentially increase electrical costs to the irrigation districts and the Reclamation Project office. Other utilities would not be impacted by the Integrated Plan.

5.17.4 Mitigation Measures

Several elements of the Integrated Plan, including the Wymer Reservoir, the Keechelus-to-Kachess pipeline, Lake Kachess inactive storage, and the enlargement of Bumping Lake Reservoir, would have the potential for added hydropower in the future which could offset the reduction in electric power. Mitigation measures for impacts from power subordination are covered in Section 5.6.4.

5.18 Transportation

Long-term effects of the No Action and Integrated Water Resource Management Plan Alternatives on transportation were determined by assessing long-term operations of proposed project elements. Long-term operations would involve trips to facilities for routine maintenance and operations.

5.18.1 No Action Alternative

The No Action Alternative would not change roads or highways or affect their use. The No Action Alternative would have no long-term impacts on transportation.

5.18.2 Integrated Water Resource Management Plan Alternative – Impacts of Individual Elements

5.18.2.1 Reservoir Fish Passage Element

The operational requirements of some fish passage projects would require infrequent trips by maintenance vehicles and would have no impact on transportation systems. Adult fish would be hauled past dams in trucks on service roads. The hauling operations would last a few weeks each year and would not prevent use of the same roads by other users.

5.18.2.2 Structural and Operational Changes Element

No long-term impacts on transportation are anticipated from proposed structural modifications. The operational requirements of some canal, pipe, or pump station projects would require infrequent trips by maintenance vehicles and would have no impact on transportation systems.

5.18.2.3 Surface Storage Element

No long-term impacts on transportation are anticipated from the proposed Wymer Dam and Kachess Reservoir inactive storage projects. The operational requirements of new storage projects would require regular trips by a small number of maintenance vehicles and would have no appreciable impact on transportation systems. New access roads may be developed at new storage facilities. Those roads would be maintained by Reclamation and would not affect the surrounding roads.

The proposed Bumping Lake Reservoir expansion would have a major, long-term adverse effect on the local road system around the lake. Enlarging the reservoir would eliminate some lakeshore access and associated facilities (e.g., boat launches and parking), and access roads that provide access to recreational sites and facilities. Access roads that would be inundated include Forest Roads 1800 (from a location south of the Bumping Crossing Campground), 1808, 1809, and 1810. These roads provide access to several trailheads and recreational sites. Expansion of Bumping Lake would limit the ability of the U.S. Forest Service to construct new access roads to trailheads that access the William O. Douglas Wilderness. These long-term impacts would be unavoidable due to the raised water levels in the lake. As mitigation, Reclamation would work with the USFS to identify potential reconstruction options for affected Forest Roads.

5.18.2.4 Groundwater Storage Element

No long-term impacts on transportation are anticipated from the Groundwater Storage Element. The infiltration and injection facilities would require only infrequent trips by maintenance vehicles.

5.18.2.5 Habitat/Watershed Protection and Enhancement Element

No long-term impacts on transportation are anticipated. The operational requirements of some fish habitat enhancement projects may require infrequent trips by maintenance vehicles and would have no impact on transportation systems.

5.18.2.6 Enhanced Water Conservation Element

No long-term impacts on transportation are anticipated. Operation of conservation projects would require only infrequent trips by maintenance vehicles and would have no impact on transportation systems.

5.18.2.7 Market Reallocation Element

The Market Reallocation Element is not expected to affect transportation.

5.18.3 Integrated Water Resource Management Plan Alternative – Impacts of Integrated Plan

No long-term impacts on transportation are anticipated beyond those that would occur if the elements were implemented individually.

5.18.4 Mitigation Measures

For most alternatives there would be no long-term impacts on transportation, and therefore no mitigation would be necessary. Reclamation would coordinate with the USFS to determine appropriate mitigation for Forest Roads inundated by the expanded Bumping Lake Reservoir.

5.19 Cultural Resources

Long-term impacts on belowground cultural resources were considered based on the level of ground disturbance anticipated and knowledge about general patterns of Native American and Euro-American land use throughout time. Long-term impacts on aboveground cultural resources were considered based on the level of disturbance to the setting and knowledge about general patterns of land use throughout history. Because the exact locations of many elements are not known, specific impacts are not yet identified. The significance of the impacts is based on the criteria for inclusion on National, State, or local historic registers.

5.19.1 No Action Alternative

Under the No Action Alternative many water supply and habitat enhancement projects would be independently undertaken. Long-term impacts on cultural resources under the No Action Alternative would be similar to those described in Section 5.19.2 for the Integrated Plan. Projects undertaken by other agencies would include separate NEPA or SEPA analysis, as appropriate, and would comply with Federal and State regulations that consider impacts on historic and cultural resources. The net impact on cultural resources is expected to be lower under the No Action Alternative because fewer large-scale projects are likely to be constructed.

5.19.2 Integrated Water Resource Management Plan Alternative – Impacts of Individual Elements

Many of the impacts on cultural resources would occur during ground disturbing activities related to construction. Although these impacts are construction related they would be permanent, and therefore they are considered long-term impacts. Construction impacts would include access and staging areas as well as any offsite mitigation areas. Upgrades to existing historic infrastructure would also have a long-term impact, although replacement of materials with like materials could minimize this impact. Other long-term impacts on buried cultural resources would largely be related to operation of new or altered facilities or changed water drainage patterns (such as meandering channels, or increased/decreased flow). The main long-term impact for most elements would be erosion of cultural deposits.

For most elements of the Integrated Plan, additional cultural resources studies would be required during site selection. These efforts would include consultation with Tribes and other concerned stakeholders, background research, field survey, and potentially more in depth investigation of specific cultural resources. This level of effort would potentially require substantial time and coordination, particularly if significant cultural resources are identified.

5.19.2.1 Reservoir Fish Passage Element

Projects undertaken as part of the Fish Passage Element have the potential to cause long-term impacts on cultural resources located within the footprint of any new ground-disturbing construction activities, including but not limited to: modification of historic dams and their appurtenances, access roads, and staging areas. Other potential disturbance of archaeological deposits could occur around the dam and in downstream areas where fish collection facilities are constructed.

Operational long-term impacts would likely include increased erosion of cultural deposits, inundation, chemical weathering, and vandalism or artifact collecting of cultural resources in reservoirs. Depending on the area and the potential for avoidance, the impacts could be substantive. All of the dams proposed for fish passage facilities are historic structures. The fish passage facilities could detract from the historic appearance of the dams; however, the dams have all undergone other modifications since construction.

It is anticipated that long-term impacts would be similar for all the dams, although those at Clear Lake Dam would be smaller because of the smaller scale of the project. Installation of the fish passage facilities at Bumping Lake Dam would be included in the enlargement of Bumping Lake Reservoir. Impacts are described in the Surface Storage Element below.

5.19.2.2 Structural and Operational Changes Element

The Structural and Operational Changes Element has the potential to cause long-term impacts on cultural resources located within the footprint of any new ground-disturbing construction activities, including but not limited to: modification of historic dams and their appurtenances, conveyance, access roads, staging areas, vegetation removal, canal improvements, and pipelines. Long-term impacts could include erosion, inundation, chemical weathering, and vandalism or artifact collecting of cultural resources in reservoirs. Also, increased inundation could change access and availability of traditional plant resources at Traditional Cultural Properties (TCPs) if present. Depending on the area and the potential for avoidance, the impacts could be substantive.

Long-term construction impacts on cultural resources for the Cle Elum Dam pool raise project could include modification of the historic Cle Elum Dam, ground disturbance associated with removing vegetation, and erosion or flooding impacts on historic structures behind the storage pool. Long-term impacts could include erosion, inundation, chemical weathering, and vandalism or artifact collecting of cultural resources in reservoirs. Also, increased inundation could change access and availability of traditional plant resources at TCPs.

Long-term construction impacts on cultural resources from the canal modifications in the KRD and Wapatox projects could include modification of historic infrastructure or disturbances to archaeological deposits adjacent to canals, in areas of new construction, or stockpile and staging areas. Long-term operational impacts could occur related to maintenance access and changes to access and availability of traditional plant resources at TCPs.

Long-term construction impacts on cultural resources could include disturbances to the historic Keechelus Dam and buried and aboveground cultural resources along the 5-mile-long pipeline alignment from the northwest shore of the Keechelus Dam outlet to Kachess Reservoir including in stockpile and staging areas. Long-term operational impacts may occur related to maintenance access and changes to access and availability of traditional resources at TCPs.

No long-term impacts are expected for the power subordination projects because no construction would be involved.

5.19.2.3 Surface Water Storage Element

New or expanded storage facilities could adversely impact cultural resources over the long term. Long-term construction impacts would be possible with any ground disturbing activity, including removal of vegetation prior to inundation, earthmoving, and use of heavy equipment, as well as in staging areas and construction access areas. Other impacts would include removal of historic structures prior to inundation. Within the reservoirs themselves, impacts on cultural resources could include destruction or damage of archaeological sites, historic structures, or TCPs located in three zones of impact: the inundation zone, the direct impact (fluctuation or drawdown) zone, and the indirect impact (backshore) zone.

Archaeological sites in reservoir settings can be damaged or destroyed through erosion, inundation, chemical weathering, vandalism or artifact collecting, and land development. These impacts often occur in combination. Of these, erosion by wind and water is the most predominant impact (Lenihan et al., 1981). Erosion impacts vary based on the site type, land form, severity of wind and water action, soil structure, and type of cultural resource. Depending on the fluctuation zone of the reservoir (the area between normal high and low water levels), the frequency of fluctuation, and the angle of the landform slope, sites can slump, be washed out, or suffer bank calving. Inundation impacts cultural sites by making them inaccessible. The site may become covered with sediment, although there is some speculation that the sedimentation provides protection to the site. Artifacts and features may be damaged by long-term inundation due to changes in the chemical composition of the surrounding geologic matrix. The impacts of sedimentation on fragile archaeological deposits have not been well studied.

Chemical weathering impacts on archaeological sites could include damage to organic remains through repeated wetting and drying of archaeological deposits, leading to a loss of scientific potential of sites along reservoir boundaries. This impact is often linked to irrigation-related reservoirs (Galm and Masten, 1988).

Vandalism and artifact collecting could be expected, especially if a new reservoir provides recreational areas. Vandalism includes a range of activities from intentional looting of sites, to off-road vehicle use in culturally sensitive areas, to extended recreational use that destabilizes soils. With increased boat use, more sites could be accessible and become vulnerable to vandalism. Increased boat use is also likely to increase erosion due to wake action. Rock art is often the target of graffiti. Site erosion often makes sites more susceptible to vandalism by increasing site exposure.

In general, any historic-age structures in the inundation and fluctuation zones of surface water projects would likely be removed prior to inundation; further efforts are needed to identify and evaluate the significance of any historic-age structures. Historic structures in the backshore zone could have increased access, which often leads to increased vandalism. The increased proximity of water may adversely impact the significance of the historic structure by altering the integrity of its setting.

If present, TCPs in the inundation zone would become permanently inaccessible. TCPs in the fluctuation zone would likely be so altered that even when exposed, they would lose their characteristics (such as isolation or resource availability), which provide their integrity of setting, feeling, or association. TCPs in the backshore zone may suffer adverse effects due to alteration of the integrity of setting, feeling, or association as well.

Long-term construction impacts on cultural resources at the Wymer Dam site could include disturbances to buried cultural resources and removal of historic structures related to preparing the reservoir as well as in areas used for construction staging and access. Long-term operational impacts on cultural resources could include erosion, inundation, chemical weathering, and vandalism/artifact collecting of cultural resources in the reservoir. These impacts have the potential to be substantive. Enlargement of Bumping Lake Reservoir would cause similar impacts. In addition, the leased recreational cabins which are considered eligible to the National Register of Historic Places would be demolished or relocated. Decreased access to areas upstream from the reservoir could reduce access to TCPs, if present.

Long-term impacts on cultural resources within the reservoir at the Kachess inactive storage project would be similar to current conditions although the increased drawdown of the reservoir would potentially expose more cultural resources (approximately 180 additional acres could potentially be exposed during an additional 80-foot drawdown). Construction of the outlet outside the reservoir has the potential to disturb cultural resources, if present.

5.19.2.4 Groundwater Storage Element

The Groundwater Storage Element has the potential to impact cultural resource properties located within the footprint of any new ground-disturbing construction activities, including but not limited to: surface infiltration reservoirs, subsurface injection sites, water treatment sites, conveyance lines, access roads, electrical transmission corridors, and staging areas. Groundwater storage infrastructure would likely be located away from significant streams and rivers that are typically associated with cultural resources. Only intake facilities are proposed at rivers. If alternative site locations are feasible, then complete avoidance of significant cultural resources may be possible.

Long-term operational impacts could adversely modify traditional cultural landscapes. This could have a negative impact on the integrity of setting and feeling of nearby archaeological sites and could also interfere with TCPs. Overall, the impact on cultural resources from the Groundwater Storage Element is expected to be low to moderate. Long-term operational impacts on cultural resources could include erosion, inundation, chemical weathering, and vandalism or artifact collecting of cultural resources in infiltration areas. These impacts have the potential to be substantive if infiltration areas cannot be located to avoid cultural resources.

5.19.2.5 Habitat/Watershed Protection and Enhancement Element

Long-term construction impacts on cultural resources from habitat enhancement projects could include disturbances to buried cultural resources in areas along the Yakima River as well as in areas used for construction staging and access. Long-term operational impacts on cultural resources could include erosion due to channel migration and vandalism or artifact collecting of cultural resources due to increased recreational access. These impacts have the potential to be substantive because the restoration projects are anticipated to be located in areas with a high likelihood for significant Native American cultural resources. Tributary enhancement locations would be expected to have less likelihood of significant cultural resources.

Acquisition and protection of properties would not cause adverse impacts on cultural resources and could protect such resources from disturbance.

5.19.2.6 Enhanced Water Conservation Element

Any on-farm conservation which involves ground disturbing activities has the potential to impact cultural resources. These include any new construction, such as ponds and conveyance lines. Overall, the impact on cultural resources from enhanced water conservation efforts is expected to be low to moderate, depending on the scale of the conservation measures.

Improvements to agricultural infrastructure have the potential to impact cultural resources in two ways. The first potential impact involves the replacement or modification of historic farm infrastructure, that is, any building or modified landscape greater than 50 years old. Disturbed or modified farm infrastructure would have to be evaluated as to its age and potential historical significance depending on State or Federal involvement. For example, projects on private property supported by grants from the Natural Resources Conservation Service, Reclamation, or local reclamation districts would be subject to the National Historic Preservation Act and would likely require at least archival review of the project for cultural resources and probably fieldwork as well.

Secondly, any new construction associated with this alternative has the potential to impact both aboveground and underground cultural resources located within their footprint. Large changes to existing farm infrastructure would have the potential impact of diminishing the integrity of setting and location for historic age cultural resources in the vicinity.

The long-term operational impacts of the Enhanced Water Conservation Element could include modified patterns of modern human activity, and potentially altered stream or spring flows. If modern patterns of human activity are substantially changed, then surficial cultural resources within these areas are prone to impact from relic collecting and site disturbance.

No impacts on cultural resources are anticipated through the municipal and domestic conservation program.

5.19.2.7 Market Reallocation Element

By transferring water from lower value to higher value uses, this alternative may result in more intensive agricultural activity in some areas. There also may be increased pressure to transfer water to higher value residential or commercial uses. All land use changes would take place consistent with adopted land use plans and zoning codes. Any shift to a more intense activity that would result in excavation would be subject to site-specific evaluations to determine the potential to affect cultural resources.

5.19.3 Integrated Water Resource Management Plan Alternative – Impacts of Integrated Plan

Long-term impacts of integrating the elements of the alternative are not expected to differ from implementing the elements individually. Projects that are implemented as part of a coordinated process might require more scrutiny of cultural resources because of State or Federal funding.

5.19.4 Mitigation Measures

As a Federal agency, Reclamation would be required to develop mitigation measures for cultural resources in consultation with the SHPO, ACHP, Native American Tribes, other Federal agencies, and public entities on historic properties that are eligible for the NRHP. In order to determine if historic properties are present in the project areas, additional cultural resources review including field investigations would be required once specific locations for project elements are identified. These inventory investigations would determine if any archaeological sites, historic structures, or TCPs would be affected. Once the inventory and evaluation was complete then mitigation measures could be determined.

The first level of mitigation is designing the project to avoid or minimize impacts on cultural resources. If a project cannot avoid or minimize impacts, the mitigation of adverse effects would be in accordance with regulations. Existing reservoirs within the region have ongoing programs for the life of the project to ensure that operational changes, continuing erosion, and new project elements address cultural resources issues. Similar programs should be established at new or expanded reservoirs.

Specific mitigation measures that could be implemented include archaeological remote sensing during planning to allow avoidance; excavation of archaeological sites that would be adversely affected by the projects; documentation of historic structures; site protection/stabilization, including site burial, use of filter fabrics, revegetation, site armoring, and other measures; efforts to reduce vandalism through public education, fencing, or site surveillance; and archaeological monitoring during construction (Draper, 1992; Lenihan et al., 1981). Construction contracts would require that if any archaeological material is encountered during construction, construction activities in the immediate vicinity would halt and the Department of Archaeology and Historic Preservation, Reclamation, and a professional archaeologist would be contacted for further assessment prior to resuming construction activity in that area.

Mitigation measures for TCPs would need to be determined in consultation with the appropriate cultural group. Because TCPs contribute to the maintenance of a culture, mitigation efforts may include documentation of the significance of the place through oral histories or recording traditional storytellers. It is not always possible to come to agreement with the appropriate cultural group on how to mitigate adverse effects to TCPs.

Specific mitigation measures cannot be developed and implemented until after a preferred alternative has been selected, and in-depth survey has been conducted and reported. The survey for any of the Integrated Plan projects can reasonably be estimated to take at least one year. If any significant cultural resources are identified and cannot be avoided, Section 106 of the National Historic Preservation Act requires a resolution of adverse effect. Mitigation of historic resources might include data recovery or archeological excavation, preservation, conservation, and interpretation of significant historic properties.

A typical scenario for mitigation of a group of historic resources to meet the requirements of Section 106 of the NHPA would be as follows:

- Identify the significant historic properties that cannot be avoided during project construction and development.
- Consult with the State Historic Preservation Office (SHPO), the Advisory Council on Historic Preservation (ACHP), Native American Tribes, other Federal agencies, and public entities on historic properties that are eligible for the National Register of Historic Places.
- Depending on the number and range of historic properties to be treated through mitigation, develop either a Programmatic Memorandum of Agreement (PMOA) or Memorandum of Agreement (MOA) among Reclamation, SHPO, and ACHP over mitigation measures. PMOA or MOA signatories may also include Tribes, other Federal agencies, and public entities.
- The MOA for an archaeological site would include a research and data recovery plan, stipulations for permanent storage and curation of recovered material, and provisions for sharing the results of the data recovery phase with the public (e.g., interpretive facilities). An MOA could also include plans to document historic

structures or conduct ethnographic research. The goal is to identify and implement a range of measures to record and preserve, in some manner, the record of historic resources affected by the project. Mitigation of historic properties can involve data recovery, large-scale archeological excavations, a program of monitoring of project effects, development of interpretive facilities and public educational opportunities, or a mix of those measures.

- The MOA may also include development of treatment plans in which goals for long-term historic properties management and monitoring are identified.
- The period for developing, implementing, and completing mitigation measures could take an estimated five years for any of the Integrated Plan elements. However, certain activities could last for many years, if not decades, beyond completion of the alternative. Museum storage and curation costs, monitoring activities, and management of historic resources in the development footprint not impacted directly by project construction are examples of some common, long-term activities which have attendant costs.
- The MOA may also include provisions for long-term management and protection of cultural resources that remain under Federal control, such as through the development of a cultural resources management plan (CRMP).

5.20 Indian Sacred Sites

Because details of specific Integrated Plan projects have not yet been identified, Reclamation has not begun consultation with the Yakama Nation to identify Indian Sacred Sites. Reclamation will consult with the Yakama Nation and the Bureau of Indian Affairs to determine the presence of sacred sites as part of project-level environmental review when specific projects are carried forward to implementation. The process for consultation is described in Chapter 6. Long-term impacts to sacred sites are expected to be those in which access to sacred sites, if they are extant, is being permanently denied to Tribal members because of construction or inundation impacts, or because of land-use restrictions.

5.21 Indian Trust Assets

Because details of specific projects have not yet been identified, Reclamation has not begun consultation with affected Tribes to identify Indian Trust Assets. Reclamation would consult with affected Tribes and the Bureau of Indian Affairs to determine the presence of Indian Trust Assets as part of project-level environmental review when specific projects are carried forward to implementation. The process for consultation is described in Chapter 6.

5.22 Socioeconomics

The assessment of long-term socioeconomic impacts and mitigation measures considers potential effects on the supply and value of goods and services derived from the basin's water and related resources, resource-related jobs and incomes, resource-related uncertainty and risk, the distribution of resource-related costs and benefits, and the structure of the economy associated with operation of the Integrated Plan facilities. This assessment examines the Integrated Plan from a programmatic perspective. As the implementing agencies propose specific projects, they will complete a detailed determination of the potential socioeconomic effects, including the assessments required by the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (U.S. Water Resources Council, 1983).

5.22.1 No Action Alternative

Under this alternative, the current patterns and trends in the relationship between the basin's natural resources and the state's economy would likely continue into the foreseeable future. Over a long period of time, the socioeconomic characteristics of the basin's water and related resources, and their interaction with the regional and statewide economies, would reflect future changes in the ecosystem and the economy, such as changes in climate and the ecosystem's responses to the changes, increases in human population and wealth, and adjustments in the demands for water-related goods and services arising from shifts in consumers' preferences.

5.22.1.1 Value of Goods and Services

Section 3.22.1 describes the goods and services potentially affected under the No Action Alternative. Changes in the value of goods and services likely would occur in accordance with ongoing and expected trends.

5.22.1.2 Jobs and Incomes

The future supply of water and related resources under the No Action Alternative would likely influence future levels of jobs and incomes via the three mechanisms identified in Section 3.22.2. Current trends in jobs and incomes related to the basin's water and related resources likely would continue. In the next decade, nonagricultural employment in Washington is projected to increase at a rate of 1.6 percent annually (Office of Financial Management, 2011), while agricultural employment is expected to increase at a 0.6 annual rate for the same time period (Washington Employment Security Department, 2011a). Jobs and incomes related to municipal/industrial uses of water and related resources as well as those related to water recreation would likely grow, roughly parallel to population and overall economic growth.

5.22.1.3 Uncertainty and Risk

Risk and uncertainty associated with the basin's water and related resources would likely worsen over the long term under the No Action Alternative. The risk of financial losses associated with potential shortfalls in the supply of water for irrigated agriculture would likely increase, as anticipated changes in climate increase the likelihood of low streamflows in late summer (Scott et al., 2007). Expected changes in climate could also increase the risk of winter and spring flooding, heat waves, and diminished fish habitat (Casola et al., 2005). Reductions in the quality of fish habitat could impose tighter restrictions on commercial and recreational fishing and increase the risk of extirpation for some species whose continued existence is valued by many.

Under the No Action Alternative there might also be increased risk and uncertainty associated with potential future conflict over water and related resources. Reductions in fish habitat and in populations of salmon and steelhead, for example, might lead to increased pressure to restrict withdrawals of water for irrigation and to restrict land and water uses likely to have an adverse impact on habitat.

5.22.1.4 Distribution of Costs and Benefits

Both the benefits and costs derived from the basin's water and related resources likely would increase in the long term under the No Action Alternative, but the overall distribution of water-related costs and benefits under the No Action Alternative likely would remain similar to what exists today. Groups currently enjoying benefits and experiencing costs likely would remain more or less unchanged.

5.22.1.5 Socioeconomic Structure

In many respects, the future structure of the regional, state, and national economies would likely resemble what exists currently. The basin likely would continue to produce commercial products, especially crops, derived from its water and related resources. These resources would also likely contribute to the economy by providing amenities that attract households and businesses, and by providing environmental services, such as natural filtration that lessens the costs municipal and industrial users would incur otherwise to obtain high-quality water. Adverse environmental changes could lead to changes in the economic structure. Reductions in fish habitat and populations could lead to the curtailment or elimination of commercial and recreational fishing, for example.

5.22.2 Integrated Water Resource Management Plan Alternative – Impacts of Individual Elements

The individual elements of the Integrated Plan have the potential to increase the value of the goods and services society derives from the basin's water and related resources in the long term. Some of the individual elements would likely have a beneficial impact on jobs and incomes related to the basin's water and related resources, but the impacts on the overall economy are likely to be mixed. In general, shifting water from lower-value to higher-value uses would boost the economy, but some sectors and individuals associated with goods and services whose supply would decline might be adversely affected. The plan elements could affect the distribution of costs and benefits associated with the basin's water resources and alter the relationships between resources and the economy, with the actual effects determined by how the plan elements would be implemented. The plan elements would likely reduce uncertainty and risk associated with the basin's water resources, by improving the supply of water available to produce higher-value goods and services.

5.22.2.1 Reservoir Fish Passage Element

Value of Goods and Services

Improving fish passage would increase the long-term value of goods and services to the extent that it would lead to larger or more stable fish populations. Larger fish populations would likely increase the value of goods and services for those who place a value on the continued existence of the fish species; for those who harvest fish commercially, recreationally, or for cultural purposes; or for those who derive recreational value from watching salmon or other species in the water. Other effects would materialize to the extent that additional anadromous fish would increase the amount of nutrients delivered to the upstream ecosystem, stimulating growth in trees, birds, and other economically important species.

Jobs and Incomes

Improvements in fish passage would have long-term impacts on jobs and incomes through several mechanisms. Reclamation (2008a) estimated that the direct impact of long-term expenditures associated with a potential fish passage project at Cle Elum Dam would be an increase of 5 to 12 operation and maintenance jobs. Any increase in jobs may be offset if the new jobs drew workers away from jobs elsewhere in regional or statewide economies.

Expected increases in fish populations resulting from improved fish passage could potentially increase jobs and incomes associated with recreational and commercial fish harvest. Jobs and incomes with no direct relationship to fish or the fish passage facilities would increase if households and businesses perceive that the resulting impacts on fish populations and the overall natural environment are significant enough to alter their location decisions. These impacts would also likely be offset, more or less, by indirect impacts. On balance, the Fish Passage Element would likely have a minor and beneficial long-term effect on jobs and incomes.

Uncertainty and Risk

Improving fish passage would reduce risk and uncertainty associated with salmon and steelhead to the extent that it would diminish the likelihood of severe future reductions in fish populations.

Distribution of Costs and Benefits

The long-term costs and benefits of improvements in fish passage would likely not be distributed equally among the same groups. This is especially the case to the extent that the costs would be borne by taxpayers and certain benefits would be realized by a subset: those who would enjoy seeing greater fish populations, or catching more fish, for example. Both costs and benefits would be realized as taxpayers pay the costs and realize the benefits as nutrients delivered by anadromous fish improve the health of ecosystem resources owned by all citizens. Overall, the Fish Passage Element would have both beneficial and adverse minor long-term effects depending on the group affected.

Socioeconomic Structure

Improvements in fish passage and resulting increases in fish populations would likely boost the recreational fishing industry and other components of the economy related to fish populations.

5.22.2.2 Structural and Operational Changes Element

Value of Goods and Services

This element of the Integrated Plan would likely change the long-term supply of financial resources, land, and other resources dedicated to the structures as well as the supply of water for irrigation, instream flows, and other goods and services derived from the structures. Overall, these changes would be expected to have a minor long-term effect on the value of resource-related goods and services in the region.

Jobs and Incomes

Long-term increases or decreases in expenditures on a modified structure or facility would increase or decrease related jobs and incomes. Similarly, increases or decreases in goods and services derived from the structure or facility, such as fish populations, recreational opportunities, and water for irrigation, would likely have a corresponding impact on jobs and incomes in associated commercial activities. In addition, any improvements or deterioration in natural resource amenities that affect the location decisions of households and businesses, or affect the cost of living and doing business, would also have long-term impacts on related jobs and incomes.

The initial impacts on jobs and incomes would be dampened to the extent that they trigger offsetting impacts. An initial increase in jobs might, for example, draw workers from other jobs, which may remain unfilled if other skilled workers do not fill those jobs. As a result, the Structural and Operational Changes Element would likely have only a minor long-term effect on jobs and incomes.

Uncertainty and Risk

Projects to modify existing structures and facilities would reduce long-term risk and uncertainty to the extent that they increase the reliability in the supply of water for irrigation or instream flow. If this element of the Integrated Plan increased the reliability of water for irrigators during periods when water supplies otherwise would be uncertain or less than irrigators’ demands, for example, it would likely reduce the costs they otherwise would incur to compensate for risk and uncertainty and induce them to adjust production decisions that result in higher net earnings.

Distribution of Costs and Benefits

Long-term impacts on the distribution of costs and benefits associated with structural and operational changes would be similar to those described in Section 5.22.1.4.

Socioeconomic Structure

Modifications to structures and facilities would alter the structure of the regional economy to the extent that resultant changes in the supply of water-related goods and services lead to long-term changes in household spending patterns, business production, or governmental activities. If the modifications result in higher production of crops and larger fish populations, for example, the regional economy likely would experience expansion in related sectors that otherwise would not occur.

5.22.2.3 Surface Storage Element

Value of Goods and Services

This element would likely change the long-term supply of several goods and services derived from the basin's water and related resources. Increased supplies of irrigation water to some lands when they otherwise would not receive their full entitlement would likely increase the production of irrigated crops from those lands. Changes in fish habitat and fish populations resulting from storage-related changes in streamflow may increase the output of the commercial fishing industry. The Surface Storage Element may affect recreational opportunities at Bumping Lake but the actual effects and their magnitude are uncertain.

Jobs and Incomes

Long-term expenditures on a new storage facility would likely increase the demand for labor and generate new job opportunities and higher incomes for some workers. The impact of these expenditures on the regional economy are expected to be small. Similarly, increases in the supply of goods and services derived from the new storage structure, such as fish populations and water for irrigation, would likely have a corresponding impact on jobs and incomes in associated commercial activities. The positive or negative impacts on the basin's natural resource amenities that affect the location decisions of households and businesses would have corresponding long-term impacts on related jobs and incomes. Any increase in jobs may be offset if the new jobs drew workers away from jobs elsewhere in regional or statewide economies. Overall, this element would be expected to have beneficial long-term effects on jobs and incomes.

Uncertainty and Risk

The development of new storage would reduce uncertainty and risk to the extent that it would increase the reliability of water to meet specific demands. Increases in reliability would yield economic benefits by enabling households, businesses, and governments to avoid costs they otherwise would incur to offset the higher uncertainty and risk.

Distribution of Costs and Benefits

Long-term impacts on the distribution of costs and benefits associated with surface water storage would be similar to those described in Section 5.22.1.4.

Socioeconomic Structure

The development of new storage would likely boost those elements of the economy that would enjoy increased supply of specific goods or services relative to those that would not. For example, the affected parts of the agricultural sector would be reinforced if new storage were to increase the reliability of water supplies for irrigation. Long-term changes in economic structure would also likely occur to the extent that new storage alters the supply of amenities that affect the location decisions of households and businesses.

5.22.2.4 Groundwater Storage Element

Value of Goods and Services

Several factors would determine the costs and benefits of storing water underground. The future prices of electricity and labor associated with operating the facilities would likely have a major effect on long-term costs. The opportunity costs of the water, land, and other resources that would be used by this alternative, such as the lost value of the water-related goods and services that otherwise would be produced when water is injected underground, also would have a major influence.

The willingness of users to pay for the goods and services derived from the stored water would determine the economic benefits. The water might provide services similar to insurance when it lies underground available to satisfy demand that otherwise would be unmet. It also might flow to the surface and/or be retrieved and produce goods and services, such as aquatic habitat, irrigation, or water for municipal and industrial uses.

Jobs and Income

Increases in the supply of goods and services derived from the Groundwater Storage Element, such as water for irrigation and increased fish populations, would likely boost jobs and incomes in associated commercial activities. Similarly, long-term expenditures on storing surface water in the ground would likely increase the demand for labor and generate new job opportunities and higher incomes for some workers. The positive or negative impacts on the basin’s natural resource amenities that affect the location decisions of households and businesses would have corresponding long-term impacts on related jobs and incomes. Any increase in jobs may be offset if the new jobs drew workers away from jobs elsewhere in regional or statewide economies. Overall, this element would be expected to have beneficial long-term effects on jobs and incomes.

Uncertainty and Risk

The greater the uncertainty regarding the ability of surface water flows to meet future demands, the greater the potential benefits of storing water underground. The greater the uncertainty regarding the availability of water to be stored and, once stored, its availability to be retrieved, the greater would be the costs and smaller would be the benefits.

Distribution of Costs and Benefits

Long-term impacts on the distribution of costs and benefits of groundwater storage would be similar to those above.

Socioeconomic Structure

The development of groundwater storage would likely boost those elements of the economy that would enjoy increased supply of specific goods or services relative to those that would not. For example, some agricultural sectors would be reinforced if new groundwater storage were to increase the reliability of water supplies for irrigation during periods of surface water shortages. Long-term changes in economic structure would also likely occur to the extent that new groundwater storage alters the supply of amenities that affect the location decisions of households and businesses.

5.22.2.5 Habitat/Watershed Protection and Enhancement Element

Value of Goods and Services

Enhancing fish habitat and acquiring and protecting sensitive lands would have a long-term effect on the value of goods and services derived from the basin's water and related resources to the extent that these actions would affect the mix and level of goods and services derived from the habitat and lands. Section 3.22.1 discusses values associated with increased fish populations and related activities. Protection of lands might also affect the supply and value of goods and services not directly related to water, such as upland recreational opportunities.

Jobs and Incomes

Changes in commercial fishing, recreational fishing, sightseeing, and other activities that might result from this element would likely lead to changes in the levels of jobs and incomes associated with these activities. Any changes in natural resource amenities that affect the location decisions of households and businesses would have additional long-term impacts on related jobs and incomes. Habitat/watershed protection and enhancements might also increase or decrease long-term maintenance expenditures on the affected land, water, and other resources and, therefore, might lead to a long-term increase or decrease in related jobs and incomes. Targeted watershed protection and enhancements would likely have only minor effects on jobs and incomes if uses, such as forestry and grazing, of acquired lands continue.

The overall impacts on jobs and incomes would be dampened to the extent that they would trigger offsetting impacts. For example, an initial increase in jobs might draw workers from other jobs, which might remain unfilled by other workers.

Uncertainty and Risk

Enhancing fish habitat and protecting sensitive lands are intended to reduce risk and uncertainty associated with the habitats' ability to yield salmon and steelhead and with the lands' ability to provide various goods and services.

Distribution of Costs and Benefits

The distribution of long-term costs and benefits from actions to enhance fish habitat and protect sensitive lands likely would resemble that of actions to improve fish passage, discussed in Section 5.22.2.1.

Socioeconomic Structure

Protecting and enhancing habitat would likely boost those elements of the economy that would enjoy increased fish populations relative to those that would not. Changes in commercial fishing, recreational fishing, sightseeing, and other activities that might result from any newly designated Wild and Scenic Rivers or Wilderness Areas would likely lead to changes in the levels of jobs and incomes associated with these activities. These designations could place restrictions on land use in the designated areas, which could limit development, particularly in Wilderness Areas. Designation of Wild and Scenic Rivers does not create new mandates on private land; therefore, no major shifts in development activity would be expected on private lands within the river corridors. There could be a minor adverse impact on the fiscal resources of Yakima and Kittitas Counties from lower property tax collections as a result of acquiring private lands and placing them in public ownership.

Conserving large tracts of ponderosa pine forest in the Teanaway River basin as part of the targeted watershed protection and enhancements could produce future ecologically-derived economic benefits given the tree species' limited range and vulnerability to climate change impacts.

These resources would likely also contribute to the economy by providing amenities that attract new households and businesses, increase the quality of life of the existing households, or influence the cost of living or the cost of doing business in the region.

5.22.2.6 Enhanced Water Conservation Element

The scope and design of specific demand-management programs and investments in infrastructure would determine their costs, benefits, and net benefits (or net costs); their impacts on jobs and income; the distribution of costs and benefits; their interaction with the economy; and the levels of risk and uncertainty they would generate for affected parties. With enhanced water conservation, an existing set of goods and services would be produced with less water, and the conserved water would be used to produce a new set of goods and services, whose value would depend on the circumstances of each specific conservation project or program.

Enhanced conservation projects and programs would have distributional effects if their benefits would accrue to one group while their costs would be borne by another. General taxpayers might incur some or all of the costs of a project, for example, but the benefits would accrue to the farmer(s) who would realize an increase in the supply of water for irrigation, and to anglers and others who would enjoy the benefits of increased streamflows and improved habitat for salmon. Enhanced conservation projects and programs would likely not alter the general structure of the economic activity and social organization linked to the basin's water resources. They might reduce uncertainty and risk associated with the movement of water resources through the basin by reducing the amount of irrigation runoff that would infiltrate into the ground and later appear somewhere else and, instead, increase the likelihood that the water would be more directly controlled by water managers. Enhanced conservation would also increase the reliability of water for irrigators during periods when water supplies otherwise would be uncertain or less than irrigators' demands, inducing irrigators to increase crop production, and reduce the costs they would incur to compensate for risk and uncertainty.

5.22.2.7 Market Reallocation Element

Market-based transfers would likely increase the value of goods and services directly derived from water resources because the net benefits that the buyer would derive from the water would exceed those that the seller would forgo. The market reallocation technical memo (Reclamation and Ecology, 2011j) concludes that "by itself, the market-based element of the Integrated Plan has the potential to offset much, but not all, of the irrigation-related economic losses from a future severe drought. It also has the potential to totally offset the losses when working in conjunction with other components of the plan."

Trends and patterns in the number, type, and location of future water transfers will be influenced by numerous factors that shape the demand for and supply of water. These include the incidence and severity of drought, the reliability of drought forecasts, population and economic growth in the basin and among outside groups with an interest in the basin's water resources, and trends in the population of salmon and other species dependent on instream flows. The evolution in transfers will be influenced by social and institutional factors that affect parties' willingness to participate in transactions. Growth in the number of transactions would occur only as more parties see that participating in them is likely to yield sufficient economic gain that it warrants the time and effort required to make them work.

5.22.3 Integrated Water Resource Management Plan Alternative – Impacts of Integrated Plan

The long-term socioeconomic effects of the Integrated Plan may differ from the sum of the effects of the individual elements. Differences would arise to the extent that implementing the elements as a package would cause interactions that would influence the impacts on the supply of goods and services derived from the basin's water and related resources, on resource-related expenditures, on resource-related risk and uncertainty, on the distribution of resource-related costs and benefits, or on the structure of the regional and statewide economies. If they reinforce one another, then the overall effect would be greater than the sum of their individual effects. If they interfere with one another, it would be smaller.

5.22.4 Mitigation Measures

The type of mitigation needed would be determined by future socioeconomic conditions and the specific steps that would be taken to implement the actions. Mitigation typically would be warranted only if an action would reduce the supply of one set of goods and services and the reduction harmed one or more individuals, businesses, landowners, or other interest groups.

5.23 Environmental Justice

Environmental justice issues arise when a project disproportionately impacts minority or low-income populations. If a project will not cause significant adverse impacts, there will not be environmental justice impacts. If significant impacts are anticipated, demographic information for the project area is compared to the Yakima basin as a whole and the State of Washington to determine if minority populations would be disproportionately impacted.

5.23.1 No Action Alternative

Under the No Action Alternative, other agencies and entities would undertake projects to improve water supply and fish habitat. These projects are expected to have similar impacts to those in the Integrated Plan; therefore no significant adverse impacts would occur and there would be no environmental justice impacts. If the projects trigger NEPA analysis, the proposing agencies or entities would conduct environmental review, including environmental justice impacts, separately from this EIS.

5.23.2 Integrated Water Resource Management Plan Alternative – Impacts of Individual Elements

5.23.2.1 Reservoir Fish Passage Element

Members of the Yakama Nation and other Tribes outside the immediate geographic area may currently use natural resources in the Cle Elum Reservoir area and would be expected to do so in the future. They may use these resources disproportionately more compared to the total population. The subsistence use of renewable natural resources (such as fish, wildlife, and vegetation) by Tribes or other populations in the construction area and downstream has not been quantified. Improvements to fish abundance from access to habitat above the dam may increase the long-term potential for subsistence use of these resources.

None of the other fish passage projects are expected to cause significant adverse impacts; therefore, no disproportionate impacts on minority or low-income populations are anticipated.

5.23.2.2 Structural and Operational Changes Element

None of the projects under the Structural and Operational Changes Element are expected to cause significant adverse impacts; therefore, no disproportionate impacts on minority or low-income populations are anticipated.

5.23.2.3 Surface Storage Element

The significant adverse impacts at the Wymer Dam project include the loss of shrub-steppe habitat and the acquisition of agricultural property for conversion to a dam site and reservoir. Impacts on shrub-steppe habitat would be lessened by the proposed Habitat/Watershed Protection and Enhancement Element that would acquire important habitat, including shrub-steppe areas. Impacts of property acquisition would be mitigated by compliance with State and Federal laws during the negotiation process. Neither of these impacts are expected to have disproportionate impacts on minority or low-income populations since all people would be impacted similarly.

The enlarged Bumping Lake Reservoir would cause significant adverse impacts by inundating recreational facilities and forest access roads that might not be able to be relocated. These recreational impacts are not expected to disproportionately impact minority or low-income populations since all people would be impacted similarly.

The Kachess Reservoir inactive storage project is not expected to cause significant adverse impacts; therefore, there would be no disproportionate impacts on minority or low-income populations.

5.23.2.4 Groundwater Storage Element

The Groundwater Storage Element would not cause significant adverse impacts; therefore, no disproportionate impacts on minority or low-income populations would occur.

5.23.2.5 Habitat/Watershed Protection and Enhancement Element

The Habitat/Watershed Protection and Enhancement Element would not cause significant adverse impacts; therefore, no disproportionate impacts would occur to minority or low-income populations.

5.23.2.6 Enhanced Water Conservation Element

The Enhanced Water Conservation Element would not cause significant adverse impacts; therefore, no adverse impacts would occur to minority or low-income populations.

5.23.2.7 Market Reallocation Element

Enhanced water markets are not anticipated to create impacts that could accrue disproportionately to minority or low-income populations.

5.23.3 Integrated Water Resource Management Plan Alternative – Impacts of Integrated Plan

Implementing the Integrated Plan as a coordinated program instead of as individual elements is not expected to result in greater environmental justice impacts. As demonstrated above, most of the projects are not expected to cause disproportionate impacts on minority or low-income populations.

5.23.4 Mitigation Measures

Since most projects are not anticipated to cause significant adverse environmental impacts, significant environmental justice impacts are not anticipated. The Wymer Dam and Bumping Lake Reservoir enlargement projects could cause significant adverse impacts, but since all populations would be affected equally, no disproportionate impacts on minority or low-income populations are anticipated. Therefore, no mitigation would be required.

5.24 Overall Long-term Impacts and Benefits of Integrated Plan

Implementation of the Integrated Plan is expected to result in greater benefits to resident and anadromous fish and water supplies for agriculture and municipal and domestic uses than implementing a series of unrelated projects. The Integrated Plan has been developed in collaboration with a multi-stakeholder interest group based on over 30 years of studies and planning in the Yakima River basin. The proposed Integrated Plan projects were modeled using Reclamation's modeling system to determine effects on water supply and streamflows. The modeling incorporated potential climate change impacts. The results indicate that all these water uses would benefit from the Integrated Plan even under projected climate change scenarios. The following discussion summarizes the impacts and benefits of each element of the plan, then provides an overall summary of the Integrated Plan impacts and benefits.

The Reservoir Fish Passage Element would provide fish passage at dams constructed in the early 1900s without passage. This would open up habitat for anadromous fish including the threatened Middle Columbia River steelhead and help support reintroduction of the extirpated sockeye. Improved passage would also benefit the threatened bull trout by providing connectivity between populations currently isolated by the dams. Fish passage facilities would be designed so there would be no impacts to existing water delivery contracts, total water supply available, or flood control operations.

The Structural and Operational Changes Element would improve the efficiency of existing irrigation systems, allowing for improved water delivery and streamflows, and reducing impacts to fish. Raising the elevation of Cle Elum Reservoir during spring and early summer would inundate a strip of land around portions of the reservoir. The additional water would benefit streamflows in the Cle Elum and Yakima Rivers. Reclamation would acquire easements for the inundated land and would install shoreline erosion protection to compensate for the higher water levels.

The Surface Water Supply Element is intended to provide additional water to meet the needs of irrigators and to improve streamflows in the mainstem rivers. New reservoirs or enlarged existing reservoirs would substantially increase the amount of available water for instream and out-of-stream uses. Increased water storage would help meet some of the identified flow targets or move flows in the direction of meeting the targets. In addition, increased storage allows for more water to be carried over at the end of the irrigation season, increasing flexibility of operations in drought years to meet irrigation and streamflow demands. Modeling indicates these benefits would be provided under the less adverse climate change scenarios and improved over No Action in moderate and more adverse scenarios.

New reservoirs would inundate additional land, potentially affecting habitat for terrestrial species. If a storage project is constructed at the Wymer site or enlarged at Bumping Lake Reservoir, shrub-steppe and old-growth habitat, which are already declining in the Yakima River basin, would be inundated. This could affect the northern spotted owl (threatened species) and sage-grouse (candidate species). An enlarged Bumping Lake Reservoir would also inundate existing recreational facilities which might not be able to be replaced in a similar location. The enlarged reservoir would also be closer to the William O. Douglas Wilderness Area and inundate some access roads to trailheads. The Integrated Plan includes measures to protect other shrub-steppe and old-growth habitat in the basin.

The pilot projects included in the Groundwater Storage Element explore the potential for using aquifer storage to improve water supplies and streamflows. Surface water would be infiltrated into aquifers during high-flow periods and stored for later pumping or passive release back to surface water. Both shallow aquifer recharge and ASR are new concepts in the Yakima River basin and their potential is unknown. The pilot studies would evaluate whether the concepts would work in the basin and the potential water that could be stored. Storage in aquifers would have fewer impacts than surface storage and could reduce the amount of surface storage needed to meet irrigation demands, improve streamflows, and discharge cooler water to improve stream temperature conditions.

Under the Habitat/Watershed Protection and Enhancement Element, additional high-quality habitat would be acquired and protected, and degraded stream conditions would be improved to provide better habitat for resident and anadromous fish. Specifically, shrub-steppe and forested habitat currently in private ownership and susceptible to development would be acquired and protected. The element also recommends additional wilderness and Wild and Scenic River designations to provide additional watershed protection. These protection mechanisms would help offset the losses in habitat caused by other Integrated Plan elements. An aggressive program to enhance mainstem floodplains and tributary stream conditions would provide improved habitat conditions for fish and help meet the goals of steelhead recovery in the basin.

The Enhanced Water Conservation Element expands on the ongoing YRBWEP conservation programs. It includes conservation measures for irrigation district infrastructure improvements, on-farm conservation and irrigation efficiency improvements, and a program to encourage municipal, domestic, commercial, and industrial conservation. The aggressive conservation program is expected to improve the reliability of irrigation supplies and provide localized streamflow benefits. The municipal and domestic conservation program would improve the reliability of existing supplies, reducing the need to obtain new supplies.

The Market Reallocation Element facilitates the transfer of water rights to allow irrigators to improve the reliability of their water supply, and municipal and domestic users to acquire water rights to meet municipal demands or to mitigate for new domestic wells. In addition, water rights could be more easily acquired to enhance streamflows in key areas. Market reallocation is expected to cause few environmental impacts. The proposed amendments to water transfer laws would include measures to mitigate for third-party impacts such as weed invasions on fallowed lands.

Most of the adverse impacts associated with the Integrated Plan elements are construction-related and there would be few long-term adverse effects excepting habitat losses at the enlarged Bumping Lake Reservoir and new Wymer Reservoir. Modeling indicates that integrated implementation of the plan elements would benefit water supplies for irrigation and municipal and domestic uses and streamflows for fish, meeting the targets for both. Fish passage and habitat enhancements would provide further benefits for fish and wildlife in the basin. The Habitat/Watershed Protection and Enhancement Element would help protect substantial areas of existing habitat from future losses due to development-related habitat impacts. The Groundwater Storage, Enhanced Conservation, and Market Reallocation Elements provide opportunities to improve the reliability of water supplies without requiring surface storage. However, additional surface storage is needed in the basin to provide adequate water to meet the instream and out-of-stream needs of the Integrated Plan. Overall, the Integrated Plan would provide long-term benefits to water supplies for agricultural and municipal and domestic uses and improve habitat conditions for resident and anadromous fish.

5.25 Long-Term Cumulative Impacts

Cumulative impacts are the effects that may result from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions (40 CFR 1508.7). "Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7). Generally, an impact can be considered cumulative if: (a) effects of several actions occur in the same locale; (b) effects on a particular resource are similar in nature; and (c) effects are long-term in nature. Potential areas where long-term cumulative impacts might occur as a result of implementation of the Integrated Plan are discussed below.

The overall long-term effects of the Integrated Plan are expected to be beneficial, although some localized impacts could occur associated with individual projects. The integrated approach to resolving water resource issues in the Yakima basin is expected to provide greater basin-wide benefits than would result from implementing projects on a piecemeal (or individual) basis. A comprehensive program that includes habitat/watershed protection and enhancement, fish passage, systemwide structural and operational modifications, and water supply components including surface water storage, groundwater storage, enhanced water conservation, and market reallocation is expected to provide greater benefits to resident and anadromous fish and irrigation and domestic water supply than would occur under the No Action Alternative. The Integrated Plan addresses water resource issues from a systemwide approach, which would avoid developing localized solutions that may address one problem, but exacerbate another, which could result if projects are implemented individually.

5.25.1 Past, Present, and Reasonably Foreseeable Future Actions: Yakima River Basin

Individual elements of the Integrated Plan would contribute to cumulative impacts when combined with other past, present, and reasonably foreseeable future actions. The Integrated Plan is intended to provide habitat improvements that would help reverse environmental damage from the early 1900s. Effects of the Reservoir Fish Passage and Habitat/Watershed Protection and Enhancement Elements are expected to be beneficial to fish, wildlife, and listed species. The water supply elements would improve streamflows, further benefiting fish populations. Fish passage would contribute to the restoration of salmon populations in the Yakima River basin. Improved conditions for fish, increased abundance and productivity of fish populations, and improved vegetation communities would provide additional food sources and nutrients and cumulatively benefit aquatic species, including resident and anadromous fish as well as terrestrial animals and plants. Other ongoing fish habitat improvements and fish enhancement projects in the Yakima basin are expected to further improve conditions for fish, which cumulatively could improve the ability of fish to withstand climate changes.

There are a number of ongoing or proposed water resource projects, included in the No Action Alternative (Section 2.3), that could contribute to cumulative impacts in the Yakima River basin. Overall these cumulative impacts are expected to be positive for water supply and fish habitat. Reclamation's Yakima River Basin Water Enhancement Project Phase II project, including the Water Conservation Project and the Interim Comprehensive Basin Operating Plan, as well as Reclamation's ongoing improvements to existing facilities, are expected to contribute to cumulative improvements in water management and water supply. The habitat enhancement projects included in the No Action Alternative (Section 2.3) are expected to provide improvements to fish habitat. These ongoing, related projects are not included in the Integrated Plan, but combined with the Integrated Plan are expected to provide substantial improvement to habitat as well as water supply within the Yakima River basin.

Expanding existing reservoirs or building new water storage facilities would add to existing impacts on fisheries in a river basin that has already been extensively dammed, and has been impacted by development, climate change, and other modifications to the system. Additional storage facilities could exacerbate the impacts of existing facilities, including the potential to create additional impediments to fish passage, increased migration times, and impaired downstream water quality. The additional storage would be used to improve streamflow conditions for fish as well as improved water supplies. Hydropower facilities could be expanded in the future by utilities as well as private developers, resulting in water quality impacts, altered reservoir operations, and other detrimental effects that could affect fisheries. The Integrated Plan has been developed in a comprehensive manner to offset these cumulative impacts, by including new fish passage, and retrofitting existing reservoirs with improved fish passage, and by including measures to enhance habitat, maintain flows, reduce water temperatures, and offset climate change-induced impacts.

5.25.2 Past, Present, and Reasonably Foreseeable Future Actions: Related Projects

There are other projects proposed for the Yakima River basin that are not part of the Integrated Plan and not directly related to water resource management, but include activities that could affect terrestrial and aquatic habitat in the basin, and compound impacts accompanying the Integrated Plan. Several projects could contribute to losses of shrub-steppe habitat in the basin beyond those proposed for the Wymer Dam project. These include wind power development ongoing throughout the area, and ongoing activities and facility expansion at the Department of Army's Yakima Training Center. These additional losses of shrub-steppe habitat could further contribute to the decline of the greater sage-grouse. Continued logging in the forested areas in the basin could reduce forest habitat, including old growth, and impact declining forest species such as the threatened northern spotted owl.

Ongoing residential, commercial, and agricultural development in the basin, which has been planned for as part of regional land use planning, would be facilitated by improvements in water supply that would occur under the Integrated Plan. These developments could further encroach upon wildlife habitat, including shrub-steppe and forest habitat. The Integrated Plan is not intended to expand the amount of irrigated acreage in the Yakima River basin. However, it would provide a more reliable water supply for prorationed users which could encourage farmers to shift to more permanent crops. These changes in agriculture are not expected to contribute to further decline in shrub-steppe habitat, because the areas are already in agricultural use.

The Habitat/Watershed Protection and Enhancement Element of the Integrated Plan is intended to help protect these habitats from further losses. Habitat improvements and land acquisition and other conservation programs, including designations of Wild and Scenic Rivers and Wilderness Areas, would help to reduce future losses of shrub-steppe and forest habitat, but even with habitat enhancement and extensive conservation programs, the overall decline likely will continue in the long term. Actions proposed in the USFS Okanogan-Wenatchee Forest Planning Process could provide cumulative benefits to watershed health.

5.25.3 Past, Present, and Reasonably Foreseeable Future Actions: Columbia River Basin

In addition to projects and programs within the Yakima River basin, there are several water resource programs and/or projects within the Columbia River Basin with the potential to cumulatively affect or be affected by the Integrated Plan, including the Odessa Subarea Special Study, the Lake Roosevelt Incremental Storage Releases, the Walla Walla Pump Exchange, the Sullivan Lake Water Supply Project, the Umatilla Aquifer Recharge Project in Oregon, and the potential renegotiation of the Canadian Treaty.

The Odessa Subarea Special Study proposes to use Columbia River water to replace groundwater currently used for irrigation in the Odessa Groundwater Management Subarea (http://www.usbr.gov/pn/programs/ucao_misc/odessa/index.html). The Lake Roosevelt Incremental Storage Releases Project would release additional water from Lake Roosevelt behind Coulee Dam to benefit municipal and industrial supply, the Odessa Subarea interruptible water right holders, and instream flows (http://www.ecy.wa.gov/programs/wr/cwp/cr_lkroos.html). The Walla Walla Pump Exchange (http://www.ecy.wa.gov/programs/wr/cwp/wallawalla.html) currently being studied would pump water from the Columbia River to replace Walla Walla River irrigation water to address restoration of streamflows in the Walla Walla River. The Sullivan Lake Water Supply Project (http://www.ecy.wa.gov/programs/wr/cwp/sullivan.html) would benefit streamflows in Sullivan Creek, and the Pend Oreille and Columbia Rivers. The project would also help meet demands for irrigation and domestic use. The State of Oregon is studying a project to divert water from the Columbia River to replenish depleted aquifers in the Umatilla basin.

The potential renegotiation of the Canadian Treaty and the expiration of the flood control project have the potential to require that reservoirs in the U.S., including those in the Yakima basin, be operated differently. The treaty has no specified end date, but it allows either Canada or the United States the option to terminate most of the provisions of the Treaty on or after September 16, 2024, with a minimum of 10 years advance written notice. If the Treaty is not terminated or modified, its provisions continue indefinitely. If the Treaty is terminated or modified, it could require unknown changes in the operation of U.S. reservoirs. Regardless of whether the Treaty continues, the purchased flood control space project expires in 2024. After 2024, the Treaty calls for a shift to a flood control operation under which the U.S. can call upon Canada for flood control assistance. The U.S. can request this “called upon" assistance as needed, but only to the extent necessary to meet forecast flood control needs in the U.S. that cannot adequately be met by U.S. projects. This new operational plan could require the U.S. to increase the draft on its reservoirs to provide additional flood control storage.

Some of these projects would improve streamflows and benefit fish in the Columbia River basin. When these projects are combined with the fish enhancement aspects of the Integrated Plan, overall benefits are expected for Columbia River Basin fish populations. However, all of these projects represent increased demand on water in the Columbia River. Several projects in the Integrated Plan would increase consumptive use and decrease the amount of water discharged to the Columbia River. All of the proposed Columbia River projects have the potential to reduce water that could be available for an exchange of water between the Columbia and Yakima Rivers included as the Columbia River study in the Integrated Plan (Section 2.4.5.4).

In addition to representing an increased demand on water, these projects all include opportunity costs. Social opportunity costs refer to the opportunities foregone by society whereby choosing one alternative would preclude the possibility to implement others. All of the projects proposed would be relatively high cost and would reduce the amount of funding available to address other water needs in eastern Washington. The social opportunity cost of one of these projects would include the projects that could not be developed if funds and other resources are allocated to that project.

Impacts of Lake Roosevelt Incremental Storage Releases Project and preliminary impacts of the Odessa Subarea Special Study were evaluated in Ecology's Columbia River Water Management Program EIS and Lake Roosevelt Incremental Storage Releases EIS. Reclamation further evaluated the impacts of the Lake Roosevelt storage releases in an Environmental Assessment (EA). Ecology has adopted these documents as part of this EIS under its SEPA regulations (Section 1.12).

Impacts of the other projects will be evaluated in separate environmental documents by the agencies proposing them. Those documents will further evaluate cumulative impacts associated with the proposed projects.

The Integrated Plan is itself an effort to manage water resources on a systemwide basis, to identify and evaluate impacts at a comprehensive level, thus reducing the potential for unintended cumulative impacts. Potential impacts associated with specific projects would undergo additional project-level review prior to implementation, which would identify specific impacts as well as cumulative impacts. Reclamation and Ecology and their partners would continue to coordinate closely to manage the resources in the Yakima River basin to avoid long-term cumulative impacts.

5.26 Unavoidable Adverse Impacts

Unavoidable significant adverse impacts are defined as environmental consequences of an action that cannot be avoided, either by changing the nature of the action or through mitigation if the action is undertaken. Long-term impacts related to forest and shrub-steppe habitat loss have been identified associated with the Surface Water Storage Element. Smaller losses of habitat would occur under the Reservoir Fish Passage and Structural and Operation Changes Elements. These impacts would be permanent and long-term; however, those impacts would be offset by the Habitat/Watershed Protection and Enhancement Element which would improve degraded habitat and protect large areas of intact habitat, including declining shrub-steppe and old-growth habitats.

5.27 Relationship between Short-Term Uses 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). This occurs when short-term negative effects are counterbalanced by a long-term positive effect (and vice-versa). Construction of components of the Integrated Plan would cause some short-term adverse impacts on water quality, fish, vegetation, wildlife, air quality, land use, and noise. These short-term impacts are counterbalanced by the long-term benefits to fish, threatened and endangered species, and ecosystem productivity.

5.28 Irreversible and Irretrievable Commitments of Resources

Irreversible commitments are decisions affecting resources, such as wetlands and vegetation, where the resource is lost and replacement can only occur over a long period of time, or at great expense, or cannot be replaced at all (for example, minerals). Irretrievable commitments refer to loss of production or use of resources as a result of a decision, such as removal of trees which eliminates another harvest until a new stand grows. They represent opportunities foregone for a period of time that a resource cannot be used.

Implementation of the Integrated Plan would result in the irreversible and irretrievable commitment of wetlands, forests, including old growth, and shrub-steppe habitat, especially with construction of projects under the Surface Water Storage Element.

5.29 Environmental Commitments

This section discusses the long-term environmental commitments made in this DPEIS. Reclamation has the primary responsibility to ensure these commitments are met if an action is implemented. Because this a programmatic environmental review of the Integrated Plan elements, specific mitigation measures have not been developed for specific project actions at this time. Additional measures would be developed during project-specific review for each project action carried forward. Below is a summary of the type of actions that would be undertaken to minimize long-term operational impacts.

5.29.1 Surface Water and Habitat

One of the goals of the Integrated Plan is to provide improved habitat and water conditions for fish and aquatic species. The long-term impacts on fish and aquatic species as a result of the Integrated Plan would primarily be beneficial to these species and their habitats. Specific projects would be evaluated through applicable Federal, State, and local environmental review and permitting processes. Project-specific mitigation measures would be identified that pertain to long-term impacts from each specific proposed activity.

In most cases, the potential for water quality impacts would be mitigated by following the required regulatory permits for the construction and operation of the project. Implementation of long-term adaptive management and monitoring would be beneficial for maintaining and enhancing water quality. Reservoir operational practices related to the timing and volume of storage releases can be structured to mitigate water quality impacts.

5.29.2 Earth

Dam safety inspections and monitoring of slopes and hydrostatic pressures would help document management strategies that are effective and identify any needed changes to management strategies over the long term. Managing recharge volumes and pressures in groundwater storage aquifers to limit seepage, inventorying slopes in the project area, and monitoring pressures in slope areas during recharge and storage would minimize potential slope instability.

Constructing facilities in accordance with all applicable design requirements, and monitoring to ensure that potential impacts do not develop during operation, would minimize the potential for earth related impacts. Implementation of habitat/watershed protection and enhancement elements is likely to serve as long-term mitigation of earth related impacts throughout the basin.

5.29.3 Groundwater

More detailed, site-specific studies of the alternatives are required to better determine their impacts and benefits and the amount of mitigation that might be required. Those studies would include seepage studies on irrigation canals that would be lined or piped, operational studies on irrigation facilities to determine the amount of water that could be conserved, groundwater studies to better characterize the amount of water that would return to surface water from the Groundwater Storage Element, and studies to better estimate the potential for large-scale water transfers to benefit irrigation water supply for some water users. Long-term impacts to groundwater could be avoided or mitigated by conducting hydrogeological studies prior to the design and using the knowledge gained in the design, construction, and implementation of projects.

Additional RiverWare modeling would also be required to better understand the impact on Yakima Project operations. Studies of the impact on return flow from irrigation conservation measures are also recommended to assist Reclamation in modeling the impact of conservation measures.

The timing of operational activities could be used to reduce the impact on groundwater. Additionally, the use of artificial recharge or withdrawal could be considered as part of the impact management strategy. Monitoring during operations would document the effectiveness of management strategies implemented.

Where local water supply wells are affected by lowered water tables due to conservation projects, mitigation measures could include extending wells to greater depths.

5.29.4 Hydropower

Further power subordination at the Roza and Chandler Powerplants would substantially impact the amount of energy produced by hydropower in the Yakima basin. Mitigation measures may be required to compensate for these impacts, such as purchase of power to replace the lost power or financial compensation to the affected parties. In addition, any changes in hydropower generation would be coordinated with Bonneville Power Administration, Reclamation, and other affected agencies.

5.29.5 Visual Resources

Involving an architect in the design of facilities and restoration of disturbed lands would ensure they meet BLM's Visual Resource Inventory management objectives and the prescribed USFS Visual Quality Objective of Retention and corresponding Scenic Integrity Level of High to the extent practicable.

5.29.6 Air Quality

Dust control plans could be developed to mitigate the impacts of increased dust from fallow fields and dry infiltration basins. Measures to reduce dust could include installing plantings around the infiltration basins and planting drought-tolerant plants in fallow areas. In some cases, air quality permits may be required for use of non-electric pumping, injection, or treatment equipment.

5.29.7 Climate Change

Changes in water availability in the Yakima River basin would require the managing agencies to adaptively manage the river to respond to changing conditions. Ecology and Reclamation would coordinate with other water, fish, agriculture, energy, forest and public health managers to adapt to climate change. The Integrated Plan on the whole would improve the ability of water and fisheries managers to mitigate the effects of climate change.

5.29.8 Property Acquisition

If individual projects that require the acquisition of land or easements are advanced for implementation, appropriate compensation would be required in accordance with applicable State or Federal regulations.

5.29.9 Cultural Resources

Additional cultural resources review including field investigations would be required once specific locations for project elements are identified. These inventory investigations would determine if any archaeological sites, historic structures, or TCPs would be affected. Once the inventory and evaluation was complete then mitigation measures could be determined.

Mitigation measures for short-term impacts on TCPs would need to be determined in consultation with the appropriate cultural group. Construction contracts would require that if any archaeological material is encountered during construction, construction activities in the immediate vicinity would halt. The Department of Archaeology and Historic Preservation and a professional archaeologist would be contacted for further assessment prior to resuming construction activity in that area. Construction contracts may also include specific requirements for working around historic dams.

Chapter 6

CONSULTATION AND COORDINATION

CHAPTER 6.0 CONSULTATION AND COORDINATION

This chapter describes the public involvement, consultation, and coordination activities undertaken by Reclamation and Ecology to date, plus future actions that will occur during the processing of this document. Public information activities will continue through future development of this project.

6.1 Public Involvement

Public involvement is a process where interested and affected individuals, organizations, agencies, and governmental entities are consulted and included in the decisionmaking process. In addition to providing information to the public regarding the DPEIS, Reclamation and Ecology solicited responses regarding the public's needs, values, and evaluations of the proposed alternatives. Both formal and informal input was encouraged and used.

6.1.1 Scoping Process

Both Reclamation and Ecology sought comments from the interested public, including individuals, organizations, and governmental agencies. The process of seeking comments and public information is called "scoping." Scoping is a term used for an early and open process to determine the scope of issues to be addressed and to identify the significant issues related to a proposal. The comments received will assist in the following activities:

- Identifying the significant issues relevant to the proposal;
- Identifying those elements of the environment that could be affected by the proposal;
- Formulating alternatives for the proposal; and
- Determining the appropriate environmental documents to be prepared.

On March 31, April 4, and April 5, 2011, Ecology published public notices in area newspapers of a Determination of Significance (DS) and request for comments on the scope of the DPEIS. Also, Ecology distributed a total of 747 scoping and meeting notices to interested individuals.

On April 5, 2011, Reclamation published a Notice of Intent (NOI) to prepare a PEIS in the *Federal Register*. Both Reclamation and Ecology issued a joint press release to local media on April 6, 2011, announcing a scoping meeting. A meeting notice was mailed to interested individuals, Tribes, groups, and governmental agencies which described the project, requested comments, and provided information about the public scoping meeting.

On May 3, 2011, Reclamation and Ecology jointly held two public scoping meetings at the Hal Holmes Center in Ellensburg, Washington, one in the afternoon and one in the evening; 45 individuals attended the two meetings. On May 5, 2011, two joint public scoping meetings were held at the Yakima Arboretum in Yakima, Washington, one in the afternoon and one in the evening; 26 individuals attended the two meetings. At the meetings, the proposed Integrated Plan was described and attendees were given the opportunity to comment on the proposal, the NEPA/SEPA process, and resources being evaluated in the PEIS.

Following the scoping meetings, Reclamation and Ecology prepared a *Scoping Summary Report* (Reclamation and Ecology, 2011m). This report summarizes the comments received during the four public scoping meetings and is available upon request or can be accessed from the Yakima River Basin Water Enhancement Project (YRBWEP) 2011 Integrated Plan Web Site: http://www.usbr.gov/pn/programs/yrbwep/2011integratedplan/index.html.

6.1.1.1 Comments and Other Information Received from the Public

The scoping period began April 2, 2011, and concluded June 15, 2011, during which time 79 comment letters were received. Reclamation and Ecology used the comments received to assist in the following activities:

- Identifying the significant issues relevant to the proposed actions;
- Identifying those elements of the environment that could be affected by the proposed actions; and
- Formulating alternatives to the proposed actions.

The comments and questions are summarized below:

Elements/Alternatives/Projects

- **General Comments**: Concern that the Integrated Plan would not add any more water to the basin but merely reregulate the snowpack, contribution of proratable water right holders, generation of electric energy whenever possible and financially feasible, need for major emphasis on conservation, and the need to include specific proposed sequencing/phasing of elements.
- **Elements and Alternatives and Projects**: Consideration of Pine Hollow Reservoir, formulation of a nonstructural alternative, formulation of an alternative that would combine irrigation districts and eliminate the distinction between “proratable” and “nonproratable” water right holders, potential removal of Roza Dam, encouragement of small-scale water storage projects, consideration of Black Rock Reservoir, the suggestion to raise all reservoirs 3 feet or more or lower outlet tunnels, a potential channel between upper and lower Lake Kachess, potential investigation of monomolecular films to reduce evaporation of water, suggested focus on sustainable agriculture, formulation of an alternative which results in minimum instream impacts, potential consolidation of irrigation diversions, the potential replacement of dams for the benefit of species, subsurface microdrip, the

potential Mabton Trestle replacement, restoration of beavers to mountain streams in northeast Washington, and the suggestion that Keechelus, Kachess, and/or Cle Elum Reservoirs be dredged to increase water storage.

- **Storage Projects**: Opposition to storage projects, concern that large-scale projects transfer wealth from poor farmers in northeast Washington to rich farmers in the Columbia Basin, the site of the Wymer pump station, cost and lack of benefit from large storage projects, suggestion that Bumping Lake enlargement should be dropped from consideration for reasons noted in the 2008 Storage Study FEIS, schedule of drilling at Bumping Lake, support for expansion at Bumping Lake, whether there is a link between funding of storage projects and of habitat improvement projects, suggestion that new storage should be used to the benefit of the river ecosystem, whether Wymer Dam would replace Roza Dam, and the flood impacts of living near a reservoir.
- **Keechelus-to-Kachess Pipeline**: Need to coordinate with work on I-90, impact on property values, disruption to the Kachess Campground, and impact on area wells.
- **Reservoir Fish Passage**: Lack of clarity on what will be installed at Clear Lake Dam, the specific location and design of fish passage at Clear Lake, Bumping, and Cle Elum Dams, the lack of progress on fish passage at Tieton, Keechelus, and Kachess Dams, and whether fish passage will be paid for by taxpayers or irrigation users.
- **Water Resources and Water Quality**: Evaporation rates and refill times for reservoirs, the possibility of a charge for water diverted from the river, consumption of water from wells, the implications for increased water rights to support housing and urban development, emergency response for spills of contaminants, impact of construction on water quality, riparian/wetland restoration, and water quality impacts from new storage reservoirs.
- **Water Conservation**: Cost of conservation, on-farm conservation, permit exempt well provisions, setting specific targets, assessing past conservation projects, and the possibility of maximizing water conservation in place of new storage.
- **Water Marketing**: Water marketing related to the potential imbalance in ability to pay between municipal and agricultural users, undesired growth, legal and institutional barriers, setting specific targets, whether it makes sense to separate the value of water rights from the land, and whether this alternative alone could meet irrigation goals.
- **Habitat/Watershed Protection and Enhancement Program**: Impact of Wilderness and Wild and Scenic Designations, need for specific priorities and goals, critical habitat for listed species, roadless acreage, the potential for levee setbacks to reduce flooding in other areas, disparate economic impact on Kittitas County, impact on recreation, and impact of studies and enhancement on current property owners.
- **Land Acquisition**: Ownership and management objectives for purchased properties, alternative techniques such as Transfer of Development Rights or

Community Forest Projects, and the impact of acquisition on the tax rolls of Yakima and Kittitas Counties.

- **Cultural Resources**: Interbasin transfer of water from the Columbia River and the potential future preemption of irrigation water to meet treaty water rights.
- **Power**: Cost of electricity to operate the project, the power source for pumping water into reservoirs, and mitigation for power subordination.
- **Economics**: How the elements of the project will be funded, how funding could impact existing funding for projects in the basin, concern that the benefits estimate is too high or too low, benefits for individual projects, the true cost of irrigated crops using market rates for water and power, the timeframe for economic impacts, the cost of mitigation, impacts on specific economic factors (demand for hotel rooms, wage levels, property values and taxes, impacts to existing restaurants and hotels, and quality of life), expected beneficiaries, and discount rates.
- **Recreation and Tourism**: Impact of Bumping Lake Reservoir expansion on the William O. Douglas Wilderness and on recreational cabins, impacts on recreational fishing, the impact of Wymer Dam on the Yakima River Canyon Scenic Byway, effects of the Integrated Plan on tourism, and the need to include river-based recreation such as rafting when assessing instream flows.
- **Groundwater**: Creation of wetlands, potential impacts of continued proliferation of permit exempt wells, the 1945 Consent Decree and reallocation of aquifer water to instream flows, potential groundwater adjudication, and the U.S. Geological Survey groundwater study.
- **Crops**: Potential future cropping patterns, the conversion of cropland to other uses, specific crops grown in the Yakima Project, and the sustainability of vineyards.
- **Climate Change**: Impacts from the Pacific Decadal Oscillation and El Nino/Southern Oscillation weather patterns, the need to analyze each water supply element independently in regard to climate change, and concern that climate change is not addressed properly.
- **Fish and Wildlife**: Impacts of project elements on bull trout, native steelhead and salmon, sage-grouse, old-growth trees, migratory birds, and spotted owl habitat, the estimate of fish benefits, historic variability of salmon runs, independent analysis of each major water supply element, prioritization of fish recovery and fish passage actions for immediate implementation, the U.S. Fish and Wildlife Service bull trout recovery plan, compliance with various regulations, and impacts on fish from construction.
- **Visual and Noise**: Visibility of projects, the need for landscaping or buffers, and the effects of light, glare, noise, and vibration from construction.
- **Transportation**: Transportation impacts and mitigation.

- **Public Services and Utilities**: Additional public safety and emergency services during dam construction, housing for employees, and impacts on local school systems.
- **Geology**: Geotechnical studies, earthquake faults and instability in the Bumping Lake Dam area, and seismic issues.
- **Environmental Justice**: Comments related to potential adverse impacts on low-income and people of color communities.
- **System Operations**: Operations at Rimrock, reducing flow in the Tieton and Naches Rivers, flood hazard management, management of reservoirs when fish passage facilities are in place, potential increase in or reactivation of acreage in the Wapato Irrigation Project, instream flow management, the 2002 Interim Comprehensive Basin Operating Plan, and the need to confirm water availability sooner in the calendar year.
- **Process and Scope**: Exclusion of affected individuals and organizations in the process, cost/benefit review of large storage projects, the length of comment periods, the need to include the City of Roslyn on all maps, the need for more detail on municipal needs and growth projections, the need for an overall mission for the Integrated Plan, the process of the Workgroup, better-defined standards for accessing new domestic water supplies, inclusion of empirical data, whether Reclamation is obligated to undertake fish passage at the large storage reservoirs regardless of further action on the Integrated Plan, the relation of the Cle Elum FEIS to the Integrated Plan, the dependence of some elements on voluntary participation, and consultation with Tribes, communities, and school districts.
- **Other Impacts/Issues**: Hazardous materials, withdrawals from the Columbia River, the relation to the 2009 Ecology EIS, air quality impacts, legal mechanisms by which water could be transferred to instream flows, and the Supreme Court's May 2, 2011 decision in *Montana v. Wyoming*.

6.2 Agency Coordination and Consultation

6.2.1 Cooperating Agencies

Reclamation and Ecology were responsible as joint lead agencies for developing this joint NEPA/SEPA PEIS.

Though many agencies are involved and interested in the Integrated Plan, only Bonneville Power Administration (BPA) and U.S. Forest Service (USFS) have assumed the role of cooperating agencies in regard to this DPEIS. As cooperating agencies, BPA and the USFS have agreed to perform the following duties:

- Participate in the NEPA process;
- At the request of Reclamation and/or Ecology, provide information on portions of the PEIS on which the cooperator has specific expertise; and
- Review the Draft and Final PEIS.

6.2.2 Endangered Species Act, Section 7

Reclamation has concluded that consultation under Section 7 of the Endangered Species Act is not required because preparation of the PEIS and selection of a preferred alternative would have no effect on listed species in the action area. Reclamation has discussed this conclusion with both the Service and NMFS, and neither agency found any fault with Reclamation's reasoning which led to the no effect determination. Consultation would be conducted for individual projects that may affect listed species or critical habitat and that Reclamation would fund, authorize, and/or carry out under the Integrated Plan in the future.

Reclamation is in the process of ongoing consultation with the Service under the Fish and Wildlife Coordination Act. The Draft Coordination Act Report (CAR) will be posted on the Yakima River Basin Water Enhancement Project 2011 Integrated Plan website at http://www.usbr.gov/pn/programs/yrbwep/2011integratedplan/index.html when this DPEIS is posted.

6.2.3 U.S. Forest Service

Reclamation will continue coordinating project activities with the U.S. Forest Service throughout the project.

6.2.4 U.S. Army Corps of Engineers

Reclamation will coordinate with the U.S. Army Corps of Engineers (Corps) in conjunction with their interests and responsibilities for wetlands. When specific projects are carried forward under the Integrated Plan, Reclamation will make application to the Corps for permits under Section 404 of the Clean Water Act as stated in the "Environmental Commitments" section.

6.2.5 U.S. Environmental Protection Agency

Coordination activities are ongoing with the U.S. Environmental Protection Agency because of its role in the NEPA review process.

6.2.6 Washington Department of Archaeology and Historic Preservation

The National Historic Preservation Act (NHPA) of 1966, as amended in 1992, requires that Federal agencies consider the effects that their projects have upon 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. These regulations encourage Federal agencies to combine NHPA public outreach efforts with the public outreach mandated by the NEPA process. Public outreach efforts for this DPEIS are described in the first part of this chapter.

To comply with Section 106 of NHPA, Federal agencies must consult with the State Historic Preservation Officer (SHPO), 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 project may cause on significant resources.

Other Federal legislation further promotes and requires the protection of historic and archeological resources by the Federal Government. Among these laws are the Archeological Resources Protection Act of 1979 and the Native American Graves Protection and Repatriation Act of 1990.

Because this EIS is programmatic and specific project details are not known at this time, additional cultural review and consultation will be undertaken as part of the additional environmental review required when projects are carried forward. That will include site-specific cultural resource studies and determination of appropriate mitigation in coordination with the Washington SHPO, the Yakama Nation, the U.S. Forest Service, and other interested parties.

6.3 Tribal Consultation and Coordination

Executive Order (EO) 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."

Reclamation will initiate Government-to-Government consultation with the Yakama Nation and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) when specific projects in the Integrated Plan are carried forward to implementation. Appropriate personnel at the Bureau of Indian Affairs (BIA), Yakama Nation, and the CTUIR will be contacted via letter and telephone to determine the potential presence of Indian Trust Assets (ITAs) within the project area. The letter will request that BIA, the Yakama Nation, and the CTUIR identify ITAs or any other resources of concern within the area potentially impacted by proposed projects. In addition to the formal consultation, the Yakama Nation has worked closely with Reclamation and Ecology to develop the Integrated Plan. The Yakama Nation has been an active participant in the YRBWEP Workgroup from its inception.

6.3.1 National Historic Preservation Act

As described in Section 6.2.6, 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 with the interested public. Reclamation has identified the Yakama Nation and the CTUIR as Tribes with a potential traditional or religious interest in the study area. Reclamation will consult with the Yakama Nation and CTUIR as provided under the NHPA, Native American Graves Protection and Repatriation Act (Section 6.3.2), and EO

13007 (Section 6.3.3) when specific projects are carried forward as part of the project-level environmental review.

6.3.2 Native American Graves Protection and Repatriation Act

Reclamation will include a stipulation and protocol in construction contracts in the event of inadvertent discovery of human remains that are determined to be American Indian.

6.3.3 Executive Order 13007: Indian Sacred Sites

Executive Order 13007 (1996) instructs Federal agencies to promote accommodation of access and protect 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.

6.4 Compliance with Other Federal Laws

In addition to the laws, EOs, and regulations described above, Reclamation will comply with the following EOs when specific projects are carried forward.

6.4.1 Executive Order 11988: Floodplain Management

Executive Order 11988 requires Federal agencies to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. In accomplishing this objective, “each agency shall provide leadership and shall take action 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 in carrying out its responsibilities.” Reclamation will comply with EO 11988 as projects are moved forward to implementation.

6.4.2 Executive Order 11990: Protection of Wetlands

Executive Order 11990 requires Federal agencies to “minimize the destruction, loss or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands.” To meet these objectives, the EO requires Federal agencies, in planning their actions, to consider alternatives to wetland sites and limit potential damage if an activity affecting a wetland cannot be avoided. Reclamation will comply with EO 11990 to minimize disturbance, loss, or degradation of wetlands as projects are moved forward to implementation.

6.4.3 Executive Order 12898: 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. Reclamation will evaluate the potential for disproportionate adverse impacts to minority or low-income populations as part of project-level environmental review when specific projects are carried forward.

LIST OF PREPARERS

LIST OF PREPARERS

Name and Title	Education and Professional Experience	Affiliation	Contribution
Lisa Adolfson Contractor	B.A., Geology, Western Washington University 24 years professional experience in SEPA/NEPA assessments, environmental permit applications	ESA	Earth
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Carmen Andonaegui Contractor	B.S. Biology, University of Montana 19 years in fisheries management	Anchor QEA	Fisheries and Aquatic Species
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Name and Title	Education and Professional Experience	Affiliation	Contribution
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Name and Title	Education and Professional Experience	Affiliation	Contribution
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Name and Title	Education and Professional Experience	Affiliation	Contribution
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Jennifer Johnson, P.E. Civil Engineer	B.S., Civil Engineering, Boise State University B.S., Geophysics, Boise State University M.Engr., Civil Engineering, Boise State University 8 years professional experience in water resources	Bureau of Reclamation	Groundwater review
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Name and Title	Education and Professional Experience	Affiliation	Contribution
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Candace McKinley Environmental Program Manager	B.S., Biology, Central Washington University 20 years of experience	Bureau of Reclamation	NEPA Manager Document review
Craig Milliken Environmental Scientist	B.A. Geography, Univ College London M.Res. Environmental Sciences, Univ College London 15 years of professional experience in transportation and facility based air quality and noise impact analysis and mitigation	HDR	Noise Air Quality
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Name and Title	Education and Professional Experience	Affiliation	Contribution
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Ann Root Contractor	B.S., Geographical Planning, Montana State University; M.S., Oregon State University; Ph.D., Oregon State University 22 years professional experience in NEPA/ SEPA documentation, water resources	ESA	SEPA and NEPA document management
Derek Sandison, Director	B.A., Biology Science, Central Washington University M.S., Natural Resource Management, Central Washington University 35 years experience in public health, environmental planning, and State environmental Policy Act compliance	Washington State Department of Ecology, Office of Columbia River	SEPA Responsible Official, study oversight, document review
Donnie Stelma Geologist	B.S., Geology, Boise State University 25 years experience in engineering geology	Bureau of Reclamation	Earth review
James B. Taylor Regional NEPA Coordinator	B.S., Chemistry, Boise State University 12 years of experience in environmental compliance, remediation, and testing	Bureau of Reclamation	NEPA guidance, document review, and filing

Name and Title	Education and Professional Experience	Affiliation	Contribution
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This Draft PEIS is available for information and review on Reclamation's Pacific Northwest Region Web site at www.usbr.gov and at the Yakima River Basin Water Enhancement Project 2011 Integrated Plan website at http://www.usbr.gov/pn/programs/yrbwep/2011integratedplan/index.html. In addition, copies were sent to those who provided comments during the scoping period and 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, Richland, Seattle; Washington DC
Honorable Patty Murray, Seattle, Tacoma, Yakima; Washington DC

House of Representatives

Honorable Richard Hastings, Pasco, Yakima; Washington DC

Governor of Washington

Honorable Christine Gregoire, Olympia

Indian Tribes

Confederated Tribes and Bands of the Yakama Nation, Toppenish
Confederated Tribes of the Umatilla Indian Reservation, Pendleton, Oregon

Washington State Legislature

13th Legislative District

Senator Janea Holmquist, Olympia
Representative Bill Hinkle, Olympia
Representative Judy Warnick, Olympia

14th Legislative District

Senator Curtis King, Olympia
Representative Charles Ross, Olympia
Representative Norm Johnson, Olympia

15th Legislative District

Senator Jim Honeyford, Olympia
Representative Bruce Chandler, Olympia
Representative David Taylor, Olympia

8th Legislative District

Senator Jerome Delvin, Olympia
Representative Brad Klippert, Olympia
Representative Larry Haler, Olympia

Federal Agencies

Department of Agriculture
  Forest Service, Cle Elum, Naches, Wenatchee
Department of Defense
  Department of the Army
    Corps of Engineers, Seattle
    Yakima Training Center, Yakima
Department of Energy
  Bonneville Power Administration, Portland, Oregon
  Office of River Protection
Department of Commerce
  National Oceanic and Atmospheric Administration
    National Marine Fisheries Service, Ellensburg, Seattle
Department of the Interior
  Bureau of Indian Affairs, Toppenish; Portland, Oregon
  Bureau of Land Management, Spokane Valley
  Fish and Wildlife Service, Lacey, Wenatchee, Yakima; Arlington, Virginia
  Geological Survey, Tacoma; Fort Collins, Colorado
Department of Transportation
  Federal Highway Administration, Olympia
Environmental Protection Agency, Seattle; Washington, DC

State and Local Government Agencies

State of Washington

Department of Ecology, Yakima
Department of Ecology SEPA Unit, Olympia
Department of Agriculture, Olympia
Department of Commerce, Olympia
Department of Fish and Wildlife, Yakima, Olympia
Department of Natural Resources, Olympia

Department of Transportation, Yakima, Olympia
Department of Archaeology & Historic Preservation, Olympia
Washington State Parks and Recreation Commission, Olympia
Recreation and Conservation Office, Olympia

Local Agencies

Benton County
    Commissioners, Prosser
City of Cle Elum
City of Roslyn
City of Ellensburg
City of Kennewick
City of Pasco
City of Richland
City of Sunnyside
City of West Richland
City of Yakima
City of Naches
City of Selah

Kittitas County
    Commissioners, Ellensburg
    Public Works, Ellensburg
    Kittitas County Conservative District, Ellensburg
Port of Benton, Richland
Port of Sunnyside, Sunnyside
Yakima County
    Commissioners, Yakima
    Planning Department, Yakima
    Public Services, Yakima
    Yakima Regional Clean Air Agency, Yakima
Yakima Valley Conference of Governments

Irrigation Districts

Ahtanum Irrigation District
Cascade Irrigation District, Ellensburg
Columbia Irrigation District, Kennewick
Benton Irrigation District, Benton City
Kennewick Irrigation District, Kennewick
Kittitas Reclamation District, Ellensburg
Naches-Selah Irrigation District, Selah
Roza Irrigation District, Sunnyside
Selah-Moxee Irrigation District, Selah
Sunnyside Valley Irrigation District, Sunnyside

Union Gap Irrigation District, Wapato
Wapato Irrigation Project, Wapato
Yakima-Tieton Irrigation District, Yakima

Libraries

Carpenter Memorial Library, Cle Elum
Ellensburg Public Library, Ellensburg
Roslyn Public Library, Roslyn
Benton City Library, Benton City
Kennewick Library, Kennewick
Kittitas Public Library, Kittitas
Mid-Columbia Library, Kennewick
Pasco Library, Pasco
Prosser Library, Prosser
Richland Public Library, Richland
Sunnyside Public Library, Sunnyside
Toppenish Library, Toppenish
Wapato Library, Wapato
Washington State Library, Olympia
West Richland Library, Richland
Yakama Nation Library, Toppenish
Yakima Valley Regional Library, Yakima

Organizations

Alpine Lakes Protection Society, Seattle
American Rivers, Seattle
American Whitewater, Seattle
Aqua Permenente, Cle Elum
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Cascade Land Conservancy, Ellensburg
Center for Environmental Law and Policy, Spokane
Columbia River Intertribal Fish Commission, Portland, Oregon
Conservation Northwest, Bellingham
Endangered Species Coalition, Washington, DC
Heart of America Northwest, Seattle
Lower Columbia Basin Audubon Society, Pasco
National Wildlife Federation, Seattle
North Cascades Conservation Council, Seattle
Pilchuck Audubon Society, Marysville
Sierra Club, Seattle
Tapash Sustainable Forest Collaborative, Ellensburg
The Wilderness Society, Seattle
Western Lands Project, Seattle
Western Watersheds Project, Boise, ID

Wise Use Movement, Seattle
Yakima Basin Fish and Wildlife Recovery Board, Yakima
Yakima Basin Joint Board, Sunnyside
Yakima Basin Storage Alliance, Granger, Yakima, Zillah
Yakima Basin Water Resource Agency, Yakima
Yakima County Farm Bureau, Wapato
Yakima Valley Audubon Society, Yakima

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Kathie Wise, Bonney Lake

Business Entities

Central Washington Homebuilders Association, Ellensburg
Gibbs Houston Pauw, Seattle
Kachess Ridge Maintenance Association (email only)
Law Offices of Phillip A. Cooke, Yuba City, California

Media

Ellensburg Daily Record, Ellensburg
North Kittitas County Tribune, Cle Elum
Tri-City Herald, Tri-Cities
Yakima Herald Republic, Yakima

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REFERENCES

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GLOSSARY

GLOSSARY

acre-foot	The volume of water that could 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 inflow to meet established reservoir operating requirements.
alluvial	Composed of clay, silt, sand, gravel, or similar material deposited by running water.
anadromous	Fish that hatch and develop to adolescence in rivers and migrate to saltwater to feed, then migrate from saltwater to freshwater to spawn.
anticline	A geologic fold that is convex upward.
appurtenant	An accompanying part or feature of something; accessory.
aquifer	A water-bearing stratum of permeable rock, sand, or gravel.
benthic	Relating to the bottom of a sea or lake or to the organisms that live there.
cfs	Flow rate in cubic feet per second.
connectivity	The relationship between groundwater and surface water.
cumulative effect	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.
economic benefits	An economics term measuring national economic welfare based on net values (e.g., net willingness-to-pay or consumer surplus for consumers and profit for producers).
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.

emergence	Refers to the fry lifestage of the salmon when they swim up through the substrate from their incubation nest (red) to live along the stream edge.
endangered species	Under the Endangered Species Act, 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.
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.
escapement	The act of adult salmon and steelhead successfully arriving at their spawning areas by avoiding harvest and predation.
eutrophication	The process by which a body of water becomes enriched in dissolved nutrients that stimulate the growth of aquatic plant life, usually resulting in the depletion of dissolved oxygen.
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.
flip-flop	An operational action in the upper Yakima River basin in late summer to encourage anadromous salmon to spawn at lower river state levels so that the flows required to keep the redds watered and protected during the subsequent incubation period are minimized.
flow	The volume of water passing a given point per unit of time.
flow objectives	The desired monthly streamflow used to guide RiverWare model operation criteria. Also used to evaluate alternative performance in terms of how closely they meet the desired monthly streamflow.
freshet	A great rise or overflowing of a stream caused by heavy rains or snowmelt.

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).
habitat	The combination of resources and the environmental conditions that promotes occupancy by individuals of a given species and allows those individuals to survive and reproduce.
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.
hydraulic conductivity	The rate at which the water can move through an aquifer.
hyporheic invertebrates	Aquatic insects that complete all or a portion of their lifecycle beneath the riverbed.
inactive capacity	The reservoir capacity or quantity of water which lies beneath the active reservoir capacity and is normally unavailable for withdrawal because of operating agreements or physical constraints.
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.
instream flows	Waterflows for designated uses within a defined stream channel, such as minimum flows for fish, wildlife, recreation, or aesthetics.
interbed	Term given to the sediments deposited between basalt flows in the Columbia Plateau Basalt Group.
liquefaction	A loss of material strength during earthquake shaking that can result in large areas of slope failure or settlement of the ground surface.

metamorphic rock	Refers to rocks that have changed in form from their original rock type (sedimentary or igneous) in response to extreme changes in temperature, pressure, or chemical environment (i.e. limestone into marble).
natural flow	Riverflow that originates from a source other than reservoir storage.
net benefits	In an economic benefit-cost analysis, Net benefits reflect the difference between the present value of the benefits and the present value of the costs (i.e., present value benefits minus present value costs). For a project to be economically justified, net benefits should be positive.
nonproratable water rights	Pre-Yakima Project senior water rights related to natural flows that are served first and cannot be reduced until all the proratable rights are regulated to zero.
normative flows	Flows that mimic the natural frequency, duration, and magnitude in the rise and fall of the river stage to the greatest extent possible giving the cultural, legal, and operational constraints associated with river basin development.
oligotrophic	Lacking plant nutrients and usually containing plentiful amounts of dissolved oxygen without stratification.
phreatic surface	Free-standing water level; surface water level.
proratable water rights	Newer junior water rights related to storage water that, in water-short years, receive less than their full right on a prorated basis.
prorationing	The process of equally reducing the amount of water delivered to junior (i.e., “proratable”) water right holders in water-deficient years.
redd	The nest that a spawning female salmon digs in gravel to deposit her eggs.
riparian	Relating to, living in, or located on a water course.
salmonid	A family of soft-finned fishes of cold and temperate waters that includes salmon, trout, chars, freshwater whitefishes and graylings.
sediment	Any very finely divided organic or mineral matter deposited by water in nonturbulent areas.

shoal	A place where the water of a sea, lake, river, pond, etc., is shallow; a shallow.
shrub-steppe	A vegetation type consisting of a mix of woody shrubs, grasses, and forbs, generally dominated by Wyoming big sagebrush and blue bunch wheatgrass.
smolt	Adolescent salmon or steelhead, usually 3 to 7 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.
target flows	Flows quantified in Title XII of the Act of October 31, 1994, for two points in the Yakima River basin (Sunnyside and Prosser Diversion Dams).
taxa	A grouping of animals or plants that share a common set of physical and/or life history characteristics.
terrestrial	Of or relating to land as distinct from air or water.
threatened species	Under the Endangered Species Act, a species that is likely to become endangered within the foreseeable future.
Title XII target flows	Specific instream target flows established for Yakima Project operations at Sunnyside and Prosser Diversion Dams by Title XII of the Act of October 31, 1994 (Public Law 103–464).
total water supply available (TWSA)	The total water supply available for the Yakima River basin above the Parker gage for the period April through September.
ungulate	A four-legged, hoofed animal.
unregulated flows	The flow regime of a stream as it would occur under completely natural conditions; that is, not subjected to modification by reservoirs, diversions, or other human works.
vesicular basaltic rock	Rock that contains many small holes or cavities formed as the rock solidifies.
waterway	A channel for conveying or discharging excess 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.
wet water year	A water supply in the Yakima River basin greater than 3,250,000 acre-feet.
wetland	Generally, an area characterized by periodic inundation or saturation, hydric soils, and vegetation adapted for life in saturated soil conditions.

Appendix A

NOTICE OF ADOPTION

NOTICE OF ADOPTION OF EXISTING ENVIRONMENTAL DOCUMENT

Description of current proposal: Yakima River Basin Integrated Water Resource Management Plan Programmatic Environmental Impact Statement (EIS)

Proponent: Washington State Department of Ecology

Location of current proposal: Yakima River Basin, State of Washington

Title of documents being adopted:

> Yakima River Basin Water Storage Feasibility Study Final Planning Report/EIS (Reclamation, 2008g)
>
> Yakima River Basin Integrated Water Resource Management Alternative Final EIS (Ecology, 2009)
>
> Lake Roosevelt Incremental Storage Releases Final Supplemental EIS (Ecology, 2008a)
>
> Columbia River Water Management Program Final EIS (Ecology, 2007b)
>
> Cle Elum Dam Fish Passage Facilities and Fish Reintroduction Project Final EIS (Reclamation and Ecology, 2011c)

Date adopted documents were prepared: January 2008, June 2009, August 2008, February 2007, April 2011

Description of documents being adopted:

> The Yakima River Basin Water Storage Feasibility Study Final Planning Report/EIS is a National Environmental Policy Act (NEPA) document prepared by the U.S. Bureau of Reclamation (Reclamation). It evaluated three storage alternatives – Black Rock, Wymer, and Wymer Plus Pump Exchange. The Final Planning Report/EIS recommends the No Action Alternative as the preferred alternative. Reclamation concluded that the benefits of the storage alternatives, when weighed against the impacts and costs, did not provide justification for moving forward with any of the three alternatives. The Final Planning Report/EIS is adopted because it includes impacts of constructing a new reservoir at the Wymer site.
>
> The Yakima River Basin Integrated Water Resource Management Alternative Final EIS is a State Environmental Policy Act (SEPA) document prepared by the Washington Department of Ecology (Ecology). It evaluated the impacts of an integrated approach to provide water for agriculture, municipal and domestic uses, and fish benefits. The integrated approach evaluated in the EIS includes seven elements: fish passage, modifying existing structures and operations, new surface storage, groundwater storage, fish habitat enhancement, and market-based reallocation of water resources. These seven

elements formed the basis for the seven elements included in the Integrated Plan and the EIS is adopted because it provided the initial analysis included in this Programmatic EIS.

The Lake Roosevelt Incremental Storage Releases EIS is a SEPA document prepared by Ecology that evaluates the impacts of releasing additional water from Lake Roosevelt to provide water to benefit municipal and industrial supply, the Odessa Subarea interruptible water right holders, and instream flows. The EIS is adopted to document cumulative impacts to water demand in the Columbia River Basin.

The Columbia River Water Management Programmatic EIS is a SEPA document prepared by Ecology. It evaluates the potential impacts of the State of Washington's program to aggressively pursue water storage and conservation and to provide additional water for instream flows. The EIS is adopted to document cumulative impacts to water demand in the Columbia River Basin.

The Cle Elum Dam Fish Passage Facilities and Fish Reintroduction Project EIS is a joint NEPA/SEPA document prepared by Reclamation and Ecology. It evaluates potential impacts of constructing fish passage facilities at the dam and reintroducing fish above the dam. It is adopted to document the potential impacts of fish passage facilities, one of the elements of the Integrated Plan.

If the document being adopted has been challenged (WAC 197-11-630), please describe:

N/A

The document is available to be read at (place/time): All of the adopted documents were distributed to agencies with jurisdiction, Tribes and other interested parties when they were released. The documents may be viewed at Department of Ecology offices during normal business hours (8:00 a.m. to 5 p.m., Monday to Friday) at the following locations:

Department of Ecology Headquarters
300 Desmond Drive
Lacy, WA 98503

Department of Ecology Central Regional Office
15 West Yakima Avenue, Suite 200
Yakima, WA 98902-3452

The adopted documents can be viewed on-line at the following locations.

Yakima River Basin Water Storage Feasibility Study Final Planning Report/EIS:

http://www.usbr.gov/pn/programs/storage_study/index.html

Yakima River Basin Integrated Water Resource Management Alternative Final EIS:

http://www.ecy.wa.gov/programs/wr/cwp/cr_yak_storage2.html#seis

Lake Roosevelt Incremental Storage Releases Final Supplemental EIS:

http://www.ecy.wa.gov/programs/wr/cwp/images/pdf/finalseis/seis_cvr_tc.pdf

Columbia River Water Management Program Final EIS:

http://www.ecy.wa.gov/programs/wr/cwp/eis.html

Cle Elum Dam Fish Passage Facilities and Fish Reintroduction Project Final EIS:

http://www.usbr.gov/pn/programs/eis/cle-elum/index.html

EIS REQUIRED: The lead agency has determined the Yakima River Basin Integrated Water Resource Management Plan is likely to have significant adverse impact on the environment. To meet the requirements of RCW 43.21C.030(2)(c), the lead agency is adopting portions of the NEPA and SEPA documents described above, in addition to preparing a stand-alone NEPA/SEPA Programmatic EIS for the proposal, to fulfill its requirements under SEPA.

The lead agency has determined that this document is appropriate for the proposal and will accompany the proposal to decision makers.

Nam of agency adoption document: Washington State Department of Ecology

Responsible Official: Derek I. Sandison

Position/title: Director, Office of Columbia River

Address: 303 S. Mission Street, Suite 200
Wenatchee, WA 98801

Phone: 509-662-0516

Date: October 22, 2011 **Signature:**

Appendix B

FISH HABITAT TABLE

Table B-1 Fish Habitat

Reach Name	Flow and Habitat Conditions	
Mainstem River Reaches		
Yakima River from Keechelus Dam to Lake Easton	*Spring*:	Flow pulses are reduced in the spring (except when the YFO responds to a request for a pulse flow from SOAC) due to runoff being captured by Keechelus Reservoir. Lower flows reduce available rearing and overwintering habitat into early spring in dry years.
	Summer:	Currently, flows are too high from July through early September when juvenile Chinook and steelhead (and potentially coho if reestablished) are rearing in this reach. Juvenile salmon seek protection against high-velocity flows to avoid being pushed downstream into less desirable habitat and to minimize energy expenditures, which can affect growth rates. The negative effects on rearing juvenile salmonids from high summer flow conditions in this reach occur during all water year types but are most significant in wet years. Flows in summer during a wet year such as 2002 average about 1,000 cfs.
	Fall:	Lower flows reduce available rearing and overwintering habitat throughout the fall.
	Winter:	During winter, flows are lower than unregulated due to runoff being captured by Keechelus Reservoir. Lower flows reduce available rearing and overwintering habitat throughout the winter.
Easton Reach, Yakima River	*Spring*:	In the spring flow pulses are dampened or absent due to the main runoff being captured in Keechelus and Kachess reservoirs and the small unregulated drainage area in this reach affecting outmigration for spring Chinook, steelhead, sockeye and coho.
	Fall/ Winter:	Lower flows in the fall and winter result in reduced available spawning, rearing and overwintering habitat.
Cle Elum River	*Spring*:	Flows are lower than desired for fish, and flow pulses are absent in the spring. Lower flows result in reduced available rearing and overwintering habitat extending through early spring. Flow pulses that mimic natural conditions in spring are needed to support juvenile outmigration.
	Summer:	Under present operations, summer flows are too high. High summer flows reduce the amount of suitable rearing habitat for these species as a result of high water velocities.

Reach Name	Flow and Habitat Conditions	
Mainstem River Reaches		
	Fall/ Winter:	Flows are lower than desired for fish. Lower flows result in reduced available rearing and overwintering habitat throughout the fall and winter. Low flows and a lack of flow variation in fall and winter limits access to available side channels when juvenile Chinook and steelhead (and potentially coho if reestablished) are rearing in this reach. Juvenile salmon seek low-velocity habitat as protection against being pushed out of a reach and to minimize energy expenditures.
Yakima River from Cle Elum to Teanaway River	*Summer*:	Under present operations, flows are too high in summer when juvenile Chinook and steelhead are rearing in this reach. Once reestablished, juvenile coho would also be rearing in this reach. High summer flows reduce the amount of suitable rearing habitat for these species as a result of high water velocities. Juvenile salmon seek low-velocity habitat as protection against being pushed out of a reach and to minimize energy expenditures. The negative effects on rearing juvenile salmonids from high summer flow conditions in this reach occur during all water year types, but are most significant in wet years.
	Fall:	Under present operations, flows are too high in early fall when juvenile Chinook and steelhead are rearing in this reach. Once reestablished, juvenile coho would also be rearing in this reach.
Yakima River from Teanaway River to Roza Dam (Ellensburg Reach)	*Summer*:	Currently, flows are too high from July through early September when juvenile Chinook, steelhead, and coho are rearing in this reach. High summer flows reduce the amount of suitable rearing habitat for these species as a result of high water velocities. Juvenile salmon seek low-velocity habitat as protection against being pushed out of a reach and to minimize energy expenditures. The negative effects on rearing juvenile salmonids from high summer flow conditions in this reach occur during all water year types, but are most significant in wet years.

Reach Name	Flow and Habitat Conditions	
Mainstem River Reaches		
Yakima River from Roza Dam to Naches River	*Spring*:	Currently flows limit fall and winter spawning and rearing for spring Chinook, steelhead, and coho. Flow pulses are absent in the spring affecting outmigration.
	Summer/ *Winter*:	Currently flows limit fall and winter spawning and rearing for spring Chinook, steelhead, and coho.
	Fall:	Currently flows limit fall and winter spawning and rearing for spring Chinook, steelhead, and coho. Flows in the fall are low and need to be increased to support spawning and rearing, and the movement of fish from this reach to the lower river.
Tieton River	*Spring*:	Under present operations, winter flows are low with limited variation into early spring.
	Fall:	In the fall, flows are too high as a result of flip-flop operations (reducing flows in the upper arm of the Yakima River and increasing flows in the Naches River with increased water releases from Rimrock Reservoir).
	Winter:	Under present operations, winter flows are low, limiting spring Chinook and steelhead rearing, and early adult steelhead migrants. Steelhead adults migrate into the Tieton River from February through May.
Lower Naches River	*Spring*:	The ramping rate from high spring flows to summer flows is abrupt, negatively affecting rearing conditions for steelhead, coho and spring Chinook. Coho spawn in this reach from mid-September to mid-December.
	Summer/ *Fall*:	Summer and fall flows are low and the ramping rate from high spring flows to summer flows is abrupt, negatively affecting rearing conditions for steelhead, coho and spring Chinook. Coho spawn in this reach from mid-September to mid-December. Lower flows affect available spawning habitat and migration conditions, including water temperature during summer (spring Chinook and sockeye). Juvenile salmonids that rear in the lower Naches River can be pushed out of this area by high flows during flip-flop operations (Haring 2001).

Reach Name	Flow and Habitat Conditions	
Mainstem River Reaches		
Yakima River from Naches River to Parker	*Summer*:	High summer flow conditions exist in this reach, when juvenile Chinook, steelhead, and coho are rearing. High summer flows can reduce the amount of suitable rearing habitat for these species as a result of high water velocities.
Yakima River from Parker to Prosser Dam	*Spring*:	Flow pulses in this river section are dampened or absent in the spring of most years due to reservoir refill operations, affecting outmigration for all salmonid smolts produced upstream in the basin (spring and fall Chinook, steelhead, coho, and sockeye).
Yakima River from Prosser Dam to Mouth	*Spring*:	Flow pulses in this river section are dampened or absent in the spring of most years due to reservoir refill operations, affecting outmigration for all salmonid smolts produced upstream in the basin (spring and fall Chinook, steelhead, coho, and sockeye).
	Summer:	Summer flows are low, negatively affecting salmonid rearing and migration conditions.
Tributaries		
Above-Reservoir Tributaries	*Year-round*:	Flow conditions above the reservoirs typically remain unaltered with unregulated flow regimes, notwithstanding effects on flow from forest practices, roads, grazing, fire, and other land use influences. Flow variability is retained due to geographic surroundings and persistent flow contributions from springs and smaller drainages. Streams that have experienced flow alterations include Gold Creek, which drains to Keechelus Reservoir, and tributaries to the Kachess River, which become dewatered due to low flows or go subsurface as reservoirs are drawn down (Haring, 2001).

Reach Name	Flow and Habitat Conditions	
Mainstem River Reaches		
Yakima River Tributaries	*Year-round*:	Yakima River tributaries frequently experience low flow in downstream portions as a result of irrigation withdrawals during the late summer and early fall. These flow conditions often preclude salmonids from occupying stream habitat, as do impassable barriers. When diversions for irrigation do not exist, flow conditions tend to remain adequate for fish. However, low precipitation can result in natural low-flow conditions and dry stream channels during the summer and fall. Several streams do not typically experience low-flow conditions. Wilson Creek, which is fed by several tributaries including Naneum Creek, provides year-round flow in the lower reaches despite upstream irrigation withdrawal. Downstream irrigation return flows are largely responsible for these flow conditions (KCCD, 1999). Ahtanum and Cowiche Creeks typically have good flows during the spring, but occasionally experience low flow or variable summer flow due to diversions (Ecology, 2005a; CBSP, 1990). For Ahtanum Creek, the most significant flow reductions occur in these seasons, but the Ahtanum Irrigation Diversion (AID) diverts water year-round and flows are also reduced somewhat in winter.

Appendix C

SPECIAL STATUS SPECIES TABLE

Table C-1. Special Status Species in the Vicinity of the Individual Elements Proposed for the Yakima River Basin Integrated Resources Water Management Plan

	Yakima River (main stem)	Keechelus Lake	Kachess Lake	Cle Elum Lake	Naches River (main stem)	Bumping Lake	Rimrock Lake	**Naches River Tributaries**	Bumping River	Tieton River	**Yakima River Tributaries**	Cle Elum River	Kachess River	Big Creek	Teanaway River	Swauk Creek	Taneum Creek	Manastash Creek	Naneum Creek	Ahtanum Creek	Toppenish Creek	Satus Creek	Cowiche Creek
PRIORITY SPECIES																							
Mammals																							
Gray wolf (*Canis lupus)*; SE, FE		X	X				X																
Wolverine (*Gulo gulo)*; SCAN, FSOC			X			X																	
Lynx (*Lynx canadensis)*; ST, FT						X			X														
Marten (*Martes americana)*; SNONE, FNONE							X			X													
Fisher (*Martes pennanti)* SE, FCAN																X							
Western gray squirrel (*Sciurus griseus)*; ST, FSOC										X											X	X	
Townsend's ground squirrel (*Spermophilus townsendii)*; SCAN, FSOC	X																						
Grizzly bear (*Ursus arctos)*; SE, FT			X	X									X			X							
Reptiles and Amphibians																							
Western toad (*Bufo boreas)*; SCAN, FSOC		X				X	X												X				
Sharptail snake (*Contia tenuis)*; SCAN, FSOC	X																						
Larch mountain salamander (*Plethodon larselli)*; SSEN, FSOC			X	X																			
Columbia spotted frog (*Rana luteiventris)*; SCAN, FNONE	X						X									X							

Table C-1. Special Status Species in the Vicinity of the Individual Elements Proposed for the Yakima River Basin Integrated Resources Water Management Plan

	Yakima River (main stem)	Keechelus Lake	Kachess Lake	Cle Elum Lake	Naches River (main stem)	Bumping Lake	Rimrock Lake	**Naches River Tributaries**	Bumping River	Tieton River	**Yakima River Tributaries**	Cle Elum River	Kachess River	Big Creek	Teanaway River	Swauk Creek	Taneum Creek	Manastash Creek	Naneum Creek	Ahtanum Creek	Toppenish Creek	Satus Creek	Cowiche Creek
Birds																							
Northern Goshawk (*Accipiter gentilis*); SCAN, FSOC		X	X	X	X	X	X		X	X			X	X		X			X				
Golden eagle (*Aquila chrysaetos*); SCAN, FNONE	X									X													
Great blue heron (*Ardea herodias*); SNONE, FNONE	X		X										X		X						X		
Vaux's swift (*Chaetura vauxi*); SCAN, FNONE																			X				
Pileated woodpecker (*Dryocopus pileatus*); SCAN, FNONE							X									X							
Merlin (*Falco columbarius*); SCAN, FNONE				X												X							
Prairie falcon (*Falco mexicanus*); SNONE, FNONE	X						X			X						X							
Peregrine falcon (*Falco peregrinus*); SSEN, FSOC					X		X																
Common loon (*Gavia immer*); SSEN, FNONE					X	X																	
Bald eagle (*Haliaeetus leucocephalus*); SSEN, FSOC	X			X			X					X								X			
Harlequin duck (*Histrionicus histrionicus*); SNONE, FNONE					X					X		X											
Lewis' woodpecker (*Melanerpes lewis*); SCAN, FNONE										X													
Black-crowned night-heron (*Nycticorax nycticorax*); SNONE, FNONE	X																						

Table C-1. Special Status Species in the Vicinity of the Individual Elements Proposed for the Yakima River Basin Integrated Resources Water Management Plan

	Yakima River (main stem)	Keechelus Lake	Kachess Lake	Cle Elum Lake	Naches River (main stem)	Bumping Lake	Rimrock Lake	**Naches River Tributaries**	Bumping River	Tieton River	**Yakima River Tributaries**	Cle Elum River	Kachess River	Big Creek	Teanaway River	Swauk Creek	Taneum Creek	Manastash Creek	Naneum Creek	Ahtanum Creek	Toppenish Creek	Satus Creek	Cowiche Creek
Mountain quail (*Oreortyx pictus)*; SNONE, FNONE			X															X					
White-headed woodpecker (*Picoides albolarvatus)*; SCAN, FNONE							X			X													
Black-backed woodpecker (*Picoides arcticus)*; SCAN, FNONE															X								
Spotted owl (*Strix occidentalis)*; SE, FT		X	X	X		X	X		X			X		X		X							
Plants																							
Tall agoseris (*Agoseris elata*); SS, FNONE																			X				
Pauper milkvetch (*Astragalus misellus* var *pauper*); SS, FNONE	X																						
Ahtiana pallidula (*Ahtiana pallidula*)																X							
Fewflower sedge (*Carex pauciflora*); SS, FS		X																					
Thompson's pincushion (*Chaenactis thompsonii*); SS, FNONE				X								X											
Gray cryptantha (*Cryptantha leucophaea*); SS, FSOC	X																						
Clustered lady's slipper (*Cypripedium fasciculatum*); SS, FSOC				X										X		X							
Basalt daisy (*Erigeron basalticus*); ST, FSOC	X																						
Piper's fleabane (*Erigeron piperianus*); SS, FNONE	X				X																		

Table C-1. Special Status Species in the Vicinity of the Individual Elements Proposed for the Yakima River Basin Integrated Resources Water Management Plan

	Yakima River (main stem)	Keechelus Lake	Kachess Lake	Cle Elum Lake	Naches River (main stem)	Bumping Lake	Rimrock Lake	**Naches River Tributaries**	Bumping River	Tieton River	**Yakima River Tributaries**	Cle Elum River	Kachess River	Big Creek	Teanaway River	Swauk Creek	Taneum Creek	Manastash Creek	Naneum Creek	Ahtanum Creek	Toppenish Creek	Satus Creek	Cowiche Creek
Swamp douglasiana (*Gentiana douglasiana*); SS, FNONE		X																					
Oregon false goldenaster (*Heterotheca oregona*); ST, FNONE									X														
Longsepal wild hollyhock (*Iliamna longisepala*); SS, FNONE																			X				
Hoover's desertparsley (*Lomatium tuberosum*); SS; FSOC	X																						
Coyote tobacco (*Nicotiana attenuate*); SS, FNONE																						X	
Small phacelia (*Phacelia minutissima*); SE, FSOC																			X				
Tacky goldenweed (*Pyrrocoma hirta* var *sonchifolia*); SS, FNONE																			X				
Oregon white oak (*Quercus garryana*)																X							
Mountain blue-eyed grass (*Sisyrinchium sarmentosum*); ST, FSOC						X	X																
Creamy lady's tresses (*Spiranthes porrifolia*); SS, FNONE			X																				
American waterawlwort (*Subularia aquatica* var *americana*); SR1, FNONE			X										X										
Hoover's umbrellawort (*Tauschia hooveri*); ST, FSOC																							X
PRIORITY HABITAT TYPES																							
Bald eagle	X		X							X			X										X

Table C-1. Special Status Species in the Vicinity of the Individual Elements Proposed for the Yakima River Basin Integrated Resources Water Management Plan

	Yakima River (main stem)	Keechelus Lake	Kachess Lake	Cle Elum Lake	Naches River (main stem)	Bumping Lake	Rimrock Lake	**Naches River Tributaries**	Bumping River	Tieton River	**Yakima River Tributaries**	Cle Elum River	Kachess River	Big Creek	Teanaway River	Swauk Creek	Taneum Creek	Manastash Creek	Naneum Creek	Ahtanum Creek	Toppenish Creek	Satus Creek	Cowiche Creek
Burrowing owl	X																						
Big game			X	X																			
Big horn sheep					X													X					
Cliffs/Bluffs	X	X	X	X	X		X		X	X			X			X		X	X				
Elk	X	X	X	X	X	X	X		X	X		X		X	X	X	X	X	X	X			
Ferruginous hawk	X																						
Golden eagle	X									X													
Great blue heron	X																					X	
Harlequin duck										X													
Mountain goat		X	X	X		X	X					X	X										
Mule and Black-tailed deer	X				X					X					X	X		X		X			
Mule deer	X						X									X			X				
Oak woodlands	X									X						X							
Old Growth		X							X			X											
Riparian Zones	X		X	X	X					X		X	X	X	X	X	X	X	X	X	X	X	X
Rocky mountain big horn sheep	X				X					X													
Rocky mountain elk							X		X	X									X				
Rural Natural Open Space	X																						
Sharptail snake	X																						
Shrub-steppe	X																						
Spotted Owl Critical Habitat		X	X	X		X	X		X	X		X	X			X	X		X				

Table C-1. Special Status Species in the Vicinity of the Individual Elements Proposed for the Yakima River Basin Integrated Resources Water Management Plan

	Yakima River (main stem)	Keechelus Lake	Kachess Lake	Cle Elum Lake	Naches River (main stem)	Bumping Lake	Rimrock Lake	**Naches River Tributaries**	Bumping River	Tieton River	**Yakima River Tributaries**	Cle Elum River	Kachess River	Big Creek	Teanaway River	Swauk Creek	Taneum Creek	Manastash Creek	Naneum Creek	Ahtanum Creek	Toppenish Creek	Satus Creek	Cowiche Creek
Talus slopes					X	X	X		X														
Urban Natural Open Space	X				X													X					X
Waterfowl concentrations	X						X																
Wetlands	X	X	X	X	X	X	X		X						X								
White-tailed deer				X																			
Wood duck	X				X					X		X			X								X

Legend

FE=Federally endangered
FT=Federally threatened
FCAN=Federal candidate species
FS=Federal sensitive species
FSOC=Federal species of concern
FNONE=No listing

SE=State endangered
ST=State threatened
SCAN=State candidate species
SS=State sensitive species
SSOC=State species of concern
SNONE=No listing
SR1=Review group 1. Of potential concern but needs more field work to assign another rank.

Appendix D

STREAMS REGULATED BY THE SHORELINE MANAGEMENT ACT

Table D-1 Rivers and Streams Protected under the Shoreline Management Act, 1972.

Benton County (WAC 173-18-070)	
Yakima River	**From Benton-Yakima County line (Sec.7, T8N, R24E) down-stream to mouth on Columbia River Sec.19, T9N, R29E).**
Yakima County (WAC 173-18-430)	
Ahtanum Creek	**From confluence of North and South Forks of Ahtanum Creek (Sec.17, T12N, R16E) downstream to mouth at Yakima River (Sec.17, T12N, R19E) excluding those reaches within Yakima Indian Reservation**
Ahtanum Creek (North Fork)	**From confluence of Ahtanum Creek North Fork and Ahtanum Creek Middle Fork (Sec.24, T12N, R14E) downstream to confluence with S. Fork of Ahtanum Creek (Sec.17, T12N, R16E)**
Ahtanum Creek (South Fork)	**From confluence of unnamed creek and Ahtanum Creek South Fork (Sec.24, T12N, R15E) downstream to confluence with N. Fork of Ahtanum Creek.**
Swauk Creek	**From the boundary (Sec.10, T20N, R17E) downstream (excluding all Federal lands) to confluence with Yakima River (Sec.20, T19N, R17E).**
Cowiche Creek (South Fork)	**From an approximate point (NW1/4 of NE1/4 Sec.33, T14N, R16E) downstream through Cowiche Creek to confluence with Naches River (Sec.9, T13N, R18E).**
Bumping River	**From U.S.G.S. gaging station (Sec.23, T16N, R12E) downstream to confluence with Naches and Little Naches rivers (Sec.4, T17N, R14E). Excluding Federal lands.**
Little Naches River	**From confluence of N. Fork and M. Fork Little Naches River (Sec.36, T19N, R12E) downstream to confluence with Naches River (Sec.4, T17N, R14E). Excluding Federal lands.**
Naches River	**From confluence of Little Naches River and Bumping River (Sec.4, T17N, R14E) downstream to confluence with Yakima River (Sec.12, T13N, R18E). Excluding Federal lands.**
Rattlesnake Creek	**From Snoqualmie National Forest boundary (Sec.6, T15N, R15E) downstream to mouth at Naches River (Sec.3, same township).**
Tieton River	**From west section line (Sec.29, T14N, R15E) downstream to confluence with Naches River (Sec.35, T15N, R16E). Excluding Federal lands.**
Tieton River (South Fork)	**From the south section line (Sec.23, T12N, R12E) downstream to mouth at Rimrock Lake (Sec.7, T13N, R14E). Excluding Federal lands.**
Yakima River	**From the Kittitas County line (Sec.33, T15N, R19E) downstream, excluding all Federal lands and Yakima Indian Reservation, to Benton County line (Sec.7, T8N, R24E).**

Kittitas County (WAC 173-18-230)	
Big Creek	**From the Okanogan-Wenatchee National Forest (OWNF) boundary (Sec.35, T20N, R13E) downstream (excluding Federal lands) to confluence with Yakima River (Sec.21, T20N, R14E).**
Cabin Creek	**From the OWNF boundary (Sec.19, T20N, R13E) downstream to confluence with Yakima River (Sec.9, T20N, R13E).**
Cle Elum River	**From the OWNF boundary crossing Cle Elum Lake (Sec.33, 34 & 35, T21N, R14E) downstream to confluence with Yakima River (Sec.32, T20N, R15E).**
Kachess River	**From the OWNF boundary (Sec.3, T20N, R13E) downstream through Lake Easton State Park and to confluence with Yakima River (same section).**
Little Creek	**From the OWNF boundary (Sec.33, T20N, R14E) (excluding all Federal lands) downstream to confluence with Yakima River (Sec.22, T20N, R14E)**
Log Creek	**From confluence of Log Creek and unnamed creek (NW1/4, SW1/4 Sec.31, T20N, R13E) downstream to confluence with Cabin Creek (Sec.19, T20N, R13E)**
Manastash Creek	**From confluence of N. and S. Forks Manastash Creek (Sec.17, T17N, R17E) downstream to confluence with Yakima River (Sec.4, T17N, R18E)**
Manastash Creek (South Fork)	**From the OWNF boundary (Sec.31, T18N, R16E) downstream to confluence with Manastash Creek (Sec.17, T17N, R17E).**
Taneum Creek	**From OWNF boundary (Sec.30, T19N, R16E) downstream (excluding all Federal lands) to mouth on Yakima River (Sec.33, T19N, R17E).**
Teanaway River	**From the confluence of the M. Fork and the W. Fork Teanaway River (Sec.6, T20N, R16E) downstream to Yakima River (Sec.3, T19N, R16E).**
Teanaway River (Middle Fork)	**From the OWNF boundary (Sec.15, T21N, R15E) downstream to confluence with Teanaway River (Sec.6, T20N, R16E).**
Teanaway River (North Fork)	**From the OWNF boundary (Sec.4, T21N, R16E) downstream (excluding all Federal lands) to the Teanaway River (Sec.6, T20N, R16E).**
Teanaway River (West Fork)	**From the OWNF boundary (Sec.30, T21N, R15E) downstream (excluding all Federal lands) to the Teanaway River (Sec.6, T20N, R16E).**
Wilson Creek	**From confluence with Naneum Creek (Sec.30, T17N, R19E) downstream to confluence with Yakima River (Sec.31, T17N, R19E).**
Yakima River	**From the OWNF boundary (Sec.15, T21N, R12E) downstream (excluding all Federal lands) to the Yakima Co. line (Sec.33, T15N, R19E).**

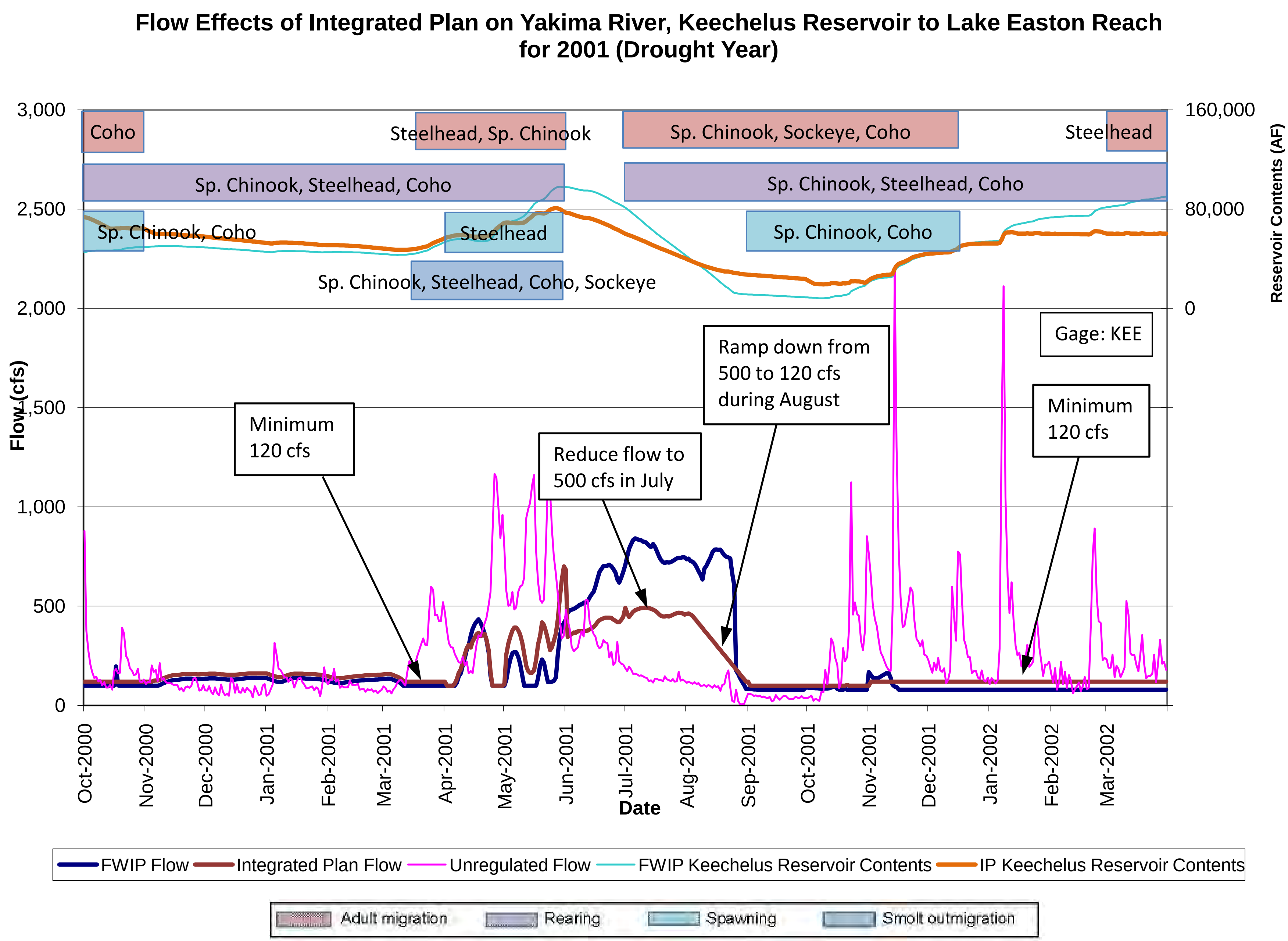
Table D-2 Lakes Protected under the Shoreline Management Act, 1972

Name	Location	Area (Acres)	Use[1]
Benton County (WAC 173-20-090)			
No Lakes in Project Area			
Kittitas County (WAC 173-20-400)			
Manastash Lake	Sec. 3, T17N, R15E	23.5	R
Lake Easton	Sec. 11, T20N, R13E	237.6	R, I
Lost Lake	Sec. 3, T21N, R11E	144.8	R
Cooper Lake	Sec. 2, T22N, R13E	119.7	R
Tucquala Lake	Sec. 3, T23N, R14E	63	R
Unnamed Lakes	Sec. 14, T21N, R12E	60	R
Lakes of Statewide Significance (WAC 173-20-400)			
Cle Elum Lake	Sec. 10, T15N, R23E	4810.0	R, I
Keechelus Lake	Sec. 12, T21N, R11E	2560.0	R, I
Kachess Lake	Sec. 34, T21, R13E	4540.0	R, I
Yakima County (WAC 173-20-800)			
Byron Ponds (Res.)	Sec. 12, T8N, R23E	50	R
Horseshoe Pond	Sec. 22, T9N, R22N	59	R
Morgan Pond	Sec. 25, T9N, R22E	24.6	R
Giffin Lake	Sec. 26, T9N, R22E	104.8	R
Oleys Lake	Sec. 7, T9N, R22E	35.4	R
Freeway Lake	Sec. 7, T13n, R19E	23.2	R
Wenas Lake	Sec. 2, T15N, R17E	61.4	R, I
Unnamed Lake	Sec. 31, T14N, R19E	22.3	R
Unnamed Lake	Sec. 11, T13N, R18E	21.4	R
Unnamed Lake	Sec. 11, T13N, R18E	21.3	R

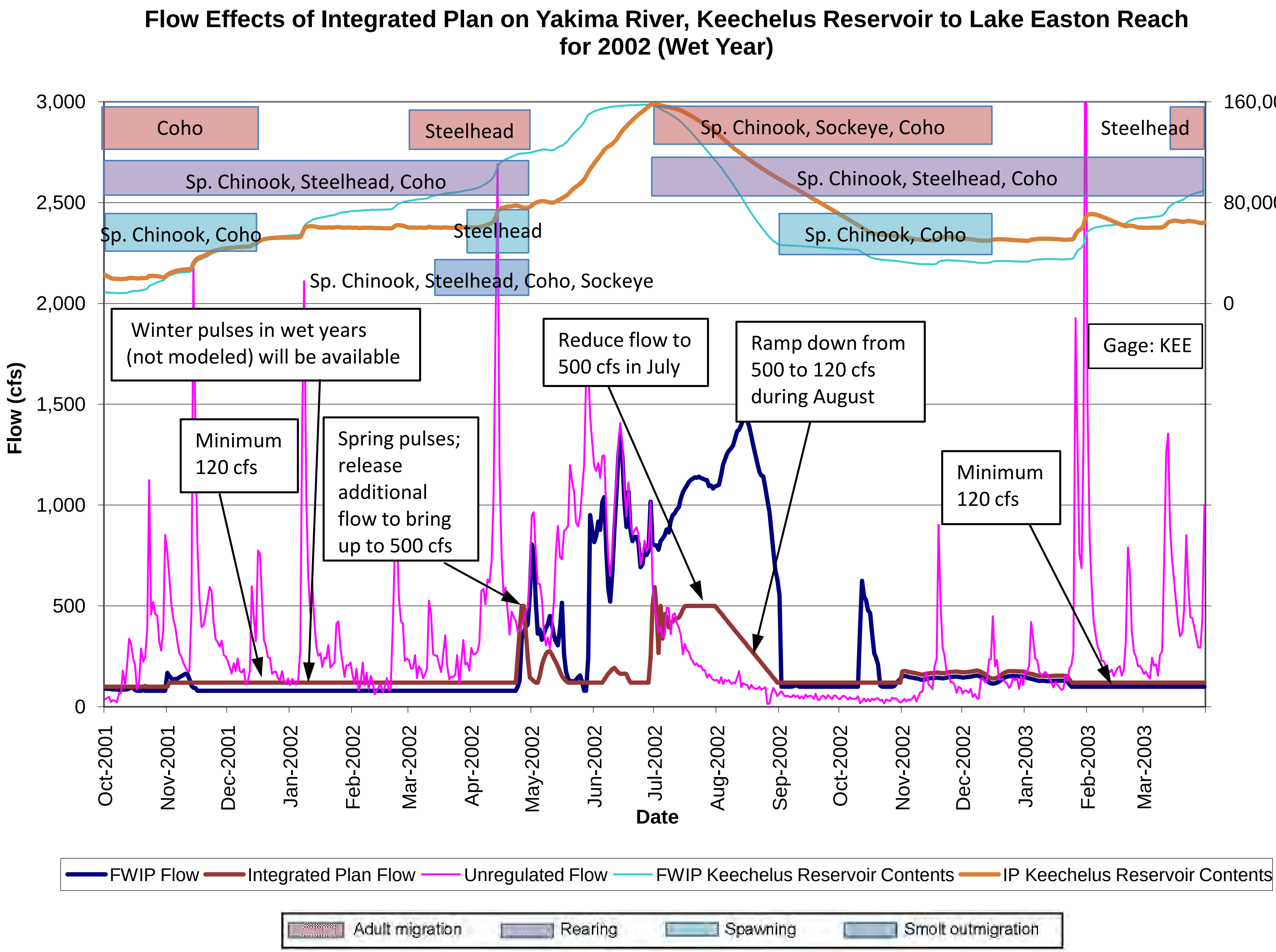
[1] R = Recreation – wildlife, general public use, beautification, fishing, etc.; I = Irrigation (WAC 173-20-040)

Appendix E

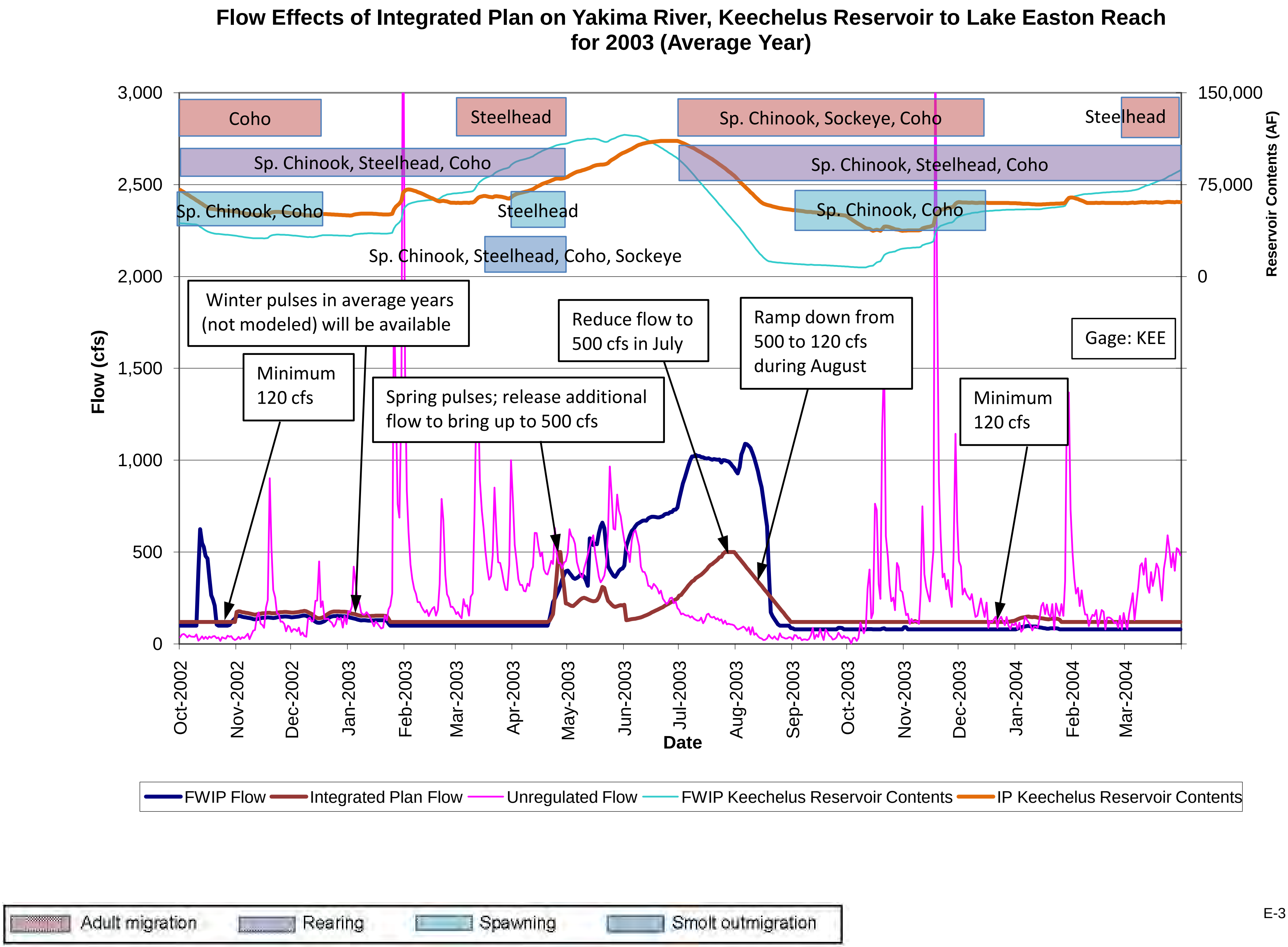
RIVERWARE MODELING

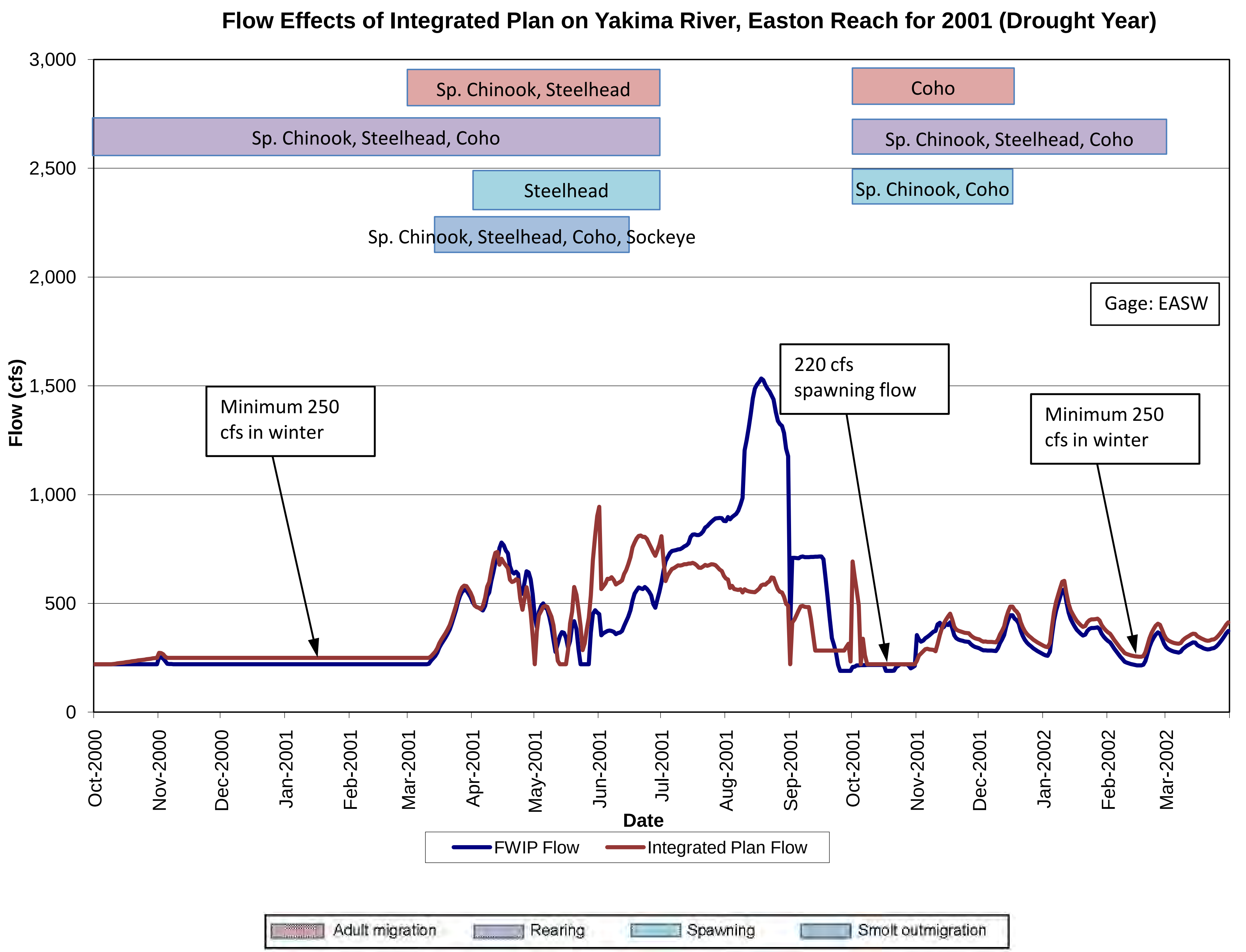


Flow Effects of Integrated Plan on Yakima River, Keechelus Reservoir to Lake Easton Reach
for 2001 (Drought Year)
Coho
Steelhead, Sp. Chinook
Sp. Chinook, Sockeye, Coho
Steelhead
Sp. Chinook, Steelhead, Coho
Sp. Chinook, Steelhead, Coho
Sp. Chinook, Coho
Steelhead
Sp. Chinook, Coho
Sp. Chinook, Steelhead, Coho, Sockeye
Gage: KEE
Ramp down from 500 to 120 cfs during August
Minimum 120 cfs
Reduce flow to 500 cfs in July
Minimum 120 cfs
3,000
2,500
2,000
1,500
1,000
500
0
Flow (cfs)
160,000
80,000
0
Reservoir Contents (AF)
Oct-2000
Nov-2000
Dec-2000
Jan-2001
Feb-2001
Mar-2001
Apr-2001
May-2001
Jun-2001
Jul-2001
Aug-2001
Sep-2001
Oct-2001
Nov-2001
Dec-2001
Jan-2002
Feb-2002
Mar-2002
Date
FWIP Flow
Integrated Plan Flow
Unregulated Flow
FWIP Keechelus Reservoir Contents
IP Keechelus Reservoir Contents
Adult migration
Rearing
Spawning
Smolt outmigration

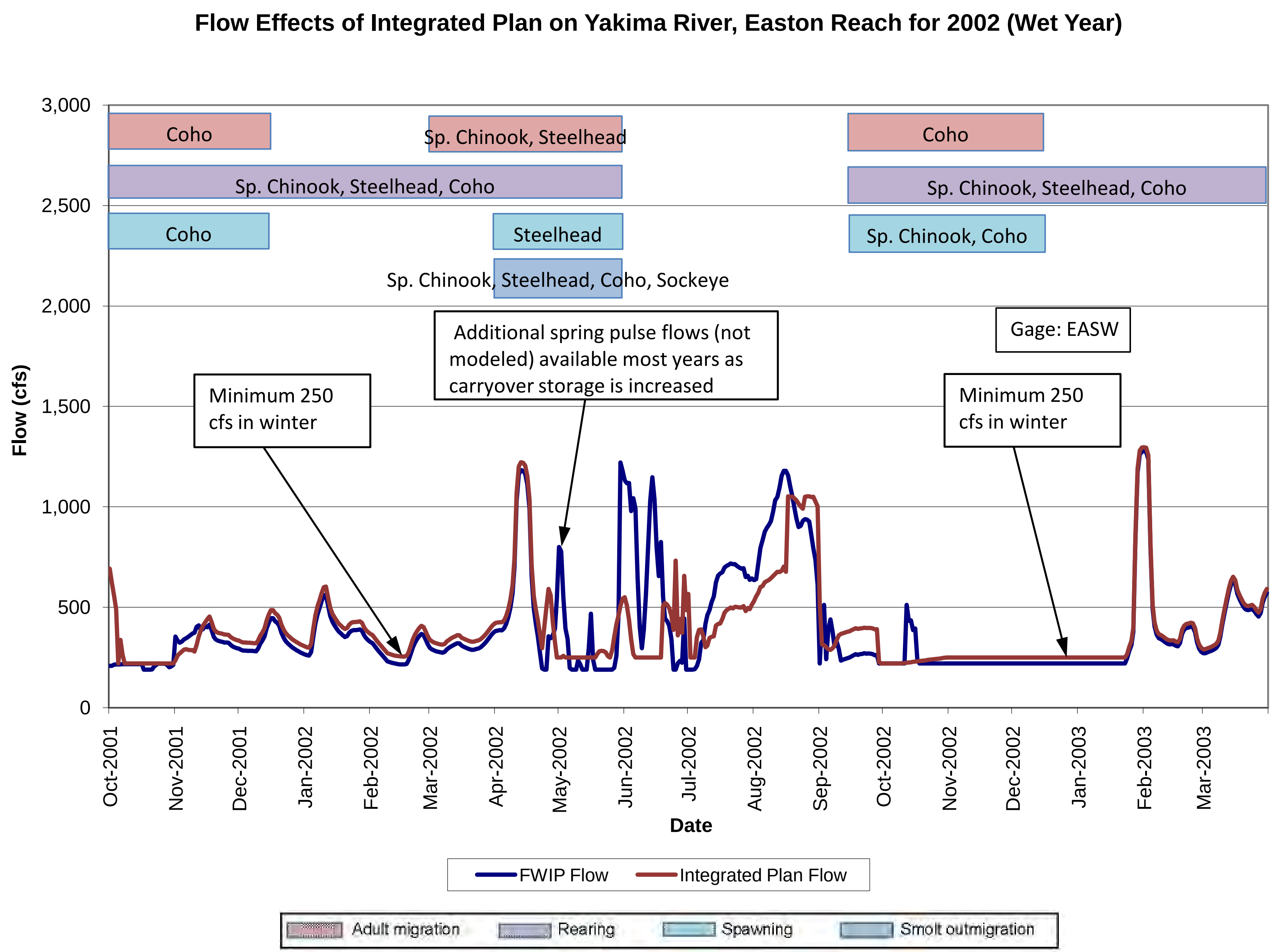


Flow Effects of Integrated Plan on Yakima River, Keechelus Reservoir to Lake Easton Reach for 2002 (Wet Year)
Coho
Steelhead
Sp. Chinook, Sockeye, Coho
Steelhead
Sp. Chinook, Steelhead, Coho
Sp. Chinook, Steelhead, Coho
Sp. Chinook, Coho
Steelhead
Sp. Chinook, Coho
Sp. Chinook, Steelhead, Coho, Sockeye
Winter pulses in wet years (not modeled) will be available
Reduce flow to 500 cfs in July
Ramp down from 500 to 120 cfs during August
Gage: KEE
Minimum 120 cfs
Spring pulses; release additional flow to bring up to 500 cfs
Minimum 120 cfs
Flow (cfs)
Reservoir Contents (AF)
Date
3,000
2,500
2,000
1,500
1,000
500
0
160,000
80,000
0
Oct-2001
Nov-2001
Dec-2001
Jan-2002
Feb-2002
Mar-2002
Apr-2002
May-2002
Jun-2002
Jul-2002
Aug-2002
Sep-2002
Oct-2002
Nov-2002
Dec-2002
Jan-2003
Feb-2003
Mar-2003
FWIP Flow
Integrated Plan Flow
Unregulated Flow
FWIP Keechelus Reservoir Contents
IP Keechelus Reservoir Contents
Adult migration
Rearing
Spawning
Smolt outmigration

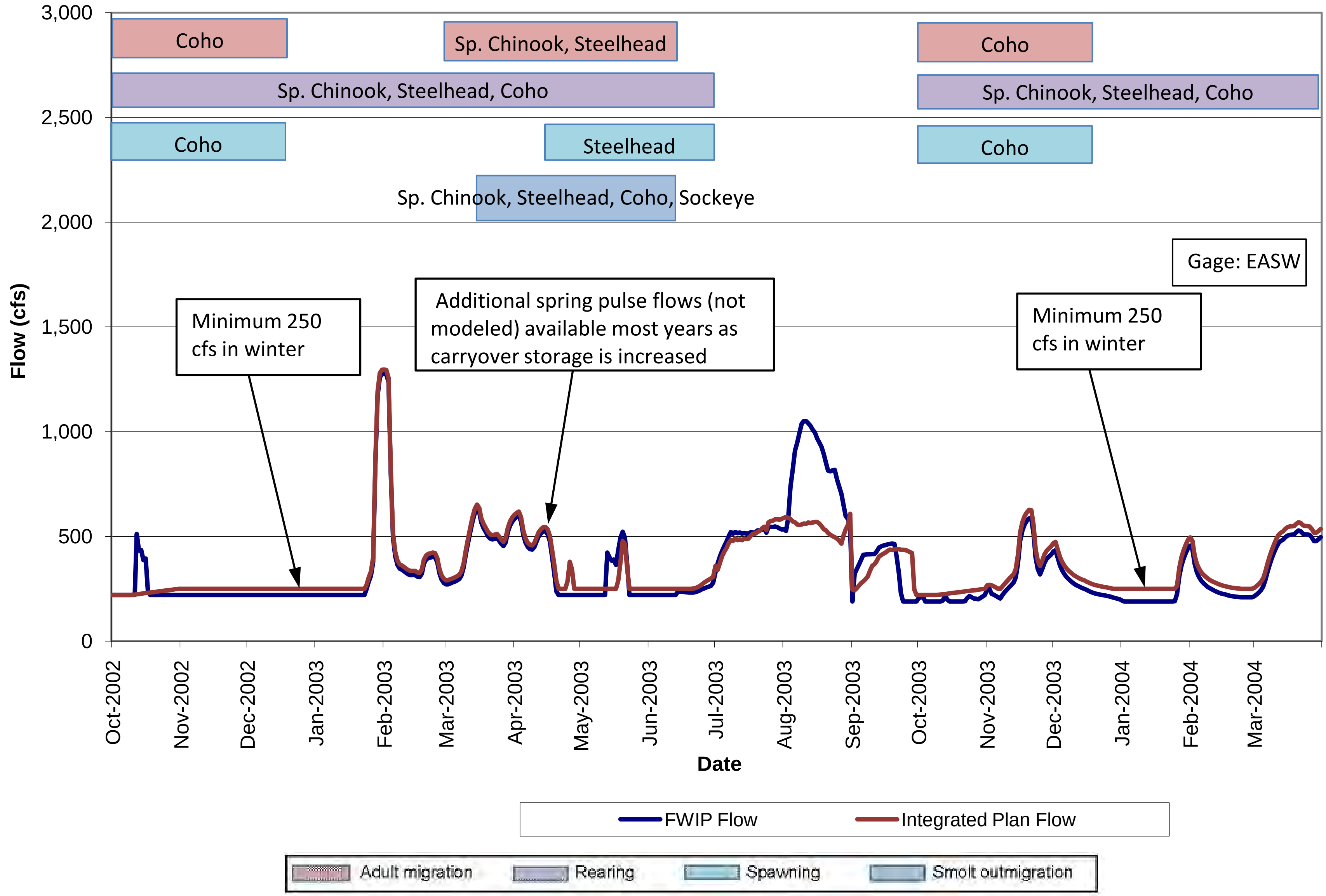

Flow Effects of Integrated Plan on Yakima River, Keechelus Reservoir to Lake Easton Reach for 2003 (Average Year)
Coho
Steelhead
Sp. Chinook, Sockeye, Coho
Steelhead
Sp. Chinook, Steelhead, Coho
Sp. Chinook, Steelhead, Coho
Sp. Chinook, Coho
Steelhead
Sp. Chinook, Coho
Sp. Chinook, Steelhead, Coho, Sockeye
Winter pulses in average years (not modeled) will be available
Reduce flow to 500 cfs in July
Ramp down from 500 to 120 cfs during August
Gage: KEE
Minimum 120 cfs
Spring pulses; release additional flow to bring up to 500 cfs
Minimum 120 cfs
Flow (cfs)
Reservoir Contents (AF)
3,000
2,500
2,000
1,500
1,000
500
0
150,000
75,000
0
Oct-2002
Nov-2002
Dec-2002
Jan-2003
Feb-2003
Mar-2003
Apr-2003
May-2003
Jun-2003
Jul-2003
Aug-2003
Sep-2003
Oct-2003
Nov-2003
Dec-2003
Jan-2004
Feb-2004
Mar-2004
Date
FWIP Flow
Integrated Plan Flow
Unregulated Flow
FWIP Keechelus Reservoir Contents
IP Keechelus Reservoir Contents
Adult migration
Rearing
Spawning
Smolt outmigration

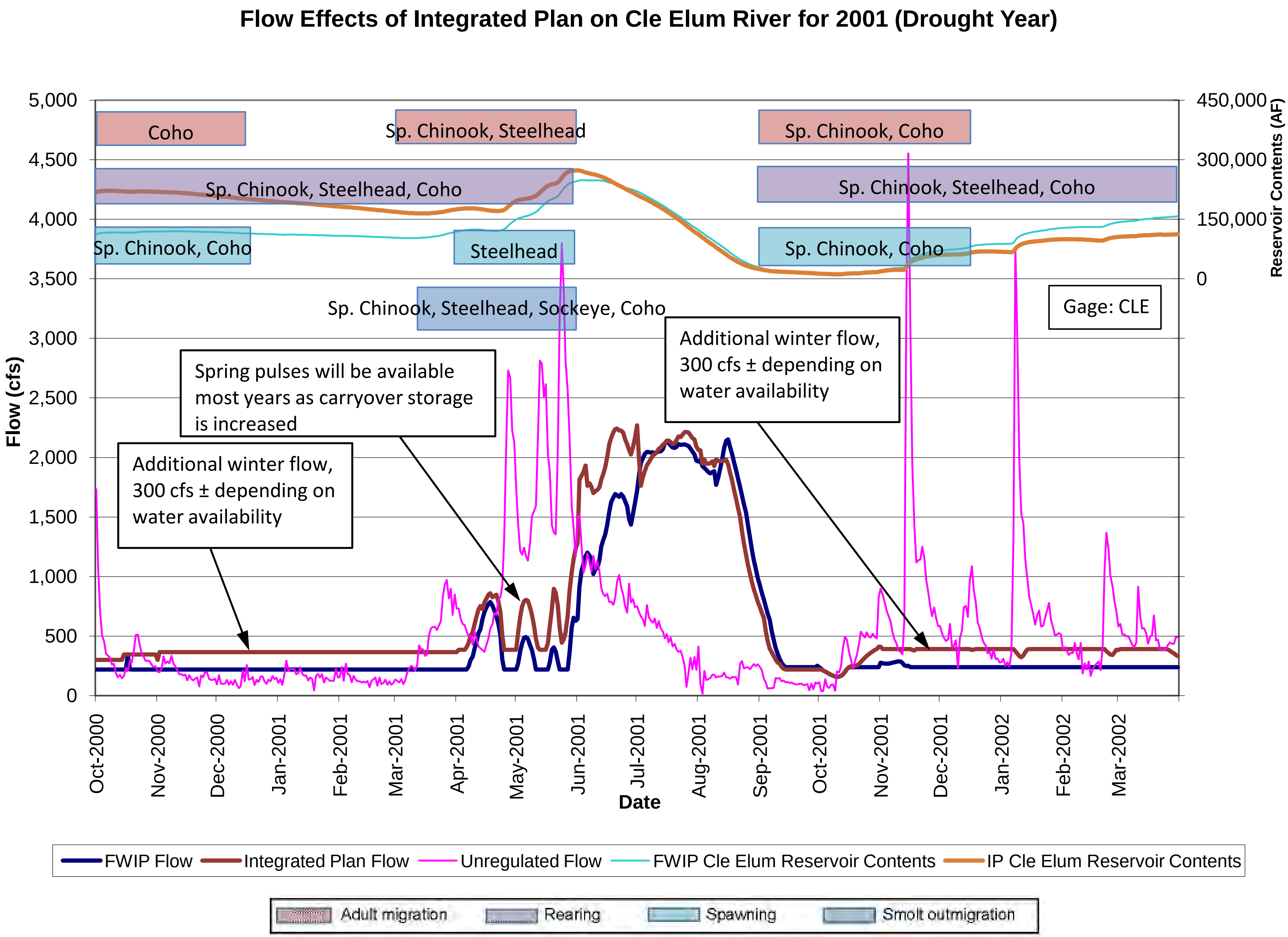


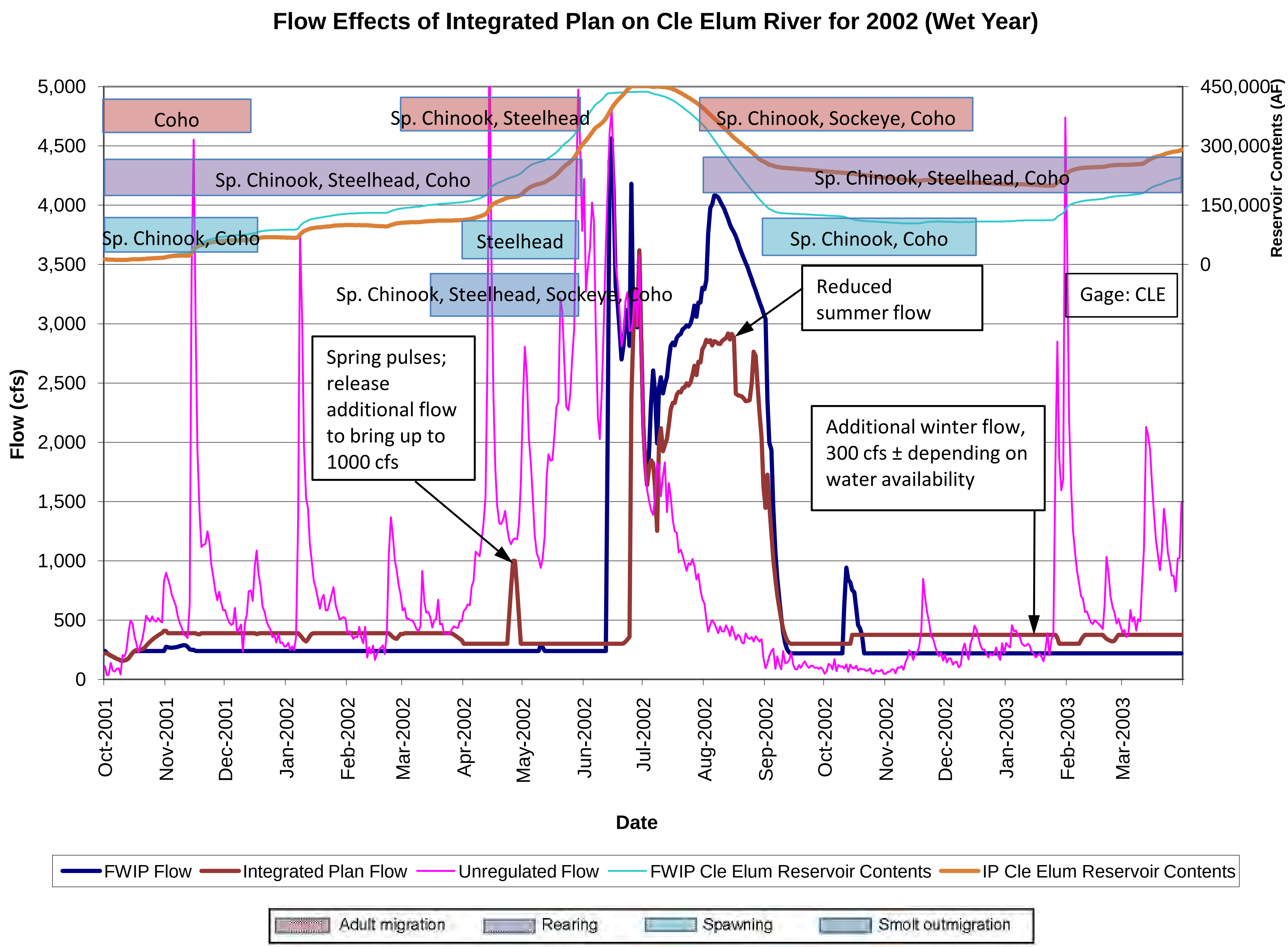
Flow Effects of Integrated Plan on Yakima River, Easton Reach for 2001 (Drought Year)
Sp. Chinook, Steelhead
Sp. Chinook, Steelhead, Coho
Steelhead
Sp. Chinook, Steelhead, Coho, Sockeye
Coho
Sp. Chinook, Steelhead, Coho
Sp. Chinook, Coho
Gage: EASW
Minimum 250 cfs in winter
220 cfs spawning flow
Minimum 250 cfs in winter
Flow (cfs)
3,000
2,500
2,000
1,500
1,000
500
0
Oct-2000
Nov-2000
Dec-2000
Jan-2001
Feb-2001
Mar-2001
Apr-2001
May-2001
Jun-2001
Jul-2001
Aug-2001
Sep-2001
Oct-2001
Nov-2001
Dec-2001
Jan-2002
Feb-2002
Mar-2002
Date
FWIP Flow
Integrated Plan Flow
Adult migration
Rearing
Spawning
Smolt outmigration


Flow Effects of Integrated Plan on Yakima River, Easton Reach for 2002 (Wet Year)
Coho
Sp. Chinook, Steelhead
Coho
Sp. Chinook, Steelhead, Coho
Sp. Chinook, Steelhead, Coho
Coho
Steelhead
Sp. Chinook, Coho
Sp. Chinook, Steelhead, Coho, Sockeye
Additional spring pulse flows (not modeled) available most years as carryover storage is increased
Gage: EASW
Minimum 250 cfs in winter
Minimum 250 cfs in winter
Flow (cfs)
3,000
2,500
2,000
1,500
1,000
500
0
Oct-2001
Nov-2001
Dec-2001
Jan-2002
Feb-2002
Mar-2002
Apr-2002
May-2002
Jun-2002
Jul-2002
Aug-2002
Sep-2002
Oct-2002
Nov-2002
Dec-2002
Jan-2003
Feb-2003
Mar-2003
Date
FWIP Flow
Integrated Plan Flow
Adult migration
Rearing
Spawning
Smolt outmigration

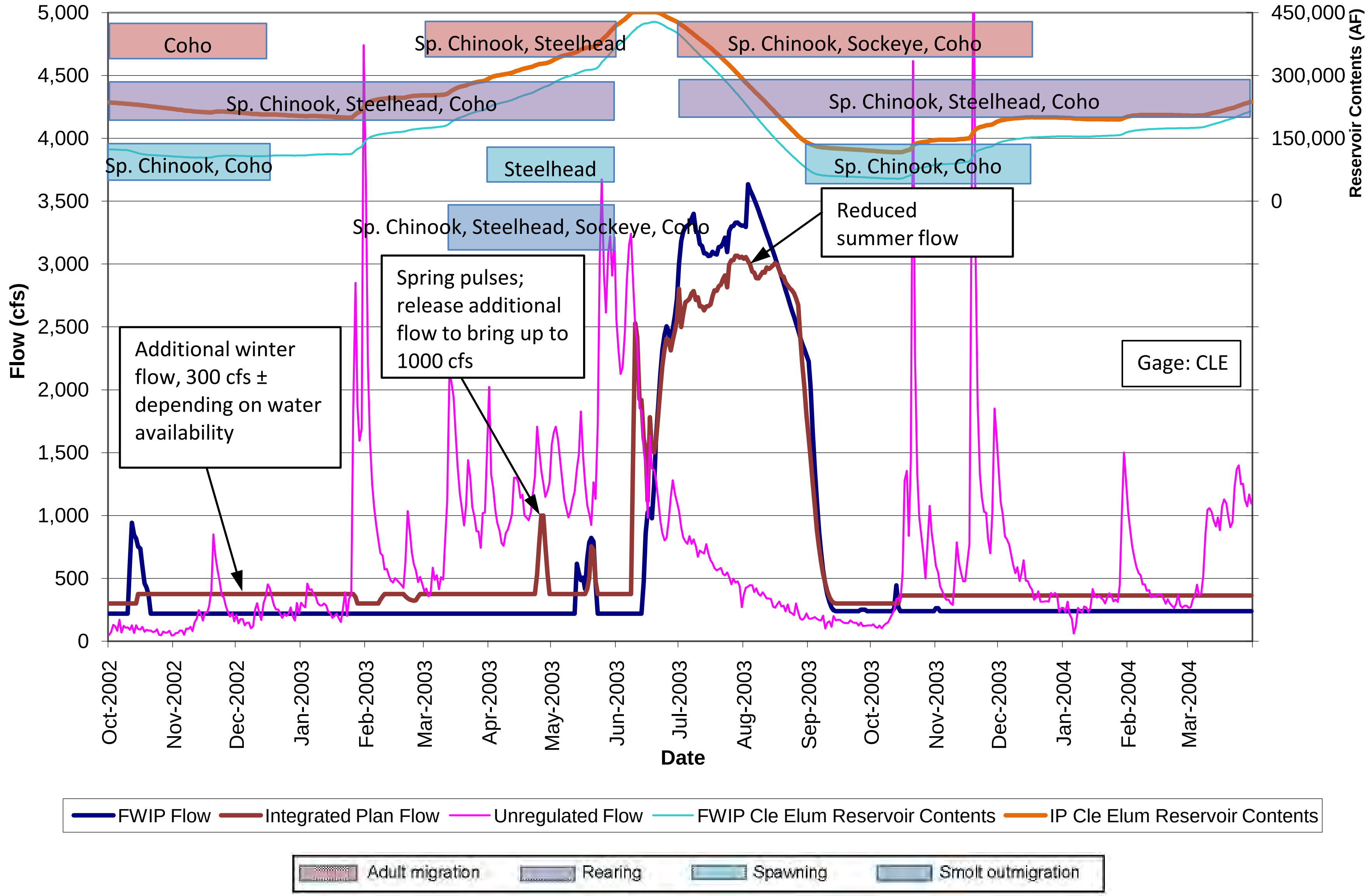
Flow Effects of Integrated Plan on Yakima River, Easton Reach for 2003 (Average Year)

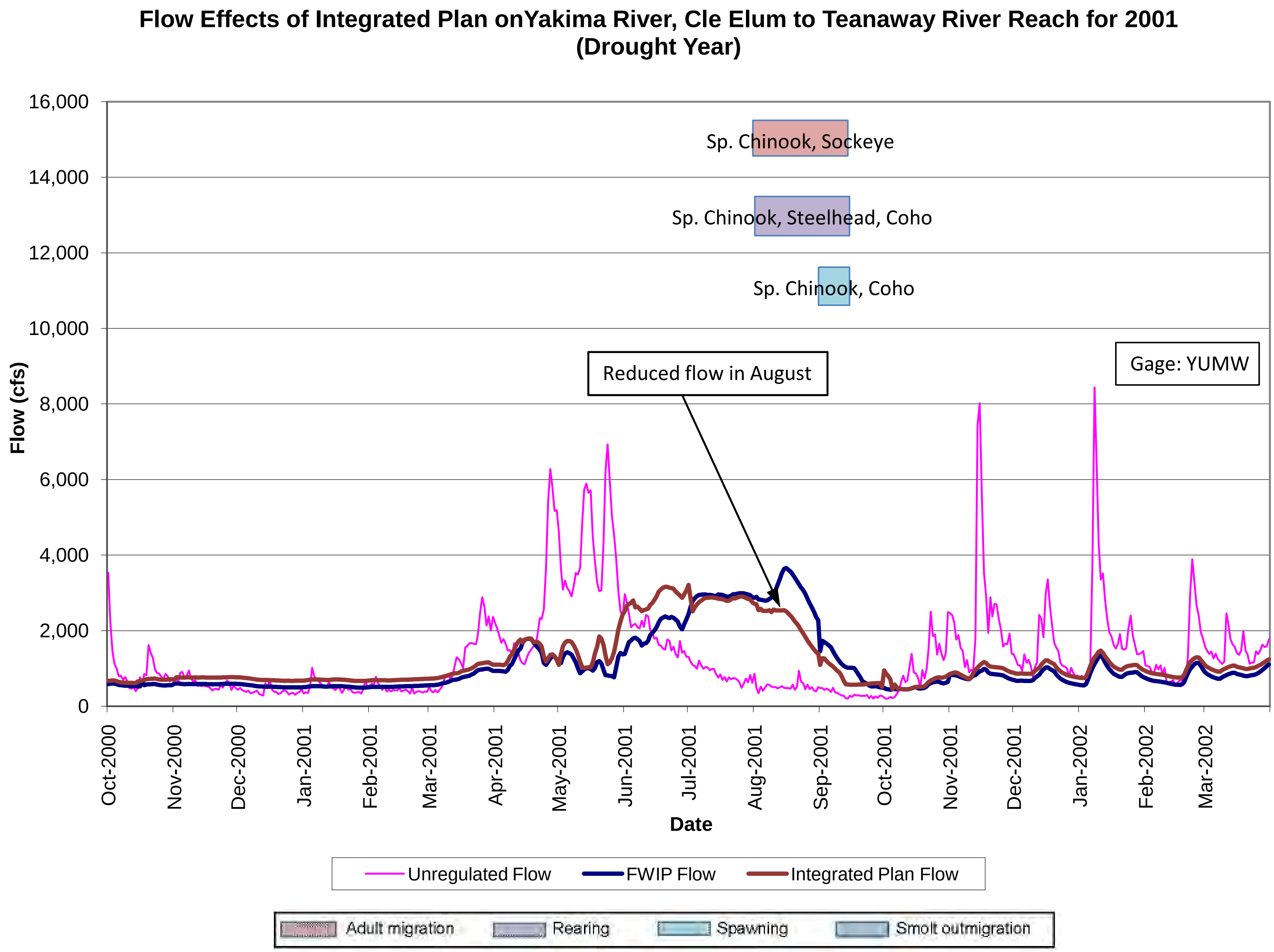



Flow Effects of Integrated Plan on Cle Elum River for 2001 (Drought Year)
Coho
Sp. Chinook, Steelhead
Sp. Chinook, Coho
Sp. Chinook, Steelhead, Coho
Sp. Chinook, Steelhead, Coho
Sp. Chinook, Coho
Steelhead
Sp. Chinook, Coho
Sp. Chinook, Steelhead, Sockeye, Coho
Gage: CLE
Additional winter flow, 300 cfs ± depending on water availability
Spring pulses will be available most years as carryover storage is increased
Additional winter flow, 300 cfs ± depending on water availability
Flow (cfs)
Reservoir Contents (AF)
Date
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
450,000
300,000
150,000
0
Oct-2000
Nov-2000
Dec-2000
Jan-2001
Feb-2001
Mar-2001
Apr-2001
May-2001
Jun-2001
Jul-2001
Aug-2001
Sep-2001
Oct-2001
Nov-2001
Dec-2001
Jan-2002
Feb-2002
Mar-2002
FWIP Flow
Integrated Plan Flow
Unregulated Flow
FWIP Cle Elum Reservoir Contents
IP Cle Elum Reservoir Contents
Adult migration
Rearing
Spawning
Smolt outmigration

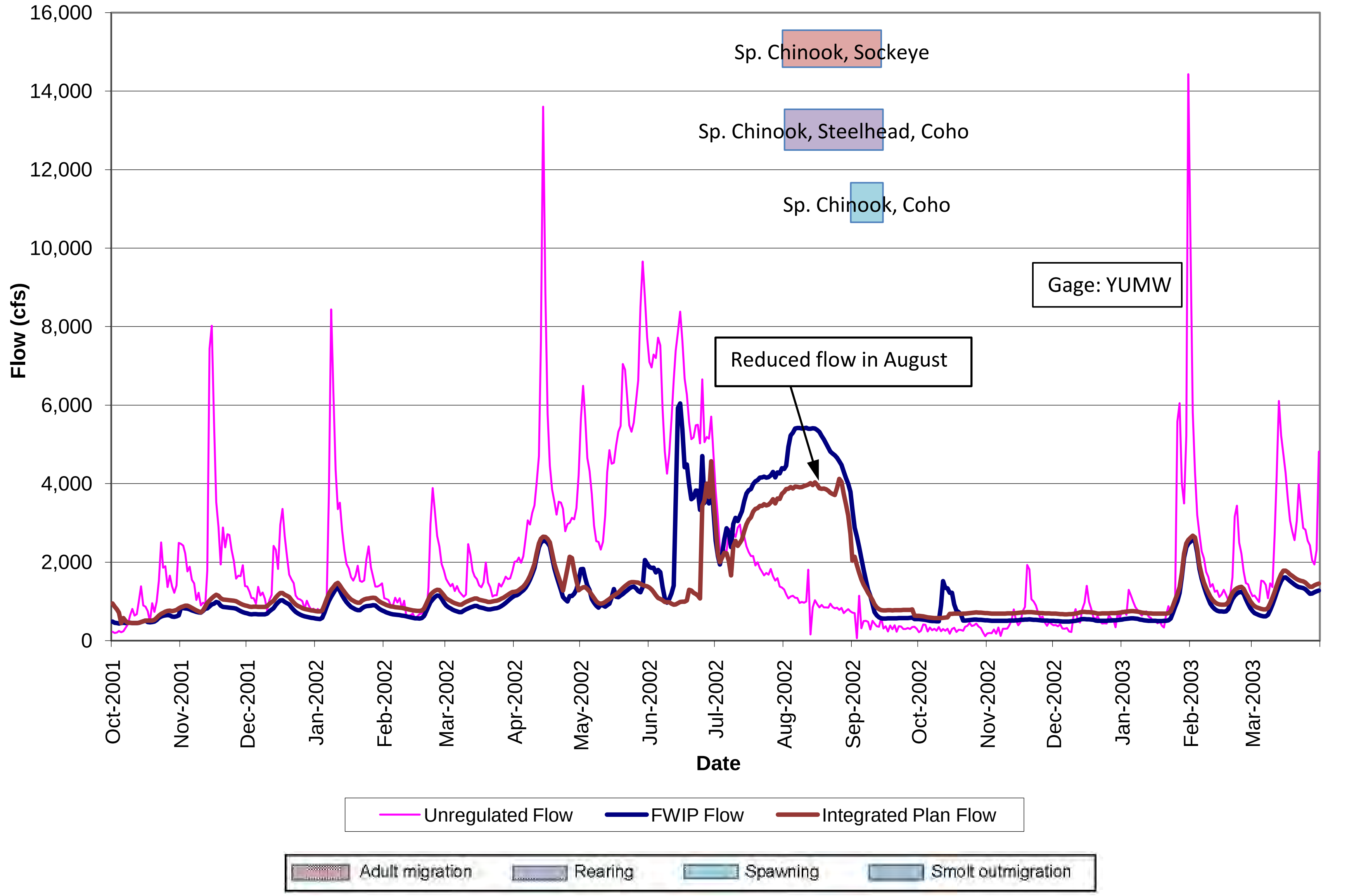

Flow Effects of Integrated Plan on Cle Elum River for 2002 (Wet Year)
Flow (cfs)
Reservoir Contents (AF)
Date
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
450,000
300,000
150,000
0
Oct-2001
Nov-2001
Dec-2001
Jan-2002
Feb-2002
Mar-2002
Apr-2002
May-2002
Jun-2002
Jul-2002
Aug-2002
Sep-2002
Oct-2002
Nov-2002
Dec-2002
Jan-2003
Feb-2003
Mar-2003
Coho
Sp. Chinook, Steelhead
Sp. Chinook, Sockeye, Coho
Sp. Chinook, Steelhead, Coho
Sp. Chinook, Steelhead, Coho
Sp. Chinook, Coho
Steelhead
Sp. Chinook, Coho
Sp. Chinook, Steelhead, Sockeye, Coho
Reduced summer flow
Gage: CLE
Spring pulses; release additional flow to bring up to 1000 cfs
Additional winter flow, 300 cfs ± depending on water availability
FWIP Flow
Integrated Plan Flow
Unregulated Flow
FWIP Cle Elum Reservoir Contents
IP Cle Elum Reservoir Contents
Adult migration
Rearing
Spawning
Smolt outmigration

Flow Effects of Integrated Plan on Cle Elum River for 2003 (Average Year)

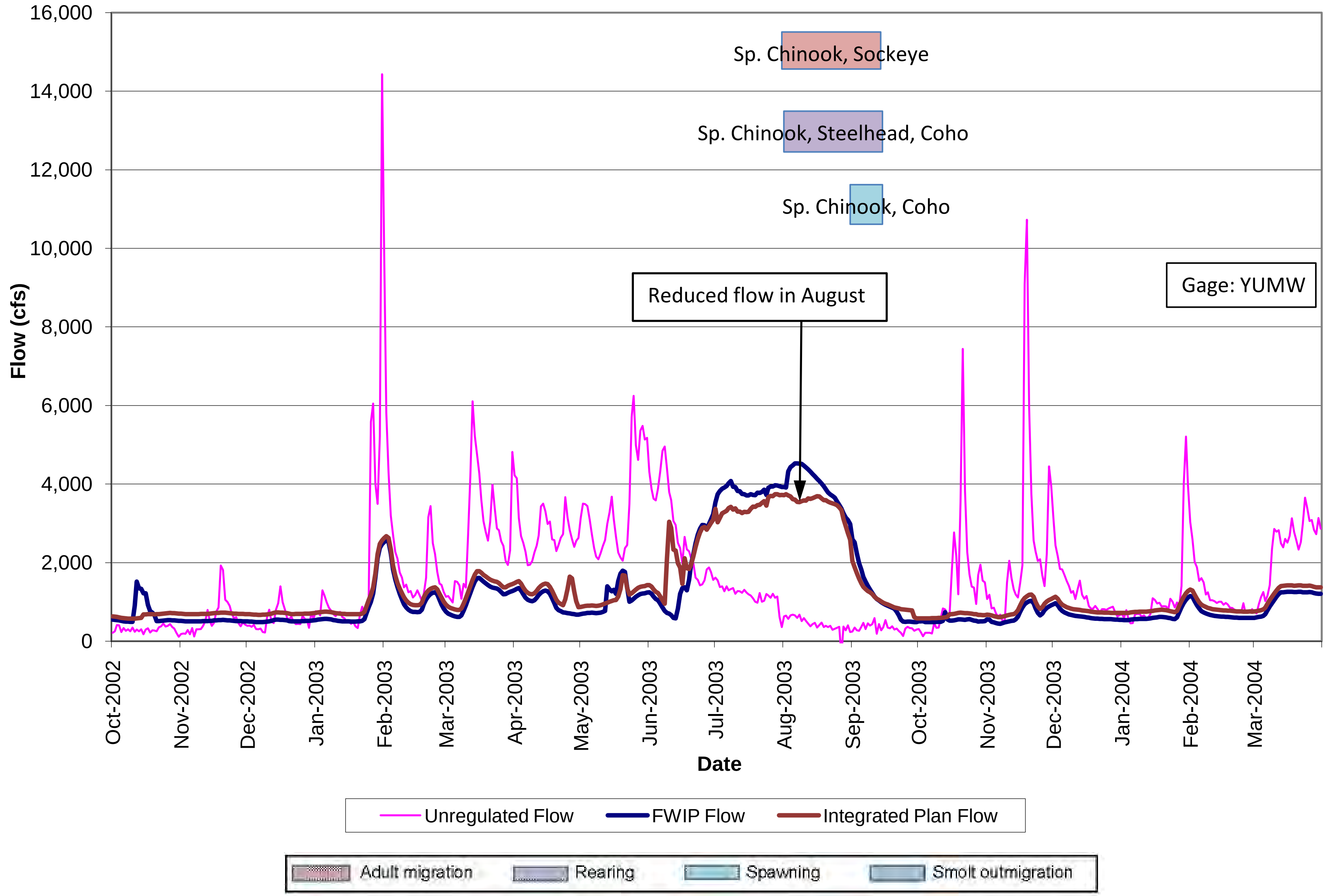


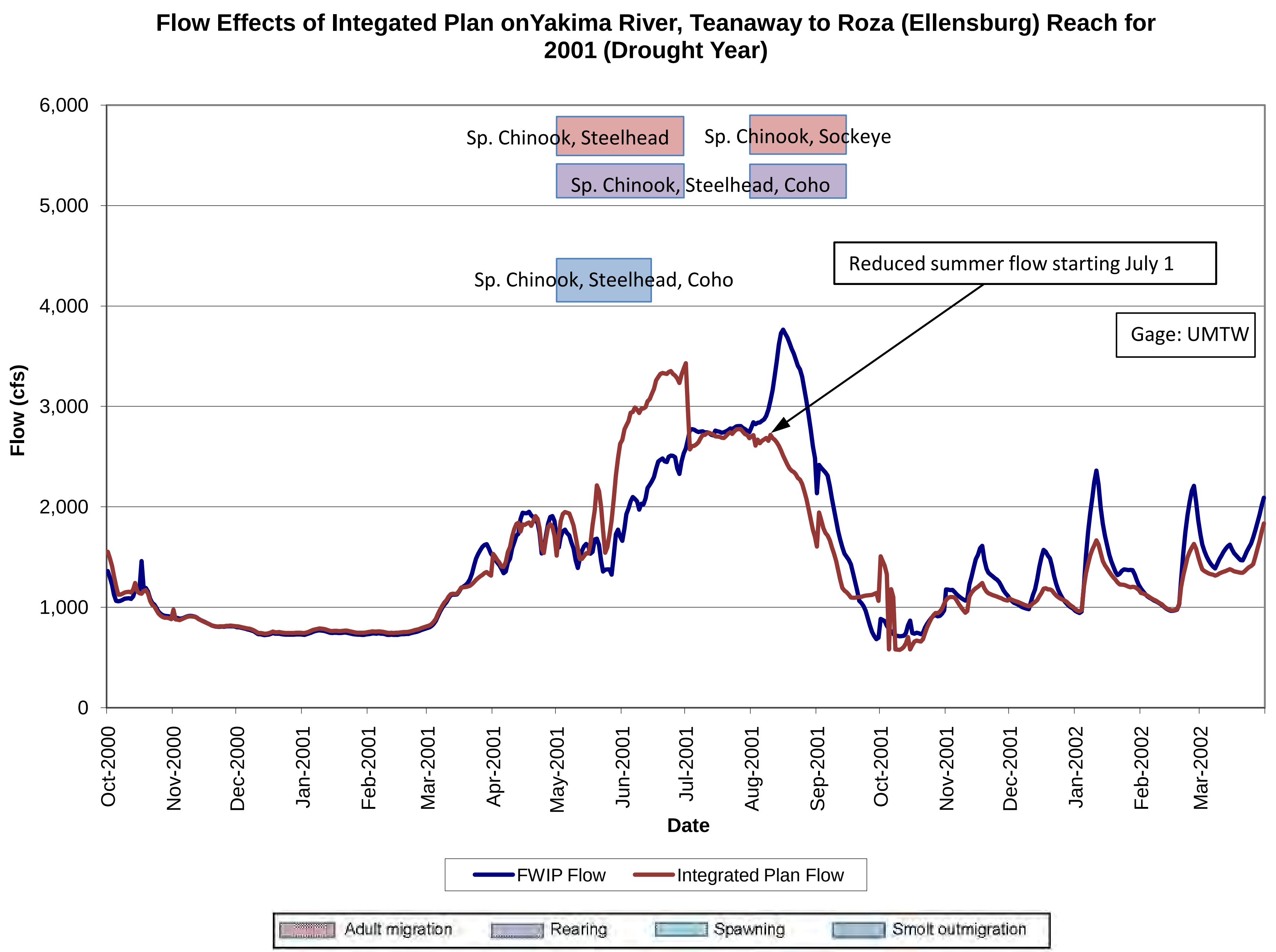

Flow Effects of Integrated Plan onYakima River, Cle Elum to Teanaway River Reach for 2001
(Drought Year)
Sp. Chinook, Sockeye
Sp. Chinook, Steelhead, Coho
Sp. Chinook, Coho
Reduced flow in August
Gage: YUMW
Flow (cfs)
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Oct-2000
Nov-2000
Dec-2000
Jan-2001
Feb-2001
Mar-2001
Apr-2001
May-2001
Jun-2001
Jul-2001
Aug-2001
Sep-2001
Oct-2001
Nov-2001
Dec-2001
Jan-2002
Feb-2002
Mar-2002
Date
Unregulated Flow
FWIP Flow
Integrated Plan Flow
Adult migration
Rearing
Spawning
Smolt outmigration

Flow Effects of Integrated Plan on Yakima River, Cle Elum to Teanaway River Reach for 2002 (Wet Year)



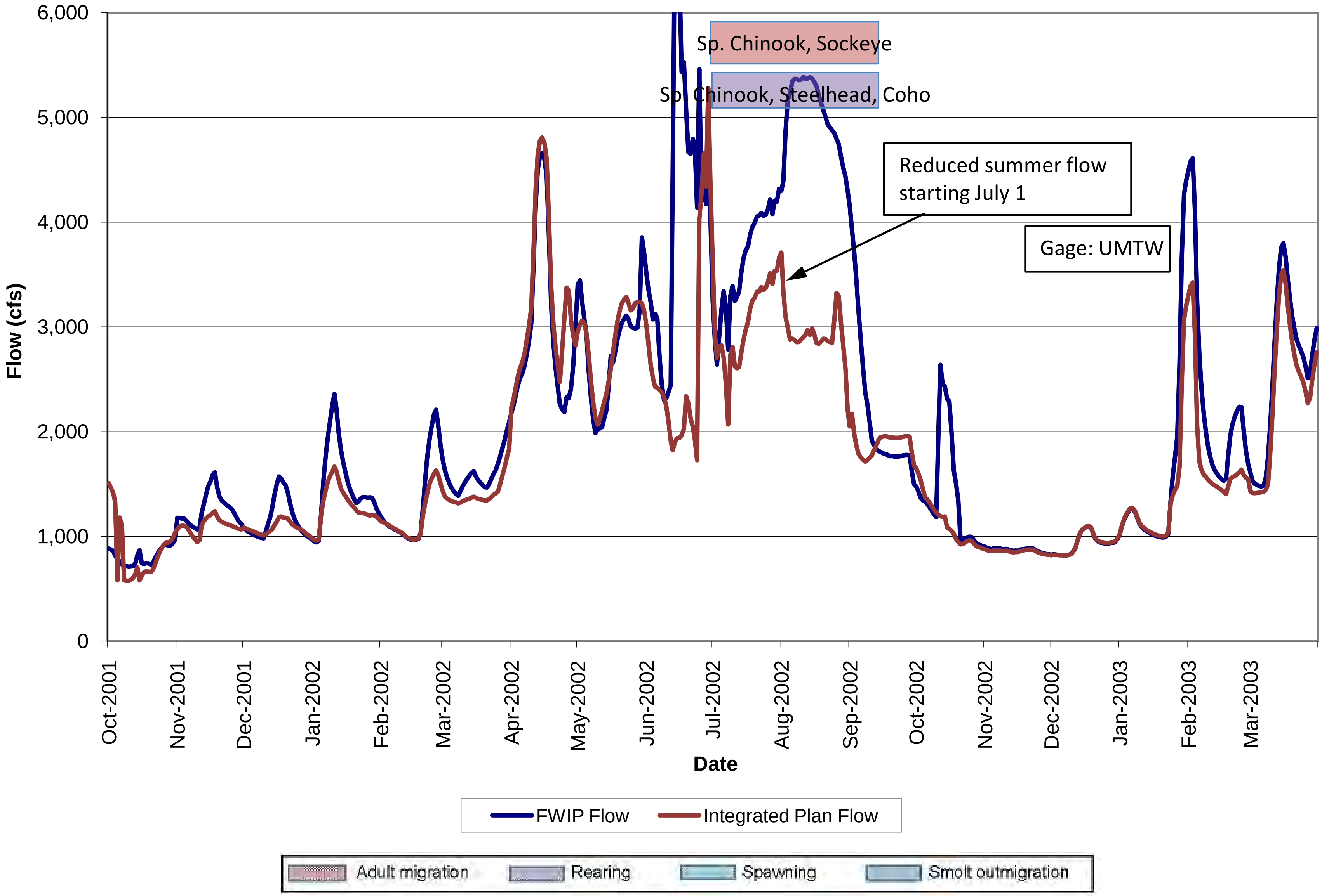
Flow Effects of Integrated Plan on Yakima River, Cle Elum to Teanaway River Reach for 2003 (Average Year)



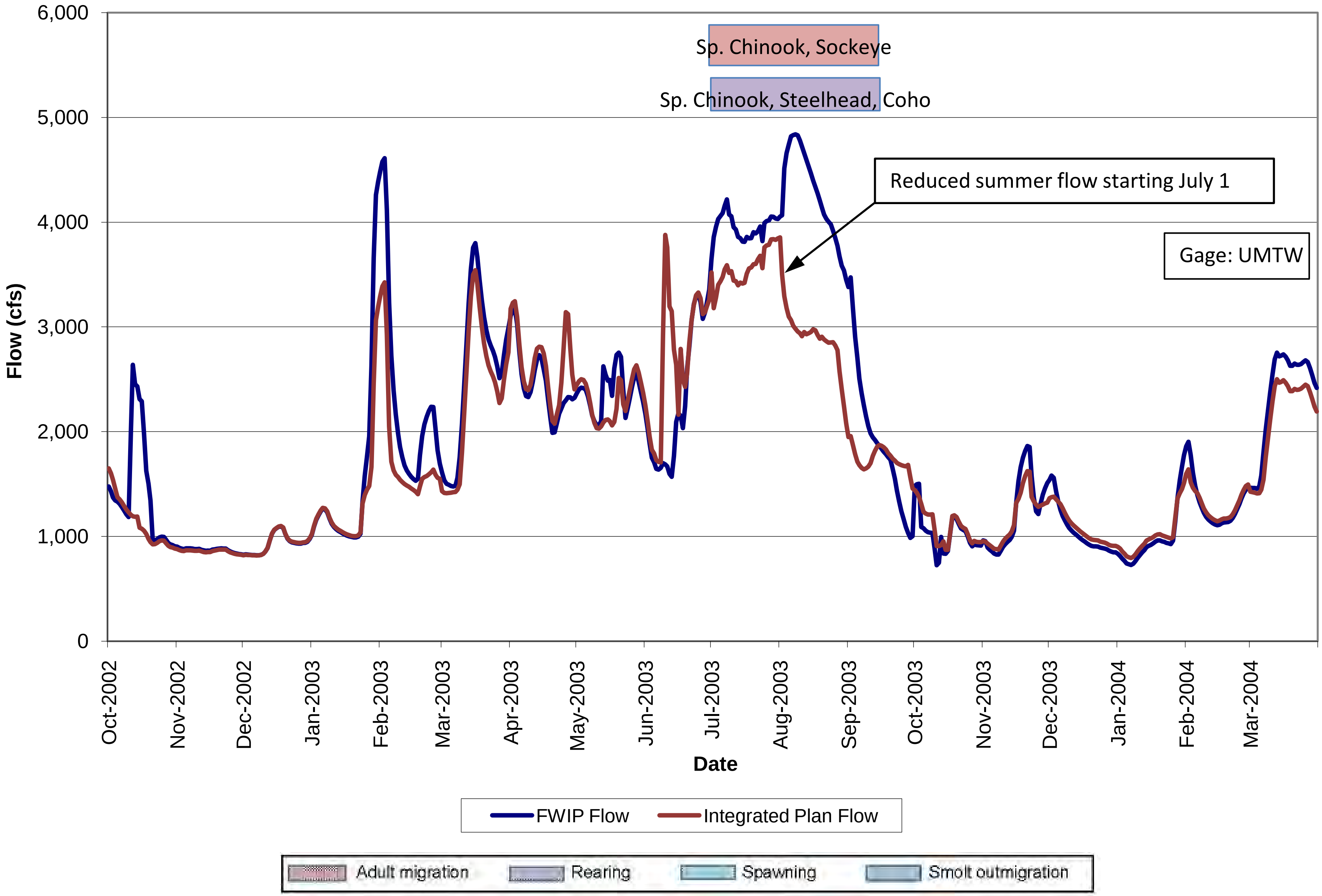


Flow Effects of Integated Plan onYakima River, Teanaway to Roza (Ellensburg) Reach for 2001 (Drought Year)
Flow (cfs)
6,000
5,000
4,000
3,000
2,000
1,000
0
Sp. Chinook, Steelhead
Sp. Chinook, Sockeye
Sp. Chinook, Steelhead, Coho
Sp. Chinook, Steelhead, Coho
Reduced summer flow starting July 1
Gage: UMTW
Oct-2000
Nov-2000
Dec-2000
Jan-2001
Feb-2001
Mar-2001
Apr-2001
May-2001
Jun-2001
Jul-2001
Aug-2001
Sep-2001
Oct-2001
Nov-2001
Dec-2001
Jan-2002
Feb-2002
Mar-2002
Date
FWIP Flow
Integrated Plan Flow
Adult migration
Rearing
Spawning
Smolt outmigration

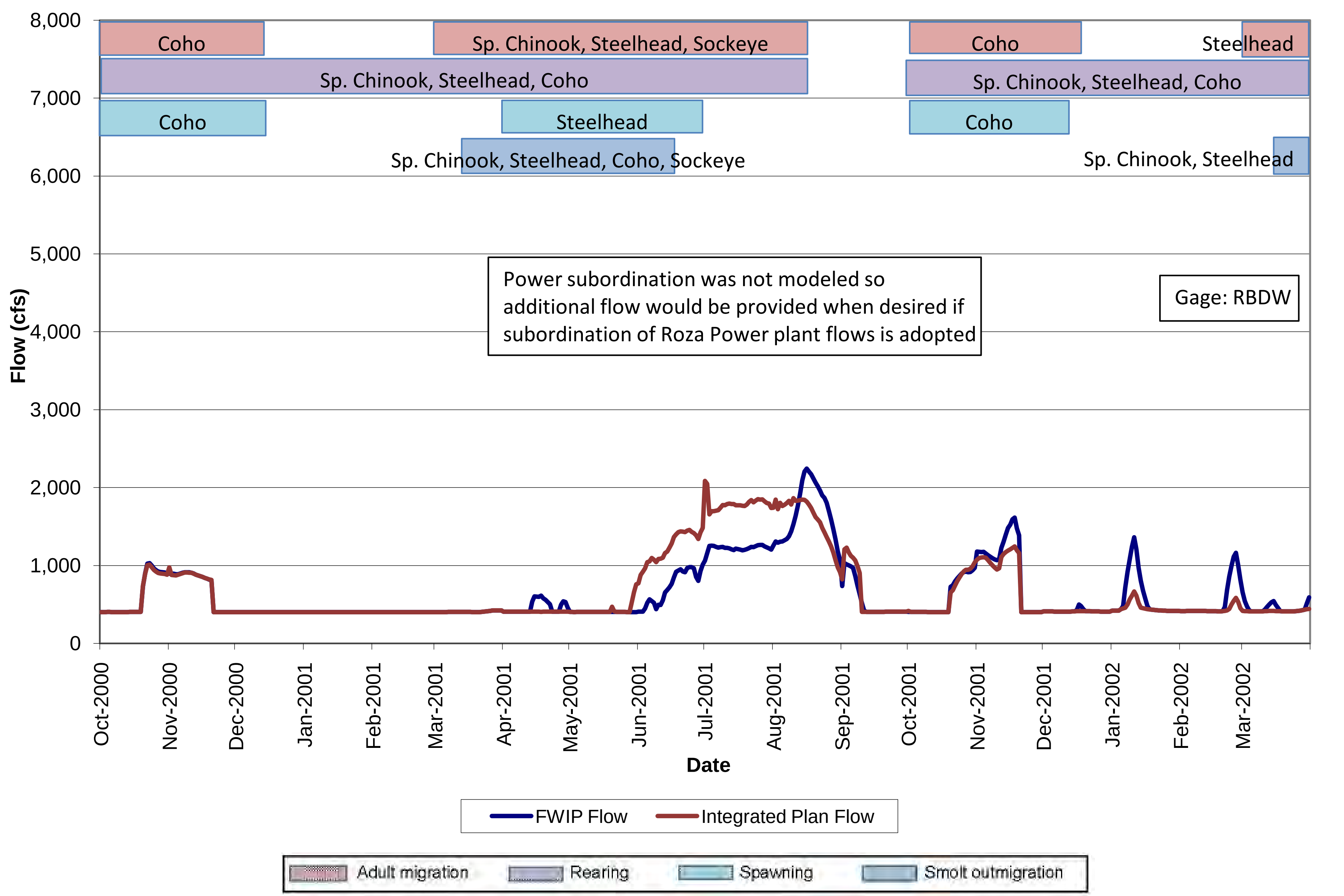
Flow Effects of Integrated Plan on Yakima River, Teanaway to Roza (Ellensburg) Reach for 2002 (Wet Year)



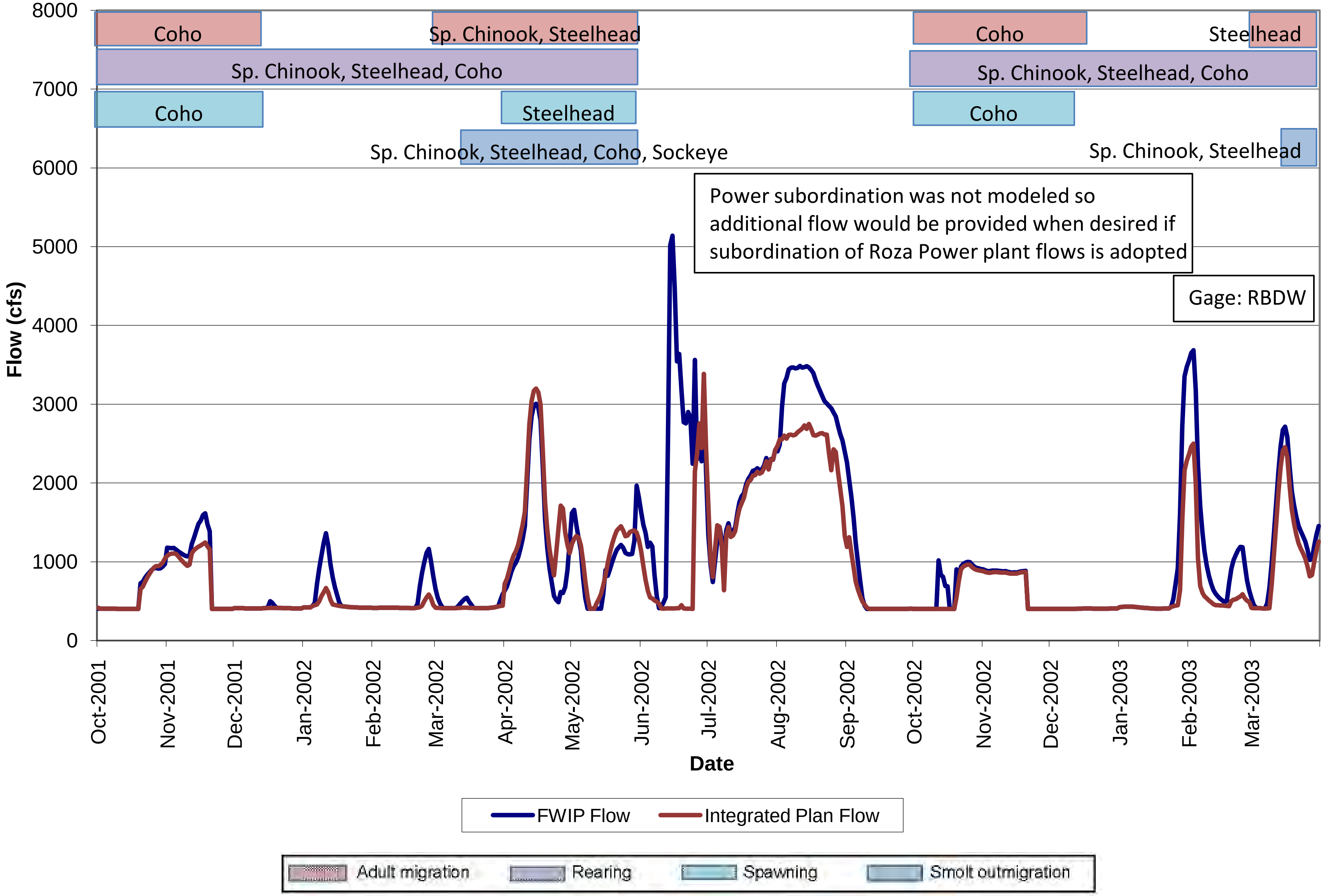
Flow Effects of Integrated Plan on Yakima River, Teanaway to Roza (Ellensburg) Reach for 2003 (Average Year)

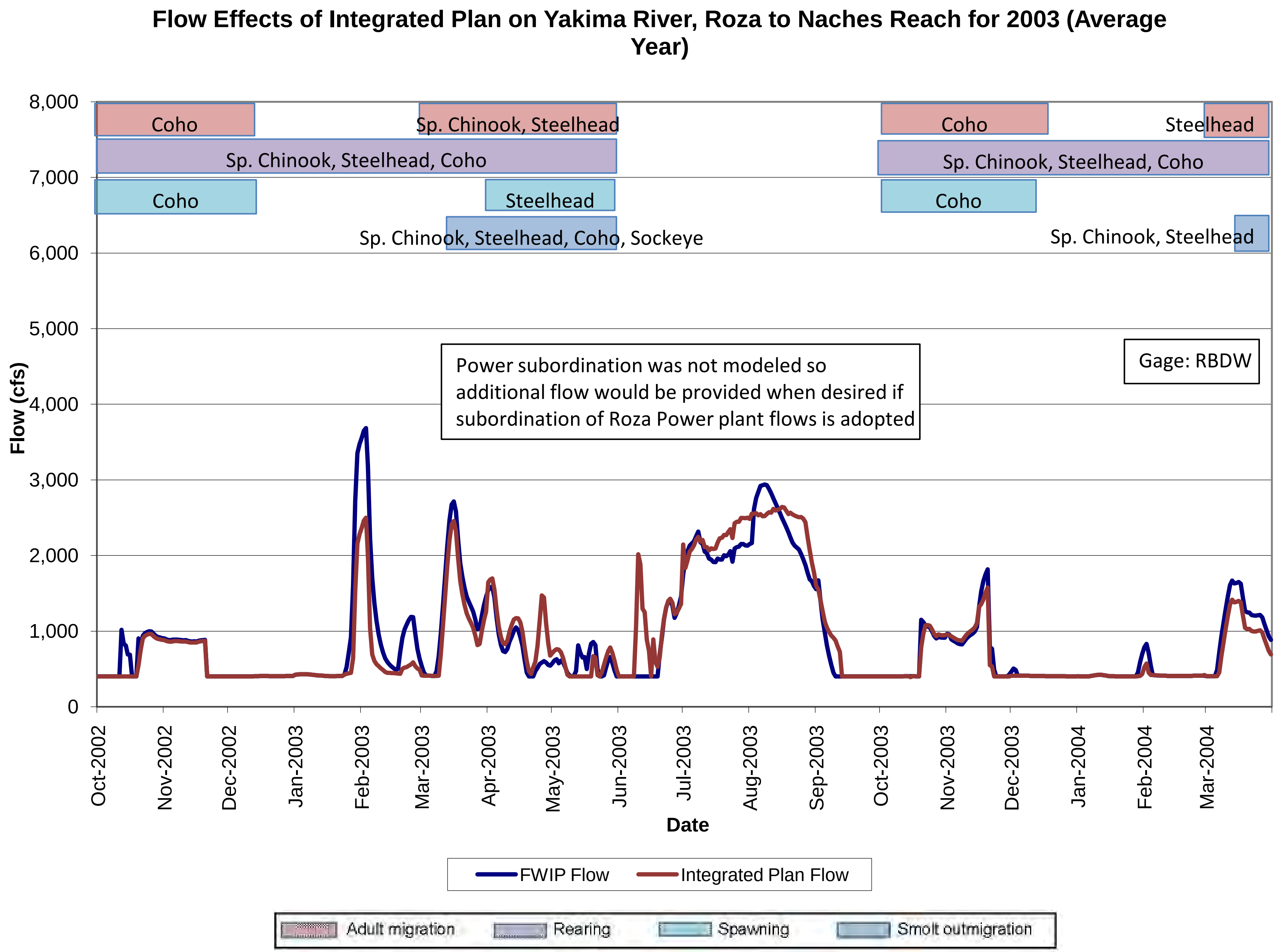


Flow Effects of Integrated Plan on Yakima River, Roza to Naches Reach for 2001 (Drought Year)



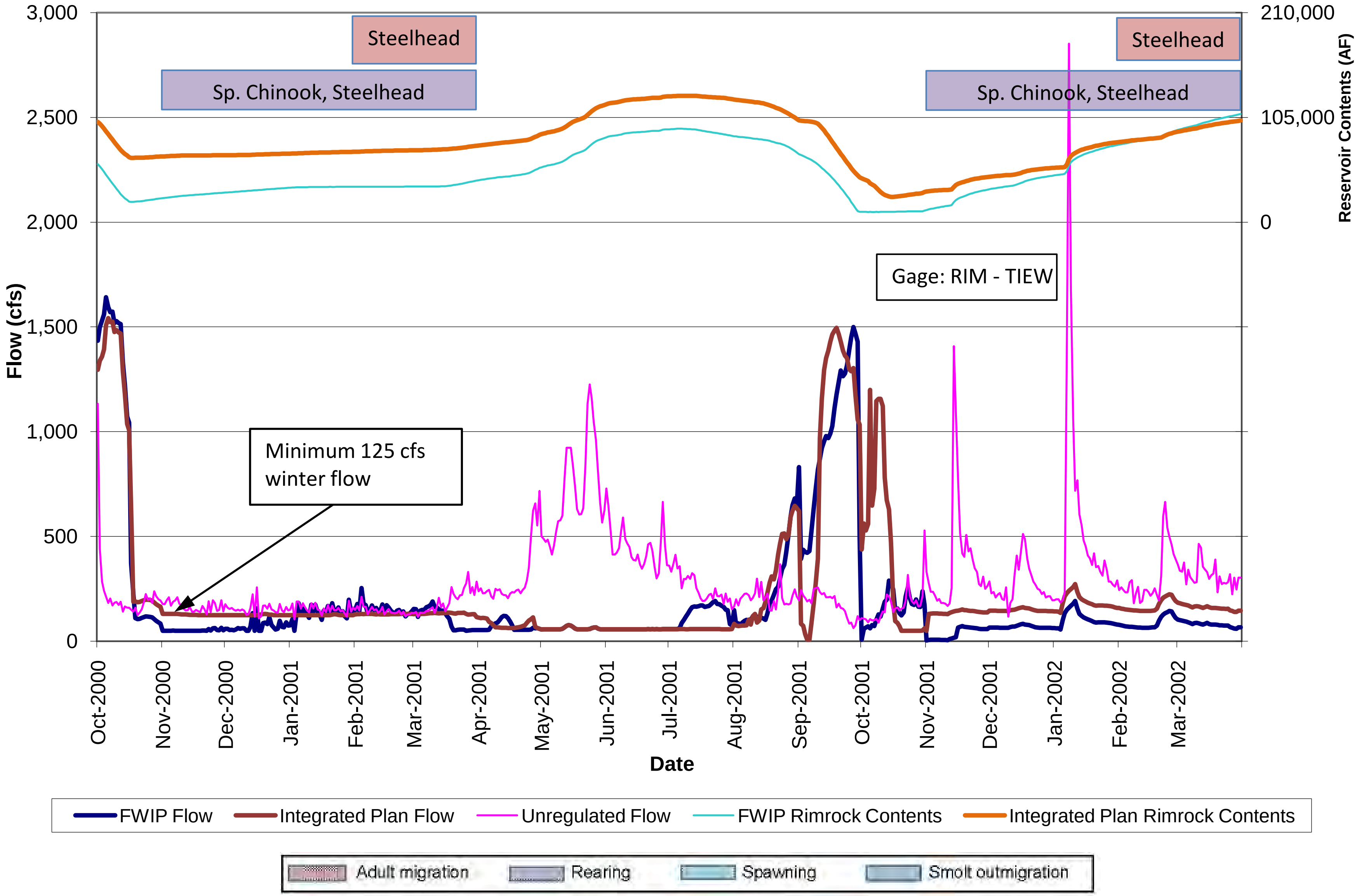
Flow Effects of Integrated Plan on Yakima River, Roza to Naches Reach for 2002 (Wet Year)



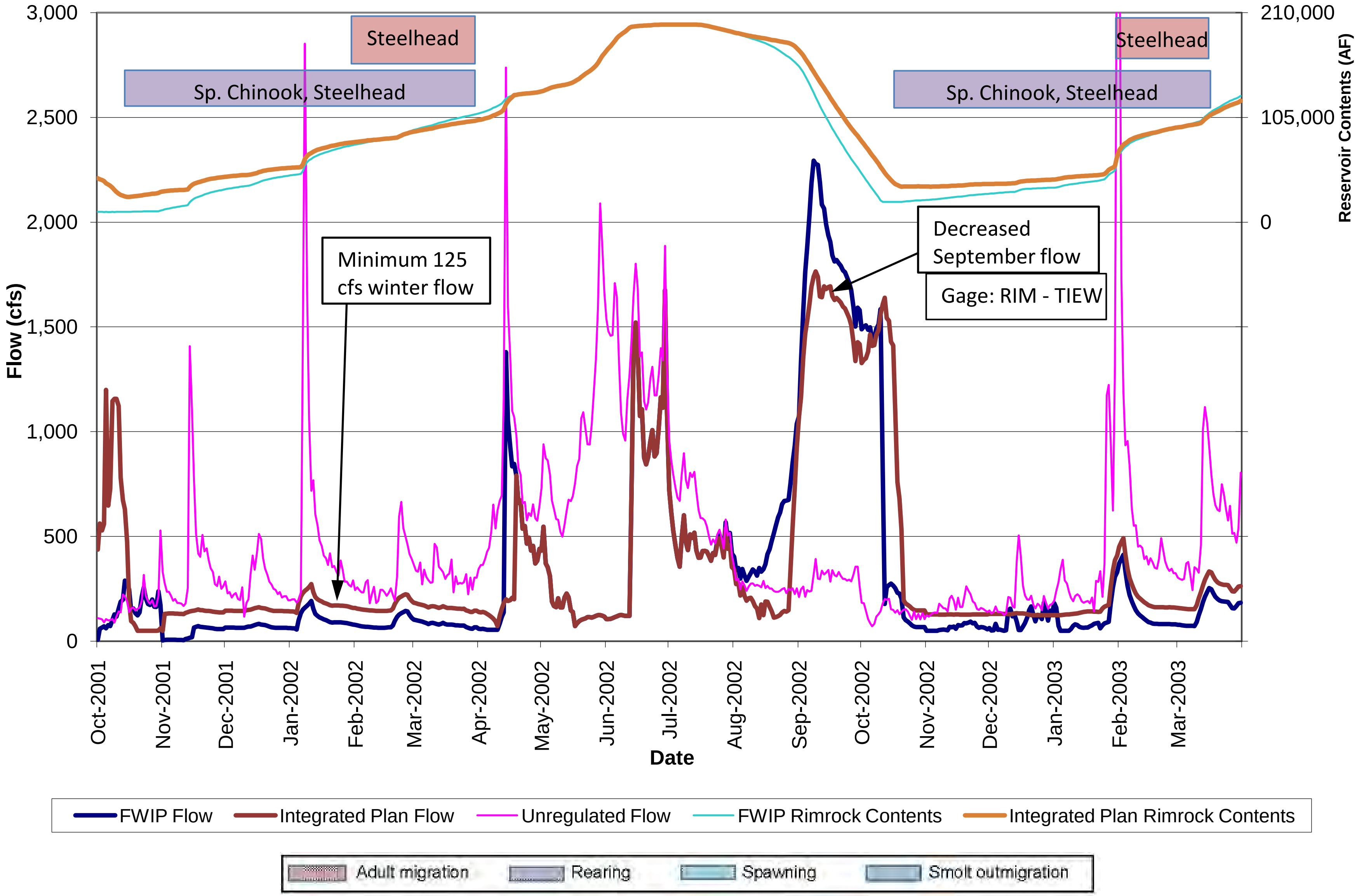


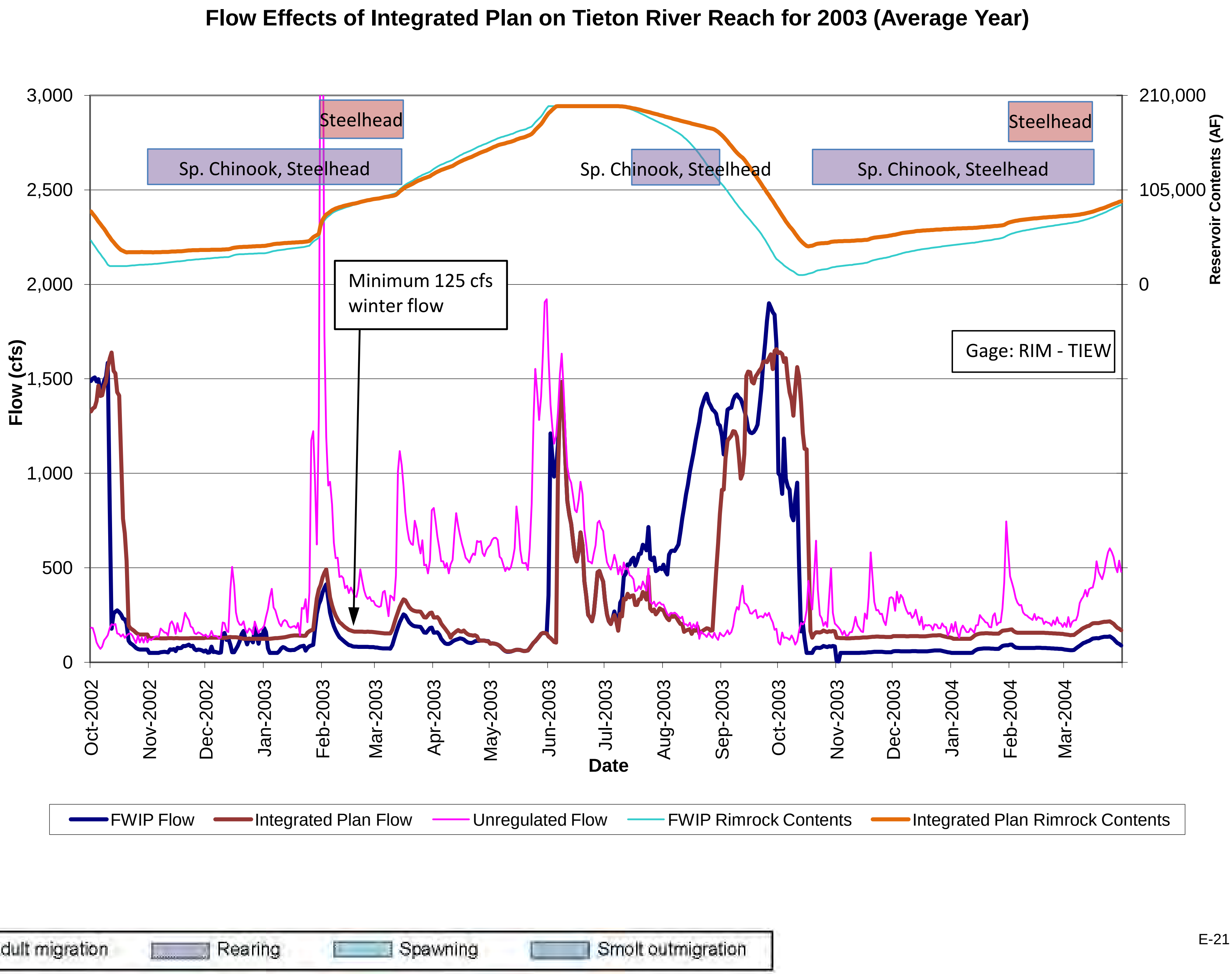
Flow Effects of Integrated Plan on Yakima River, Roza to Naches Reach for 2003 (Average Year)
Coho
Sp. Chinook, Steelhead
Coho
Steelhead
Sp. Chinook, Steelhead, Coho
Sp. Chinook, Steelhead, Coho
Coho
Steelhead
Coho
Sp. Chinook, Steelhead, Coho, Sockeye
Sp. Chinook, Steelhead
Power subordination was not modeled so additional flow would be provided when desired if subordination of Roza Power plant flows is adopted
Gage: RBDW
Flow (cfs)
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Oct-2002
Nov-2002
Dec-2002
Jan-2003
Feb-2003
Mar-2003
Apr-2003
May-2003
Jun-2003
Jul-2003
Aug-2003
Sep-2003
Oct-2003
Nov-2003
Dec-2003
Jan-2004
Feb-2004
Mar-2004
Date
FWIP Flow
Integrated Plan Flow
Adult migration
Rearing
Spawning
Smolt outmigration

Flow Effects of Integrated Plan on Tieton River Reach for 2001 (Drought Year)



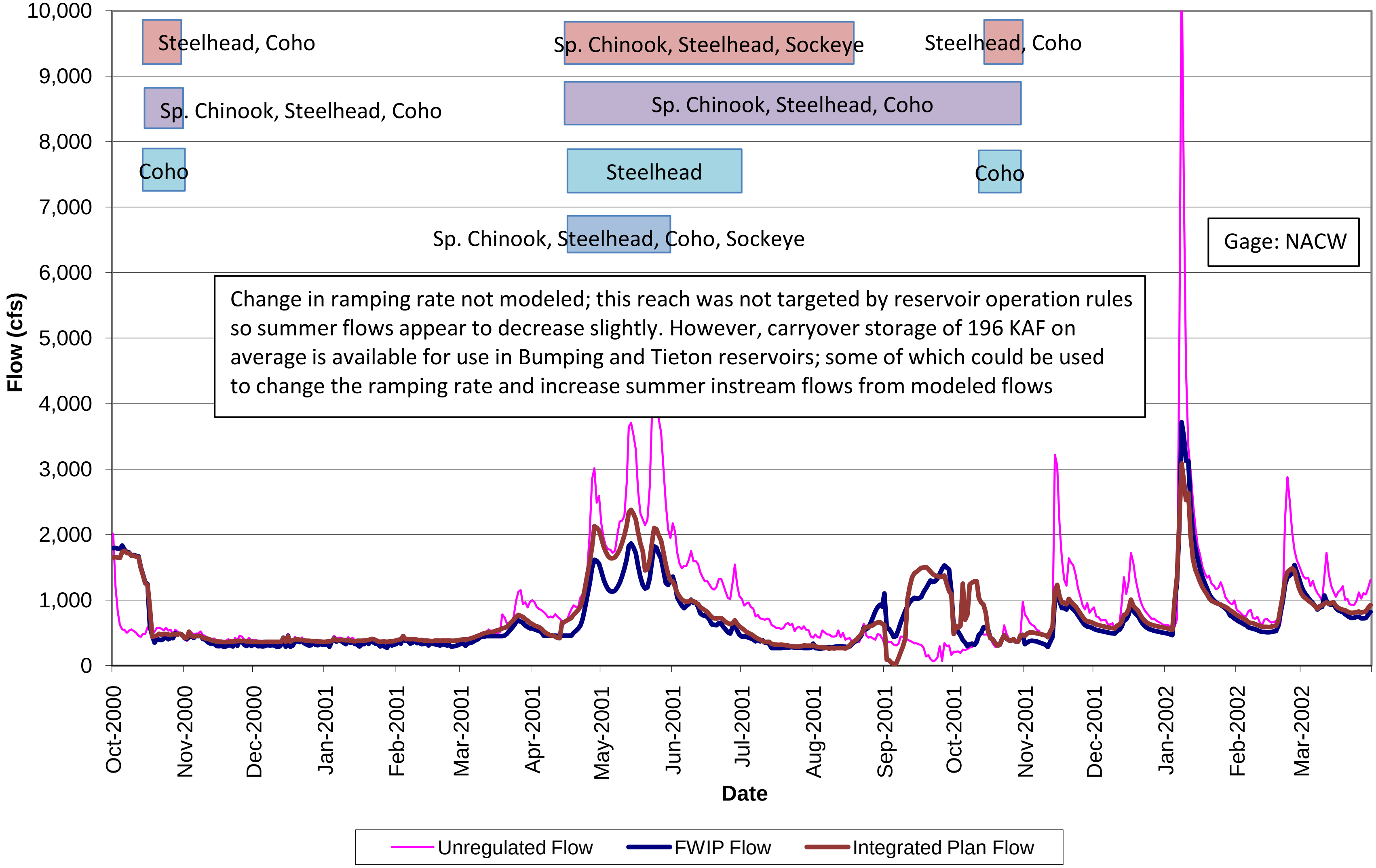
Flow Effects of Integrated Plan on Tieton River Reach for 2002 (Wet Year)



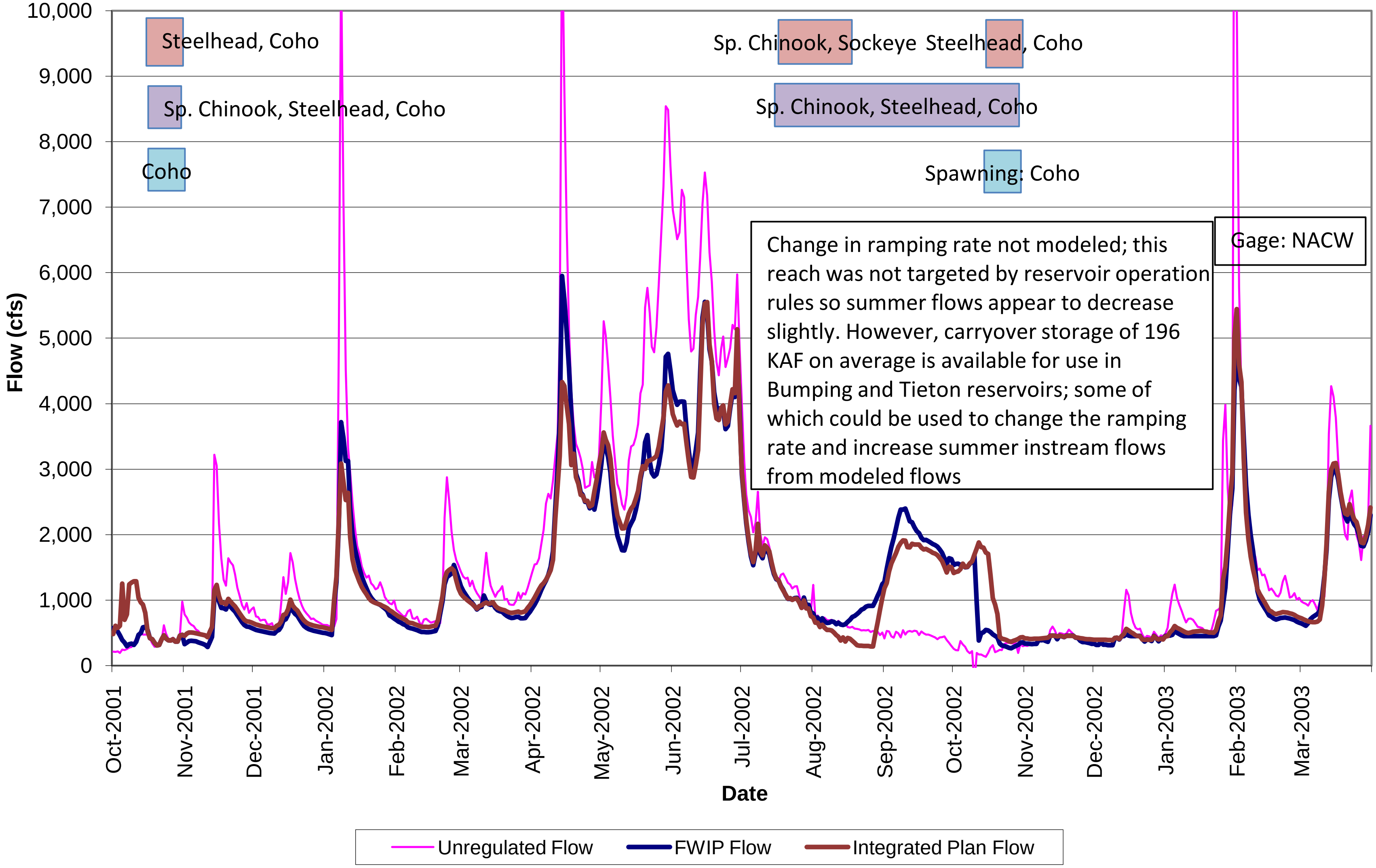


Flow Effects of Integrated Plan on Tieton River Reach for 2003 (Average Year)
Steelhead
Sp. Chinook, Steelhead
Sp. Chinook, Steelhead
Sp. Chinook, Steelhead
Steelhead
Minimum 125 cfs winter flow
Gage: RIM - TIEW
Flow (cfs)
Reservoir Contents (AF)
3,000
2,500
2,000
1,500
1,000
500
0
210,000
105,000
0
Oct-2002
Nov-2002
Dec-2002
Jan-2003
Feb-2003
Mar-2003
Apr-2003
May-2003
Jun-2003
Jul-2003
Aug-2003
Sep-2003
Oct-2003
Nov-2003
Dec-2003
Jan-2004
Feb-2004
Mar-2004
Date
FWIP Flow
Integrated Plan Flow
Unregulated Flow
FWIP Rimrock Contents
Integrated Plan Rimrock Contents
Adult migration
Rearing
Spawning
Smolt outmigration

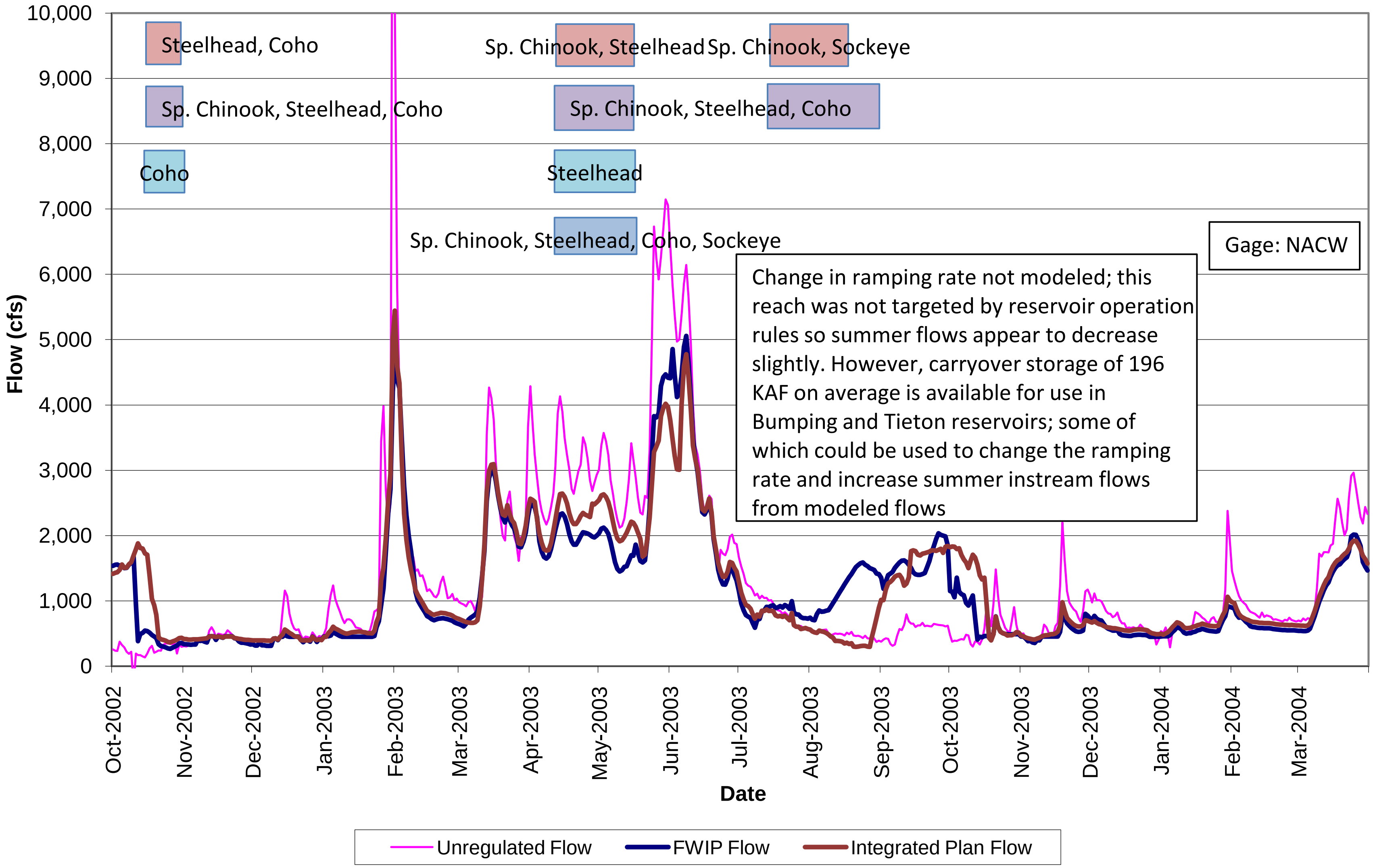
Flow Effects of Integrated Plan on Lower Naches River Reach for 2001 (Drought Year)

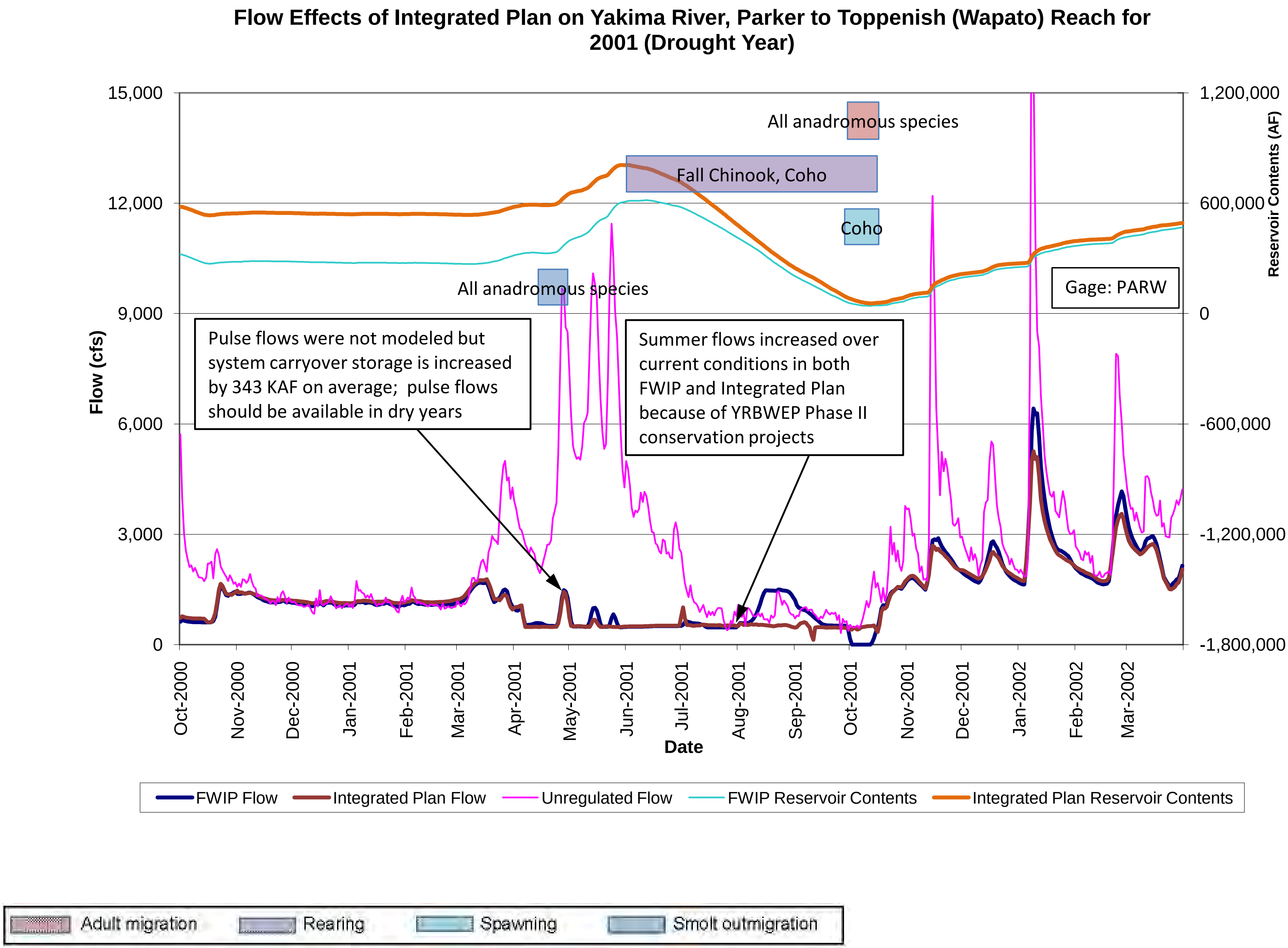


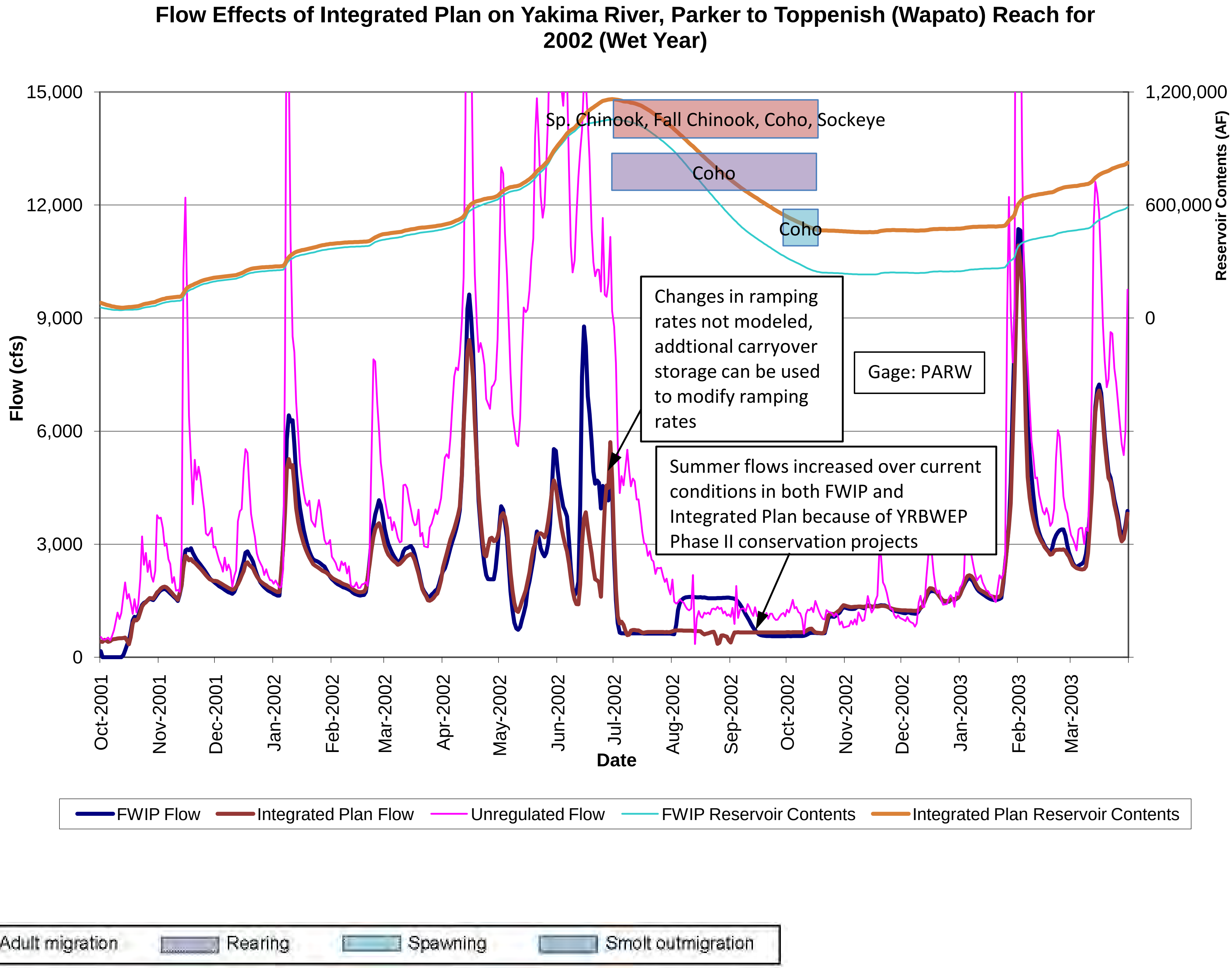
Flow Effects of Integrated Plan on Lower Naches River Reach for 2002 (Wet Year)

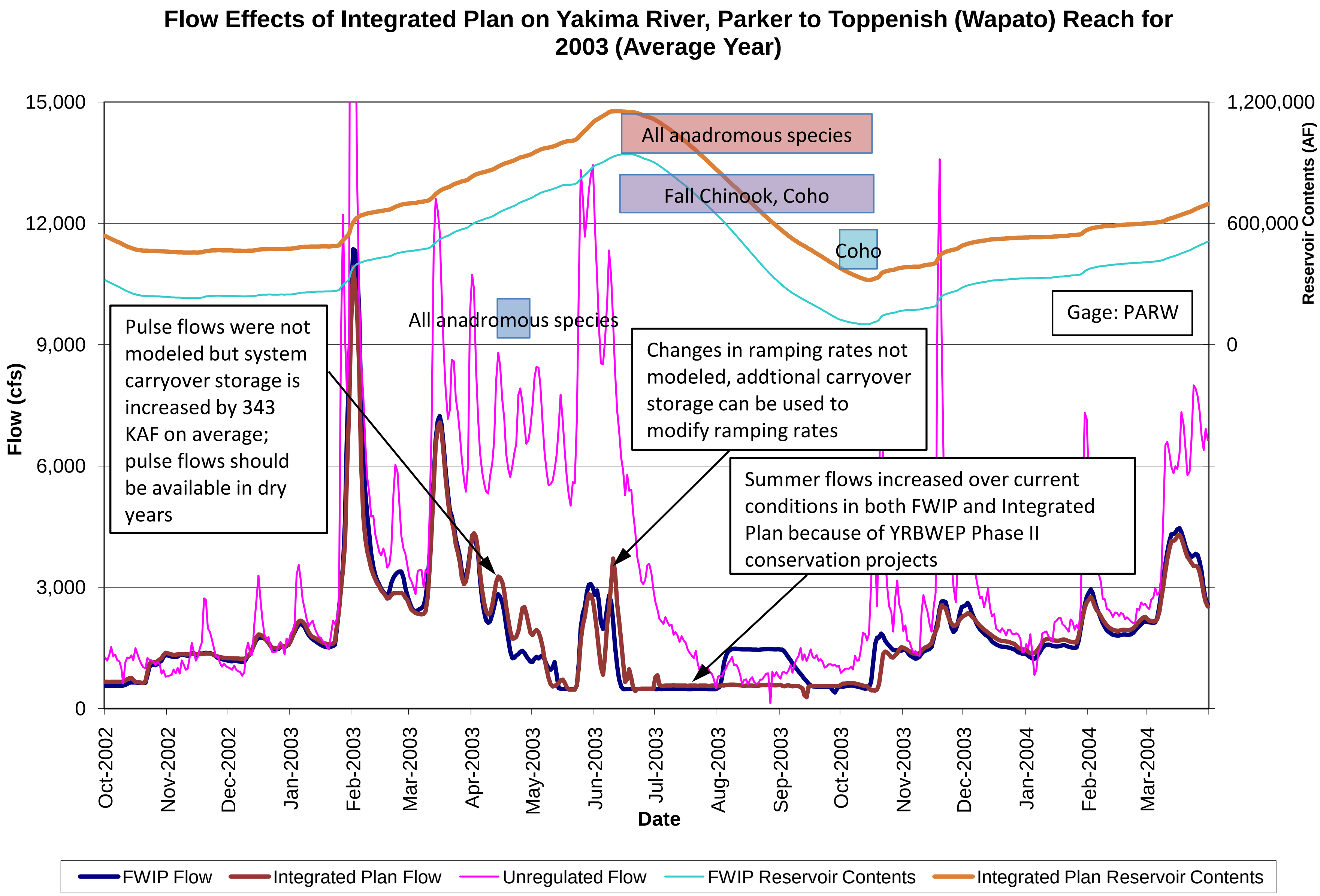


Flow Effects of Integrated Plan on Lower Naches River Reach for 2003 (Average Year)




Flow Effects of Integrated Plan on Yakima River, Parker to Toppenish (Wapato) Reach for 2001 (Drought Year)
Flow (cfs)
Reservoir Contents (AF)
15,000
12,000
9,000
6,000
3,000
0
1,200,000
600,000
0
-600,000
-1,200,000
-1,800,000
All anadromous species
Fall Chinook, Coho
Coho
All anadromous species
Gage: PARW
Pulse flows were not modeled but system carryover storage is increased by 343 KAF on average; pulse flows should be available in dry years
Summer flows increased over current conditions in both FWIP and Integrated Plan because of YRBWEP Phase II conservation projects
Oct-2000
Nov-2000
Dec-2000
Jan-2001
Feb-2001
Mar-2001
Apr-2001
May-2001
Jun-2001
Jul-2001
Aug-2001
Sep-2001
Oct-2001
Nov-2001
Dec-2001
Jan-2002
Feb-2002
Mar-2002
Date
FWIP Flow
Integrated Plan Flow
Unregulated Flow
FWIP Reservoir Contents
Integrated Plan Reservoir Contents
Adult migration
Rearing
Spawning
Smolt outmigration


Flow Effects of Integrated Plan on Yakima River, Parker to Toppenish (Wapato) Reach for 2002 (Wet Year)
Flow (cfs)
15,000
12,000
9,000
6,000
3,000
0
Reservoir Contents (AF)
1,200,000
600,000
0
Sp. Chinook, Fall Chinook, Coho, Sockeye
Coho
Coho
Changes in ramping rates not modeled, addtional carryover storage can be used to modify ramping rates
Gage: PARW
Summer flows increased over current conditions in both FWIP and Integrated Plan because of YRBWEP Phase II conservation projects
Oct-2001
Nov-2001
Dec-2001
Jan-2002
Feb-2002
Mar-2002
Apr-2002
May-2002
Jun-2002
Jul-2002
Aug-2002
Sep-2002
Oct-2002
Nov-2002
Dec-2002
Jan-2003
Feb-2003
Mar-2003
Date
FWIP Flow
Integrated Plan Flow
Unregulated Flow
FWIP Reservoir Contents
Integrated Plan Reservoir Contents
Adult migration
Rearing
Spawning
Smolt outmigration

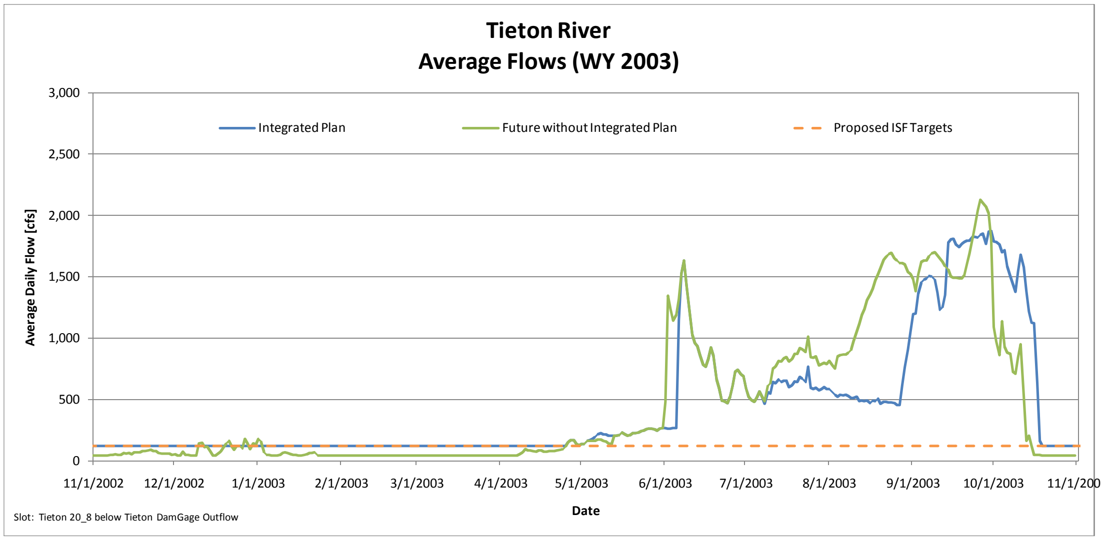

Flow Effects of Integrated Plan on Yakima River, Parker to Toppenish (Wapato) Reach for 2003 (Average Year)
Flow (cfs)
Reservoir Contents (AF)
15,000
12,000
9,000
6,000
3,000
0
1,200,000
600,000
0
All anadromous species
Fall Chinook, Coho
Coho
All anadromous species
Gage: PARW
Pulse flows were not modeled but system carryover storage is increased by 343 KAF on average; pulse flows should be available in dry years
Changes in ramping rates not modeled, addtional carryover storage can be used to modify ramping rates
Summer flows increased over current conditions in both FWIP and Integrated Plan because of YRBWEP Phase II conservation projects
Oct-2002
Nov-2002
Dec-2002
Jan-2003
Feb-2003
Mar-2003
Apr-2003
May-2003
Jun-2003
Jul-2003
Aug-2003
Sep-2003
Oct-2003
Nov-2003
Dec-2003
Jan-2004
Feb-2004
Mar-2004
Date
FWIP Flow
Integrated Plan Flow
Unregulated Flow
FWIP Reservoir Contents
Integrated Plan Reservoir Contents

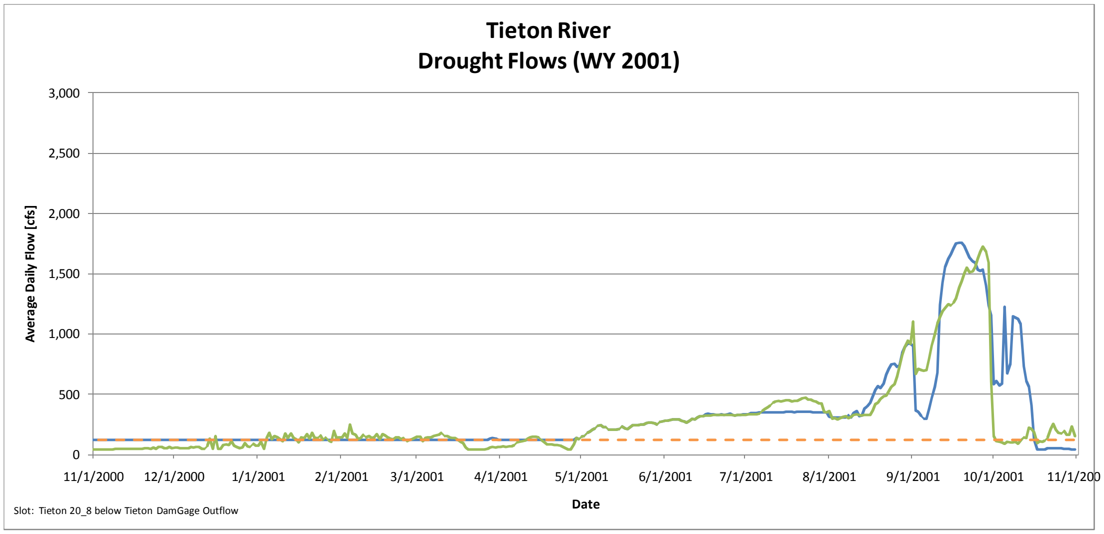
Hydrologic Indicator	**Integrated Plan**					**Future without Integrated Plan**				
	Average 1981-2005	Drought Year 1994	Drought Year 2001	Drought Year 2005	Wet Year 1997	Average 1981-2005	Drought Year 1994	Drought Year 2001	Drought Year 2005	Wet Year 1997
April 1 TWSA (maf)						2.79				
April-September flow volume at Parker gage (kaf)	3.00 605	2.22 245	198	2.32 181	4.73 1937	644	1.74 313	1.76 252	1.71 245	4.52 1937
March-October flow volume at Parker gage (kaf)	907	400	2.45 335	310	2638	940	456	377	366	2603
April-September diversion volume upstream of Parker gage (maf)	1.69	1.52	1.55	1.53	1.73	1.61	1.23	1.29	1.25	1.71
September 30 non-Bumping or Wymer reservoir contents (kaf)	348	-121	75	-19	709	218	41	48	62	510
October 31 non-Bumping or Wymer reservoir contents (kaf)	329	-120	74	-26	802	213	65	67	56	619
September 30 Bumping and Wymer reservoir contents (kaf)	229	56	145	144	267	15	7	11	14	18
April-September flow volume at mouth of Yakima River (kaf)	867	349	272	293	2262	888	386	300	333	2245
Irrigation proration level (percent)[1]	92%	70%	70%	70%	100%	80%	21%	32%	28%	100%

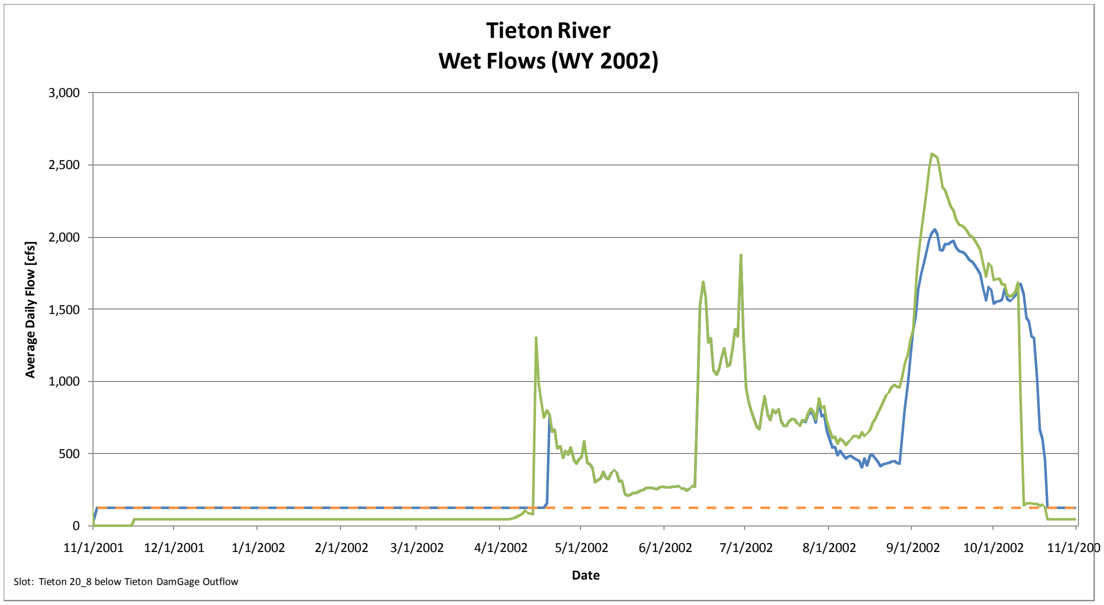
Resource indicator (measurement)	Integrated Plan	Future without Integrated Plan
WATER RESOURCES		
Average for water years 1981–2005 (maf)		
Water supply		
April 1 total water supply available (TWSA)	3.00	2.79
Water distribution		
April–September Parker flow volume	0.60	0.64
April–September diversion	1.69	1.61
September 30 reservoir contents	0.58	0.24
April–September flow volume at mouth of Yakima River	0.87	0.89
1994 dry-year (maf)		
Water supply		
April 1 TWSA	2.22	1.74
Water distribution		
April–September Parker flow volume	0.25	0.31
April–September diversion	1.52	1.23
September 30 reservoir contents	-0.06	0.05
April–September flow volume at mouth of Yakima River	0.35	0.39
Irrigation proration level	70%	21%

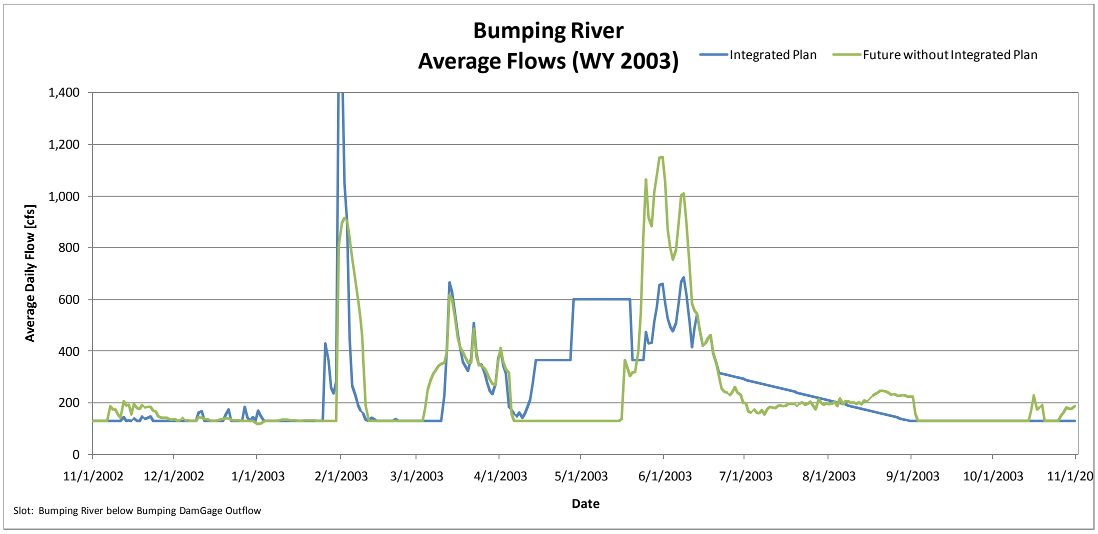
Resource indicator (measurement)	Integrated Plan	Future without Integrated Plan
ANADROMOUS FISH		
Rate of change in flow during flip-flop (average cfs/day August 16–September 14)		
Easton reach	-7	-21
Ellensburg reach	-45	-103
Lower Naches River reach	31	33
Pre- (August 1-15) and post- (September 14-28) flip-flop flow and absolute change in flow		
Easton reach		
Pre-flip-flop flow (cfs)	574	890
Post-flip-flop flow (cfs)	364	287
Absolute change in flow (cfs)	-211	-603
Ellensburg reach		
Pre-flip-flop flow (cfs)	2,867	4,346
Post-flip-flop flow (cfs)	1,574	1,364
Absolute change in flow (cfs)	-1,293	-2,982
Lower Naches River reach		
Pre-flip-flop flow (cfs)	644	824
Post-flip-flop flow (cfs)	1,548	1,776
Absolute change in flow (cfs)	904	953
Average, minimum, and maximum reservoir elevation (feet) during bull trout spawning migration: July 15–September 15 (feet)		
Kachess Lake	2235.41 2146.99-2261.96	2239.13 2198.02-2261.96
Keechelus Lake	2476.7 2432.28-2516.96	2465.38 2432.44-2516.88
Rimrock Lake	2914.66 2801.26-2926	2905.93 2846.64-2926

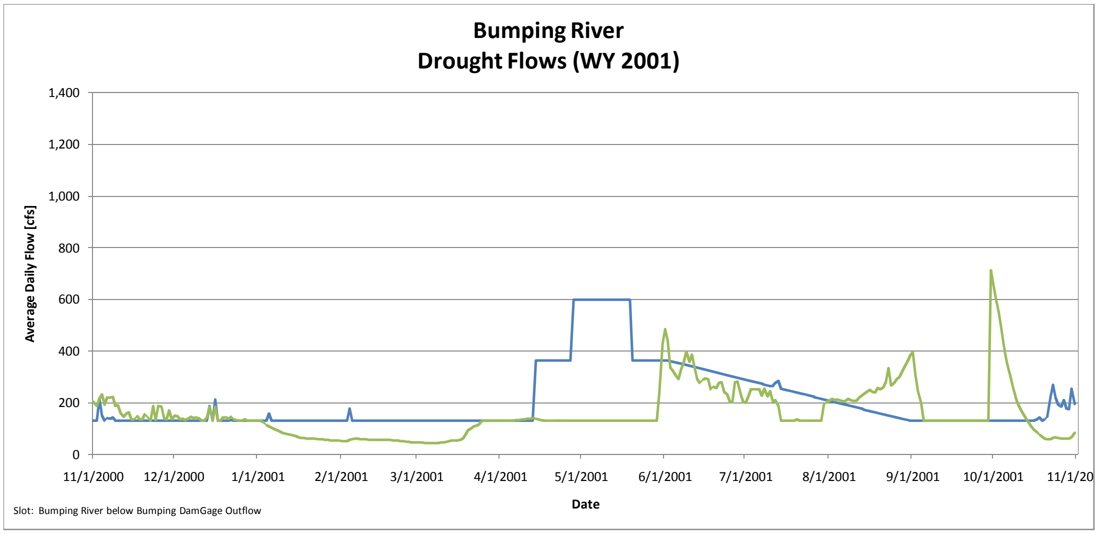
Item	Future without Integrated Plan	Integrated Plan	Improvement
Average 1981-2005			
TWSA [April 1, kaf]	2789.0	3004.9	215.9
March-October flow volume at Parker gage [kaf]	940.2	906.7	-33.6
Drought Year 1994			
TWSA [April 1, kaf]	1740.3	2215.7	475.4
March-October flow volume at Parker gage [kaf]	456.2	399.8	-56.4
Drought Year 2001			
TWSA [April 1, kaf]	1762.1	2453.2	691.1
March-October flow volume at Parker gage [kaf]	377.4	335.5	-41.9
Drought Year 2005			
TWSA [April 1, kaf]	1706.3	2320.8	614.5
March-October flow volume at Parker gage [kaf]	365.7	310.2	-55.5
Wet Year 1997			
TWSA [April 1, kaf]	4517.9	4728.6	210.7
March-October flow volume at Parker gage [kaf]	2603.3	2638.3	35.0

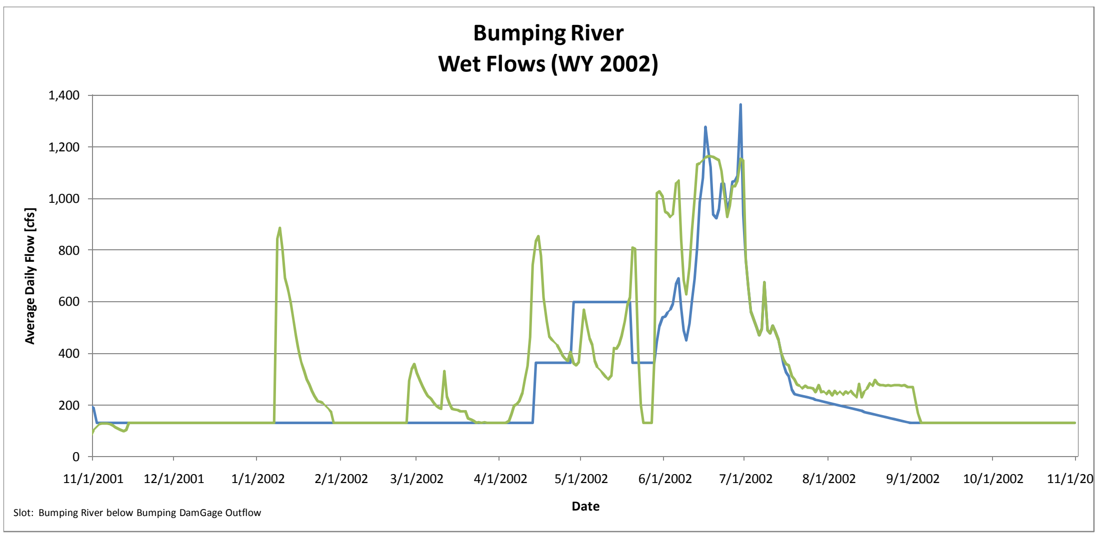

Tieton River
Average Flows (WY 2003)
Integrated Plan
Future without Integrated Plan
Proposed ISF Targets
Average Daily Flow [cfs]
3,000
2,500
2,000
1,500
1,000
500
0
11/1/2002
12/1/2002
1/1/2003
2/1/2003
3/1/2003
4/1/2003
5/1/2003
6/1/2003
7/1/2003
8/1/2003
9/1/2003
10/1/2003
Date
Slot: Tieton 20_8 below Tieton DamGage Outflow

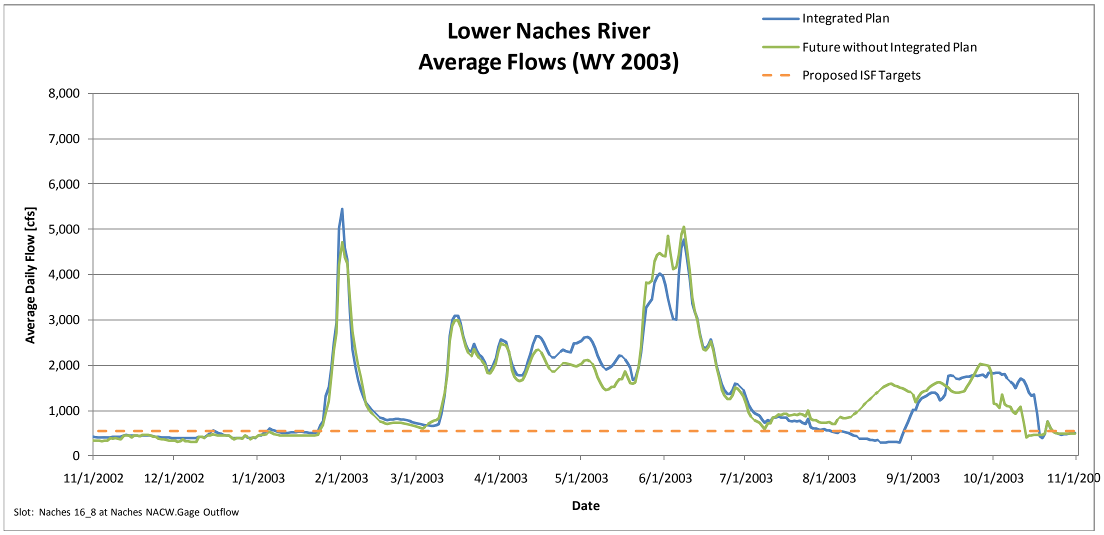

Tieton River
Drought Flows (WY 2001)
Average Daily Flow [cfs]
3,000
2,500
2,000
1,500
1,000
500
0
11/1/2000
12/1/2000
1/1/2001
2/1/2001
3/1/2001
4/1/2001
5/1/2001
6/1/2001
7/1/2001
8/1/2001
9/1/2001
10/1/2001
Date
Slot: Tieton 20_8 below Tieton DamGage Outflow

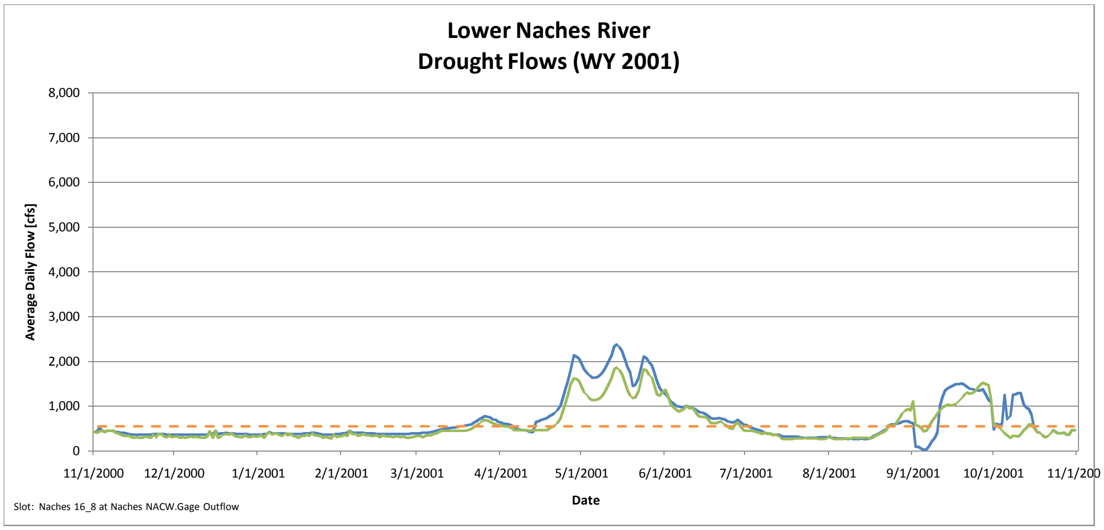

Tieton River
Wet Flows (WY 2002)
Average Daily Flow [cfs]
3,000
2,500
2,000
1,500
1,000
500
0
11/1/2001
12/1/2001
1/1/2002
2/1/2002
3/1/2002
4/1/2002
5/1/2002
6/1/2002
7/1/2002
8/1/2002
9/1/2002
10/1/2002
Date
Slot: Tieton 20_8 below Tieton DamGage Outflow

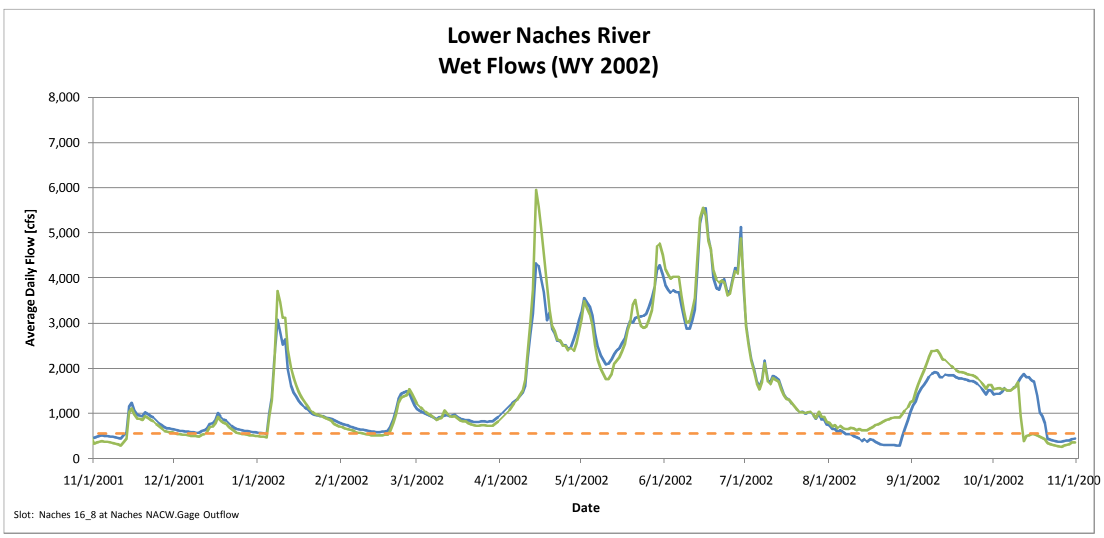

Bumping River
Average Flows (WY 2003)
Integrated Plan
Future without Integrated Plan
Average Daily Flow [cfs]
1,400
1,200
1,000
800
600
400
200
0
11/1/2002
12/1/2002
1/1/2003
2/1/2003
3/1/2003
4/1/2003
5/1/2003
6/1/2003
7/1/2003
8/1/2003
9/1/2003
10/1/2003
11/1/20
Date
Slot: Bumping River below Bumping DamGage Outflow

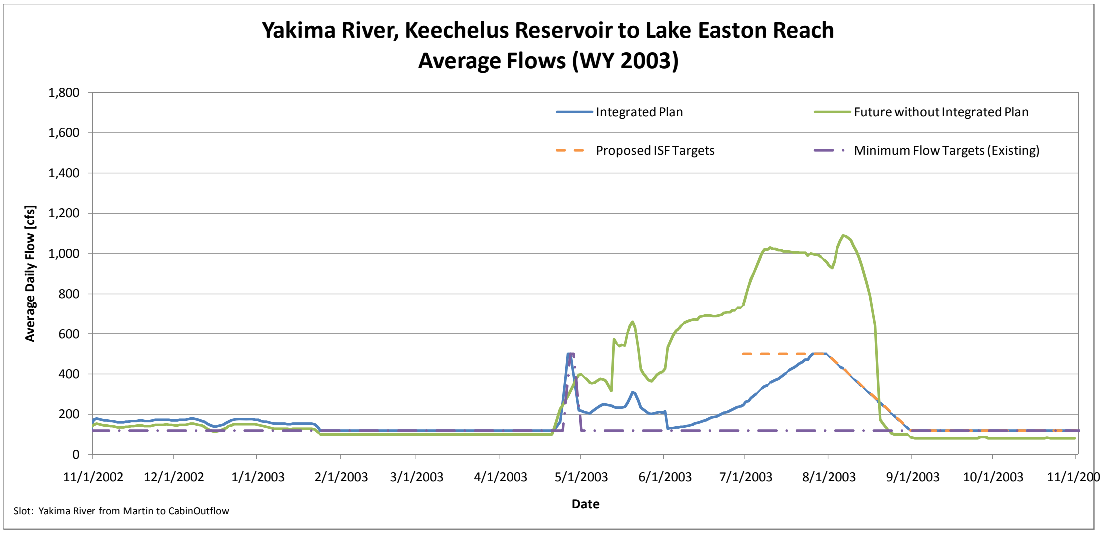

Bumping River
Drought Flows (WY 2001)
Average Daily Flow [cfs]
1,400
1,200
1,000
800
600
400
200
0
11/1/2000
12/1/2000
1/1/2001
2/1/2001
3/1/2001
4/1/2001
5/1/2001
6/1/2001
7/1/2001
8/1/2001
9/1/2001
10/1/2001
11/1/20
Date
Slot: Bumping River below Bumping DamGage Outflow

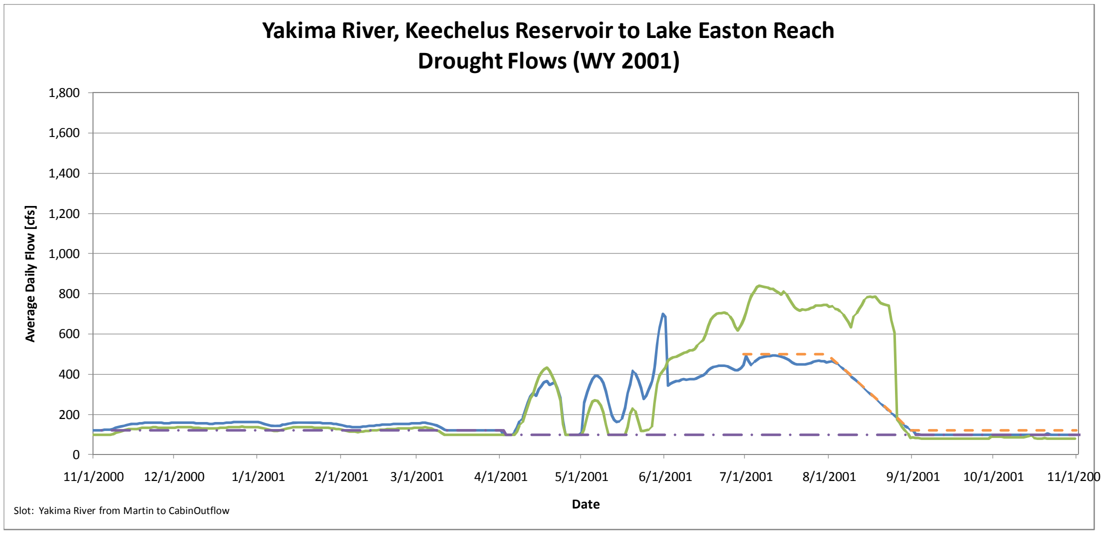

Bumping River
Wet Flows (WY 2002)
Average Daily Flow [cfs]
1,400
1,200
1,000
800
600
400
200
0
11/1/2001
12/1/2001
1/1/2002
2/1/2002
3/1/2002
4/1/2002
5/1/2002
6/1/2002
7/1/2002
8/1/2002
9/1/2002
10/1/2002
11/1/20
Date
Slot: Bumping River below Bumping DamGage Outflow

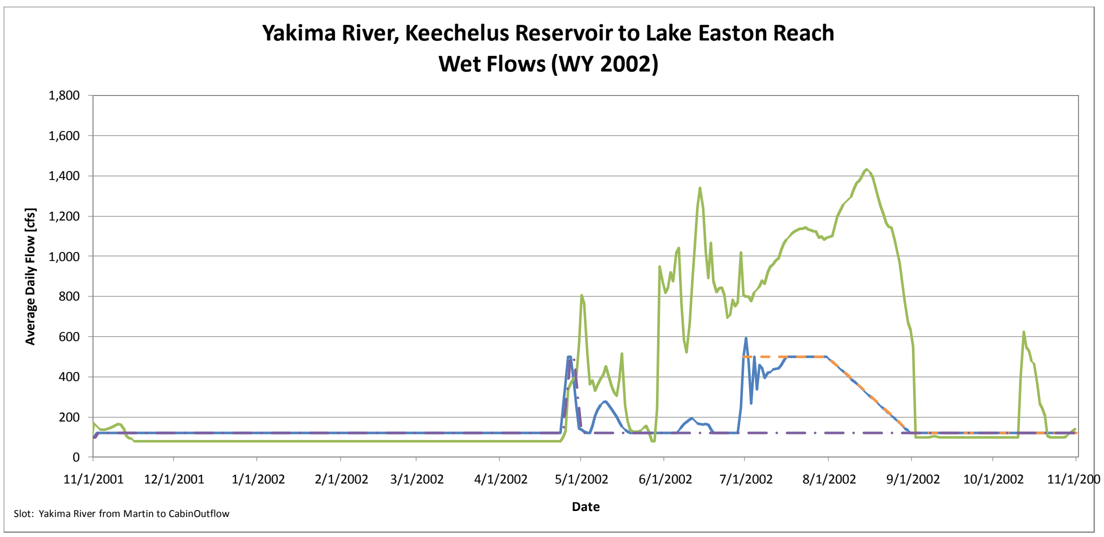

Lower Naches River
Average Flows (WY 2003)
Integrated Plan
Future without Integrated Plan
Proposed ISF Targets
Average Daily Flow [cfs]
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
11/1/2002
12/1/2002
1/1/2003
2/1/2003
3/1/2003
4/1/2003
5/1/2003
6/1/2003
7/1/2003
8/1/2003
9/1/2003
10/1/2003
11/1/200
Date
Slot: Naches 16_8 at Naches NACW.Gage Outflow

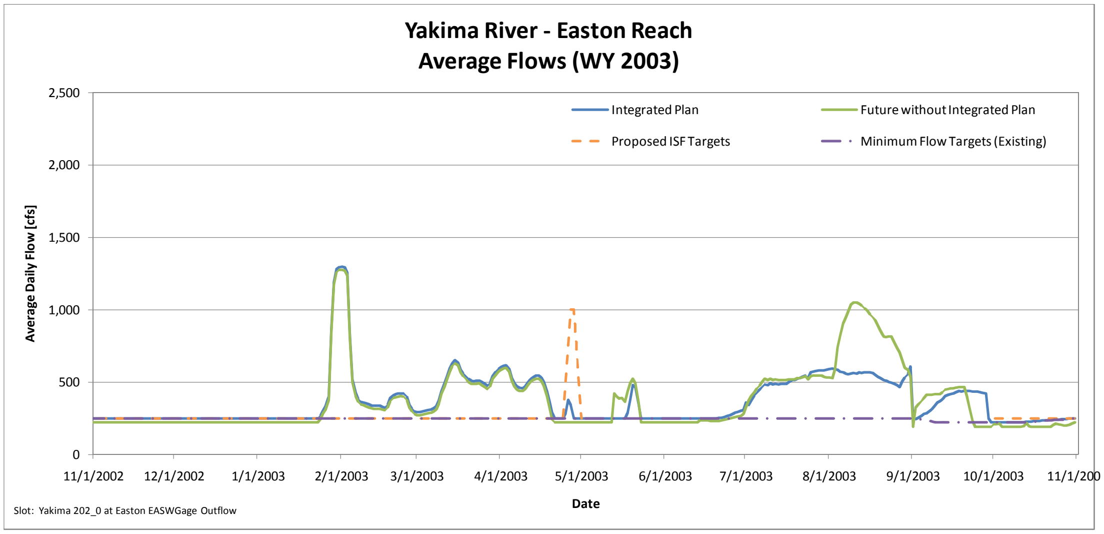

Lower Naches River
Drought Flows (WY 2001)
Average Daily Flow [cfs]
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
11/1/2000
12/1/2000
1/1/2001
2/1/2001
3/1/2001
4/1/2001
5/1/2001
6/1/2001
7/1/2001
8/1/2001
9/1/2001
10/1/2001
11/1/200
Date
Slot: Naches 16_8 at Naches NACW.Gage Outflow

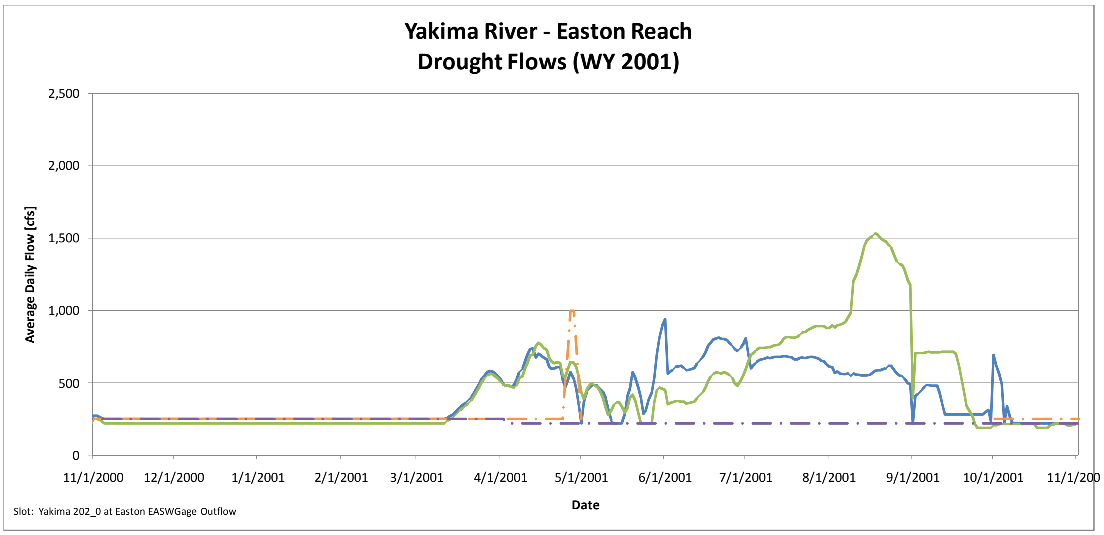

Lower Naches River
Wet Flows (WY 2002)
Average Daily Flow [cfs]
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
11/1/2001
12/1/2001
1/1/2002
2/1/2002
3/1/2002
4/1/2002
5/1/2002
6/1/2002
7/1/2002
8/1/2002
9/1/2002
10/1/2002
11/1/200
Date
Slot: Naches 16_8 at Naches NACW.Gage Outflow

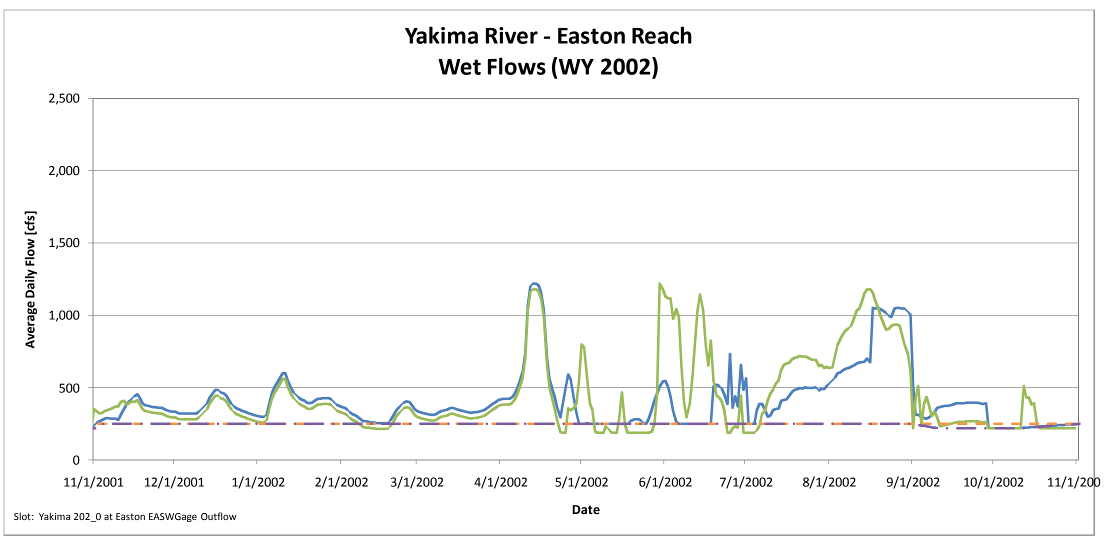

Yakima River, Keechelus Reservoir to Lake Easton Reach
Average Flows (WY 2003)
Integrated Plan
Future without Integrated Plan
Proposed ISF Targets
Minimum Flow Targets (Existing)
Average Daily Flow [cfs]
Date
Slot: Yakima River from Martin to CabinOutflow

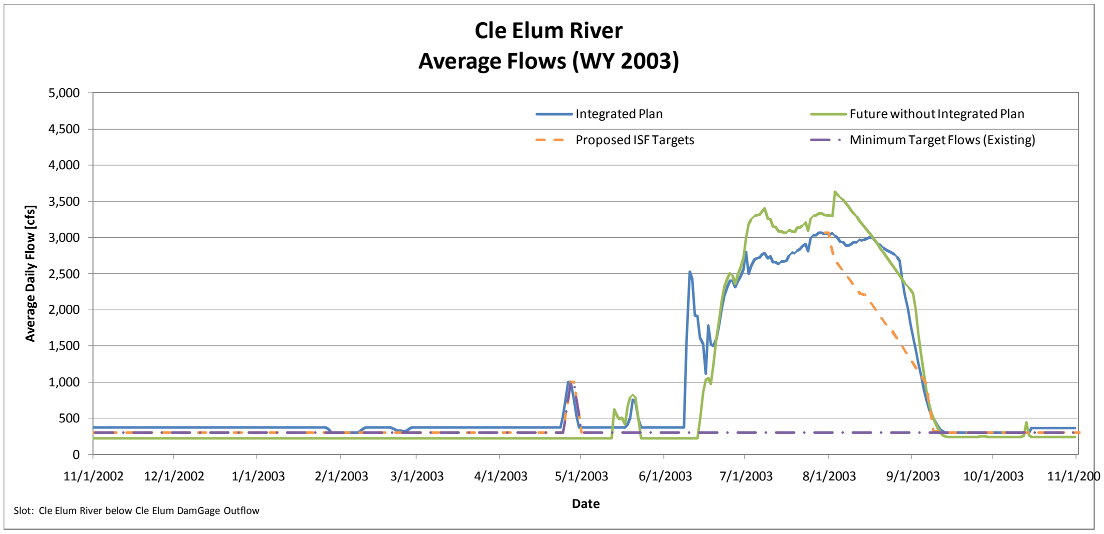

Yakima River, Keechelus Reservoir to Lake Easton Reach
Drought Flows (WY 2001)
Average Daily Flow [cfs]
Date
Slot: Yakima River from Martin to CabinOutflow

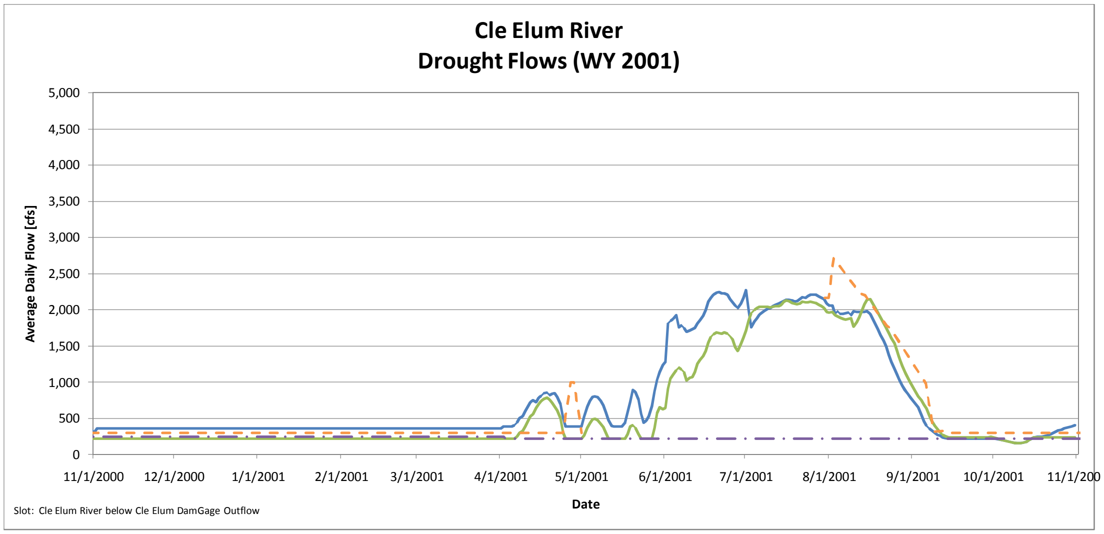

Yakima River, Keechelus Reservoir to Lake Easton Reach
Wet Flows (WY 2002)
Average Daily Flow [cfs]
Date
Slot: Yakima River from Martin to CabinOutflow

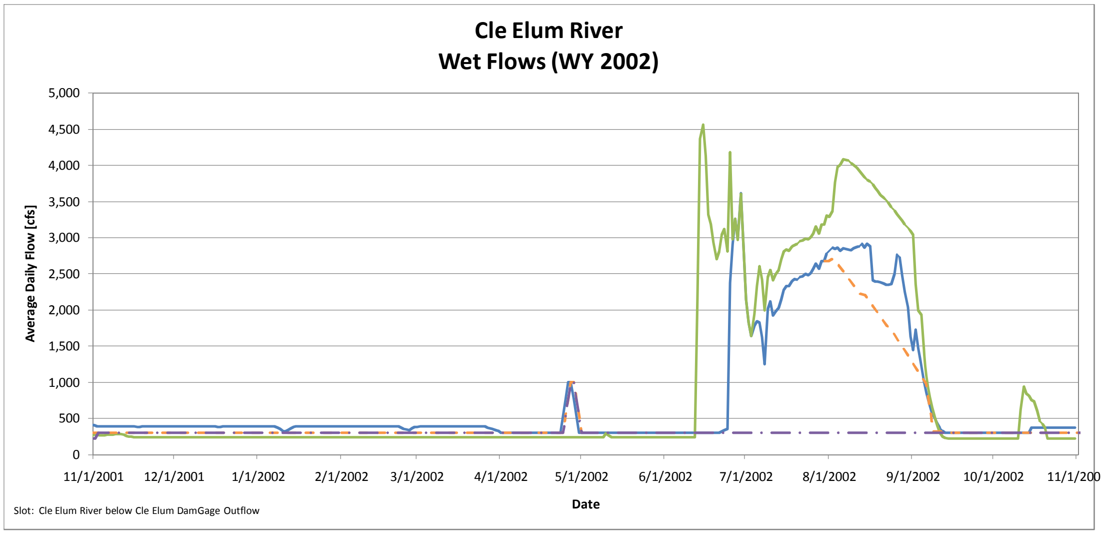

Yakima River - Easton Reach
Average Flows (WY 2003)
Integrated Plan
Future without Integrated Plan
Proposed ISF Targets
Minimum Flow Targets (Existing)
Average Daily Flow [cfs]
Date
Slot: Yakima 202_0 at Easton EASWGage Outflow

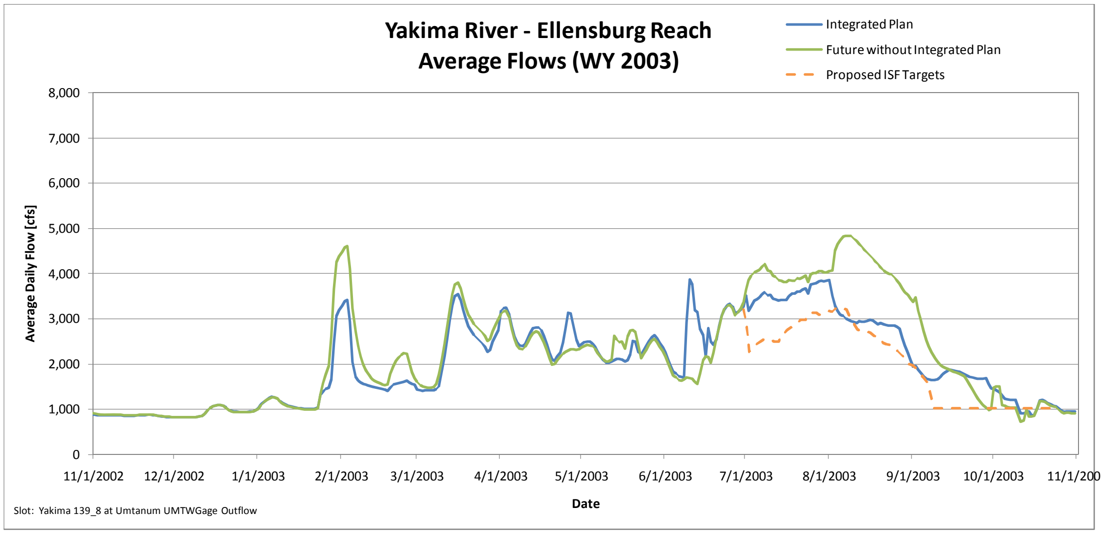

Yakima River - Easton Reach
Drought Flows (WY 2001)
Average Daily Flow [cfs]
Date
Slot: Yakima 202_0 at Easton EASWGage Outflow

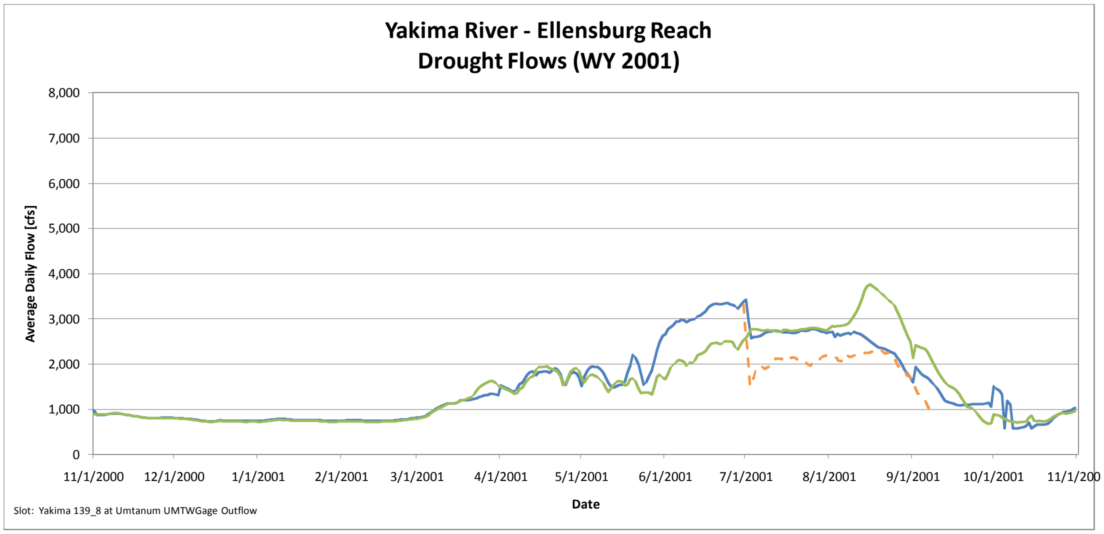

Yakima River - Easton Reach
Wet Flows (WY 2002)
Average Daily Flow [cfs]
Date
Slot: Yakima 202_0 at Easton EASWGage Outflow

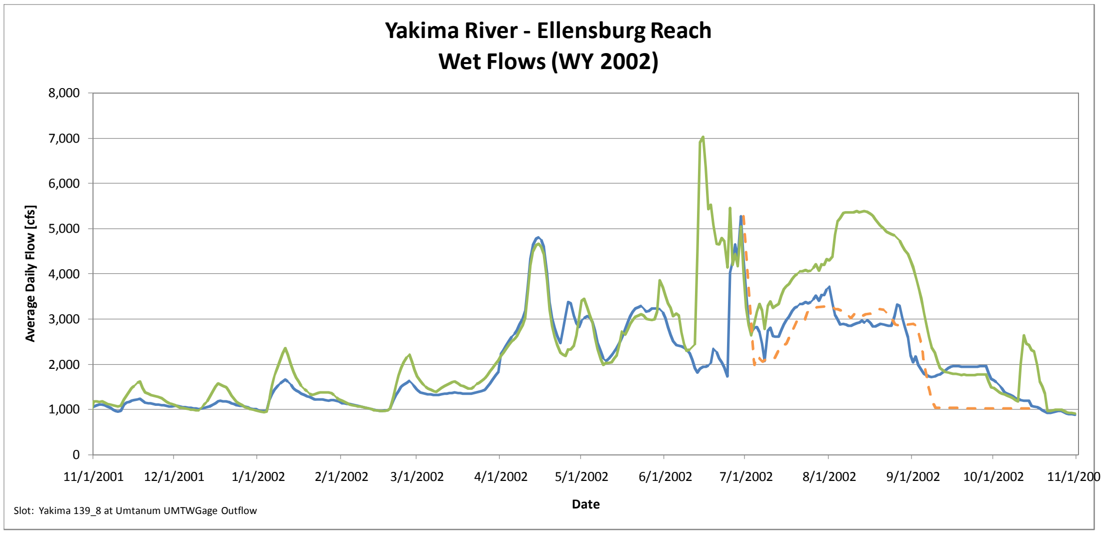

Cle Elum River
Average Flows (WY 2003)
Integrated Plan
Future without Integrated Plan
Proposed ISF Targets
Minimum Target Flows (Existing)
Average Daily Flow [cfs]
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
11/1/2002
12/1/2002
1/1/2003
2/1/2003
3/1/2003
4/1/2003
5/1/2003
6/1/2003
7/1/2003
8/1/2003
9/1/2003
10/1/2003
11/1/2003
Date
Slot: Cle Elum River below Cle Elum DamGage Outflow

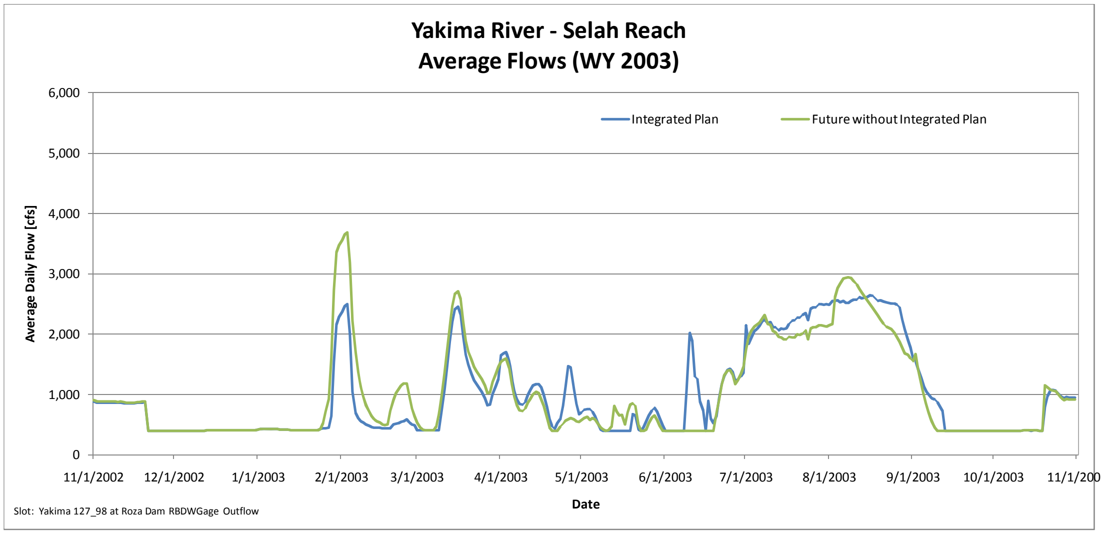

Cle Elum River
Drought Flows (WY 2001)
Average Daily Flow [cfs]
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
11/1/2000
12/1/2000
1/1/2001
2/1/2001
3/1/2001
4/1/2001
5/1/2001
6/1/2001
7/1/2001
8/1/2001
9/1/2001
10/1/2001
11/1/2001
Date
Slot: Cle Elum River below Cle Elum DamGage Outflow

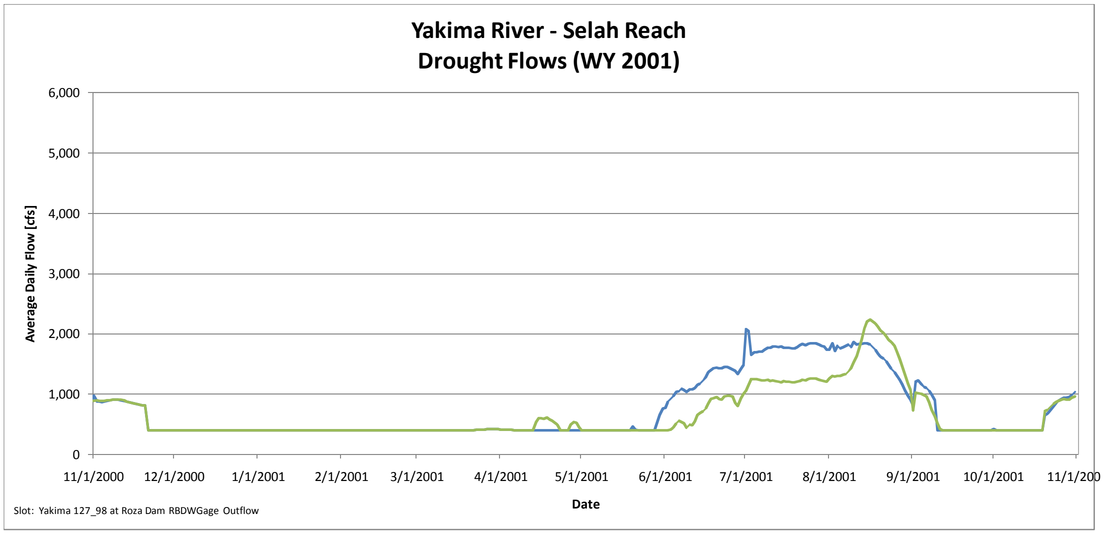

Cle Elum River
Wet Flows (WY 2002)
Average Daily Flow [cfs]
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
11/1/2001
12/1/2001
1/1/2002
2/1/2002
3/1/2002
4/1/2002
5/1/2002
6/1/2002
7/1/2002
8/1/2002
9/1/2002
10/1/2002
11/1/2002
Date
Slot: Cle Elum River below Cle Elum DamGage Outflow

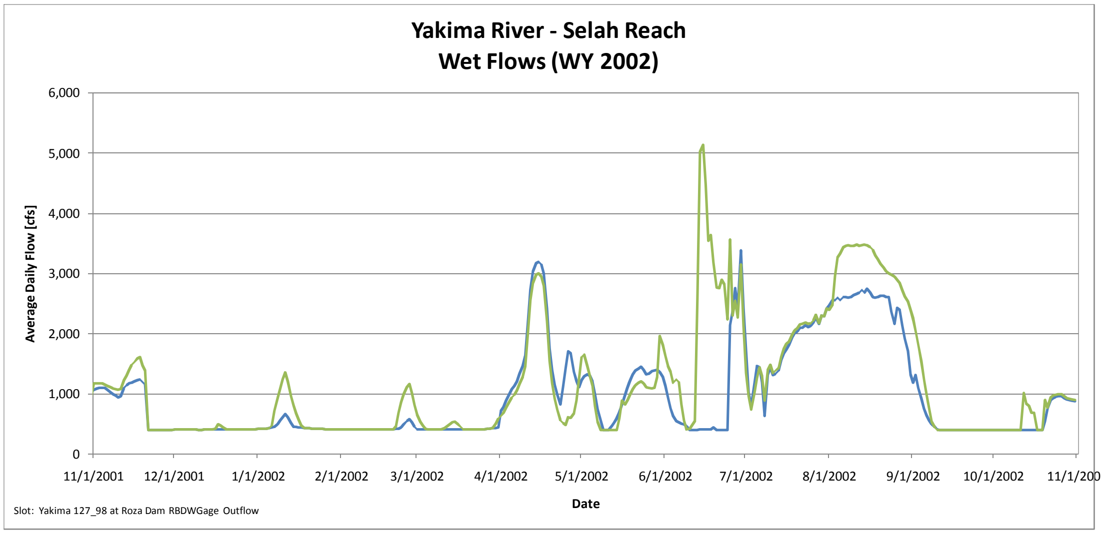

Yakima River - Ellensburg Reach
Average Flows (WY 2003)
Integrated Plan
Future without Integrated Plan
Proposed ISF Targets
Average Daily Flow [cfs]
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
11/1/2002
12/1/2002
1/1/2003
2/1/2003
3/1/2003
4/1/2003
5/1/2003
6/1/2003
7/1/2003
8/1/2003
9/1/2003
10/1/2003
Date
Slot: Yakima 139_8 at Umtanum UMTWGage Outflow

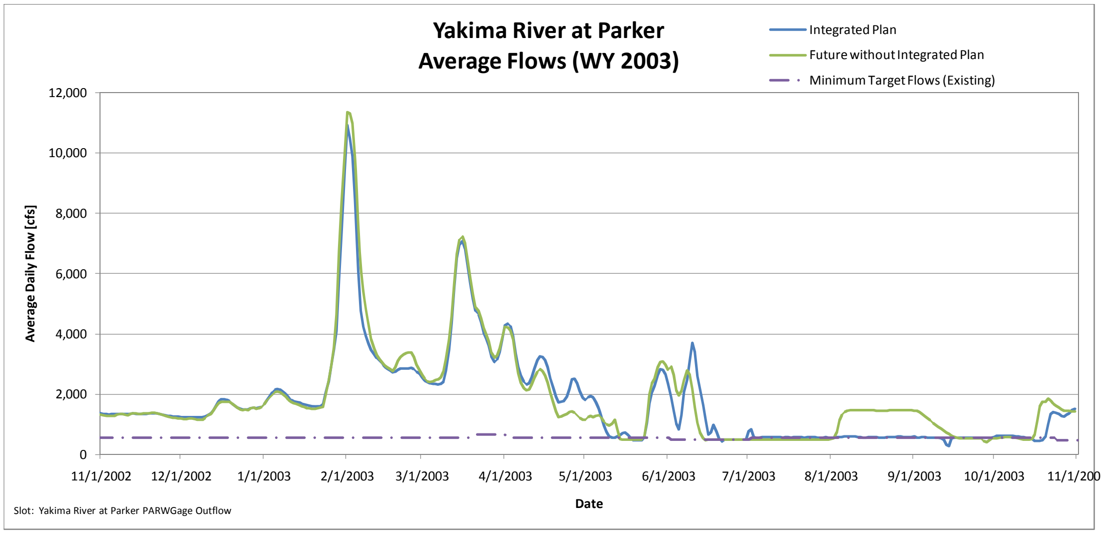

Yakima River - Ellensburg Reach
Drought Flows (WY 2001)
Average Daily Flow [cfs]
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
11/1/2000
12/1/2000
1/1/2001
2/1/2001
3/1/2001
4/1/2001
5/1/2001
6/1/2001
7/1/2001
8/1/2001
9/1/2001
10/1/2001
Date
Slot: Yakima 139_8 at Umtanum UMTWGage Outflow

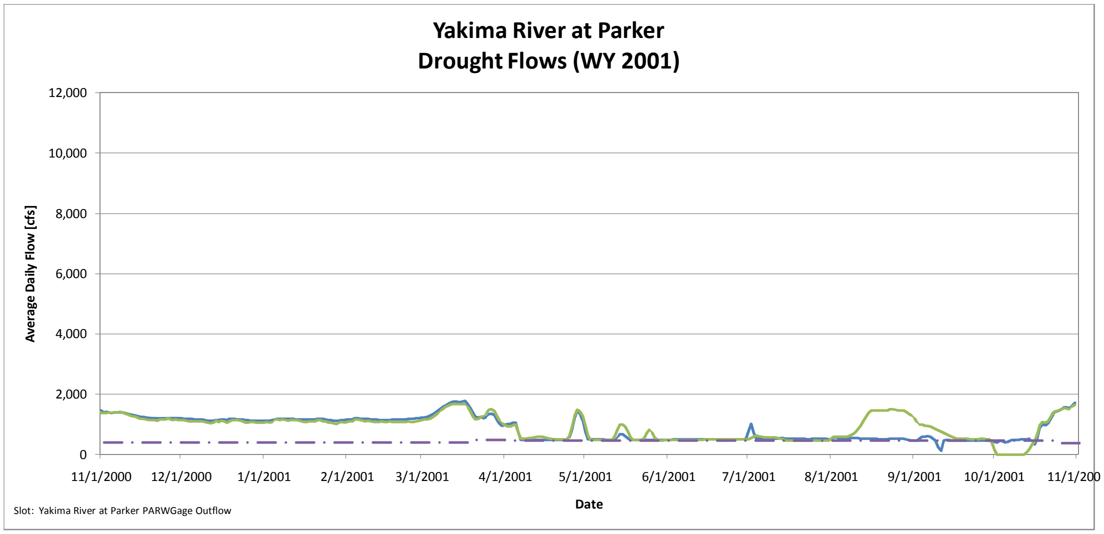

Yakima River - Ellensburg Reach
Wet Flows (WY 2002)
Average Daily Flow [cfs]
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
11/1/2001
12/1/2001
1/1/2002
2/1/2002
3/1/2002
4/1/2002
5/1/2002
6/1/2002
7/1/2002
8/1/2002
9/1/2002
10/1/2002
Date
Slot: Yakima 139_8 at Umtanum UMTWGage Outflow

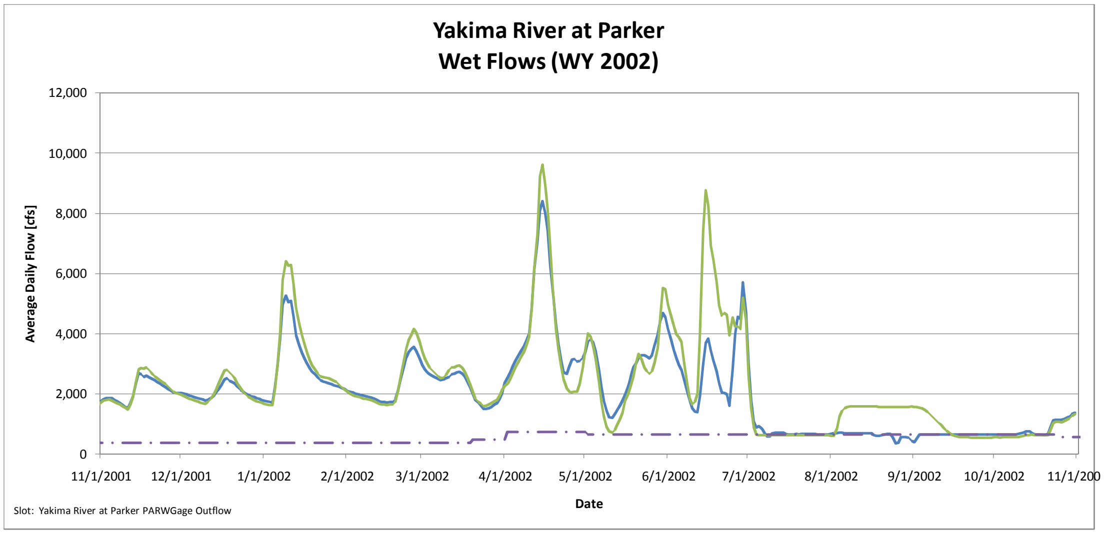

Yakima River - Selah Reach
Average Flows (WY 2003)
Integrated Plan
Future without Integrated Plan
Average Daily Flow [cfs]
6,000
5,000
4,000
3,000
2,000
1,000
0
11/1/2002
12/1/2002
1/1/2003
2/1/2003
3/1/2003
4/1/2003
5/1/2003
6/1/2003
7/1/2003
8/1/2003
9/1/2003
10/1/2003
11/1/200
Date
Slot: Yakima 127_98 at Roza Dam RBDWGage Outflow

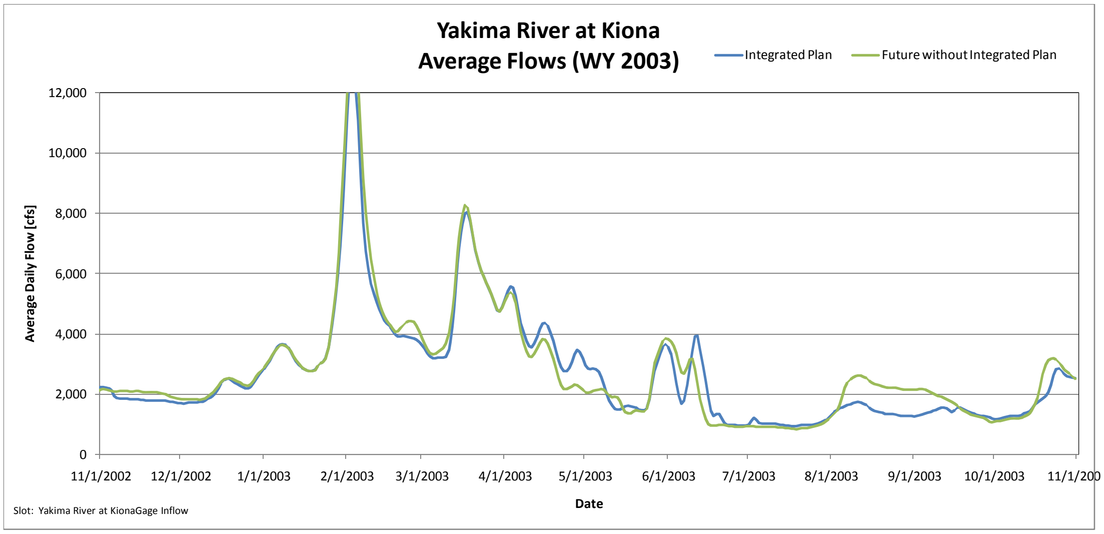

Yakima River - Selah Reach
Drought Flows (WY 2001)
Average Daily Flow [cfs]
6,000
5,000
4,000
3,000
2,000
1,000
0
11/1/2000
12/1/2000
1/1/2001
2/1/2001
3/1/2001
4/1/2001
5/1/2001
6/1/2001
7/1/2001
8/1/2001
9/1/2001
10/1/2001
11/1/200
Date
Slot: Yakima 127_98 at Roza Dam RBDWGage Outflow

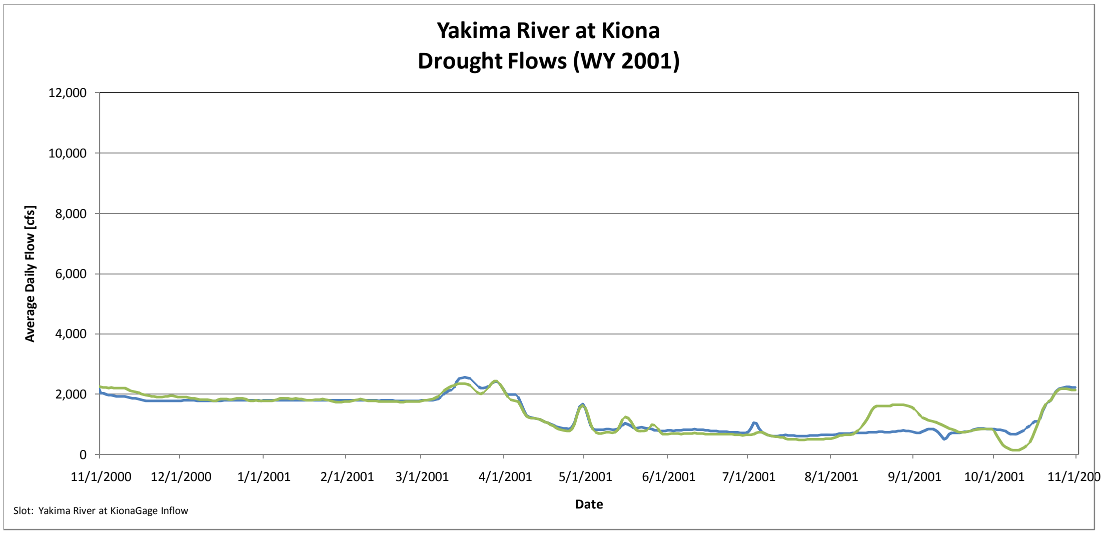

Yakima River - Selah Reach
Wet Flows (WY 2002)
Average Daily Flow [cfs]
6,000
5,000
4,000
3,000
2,000
1,000
0
11/1/2001
12/1/2001
1/1/2002
2/1/2002
3/1/2002
4/1/2002
5/1/2002
6/1/2002
7/1/2002
8/1/2002
9/1/2002
10/1/2002
11/1/200
Date
Slot: Yakima 127_98 at Roza Dam RBDWGage Outflow

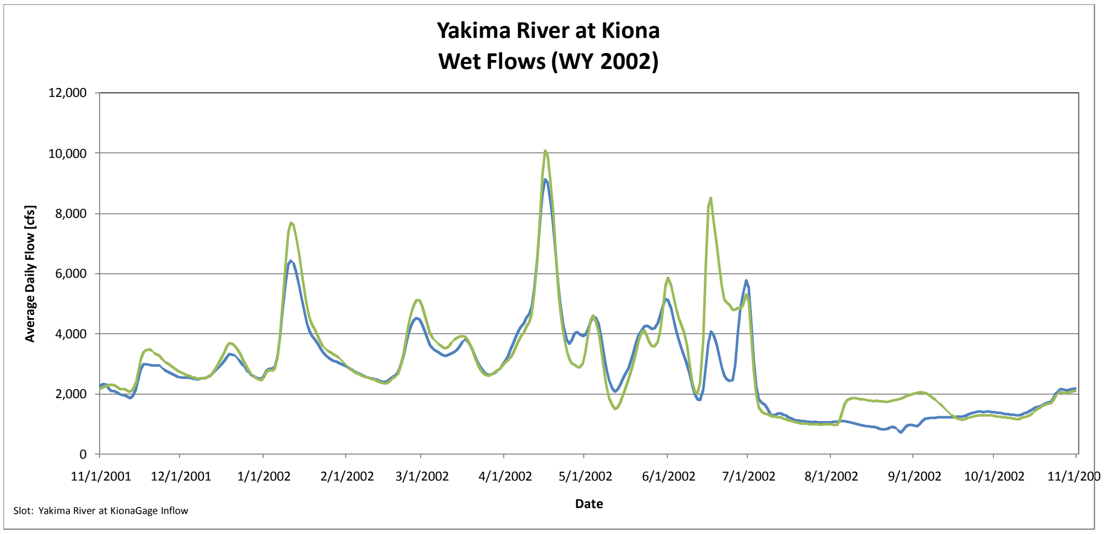

Yakima River at Parker
Average Flows (WY 2003)
Integrated Plan
Future without Integrated Plan
Minimum Target Flows (Existing)
Average Daily Flow [cfs]
12,000
10,000
8,000
6,000
4,000
2,000
0
11/1/2002
12/1/2002
1/1/2003
2/1/2003
3/1/2003
4/1/2003
5/1/2003
6/1/2003
7/1/2003
8/1/2003
9/1/2003
10/1/2003
11/1/200
Date
Slot: Yakima River at Parker PARWGage Outflow

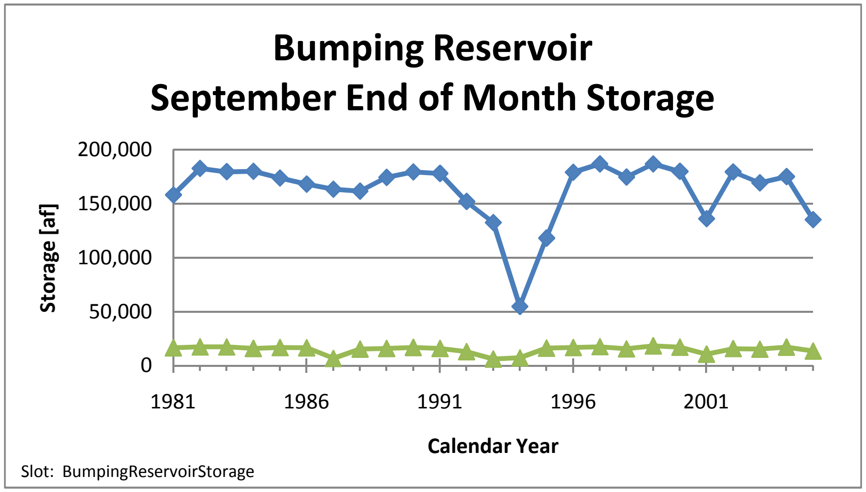

Yakima River at Parker
Drought Flows (WY 2001)
Average Daily Flow [cfs]
12,000
10,000
8,000
6,000
4,000
2,000
0
11/1/2000
12/1/2000
1/1/2001
2/1/2001
3/1/2001
4/1/2001
5/1/2001
6/1/2001
7/1/2001
8/1/2001
9/1/2001
10/1/2001
11/1/200
Date
Slot: Yakima River at Parker PARWGage Outflow

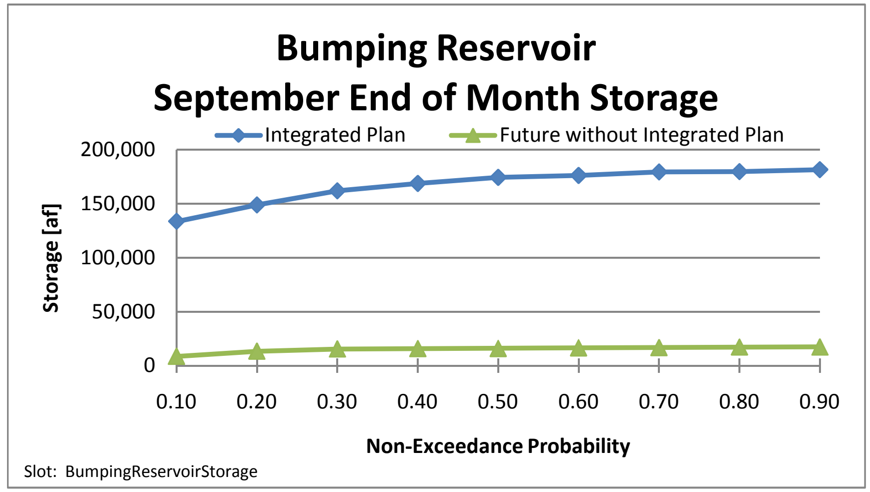

Yakima River at Parker
Wet Flows (WY 2002)
Average Daily Flow [cfs]
12,000
10,000
8,000
6,000
4,000
2,000
0
11/1/2001
12/1/2001
1/1/2002
2/1/2002
3/1/2002
4/1/2002
5/1/2002
6/1/2002
7/1/2002
8/1/2002
9/1/2002
10/1/2002
11/1/200
Date
Slot: Yakima River at Parker PARWGage Outflow

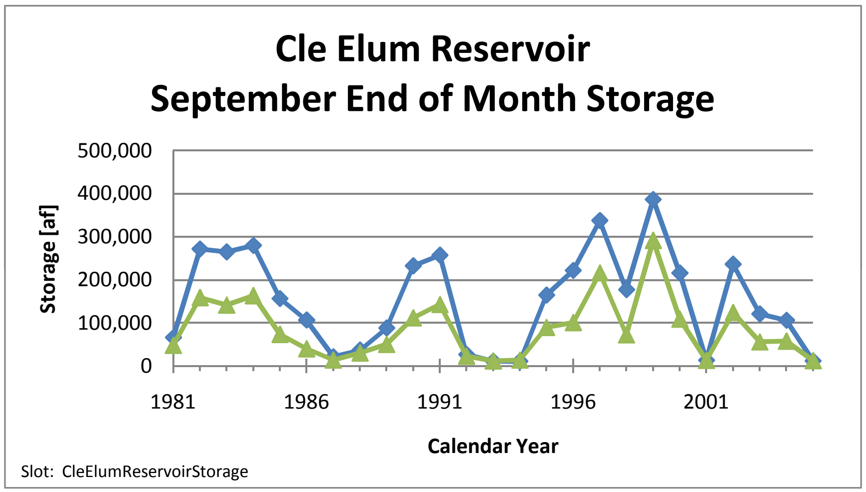

Yakima River at Kiona
Average Flows (WY 2003)
Integrated Plan
Future without Integrated Plan
Average Daily Flow [cfs]
12,000
10,000
8,000
6,000
4,000
2,000
0
11/1/2002
12/1/2002
1/1/2003
2/1/2003
3/1/2003
4/1/2003
5/1/2003
6/1/2003
7/1/2003
8/1/2003
9/1/2003
10/1/2003
11/1/200
Date
Slot: Yakima River at KionaGage Inflow

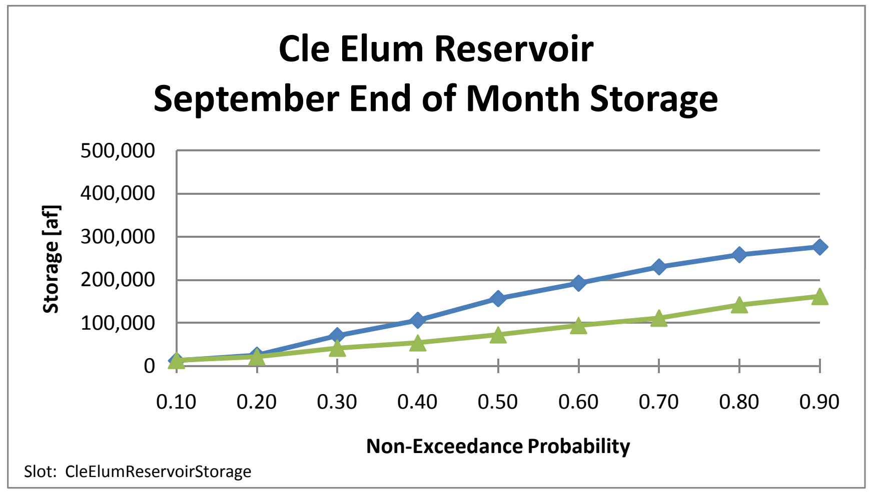

Yakima River at Kiona
Drought Flows (WY 2001)
Average Daily Flow [cfs]
12,000
10,000
8,000
6,000
4,000
2,000
0
11/1/2000
12/1/2000
1/1/2001
2/1/2001
3/1/2001
4/1/2001
5/1/2001
6/1/2001
7/1/2001
8/1/2001
9/1/2001
10/1/2001
11/1/200
Date
Slot: Yakima River at KionaGage Inflow

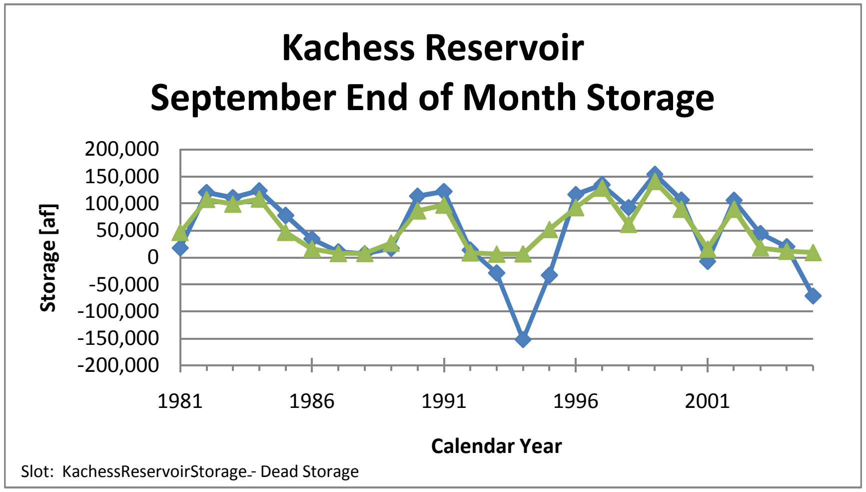

Yakima River at Kiona
Wet Flows (WY 2002)
Average Daily Flow [cfs]
12,000
10,000
8,000
6,000
4,000
2,000
0
11/1/2001
12/1/2001
1/1/2002
2/1/2002
3/1/2002
4/1/2002
5/1/2002
6/1/2002
7/1/2002
8/1/2002
9/1/2002
10/1/2002
11/1/200
Date
Slot: Yakima River at KionaGage Inflow

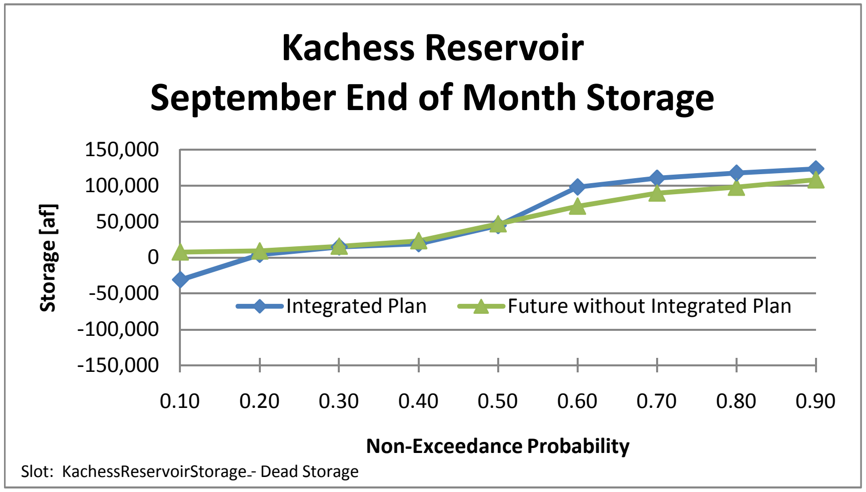

Bumping Reservoir
September End of Month Storage
200,000
150,000
100,000
50,000
0
Storage [af]
1981
1986
1991
1996
2001
Calendar Year
Slot: BumpingReservoirStorage

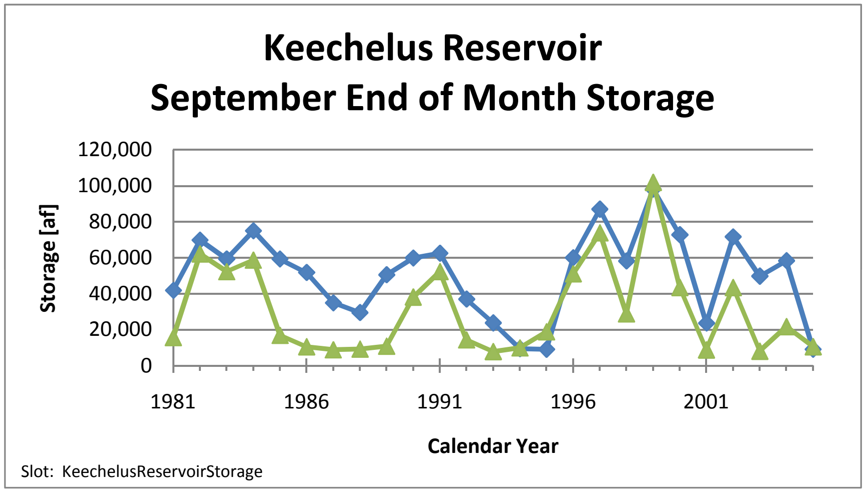

Bumping Reservoir
September End of Month Storage
Integrated Plan
Future without Integrated Plan
200,000
150,000
100,000
50,000
0
Storage [af]
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
Non-Exceedance Probability
Slot: BumpingReservoirStorage

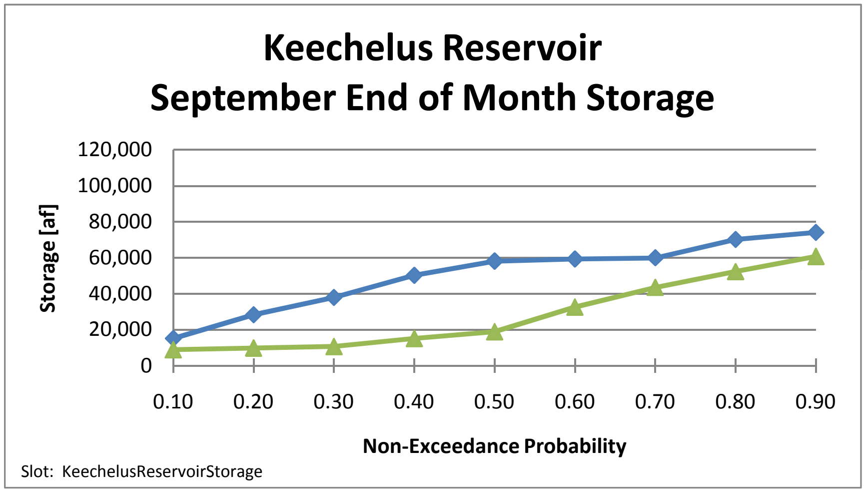

Cle Elum Reservoir
September End of Month Storage
500,000
400,000
300,000
200,000
100,000
0
Storage [af]
1981
1986
1991
1996
2001
Calendar Year
Slot: CleElumReservoirStorage

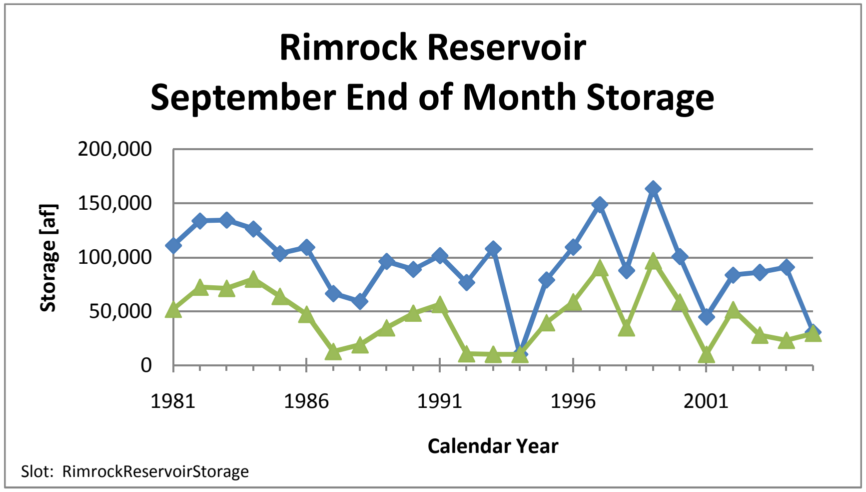

Cle Elum Reservoir
September End of Month Storage
500,000
400,000
300,000
200,000
100,000
0
Storage [af]
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
Non-Exceedance Probability
Slot: CleElumReservoirStorage

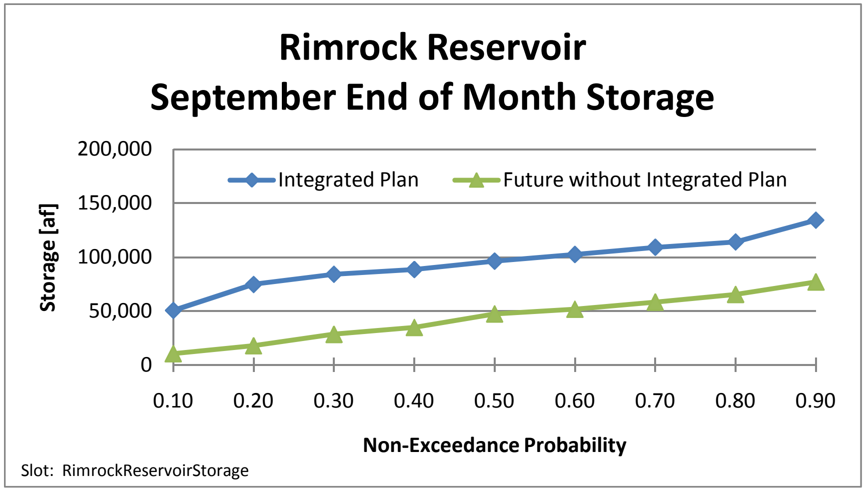

Kachess Reservoir
September End of Month Storage
200,000
150,000
100,000
50,000
0
-50,000
-100,000
-150,000
-200,000
Storage [af]
1981
1986
1991
1996
2001
Calendar Year
Slot: KachessReservoirStorage.- Dead Storage

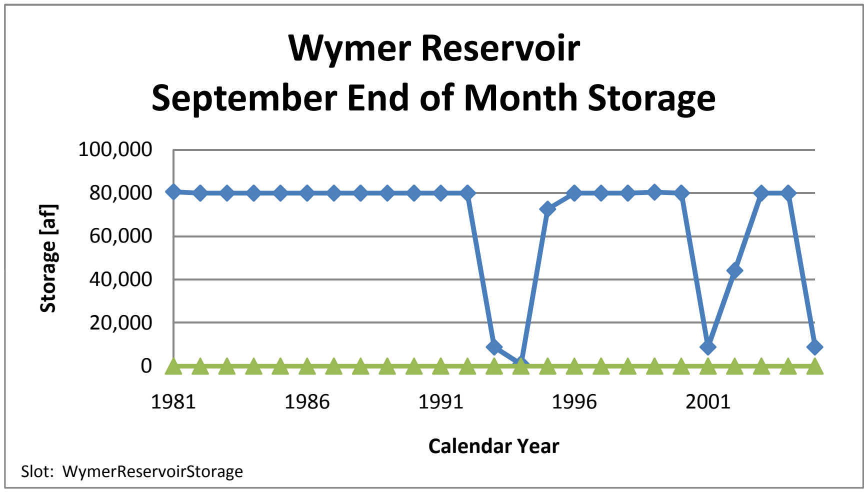

Kachess Reservoir
September End of Month Storage
150,000
100,000
50,000
0
-50,000
-100,000
-150,000
Storage [af]
Integrated Plan
Future without Integrated Plan
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
Non-Exceedance Probability
Slot: KachessReservoirStorage.- Dead Storage

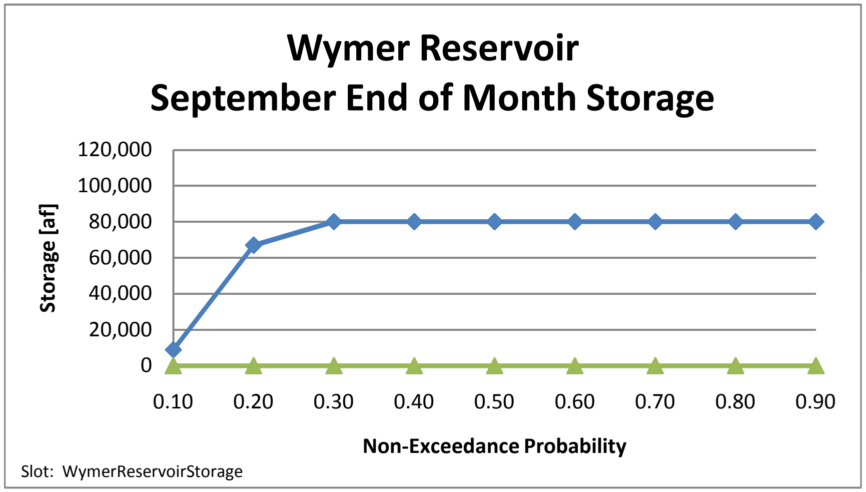

Keechelus Reservoir
September End of Month Storage
120,000
100,000
80,000
60,000
40,000
20,000
0
Storage [af]
1981
1986
1991
1996
2001
Calendar Year
Slot: KeechelusReservoirStorage

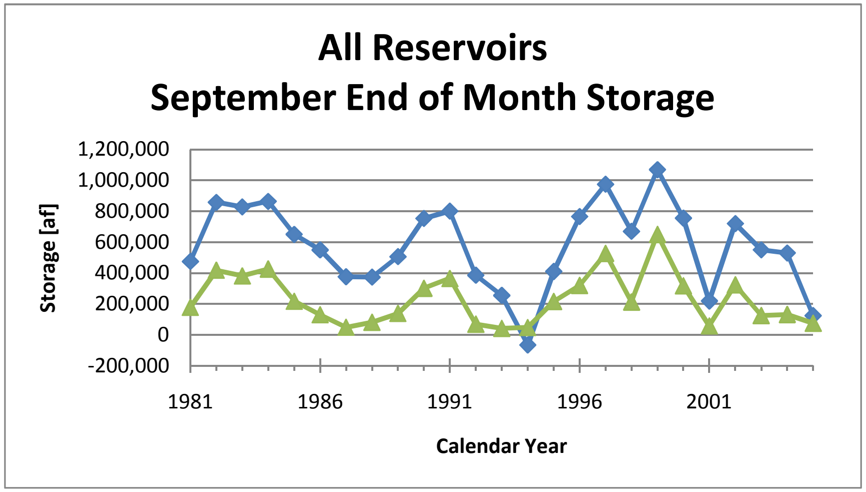

Keechelus Reservoir
September End of Month Storage
120,000
100,000
80,000
60,000
40,000
20,000
0
Storage [af]
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
Non-Exceedance Probability
Slot: KeechelusReservoirStorage

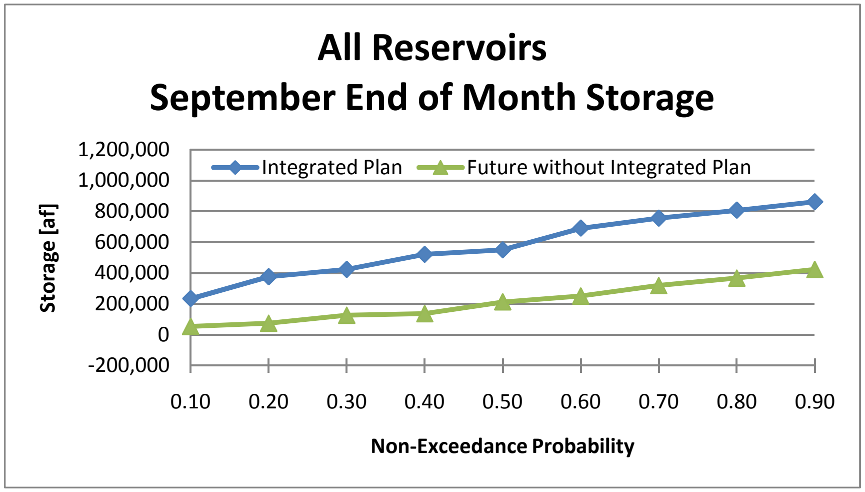

Rimrock Reservoir
September End of Month Storage
Storage [af]
200,000
150,000
100,000
50,000
0
1981
1986
1991
1996
2001
Calendar Year
Slot: RimrockReservoirStorage

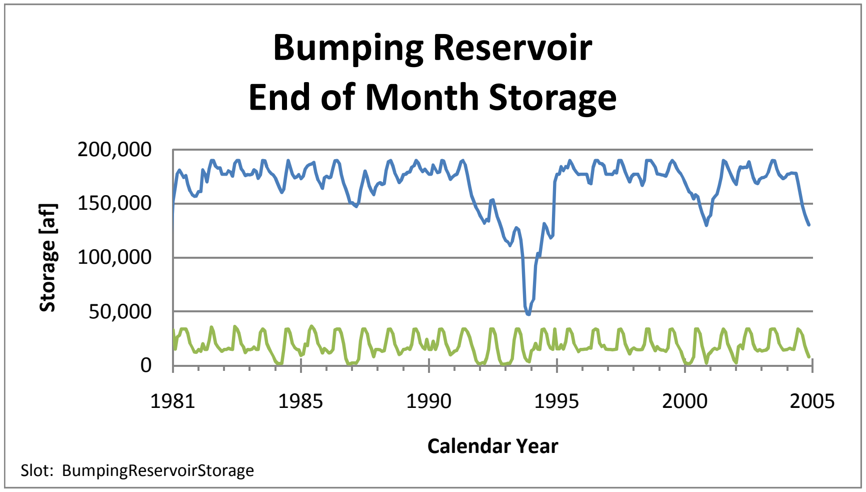

Rimrock Reservoir
September End of Month Storage
Integrated Plan
Future without Integrated Plan
Storage [af]
200,000
150,000
100,000
50,000
0
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
Non-Exceedance Probability
Slot: RimrockReservoirStorage

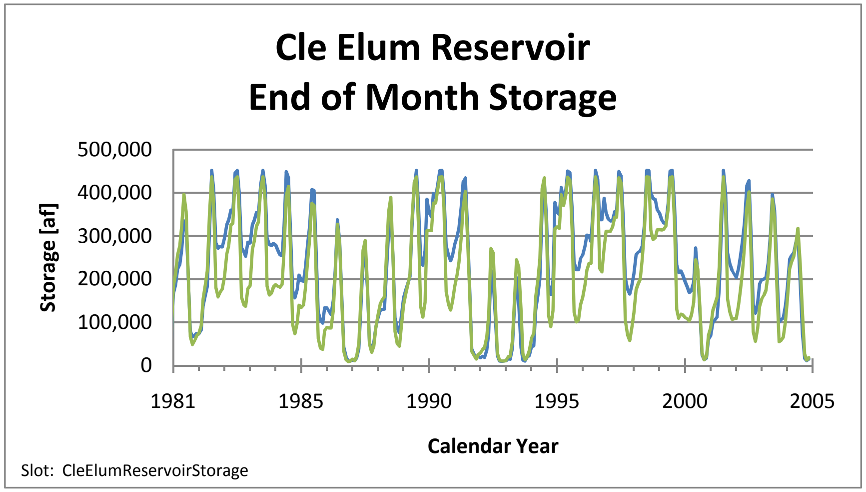

Wymer Reservoir
September End of Month Storage
Storage [af]
100,000
80,000
60,000
40,000
20,000
0
1981
1986
1991
1996
2001
Calendar Year
Slot: WymerReservoirStorage

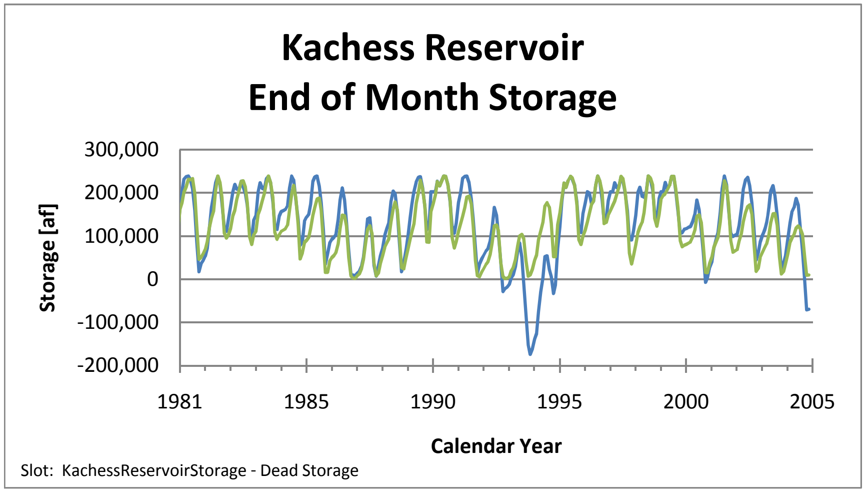

Wymer Reservoir
September End of Month Storage
Storage [af]
120,000
100,000
80,000
60,000
40,000
20,000
0
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
Non-Exceedance Probability
Slot: WymerReservoirStorage

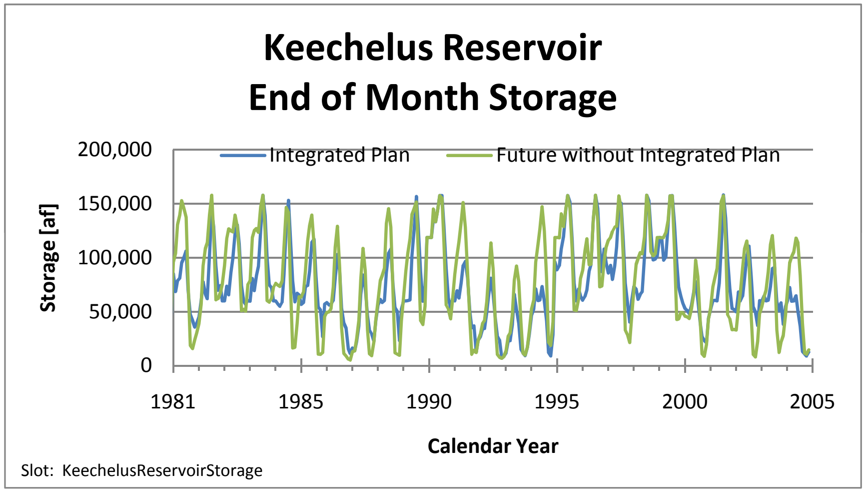

All Reservoirs
September End of Month Storage
Storage [af]
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
-200,000
1981
1986
1991
1996
2001
Calendar Year

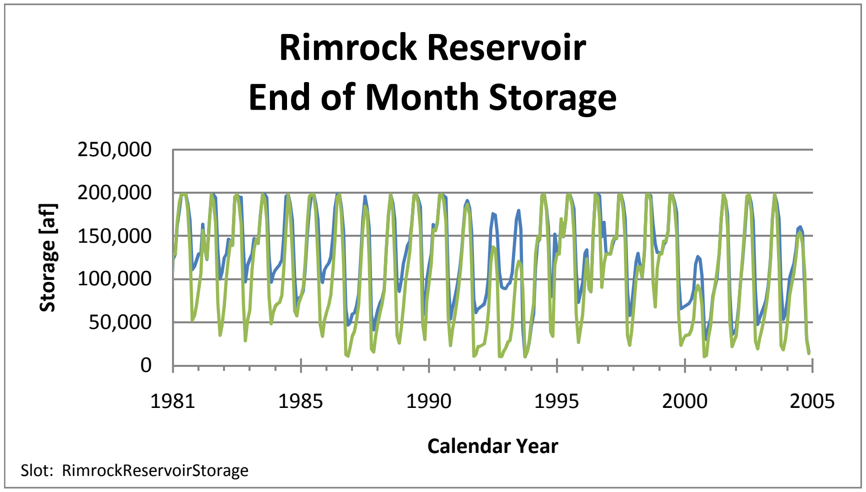

All Reservoirs
September End of Month Storage
Integrated Plan
Future without Integrated Plan
Storage [af]
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
-200,000
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
Non-Exceedance Probability

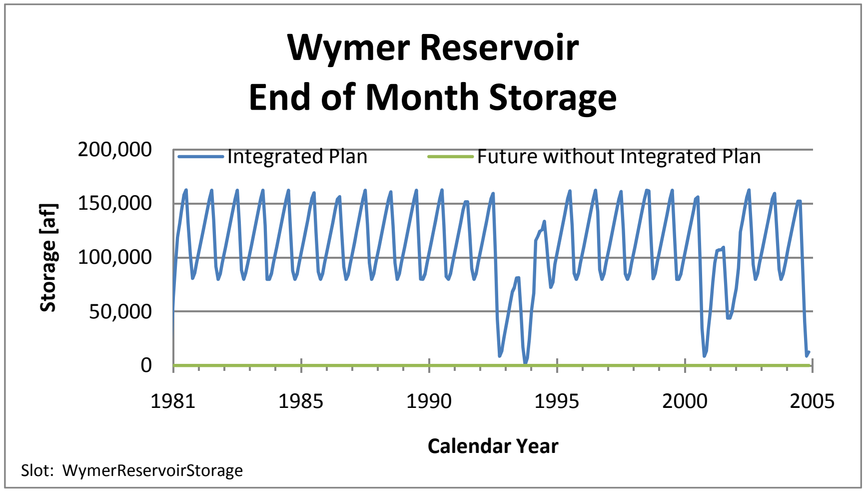

Bumping Reservoir
End of Month Storage
200,000
150,000
100,000
50,000
0
Storage [af]
1981
1985
1990
1995
2000
2005
Calendar Year
Slot: BumpingReservoirStorage

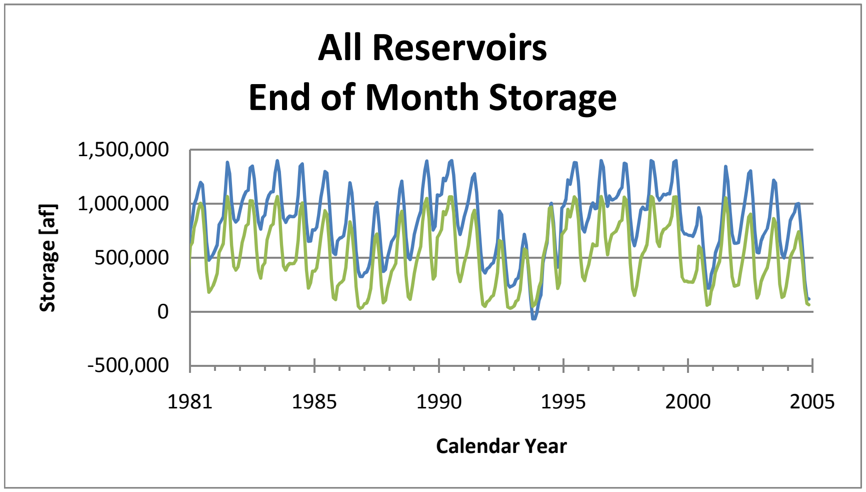

Cle Elum Reservoir
End of Month Storage
500,000
400,000
300,000
200,000
100,000
0
Storage [af]
1981
1985
1990
1995
2000
2005
Calendar Year
Slot: CleElumReservoirStorage

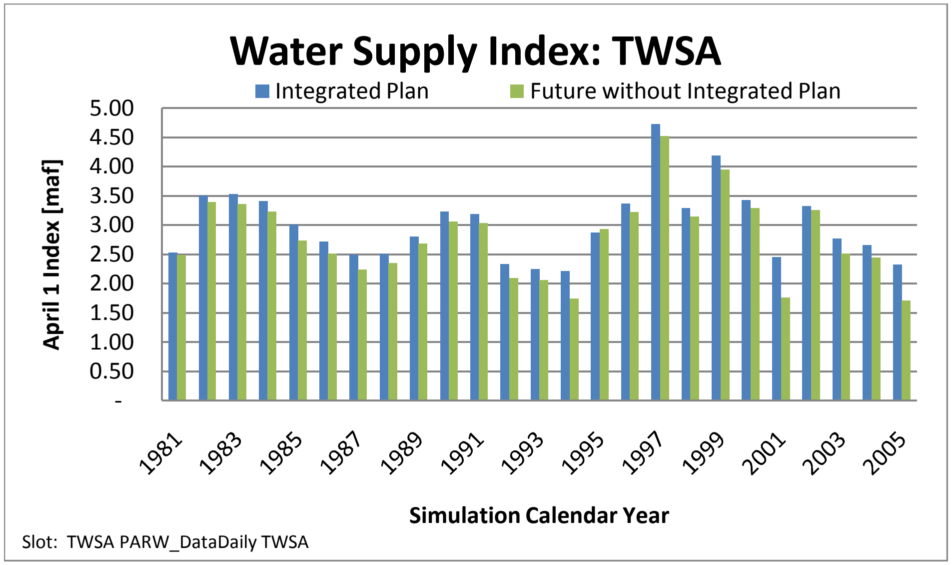

Kachess Reservoir
End of Month Storage
300,000
200,000
100,000
0
-100,000
-200,000
Storage [af]
1981
1985
1990
1995
2000
2005
Calendar Year
Slot: KachessReservoirStorage - Dead Storage

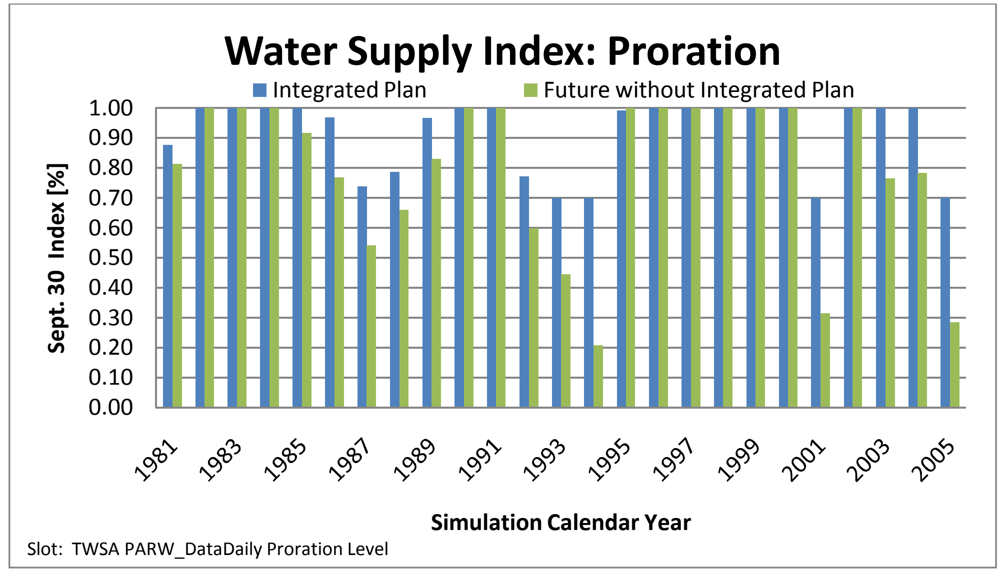

Keechelus Reservoir
End of Month Storage
Integrated Plan
Future without Integrated Plan
200,000
150,000
100,000
50,000
0
Storage [af]
1981
1985
1990
1995
2000
2005
Calendar Year
Slot: KeechelusReservoirStorage

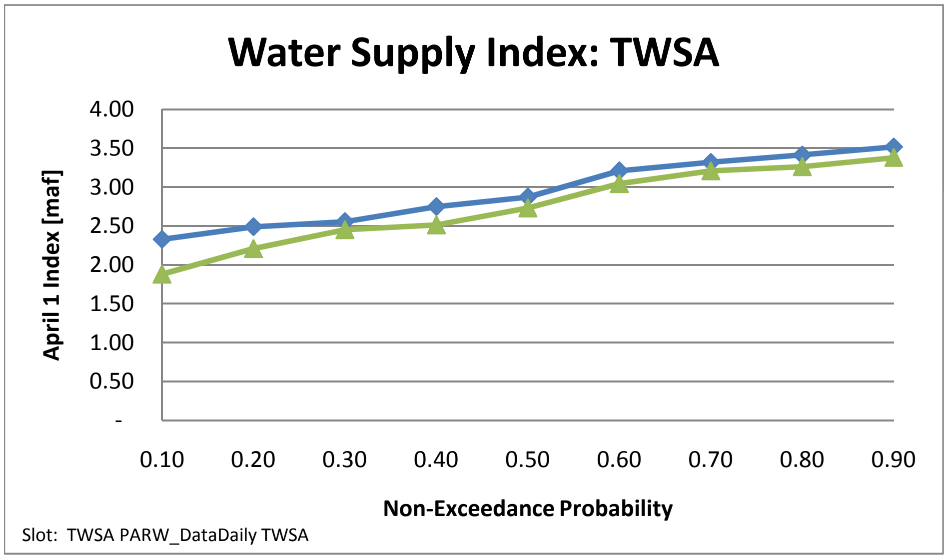

Rimrock Reservoir
End of Month Storage
250,000
200,000
150,000
100,000
50,000
0
Storage [af]
1981
1985
1990
1995
2000
2005
Calendar Year
Slot: RimrockReservoirStorage

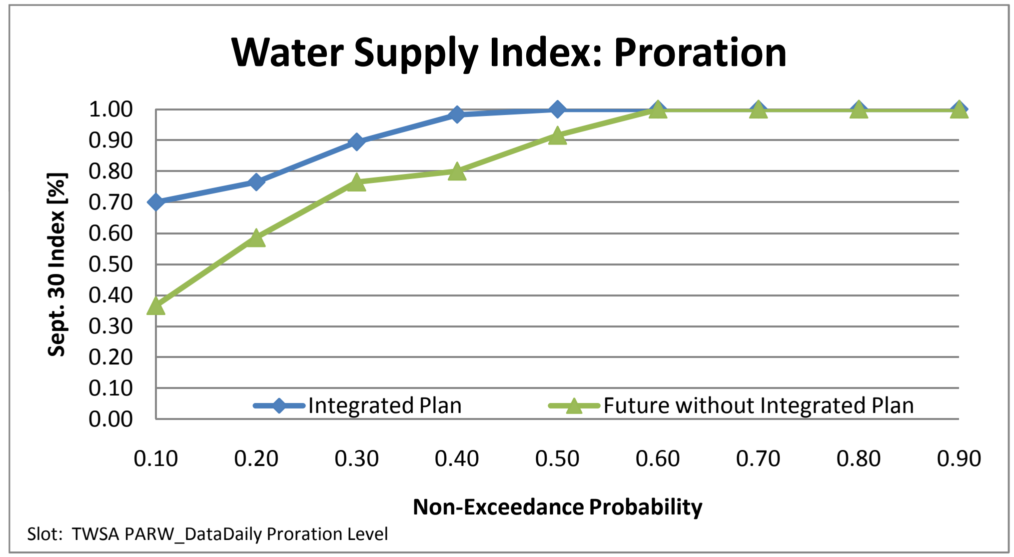

Wymer Reservoir
End of Month Storage
Integrated Plan
Future without Integrated Plan
200,000
150,000
100,000
50,000
0
Storage [af]
1981
1985
1990
1995
2000
2005
Calendar Year
Slot: WymerReservoirStorage


All Reservoirs
End of Month Storage
1,500,000
1,000,000
500,000
0
-500,000
Storage [af]
1981
1985
1990
1995
2000
2005
Calendar Year

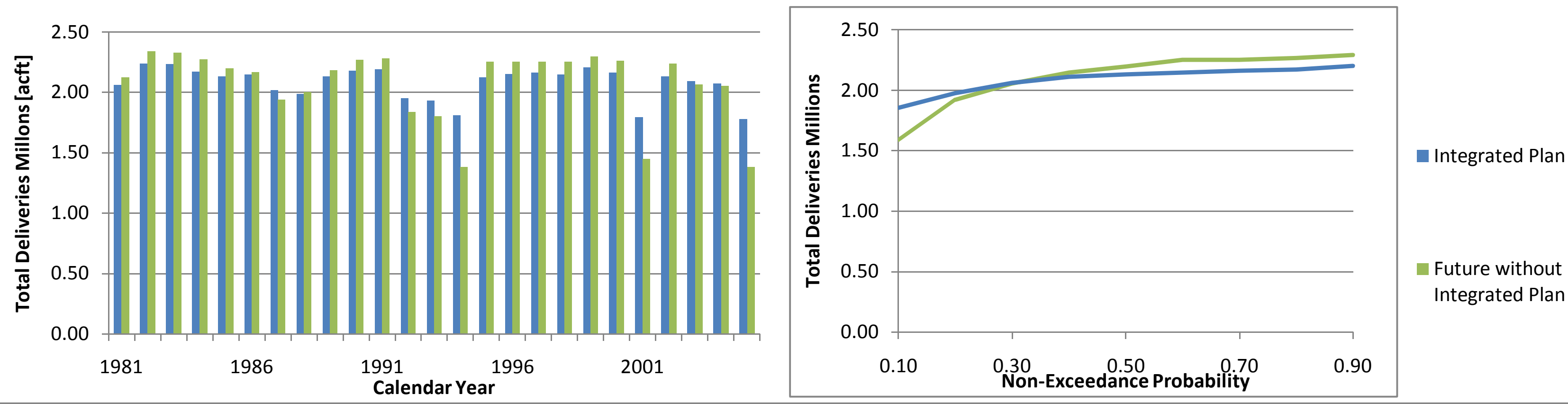

Water Supply Index: TWSA
Integrated Plan
Future without Integrated Plan
April 1 Index [maf]
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
-
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Simulation Calendar Year
Slot: TWSA PARW_DataDaily TWSA


Water Supply Index: Proration
Integrated Plan
Future without Integrated Plan
Sept. 30 Index [%]
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
Simulation Calendar Year
Slot: TWSA PARW_DataDaily Proration Level

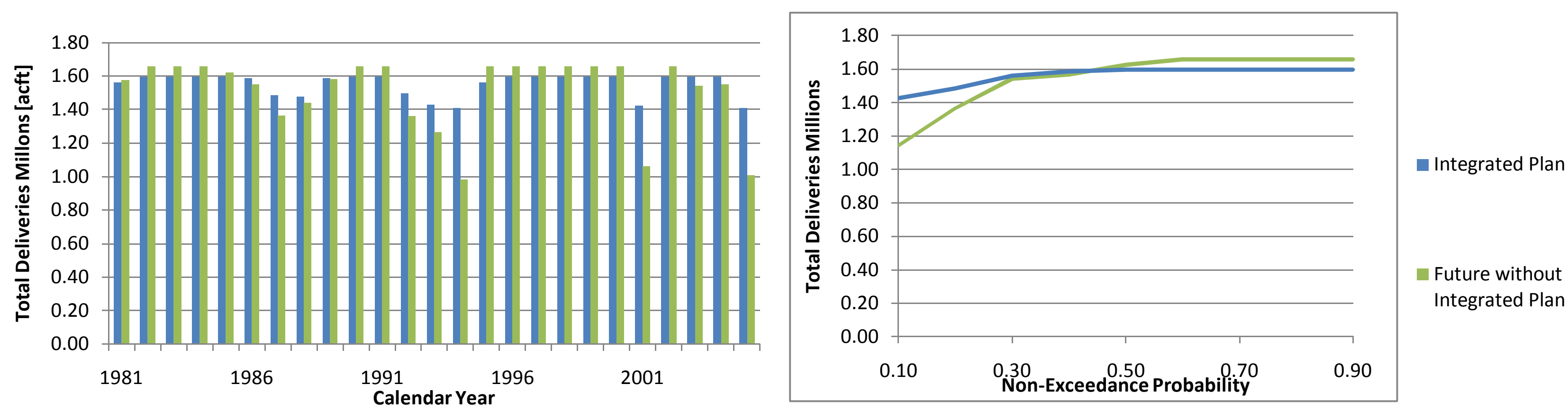

Water Supply Index: TWSA
April 1 Index [maf]
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
-
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
Non-Exceedance Probability
Slot: TWSA PARW_DataDaily TWSA


Water Supply Index: Proration
Sept. 30 Index [%]
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Integrated Plan
Future without Integrated Plan
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
Non-Exceedance Probability
Slot: TWSA PARW_DataDaily Proration Level

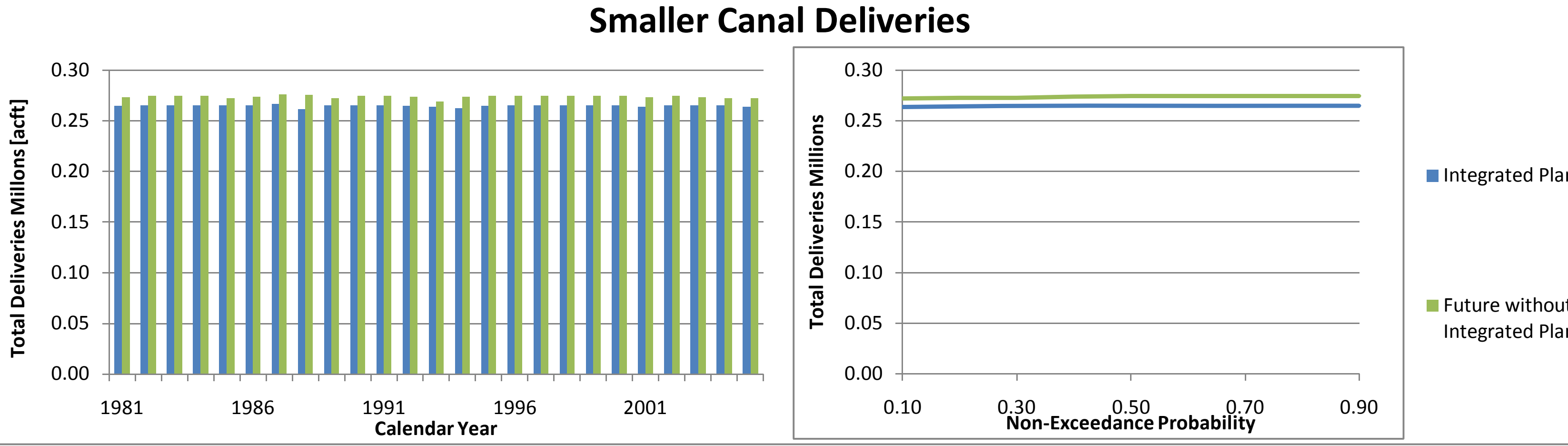
Main Canal Deliveries



Sunnyside, KRD Irrigation, Roza Irrigation, New Reservation Canal, Tieton, and Kennewick Deliveries



Smaller Canal Deliveries



M&I Surface Water Deliveries