

CHAPTER 5.0 LONG-TERM IMPACTS AND MITIGATION MEASURES

This chapter describes the long-term impacts that could result from the alternatives proposed in this Supplemental Draft EIS. Long-term impacts are those that would occur as a result of implementing the selected alternatives. Possible mitigation measures for the impacts are also discussed. Because this is a Programmatic EIS and the details of project implementation are not known, long-term impacts are discussed in general terms. Specific projects may be required to undergo additional environmental review to identify specific long-term impacts.

Impacts are evaluated for both the No Action Alternative and the Integrated Water Resource Management Alternative. The Integrated Water Resource Management Alternative includes four elements—fish passage, modifying existing structures and facilities, new storage, and fish habitat enhancement. Impacts associated with the four elements are presented individually first. Because Ecology intends that the Integrated Water Resource Management Alternative would be implemented as a combined package, the impacts of integrating the elements are also presented. Long-term cumulative impacts are presented at the end of this chapter.

5.1 Earth

5.1.1 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 to earth resources.

5.1.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements

5.1.2.1 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. Site scale stream channel erosion and channel modification are also possible.

5.1.2.2 Modifying Existing Structures and Facilities 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 to existing reservoirs that are currently operated at different pool levels.

5.1.2.3 New Storage Element

The new storage facilities element has the greatest potential to cause impacts to earth resources over the long term. Storage facilities, including the expansion of the Bumping Lake, have the potential to alter the transport of upstream sediments, resulting in increased deposition in the reservoir and reduced sediment loads to downstream waters. The flushing of deposited sediment on reservoir beds could potentially deliver sediment to receiving waters over more concentrated time periods. Seepage at the downstream face of a dam or embankment could increase slope instability, erosion, or mass failure. No landslide masses or potential unstable masses were identified at Bumping Lake during previous preliminary geologic investigations (Reclamation, 1979). Detailed earth-related impacts for storage facilities would be described in future site-specific geologic investigations.

5.1.2.4 Fish Habitat 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 inundation.

5.1.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements

Implementing the elements under the Integrated Water Resource Management Alternative 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. These effects are not expected to be greater than if the elements or projects were implemented individually, and could result in lower impacts associated with coordinated implementation. Increased coordination of project elements could help minimize overall impacts by enhancing efficiency in design and construction, and monitoring of projects.

5.1.4 Mitigation Measures

Mitigation measures to reduce sedimentation could be accomplished through roadway design, stream buffers, and compliance with state stormwater requirements. As discussed in Section 4.1.3, site-specific geotechnical studies would identify subsurface issues and would help design projects to minimize risks associated with potential or actual geologic instabilities. 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.

5.2 Climate Change

For purposes of this Supplemental Draft EIS, the effect of climate change on proposed projects discussed as a long-term impact. The potential of proposed projects to generate greenhouse gas emissions were discussed as a short-term impact in Section 4.2.

5.2.1 No Action Alternative

Changes in precipitation, snowmelt, and runoff that are likely to 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 efficiencies in implementation. An uncoordinated approach may reduce the potential to adapt water management strategies to adjust to changing climatic conditions.

5.2.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements

The effects of climate change could alter runoff 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. Fish in the basin would have to withstand or adapt to changing conditions. Improvements to storage, water supply, and fish habitat that are proposed under the Integrated Water Resource Management Alternative may improve the ability of water agencies to adapt to changing water supply conditions, and of fish to withstand and adapt to changing habitat conditions. How each element of the Integrated Water Resource Management Alternative affects fish and the ability to adapt are presented below.

5.2.2.1 Fish Passage Element

The fish passage element would expand the territory available to anadromous salmonids by opening up habitat in higher mountain areas. The cooler streams in these areas may provide salmonids with habitat that helps them withstand changing climate conditions.

5.2.2.2 Modifying Existing Structures and Facilities 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 to fish. These improvements could improve the adaptability of the system to future climate changes.

5.2.2.3 New Storage Element

Providing additional storage in the Yakima River basin is expected to improve irrigation deliveries and stream flows. These 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 stream flows for fish. Storage facilities that are constructed in the upper reaches of the basin could provide a source of cooler water for fish flows.

5.2.2.4 Fish Habitat Enhancement Element

Fish habitat enhancements would create a healthier habitat for fish in the Yakima River basin by reconnecting and re-establishing 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.

5.2.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements

If the elements of the Integrated Water Resource Management Alternative are implemented as an integrated package, it is anticipated that the combined benefits to water supply and fish would increase the ability of water managers to adapt to future climate changes and the ability of fish to withstand those 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 during dry periods. Improved stream flows 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.

5.2.4 Mitigation Measures

Changes in water availability in the Yakima River basin will require the managing agencies to adaptively manage the river to respond to changing conditions. Ecology and Reclamation will coordinate with other water and fish managers to adapt to climate change.

5.3 Surface Water

5.3.1 No Action Alternative

The No Action Alternative includes conservation measures through YRBWEP (described in Section 2.2.1) that may impact surface water. These impacts could include a slight increase in TWSA and stream flow in various Yakima River reaches and tributaries. The surface water impacts are similar to those listed in Section 4.2.2.1 in the Draft Planning Report/EIS, although benefits would be less than those listed.

5.3.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements

5.3.2.1 Fish Passage Element

Surface water resources are not expected to be impacted in the long term from implementation of the fish passage element assuming the Yakima Project reservoirs will be operated the same as they are currently.

5.3.2.2 Modifying Existing Structures and Facilities Element

Operational Changes at Existing Facilities

Subordination of Roza Power Plant diversions during April and May would affect surface water. This element would allow water to remain in the middle Yakima River reach between Roza Canal and the Roza Power Plant return in April and 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 Power Plant diversion during the spring (April to June) would affect surface water. This element would allow additional water to remain in the lower 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 Power Plant subordination.

Structural Changes to Existing Facilities

The Wapato Irrigation Project (WIP) improvements would add a pump station near Granger to pump flow from the Yakima River to the Satus Unit. This project would affect surface water by allowing water normally diverted at Wapato Diversion Dam for the Satus Unit to remain in the Yakima River to the pump station. This element would decrease flow in the WIP canal and increase spring and summer flows in the middle Yakima River reach between Wapato Diversion Dam and the location of the pump station. The estimated increase in flow is 50 cfs.

Changes to the Chandler juvenile fish bypass outfall are not expected to cause long-term impacts to surface water.

KRD Canal Modifications to Improve Tributary Flows

The Main Canal and South Branch Canal of the Kittitas Reclamation District (KRD) can be used to supply water to enhance the flows of Yakima River tributaries, specifically Big Creek, Little Creek, Taneum Creek, and Manastash Creek. KRD currently spills water to enhance flows at these tributaries. During peak times, however, the KRD canals are limited in capacity, and this water may not be available to spill. This element would free up capacity in the KRD system and allow additional flow enhancement for these tributaries.

Lateral Piping Projects along the Main Canal and South Branch Canal

Piping laterals off the Main Canal and South Branch Canal of the KRD would save water typically lost to conveyance and operation. Previous studies determined that 30 percent of water is lost to the KRD system. This value results in an average of 1.68 acre-feet of water lost per acre annually, all of which can be saved with piping improvements (CH2M Hill, 1999).

Using this loss per acre and the acreage served by each lateral proposed to be improved, a total savings amount can be estimated. Table 5-1 lists the estimated savings by lateral.

Table 5-1 Estimated Water Savings from KRD Lateral Improvements

Lateral	Acreage Served (acres)	Estimated Savings (acre-feet/year)	Average Flow Savings (cfs)
MC 4.9	142	239	0.67
MC 6.1	307	516	1.45
MC 7.7	208	349	0.98
MC 13.6	602	1,011	2.84
MC 16.9	50	84	0.24
Main Canal Total	1,309	2,199	6.18
SB 9.9	804	1,351	3.79
SB 13.8	1,064	1,788	5.02
SB 14.3	577	969	2.72
SB 16.7	416	699	1.96
SB 17.6	257	432	1.21
South Branch Total	3,118	5,239	14.70
Improvements Total	4,427	7,438	20.88

Sources: Satnik, 2008; CH2M Hill, 1999

This water savings from lateral improvements represents available capacity in the KRD Main Canal and South Branch Canal which can be used to supplement flow or supply water users in the tributaries within the KRD system, namely Big Creek, Little Creek, Taneum Creek, and Manastash Creek.

Big Creek and Little Creek are located on the Main Canal reach of the KRD. If the savings from the Main Canal lateral improvements are used solely to supplement flow or supply water users, an additional 2,200 acre-feet would be available for Big and Little Creeks, an average of 6.2 cfs over a six-month irrigation season. The total surface water right allotments on Big and Little Creeks are 1,950 acre-feet, so the water savings from Main Canal laterals can completely replace the water used in diversions from Big and Little Creeks (CH2M Hill, 2001). Actual distributions of flow to Big and Little Creeks would be determined by an adaptive management team.

Taneum and Manastash Creeks are located in the South Branch Canal area of the KRD. If the savings from the South Branch Canal lateral improvements are used solely to supplement flow or supply water users, an additional 5,240 acre-feet would be available

for Taneum and Manastash Creeks, an average of 14.7 cfs over a six-month irrigation season. The total surface water right allotments of Taneum and Manastash Creeks are 37,780 acre-feet, so the water savings from South Branch Canal laterals can replace 14 percent of the water used in diversions from Taneum and Manastash Creeks (CH2M Hill, 2001). Actual distributions of flow to Taneum Creek and Manastash Creek would be determined by an adaptive management team as described for Operational Changes at Existing Facilities above.

KRD Pumping Near End of Canal

Pumping from the Yakima River to the lower portion of the KRD system would free capacity in the Main Canal and South Branch Canal in the amount that is replaced. Table 5-2 lists the proposed lateral canals (laterals) that the Yakima River pumping would replace and the estimated average flow rate freed by this option.

Table 5-2 Results of Yakima River Pumping to Lower Portion of KRD System

Lateral	Acreage Served (acres)	Estimated Capacity Freed (cfs)
SB 14.3	577	11.5
SB 16.7	416	8.3
SB 17.6	257	5.1
Total	1,250	25.0

Sources: Satnik, 2008; CH2M Hill, 1999

The estimated capacity freed is based on the assumption that 0.02 cfs per acre is being distributed on average to water users (CH2M Hill, 1999).

This freed capacity can be used to divert water going through the KRD system that normally supplies irrigators on the laterals shown in Table 5-2 to Big, Little, Taneum, and/or Manastash Creeks. Approximately 7,000 acre-feet of water per year would be available for tributary enhancement. This volume is based upon average diversion rates for KRD (CH2M Hill, 1999).

Complete the Wapatox Project

Impacts caused by completing the Wapatox Project were described in Section 2.3.1.2 of the January 2008 Draft Planning Report/EIS.

Summary of Impacts

A qualitative analysis of impacts to flows was made for the group of projects in this element of the Integrated Water Resources Management Alternative. The qualitative analysis illustrates the potential benefit to the flow regime for winter, spring, and summer flows in the reaches of the Yakima River, Naches River, and tributaries described in Chapter 3. The benefit to the flow regime may be increased or decreased flow in a reach or tributary during a particular season. The magnitude of that increase or decrease relative to a flow regime that more closely resembles the natural hydrograph was

qualitatively assessed and described as having no benefit or having a low, medium, or high benefit. The benefits are illustrated in Table 5-3.

Table 5-3 Summary of Impacts to Flow by Modifying Existing Structures & Operations Element (includes Chandler, Roza, WIP Pump Station, KRD Feed to Creeks, Wapatox) – 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/Jack Creek	Swauk Creek	Taneum Creek	Manastash Creek	Reecer Creek	Wilson/Naneum/Cherry/Coleman Creeks	
Winter (Oct-March)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Spring (April-June)	○	○	○	○	○	◐	◐	○	○	○	○	◐	◐	○	○	○
Summer (July-Sept)	○	○	○	○	○	●	●	○	○	○	○	●	●	○	○	○

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	Mainstem Reach	
	Mainstem Reach	Above Dam	Mainstem Reach		Above Dam	Mainstem Reach		Tributary	Mainstem Reach		Tributary	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/Indian Creek	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	Wide Hollow Creek	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)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Spring (April-June)	●	○	○	○	○	○	◐	○	●	○	○	○	○	○	○	○	○	○	○
Summer (July-Sept)	○	○	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○	○	○

Symbol	
●	High Benefit
◐	Medium Benefit
◑	Low Benefit
○	No Change or Benefit

5.3.2.3 New Storage Element

Naches River Storage Reservoirs

Bumping Lake Expansion – Large Option

Reservoir Storage Capacity

The Bumping Lake enlargement option would change the storage capacity for Bumping Lake from 33,700 acre-feet to 458,000 acre-feet. Of this additional 424,300 acre-feet, 100,000 acre-feet would be used to enhance proratable irrigation during dry years and 324,300 acre-feet would be used for fish enhancement purposes. Examples of fish enhancement purposes include providing additional flow in the Yakima, Cle Elum, and Naches Rivers in spring months; providing pulse flow in those same rivers as desired; and increasing flow in the Yakima River in summer months downstream of the Sunnyside Canal diversion. The specific uses for the additional storage water would be dependent on flow and water supply conditions and would be determined by a management team consisting of representatives from Reclamation, the Yakama Nation, major irrigators, and fish agencies.

Table 5-4 describes the water storage capacity in reservoirs before and after the large option of the Bumping Lake enlargement is complete.

Table 5-4 Water Storage Capacity in Yakima Project Reservoirs

Storage Location (Reservoirs)	Before Enlargement (acre-feet)	After Enlargement (acre-feet)
Upper Yakima (Keechelus, Kachess, Cle Elum)	833,700	833,700
Naches Arm (Bumping, Rimrock, Clear Creek)	237,000	661,300
Total	1,070,700	1,495,000

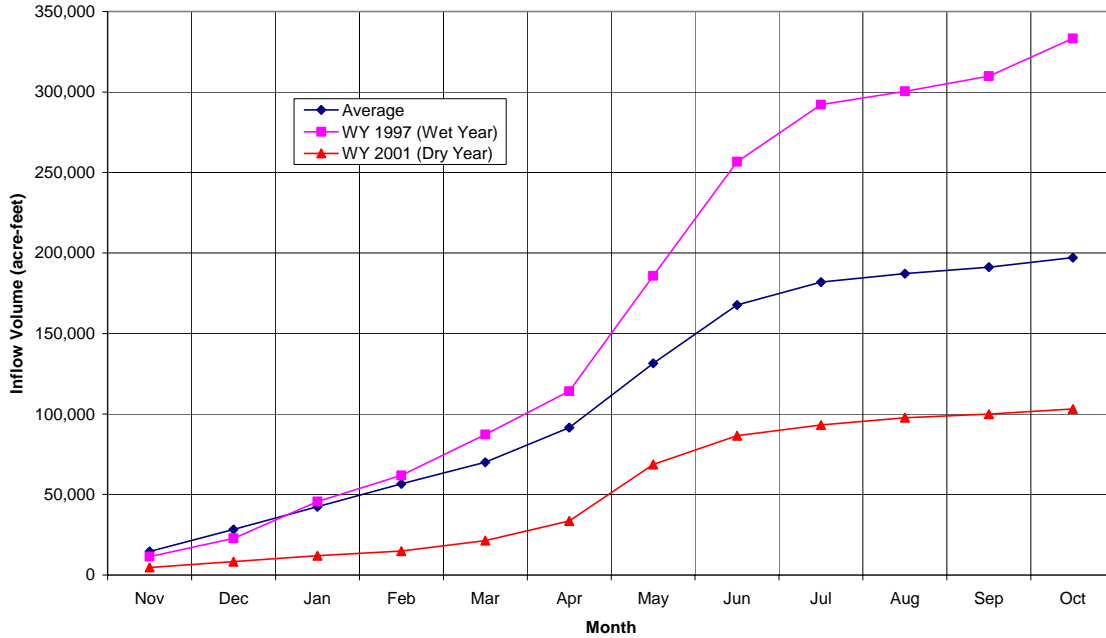
Volume of Flow into Bumping Lake

Reclamation collects real-time data from gages on Bumping Lake and the Bumping River to measure the volume of flow coming into Bumping Lake. An average of 197,100 acre-feet flowed into Bumping Lake annually from 1981 to 2005. The year of greatest flow into Bumping Lake during this period was 1997, when 333,300 acre-feet flowed into Bumping Lake. The year of least flow into Bumping Lake during this period was 2001, when 103,000 acre-feet flowed into Bumping Lake (Reclamation, 2008f).

These values are similar to ones presented in the 1976 Joint Feasibility Report for Bumping Lake Enlargement (Reclamation and USFWS, 1976). The 1976 report collected runoff data from 1926 to 1973, when an average runoff was determined to be 213,000 acre-feet. The maximum runoff year was 1956 with 326,500 acre-feet, and the minimum runoff year was 1941 with 110,000 acre-feet (Reclamation and USFWS, 1976).

Figure 5-1 shows a comparison between the average volume, the 2001 volume, and the 1997 volume. The monthly flow volume into Bumping Lake for 1981-2005 can be found in Appendix D.

Figure 5-1 Annual Volume of Flow into Bumping Lake, 1981-2005

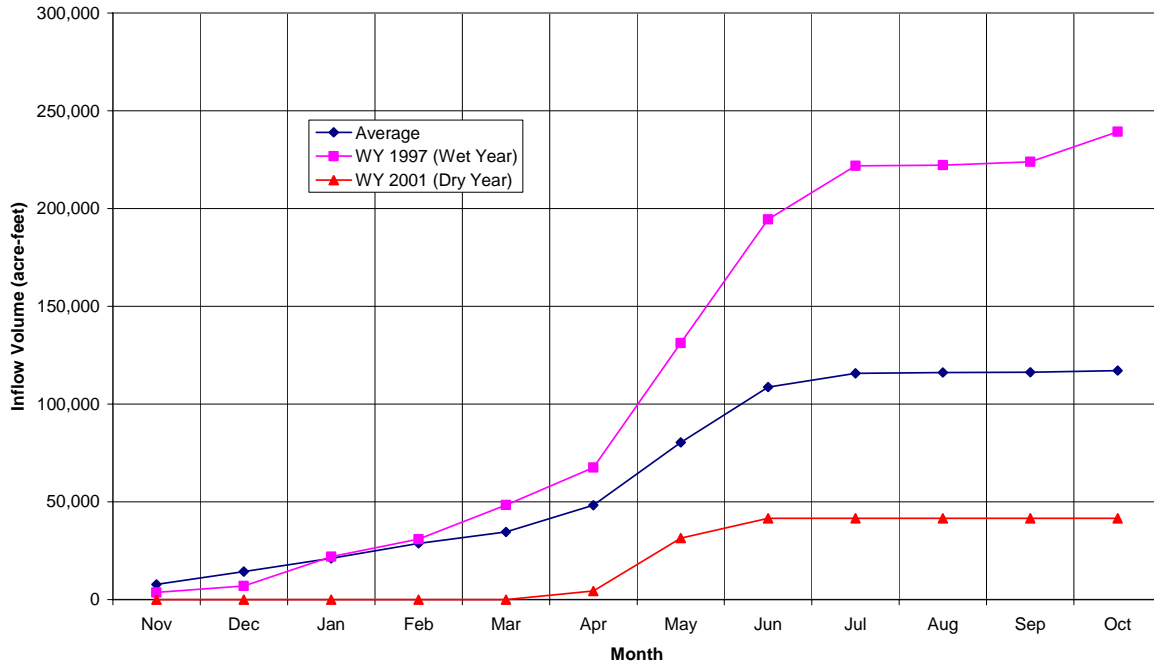


Water Available for Storage

The water available for storage for the large option of the Bumping Lake enlargement was estimated by subtracting the minimum release for fisheries in the Bumping River from the inflow into Bumping Lake. In Reclamation’s 2006 Appraisal Assessment, the minimum instream flow requirement for Bumping River below the dam was assumed to be 130 cfs (Reclamation, 2006).

Using this assumption for the minimum instream flow requirement for Bumping River, the average annual volume available for storage was 117,100 acre-feet from 1981 to 2005. In 1997, the volume available for storage was 239,300 acre-feet. In 2001, the volume available for storage was 41,600 acre-feet. These volumes represent the amount of water that could be available for storage on an average, wet, and dry year, respectively. Figure 5-2 shows a comparison between the average volume, 2001 volume, and 1997 volume. The water available for Bumping Lake storage from 1981 to 2005 for this analysis is shown in Appendix D.

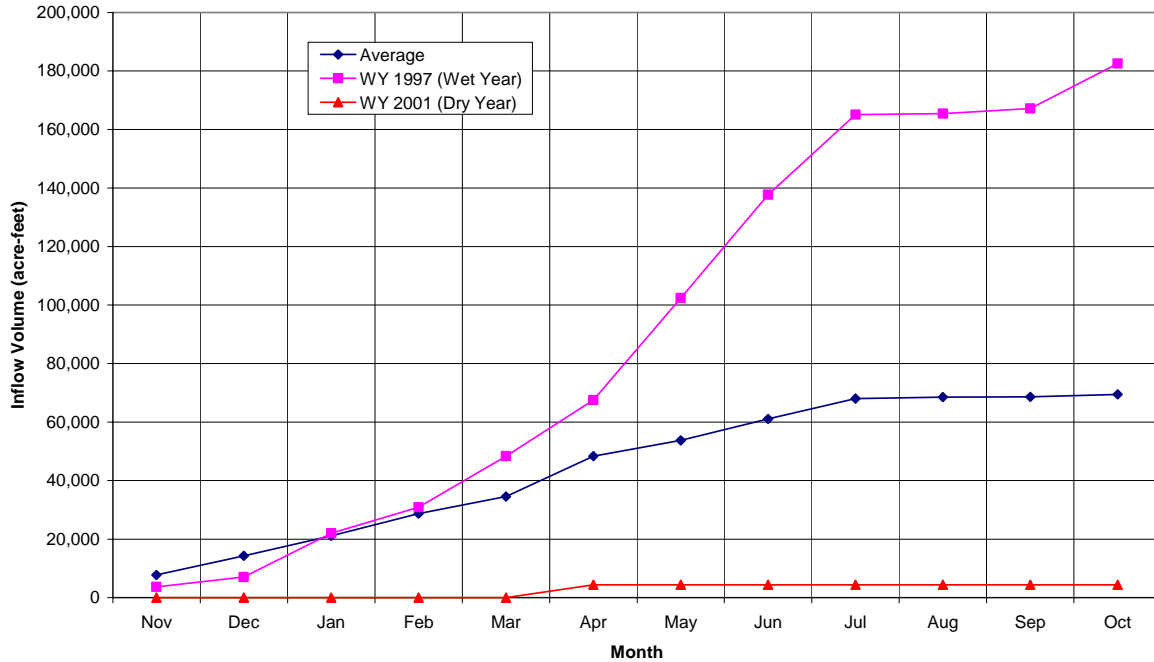
**Figure 5-2 Annual Available Storage for Bumping Lake, 1981-2005
(each month 130 cfs instream flow)**



The storage analysis was also performed assuming that the minimum instream flow requirement will be increased in May and June to provide additional flow for spring out-migration. For this analysis, the instream flow was assumed to be the lesser of unregulated flow or 600 cfs. The 600 cfs flow is the approximate average flow into Bumping Lake during May and June for the period of 1981 to 2005.

Using this assumption combined with the 130 cfs minimum instream flow for July through April, the average annual volume available for storage is estimated to be 69,500 acre-feet from 1981 to 2005. In 1997, the volume available for storage was 182,600 acre-feet. In 2001, the volume available for storage was 4,400 acre-feet. These volumes represent the amount of water that could be available for storage on an average, wet, and dry year, respectively. The annual volume of water captured for storage will depend on the management of the reservoir system. Figure 5-3 shows a comparison between the average volume, 2001 volume, and 1997 volume. The water available for Bumping Lake storage from 1981-2005 for the analysis assuming a greater May-June instream flow is shown in Appendix D.

**Figure 5-3 Annual Available Storage for Bumping Lake, 1981-2005
(higher May-June instream flow)**



Reservoir Management

In the 2006 Appraisal Assessment, Reclamation proposed the enlargement of Bumping Lake to provide additional storage space within the Yakima Project (Reclamation, 2006). Reclamation assumed that the additional water would be used to increase the total water supply available (TWSA) and improve the ability to meet the Title XII (YRBWEP) flows required at Parker. Under that management scenario, Bumping River would shift further away from the natural (unregulated) hydrograph, which was considered unacceptable. Therefore, Bumping Lake expansion was removed from further consideration at that time (Reclamation, 2006).

The proposal in this Supplemental Draft EIS differs from the proposal in Reclamation’s 2006 Appraisal Assessment. The increased capacity in Bumping Lake would increase the water storage capacity, but the additional storage water would be kept separate from the TWSA. Instead, 100,000 acre-feet of the additional storage water would be provided to irrigation districts with proratable water rights that provide a portion of the funding for the project. The districts would use the water in dry years. Roza Irrigation District (Roza) and Kittitas Reclamation District (KRD) have expressed interest in this process. This water would not be used to increase the entitlement for the irrigation district(s); instead, it would be used to increase the proration percentage for the district(s) during drought years. As stated in Table 2.3 in Section 2.2.1.2 of the January 2008 Draft Planning Report/EIS, KRD has 336,000 acre-feet of annual proratable water entitlements and Roza has 375,000 acre-feet of annual proratable water entitlements. Table 5-5 lists the increase in proration percentage for KRD and Roza for a range of additional storage water available. Table 5-6 lists past water years when the full supply was not available

with the proration percentage incurred by proratable irrigation districts. The irrigation districts have indicated that they would only use water from the additional storage when their water supply is less than 70 percent of their entitlements, which has occurred six times since 1987.

Table 5-5 Increase in Proration Percentage for KRD and Roza

Volume of Increased Storage (acre-feet)	Potential Increase in Proration Percentage	
	KRD (336,000 acre-feet proratable entitlement)	Roza (375,000 acre-feet proratable entitlement)
25,000	7%	7%
50,000	15%	13%
75,000	22%	20%
100,000	30%	27%

Table 5-6 Previous Proration Years and Percentages

Water Year	Proration Percentage
1981	93
1986	89
1987	64
1988	72
1989	96
1992	68
1993	56
1994	28
2001	40
2003	92
2004	94
2005	38

The 324,300 acre-feet of additional storage reserved for fish enhancement would also not be added to the TWSA. Instead, an adaptive management team composed of Reclamation, fish agencies, and the Yakama Nation would recommend how the additional stored water would be used for fish enhancement. Reclamation would be responsible for operating the reservoir to meet those recommended releases. Below are some examples of how the additional storage could be used.

During the spring irrigation season, flows are typically lower than the natural hydrograph in the Keechelus and Easton reaches of the Yakima River, as well as in the Cle Elum River. This low-flow period is due to a portion of the natural runoff being stored at the Keechelus, Kachess, and Cle Elum Lakes to have water available for irrigation in the summer months when the natural flow is lower. An increase in storage at Bumping Lake

would allow for additional water to be released during the spring months to more closely replicate the natural hydrograph. This additional runoff would be countered by storage in Bumping Lake to be used later in the irrigation season, so the net TWSA would not change.

During the summer irrigation season, flows are typically higher than the natural hydrograph for the Yakima River upstream of Parker. This is due to the majority of irrigation supply coming from Keechelus, Kachess, and Cle Elum Lakes. Irrigation demand is also high during the summer months. An increase in storage at Bumping Lake would allow for water to be released from Bumping Lake rather than Keechelus, Kachess, or Cle Elum Lakes. This would lower the flow upstream of the confluence between the Naches and Yakima Rivers. This option could be used in tandem with increasing spring flows mentioned above.

In September, Rimrock Lake releases to the Tieton River are increased due to “flip-flop” operations. This causes flows to be typically higher than the natural hydrograph in the Tieton River. An increase in storage at Bumping Lake would allow for a portion of the water to be released from Bumping Lake rather than Rimrock Lake, lowering the September flow in the Tieton River.

During the summer irrigation season, flows are typically low below the Parker gage. Major irrigation diversions above the Parker gage (Sunnyside, Wapato, Roza, Tieton, and Kittitas) cause the reduced flows at Parker gage. In order to maintain instream flows in the lower Yakima River as required by court orders and federal legislation, Title XII flows set minimum target flows on the Yakima River below Sunnyside Dam (Parker gage) and below Prosser Dam. The required flows are based on the estimated TWSA. This aspect of Yakima River flow is described in more detail in Section 2.2.1.1 of the January 2008 Draft Planning Report/EIS. Table 5-7 lists the Title XII target flows for various scenarios of TWSA.

Table 5-7 Title XII Target Flows

Scenario	TWSA estimate (million acre-feet)				Target Flow through October below Sunnyside Dam and Prosser Dam (cfs)
	Apr-Sep	May-Sep	Jun-Sep	Jul-Sep	
1	3.20	2.90	2.40	1.90	600
2	2.90	2.65	2.20	1.70	500
3	2.65	2.40	2.20	1.50	400
4	<2.65	<2.40	<2.20	<1.50	300

An increase in storage at Bumping Lake could allow additional water to be released from Rimrock and/or Bumping Lakes to provide flows beyond what is required by Title XII target flows. This would enhance Yakima River flow downstream of the confluence with the Naches River.

During the winter season, flows are controlled by the reservoir storage system and fluctuations are minimized. An increase in storage at Bumping Lake could allow additional flexibility within the system to allow pulse flows to increase fluctuations within the system similar to natural conditions, such as when a heavy rain event occurs, creating a peak flow event for a short period of time. These pulse flows can create a more beneficial river system for habitat.

Refilling Time

Using the assumptions developed to determine the amount of water available for storage, it would take six to seven years on average to completely refill Bumping Lake under the large option if the lake was empty when refilling began. It would take three consecutive wet years (similar to 1995-1997) to completely refill. These estimates are similar to estimates produced by previous reports (Reclamation, 1979). The actual storage policy would be determined by an adaptive management team.

Available Flow for Fish Enhancement

An adaptive management team, as described in Section 5.3.2.2, would make recommendations for the amount, place, and time of use of additional storage water in the Yakima River system. If it is assumed that only the flow into Bumping Lake would be released in an average year, 117,100 acre-feet of water could be available for fish enhancement if the instream flow requirement for Bumping River were 130 cfs for all months. If the instream flow for May and June were increased as described previously, 69,500 acre-feet of water could be available for fish enhancement. Those volumes would be dependent on the timing of the inflow and the reservoir capacity available to store the flow for later release.

If a wet year similar to 1997 is assumed and only the flow into Bumping Lake is released, 239,300 acre-feet of water could be available for fish enhancement if the instream flow requirement for Bumping River were 130 cfs for all months. If the instream flow for May and June were increased, 182,600 acre-feet of water could be available for fish enhancement. Those volumes would be dependent on the timing of the inflow and the reservoir capacity available to store the flow for later release.

Table 5-8 summarizes the additional instantaneous flow rate that would be available for fish enhancement for a range of water volumes available if the use was averaged over one to five months.

Table 5-8 Additional Instantaneous Flow Rate Available for Fish

Water Volume Available (acre-feet)	Additional Instantaneous Flow Rate Available (cfs)				
	1 month	2 months	3 months	4 months	5 months
69,500	1,170	585	390	293	234
117,100	1,971	986	657	493	394
182,600	3,074	1,537	1,025	769	615
239,300	4,029	2,014	1,343	1,007	806

Effects on Naches River Basin Flow

Effects on the Naches River basin flow are described by reach below. Overall, changes to flow within the Naches River basin would be dependent on adaptive management decisions that would determine the operation and use of the additional stored water at Bumping Lake after the reservoir is expanded.

Currently, stream flow in the Bumping River reach resembles the natural hydrograph from September through March because the existing Bumping Lake storage is a small percentage of the actual inflow. Flows are lower than the natural hydrograph from April through May, and higher than the natural hydrograph from June through August (Reclamation, 2006).

The Bumping Lake enlargement would likely result in the Bumping River reach having flows lower than the natural hydrograph from April through June and higher than the natural hydrograph from July through September. During spring, the additional storage in Bumping Lake would allow runoff to be stored rather than released, which would extend the lower flow period beyond current conditions. However, the spring reduction in flow in the Bumping River reach would occur only during wetter-than-average years because of revised instream flows in May and June (previously described). During summer, the enlargement would allow for additional releases to be sustained longer at a higher flow rate, causing the flow to be higher than the natural hydrograph in July through September.

Currently, the upper Naches River reach closely resembles the natural hydrograph throughout the year. Flows are somewhat lower in the spring and higher in the summer because of Bumping Lake operations (Reclamation, 2006).

The Bumping Lake enlargement would likely result in the upper Naches River reach having lower flows from April through June and higher flows from July through September. The changes would be similar to the Bumping River but not as pronounced. The difference would be due to the American River flow being unregulated and adding to the total flow in the upper Naches River reach, reducing the effect on the natural hydrograph caused by the Bumping Lake enlargement.

The Tieton River reach currently has high flow rates in September during the “flip-flop” operation. The Bumping Lake enlargement would likely result in a reduction of these high flow rates. If both Bumping Lake and Rimrock Lake released water for irrigators

located on the middle Yakima River reach, the upper Yakima River reach would still have low flow as desired by the “flip-flop” operation, but the Tieton River reach would not bear the complete increase in flow as occurs under current operations.

The lower Naches River reach is currently similar to the Bumping River reach with a resemblance to the natural hydrograph from September through March, lower flows from April through May, and higher flows from June through August (Reclamation, 2006). The Bumping Lake enlargement would likely result in the lower Naches River reach having lower flows from April through June and higher flows from July through September. The reasons for the flow differences are similar to those described for the Bumping River reach changes.

Effects on Mainstem Yakima River Flow

The Bumping Lake enlargement would affect flow in the mainstem Yakima River. The effect on the flow would depend largely on the adaptive management team’s decisions. Most effects on the mainstem Yakima River were discussed above in the different fish enhancement storage use options.

The Bumping Lake enlargement would also affect the flow of the middle and lower Yakima River reaches below the confluence with the Naches River. Compared to current operations, spring flows would likely be reduced and summer flows would likely be increased because of the reasons previously described for the Bumping River reach. These impacts would be dependent on adaptive management decisions.

Effects on Columbia River

The Bumping Lake enlargement would affect flow in the Columbia River downstream of its confluence with the Yakima River. Compared to current operations, spring flows would likely be reduced and summer flows would likely be increased due to reasons previously described for the Bumping River reach. Impacts would be less because the amount of flow from the Bumping River is a small portion of the amount of flow in the Columbia River below the Yakima River confluence. A reduction in total flow would occur after the seasons when water stored for irrigation would be used to help meet proratable irrigation district needs (dry years). Bumping Lake would need to capture 100,000 acre-feet of storage to reach its desired irrigation supply.

Bumping Lake Expansion – Small Option

Many of the effects for the small option of the Bumping Lake enlargement would be the same as those for the large option. Those that would be different are described below.

Reservoir Storage Capacity

The small option for the Bumping Lake enlargement would change the storage capacity for Bumping Lake from 33,700 acre-feet to 250,000 acre-feet. Of this additional 216,300 acre-feet, 100,000 acre-feet would be used to enhance proratable irrigation during dry years and 116,300 acre-feet would be used for fish enhancement purposes.

Table 5-9 summarizes the water storage capacity in reservoirs before and after completion of the small option for the Bumping Lake enlargement.

Table 5-9 Water Storage Capacity in Yakima Project Reservoirs

Storage Location (Reservoirs)	Before Enlargement (acre-feet)	After Enlargement (acre-feet)
Upper Yakima: Keechelus, Kachess, Cle Elum	833,700	833,700
Naches Arm: Bumping, Rimrock, Clear Creek	237,000	453,300
TOTAL	1,070,700	1,287,000

Refilling Time

Using the previous assumptions made for the large option, it would take three to four years on average to refill Bumping Lake under the small option if the lake was empty when refilling began. It would refill in a wet year followed by an average year, or vice versa if it was previously empty.

Available Flow after Refilling

If it is assumed that only the annual flow into Bumping Lake would be released on an average year, 116,300 acre-feet of additional water could be available for fish enhancement if the instream flow requirement for the Bumping River were 130 cfs for all months. If the instream flow for May and June were increased as described previously, 69,500 acre-feet of additional water could be available for fish enhancement. Those volumes would be dependent on the timing of inflow and the reservoir capacity available to store the flow for later release. An adaptive management team would make recommendations for the amount, place, and time of use within the Yakima River system.

Table 5-10 gives the additional instantaneous flow rate available for fish enhancement for a range of water volumes available if the use was averaged over one to five months.

Table 5-10 Additional Instantaneous Flow Rate Available for Fish

Water Volume Available (acre-feet)	Additional Instantaneous Flow Rate Available (cfs)				
	1 month	2 months	3 months	4 months	5 months
69,500	1,170	585	390	293	234
116,300	1,958	979	653	489	392

Other Potential Water Storage Sites

Additional potential water storage sites within the Naches Arm would have similar impacts to surface water as those described in this section for Bumping Lake expansion options.

Summary of Impacts

A qualitative analysis of impacts to flows was made for the Naches River storage reservoirs option assuming the large Bumping Lake option would be constructed. The other potential storage reservoirs in the Naches River basin would have similar impacts. The qualitative analysis illustrates the potential benefit or impact to the flow regime for winter, spring, and summer flows in the reaches of the Yakima River, Naches River, and tributaries described in Chapter 3. The benefit to the flow regime may be increased or decreased flow in a reach or tributary during a particular season. The magnitude of that increase or decrease relative to a flow regime that more closely resembles the natural hydrograph was qualitatively assessed and described as having no benefit or impact, or having a low, medium, or high benefit or impact. The benefits and impacts are illustrated in Table 5-11 for the upper, middle, and lower Yakima River.

Table 5-11 Summary of Impacts to Flow by New Storage Elements (Naches River basin Storage) – 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/Jack Creek	Swauk Creek	Taneum Creek	Manastash Creek	Reecer Creek	Wilson/Naneum/Cherry/Coleman Creeks
Winter (Oct-March)	○	▪	○	▪	▪	○	○	○	○	○	○	○	○	○	○	○
Spring (April-June)	○	▪	○	▪	▪	○	○	○	●	●	○	○	○	○	○	○
Summer (July-Sept)	○	▪	○	▪	▪	○	○	○	▪	▪	○	○	○	○	○	○

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	Mainstem Reach		
	Mainstem Reach	Above Dam	Mainstem Reach		Above Dam	Mainstem Reach		Tributary	Mainstem Reach		Tributary	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/Indian Creek	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	Wide Hollow Creek	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)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Spring (April-June)	●	○	○	○	○	○	○	○	▪	▪	○	○	▪	▪	▪	○	○	▪	▪
Summer (July-Sept)	▪	○	○	○	○	●	●	○	●	●	○	○	●	●	●	○	○	●	●

Symbol	
●	High Benefit
◐	Medium Benefit
▪	Low Benefit
○	No Change or Benefit

Wymer Reservoir

North Branch Option

Reservoir Storage Capacity

Wymer reservoir would have an active capacity of 162,500 acre-feet. In the January 2008 Draft Planning Report/EIS, it was assumed that 82,500 acre-feet would be released every year in July and August to meet downstream irrigation demands and Title XII target flows downstream from Sunnyside Dam. The remaining 80,000 acre-feet would be released only in dry years when the irrigation proration level was less than 70 percent. Wymer reservoir could be operated consistent with Reclamation’s analysis, or it could be operated in a manner similar to that described for the Bumping Lake expansion option. Table 5-12 describes the water storage capacity in reservoirs before and after the Wymer reservoir North Branch option is complete. The difference between this option and that described by Reclamation is the way that the reservoir would be filled.

Table 5-12 Water Storage Capacity in Yakima Project Reservoirs

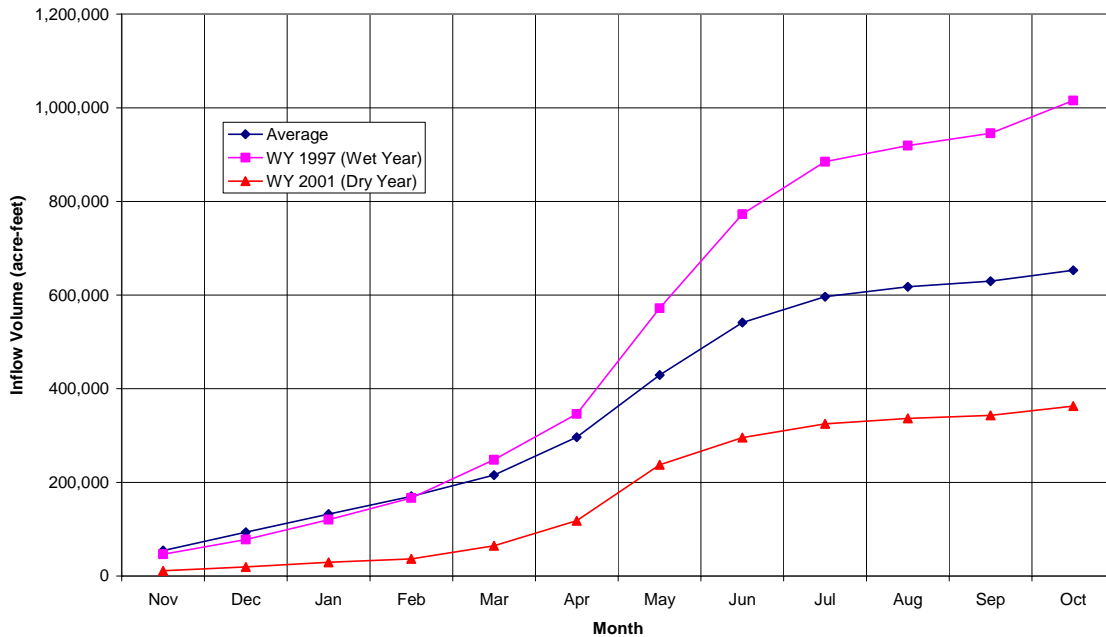
Storage Location (Reservoirs)	Before Wymer (acre-feet)	After Wymer (acre-feet)
Upper Yakima—Keechelus, Kachess, Cle Elum, Wymer	833,700	996,200
Naches Arm—Bumping, Rimrock, Clear Creek	237,000	237,000
TOTAL	1,070,700	1,233,200

Volume of Flow into Cle Elum Lake

Reclamation collects real-time data from gages on Cle Elum Lake and the Cle Elum River to measure the volume of flow coming into Cle Elum Lake. The data were used to estimate the potential water supply yield of Wymer reservoir when being refilled through the North Branch Canal. An average of 653,100 acre-feet flowed into Cle Elum Lake annually from 1981 to 2005. The year of greatest flow during this period was 1997, when 1,015,400 acre-feet flowed into Cle Elum Lake. The year of least flow during this period was 2001, when 362,900 acre-feet flowed into Cle Elum Lake (Reclamation, 2008f).

Figure 5-4 shows a comparison between the average volume, 2001 volume, and 1997 volume. The monthly flow volume into Cle Elum Lake for 1981 to 2005 is shown in Appendix D.

Figure 5-4 Annual Volume of flow into Cle Elum Lake, 1981-2005



Operation

Excess water available from Cle Elum Lake would be used to fill Wymer reservoir. In the Wymer reservoir alternative described in Section 2.5.2 of the January 2008 Draft Planning Report/EIS, a 420 cfs capacity pump station would be used to fill Wymer reservoir from the Yakima River. Approximately 82,500 acre-feet of stored water would be obtained by releases from Cle Elum Lake from October 1 to May 31, and would then be pumped into the reservoir. The remaining volume would be obtained by skimming flows from the Yakima River when stream flow exceeds 1,475 cfs between January 1 and March 31.

In the North Branch option proposed in this Supplemental Draft EIS, a higher conveyance capacity canal (500 to 1,500 cfs) would be used to refill Wymer reservoir. This would allow more water to flow to Wymer reservoir during spring, summer, and fall. The actual flow available for refilling Wymer reservoir would depend on the instream flow requirements for the Cle Elum River and the upper Yakima River that have yet to be established.

Another constraint would be the operating season. Currently the Main Canal and North Branch Canal are operated only during the irrigation season because of snow and ice and maintenance requirements. Releases from Cle Elum Lake to Wymer reservoir could also conflict with the need to fill Cle Elum Lake. Additional analyses would be required to determine if it would be feasible to fill Wymer reservoir in the spring.

Effects on Mainstem Yakima River

This option of filling Wymer reservoir would give an additional pathway for transporting water to irrigators in the middle and lower Yakima River reaches. During summer

months, the flow in the upper Yakima River is higher than natural because irrigation demands require releases from the upper Yakima River reservoirs that exceed the natural flow rate. The Main Canal and North Branch Canal of the KRD could take water stored in Cle Elum Dam and release it directly to Wymer reservoir, which would take a portion of the water out of the Cle Elum River and the upper Yakima River, reducing the flow in the summer months for those reaches.

During refilling of Wymer reservoir, flows within the Yakima River would likely be lower during spring. Under current operations, water in the Cle Elum drainage area that would not be stored would be released into the Cle Elum River and flow into the Yakima River. With the Wymer reservoir option proposed in the Supplemental Draft EIS, these flows could be taken through the Main Canal and North Branch Canal to be stored in Wymer reservoir. These operation decisions would be made by Reclamation in consultation with an adaptive management team.

Effects on Naches Arm

During September and October, flows from Rimrock Lake are increased for “flip-flop” operation. This causes a higher flow than the natural hydrograph in the Tieton River and lower Naches River. As described in Section 2.3.2 of the January 2008 Draft Planning Report/EIS, the main purpose of the “flip-flop” operation is to promote spring Chinook spawning at a lower stream flow that requires less release of water for the protection of redds.

The option for filling Wymer reservoir presented in the Supplemental Draft EIS could allow water to be released from Cle Elum Lake or Wymer reservoir without increasing the flow in the upper Yakima River to supply the irrigation needs in the middle Yakima River and reducing the release from Rimrock Lake. This would lower flows in the Tieton River and lower Naches River, bringing the flow toward a more natural hydrograph in September and October.

Effects on Columbia River

During the refilling of Wymer reservoir, flows in the Columbia River downstream of its confluence with the Yakima River would likely be lower during spring because flows would be routed through the Main Canal and North Branch Canal rather than through the river. The reasons for this decrease are described in the Yakima River effects section above. This decrease would have a smaller effect on the Columbia River than the Yakima River because the flow contribution taken away from Wymer reservoir is a small percentage of the total Columbia River flow below the confluence with the Yakima River. A reduction in total flow would occur after the years when water stored for irrigation is used to help meet proratable irrigation district needs (dry years). Wymer reservoir would need to capture 80,000 acre-feet to obtain its desired irrigation supply.

South Branch Option

The impacts to surface water flow for the South Branch option of Wymer Dam would be similar to the impacts described above for the North Branch option of filling Wymer reservoir.

Pipeline Option

The impacts to surface water flow for the pipeline option of Wymer Dam are similar to the impacts described above in the impacts to surface water flow for the North Branch option of Wymer Dam. The major difference between this option and the North Branch or South Branch option in terms of surface water flow is that this option would be available all 12 months of the year for routing water and refilling Wymer reservoir. The route to Wymer Dam would only be available during the irrigation season (April-October) for the North Branch or South Branch option. This causes the amount of water available for refilling Wymer reservoir to be greater in the pipeline option compared with the North Branch or South Branch option as additional flood water can be captured.

Summary of Impacts

A qualitative analysis of impacts to flows was made for Wymer reservoir assuming the pipeline feed option would be constructed. The qualitative analysis illustrates the potential benefit or impact to the flow regime for winter, spring, and summer flows in the reaches of the Yakima River, Naches River, and tributaries described in Chapter 3. The benefit to the flow regime may be increased or decreased flow in a reach or tributary during a particular season. The magnitude of that increase or decrease relative to a flow regime that more closely resembles the natural hydrograph was qualitatively assessed and described as having no benefit or impact, or having a low, medium, or high benefit or impact. The benefits and impacts are illustrated in Table 5-13 for the upper, middle, and lower Yakima River.

Table 5-13 Summary of Impacts to Flow by New Storage Element (Wymer Dam plus Pipeline Feed) – 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/Jack Creek	Swauk Creek	Taneum Creek	Manastash Creek	Reecer Creek	Wilson/Naneum/Cherry/Coleman Creeks
Winter (Oct-March)	○	▪	○	▪	▪	○	○	○	○	○	○	○	○	○	○	○
Spring (April-June)	○	▪	○	▪	▪	○	○	○	◐	◐	○	○	○	○	○	○
Summer (July-Sept)	○	▪	○	▪	▪	○	○	○	●	●	○	○	○	○	○	○

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	Mainstem Reach
	Mainstem Reach	Above Dam	Mainstem Reach		Above Dam	Mainstem Reach		Tributary	Mainstem Reach		Tributary	Tributary	Mainstem Reach		Mainstem Reach	Tributaries		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/Indian Creek	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	Wide Hollow Creek	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)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Spring (April-June)	◐	○	○	○	○	○	○	◐	◐	○	○	◐	◐	◐	○	○	◐	◐
Summer (July-Sept)	◐	○	○	○	○	◐	◐	◐	◐	○	○	◐	◐	◐	○	○	◐	◐

Symbol	
●	High Benefit
◐	Medium Benefit
▪	Low Benefit
○	No Change or Benefit

Ahtanum Creek Watershed Restoration Program, Including Pine Hollow Reservoir

The effects on surface water were previously presented in detail in Section 6.2.2 of Ecology's 2005 Final Programmatic EIS for the Ahtanum Creek Watershed Restoration Program (Ecology, 2005a).

Overall, the Pine Hollow reservoir component of the Ahtanum Creek Watershed Restoration Program would store and distribute approximately 15,000 acre-feet annually to meet irrigation demand and augment instream flows. Currently, the shut-off date for the Ahtanum Irrigation District is July 10; the Ahtanum Creek Watershed Restoration Program would allow the irrigation season to be extended beyond this date. Supplemental irrigation sources would still be required to meet the total irrigation demand within the Ahtanum basin (Ecology, 2005a). See Section 5.4.2.3 for a discussion of water rights issues associated with Pine Hollow reservoir.

During dry years, Pine Hollow reservoir would likely not fill, so little additional water would be available to supplement irrigation or instream flows. If the dry year was preceded by a wet year, however, some carry-over water may be available during the early part of the year (Ecology, 2005a).

5.3.2.4 Fish Habitat Enhancement Element

This element 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.

5.3.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements

Implementing the elements of the Integrated Water Resource Management Alternative in an integrated way would have wide-scale geographic and temporal benefits on flows throughout the Yakima River basin. The qualitative analysis shown in Table 5-14 illustrates the potential benefit or impact to the flow regime for the upper, middle, and lower Yakima River. The benefit to the flow regime may be increased or decreased flow in a reach or tributary during a particular season. The magnitude of that increase or decrease relative to a flow regime that more closely resembles the natural hydrograph was qualitatively assessed and described as having no benefit or impact, or having a low, medium, or high benefit or impact. The effects of the Integrated Water Resource Management Alternative are shown to have medium to high benefits in spring and summer for many of the reaches in the Yakima River basin.

Table 5-14 Summary of Impacts to Flow by Integrated Water Resource Management Alternative – 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/Jack Creek	Swauk Creek	Taneum Creek	Manastash Creek	Reecer Creek	Wilson/Naneum/Cherry/Coleman Creeks
Winter (Oct-March)	○	▪	○	▪	▪	○	○	○	○	○	○	○	○	○	○	○
Spring (April-June)	○	▪	○	▪	▪	◐	◐	○	◐	◐	○	○	◐	◐	○	○
Summer (July-Sept)	○	▪	○	▪	▪	●	●	○	●	●	○	○	●	●	○	○

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	Mainstem Reach		
	Mainstem Reach	Above Dam	Mainstem Reach		Above Dam	Mainstem Reach		Tributary	Mainstem Reach		Tributary	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/Indian Creek	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	Wide Hollow Creek	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)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Spring (April-June)	●	○	○	○	○	○	○	●	◐	○	○	◐	◐	◐	○	○	●	◐
Summer (July-Sept)	◐	○	○	○	○	◐	●	◐	◐	○	◐	◐	◐	◐	○	○	◐	◐

Symbol	
●	High Benefit
◐	Medium Benefit
▪	Low Benefit
○	No Change or Benefit

5.3.4 Mitigation Measures

No 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 alternative.

5.4 Water Rights

5.4.1 No Action Alternative

Several projects included in the No Action Alternative have the potential to cause long-term impacts to water rights. Impacts to water rights under the No Action Alternative would be evaluated separately as those projects are undertaken.

Water rights acquired on a temporary basis for a period of longer than one year and those acquired on a permanent basis would be considered to have long-term impacts. The water rights would be transferred to the state Trust Water Rights Program and would improve stream flows for fish. Because state water law protects water rights from injury, no negative impacts to water rights are anticipated.

The Yakama Nation holds a water right for instream flow for fish with a priority date of time immemorial. The water right is not quantified. The court in the Yakima Adjudication confirmed a right to the “minimum instream flow necessary to support aquatic life.” Alternatives that would result in an increase in stream flow would not change the water right confirmed by the court; however, for purposes of this analysis an increase in streamflow will be considered to have a positive impact on the Yakama Nation’s water right for fish.

Similar long-term impacts would be anticipated from water acquired for instream flow through grants from the SRFB and through the work of private conservation groups such as the Washington Rivers Conservancy and the Washington Water Trust.

5.4.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements

5.4.2.1 Fish Passage Element

No long-term impacts to water rights are expected from the fish passage element.

5.4.2.2 Modifying Existing Structures and Facilities Element

Operational Changes at Existing Facilities

Operational changes at the power generation facilities at Roza Dam and Chandler Power Plant have the potential to cause long-term impacts to Reclamation’s ability to fully exercise its water rights for power production. The water rights for power production authorize the diversion of a maximum instantaneous quantity of water. The court did not confirm an annual quantity for the rights because the power plants are operated as run-of-the-river plants. The water rights authorize year-round diversions with the conditions described in Section 3.4.2.1.1 and Section 3.4.2.1.2. At Roza, the proposal is to reduce or

eliminate diversions for power production during smolt out-migration from April 1 to May 31. At Chandler Power Plant the proposal is to increase the threshold stream flow at which Reclamation reduces diversions from the Yakima River for power production. To the extent either of these proposals is implemented on a long-term or permanent basis, Reclamation's ability to fully exercise its water rights for power production would be reduced. The actions would increase stream flow in the Yakima River bypass reaches, 15 miles at Roza Dam and 12 miles at Chandler Power Plant. This increased stream flow would have a positive impact on the Yakama Nation's water right for instream flow for fish.

Structural Changes to Existing Facilities

The WIP is operated by the Bureau of Indian Affairs in consultation with the Yakama Nation. The WIP, working with Reclamation, is proposing to change the point of diversion for the Satus diversion at Wapato Dam downstream to a new pump station near Granger. This would require a change in point of diversion for the WIP water right, which would be subject to approval by Ecology and only approved if there would be no unmitigated impacts to other water rights. The change, which would result in water left instream for another 25 miles of the Yakima River, would have a positive effect on the Yakama Nation's water right for instream flow for fish.

KRD Canal Modifications to Improve Tributary Flows

Four tributaries in the KRD have been identified as having instream flow problems: Taneum, Manastash, Big and Little Creeks. One proposal is to modify the KRD Main Canal and South Branch Canal to provide water to water users who divert from the tributaries. In addition it has been suggested that acquiring water from those water users now diverting from the tributaries could improve flows in the tributaries. To the extent water is acquired by a long-term lease or on a permanent basis, there would be positive impacts to stream flow and to the Yakama Nation's water right for instream flow for fish.

Proposals to pipe laterals along the Main Canal and South Branch Canal of KRD and to install a pump station at the tail end of the South Branch Canal would be expected to free capacity in the canals. This would allow KRD to discharge water directly to the creeks or to water users who currently divert from the creek. To the extent stream flows in the tributaries are increased by direct delivery of water, there would be a positive impact on the Yakama Nation's water right for instream flow.

For KRD to directly supply water to water users who are now diverting from the creeks would require Ecology's approval to change the point of diversion and source of water under the water rights. The water users, who have confirmed rights to divert from the creeks, would be required to change their point of diversion to KRD's main diversion from the Yakima River. The source would also change from the creek to the Yakima River. KRD and the water right holders would enter into an agreement for KRD to divert and convey water through its system to the individual users. KRD would be authorized to divert additional water from the river to supply the water right holders who change their point of diversion. In the alternative, KRD may allow the individuals to become

members of KRD, and KRD would acquire the right to divert and convey the water under KRD's water right.

The potential impacts to the tributaries and the individual water users are positive. There is a potential for impairment of any water rights that have a point of diversion between KRD's diversion from the Yakima River and the confluence of the tributary with the river. The flow in the river in this reach would be reduced by the additional quantity diverted by KRD. The extent of potential impairment to the Yakama Nation's water right for instream flow depends upon the flow requirements in the Yakima River during the time when KRD would be diverting the additional water. Any impairment may be offset by increased flows in the tributaries.

Complete the Wapatox Project

The proposals include consolidating the Wapatox and Naches-Selah diversions and/or using the Wapatox diversion to supply water to the Yakima treatment plant and the Glead Ditch (see Figure 2-3). Both of these proposals would require changes in the point of diversion of water rights confirmed in the Yakima Adjudication. Both proposals would improve stream flow in the Naches River and have a positive impact on the Yakama Nation's water right for instream flow for fish. Modifying the conveyance system would also have a positive impact on the irrigators' water rights by allowing them access to the full amount of water under their water rights.

5.4.2.3 New Storage Element

Reclamation's water rights, including those for storage, were confirmed by the Adjudication Court on March 12, 2007. The court quantified Reclamation's storage rights in terms of "total active capacity" with no cap for the annual amount of water that may be stored as Reclamation drafts down the reservoirs and then refills them during the season. Any expansion of existing storage capacity beyond that confirmed by the court and any construction of new storage reservoirs would require a new water right from the state. Reclamation would apply for new water rights under its Withdrawal from Appropriation, which was filed on February 17, 1981, and extended again this year until January 18, 2013. The public notice regarding the request for an extension stated that Reclamation intends to use unappropriated waters to satisfy purposes under YRBWEP and for water storage projects currently authorized or those authorized in the future (Ecology, 2007b).

Construction and operation of new storage facilities would require obtaining a reservoir permit from Ecology (RCW 90.03.370). Applications for reservoir permits are subject to the permitting requirements in RCW 90.03.250 through 90.03.320. Ecology would apply the same four-part test to Reclamation's request for a new water right as it does in deciding whether to issue any new water right. Ecology may only issue a new water right if there is water available, if it would be used for a beneficial use, and if it would not impair existing rights or be detrimental to the public welfare (RCW 90.03.290).

Generally, parties that propose to put stored water to a beneficial use must also file an application for a secondary permit. However, a secondary permit is not required where a water right permit or certificate for the source of the stored water authorizes the beneficial use (RCW 90.03.370(1)(c)). Thus, a secondary permit would not be required for proratable irrigation districts that have water rights to the Yakima River. If water users wish to have additional quantities of water over and above their adjudicated amounts, they would be required to file for a secondary permit.

Expansion and construction of new storage is intended for the multiple purposes of providing a better supply of water for irrigation during drought years, water for future municipal growth, and improved stream flow. The court confirmed Reclamation's storage rights with the following condition: "Filling, detention, carryover, release and delivery of water to ... Reclamation and entities authorized to receive water from Reclamation." For existing rights in the adjudication, the specific purpose of use for the water is to be described on the diversionary water right certificates of those who receive water from Reclamation. The irrigators who would receive more water during drought years have existing diversionary rights for irrigation. Water for municipal growth may be under existing permits or new municipal water rights. Water released for instream flow would be transferred to the state Trust Water Rights Program and the certificate held by the state (RCW 90.38.040).

Bumping Lake Expansion

The existing water right for Reclamation to store water in Bumping Lake is for a total active capacity of 38,768 acre-feet. The large expansion option would be to store 458,000 acre-feet. The small option would allow storage of 200,000 acre-feet. Operation of the new storage capacity would supply additional water to proratable irrigators in dry years only and to provide additional water for fish to allow flexibility in the system. Examples of how the new storage could be used are listed in Section 2.3.4.1.

The impacts to proratable water rights would be positive, as would impacts to the Yakama Nation's right to instream flow for fish. The storage could be used to shape flows in the Yakima and Tieton Rivers to provide better fish habitat. It could also be used to provide pulse flows to assist out-migrating smolts.

Wymer Dam

Storage in a new Wymer reservoir would require Reclamation to obtain a new water right. Until a route for conveying water to a new reservoir is established, specific potential impacts on water rights cannot be determined. However, as explained in Section 5.4.2.3, Ecology may not issue a new water right to Reclamation if it would adversely impact existing water rights or be detrimental to the public welfare. If construction of Wymer reservoir resulted in Reclamation's ability to modify river operations, it could provide positive impacts to the Yakama Nation's right to instream flow for fish.

Ahtanum Creek Watershed Restoration Program, Including Pine Hollow Reservoir

The impacts to water rights from this option, including Pine Hollow reservoir, were discussed in Ecology's Final Programmatic EIS for the Ahtanum Creek Watershed Restoration Program (Ecology, 2005) (Section 6.13.2). As discussed in the EIS, a new water right would be required to authorize diversion into the reservoir and storage of water. The minimum quantity of water required would be the total amount needed to supply water to the WIP, Johncox Ditch, and Ahtanum Irrigation District water users. The reservoir would allow all water users within the reservoir service area to stop diverting from streams or withdrawing ground water from wells. These changes would require Ecology's approval for a change in point of diversion.

The Adjudication Court has issued rulings since Ecology issued the Final Programmatic EIS for the Ahtanum Creek Watershed Restoration Program that will affect the potential impacts of this alternative. Significantly, the court ruled that the Northside water users do not have a right to divert after July 10 under their existing rights (Supplemental Report of the Court Concerning the Water Rights for Subbasin No. 23 (Ahtanum Creek), Ahtanum Irrigation District, Johncox Ditch Company and United States/Yakama Nation, February 25, 2008). Under this ruling, they would need to apply for a new water right to receive delivery of water from the reservoir after July 10 each year. The court also held that there is no requirement to maintain 0.25 cfs in the stream for non-diversionary stockwater in Bachelor and Hatton Creeks. This means that there is no requirement to divert water from Ahtanum Creek into these creeks after July 10. The court heard exceptions to these and other rulings at a hearing in late October 2008. The court's final decision is anticipated in early 2009.

5.4.2.4 Fish Habitat Enhancement Element

If fish enhancement projects include acquisition of water for instream flow, the discussion in Section 5.4.1 applies. For the reach of the Yakima River from Roza Dam to Prosser Dam, irrigation would occur in winter to saturate floodplains. This would either require acquisition of a new water right or a change in the season of use of an existing irrigation right. As with any new water right or change to a water right, Ecology may not approve the water right or change if it would impair existing water rights.

5.4.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements

With respect to water rights, it is anticipated that the Integrated Water Resource Management Alternative would have additive positive impacts to the Yakama Nation's senior water right for instream flow for fish. New storage to provide additional water for proratables during drought years would also be additive. Because no new water rights may be issued or changes to water rights may be approved that would impair existing rights, the Integrated Water Resource Management Alternative should not have negative impacts on water rights.

5.4.4 Mitigation Measures

If impacts of new water rights or changes to water rights are identified, the water right may be issued or the change approved if the impact can be mitigated. For example, one alternative is for KRD to divert water at its diversion point on the Yakima River and deliver it to water users on tributaries within the District's service area in lieu of diversions directly from the tributaries. In this case, there would be a corresponding reduction in flow in the Yakima River from KRD's point of diversion downstream to the confluence of the tributaries and an impact on the Yakama Nation's water right to instream flow for fish. However, the Yakama Nation may agree that this impact is mitigated by the increased flow in the tributaries. Whether mitigation is required would be specific to each situation and would be determined during the water rights review process.

5.5 Ground Water

5.5.1 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 may increase demand on ground water. An increase of land conversion to residential use may result in an increase in new exempt wells, resulting in overuse of ground water. Continued issuance of permits for emergency use of ground water wells in drought years could also result in overuse of ground water. Existing ground water levels and issues would likely persist.

5.5.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements

Long-term impacts to ground water may occur during the operation of constructed facilities. Increased recharge to ground water may increase aquifer pressure and result in increased base flows. Decreasing the ground water irrigation demand may increase downstream ground water levels. The ground water impacts for specific projects would be described in detail in future site-specific investigations.

5.5.2.1 Fish Passage Element

No long-term impacts on ground water are expected from the operation of constructed fish passage facilities.

5.5.2.2 Modifying Existing Structures and Facilities Element

Releasing additional volumes for stream flow augmentation during dry seasons would have a limited long-term impact on regional ground water conditions. Shallow and ground water in close connection to stream flows could be improved by stream flow augmentation. Improvements in irrigation conveyance facilities would decrease localized ground water recharge and shallow ground water interception that currently occurs from canal seepage.

5.5.2.3 New Storage Element

Operating new storage would permanently increase ground water levels near new reservoirs. Increased infiltration beneath the reservoir would also occur. The magnitude of impact to 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. Increases in ground water elevation could occur in the immediate vicinity of the reservoir and larger-scale changes in ground water flow patterns are possible. A decreased demand on downstream ground water for irrigation may also increase ground water levels downstream of the storage facility.

5.5.2.4 Fish Habitat Enhancement Element

Alterations in floodplain and off-channel storage connectivity could result in long-term changes to ground water interaction with streams. In general, improvements to fish habitat would also result in improvements to near-channel ground water interaction and connectivity between stream channels and shallow/hyporheic ground water.

5.5.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements

Ground water levels and quantity are expected to increase through additional recharge from storage facilities, riparian enhancements, wetland and wet meadow construction, and from floodplain enhancements. Some localized decreases in recharge are expected from improving conveyance facilities.

5.5.4 Mitigation Measures

Long-term impacts to ground water 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. The benefit of these studies would depend on the type and magnitude of project and the extent of study.

The timing of operational activities could be used to reduce the impact to ground water. 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.

5.6 Water Quality

Water quality can be affected by construction activities, impoundment of water, the depth at which water is withdrawn from reservoirs, and the flow regime. Construction increases the risk of erosion and introduction of contaminants. Impounding water tends to increase water temperatures and can reduce dissolved oxygen (DO) levels. These adverse effects may be transported downstream depending on the level at which water is released from the reservoir. Release of water from the surface of the reservoir tends to transport warm, well oxygenated water downstream. The release of water from deeper in the reservoir can transport cooler, low DO water downstream depending on reservoir

conditions. The effects on stream flows would depend on the temperature of water released, solar radiation, and ground water inflow.

5.6.1 No Action Alternative

Under the No Action Alternative, the existing activities, programs, and trends in the Yakima River basin will continue. Existing water quality issues and trends will persist or worsen lacking a comprehensive, integrated management program that provides a system-wide approach. Projects funded and scheduled under the No Action Alternative could have impacts to water quality similar to those described in the following sections. Water quality impacts of those projects would be identified in separate NEPA or SEPA analysis, as appropriate.

5.6.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements

In general, components of the Integrated Water Resource Management Alternative are intended to provide net water resource benefits, including water quality improvements. However, some impacts could occur. Long-term impacts to water quality that could occur include migration of contaminated soils that are in newly inundated areas to surface or ground water, and leaching and migration of subsurface natural and artificial contaminants. The water quality impacts for specific projects would be described in future site-specific investigations.

5.6.2.1 Fish Passage Element

Seasonal operation of the constructed fish passage elements could increase the delivery of organic debris, sediment, and nutrients to downstream waters. New spill gates and outflow structures could potentially influence the entrainment of air into water and thereby affect total dissolved gas levels. However, design and operation of these facilities would be aimed at improving fish habitat. Therefore it is unlikely that total dissolved gas levels would be increased to the extent that they would exceed water quality standards or adversely affect fish.

5.6.2.2 Modifying Existing Structures and Facilities Element

Altering stream flows in the Yakima River and its tributaries could seasonally alter stream temperatures and associated DO concentrations. The magnitude of cooling/warming effects and associated changes in DO concentrations would vary depending on the location and season of altered flows. Water quality standards could be exceeded by warmer temperatures or lower DO levels, which could adversely affect fish, especially during spawning and incubation. Increased mainstem flows would provide additional dilution of contaminants.

5.6.2.3 New Storage Element

The extent of impacts associated with new storage would depend on the size and location of the facility. In general, larger projects would have a higher likelihood of causing substantial effects (both positive and negative). For example, expanding Bumping Lake

capacity to 450,000 acre-feet would have greater effects than expanding it to 200,000 acre-feet. Long-term impacts could include seasonal increases in downstream sediment loading and gas entrainment, debris impoundment, changes to downstream riparian vegetation, decreased downstream turbidity, increased downstream temperature, increased eutrophication of impounded water, and increased pollutant accumulation in the impounded water.

Long-term water quality improvements from new storage facilities would result from flow releases to meet minimum flow requirements for fish (Reclamation, 1979). However, if downstream flow releases are of a lower quality (e.g., warmer temperature) than existing ground water base flows, discharges could degrade surface water quality. Differences between the chemistry of flow releases and existing ground water could cause chemical reactions that would result in precipitation of minerals, changes to the taste or odor of the water, or biological changes (i.e., coliform, algae, or microbial). Recreational use on the new and/or enlarged reservoirs could also decrease water quality through addition of oils and greases from water craft, nutrients, or invasive aquatic plants introduced by boats.

5.6.2.4 Fish Habitat Enhancement Element

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. Chemicals deposited in soils during past land use practices may include pesticides, herbicides, fertilizers, endocrine disruptors, hydrocarbons, and other hazardous residues. The impact of potential contaminants would depend on the contaminant concentrations, which are determined primarily by historic land use practices, and the ability of soils to absorb and/or bind contaminants. Free draining gravelly soils, for example, often have less capacity to adsorb some contaminants than less permeable soils with high organic content. Riparian and wetland habitat enhancements would help remove instream contaminants and cool the water.

5.6.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements

Protection and enhancement benefits to water quality are expected to be based on the extent that implementing the elements as an integrated package improves stream flows. In addition, coordinating the activities under the Integrated Water Resource Management Alternative would facilitate better overall management of water quality from the actions implemented. This is expected to reduce the likelihood and magnitude of water quality impacts in comparison to conducting the individual water resource management elements individually.

5.6.4 Mitigation Measures

Mitigation of the long-term impacts to water quality could include controlling the depth at which water is drafted from reservoirs to minimize increased downstream temperature and decreased DO, allowing reservoir waters to cool by infiltration before recharging surface waters, providing sediment bypass facilities, and implementing nutrient control

measures. Natural mixing and dilution could also help mitigate impacts to water quality. Recreational impacts could be minimized by restricting uses. Water quality impacts could further be mitigated through the use of evaluations that consider site-specific characteristics to aid in design and selection for individual improvements to be implemented.

Assessment of potential contaminants in soil prior to inundation would identify problem areas and allow for removal or stabilization of soils and sediments that might affect water quality.

Implementation of long-term management plans addressing water quality, recreation, frequently flooded areas, and riparian and wetland areas would also help maintain and enhance water quality. Monitoring reservoir and downstream water quality would document the effectiveness of water quality management strategies that are implemented.

5.7 Hydropower

5.7.1 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 2.2.

5.7.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements

5.7.2.1 Fish Passage Element

The fish passage element is not expected to have long-term impacts on hydropower because no changes in flow through hydroelectric facilities would occur with this alternative.

5.7.2.2 Modifying Existing Structures and Facilities Element

The proposal to increase out-migration flow in the Yakima River below Roza Dam during the smolt migration period (April 1 to May 31) would reduce or eliminate power diversions, thereby reducing hydropower production for these two months. The actual reduction of power generated is unknown because the amount of flow desired below Roza Dam is yet to be determined. The rate of reduction of power generated is 10 kWh per cfs reduced each hour (Reclamation, 2002). The reduction in power generated for a range of flow increases from 50 cfs to 300 cfs was estimated by multiplying the rate of power reduction per cfs by the flow increase and length of time the increase occurs. Table 5-15 summarizes the estimated April and May reductions in generation and compares those reductions to the average amount of generation by the Roza Power Plant in April and May and total annual generation. The estimated reduction in power generated would range from 732,000 kWh for a 50 cfs flow increase to 4,392,000 kWh for a 300 cfs flow increase. The total annual generation by the power plant averages 55,535,300 kWh.

Table 5-15 Estimated Reduction in Power Generated for Roza Power Plant

Increase in Yakima River Flow (cfs)	Reduction in Power Generated (kWh)	
	April	May
50	360,000	372,000
100	720,000	744,000
150	1,080,000	1,116,000
200	1,440,000	1,488,000
250	1,800,000	1,860,000
300	2,160,000	2,232,000
<i>Average Gross Generation (1981-1999)</i>	<i>6,100,000</i>	<i>7,100,000</i>
<i>Roza Irrigation Pump Requirements (1981-1999)</i>	<i>3,050,000</i>	<i>5,000,000</i>
<i>Annual Average Gross Generation (1981-1999)</i>	<i>55,535,300</i>	
<i>Annual Average Net Marketed Generation (1981-1999)</i>	<i>18,974,100</i>	

Source: Reclamation, 2002

Subordination of Chandler Power Plant Diversions in Spring

The proposal to increase the minimum flow level between April and June in the Yakima River below Prosser Dam (currently at 1,000 cfs) would reduce generation at the Chandler Power Plant. The actual reduction of power generated is unknown because the amount of flow increase has not been determined. The rate of reduction of power generated is 10 kWh per cfs reduced each hour (Reclamation, 2002). The reduction in power generated for a range of new minimum flows from 1,100 cfs to 2,000 cfs was estimated by multiplying the rate of power reduction per cfs by the flow increase and length of time the increase occurs. Since minimum flows are not always present, the reduction in power generation was computed to occur only when flows exceeded 1,100 cfs and only up to the amount of flow available for diversion into Chandler Canal for hydropower generation purposes. Table 5-16 summarizes the estimated April through June reductions in generation and compares those reductions to the average amount of generation by the Chandler Power Plant in April through June and total annual generation. The estimated reduction in power generated would range from 236,700 kWh for a new minimum flow level of 1,100 cfs to 2,174,000 kWh for a new minimum flow level of 2,000 cfs. The total annual generation by the power plant averages 49,500,000 kWh. The reduction in power generated is based on an average of flows from 1995-2004.

Table 5-16 Estimated Reduction in Power Generated for Chandler Power Plant (1995-2004)

New Minimum Flow Level below Prosser Dam (Apr-Jun) (cfs)	Reduction in Power Generated (kWh)		
	April	May	June
1,100	62,200	66,300	108,200
1,200	132,100	147,900	155,100
1,300	168,300	248,600	202,600
1,400	187,100	347,000	261,200
1,500	212,100	453,400	337,500
1,600	252,100	554,100	416,300
1,700	299,200	659,100	493,300
1,800	348,500	770,200	566,400
1,900	411,000	879,400	637,900
2,000	493,500	974,500	706,000
<i>Average Net Generation (1995-2004)</i>	<i>4,600,000</i>	<i>3,900,000</i>	<i>2,600,000</i>
<i>Average Annual Net Generation (1995-2004)</i>	<i>45,900,000</i>		

Sources: Reclamation, 2002; Reclamation, no date

Structural Changes to Existing Facilities

Wapato Irrigation Project Improvements

Installing a pumping plant would increase the electricity demand in the area and could slightly reduce hydroelectric generation at the two power plants owned by the Bureau of Indian Affairs and operated by WIP.

Changes to Chandler Juvenile Bypass Outfall

This project is not expected to have long-term impacts on hydropower because the project would not change flow through any hydroelectric facility.

KRD Canal Modifications to Improve Tributary Flows

Lateral Piping Projects along the Main Canal and South Branch Canal

This project is not expected to have long-term impacts on hydropower because the project would not change flow through any hydroelectric facility.

Pumping near Tail End of Canal

Installing a pumping plant would increase the electricity demand in the area but would not affect hydroelectric generation because the project would not change flow through any hydroelectric facility.

Complete the Wapatox Project

This project is not expected to have long-term impacts on hydropower as the project would not change flow through any hydroelectric facility.

5.7.2.3 New Storage Element

Constructing additional storage may have long-term impacts on hydropower. Additional storage would cause a slight increase in electricity demand from operations; however, these increases are expected to have a negligible impact on hydropower availability. If hydroelectric facilities were added to a new storage project, this could increase hydroelectric generation in the project area.

Creation of new storage would cause a slight reduction of 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. The impacts would depend on the operation of the new storage, but hydropower generation could decrease in the winter and spring as a new reservoir is filled, and increase in the summer as flow is released out of storage to improve stream flow. 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.

5.7.2.4 Fish Habitat Enhancement Element

This project is not expected to have long-term impacts on hydropower as the project would not change flow through any hydroelectric facility.

5.7.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements

Implementing the elements under the Integrated Water Resource Management Alternative as an integrated package would result in a combination of effects including a reduction of hydroelectric generation at the Roza and Chandler Power Plants and at the two in-line power plants 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. Additional demand for electricity would occur from some elements of the integrated alternative. If a hydroelectric generation facility is feasible at a new reservoir site, then the overall effect may be an increase in hydroelectric generation.

5.7.4 Mitigation Measures

No mitigation measures are proposed because the impacts are not expected to be significant and may be offset by an increase in hydroelectric generation at a new reservoir site. Any changes in hydropower generation would be coordinated with Bonneville Power Administration, Reclamation, and other affected agencies.

5.8 Vegetation and Wildlife

5.8.1 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 vegetation and wildlife impacts from construction would be prepared separately.

5.8.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements

5.8.2.1 Fish Passage Element

Construction of fish passage facilities could result in permanent removal of vegetation and displacement of wildlife. However, at Keechulus, Kachess, Cle Elum, and Rimrock Lakes, much of the area where construction would occur is currently absent of vegetation. Structures placed in the drawdown zone of the lakes would not result in vegetation impacts. Construction areas would be adjacent to existing spillways or dam abutments and embankments, where vegetation is nonexistent or limited to grasses. Minor effects to the habitat could occur through the removal of a few mature Douglas fir or other conifers for construction of the adult fish collection facilities and access roads. Conifer removal would be minimized to the extent possible.

According to Reclamation (2008c) 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. 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, resulting in some habitat losses.

At Bumping Lake, the construction area lies entirely within the spotted owl Critical Habitat Unit (CHU) Number 6: Southeast Washington Cascades (USFWS, 2008a). The adult fish collection facility including the fish ladder, loading slab, building, fish lock, and holding pool would permanently replace about 19,600 square feet of riparian and second-growth Douglas fir habitat (Reclamation, 2008c). An old-growth stand of western red cedar is present to the northeast of the proposed facility location. The footprint of the fish collection facility has been adjusted to minimize overlap with the stand, but there would be a potential for adversely impacting a small portion of this habitat. The fish passage conduit would be constructed in the dam embankment, across a disturbed area at the foot of the dam and into the river, resulting in the permanent loss of

a small stand of trees and riparian vegetation. This would cause minimal impacts to wildlife because the area of impact is small and adjacent suitable habitat is available.

Based on the current level of disturbance at the reservoir dams and the minimal loss of vegetation for fish passage facility construction, impacts to wildlife are anticipated to be minimal at Keechulus, Kachess, Cle Elum, and Rimrock Lakes. Human activities associated with the operation of the juvenile passage intake structures, the adult fish collection facilities, and the trap and haul trucks would increase in the project areas and may result in long-term disturbance to wildlife.

5.8.2.2 Modifying Existing Structures and Facilities Element

No impacts to plants and wildlife are anticipated because construction and operation would occur in areas already disturbed and developed. Wildlife in the vicinity are accustomed to existing activity levels, which would not change significantly.

5.8.2.3 New Storage Element

Construction of new storage facilities has the greatest potential for impacts to vegetation and wildlife. A new reservoir would permanently remove vegetation and displace wildlife from the reservoir area. Depending on the size and location of the facility, it could alter wildlife and vegetation communities. Generally larger facilities are expected to cause greater impacts. Site specific studies would be constructed prior to facility design and construction at all proposed facilities.

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 Bumping Lake. The expansion would increase the current 1,300-acre reservoir to 4,120 acres under the large option, and unknown but fewer acres under the small option. 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.

Forest communities within the expansion zone would be lost over time due to prolonged inundation and replaced by open water. The extent of the storage impact on vegetation would depend on the size and location of the facility with larger facilities creating greater impacts. If rare plants or rare plant communities are present within the expansion zone, these would be adversely affected. Site specific studies would be necessary to determine if such species are present. 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. Travel corridors for wildlife would also be impacted by the change in lake level, likely resulting in adverse effects to 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 spotted owl. If Bumping Lake or a similar area is selected for new or expanded storage, additional studies would be required to document species in the area and potential impacts to those species.

Construction of water conveyance routes for the proposed Wymer reservoir, including the North and South Branch Options, could result in vegetation removal. The enlargement of existing canals or construction of new canals would likely permanently remove vegetation. Most of these facilities would be located in already disturbed areas. Impacts to shrub-steppe habitat that could result from construction of the Wymer reservoir were previously evaluated in Section 4.7.2.4 of the January 2008 Draft Planning Report/EIS.

Construction of the storage reservoir in Pine Hollow would result in flooding of the grassy vegetation and replacing an area of disturbed shrub-steppe vegetation with an artificial lake (Ecology, 2005). After construction, the earthen dam would be planted with native vegetation, which would provide improved habitat for wildlife. The reservoir would be drawn down during the summer, leaving exposed mud flats at the upstream end of the reservoir. It is likely that a mix of native and non-native vegetation, including smartweed (*Polygonum sp.*) and cocklebur (*Xanthium sp.*), would colonize the mud flats during the summer. The reservoir would likely provide new habitat for waterfowl species, especially during spring and fall migration. Shorebirds may be attracted to the mud flat areas during fall migration. The loss of riparian vegetation along the Johncox Ditch would result in less protective vegetation cover for wildlife species such as small mammals, birds, and reptiles. The movement of small mammals and reptiles could also be blocked or altered by the new access roads and pipelines.

5.8.2.4 Fish Habitat Enhancement Element

The proposed habitat protection, restoration, and enhancement projects would improve native plant diversity and habitat for wildlife. Projects that reconnect side channels and/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.

5.8.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements

The integrated elements would result in negative impacts to vegetation and wildlife using the area of a new reservoir or the proposed reservoir expansion adjacent to Bumping Lake. Impacts would be positive for vegetation and terrestrial wildlife along the mainstem and tributaries in the Yakima River basin. An integrated implementation of fish habitat enhancement projects and stream flow improvements would provide greater benefits to riparian vegetation and wildlife than implementing the elements separately because integrated management approaches are more likely to achieve system-wide benefits. Operational and structural changes to existing facilities are not anticipated to result in impacts because construction associated with these elements would occur in previously disturbed areas or built environments.

5.8.4 Mitigation Measures

The impacts to vegetation 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. 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.

Removal of mature trees should be avoided where possible in all construction areas. At Bumping Lake, the known stand of old-growth western red cedar located downstream of Bumping Lake Dam should be flagged by a qualified forester or biologist and protected from disturbance. 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

5.9 Fish and Aquatic Resources

5.9.1 No Action Alternative

The No Action Alternative would not include a program of comprehensive, integrated water storage, fish passage, and habitat enhancement actions for the Yakima River basin. This alternative does include continued water conservation, fish recovery, and habitat restoration activities that would be undertaken by various agencies and individual entities in the Yakima River basin. Fish recovery and habitat restoration activities may be coordinated to some degree under other programs or processes, but may not be integrated with water storage, water conservation, and water management activities being implemented elsewhere in the basin. Without a comprehensive, integrated program, these activities, along with continuing, competing demands on limited water resources, floodplain habitat, and riparian zones, would continue to limit fish restoration opportunities in the Yakima River basin.

5.9.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements

This section describes the long-term impacts that could be associated with implementation of individual elements under the Integrated Water Resource Management Alternative. This programmatic Supplemental Draft EIS does not evaluate the impacts of any specific project that may be proposed. Projects that could be proposed under this alternative would require additional environmental review depending on the extent of federal or state funding or permitting.

5.9.2.1 Fish Passage Element

The fish passage element of the Integrated Water Resource Management Alternative would address fish passage at existing Yakima River basin reservoirs in the following order of priority: Cle Elum, Bumping, Rimrock, Keechelus, and Kachess. There are currently no upstream or downstream fish passage facilities at any of the five dams. The lakes and tributaries upstream from these dams formerly supported large runs of anadromous salmonids, and have varying amounts and quality of potential spawning and

rearing habitat suitable for anadromous salmon and steelhead. Prior to construction of the dams, non-anadromous fish species traveled back and forth between natural lakes and the river below (Reclamation, 2005a).

In 2005, Reclamation completed an assessment of a range of options and opportunities for providing fish passage and potentially reestablishing populations of anadromous salmonids in some tributaries upstream of Reclamation reservoirs. Based on this initial assessment, Reclamation determined that some form of upstream and downstream passage would be technically feasible at all storage projects. However, it identified the Cle Elum and Bumping River projects as priority drainages for reestablishing fish passage (Reclamation, 2005a).

Section 2.3.2 provides a general description of fish passage options and potential benefits at each of these five Yakima River basin reservoirs. Table 5-17 illustrates the relative benefit or impact to Chinook, coho, sockeye, steelhead, and bull trout life stages by stream reach within the Yakima basin as a result of restoring fish passage at each of the five reservoirs. Fish passage at some or all of the storage dams is said to be a key component for both steelhead and bull trout recovery, as well as for reestablishment of sockeye salmon in the Yakima River basin, and it offers significant benefits to Chinook and coho salmon that are not listed under the Endangered Species Act (ESA) (YBFWRB, 2008).

Species and Life Stage	Middle Yakima River from Roza Dam to Prosser Dam															Lower Yakima River from Prosser Dam to the Columbia River			
	Naches River Basin															Mainstem Reach	Mainstem Reach		
	Mainstem Reach	Above Dam	Mainstem Reach		Above Dam	Mainstem Reach		Tributary	Mainstem Reach		Tributary	Tributary	Mainstem Reach		Mainstem Reach			Tributaries	
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/Indian Creek	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	Wide Hollow Creek	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	
Spring Chinook																			
Adult Migration	○	●	○	○	●	○	○	---	○	○	---	---	○	○	○	---	---	○	○
Spawning & Incubation	---	●	○	○	●	○	○	---	---	---	---	---	---	---	---	---	---	---	---
Rearing	○	●	○	○	●	○	○	○	○	○	○	○	○	○	○	○	---	---	---
Fall Chinook																			
Adult Migration	---	---	---	---	---	---	---	---	○	○	---	---	○	○	○	---	---	○	○
Spawning & Incubation	---	---	---	---	---	---	---	---	○	○	---	---	○	○	○	---	---	○	○
Rearing	---	---	---	---	---	---	---	---	○	○	○	○	○	○	○	○	○	○	○
Coho																			
Adult Migration	○	●	○	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Spawning & Incubation	○	●	○	○	●	○	○	○	○	○	○	○	○	○	○	○	○	---	---
Rearing	○	●	○	○	●	○	○	○	○	○	○	○	○	○	○	○	---	---	---
Sockeye																			
Adult Migration	○	●	○	○	●	○	○	---	○	○	---	---	○	○	○	---	---	○	○
Spawning & Incubation	---	●	---	---	●	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Rearing	---	●	---	---	●	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Steelhead																			
Adult Migration	○	●	○	○	●	○	○	○	○	○	---	---	○	○	○	○	○	○	○
Spawning & Incubation	○	●	○	○	●	○	○	○	○	○	---	---	○	○	○	○	○	---	---
Rearing	○	●	○	○	●	○	○	○	○	○	○	○	○	○	○	○	---	---	---
Bull Trout																			
Adult Migration	○	●	○	○	●	○	○	○	---	---	---	○	---	---	---	---	---	---	---
Spawning & Incubation	---	●	○	○	●	○	---	○	---	---	---	○	---	---	---	---	---	---	---
Rearing	---	●	○	○	●	○	---	○	---	---	---	○	---	---	---	---	---	---	---

Symbol
● High Benefit
● Medium Benefit
• Low Benefit
○ No Change or Benefit
--- Not Applicable

Providing fish passage at the dams could increase or enhance populations of upper Yakima basin steelhead, coho salmon, and spring Chinook salmon by restoring access to historically occupied habitat, restoring life history and genetic diversity of salmonids, allowing reintroduction of sockeye salmon back into the watersheds where they occurred historically, and reconnecting isolated populations of bull trout and other resident fish species. Over time, anadromous salmonids would be expected to recolonize the watersheds upstream from the dams, taking advantage of available spawning and rearing habitat.

The potential increases or changes to anadromous salmonid production as a result of habitat expansion upstream of reservoirs have not been calculated. Therefore, the length (in miles) of available and potentially accessible reservoir tributary habitat was used as a surrogate for production in the Reclamation Phase I assessment (Reclamation, 2005a). Table 5-18 provides an estimated overall reservoir tributary stream length, in miles of suitable spawning and rearing habitat that would be potentially accessible to anadromous salmonids if passage were provided at the five dams. The table includes additional detail on individual tributaries to the five reservoirs and the quantity of potentially accessible tributary habitat that would likely be available.

Table 5-18 Potentially Accessible Stream Reaches	
Dams and Tributary Streams^a	Potentially Accessible (miles)
Keechelus Dam	
Meadow Creek	3.9
Gold Creek	7.0
Cold Creek	0.0
Mill Creek	0.2
Coal Creek	2.5
Townsend Creek	0.2
Total stream length to natural or manmade barrier	13.8
Kachess Dam	
Kachess River	0.5
Box Canyon Creek	1.6
Mineral Creek	0.25
Gale Creek ^b	1.5
Thetis Creek ^b	1.0
Total stream length to natural or manmade barrier	2.4
Cle Elum Dam	
Cle Elum River	21.6
Thorp Creek	0.0
Cooper River	0.6
Waptus River	7.2
Total stream length to natural or manmade barrier	29.4
Bumping Lake Dam	
Bumping River	1.0
Deep Creek	5.0-5.6
Total stream length to natural or manmade barrier	6.0-6.6
Tieton Dam	
South Fork Tieton River	13.5
Short and Dirty Creek	0.1
Corral Creek	2.2
Bear Creek (South Fork Tieton)	0.5
Bear Creek (Rimrock)	3.7
North Fork Tieton River	9.9
Clear Creek	2.0
Indian Creek	4.9
Total stream length to natural or manmade barrier	36.8

Source: Reclamation, 2005b

^a Other tributaries were considered too small or steep to support migratory fish.

^b Since Gale Creek and Thetis Creek commonly go subsurface, they are not considered as being accessible to anadromous salmonids, and the overall tributary stream length is 2.4 miles.

Restoring fish passage at Reclamation reservoirs alone would not be sufficient to restore sustainable salmon and steelhead populations upstream of the reservoirs. The Yakima basin fisheries co-managers—the Yakama Nation and WDFW—have determined that some level of artificial supplementation would be necessary. Considering the significant costs involved in planning, engineering, constructing, operating, and maintaining even temporary fish passage facilities at reservoir dams, the fisheries co-managers and Reclamation determined that waiting for existing fish populations downstream of the dams to colonize or “pioneer” newly accessible upstream habitat would not be acceptable (Reclamation, 2005b). It could take three or four salmon generations (15 to 20 years) or more to realize significant use of habitat above the reservoirs if fish reintroduction, especially for sockeye salmon, is not aided by human intervention.

Supplementation would contribute to recovery of sustainable populations by reintroducing those species extirpated from the Yakima basin with locally adapted broodstock (sockeye and coho salmon) and support the more rapid establishment of fish numbers capable of taking advantage of newly available habitats (Reclamation 2005a, Reclamation, 2008c). Toward this goal, the fisheries co-managers have developed plans for anadromous fish reintroduction upstream of the dams (Reclamation, 2005b).

The primary benefit to reestablishing anadromous salmonid passage upstream of the dams would be the reintroduction of sockeye salmon, which utilize the lake environment for juvenile rearing. Sockeye were extirpated from the Yakima basin by 1933 and therefore are not listed under ESA. Sockeye salmon apparently played a substantial ecological role in the upper mainstem Yakima River. The available information suggests that the bulk of the sockeye salmon run returned to Cle Elum Lake, Kachess Lake, and Keechelus Lake. Bumping Lake in the Naches River basin was a relatively small contributor to the overall population. The infusion of marine-derived nutrients into the system from these returning sockeye salmon, as well as other salmon species, would have contributed to the overall productivity of the upper mainstem Yakima River for all species. Restoration of these sockeye salmon and other anadromous salmonid runs would help restore some of this historical nutrient input and associated increased productivity. Kokanee occur in all lakes and apparently spawn successfully in tributaries. Some shoreline spawning is believed to occur in at least some of the lakes. Successful kokanee reproduction may indicate that restoration of sockeye salmon might be successful.

Steelhead reintroduction above the dams is considered a “long-term” objective. Steelhead are an ESA-listed species; however, the native, wild stock of steelhead that is currently present in the Yakima basin is not fully utilizing all of the accessible spawning and rearing habitat downstream of the dams. Therefore, fisheries co-managers have determined that it is premature to attempt to expand their distribution (Reclamation 2005b).

Spring Chinook salmon also an ESA-listed species, and reintroduction above Yakima Project storage dams is considered a “long-term” objective because all smolts produced at the Cle Elum Supplementation and Research Facility (CESRF) are fully allocated to a

sophisticated experimental design and cannot be used for reintroduction experiments at this time (Reclamation, 2005b).

Bull trout abundance would be expected to expand due to enhanced connectivity and interaction among the presently isolated populations, and expanded foraging and overwintering habitat. 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 that would insure survival in variable environments and thus decrease the probability of local extirpations.

5.9.2.2 Modifying Existing Structures and Facilities Element

Modifying existing water diversion structures and operations would provide opportunities to improve water supply for irrigation while providing benefits to fish. Operational changes proposed include reducing the amount of water diverted for power generation at the Roza and Chandler Power Plants in spring to increase instream flow and improve smolt out-migration. Structural changes include modifying fish bypass systems and canals, and moving points of diversion to increase flows in a reach of the Yakima River. Historical changes in stream flows related to development of irrigation systems have contributed to the decline of anadromous salmonids in Yakima basin streams (YBFWRB, 2008). Restoring and maintaining appropriate stream flows would improve habitat restoration benefits in tributary reaches that have been negatively impacted by diversion withdrawals or system operations.

Structural and operational changes could improve stream flows and water quality in some reaches. 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. Table 5-19 illustrates the relative benefit or impact to life stages of Chinook, coho, sockeye, steelhead, and bull trout by stream reach within the Yakima basin as a result of modifying existing structures and operations. Operational changes proposed include reducing the amount of water diverted for power generation at the Roza and Chandler Power Plants in spring to increase instream flow and improve smolt out-migration. Structural changes include modifying fish bypass systems and canals, and moving points of diversion to increase flows in a reach of the Yakima River.

Species and Life Stage	Middle Yakima River from Roza Dam to Prosser Dam																Lower Yakima River from Prosser Dam to the Columbia River		
	Naches River Basin																Mainstem Reach	Mainstem Reach	
	Mainstem Reach	Above Dam	Mainstem Reach		Above Dam	Mainstem Reach		Tributary	Mainstem Reach		Tributary	Tributary	Mainstem Reach		Mainstem Reach	Tributaries			
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/Indian Creek	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	Wide Hollow Creek	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	
Spring Chinook																			
Adult Migration	•	---	○	○	---	○	○	---	○	○	---	---	○	○	○	---	---	○	○
Spawning & Incubation	---	---	○	○	---	○	○	---	○	○	---	---	---	○	---	---	---	---	---
Rearing	•	---	○	○	---	○	●	○	○	○	○	○	○	○	○	○	○	---	---
Fall Chinook																			
Adult Migration	---	---	---	---	---	---	---	---	○	---	---	---	○	○	○	---	---	○	○
Spawning & Incubation	---	---	---	---	---	---	---	---	○	---	---	---	○	○	○	---	---	○	○
Rearing	---	---	---	---	---	---	---	---	•	---	○	•	•	•	•	○	○	•	•
Coho																			
Adult Migration	○	---	○	○	---	○	•	○	○	○	○	○	○	○	○	○	○	●	○
Spawning & Incubation	○	---	○	○	---	○	●	○	○	○	○	○	○	○	○	○	○	---	---
Rearing	●	---	○	○	---	○	●	○	○	○	○	○	○	○	○	○	○	---	---
Sockeye																			
Adult Migration	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spawning & Incubation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Rearing	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Steelhead																			
Adult Migration	•	---	○	○	---	○	•	○	○	○	---	○	○	○	○	○	○	●	○
Spawning & Incubation	---	---	○	○	---	○	●	○	○	○	---	○	○	○	○	○	○	---	---
Rearing	•	---	○	○	---	○	●	○	○	○	○	○	○	○	○	○	○	---	---
Bull Trout																			
Adult Migration	•	○	○	○	○	○	•	○	---	---	---	○	---	---	---	---	---	---	---
Spawning & Incubation	---	○	---	---	○	○	---	○	---	---	---	○	---	---	---	---	---	---	---
Rearing	---	○	○	○	○	○	---	○	---	---	---	○	---	---	---	---	---	---	---

Symbol
● High Benefit
● Medium Benefit
• Low Benefit
○ No Change or Benefit
--- Not Applicable

Improved stream flows as a result of moving the WIP Satus diversion from Wapato Dam downstream to a new pump station near Granger would benefit all salmon and steelhead species and life stages by increasing instream flows in the WIP-diversion-to-Granger reach (25 river miles) during the irrigation season. Improving stream flows in the spring would benefit adult migrants attempting to move upstream and benefit smolts migrating downstream. Both life stages require adequate flows to allow passage and decrease migration times.

KRD canal modifications (piping laterals) would benefit all life stages for 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 stream flows in these affected tributaries to the Yakima River during migration, spawning, and rearing periods. The estimated savings of approximately 20 cfs throughout the irrigation season would help address stream flow problems that negatively affect fish passage and survival in the affected reaches. 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 (25 cfs) to augment the affected tributaries, thereby further contributing to improved flow conditions.

Modifying the current configuration of the Chandler Dam juvenile bypass would increase juvenile survival at this structure by improving egress conditions at the bypass exit, thereby reducing predation on juveniles at this facility. This would benefit all species of anadromous salmonids found in the Yakima basin.

Two proposals to reduce or eliminate water diversions for power generation during the spring smolt outmigration season (April 1 to May 31) would increase stream flows in the middle and lower Yakima River reaches. These changes would benefit all species of salmonid smolts in the basin which have their peak migration during this period. Only the coho salmon peak smolt migration period, which peaks during fall and winter, falls outside of April and May. The proposals would benefit migrating spring Chinook salmon the most since their migration period is most specifically tied to April and May.

Flows diverted to generate power at Roza Dam would instead remain in the Yakima River between Roza Dam and the discharge location 15 miles downstream, benefitting fish use in this mainstem reach. The proposal to increase minimum flows in the reach of the Yakima River affected by operations at the Chandler Power Plant would contribute to improved stream flows in the lower river from Prosser Dam to the power plant return 12 miles downstream. Current operations divert water to run the Chandler Power Plant and maintain minimum flows of 1,000 cfs in this reach. An increase in minimum flows in the Yakima River during April and May would contribute to improved smolt survival in this lower river reach by reducing travel times, especially in the pool upstream of Chandler Dam, and reducing juvenile entrainment in the power plant diversion. This would reduce mortality rates associated with the canal and the plant outfall.

Modifying the water conveyance system for the Wapatox Project would free up the remainder of the 350 cfs power generation water right owned by Reclamation and

augment flow in 7.4 miles of the lower Naches River. This would benefit spring Chinook, coho, and steelhead adult and juvenile migrants spawning and rearing in this reach of the Naches River.

Modifying existing water diversion structures and operations alone is likely not sufficient to support the restoration of sustainable salmon and steelhead populations in the Yakima basin. Having appropriate instream flows with acceptable water quality year-round will be critical to salmonid survival. Habitat restoration actions, coupled with restoring fish passage into historic habitat, would be a necessary component of meeting fish survival targets in coordination with modifying existing water diversion structures and operations.

5.9.2.3 New Storage Element

The new storage element of the Integrated Water Resource Management Alternative would address opportunities to expand existing water storage facilities or construct new facilities. New storage would be necessary to support increased flows for anadromous and resident fish passage and survival during drought years while sustaining irrigation water supply and future municipal growth.

Section 2.3.4 of this Supplemental Draft EIS describes the proposed storage options, including their potential benefits. Table 5-20 illustrates the relative benefit or impact to life stages of Chinook, coho, sockeye, steelhead, and bull trout by stream reach within the Yakima basin as a result of expanding existing water storage facilities or constructing new facilities.

Table 5-20 Summary of Impacts to Species by Life Stage from Storage Elements – Upper, Middle, and Lower Yakima River

Species and Life Stage	Upper Yakima River																
	Above Dam		Mainstem Reach	Above Dam		Mainstem Reach		Tributaries		Cle Elum River Basin		Mainstem Reach		Tributaries		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/Jack Creek	Swauk Creek	Taneum Creek	Manastash Creek	Reecer Creek	Wilson/Naneum/Cherry/Coleman Creeks	
Spring Chinook																	
Adult Migration	---	○	---	---	○	---	---	---	○	○	○	---	---	---	---	---	
Spawning & Incubation	---	○	---	---	○	---	---	---	•	○	○	---	---	---	---	---	
Rearing	---	○	---	---	○	○	○	---	●	•	○	○	○	○	○	○	
Fall Chinook																	
Adult Migration	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Spawning & Incubation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Rearing	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Coho																	
Adult Migration	---	○	---	○	○	○	○	---	•	○	○	○	○	○	○	○	
Spawning & Incubation	---	○	---	○	○	○	○	---	●	○	○	○	○	○	○	○	
Rearing	---	○	---	○	○	○	○	---	●	•	○	○	○	○	○	○	
Sockeye																	
Adult Migration	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Spawning & Incubation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Rearing	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Steelhead																	
Adult Migration	---	○	---	○	○	○	○	---	○	○	○	○	○	○	○	○	
Spawning & Incubation	---	○	---	○	○	○	○	---	○	○	○	○	○	○	○	○	
Rearing	---	○	---	○	○	○	○	---	●	○	○	○	○	○	○	○	
Bull Trout																	
Adult Migration	○	○	---	---	○	---	---	○	○	○	○	○	○	○	---	○	
Spawning & Incubation	○	○	---	---	---	---	---	○	---	---	○	○	○	○	---	○	
Rearing	○	○	---	○	○	---	---	○	•	•	○	○	○	○	---	○	

Species and Life Stage	Middle Yakima River from Roza Dam to Prosser Dam																Lower Yakima River from Prosser Dam to the Columbia River		
	Naches River Basin																Mainstem Reach	Mainstem Reach	
	Mainstem Reach	Above Dam	Mainstem Reach		Above Dam	Mainstem Reach		Tributary	Mainstem Reach		Tributary	Tributary	Mainstem Reach		Mainstem Reach	Tributaries			
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/Indian Creek	Tieton River from Tieton Dam to Confluence with Naches River	Lower Naches River from Naches/Tieton Confluence to Yakima River	Cowichee Creek	Yakima River from Naches River to Roza Power Plant Return	Yakima River from Roza Power Plant Return to Wapato Diversion Dam	Wide Hollow Creek	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	
Spring Chinook																			
Adult Migration	○	---	•	•	---	○	•	---	•	•	---	---	•	•	○	---	---	○	○
Spawning & Incubation	---	---	○	○	---	○	○	---	○	○	---	---	---	---	○	---	---	---	---
Rearing	○	---	○	○	---	○	•	○	•	○	○	•	○	○	○	○	---	---	
Fall Chinook																			
Adult Migration	---	---	---	---	---	---	---	---	○	○	---	---	○	○	○	---	---	○	○
Spawning & Incubation	---	---	---	---	---	---	---	---	○	○	---	---	○	○	○	---	---	○	○
Rearing	---	---	---	---	---	---	---	---	•	•	○	•	•	•	○	○	○	○	
Coho																			
Adult Migration	○	---	○	○	---	○	○	○	○	○	○	○	○	○	○	○	○	○	
Spawning & Incubation	○	---	○	○	---	○	○	○	○	○	○	○	○	○	○	○	---	---	
Rearing	○	---	•	•	---	○	•	○	•	•	○	●	•	•	○	○	---	---	
Sockeye																			
Adult Migration	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Spawning & Incubation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Rearing	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Steelhead																			
Adult Migration	○	---	•	•	---	○	○	○	○	○	---	○	○	○	○	○	○	○	
Spawning & Incubation	---	---	•	•	---	○	○	○	○	○	---	•	○	○	○	○	---	---	
Rearing	○	---	•	•	---	○	○	○	•	○	○	●	○	○	○	○	---	---	
Bull Trout																			
Adult Migration	○	•	○	○	○	○	○	○	---	---	---	•	---	---	---	---	---	---	
Spawning & Incubation	---	●	○	○	○	○	---	○	---	---	---	○	---	---	---	---	---	---	
Rearing	---	•	•	•	○	○	---	○	---	---	---	•	---	---	---	---	---	---	

Symbol: ● High Benefit/● High Impact ● Medium Benefit/● Medium Impact • Low Benefit/• Low Impact ○ No Change or Benefit --- Not Applicable

Construction or expansion of storage in the Yakima basin has the potential for both positive and negative impacts to salmonid fish populations. Additional storage would provide flexibility for altering operations among the Yakima basin reservoirs. Constructing Wymer reservoir could provide opportunities for Reclamation to modify the “flip-flop” operation and benefit salmonids in the Tieton River and the lower Naches River. Expanding storage at Bumping Reservoir would also provide opportunities for Reclamation to modify the “flip-flop” regime.

Normalizing fall flow regimes in the Tieton and Naches Rivers would benefit juvenile spring Chinook, coho, and steelhead rearing in the affected river reaches. Under current river operations, high flows are produced in the fall by increasing outflow out of Rimrock Lake when water supply is switched between Cle Elum and Rimrock Lakes. The switch in operations is intended to meet downstream water needs in the late irrigation season, and it flushes rearing juvenile steelhead and spring Chinook from the Tieton and lower Naches system.

Concerns exist regarding the potential for negatively affecting what are now mostly naturalized flows in the Naches River basin as a result of expanding water storage. Reclamation’s hydrologic modeling of the potential effect of the large increase in storage at Bumping Reservoir (420,000 acre-feet for a total storage volume of 458,000 acre-feet) concluded there would be a decrease and shifting in timing of flows in spring. A decrease in spring flows as runoff is captured to refill an expanded Bumping Lake reservoir could reduce attraction for spring-migrating steelhead and spring Chinook.

Also associated with an increase in storage at Bumping Lake is an increased area of impact. The new dam would inundate approximately 10 miles of perennial and intermittent stream habitat downstream from the existing dam and upstream of the existing reservoir, affecting the aquatic ecosystem and fishery resources. Bull trout inhabit Bumping Lake and its tributaries above Bumping Lake Dam. The inundated area includes portions of Deep Creek and the Bumping River that are designated as critical bull trout habitat (Reclamation and Ecology, 2008). Deep Creek appears to be the primary tributary of Bumping Lake where bull trout spawn. However, the new dam that would be constructed would include fish passage facilities and would open up habitat. The bull trout population previously isolated upstream of the dam would experience restored historic connectivity to other habitats and an increased gene flow among other populations in the Yakima basin (USFWS, 2001b).

Construction of small tributary water storage projects, such as Pine Hollow reservoir on Ahtanum Creek, has the potential to benefit but also negatively impact salmonid populations in the Yakima River basin. If smaller tributary water storage projects were designed like the Pine Hollow reservoir alternative to provide both water supply and fisheries benefits, the impacts to salmonids could be avoided, minimized, and mitigated (Ecology, 2005a). Impacts might include altering the flow regime of a stream such that it negatively affects adult or juvenile migration, spawning, or rearing; blocking fish passage at the dam structure; or inundating spawning or rearing habitat. Benefits of a small storage project to instream flows during late summer or early fall or during drought years may be small. However, if adequate storage existed, fish benefits might include operating

the storage facility to provide late season instream flows for rearing juvenile fish downstream of the facility.

5.9.2.4 Fish Habitat Enhancement Element

Habitat has historically been significantly altered in the Naches and Yakima Rivers. Properly functioning habitat in this area is characterized by an adequate supply of cool, clear water with minimal fine sediments, channels with stable banks and abundant and appropriate substrates (e.g., spawning gravels for salmonids), and plentiful streamside vegetation. Thus, the emphasis for habitat enhancement projects is placed on restoring and protecting natural channel function and associated habitat, most importantly within the floodplain. Activities could include habitat enhancements such as:

- Reconnecting and reestablishing floodplains and side channels;
- Enhancing and restoring riparian habitat conditions; and
- Increasing channel complexity.

The purpose of the enhancements is to restore or reestablish more natural channel and floodplain conditions for fish and aquatic communities. Therefore, long-term impacts from these projects are expected to be beneficial and to improve overall habitat function.

Anadromous Fish

Beneficial impacts would occur that are specific to different life history stages of anadromous salmonids using the affected area. These benefits would improve the growth, survival, and abundance of salmonids in various ways. For all anadromous salmonids, incubating eggs and juveniles would benefit from reduced fines in the stream and decreased 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 refuge cover from large woody debris (LWD) or boulder complexes 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 via 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 via an increase in floodplain and off-channel habitats. In addition, spawner condition would benefit from riparian vegetation enhancement and the concurrent decrease in water temperatures.

The following discusses the benefits of fish habitat enhancement to Yakima and Naches basin salmonids within general river reaches in each basin. Table 5-21 provides a summary of life stages benefits within more detailed reaches in the basins.

Table 5-21 Summary of Impacts to Species by Life Stage from Fish Habitat Enhancement Elements – Upper, Middle, and Lower Yakima River

Species and Life Stage	Upper Yakima River															
	Above Dam		Mainstem Reach	Above Dam		Mainstem Reach		Tributaries		Cle Elum River Basin		Mainstem Reach		Tributaries		Wilson/Naneum/Cherry/Coleman Creeks
	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/Jack Creek	Swauk Creek	Taneum Creek	Manastash Creek	Reecer Creek	
Spring Chinook																
Adult Migration	---	•	---	---	•	---	---	---	•	•	◐	---	---	---	---	---
Spawning & Incubation	---	•	---	---	•	---	---	---	•	◐	◐	---	---	---	---	---
Rearing	---	•	---	---	•	•	•	---	◐	◐	◐	•	•	•	•	◐
Fall Chinook																
Adult Migration	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spawning & Incubation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Rearing	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Coho																
Adult Migration	---	•	---	○	•	◐	◐	---	•	•	◐	◐	◐	◐	◐	◐
Spawning & Incubation	---	•	---	○	◐	◐	◐	---	•	◐	●	●	◐	◐	●	●
Rearing	---	•	---	○	◐	◐	◐	---	◐	●	●	●	◐	◐	●	●
Sockeye																
Adult Migration	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spawning & Incubation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Rearing	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Steelhead																
Adult Migration	---	•	---	○	•	◐	◐	---	•	•	◐	◐	•	•	◐	•
Spawning & Incubation	---	•	---	○	◐	◐	◐	---	◐	◐	●	●	◐	◐	●	●
Rearing	---	•	---	○	◐	◐	◐	---	◐	●	●	●	◐	◐	●	●
Bull Trout																
Adult Migration	○	•	---	---	•	---	---	○	•	•	●	◐	◐	◐	---	◐
Spawning & Incubation	○	•	---	---	---	---	---	○	---	---	●	◐	◐	◐	---	◐
Rearing	○	•	---	○	◐	---	---	○	•	•	●	◐	◐	◐	---	◐

Species and Life Stage	Middle Yakima River from Roza Dam to Prosser Dam																Lower Yakima River from Prosser Dam to the Columbia River		
	Naches River Basin																Mainstem Reach	Mainstem Reach	
	Mainstem Reach	Above Dam	Mainstem Reach		Above Dam	Mainstem Reach		Tributary	Mainstem Reach		Tributary	Tributary	Mainstem Reach		Mainstem Reach	Tributaries			
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/Indian Creek	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 Roza Power Plant Return	Yakima River from Roza Power Plant Return to Wapato Diversion Dam	Wide Hollow Creek	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	
Spring Chinook																			
Adult Migration	•	---	•	•	---	•	•	---	•	•	---	---	•	•	•	---	---	○	○
Spawning & Incubation	---	---	•	●	---	●	---	---	---	---	---	---	---	---	---	---	---	---	---
Rearing	•	---	●	●	---	●	●	•	●	●	●	●	●	●	•	•	---	---	
Fall Chinook																			
Adult Migration	---	---	---	---	---	---	---	---	•	•	---	---	•	●	●	---	---	•	•
Spawning & Incubation	---	---	---	---	---	---	---	---	●	●	---	---	●	●	●	---	---	●	●
Rearing	---	---	---	---	---	---	---	---	●	●	•	•	●	●	●	•	•	●	●
Coho																			
Adult Migration	•	---	•	•	---	●	●	●	•	•	●	●	●	●	•	●	●	•	•
Spawning & Incubation	●	---	•	●	---	●	●	●	●	●	●	●	○	●	•	●	●	---	---
Rearing	●	---	•	●	---	●	●	●	●	●	●	●	•	●	•	●	●	---	---
Sockeye																			
Adult Migration	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spawning & Incubation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Rearing	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Steelhead																			
Adult Migration	•	---	•	•	---	•	•	•	•	•	---	•	•	•	●	•	•	•	•
Spawning & Incubation	○	---	•	●	---	●	●	●	•	•	---	●	○	○	○	●	●	---	---
Rearing	●	---	•	●	---	●	●	●	●	●	●	●	•	●	●	●	●	---	---
Bull Trout																			
Adult Migration	●	•	•	•	•	•	•	•	---	---	---	●	---	---	---	---	---	---	---
Spawning & Incubation	---	•	•	•	•	•	---	•	---	---	---	●	---	---	---	---	---	---	---
Rearing	---	•	•	•	•	•	---	•	---	---	---	●	---	---	---	---	---	---	---

Symbol
● High Benefit
◐ Medium Benefit
• Low Benefit
○ No Change or Benefit
--- Not Applicable

In the upper Yakima River basin from Keechelus Dam to Roza Diversion, habitat enhancement would benefit spring Chinook, coho, steelhead, and bull trout that all migrate, spawn, incubate, and rear in this reach or its tributaries. It would also benefit sockeye adults that migrate, spawn, and incubate there. In the middle Yakima Basin from Roza Diversion to Prosser Dam, spring Chinook, fall Chinook, coho, sockeye, steelhead and bull trout, all of which spawn, migrate, incubate, and rear in this reach or its tributaries would benefit. For the lower Yakima River from Prosser Dam to the Columbia River confluence, habitat enhancement would benefit fall Chinook that migrate, spawn, incubate, and rear in this reach. It would also benefit spring Chinook, coho, steelhead, and bull trout that migrate through as adults and rear there as juveniles. Sockeye adults would also benefit because upstream migration occurs there.

In the upper Naches River basin from Bumping Dam to the Tieton River confluence, fish habitat enhancement would benefit spring Chinook, steelhead, and bull trout because adult migration, spawning, incubation, and rearing all occur in this reach or its tributaries. Coho and sockeye adults would also benefit because upstream migration occurs in the reach; sockeye also spawn and incubate there. In the lower reach encompassing the Tieton River confluence to the Yakima River confluence, habitat enhancement would benefit spring Chinook and steelhead because adult migration, spawning, incubation, and rearing all occur in this reach or its tributaries. Coho, sockeye, and bull trout adults would also benefit because upstream migration occurs there.

Resident Fish and Aquatic Invertebrates

Resident fish and aquatic invertebrate communities would receive long-term benefits from habitat enhancement. Resident fish and aquatic invertebrates are discussed as a group here because their habitat needs are highly interconnected. Benefits provided are discussed below, organized by each habitat enhancement type.

Floodplain/side channel reconnection and reestablishment would provide improved connectivity between streams and adjacent riparian areas, floodplains, and uplands. It would also increase floodplain water storage capacity to provide more stable instream flows. This enhancement would reestablish the source for organic matter input and terrestrial insects to support aquatic invertebrate communities and provide prey for resident fish that rely upon these organisms for growth and survival. Rearing habitat for juvenile fish would be increased, as well as refuge habitat for fish seeking protection from high flows. The increase in side channels would also create an increase in spawning habitat for fish and invertebrates that reproduce in these areas.

Riparian habitat enhancement/ restoration would improve native streamside plant communities that provide habitat for assemblages of water-associated insects and invertebrates. It would also increase terrestrial organic matter and insect inputs to streams to support aquatic invertebrate communities that function as fish prey. Restoring vegetative cover along the stream banks would result in reduced water temperatures via minimized solar heating, which would help provide adequate conditions for resident fish and aquatic communities. These plants and trees would also increase bank stability as they protect soils from erosion. When trees senesce and fall into the stream, they would

provide LWD that contributes to an increasingly complex channel form and diverse habitats for resident fish and invertebrates.

Increased channel complexity (LWD, channel reconstruction, boulders, etc.) would result in increased trapping of organic matter to support aquatic invertebrate communities and fish prey. In addition, complex channels would trap more gravels that provide appropriate substrates for these organisms. Diverse channel habitat would also promote increased bank stability and reduced sedimentation due to the structural protection afforded by the LWD and boulder complexes. These complexes would encourage increased scour around the structures, thereby increasing pool quality and quantity. The pools provide refuge habitat for resident fish and invertebrates.

5.9.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements

The most evident long-term impact of the Integrated Water Resource Management Alternative would be the benefits of implementing the fish passage and fish habitat enhancement elements of the Integrated Water Resource Management Alternative. These elements, coupled with modifying existing irrigation supply structures and operations and creating new storage, would address many in-basin factors limiting the restoration of sustainable salmonid fish populations in the Yakima basin. The factors most responsible for limiting salmon, steelhead, and bull trout populations in the Yakima basin vary somewhat between watersheds but are generally accepted to include an altered hydrograph, high water temperatures, fine sediment, fish passage barriers at Reclamation water storage reservoirs and associated with irrigation facilities and operations, loss of floodplain and riparian function, and loss of instream habitat complexity. Thus, long-term impacts of the alternative addressing these factors are primarily expected to be beneficial.

Another long-term beneficial impact would come from implementing artificial supplementation programs for salmonid species consistent with the Anadromous Fish Reintroduction Plan (Reclamation, 2005b) concurrent with providing fish passage at Reclamation reservoirs, enhancing and restoring habitat, and improving opportunities to manage basin water resources to meet aquatic needs. These activities would benefit sockeye and coho salmon populations in the Yakima basin. Similarly, artificial supplementation programs to enhance ESA-listed spring Chinook salmon and summer and fall Chinook-run salmon are being implemented under the Yakima-Klickitat Fish Program by the fisheries co-managers (WDFW and the Yakama Nation). The Chinook enhancement programs have been designed to provide the best opportunity to recolonize habitats in the Yakima basin and to restore sustainable populations. Monitoring and evaluation activities associated with artificial production programs would assist fishery managers with minimizing supplementation program effects on other fish species and natural spawners.

Incorporating these elements into an integrated alternative is also considered the best opportunity to implement successful water storage projects in the Yakima basin to help meet irrigation and municipal water needs during drought years. Identifying and implementing water storage and facility improvement projects that also meet fish

management needs is expected to have the highest likelihood of success over the long term.

Table 5-22 illustrates the relative impacts or benefits to Chinook, coho, sockeye, steelhead, and bull trout life stages by stream reach as a result of implementing the elements of the Integrated Water Resource Management Alternative—fish passage, modification of existing structures and operations, new storage, and fish habitat enhancements—as an integrated package. The table reflects the discussion in this section and in Section 2.3.1.

Table 5-22 Summary of Impacts to Species by Life Stage from the Integrated Elements – Upper, Middle, and Lower Yakima River

Species and Life Stage	Upper Yakima River															
	Above Dam		Mainstem Reach	Above Dam		Mainstem Reach		Tributaries		Cle Elum River Basin		Mainstem Reach		Tributaries		Wilson/Naneum/Cherry/Coleman Creeks
	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/Jack Creek	Swauk Creek	Taneum Creek	Manastash Creek	Reecer Creek	
Spring Chinook																
Adult Migration	•	•	•	---	•	---	---	•	•	•	◐	---	○	○	---	---
Spawning & Incubation	•	•	•	---	•	---	---	•	◐	◐	◐	---	○	○	---	---
Rearing	•	•	•	---	•	•	•	•	●	◐	◐	•	◐	◐	•	◐
Fall Chinook																
Adult Migration	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Spawning & Incubation	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Rearing	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Coho																
Adult Migration	•	•	•	○	•	●	●	●	◐	•	◐	◐	●	●	◐	◐
Spawning & Incubation	•	•	•	○	◐	◐	◐	●	◐	◐	●	●	◐	◐	●	●
Rearing	•	•	•	○	◐	●	●	●	●	●	●	●	●	●	●	●
Sockeye																
Adult Migration	◐	•	◐	○	○	---	---	●	○	○	---	---	---	---	---	---
Spawning & Incubation	◐	---	◐	---	---	---	---	●	---	---	---	---	---	---	---	---
Rearing	◐	---	◐	---	---	---	---	●	---	---	---	---	---	---	---	---
Steelhead																
Adult Migration	•	•	•	○	•	◐	◐	●	•	•	◐	◐	◐	◐	◐	•
Spawning & Incubation	•	•	•	○	◐	●	●	●	◐	◐	●	●	●	●	●	●
Rearing	•	•	•	○	◐	●	●	●	●	◐	●	●	●	●	●	●
Bull Trout																
Adult Migration	●	•	●	○	•	---	---	●	•	•	●	◐	◐	◐	---	◐
Spawning & Incubation	◐	•	◐	○	---	---	---	●	---	---	●	◐	◐	◐	---	◐
Rearing	◐	•	◐	○	◐	---	---	●	◐	◐	●	◐	◐	◐	---	◐

Species and Life Stage	Middle Yakima River from Roza Dam to Prosser Dam																Lower Yakima River from Prosser Dam to the Columbia River	
	Naches River Basin																Mainstem Reach	Mainstem Reach
	Mainstem Reach	Above Dam	Mainstem Reach		Above Dam	Mainstem Reach		Tributary	Mainstem Reach		Tributary	Tributary	Mainstem Reach		Mainstem Reach	Tributaries		
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/Indian Creek	Tieton River from Tieton Dam to Confluence with Naches River	Lower Naches River from Naches/Tieton Confluence to Yakima River	Cowichee Creek	Yakima River from Naches River to Roza Power Plant Return	Yakima River from Roza Power Plant Return to Wapato Diversion Dam	Wide Hollow Creek	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
Spring Chinook																		
Adult Migration	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Spawning & Incubation	---	●	●	●	●	●	○	---	○	○	---	●	●	○	---	---	---	---
Rearing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Fall Chinook																		
Adult Migration	---	---	---	---	---	---	---	---	●	●	---	---	●	●	●	---	---	●
Spawning & Incubation	---	---	---	---	---	---	---	---	●	●	---	---	●	●	●	---	---	●
Rearing	---	---	---	---	---	---	---	---	●	●	●	●	●	●	●	●	●	●
Coho																		
Adult Migration	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Spawning & Incubation	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	---	---
Rearing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	---	---
Sockeye																		
Adult Migration	○	●	○	○	●	○	○	---	○	○	---	---	○	○	○	---	---	○
Spawning & Incubation	---	●	---	---	●	---	---	---	---	---	---	---	---	---	---	---	---	---
Rearing	---	●	---	---	●	---	---	---	---	---	---	---	---	---	---	---	---	---
Steelhead																		
Adult Migration	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Spawning & Incubation	○	●	●	●	●	●	●	●	●	●	●	○	○	○	●	●	---	---
Rearing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	---	---
Bull Trout																		
Adult Migration	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Spawning & Incubation	---	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	---	---
Rearing	---	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	---	---

Symbol
 ● High Benefit/● High Impact
 ● Medium Benefit/● Medium Impact
 ● Low Benefit/● Low Impact
 ○ No Change or Benefit
 --- Not Applicable

5.9.4 Mitigation Measures

As discussed in Sections 5.9.2 and 5.9.3 of this Supplemental Draft EIS, the goal and purpose of the Integrated Water Resource Management Alternative is to provide improved habitat and water conditions for fish and aquatic species. The long-term impacts to fish and aquatic species as a result of this alternative would primarily be beneficial to these species and their habitats. 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 particular mitigation measures would be identified that pertain to long-term impacts from specific proposed activities.

Some unavoidable long-term impacts may occur because some habitats would be negatively impacted in order to positively impact others elsewhere. An example of this is the expansion of water storage at Bumping Dam to benefit downstream flows and fish passage, which would require inundation of existing habitat at the storage site. Another example is the shifting of spring flows in the Naches basin that may result in reduction of fish attraction during salmonid upstream migration to certain streams. In either case, mitigation may be required and could include such actions as artificial spawning channels, constructed riffles, native plant species revegetation/enhancement, or other improvements that would benefit fish and aquatic species. These measures not be necessary or may be reduced if the action(s) become part of a watershed restoration program that integrates habitat improvement.

5.10 Recreational Resources

5.10.1 No Action Alternative

The No Action Alternative would not result in direct long-term recreational resource impacts 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. To the extent that NEPA or SEPA analysis would be required for these actions, appropriate documentation of the recreational resource impacts from these projects would be prepared separately.

5.10.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements

Long-term impacts would be primarily related to activities that may result in the loss of property used for recreational purposes, and in management and operational changes that alter the flow regime of the systems within the Yakima River basin. These elements are discussed in the following sections, and in Section 5.11.

5.10.2.1 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.

No other long-term impacts to recreational resources are expected from the proposed fish passage element projects.

5.10.2.2 Modifying Existing Structures and Facilities Element

Operational and structural changes at existing facilities would be designed to benefit fish passage and survival rates within the affected reaches. This could be a long-term beneficial impact on recreational fishing opportunities.

No other long-term impacts to recreational resources are expected from modification of existing structures and facilities.

5.10.2.3 New Storage Element

The proposed Bumping Lake expansion would eliminate some recreational facilities in the area. All of the lakeshore access and associated facilities (e.g., boat launches and parking), several formal and informal campsites, vacation rentals, trails and trailheads, access roads, and other recreational facilities would be inundated by the expansion of the lake. New recreational facilities would be constructed, but would likely take many years to be finished after completion of the Bumping Lake expansion project. The impacts to recreational resources from the proposed expansion of Bumping Lake were further analyzed in the Proposed Bumping Lake Enlargement Final EIS prepared by Reclamation (Reclamation, 1979).

The proposed Pine Hollow reservoir could provide additional recreational opportunities, including boating and fishing (Ecology, 2005). Long-term impacts to recreational facilities for other storage options could be similar to those for the Bumping Lake expansion, though not likely as extensive, as the other proposed options would encompass a smaller area.

Creation of a new reservoir with construction of the Wymer Dam would create new recreational opportunities in that area. Section 4.12.2.4 of the January 2008 Draft Planning Report/EIS (Reclamation and Ecology, 2008) describes in detail the recreational setting for the potential Wymer reservoir. This would be a long-term beneficial impact by supplying new recreational activities.

Existing river operations result in low flows in the upper Yakima River basin through most of the irrigation season, and then high (essentially bank full) flows in the fall. As described in Section 3.10.1, whitewater rafters use the Class III rapids on the Tieton

River that result from the additional water release. Construction of additional storage in the Naches River basin could modify river operations and reduce the higher flows on the Tieton River in the fall. Reduction or elimination of the rapids would constitute an impact to this recreational resource. Modification of river operations could, however, increase recreational fishing opportunities on the mainstem Yakima River during the summer months by reducing flows.

5.10.2.4 Fish Habitat 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 easements. This would not necessarily preclude the use of these lands for public access or recreational uses (e.g., fishing); however, the specific uses allowed within each area would be defined as conditions of project permitting.

5.10.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements

Implementation of the elements under the Integrated Water Resource Management Alternative would result in long-term impacts to recreational resources. However, recreational resources that are eliminated would be replaced over time. Collectively, the combined elements from the proposed projects would have a beneficial impact by making more of the basin available for recreational fishing.

5.10.4 Mitigation Measures

Recreational facilities directly impacted, or eliminated, by implementation of various project components (e.g., the Bumping Lake expansion) would be replaced over time, as described in the Proposed Bumping Lake Enlargement Final EIS (Reclamation, 1979).

5.11 Land and Shoreline Use

5.11.1 No Action Alternative

The No Action Alternative would not result in direct long-term land use impacts 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. To the extent that NEPA or SEPA analysis would be required for these actions, appropriate documentation of the long-term land use impacts of these projects would be prepared separately.

5.11.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements

5.11.2.1 Fish Passage Element

No long-term impacts to land use are expected from the fish passage element projects. None of the proposed projects would require the acquisition of land or a change in land use.

5.11.2.2 Modifying Existing Structures and Facilities Element

Operational modifications associated with this element would not require a change in land use in the Yakima River basin. Some of the proposed projects, however, would require acquisitions of land or easements, such as for the lateral piping projects associated with the KRD canal modifications. Depending on the current use of the property to be acquired, this may constitute a change in land use.

5.11.2.3 New Storage Element

Most of the new storage options would require the acquisition of land or easements. For example, if the Pine Hollow reservoir is constructed, the lake site would have to be acquired by the implementing entity (Ecology, 2005). The Bumping Lake inundation area is currently managed by Reclamation and would not require acquisition. However, there are several privately-owned residences on the north shore of Bumping Lake, which would have to be acquired or relocated. Public recreational facilities, such as campgrounds and day-use areas, would also be inundated and would have to be constructed elsewhere. For additional information on recreational impacts, see Section 5.10.2.3 above.

5.11.2.4 Fish Habitat Enhancement Element

Some of the habitat enhancement options would also 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. Both acquisition and placement of property in easements would constitute a change in land use.

5.11.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements

Implementation of the elements under the Integrated Water Resource Management Alternative would result in long-term impacts to land use. However, the integrated projects are not expected to have disproportionately larger land use impacts than the individual projects described above.

5.11.4 Mitigation Measures

If individual projects are chosen that require the acquisition of land, appropriate compensation would be required in accordance with applicable state or federal regulations. Additional environmental analysis would be performed at the time specific projects are identified to determine any further impacts to land use, including compliance with all applicable policies and regulations.

5.12 Cultural Resources

5.12.1 No Action Alternative

Long-term impacts to cultural resources under the No Action Alternative would be similar to those described in Section 5.20.2 of the January 2008 Draft Planning Report/EIS. Projects undertaken by other agencies would undergo separate NEPA or SEPA analysis, as appropriate, and would comply with federal and state regulations that protect historic and cultural resources.

5.12.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements

The long-term impacts to buried cultural resources from an integrated approach to water supply and fish habitat improvements would largely be related to operation of new facilities or changed water drainage patterns (such as meandering channels, increased/decreased flow). The main long-term impact for most elements would be erosion of cultural deposits.

5.12.2.1 Fish Passage Element

The long-term impacts to cultural resources from the fish passage improvements might include increased erosion of cultural deposits.

5.12.2.2 Modifying Existing Structures and Facilities Element

The long-term impacts to cultural resources for this element are considered minimal as any adverse impact would occur during construction.

5.12.2.3 New Storage Element

General Impacts

New or expanded storage facilities could adversely impact cultural resources over the long term. The impacts to cultural resources within reservoirs could include destruction or damage of archaeological sites, historic structures, or Traditional Cultural Properties (TCPs). There are generally three zones of impact to cultural resources in storage reservoir settings: the inundation zone, the direct impact (fluctuation or drawdown) zone, and the indirect impact (backshore) zone.

Archaeological sites can be damaged or destroyed through erosion, inundation, chemical weathering, vandalism/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) 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 for research. 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. No detailed studies have been conducted to evaluate the impacts of sedimentation on fragile archaeological deposits.

Chemical weathering impacts to 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, which 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.

Land development in the areas surrounding a reservoir can include construction of roads and recreational facilities, grazing, agricultural or orchard uses, and increased residential, commercial, or industrial use. Grazing cattle can adversely affect cultural deposits up to a meter below ground surface as cattle come to water's edge to drink and wallow. The impacts to trampled sites are compounded by fluctuations in the shoreline and changes to soil chemistry related to manure.

Historic structures in the inundation and fluctuation zones would likely be removed prior to inundation. 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.

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.

Specific Impacts on Bumping Lake and Pine Hollow Areas

At Bumping Lake, features related to the construction of the original dam, historic recreational residences, and recorded precontact archaeological sites are known to be present in the area proposed for expansion. As no formal surveys have been conducted of the area since the early 1990s, it is anticipated that some structures have become eligible for the National Register of Historic Places (i.e., are now older than 50 years). Even those cultural resources that would not be directly impacted by the enlargement of Bumping Lake might be affected in terms of changes to their association, setting, or feeling. Some of these impacts to the original dam may have been addressed in the mid 1990s (Reclamation 1993).

Impacts to historic and cultural resources at the proposed Pine Hollow reservoir were evaluated in the Programmatic EIS on the Ahtanum Creek Watershed Restoration Program (Ecology, 2005). The reservoir area has the potential for buried archaeological deposits, which could be impacted by the reservoir as described above.

5.12.2.4 Fish Habitat Enhancement Element

Long-term impacts to cultural resources associated with fish habitat enhancements might include increased erosion of cultural deposits.

5.12.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements

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.

5.12.4 Mitigation Measures

Mitigation measures would be similar to those discussed in Sections 4.20.2.4 and 5.20.3 of the January 2008 Draft Planning Report/EIS. The actual process to be followed to mitigate adverse effects would be determined by the regulatory nexus for the project element. Existing reservoirs within the region have ongoing programs for the life of the project to assure that operational changes, continuing erosion, and new project elements address cultural resources issues. Similar programs should be established at new or expanded reservoirs.

5.13 Socioeconomics

Consistent with the approach used in Section 5.14 of the January 2008 Draft Planning Report/EIS, as well as in Section 4.13, 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. This analysis is

programmatic, and detailed determination of potential socioeconomic effects would be undertaken as specific projects are proposed.

5.13.1 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 likely would 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. These changes could include 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.

5.13.1.1 Value of Goods and Services

All management decisions affecting water and related resources in the basin affect the ability of the ecosystem to produce goods and services. The goods and services potentially affected by the No Action Alternative are described in Section 3.12.1, and in Section 5.14.1 of the January 2008 Draft Planning Report/EIS. The nature of the potential changes in the value of goods and services that Reclamation could quantify and monetize were described in the discussion of the No Action Alternative, in Section 5.14.2 of the January 2008 Draft Planning Report/EIS. Additional changes in the value of goods and services also likely would occur. Expected reductions in the populations of salmonids, for example, would reduce the value some people place on knowing that the populations will be robust and available for the enjoyment of future generations.

5.13.1.2 Jobs and Incomes

The future supply of water and related resources under the No Action Alternative likely would influence future levels of jobs and incomes via three mechanisms. One would materialize when resources become inputs to commercial activities, such as irrigated agriculture or water-related tourism. Another would materialize as the supply of water-related amenities, such as recreational opportunities and clean water in the Yakima River and its tributaries, affect the locational decisions of households and businesses, with an increase in the supply increasing the propensity for families and firms to locate nearby. The third mechanism would materialize as elements of the basin's water-related ecosystem affect the cost of living and doing business in the basin. Such impacts might occur, for example, if healthy wetlands and floodplains were to attenuate the extent of the damage resulting from future flood events, or if changes in water quantity or quality in streams were to affect the cost of securing and treating water for municipal and industrial use.

Current trends in jobs and incomes related to the basin's water and related resources likely would continue in the foreseeable future under the No Action Alternative. Total, water-related jobs and incomes would likely increase, both statewide and in the two economic regions that incorporate portions of the Yakima River basin. Section 5.14.1.2 of the January 2008 Draft Planning Report/EIS describes these regions—one centered on

the Seattle-Tacoma-Olympia metropolitan areas, and the other centered on Kennewick, Pasco, and Richland. Total jobs and incomes in industries related to farming likely would grow slowly, if at all, although employment and incomes in some parts of the agricultural industry might experience shifts. Expansion of grape and wine production, for example, might generate growth in related jobs and incomes, while conversion of farmland to urban uses might eliminate jobs and incomes associated with farm production on those lands.

Washington State’s Office of Financial Management has estimated population and employment trends through 2030, as shown in Table 5-23. The data show that populations in Kittitas and Yakima Counties and the State of Washington are expected to follow similar trajectories, with increases projected at around 18 percent by 2020 and at about 36 percent by 2030, compared to the 2010 estimate. When compared to the same 2010 base year, non-agricultural employment in Washington is projected to grow at rates lower than those of population, increasing by 12 percent by 2020 to almost 3.5 million jobs, and by 25 percent by 2030, to almost 3.8 million jobs. However, for the same time periods, agricultural employment exhibits trends in the opposite direction showing almost no growth, or 0.7 percent, by 2020, and a decline of nearly 50 percent by 2030.

Table 5-23 Trends in Population and Employment in the Yakima River Basin and State of Washington

Year	Population			Non-Agricultural Employment	Agricultural Employment
	Kittitas County	Yakima County	Washington State	Washington State	Washington State
2010	43,901	259,917	7,372,751	3,060,800	326,800
2020	52,265	307,116	8,713,386	3,430,800	329,000
2030	60,322	352,476	10,026,660	3,835,600	170,900

Source: Office of Financial Management (2008a, 2008b)

Jobs and incomes related to municipal/industrial uses of water and related resources likely would grow, roughly parallel to population and overall economic growth. Jobs and incomes linked to water-related recreation likely would grow, roughly parallel to growth in population and wealth.

5.13.1.3 Uncertainty and Risk

Several types of economically important risk and uncertainty associated with the basin’s water and related resources likely would 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 likely would increase, as anticipated changes in climate increase the likelihood of low stream flows in late summer (Scott et al., 2007). This risk also would be exacerbated insofar as existing institutional and other barriers to water transfers and conservation persist (described in Section 5.14.1.4 of the January 2008 Draft Planning Report/EIS). These barriers would extend current patterns, with lower-value crops receiving water while higher-value crops go without.

Anticipated changes in climate could heighten other types of risk and uncertainty regarding increased probability of flooding in the winter and spring, higher temperatures and more heat waves, and diminished fish habitat in streams experiencing low and hot flows in late summer (Casola et al., 2005). Reductions in the quality of fish habitat also could raise the probability of adverse impacts on populations of salmon and steelhead and tighter restrictions on commercial and recreational fishing.

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.

5.13.1.4 Distribution of Costs and Benefits

The future, long-term distribution of water-related costs and benefits under the No Action Alternative likely would remain similar to what it is today. The overall economic costs to the regional and statewide economies associated with individual uses of water and related resources likely would continue to exceed the financial costs the users, themselves, would incur. Thus, society as a whole would bear some portion of the total economic cost, known as the societal opportunity cost, as individual water users realize the benefits.

Irrigated agriculture likely would continue to account for most of the water withdrawals and consumption in the basin. Therefore, it also would account for most of the private benefits and societal opportunity costs associated with withdrawals and consumption. Other groups with significant private benefits and societal opportunity costs would include municipal and domestic users of water, those who would participate in water-related recreation in the basin, and those who would benefit from actions that protect water-related amenities. Societal opportunity costs would be borne by those who would prefer greater production of other water-related goods and services, such as those associated with fish habitat, wetlands, and native riparian vegetation, and by those who would provide financial resources to support the development and operation/maintenance of specific water uses.

5.13.1.5 Socioeconomic Structure

Water-related aspects of the basin's economic structure, and its relationship to the overall state economy, likely would experience many long-term changes under the No Action Alternative, in response to changes in the ecosystem, the economy, laws governing resource management, and budgets available for resource managers. Overall, however, the future structure likely would largely resemble what exists currently. The basin likely would continue to produce commercial products, especially crops, derived from its water and related resources. These resources also likely would 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 to obtain high-quality water. These impacts would not all occur at the same rate, so incremental shifts in the water-related economic structure likely

would occur. These shifts may or may not stimulate change in the structure of institutions, policies, and programs affecting management of the basin's water and related resources.

5.13.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements

5.13.2.1 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 probably would 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.

Improved fish passage also likely would have collateral effects on the value of other goods and services. Anadromous fish deliver nutrients derived from the ocean to the upstream ecosystem, stimulating growth in trees, birds, and other economically important species. Fish passage improvements may create new recreational opportunities. Some may derive value just from seeing fish bypass what were once insurmountable barriers, or from knowing that adverse impacts of past activities that created a barrier have been reversed.

Jobs and Incomes

Improvements in fish passage might have long-term impacts on jobs and incomes through several mechanisms. Jobs and incomes related to operation and maintenance would increase to the extent that the fish-passage facilities would have higher labor requirements than the facilities they modify. They would decrease if the reverse proved true. Reclamation (2008c) has estimated that the first-order impact of long-term expenditures associated with a potential fish passage project at Cle Elum Dam would be an increase of five to 12 jobs, and \$100,800 to \$252,200 in labor income. The analysis found that a similar project at Bumping Lake Dam would generate one to two long-term jobs, and \$10,100 to \$30,400 in labor income. These first-order impacts would be offset, more or less, by second-order effects that would materialize, for example, if the new jobs drew workers away from jobs elsewhere in the regional or statewide economies.

Expected increases in fish populations resulting from improved fish passage potentially could 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 locational decisions. These first-order impacts also likely would be offset, more or less, by second-order impacts.

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 likely would 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 the benefits would be realized by a subset: those who would enjoy seeing greater fish populations, or catching more fish, for example. The costs and benefits would coincide insofar 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.

Socioeconomic Structure

Improvements in fish passage and resulting increases in fish populations likely would boost the recreational fishing industry and other components of the economy related to fish populations.

5.13.2.2 Modifying Existing Structures and Facilities Element

Value of Goods and Services

This element of the Integrated Water Resource Management Alternative likely would 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.

Jobs and Incomes

Long-term increases or decreases in expenditures on a modified structure or facility, relative to what would exist otherwise, would respectively increase or decrease jobs and incomes associated with the structure or facility. Similarly, increases or decreases in goods and services derived from the structure or facility—such as fish populations, recreational opportunities, and water for irrigation—likely would have a corresponding impact on jobs and incomes in commercial activities associated with them. In addition, any improvements or deterioration in natural resource amenities that affect the locational decisions of households and businesses also would have long-term impacts on related jobs and incomes. Any changes in the ecosystem's ability to provide goods and services that affect the cost of living and doing business in the region also could affect jobs and incomes.

The initial impacts on jobs and incomes would be dampened to the extent that they trigger offsetting second-order impacts. An initial increase in jobs might, for example,

draw workers from other jobs, which would remain unfilled, so the net impact would be near zero.

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 of the future supply of a good or service. Increased reliability in the supply of water for irrigation or instream flow, for example, would diminish the risk and uncertainty associated with the probability that irrigators would have too little water to irrigate crops, or that fish would have poor habitat conditions.

Distribution of Costs and Benefits

The long-term costs and benefits of modifications to existing structures and facilities likely would 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 the benefits would be realized by a subset: recreationists who would enjoy larger fish populations, for example. The costs and benefits would coincide insofar as taxpayers pay the costs and realize the benefits of better health for ecosystem resources owned by all citizens.

Socioeconomic Structure

Modifications to structures and facilities likely would boost those elements of the economy that would enjoy increased supply of specific goods or services relative to those that would not. The recreational fishing industry would be reinforced, for example, if modifications were to increase fish populations.

5.13.2.3 New Storage Element

Value of Goods and Services

This element likely would change the long-term supply of several goods and services derived from the basin's water and related resources. An individual project might, for example, increase the supply of water for irrigated agriculture for some lands at some times, and increase the production of irrigated crops from those lands. New storage also might create new opportunities for recreational activities, such as reservoir-related water sports. The value of an initial increase in the production of some goods and services might be offset by second-order effects. An increase in the production of some crops resulting from new storage might, for example, reduce the price all producers in the state receive for the crop. Some recreationists might take advantage of the recreational opportunities at a new reservoir by reducing their recreational visits to similar sites at other reservoirs, so that the overall amount of recreational activity remains nearly unchanged.

Section 5.14.1.1 of the January 2008 Draft Planning Report/EIS presented general estimates of the value of incremental changes in the supply of water for irrigating crops, municipal/industrial use, and the production of some other goods and services. Section

5.14.2.2 of the January 2008 Draft Planning Report/EIS presented estimates of value derived from observed prices of transactions that transferred water from agricultural use to municipal use or to another agricultural use.

Jobs and Incomes

Long-term expenditures on a new storage facility likely would increase the demand for labor and generate new job opportunities and higher incomes for some workers. Similarly, increases in the supply of goods and services derived from the new storage structure—such as fish populations, recreational opportunities, and water for irrigation—likely would have a corresponding impact on jobs and incomes in commercial activities associated with them. The structure's impacts, positive or negative, on the basin's natural resource amenities that affect the locational decisions of households and businesses would have long-term impacts on related jobs and incomes.

Uncertainty and Risk

The development of new storage would reduce risks and uncertainties to the extent that it would increase the reliability of water to meet specific demands. If a new storage project increased the reliability of water for irrigators during periods when water supplies otherwise would be uncertain or less than irrigators' demands, it likely would induce the irrigators to increase crop production, and reduce the costs they would incur to compensate for risk and uncertainty. If new storage increased the reliability of water supplies to provide fish habitat during periods when stream flows otherwise would be lower and less favorable, then it might increase the habitat's ability to support larger fish populations, and enable fish and water managers to avoid the costs of alternative actions to improve habitat. Increased reliability in the supply of water for municipal/industrial users of water would allow them to avoid the costs of potential future shortages or the costs of finding other means for increasing reliability.

Distribution of Costs and Benefits

The long-term costs and benefits of new storage likely would 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 the benefits would be realized by a subset: irrigators who would enjoy a more reliable supply of water, for example. The costs and benefits would coincide insofar as the taxpayers who would pay the costs also would realize the benefits of better health for ecosystem resources owned by all citizens.

Socioeconomic Structure

The development of new storage likely would boost those elements of the economy that would enjoy increased supply of specific goods or services relative to those that would not. The affected parts of the agricultural sector would be reinforced, for example, if new storage were to increase the reliability of water supplies for irrigation.

5.13.2.4 Fish Habitat Enhancement Element

Value of Goods and Services

Enhancing fish habitat likely 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 it would increase fish populations. Huppert et al. (2004) estimated the value Washingtonians place on changes in salmon populations at approximately \$715 per fish (2003 dollars). Other studies also provide insight into the potential value of possible increases in salmon and steelhead populations. All estimates are in 2003 dollars. Goodstein and Matson (2007) found that, when households elsewhere were taken into account, the value of marginal increases in salmon populations in the Columbia River basin is \$2,890 per fish. Loomis and White (1996) found that households in the U.S. were willing, on average, to pay \$31 to \$88 per household per year to ensure the survival of Pacific salmon and steelhead. Platt (2008) estimated the average value of recreational and commercial catch of different species originating in the Yakima River basin and found:

- The average recreational value per fish is about \$101 for Chinook and \$118 for coho caught in the ocean; \$304 for all species caught in the lower Columbia River; and \$462 for spring Chinook and \$368 for fall Chinook and coho caught in the Yakima River basin.
- The average commercial profit per fish is about \$26 for Chinook and \$8 for coho caught in the ocean; \$46 for spring Chinook, \$15 for fall Chinook, and \$6 for coho caught by the non-Indian commercial fishery in the lower Columbia River; and \$23 for spring Chinook, \$9 for fall Chinook, and \$3 for coho caught by the Indian commercial fishery in the lower Columbia River.
- The lower-bound average value of fish for Indian ceremonial and subsistence uses (in the Yakima River basin and the Columbia River basin) is about \$28 for spring Chinook, \$11 for fall Chinook, and \$4 for coho.

Enhancing fish habitat might increase the supply of goods and services other than those associated with catching salmon and steelhead. If other fish species were to benefit from the habitat enhancements and stimulate additional recreational fishing activities, for example, the current average value of such activities to those who participate in them is about \$42 per person per day (Loomis, 2005). If the habitat enhancements were to induce increases in hunting and sightseeing, the current average value of these activities to those who participate in them is about \$35 and \$61 per person per day, respectively.

Habitat enhancements might increase the supply of other goods and services for which there does not exist an estimate of value. This does not mean that the value would be zero, but that analysts have not estimated the value to date.

Jobs and Incomes

Fish habitat enhancements might increase or decrease long-term 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. Enhancement of habitat might, for example, attract more visitors who leave more trash and increase expenditures, jobs, and incomes associated with clean-up. Or, it might expand the ability of wetlands and floodplains to accept high stream flows and reduce expenditures, jobs, and incomes related to downstream flooding.

Changes in commercial fishing, recreational fishing, sightseeing, and other activities that might result from enhanced fish habitat likely would lead to changes in the levels of jobs and incomes associated with these activities. Any changes in natural resource amenities that affect the locational decisions of households and businesses would have long-term impacts on related jobs and incomes.

The initial impacts on jobs and incomes would be dampened to the extent that they would trigger offsetting second-order impacts. An initial increase in jobs might, for example, draw workers from other jobs, which would remain unfilled, so the net impact would be near zero.

Uncertainty and Risk

Enhancing fish habitat would reduce risk and uncertainty associated with salmon and steelhead to the extent that it would diminish the likelihood of future severe reductions in fish populations.

Distribution of Costs and Benefits

The long-term costs and benefits of fish habitat enhancements likely would 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 the benefits would be realized by a subset: those in the commercial fishing industry who would enjoy opportunities to increase their catch of salmon and steelhead, for example. The costs and benefits would coincide insofar as the taxpayers who would pay the costs also would realize the benefits of better health for ecosystem resources owned by all citizens.

Socioeconomic Structure

The enhancement of fish habitat likely would boost those elements of the economy that would enjoy increased fish populations relative to those that would not.

5.13.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements

The long-term socioeconomic effects of the Integrated Water Resource Management Alternative 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 enable them to interact with one another in their 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.

Interactive effects among the individual elements might emerge from sources peripheral to the economy. Biophysical systems might respond differently if the elements were implemented in an integrated manner than if they were implemented separately, for example. Similarly, resource-management systems and funding mechanisms might respond differently, so that the overall socioeconomic effects would be larger or smaller than the sum of the effects of the individual elements. Interactive effects also might occur within the economy itself. Households and businesses, for example, might alter their activities and investment decisions if they perceive that, with the Integrated Water Resource Management Alternative, the likelihood of a change in the supply of economically important goods and services would be significantly different than it would be if the different elements were implemented individually. Further investigation would be required to determine the potential for such interactive effects.

5.13.4 Construction Cost Estimate

5.13.4.1 Construction Cost Estimates for the Integrated Water Resource Management Alternative

Construction cost estimates for elements of the Integrated Water Resource Management Alternative were determined from cost estimates from previous studies where available. Costs were assumed to be based on costs as of April 2007 to be consistent with the Planning Report/EIS. When a cost estimate was used, Reclamation's composite trend of the construction index was applied to convert the previous cost estimate into April 2007 costs. Reclamation's Construction Cost Trends can be accessed at http://www.usbr.gov/pmts/estimate/cost_trend.html. Table 5-24 presents the values used for construction indices for 1986 to 2008.

Table 5-24 Construction Index – Composite Trend (1986-2008)

Year	Construction Index
2008	318
2007	309
2006	303
2005	288
2004	274
2003	250
2002	242
2001	236
2000	233
1999	227
1998	221
1997	218
1996	212
1995	207
1994	199
1993	194
1992	188
1991	185
1990	181
1989	176
1988	168
1987	162
1986	160

The cost estimates for the elements of the Integrated Water Resources Management Alternative are listed in Table 5-25. Not all costs are known and most cost estimates are preliminary. The total estimated costs for the fish passage element are \$243.9 million. The total estimated costs for the modifying existing structures and operations element range from \$12 million to an unknown value. The total estimated costs for the new storage element range from \$364.9 million to \$2.3 billion. The total estimated costs for the fish habitat enhancement element range from \$115.8 million to an unknown value. Combining the elements of the Integrated Water Resources Management Alternative into a comprehensive program that benefits fisheries and water supply would cost an estimated \$736.6 million to over \$2.6 billion.

Table 5-25 Cost Estimates for Elements of the Integrated Water Resource Management Alternative

Element	Estimated Construction Cost	Construction Duration	Source
Fish Passage			
-Cle Elum Dam	\$93,300,000	3 years	Reclamation, 2008c
-Bumping Dam	\$26,200,000	2 years	Reclamation, 2008c
-Tieton Dam	\$52,600,000	TBD	Reclamation, 2005a
-Keechelus Dam	\$35,900,000	TBD	Reclamation, 2005a
-Kachess Dam	\$35,900,000	TBD	Reclamation, 2005a
Subtotal – Fish Passage Element	\$243,900,000		
Modifying Existing Structures and Operations			
-Operational Changes at Existing Facilities	\$0	0 years	
-Structural Changes to Existing Facilities			
--WIP Granger pump station	TBD	TBD	
--Chandler Dam modifications	TBD	TBD	
-KRD Canal Modifications to Improve Tributary Flows			
--Lateral piping projects along Main Canal and South Branch Canal	\$9,100,000	TBD	CH2M Hill, 1999
--Pumping near tail end of canal	TBD	TBD	
-Complete Wapatox Project	\$2,900,000	TBD	Yakima Steelhead Recovery Plan, 2008
Subtotal - Modifying Existing Structures and Operations	\$12,000,000-unknown		
New Storage			
-Naches River Storage Reservoirs			
--Bumping Lake large expansion	\$315,800,000	6 years	Reclamation, 2006, 1979
--Bumping Lake small expansion	\$213,200,000	4 years	Reclamation, 1986

Element	Estimated Construction Cost	Construction Duration	Source
--Other potential water storage sites	TBD	TBD	
-Wymer Dam (South Branch Option to Pipeline Option)	\$1,000,000,000-1,800,000,000		Reclamation, 2006; Montgomery Water Group, 2002
-Ahtanum Creek Watershed Restoration Program, Including Pine Hollow Reservoir	\$151,700,000	TBD	Ecology, 2005a
Subtotal – New Storage (assuming Bumping Lake small expansion to all storage elements with Bumping Lake large expansion)	\$364,900,000-\$2,267,500,000		
Fish Habitat Enhancement			
-Yakima and Naches Rivers			
--Yakima River: Keechelus Dam to Roza Dam	\$26,000,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Yakima River: Roza Dam to Prosser Dam	\$20,400,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Yakima River: Prosser Dam to Columbia River	TBD	TBD	
--Naches River: Bumping Dam to Tieton River	\$1,200,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Naches River: Tieton River to Yakima River	\$11,400,000	TBD	Yakima Steelhead Recovery Plan, 2008
-Tributary Habitat Improvements			
--Big Creek	TBD	TBD	Yakima Steelhead Recovery Plan, 2008
--Cle Elum River	\$150,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Teanaway River	\$5,000,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Swauk Creek	\$780,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Taneum Creek	\$6,050,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Jack Creek	\$730,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Indian Creek	TBD	TBD	Yakima Steelhead Recovery Plan, 2008
--Cherry Creek	\$30,000	TBD	Yakima Steelhead Recovery Plan, 2008

Element	Estimated Construction Cost	Construction Duration	Source
--Manastash Creek	\$4,890,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Reecer Creek	\$1,970,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Naneum Creek	\$30,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Coleman Creek	\$30,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Bumping River	\$1,890,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Cowiche Creek	\$4,570,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Wide Hollow Creek	TBD	TBD	Yakima Steelhead Recovery Plan, 2008
--Toppenish Creek	\$10,350,000	TBD	Yakima Steelhead Recovery Plan, 2008
--Satus Creek	\$20,360,000	TBD	Yakima Steelhead Recovery Plan, 2008
Subtotal – Fish Habitat Enhancement	\$115,800,000-unknown		
TOTAL – Integrated Water Resource Management Alternative	\$736,600,000-unknown		

TBD = To be determined

The element with the least amount of information available on costs is the fish habitat enhancement element. Costs for habitat restoration projects were obtained from the Yakima Steelhead Recovery Plan (2008); however, the estimates appear to be very preliminary. Table 5-26 presents estimated costs for common items in fish habitat enhancement projects. When more detail is available on fish habitat enhancement projects, these types of unit costs would be applied to quantities estimated for each project to obtain an estimated construction cost. Additional costs such as design, permitting, and administrative costs would also need to be added; those costs can total up to 25 percent of the construction cost.

Table 5-26 Unit Costs for Common Items in Fish Habitat Enhancement Element

Item	Units	Unit Cost
Clearing and grubbing	Acre	\$5,000
Coffer dams/fish exclusion at structures	Each	\$10,000
Riprap and boulders	Ton	\$50
LWD pieces placed in structures	Each	\$800
Excavation	Cubic Yard	\$4 to \$12
Stream bed gravel	Cubic Yard	\$10 to \$25
Compost	Cubic Yard	\$60
Seeding	Acre	\$2,500
Bank stabilization	Linear Foot	\$50 to \$250
Channel connectivity	Linear Foot	\$850
Log control weir	Each	\$10,000
Plant removal/control	Acre	\$4,000
Riparian restoration	Square Foot	\$2

Additional analyses of all the elements will be prepared if the projects proceed to a feasibility-level study.

5.13.4.2 Lost Revenue from Modifying Existing Structures and Facilities

Section 5.7.2.2 described the potential loss of hydroelectric generation that could occur under the modifying existing structures and facilities element, specifically the subordination of Roza Power Plant diversions in April and May and the subordination of Chandler Power Plant diversions during spring months (April-June). An estimate of the lost generation revenue was made using rate tables from BPA’s 2007 Supplemental Wholesale Power Rate Case schedules (BPA, 2008). After comparing the monthly demand rates and monthly energy rates, a rate of 25 mills/kWh (\$0.025/kWh) was selected to represent the amount of revenue lost from reduced hydroelectric generation for this document.

Table 5-27 lists the estimated amount of monthly revenue lost due to Roza Power Plant subordination, and Table 5-28 lists the estimated amount of monthly revenue lost due to Chandler Power Plant subordination for various amounts of flow left instream.

Table 5-27 Estimated Reduction in Annual Revenue Generated from Roza Power Plant

Increase in Yakima River Flow (cfs)	Reduction in Revenue Generated		
	April	May	Total
50	\$9,000	\$9,300	\$18,300
100	\$18,000	\$18,600	\$36,600
150	\$27,000	\$27,900	\$54,900
200	\$36,000	\$37,200	\$73,200
250	\$45,000	\$46,500	\$91,500
300	\$54,000	\$55,800	\$109,800

Table 5-28 Estimated Reduction in Annual Revenue Generated from Chandler Power Plant

New Minimum Flow below Prosser Dam (Apr-Jun) (cfs)	Reduction in Revenue Generated			
	April	May	June	Total
1,100	\$1,600	\$1,700	\$2,700	\$6,000
1,200	\$3,300	\$3,700	\$3,900	\$10,900
1,300	\$4,200	\$6,200	\$5,100	\$15,500
1,400	\$4,700	\$8,700	\$6,500	\$19,900
1,500	\$5,300	\$11,300	\$8,400	\$25,000
1,600	\$6,300	\$13,900	\$10,400	\$30,600
1,700	\$7,500	\$16,500	\$12,300	\$36,300
1,800	\$8,700	\$19,300	\$14,200	\$42,200
1,900	\$10,300	\$22,000	\$15,900	\$48,200
2,000	\$12,300	\$24,400	\$17,700	\$54,400

Note: Current minimum flow below Prosser Dam is 1,000 cfs for April to June time period.

If the Roza Power Plant is subordinated to increase Yakima River flow by 50 cfs in April and May, the loss in annual revenue from hydroelectric generation is estimated to be \$18,300. If the flow is increased to 300 cfs in April and May, the loss in annual revenue is estimated to be \$109,800.

If the Chandler Power Plant is subordinated to increase the minimum flow level in the Yakima River below Prosser Dam from 1,000 cfs to 1,100 cfs in April to June, the loss in annual revenue from hydroelectric generation is estimated to be \$6,000. If the minimum flow is increased to 2,000 cfs from April to June, the loss in annual revenue is estimated to be \$54,400.

5.13.5 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 insofar as an action would reduce the supply of one set of goods and services (to increase the supply of another) and the reduction harmed one or more individuals, businesses, landowners, or other interest groups. For example, mitigation might involve compensation if the fallowing of land to develop new storage were to render a farmer unable to grow a certain crop. Alternatively, mitigation might involve the provision of substitutes for the reduced goods and services.

5.14 Public Services and Utilities

5.14.1 No Action Alternative

The potential long-term impacts from conservation measures contained in YRBWEP are similar to those described in Section 5.15 of the January 2008 Draft Planning Report/EIS. Other programs that are components of the No Action Alternative are not expected to have long-term impacts on public services and utilities.

5.14.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements

The greatest potential for long-term impacts to public services and utilities are those that affect hydropower production. The modifying existing structures and facilities and new storage elements have the potential to alter hydropower production. These impacts were described in Section 5.7. No other long-term impacts to public services and utilities are anticipated. None of the proposed elements would require additional services and additional demands for utilities would be minor.

5.14.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements

Implementing the elements as an integrated package is not expected to impact public services or utilities. The impacts would be the same as implementing the elements individually.

5.14.4 Mitigation Measures

No mitigation measures are proposed because the impacts are not expected to be significant.

5.15 Air Quality

This section discusses potential impacts to air quality from implementation of the alternatives proposed in this Supplemental Draft EIS. Potential climate change impacts are discussed in Sections 4.2 and 5.2.

5.15.1 No Action Alternative

Long-term air quality impacts associated with the No Action Alternative would be similar to those described in Sections 4.17 and 5.17 of the January 2008 Draft Planning Report/EIS.

5.15.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements

5.15.2.1 Fish Passage Element

No long-term impacts to air quality are anticipated from proposed fish passage elements.

5.15.2.2 Modifying Existing Structures and Facilities Element

No long-term impacts to air quality are anticipated from proposed structural modifications.

5.15.2.3 New Storage Element

Dust and other airborne particulates originating from the drawdown zone of any new storage facilities, including either of the two expansion options at Bumping Lake or the new Pine Hollow reservoir, may result in a chronic contribution to PM10 levels.

5.15.2.4 Fish Habitat Enhancement Element

No long-term impacts to air quality are anticipated from proposed fish habitat enhancement elements.

5.15.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements

The air quality impacts of implementing the elements as an integrated package would be similar to those of implementing the elements individually.

5.15.4 Mitigation Measures

Because no long-term impacts have been identified for most elements, no mitigation is required. No mitigation measures are practical for controlling dust in the drawdown areas of new or expanded reservoirs.

5.16 Noise

5.16.1 No Action Alternative

The No Action Alternative includes storage modification, supplementation, and fish enhancement projects that would likely be implemented by other agencies and special interest groups. To the extent that NEPA or SEPA analysis would be required for these actions, appropriate documentation of the noise impacts from implementation of these projects would be prepared separately.

5.16.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements

5.16.2.1 Fish Passage Element

No long-term noise impacts are expected from proposed fish passage elements.

5.16.2.2 Modifying Existing Structures and Facilities Element

No changes in existing noise are expected from any of the proposed structural or operational modifications. There would be no long-term noise impacts.

5.16.2.3 New Storage Element

Potential noise impacts from the new storage elements would be similar to those described in Sections 4.18.23 and 4.18.25 of the January 2008 Draft Planning Report/EIS. New noise sources from proposed facilities are not expected to significantly change the existing conditions.

5.16.2.4 Fish Habitat Enhancement Element

No long-term noise impacts are expected from proposed fish habitat enhancement elements.

5.16.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements

No long-term noise impacts are expected from implementation of the integrated elements.

5.16.4 Mitigation Measures

No long-term noise impacts are expected; therefore, no mitigation is necessary.

5.17 Visual Resources

5.17.1 No Action Alternative

The No Action Alternative includes individual actions that could affect visual resources. Riparian habitat improvements, included in some of these actions, would have a beneficial impact on the visual resource settings. Other projects could also have visual resource impacts, but those impacts would be less obvious because they would be associated with existing facilities. These projects would undergo separate NEPA or SEPA analysis, as appropriate. Because the projects would not be implemented as an integrated program, they have the potential to have greater impacts on visual resources.

5.17.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements

5.17.2.1 Fish Passage Element

The proposed fish passage elements would be located in landscape settings where visual character and scenic quality are high. It is often more difficult to blend or design compatible facilities in such settings without creating a significant 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. 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, Rimrock, Keechelus, and Kachess 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 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.

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.

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, though some impacts would be locally significant.

5.17.2.2 Modifying Existing Structures and Facilities Element

The fish bypass systems and canal projects would result in smaller scale facilities, though similar types of visual impacts as described above for the fish passage element.

Operational changes at existing facilities would have minimal visual impact. Flows may be increased or decreased in individual reaches, but would be within the range of river levels. Structural changes to existing facilities would include improvements to the Wapato Irrigation Project, and changes to the Chandler juvenile fish bypass outfall. These changes would not cause visual impacts.

Options for modifying the KRD Main Canal and South Branch Canal could result in visual changes related to piping existing open ditches (laterals) and constructing a new pump station on the Yakima River near the tail end of the South Branch Canal. Given the open, agricultural and sparsely developed character of the landscape through which these pipelines would be routed, their long-term visual impact would be minimal. Depending on the selected location for the new pump station, the visual impact of the facility could be significant on a local scale (i.e., to existing residents in the immediate vicinity or to recreationists on the river).

Completing the Wapatox Project could result in visual changes at a local scale related to modifying the conveyance system or consolidating the Wapatox and Naches-Selah diversions, but would remain within the agricultural and sparsely developed character of the landscape.

5.17.2.3 New Storage Element

Construction of a new storage facility would result in significant long-term visual impacts to the area. The magnitude of the impact would depend on the proposed location of the facility, the existing character of the surrounding landscape, and the scale of the project. Areas inundated by the reservoir would be permanently removed from the visual landscape; downstream reaches of receiving waters would be altered where the flow regime is altered.

The Bumping Lake expansion would increase the current 1,300-acre reservoir to 4,120 acres under the large option, and an unknown but lesser acreage under the small option. The new dam structure under the large option would be 230 feet high, an almost four-fold increase in height over the existing dam. The new dam and expansion of Bumping Lake would significantly and irrevocably affect the visual character of the Bumping Lake valley.

The new dam and expanded reservoir would be visible from viewpoints surrounding the reservoir. This change 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 perceived opportunity (e.g., access for various types of recreation and similar pursuits). The dam and expanded reservoir would be visible to trail users from a number of obstructed viewpoints (filtered views through trees) and unobstructed viewpoints in the William O. Douglas Wilderness Area. Many of these trail users are in the Wilderness Area because they value natural settings, and they would likely view the new dam and expanded reservoir as negative.

Modification of river operations in conjunction with storage in the Naches River basin could include changes to canals and ditches in the KRD system, including the KRD Main Canal, North Branch Canal, and South Branch Canal. These changes may be visible from local roads, highways, recreational areas, and residences and could include new, combined or enlarged canals, ditches, siphons, and tunnels. While most of these changes would occur in the vicinity of existing systems, a new canal from Cle Elum Dam to the KRD Main Canal is also included.

One option for filling the proposed Wymer reservoir would require 46 miles of pipeline between Cle Elum Dam and Wymer Dam. With the exception of some above-ground easement appurtenance facilities, this alternative is composed entirely of underground pipelines; the only surface manifestation would be a managed corridor of land along the easement or right-of-way. Management of the corridor would include prohibition of permanent structures, but landscape plantings, agriculture in some form, and/or restored natural vegetation (as appropriate to the environment along the route) would characterize the corridor after construction. Given the open, agricultural, and sparsely developed character of the landscape through which these pipelines would be routed, their long-term visual impact would be minimal.

Pine Hollow reservoir was included in Ecology's Final Programmatic EIS on the Ahtanum Creek Watershed Restoration Program (Ecology, 2005). As described in the EIS, construction of the Pine Hollow reservoir would alter the appearance of the Pine Hollow area. A portion of the grassy, rocky canyon area would be converted to a reservoir with an earthen dam at the western end. The dam would block views from the surrounding ridges down Pine Hollow. When full, the reservoir would resemble a lake that would contrast with the surrounding arid area. Filling and drawing down the reservoir would result in white mineral deposits ("bathtub ring") and exposed mud flats during drawdowns, which would be visible to residents in the Pine Hollow area until the reservoir is refilled in late winter/early spring. The appearance of the Johncox Ditch area would also be altered by the reservoir.

5.17.2.4 Fish Habitat Enhancement Element

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 visual setting, which would generally be viewed as positive.

5.17.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements

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 predominately from a distance, the overall long-term visual resource impact is not expected to be significant.

5.17.4 Mitigation Measures

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 old-growth western red cedar stand and mature conifers in the area located downstream of Bumping Lake Dam would be protected from disturbance to the extent possible. 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 minimize their visibility from public areas.

Consultation with the landscape architect for the Okanogan-Wenatchee National Forest in advance of preparing designs will assure the fish passage facilities, storage elements, and restoration of lands disturbed during construction within U.S. Forest Service property will meet the High Scenic Integrity Level (Retention VQO) as much as possible given engineering requirements.

5.18 Transportation

5.18.1 No Action Alternative

Long-term transportation associated with the No Action Alternative would be similar to those described in Sections 4.16 and 5.17 of the January 2008 Draft Planning Report/EIS.

5.18.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements

5.18.2.1 Fish Passage Element

No long-term impacts to transportation are anticipated. 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 impact transportation.

5.18.2.2 Modifying Existing Structures and Facilities Element

No long-term impacts to 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 New Storage Element

No long-term impacts to transportation are anticipated from proposed new storage projects. No road or rail facilities would be closed or relocated. The operational requirements of new storage projects would require infrequent trips by maintenance vehicles and would have no impact on transportation systems. New access roads could be required to access new storage facilities. Those roads would be maintained by the

operating entity of the reservoir. 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 Area.

5.18.2.4 Fish Habitat Enhancement Element

No long-term impacts to 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.

5.18.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements

No long-term impacts to transportation are anticipated beyond those that would occur if the elements were implemented individually.

5.18.4 Mitigation Measures

Since there would be no long-term impacts to transportation, no mitigation is necessary.

5.19 Public Health and Safety

5.19.1 No Action Alternative

The No Action Alternative would not result in direct long-term public health or safety impacts 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. To the extent that NEPA or SEPA analysis would be required for these actions, appropriate documentation of the public health and safety impacts from implementation of these projects would be prepared separately.

5.19.2 Integrated Water Resource Management Alternative—Impacts of Individual Elements

5.19.2.1 Fish Passage Element

All potential long-term impacts to public health and safety from fish passage elements would be similar to those described in Section 4.23.2.3 of the January 2008 Draft Planning Report/EIS.

5.19.2.2 Modifying Existing Structures and Facilities Element

Operational changes at existing facilities are not expected to have any short-term public health or safety impacts. All potential long-term impacts to public health and safety from modification of existing structures would be similar to those described in Section 4.23.2.3 of the January 2008 Draft Planning Report/EIS.

5.19.2.3 New Storage Element

Potential long-term impacts to public health and safety from new storage elements would be similar to those described in Section 4.23.2.3 of the January 2008 Draft Planning Report/EIS.

5.19.2.4 Fish Habitat Enhancement Element

Potential long-term impacts to public health and safety from fish habitat enhancement elements would be similar to those described in Section 4.23.2.3 of the January 2008 Draft Planning Report/EIS.

5.19.3 Integrated Water Resource Management Alternative—Impacts of Integrated Elements

Potential long-term impacts to public health and safety from the integrated elements would be similar to those described in Section 4.23.2.3 of the January 2008 Draft Planning Report/EIS.

5.19.4 Mitigation Measures

Mitigation measures proposed for long-term impacts to public health and safety were outlined in Sections 4.23.2.6 and 5.21.3 of the January 2008 Draft Planning Report/EIS.

5.20 Cumulative Impacts

The overall cumulative impacts of the Integrated Water Resource Management Alternative are expected to be beneficial, although some localized impacts could occur associated with individual projects. The integrated approach to resolving water resource problems in the Yakima River basin is proposed to provide greater benefits than implementing any one project element alone. A combined package of fish passage, water storage, and habitat enhancement is expected to provide greater benefits to resident and anadromous fish than any one of those elements would individually. Water storage and modifications to existing facilities and operations are expected to provide greater benefits to irrigation and municipal water supply. Integrating improvements to fish habitat and water supply improves the potential for implementing those improvements.

Individual elements of the Integrated Water Resource Management Alternative could cause cumulative impacts when combined with other past, present, and reasonably foreseeable future actions. Building new water storage facilities or expanding existing reservoirs would add to existing impacts in a river basin that has already been extensively dammed. Additional storage facilities could exacerbate the impacts of existing facilities. For example, on-channel storage could add additional impediments to fish passage, increase migration times, and affect downstream water quality. However, any new facility constructed as part of the Integrated Water Resource Management Alternative would include fish passage and fish passage would be installed at existing reservoirs as part of the package. New or expanded reservoirs could inundate terrestrial wildlife habitat and impact plant or wildlife species already in decline.

The Integrated Water Resource Management Alternative is not intended to expand irrigation 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 add to the decline in shrub-steppe habitat or other important habitat in the basin.

The proposed Integrated Water Resource Management Alternative is intended to have incremental benefits on fish species, including those that are listed as threatened and endangered. Providing fish passage at the reservoirs and enhancing habitat on the rivers and tributaries in the basin would help reverse environmental damage from the early 1900s. These improvements, combined with improved stream flows, would benefit resident and anadromous in the Yakima River basin and reduce the risks of further decline.

This Supplemental Draft EIS is the first step in phased review of an Integrated Water Resource Management Alternative. The development of an integrated approach is itself an effort to evaluate and manage water resources on a system-wide basis. This system-wide approach will help to identify impacts at a comprehensive level thus reducing the potential for unintended cumulative impacts. The proposed elements in this document will be blended with the enhanced water conservation, market-based reallocation of water resources, and ground water storage alternatives proposed in the January 2008 Draft Planning Report/EIS to create an integrated package for improving water resources in the Yakima River basin. The elements will be further evaluated in the Final EIS which is expected to be released in March 2009. Potential impacts of specific projects that are identified as part of the Integrated Water Resource Management Alternative will undergo additional project-level review when they are identified. The project-level review will identify specific project impacts and ways to avoid or mitigate those impacts. To avoid potential cumulative impacts of the Integrated Water Resource Management Alternative, Ecology will continue to coordinate with the Yakama Nation and local, state, and federal agencies that manage resources in the Yakima River basin.