CHAPTER 4.0 IMPACTS AND MITIGATION MEASURES FOR INCREMENTAL STORAGE RELEASES

This chapter describes the potential impacts associated with the Lake Roosevelt Incremental Storage Releases Project. The chapter includes a general discussion of the impacts associated with the No Action Alternative. Impacts associated with the Proposal are described for areas that could be impacted—Lake Roosevelt, the Columbia River downstream from Grand Coulee Dam, and Banks Lake and the Odessa Subarea. Because of the nature of this Proposal, with a variety of actions that would take place in different years, most impacts associated with it are considered long-term or operational impacts. Short-term impacts are only discussed in terms of construction that would be required to implement the Proposal. The chapter includes appropriate mitigation measures for any significant adverse impacts that are identified.

4.1 No Action Alternative

Under the No Action Alternative, Lake Roosevelt would continue to be operated as it is currently, with no additional releases from storage. Impacts of the No Action Alternative for the Incremental Storage Releases Project were evaluated in Section 5.4 of the Programmatic EIS (Ecology, 2007). The Programmatic EIS concluded that the No Action Alternative would have no impacts on most elements of the environment. The following potential impacts were identified to ground water, water rights, fish, and socioeconomics.

- Ground water levels in the Odessa Subarea would continue to decrease at approximately the same rate that they do today.
- There would be less water available for pending municipal/industrial users, and no water would be available for interruptible water rights during drought years.
- No additional water would be available to supplement stream flows in the mainstem of the Columbia River.
- Farmers in the Odessa Subarea would continue to experience rising costs of pumping ground water, which would diminish the feasibility of irrigation. Some irrigators may shift to crops that require less water or cease operations. This could result in a loss of sales, jobs, and income in the area.

This Supplemental EIS evaluates the Lake Roosevelt Incremental Flow Releases in more detail and provided more background information on such subjects as climate change, landslide potential, recreational boat ramps, and legal considerations related to the operation of Lake Roosevelt. With the exception of legal considerations, no additional impacts were identified from the No Action Alternative. Under the No Action Alternative, opportunities to provide additional water to improve water management in the Columbia River Basin would be delayed or lost. The opportunity to provide water to municipal and industrial users, interruptible water rights holders, users of ground water in the Odessa Subarea, and increased stream flows for fish would be lost. Ecology has no

legal requirement to provide water to those users and other options may exist to provide water to those uses.

4.2 Proposal

4.2.1 Lake Roosevelt

4.2.1.1 Earth

Short-term impacts

No short-term impacts are anticipated.

Long-term/operational impacts

Landslides, changes in alluvial deposits and additional exposed lakebed sediment are potential long-term impacts associated with additional drawdown of Lake Roosevelt. These potential impacts are described below.

Landslides

Landslide potential would not change as a result of the Proposal. The additional drawdown during the period with highest landslide potential (April and May when the lake level is less than 1,240 feet msl) would be minimal (less than 1 inch), and no impact is predicted during this period. The maximum additional drawdown (1.8 feet or less) would occur at the end of August, during the period of lowest landslide risk (summer, which is when the lake level is greater than 1,254 feet msl) and is within the normal operating levels of the reservoir.

Alluvial Deposition

Alluvial deposition patterns, including at the mouth of small tributaries, would not change as a result of the Proposal. This is because the additional drawdown period would primarily occur during the summer when there is little deposition occurring, and negligible (less than 1 inch) change in lake level during periods of higher deposition.

Exposed Sediment

Little additional lakebed area would be exposed as a result of the additional drawdown. The maximum additional drawdown (1.8 feet or less) would occur during the summer when lake level is greater than 1,254 feet msl. These lakebed areas would become exposed without the incremental storage releases as a result of normal reservoir operations. Impacts, if any, would be related to the duration of exposure. With additional drawdown, lakebed sediments may be exposed for a longer duration, even though the total area of exposure would be the same as under current conditions.

The bathymetry of 14 selected embayments of Lake Roosevelt was used to estimate how much exposed sediment corresponds to 1 foot of drawdown. Table 4-1 shows the amount of lakebed area exposed across 5-foot increments of pool heights. These data were used to determine a relationship between additional area exposed and drawdown on a continuous basis (i.e., per foot). In general, between 35 and 45 acres of lakebed is exposed for every 1 foot of drawdown when the lake elevation is between 1,290 and 1,255 feet msl. When the lake is below 1,255 feet msl, a larger area (up to 120 acres) is exposed per foot of drawdown.

Table 4-1 Total Exposed Lake Roosevelt Lakebed Area per Foot of Drawdown for the 14 Selected Embayment Areas

Contour Interval (feet msl)	*Additional Area (acres) Exposed per 1 ft Drawdown*
1,285 to 1,290	37.3
1,280 to 1,285	45.2
1,275 to 1,280	34.0
1,270 to 1,275	46.2
1,265 to 1,270	38.2
1,260 to 1,265	40.4
1,255 to 1,260	40.8
1,250 to 1,255	57.1
1,245 to 1,250	86.8
1,240 to 1,245	120.1

See Section 4.1.1.9, Environmental Health for additional discussion of the potential exposure of contaminated sediments.

Mitigation

Reclamation conducts annual inspections of the Lake Roosevelt shoreline, to observe and, if necessary, mitigate the effects of landslides along the shoreline. These inspections and other existing operational management guidelines are sufficient to address the potential for slope failure and erosion. No significant change in the extent of exposed lakebed sediments is anticipated. Therefore, no additional mitigation is required.

4.2.1.2 Climate

A program such as the Lake Roosevelt Incremental Storage Releases Project could both affect, and be affected by, climate change. Projects can affect climate change by increasing carbon emissions that contribute to global warming. As noted in Section 3.3, climate change could affect precipitation, snowmelt and runoff to Lake Roosevelt, which could affect the water available for the incremental storage releases. For the purposes of this Supplemental EIS, the effect of the Proposal on climate change is discussed as a short-term impact, and the effect of climate change on the Proposal is discussed as a long-term impact.

Short-term impacts

The Proposal is not expected to increase emissions that would affect climate change since there would be no construction involved and there would be no increase in transportation emissions. The storage releases are expected to slightly reduce hydropower production,

which could increase the need to shift to another form of power generation, possibly with increased carbon emissions.

Long-term/operational impacts

The potential, general impacts of climate change on water resource management are described in Section 3.2. The impacts of climate change could affect water management at Lake Roosevelt by altering the amount and timing of water available in the reservoir. Because of the uncertainty of predictions of runoff and precipitation in the Pacific Northwest, it is not possible to discuss those impacts quantitatively. If less water is available in Lake Roosevelt or if the runoff occurs earlier in the year, water availability for the Incremental Storage Releases Project could be affected. Impacts related to reduced water availability include more interruptible water rights, reduced water available to meet target flows, and additional unusable recreational facilities.

Mitigation

Changes in water availability in the Columbia River Basin will require the managing agencies to adaptively manage the river to respond to changing conditions. If conditions change, Ecology will coordinate with Reclamation and other Columbia River managing agencies to adapt to climate changes. Possible mitigation actions include changes to Reclamation service contracts and an adaptive management plan for recreation impacts.

4.2.1.3 Surface Water

Water Quantity

Short-term impacts

No short-term impacts will occur. All facilities needed to release additional water from Lake Roosevelt exist and no construction would be required.

Long-term/operational impacts

The long-term impacts of modifying the release schedule for Lake Roosevelt will be a slight change in the water levels in Lake Roosevelt during the April-October time period. Tables 4-2 through 4-8 summarize the predicted difference in water levels for the alternative and flow options. On all the tables, the bottom row summarizes the cumulative drawdown of Lake Roosevelt at the end of each month. The predicted drawdown of Lake Roosevelt varies slightly between the alternatives for the Odessa Subarea demands because of the varying lake elevation-water storage relationship as the lake level changes. As lake levels drop, there is less water storage per foot of drop. The drawdowns shown in Tables 4-2 through 4-8 are best estimates using recorded lake elevations that occurred in years representing average (2002), dry (2003) and drought (2001) conditions. Figures 4-1 through 4-4 illustrate those predicted differences using recorded daily lake elevations for each representative year.

Table 4-2. Alternative 1A—Average Year

Purpose of Flow Releases	***Total Released (acre-feet)***	***Difference in Lake Roosevelt Water Levels (inches)***						
		April	May	June	July	August	September	October
Odessa	30,000	0	0	0	1.76	1.76	0	0
Fish	27,500	0	0	0	2.18	2.18	0	0
Municipal/ Industrial	25,000	0	0	0	1.98	1.98	0	0
Cumulative Total	82,500	0	0	0	5.92	11.84	0	0

Table 4-3. Alternative 1B(a)—Average Year

Purpose of Flow Releases	***Total Released (acre-feet)***	***Difference in Lake Roosevelt Water Levels (inches)***						
		April	May	June	July	August	September	October
Odessa	30,000	0.32	0.63	0.95	1.26	0.94	0.48	0.17
Fish	27,500	1.11	0.55	0.32	0.31	1.03	1.03	0
Municipal/ Industrial	25,000	0.43	0.60	0.75	0.71	0.75	0.70	0
Cumulative Total	82,500	1.86	3.64	5.66	7.94	10.66	0[1]	0[1]

[1]Cumulative total in September and October is zero because the lake will be refilled to previous levels by September 30.

Table 4-4. Alternative 1B(b)—Dry Year

Purpose of Flow Releases	***Total Released (acre-feet)***	***Difference in Lake Roosevelt Water Levels (inches)***						
		April	May	June	July	August	September	October
Odessa	30,000	0.33	0.65	0.98	1.31	0.97	0.50	0.17
Fish	27,500	1.51	1.50	1.50	0	0	0	0
Municipal/ Industrial	25,000	0.45	0.62	0.78	0.73	0.77	0.73	0
Cumulative Total	82,500	2.29	5.06	8.32	10.36	12.10	0[1]	0[1]

[1]Cumulative total in September and October is zero because the lake will be refilled to previous levels by September 30.

Table 4-5. Preferred Alternative 1C(a)—Worst Case Scenario in Average Year

Purpose of Flow Releases	***Total Released (acre-feet)***	***Difference in Lake Roosevelt Water Levels (inches)***						
		April	May	June	July	August	September	October
Odessa	30,000	0.32	0.63	0.95	1.26	0.94	0.48	0.17
Fish	27,500							0
Municipal/ Industrial	25,000							0
Cumulative Total	82,500	1	1	1	1	12.41[2]	0[2]	0

-Period of time flow releases can occur.

[1]Not calculated as distribution of flow releases can vary yearly.

[2]Cumulative total in September and October is zero as lake will be refilled to previous levels by September 30.

Table 4-6. Preferred Alternative 1C(b)—Worst Case Scenario in Dry Year

Purpose of Flow Releases	***Total Released (acre-feet)***	***Difference in Lake Roosevelt Water Levels (inches)***						
		April	May	June	July	August	September	October
Odessa	30,000	0.33	0.65	0.98	1.31	0.97	0[1]	0.65[1]
Fish	27,500				0	0	0	0
Municipal/ Industrial	25,000				0	0	0	0
Cumulative Total	82,500	[2]	[2]	10.55	11.86	12.83[3]	0[3]	0[3]

-Period of time flow releases can occur.

[1]Odessa demand is supplied by Banks Lake in September and Lake Roosevelt in October. October demand on Lake Roosevelt includes September demands to refill Banks Lake.

[2]Not calculated as distribution of flow releases can vary yearly.

[3]Cumulative total in September and October is zero as lake will be refilled to previous levels by September 30.

Table 4-7. Alternative 1D—Demand Option in Drought Year

Purpose of Flow Releases	***Total Released (acre-feet)***	***Difference in Lake Roosevelt Water Levels (inches)***						
		April	May	June	July	August	September	October
Odessa	30,000	0.33	0.65	0.98	1.31	0.98	0.50	0.17
Fish	44,500	2.43	2.44	2.43	0	0	0	0
Municipal/ Industrial	25,000	0.45	0.62	0.78	0.73	0.77	0.73	0
Interruptible Water Rights	33,000	1.08	1.09	1.08	1.09	1.09	0	0
Cumulative Total	132,500	4.29	9.09	14.36	17.49	20.33	0[1]	0[1]

[1]Cumulative total in September and October is zero as lake will be refilled to previous levels by September 30.

Table 4-8. Preferred Alternative 1E—Worst Case Scenario in Drought Year

Purpose of Flow Releases	***Total Released (acre-feet)***	***Difference in Lake Roosevelt Water Levels (inches)***						
		April	May	June	July	August	September	October
Odessa	30,000	0.33	0.65	0.98	1.31	0.98	0.50	0.17
Fish	44,500				0	0	0	0
Municipal/ Industrial	25,000	0	0	0				0
Interruptible Water Rights	33,000	0	0	0				0
Cumulative Total	132,500	[1]	[1]	9.26	[1]	21.05[2]	0[3]	0[3]

-Period of time flow releases can occur.

[1]Not calculated as distribution of flow releases can vary yearly.

[2]Assumes complete Municipal/Industrial, Fish, and Interruptible Water Rights flow released by August 31 and refilled by September 30.

[3]Cumulative total in September and October is zero as lake will be refilled to previous levels by September 30.

The maximum change in Lake Roosevelt elevations is approximately a 1-foot drawdown from existing operations. The maximum change occurs at the end of August, and decreases to zero at the end of September as the reservoir refills. For alternatives with releases to the Columbia River in September (Alternatives 1B(a), 1B(b), 1D), reservoir refill will occur in October as long as an elevation of 1,283 feet msl is reached by October 1 for kokanee spawning access.

The Preferred Alternative, Alternative 1C, has a maximum drawdown of 1.0 feet at the end of August in an average year and a maximum drawdown of 1.1 feet at the end of August in a dry year. The actual flow releases and resulting lake drawdown for the Preferred Alternatives will be determined by a panel of fisheries and water managers described in Section 2.3.1.

During drought years with additional release for downstream interruptible water rights and stream flow enhancement, the maximum change is estimated to be 1.7 feet at the end of August for Alternative 1D. The Preferred Alternative in a drought year, Alternative 1E, has a maximum drawdown of 1.8 feet at the end of August. This conservatively assumes the maximum flow releases from this proposal (44,500 acre-feet for fish, 25,000 acre-feet for municipal and industrial, and 33,000 acre-feet for interruptible water rights) will occur prior to the end of August. The actual flow releases and resulting drawdown will depend on the flow release schedule developed by the panel of fisheries and water managers.

Figures 4-1 to 4-4 illustrate the small difference in Lake Roosevelt water levels compared to the entire range of existing operations. Figure 4-5 provides a close-up view of the drawdown during the period of maximum drawdown and refill (June-September) for Preferred Alternative 1E.

Mitigation

No mitigation measures are proposed for surface water impacts because the drawdowns would be within the normal operating levels of Lake Roosevelt.

Water Quality

Water temperatures within and downstream of Lake Roosevelt are affected by the balance of inflows and outflows and the total surface area of the lake. Total dissolved gas (TDG) levels below Lake Roosevelt are affected by the volume of water released from Grand Coulee Dam.

Short-term impacts

No short-term impacts are anticipated because no new construction would be required.

Long-term/operational impacts

Lower Lake Roosevelt water levels are not expected to change the lake's overall thermal characteristics, including stratification. Additional drawdown would reduce the total depth or thickness of the water column. However, since maximum additional drawdown (1.8 feet or less) will occur during the summer when lake level is highest, the total range of water column thickness will remain virtually the same as under current conditions. Impacts, if any, would be related to a slight shift in the timing and duration of a given water column thickness. These impacts are not considered significant.

Mitigation

No mitigation measures are necessary because no impacts are anticipated.

4.2.1.4 Ground Water

Water Quantity

Aquifers for wells located within 1 mile of Lake Roosevelt are generally in hydraulic connection with Lake Roosevelt. Ground water level elevations follow the same increases and decreases as observed in surface water level elevations of Lake Roosevelt.

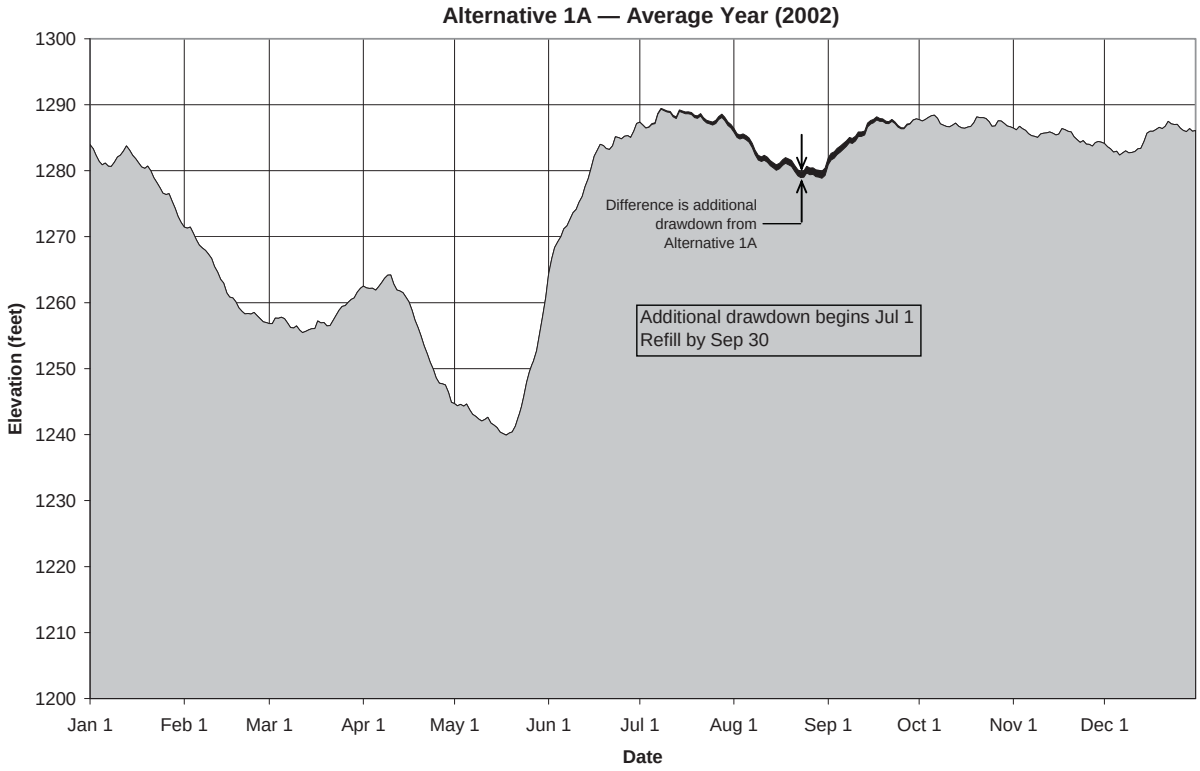

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Figure 4-1
Lake Roosevelt Water Elevations — Alternative 1A

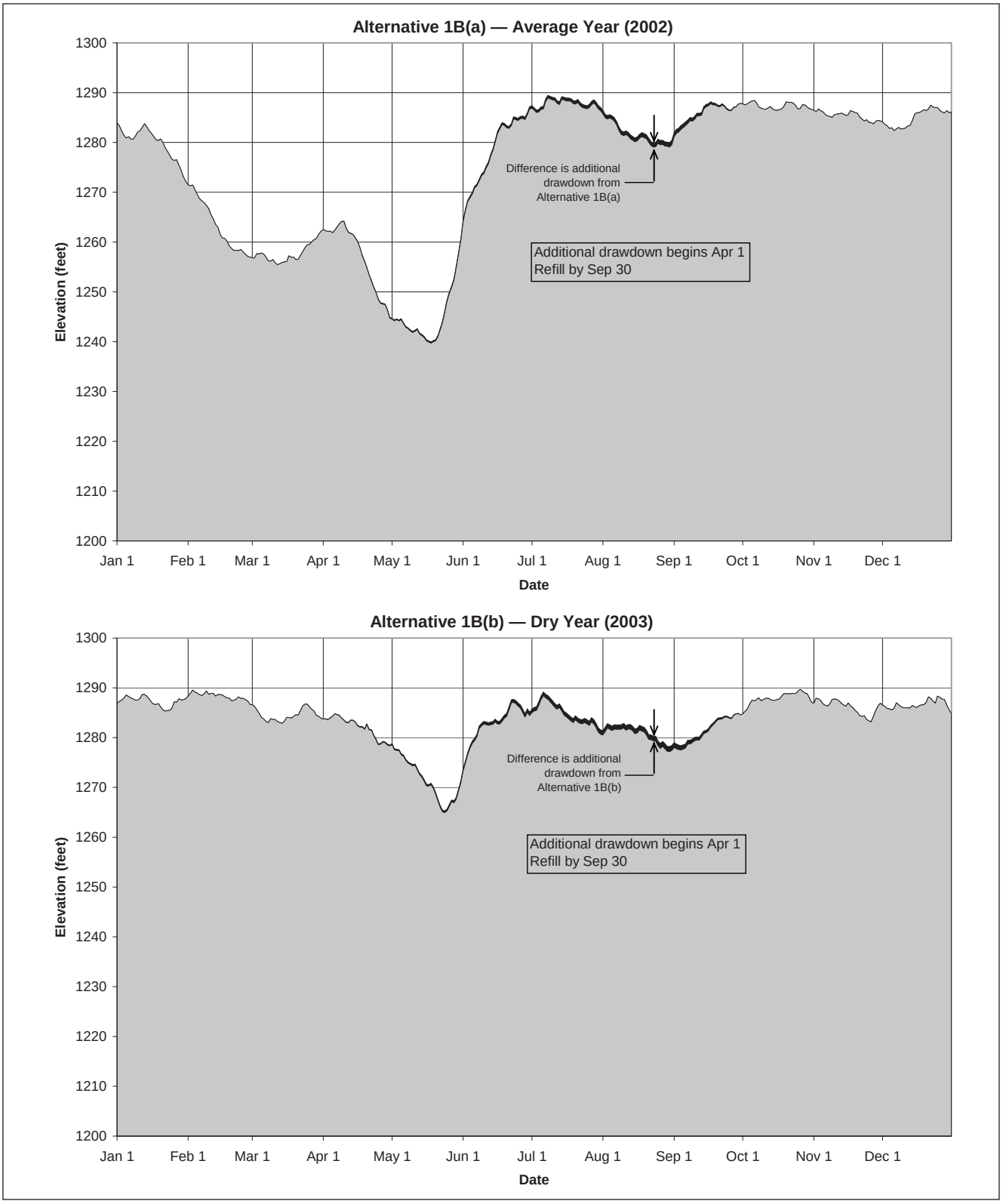

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Figure 4-2
Lake Roosevelt Water Elevations — Alternative 1B

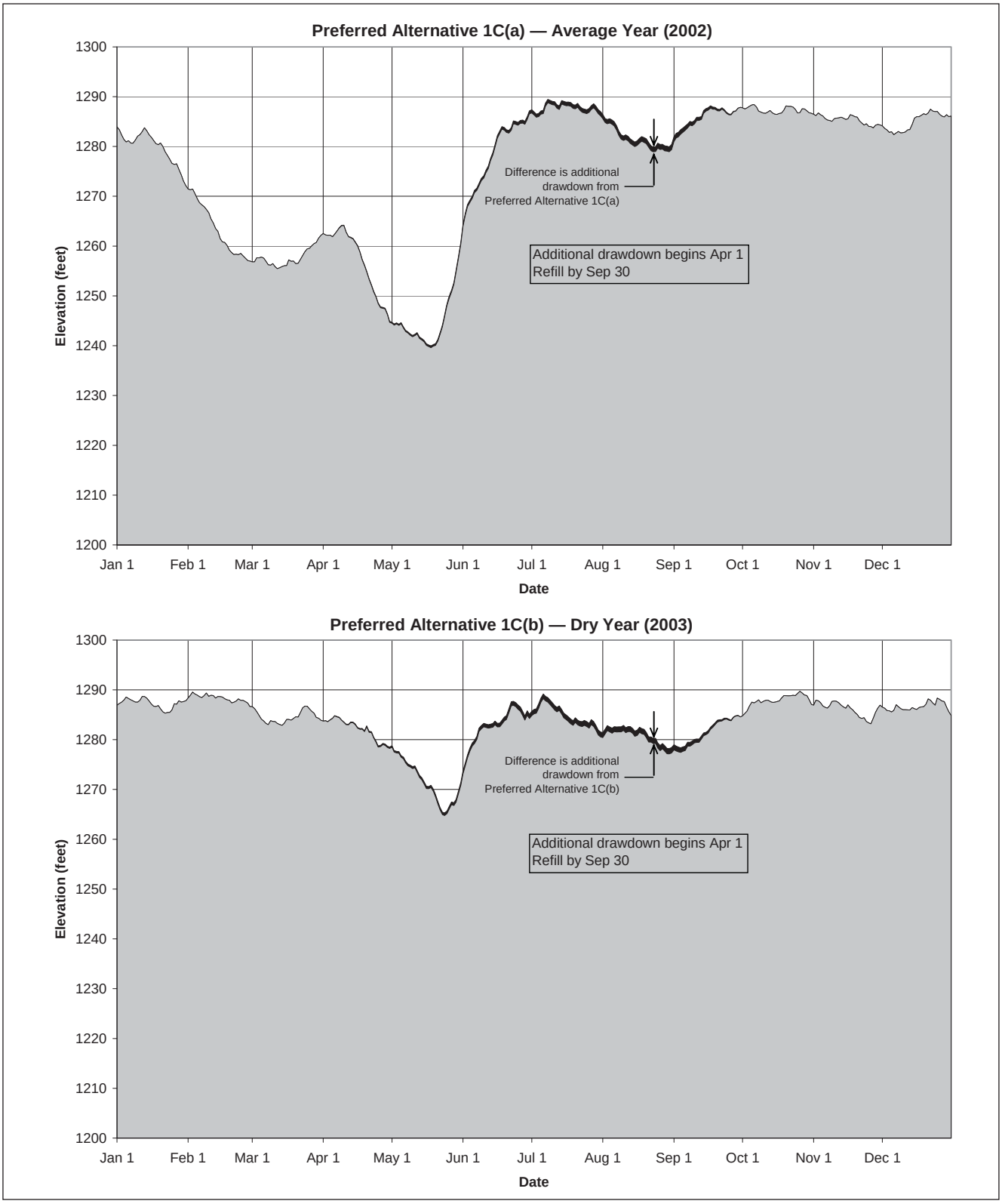

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Figure 4-3

Lake Roosevelt Water Elevations — Alternative 1C

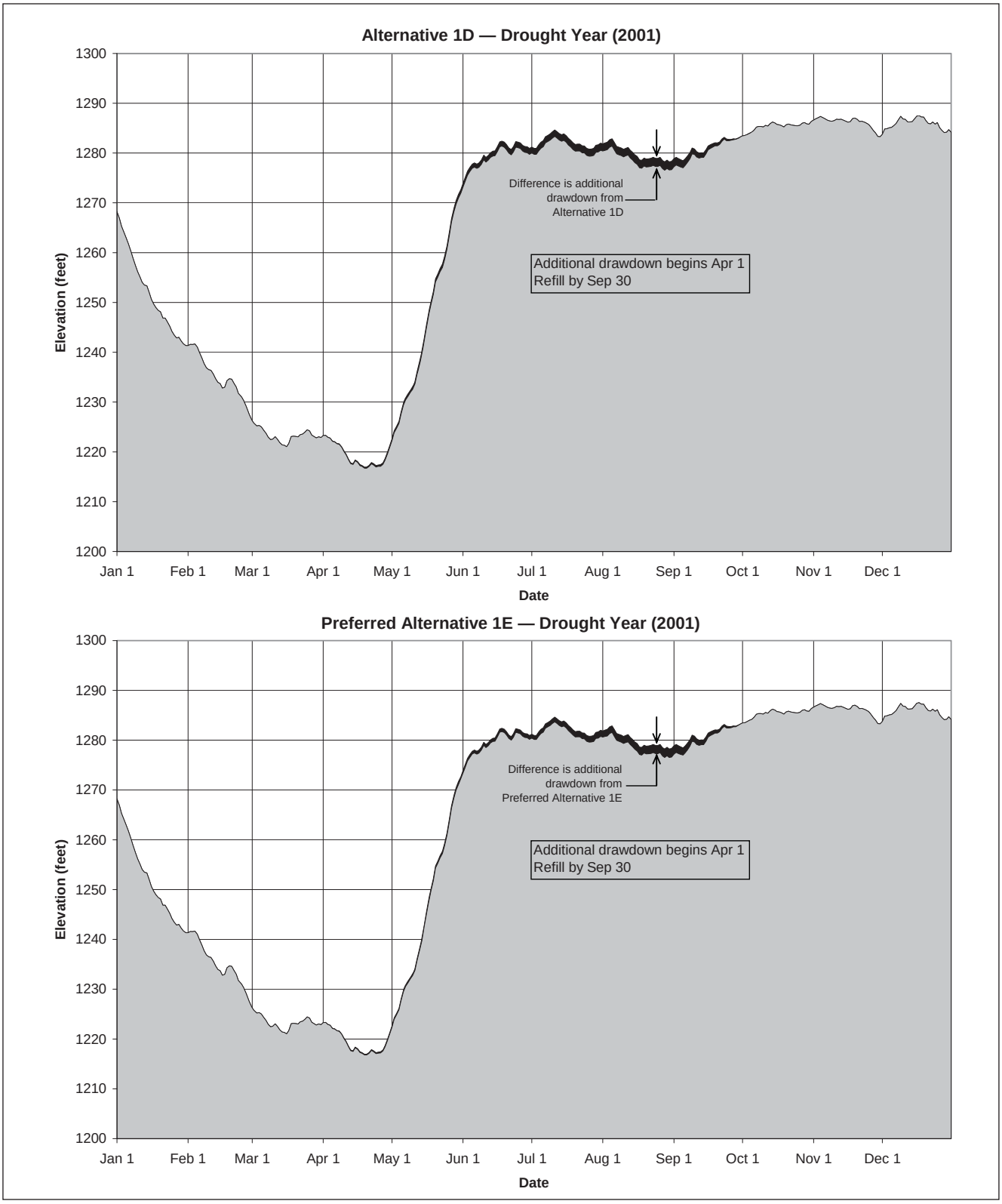

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Figure 4-4

Lake Roosevelt Water Elevations — Alternatives 1D, 1E

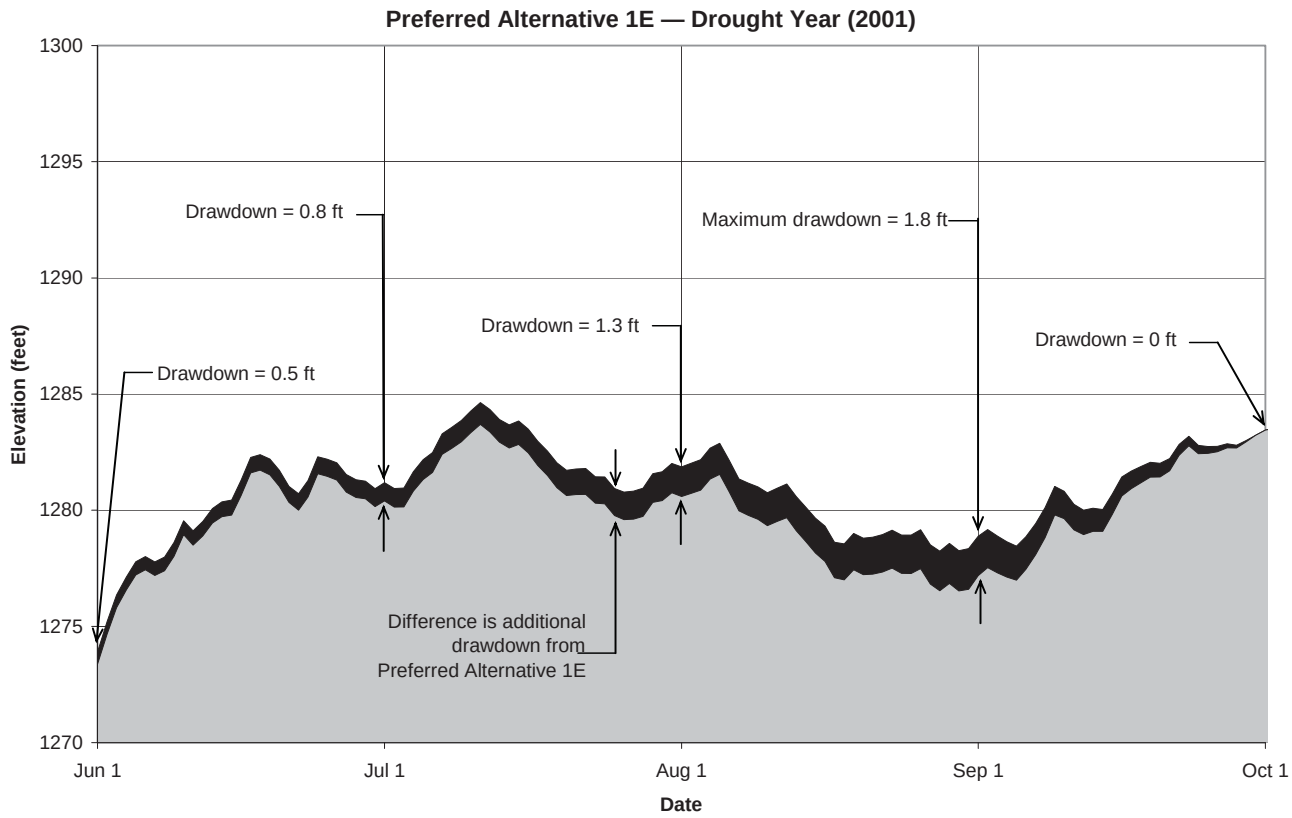

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Figure 4-5

Lake Roosevelt Water Elevations — Alternative 1E (Expanded Scale)

Short-term impacts

No short-term impacts are anticipated because no new construction would be required.

Long-term/operational impacts

The Proposal includes a maximum 1.0 to 1.8 foot decrease in the water level of Lake Roosevelt for a short period at the end of August. A smaller decrease will occur from April up to August as additional water is withdrawn from Lake Roosevelt. Those decreases are shown in Tables 4-2 through 4-8. Wells that are hydraulically connected to Lake Roosevelt may see a smaller, but similar decrease in their static water level during the period of additional drawdown. The magnitude of these decreases is dependent on individual characteristics of the wells and nearby geology. The maximum additional drawdown will occur in late August, well after the period that Lake Roosevelt is lowest (prior to spring melt). The change in water levels in August is within the normal operating range of Lake Roosevelt. Existing wells that can operate over the current range of Lake Roosevelt water levels will not be affected by the additional drawdown. A slight increase in pumping head may result. The increase will be proportional to the decrease in static water level divided by the depth from the ground surface to the static water level. For example, a 1 foot decline in static water levels for a well with a 200 foot depth to static water level would cause a 0.5 percent increase in pumping head.

Mitigation

No mitigation measures are necessary because no impacts to ground water are anticipated.

Water Quality

Short-term impacts

No short-term impacts are anticipated because no construction would be required.

Long-term/operational impacts

Ground water quality is not significantly influenced by Lake Roosevelt since the ground water gradient appears to be toward the lake, not away from it. Therefore, operation of the lake, while it may influence ground water levels, should not significantly affect ground water quality over the long term.

Mitigation

No mitigation measures are necessary because no impacts are anticipated.

4.2.1.5 Legal Considerations

Water Rights

Short-term impacts

No short-term impacts to water rights are anticipated since there would be no construction.

Long-term/operational impacts

Reclamation has water rights for 6.4 million acre-feet of live storage in the reservoir and water rights to release approximately 3 million acre-feet for downstream consumptive

beneficial use.[1,2] Any additional releases from the reservoir will be authorized under secondary use permits issued by Ecology. One potential for impacts on other water rights is in drought years when Reclamation has agreed to release additional water for interruptible water right holders and to augment instream flow. However, Ecology may not grant the permits if additional releases would impair or adversely affect existing water rights from the reservoir. Therefore, no impacts to existing water rights are anticipated.

Mitigation

Mitigation would be required if the additional releases would adversely affect water right holders who divert from Lake Roosevelt. Any required mitigation would be determined by Ecology as the water right applications are processed.

Biological Opinion

Short-term impacts

No short-term impacts are anticipated.

Long-term/operational impacts

RPA Action 4 in the 2008 Biological Opinion addresses Storage Project Operations, including Grand Coulee operations. Operations include releasing flows from the reservoir to support salmon flow objectives during July and August, with a variable draft limit of 1,278 msl in dry years and to 1,280 feet msl in other years. The drawdown expected with the incremental releases from Lake Roosevelt ranges from 1,277.34 in dry years (2003) to 1,279.36 feet msl in average years (2002). With these releases, the reservoir would be drafted below the target in the Biological Opinion. However, the Biological Opinion recognizes the need for flexibility in the operations of Lake Roosevelt that may affect reservoir draft limits. RPA Action 14 calls upon the Action Agencies to coordinate use of this flexibility, including the need during dry years to distribute water across the expected migration season (NOAA Fisheries, 2008).

The Draft MOA between the CCT and the Action Agencies (CCT and Action Agencies, 2008) also calls for a study to evaluate lowering Lake Roosevelt to 1,278 feet msl only in the lowest 20 percent of water years and to 1,280 feet msl in all other water years. The Draft MOA calls for an investigation of Dry Water Year Operations other than summer drafting.

Section A.1.e(ii)(4) of the Draft MOA acknowledges the stream flow enhancement component of the Lake Roosevelt Incremental Storage Releases Project and calls for an investigation to evaluate the proposed release of water in April through June (rather than

[1] The water rights held by Reclamation were issued pursuant to the agency's withdrawal of the water from appropriation under RCW 90.40.030. The reservation need not be renewed because any withdrawal of water "associated with the Columbia Basin Project shall continue as withdrawn from appropriation, without need for periodic renewal, until the project is declared completed or abandoned by the United States acting by and through the secretary of the interior or such other duly authorized officer of the United States" (RCW 90.40.100).

[2] Reclamation has additional water rights for non-consumptive hydropower generation.

July and August) in the driest 20 percent of years to benefit Upper Columbia River out-migrants.

Mitigation

There will need to be on-going discussions and communication between the State of Washington, the Action Agencies, and the Tribes so that actions under all agreements and plans that relate to the operation of Lake Roosevelt are coordinated.

Canadian Treaty

Short-term impacts

The additional releases from the reservoir will have no short-term impacts on the Canadian Treaty because the releases are within the normal operations of Lake Roosevelt.

Long-term/operational impacts

The additional releases will have no long-term impacts on the Canadian Treaty because it is within the normal operation levels of the reservoir. The renegotiation of the Treaty may, however, have impacts on the water supply to Lake Roosevelt and the flexibility in how the reservoir is operated.

Mitigation

No impacts are anticipated and no mitigation is necessary. Any changes to reservoir operations as a result of future Treaty negotiations could require adaptive management which would be resolved in the Treaty negotiations.

4.2.1.6 Fish

Short-term impacts

Infrastructure exists to implement the flow releases from Lake Roosevelt. Thus, short-term effects of construction activities are not anticipated.

Long-term/operational impacts

Drawdown

The magnitude, seasonal timing and duration of drawdown under the various release alternatives and options are summarized in Tables 4-2 through 4-8 and graphically shown in Figures 4-1 to 4-5. The annual volume of water released under each of the scenarios is fixed. Spreading the timing of the releases across a number of months under the alternatives decreases the relative level of drawdown, but extends the period of exposure. The worst-case drawdown of 1.0 and 1.1 feet under average and dry year conditions (96 percent of the time) are anticipated to occur annually at the end of August under Alternative 1A, 1B, and 1C. Drawdowns during the balance of the months for non-drought years range between 0.0 and 0.9 feet depending upon the alternative. The worst-case drawdown under drought conditions (Preferred Alternative 1E) is 1.8 feet during the end of August (Table 4-8, Figure 4-4). The seasonal timing of various life history stages of rainbow trout and kokanee salmon in the reservoir are shown in comparison to the annual average drawdown of Lake Roosevelt in Figures 4-6 and 4-7.

This section of the Supplemental EIS evaluates the influence of the anticipated drawdown on: (1) exposure of shallow lakeshore (littoral) habitats; (2) access of adfluvial stocks of fish to tributary waters of the lake; (3) hatchery enhancement programs in the lake via changes in reservoir residence time and fish entrainment; and (4) aquatic habitats in the Spokane River/Chamokane Creek area of the lake.

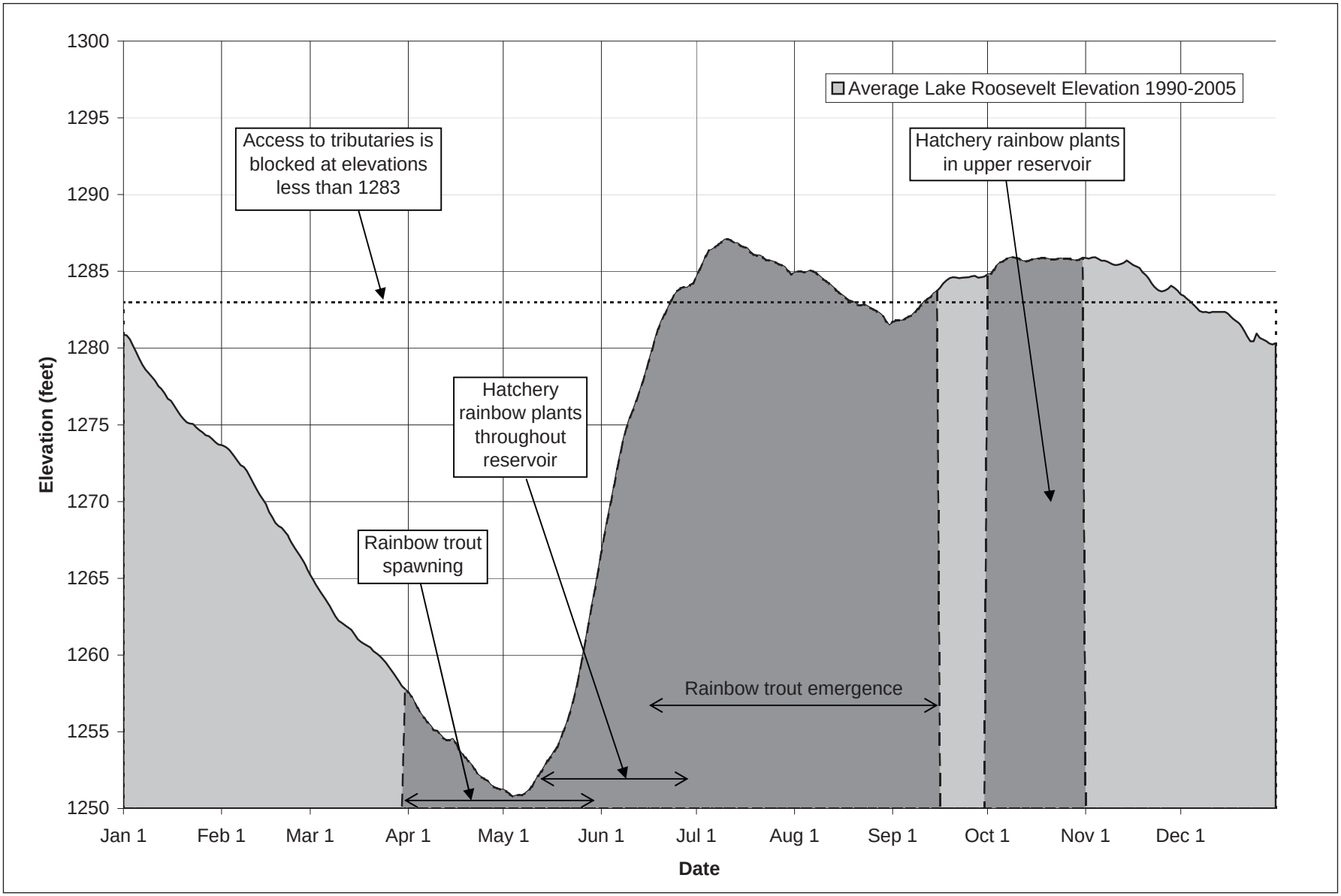

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Figure 4-6
Lake Roosevelt Water Elevations for Rainbow Trout

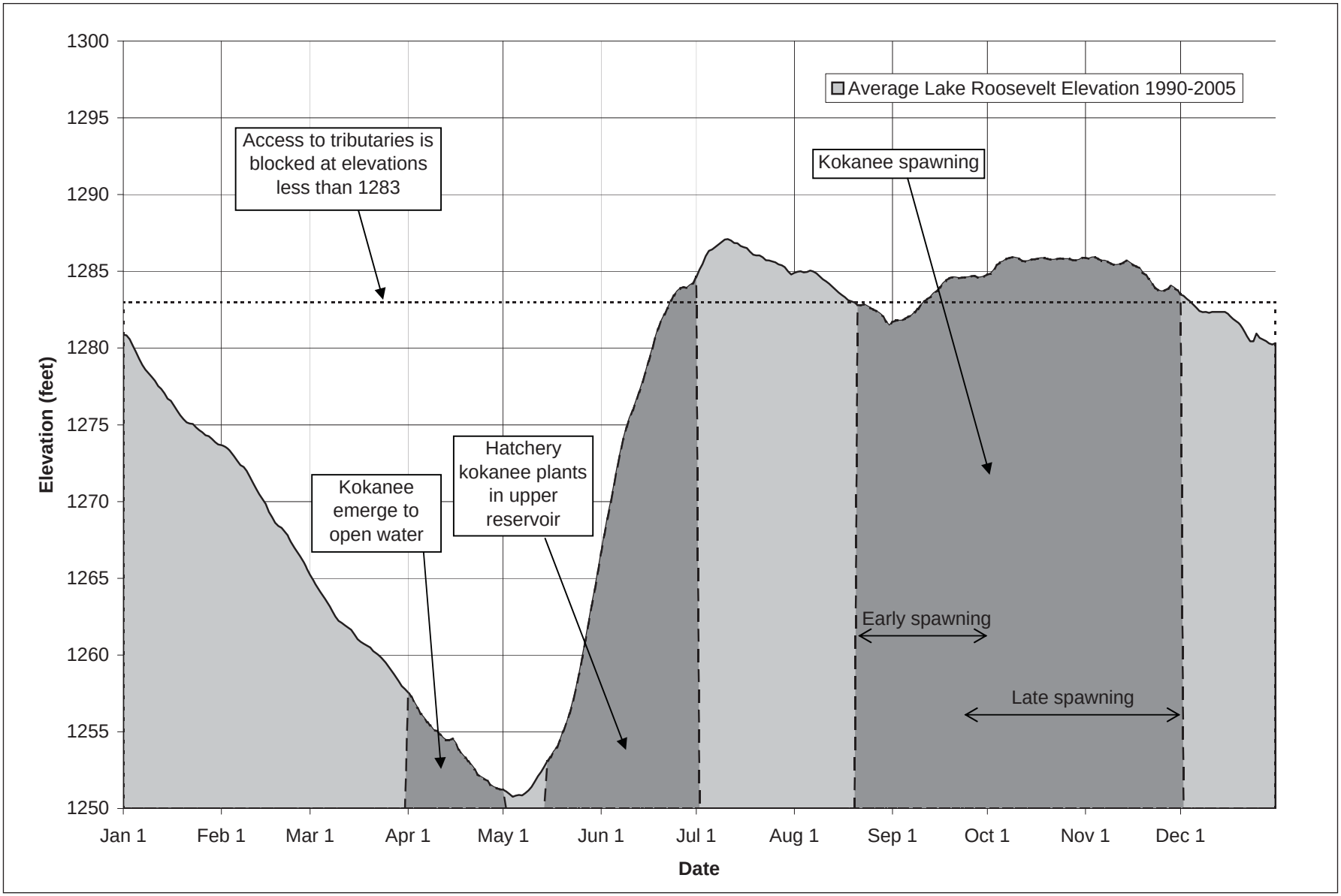

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Figure 4-7
Lake Roosevelt Water Elevations for Kokanee Salmon

Littoral Habitats

Lakeshore

As noted in Section 3.4.1.1, Lake Roosevelt water elevations during the late winter - spring drawdown period routinely vary between 25 and 80 feet and average 50 feet from full pool. The normal operating drawdown exposes a large area of lakebed along the shore, limiting vegetative growth and aquatic productivity in this zone (Stober et al., 1977; WDG, 1986; Sholtz et al., 1986; Voeller, 1993). The lack of stable littoral habitats in the lake has resulted in little macrophyte community growth and limited benthic macroinvertebrate assemblages (Voeller, 1993). Ultimately, the lack of aquatic productivity in littoral areas limits fish communities that rely on such habitats (Stober et al., 1977).

Kokanee Salmon

In their annual contract report to Ecology for the Columbia River Basin Water Management Program, WDFW suggested direct effects to kokanee salmon at the shoreline from the additional 1.0- to 1.8-foot drawdown would not be measurable in relation to the wide range of impacts from existing reservoir operations (WDFW, 2007). WDFW formed this conclusion because kokanee in Lake Roosevelt primarily utilize open water habitat. Indirect effects of the drawdown on kokanee salmon may occur with a loss of zooplankton and fish through entrainment. These effects are discussed in subsections below. Influences of reservoir operations on tributary access and hatchery programs for kokanee salmon are also addressed below.

RainbowTrout/White Sturgeon

Wild production of rainbow trout and white sturgeon is not dependent upon lakeshore spawning habitats that would be influenced by drawdown. Wild adfluvial populations of rainbow trout spawn in Lake Roosevelt tributaries, while white sturgeon use deep water portions of the riverine section of the upper reservoir for spawning generally upstream of the confluence of the Colville River. Additional drawdown would slightly increase the proportion of riverine habitats in the reservoir, but not likely to the extent of improving juvenile recruitment to the reservoir population. White sturgeon utilize benthic food sources and all life stages have been documented to use shallow water habitats at times. Thus, any change in benthic production in the reservoir could alter white sturgeon growth and rearing. The influences of reservoir operations on riverine spawning, tributary access, and hatchery programs for rainbow trout and white sturgeon are addressed below.

Embayments

Embayments throughout the reservoir provide the greatest surface area of shallow, warm water littoral habitats. These habitats support spawning and rearing of many spiny-ray game, non-game, and prey base species. The amount of surface area and seasonal frequency when the reservoir elevations fall between 10-foot increments of pool heights for 14 example embayments are shown in Table 4-9. The bathymetry of these selected embayments offers a sub-sample of the many similar embayments along the reservoir. The estimated potential amount of embayment surface area exposure under the worst-

case maximum monthly reservoir drawdown under Preferred Alternative 1C is shown in Table 4-9.

Table 4-9. Approximate Area Exposed in Select Shallow Water Embayments

Location		Area (acres)				
Region	Embayment	1280 – 1290[1]	1270 – 1280[1]	1260 – 1270[1]	1250 – 1260[1]	1240 – 1250[1]
Riverine	Kettle Falls River	1.8	5.7	8.2	15.6	48.1
	Colville River	4.2	3.4	3.7	5.9	6.1
	Marcus Flats	Contours to 1,275'		2.6	2.7	18.1
Transitional	Hall Creek Bay	1.5	0.8	0.8	0.8	1.4
	Nez Pierce Creek	1.9	1.6	1.0	1.0	1.0
	Wilmont Creek	3.1	3.9	1.8	1.8	2.7
	Nine Mile Bay	0.2	0.2	0.2	0.2	0.2
Impounded	Spokane River	1.4	1.4	1.5	1.7	3.0
	Hawk Creek Arm	3.6	2.7	2.2	1.7	2.6
	Swawilla Bay	5.3	5.7	5.2	6.9	7.1
	Welch Creek	0.2	0.2	0.2	0.2	0.5
	San Poil Arm	16.0	10.5	9.9	8.6	10.9
	Crescent Bay	0.4	0.4	0.4	0.4	0.4
	Porcupine Bay	1.5	1.9	1.7	1.5	1.4
Annual Duration (%)		60%	6%	10%	15%	8%
Season		Summer/ Winter	Winter/ Spring	Winter/ Spring	Winter/ Spring	Spring

[1]feet msl

The maximum drawdown of approximately 1 foot under Alternative 1A during non-drought years would occur at the end of August, a period when the reservoir level is typically between 1,280 and 1,290 feet msl. As a consequence, approximately 41 acres of shallow embayment habitat would be exposed with a 1-foot drawdown under average flow release conditions for the 13 embayments with bathymetric data at this elevation, or on average, approximately 3.2 acres per embayment.

The period of maximum exposure would be brief since refilling the reservoir commences within a week of maximum drawdown. The lakebed area exposed with the incremental flow releases is routinely exposed under normal lake level drawdowns. Thus, the existing habitat quality of this shallow littoral zone to support aquatic production is already severely compromised (see Drawdown section above). The effect of the additional drawdown associated with the incremental flow releases is incidental to the normal operation of Lake Roosevelt.

Access to Tributaries for Adfluvial Stocks (San Poil River Access)

The upper San Poil Arm near full pool consists of a large shallow flat. The longitudinal gradient of the channel where the river enters the embayment is approximately 0.2 percent slope (see Figure 6 in the Map Folio, most northern of the four San Poil Embayments figures). The shallowest portion of the Arm lies between elevation 1,280 and 1,285 feet msl. Operation of the lake under the reservoir rule curve strives to achieve a pool elevation of 1,283 feet msl during the fall months to provide sufficient water depth for the upstream migration of the local adfluvial stock of kokanee salmon. The release of fish-flows under normal operating conditions during July and August currently draws the reservoir down to near 1,280 feet msl in late August. Achieving an elevation of 1,283 feet msl upon refilling the lake in September generally occurs early in September under average reservoir conditions (Figures 4-1 to 4-5). However, this timeframe naturally varies between the first week and the last week of September depending upon hydrological conditions of the water year as shown in Table 4-10.

Table 4-10. Time to Refill the Reservoir to Elevation 1,283 feet msl in Fall with and without the Incremental Storage Releases Project

Water Year Condition	*Approximate Time to Elevation 1,283 feet msl*	*Change in Time to Elevation 1,283 feet msl with Releases*
Average	1st Week September	2 days
Dry	3rd Week September	1 day
Drought	4th Week September	0 days

The change in time to reach the desired lake elevation under the incremental flow releases would be minor. The anticipated worst-case delay of two days would represent less than 10 percent of the normal range in annual variation to achieve the target lake elevation. The influence of a one- to two-day delay on the upstream migration and spawning success of adult kokanee salmon would also be minimal. River entry of the fish is influenced not only by lake elevation, but by river water temperature, river flow and occurrence of a rainfall event in the San Poil subbasin to initiate migratory behavior in the fish. In addition, the influence on the spawning population is a factor of the proportion of fish in the population returning for entry into the river during the early part of September. River entry for the spawning migration of kokanee can occur anytime between late August and mid-November (LeCaire, 1999; McLellen and Sholz, 2003). As a worst-case assumption for this assessment, lack of achieving pool elevation of 1,283 feet msl is regarded as a complete barrier to upstream movement. As a worst-case

assumption for this assessment, lack of achieving pool elevation of 1,283 feet msl is regarded as a complete barrier to upstream movement.

An extra expenditure of energy for fish waiting to spawn is a general concern for all fisheries and especially for one defined as a critically low population like the wild San Poil kokanee salmon (LeCaire, 1999). Nevertheless, a one- to two-day delay in early September is normal for fish staging in the San Poil Arm waiting for river entry. It is unlikely the time to refill Lake Roosevelt under the proposed incremental flow releases would have a significant adverse effect on the spawning success of adfluvial kokanee salmon returning to spawn in the San Poil River.

Artificial Propagation (Kokanee, Rainbow Trout, White Sturgeon)

The influence of the drawdown on existing hatchery programs and recreational fisheries in the lake would be related to (1) the changes in standing stock of prey items (e.g., zooplankton biomass) as measured by differences in reservoir residence time in days; and (2) potential changes in entrainment of released hatchery fish past Grand Coulee dam. Both of these relationships are addressed for the various hatchery fish released in the reservoir in the subsequent paragraphs.

Reservoir Residence Time

As water particle residence time increases, primary productivity levels and zooplankton populations have an opportunity to expand. Correspondingly, Underwood and Shields (1996) showed zooplankton density generally decreased as water retention time decreased below 30 days. Zooplankton are the primary food source for kokanee, rainbow trout, suckers, whitefish, and fry life history stages of all species (Cichosz et al., 1999). Thus, it is possible that withdrawals that reduce water retention time can result in reduced food availability for fish and the overall fish carrying capacity of the lake. However, most researchers have noted the existing zooplankton biomass is not limiting fish production (Beckman et al., 1985; Sholtz et al., 1986; Peone et al., 1990; Voeller, 1993; Baldwin and Polacek, 2002).

A slight reduction in planktonic biomass of less than 1 to 2 percent during non-drought and drought conditions, respectively, as a result of reduced reservoir residence times is anticipated under the various flow release alternatives (Table 4-11). The minimal reduction should not adversely influence the capacity of the lake to support growth or rearing of either kokanee salmon or rainbow trout. Similarly, since white sturgeon primarily feed on benthic food sources, growth and rearing should not be negatively influenced by a slight change in reservoir residence time.

Table 4-11. Estimated Change in Reservoir Retention Time (days) Compared to Current Conditions

Alternative				*Water Particle Retention Time*		
Maximum Monthly Outflow				*Baseline*	*With Proposal*	*Difference*
Alternative	*Outflow (cfs)*	*Month*	*Drawdown (feet)*	*Days*	*Days*	*Days (%)*
Example at 1,280 feet msl - **Average Year** - 1-foot elevation change						
1A	428	August	1,279	46.0	45.8	0.2 (0.4%)
1B(a)	183	August	1,279	46.0	45.9	0.1
1C(a)	0-855	August	1,279	46.0	45.6-46.0	0-0.4 (0-0.8%)
Example at 1,280 feet msl - **Dry Year** - 1-foot elevation change						
1B(b)	234	June	1,279	41.4	41.3	0.1 (0.2%)
1C(b)	0-844	June	1,279	41.4	41.1-41.4	0-0.3 (0-0.7%)
1C(c)	271	July	1,279	83	82	1.2 (1.5%)
Example at 1,280 feet msl - **Drought Year** - 2-foot elevation change						
1D	441	June	1,278	64.7	64.3	0.4 (0.6%)
1E	0-945	July	1,278	100.3	98.5-100.3	0-1.7 (0-1.7%)

Fish Entrainment

Kokanee Salmon/Rainbow Trout

A strong relationship exists between the volume of reservoir drawdown and the entrainment of fish in water passing Grand Coulee Dam for both kokanee and rainbow trout (see Section 3.7.1). For this assessment, it is assumed fish lost to the lake via entrainment are a detriment to the artificial propagation programs designed to increase recreational fisheries in Lake Roosevelt. It is conceivable that entrained hatchery fish contribute to fisheries downstream in the mainstem Columbia River reservoirs of Lake Rufus Woods and Lake Pateros; the reservoirs of Rock Island, Rocky Reach, Wanapum, and Priest Rapids dams; and the Hanford Reach.

The highest potential monthly outflow for all of the flow release alternatives remains less than 2 percent of the normal outflow at Grand Coulee Dam (Table 4-12). This small increase in outflow volume would have a very minor influence on the current level of fish entrainment past the dam.

Hatchery management programs responded to reports of increased entrainment associated with steep levels of reservoir drawdown by focusing release strategies on larger (post-smolt) size fish, and releasing fish later in late-May and early June when the reservoir begins its refilling phase. Additional emphasis on the use of local sources for broodstock to overcome a prevalence for juveniles to move downstream in the spring (simulated outmigration patterns) has the potential to improve the retention of hatchery-released fish in the lake for increased return to the fishery.

Table 4-12. Maximum Monthly Outflow under Various Flow Release Alternatives Compared to Existing Conditions

Alternative	*Maximum Monthly Outflow (CFS)[1/]*	*Peak Month*	*Existing mean monthly discharge at GCD (CFS)[2/]*	*Increase in outflow (%)*
Average Year				
1A	428	August	110,400	0.39
1B(a)	183	August	110,400	0.17
1C(a)	0-855	August	110,400	0-0.77
Dry Year				
1B(b)	234	June	122,400	0.19
1C(b)	0-884	June	122,400	0-0.72
Drought Year				
1D	441	June	78,400	0.56
1E	0-945	July	50,600	0-1.87

[1]Flow volumes include both withdrawals and flow releases past Grand Coulee Dam.

[2] Source: USGS Gauge# 12436500 Columbia River at Grand Coulee, Washington.

White Sturgeon

White sturgeon annually released into the lake during the month of May would not be adversely influenced by entrainment under the flow releases project. Preferred habitats of white sturgeon occur in the riverine portion of the reservoir, upstream of the confluence of the Colville River. With the use of radio telemetry, sturgeon have been tracked downstream to near the confluence of the Spokane Arm. Nevertheless, these fish are not

known to be subject to entrainment differences with changes in drawdown patterns (LeCaire, 1999; Simmons et al., 2002).

Summary of Effects on Lake Roosevelt Hatchery Programs and Recreational Fisheries

A review of the factors related to reservoir drawdown with a potential to influence artificial production programs in the lake indicates the flow release alternative scenarios would not materially change the existing lake conditions or influence the hatchery production programs. It is unlikely that anglers would be able to detect a difference related to slight changes in populations of game fish resulting from alterations in lake residence time or entrainment.

Spokane River/Chamokane Creek

Drawdown of Lake Roosevelt under any of the flow release alternatives is not anticipated to measurably influence ground water levels in the Spokane basin (Section 4.1.1.4). As a consequence, surface water conditions in the Spokane River subbasin and in Chamokane Creek upstream of full pool reservoir elevation 1,290 feet msl will not be modified. Corresponding changes to aquatic habitats or species are not anticipated under any of the alternatives.

Mitigation

Releases of fish flows to benefit off-site fisheries, described in the Programmatic EIS (Ecology, 2007), are designed to offset the minor effects that may occur to Lake Roosevelt fisheries. Per the recommendation of WDFW, a slight reduction in zooplankton with reduced reservoir residence time and an increase in fish entrainment due to the additional drawdown associated with the incremental flow releases may be mitigated with changes to the current artificial production supplementation program (WDFW, 2007).

4.2.1.7 Wildlife and Plants

Changes to emergent and riparian vegetation, nesting waterfowl and breeding amphibians are the potential impacts associated with the additional drawdown of Lake Roosevelt. The magnitude and extent of these impacts is dependent on the time of year, the number of days the reservoir is drawn down, and the extent of area exposed. Impacts to federal and state-listed plant and wildlife species were previously discussed in the Programmatic EIS (Ecology, 2007).

Short-term impacts

No short-term impacts to wildlife habitats or plants are anticipated from the Proposal for the drawdown of Lake Roosevelt because no new infrastructure is required to implement the flow releases.

Long-term/operational impacts

Vegetation

The distribution and abundance of emergent and riparian vegetation along the Lake Roosevelt shoreline would not measurably change as a result of the Proposal. As discussed in the Programmatic EIS and in Section 3.8.1, the normal operating drawdown of Lake Roosevelt currently negatively affects littoral habitats and vegetation. Due to

reservoir fluctuations, there is limited production of emergent and aquatic bed vegetation near the shoreline (Voeller, 1993). Under the Proposal, the additional drawdown of 1 foot during non-drought years is within the normal operation levels of the reservoir. The maximum additional drawdown would occur when the lake level is currently between 1,280 and 1,290 feet msl (at the end of August). The vegetation communities below this level would have developed under the fluctuating conditions and have been previously exposed as a result of normal reservoir operations.

Changes to littoral habitats within 14 example embayments along the impounded, transitional and riverine sections of the reservoir are shown in Table 4-10. Within these selected embayments, between 35 and 45 acres of littoral zone habitat would be exposed after the additional 1-foot drawdown. These areas would have also been previously exposed during normal reservoir operations earlier in the summer, prohibiting the growth of emergent and aquatic bed vegetation as well as stranding aquatic nuisance species (i.e., Eurasian watermilfoil). In addition, the period of maximum exposure would be less than a week, as normal operations include refilling the reservoir beginning in early September to meet target lake levels for kokanee salmon. Thus, the additional drawdown will not have a measurable effect on vegetation distribution and abundance within the selected embayments. The one week of additional exposure is not likely to result in a significant increase in aquatic nuisance weed species. Thus, the extent of vegetation in these areas will likely continue in a similar manner as it is currently.

The additional 0.5 feet of drawdown under drought conditions would not have a discernable effect on the establishment of aquatic plants and riparian vegetation. The additional drawdown during drought years would result in a slight increase in the distribution and abundance of aquatic nuisance weeds such as Eurasian watermilfoil in shallow water areas or embayments. However, this increase is considered to be minimal because the period of maximum exposure would be less than one week and non-drought years do not occur every year. The low frequency of both drought events and days of exposure attributable to the storage releases of the Proposal are not anticipated to create a significant increase in the growth of Eurasian watermilfoil.

Nesting Waterfowl and Breeding Amphibians

As discussed in the Programmatic EIS and in Section 3.8.1, the lack of stable littoral habitats along the shoreline of Lake Roosevelt prevents the formation of extensive emergent and riparian vegetation suitable for wildlife breeding and roosting. Nesting waterfowl and breeding amphibians that do find suitable habitat are currently impacted by the rapid drawdown in spring, resulting in losses each year. The additional drawdown of the lake is not anticipated to increase the current level of impact substantially, but will expose slightly more surface area in shallow waters (Table 4-10). Between 35 and 45 acres of shallow embayment habitat within the 13 selected embayments would be exposed under the additional drawdown. However, the worst-case scenario under drought conditions would occur at the end of August and after the height of the spring breeding season for many amphibians and waterfowl.

In summary, given the large volume of water held by the lake and the extreme fluctuation of water levels under normal operating conditions, the additional changes that would occur to wildlife as a result of the additional drawdown under both non-drought and drought conditions are generally within the range of fluctuations that currently exist.

Mitigation

No mitigation is proposed for impacts to wildlife and plants.

4.2.1.8 Cultural Resources

Short-term impacts

No new short-term impacts to cultural resources are anticipated as a result of the Proposal as there is no construction associated with this alternative.

Long-term/operational impacts

Potential impacts to cultural resources were described in Section 5.1.1.9 of the Programmatic EIS. No new long-term/operational impacts to cultural resources are anticipated as a result of incremental storage releases. Under the various alternatives, additional drawdowns will occur at different times of the year than under current operations. However, under all alternatives, the drawdowns during peak recreation season are anticipated to be small and within normal operational range. The NPS has identified sites on its managed lands that would be exposed by the Proposal during the peak recreation season.

Mitigation

The State of Washington has entered into Water Resource Management Agreements with the CCT and the STI to mitigate effects of the storage releases including effects to cultural resources (Washington State and CCT, 2007; Washington State and STI, 2008). These agreements provide for full mitigation of potential effects to cultural resources within each tribe's Lake Roosevelt management area therefore no additional mitigation measures are proposed. Ecology will coordinate with NPS to develop appropriate mitigation for potential impacts to cultural resources on NPS managed lands.

4.2.1.9 Environmental Health

Short-term impacts

As described in the Programmatic EIS, drawdowns from Lake Roosevelt occur on a daily and seasonal basis, and no construction or short-term activities would be necessary to accomplish the additional drawdowns for this project.

Long-term/operational impacts

Alternative 1A

Alternative 1A proposes releases during July and August only and a maximum drawdown of 1 foot. While the additional drawdown of 1 foot is within the normal operation levels of the reservoir, some increased environmental health risks might be present due to the timing of drawdown during summer months when recreational lake use increases.

Contaminated Sediments

Drawdowns at Lake Roosevelt increase the potential for contaminated sediment exposure. Lower lake levels during summer months could leave contaminated sediments exposed and prone to drying. Concern has been raised that dry sediments could then become airborne, carrying toxic metals and organic compounds (Office of Governor Christine Gregoire, 2005). Increased recreational use of Lake Roosevelt during summer months could therefore increase chances of the public coming into contact with exposed or wind-blown contaminated sediments. Exposure and movement of contaminated sediments and pore-water chemistry could also increase fisheries contact with contamination, providing another exposure pathway to the public, especially anglers. The area of sediment that will be exposed by the incremental storage releases is within the area exposed by current operations; however, the drawdown would occur at a period when recreation use of the lake is highest.

Teck Cominco and the EPA are currently conducting a Remedial Investigation and Feasibility Study (RI/FS), which will include human health and environmental risk assessments of contaminated sediments in Lake Roosevelt. Results of the RI/FS will not be available for this Supplemental EIS, but will be considered by Ecology upon completion.

Swimming and Boating Hazards

Lower lake levels during summer months at periods of high recreational use may result in increased swimming and boating hazards. Elevation increases of docks above the water surface present falling hazards for both boaters and swimmers. Lower lake levels may also present diving hazards in shallow areas and draw swimmers away from designated swimming areas in search of more ideal swimming conditions. Drawdowns also increase the risk of boaters coming into contact with bottom hazards and shallow waters, presenting navigational hazards.

Sanitation

Minimal decreases in lake elevation that do not affect recreational use of campgrounds and swimming areas could lead to an increase in total beach area, therefore increasing the amount of area susceptible to improper sanitation practices (e.g., human waste deposition). However, additional human waste deposition would not necessarily be expected with increased beach area as the number of recreational users is not expected to increase significantly.

As described in the Programmatic EIS, Grand Coulee Dam currently regulates Lake Roosevelt water levels between 1,208 feet msl and 1,290 feet msl, with lake levels varying throughout the year. Fluctuations in water levels (e.g., reservoir drawdowns) have been noted as an effective method of control for mosquito populations (Snow, 1956 and Hess and Kiker, 1943 in Reclamation, 2004). Drawdowns during summer months will help control mosquito populations at Lake Roosevelt by limiting mosquito habitat near vegetated shores.

Other Alternatives

The impact of Alternatives 1B and 1C are generally similar to Alternative 1A. Exposure of slightly more surface area in shallow waters at the end of August could mean more risk of exposure to contaminated sediments and an increase in swimming and boating hazards; however, the slight increase in the current level of impact is not considered to be significant. The drought year alternatives 1D and 1E would increase the maximum drawdown to 1.8 feet and slightly increase the risk of exposure to contaminated sediments and swimming and boating hazards. These impacts are not expected to be significant.

Mitigation

Contaminated Sediments

Teck Cominco and the EPA are conducting a human health and ecological RI/FS to determine future hazardous substances remediation and mitigation needs. That process has just begun, and the results of that body of study will not be available for this Supplemental EIS. These documents are expected to guide mitigation of impacts from contaminated sediments upon their approval by EPA. If it is determined that the Proposal negatively impacts the environment by re-entraining pollutants into the air or water, the State will establish a working group with the CCT to develop mitigation measures and pursue funding for those measures (Washington State and the CCT, 2007).

Swimming and Boating Hazards

The State of Washington has signed Water Resource Management Agreements with the CCT and STI to mitigate potential effects of the drawdown. The state will finance improved lake access facilities. These improvements are expected to include extending boat ramps, modifying boat docks and swimming areas, and other retrofitting of facilities to accommodate lower lake levels.

Sanitation

The NPS is developing a Shoreline Management Plan that will address sanitation issues along Lake Roosevelt. The NPS is also increasing educational outreach and has printed brochures for distribution concerning sanitation requirements. Further outreach efforts and additional sanitary services are being considered.

Mosquitoes

Drawdowns occurring in late summer would likely reduce mosquito breeding habitat; therefore, no mitigation is proposed.

4.2.1.10 Recreation and Scenic Resources

Short-term impacts

As described in the Programmatic EIS, storage releases from Lake Roosevelt occur on a daily and seasonal basis, and no construction or short-term activities would be necessary to accomplish the additional storage releases for the Proposal.

Long-term/operational impacts

An engineering analysis to assess the impacts of the alternative release scenarios on NPS recreational facilities was completed following the issuance of the Draft Supplemental EIS. The results of this analysis are incorporated into the discussion below (KPFF, 2008; Appendix G, *Lake Roosevelt Shoreline Management Waterfront Facilities Drawdown Impact Study*).

Drawdown

The drawdown was evaluated according to magnitude, seasonal timing, and duration under the various operational scenarios to assess the potential impacts to recreation facilities. Impacts can occur if the Proposal were to affect the predictability of lake levels and facility availability, require retrofitting or additional maintenance of facilities, or result in the loss of recreational use.

The primary facilities that could be affected by additional drawdowns on the lake would be boat ramps, mooring docks, swimming beaches, and camping areas. Fluctuation in pool elevations is a normal aspect of reservoir operations, and facilities have been designed and operated to accommodate these fluctuations. While the proposed drawdowns would not produce lake levels outside the range of historical seasonal fluctuations, the project likely would cause the lake's surface to fall to levels that interfere with shore facilities earlier in the summer than currently occurs, and, for some years, expand the number of days in which some water-related recreational activities are restricted. These changes could result in changes in operation costs and temporary closures at some facilities.

The maximum drawdown of approximately 1 foot under non-drought conditions in Alternatives 1A, 1B, and 1C (96 percent of the time) and 1.8 feet under drought conditions in Alternatives 1D and 1E (4 percent of the time) is anticipated to occur annually with the greatest potential for impacts for a few days or weeks at the end of August.

Boat Ramps and Moorage Facilities

Comments received on the Draft Programmatic EIS suggested that even small lowering of lake level during the month of August could result in impacts to water-dependent facilities. At lower lake levels, some boat ramps and mooring docks that are currently operable in August may be limited by water depth, boat draft, and siltation. While most facilities are designed to accommodate the wide fluctuations that already occur, some facilities would need to be retrofitted, relocated, or temporarily closed. The NPS extended many boat ramps after the year 2000 to be operable during lower lake levels and further opportunities to extend launch ramps lower are limited (Dashiell pers. comm., 2008).

Of the four marinas on the lake, three have boat ramps that are accessible at low lake levels. The only marina that does not have low-level access is also the only marina on the Spokane Arm of the lake. This suggests potentially greater vulnerability of the Spokane Arm region of the lake than the main body of the lake to boat access impacts. NPS boat ramps that are not currently designed to function at lower lake elevations

(below 1,280 feet) and the expected impact to these facilities under the release alternatives are shown in Table 4-13.

Table 4-13. NPS Boat Launches with Minimum Boat Launch Operating Elevations of 1,280 Feet msl or Lower

Facility	Minimum Launch Elevation	Impacts
Hawks Creek, Lincoln Co.	1,281	No new impact
Marcus Island, Stevens Co.	1,281	No new impact
Evans, Stevens Co.	1,280	Slight impact in average or wet year only
North Gorge, Stevens Co.	1,280	Slight impact in average or wet year only
Napoleon Bridge, Ferry Co.	1,280	Slight impact in average or wet year only
China Bend, Stevens Co.	1,280	Slight impact in average or wet year only
Kettle Falls	-	No new impact to swim area
Kamloops	-	No new impact. Courtesy dock on dry land above 1,280 feet
Kettle River	-	No new impact. Courtesy dock on dry land above 1,280 feet

Source: KPFF, 2008

In average years (Preferred Alternative 1Ca and Alternatives 1A and 1Ba), the additional flow releases would lower the lake level to approximately 1,279 feet at the end of August (1 foot lower that current lake elevations at this time of the year during average or wet years). This drawdown elevation remains within the current normal range of summer elevations during dry or drought years. Although the influence of the additional 1-foot drawdown at the end of August is expected to be minor relative to existing reservoir operational impacts on recreational facilities, certain boat ramps and moorage facilities that are currently not affected during average or wet years could be affected. Hawks Creek and Marcus Island boat ramps currently experience lake level drops below their recommended launch elevation each year during the summer season. Because they are already not recommended for use at that time of year, the additional drawdown is not expected to affect those facilities. Evans, North Gorge, China Bend, and Napoleon Bridge boat ramps experience lake elevations below minimum launch elevations at the end of August during dry and drought years. The boat ramps are not typically closed at the listed elevations. Site inspections revealed that all but very large boats and trailers could

continue to use the ramps with the new drawdown elevation of 1,279 feet (KPFF, 2008). In dry years (Preferred Alternative 1Cb and Alternative 1Bb), the additional storage releases would lower the lake level to approximately 1,277 feet at the end of August (1.1 foot less than the current operating elevation at the same time of the year in dry years). Impacts would be similar to those described below for drought years.

Under drought conditions , the additional flow releases would lower the lake level to approximately 1,276 feet at the end of August under Preferred Alternative 1E and the end of September under Alternative 1D(1.8 feet lower that current lake elevations at this time of the year during a drought year). This would occur approximately 4 percent of the time. The primary impact would be less usable dock area for courtesy docks (floating dock sections next to boat ramps). In addition to the boat ramps impacted during an average or wet year, one additional ramp, Snag Cove, would be impacted under the Preferred Alternative 1E and Alternative 1D. The Snag Cove boat launch is listed as having a recommended minimum lake elevation of 1,277 feet. The proposed drought drawdown elevation is 9.5 inches lower than this recommended elevation. The recommended minimum lake boat launch elevations are typically conservative and are expected to impact only very large boats. It is estimated that few, if any people, will be unable to launch at this ramp during the proposed drought year drawdown (KPFF, 2008).

Of the three regions on the lake (Kettle Falls, Fort Spokane, and Spring Canyon), each region has at least two boat ramps that will be operable at a level down to 1,275 feet during drought conditions. It is expected that some slip areas would not be operable within the Seven-Bays Marina. The marina would remain accessible, but boat moorage would decrease if docks could not be retrofitted to allow for temporary relocation.

Based on boat ramp use data from the most recent drought year (2001), if ramps become inoperable, use is expected to shift to other boat ramps, as currently occurs when lake levels reach this elevation. While the additional use at the operable boat ramps could cause increased congestion and a decrease in the overall quality of the recreation experience, evidence suggests that overall boat ramp visitation would not decline during July and August. Thus, the increase in the current level of impact on boat ramps is not considered to be significant. See Section 4.1.1.11, Socioeconomics, for additional information. If lower lake levels were to impact the availability of moorage slips, significant adverse effects to boating could occur. This would be most likely to occur under drought conditions (Preferred Alternative 1E and Alternative 1D).

Swimming and Boating

At lower water levels, some developed swimming areas that are currently operable in August may be affected by the additional drawdown. The main impact would be less surface area and depth of water in enclosed swimming areas. This would be more likely to occur under drought conditions (Preferred Alternative 1E and Alternative 1D). At lower lake levels, sandy beach areas may be far from the water's edge with unattractive and unappealing mud flats being exposed. This would discourage swimming and other beach activities. Swimming floats could be beached or water levels could become too shallow for use. Depending on the extent of exposure, changes may have adverse effects and lead to decreased visitor use at those recreation areas. Preliminary information

indicates the drawdown may cause the swimming hole at AA Campground to become inoperable at the end of August.

Lower lake levels during summer months at periods of high recreational use may also result in increased swimming hazards. Lower lake levels may present diving hazards in shallow areas and draw swimmers away from designated swimming areas in search of better swimming conditions.

Channels used to navigate from the water access sites could be affected if water levels are too low to allow the safe passage of watercraft. Boats with greater draft requirements, such as sailboats, would be particularly affected by shallower channel depths. Navigation hazards and shallow waters require boaters to take detours around inaccessible areas. Additionally, as reservoir elevations lower and surface area decreases, congestion may become more noticeable in popular areas that receive high-use or where narrow channel corridors exist.

Camping

Lower lake levels under the additional drawdown may also reduce the attractiveness of certain campgrounds and cause recreational users to recreate in more remote locations or go elsewhere. This would be more likely to occur under drought conditions (Alternatives 1D and 1E). Because of their remote locations, management of dispersed camping areas is an ongoing challenge and an increase in dispersed camping would add to the management burden. Lower lake levels could also make patrol of dispersed camping areas by boat more difficult. The NPS is developing a plan to assess damage and manage dispersed sites along the shoreline.

Scenic Resources

Lower lake levels would create a change in the viewscape, as more of the shoreline would be exposed. This would be most noticeable for a few days under drought conditions (Preferred Alternative 1E and Alternative 1D). Once the drawdown is over, lake levels would increase. The proposed drawdown would have no long-term adverse impacts to scenic resources in the area.

Mitigation

In addition to the mitigation described in the Programmatic EIS, the state of Washington and the Spokane and Colville tribes have signed agreements to mitigate effects of the drawdown by providing financial compensation for impacts on the tribes.

The Washington State Department of Ecology provided funding to the NPS to conduct an engineering analysis to assess the impacts of the alternative release scenarios on their recreational facilities. The results of this analysis were incorporated into the Final SEIS and are included in the *Lake Roosevelt Shoreline Management Waterfront Facilities Drawdown Impact Study* (KPFF, 2008; Appendix G).

The *Lake Roosevelt Shoreline Management Waterfront Facilities Drawdown Impact Study* (2008) recommends specific retrofit measures to address drought year impacts on NPS boat launch and swimming facilities. Mitigation measures for courtesy docks typically involve adding an additional dock section to the end of the existing dock system to maintain the same useable length of dock for the end of August water levels. Shifting

docks to slightly deeper water where possible is recommended for maintaining usability at marina docks during August. Mitigation measures for swimming beaches typically involve lengthening log boom systems and extending the booms into deeper water. Recommended mitigation measures for specific facilities are included in Appendix G.

In addition, Ecology is funding a portion of the NPS shoreline management program to more specifically assess the impacts of the alternative release scenarios on NPS facilities and to address needed management actions for current and future conditions. The results of these studies will be incorporated into an adaptive management plan. The adaptive management plan will prioritize and implement specific mitigation measures recommended in the studies to address the impacts.

4.2.1.11 Socioeconomics

The following information suggests that the Proposal will not have socioeconomic impacts on the local economy different from those arising from the current management of Lake Roosevelt. Instead, additional drawdowns resulting from the Proposal likely would add incrementally to the existing impacts. There may be new impacts at other areas.

Short-term impacts

There would be no short-term impacts to socioeconomics because no construction is required to implement the incremental flow releases project.

Long-term/operational impacts

Research suggests that reservoirs have more recreational use value at high levels than at low levels. A study conducted in 2005 of Lake McConaughy in Nebraska found that, recreationists were willing to pay $14.43 per visitor-day of recreation at the lake, but would be willing to pay an additional $1.42 per visitor-day if the reservoir were maintained at a slightly higher level. When the reservoir is at 20 percent of capacity, adding 100,000 acre-feet would increase total recreation value by $1.4 million per year (Supalla, 2005). Lower water levels in reservoirs correlate with fewer visits by anglers and other recreationists. With low water levels in 2000, in southwestern Nebraska's Swanson and Enders Reservoirs, for example, visitation dropped by 12 to 14 percent and expenditures by anglers, many of whom come from Colorado, dropped by more than $150,000 (Nebraska Game and Parks).

Data from other reservoirs indicate that property adjacent to reservoirs, all else being equal, is more valuable than property that is not, and property values are greater at high lake levels than low levels. Knetsch (1964) found that reservoir-front property demanded a premium in the Tennessee River Valley. A study of level fluctuations in six Alabama reservoirs revealed changes in the value of nearby residential property, expenditures on reservoir-related recreation, and reservoir-related non-use values (Hanson et al., 2002). They found that a permanent 1-foot reduction in summer reservoir levels reduced the value of lakefront property 4 to 15 percent and recreational expenditures 4 to 30 percent. Respondents to a survey who indicated they currently do not use the reservoirs nonetheless indicated a willingness to pay $47 per household, on average, to maintain the status quo.

Similarly, research on Lake Travis, a reservoir in Texas, found a premium of $79,000 to $102,000 (1990 dollars) for reservoir-front property. Houses within 2,000 feet of the reservoir reflected significant premiums while this premium faded at 4,000 feet. Recreation and amenity values dropped even more rapidly at 150 feet from the reservoir (Lansford and Jones 1995). Numerous additional studies use travel costs and real estate premiums to estimate the value of lakes and reservoirs at "full" water levels (e.g., Cordell and Bergstrom, 1993; Burt and Brewer, 1971; Cameron et al., 1996).

The impacts of the Proposal on recreational facilities are discussed in Section 4.2.1.10. The analysis indicates that for some alternatives, decreased lake levels at the end of August could temporarily make some boat ramps inoperable. Restrictions on boating activities might lower the value recreationists derive from Lake Roosevelt, the economic activity derived from recreationists' expenditures, or both. However, any restrictions on boating-related recreation resulting from the Proposal would not be unlike those that would occur without it. Past experience indicates that, if the Proposal were to cause a boat ramp or other facility to become inoperable, recreationists would have access to substitute facilities and, thus, still have the ability to avail themselves of the lake's recreational opportunities, although the substitutes might be less convenient or more costly.

As the lake fills from April through July, a broad range of lake levels occurs. In 2007, lake level ranged from 1,257 to 1,287 feet msl during this time. During 2001, a drought year, the lake levels ranged from 1,219 to 1,282 feet msl during this period. Recreational users of the lake are therefore accustomed to changing accessibility of boat ramps as the lake level vary

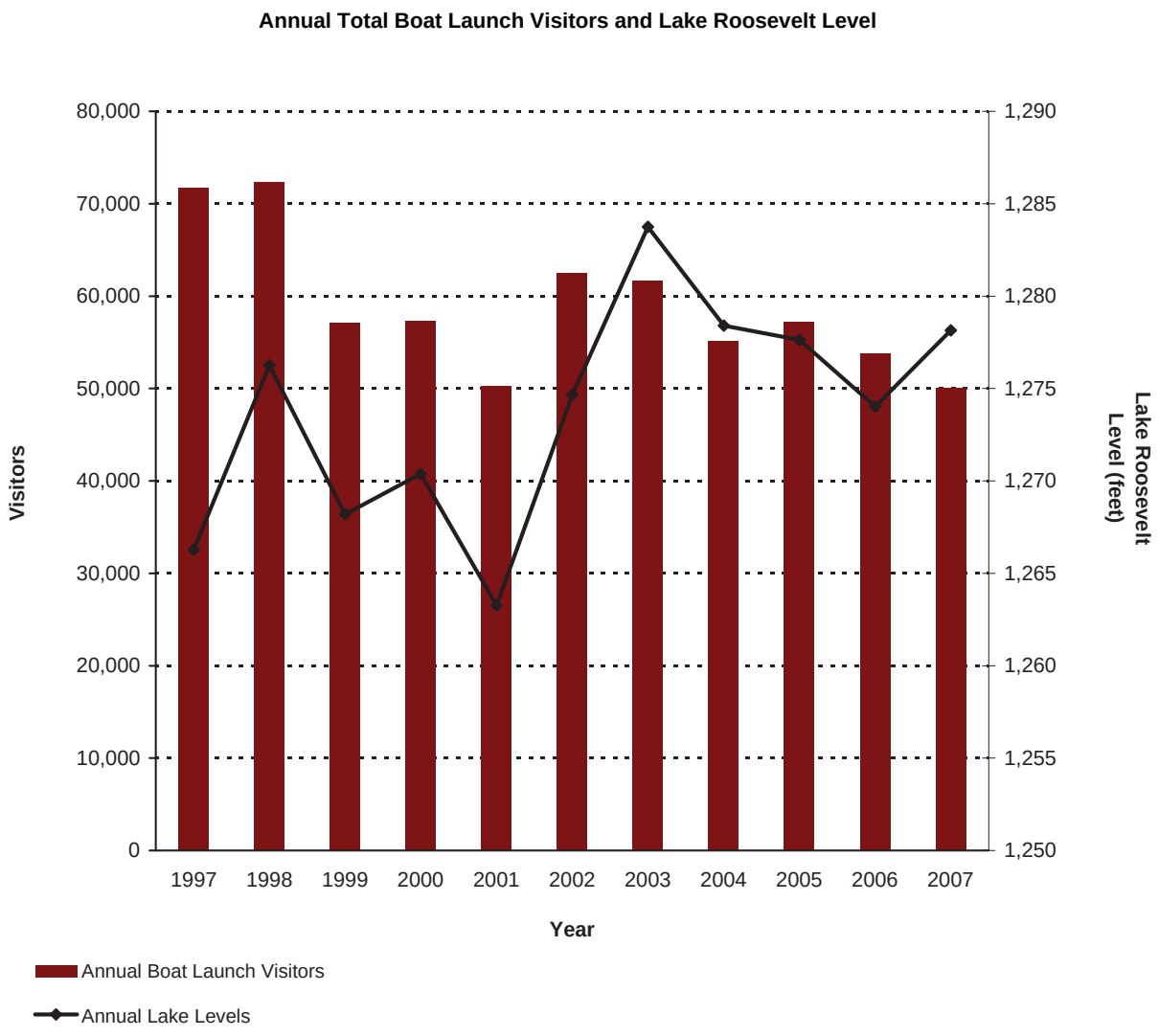
Figure 4-8 shows that, over the past 10 years, average lake levels and annual total boat launch visitors have both fluctuated. The average lake level fluctuated from 1,264 to 1,284 feet msl. Annual visitation fluctuated from roughly 50,000 to more than 70,000. While the data show some tendency for lake levels and visitor numbers to correlate positively, the relationship is not sufficient to conclude that changes in average lake level necessarily would be accompanied by corresponding changes in visitation. Further research might, however, reveal a tighter relationship between the two variables, controlling for the influence of other factors.

Figure 4-9 shows that monthly fluctuations in lake level and visitors to boat launches also do not demonstrate a strong correlation. July and August have the most visitors, substantially more than in other months that experience similar lake levels. The number of visitors to boat launches was low in April and May of 2001 and 2007, although the lower levels in 2001 also correspond to lower visitor numbers than 2007. Figure 4-6 shows that these patterns hold for 2001 as well, a drought year. Lake levels during July and August were 5 feet and 2 feet lower respectively during 2001 than 2007. The 2001 lake level was substantially lower than the maximum drawdown expected with the Proposal. However, there were more total visitors to boat launches in 2001 than 2007. Evidence does not suggest that the drawdowns will uniformly decrease boat launch visitation.

While lower lake levels during the summer of 2001 did not correspond to fewer total visitors than higher levels in 2007 (Figure 4-9), fewer visitors in 2001 used the ramps that

require high lake levels for access (Figure 4-10). These data suggest that total visits do not decrease with the differences of a few feet, but that visitors relocate to boat ramps that are operable. A 5-foot drop in lake level in 2007 from July to August also corresponded to an increase in visitor days for these ramps with the highest minimum launch levels.

While literature suggests that the quality of the recreational experience might be reduced with lower lake levels, there is no evidence that decreases in lake level at the scale of the drawdowns associated with the Proposal would reduce the overall number of visitors for boating purposes. Instead, lower levels likely would reduce the usage of ramps that can be accessed only at high lake levels. Based on past responses to fluctuations in lake level, it appears that the overall impact of the Proposal on visitation would not be substantial. Localized impacts on activities associated with individual boating facilities seem likely to occur only when the Proposal causes the maximum drawdown for a few days at the end of August, especially in drought years.



FILE NAME: Fig04-8_AnnualVisitors-LkLevel.ai
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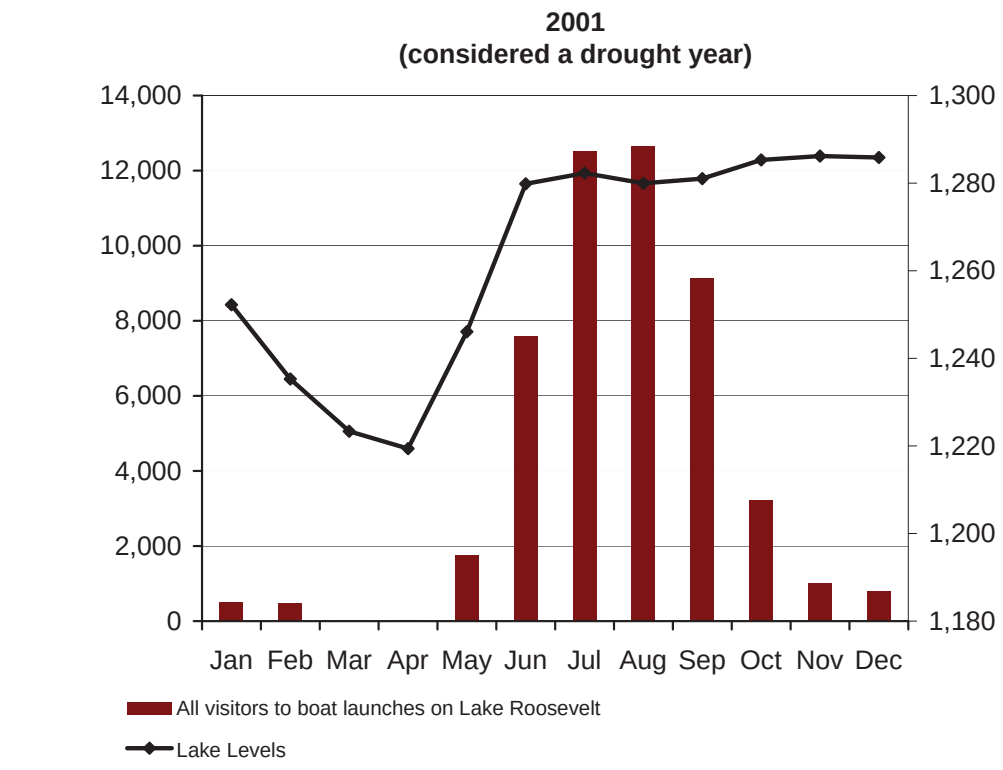
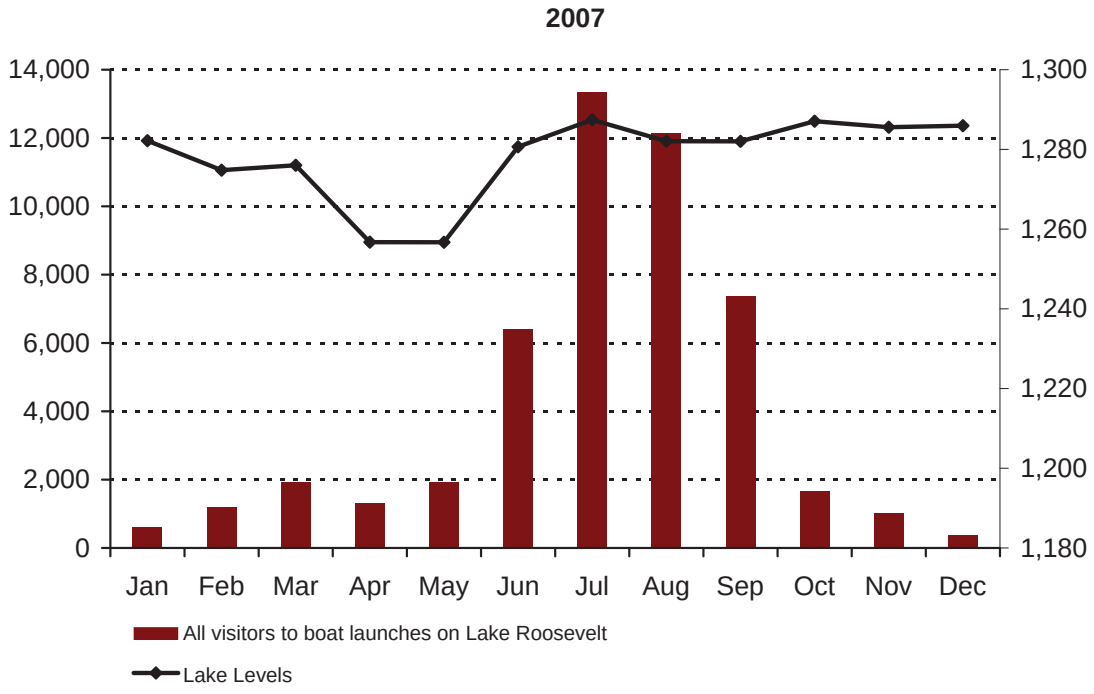
Figure 4-8

Annual Total Boat Launch Visitors and Lake Roosevelt Level





FILE NAME: Fig04-9_2001-2007Visitors-LkLevel.ai
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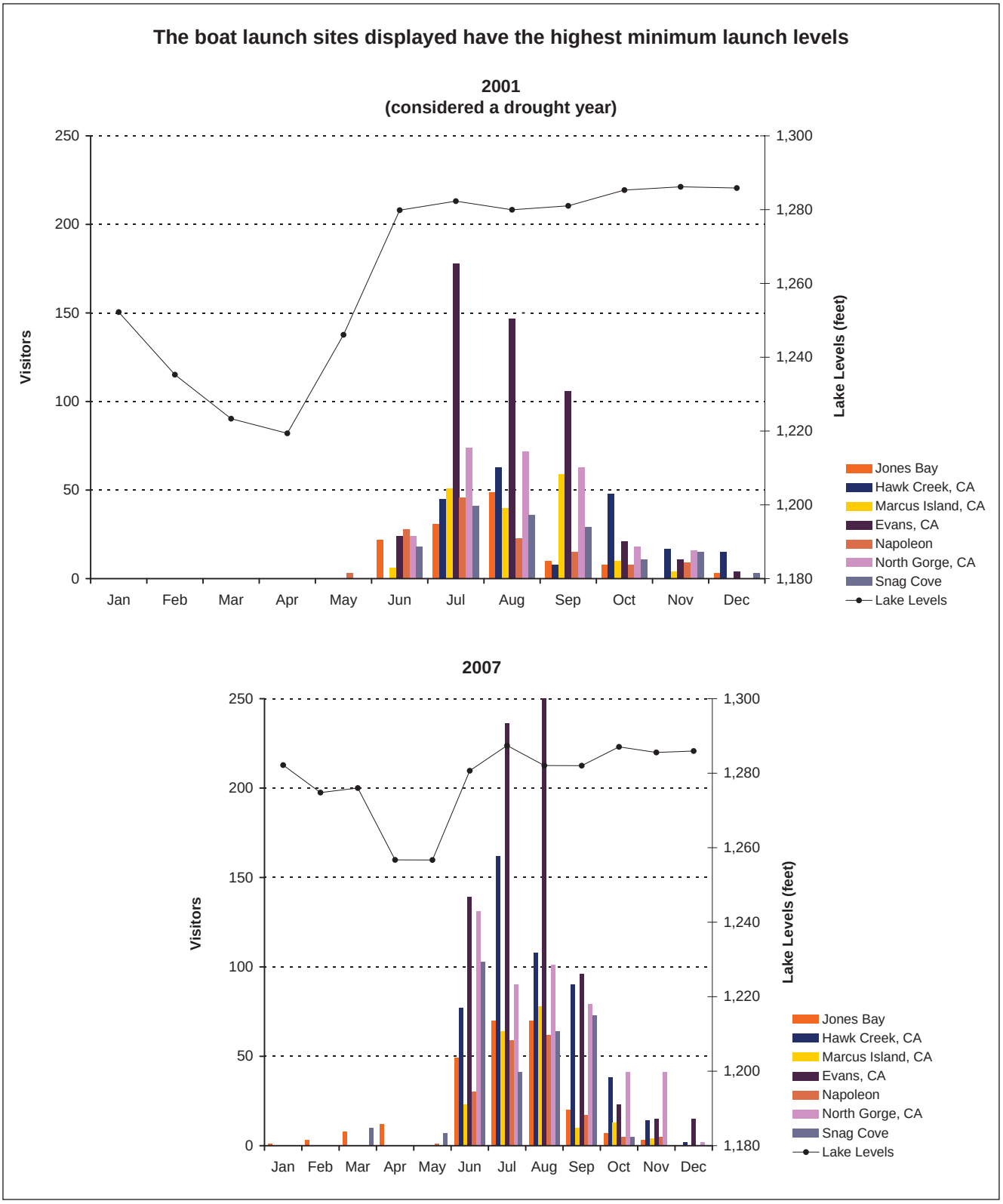
Figure 4-9

Total Visitors to Boat Launches and Lake Roosevelt Level



FILE NAME: Fig04-10_LaunchSites-LkLevel.ai
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Figure 4-10

Boat Launches at High Minimum Launch Sites and Lake Roosevelt Level

Fishing Recreation Effects

Annual angler trips on Lake Roosevelt from 1990 to 1998 ranged from 146,000 (1997) to 595,000 (1993) (Underwood, 2000). Walleye and rainbow trout are the most commonly caught and harvested species, followed by kokanee salmon (Underwood, 2000). A survey of anglers on Lake Roosevelt conducted from 1994 to 1995 revealed consumption preference for rainbow trout and walleye over kokanee and bass, with little consumption of other species (Washington State Department of Health, 1997).

The Proposal may alter the value of anglers' fishing experience on Lake Roosevelt. If it results in boat ramps and other facilities becoming unusable earlier, anglers may find it more inconvenient to reach targeted fishing areas, and some areas may become too shallow to fish. The value anglers place on their fishing experience tends to correlate with their success in catching fish, especially larger fish. As described in Section 4.1.1.6, analyses of fishery impacts within Lake Roosevelt suggest no likely reduction in fishery populations due to the Proposal. Insofar as population density drives impacts for recreational fishing, this reduction will correspond to no loss of value.

Mitigation

The State of Washington and the STI and CCT have signed Water Resource Management Agreements to mitigate effects of the storage releases by financing improved spawning habitat and lake access facilities. No additional mitigation is proposed.

4.2.1.12 Public Services and Utilities

Impacts to public services and utilities were described in the Programmatic EIS (Ecology, 2007). Additional information is provided here on impacts to hydropower production.

Short-term impacts

There would be no short-term impacts to hydropower production because there would be no construction associated with the Proposal.

Long-term/operational impacts

The Proposal is not expected to affect hydropower generation at Grand Coulee Dam. Potential impacts to downstream hydroelectric facilities are discussed in Section 4.2.2.12.

Mitigation

Because no impacts are anticipated, no mitigation is proposed.

4.2.1.13 Transportation

Short-term impacts

As described in the Programmatic EIS, drawdowns from Lake Roosevelt occur on a daily and seasonal basis and no construction or short-term activities would be necessary to accomplish the additional drawdowns for the Proposal. Therefore, no short-term impacts to transportation systems are expected from the drawdowns.

Long-term/operational impacts

Since the drawdown is within the normal range of operations, the Keller Ferry on State Route 21 would not be affected. The ferry can operate normally with lake levels as low

as 1,208 feet. With some special provisions in the ferry operations, it can be operated on a limited basis with levels as low as 1,180 feet (WSF, 2008).

The Inchelium-Gifford Ferry becomes inoperable when Lake Roosevelt elevation falls below 1,228 feet, requiring additional driving of approximately 30 miles to the Keller Ferry. The probability that the ferry would become inoperable is greatest in April when lake levels are drawn down for flood control under existing conditions. Under the Proposal, water would be released from Lake Roosevelt during April of drought years, but the drawdown is not expected to extend the length of time that the ferry would be inoperable. Therefore, no impacts to the operation of the Inchelium-Gifford are anticipated from the Proposal.

According to comments from the STI, low lake levels increases the need for removal of debris (e.g., logs) from the ferry ramps. The problems are worse when lake levels are lowest (drought years) and only at certain times of the year (April). The Proposal is not expected to extend the length of the April low lake level period; therefore, no increase in debris at the ramps is anticipated.

Mitigation

In addition to the mitigation described in the Programmatic EIS, the State of Washington, the CCT, and the STI have signed agreements to mitigate effects of the drawdown. Included in the Water Resources Management Agreement with the CCT is the State's support for a federal appropriation for on-going maintenance of the ferry and of a study of locating a bridge at the ferry site.

4.2.2 Columbia River Downstream

4.2.2.1 Earth

Short-term impacts

No short-term impacts are anticipated because there would be no construction.

Long-term/operational impacts

The additional drawdown would increase flow releases up to 428 cfs during the summer. The increase in flow would be less than 1 percent of the current release and is therefore unlikely to cause an increase in landslide potential.

Mitigation

Reclamation currently monitors known landslide areas downstream of the Grand Coulee Dam, and will continue to do so. Erosion and landslide hazards are addressed as part of the normal operating procedures for Lake Roosevelt operations. No additional mitigation is warranted to address landsliding impacts.

4.2.2.2 Climate

Short-term impacts

The short-term impacts of the Proposal on climate change were described in Section 4.1.1.

Long-term/operational impacts

The long-term impacts of the Proposal on climate change were described in Section 4.1.1.

Mitigation

As discussed in Section 4.1.1, Ecology and Reclamation would coordinate with other Columbia River managing agencies to adaptively manage the Columbia River under changing climate conditions.

4.2.2.3 Surface Water

Water Quantity

Short-term impacts

No short-term impacts will occur as all facilities needed to release or pump additional water from Lake Roosevelt to the Columbia River currently exist.

Long-term/operational impacts

The long-term impacts from changing the release schedule from Lake Roosevelt will be a change in flow in the Columbia River (Table 4-14). The timing of the increase in flow varies with the alternative; however, the maximum additional flow release is approximately 440 cfs in June of a drought year for Alternative 1D. The decrease in flow during September when Lake Roosevelt is filling to compensate for summer drawdowns is predicted to range from approximately 1,360 to 1,370 cfs during dry and average years and up to approximately 2,200 cfs during a drought year, depending on the alternatives.

Table 4-14. Estimated Difference in Columbia River Flow Downstream of Lake Roosevelt

Alternative	*Difference in Flow by Month (cfs)*						
	April	*May*	*June*	*July*	*August*	*September*	*October*
1A—Average Year	0	0	0	428	428	-1,258	0
1B(a)—Average Year	164	119	114	105	183	-1,371	-17
1B(b)—Dry Year	201	211	234	73	77	-1,371	-17
1C(a)—Average Year[1]	0 to 884 (173)[2]	0 to 855 (173)[2]	0 to 884 (173)[2]	0 to 855 (173)[2]	0 to 855 (173)[2]	-1,371[3]	-17
1C(b)—Dry Year[1]	0 to 884 (291)[2]	0 to 855 (291)[2]	0 to 884 (291)[2]	0	0	-1,320[3]	66
1D—Drought Year	407	411	441	180	185	-2,213	-17
1E—Drought Year[1]	0 to 749 (247)[2]	0 to 725 (247)[2]	0 to 749 (247)[2]	0 to 945 (472)[2]	0 to 945 (472)[2]	-2,162[3]	17

[1] Preferred alternative.

[2] Actual difference in flow is dependant on panel described in Section 2.3.1. This table presents a range of possible values and a value in parenthesis that assumes the releases are distributed in full equally throughout the allowable period.

[3] Actual difference in flow is dependant on panel described in Section 2.3.1. This value assumes the full allotments allowable within the alternative are released.

Table 4-15 summarizes the average monthly flows from Lake Roosevelt under current operations. Table 4-16 provides the percent difference between current operations and proposed releases with the alternatives described in Chapter 2. Figures 4-1 through 4-5 illustrate the changes in flow.

Table 4-15. Average Monthly Flow in Columbia River Downstream of Lake Roosevelt

Type of Flow Year	Average Flow for Month (cfs)						
	April	May	June	July	August	September	October
Average (2002)	110,903	118,226	178,193	163,081	110,371	71,600	76,984
Dry (2003)	100,690	118,577	122,443	101,397	94,158	64,523	73,190
Drought (2001)	60,463	47,903	78,403	50,590	68,703	62,277	55,955

Table 4-16. Difference in Average Monthly Flow in the Columbia River Downstream of Lake Roosevelt with Additional Flow Releases

Alternative	April	May	June	July	August	September	October
1A – Average Year	0.0%	0.0%	0.0%	0.3%	0.4%	-1.7%	0.0%
1B(a) – Average Year	0.2%	0.1%	0.1%	0.1%	0.2%	-1.9%	-0.0%
1B(b) – Dry Year	0.2%	0.2%	0.2%	0.1%	0.1%	-2.1%	-0.0%
1C(a) – Average Year[1]	0 to 0.8% (0.2%)[2]	0 to 0.8% (0.2%)[2]	0 to 0.5% (0.1%)[2]	0 to 0.5% (0.1%)[2]	0 to 0.8% (0.2%)[2]	-1.9%[3]	-0.0%
1C(b) – Dry Year[1]	0 to 0.9% (0.3%)[2]	0 to 0.7% (0.2%)[2]	0 to 0.7% (0.2%)[2]	0.0%	0.0%	-2.0%[3]	0.0%
1D – Drought Year	0.7%	0.9%	0.6%	0.4%	0.3%	-3.6%	-0.0%
1E – Drought Year[1]	0 to 1.2% (0.4%)[2]	0 to 1.5% (0.5%)[2]	0 to 1.0% (0.3%)[2]	0 to 1.9% (0.9%)[2]	0 to 1.4% (0.7%)[2]	-3.5%[3]	0.0%

[1] Preferred alternative.

[2] Actual difference in flow is dependant on panel described in Section 2.3.1. This table presents a range of possible values and a value in parenthesis that assumes the releases are distributed in full equally throughout the allowable period.

[3] Actual difference in flow is dependant on panel described in Section 2.3.1. This value assumes the full allotments allowable within the alternative are released.

The maximum increase in flow immediately downstream of Lake Roosevelt would be up to 1.8 percent during July for Alternative 1E during a drought year. This assumes the full allocation of releases to municipal and industrial and interruptible water rights occurs in July. If the flows are distributed equally through the April to August time period, the maximum increase is estimated to be 0.9 percent in July. The maximum estimated decrease in September would be 3.5 percent also for Alternative 1D during a drought year.

For the Preferred Alternatives, the increase in flow immediately downstream of Lake Roosevelt depends on releases determined by the panel of fisheries and water managers described in Section 2.3.1. The range would be 0 to 1.9 percent. The maximum decrease in September would be 3.5 percent for Preferred Alternative 1E. This assumes the full allocation of releases for fish, municipal and industrial, and interruptible water rights occurs.

The differences in flow are a very small percentage of flow in the Columbia River downstream of Lake Roosevelt. As tributaries enter the Columbia River, the percentages decrease. For example, the average monthly flow in the Columbia River at The Dalles Dam during August in a dry year (2003) is 131,300 cfs, compared to 94,160 cfs below Lake Roosevelt. During September, the average monthly flow at The Dalles Dam is 94,600 cfs compared to 73,200 cfs below Lake Roosevelt. That additional flow is 30 to 40 percent of the Columbia River flow below Lake Roosevelt.

No impacts to surface water are anticipated. Flows in the Columbia River will increase during most months. The increases and decreases in flow are small relative to overall flows in the river and are not expected to significantly affect water levels in the river or downstream reservoirs. Specific impacts to water rights, Biological Opinion flows, fish, and hydropower are discussed in following sections.

Mitigation

No mitigation is proposed because no impacts to surface water are anticipated.

Water Quality

Short-term impacts

No short-term impacts are anticipated because no construction is required to release water to the Columbia River.

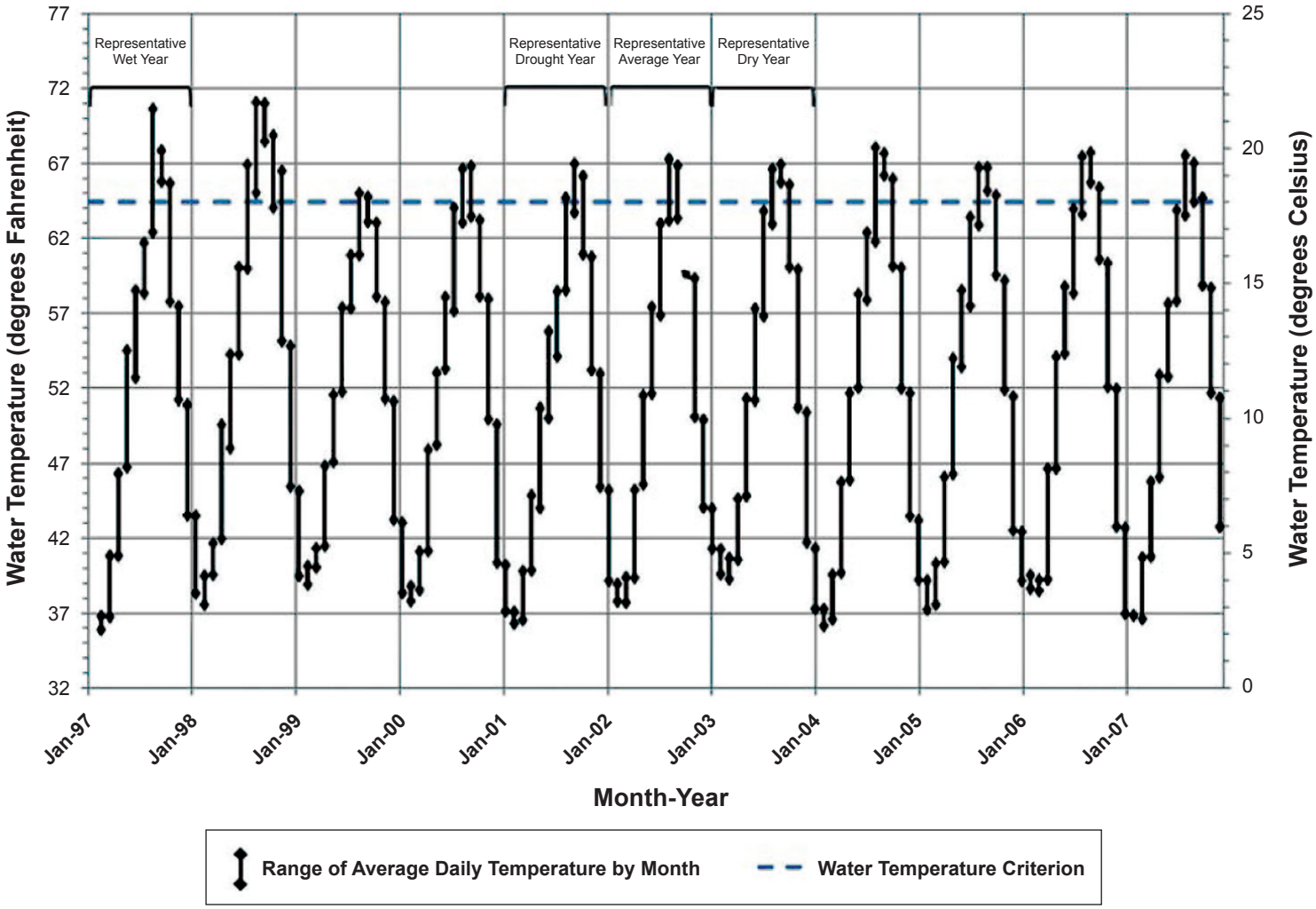
Long-term/operational impacts

The temperature of the water in Lake Roosevelt is influenced by a number of factors including pool elevation, inflow water temperatures, weather conditions (e.g., air temperature, wind and solar radiation), and water releases (Reclamation, 2000). The different intake depths for the power plant flows (see discussion in Section 3.4.2.2) suggest that using preferential power plant operations could influence water temperatures downstream from the dam. However, Reclamation (2000) reported that the limited volume of cool water in the reservoir could not provide significantly cooler summertime releases for prolonged periods. The volume of cool water in the reservoir is limited because flood control activities release a large amount of the cool water and the

remaining cooler water is removed in the spring and early summer due to the large volumes of water that are released each month (Reclamation, 2000).

There are no major inflows to the river in the 6-mile reach of the river between Grand Coulee Dam and the downstream gage. Water temperatures measured 6 miles downstream from the dam represent the temperature of the water released from Lake Roosevelt plus any heating or cooling that occurs within the first 6 miles downstream of the dam. Given the small change in release flows (see Table 4-16) that would result from changing Lake Roosevelt's release schedule and the lack of significant accretion (surface and ground water inflow) to this reach, any temperature change downstream of the dam is expected to be negligible. Therefore, the incremental water releases under each scenario would be expected to be very similar to the water temperature measured at the downstream gage under existing conditions.

The incremental storage releases would continue to maintain typical summertime release temperatures warmer than the 64.4 degrees F (18 degrees C) criterion, but cooler than 68 degrees F (20 degrees C)



Source: Reclamation (2008a)

Notes: Data are collected by the U.S. Army Corps of Engineers. The downstream gage (GCGW) is located 6 miles downstream from the dam. Daily average data were not available for all days in some months: January 1-February 4, 1997; July 16-21, 1998, July 30 - 31, 1998; November 8-12, 1998; July 6-10, 2001. In addition, erratic data were not used to develop the summary table: July 8- 30, 1997; August 1-3, 1997; August 20 - September 1, 1997; January 12-22, 1998; March 11-13, 1998; April 4-13, 1998; April 21, 1998; July 4 - 10, 1998; October 7-18, 1999; July 11, 2001; September 7-9, 2002; and September 30-October 30, 2002.

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Figure 4-11

Ranges of Average Daily Water Temperature
Downstream of Grand Coulee Dam by Month, 1997-2007
Washington

Additional flow releases of up to 428 cfs are not expected to cause a measurable increase in TDG saturation below the dam. Total flow would increase by less than one percent in comparison to current releases and therefore is not expected to cause a measurable increase in TDG saturation levels below Grand Coulee Dam.

Mitigation

No mitigation measures are necessary because no construction is proposed and no significant long-term adverse effects are expected for water quality.

4.2.2.4 Ground Water

Water Quantity

Short-term impacts

No short-term impacts are anticipated because there would be no construction to disrupt ground water.

Long-term/operational impacts

Long-term impacts would be similar to those described for the Lake Roosevelt area (Section 4.1.1.4) and dependent on the water released from Lake Roosevelt.

Mitigation

No impacts are anticipated to ground water wells in downstream Columbia River area; therefore, no mitigation is necessary.

Water Quality

Short-term impacts

There would be no short-term impacts to Columbia River ground water quality because there would be no construction.

Long-term/operational impacts

Total flow would increase by less than 1 percent in comparison to current releases and therefore is not expected to cause significant changes in stage or water quality of the Columbia River downstream of Grand Coulee Dam. Incremental flow releases should not significantly affect the hydraulic continuity between surface and ground water and therefore should not significantly affect ground water quality.

Mitigation

Because no impacts to ground water quality are expected, no mitigation measures are proposed.

4.2.2.5 Legal Considerations

Water Rights

Short-term impacts

No short-term impacts to water rights are anticipated because no is construction required to implement the storage releases.

Long-term/operational impacts

Annual Releases

Positive impacts may occur with annual releases. In such years, 25,000 acre-feet of water would be released for the 128 pending applications for municipal and industrial water rights within 1 mile of the river; 27,500 acre-feet for flow augmentation downstream of Grand Coulee Dam; and 30,000 acre-feet for irrigation in the Odessa Subarea.

According to the MOU between the state, Reclamation, and the Columbia Basin Project irrigation districts, water for municipal and industrial purposes would be provided to Ecology under a Municipal and Industrial Contract (a water service delivery contract) with Reclamation. The water would be transferred to Ecology's Trust Water Rights Program as mitigation for some or all of the pending water right applications for municipal and industrial water rights. Although the water rights would be permanent, federal law prohibits Reclamation from entering into permanent water service delivery contracts. Ecology and Reclamation will negotiate the length of the service contract as part of a MOA covering the secondary use permits. There is a chance of adverse impact on permanent new municipal and industrial water rights if the water service delivery contract with Reclamation is not renewed when its term expires. However, by that time it is Ecology's intention to have provided alternative sources of water through new storage and conservation programs.

The MOU called for the first increment of water for the Municipal and Industrial Contract to be made available from January 2006 through December 2007. At the time of this writing, Reclamation and Ecology have yet to enter into the contract. Ecology will not conclude negotiation of the contracts until this Supplemental EIS is finalized.

Municipal and industrial water rights are issued for year-round use. Under Alternative 1A, water would be released only in July and August. Under Alternative 1B, water would be released to meet demand, including year-round for municipal and industrial water supply. Under Alternative 1C, water would be released as determined by the demand for fish. For the alternatives where water would be delivered year-round and releases would be less than year-round, an OCPI determination is required (WAC 173-563-080) (Section 2.3). The determination allows diversion of water from the Columbia River even if instream flows are not being met (WAC 173-563-080). This could result in an adverse impact to instream flows.

The additional water released from Lake Roosevelt for new municipal and industrial water rights is anticipated to provide new rights for applicants as far downstream as Camas, Klickitat County, Maryhill State Park, and Washougal (Ecology, 2008a). Instream flows set by rule are recognized water rights. The additional flows during all years (drought and non-drought) would assist in maintaining flows set by rule.

Drought Year Releases

During drought years there would be positive impacts associated with permanent standby-reserve permits issued to those holding one of the 379 interruptible water rights and both positive and potentially negative impacts on stream flows.

In drought years, 33,000 acre-feet would be released from Lake Roosevelt for interruptible water rights from the mainstem Columbia River and an additional 17,000 acre-feet would be released for flow augmentation downstream of Grand Coulee Dam. The water is to be made available through a Drought Relief Contract between Reclamation and Ecology. Those holding interruptible water rights will apply to Ecology for permanent standby-reserve permits to be used during drought years.

The standby-reserve permits will be issued for the entire irrigation season (April to October) even though the releases from the reservoir will be from April 1 to August 31. An OCPI determination will be required to authorize permits to divert water at times when there are no releases from the reservoir (WAC 173-563-080) (Section 2.3). This could result in negative impacts on stream flows.

Generally, the standby-reserve permits will have a positive impact for those holding interruptible water rights. However, those who obtain a standby-reserve permit will be required to call in to Ecology weekly to find out whether they can divert water in the coming week. When instream flows established under Chapter 173-563 WAC are met, those users with a standby-reserve permit will be authorized to divert. When instream flows will not be met, those holding standby-reserve permits may divert only if there is water in Ecology's "drought insurance" program available to mitigate the diversion. The drought insurance program includes the 33,000 acre-feet from Lake Roosevelt and water obtained by Ecology from dry-year leases, water conservation projects, and aquifer and surface storage.

Reclamation's authority to enter into Drought Relief Contracts with the state depends upon the continued reauthorization of the federal Drought Relief Act. The Drought Relief Act is currently authorized until September 30, 2010 by Title 2, Chapter 3, Sec. 2306 of Public Law 109-234, June 5, 2006 (Emergency Supplemental Appropriations Act for Defense, The War on Terror, and Hurricane Recovery, 2006).

Releases from Lake Roosevelt are intended to provide water for interruptible water rights that are diverted as far downstream as the Quad-Cities (Ecology, January 2008a). The water will be transferred to the state Trust Water Rights Program and tracked as trust water downstream to the point of diversion.

Mitigation

Ecology would determine appropriate mitigation when processing water right applications if it determines that the new water rights would impact existing water rights. Ecology will negotiate with Reclamation to develop long-term service contracts with options for renewal to meet the need for certainty for municipal and industrial water rights.

Biological Opinion

Short-term impacts

Positive short-term impacts on instream flow are expected during drought years, which would assist in supporting flows under the federal Biological Opinion.

Long-term/operational impacts

The availability of an additional 27,500 acre-feet of water for flow augmentation most years and a total of 44,500 acre-feet of water for flow augmentation in drought years would assist in supporting flows under the federal Biological Opinion. Under all alternatives there would be increased flows below Lake Roosevelt from April through August. Reduced flows would occur in September and/or October, outside of the "salmon flow objective period" (April to August) in the Biological Opinion.

Table 1 of the Biological Opinion states "if the Lake Roosevelt drawdown component of Washington's Columbia River Water Management Program (CRWMP) is implemented, it will not reduce flows during the salmon flow objective period (April to August)." Appendix B.2.1 of the 2007 Biological Assessment discusses the CRWMP and the fact that one-third of the water withdrawn from Lake Roosevelt would be available to supplement fish flows from April through August. This will result in the delivery of "water below Grand Coulee Dam that would not be available under current operations to benefit ESA-listed fish anytime from April through August."

Mitigation

The impacts on stream flows in the Biological Opinion would be generally positive and no mitigation would be required. However, where water rights for out-of-stream uses would be issued for times other than when water is being released from the reservoir, an OCPI determination would be required. If such a determination is made for out-of-stream diversions, there could potentially be a negative impact on stream flows, which would require mitigation.

Canadian Treaty

Short-term impacts

As discussed in Section 4.1.1.5, there would be no short-term impacts on the Canadian Treaty.

Long-term/operational impacts

As discussed in Section 4.1.1.4, the additional releases will have no long-term impacts on the Canadian Treaty. The renegotiation of the Treaty may, however, have impacts on the water supply to Lake Roosevelt and the flexibility in how the reservoir is operated.

Mitigation

Since there would be no impacts on the Canadian Treaty, no mitigation would be required. Any changes to reservoir operations as a result of future Treaty negotiations could require adaptive management which would be resolved in the negotiations.

4.2.2.6 Fish

Short-term impacts

Infrastructure exists to implement the Lake Roosevelt Incremental Storage Releases Project. Thus, short-term related effects of construction activities on aquatic resources are not anticipated.

Long-term/operational impacts

The changes in monthly flows are summarized in Tables 4-14 to 4-16. The annual volume of water released under each of the incremental flow release scenarios is fixed. Spreading the timing of the releases across a number of months under the alternatives decreases the relative level of effect but extends the period of influence.

Lake Rufus Woods

As shown in Tables 4-14 to 4-16, flow releases for fish under the different alternatives would increase volumetric flow rates from the lake by 0.1 to 0.9 percent depending upon the alternative and time of year. The single greatest increase (338 cfs) over current river flows would occur under Preferred Alternative 1E drought conditions during the month of June. The smallest relative increase (173 cfs) over background river flows would occur during the month of June under average water year conditions with Preferred Alternative 1C(a). The amount of water released is minor and by itself is not expected to provide a positive or negative effect on fish in the Lake Rufus Woods under any of the alternatives. It is expected to help meet stream flow targets and provide cumulative benefits to fish. The releases fall within the range of current daily fluctuations and cannot be differentiated from background.

When Lake Roosevelt is refilled during the month of September, river flows below Grand Coulee Dam into Lake Rufus Woods will decrease compared to existing conditions. The decreases in flow rates are calculated to be approximately 2 percent during average and dry conditions and approximately 3.5 percent during drought conditions (Table 4-16). Similar to the benefits of flow increases during other months, the decrease in flows in September is minor and not expected to cause a positive or negative effect on the fish in Lake Rufus Woods under any of the alternatives. The changes in volumetric rates occur within the range of current daily fluctuations and cannot be differentiated from background conditions.

Mid-Columbia River

The influence of the flow releases for fish on habitat conditions would decrease in the downstream direction of the Columbia River as the mainstem discharge naturally increases. The increased flows, although minor, are expected to help meet stream flow targets and provide cumulative benefits to fish.

Hanford Reach

The largest amount of water contemplated for release to augment downstream fisheries under the incremental flow release alternatives occurs during drought conditions. The highest expected monthly flow discharged annually under Alternative 1E (472 cfs) compared to the lowest mean monthly flow on record at Priest Rapids Dam (56,700 cfs) represents a 0.8 percent increase in river discharge in the free-flowing Hanford Reach section of the Columbia River. Under average conditions, the 428 cfs discharged under Alternative 1A during normal August flow conditions (120,000 cfs below Priest Rapids Dam; USGS, 2006) represents 0.4 percent increase in flow. Should the flow release panel described in Section 2.3.1 elect to release all of the water allocation in one month, the increased flow in the Hanford Reach related to project would nearly double representing a 0.7 percent increase in average conditions and an 1.7 percent increase

under drought conditions. Such flow level increases are unlikely to have a measurable influence on habitat conditions or aquatic resources in the mainstem Columbia River. However, they are expected to help meet stream flow targets and provide cumulative benefits to fish. Under all alternatives, the salmon flow objectives in the Biological Opinion would be met (see Section 4.2.2.5)

Mitigation

Because no negative impacts to fish are anticipated in the Columbia River downstream of Grand Coulee Dam, no mitigation is proposed.

4.2.2.7 Wildlife and Plants

Changes to nesting waterfowl and breeding amphibians are the potential impacts associated with increased flow releases at Grand Coulee Dam. Impacts to federal and state-listed plant and wildlife species were previously discussed in the Programmatic EIS (Ecology, 2007).

Short-term impacts

No short-term impacts to wildlife and plants are anticipated because no construction is required to release water to the Columbia River.

Long-term/operational impacts

The additional water released at Grand Coulee Dam as part of the Proposal will not result in impacts to wildlife. The increase in flow would be less than 1 percent of the current release and is therefore unlikely to cause a measurable increase in the risk to nesting waterfowl or breeding amphibians in Lake Rufus Woods and downstream of Chief Joseph Dam. The increase in flow will be within the range of current daily fluctuations and cannot be differentiated from existing conditions. Further downstream, including the Hanford Reach, the influence of the additional flow on vegetation communities becomes further minimized as it represents only a 0.4 percent increase from existing conditions.

Mitigation

No mitigation is expected to be required for wildlife and plants because no impacts are anticipated.

4.2.2.8 Cultural Resources

Short-term impacts

No new short-term impacts to cultural resources are anticipated to the Columbia River downstream area because no construction would be required to implement the Proposal.

Long-term/operational impacts

No new long-term/operational impacts to cultural resources are anticipated to the Columbia River downstream area as a result of increased flows as the increase represents less than a 1 percent change from current operational flows.

Mitigation

Because no new impacts to cultural resources are anticipated, no mitigation measures are proposed for the Columbia River downstream area.

4.2.2.9 Environmental Health

Short-term impacts

As described in the Programmatic EIS (Ecology, 2007), withdrawals from Lake Roosevelt occur on a daily and seasonal basis, and no construction or short-term activities would be necessary to accomplish the additional withdrawals for the Proposal. Therefore no short-term impact to environmental health would occur.

Long-term/operational impacts

The Proposal would result in increased stream flows downstream in the Columbia River at times. While increased flows downstream have the potential to transport contaminants, impacts are not expected to significantly increase, as withdrawals from Lake Roosevelt already occur on a daily and seasonal basis.

Mitigation

No environmental health impacts are anticipated to the Columbia River downstream area; therefore, no mitigation is proposed.

4.2.2.10 Recreation and Scenic Resources

Short-term impacts

As described in the Programmatic EIS (Ecology, 2007), withdrawals from Lake Roosevelt occur on a daily and seasonal basis, and no construction or short-term activities would be necessary to accomplish the additional withdrawals for the Proposal.

Long-term/operational impacts

The project would result in increased stream flows downstream in the Columbia River at times. As described in Section 4.1.2.3, Surface Water, the change in flow downstream of Lake Roosevelt would be a small percentage of flow in the Columbia River. The maximum estimated increase in flow in July and August would be 428 cfs. For context, the average monthly flow in the Columbia River downstream of Grand Coulee Dam was 50,590 cfs during July 2001 and 68,700 cfs during August 2001, a severe drought year (USGS, 2006). This difference represents less than 1 percent of current flow. The maximum estimated decrease in September would be 3.43 percent. Tables 4-14 to 4-16 illustrate the change in flow. These changes in flow are not expected to be noticeable to the average recreational user.

As a consequence of the new water supplies, development in areas that would benefit from the new water supplies could increase. As described in the Programmatic EIS, this could affect scenic resources if the development occurs within scenic areas. Additional development and population growth would also increase the demand for recreation areas. However, most of this development would be expected to occur in already developed areas and areas where growth has been planned, thus additional development would not likely have significant adverse impacts. Recreation facilities, such as playfields and parks, could benefit from more reliable municipal water supplies.

Mitigation

No additional mitigation measures are proposed because no impacts were identified.

4.2.2.11 Socioeconomics

Short-term impacts

No short-term impacts are anticipated because there would be no construction required to release flows to the Columbia River.

Long-term/operational impacts

The Proposal will increase flows downstream of Lake Roosevelt during some periods, and decrease them in others. Because the changes in flows will be minor, no impacts to socioeconomic are expected.

Mitigation

No mitigation is proposed because no impacts are anticipated.

4.2.2.12 Public Services and Utilities

Impacts to public services and utilities in the Columbia River downstream area were described in the Programmatic EIS (Ecology, 2007). This section provides additional discussion of potential impacts to hydropower.

Short-term impacts

No short-term impacts would occur in the Columbia River downstream area because there would be no construction associated with the flow releases.

Long-term/operational impacts

Tables 4-14 through 4-16 provide an estimate of the differences in the amount and percentage of flow in the downstream Columbia River compared to existing operations. The change in flow is an increase in discharge from Lake Roosevelt from April through August and a larger decrease in September and October to help refill the storage used earlier in the season. Releases made for stream flow enhancement (27,500 acre-feet for non-drought years and 42,500 acre-feet for drought years) would remain instream and increase hydroelectric generation through the entire system of dams and hydroelectric generation facilities from Grand Coulee Dam downstream.

Releases made for municipal/industrial supply (25,000 acre-feet) and for interruptible water rights holders (an additional 33,000 acre-feet) in drought years would increase flows and hydroelectric generation down to their point of withdrawal. The potential withdrawal points for interruptible water rights have been mapped by Ecology (2008b) (Figure 4-12). The map only includes the interruptible water rights that are within one mile of the Columbia River and does not show the interruptible water rights located on the tributaries including the Methow, Okanogan, and Wenatchee Rivers. The potential withdrawal points extend from just downstream of Lake Roosevelt to the Dalles pool with a large concentration located in the McNary Dam pool. The actual point of withdrawal will depend on the allocation method Ecology uses as described in Section 2.3.2. The location of withdrawals for additional municipal and industrial use is not yet known but will likely occur near Wenatchee and the Quad-Cities as they are the largest population centers on the Columbia River. A large volume of the municipal and industrial supply and interruptible water supply would likely remain instream until the

McNary pool. Section 2.3.1 describes the potential allocation option for the municipal and industrial water supply.

The impact on hydroelectric generation is complex as it involves understanding the flow differences at a particular generation facility, the timing of hydroelectric generation at that facility, energy market conditions, required spills and other factors. Information contained in Watson (2008), BPA (2007a) and U.S. Department of Energy (2008a, b) was used to characterize the potential impact on hydroelectric generation.

The Watson report analyzed the effect of various operating scenarios of the Federal Columbia River Power System (FCRPS) on revenues derived by the CCT. The report focuses solely on federally-owned dams and did not include the mid-Columbia PUD owned dams. However, the impact on generation would likely be similar for the mid-Columbia PUD owned dams as they have the same flow regime and supply power to similar customers, and sell and buy power in the same energy market.

Hydroelectric revenue generated for Bonneville Power Administration (BPA) is a function of “firm” and “spot” power revenues. Firm power revenue is sales to preference customers by contracts, and spot power revenue is sales of surplus power on the spot market. If generation is not sufficient and power is needed to fulfill a firm contract (in a drought year) the spot power revenue may be reduced.

In the Pacific Northwest, the greatest demand for power is during the winter for heating purposes, and the firm power requirements are the greatest. The firm power requirements are the least during the April to August time period. During that period, spot power sales by BPA to external customers are the greatest. Spot power sales during September are much lower. The prices for spot power are variable depending on many factors, but are approximately double the prices for firm power contracts.

The effect on hydroelectric generation will be an increase in power production in the April to August period approximately equal to the increase in flow in the Columbia River, which will vary between zero and 1.9 percent for generation facilities between Grand Coulee Dam and McNary Dam. Downstream from McNary Dam, the increase will be less as only the fish enhancement flows will add to Columbia River flows. In September and October as outflow from Lake Roosevelt is decreased up to 3.5 percent, a corresponding decrease in hydroelectric generation will occur through all mainstem Columbia River dams. Although the decrease in generation appears to be larger than the April to August increase, the flow in September and October is also much less.

Interruptible Water Rights within the Columbia River Program

Interruptible Qa by WRIA

WRIA	Qa (afy)	No. of Rights
33	102,988	37
31	51,699	63
47	34,166	14
50	28,662	72
40	26,764	31
36	17,103	17
49	11,195	30
32	10,815	9
44	9,825	51
37	4,960	1
48	4,537	7
53	1,732	4
45	1,504	5
35	1,425	13
30	824	9
46	412	5
41	400	4
58	150	4
61	34	3
Total	309,159	379

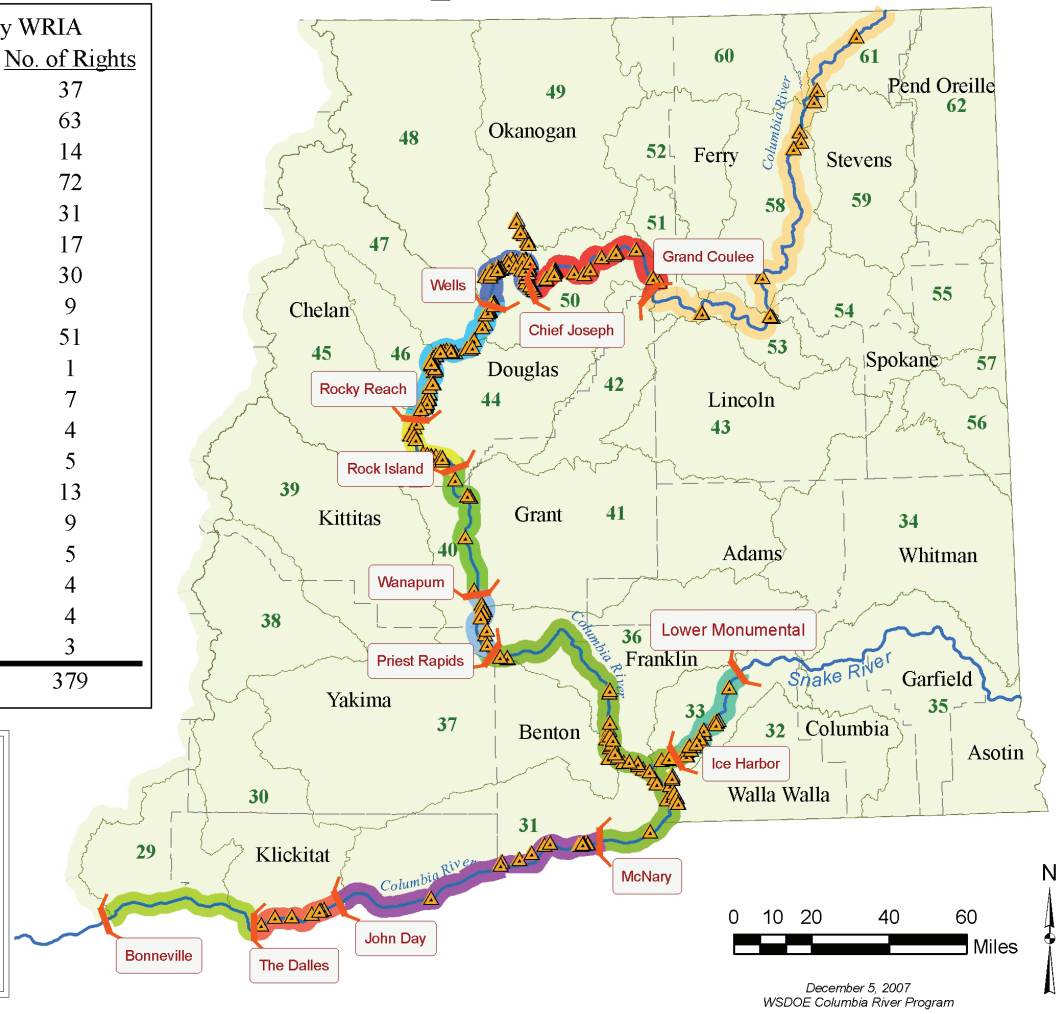

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Figure 4-12
Locations of Interruptible Water Rights
Washington

For example, the average monthly flow in September for an average water year is 71,600 cfs compared to the range of 110,400 to 178,200 cfs in April-August. Table 4-16 presents an estimate of the change in hydroelectric production assuming the Preferred Alternative 1C(a). Alternative 1C(a) was selected as being representative of the potential effects during an average year. It was assumed for the calculation that the flow releases for fish and municipal and industrial uses would be evenly distributed over the April to August time period. It was also assumed that the change in hydroelectric production is directly proportional to the change in flow. The values of production used in the table are for 2006 and were obtained from the Department of Energy (2008a, b) and include production at all mainstem Columbia River dams.

Table 4-16. Estimate of Change in Hydroelectric Production along the Columbia River for Alternative 1C(a)

Production (MW-hrs)							
	April	***May***	***June***	***July***	***August***	***Sept.***	***Oct.***
Production in 2006	8,760,951	8,930,501	9,590,400	7,298,040	5,880,767	4,544,862	4,773,586
Estimated Percent Difference	0.10	0.08	0.07	0.11	0.14	-1.89	-0.02
Estimated Change in Production	8,600	7,200	7,100	8,300	8,400	-86,000	-1,100

Source of data: Department of Energy (2008a,b)

The estimated increase in production is approximately 439,600 MW-hours in April through August, while the decrease in September to October is approximately 87,100 MW-hours. The impact on generation revenue for mainstem Columbia River dams will be dependent on the value of spot power received (or not received). Spot prices are variable depending on the available supply of electricity and the demand. They are usually lowest in June when production is highest during the spring melt. As production declines through the summer and fall, spot prices increase.

Mitigation

No additional mitigation is proposed for hydropower impacts beyond the measures described in the Water Resources Management Agreement with the CCT (Washington and CCT, 2007).

4.2.2.13 Transportation

Short-term impacts

As described in the Programmatic EIS (Ecology, 2007), withdrawals from Lake Roosevelt occur on a daily and seasonal basis, and no construction or short-term activities would be necessary to accomplish the additional withdrawals for the Proposal. As a

result, there would be no short-term transportation impacts in the Columbia River downstream area.

Long-term/operational impacts

The total additional volume of water discharged to the downstream areas would be small relative to the normal flows and would not affect barge or other vessel transportation on the river. As a result, there would be no long-term transportation impacts in the Columbia River downstream area.

As described in the Programmatic EIS, development in areas served by municipal water supplies that would benefit from the Proposal could increase, which would increase demands on transportation systems. Any new development that occurs as a result of the new municipal water supplies is expected to be consistent with adopted land use plans and polices, which have incorporated transportation requirements to accompany growth projections.

Mitigation

No additional mitigation measures are identified since no impacts are anticipated in the downstream area.

4.2.3 Odessa Subarea and Banks Lake

4.2.3.1 Earth

Short-term impacts

Short-term impacts were previously discussed in the Programmatic EIS (Ecology, 2007). Since the Programmatic EIS was issued, Reclamation and the East Columbia Basin Irrigation District have identified the need for improvements to existing irrigation facilities in order to deliver the 30,000 acre-feet of water to the Odessa Subarea. These proposed improvements and general construction impacts are described in Section 2.3.3.

The Weber Branch Siphon would require approximately 32,000 cubic yards (cy) of excavation and 27,000 cy of fill around and over the siphon pipe. Approximately 3,000 cy of gravel fill may be imported from offsite to provide a suitable foundation for the siphon pipe. The Weber Coulee Siphon will require approximately 61,000 cy of excavation and 52,000 cy of fill around and over the pipeline. An additional 5,000 cy of gravel fill may be required to provide a suitable foundation. All fill materials would come from an approved source of material, either a WSDOT certified pit or another similarly permitted site. Both siphons will generate excess excavated materials—8,000 cy at the Weber Branch Siphon and 14,000 cy at the Weber Coulee Siphon. All excess material would be hauled off site and disposed of at an approved fill site.

Excavation would clear the ground and expose soils and increase the potential for soil erosion. The area is flat and receives little precipitation; therefore, the erosion potential would be limited. Best management practices such as silt fencing, would be implemented and the project would comply with state and local stormwater regulations. Excavation and hauling of materials would also increase fugitive dust in the area.

Long-term/operational impacts

Long-term/operational impacts were previously discussed in the Programmatic EIS (Ecology, 2007).

Mitigation

Mitigation measures for construction were described in the Programmatic EIS (Ecology, 2007). The implementation of BMPS to control runoff and dust and compliance with stormwater regulations are expected to mitigate increased erosion potential at the Weber Siphon project.

4.2.3.2 Climate

Short-term impacts

The short-term impacts of the Proposal on climate change were described in Section 4.1.1. The construction proposed for the Weber Siphon (Section 2.3.3) would cause temporary increases in emissions from construction vehicles. These increases are estimated to last approximately 6 months to one year. Most emissions would be generated during a shorter time period when materials are being hauled to or from the site. Potential greenhouse gas emissions were estimated using a worksheet developed by the City of Seattle. The calculation assumed 3,000 vehicle trips, a maximum distance traveled of 50 miles, consumption of 0.125 gallons of gas per mile, and 24.30 pounds of carbon emissions per gallon of gasoline. The gallons of gas per mile and pounds of carbon emissions per gallon of gasoline estimates are based on national averages. The estimated greenhouse gas emissions for the Weber Siphon construction would be 225 metric tons of carbon equivalents during the one-year construction period. The completed project would not generate additional greenhouse gas emissions.

Long-term/operational impacts

The long-term impacts of the Proposal on climate change were described in Section 4.2.1.2.

Mitigation

Emissions from construction vehicles could be reduced by following best management practices to minimize emissions, such as maintaining engines in good working order and minimizing trip distances. These are described in Section 4.2.1.2 of the Programmatic EIS (Ecology, 2007). As discussed in Section 4.2.1.2, Ecology and Reclamation would coordinate with other Columbia River managing agencies to adaptively manage the Columbia River under changing conditions.

4.2.3.3 Surface Water

Water Quantity

Short-term impacts

Potential short-term impacts to the surface water associated with irrigation infrastructure needed in the Odessa Subarea were described in Section 5.1.2.3 of the Programmatic EIS (Ecology, 2007). The proposed improvements to the East Low Canal (Section 2.3.3) would cause construction impacts similar to those described in the Programmatic EIS. Construction at the Weber Siphons would take place both during and outside the

irrigation season, but construction is not expected to impact the delivery of water since the existing barrel siphon could be used for the delivery. There would be no short-term impacts to Banks Lake because construction would not be required to pass the additional flows through Banks Lake.

Long-term/operational impacts

The additional 30,000 acre-feet pumped to Banks Lake will be used by irrigators in the Odessa Subarea in accordance with normal crop irrigation requirements during the irrigation season. Alternatives 1B, 1C and 1D assume that the pattern of additional water pumped to Banks Lake will match the normal crop irrigation requirement pattern. Therefore, additional water will not be stored in Banks Lake and the water levels in the lake will follow the existing pattern of drawdown and refill.

Alternative 1A differs in that it is assumed that the entire 30,000 acre-feet is pumped from Lake Roosevelt to Banks Lake in July and August. To meet irrigation demands in April to June from the portion of the Odessa Subarea to be served by the additional flow, Banks Lake will need to be drawn down slightly from its current operating condition. The April to June demands are estimated to be 12,000 acre-feet. That corresponds to a decrease in Banks Lake levels of approximately 0.45 feet using the volume of 133,600 acre-feet present between elevations 1,570 and 1,565 feet (Reclamation, 2004). Banks Lake would be refilled by the end of August to normal operating conditions. The decrease in Banks Lake levels is well within the operating levels currently experienced as the lake varies between 1,565 feet and 1,570 feet in late July and August.

Under the Preferred Alternatives, water would be withdrawn directly from Banks Lake in September with no flow releases from Lake Roosevelt. In most years Reclamation is able to release Lake Roosevelt water into Banks Lake over Labor Day weekend because power demand is reduced. In dry and drought years (Alternatives 1C(b) and 1E), not enough water is available for the Labor Day releases. Therefore, Banks Lake would be drawn down during September. The drawdown would be approximately 1.5 inches at the end of September and is not expected to be noticeable. The Lake would refill in October.

Mitigation

No additional mitigation is proposed for the Odessa Subarea or Banks Lake beyond the measures described in the Programmatic EIS (Ecology, 2007) because no additional impacts to surface water quantity have been identified.

Water Quality

Short-term impacts

Short-term impacts were previously discussed in the Programmatic EIS (Ecology, 2007). No additional impacts are anticipated. Construction impacts associated with the improvements to the East Low Canal would be similar to impacts described in the Programmatic EIS. Eroded materials could runoff into the wasteway in Weber Coulee.

Long-term/operational impacts

Long-term/operational impacts were previously discussed in the Programmatic EIS (Ecology, 2007). No additional impacts are anticipated.

Mitigation

Mitigation was previously discussed in the Programmatic EIS (Ecology, 2007). Construction best management practices would be implemented to minimize impacts to the stream in Weber Coulee. No additional mitigation is proposed.

4.2.3.4 Ground Water

Water Quantity

Short-term impacts were previously discussed in the Programmatic EIS (Ecology, 2007). No additional impacts are anticipated. Construction of the Weber Siphons is not expected to impact ground water because excavation would be above the ground water table.

Long-term/operational impacts

Long-term/operational impacts were previously discussed in the Programmatic EIS (Ecology, 2007). No additional impacts are anticipated.

Mitigation

Mitigation was previously discussed in the Programmatic EIS (Ecology, 2007). No additional mitigation is proposed.

Water Quality

Short-term impacts were previously discussed in the Programmatic EIS (Ecology, 2007). No additional impacts are anticipated.

Long-term/operational impacts

Long-term/operational impacts were previously discussed in the Programmatic EIS (Ecology, 2007). No additional impacts are anticipated.

Mitigation

Mitigation was previously discussed in the Programmatic EIS (Ecology, 2007). No additional mitigation is proposed.

4.2.3.5 Legal Considerations

Water Rights

Short-term impacts

No short-term impacts to water rights are expected. Construction of the Weber Siphons is not expected to impact the delivery of water to irrigators as the siphons would be built separate from the existing siphons and primarily outside of the irrigation season.

Long-term/operational impacts

Under Section 14 of the MOU, the parties agreed to pursue the delivery of 30,000 acre-feet of water from Lake Roosevelt to the Odessa Subarea (MOU, Section 14). Reclamation filed a water right application with Ecology in March 2005. The water right for irrigation water for the Odessa Subarea will be a permanent secondary use permit, which will authorize Reclamation to release water from Lake Roosevelt, which it stores under its storage certificate, C-11793, priority date May 16, 1938. The secondary use permit will contain language acknowledging the intent under the MOU that water will be

developed from new storage and conservation to replace the water being provided from Lake Roosevelt (Haller, pers. comm., 2008).

Reclamation has a contract with the East Columbia Basin Irrigation District (ECBID) to deliver water to ECBID who will, in turn, deliver the water to its members in the Odessa Subarea. Water users in the Odessa Subarea currently hold ground water permits and certificates, which authorize them to withdraw ground water to irrigate their crops. Per RCW 90.44.510, the members of ECBID who receive project water from Reclamation will be issued a superseding permit or certificate from Ecology for their ground water right. The superseding permit or certificate will identify their ground water right as a standby or reserve water right to be used in times when the project water is not available. The ground water right will thereby be exempt from relinquishment during the times it is not used because project water is provided (RCW 90.14.140(2)(b)).

Under all alternatives for the timing of releases from Lake Roosevelt, Odessa Subarea water users will receive irrigation water throughout the irrigation season. This will firm up their irrigation water supply and eliminate the need to drill ever-deeper wells to obtain ground water.

Ecology may only approve Reclamation's application for a secondary permit under its existing water right if there is water available, the water will be put to a beneficial use, it will not impair existing rights, and it will not be detrimental to the public interest (RCW 90.03.250). There is water available under Reclamation's storage right, and irrigation is a beneficial use. However, under Alternative 1A, water would be released from the reservoir only during July and August, but water will be delivered to ECBID and its members from April to October. In order to authorize diversion of water at times other than during the releases, the director of Ecology must deem it to be an overriding public interest requirement (WAC 173-563-080).

Under Alternatives 1B and 1C, water would be released from the reservoir throughout the irrigation season. If it is determined that it is in the public interest to continue irrigated agriculture in the Odessa Subarea, granting Reclamation a secondary permit should be in the public interest.

Mitigation

Ecology will determine appropriate mitigation for any impacts to water rights as necessary during the processing of the water right application.

Biological Opinion

Short-term impacts

There would be no short-term impacts to the Biological Opinion from the flow releases to Banks Lake and the Odessa Subarea.

Long-term/operational impacts

There would be no long-term impacts to the Biological Opinion from the flow releases to Banks Lake and the Odessa Subarea. The flow requirements of the Biological Opinion would be met if the Proposal were implemented.

Mitigation

Because there would be no impacts to Biological Opinion flow requirements, no mitigation would be required.

Canadian Treaty

Short-term impacts

There would be no short-term impacts to the Canadian Treaty from the flow releases to the Banks Lake and the Odessa Subarea.

Long-term/operational impacts

There would be no long-term impacts to the Canadian Treaty from the flow releases to the Banks Lake and the Odessa Subarea.

Mitigation

Because there would be no impacts to the Canadian Treaty, no mitigation would be required. The renegotiation of the Treaty may, however, have impacts on the water supply to Lake Roosevelt and the flexibility in how the reservoir is operated.

4.2.3.6 Fish

Short-term impacts

Habitat changes and potential effects on local fishery resources related to construction to supply Lake Roosevelt water to the Odessa Subarea were addressed in the Programmatic EIS (Ecology, 2007). No additional impacts are anticipated from improvements to the East Low Canal because no water bodies containing fish would be affected.

Long-term/operational impacts

Flows to the Odessa Subarea are fixed under the Incremental Storage Releases Project at 30,000 acre-feet regardless of water year conditions. Only two alternatives exist for the water delivery schedule under the flow release alternatives: a July and August delivery of 244 cfs as discussed in the Programmatic EIS (Ecology 2007), and an extended April through October delivery schedule as shown in Table 4-19.

Table 4-19. Magnitude and Timing of Lake Roosevelt Flow Releases (cfs) Delivered to the Odessa Subarea under Proposal Alternatives

Alternative	*April*	*May*	*June*	*July*	*August*	*September*	*October*
Average, Dry, and Drought Water Year Conditions							
1A				181	181		
1B(a,b), 1C(a,b,), 1D, 1E	34	65	101	130	97	51	17

An increase in the amount of water conveyed through Banks Lake, Billy Clapp Lake, the Main Canal, and the East Low Canal would result from providing a surface water supply to irrigators in the Odessa Subarea. As discussed in the Programmatic EIS (Ecology, 2007), aquatic habitats are only found in Banks and Billy Clapp Lakes, as summarized below.

Banks Lake

The water storage capacity of Banks Lake is a little over 1 million acre-feet. Distributing an additional 30,000 acre-feet under Alternative 1A during the months of July and August, when the lake is annually refilling and near full pool at 1,570 feet msl, represents 1.5 percent of the storage capacity. Allocating the Odessa Subarea water across all months of the irrigation season in accordance with all other distribution alternatives would represent between 0.1 to 0.8 percent of the reservoir storage capacity between April through October.

Water flowing into Banks Lake destined for the Odessa Subarea would be simultaneously withdrawn from the south end at Dry Falls Dam. Unless a lag time between inflow and outflow occurs, lake elevations would not change materially with the incremental flow release alternatives. The flow regime would increase through-lake water velocities between 0.1 and 1.5 percent depending upon the month and alternative under consideration. During the month of September when Lake Roosevelt is being refilled, water destined for the Odessa Subarea will come from existing storage in Banks Lake and lake elevations are anticipated to decrease approximately 1.5 inches. This level of change is too small to quantify shifts in hydrological or biological conditions in the lake.

Lewis et al. (2002) report lake residence times of 146 days during the irrigation season. Worst-case influence of Alternative 1A flow regimes in Banks Lake would reduce the residence time on the order of two days in July and August. The worst-case reduction in lake residence time under the other alternatives, including the Preferred Alternative 1C, would be approximately one day in July. These modifications are too small to adversely influence either phytoplankton or zooplankton production, fish feeding or breeding opportunities in the lake, or increase the potential for fish entrainment past Dry Falls Dam.

Billy Clapp Lake

The 1,000-acre Billy Clapp Lake is a Reclamation re-regulating reservoir for the Columbia Basin Project. Reservoir volume is 64,200 acre-feet and flows can be in the range of 10,000 cfs. Water particle residence times are very short. The reservoir is filled in the spring to accommodate irrigation deliveries and drawn down in the fall to accommodate winter runoff. Reclamation strives to maintain high, stable reservoir levels in the summer. Since Billy Clapp Lake is the headworks for the Main Canal, reservoir levels remain high and stable during the irrigation season.

Potential impacts related to routing additional water through Billy Clapp Lake to fish and fish habitat, and recreational fisheries for rainbow trout, kokanee salmon and walleye pike, were addressed in the Programmatic EIS (Ecology, 2007). The only change to address in this Supplemental EIS is the extended duration of water delivery throughout the irrigation season under Alternatives 1A, 1B, and 1D compared to the Preferred Alternatives 1C and 1E.

Assuming inflow and outflow of irrigation water destined for the Odessa Subarea are simultaneous in Billy Clapp Lake, the incremental flow release alternatives should not alter reservoir elevations compared to normal seasonal operations of the reservoir. Lake residence times would be reduced compared to existing conditions, but not in a manner that would adversely influence aquatic productivity, fish spawning or rearing opportunities.

Mitigation

No impacts would occur to fisheries in the Odessa Subarea or Banks Lake; therefore, no mitigation is proposed.

4.2.3.7 Wildlife and Plants

Short-term impacts

Few short-term impacts to wildlife or plants will occur as a result of the proposed water to be diverted to the Odessa Subarea. The 30,000 acre-feet of irrigation water would be delivered with existing infrastructure. Conveyance systems would need to be built to move water from existing canals to individual farms. The conveyance systems would be located in existing disturbed and agricultural areas and few impacts to plants and wildlife are anticipated. Potential impacts of this construction would be evaluated under separate SEPA or NEPA analysis, if required.

As discussed in Section 4.1.2.6, the proposed drawdown and flow increases would not result in significant changes to lake elevations within Banks Lake. Water flowing into the lake would be nearly simultaneously withdrawn to provide irrigation water to the Odessa Subarea. The worst-case reduction in lake residence time would be one to two days, which would not have measurable effects on vegetation communities or nesting waterfowl in Banks Lake.

Short-term effects of construction on wildlife species at the Weber Siphons are anticipated to be minimal because of the limited habitat in the project area. Construction would take place within the existing canal right-of-way in an area surrounded by agricultural land and is adjacent to I-90 (Figure 2-1). No native vegetation would be removed or disturbed by the project. Construction could cause temporary disturbance to those wildlife species occurring in the area that are noise intolerant. Impacts would be associated with noise disturbance will be short-term and are expected to be minimal as all construction would occur within the built environment. Temporary noise disturbance is estimated to last approximately 6 months to one year. Wildlife species that are noise intolerant would be expected to return to the area once construction is complete.

Long-term/operational impacts

No long-term impacts to wildlife or plants will occur as a result of the proposed delivery of 30,000 acre-feet of water to the Odessa Subarea. The water would be used to irrigate existing agricultural areas and no expansion is anticipated.

Mitigation

No mitigation is required for impacts to wildlife and plants because no impacts are anticipated.

4.2.3.8 Cultural Resources

Short-term impacts

Short term impacts to cultural resources under this alternative are anticipated to be limited to infrastructure improvements such as on-farm canals. Potential impacts would be similar to those described in Section 4.1.2.9 of the Programmatic EIS (Ecology, 2007). Construction at the Weber Siphons is not expected to disturb cultural resources since construction would be limited to previously disturbed areas within the canal right-of-way.

Long-term/operational impacts

No new long term/operational impacts to cultural resources are anticipated under this alternative as there will be no changes to land use.

Mitigation

Because no new impacts are anticipated, no mitigation measures are proposed. If any canal construction projects receive state or federal funding, those projects would be subject to further cultural review.

4.2.3.9 Environmental Health

Short-term impacts

No significant short-term impacts are expected. Construction associated with the Weber Siphons would generate dust during the construction period, but this would be temporary. Few people are located in the Weber Siphon area, so no health impacts are anticipated from the temporary increase in dust.

Long-term/operational impacts

No significant long-term or operational impacts are expected.

Mitigation

No mitigation would be required beyond BMPs to minimize creation of dust at the Weber Siphons.

4.2.3.10 Recreation and Scenic Resources

Short-term impacts

Short-term impacts related to construction could occur indirectly as a consequence of the new water supplies, and construction of new irrigation infrastructure for the Odessa Subarea, are described in Section 5.1.2.11 of the Programmatic EIS (Ecology, 2007). The temporary aesthetic impacts of construction would be minor, as most of the activities would occur in or near already developed areas, or on agricultural lands. Recreation resources could also be affected, depending on the location of construction. These temporary impacts are not expected to be significant.

No construction or short-term activities would be necessary to accomplish the additional releases to Banks Lake. Construction at the Weber Siphon area would not affect recreation or scenic resources.

Long-term/operational impacts

The flows released to the Odessa Subarea would result in an increase in the amount of water conveyed through Banks Lake. However, water will be released from the south end of Banks Lake simultaneously with the water supplied to the lake. Therefore, there will be no changes to lake levels and the increased flows would not be noticeable to the recreational user.

The Proposal would result in an increase in the amount of water conveyed through Banks Lake. The total additional volume of water to be pumped to Banks Lake is 30,000 acre-feet. The average annual volume of water diverted from Banks Lake by the Columbia Basin Project irrigation districts is approximately 2.4 million acre-feet. The effect on water levels is described in Section 4.1.3.3. For all alternatives except 1A, it is expected that no change in current water levels will occur. For Alternative 1A, the level of Banks Lake may be drawn down approximately 0.45 feet by the end of June to provide irrigation water to Odessa Subarea irrigators. Anecdotal evidence suggests that drawing the lake down lower than 1,575 feet msl would negatively affect some recreational facilities (Reclamation, 2004). The decrease in lake level is well within the operating levels currently experienced as the lake varies between 1,565 and 1,570 msl in July and August. The lake would be refilled to its normal operating level by the end of August. The decrease would not be noticeable to the recreational user.

Mitigation

There would be no impacts to recreation and scenic resources; therefore, no mitigation is proposed.

4.2.3.11 Socioeconomics

Short-term impacts

There could be minor short-term economic benefits associated with the construction of irrigation infrastructure required to deliver water to individual farms.

Long-term/operational impacts

The Proposal will provide a surface water supply for irrigation in the Odessa Subarea. This water is expected to offset some demand for ground water. The economic benefits and impacts of the supply of surface water were evaluated in Section 5.1.2.7 of the Programmatic EIS.

Mitigation

No adverse economic impacts are anticipated; therefore, no mitigation is proposed.

4.2.3.12 Public Services and Utilities

Impacts to public services and utilities in Banks Lake and the Odessa Subarea were described in Section 5.1.2.12 of the Programmatic EIS (Ecology, 2007). This section provides additional discussion of potential impacts to hydropower.

Short-term impacts

There would be no short-term impacts to hydropower production in the Odessa Subarea or Banks Lake area.

Long-term/operational impacts

No impact is anticipated to the power generation at Banks Lake because the pump-storage facility will be operated the same as under existing conditions. The operation of the pumps required to lift the additional 30,000 acre-feet of water from Lake Roosevelt to Banks Lake will require energy from the Grand Coulee Dam project, which will reduce energy that may be available to the regional power grid.

A slight increase in hydroelectric production would occur at the Summer Falls and Main Canal Headworks hydroelectric facilities operated by the Grand Coulee Project Hydroelectric Authority. Those projects recover energy from water flowing from Banks Lake to the Main Canal. The Main Canal project is 26 MW and generates 10aMW. The Summer Falls Project is 92 MW and generates 39aMW. Those two plants produce roughly one-half the energy used to lift water to Banks Lake from Lake Roosevelt.

The supply of water through the East Columbia Basin Irrigation District canal system to Odessa Subarea irrigators will reduce the groundwater pumping needs in the Odessa Subarea. Pumping heads in the Odessa Subarea aquifer generally range from 500 to over 1000 feet (Ecology 2007). A reduction in energy used for groundwater pumping will benefit the regional power grid.

Mitigation

No additional mitigation is proposed for hydropower impacts beyond the measures described in the Water Resources Management Agreement with the CCT (Washington and CCT, 2007).

4.2.3.13 Transportation

Short-term impacts

As described in the Programmatic EIS, no significant short-term impacts on transportation are expected, because construction in the receiving areas would be very limited and spread over a wide area. Construction associated with the Weber Coulee Siphon is not expected to affect traffic I-90 (Figure 2-2). The siphon barrel has already been installed under the roadway. Connecting the siphon barrel to the East Canal would take place outside the I-90 right of way. Construction of the Weber Siphon could cause temporary disruption of traffic when improvements are made under Road U Northeast.

Long-term/operational impacts

As described in the Programmatic EIS, no long term transportation impacts are expected, because no major infrastructure improvements are needed and no disruption to existing transportation systems would occur.

Mitigation

Detours or traffic rerouting would be used to maintain access to areas served by Road U Northeast. Additional mitigation is as described in Section 5.1.2.10 of the Programmatic EIS.

4.3 Cumulative Impacts

The potential cumulative impacts of the Lake Roosevelt Incremental Storage Releases Project were evaluated in Sections 4.3 and 5.5 of the Programmatic EIS (Ecology, 2007). The Programmatic EIS acknowledged that the development of additional water projects in the Columbia River Basin could cause cumulative impacts that would exacerbate the impacts of existing facilities. Potential cumulative impacts include additional impediments to fish passage and increased migration times, increased total dissolved gas problems, water quality degradation, further reductions in shrub-steppe habitat and resulting impacts to wildlife, and potential social opportunity costs. The cumulative impacts could cause species already in decline to experience more severe impacts than if a single project were constructed in a less disturbed environment.

This Supplemental EIS has determined that the additional maximum drawdown of 1.8 feet for a few days at the end of August during drought years could incrementally increase the impacts described in the Programmatic EIS; however, because of the short duration of increased drawdown, the incremental increase would not be expected to be significant.

The Proposal would provide increased stream flows to benefit fish in the Columbia River downstream of Grand Coulee. These increased stream flows are expected to provide cumulative benefits to fish in most months. The adaptive management strategy developed for the preferred alternatives will allow Ecology to maximize benefits of the flow releases for fish.

The Lake Roosevelt Incremental Storage Releases Project is one of several projects that Ecology is developing to improve water management in the Columbia River Basin (Section 1.6). All of the proposed projects will undergo separate environmental review under NEPA and/or SEPA when or if the projects are carried forward. The future environmental reviews will identify impacts of the individual projects and cumulative impacts to the Columbia River Basin. Ecology will work with other managing agencies in the Columbia River Basin to identify potential cumulative impacts and develop an adaptive management strategy to minimize impacts of any further water project development. Ecology is committed, through the Columbia River Water Management Act (RCW 90.90.010(3)(a)), to basin-wide management approaches that do not result in increased cumulative impacts.

Operation of Grand Coulee Dam and all the water supply projects in the Columbia River Basin could be impacted in the future by changes in climate and by renegotiation of the Columbia River Treaty with Canada. Climate change may reduce snowpack and alter the amount and timing of runoff to Lake Roosevelt. Any renegotiation of the Columbia River Treaty could require changes in the operation of Lake Roosevelt. Ecology will coordinate with other managing agencies in the Columbia River Basin to plan for and adapt to these changes as they occur.