Chapter 4

Environmental Consequences

This chapter will compare the No Action (preferred alternative) conditions of the resources with the impact of Reclamation's Action Alternative. The resources evaluated are vegetation, fish, wildlife, threatened and endangered species, economics, recreation, irrigated agriculture, historic resources, traditional cultural properties, Indian trust assets, environmental justice, surface water quality, groundwater quality, Native American sacred sites, visual quality, air quality, soils, and safety, health, social environment, and public health. Another section in Vegetation, Fish, and Wildlife addresses concerns about FDR Lake biota.

Vegetation, Fish, and Wildlife

The littoral zone is important for many species of fish, supporting both juvenile and adult life stages. This zone supports aquatic emergent and submergent plants (aquatic macrophytes) that provide important food sources and nesting habitat for a wide variety of waterfowl, shorebird, mammal, and amphibian species. The fringe of riparian vegetation species that line the edge of the reservoir also provides crucial habitat for a wide variety of wildlife species.

The key to determining the magnitude and extent of impacts to the littoral zone is the time of year and the length of time the reservoir is drawn down, and the extent of drawdown that exposes the littoral zone to dessication. Therefore, the focus of this analysis centers on this narrow, but crucial, zone of the reservoir. Weather patterns during the drawdown would influence the degree of impact. If the period from August 1 to September 22 is cool and rainy, substrates would not dry out as fast or as deeply as they would if this period were hot and dry. Ten-year average monthly rainfall for Grant County is 0.34 inches for August and 0.21 inches for September (Quall et al. 2003). Ten-year average monthly high temperature for Grant County is 84.21 °F for August and 78.53 °F for September; while average monthly low temperature is 56.87 °F for August and 49.92 °F for September. Also, the type of substrate determines how much soil moisture is held. Clay and organic matter dry out more slowly than sand and loam.

Most aquatic macrophytes in the Banks Lake littoral zone occur in a band from water surface elevation 1569 feet to 1566 feet. The number of days that the littoral

zone would be exposed during drawdown is determined from the number of days the reservoir is at or below elevation 1566 feet. The maximum amount of drawdown below the aquatic macrophytes zone that occurs under the No Action Alternative is 1 foot, and the length of time the aquatic macrophytes zone is exposed (dewatered) under the No Action Alternative ranges from approximately 6 days to 36 days. The maximum amount of draft below the aquatic macrophytes zone under the Action Alternative is 6 feet, and the length of time the aquatic macrophytes zone is exposed ranges from approximately 23 days to 43 days (see table 4-1)

Table 4-1.—Number of days aquatic macrophytes are exposed during drawdown. Aquatic macrophytes generally occur in Banks Lake from elevation 1569 feet to 1566 feet

Scenario	No Action Alternative Number of days exposed 1 foot	Action Alternative Number days exposed 1 to 6 feet
Low water	36	43
Early draft	26	34
Uniform draft	10	29
Late draft	6	23

FDR Lake Plant and Animal Life

The impacts analyzed in this EIS were specifically limited to those that would occur directly to the Banks Lake biota. However, this section addresses concerns about the biota in FDR Lake.

The total storage capacity of FDR Lake is approximately 9.7 million acre-feet, of which about 5.2 million acre-feet constitutes active storage capacity. The Action Alternative would result in an additional 127,000 acre-feet being released from Grand Coulee Dam for augmentation flows (instead of pumped to Banks Lake) for a period ranging from August 1 to September 1, depending on the drawdown scenario (Low Water, Early Draft, Uniform Draft, or Late Draft). The Action Alternative calls for refill (pumping from FDR Lake to Banks Lake) to occur from September 1 to September 22. The 260,000 acre-feet (10 feet in Banks Lake) represents 0.03 percent of the total volume of FDR Lake. This is equivalent to about 1 ½ feet in FDR Lake (or an additional ¾ foot above the No Action Alternative operations). However, because there is an end-of-September target elevation of 1283 feet, refilling Banks Lake would result in reduced releases downstream from Grand Coulee Dam instead of lower water surface elevations in FDR Lake. Additional details on the operations of the pumping plant, as well as the Left Powerhouse, Right Powerhouse, and Third Powerhouse are described in detail in the Economics section of the EIS.

Also, Grand Coulee Dam serves as primary storage for the entire Columbia River (outside Canada), with approximately 9.7 million acre-feet of storage, 5.2 million-acre feet as active storage capacity. It, along with Chief Joseph Dam downstream, generates

50 percent of the power used in the Pacific Northwest. Ninety-five percent of the peaking capacity (providing power during peak use periods) resides at Grand Coulee and Chief Joseph Dams for the Pacific Northwest. As such, flows through Grand Coulee Dam fluctuate greatly. Additional factors influencing how Grand Coulee is operated includes the Biological Opinion issued by NMFS in 2000. Other factors that influence releases at Grand Coulee include the power market, Treaty, and Non-Treaty storage managed by BPA, as well as recreation, fish, and wildlife values managed for FDR Lake. The additional 127,000 acre-feet of water is passed downstream and would result in no net change in water surface in FDR Lake in August. Water residence times would not be affected as total combined outflows from FDR Lake would not change. Water previously pumped from FDR Lake to Banks Lake would now be released through the turbines, increasing downstream flows by up to 7,000 cfs.

Entrainment of fish, particularly kokanee and rainbow trout, through the turbines at Grand Coulee has been identified as a major limiting factor for maintaining these fisheries. Entrainment through the Third Powerhouse is significant. Recent research using strobe lights to reduce entrainment (Perry et al. 2003, Johnson et al. 2003, LeCaire 1999) indicates that the entrainment rate is proportional to flow through the turbines. Entrainment also varies by season with some of the highest entrainment rates occurring during August. In theory, it is reasonable to conclude that increasing flows through the Third powerhouse during the August Banks Lake drawdown would result in higher entrainment rates of fish, including kokanee and rainbow trout. However, given the large volumes of water and the extreme fluctuations, the relative contribution of Banks Lake drawdown water is extremely small. For example, flows at Grand Coulee Dam during August 2003 regularly fluctuated between approximately 60,000 cfs and 110,000 cfs (see the Hydromet station at www.usbr.gov/pn/hydromet/graphs/gcl_qd_wy.html). Reclamation, therefore, concludes that no appreciable changes would occur to the biota of FDR Lake, including resident fish, or to the biota of the Columbia River immediately downstream of Grand Coulee Dam.

Vegetation

Riparian plant species and many aquatic macrophyte plant species in the semi-arid and arid portions of the West, where water availability from rain and snowmelt are limited and sporadic, are adapted to drawing much of their seasonal water needs from groundwater (Stromberg 1994; Rood and Mahoney 1990). Any significant changes in the normal range and seasonal patterns of fluctuation of the groundwater table would be expected to have adverse effects on these species. Mortality or even stress in these species would lead to changes in vegetation community composition. Any significant change in water table elevation during the growing season can potentially adversely affect these communities (Stromberg 1992).

Many species of riparian vegetation, especially cottonwood, have very specific soil moisture requirements needed for germination. These requirements typically involve early spring high water levels that recede at just prior to seed fall providing a moist seedbed. Alteration of the timing or magnitude of these events increases the probability that recruitment would be adversely affected (Bradley and Smith 1986; Stromberg 1992). Significant modification either to the groundwater table, which

supports established vegetation, or the hydrologic conditions, which create conditions suitable for successful recruitment, may cause long-term effects to susceptible littoral zone riparian and aquatic macrophyte vegetation communities.

Drought tolerance of aquatic macrophytes species and the length of time that roots are exposed to drying conditions are factors used to determine the ability of plants to survive drawdowns. Another factor that affects plant survival is the weather during the drawdown. Hot, dry weather would dry out substrates faster than cool, wet weather. The growing season is nearing its end in August; therefore, decreasing adverse impacts that might occur if drawdown occurred earlier in the growing season. The substrate type (soil composition) determines how fast groundwater would recede from soils in beds of aquatic macrophytes and, therefore, determines how fast the substrate would dry out during drawdown. Soils high in clay content or high in organic matter retain moisture longer through capillary action. Soils that are mostly sandy drain and dry out rapidly.

The following soil types are based on Grant County and Douglas County soil surveys. Loam, very fine sandy loam, silt loam, sandy loam, fine sand, and loamy sand generally occur near the Million Dollar Mile North Boat Launch; west of the coulee wall in Section 2 of T.25N./R.28E. and in Section 35 of T.26N./R.28E.; on the south half of the Steamboat Rock State Park peninsula; at the Steamboat Rock Rest Area and Boat Launch; most of the Barker Flat area; and most of the upper reservoir area north of Kruks Bay. Soils with gravelly loam, stony loam, and cobbly loam generally occur in the south/southeast portion of the reservoir area near Dry Falls Dam. Soils subject to seasonal flooding, and soils that are poorly drained, very cobbly, or that consist of rock outcrop are found predominantly in the Northrup Canyon, Steamboat Rock, Barker Cove, Old Devil's Lake, and Lovers Lane areas. Little site-specific data on soil composition exist for the Banks Lake littoral zone, increasing the uncertainty for any analysis of impacts.

There are two measures of impact to vegetation following exposure to desiccation during drawdown: (1) the distribution, abundance, and species composition of aquatic macrophytes in the Banks Lake littoral zone and (2) the distribution, abundance, and species composition of riparian vegetation. The analysis is accomplished by examining the potential impacts to representative plant species that are combined to provide an overall impact assessment for each vegetative community.

No Action Alternative

Distribution, Abundance, and Species Composition of Aquatic Macrophytes.— Depending on the scenario, the number of days the littoral zone is exposed during drawdown ranges from approximately 6 to 36 days. Drawdown would be limited to elevation 1565 feet. The present well-developed stands of aquatic macrophytes would likely continue relatively unchanged. Reed canarygrass, an invasive exotic species, would continue to spread, although its rate of spread is difficult to predict. Eurasian water milfoil, also an invasive exotic, has spread extensively in the past,

requiring extensive winter drawdowns to kill it. Though the present extent is relatively low, this species would likely continue to grow and spread.

Distribution, Abundance, and Species Composition of Riparian Vegetation.—The species composition and abundance of riparian vegetation species is likely to continue to exist in a similar manner for the 50-year life of the project.

Action Alternative

Distribution, Abundance, and Species Composition of Aquatic Macrophytes.—Depending on the scenario, the number of days the littoral zone is exposed ranges from approximately 23 days to 43 days. Drawdown would extend to elevation 1560 feet—up to 6 feet below the current lake elevation fluctuation. Drought-tolerant species, including Nebraska sedge, beaked sedge, hardstem bulrush, baltic rush, and common spikerush, are unlikely to be adversely affected. Common cattail and narrow-leaved cattail are likely to increase in density as summer drawdowns stimulate germination of seeds (Sojda 1993). Reed canarygrass is also likely to increase in density, as this is a hardy, drought-tolerant, highly invasive species, particularly in wetland situations (Schmierer 2000). American bulrush, softstem bulrush, redtop bentgrass, lesser duckweed, and sago pondweed are drought intolerant and are likely to be reduced in distribution and abundance. The Eurasian water milfoil is unlikely to be adversely affected, as this species requires exposure of the roots to freezing temperatures. The lake levels would return to full pool prior to the onset of cold weather.

Stands of aquatic macrophytes are likely to continue to persist in the littoral zone of Banks Lake under the Action Alternative in a similar extent as occurs at present. These stands would likely consist mostly of reed canarygrass and Baltic rush. These two species are currently the dominant aquatic macrophyte species at Banks Lake. They are drought tolerant and are unlikely to be adversely impacted by August drawdowns. Nebraska sedge, beaked sedge, hardstem bulrush, and common spikerush, as well as other drought-tolerant species, would also persist in these stands. Though it is difficult to predict with absolute certainty, it is likely that cattails would become denser, as well as stands of reed canarygrass. Major adverse impacts that are likely to occur are the reduction or elimination of drought-intolerant species, such as American bulrush, softstem bulrush, redtop bentgrass, lesser duckweed, and sago pondweed, thus reducing the overall species diversity. It is very likely that other plant species would grow in the drawdown zone during the August drawdown. Seasonal drawdowns are the primary method that wildlife managers use to promote the growth of plants favorable for waterfowl in the drawdown zone. Table 4-2 provides a summary of impacts to representative species of aquatic macrophytes that occur in the study zone.

Distribution, Abundance, and Species Composition of Riparian Vegetation.—The primary source of impact to the thin strip of riparian vegetation along the shoreline is the amount of drying that occurs to the substrates during drawdown and the ability of each species to tolerate soil drying. The present distribution and species

composition of the thin strip of riparian vegetation above the high water line at elevation 1570 feet has developed and persisted under a water level regime that centers on fairly consistent elevations from 1568 feet to 1566 feet for most of the growing season.

Groundwater levels recede both vertically and horizontally much more quickly in sandy and cobbly soils than in soils containing loam, clay, or organic material. A rough rule of thumb for the rate that groundwater recedes in the most well drained soils is 2.5 feet per month in vertical elevation and 10.4 feet per month in horizontal distance. At the other extreme, soils with high clay content can seal off at the surface and retain high soil moisture levels for extended periods of time. The clay and organic matter content of the soils beneath the riparian vegetation community at Banks Lake has not been characterized other than by the broad county soils maps, as discussed earlier. Therefore, some uncertainty exists regarding the response of riparian species to drawdowns. An additional source of uncertainty is the weather conditions that would be encountered in August and September during drawdowns. Therefore, a range of impacts is discussed.

In general, for mature, established riparian species, soil moisture should remain adequate for all soil types, even for low drought-tolerant species, such as the few mature black cottonwood trees that remain. However, seedlings of low-drought-tolerant species, such as black cottonwood and peachleaf willow with shallow root systems, may become stressed or eliminated if they have established on sandy, well-drained soils. The Low Water Scenario has 43 days of exposure and may result in the greatest adverse impact. Other species have a range of drought tolerance from low to high, such as coyote willow and Wood's rose. Some individuals of these species may be reduced or stressed, depending on the substrate. Stands of Russian olive may increase, as this species is drought tolerant and rapidly colonizes riparian areas.

Summary of Impacts.—Table 4-2 summarizes the impacts to aquatic macrophytes species in the Banks Lake littoral zone, and Table 4-3 summarizes the impacts to the thin strip of riparian species along the shoreline.

Table 4-2.—Summary of impacts to aquatic macrophyte species in the Banks Lake littoral zone

Species	No Action	Action Alternative
Nebraska sedge	No impact. Would continue to exist in subdominant stands in protected bays and shorelines. Prefers saturated soils early in the season, but later dry out—ideal conditions provided by No Action.	No impact. August drawdown provides ideal conditions. Distribution and abundance likely to remain the same.
Beaked sedge	No impact. Tolerates extreme water level fluctuations.	No impact; however, shoot size may be reduced.
Hardstem bulrush	No impact. Can tolerate several years of dry conditions.	No impact. Distribution and abundance likely to remain the same.
Baltic rush	No impact. Drought-tolerant, dominant stands in protected bays. Distribution and abundance would remain stable.	No impact. Distribution and abundance likely to remain the same.
Common spikerush	No impact. Prefers saturated soils in early season that dry up in summer.	No impact.
Eurasian water milfoil	No impact. Requires exposure during freezing temperatures to kill plant. Unlikely to occur in August or September.	No impact.
Common cattail	No impact. Drought tolerant.	No impact to beneficial impact. Drawdowns stimulate germination of seeds. Stands may become denser.
Narrow-leaved cattail	No impact. Drought tolerant.	No impact to beneficial impact if drawdowns stimulate seed germination.
Reed canarygrass	No impact. Drought tolerant. Dominant stands in protected bays. Distribution and abundance increasing.	No impact. Highly invasive species in wetlands.
American bulrush	No impact. The very slight 5 feet fluctuations allow this species to persist.	Adverse impact. Drawdowns likely to reduce or eliminate species, as it requires saturated soils.
Softstem bulrush	No impact. Present distribution and abundance likely to remain unchanged.	Adverse impact. Present distribution and abundance likely to be reduced.
Redtop bentgrass	No impact. Present distribution and abundance likely to remain unchanged.	Adverse impact. May be reduced or eliminated in soil areas that dry out completely.
Lesser duckweed	No impact. Present distribution and abundance likely to remain unchanged.	Adverse impact. Would likely be reduced, regardless of soil composition.
Sago pondweed	No impact. Present distribution and abundance likely to remain unchanged.	Adverse impact. Would likely be reduced, regardless of soil composition.

[1/] Facultative species can occur in either uplands or wetlands.

Table 4-3.—Summary of impacts to riparian species present in the Banks Lake littoral zone.

Species	No Action	Action Alternative
Black cottonwood	No impact. Riparian species tolerates drought conditions when established. Present distribution and abundance likely to remain unchanged.	Low impact to mature trees. Moderate impact to seedlings particularly in the Low Water and Early Draft Scenarios. Mature trees can store water in trunk, but seedlings and young plants may be reduced if soils, particularly in sandy areas, are dried out.
Russian olive	No impact. Riparian exotic species, high drought tolerance. Present distribution and abundance likely to increase.	No impact to beneficial impact. Stands of Russian olive may increase because it can rapidly colonize riparian areas.
Peachleaf willow	No impact. Facultative wetland species located on transitional riparian sites. Likely to persist where it currently exists.	Low drought tolerance. May be reduced in areas with well drained or sandy soils.
Coyote willow	Obligate wetland species that occurs in transitional riparian areas. Likely to persist where it currently exists.	Drought tolerance ranges from low to medium. May be reduced or stressed, particularly in the Low Water and Early Draft Scenarios.
Red-osier dogwood	Facultative[1/] species with medium drought tolerance. Likely to persist where it currently exists.	May decrease in areas with well drained sandy soils, particularly in the Low Water and Early Draft Scenarios.
Wood's rose	Drought tolerance ranges from low to high. Likely to persist where it currently exists.	Some drought-intolerant individuals may be reduced.

[1/] Facultative species can occur in either uplands or wetlands.

Fish

One of the major concerns of the proposed action is the potential to reduce or eliminate the aquatic macrophytes that serve as critical spawning and nursery habitat for the majority of Banks Lake fish species. Fish species that spawn in littoral areas can be adversely affected by water level fluctuations. Drawdowns can result in habitat loss and mortality to eggs and young after exposure or suffocation by eroded sediments (Hassler 1970). Drawdowns can also affect water temperatures, increase predation, and decrease food availability. Rapidly receding waters may also cause nest desertion, poor egg survival, and disrupted spawning for species, such as largemouth bass, yellow perch, and common carp that spawn in shallow water. Low and variable spring water levels can adversely affect the spawning success of species, such as yellow perch (Walburg 1976). Conversely, rising or high water levels during the spawning season, and for several months afterward, enhance postspawning survival by inundating shoreline vegetation that provides refugia and abundant food for young-of-year fish (Ploskey 1986).

Another concern is the exposure of juvenile fish to increased predation. Juveniles of many species move offshore during late summer and would not be affected by the dewatering of aquatic macrophytes or other littoral zone cover. Other species, however, rely on the cover of aquatic macrophytes year round and would thus be

affected. The degree of impact to fish populations would depend on the length of time water levels are drawn down.

Water level fluctuations can alter predator-prey relations by reducing habitat complexity and the overall amount of habitat available. Drawdowns may force small fish to abandon complex habitat in littoral areas, serving as refugias and increase their vulnerability to predation (Jenkins 1970). Piscivores, such as walleye and trout, on the other hand, often increase in weight by feeding heavily on the concentrated prey. Water level drops would force juvenile and small fish out of the cover of aquatic macrophytes, as well as other cover, such as logs, brush, boulders, and cobbles, increasing their susceptibility to predation.

To determine the environmental consequences to fish habitat and fish populations, the following indicators were analyzed for the No Action and Action Alternatives.

- Quality and quantity of spawning and nursery habitat in shallow aquatic macrophytes; shallow unvegetated flats; and boulders, cobble, gravel.
- Ability of juvenile fish to withstand predation pressure during drawdown.
- Quality and quantity of aquatic food base.

No Action Alternative

Quality and Quantity of Spawning and Nursery Habitat.—The well-developed stands of aquatic macrophytes would continue to provide suitable spawning and nursery habitat for fish. Shallow, unvegetated flats would also be abundant, as well as boulders, cobble, and gravel habitats.

Susceptibility of Juvenile Fish to Predation.—Reservoir water levels would remain at or above elevation 1565 feet through August, keeping some aquatic macrophytes available to juvenile fish for cover and protection from predation. The present level of predation on juvenile fish would likely continue, and fish populations would not change from the present condition.

Quality and Quantity of Aquatic Food Base.—Stable water levels would allow continued production of benthic invertebrates.

Fish Nets at Dry Falls Dam.—Lowering the water surface causes accelerated wear to the bottom of the fish nets as more of the nets contact the bottom and wave movement of the floats causes abrasion on the net bottom.

Action Alternative

Quantity and Quality of Spawning and Nursery Habitat.—Spawning and nursery habitat can be found in aquatic macrophytes, shallow, unvegetated flats, and boulders, cobble, and gravel.

Aquatic Macrophytes.—The basic question to be answered is whether a drawdown to water surface elevation 1560 feet during August and a refill starting September 1 to elevation 1570 feet by September 22 would adversely impact stands of aquatic macrophytes that currently provide spawning and rearing habitat for at least 10 fish species in Banks Lake. August drawdowns are unlikely to adversely impact drought-tolerant aquatic macrophyte species which include the two most dominant species at Banks Lake—Baltic rush and reed canarygrass. Other drought tolerant species present at Banks Lake that would not be adversely impacted include Nebraska sedge, beaked sedge, hardstem bulrush, common spikerush, common cattail, and narrow-leaved cattail. All of these species would continue to be present in the existing stands of aquatic macrophytes along shallow protected bays and shorelines. These stands of aquatic plants would continue to be available to fish during the spring spawning and early larval rearing period. Drought-intolerant species, such as American bulrush, softstem bulrush, redtop bentgrass, lesser duckweed, and sago pondweed would likely be reduced in distribution and abundance in these stands. The basic conclusion is that the present extensive stands of aquatic vegetation would persist in the face of August drawdowns, but the species composition of those stands may change. Drought-tolerant plant species would continue to provide substrate for algae, for aquatic macroinvertebrate production for food; and cover for eggs and juvenile fish from predators.

Shallow, Unvegetated Flats.—The North Banks Lake and South Banks Lake maps (figures 3-2 and 3-3) highlight the proposed 5-foot drawdown zone to elevation 1560 feet (light green). The wider the space between contour intervals, the lower the gradient becomes. Extremely wide areas can be seen adjacent to Barker Flat, on the west and south shores of the Steamboat Rock State Park, and along the Million Dollar Mile, as well as along the southwest portion of the lake in the game refuge. These are mostly unvegetated flats. The primary value of these areas is that they are shallow. The proposed 5-foot drawdown may force fish species into deeper habitats with potentially increased risk of predation. However, due to the gradients of the shoreline, shallow areas temporarily lost as a result of the drawdown would be replaced by a similar amount of new shallow habitat.

There are some areas that may become vulnerable to substrate erosion. This can be seen on the map as the zone where a sharp dropoff occurs—shoreline areas out from the Million Dollar Mile South Boat ramp and Chase Draw to the south, as well as the south end of Steamboat Rock State Park. Erosion that occurs here may eliminate fine sediments, leaving more exposed boulders and cobble, which would not erode. This may increase interstitial spaces for small fish cover.

Boulders, Cobble, Gravel.—This habitat type is typically found throughout much of the shoreline of Banks Lake, particularly in areas exposed to greater amounts of wind and wave action. It is unlikely that any erosion caused by declining water levels would change the composition of this substrate, except to remove some fine sediment.

Ability of Juvenile Fish to Withstand Predation during Drawdown.—Eight species of fish in Banks Lake have juveniles present in stands of aquatic macrophytes during August. These species include yellow bullhead, largemouth bass, pumpkinseed, longnose sucker, largescale sucker, bridgelip sucker, prickly sculpin, and northern pikeminnow. Juveniles of these species would be forced out of the protective cover of aquatic macrophytes and would be exposed to increased risk of predation. The amount of adverse impact on these species would depend on the length of time exposed to increased predation. The greatest impact would occur during the Low Water scenario, resulting in 43 days of littoral zone exposure, during which time increased predation could occur. Predation pressure may be offset somewhat in species that have rapidly growing, fairly large young. Largemouth bass juveniles tend to be larger by late summer (2 to 5 inches) than other species. Their larger size may enable some to escape predators better than smaller individuals. Rainbow trout and kokanee are stocked at a larger size to avoid predation.

Ten species of fish have juveniles that are not present in aquatic macrophytes or other shallow water habitats during August; therefore, changes in water levels would not affect their susceptibility to predation. These species include channel catfish, brown bullhead, smallmouth bass, black crappie, walleye, yellow perch, lake whitefish, mountain whitefish, peamouth chub, and common carp. Bluegills are able to withstand extreme water level fluctuations. Rainbow trout and kokanee are unable to naturally reproduce in Banks Lake and are stocked at larger sizes to prevent predation.

- *Ictaluridae.*—Juvenile channel catfish are not dependent on vegetation for cover but rely on turbid water to avoid predation. At water surface elevation 1560 feet, shallow, turbid water would still be available along much of the western shoreline and in bays such as Osborn, Kruk's, Jones, and Airport, as well as in the Devil's Punch Bowl and Barker Cove (see figures 3-6). Therefore, increased predation on juvenile channel catfish would not result under the Action Alternative. Brown bullhead juveniles disperse to deeper water in the fall and should not experience elevated predation rates.

- *Centrarchidae.*—Juvenile largemouth bass cruise the shorelines as they mature but still require the cover of logs, brush, and vegetation for protection from predation. Drawdowns may force juveniles out of the protective cover of aquatic macrophytes, increasing predation risk temporarily. Smallmouth bass juveniles are dispersed in deeper water by summer and should experience little increase in predation.

- *Percidae.*—By late summer, juvenile walleye move toward the lake bottom in 10 to 30 feet of water. There would be little increase in predation as a result of drawdown. Yellow perch juveniles move into deeper water by mid- to late summer but could be exposed to increased predation for 23 to 43 days, depending on the drawdown scenario.

- *Salmonidae*.—The young of mountain whitefish move offshore in summer and should experience no increase in predation risk. Rainbow trout are stocked at a size large enough to avoid most predation.

- *Cyprinidae*.—Young common carp move into deeper water in late summer and would experience little increase in predation risk. However, young northern pikeminnows are found in shallow vegetation and would be exposed to increased predation.

- *Catostomidae*.—The young longnose suckers, large-scale suckers, and bridgelip suckers remain in shallow, weedy areas of lake shores and would likely be subjected to increased predation during drawdown.

- *Cottidae*.—Young prickly sculpin occupy shallow vegetation and would be subject to increased predation as water levels drop below the shallow aquatic macrophyte zone.

Quantity and Quality of Aquatic Food Base.—Aquatic plants that support bacteria, zooplankton, benthic invertebrates, and fish can be affected directly and indirectly by water level fluctuations. Water level changes directly affect phytoplankton (single-celled algae) by physical entrainment and removal in reservoir outflows (Benson and Cowell 1967) and indirectly affect nutrient concentrations, turbidity (which affects light levels), temperature, and grazing pressure (Jones and Bachmann, Prediction..., 1978; Jones and Bachmann, Trophic..., 1978).

Zooplankton—Water level changes rarely directly affect zooplankton. Direct effects are limited to displacement or removal, due to shortened water retention time (Benson and Cowell 1967). As reservoir pool elevation drops 10 feet, water temperatures would increase slightly. The north pool would remain weakly stratified, while the south pool would become slightly more stratified. Water quality conditions in the north pool would not change under any of the drawdown and refill scenarios. The exchange rate would be similar to the present condition. Nutrients and zooplankton would continue to be diverted into Banks Lake from the Columbia River as at the present time. The overall abundance and diversity of zooplankton would not be significantly impacted by the Action Alternative.

Benthic Invertebrates.—Benthic invertebrates are directly affected by changes in water levels: (1) exposure and mortality of species with poor mobility or without resting mechanisms, and (2) entrainment and loss of planktonic stages from reservoirs during periods of rapid discharge (Agass 1960). Indirect effects result from changes in habitat, food resources, or the chemical environment. The most obvious direct effect of water-level changes on benthos is exposure and desiccation after drawdown. Mortality of exposed organisms reduces populations within the fluctuation zone and may partly explain the inverted vertical distributions of benthos observed in fluctuating reservoirs. The abundance of benthos in nonfluctuating reservoirs usually is greater in shallow areas than in deep areas; however, in fluctuating reservoirs, inverted distributions may result from the lack of a littoral

community or concentration of mobile species at or just below the drawdown limit (Davis and Hughes 1966; Cowell and Hudson 1967).

Adverse impacts to benthic invertebrates from drawdowns at other reservoirs have been well documented. Limnological studies conducted in Hungry Horse and Libby Reservoirs described seasonal productivity of the food web in relation to drawdown (Independent Scientific Advisory Board 1997). Summer and fall growth periods for mountain whitefish, northern pikeminnow, largescale suckers, longnose suckers, and yellow perch were driven mainly by abundance of zooplankton and benthic midges, although terrestrial insects were also of considerable importance. Availability of these forage sources was found to be influenced by seasonal temperature and drawdowns. Reservoir environments were more productive, and fish grew faster when reservoirs filled early and were not deeply drafted in the summer. August drawdown affects a somewhat different complex of invertebrates, leading to reductions in the food supply for resident fishes at a critical time for growth. Because those invertebrates have a life cycle extending for more than 1 year, their reduction in the fall carries over into the spring, exacerbating the changes brought about by spring drawdown (Independent Scientific Advisory Board 1997). The applicability of these studies to Banks Lake benthic invertebrates is somewhat offset by the scale of the drawdowns. At Banks Lake, the proposed additional drawdown is 5 feet whereas the drawdowns at Hungry Horse and Libby were 30 feet or more.

It is likely that some adverse impacts to benthic invertebrates would occur during the 5-foot August drawdown to elevation 1560 at Banks Lake, resulting from changes in water levels through exposure and mortality of species with poor mobility or without resting mechanisms. Mortality of exposed organisms would reduce populations within the fluctuation zone. Indirect effects result from changes in habitat, food resources, or the chemical environment.

Summary of Impacts.— A summary of impacts to fish and its habitat for spawning and nurseries, juvenile fish predation, and aquatic food base is shown in table 4-4, 4-5, and 4-6.

Table 4-4.—Summary of impacts to quantity and quality of spawning and nursery habitat

Measurement	No Action	Action Alternative
Shallow aquatic macrophytes	Present distribution, abundance, and species composition likely to remain unchanged.	Low impact. Drought -tolerant species including the two dominant species at Banks Lake—reed canarygrass and Baltic rush, as well Nebraska sedge, beaked sedge, hardstem bulrush, common spikerush, common cattail, and narrow-leaved cattail would persist in the littoral zone and continue to be available to spawning adults and rearing larvae. Cattails and reed canarygrass stands may become denser, which may lower suitability for spawning and rearing. Drought-sensitive plant species may be replaced by drought-tolerant species. Substrate in low gradient bays and shorelines would not change due to erosion or sediment deposition.
Shallow, unvegetated flats	Present conditions would remain unchanged. Significant erosion unlikely.	Low impact. Low gradient flats would remain available below water surface elevation 1560 feet in most areas of the lake. Substrate in low gradient flats would not change due to erosion or sediment deposition. Some areas of steep gradients subject to increased erosion.
Boulders, cobble, gravel	Present conditions would remain unchanged.	Low impact. Drawdown may remove some fine sediment, but basic structure would remain unchanged.

Table 4-5.—Summary of impacts —Susceptibility of juvenile fish to predation

Species	No Action	Action Alternative
Channel catfish	No impact. No increase in susceptibility to predation.	No impact. Juveniles rely on shallow water for predator protection, but not on vegetation cover. Shallow water would still be available below 1560 ft in most areas. No increase in susceptibility to predation.
Brown bullhead	No impact. No increase in susceptibility to predation.	No impact. Susceptibility of juveniles to predation unchanged, as they are normally dispersed in deeper water by August.
Yellow bullhead	No impact. No increase in susceptibility to predation.	Adverse impact. Juveniles dependent on aquatic macrophyte cover for predation protection. Would be forced from cover and exposed to predation 23 to 43 days, depending on drawdown scenario.
Largemouth bass	No impact. No change in susceptibility of juveniles to predation.	Adverse impact. Young cruise shoreline as they mature but still require cover of logs, brush, and aquatic macrophytes for predator protection. Would be exposed to increased predation 23 to 43 days. Relatively large size of young (2 to 5 inch) may reduce predation risk somewhat.
Smallmouth bass	No impact. No change in susceptibility of juveniles to predation.	No impact. Susceptibility of juveniles to predation unchanged, as juveniles are dispersed in deeper water by August.
Black crappie	Same as above.	No impact. Susceptibility of juveniles to predation unchanged, as juveniles are dispersed in deeper water by August.
Bluegill	Same as above.	No impact. This species withstands extreme water level fluctuations well.
Pumpkinseed	Same as above.	Adverse impact. Young rely on dense aquatic macrophytes for predator protection. Preyed on heavily by many species. Juveniles exposed to increased predation risk 23 to 43 days.

Species	No Action	Action Alternative
Walleye	Same as above.	No impact. Susceptibility of juveniles to predation unchanged, as juveniles move toward lake bottom in 10 to30 feet of water by late summer and would be unaffected by drawdown to elevation 1560 feet.
Yellow perch	Same as above.	Adverse impact. Juveniles rely on dense aquatic macrophytes until late fall. Size of young can be as small as 1.8 inch in August. Preyed on heavily by predatory fish. Would be exposed to increased predation 23 to 43 days.
Rainbow trout	No impact. Unable to establish reproducing population.	No impact. Trout stocked at larger sizes would not be susceptible to predation.
Kokanee	No impact. Reservoir population has declined signifi-cantly, due to insufficient zoo-plankton populations.	No impact. No increase in zooplankton production anticipated. Populations would continue to rely on stocking larger individuals.
Lake whitefish	No impact. No change in susceptibility of juveniles to predation over current conditions.	No impact. Susceptibility of juveniles to predation unchanged. Young move into deeper water by early summer.
Mountain whitefish	Same as above.	No impact. Susceptibility of juveniles to predation unchanged as juveniles move offshore in summer.
Longnose sucker	Same as above.	Adverse impact. Young remain in weedy shallows and may be exposed to increased risk of predation 23 to 43 days.
Largescale sucker	Same as above.	Adverse impact. Fry feed in vegetated shallows at night. May be exposed to increased predation 23 to 43 days, depending on drawdown scenario.
Bridgelip sucker	Same as above.	Adverse impact. Young remain in weedy shallows. Exposed to increased risk of predation 23 to 43 days. Young somewhat larger than other suckers in summer (2.5 to 3.1 inch), which may reduce vulnerability to predation somewhat.
Prickly sculpin	Same as above.	Adverse impact. Young rely on shallows with aquatic macrophytes. Exposed to increased risk of predation 23 to 43 days. Young sculpin are quite small (1.4 inch) in summer.
Peamouth chub	Same as above.	No impact. Juveniles move into deeper water in late summer.
Northern pikeminnow	Same as above.	Adverse impact. Young in 3-feet-deep water with vegetation in summer. Exposed to increased risk of predation 23 to 43 days. Young relatively small in summer (1.8 inch) and are vulnerable to predation.
Common carp	Same as above.	No impact. Juveniles move to deeper water as they mature.

Table 4-6.—Summary of impacts to the quantity and quality of the aquatic food base

Measurement	No Action	Action Alternative
Zooplankton	No impact. Low reservoir water retention times would continue to limit zooplankton production.	No impact. No substantial changes in water retention times. No change in zooplankton production.
Benthic invertebrates	No impact. Relatively minor water level changes would allow the continued production of benthic invertebrates.	Moderate impact. Ten foot August drawdown would reduce production of benthic invertebrates in exposed areas, but remaining shallow habitat still productive.

Fish Nets at Dry Falls Dam.—Impacts to the fish nets would be the same as for the No Action Alternative. Maintenance and cleaning using the wash barge would be possible because access to the water would be developed under recreation mitigation activities.

Wildlife

To determine how the proposed August drawdown affects wildlife, the distribution, abundance, and species composition of littoral zone wildlife species were analyzed. Analysis centers principally on the impacts of drawdowns on two habitats: aquatic macrophytes in shallow bays and protected shorelines, and the thin strip of riparian vegetation.

No Action Alternative

The present distribution, abundance, and species composition of wildlife present in the littoral zone of Banks Lake is likely to remain unchanged from existing conditions.

Action Alternative

Raptors.—Most of the nesting substrate for raptors is along the adjacent cliffs, although some raptors may nest on mature cottonwoods and Russian olives along the shoreline. Raptors also use the mature trees as perch sites. It is unlikely that mature trees would be adversely affected either by increased erosion or by changes in groundwater during drawdowns.

Neotropical Migrant Songbirds.— Species such as red-winged blackbirds, yellow-headed blackbirds, and marsh wrens that nest in cattails would be unaffected by the Action Alternative, because aquatic macrophytes would remain largely intact. Other species that nest in riparian vegetation (such as willows, Russian olive, and cottonwoods) would not be affected, because little change, if any, would occur to mature trees. Over the long term, the seedlings of some willow species, as well as cottonwood, may be adversely impacted by extended drawdown periods. This may ultimately affect recruitment of the population of these plant species, which, in turn,

may affect nesting substrate for some species of warblers, grosbeaks, and vireos. Those species nesting in the uplands around Banks Lake would not be affected.

Waterfowl.—Water levels would remain stable during the waterfowl nesting and brood rearing season. Adequate aquatic macrophytes should remain available for cover and nesting. Drawdowns, however, do have an adverse impact on benthic invertebrates, which form a major source of food for newly hatched young. Grimas (1964) found that reservoir fluctuations as little as 33 feet can destroy littoral benthos, while 20-foot fluctuations can reduce densities up to 50 percent (Grimas 1962). The ability of benthic invertebrates to recolonize areas after drawdown may be insufficient to provide adequate food during this critical period. Offsetting this situation, however, is the potential for vegetation to establish in the variable (drawdown) zone during the last part of the growing season following the 10-foot drawdown. When reflooded in the fall, these plants provide excellent food for waterfowl, as well as fish.

Colonial Nesting Birds.—Under the Action Alternative, water levels would begin to decline after most chicks have been fledged. No land bridges that could provide access to nesting colonies by mammalian predators would be created.

Mammals.—The structure of aquatic macrophytes stands and riparian habitat would remain fundamentally unchanged. It is unlikely that mammals using either of these habitats would be adversely affected by the Action Alternative. However, highly aquatic species, such as the muskrat, may temporarily lose the cover of aquatic macrophytes during the drawdown period and may be at increased risk of predation. There should be no impact to muskrat or beaver dens that occur along the banks of the lake.

Amphibians and Reptiles.—The most notable impact of drawdowns to amphibians occurs when water levels are lowered in winter. The subsequent freezing of sediments can kill frogs, turtles, and invertebrates that overwinter in the drawdown area. However, all Action Alternative scenarios call for refill by September 22. Thus, winter mortality should not be a factor. Several amphibian species that potentially could inhabit Banks Lake use shoreline and upland habitats such as rotten logs, rocks, and low plant growth in the riparian area. Impacts are unlikely to occur to adults; however, the young of some species, such as salamanders, may be affected if they are unable to metamorphose to adults before the August drawdown begins. Highly aquatic species that rely on thick aquatic macrophytes, such as bullfrogs, would not be affected, because drawdowns are likely to cause common cattails to increase slightly. Habitat for reptiles is predominantly in the adjacent uplands, as well as in the riparian vegetation. These habitats would not be affected by the Action Alternative.

The Action Alternative would not adversely impact the distribution, abundance, and species composition of wildlife in the study area.

Summary of Impacts.—A summary of impacts to wildlife is shown in table 4-7.

Table 4-7.—Summary of impacts to wildlife

Measurement Distribution, abundance, and species composition of littoral zone wildlife	**No Action**	**Action Alternative**
Raptors	No impact. Present distribution, abundance, and species composition likely to continue unchanged.	Low impact. No adverse impacts to mature perch trees, but seedlings may be affected, reducing the availability of perch trees in the future. Russian olive would likely continue to spread, providing perching and nesting substrate. Distance to water from perch trees for species foraging on fish or waterfowl would be increased during drawdown, resulting in some adverse impact. Overall abundance of fish and waterfowl as food base would likely remain similar.
Neotropical migrant songbirds	No impact. Present distribution, abundance, and species diversity likely to continue unchanged. Populations would continue to be adversely impacted by external mortality factors, such as winter habitat losses, migration mortalities, etc.	Low impact. Drought -tolerant aquatic macrophytes would continue to provide cover and food. Riparian vegetation would continue to persist.
Waterfowl	No impact. Present distribution, abundance, and species likely to continue unchanged. Populations would be influenced by breeding habitat conditions in northern ranges.	Low impact. Water levels would remain stable during nesting and brood rearing. Drought-tolerant aquatic macrophytes would continue to provide cover and food.
Colonial nesting birds	No impact. Present distribution, abundance, and species composition likely to continue unchanged.	Low impact. Aquatic macrophytes would remain widespread, though some species changes may occur as drought-intolerant species drop out. Water levels drop after chicks fledge. No increased of predation would occur.
Mammals	No impact. Same as above.	Low impact. Habitat values remain largely unchanged; however, muskrats may be exposed to increased risk of predation.
Amphibians and reptiles	No impact. Same as above.	Low impact. Reservoir refilled before winter frost could kill any amphibians in mud substrate. Aquatic macrophyte stands remain largely intact. Reptile habitat unaffected.

Threatened, Endangered, and Special Status Species

The analysis of impacts to threatened, endangered, and special status species centers on potential impacts to the habitat required for each species, as well as potential changes in the availability of prey for species, such as the bald eagle.

No Action Alternative

Threatened, endangered, and special status species at Banks Lake would likely continue unchanged into the foreseeable future or may improve somewhat. Protective measures discussed in the Resource Management Plan for Banks Lake would likely improve overall habitat quality by instituting protective measures.

Action Alternative

The Banks Lake drawdown would augment flows in August, when flow objectives at McNary Dam are 200,000 cubic feet per second (cfs). This flow objective is intended to primarily benefit Snake River fall chinook salmon. The Snake River fall chinook juvenile migration tends to peak in mid-July, with numbers tapering off into mid-August. Nearly half of the Snake River fall chinook can be transported from the Snake River collector dams and may not benefit from flow augmentation through the McNary to Bonneville reach of the Columbia River (Connor et al, 1998; Connor et al. 2000; Conner et al. 2002; Connor et al. 2003a; Connor et al. 2003b). However, even barged fish are likely to benefit from flow augmentation from Bonneville Dam to ocean entry. A detailed analysis of impacts of flow augmentation is contained in the Biological Opinion (NMFS 2000). This document is incorporated in this EIS by reference.

The following analysis of impacts to federally listed threatened and endangered species present, or potentially present, at Banks Lake is included in the EIS as part of Reclamation's Biological Assessment, required under section 7(a)(2) of ESA.

Snake River Fall Chinook

This species migrates through the lower Snake and Columbia Rivers. Additional flows may potentially benefit this species. A detailed analysis of the benefits of flow augmentation is contained in the Biological Opinion (NMFS 2001) and is included in this document by reference.

Pygmy Rabbit

The Action Alternative would not affect the adjacent sagebrush-steppe community at Banks Lake either directly or indirectly and, therefore, would not affect the pygmy rabbit.

Bald Eagle

Bald eagles could be potentially impacted by changes in reservoir fish abundance and availability in shallow areas, abundance of waterfowl, and availability of suitable perch trees along the riparian zone. Overall abundance of fish may be adversely impacted as juveniles of nearly half of the species present would be forced out of the protective cover of aquatic macrophytes and subjected to increased predation during the August drawdown. However, these adverse impacts are moderated by the fact that exposure to predation occurs during a relatively short timeframe—23 to 43 days—and the fact that aquatic macrophytes would remain throughout the shallow littoral zone habitats, providing spawning substrate and cover for rearing juvenile fish. Water levels during critical spawning and rearing periods would not be altered from the current condition. Some decrease in benthic invertebrates and algae, as a result of drawdown, would reduce available food and slightly affect fish productivity. Overall zooplankton productivity is not anticipated to change.

Late summer drawdowns may encourage the growth of plants in the drawdown zone. The late summer drawdown, followed by rising water levels in the fall, is the basic technique used by reservoir managers to provide food for migrating waterfowl. It is possible that waterfowl numbers could increase during fall and winter as a result of August drawdowns. However, the supply of fish and waterfowl is not limiting to bald eagles currently present at Banks Lake. The slight increase in waterfowl availability is unlikely to benefit or adversely affect eagles.

Mature cottonwoods and willows are unlikely to be reduced or eliminated as a result of the Action Alternative, nor is the risk of erosion expected to increase. Therefore, mature perch trees used by eagles would be unaffected in the short term. However, over the long-term, if seedling survival is compromised during August drawdowns, the availability of perch trees may be reduced. This situation may be offset somewhat by Russian olive, an exotic species that is rapidly colonizing the shoreline of Banks Lake. As this is a drought-tolerant species, it is likely to continue to thrive and may provide suitable perches.

The increased distance between the water level and shoreline perch trees during the August drawdown may affect but not likely to adversely affect bald eagles. Eagles may be forced to abandon frequently used perch trees in favor of cliffs. Cliffs and other rocky outcrops, while used for perches by foraging eagles, are not preferred perch sites.

Ute Ladies'-Tresses

The Service (2002) indicates that the most suitable habitat present in the Banks Lake area exists at Bebe Springs and along two intermittent streams on the northwest side of Banks Lake. It is unlikely that these potentially suitable habitat areas would be affected by the Action Alternative.

Western Sage Grouse

Sagebrush-steppe communities needed by sage grouse exist above the influence of the littoral zone at Banks Lake and would not be affected by the Action Alternative.

Washington Ground Squirrel

Sagebrush-grassland habitat suitable for the Washington ground squirrel exists outside the influence of Banks Lake water levels. Additionally, it is unlikely that significant indirect impacts would occur to such factors as predator densities.

Species of Concern

Fringed Myotis.—Benthic invertebrates (mayflies, caddisflies, stoneflies, etc.) would be somewhat impacted by August drawdowns, resulting in some decreases of adult aquatic insects potentially available for bats. However, the overall structure and function of the aquatic macrophytes would remain intact, as would riparian vegetation species and the adjacent upland species. Insects that utilize these plants would remain unaffected and would be available for foraging bats. Roosting habitats would not be affected by the 10-foot drawdown.

Long-Eared Myotis.—Same as for fringed myotis.

Pale Townsend's Big-Eared Bat.—Because this species tends to forage more in uplands than over water or riparian areas, it is unlikely to be affected by the proposed drawdown.

Small-Footed Myotis.—This bat forages around cliffs, rock outcrops, and dry canyons and is unlikely to be affected by the proposed 10-foot drawdown.

Yuma Myotis.—The roost located near Northrup Creek would not be affected, nor would any human or resource management activities be altered as a result of the proposed 10-foot drawdown. Benthic invertebrates may be slightly reduced as a result of the August drawdown, but it should not adversely affect overall foraging for the Yuma myotis.

Black Tern.—The black tern may potentially exist in the marsh areas of Banks Lake during spring or fall migration. However, the proposed drawdown would not occur until August, and would be refilled by September 10. Overall productivity of the marshes in the littoral zone of Banks Lake would not be significantly reduced by the proposed drawdown and, thus, would not adversely affect the black tern.

Columbia Sharp-Tailed Grouse.—The proposed August drawdown would not adversely impact the shrub-steppe, grassland, or riparian habitats at Banks Lake and, thus, would have no effect on the Columbia sharp-tailed grouse.

Loggerhead Shrike.—The shrub-steppe habitats would not be affected by the proposed drawdown, nor would potential perch trees required by this species. There would be no effect to the loggerhead shrike.

Olive-Sided Flycatcher.—The coniferous trees in Northrup Canyon potentially used by this flycatcher would not be affected by the August drawdown.

Western Burrowing Owl.—The proposed drawdown would not affect any habitats utilized by this owl, as they are outside the Banks Lake littoral zone.

Northern Sagebrush Lizard.—The proposed drawdown would not affect any habitats utilized by this lizard.

Columbia Spotted Frog.—The Columbia spotted frog has been documented in the Banks Lake area (Service 2002), as well as scattered across much of eastern Washington. It prefers warm water marshes, wetlands, and bogs with nonwoody wetland vegetation. Given the abundant population of predatory fish in Banks Lake, it is unlikely that this species would be found in Banks Lake itself. However, there are several marshes on the east side of Highway 2, adjacent to Banks Lake that may provide suitable habitat. Declines in groundwater levels associated with the August drawdown may lower the water in these marshes. Larvae should have metamorphosed by late August and would not be adversely impacted by temporary declines in water level.

California Floater.—Overall, fish populations would not be significantly affected by a 10-foot August drawdown. While this species has not been documented at Banks Lake, the suitability for this snail species would continue to be adequate.

Chelan Rockmat.—Potential habitat along the basalt cliffs would be unaffected by an August drawdown.

Sticky Phacelia.—Potential habitat along the basalt cliffs would be unaffected by an August drawdown.

Table 4-8 presents a summary of impacts to species of concern.

Table 4-8.—Summary of impacts to species of concern

Species	No Action	Action Alternative
Snake River fall chinook salmon	No impact.	Potential beneficial impact. Contributes to flow augmentation for juvenile migration.
Pygmy rabbit	No impact.	No impact. Sagebrush-steppe habitat would not be affected by proposed drawdown.
Bald eagle	No impact to breeding or winter habitat.	No impact to food and perch availability. Potential impact during drawdown, as distance from perches to lake level for foraging increase.
Ute ladies'-tresses	No impact.	No impact to potential suitable habitat at Bebe Springs and two intermittent streams.
Western sage grouse	No impact.	No impact to sagebrush-steppe habitat.
Washington ground squirrel	No impact.	No impact. Sagebrush-steppe habitat not affected by drawdown.
Fringed myotis	No impact.	No impact. Some benthic invertebrates would be adversely affected, but overall insect abundance would remain unaffected.
Pale Townsend's big-eared bat	No impact.	No impact to roosting or foraging habitats.
Small-footed myotis	No impact.	No impact to roosting or foraging habitats.
Yuma myotis	No impact.	No impact to Northrup Canyon roost site. Overall insect abundance unaffected.
Black tern	No impact.	No impact to fall and spring habitat areas in aquatic macrophytes.
Columbia sharp-tailed grouse	No impact.	No impact to habitat areas in Barker Canyon or Northrup Canyon.
Loggerhead shrike	No impact.	No impact to shrub-steppe, pine-oak, and pinon juniper woodlands.
Olive-sided flycatcher	No impact.	No impact to conifer trees in Banks Lake area.
Western burrowing owl	No impact.	No impact to shrub-steppe habitat.
Northern sagebrush lizard	No impact.	No impact to sagebrush-steppe habitat.
Columbia spotted frog	No impact. Unlikely to be present in Banks Lake, due to presence of abundant predatory fish. May be in adjacent wetlands.	No impact. Water level in adjacent wetlands may decline after young have metamorphosed to adult stage.
California floater	No impact.	No impact.
Chelan rockmat	No impact.	No impact to potential habitat along basalt cliffs. Outside littoral zone and influence of August drawdown.
Sticky phacelia	No impact.	No impact to potential habitat along basalt cliffs. Outside littoral zone and influence of August drawdown.

Recreation

No Action Alternative

Historically, elevation changes to Banks Lake have an effect on the availability of recreational resources surrounding the lake. Under the No Action Alternative, there are no additional effects on the current recreational opportunities at Banks Lake. Banks Lake is recognized locally and regionally for its diverse and outstanding recreational opportunities. These opportunities exist throughout the area for camping, swimming, boating, picnicking, and other recreational pursuits under the No Action Alternative.

Public use varies seasonally, with peak activity and visitation occurring from mid-May through September. Both local residents and people who generally travel 100 to 200 miles use the area. Most out-of-area users are from the Puget Sound (Seattle/Tacoma) area, and are looking for uncrowded recreational opportunities, sunny days, and warm water. Over the Labor Day weekend, most camping and recreational facilities are at full capacity.

Action Alternative

The Action Alternative may have various impacts to the recreational opportunities at Banks Lake. Of the 19 developed recreational areas, 12 maintain usable boat launches. Anecdotal evidence, developed during the project's scoping process, suggests that drawing the lake down lower than elevation 1565 feet would negatively affect some recreational facilities and operations on the lake. For example, the following boat launches are left out of the water and thus rendered unusable at elevations lower than 1565: Steamboat Rock State Park, Sunbanks Resort, and Coulee City Community Park (see figures 3-2 and 3-3). Coulee City Community Park has the only accessible boat launch for the southern half of the lake at elevation 1565 feet. A 10-foot drawdown to elevation 1560 feet would leave only two boat launches for use: Steamboat Rock Rest Area and Coulee Playland. These two boat launches are located on the northern portion of the Lake. No boat launch would remain for the southern half of the lake.

Reclamation does not directly manage any of the recreational sites at Banks Lake. The WDFW is currently responsible for the operation and maintenance of six boat launch sites, and the SPRC is responsible for three boat launch sites at Banks Lake. Operation and maintenance responsibilities for the other boat launches located on the lake (Coulee Playland, and Coulee City Community Park) are the responsibility of the respective lessee or concessionaire. Sun Banks Resort is located on non-Federal land and is administered by the WDNR.

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. These changes to the recreational

opportunities may have adverse effects and lead to decreased visitor use at the recreation areas on the lake.

The Washington State Department of Transportation is concerned that lower water levels may affect the stability of the road bed where State Highway 155 directly abuts the lake. Wave action on the lower portion of the subgrade may erode the roadway foundation. In addition, the underground/underwater power line that serves the recreation area at Steamboat Rock State Park would be exposed near the Steamboat Rest Area and Boat Launch.

As previously stated, the primary facilities that could be affected by lowering the lake would be boat launches, mooring docks, and swimming beaches at the various water access sites. In addition, the channels used to proceed from the boat launching areas (i.e., at Coulee City Community Park, Steamboat Rock State Park, and Sun Banks Resort) to the main body of the lake may become too low to allow the passage of watercraft. During drawdowns, rocks and sandbars are sometimes exposed or lie just below the surface. Launching is reported to increase at the Steamboat Rock Rest Area and Boat Launch during low water surface elevation periods (Steinmetz 1998).

Recreation Visits.—The recreational opportunities that are available at Banks Lake can be reduced because of several factors. A degree of difficulty regarding watercraft access may be present at water elevations below 1565 feet. A minimum water elevation of 3 feet above that toe of a boat ramp is usually necessary for launching a medium sized boat. Only two boat launches would be available at elevation 1560 feet, Coulee Playland and the Steamboat Rock Rest Area and Boat Launch. Watercraft could access the lake; however, it would be limited, and usage would increase at those sites.

Dock and mooring areas may also be rendered unusable by lower water levels. Most docks on the lake are floatable to accommodate some variation in lake levels and still be usable. However, because the lake elevation rarely has gone lower than elevation 1565 feet, docks and mooring areas may be unusable at this level without additional modifications. Accessibility requirements would also have to be addressed.

Coulee City Community Park, the channel between Devil's Punch Bowl and the main body of the lake, and Sun Banks Resort have been identified as places where water levels below elevation 1565 feet impede watercraft access to the main body of the reservoir.

Swimming is a popular activity at Banks Lake. Low water levels may negatively affect the four developed swimming areas on the reservoir. Beach areas may be left high and dry at water levels below 1565 feet.

Mitigation

Extending boat launches, modifying mooring docks, and dredging deeper channels would improve watercraft access at lower water levels. Funds would be provided to ensure that usable boat ramps, courtesy docks, and swimming areas still exist on both the north and south ends of Banks Lake so that public access would be maintained to the lake for recreational purposes.

Economics

Hydropower Resources

The Bonneville Power Administration has developed a Federal Columbia River Basin Power System model that they use to determine power impacts to the integrated FCRPS system resulting from changes in facility operations at the different participating projects. The changes in operation of Banks Lake and Grand Coulee Dam and the resulting impact to FCRPS hydropower generation under the Action Alternative were evaluated by BPA. Reclamation estimated impacts to the three PUDs. GCPHA provided estimates of changes in power generation at the Main Canal Powerplant as a result of changes in head due to Banks Lake level fluctuations.

Power impacts are composed of two measures—the first being capacity values, the second being energy values. Capacity values are derived from the fixed costs of the hydropowerplants and include the fixed costs of the plant, fixed fuel inventory cost, fixed operation and maintenance (O&M) costs, administrative and general expenses, and transmission costs and losses to load center. Energy values are composed of the variable costs of the hydropowerplant and are made up of two components, variable O&M cost and variable fuel costs.

Hydropower Generation Impacts

Changes in power generation for all Grand Coulee powerplants and the resulting impacts to the FCRPS would occur mainly in the month of August, when Banks Lake would be drawn down to its lowest levels under the Action Alternative. These changes in hydropower generation at Grand Coulee and the five PUD hydro-powerplants result from changes in the timing and duration of releases from Grand Coulee Dam to meet endangered fish flow targets in the Columbia River at McNary Dam. Water that would have been pumped from FDR Lake up into Banks Lake during the month of August would be released through Grand Coulee Dam. Banks Lake would be drafted by irrigation demands and then refilled in September to elevation 1570 feet. The August release from FDR Lake and September refill of Banks Lake results in changes in power revenues due to lower power rates in August (when additional power is generated from increased releases from Grand Coulee Dam) and higher rates in September (when power generation is reduced due to flows being diverted to Banks Lake instead of the Columbia River). Additional revenue

impacts to the FCRPS and the PUD hydropowerplants would also be experienced as a result of spill requirements. During August, some projects are required to spill a percent of their flow for fish passage, thus they are not able to run all of the flows through their generators to produce power. This results in a reduced amount of water to generate with as well as reduced revenues from selling power at lower August power rates. There are no spill requirements in September.

Less energy would be generated at the GCPHA Main Canal powerplant because of the head loss accompanying reduced lake elevations. This would also continue until Banks Lake refilled.

FCRPS Impacts

Preliminary impacts to the FCRPS were provided by BPA and were discussed by level of drawdown for each alternative for comparison. Impacts were measured as a result of Banks Lake drawdown from water surface elevation 1570 feet to 1565 feet and elevation 1565 feet to 1560 feet during the month of August and reported in megawatt-hours (MWh). MWh impacts were then converted to real dollar values, using replacement cost values representing the next 3 years rates for the mean Light Load Hour (LLH) and Heavy Load Hour (HLH) rates estimated by BPA. The net energy[1] impact resulting from refill of Banks Lake to elevation 1570 feet by September 23 was also estimated, as well as an estimate of the net annual revenue impact from a comparison of the No Action and Action Alternatives. BPA anticipates that there would be no change in total FCRPS capacity[2] as a result of the Action Alternative flow changes and timing of releases from Grand Coulee Dam through Bonneville Dam. Additionally, because the net energy loss over the August-through-September period is small, there is no significant effect on the FCRPS ability to meet future loads. Tables 4-9 and 4-10 display the FCRPS energy generation for each alternative.

[1]Energy is the electric power provided by generators and measured in kilowatts over a period of time, usually hours, to yield kilowatt-hours (kWh).

[2]Capacity is the maximum load or demand that a generator or system can carry under existing service conditions.

**Table 4-9.—FCRPS energy generation
No Action Alternative (MWh and $).**

No Action Alternative	Low water scenario	Early, Uniform, and Late Drafts
Power generated from Grand Coulee to Bonneville	85,000	85,000
Value of energy generated	$2,079,100	$2,587,400
Reduced pump load by not pumping to Banks in August	33,000	33,000
Value of energy generated	$807,180	$1,004,520
Pump load to refill Banks to elevation 1570 feet	(33,000)	(33,000)
Energy replacement cost	($1,180,080)	($1,180,080)
Loss in generation from Coulee to Bonneville due to refill	(93,000)	(93,000)
Energy replacement cost	($3,325,680)	($3,325,680)
Total FCRPS energy impact (MWh)	**(8,000)**	**(8,000)**
Total FCRPS revenue impact	**($1,619,480)**	**($913,840)**

* Banks Lake would begin drafting July 22 from elevation 1570 feet to be at water surface elevation 1565 by August 1. These numbers are compared to no draft at Banks Lake.
Source: BPA, FCRPS model.

**Table 4-10.—FCRPS energy generation
Action Alternative (MWh and $).**

Action Alternative	Low water scenario	Early, Uniform, and Late Drafts
Power generated from Grand Coulee to Bonneville	166,000	166,000
Value of energy generated	$4,544,740	$5,053,040
Reduced pump load by not pumping to Banks in August	66,000	66,000
Value of energy generated	$1,811,700	$2,009,040
Pump load to refill Banks to elevation 1570 feet	(66,000)	(66,000)
Energy replacement cost	($2,380,000)	($2,380,000)
Loss in generation from Coulee to Bonneville due to refill	(182,000)	(182,000)
Energy replacement cost	($6,562,792)	($6,562,792)
Total FCRPS energy impact (MWh)	**(16,000)**	**(16,000)**
Total FCRPS revenue impact	**($2,586,352)**	**($1,880,712)**

Source: BPA

No Action Alternative—Under this alternative, Banks Lake water surface elevation could draft to elevation 1565 feet prior to August 1 during a low water year or be lowered from1570 to1565 feet in August during normal water years. During a low water year in which Banks Lake remained at water surface elevation 1565 feet for the month of August, drafting Banks Lake from water surface elevation 1570 feet to elevation 1565 feet would occur during the latter part of the month of July and provide 85,000 MWh of energy production. During normal water years, drafting

Banks Lake from elevation 1570 to 1565 feet would likewise result in 85,000 MWh of energy production to the FCRPS for the month of August, due to higher Grand Coulee flows through Bonneville. Not pumping water from FDR Lake into Banks Lake to replace irrigation demands for the month of July and August would reduce the FCRPS load by about 33,000 MWh per 5 feet of draft.

The refill of Banks Lake from water surface elevation 1565 to 1570 feet would require an additional load of 33,000 MWh to run the pumps and would result in a loss of generation of 93,000 MWh of energy, due to the reduction of flows from Grand Coulee Dam through Bonneville Dam. Annual energy impacts to the FCRPS result in a generation loss of 8,000 MWh under all the No Action Scenarios.

Action Alternative.—

Low Water Scenario.—Estimated power generation for the Action Alternative low water scenario which drafts Banks Lake from water surface elevation 1570 feet to1565 feet in the last 10 days of July and then from 1565 to1560 the first 10 days of August and refills to elevation 1570 feet during the first 22 days of September results in net energy loss to the FCRPS of 16,000 MWh.

Early, Uniform, and Late Draft Scenarios.—The early draft scenario starts with Banks Lake at water surface elevation 1570 feet on August 1 and relies on the expected irrigation demands for the month to draft the lake down to water surface elevation 1560 feet. This would take 20 to 31 days, after which pumping would resume to maintain Banks Lake at water surface elevation 1560 feet through the end of the month. The uniform draft scenario assumes that beginning August 1, the Banks Lake pool water surface elevation is 1570 feet and is drafted evenly through August to water surface elevation 1560 feet. The late draft scenario would start drafting Banks Lake from elevation 1570 feet on August 11 reaching the final elevation of 1560 feet on August 31.

These three scenarios would each result in 166,000 MWh of energy production to the FCRPS for the month of August, due to higher flows from Grand Coulee Dam through Bonneville Dam. A reduction in pumping water from FDR Lake into Banks Lake to replace irrigation demands for the month of August would reduce the FCRPS load by about 66,000 MWh.

The refill of Banks Lake due to this Federal action (drafting from elevation 1570 feet to 1560 feet) requires the refill of 10 feet (elevation 1560 to 1570) by September 23. Refilling Banks Lake from water surface elevation 1560 to 1570 feet would require an additional load of 66,000 MWh to run the pumps and result in a loss of generation of 182,000 MWh of energy, due to the reduction of flows from Grand Coulee Dam through Bonneville Dam.

Taking into account both the drawdown and the refilling of Banks Lake under the Action Alternative scenarios of low water, early, uniform, and late draft, annual energy impacts to the FCRPS result in generation losses of 8,000 MWh under the

No Action alternative scenarios and 16,000 MWh for the Action Alternative scenarios during the July, August, and September time period.

Net Energy Impacts to the FCRPS.—Table 4-11 displays the resulting net changes in FCRPS energy production as a result of comparing the No Action Alternative against the Action Alternative for Banks Lake operational changes. Net energy impacts are a loss of 8,000 MWh for all the scenarios of the Action Alternative. The cost of each of these net energy impacts are calculated using the projected mean LLH and HLH energy values for July, August, and September provided by BPA. This loss can be attributed to spill requirements at the lower FCRPS projects during July and August when drafting Banks Lake. There are no spill requirements in the month of September during refill. Because of spill requirements during July and August, all of the additional flows cannot be used to generate power. Likewise, flows normally used in September to generate will be reduced during the refill of Banks Lake.

Table 4-11.—Net FCRPS energy impacts from Banks Lake operational changes (MWh and $).

Alternative and item	Low water scenario	Early, Uniform, and Late Drafts
No Action Alternative		
Net FCRPS generation (MWh)	(8,000)	(8,000)
FCRPS energy replacement cost through refill of Sept 22	($1,619,480)	($913,840)
Action Alternative		
Net FCRPS generation (MWh)	(16,000)	(16,000)
FCRPS energy replacement cost through refill of Sept 22	($2,586,352)	($1,880,712)
Total net FCRPS change through refill of Sept 22 (MWh)	(8,000)	(8,000)
Total net FCRPS energy replacement cost through refill of Sept 22 ($)	($966,872)	($966,872)

Main Canal Low Head Powerplant —GCPHA

No Action Alternative.—Under No Action, Banks Lake levels do not go below water surface elevation 1565 feet, which represents the normal current historic range of lake operations. The GCPHA powerplant would continue to operate as it has historically, as shown in table 4-12.

Table 4-12.—GCPHA power generation—No Action Alternative

	Low water early draft	Early draft	Uniform draft	Late draft
Maximum daily capacity (MW)	20.5	23.1	23.1	23.1
Energy (MWh)	30,667	31,622	32,100	32,522

Source: GCPHA

Action Alternative.—Table 4-13 displays the capacity and energy generation at the GCPHA powerplant.

Table 4-13.—GCPHA power generation—Action Alternative

	Low water early draft	Early draft	Uniform draft	Late draft
Maximum daily capacity (MW)	20.5	23.1	23.1	23.1
Energy (MWh)	28,972	29,930	30,883	31,711

Source: GCPHA

Table 4-14 displays the GCPHA power generation difference between No Action and the Action Alternative. A capacity cost of $3,300 per MW and an energy replacement cost of $30.44 for August and $36.12 for September per MWh were used to arrive at the maximum estimated annual dollar losses for each alternative comparison.

Table 4-14.—GCPHA power generation impacts

	Low water early draft	Early draft	Uniform draft	Late draft
Capacity difference (MW)	0	0	0	0
Capacity loss	0	0	0	0
Energy difference (MWh)	1,695	1,692	1,217	812
Energy replacement cost	$53,600	$53,527	$39,062	$26,715
Total estimated replacement cost (capacity and energy)	$53,600	$53,527	$39,062	$26,715

Costs for kokanee entrainment net inspection and maintenance would be incurred by either alternative at a cost of $8,000 to $10,000 annually.

Public Utility District Hydropowerplants on the Columbia River

Impacts were estimated to the five PUD hydropowerplants downstream of Chief Joseph Dam, between Chief Joseph and McNary Dams on the Columbia River. A comparison between the No Action and Action Alternative scenarios was made to arrive at the net change in energy production resulting from increased Columbia River flows during August and the subsequent reduced flows attributed to the Banks Lake refill period.

Each of the PUDs would need to replace the net energy generation lost as a result of operations under the Action Alternative to continue providing power to their customers. Using the same average energy replacement cost of $30.44 per for August and $36.12 for September per MWh, the maximum estimated annual dollar losses for each alternative scenario comparison were determined. Table 4-15

displays the energy generation and replacement power cost impacts to Wells, Rocky Reach, Rock Island, Wanapum and Priest Rapids hydropower projects.

Table 4-15.—Energy impacts to PUD powerplants on the Columbia River (MWh).

	Low water	Early draft	Uniform draft	Late draft
No Action Alternative—Energy generation				
Wells	(202)	(202)	(98)	0
Rocky Reach	(420)	(420)	(203)	0
Rock Island	(970)	(970)	(469)	0
Wanapum	(2,425)	(2,425)	(2,425)	(2,425)
Priest Rapids	(3,734)	(3,734)	(3,734)	(3,734)
Total energy generation	(7,751)	(7,751)	(6,929)	(6,159)
Action Alternative—Energy generation				
Wells	(394)	(296)	(191)	(79)
Rocky Reach	(820)	(615)	(397)	(164)
Rock Island	(1,420)	(1,065)	(687)	(284)
Wanapum	(4,733)	(4,733)	(4,733)	(4,733)
Priest Rapids	(7,290)	(7,290)	(7,290)	(7,290)
Total energy generation	(14,657)	(13,999)	(13,298)	(12,550)
Total Net energy impact (MWh of replacement power needed)				
Wells	192	94	93	79
Rocky Reach	400	195	194	164
Rock Island	450	95	218	284
Wanapum	2,308	2,308	2,308	2,308
Priest Rapids	3,556	3,556	3,556	3,556
Total replacement power needed	6,906	6,248	6,369	6,391
Total Net Energy Replacement Cost ($)				
Wells (Douglas Co.)	52,013	1,882	1,238	221
Rocky Reach (Chelan Co.)	72,185	5,616	4,276	2,160
Rock Island (Chelan Co.)	42,845	7,387	8,128	7,337
Wanapum (Grant Co.)	125,663	82,159	82,159	82,159
Priest Rapids (Grant Co.)	158,995	128,156	128,156	128,156
Total net energy replacement cost	451,701	225,200	223,957	220,033

Source: Pacific Northwest Region

Wells, Rocky Reach, and Rock Island Dams have spill requirements in July and the first half of August, but none the second half of August or September. Wanapum and Priest Rapids have spill requirements during all of July and August and none in September.

Summary of Resulting Impacts to Power Rates

Although the pump/generators play an important role in load management for the FCRPS, they are a small part of a large system, made up of many facilities whose operations can be adjusted to compensate for this small overall change in a single facility's generation or use. Net revenue losses based on power replacement costs are estimated to be $966,872 for the Low Water, Early, Uniform, and Late Draft scenarios of the Action Alternative. Spreading these costs over the entire BPA rate base could result in insignificant rate changes. This is borne out in the significant changes in operations for the entire Columbia River power system, which were analyzed for the alternatives in the Columbia River System Operation Review Final EIS.

Impacts to GCPHA as a result of decreased generation and increased expenses could range from annual maximums of $36,715 to $63,600, including annual maintenance costs on the kokanee entrainment nets. These revenue losses range from 5 to 8 percent of GCPHA's annual operating revenues and may affect rates to GCPHA customers. Greater impacts would be expected in drought years when market conditions could result in significantly higher replacement power rates.

Columbia River hydropower generation impacts to the three PUDs of Grant, Chelan, and Douglas Counties range from estimated losses of $221 for Douglas County up to a total of $284,658 for Grant County, based on replacement power costs in August and September of $30.44 and $36.12 per MWh. These impacts collectively range from $220,033 to $451,701. However, these impacts should have an insignificant effect on customer power rates when spread over each counties rate base and its contracted customers.

As a result of the impacts, it is not anticipated that there would be significant retail rate changes, either increases or decreases, to FCRPS, GCPHA, or the three counties PUD customers as a result of drawing down Banks Lake during the month of August and its subsequent refill. Operation and maintenance costs to the power users and irrigators are also not anticipated to be affected by the proposed change in Banks Lake operations.

Regional/Local Economy

It follows that a change in operating procedures like those included in the Action Alternative could have a direct effect on some parts of the local and regional economic environment. Economic data, historic visitor use data, and expected future visitor use, were all considered in identifying and discussing expected impacts. A fourth factor, the length of time the reservoir would be at levels below 1565 feet, was also considered. This analysis and a qualitative analysis of the other factors are provided for the comparison of alternatives for decision making purposes.

The context, intensity, and duration of impacts were used to compare the Action Alternative to the No Action Alternative. Context refers to the relative area within

which impacts occur; for the most part, impacts from the Action Alternatives would affect a regional area (Grant County) and/or a local area (e.g., a gateway community such as Coulee City).

Impact intensity is the degree to which a topic is positively or negatively affected. For this analysis, impacts on recreation were qualitatively evaluated and described. The following terms were used to describe the level of impact:

- Negligible – the impact is at the lower levels of detection.
- Minor – the impact is slight but detectable.
- Moderate – the impact is readily apparent.
- Major – the impact is severely adverse or exceptionally beneficial.

Impact duration refers to how long an impact would last. For this evaluation of impacts, the following definitions of duration were used:

- Short term – the impact lasts less than 3 years.
- Long term – the impact lasts more than 3 years (and can be considered a permanent change in conditions).

The various permutations of the No Action Alternative never permit the lake level to go below elevation 1565 feet. This alternative represents the normal current range of lake operations—water surface elevation 1570 feet to 1565 feet. Historically, the most likely operating range was between elevation 1569 feet and elevation 1567 feet. Operation within this range has no additional impacts on recreation at Banks Lake. (Infrequent, every 10 to 15 years, maintenance operations on the dam and other Reclamation facilities may require the lake be lowered to elevation 1545 feet. This low level would severely decrease the recreation opportunities available at the lake.)

Recreation Days.—For purposes of this analysis, it is assumed that recreational use of Banks Lake is not affected when the lake level is between elevation 1570 feet and elevation 1565 feet. Recreation opportunities could be negatively affected when the lake level falls below elevation 1565 feet. A first measure of this negative impact is the number of days that the lake is below this threshold during the month of August. Table 4-16 provides details of the impact analysis based upon the lake levels.

In any 1-year, the Action Alternative can follow a variety of scenarios, depending upon the starting lake level and the procedure of the draft; the Low Water (1565 feet) and the Late Draft Scenarios bound the possible range of scenarios. For the purposes of this EIS, four scenarios have been selected for analysis. Each results in a lowering of the reservoir to elevation 1560 feet for some time in August, depending upon the hydrology of that particular year. The refill period (to reach elevation 1570 feet) is the same for all possible action scenarios and is assumed to be 22 days, which represents the worse case situation.

Table 4-16.—Summary of Banks Lake elevation under No Action and Action Alternatives

Altern-ative	Scenario	Elevation	Time period	Results	
				Number of days at different elevations	Impacts on recreation
No Action	Low water	1565	Aug. 1-31	31 days at < 1570 ft 31 days at 1565 ft Zero days at < 1565 ft	No impact
	Early draft	1570-1565 1565	Aug. 1-10 Aug. 11-31	31 days at < 1570 ft 21 days at 1565 ft Zero days at < 1565 ft	No impact
	Uniform draft	1570-1565	Aug. 1-31	31 days at < 1570 ft 1 day at 1565 ft Zero days at < 1565 ft	No impact
	Late draft	1570-1565 1565	Aug. 1-21 Aug. 22-31	21 days at 1570 ft 10 days at < 1570 ft Zero days at < 1565 ft	No impact
No Action refill of Banks Lake	Refill	1565-1570	Sept. 1-22 The refill time is the same for all scenarios	22 days at < 1570 ft Zero days at <1565 ft	No impact
Action	Low water	1565-1560 1560	Aug. 1-10 Aug. 11-31	31 days at < 1570 ft 31 days at < 1565 ft 21 days at 1560 ft	31 fewer recreation days Fewer recreation visits Lower $ expenditures Indeterminate effect on net benefits
	Early draft	1570-1565 1565-1560 1560	Aug. 1-10 Aug. 11-20 Aug. 20-31	31 days at < 1570 ft 21 days at < 1565 ft 11 days at 1560 ft	21 fewer recreation days Fewer recreation visits Lower $ expenditures Indeterminate effect on net benefits
	Uniform draft	1570-1565 1565-1560	Aug. 1-15 Aug. 16-31	31 days at < 1570 ft 16 days at < 1565 ft 1 day at 1560 ft	16 fewer recreation days Fewer recreation visits Lower $ expenditures Indeterminate effect on net benefits
	Late draft	1570 1570-1565 1565-1560	Aug. 1-11 Aug. 12-21 Aug. 22-31	11 days at 1570 ft 20 days at < 1570 ft 10 days at < 1565 ft 1 day at 1560 ft	10 fewer recreation days Fewer recreation visits Lower $ expenditures Indeterminate effect on net benefits
Action refill of Banks Lake	Refill	1560-1565 1565-1569 1569-1570	Sep. 1-10 Sep. 11-18 Sep. 19-22	18 days at < No Action elevation; 22 days to reach 1570 ft	10 fewer recreation days for all Action Alternative scenarios

- Low Water from 1565 feet: The water level of the reservoir begins to be lowered on August 1. This variation results in the reservoir being below 1565 feet for 41 days – August 1 through September 10. This scenario provides the lower boundary for the Action Alternative.

- Early Draft from 1570 feet: Under this scenario the lake level would not go below 1565 feet until August 11. The reservoir would be below 1565 feet for 31 days – August 11 through September 10.

- Uniform Draft from 1570 feet: This condition results in the reservoir falling below 1565 feet on August 16. The lake level would be below 1565 feet for 26 days – August 16 through September 10.

- Late Draft from 1570 feet: This situation starts the drawdown on August 12. It is not until August 22 that the reservoir level falls below 1565 feet. The lake level would be below 1565 feet for 20 days – August 22 through September 10. This scenario provides the upper boundary for the Action Alternative.

Recreation Visits.—Historically, lower recreational use at Coulee City Community Park, Steamboat Rock State Park, and Sunbanks Resort were recorded when water levels went lower than elevation 1565 feet. This could result in fewer recreation visits occurring on Banks Lake.

Expenditures.—The economic impacts on Grant County and local businesses are of concern to local interests. Specifically, reduced water access could decrease the recreation opportunities at the lake, thereby resulting in fewer visitors to the commercial enterprises. The lost income for some enterprises can negatively affect their financial viability. Representatives of Coulee City Community Park, Steamboat Rock State Park, and Sunbanks Resort have all expressed concern regarding the impact that lower lake levels may have on their businesses.

However, the overall economic impact on the Grant County economy is expected to be negligible. In 1999, Grant County's economy provided over 38,000 jobs and more than $900 million in earnings to workers. Any decline in business for recreation enterprises would have little effect on these elements of the economy. In addition, recreational businesses are highly seasonal in nature. This fact makes individual firms more susceptible to negative shocks during the summer season but also ameliorates the impact such occurrences have on the county's overall economy.

The local economy at the north end of Banks Lake is based as much on the utility sector, including employment at Grand Coulee Dam and Powerplants, as it is on recreation. The utility portion of the economy is strong, would not be affected by drawdown, and is a year round source of economic strength. The impacts on the economy of the North Grant County area are further demonstrated by the fact that Banks Lake related recreation is a seasonal business, with most of its employees being only temporary hires. The loss of these positions would be less disruptive than the loss of year-round jobs.

Net Benefits.—The net benefits (value of consumer surplus) of recreation opportunities at Banks Lake would be expected to decline because of the reduction in visitor use. However, there are many close substitutes for recreation on Banks

Lake. The vast Lake Roosevelt (Coulee Dam National Recreation Area) lies a short distance northeast of Grant County. A number of lakes and reservoirs offering public recreation opportunities similar to those found at Banks Lake are also found in Grant County; Sun Lakes, and Potholes Reservoir to name two with State Parks on their shores. It is expected that some visitors displaced by the lower water levels at Banks Lake would take advantage of recreational opportunities at these other lakes. If so, then some of the net benefits that would disappear at Banks Lake would reappear at these other reservoirs. The degree to which losses at Banks Lake are gains at other lakes is unknown; thus, the Action Alternative would have an indeterminate effect on net benefits for recreation.

Any adverse impacts resulting from the Action Alternative would be focused within Grant County in general and specifically on a few recreational enterprises located on Banks Lake. Because of the size of the Grant County economy, the economic effects would be negligible at the county level. However, some individual enterprises may be negatively affected from a moderate to major degree. The change of water levels on Banks Lake is a long-term change in the operation of the reservoir. Some of the impacts on local business may be either short- or long-term, depending upon the degree to which local enterprises can accommodate and adapt to the August-September changes in water level.

Irrigated Agriculture

No Action Alternative

Reclamation's ability to provide full irrigation operations from Banks Lake would not be affected.

Action Alternative

The Action Alternative would not impact Reclamation's ability to provide Banks Lake irrigation operations in a normal year. However, during a period when mechanical problems preclude refilling of Banks Lake until after October 31, a near maximum draft of the reservoir would occur and in 3 of the last 10 years, under a worst case example, there would not have been sufficient water in Banks Lake to supply irrigators' demands.

Historic Resources

No Action Alternative

Archeological inventories in the normal drawdown zone identified 107 potentially significant historic properties. Eighty-two of these appear to be affected from erosion by current operations. The major impact to these properties are from water fluctuation and wave action.

Secondary impacts to historic resources from visitor use is an on-going concern. These impacts range from the unintentional, such as trampling from foot traffic, or ruts from off-road vehicles, or dragging a boat over an archeological deposit, to outright vandalism and looting of sites for artifacts.

Reclamation is addressing these impacts as part of the land management programs implemented under the Banks Lake Resource Management Plan.

Action Alternative

The archeological survey of the normal 5-foot drawdown identified 66 additional historic properties, which when incorporating properties that were recorded previously lying adjacent to the drawdown zone impacts about 107 potentially significant historic properties. It is, therefore, reasonable to believe there are several dozen historic properties that would be identified in a drawdown zone below water surface elevation 1565 feet.

Like the No Action Alternative, impacts to historic resources from this alternative, if any, are presumed to be linked to water fluctuations, wave action, alternating wetting and drying of the soil, and wind disturbances. During the peak tourist season, heavy visitation along the drawdown zone would likely lead to intentional or innocent collection of artifacts, perhaps even stimulating organized looting of cultural deposits.

Mitigation

Historic resources that are eligible for the National Register must be managed, and they are eligible for the register until they are determined ineligible. Of concern, however, is that none of the identified properties have yet been formally evaluated for the National Register. This, in itself, is a large task, and it is reasonable to assume that a majority of the known historic resources would be determined ineligible. Nevertheless, an unknown number would be eligible, and management treatments for them present yet another large task. Some of these treatments may involve data recovery, some may safely be left alone, and others may require conservation measures to prevent damage from natural forces.

If the Action Alternative is selected, Reclamation will conduct archeological surveys of the lands exposed by the additional 5-foot drawdown and would complete test excavations to determine site eligibility. In consultation with SHPO and the tribes, Reclamation would define treatments to protect or mitigate impacts to the most significant historic properties.

Traditional Cultural Properties

No Action Alterative

Nine traditional cultural properties would be affected by the normal drawdown, from water surface elevation 1570 feet to elevation 1565 feet, and three of these are believed to be potentially eligible to the National Register. These properties present a task for additional field verification and recording under this alternative. Impacts associated with the No Action Alternative are being addressed under the Banks Lake Resource Management Plan.

Action Alternative

The traditional cultural properties identified in the No Action Alternative are involved, and it is probable more TCPs lie in the drawdown zone below elevation 1565 feet.

Mitigation

Management of traditional cultural properties is a relatively new component of historic preservation and few protocols exist to protect them without a Federal action, as well as provide mitigation in the face of an agency action. In a landscape, such as Banks Lake, where the native cultures are strongly associated, non-material values, such as traditional cultural properties, are difficult to quantify and protect. Evaluation of three known TCP sites within the drawdown area elevation of 1570 to 1565 feet will occur.

Reclamation will consult with tribes to further define actions that might reduce or avoid impacts to National Register eligible TCPs. To the extent consistent with agency authority and multiple use project purposes, Reclamation will implement actions to avoid or reduce impacts.

Native American Sacred Sites

A discussion of Native American sacred sites seeks to disclose whether or not access to sites deemed "sacred" in accordance with Executive Order 13007 would be affected by a proposed action. There are two ways to learn if sacred sites are present, either of which can be inconclusive for reasons unique to the Tribe(s) involved: (1) asking the Tribes directly, or (2) from inference based on related resource surveys, such as surveys for historic resources, traditional cultural properties, or other natural resources, such as plants or geological investigations. Both of these methods apply to the current action.

Current knowledge on the locations and kinds of sacred sites in the drawdown zones is incomplete, primarily because tribal cultures have their own reasons for not sharing the information. Probably because Steamboat Rock is such a prominent

landscape feature and figures into the mythology of both the Colville and Yakama Tribes, they have been willing to inform the public that Steamboat Rock is important culturally (Carmack 2001; Consortium of Johnson O'Malley Committees of Region IV 1974: 203) and may represent sacred sites, subject to Executive Order 13007.

No Action Alternative

Access to Steamboat Rock would be the same as currently exists; no other adverse impacts are expected under this alternative.

Action Alternative

Access to Steamboat Rock would not be affected; no other adverse impacts are expected under this alternative.

Indian Trust Assets

No Action Alternative

Much of Banks Lake area retains resources that support hunting, fishing, and gathering activities. Some areas, however, have been disturbed to the extent that they no longer can support such traditional uses. No additional impacts would occur for Indian trust assets under the No Action Alternative.

Action Alternative

There would be no impacts to ITAs in the drawdown zone between water surface elevations 1565 feet and 1560 feet.

Environmental Justice

The Council on Environmental Quality's Environmental Justice Guidance under the National Environmental Policy Act (1997) states race, ethnicity, and income should be examined. Data from the U.S. Census Bureau (1990 and 2000) were used to determine the minority population in the Banks Lake area. As income data from Census 2000 were not available, U.S. Census Bureau County Estimates for People of All Ages in Poverty for Washington: 1998 were used as a proxy for low-income.

Council on Environmental Quality (CEQ) guidance states minority population should be identified where either the minority population of the affected area exceeds 50 percent or the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population.

Professional expertise and judgment were used to review impacts of implementing the Action Alternative to determine whether minority or low-income populations would be disproportionately adversely affected.

Although the minority population of Grant County is less than 50 percent of the total population, as discussed in the Economics section, the loss of income for some businesses dependent on recreation at Banks Lake can negatively affect their financial viability. However, racial and ethnic employment data are not available for individual businesses, thus disproportionately adverse impacts cannot be determined for them. Minority agricultural workers would not be affected as no impacts to agriculture were identified. Power rates are not anticipated to change as a result of this action, thus minority and low-income populations would not be disproportionately adversely affected.

No Action Alternative

No adverse impacts would occur under this alternative.

Action Alternative

No adverse environmental justice impacts were identified.

Surface Water Quality

The following indicators have been used for the water quality evaluation:

- Lake changes in temperature profiles, stratification, and other water quality parameters.
- Groundwater changes in concentration and water levels.

No Action Alternative

Four different drawdown scenarios have been developed to show the range of conditions that may occur as the Lake is operated from water surface elevation 1570 feet to elevation 1565 feet, depending upon hydrologic differences. These scenarios would have small differences of water quality between them; timing of the events from each of the scenarios would cause minor differences between them also. Although lowering of the surface elevations may result in slumping, the scenarios that stay at one elevation would have more shoreline erosion than if the erosive processes occur over a range of elevations.

Shoreline erosion would be the greatest for the Low Water Scenario when the lake elevation would be at elevation 1565 feet during most of the month. Surface runoff would wash sediment exposed above elevation 1565 feet into the water. This

process would increase the turbidity along the shore of the lake and over time would create an armored section of coarse pebbles or rock in some areas.

The Early Draft Scenario would tend to wash sediment down to elevation 1565 and would erode the sediment at elevation 1565. This would create turbidity along the shoreline where fine sediments exist. The water temperature in these areas would increase temporarily in the shallow waters but would return to normal conditions as the water turbidity reduced.

The Uniform Draft Scenario would distribute the erosive action from elevation 1570 feet to 1565 feet. This may move the sediment into the reservoir quickly as the soils would be wetted and subject to erosion as the water receded between these elevations. However, the erosion would be much the same as with current operations. Changing one month's operation would not change the water quality in any significant way for the year's operation. Sediment would be redeposited to lower elevations as the reservoir was operated at a higher elevation later in the year.

The Late Draft Scenario would be at full elevation during the first 20 days of August and would have little change because the erosion at full pool has already stabilized. Some additional erosion would occur during the beginning of September where fine sediment has been deposited.

Thermal changes occur in the lake as the lake surface is lowered. As the water elevation is decreased, the temperature profile remains constant from the surface to the bottom as water is taken from the bottom for irrigation. The temperature profile of the reservoir would appear much as if the lower 5 feet of the profile was cut off the bottom of the reservoir when the reservoir surface is lowered 5 feet. There would be little change in the water released because of the nearly constant temperature in the bottom of the reservoir. Because the profile does not change the physical and biological processes would not change in the reservoir. Both the No Action and Action Alternatives would change as described above.

Anecdotal reports from fishermen indicate warmer temperature profiles have been observed at lower reservoir elevations. This may be the result of having large areas with shallow water accumulating more heat than at higher elevations plus the volume of water is slightly smaller at a lower elevation. Both factors would increase the water temperature slightly as the shallow warmer water is mixed in the lake. Consequently, the Low Water Scenario, maintained at elevation 1565 feet, would result in the greatest increase in lake temperature. The Early Draft scenario would have the next greatest temperature increase, followed by the Late Draft scenario and then by the Uniform Draft Scenario, which would have the smallest lake temperature increase. The amount of temperature increase would probably be small and would likely be within the range of temperature variations experienced in the past from year-to-year variability of meteorological conditions.

There are elevated levels of total dissolved gas in FDR Lake and the mainstem Columbia River downstream which have been attributed primarily to spills at

hydroelectric facilities on the Columbia, Pend Oreille, and Spokane Rivers upstream in the United States and Canada, and from involuntary spills at Grand Coulee. High gas levels occur primarily during the spring and early summer when flood flows in excess of powerplant capacity are spilled. Dissolved gas problems also occur at downstream facilities as a result of both system-wide flood control releases and flow augmentation to support salmon migration. Mainstem total dissolved gas levels are managed to enhance fish passage and to comply with Washington State water quality standards, which have been modified to accommodate salmon recovery efforts. Exceedences of total dissolved gas standards associated with operational spills at Grand Coulee would be virtually eliminated with completion of proposed spill deflectors at Chief Joseph Dam and implementation of joint operation of Grand Coulee and Chief Joseph Dams to facilitate gas abatement. The fate of dissolved gas in Banks Lake has not been studied, and is largely unknown. However, fishery problems associated with gas bubble disease have not been reported in Banks Lake.

Action Alternative

The Action Alternative scenarios consider that the lake level would be dropped to elevation 1560 feet in August. Small changes in temperature profiles and stratification may occur as a result of no pumping from FDR Lake into Banks Lake. Also, the processes that increase the warming would increase as the lake is drawn to a lower elevation. As indicated in the No Action Alternative, nearly the same amount of heat would be entering the surface of the lake and the volume of water may be less at lower elevations and the surface layers of the lake would become warmer as a result. The stratification would become more defined and the surface to bottom temperature difference would increase slightly. The scenarios within the Action Alternative would be discussed in order of least change to greatest change from No Action.

The Low Water Scenario starts at elevation 1565 feet and drops linearly with time to elevation 1560 feet at the middle of the month and stays at the lower elevation longer increasing lake temperatures. The lake would be warmer at the lower elevation of 1565 feet as has been observed historically. The volume from drawdown would be about the same as irrigation needs from August 1 until the middle of the month. Mixing would result in less storing of solar energy in the top layers of the reservoir. After the middle of the month pumping would be needed to maintain elevation 1560 feet. Increased mixing would occur at the first of September and the stored solar energy, in the form of higher temperatures in the upper layer would combine with a constant solar heat input to a lower reservoir volume to heat the lake more than any of the scenarios.

For the Early Draft, the water surface would change from elevation 1570 feet to elevation1560 feet from August 1 to August 21, remain at 1560 until the end of August, then pumping would occur until elevation 1570 was reached. Temperature profiles would be very similar to the No Action early drawdown. With this scenario, the irrigation demand would be supplied by drawdown until August 21, then

pumping would be needed to meet irrigation demand until the end of the month. Then increased pumping would fill the Lake to elevation 1570 feet. More pumping than for the Late or Uniform Drafts would occur. Mixing the stored solar energy in the lake and increasing the temperature while the lake was at elevation 1560 feet. Nearly constant solar heating of a smaller reservoir volume would further increase water temperatures.

The Uniform Draft Scenario starts at elevation 1570 feet and decreases linearly to elevation 1560 feet by the end of the month, then pumping starts to reach elevation 1570 feet by September 22. The rate of drawdown is very close to the irrigation demand during August, so no additional pumping would be required from FDR Lake. The pumping would tend to cause more mixing in September and would tend to warm the reservoir to a greater depth than for the Late Draft Scenario. A greater amount of heat would be gained than for the Late Draft Scenario, because nearly the same amount of heat as at full pool would be mixed in a smaller volume of the reservoir over the month of August. As a result Banks Lake would increase in temperature more than it would for the Late Draft Scenario.

The Late Draft Scenario would draw Banks Lake down linearly, beginning August 10 and continuing to the end of the month. Pumping would be needed during the month to meet the irrigation needs and the pumped cooler water from FDR Lake would be most similar to the No Action Alternative conditions. Pumping would start in September and would cool Bank's Lake temperatures. Also heating of the lake would be less than any of the action scenarios because a nearly constant heat transfer into a larger volume of water would minimize the temperature change from No Action. However, the Action Alternative may increase mixing more as the reservoir is refilled and this may cause the nearly uniform temperature to occur earlier in the year. This shift would likely be from 1 to 2 weeks at most. Growth of zooplankton and other biological activities may be decreased compared to the No Action Alternative.

As under the No Action Alternative, total dissolved gas levels in the mainstem Columbia River would continue to be managed to support salmon recovery and provide for compliance with Washington's total dissolved gas standard under all action alternatives. Although the fate of total dissolved gas in Banks Lake has not been studied, and is largely unknown, no dissolved gas would be generated as a result of the proposed increased drawdown of Banks Lake. Further, the proposed September refill period for Banks Lake occurs when total dissolved gas levels in the Grand Coulee forebay are generally in compliance with State and tribal water quality standards.

Groundwater Quality

No Action Alternative

No change to existing groundwater conditions would occur under the No Action Alternative.

Action Alternative

Effects on groundwater quality would be small, if any, due to the short period of time that the water level of Banks Lake is drawn down and the change of water surface is only 0 to 5 feet. Some local fissures and cracks in the surface rocks could respond to the changes in lake elevation but would be localized to the immediate vicinity of the lake/soil interface, not affecting the groundwater levels or concentration. Groundwater movement through soils is very slow and the aquifer would barely start to respond to changes in recharge elevation before the reservoir would be refilled to elevation 1565 feet by September 10. These small changes in recharge rates as a result of the Action Alternative would likely have no measurable change in the groundwater quality.

Visual Quality

No Action Alternative

The visual quality of the Banks Lake area would not be affected.

Action Alternative

The visual quality of the Banks Lake drawdown would have a minimal additional effect because of the predominance of visual impacts of the Grand Coulee surrounding the lake.

Air Quality

There would be no adverse impacts to air quality in either the No Action or the Action Alternatives.

Soils

No Action Alternative

All drawdown scenarios would be so gradual (less than 2 feet per day) that they would not adversely affect the soils in the study area. Impacts would be limited to erosion from exposed soils left between elevation 1570 feet and the water surface or from wave and ice impacts at the waters surface. According to the refill

configuration used, that elevation may be anywhere between elevation 1570 feet and 1565 feet. Such activities in previously undisturbed areas would cause mechanical disturbance to the soil surface and destruction of the protective vegetative cover, including vascular plants and soil stabilizing microbiotic soil crusts.

These disturbances often lead to soil aggregate destruction and channel formation. Destruction of vegetation and disturbance of spawning beds caused by erosion would continue regardless of the surface elevation of the lake but the zone of erosion would take place at the surface elevation. This would allow redeposition of soils during the spring and summer to fill erosional areas developed during the time of drawdown and help to maintain the current high water shoreline. This would maintain a more stable lake bottom from elevation 1570 to elevation 1565.

The most severe soil resource effects are expected to continue on those portions of the shoreline located south of the Million Dollar Mile North Boat Launch, on the south half of the Steamboat Rock peninsula, at Barker Flat, at Kruk's Bay/Airport Bay, and in the upper (north) portion of Banks Lake.

Action Alternative

Similar to the No Action Alternative, all scenarios of drawdown in the Action Alternative are less than the maximum of 2 feet per day that it is believed would cause failures in the shoreline of Banks Lake. As all scenarios also refill the reservoir to elevation 1565 by September 10, there would be no additional adverse effects on soils from the Action Alternative.

Social Environment and Public Health

This section describes the environmental consequences to the social environment and the potential impacts of mosquitoes to public health.

Social Environment

No Action Alternative

For some, as operation of Banks Lake would not change, values would not be affected. For others who value increased water for endangered salmon runs, their values would not be upheld.

Action Alternative

Impacts to recreation, the local economy, power production and power rates are discussed in the Economics section. While recreation opportunities may minimally decline at Banks Lake during the period of drawdown, other opportunities for water-based recreation are nearby. Recreating individuals with strong emotional ties to Banks Lake would be most adversely affected. Overall impacts to the Grant County

economy are expected to be negligible. While lost income for some businesses can negatively affect their financial viability, the degree of impact would depend in part upon their ability to adapt their facilities to the lower lake levels in August. Those who are not able to adjust to a loss of income or are unable to adapt their facilities would be most adversely affected. Power production and power rates should not be significantly adversely affected.

The social values of those who desire increased water for endangered salmon runs would be upheld.

Public Health—Mosquitoes

No Action Alternative

Under current historical reservoir operations, August surface elevations of Banks Lake are lowered from a maximum water surface elevation of 1570 feet to a minimum elevation of 1565 feet. Reservoir drawdowns that occur in late summer likely have negative impacts to mosquito production.

Withdrawal of water from vegetated shoreline would decrease mosquito populations and mitigate against any potential production from drawdown pools. Colonization of isolated pools in August occurs at a time when egg production by females is low and the time needed to achieve multiple generations, which would lead to high adult densities, is unavailable. In many cases, the combination of sparse vegetation along with the presence of fish would decrease opportunities for mosquito colonization of newly formed pools. August is also the time of year when rapid evaporation of pools would take place because of high air temperatures.

Mosquito control that is undertaken by local authorities to minimize West Nile Virus infection in humans would take place early in the season. Therefore, only a minimal number of adults would be present for potential use of drawdown areas.

Types and abundance of mosquitoes potentially associated with the drawdown could be documented. Often mosquitoes that are assumed to come from a wetland or ponded water in an impoundment originate elsewhere. However, a review of the topography described below states few ponding areas were evident in the Banks Lake pool. There is ponded water below Dry Falls Dam that would not be affected by either alternative.

Refill of the reservoir in September would, of course, flood vegetated shorelines and allow for potential mosquito production. The limited amount of time left in the season would likely limit mosquito populations. Mosquitoes that were produced would likely be flood-water mosquitoes (e.g., *Aedes*) and not the *Culex* species typically associated with West Nile Virus.

Action Alternative

Under the Action Alternative, the water surface elevation would be drawn down to elevation 1560 feet. Concern has been expressed that this change would result in increased habitat for mosquitoes and would enhance the spread of West Nile Virus. Reclamation identified the potential ponding areas by reviewing historic topography maps prepared in July, 1950, by R. W. Tipton. The topography was created in 2-foot contour intervals. In the drawdown area, little or no shallow ponding areas were evident.

As stated in the No Action alternative, reservoir drawdowns that occur in late summer likely have negative impacts to mosquito production. The later refill period associated with the Action Alternative would likely further limit mosquito production from the vegetated margins of the reservoir. See the No Action Alternative for additional information.

Cumulative Impacts

Cumulative impacts are impacts on the environment that result from the incremental consequences of a proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of who undertakes these actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Those projects described in Chapter 1 under Other Related Actions and Activities may add to cumulative impacts to these resources.

Aquatic Macrophytes/Riparian Vegetation

Implementation of the Banks Lake RMP (Reclamation 2001) is expected to enhance shoreline vegetation. The RMP includes several actions, such as the closure of several roads that currently impact the shoreline, reduction of indiscriminate dispersed camping, active invasive vegetation control, more controlled grazing, and active vegetation management that are expected to improve the conditions of riparian habitat at Banks Lake. These actions would tend to offset some of the impacts associated with the potential 10-foot drawdown as disturbance associated with the drawdown is offset by the elimination of other disturbances to shoreline vegetation.

The Bass Anglers Sportsman Society (BASS) Federation of Washington State submitted to Reclamation and the State a plan to restore and enhance shoreline vegetation and to provide subsurface structure to enhance the survival of fish fry in Banks Lake. The plan has been accepted by Reclamation and the State, and several of the projects outlined in the plan have been started. Implementation of this plan will likely have a beneficial impact on shoreline vegetation.

Fish and Wildlife

Among the goals of the Banks Lake RMP (Reclamation 2001) is the improvement and maintenance of fish and wildlife habitat. The RMP did not address any specific improvements to fish habitat but attempted to ensure that human actions did not detract from primary spawning habitat for fish. A number of actions involved in the RMP are directly related to improving and maintaining the terrestrial habitat for a variety of species. As an example, the limiting of dispersed camping to designated sites should concentrate human impacts to fewer areas. The potential 10-foot drawdown is not anticipated to affect any of the improvements or maintenance items outlined in the RMP.

The BASS Federation plan addresses both underwater structure and shoreline vegetation with the goal of improving the fish habitat within Banks Lake. By making slight changes to the location of the underwater structure and the selection of vegetation, the potential 10-foot drawdown should not affect the positive aspects of the BASS plan.

Recreation

Historically, elevation changes to Banks Lake affect the availability of recreational resources surrounding the lake. Banks Lake is recognized locally and regionally for its diverse and outstanding recreational opportunities. These opportunities exist throughout the area for camping, swimming, boating, picnicking, and other recreational pursuits under the No Action Alternative.

Nineteen developed recreation areas are currently provided by a variety of public agencies and private entities. These areas are served by a wide range of developed day and overnight recreation sites and facilities, and generally are concentrated at the south and northeast ends of the reservoir. Of the 19 developed recreational areas, 12 maintain usable boat launches. Drawing the lake down lower than 1565 feet would negatively affect some recreational facilities and operations on the lake.

No other activities in the area are expected to adversely impact the recreational facilities around Banks Lake.

Anadromous Fish

Action 14 of the NMFS BiOp (NMFS 2000) is flow management in the mainstem Columbia River and in the lower Snake River as a measure to improve the survival of ESA-listed salmon. NMFS specified a flow of 200,000 cfs at McNary Dam during the July to August period; however, this target is not always achieved. To supplement flows during August, the action agencies would release water from a number of sources, including Banks Lake. While individually not significant in the overall flow of the Columbia River, the contribution to McNary flows by Banks Lake water, in combination with water from other sources, would make it possible to meet flow objectives in a larger number of years.

Total augmentation water from all sources within the Columbia River basin is more than 5 million acre-feet, including the Canadian projects. In combination, these augmentation sources during the first half of August meets target flows 42 percent of the time and during the second half of August meets target flows 12 percent of the time. Without the combination of augmentation flows, August flow objectives are never met.

The flow objectives at McNary Dam would not be met in any year during either August period without the combined summer flow augmentation. The additional 127,200 acre-feet from Banks Lake would comprise less than 6 percent, on average, of the combined flow augmentation provided in August from Libby, Hungry Horse, Grand Coulee, Dworshak, the upper 5 feet of Banks Lake, the upper Snake, and Brownlee reservoirs.

Unavoidable Adverse Impacts

Unavoidable adverse impacts are long-term impacts to resources that would be affected by implementation of the action. Unavoidable adverse impacts are expected to occur to nine fish species directly as juveniles would be subject to increased predation as a result of the August drawdown. While the overall structure and function of the aquatic macrophyte community that serves as spawning and nursery habitat for many of the fish species in Banks Lake will remain unchanged, unavoidable adverse impacts will occur to drought intolerant plant species resulting in a reduction of species diversity. Seedlings of drought intolerant riparian species such as black cottonwood may be adversely affected during drawdowns.

The Federal Columbia River Power System annually experiences an 8,000 MWh loss under the No Action Alternative when compared to keeping Banks Lake full. Under the Action Alternative, there would be an additional loss of about 8,000 MWh. Under the Action Alternative, the PUD powerplants would experience additional losses of 6,248 MWh to 6,906 MWh annually and the GCPHA would experience additional losses of 812 MWh to 1,695 MWh annually.

The Action Alternative would adversely affect at least one business because access to the lake would be limited in that area. Some recreation uses would change as the lake elevation lowered for August and until it was refilled to at least elevation 1565 feet.

Relationship Between Short-Term Uses and Long-Term Productivity

This analysis examines the relationship between short-term uses of environmental resources and the maintenance and enhancement of long-term productivity.

Compared to the No Action Alternative, the Action Alternative would reduce pumping to Banks Lake by 127.2 thousand acre-feet (kaf) and increase Columbia River flows in August. The resulting reduction in Banks Lake water surface from elevation 1565 feet to 1560 feet would result in temporary adverse effects by making boat ramps, mooring docks, and shallow channels unusable. Swimming beaches may also be unusable during the lower water surface elevations. These impacts would most likely result in decreased visitors to the lake in August and early September. However, Reclamation proposes to mitigate these impacts by extending the boat ramps, modifying the mooring docks, dredging deeper channels, and modifying or changing the location of the swimming beaches. Therefore, these impacts should not affect the long-term recreational use of the lake.

The Banks Lake water would be used to augment the flows in August. This flow objective is intended to primarily benefit ESA-listed Snake River fall chinook salmon, although these flows also are likely to benefit the non-listed Hanford Reach fall Chinook populations. The Snake River fall chinook juvenile migration tends to peak in the second half of July with numbers tapering off through August. Nearly half of the Snake River fall chinook can be transported from the Snake River collector dams and may not benefit from flow augmentation through McNary Dam to the Bonneville reach of the Columbia River. However, even barged fish may benefit from flow augmentation from Bonneville Dam to ocean entry. In addition, there is some uncertainty surrounding flow augmentation benefits for fish survival. Snake River fall chinook is one species that appears to have a stronger flow survival relationship, although that survival relationship is also influenced by water temperature and turbidity. It is anticipated that the additional August flows would enhance the survival of listed Snake River fall chinook populations.

Irreversible and Irretrievable Commitments of Resources

Irreversible commitments are decisions affecting renewable resources such as soils, wetlands, and riparian areas. Such decisions are considered irreversible, because their implementation would affect a resource that has deteriorated to the point that renewal can occur only over a long period of time or at a great expense, or because they would cause the resource to be destroyed or removed.

Irretrievable commitments of natural resources occur when a decision causes a loss of production or use of resources. They represent opportunities foregone for the time that a resource cannot be used. The primary impacts that would be irretrievable are those that involve physical processes and resources, such as water storage. Under the Action Alternative, a maximum of 127,200 acre-feet of water may be kept out of the reservoir and left in the Columbia River during August. In such circumstances, water for some of the available recreational uses in the reservoir would be lost to water used for the benefit of anadromous fish. However, during certain conditions when Reclamation's operational and other needs may require that

the water remain in the reservoir, existing recreational uses of the reservoir would not be irretrievably lost.

The loss of the water during the month of August and part of September would affect some vegetation and some power production. Under the Action Alternative, 8,000 MWh of energy generation would be irretrievably lost.