Final Environmental Impact Statement

Elwha River Ecosystem Restoration

Purpose and Need: The Elwha River ecosystem and native anadromous fisheries are severely degraded as a result of two hydroelectric dams (projects) and their reservoirs built in the early 1900s. Congress has mandated the full restoration of this ecosystem and its native anadromous fisheries through the Elwha River Ecosystem and Fisheries Restoration Act (Public Law 102-495). The Department of the Interior therefore finds there is a need to return this river and the ecosystem to its natural, self-regulating state, and proposes removing both dams to accomplish this purpose and fulfill the congressional mandate.

Proposed Action: The U.S. Department of the Interior proposes to fully restore the Elwha River ecosystem and native anadromous fisheries through the decommissioning of Elwha Dam and Glines Canyon Dam and removal of all structures necessary, including all or part of both dams, powerhouses, reservoirs, and associated facilities to achieve this purpose. The proposed action is located in Clallam County, on the Olympic Peninsula, in Washington State.

Lead agency: National Park Service

Cooperating agencies: U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, U.S. Bureau of Indian Affairs, U.S. Army Corps of Engineers, and the Lower Elwha S'Klallam Tribe

Type of statement: This is a final environmental impact statement. In preparing this, the Department of the Interior has adopted the majority of a draft environmental impact statement titled "Proposed Elwha (FERC No.2683) and Glines Canyon (FERC No.588) Hydroelectric Projects, Washington" as updated and renamed Draft Staff Report in March 1993 prepared by the Federal Energy Regulatory Commission. Also incorporated into the record of this environmental impact statement is the Elwha Report and its appendixes, prepared by the U.S. departments of the Interior and Commerce and the Lower Elwha S'Klallam Tribe (Jan. 1994). This environmental impact statement supersedes both the Federal Energy Regulatory Commission environmental impact statement and the Elwha Report.

Abstract: In addition to the proposed action, four other alternatives are examined. They are: Dam Retention with mitigation measures installed for fish passage, Removing Glines Canyon Dam only and installing fish passage measures at Elwha Dam, Removing Elwha Dam only and installing fish passage measures at Glines Canyon Dam, and No Action (dams are retained without fish passage measures). The proposed action is also the Department of the Interior's "preferred alternative." Short term negative impacts from removing both dams could occur from sediment built up behind them. If sediment is allowed to erode naturally, the finer grained particles, such as silt and clay, could temporarily but significantly impact fish or other aquatic organisms. Impacts on water quality, river morphology, native anadromous and resident (i.e., trout and char) fisheries, living marine resources, wildlife, threatened and endangered species, vegetation, cultural resources, land use, recreation, esthetics, socioeconomics and river ecology are also examined in this environmental impact statement. Alternatives other than the proposed action may also have significant impacts on each of these resources.

Difference between the Final and Draft Environmental Impact Statement: Comments were taken both orally and in writing for a period of 60 days on the draft environmental impact statement released in October 1994. The comment period ended December 23, 1994. Substantive comments were responded to both in a question and answer format and/or by making changes, additions or corrections in the text of the draft environmental impact statement. The changed draft is this document, Interior's final environmental impact statement.

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Summary

In the early 1900s, the free-flowing Elwha River on the Olympic Peninsula in Washington State was blocked with two hydroelectric dams (See Figure 1). The Elwha Dam was built 4.9 miles from the mouth of the Elwha River beginning in September 1910. It impounded the reservoir known as Lake Aldwell. Construction on Glines Canyon Dam, 8.5 miles farther upstream, began in 1926, creating the reservoir known as Lake Mills. Although the dams helped in the early development of the peninsula, the presence and operation of the hydropower projects cause severe problems for anadromous fish, the ecosystem, and the Lower Elwha S'Klallam Tribe.

The dams block the migration path for several species of salmon and trout, which, after maturing in the ocean, return to the Elwha to lay their eggs (spawn). Migrating fish such as these are anadromous. The dams also prevent or limit the downstream flow of nutrients, sediment, and woody debris the fish need to successfully spawn and rear juveniles, inundate fish habitat and result in elevated temperatures downstream. The Elwha River was used by 10 runs of salmon and trout before the dams were built. The fish fed more than 22 species of wildlife and were the basis of much of the culture and economy of the Lower Elwha S'Klallam Tribe.

Because of the dams, the flow regime of the river changed from active meandering in many places to less active and more channelized. Reduced sediment supply from the river has caused the eastern edge of the pre-dam Elwha delta to erode, and the barrier beach at Freshwater Bay to recede and steepen. It has also contributed to the erosion of Ediz Hook, the sand spit that protects Port Angeles Harbor.

In recognition of these problems, the Department of the Interior finds, consistent with congressional intent expressed in the Elwha River Ecosystem and Fisheries Restoration Act (P.L. 102-495; see Appendix), a need to fully restore the native anadromous fisheries and Elwha River ecosystem. For the purposes of Elwha River restoration, "full restoration" is interpreted by the Department of the Interior to mean reestablishment of natural physical and biological ecosystem processes, including recovery of the terrestrial and riverine habitat currently inundated by the reservoirs. Since the wildlife habitat and river upstream of the dams are in nearly pristine condition, removing the dams and fully restoring the 10 runs of salmon and trout would fully restore the Elwha River ecosystem. It would also return the cultural and economic focus of the Lower Elwha S'Klallam Tribe, uphold the federal trust responsibility to affected Indian tribes, and provide substantial long term benefits to sport fishing, tourism, and the local economies associated with these activities.

The National Park Service has the lead in preparing this final environmental impact

statement, which is a programmatic or policy environmental impact statement. The majority of the March 1993 Federal Energy Regulatory Commission Draft Staff Report was adopted as part of this document. The Elwha Report and its appendixes, prepared by the U.S. departments of the Interior and Commerce and the Lower Elwha S'Klallam Tribe (Jan. 1994), were also incorporated. Material in this document supersedes both that in the Draft Staff Report and in the Elwha Report.

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If the decision maker, the secretary of the interior; chooses the Proposed Action of removing both dams, the National Park Service will prepare a second environmental impact statement, the "Implementation EIS," that would examine options for implementing the decision.

Several alternatives for restoring fish habitat are examined in this programmatic impact statement. Only one alternative has the potential to fully restore Elwha native anadromous fisheries—the **Proposed Action** of removing both the Elwha and Glines Canyon dams. Chances for restoring nine of the ten runs of fish are rated as either "good" or "excellent" if both dams are removed (sockeye salmon suffer from potential stock limitation and habitat problems outside the confines of the Elwha River project and, therefore, have only "poor" to "fair" chances of returning in pre-dam numbers). Removing both dams would also restore natural flow conditions in the Elwha River.

Figure 1. Location Map (Scan)

Because federal agencies examine a full range of reasonable alternatives in an environmental impact statement, the National Park Service also analyzed leaving the dams in place and installing fish passage facilities, as well as removing each dam separately. These alternatives are **Dam Retention** (with passage facilities installed at both dams), **Removal of Elwha Dam**, and **Removal of Glines Canyon Dam**. **No Action**, or leaving the dams in place without mitigation measures (as they are now), was also analyzed to provide a basis for comparing all action alternatives.

The chances of restoring native anadromous fish drop substantially under each of these alternatives. None of the ten runs has a good or excellent chance of full restoration if fish passage measures are installed (i.e., the **Dam Retention** alternative) or if **Elwha Dam alone is removed**. Although there is a good chance that both winter and summer runs of steelhead could be restored if **Glines Canyon Dam were removed**, the remaining eight runs do not fare as well. For all alternatives except **Proposed Action**, mortality associated with fish passage and poor habitat is likely to drive the Elwha pink salmon stock to extinction (if it is not already) and chum salmon stock to extremely low levels or extinction.

Anadromous fish populations would return to normal if the dams were removed, and other features of the ecosystem would benefit as well. Natural sediment transport conditions would be reestablished if the dams were removed. This would restore needed spawning gravel and woody debris for fish, and also replace sand missing from the river's estuary, nearby beaches, and the nearshore environment as far east as Ediz Hook. The estuary would grow to its pre-dam size and once again serve as an important transitional habitat between fresh and salt water for many species of fish and other aquatic organisms. Instead of a stable channel, the Elwha River would return to its active meandering morphology, creating the riffles, pools, and slower moving side channels that many anadromous fish prefer for spawning and rearing.

Draining the reservoirs and returning the river and surrounding land to pre-dam conditions would reduce downstream temperatures in the river; immediately restore more than five miles of stream habitat, and provide access to 70 miles of usable river, greatly benefiting fish. Within three years, revegetation of the reservoir lands would take firm hold; natural succession of a mix of riparian and upland terrestrial habitat would start. Now, 715 acres of potential wildlife habitat are occupied by the reservoirs and dam facilities. If the dams were removed, these acres would return for use by native mammals and other terrestrial species.

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With the reintroduction of salmon and trout throughout the river's length, wildlife would again benefit from the year-round, stable food source these fish once provided. Threatened or endangered animals such as bald eagles would benefit directly from an increase in available prey, others from the creation of additional habitat. Eventually, restored forest lands would benefit the threatened marbled murrelet and northern spotted owl.

Some negative impacts might occur from the **Proposed Action**. The dams are considered a historic resource, as they are examples of early hydropower plants. Although important features would be documented and recorded, removal would result in the loss of the dams and power plants. The average annual power produced, 172 gigawatts, or 43% of the power needs for the Daishowa paper and pulp mill in Port Angeles, would also be lost. The reservoirs, which would be drained if the dams are removed, are a recreational resource to flat-water boaters and anglers, as well as winter habitat for the trumpeter swan.

With the dams gone, sediment built up over the last 80 years would be released into the river, though finer sediment could be dredged and removed. If fine sediments (silt and clay) were released uncontrolled, they could kill adult and juvenile fish, their eggs, and other aquatic life. This would be a temporary but severe impact.

Released sediment could also affect surface water users, including the city of Port Angeles and its industrial customers. Several mitigation options are under consideration for analysis in the Implementation EIS, but the Department of the Interior is bound by the Elwha Restoration Act (i.e. the Elwha River Ecosystem and Fisheries Restoration Act; PL 102-495) to ensure that municipal and industrial users are protected from adverse impacts to existing water quality and availability that might occur if the dams were removed.

If the dams were removed and upstream sediment flowed into the middle and lower river, the riverbed itself might rise to pre-dam levels, which has been estimated to be on the order of 1 to 5 feet above the present level. A raised riverbed would raise the water level also, and localized flooding could occur more frequently.

In addition to achieving the congressionally mandated goal of restoring both the native anadromous fisheries and ecosystem, the **Proposed Action** would have long-term positive impacts on the local economy through increases in tourism, commercial and recreational fishing; river recreational access; improvement of esthetics; uncovering of tribal cultural resources now buried or inaccessible; and aiding the very depressed tribal economy. Any potential safety risk posed by the dams (although now considered safe, earthquake risk is being reexamined) would be eliminated. The volume of water currently available to users, and high flow volumes (i.e., large floods) would remain the same as now, as the dams have a very limited ability to store water.

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The following discussion summarizes environmental problems that each alternative might create for a particular resource (such as water quality). A comparison of impacts, or the extent of these problems, for each alternative is located in chart form beginning on p.22 of this document.

Summary of Issues

Issues are environmental problems which might occur if the Proposed Action or any of the alternatives are undertaken. The expected extent of these problems is called impact. Impact analyses predict how severely a particular environmental resource (i.e., water quality) would be affected with implementation of each alternative. A description of issues follows; impacts are discussed in the chapter titled "Impacts of Each Alternative".

Geology, River Morphology, Hydrology & Water Quality

The dams have limited coarse-grained sediment and woody debris from flowing downstream of river mile 13.4, the location of Glines Canyon Dam. As a result, cobbles, gravel, and sand have built up in deltas where the river or tributaries enter the reservoirs. Salmon and trout are denied the spawning gravel needed to successfully reproduce. Erosion of coastal features such as Ediz Hook and beaches near the mouth of the river is exacerbated.

Approximately 17 million cubic yards of clay, silt, sand, gravel, and cobbles are now (1994) trapped in the two reservoirs, most behind Glines Canyon Dam. Some portion of this sediment would be released into the river should the Proposed Action or single dam removal alternatives be implemented. The Elwha Report investigates three ways to manage this sediment: (1) eroding the material to the Strait of Juan de Fuca, (2) mechanically removing the material by dredging and slurrying to either a terrestrial or saltwater site, or (3) stabilizing the sediments within the confines of the existing reservoirs.

Any of these options for implementing the Proposed Action would return gravel and help halt erosion of coastal features over time. However, each may have different short-term impacts to both fisheries and water quality.

The erosion option would supply material to the river, but would also have a potentially adverse impact on water quality and on spawning or rearing fish through the release of fine-grained sediment (silt and clay). The stabilization and removal options would not have these impacts to the same degree, but restoring spawning gravel would take longer. Removing only Elwha Dam would allow the release of a relatively small amount of sediment (2 to 3 million cubic yards; or one-half to two-thirds of the total 4 million cubic yards estimated behind Elwha Dam) into a relatively short section (4.9 miles) of river. This material would wash out to the strait and not be replenished since Lake Mills would continue to trap upstream sediment. Removing only Glines Canyon Dam would release a larger volume (7-9 million cubic yards; or one-half to two-thirds of the total approximately 13 million cubic yards behind Glines Canyon Dam) of sediment into the middle river. Until Lake Aldwell filled, this material would be trapped behind Elwha Dam. However, sediment eventually would pass through the penstocks and over the spillways of Elwha Dam and flow into the lower river and nearshore marine environment.

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Removal of both dams would positively affect native anadromous fish by returning spawning gravels throughout the lower and middle Elwha River, lowering water temperatures, and restoring fish habitat. Returning anadromous fish would also cause changes to river water over the long term through the addition of organic material and nutrients such as phosphorus and nitrogen. Biological productivity would increase as a result.

Water users could be affected by silt and clay for a short time, but the Elwha Restoration Act requires mitigation for adverse impacts to municipal and industrial users.

Water quality may also change over time. Although a portion of suspended sediment now flows over the dams and downstream, removing the dams would result in a larger fraction of this finer material being transported to the middle and lower river and out to sea. However, since elevated turbidity levels from the natural river would generally occur only during high flow periods, there would be little if any noticeable effect during low flow periods.

Releasing stored sediment behind either or both dams would also cause the riverbed to "aggrade" or rise in some places. This would elevate river levels as well, possibly causing more frequent localized flooding.

Native Anadromous and Resident Fisheries

Resources

Currently, there are no salmon or seagoing trout in either the middle (between the dams) or upper (upstream of Lake Mills) reaches of the river because of the dams. Installing fish passage facilities on the dams could provide native anadromous fish access to unused habitat in the Elwha. At the same time, passage measures could harm or kill juveniles trying to reach the sea or adults moving upriver. Juveniles would also experience increased mortality negotiating the reservoirs, even with passage measures. Different levels of mortality due to passage for each species would be expected under different alternatives.

Sources of either Elwha native or very closely related stocks of all ten runs are available. With in-river fishing controls and management of the species' ocean harvest, nine of ten have good or excellent chances of full restoration if the dams are removed. This is because freshwater habitat, not conditions in the marine environment, is the primary limiting factor for North Coast anadromous fish over the long term.

Elwha sockeye salmon require access to Lake Sutherland to complete their reproductive cycle. Removing the dams would allow unobstructed access to Lake Sutherland, but stock availability may limit restoration success.

The single dam removal alternatives and the Dam Retention with mitigation (i.e., fish passage facilities) alternative all pose passage problems that cause high levels of mortality for all runs. These would not restore habitat to the same extent as the Proposed Action. Removing Glines Canyon Dam would restore natural transport of spawning gravel and woody debris to the middle river, but Elwha Dam would continue to block material from entering the lower river or marine environment. The 2.8 miles of still water in Lake Aldwell and fish passage at Elwha Dam would be difficult for sockeye and chinook to navigate and virtually impossible for pink and chum.

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Removing Elwha Dam would not restore natural transport of gravel, as Glines Canyon Dam would remain in place with approximately 2.5 miles of potentially very high quality river habitat still inundated by Lake Mills. Navigating fish passage at Glines Canyon Dam or swimming through the reservoir during downstream juvenile migration would severely affect chinook, pink, chum, and coho. Retaining either reservoir would also continue to inundate important spawning and rearing habitat, especially for pink and chum salmon.

Implementing the Proposed Action would eliminate passage problems posed either by the dams or the reservoirs, restore natural transport of spawning gravel and large woody debris, return 5.3 miles of inundated river to high quality pool and riffle habitat for fish, reduce elevated water temperatures and the risk of disease, and recreate the large estuary at the mouth of the river used as a fish nursery by salmon juveniles before entering their saltwater phase. Short-term impacts to fish from the release of sediment are discussed in the “Geology, River Morphology, Hydrology & Water Quality” section.

Of the ten runs originally occupying the pre-dam Elwha River, none have good or excellent chances of restoration if either the Dam Retention or Elwha Dam Removal alternative is implemented. Two have good chances (none have excellent) if Glines Canyon Dam Removal is selected. Nine of ten runs have good or excellent chances of full restoration in the river if the Proposed Action is implemented.

Living Marine Resources

Removing both dams would send sand, gravel, and lesser amounts of cobble back into Freshwater Bay at the mouth of the river. As a result, the amount of sand-gravel type habitat would increase. The present community would change from species preferring rocky substrates (kelp, rock crabs, clingfish, gunnels, barnacles, and mussels) to those preferring a sandy substrate (eelgrass, Dungeness crab, flatfish, and hardshell clams). Dam removal would also contribute to the restoration of the delta, estuary, and associated shellfish habitat, increasing the shellfish fishery.

In the short term, marine organisms unable to move, such as algae or shellfish, might be smothered if suspended sediments were allowed to wash out naturally. However, nearshore currents would carry some portion of these sediments in suspension into Puget Sound where they would be diluted and have little impact.

Wildlife and Vegetation

All action alternatives would reintroduce salmon and seagoing trout to the middle and upper Elwha River. Since many of these fish spawn and die, they would provide a source of food for a variety of birds and mammals, perhaps increasing populations of some in the Elwha River basin.

Removing either dam and draining and revegetating the reservoir lands would add terrestrial acreage. Some of the wetlands near the reservoir shoreline may be eliminated; those that existed along the river before the dams were built would be restored. Species such as the trumpeter swan that presently use the reservoirs would lose that habitat within the Elwha River basin. Species such as the threatened marbled murrelet and bald eagle that depend on forest habitat and feed on salmon would benefit in time.

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Land Use, Recreation and Esthetics

Land may be needed for disposal of dam and dredge material under any of the dam removal alternatives, although ocean disposal and other uses for the rubble would be explored in the Implementation EIS.

Prior to removing either or both dams, project land (that land associated with the dams, reservoirs, and their facilities) would be acquired by the Department of the Interior. The Elwha Restoration Act states that land acquired inside Olympic National Park boundaries will be kept by the park and managed according to park policies. The act also dictates that acquired river banks, whether in or out of the park, will be managed according to the declared policy of Section 1(b) of the Wild and Scenic Rivers Act. Lands outside the park may be added to the park, placed in the National Wildlife Refuge System, or held in trust for the Lower Elwha S'Klallam Tribe. The impacts of each land disposition option would be explored in the Implementation EIS if the secretary decides to remove the dams.

Hikers, campers, and anglers in the Elwha subdistrict of Olympic National Park would be temporarily kept out of the project area during fish passage construction or dam removal. All dam removal alternatives would require some fishing restrictions to restore the native anadromous salmon and trout to their historic ranges in the Elwha River and would eventually improve fishing. These fish would compete with and result in fewer resident trout, consistent with a natural system.

Whitewater boaters would be able to float additional sections of the river if either or both dams were removed. If the dams were removed, reservoirs now used by flat-water boaters and anglers would be drained.

Some hikers or campers might find the drawn-down reservoirs ugly because tree stumps and barren land would be evident for a few years following dam removal. Others might find fascination in the scene of a river returning to its natural state. In the long term, recreationists seeking a river experience would find the Elwha attractive if the dams were removed.

Socioeconomics

Total benefits of the Proposed Action greatly exceed total costs. Business benefits associated with recreation and tourism, including sport fishing, would total $133 million over 100 years of project life (at 3% rate of discount). Commercial fishermen would obtain $3.5 million per year of net economic benefits after fish stocks were restored, amounting to $30 million over project life. Approximately $1 million over the life of the project would be saved in erosion control costs at Ediz Hook, and shellfish harvest would likely be more abundant. Removal of both dams would also substantially improve material and cultural circumstances of the Lower Elwha S'Klallam Tribe.

Activity associated with removal of both dams would generate between 760 and 1,067 jobs in Clallam County, $21-29 million of personal income, and between $40 and $55 million in business activity in Clallam County over the 10-year period of river restoration activity. A recent study also estimated restoring the river ecosystem would provide substantial non-market benefits to U.S. citizens.

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After restoration was complete, 446 annual jobs and a payroll of $4.6 million would be generated in the Clallam County recreation and tourism sector, increasing local sales taxes by $296,000 per year.

The Dam Retention alternative would generate 37 jobs during construction, increase property tax revenue by $639,000, and generate $1.07 million in fisheries business benefits. To install fish passage measures would cost an estimated $38 million. Factored into the increased cost of power, the mill now using hydropower from the dams would pay an additional $196.7 million over the 100-year life of the project.

Removing Glines Canyon Dam only would provide 172 person-years employment, increase property tax revenue by $243,000, and increase fisheries benefits to $1.97 million after restoration was complete. It would cost an estimated $86 million, including $31 million for fish passage and mitigation. Factored into the increased cost of power (fish passage and mitigation), the mill would pay an additional $281.6 million over the 100-year life of the project.

Removing only Elwha Dam would provide 84 person-years of employment, increase tax revenues by $166,000, and increase fisheries benefits to $1.57 million after restoration was complete. It would cost an estimated $65 million, including $25 million in fish passage and mitigation. Factoring the cost of these required actions into the cost of replacement power, the mill would pay an additional $187.6 million over the life of the project.

The Proposed Action is estimated to cost between $75 and $101 million; this includes $29.5 million to acquire both dams (determined by Congress). It would increase fisheries benefits to $3.5 million, and would do so more quickly than other action alternatives, as restoration would be completed without passage losses imposed by the dams and reservoirs. The increased cost of replacement power over the 100-year life of the project would amount to $171.9 million. Although property tax could decline by $230,000, payments to the local energy utility would increase $561,000.

Cultural Resources

Cultural resources include structures, landscapes, traditional cultural properties, archeological sites, ethnohistoric sites, and contemporary resources such as fish and cedar used for cultural purposes. Ethnographic and ethnohistoric research shows that Elwha S'Klallam settlements were located along the Elwha River and coastal portions of the project area. Archeological research has demonstrated native occupation of the area for centuries prior to the arrival of Euro-American settlers. Though the aboriginal S'Klallam harvested a variety of plants and animals, salmon were their most important source of food, both for immediate consumption and for seasonal storage. Restoring the salmon would restore an important traditional economic and social base for the tribe.

Non-Indian settlement of the Elwha region began in the 1860s when home sites were established in the lower part of the Elwha valley. Homesteads were developed by both S'Klallam and Euro-American settlers.

In the late 19th and early 20th centuries, the Elwha S'Klallam continued to rely on their fisheries as the mainstay of their economy, but also made their living along with the non-Indian population by cultivating crops and orchards, raising stock and selling surplus produce and dairy products, lumber and shake mill work, packing, guiding, employment in Port Angeles and elsewhere, and providing much of the labor force to construct bridges and county roads in the vicinity. The development and construction of the dams was a major event in the valley during the early 20th century.

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The tribe also has cultural properties that now lie under the reservoirs or have been made inaccessible by them. Removing the dams could eventually uncover inundated or buried cultural resources and reestablish access to currently inaccessible sites.

The historic resources of the area include structures at the Elwha Ranger Station Historic District, a bridge, the hydroelectric projects themselves, and others. Prior to removal, each dam would be fully inventoried, documented according to Historic American Engineering Record standards, and photographed. If both dams were removed, a wider meandering river and higher elevation riverbed might result; mitigation for potential flooding of the Elwha Ranger Station and other historic properties would be needed.

Safety

Inspections by the Federal Energy Regulatory Commission and the U.S. Army Corps of Engineers have resulted in additional strengthening and securing of the two dam structures over the years. The Washington State Department of Ecology Office of Dam Safety indicates that both dams currently meet state safety standards for both probable maximum floods and earthquakes. However, additional investigation of deep and shallow faults in the Port Angeles region and re-examination of earthquake safety standards are currently underway. The results of these investigations could change the ratings of either or both dams.

If the dams were removed, the Elwha River would be resupplied with sand and gravel, elevating the riverbed and water elevation. The river would more often overflow its banks in some places and also meander more frequently across a wider swath of the floodplain. Some existing facilities (residences, well heads, roadways, and levees) on the outwash plain near the river mouth might need to be raised and reinforced or other mitigation employed (e.g., flood insurance) to provide the same level of flood protection as is now available.

Asbestos has been detected in the power cables, residences, and offices of the dam facilities. One of the soil samples taken at the Glines Canyon Dam switchyard contained low levels of polychlorinated biphenyls (PCBs). Any hazardous material would be handled and disposed of in a safe manner consistent with federal regulations.

Ecosystem and Stream Ecology

Before the dams were built, native anadromous salmon and trout entered, spawned, and exited the Elwha River throughout the year. Removing both dams would reestablish this year-round supply of food to at least 22 species of birds and mammals. Vital nutrients released from decaying fish carcasses would also be restored, increasing the biological productivity of the entire aquatic ecosystem. The 715 acres of terrestrial habitat, including riparian and wetland acreage, would be restored to support wildlife if the dams were removed. In addition, 5.3 miles of high quality stream habitat inundated by the reservoirs would be returned to fish and other aquatic organisms.

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Removing only one dam or installing fish passage measures on the existing dams would help reestablish some fish runs and hence improve the condition of the ecosystem and stream ecology, but to a lesser extent than the **Proposed Action.**

Indian Trust Assets

In addition to ecological damage, the dams dramatically reduced the treaty fisheries of at least four federally recognized Indian tribes—the Lower Elwha S'Klallam, the Port Gamble S'Klallam, the Jamestown S'Klallam, and the Makah—and blocked access to treaty-reserved usual and accustomed fishing places. These treaty-reserved interests of the four tribes to take fish as well as to access usual and accustomed fishing places are property interests subject to the federal trust responsibility which cannot be abrogated or diminished without the specific action of Congress. This issue is discussed in various appropriate places throughout this document (water quality, fisheries, land use, etc.). Impacts to the Indian trust assets are not discussed in a separate impact section.

The tribes have a federal reserved water right in the Elwha River in an amount necessary to propagate native anadromous fisheries and to meet the purposes of the Lower Elwha Indian Reservation (see discussion of sediment, river morphology, and water quality). The Elwha hydropower project has operated for more than 80 years with loss of tribal access to usual and accustomed fishing places, with significant loss of both freshwater and marine fisheries resources, and with no consideration for preservation of river hydrology or morphology for the needs of the fisheries.

In general terms, removing both the Elwha and Glines Canyon dams would fully restore the Elwha River ecosystem and native fisheries, and uphold the federal trust responsibility to affected Indian tribes. All other action alternatives would partially restore the ecosystem and native fisheries in varying degrees, but would not uphold the federal trust to affected tribes relative to the fisheries resource and access to usual and accustomed fishing places (Department of the Interior, 1994).

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Introduction

In the early 1900s, the free-flowing Elwha River on the Olympic Peninsula in Washington State was dammed with two hydroelectric dams. Built without fish passage facilities, they blocked the upstream migration path for all of the species of native anadromous salmon and trout that had used the river for spawning. The dams also interrupted the downstream movement of gravel needed for spawning and, through inundation, destroyed important river salmon and trout habitat.

By 1930, the dams supplied a portion of the power needs for a pulp and paper mill in Port Angeles, Washington, currently owned by the Daishowa America Corporation. In 1968, the owner and operator of the dams (then, Crown Zellerbach Corporation and now, James River Corporation) submitted an application to license the Elwha Dam and in 1973 an application to relicense the Glines Canyon Dam with the Federal Energy Regulatory Commission (commission). Licensing was controversial and a number of parties challenged the commission's jurisdiction to relicense the Glines Canyon Dam primarily because of its location in Olympic National Park.

Before the commission could take action, it first had to comply with the National Environmental Policy Act. In 1991, a draft environmental impact statement was published and circulated for public review (Proposed Elwha [FERC No.2683] and Glines Canyon [FERC No.588] Hydroelectric Projects, Washington). Comments on the draft were received and responded to by either modifying or adding information to the draft or by answering questions in the "Responses to Comment" section. The revised draft and "Responses" section would normally have been circulated as the final environmental impact statement prior to a licensing decision, but was never released by the commission.

Congress responded to the controversy by enacting Public Law 102-495, the Elwha River Ecosystem and Fisheries Restoration Act, in October 1992. Under the act, the secretary of the interior was directed to study ways to restore the native anadromous fisheries and ecosystem of the Elwha River. The resultant Department of the Interior study was named the "Elwha Report." The act stayed the Federal Energy Regulatory Commission licensing process. The Department of the Interior requested the amended environmental impact statement and responses to comments to aid in its preparation of the study. The two volumes were retitled "Federal Energy Regulatory Commission Draft Staff Report" (Draft Staff Report).

In the Elwha Act, Congress called for the secretary of the interior to consider whether full restoration of the fisheries and ecosystem was possible only if both dams were removed and, if so, to establish a "definite plan" for removal. In late 1993 and early 1994, the Elwha Report was reviewed by the public, finalized by Interior, and submitted to Congress. In it, the secretary determined that removing the dams was both feasible and necessary to restore the fisheries and ecosystem and to uphold the federal trust responsibility for affected Indian tribes. The Elwha Report examined several options for dam removal.

NEPA Issues. While the Elwha Report reached certain conclusions about potential river restoration, further evaluation of issues, alternatives, and potential river impact was needed for the secretary of the interior to make a final decision. A full range of alternatives to the proposed removal of both dams, and the environmental impact of each alternative, has been analyzed. Much of this information and analyses is contained in the Draft Staff Report and the Elwha Report and their appendixes.

Pg. 16 = pg. 2&3

The commission's purpose in preparing an environmental impact statement was to determine whether to license the two dams. Interior's responsibility, as defined by the Elwha Act, is to decide whether to remove the dams and fully restore the fisheries and ecosystem. Both agencies are bound by requirements to be objective and study all reasonable alternatives, even those outside their jurisdiction. Therefore, although the commission licenses non-federal hydropower dams and requires fish passage, its environmental impact statement examined the alternatives of removing each dam separately or removing both dams. Likewise, although the secretary of the interior is considering removing both dams to achieve full restoration of the Elwha ecosystem and native fisheries, this environmental impact statement also examined single dam removal scenarios and the installation of fish passages on the dams. Thus, the range of alternatives in both the commission and Interior documents is substantially the same.

Since much of the required analyses had been conducted by the commission, Interior adopted the commission's environmental impact statement (as updated and re-named Draft Staff Report in March 1993) in preparing its own environmental impact statement (40 CFR 1506.3). Also, since the Elwha Report postdates the Draft Staff Report, Interior incorporated it and its appendixes.

Information from these two documents considered important to understand impacts is summarized in this "Elwha River Ecosystem Restoration Final Environmental Impact Statement" (final environmental impact statement). Sections and pages of the Draft Staff Report and Elwha Report are cited so that readers can find more information. This final environmental impact statement also contains new data and analyses not found in either of the earlier reports. Material in this document supersedes both the Draft Staff Report and Elwha Report.

Public meetings on the draft environmental impact statement were held in Port Angeles and Seattle in November, 1994; responses to substantive comments received both at those meetings and subsequently in writing are incorporated both as text changes and appear in a question-answer format in this final environmental impact statement.

This final environmental impact statement focuses on impacts to those resources Congress requested Interior to evaluate--fisheries and the ecosystem. By adopting the commission Draft Staff Report and incorporating the Elwha Report, this document will provide the secretary with enough information to decide whether to remove the dams. It is therefore referred to as a "policy" or "programmatic" statement.

Since the Draft Staff Report also details a full dam removal alternative, the secretary could decide to begin removal of the dams based on this environmental impact statement. Yet to be determined, however, are less expensive, lower impact dam removal alternatives.

To give the secretary a broad range of feasible options, Interior will write a second environmental impact statement. If the secretary chooses dam removal as the best alternative, the second document would examine several ways to implement this decision. It would analyze the economic and environmental costs and benefits of each, and be reviewed by the public. The second environmental impact statement will be referred to as the "Implementation EIS" throughout this document.

Pg. 17 = pg. 3,4&5

For legal purposes, this final environmental impact statement cites pages of the Draft Staff Report that Interior will adopt to aid the secretary in making his decision. All pages will be adopted except: 2-8 to 2-16 (Applicant Proposal), 2-28 to 2-44 (Cost-Benefit Analysis), 5-29 to 5-38 (FERC Staff Conclusions) and Appendix E (Cost Material). The entire Elwha Report and its appendixes are also incorporated in this document.

A limited number of the two-volume Draft Staff Report is available from the Denver Service Center of the National Park Service (Sarah Bransom at 303/ 969-2210). The Federal Energy Regulatory Commission documents are also available at most public libraries and offices of the National Park Service in Seattle or Port Angeles. The Elwha Report is available from Dr. Brian Winter, Elwha Project Coordinator, Olympic National Park, (360/452-0302).

Purpose and Need

Background

The 45-mile Elwha River and its tributaries were once rich in salmon and trout. These fish were used by Native Americans for thousands of years before the first European explorers reached the Northwest Coast. Today the Lower Elwha S'Klallam Indian Reservation, occupying 574 acres of land at the mouth of the river, is the homeland of the Lower Elwha S'Klallam Tribe, which bases much of its culture and economy on the salmon in the Elwha River. The salmon also provide substantial commercial and recreational catches to both tribal and nontribal fishermen in the ocean approaches to the river. The fisheries resources of the Elwha are subject to the treaty reserved interests of four Indian tribes: the Lower Elwha S'Klallam, the Port Gamble S'Klallam, the Jamestown S'Klallam, and the Makah.

In 1913, the first of two dams was completed 4.9 miles from the mouth of the river. A second dam was built 8.5 miles farther upstream in 1926 (see Figure 2). The Elwha Dam created a reservoir, Lake Aldwell, and the Glines Canyon Dam created a reservoir, Lake Mills. Glines Canyon Dam is now within the boundary of Olympic National Park, its presence in conflict with park policies. Both dams were built without fish passage facilities. The numbers of Elwha native anadromous fish have declined drastically since the dams were built, a direct result of past and continued impacts of the dams.

The relative health of North Coast salmon stocks is erratic and depends on a combination of the conditions in the ocean and freshwater environments. Conditions in the ocean environment tend to fluctuate over time, producing long-term cyclic changes in the size of salmon populations. However, the ability of the freshwater environment to support fish is largely dependent upon the amount and quality of spawning and rearing habitat available. Available high quality freshwater habitat in the North Coast area has been declining steadily over the years, with a corresponding steady decline in salmon production. Agricultural, industrial, residential, and other land use and development such as logging send silt and pollutants into rivers. Water diversions, development of estuaries, channeling for flood protection, and other factors eliminate stream habitat that salmon and steelhead need to successfully reproduce. Dams and reservoirs, even those with fish passage facilities, are a primary source of mortality for both spawning adults and outmigrating juveniles.

Pg. 18 = pg. 5&6

On the Elwha River, the dams have completely blocked upstream passage to 93% of the salmon and steelhead spawning and rearing habitat. Populations, primarily sustained through hatchery operations, exist in very low quality habitat in the remaining lower 4.9 miles of river. Surface releases from the reservoirs raise temperatures 2-4 degrees C in warm summer months, a condition strongly correlated with a higher than average incidence of disease in Elwha chinook. Redds, or spawning nests, are much more crowded than under natural conditions. Gravel needed for spawning and large woody debris required for rearing are held back by the dams. The river's estuary or fish "nursery," which once included one-half mile of habitat, is now confined to the first 300 feet of the river. More than five miles of stream habitat have been inundated by the two reservoirs.

Figure 2. Project Area (Scan)

The river downstream of the dams has also changed in character since they were built. Where the Elwha was once an active, meandering river with alternating pools and riffles ideal for fish, it now flows in a stable, armored channel.

By changing habitat downstream and barring fish from quality habitat upstream, the dams have altered the entire ecosystem of the Elwha River valley. Terrestrial wildlife that previously fed on the salmon lost a year-round, stable supply of food. Since decaying salmon carcasses are an important source of nitrogen and phosphorus to the aquatic food chain, their absence has altered the river ecology as well.

Unlike other dammed rivers in the northwest surrounded by development, the bulk of the Elwha River system is within the Olympic National Park and remains in a natural condition. Because of this, the **Proposed Action** provides a rare opportunity to restore an entire ecosystem through the single action of removing the dams. Congress has recognized this in passing the Elwha River Ecosystem and Fisheries Restoration Act (Public Law 102-495), which mandates the study of, and a definite plan for, the removal of the dams to restore the Elwha River fisheries and ecosystem.

Congress established Olympic National Park in 1938, and expanded its boundaries in 1940, including the Glines Canyon project. The presence and operation of the project is inconsistent with National Park Service policy to "...restore natural aquatic habitats and the natural abundance and distribution of native aquatic species, including fish, together with the associated terrestrial habitats and species" (National Park Service Management Policies, 1988). The project also conflicts with park objectives to "...conserve, maintain, and restore, where possible, the primary natural resources of the park and those ecological relationships and processes that would prevail were it not for the advent of modern civilization" (Olympic National Park Statement for Management, 1989). These policies and objectives are more than just local or even national concerns, since in 1976, the park was designated as an International Biosphere Reserve and in 1981 gained the distinction of being named a World Heritage Site.

Both Lake Mills and Lake Aldwell have inundated or made inaccessible sites of cultural and religious significance for the Lower Elwha S'Klallam Tribe. The dams are also inconsistent with the federal trust responsibility to the four affected Indian tribes. Removing the dams is the only alternative that would both uphold this trust responsibility and be consistent with stated park policies and management efforts. It is also the only way to fully restore habitat for Elwha native anadromous fish, prevent mortality from fish passage measures and reservoirs, and return natural sediment transport and river channel conditions.

Pg. 19 = pg. 9

Purpose and Need

The Elwha and/or Glines Canyon Dams:

- block native anadromous fish passage to the majority of the Elwha River and tributaries;
- trap sediments and woody debris which are critical components of anadromous fish habitat and which maintain the Elwha River estuary;
- limit nutrients important to the aquatic and terrestrial food chain of the Elwha River valley;
- raise water temperatures, resulting in higher incidence of diseased or physiologically stressed fish;
- inundate important riverine and terrestrial habitat;
- inundate lands and sites of cultural and religious significance to the Lower Elwha S'Klallam Tribe;
- Glines Canyon Dam is within the boundary of Olympic National Park, but in conflict with park policy to restore fisheries and aquatic habitats to their natural states;
- result in beach erosion on the Elwha Reservation and east to Ediz Hook;
- are inconsistent with the federal trust responsibility to four affected Indian tribes.

These are the specific problems Interior intends to resolve in following congressional mandate to "...fully restore the Elwha River ecosystem and native anadromous fisheries..." consistent with the rights of Indian tribes secured by treaty or other federal law as stated in the Elwha Restoration Act (PL 102-495). Removing both dams will alleviate each of the above conditions, either completely or to a very large degree. Therefore, Interior finds there is a need to accomplish the congressional and agency purpose of full restoration of the Elwha River ecosystem and native anadromous fisheries through its proposed action of removing both the Elwha & Glines Canyon Dams. The specific Department of Interior objectives are:

1. Fully restore all runs of Elwha River native anadromous fish
2. Restore the Elwha River ecosystem

Congress has directed Interior to determine the feasibility of dam removal scenarios, protect downstream water quality for municipal and industrial users, and evaluate options for the disposition of acquired lands outside park boundaries should the dams be removed. Specific alternatives for each can be found in the Elwha Report: for dam removal, pp.65 to 90; for protecting water quality for municipal and industrial users, pp.91 to 100; for disposition of lands, pp.117 to 120. All are considered technically feasible by Interior. Preliminary cost estimates for dam removal and water quality protection for municipal and industrial users are presented in the Elwha Report and refined in this EIS. These issues, plus the treatment of specific associated dam structures, would be examined in more detail in the Implementation EIS.

Description of the Alternatives

This chapter will describe each of the five alternatives that Interior has analyzed and summarize both the impacts and the degree to which each accomplishes the Interior objectives, identical to congressional mandates, first identified in the "Purpose and Need" chapter.

Pg. 20 = pg. 11&12

The Elwha Dam, built 4.9 miles from the mouth of the Elwha River, began operation in 1913. The concrete structure, consisting of a central gravity-type section with an adjacent buttress-type intake section flanked by spillways at each abutment, is 450 feet long at its crest and 105 feet high. Lake Aldwell, the 2.8 mile impoundment created by the dam, has a total storage capacity of approximately 8,100 acre-feet. The total installed power generation capacity of the dam is 12.6 megawatts. The Elwha Dam has never been licensed.

Glines Canyon Dam, located 8.5 miles farther upstream, began operation in 1927. It is a varied radius, single-arch concrete dam 210 feet high, varying in width from 55 feet at its base to 270 feet at its crest. The 2.5-mile Lake Mills reservoir provides approximately 30,000 acre-feet of active storage, with drawdowns up to 4,000 acre-feet during extreme low flows. The total installed capacity is 16.0 megawatts. The Glines Canyon Dam has operated under an annually renewed federal license since 1976.

Description of the Alternatives

Proposed Action

Removing both Elwha and Glines Canyon dams would require the acquisition and decommissioning of the two projects, draining the reservoirs, and removing all or parts of the dams, powerhouses, and auxiliary structures. As required by the Elwha River Ecosystem and Fisheries Restoration Act, the quality and availability of downstream municipal and industrial water supplies would be protected.

Specific steps to remove the dams (described in detail in the Elwha Report, pp.70-90) include diverting the river through or around the dams to drain the reservoirs; decommissioning and removing all structures necessary for safety or for fish passage; and draining the reservoirs and managing the 17 million cubic yards of sediments that have accumulated behind the dams for the past 80 years. Several scenarios to manage sediment and divert the river were investigated in the Elwha Report. The river could be routed by way of a tunnel, surface diversion channel, low level diversion through the dam structure, or by notching the dam down from the top. Sediment could be transported naturally by the river, stabilized on site, or dredged and moved (probably by slurry pipeline) off site. Some historically important structures could be left in place.

Some of these options were investigated in the Elwha Report. Many of these, as well as other alternatives, would be further explored in the Implementation EIS if the **Proposed**

Action is selected by the secretary of the interior. The Implementation EIS also would address specific fisheries and ecosystem restoration, protection of the quality and availability of existing water supplies, flood control, and disposition of acquired lands.

If the Department of the Interior acquires the dams, interim management consistent with policy direction in the Elwha Restoration Act might be required while the Implementation EIS or other planning is underway. Interior could begin its native anadromous fisheries restoration efforts by planting some species in the middle and upper river while the dams were still in place. To accommodate juvenile downstream migration of these species, turbines or turbine runners may need to be removed at both dams.

Pg. 21 = pg. 12&13

At Glines Canyon Dam, initial reservoir drawdown would include the use of the spillway and penstock. Releases through the penstock would be limited, and passage for any outplanted anadromous fish hazardous if the turbines remain. To accommodate both drawdown and fish passage, the turbines may be removed and a large control gate installed. This alternative may require the construction of an energy dissipator to prevent severe channel erosion downstream of the control gate (due to larger flows). Two options have been considered for locating the large control gate: one is to install it within the power plant where the turbine formerly had been located; the other is to install it at the end of a steel bypass pipe branching off the penstock outside of the power plant. In the latter case, the control gate and an energy dissipator would be installed near the power plant on land that has been disturbed and lies outside the river channel. Typical construction vehicles required for this work would include a mobile crane, a front end loader, flatbed trucks, and concrete mixers. These vehicles would use existing roads and the parking lot as a staging area. All standard practices to ensure that fuel or leaks were contained would be followed.

At Elwha Dam, initial reservoir drawdown would include the use of both spillways and penstocks. The turbine of the larger penstock could be removed to provide additional release capacity and provide improved passage for outplanted salmon and trout. A control gate would not be required, as flow can be controlled to a great extent by the use of the spillways on both the left and right abutments. If turbines were removed, they could be cut up and sold for salvage value.

The environmental impacts of removing the turbines would be minor--temporary impacts to air quality from construction vehicles and ground disturbance associated with the bypass around the Glines powerhouse. Oil or fuel used on site to construct the bypass or energy dissipator, should they be required, would be physically prevented from entering the river by berms or other means.

Removing the turbines would also mean the loss of an average 18.7 megawatts of power the hydroelectric plants now produce. Costs of replacement power are analyzed in the socioeconomic section of this document, and the possible environmental impacts of different sources of replacement power in the Draft Staff Report (pp 4-213 to 215) and Elwha Report (pp 128-129).

No Action Alternative

Review of this alternative provides an analysis of existing conditions against which to compare all action alternatives. For the purposes of this environmental impact statement,

No Action means that Interior would take "no action;" the two dams, powerhouses, reservoirs, and auxiliary structures would remain as now, without fish passage or other mitigation. The **No Action** alternative described here (as opposed to No Action = No Dams) is used because it provides a context or yardstick against which to compare impacts of proposed actions.

The implementing regulations of the National Environmental Policy Act also ask agencies to consider possible ensuing actions if No Action is the selected alternative. The Department of the Interior legally challenged the authority of the Federal Energy Regulatory Commission in relicensing the Glines Canyon hydroelectric project within Olympic National Park before Congress passed the Elwha Restoration Act. This and other litigation may result if this alternative is selected and the commission resumes the relicensing process.

Pg. 22 = pg. 13&14

Dam Retention Alternative

To achieve fullest possible restoration, Interior has added mitigation measures to those proposed by the commission to better pass fish over the dams. These measures, described in detail on pp. 29-31 of the Elwha Report, are summarized here. This alternative is very similar to that described as "Applicant's Proposal with Supplemental Measures" in the Draft Staff Report.

Elwha Dam would be fitted with a fish ladder, ladder entrance, holding and sorting pools, and an inclined bar rack at the powerhouse tail race exit portals to prevent fish entry into the draft tubes where the adults could be delayed or injured while migrating upstream. To convey juveniles downstream, all water would be passed through modified spillways and screens would be installed on intake structures. A bypass pipe and vertical traveling screen facility, an open channel flume, and a concrete pool and weir structure would be built.

A trap-and-haul operation to convey fish past the 190-foot vertical lift at Glines Canyon Dam would be used to transport adults upstream. This system would include an electric weir to direct fish into the traps, holding and sorting pools, and a hoist to load fish onto a transport truck as well as other features (Elwha Report, p. 30). A year-round release of 450 cubic feet per second would flow over the Glines Canyon Dam spillway to help pass juveniles, and a screened or relocated intake for the power plant would be installed. The year-round release and the screened or relocated intake are additional mitigation not described in the Draft Staff Report, but required by Interior.

In addition to fish protection, this alternative includes the enhancement of 898 acres of applicant (James River Corporation) property outside Olympic National Park for wildlife benefits and the construction of three remote boat-in campsites on the east side of Lake Aldwell.

Removal of Glines Canyon Dam Alternative

Glines Canyon Dam would be decommissioned, the reservoir drained and features of the dam, powerhouse, and auxiliary structures necessary for safety and for fish passage removed. The mitigation measures described in the **Dam Retention** scenario for Elwha Dam would be installed. Sediment management and river diversion options, as well as land disposal, fish restoration, and water quality mitigation measures for this alternative would be further examined in the Implementation EIS if the secretary chooses this option.

Removal of Elwha Dam Alternative

Features of the Elwha Dam project would be removed as necessary for safety or fish passage as described above, and the trap-and-haul and other mitigation measures for fish would be installed at Glines Canyon Dam. Sediment management and river diversion options, as well as land disposal, fish restoration, and water quality mitigation measures for this alternative would be further examined in the Implementation EIS if the secretary chooses this option.

Pg. 23 = pg. 14&15

Alternatives Considered But Rejected

Several of the alternatives described in the Elwha Report (pp 78-89) would have relied on truck transportation of coarse sediment to a terrestrial site. These include options #1 and 2, estimated to cost between $200 million and $300 million. Interior has rejected truck transportation of sediment to a disposal site because it has no environmental advantage over the less expensive option of slurrying sediment via a pipeline.

Also, the concept of transporting and storing fine sediments away from the river at a terrestrial location has been eliminated as technically and economically infeasible. Such an alternative would require a large amount of land--more than 200 acres if sediment is stored 20 feet high. Since the sediments would be watery, it would take extensive erosion control measures to keep the silt and clay from returning to the river. The Federal Energy Regulatory Commission rejected land disposal of fine sediment away from the river as economically infeasible for these reasons. Interior, upon re-examination of the commission's analysis (not included in, but prepared in conjunction with the Draft Staff Report) agreed. If fine sediments are disposed of on land, the technically and economically preferred option would be within the drained reservoir lands and out of the floodplain. This is referred to as the stabilization alternative in this environmental impact statement.

Finally, several alternatives were suggested by commentors on the draft of this statement. Interior has considered the merits of each, and would examine several further in the Implementation EIS if appropriate. Several were rejected as infeasible. See the Response to Comments section of this document, "Alternatives" questions for more information.

Meeting Department of the Interior Objectives

In the "Purpose and Need" chapter, the congressional mandates spelled out in the Elwha Restoration Act, and hence Interior's objectives in taking action at this time, were first introduced. Here, each alternative is evaluated against these criteria to see how well it performs. The objectives are:

1. Fully restore all runs of Elwha River native anadromous fish.
2. Restore the Elwha River ecosystem.

In general terms, only by removing both the Elwha and Glines Canyon dams would the Elwha River ecosystem and native anadromous fisheries be fully restored. Other action alternatives would partially restore the ecosystem and fisheries to varying degrees.

The following is a summary of how effectively each alternative meets the specific objectives:

Objective #1. Fully Restore All Runs of Elwha River Native Anadromous Fish

Very few runs of native anadromous salmon and trout would be restored to the Elwha unless both dams were removed. Only winter and summer steelhead have a "good" chance for restoration in any of the partial restoration alternatives. All others have "fair," "poor," or "no chance" of restoration. If both dams were retained without mitigation (**No Action**), self-sustaining runs of salmon would never be restored to the river.

Pg. 24 = pg. 15&16

No Action (current conditions)

Elwha River anadromous salmon and steelhead exist in only 7% of their pre-dam freshwater habitat, as construction of the Elwha Dam eliminated access to 93% of the historical habitat. Spawning gravel and woody debris, both required for successful spawning and rearing, are largely or completely absent in these 4.9 miles of available river. More than five miles of quality freshwater fish habitat are inundated by the two reservoirs. Upstream releases of reservoir water elevate stream temperatures as much as 4^{o} C in warm months, a condition strongly associated with higher than average incidence of disease in chinook. Chinook redds, or spawning nests, are five times more crowded than under natural conditions, and populations are maintained only through hatchery production. If both dams were retained without fish passage, self-sustaining runs of wild salmon or steelhead would never be restored on the Elwha.

Continuing the present course would particularly hurt the Lower Elwha S'Klallam Tribe, since many of its members are unemployed or economically depressed and depend on the fisheries for food and income.

Dam Retention

If mitigation as described in the "Alternatives" chapter of this document is added, three runs might be partially restored in the long term: coho salmon and the winter and summer steelhead. However, none has even a "good" chance for full restoration. Partial restoration would include (as do all alternatives) phasing out hatchery production and enforcing fishing restrictions in the short term. Although populations of wild coho and steelhead would be dispersed throughout the river's length in greater numbers than today, the total number of anadromous fish in the river would decline.

The seven other runs of salmon and trout have poor or unknown chances of restoration if both dams were retained and mitigated with fish passage measures. This would be a result of unavoidable passage losses, inundated riverine habitat, and poor habitat quality between and below the dams.

Removal of Glines Canyon Dam

If the Glines Canyon Dam were removed, chances of restoring steelhead, coho, and chinook would be higher than in the **Dam Retention** alternative. The chances of fully restoring both winter and summer steelhead are considered good, but this is not true for any other runs. Since these species are commercially valuable, this alternative would be economically beneficial, but to a far lesser degree than if both dams were removed.

Removing this dam would provide passage to the upper river; recreate 2.5 miles of riverine habitat now inundated; reduce artificially high water temperatures; restore gravel, nutrients, and organic debris needed in the middle stretch of the river; and remove Lake Mills, a serious barrier to juvenile outmigration for some species. Fish such as pink and chum salmon, unable to survive passage through Lake Aldwell, would fare poorly even if Glines Canyon Dam were removed. Passage success for cutthroat and native char is unknown. Approximately 2.8 miles of river habitat for fish would continue to be inundated by Lake Aldwell.

Pg. 25 = pg. 17&18

Removal of Elwha Dam

Since the **Removal of Elwha Dam** would leave Glines Canyon Dam in place, chinook, coho and steelhead would not fare as well under this alternative as the **Glines Canyon Dam Removal** alternative. On the other hand, since passage over the mitigated Elwha Dam is unlikely for pink, chum, and sockeye salmon, these species would be expected to have a better chance for restoration if Elwha Dam were removed than if Glines Canyon Dam were taken out. Economic benefit from fisheries would be about equal to the **Glines Canyon Dam Removal** scenario, but again, to a lesser degree than if both dams were removed.

If Elwha Dam were removed, Glines Canyon Dam would continue to block nutrients, spawning gravels, and woody debris from the majority of the watershed and affect water temperature. It would also present major passage problems for species unable to migrate through the still waters of the reservoir (many use the stream current to move downstream) or withstand losses from the spillway or trap-and-haul process. Lake Mills would continue to inundate 2.5 miles of river habitat for fish.

Proposed Action

Removing both dams would allow native anadromous fish to spawn upstream and allow nutrients, sediment, and debris to flow unobstructed downstream into currently impoverished parts of the river. River temperatures would return to normal, and more than five miles of high quality freshwater anadromous fish habitat would be restored.

Removing the dams would immediately restore the 93% of the freshwater anadromous fish habitat lost when the Elwha Dam was built. A source of native Elwha River or closely related stock is available for all 10 runs, and agency and tribal-enforced fishing restrictions are in place.

With the exception of sockeye salmon, all species have a good to excellent chance of full restoration if both dams are removed. Sockeye stand a fair or poor chance of restoration.

The four affected Indian tribes and Clallam County businesses would benefit economically and culturally from the full return of the native anadromous fishery. It is estimated that this alternative would restore at least four times as many wild salmon and trout to the Elwha as the single dam removal alternatives.

Objective #2. Restore the Elwha River Ecosystem

An ecosystem is composed of physical and biological pieces mutually dependent upon or interactive with one another. Fully restoring an ecosystem means all are balanced, healthy, and functioning naturally.

In the Elwha River basin, the role of the ten runs of salmon and trout that occupied the river before the dams were built is critical to ecosystem restoration. These fish brought nutrients from the sea, in the form of biomass or body weight, which they spread throughout the river as they migrated. Their eggs and especially their carcasses supplied food to an abundance of birds and mammals along the river. Just as the fish carcasses supported the terrestrial wildlife, nutrients from decomposing carcasses were the base of an aquatic food cycle which eventually fed the juvenile salmon themselves.

Pg. 26 = pg. 18&19

As a result of competition for spawning sites, food, and limited rearing habitat, salmon and trout evolved staggered timetables; adults of different species enter and spawn and juveniles leave the river at different times of the year. The terrestrial and aquatic ecosystems were provided food and nutrients throughout the year, even when other food was scarce.

No alternative except full dam removal would reestablish this pre-dam species distribution, or provide terrestrial and aquatic life with the nutrients they need to fully use other features of the natural habitat within Olympic National Park.

No Action

Native anadromous salmon and trout now never reach beyond the Elwha Dam or first 4.9 miles of the Elwha River. Fish produced by hatcheries return to crowded, poor quality stream conditions to spawn, where they are subject to physiological stress, disease, high water temperatures, and inadequate spawning or rearing habitat. Since adults are collected to maintain hatchery production, even fewer salmon carcasses, eggs, and juveniles are available to wildlife in the lower river. Birds and mammals in the middle and upper river completely lack the prey resource these fish once provided, and riparian and upland habitat once available to them is now degraded or inundated.

The river channel and flow characteristics are also altered by the dams. Before the dams were built, much of the middle river (between the dams) was an active, meandering channel with sand, gravel, and cobble bars. The riverbed was composed of sand, gravel, cobbles, and boulders, with most of the finer grained material (silt and clay) washing through the system (FERC, p.3-l1). The sand and gravel would move during higher flows, preventing permanent vegetation from taking hold on in-river sediment bars.

Since the dams were built, sand and gravel in both the lower and middle reaches of the rivers have become trapped in the reservoirs. Bedload is now composed primarily of cobbles and boulders that rarely move. The river meanders less and the channel has become more stabilized and less active. In some places, the channel has degraded (lowered) as much as 1 to 5 feet. In the absence of moving pulses of sand and gravel, "islands" of sediment have become vegetated, some with mature trees.

The estuary at the mouth of the river, used by all juvenile native anadromous fish during transition from fresh water to salt water, is also affected by the dams. It has decreased by approximately one-half mile from its pre-dam size, is deeper, and consists mostly of larger cobbles and boulders. In addition, the beaches and nearshore area east to Ediz Hook are sediment starved and eroding.

Dam Retention
Although mitigation measures would allow some fish to pass over the dams and swim upstream, impacts to the ecosystem would largely remain. Water temperature related distress, disease, and fish mortality would persist. The flow of the river would remain unnaturally modified, sediments would not reach the middle or lower Elwha or the estuary at its mouth, beaches east to Ediz Hook would remain sediment-starved, and river and upland habitat would remain flooded by the reservoirs. Some wild anadromous fish would reach wildlife in the upper Elwha that use them for food, but far fewer fish (due to passage mortality, fewer fish runs, and inundated habitat) would be available than under pre-dam conditions, and their migrations would be clustered into certain seasons rather than dispersed throughout the year.

Pg. 27 = pg. 20&21

Removal of Glines Canyon Dam
Glines Canyon Dam is located within the boundary of Olympic National Park. Its impacts are in direct conflict with park policy to "conserve, maintain, and restore, where possible, the primary natural resources of the park and those ecological relationships and processes that would prevail were it not for the advent of modern civilization," (Statement for Management, 1989). Dam removal would eliminate the obvious presence of modern civilization and restore natural ecological processes to the Elwha River valley to some extent within park boundaries. The river would, however, continue to be negatively affected by the Elwha Dam. Because it presents passage problems for the native anadromous fish, wildlife and the aquatic ecosystem would be denied more than 500,000 pounds of fish biomass during critical times of the year (Elwha Report, p.36). In addition, Lake Aldwell would continue to inundate important riverine and terrestrial habitat and affect quality in the lower river by elevating water temperature during late summer and fall.

Stream flow regime and transport of nutrients, gravels, and debris would resume, but only as far as Elwha Dam, to be blocked until Lake Aldwell filled with sediment and began to flow through the penstocks and spillways. This would not result in natural, pre-dam conditions, however, as sediment stored in Lake Aldwell and its delta would remain permanently.

Although some fish would pass the Elwha Dam and be reintroduced into the middle and upper Elwha, species would not distribute themselves throughout the year and might not be available during critical wildlife feeding periods. Nor would they provide the year-round fishery that the Lower Elwha S'Klallam Tribe historically relied upon.

Removal of Elwha Dam
This alternative adds approximately 27,000 pounds of sockeye biomass (Elwha Report, p.36) to the projected total for the Removal of Glines Canyon Dam alternative. Poor habitat in the middle and lower would preclude full restoration of any other anadromous fish species. Species distribution of salmon and anadromous trout would not approximate pre-dam conditions.

Stream flow and river channel characteristics would remain modified by the presence of Glines Canyon Dam. The estuary and beaches east to Ediz Hook would remain sediment starved. Salmon and anadromous trout would not be distributed along the river corridor throughout the year, depriving wildlife and tribal fishermen of a resource they historically relied upon.

Proposed Action
Only this alternative would fully restore the Elwha River Valley ecosystem since it restores all of the natural biological and physical processes of the river. Removing the dams would restore important riverine and terrestrial habitat now inundated or made inaccessible by the reservoirs and recreate natural species distribution and abundance of native anadromous fish.

With both dams removed, barriers are removed for fish migrating upstream and nutrients flowing downstream. Water temperatures would return to normal. Approximately 800,000 pounds of fish biomass would return to the middle and upper Elwha River and, with it, 13,000 pounds of recycled nitrogen and phosphorus in the form of decaying carcasses (Elwha Report, p. 36). These nutrients would help support the aquatic food chain, and the fish themselves feed an abundance of wildlife. Since nine of the ten runs have good or excellent chances of full restoration, the river would be filled with salmon or trout all year, providing a necessary food source for some wildlife, especially during the critical late fall and winter months.

With no dams, the stream flow would return to its normal, dynamic state--naturally moving sand and gravel downstream, flooding, changing course, undercutting riverbanks, and filling the bed with coarse sediment as storms wash material from upstream. The estuary would be restored and the process of beach erosion would be reversed.

The chart below summarizes impacts of each alternative so that readers may evaluate their comparative merits. This information is from the "Impacts of Each Alternative" chapter.

Table 1. Impact Summary Chart

ALTERNATIVES

	No Action	Dam Retention	Glines Canyon Dam Removal	Elwha Dam Removal	Proposed Action
FLUVIAL PROCESSES					
Channel morphology	Static	Static	Middle section dynamic	Static	Entire river dynamic
Aggradation	None	None	1-5 ft. between reservoirs short term, entire river after 50 years if Lake Aldwell fills*	Temporary	1-5 ft., (pre-project conditions)*
Sediment & organic	Limited	Limited	Restored to	Limited	Fully restored

matter transport			middle river, in 50 years to all of river if Lake Aldwell fills		
Reservation beaches	Erosion continues, overall reduction of beach area	Erosion continues, overall reduction of beach area	Erosion continues, overall reduction of beach area	Erosion continues, overall reduction of beach area	Reduced rate of erosion, some land area restored
Ediz Hook	Erodes at present rate	Erodes at present rate	Erodes at present rate	Erodes at present rate	Reduced rate of erosion
WATER QUALITY					
Turbidity: long term	Periodically turbid	Periodically turbid	Periodically turbid	Periodically turbid	Some increased turbidity
Turbidity: short term	No change	Some during construction of fish passage measures	Some during construction; may be significant in river below Glines Canyon Dam depending on sediment management scenario used	Some during construction; may be significant in river below Elwha Dam depending on sediment management scenario used	Some during construction; may be significant in river below Glines Canyon Dam depending on sediment management scenario used
Temperature	Elevated during summer	Elevated during summer	Near normal	Elevated during summer	Return to normal
FISHERIES					
Restoration Potential					
Pink salmon	None	None/poor	None/poor	Poor	Good
Chum	None	None/poor	None/poor	Poor	Good
Searun cutthroat	None	Unknown/poor	Unknown	Unknown	Good
Native char	None	Unknown/poor	Unknown	Unknown	Good
Summer/fall Chinook	None	Poor	Fair/good	Poor/fair	Excellent
Spring Chinook	None	Poor	Fair/good	Poor/fair	Good
Coho	None	Fair	Fair/good	Fair	Good/excellent
Summer steelhead	None	Fair	Good	Fair	Good
Winter steelhead	None	Fair	Good	Fair	Excellent
Sockeye	None	None/poor	None/poor	Poor/fair	Poor/fair
Spawning habitat gravels	5.3 miles of river habitat inundated;	5.3 miles of river habitat inundated;	2.8 miles of river habitat inundated;	2.5 miles of river habitat inundated;	5.3 miles of river habitat restored;

	limited spawning gravels in mid- and lower river	limited spawning gravels in mid- and lower river	limited spawning gravels below Elwha Dam	limited spawning gravels in mid- and lower river	spawning gravels restored to mid- and lower river
Impacts to resident trout population	Unnaturally large population	Reduce population	Reduce population	Reduce population	Reduce population
LIVING MARINE RESOURCES					
Marine community	Favors organisms that prefer offshore rocky substrate	Favors organisms that prefer offshore rocky substrate	Favors organisms that prefer offshore rocky substrate	Favors organisms that prefer offshore rocky substrate	Sandy substrate restored, favors organisms that prefer sandier substrate, hardshell clams may be restored
WILDLIFE AND VEGETATION					
Restoration potential					
Terrestrial wildlife-prey and habitat	Habitat underutilized	Habitat underutilized	Habitat more fully utilized, prey partially restored	Habitat more fully utilized, prey partially restored	Habitat fully utilized, prey fully restored
Threatened and endangered species-prey and habitat	Habitat inundated, prey lost	Habitat inundated, prey lost	Some prey, habitat partially restored	Some prey, habitat partially restored	Prey returned, habitat fully restored
Vegetated area	No change, 715 acres inundated or unavailable	No change, 715 acres inundated or unavailable	425 acres recovered	290 acres recovered	715 acres recovered
Wetlands	None	None	26 acres new	22 acres new, small portion of 36 acres may be lost near reservoir	48 acres new, 122 acres wet channel restored, small portion of 43 acres may be lost near reservoir
Riparian lands	553 acres	553 acres	Restore 287	Restore 246	Restore 553

	inundated and unavailable	inundated and unavailable	acres	acres	acres
LAND USE, ESTHETICS AND RECREATION					
Land Use					
Olympic National Park	Conflicts with park policy	Conflicts with park policy	Elwha Dam somewhat inconsistent with park policy	Glines Dam conflicts with park policy	Consistent with park policy
Puget Sound Salmon Management Plan	Inconsistent with plan	Largely inconsistent with plan	Largely inconsistent with plan	Largely inconsistent with plan	Fully consistent with plan
Clallam County Comprehensive Plan	Inconsistent with plan	Largely inconsistent with plan	Largely inconsistent with plan	Largely inconsistent with plan	Fully consistent with plan
Esthetics					
Views	Lake views	Lake views	River and lake view	River and lake view	River view
Recreation					
Park recreation	Lake oriented	Lake oriented	River and lake oriented	River and lake oriented	River oriented
Fishing	Only resident fish above dam	Anadromous fish increase, fewer resident trout	Anadromous fish increase, fewer resident trout	Anadromous fish increase, fewer resident trout	Full restoration of native anadromous salmon & trout, resident trout decrease
CULTURAL					
Tribal	Tribal river focus lost	Tribal river focus lost	Tribal river focus partially restored	Tribal river focus partially restored	Tribal river focus fully restored
Cultural properties	Inundated and innaccessible	Inundated and innaccessible	Inundated and innaccessible	Some uncovered and accessible	Most uncovered and accessible
Historic structures	Historic structures remain unmodified; on National Register of	Dams modified, but eligibility for Register unaffected	One dam removed and other modified but eligibility for Register	One dam removed and other modified but eligibility for Register	Both dams removed but fully inventoried, loss of historic structures

	Historic Places		unaffected	unaffected	
SOCIOECONOMIC					
Property taxes	$231,000 (1994)	Increase of $639,000	Increase of $295,000	Increase of $166,000	None
Construction jobs	0 (now)	32 person years	172 person years	84 person years	763-1,067 person years
FERC cost estimates	$0	$38M	$86M	$65.1M	$75M-$101M**
Base year (1997) local real cost replacement power (millions of dollars)*	$2.1M	$8.1M	$9.3M	$6.7M	$4.8M
Annual fisheries benefits	$.84M	$1.1M	$2M	$1.6M	$3.5M
SAFETY AND FLOODING					
Hazard potential	High	High	High	High	Nonexistent
Ability to withstand maximum probable flood	Safe	Safe	Precautions needed during dam removal	Precautions needed during dam removal	Precautions needed during dam removal
Earthquake***	Both considered safe	Both considered safe	Elwha Dam considered safe	Glines Canyon Dam considered safe	N/A
Localized floods	Occur now	Same frequency and impact as now	Higher flood stage in middle reach	Temporary higher flood stage in lower reach	Higher flood stage
Hazardous materials	Asbestos at both sites; very low PCB levels at Glines Canyon Dam	Asbestos at both sites; very low PCB levels at Glines Canyon Dam	Asbestos, PCB's removed from Glines Canyon Dam sites and disposed; asbestos remains at Elwha Dam site	Asbestos removed from Elwha Dam site and disposed; asbestos and PCBs remain at Glines Canyon Dam site	All asbestos and PCBs are removed and disposed
ECOSYSTEM					
Biomass (1,000 lbs. Of salmon/trout)	0	109	284	312	818

Nitrogen & phosphorous (pounds)	0	1,800	4,770	5,200	13,000
Number of runs with "good" or better restoration potential	0	0	2	0	9
River ecology	Nutrients & debris blocked, flow regime altered	Nutrients & debris blocked, flow regime altered	Nutrients & debris blocked below RM 4.9, flow regime natural to RM 4.9	Nutrients & debris blocked, flow regime altered	Nutrients & debris transported along entire river, flow regime restored

* Preliminary estimate only
** From recent estimates in Meyer, et. al., 1995 and U.S. Bureau of Reclamation, 1995
*** Ongoing research to both assess the hazard from newly discovered faults in the area and revise earthquake safety standards may require re-evaluation of the safety of the dams

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Impacts of Each Alternative

This chapter will first present a description of existing environmental conditions for each resource (sediment, water quality, etc.), and, second, a discussion of impacts expected to the resource if the alternatives were to be implemented. The existing conditions are termed "Affected Environment."

Sediment, River Morphology and Water Quality

Affected Environment

The Elwha River is 45 miles long, has 100 miles of tributary streams, and drains 321 square miles of the Olympic Peninsula (See Figure 3). Eighty-three percent of the drainage lies within Olympic National Park, comprising approximately 20% of the total park area. Impoundment of the river in Lake Mills and Lake Aldwell has inundated 5.3 miles of riverine and 715 acres of lowland habitat.

Annual precipitation in the Elwha River basin ranges from 220 inches in its upper reaches to 56 inches near the mouth of the river. Average annual daily discharge is 1500 cubic feet per second. Discharge is influenced by early winter storms and spring snowmelt, and by baseflow conditions during the summer. The lowest flow period is during late summer and early fall.

The Elwha River, its tributaries, and Lake Mills and Lake Aldwell are classified by the Washington Department of Ecology as Class AA waters, signifying "extraordinary" quality. Overall, the Elwha has relatively low concentrations of dissolved and suspended sediment loads, nutrients, and organics. Changes in natural water quality occur in the lower part of the watershed, mostly as a result of reduced sediment load and elevated water temperatures during the summer. Suspended sediment concentrations and turbidity of the lower river are related to flood flows, logging, agricultural practices, and bank erosion.

The city of Port Angeles holds 200 of the 206 cubic feet per second of state-issued water rights on the Elwha River; a 50 cubic feet per second groundwater right for municipal purposes at a Ranney well next to the river; and a 150 cubic feet per second surface right covering a diversion structure and canal approximately 3 miles upstream from the river mouth. This surface diversion provides water to three industrial users, two large paper and pulp mills, and the Washington Department of Fish and Wildlife fish rearing channel. Private landowners and the Lower Elwha S'Klallam Tribe hold rights to the other 6 cubic feet per second. The United States holds additional water rights in trust for the tribe that are not issued by or registered with the state.

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These rights protect sufficient water to support treaty fisheries and the purposes of the Lower Elwha Indian Reservation.

Sediments in the Elwha River drainage basin are dominated by glacial deposits and recent alluvium. These sediments, developed in the last 8,000 years as glacial deposits, range in size from clay to cobble and provide much of the material transported by the Elwha. Upstream from Lake Mills, the riverbed material consists of sand, gravel, cobbles, boulders, and, in some places, bedrock outcrops. Downstream from both dams, the volume of sand and gravel is much reduced.

The Elwha River has a steep slope--steepest at the headwaters (16% average gradient) and generally decreasing in the downstream direction. The river flows through several steep, narrow, bedrock canyons. Between these canyons, the channel is more mildly sloping and has wider reaches with floodplains. Near the mouth, the river has the widest floodplain and the flattest slope.

The sometimes high and variable sediment loads carried by the upper Elwha make this natural reach dynamic, with bank erosion, channel migration, and gravel and cobble bars that erode and are later re-formed. Although the river below the dams was once the same, the greatly reduced coarse sediment load has changed the formerly dynamic lower reach to one that is static, with stable gravel bars and mature, woody vegetation established in the floodplains.

Near what is now Lake Mills, the pre-dam river gradient was less steep than immediately up- or downstream. In this natural bottom or flatter area, the Elwha River was a meandering and locally braided channel with gravel and cobble bars. These bars were maintained with high sediment input from upstream and from erosion of the surrounding floodplain and valley walls. Sand and gravel are currently trapped by Lake Mills and the riverbed in the middle stretch has become armored with only larger cobbles and boulders. Without the natural upstream sediment supply, local channel migration has decreased and many floodplains have become well vegetated. Conditions are similar in the first two miles below Elwha Dam.

Below these two miles, the river flows out into a wide, wooded floodplain with soils of sands, silts, and cobbles. This floodplain is bound on the west side by steep cliffs more than 150 feet high. Here, the pre-dam river channel migrated throughout its entire floodplain, 1.2 miles wide near the mouth of the river, preventing the establishment of mature evergreen forest. Currently, channel migration near the mouth is constrained by dense, woody vegetation in the floodplain and on the east by a setback levee constructed in 1989. This levee is located beyond the limits of the current meander-belt width (based on empirical relationships and historical evidence from aerial photographs); however, it is not considered structurally capable of constraining channel migration if that meander belt is widened, as it may be if the dams were removed (U.S. Army Corps of Engineers, 1994). A 600-foot-long levee that extends downstream from the high river bluffs on the west side of the river near its mouth also restricts the floodplain. It may be necessary to modify (i.e., strengthen) these levees if the dams are removed.

Figure 3. Elwha River System (Scan)

Erosion and river transport for 9,000 years delivered an estimated 280,000 cubic yards of sediment annually to form an extensive delta at the river mouth before the Elwha Dam was completed in 1914. Currently, the only sources of delta sediment are those in the three miles upstream from the mouth, i.e., erosion of loose material (alluvium) and of the bluffs that lie along the west side of the river. As a result, sediment yields to the delta have dropped to 5,900 cubic yards per year, or approximately 2% of the pre-dam volume, and the beaches east of the river mouth have eroded substantially (75-150 feet of shoreline recession, FERC, p.3-19).

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Material from the historic Elwha delta helped to create and feed Ediz Hook, an above-surface extension of sand, gravel, and cobbles that forms the bayward side of Port Angeles Harbor (FERC, p.3-20). It has also nourished beaches and nearshore areas. The drastic reduction in supply from the river has caused some erosion of both beaches and the western edge of Ediz Hook.

The U.S. Army Corps of Engineers, which spends approximately $100,000 annually to control further erosion of Ediz Hook (U.S. Army Corps of Engineers, Jan.1995), estimates contribution from the river before the dams were built to have been between 50,000 and 80,000 cubic yards per year. Currently, the river contributes a negligible volume of sediment to the Hook. A set of marine cliffs east of the river mouth also helped form and sustain Ediz Hook, but this source, too, has been vastly reduced. In 1930 and again in 1958, the cliffs were stabilized to control erosion and protect the city's water supply line at their base. Based on updated information, the Army Corps now believes the dams have reduced sediment to the coastal area from the Elwha River mouth to Ediz Hook by 35%, and stabilization of the marine cliffs by 55% (US Army Corps of Engineers, personal communication, 1995).

Impacts

The dams and reservoirs have altered and continue to alter the character of the river; these impacts are the impacts of the **No Action** alternative. The morphology of the Elwha River has been modified by the presence of Lake Mills and Lake Aldwell. The meandering and braided channels that existed prior to the dams have been downcut and are armored. Dam construction has resulted in trapping of sediment, large woody debris, and nutrients in the reservoirs; inundation of native anadromous fish habitat; and alteration of aquatic habitats downstream from the dams. The marine nearshore is also different as a result of the dams (see Living Marine Resources). Deposits in the intertidal and shallow subtidal zone are now primarily cobble instead of sand.

Although a portion of the fine sediment (clays and silts) has escaped the dams and been transported downstream, the dams have retained larger sized sediment, and much less sand and gravel exists in the lower and middle reaches than before the dams were built. As a result, the riverbed may be as much as 1 to 5 feet lower than under pre-dam conditions (FERC, p.4-2) and is composed primarily of cobbles and boulders which move only during very high flood events. River elevation has also dropped and, as a result, is more often contained within its channel during moderate flow conditions.

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As of 1994, the volume of sediment trapped behind Glines Canyon Dam was estimated to be 13 million cubic yards (J. Gilbert and R. Link, U.S. Bureau of Reclamation, personal communication, March 1995). If averaged over the years since it was completed (1927 to 1994), approximately 190,000 cubic yards per year has been trapped in the reservoir. It is unlikely that uniform transport of material has been the annual norm since there is evidence of upstream landslides during this same period.

All of the coarser grained gravel, sand, cobbles, and boulders and a portion of the finer clays and silt have settled in or immediately upstream of the reservoirs. In Lake Mills, silt and clay deposits have an average thickness of 12 feet. The delta at the upper end of the lake consists primarily of sand and gravel (with smaller amounts of clay, silt, and boulders) and is as much as 70 feet thick (FERC, p.3-l1).

The volume of sediment trapped in Lake Aldwell and its delta is estimated to be 4 million cubic yards (Gilbert and Link, personal communication, 1995). Approximately one-half of these deposits were trapped in the reservoir prior to construction of the Glines Canyon Dam.

The **No Action** alternative would continue to impact water quality in the river by trapping nutrients and organic material and by raising temperatures through surface releases of reservoir water. Because a large portion of the finer grained sediment (clay and fine silt) remains suspended, the river is turbid during high flows regardless of the dams. Water temperatures in the middle and lower river would continue to be elevated 2 to 4 degrees C during late summer and early fall (FERC, p.3-24). Warmer temperatures in the middle and lower portions of the river have been linked to the occurrence of *Dermocystidium salmonis*, a disease that has caused increased mortality in the lower Elwha population of chinook salmon.

River flow rate downstream of the dams is very similar to that naturally occurring (i.e., before the dams) since the dams are almost always operated in a "run-of-the-river" mode. Thus, the reservoirs reduce the effects of only the shortest duration and most minor floods. Otherwise, the rate that water enters and exits the reservoirs at any given time is roughly the same.

Although some additional sediment would be introduced into the middle and lower Elwha River during construction of fish passage measures, the long-term impacts of the **Dam Retention** (with mitigation) alternative on sediment transport and water quality would otherwise be identical to those described for the **No Action** alternative.

If only **Glines Canyon Dam** were removed, 7 to 9 million cubic yards of sediment (one-half to two-thirds of the total) would be expected to naturally erode. The majority of finer grained sediment (silt and clay) would wash out within the first six months following dam removal. Although some would settle in Lake Aldwell, most fine sediment would stay in suspension and flow out to the lower river and into the marine environment. The larger-sized material would wash into the middle river and settle in Lake Aldwell and its delta. If sediment was released from Lake Mills, the resulting sedimentation in Lake Aldwell would reduce that lake's capacity by 40 to 60%. Restoration of the natural sediment transport regime would result in the filling of the remaining reservoir capacity within an estimated 40-50 years.

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Since the intake for water to the powerhouse is located near the surface of Lake Aldwell, the power plant would theoretically remain operative until nearly the entire reservoir was filled. However, larger-sized sediment such as sand would begin to pass through the penstocks, dulling and ultimately destroying the turbine runners. Although it would be possible to routinely replace runners as they were destroyed, the cost of doing so would probably prohibit the ongoing operation of the Elwha power plant. In the long run, sediment could flow through the spillway and penstocks and into the lower river and marine environment.

Under the **Removal of Elwha Dam** alternative, 2 to 3 million cubic yards of sediment (one-half to two-thirds of the total) would be expected to wash into the lower river and coastal zone if naturally eroded. This volume would be washed away within one to ten years. Since Glines Canyon Dam would remain in place, normal sediment transport would not be reestablished in the middle or lower river.

If the **Proposed Action** were implemented, the natural transport of sediment from upper to lower river would be restored regardless of the type of sediment management selected. However, the volume of material entering the river and/or marine environment in the short term would vary depending on the method of sediment management. This environmental impact statement presumes sediment would be naturally eroded under each of the single dam removal alternatives. A full spectrum of sediment management options, including natural erosion, mechanical removal via a slurry pipeline, and stabilization of sediments in place in the reservoir area, are possible means of implementing the Proposed Action. The feasibility of several of these options was analyzed in the Elwha Report.

Allowing all sediment behind the dams to wash out naturally would result in the largest amount of sediment in the river in the short term. Although it depends heavily on the degree of mitigation needed to protect industrial and municipal water supplies, at this time, it also appears to be the lowest cost option (Elwha Report, pp 140-141, as updated by Bureau of Reclamation, 1995). Mechanically removing sediment or stabilizing it on site before the dams are removed could be the most costly (Elwha Report, pp.138-139, as updated by BOR, 1995) but potentially result in the smallest amount of sediment entering the river in the short term. Combinations of these approaches are possible and some would be analyzed in the Implementation EIS.

If both dams were removed, up to 9 to 12 million cubic yards of sediment (one-half to two-thirds of the total) could be introduced into the river system. The **Proposed Action** is the only alternative which would return near-natural (a city diversion structure near the mouth of the river may remain) sediment transport conditions to the Elwha River. Following removal of both dams and revegetation of the reservoir area, channel activities and substrate conditions would eventually return to pre-dam conditions (see "Affected Environment"). Increased sediment to the coastal areas would create shoals and bars, and supply sediment to the river delta, Angeles Point, and Ediz Hook. Over time, some or all of these features would be partially or fully restored (FERC, p. 4-93).

Aggradation, or the degree to which the riverbed rises, differs with each alternative. **No Action** or **Dam Retention** (with mitigation) would continue to deny sediment to the middle and lower river, with the riverbed remaining artificially lowered and armored. If either **Removal of Glines Canyon Dam** or the **Proposed Action** were selected, preliminary estimates suggest the riverbed and river elevation could rise 1 to 5 feet in some places, potentially causing more frequent localized flooding and/or a wider meander across the floodplain. Residences, well heads, and roadways may require raising or some other means of flood proofing. Downstream levees might need to be raised 2-4 feet and strengthened with riprap to withstand increased channel meandering (Elwha Report, pp. 36-37). Removing only Elwha Dam could result in temporary aggradation. However, since natural transport conditions would not be restored, sediment would eventually wash out of the lower river and return the riverbed to its present altered condition.

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All action alternatives would affect water quality in the short term, primarily through increases in turbidity. In some cases, these increases could have severe impacts on aquatic life or water quality which would require mitigation. Construction of fish passage measures, such as those required in the **Dam Retention** or **Single Dam Removal** alternatives, would require work in the river and/or reservoir, resulting in some temporary increases in suspended sediment and other pollutants in the river. Removing either or both dams would release stored sediment. Suspended sediments would be washed out immediately into the river, with the majority of impacts ending within six months after dam removal. Larger sediment (sand, gravel, cobbles) would be carried downstream over several months or even years.

Case studies have shown river systems generally recover completely from extreme sediment events within two to seven years of the time the event is complete (i.e., higher than average loads cease) (FERC, p.4-92; and see "impacts to fisheries" in this environmental impact statement).

Increases in suspended solids, especially under the **Remove Glines Canyon Dam** or **Proposed Action** scenarios, could kill large numbers of fish, their eggs, and other aquatic life in the short term. In addition, short term increases in organic matter, bacteria, and nutrients would occur in the middle and lower reaches of the Elwha (FERC, p.4-96), potentially causing periodic lethal or harmful decreases in dissolved oxygen for aquatic life in the river. If dam removal were sequenced over several years, fish could experience periodic lethal or harmful doses of silt and clay for as many as four or more years. Mechanical removal of fine-grained sediment or complete stabilization of sediments on site before the dams were removed would reduce or eliminate fish kills. Either or both of these options may be more fully examined in the Implementation EIS.

In the long run, water quality would be similar to existing conditions. During high flows, the river would be turbid as it is now. Increases in nutrients and organic material would result from the return of the anadromous fisheries. This, in turn, would increase aquatic invertebrate diversity and productivity of the river below the dams. **Removing either Glines Canyon Dam** or **both dams** would reduce downstream water temperatures as much as 4^{o} C in the late summer and early fall. This would help reduce disease and increase reproductive success of anadromous fish in the lower river.

Users who draw on surface water (industrial users and fish hatcheries) could also be directly affected by sediment in the short term (FERC, p. 4-97). Water is currently treated before use by the Rayonier and Daishowa mills since the river is turbid under high flow conditions. The Washington Department of Fish and Wildlife rearing channel is fed directly from surface flow. Although the tribe's hatchery is supplied with an underground infiltration gallery, water in it is only slightly less turbid than surface water because the gallery is located in coarse backfill and buried close to the surface.

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Port Angeles's domestic water is filtered by underground gravels and sands before it reaches a Ranney collector well, and is expected to be only slightly affected (FERC, p.4-97). If a high sediment load were carried by the river during dam removal, filtering of the sediment from the water by the underground gravels and sands could slightly reduce the capacity of the Ranney collector well. The state is currently evaluating whether the city's supply could be contaminated through surface water sources of organisms such as *Giardia lamblia*, *Legionella*, or viruses (Washington Dept. of Health letter to U.S. Bureau of Reclamation, 1994).

The volume of water would not change with any alternative, although the location of the river or its meander pattern might. The river is currently migrating away from the Ranney installation, causing reduced water yield. Removing the dams could cause more frequent or wider meanders, further reducing Ranney collector well yield.

Most private wells would be unaffected regardless of alternative. The bedrock underlying both reservoirs is nearly impermeable and the ground water gradient (flow direction) is toward the river. Therefore, reservoir water is not recharging the surrounding upland aquifers where most of the private wells are located.

The water source for a few wells located above Lake Aldwell is in the river alluvium, within the confluence basin of Indian Creek and the Elwha River. These wells might have lower water levels if the lake were drained. The water levels in wells located in the Elwha River valley would be expected to have greater and more frequent fluctuations if the river returned to a more dynamic natural state. Wells located on and near tribal land in the lower Elwha valley would be expected to have slightly higher water levels due to riverbed aggradation and higher river levels.

Mitigation

Mitigation for impacts on municipal and industrial water users from removing the dams is required by the Elwha River Ecosystem and Fisheries Restoration Act. It mandates protection of "...existing quality and availability of water from the Elwha River for municipal and industrial use from possible adverse impacts of dam removal," and goes on to say that the costs to design, construct, operate, and maintain these water quality control facilities "...will be federal costs at the discretion of the Secretary of the Interior" (See section 4(3)(b)).

A much more extensive analysis of mitigation and preferred options for each of the sediment management alternatives would be presented in the Implementation EIS. However, only feasible and cost-effective mitigation options are being considered. Water quality mitigation costs are inverse to sediment management costs, i.e., the more spent to reduce sediment in the river, the less water quality mitigation required. Costs to protect water quality for municipal and industrial users range as high as $34 million and depend on sediment management (costs to protect water quality are inversely related to those for sediment management).

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The following mitigation measures are technically feasible and, if implemented, would fulfill the congressional directive. They are analyzed in the Draft Staff Report (pp.4-102 to 4-104) and the Elwha Report (pp.98-100).

If necessary, the Port Angeles municipal water supply could be protected through the construction and use of additional Ranney wells. Periodic back-flushing of the Ranney well collectors might be necessary to prevent clogging. The city's water supply and quality for industrial users could be maintained by constructing an infiltration gallery, a new inlet and settling basin, additional Ranney wells, or a diversion inlet with chemical pretreatment and a settling basin. Improving or adding to the treatment facilities currently used by the mills could be another option to protect water quality.

Water supplied to the tribal fish hatchery would be protected if the existing infiltration pipe was relocated, a new or additional infiltration gallery built, and the original protection dike enlarged to control changes in the channel.

During public review of the draft environmental impact statement, several homeowners expressed concerns that their property could be subject to flooding and degraded water quality if the dams were removed. Measures that would mitigate impacts to water quality and flooding for the Elwha Place Homeowners Association, including reinforced levees and other means of floodproofing, would be evaluated in the Implementation EIS. The Dry Creek Water Association's water supply could be protected by modifying or replacing the wells closest to the Elwha River. Mitigation for private well users is also being investigated.

In order to protect the water supplied to the mills and the Washington Department of Fish and Wildlife fish rearing channel, diversion facilities could be modified to correct existing fish passage problems at the industrial diversion dam and facilitate downstream sediment transport. A flood protection barrier could also be constructed between the river and the rearing channel.

Raising the U.S. Army Corps of Engineers flood control levee by as much as 4 feet in some places (again, based on preliminary estimates) and armoring it with riprap would maintain the 200-year flood level of protection for residents against possible additional downstream flooding and meandering of the river (U.S. Army Corps of Engineers, 1994). A second homeowner's levee on the west side of the same part of the Elwha floodplain might also need to be raised and/or armored to preserve its present level of protection.

Cumulative Impacts
Water quality in the lower Elwha River experiences some degradation from other sources. Indian Creek, a major tributary which enters the Elwha above Lake Aldwell, drains a watershed that has been logged, farmed, and developed residentially. Little River, another tributary above Elwha Dam, travels through a watershed highly disturbed by logging. Both of these streams bring sediment and may carry trace quantities of pesticides, fertilizers, and other contaminants.

Conclusions
Present estimates, based on the interpretation of visual evidence of terraces downstream of the dams, are that the riverbed may be 1 to 5 feet lower and more channelized because of the dams. Water is generally clear and of high quality, although it is cloudy during rainy or high flow seasons. Releases of warmed surface water from the reservoirs have increased late summer water temperatures 2 to 4 degrees C above pre-dam conditions.

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Construction of fish passage measures, such as those required in the **Dam Retention** or **Single Dam Removal** alternatives, would require work in the river and/or reservoir and would result in temporary increases in suspended sediment and other pollutants in the river. Removing either or both dams would release stored sediment. Suspended sediments would be washed out immediately into the river with the majority of impacts ceasing within six months following dam removal. Larger sediment (sand, gravel, cobbles) would be carried downstream over several months or even years.

Increases in suspended solids, especially under the **Remove Glines Canyon Dam** or **Proposed Action** scenarios, could kill large numbers of fish, their eggs, and other aquatic life. In addition, short term increases in organic matter, bacteria, and nutrients would occur in the middle and lower reaches of the Elwha (FERC, p.4-96), potentially causing periodic harmful decreases in dissolved oxygen for aquatic life in the river. Although more expensive, mechanically removing sediments or stabilizing them in place would reduce the amount of sediment in the short term.

In the long term, removing both dams would reintroduce spawning gravel and nutrients for fish and return the river to a meandering, dynamic state. It would also result in pre-dam water temperatures, and could raise the riverbed and result in localized flooding. **Removing only Glines Canyon Dam would** do much the same, but would not return sand and gravel to the estuary, beaches, or Ediz Hook in the foreseeable future. **Removing only the Elwha Dam** would not substantially change river morphology or water quality from existing conditions in the long term. Only the **Proposed Action** would restore natural sediment transport regime and channel morphology.

Native Anadromous and Resident Fisheries

Since the impacts to native anadromous fish are rated somewhat differently in the Draft Staff Report than in the Elwha Report, a discussion of the Department of the Interior methodology for assessing impacts is presented below. Also, this section is organized differently than other sections to make it easier to read. Following a discussion of Interior methodology is a summary of both affected environment and impacts to Elwha salmonids. This includes a concise analysis of restoration potential and harvest restrictions for each run of salmon or anadromous trout. For readers who wish more information on each species, a more detailed section organized by run follows the summary of restoration potential. This section is titled "Species Specific Impacts."

Department of the Interior Impact Methodology

In assessing impacts to native anadromous fish under each alternative, the Draft Staff Report and Elwha Report address three primary factors: available stock; ability for adults to pass over the dams as they migrate upstream and juveniles to pass downstream on their way to the sea; and the condition of the stream habitat. A fourth, the ability to manage harvest to achieve restoration, would depend on how well the fish survive passage, condition of stream habitat, marine survival, and the number of years restoration is expected to take. For the purposes of this environmental impact statement, the ability to manage harvest to achieve restoration is referred to as the ability to withstand fishing pressure. Hatchery supplementation of each species is presumed to end once restoration goals have been met for any of the alternatives.

Restoration potential for each run is classified based on how successfully the run was rated under each of these factors, similar to the approach used by the Federal Energy Regulatory Commission. However, there are some differences. The commission rates losses less than 20% for passage mortality as "favorable", while Interior disagrees and believes mortality should be kept as low as technologically possible. Further, the availability of native Elwha River genetic stock is not as important in driving restoration potential, since the Elwha Report has identified several alternative sources of genetic material Interior believes to be appropriate for restoring runs.

With these caveats, the Department of the Interior generally agrees with the following rating:

Any rated as "none" = No chance of restoration
Any rated as "unfavorable" = Poor chance of restoration
Two or three factors "marginal" = Fair chance of restoration
Two factors "favorable" = Good chance of restoration
Three factors "favorable" = Excellent chance of restoration

Table 2. Restoration Potential of Elwha Salmonids for Each Alternative (Scan)

Table 2 summarizes the restoration potential in light of each of these factors, including ability to withstand fishing pressure. It should be noted that identical ratings of ability to withstand fishing pressure do not mean that identical fisheries would be in place. The amount of fishing that can take place differs under each alternative. For example, if both dams are retained, the ability of winter steelhead to withstand fishing pressure is rated as favorable. However, this may mean that the fishery must be managed for the "catch and release" of wild fish. On the other hand, under the Proposed Action, it will be possible to catch and keep wild fish (see the species specific impact section of this document.)

The Elwha Report presumes that either dam, if left in place, would be mitigated to a greater degree than does the commission. These mitigation measures include increased flows over the Glines Canyon Dam spillway, screens on a relocated water intake at Glines Canyon Dam, and the possible importation of gravel to the middle and lower river if that dam is not removed. Even so, the Elwha Report predicts poorer chances of restoring most runs than does the Draft Staff Report with either dam left in place (Elwha Report, pp.36-58, 96-105, Appendix G). Since the Elwha Report contains more current information than the Draft Staff Report, material from the Elwha Report is summarized when there is a discrepancy between the two.

Summary of Affected Environment and Impacts to Fisheries

Summery of Affected Environment

All species of native anadromous fish are presently prevented by Elwha Dam from accessing more than 70 miles of the Elwha River and usable tributaries, and are confined to the 4.9 miles downstream of the dam, known as the lower river. This habitat is in poor condition: water temperatures are abnormally high during summer and early fall; spawning fish are unnaturally crowded and subject to disease; nutrient flow necessary for invertebrate (food) production and the transport of large woody debris important for cover during the winter is diminished; spawning gravels essential for successful natural reproduction are missing because they are trapped in each reservoir; and the estuary, which serves as a nursery for juvenile salmonids, is reduced in size and quality.

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Hatchery operations below Elwha Dam presently produce chinook and coho salmon and steelhead, although there is some natural spawning of each of these and other species in the lower river.

Impacts All Native Anadromous Fish Share

Like most other natural resources, anadromous fish would experience great benefits in the long term, but may be subject to adverse impacts in the short term if both dams are removed. The short term effects would arise primarily as a result of sediment stored behind the dams washing into the river. Particularly the finer-grained sediments, such as silt and clay, at very high concentrations could affect fish by smothering adults, filling spaces between spawning gravels and making them unavailable to eggs, and limiting dissolved oxygen concentrations necessary for incubating salmon and trout eggs.

The degree and timing of sediment releases into the river, and thus the impacts on native anadromous fish, would depend on the selected dam removal and sediment management alternatives. Several alternatives for each are examined in the Elwha Report as required by the Elwha River Ecosystem and Fisheries Restoration Act. A few of these methods will be expanded and analyzed in the Implementation EIS.

If both dams were removed and most of the accumulated sediment washed out by winter storms within one year, there would be the potential for loss of an entire brood year of naturally spawned native anadromous fish, although multiple year classes of some fish and efforts to remove some fish to hatchery facilities would mitigate this loss. If dams were removed sequentially and sediment managed by downstream coffer dams or stabilized on site, adverse impacts to fish would be further limited. Dredging and slurrying fine sediments would substantially reduce the amount of sediment entering the river.

For comparison purposes, Interior examined recovery after other actions that resulted in larger than usual amounts of sediment in Pacific Northwest rivers used by salmonids. Although clearcut logging can send 2.5-3 times (approximately 3,200 cubic yards per square mile) the material into streams as would naturally be transported in the Elwha River (an estimated 1,200 cubic yards per square mile), using it for comparison would underestimate the impacts of releasing sediment now stored behind the Elwha dams. The May 18, 1980, eruption of Mount St. Helens and aftermath would overestimate the impact more than 50-fold, but may serve as a useful comparison.

The volcanic eruption caused a debris flow that sent an estimated three billion cubic yards of material into the upper 17 miles of the North Fork Toutle River basin and approximately 50 million cubic yards into the South Fork Toutle River (Lucas 1985). Approximately 90% of the upper North Fork and tributaries previously accessible to salmon were buried up to 213 yards deep by mud flows. Riparian vegetation, important to fish because it shades streams and keeps water temperatures cool, was completely wiped out along the Toutle. In contrast, the total estimated sediment accumulation within the two Elwha reservoirs is 17 million cubic yards, and existing riparian vegetation along the Elwha would be unaffected should the **Proposed Action** be implemented.

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The eruption devastated most of the anadromous fish habitat in the Toutle River; initially, many adult salmonids avoided entering it because of high sediment loads and strayed to other Columbia River tributaries (Lucas 1985). However, natural fish recovery began quickly. The first adult summer steelhead was observed in the North Fork Toutle River in August 1980, only three months after the eruption. Steelhead redds (spawning nests) were observed in a North Fork and many South Fork Toutle River tributaries. Fry (juveniles) were later captured in these tributaries, indicating successful reproduction (Rawding 1995). The numbers of yearling and older steelhead increased ten-fold from 1981 to 1984 in a South Fork tributary (Lucas 1985). Despite the devastation wreaked on the Toutle River anadromous fishery by the eruption, recovery began immediately and continues today. Conditions in the Elwha River, even under the worst of circumstances for short-term impacts to fish (i.e., natural erosion), would be far better and restoration expected to occur much more quickly.

By run, the restoration potential for Elwha species if the Proposed Action were implemented is summarized below. More information is available in the section "Species Specific Impacts."

Summary of Impacts

As explained above, four factors were evaluated to determine a species' chances of restoration--available stock, passage mortality, habitat and fishing pressure. A summary of the impacts of each of these factors on restoration potential for Elwha River salmon and seagoing trout is presented below.

Available Stock: One of these factors--available stock--remains constant regardless of the alternative. The Elwha Report (Appendix G) lists 28 different options for restoring the 10 original Elwha fish stocks. In addition, this environmental impact statement includes more information on sources of stock in the Responses to Comment section on "Fisheries."

Availability of suitable stocks are considered:
"favorable" for summer/fall chinook salmon; "marginal/favorable" for winter steelhead;
"marginal" for coho and chum salmon, summer steelhead and searun char;

"unfavorable/marginal" for spring chinook, pink and sockeye salmon; and "unknown" for searun cutthroat trout. (See Elwha Report, Appendix G).

Passage: As noted under the "Methodology" section, Interior has assumed state-of-the-art fish passage measures for the purposes of this environmental impact statement. Yet, Interior disagrees with the Draft Staff Report assumption that up to 20% mortality from passage is "favorable," and so also disagrees with commission findings on the impacts of fish passage to Elwha anadromous fish.

Although passage mortality varies among species, pink, chum, and sockeye salmon would be expected to encounter the most problems at Elwha Dam. Both pink and chum salmon produce juveniles that begin migrating downstream within hours of hatching. Because they are very small, they would be unable to effectively negotiate the reservoirs and could suffer significant mortalities at screens proposed for the penstocks. If Elwha Dam were removed, the middle stretch of river would become available to pink and chum, although habitat quality in this stretch would remain poor.

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The Elwha Dam now blocks travel to and from Lake Sutherland for sockeye salmon that need the lake to reproduce. Although fish passage measures at Elwha Dam would allow sockeye to complete the journey, smolts of this species lose their scales at a higher rate than all other salmon species, and descaling during passage at Elwha Dam could be significant. **Removal of Elwha Dam** or **Proposed Action** would allow sockeye salmon unimpeded access to Lake Sutherland.

Based on studies conducted at Lake Mills, spring and summer/fall chinook salmon juveniles would likely suffer significant losses migrating downstream through the reservoir and past Glines Canyon Dam. Also, a large number of adult spring chinook salmon would die while migrating upstream past fish passage facilities (the trap-and-haul facility at Glines Canyon Dam) because these fish are sensitive to handling following their entry into fresh water. Passage survival is rated as "unfavorable" for spring chinook if either the **Dam Retention** or **Removal of Elwha Dam** alternative is selected. Summer/ fall chinook salmon, more tolerant of handling, are rated "marginal" if the **Removal of Elwha Dam** alternative is selected.

Research and experience with searun cutthroat trout and char at fish passage facilities are limited. Further investigation is necessary to define the criteria for effective passage of these fish. Until then, Interior has rated the ability of these fish to pass the facilities proposed for the Elwha and Glines Canyon Dams as "unknown."

Pink, chum, sockeye, spring and summer/fall chinook salmon, searun cutthroat trout, and char have poorer chances for restoration under the mitigated **Dam Retention** alternative (Elwha Report, p.35) than if one dam is removed. Only coho salmon and winter and summer steelhead are thought to have even a "marginal" chance of surviving passage, and are rated as having "fair" restoration potential if both dams remain. In all alternatives that retain at least one dam, passage survival limits chances of restoration.

Habitat: The third factor, habitat, is particularly important to the long-term sustainability of all runs of salmon and trout. Currently, both the middle and lower sections of the river have very little spawning-size gravel the fish need to lay their eggs. Riffles and pools, important for juvenile rearing, are far less abundant than before the dams were built. Water temperatures are higher than under pre-dam conditions because the still waters of the reservoirs are warmed by the sun and store heat, which is later released downstream. The two dams also limit the downstream transport of nutrients and woody debris essential to aquatic invertebrates and fish. Glines Canyon Dam bars the natural transport of these materials into the middle reach as well as the lower 4.9 miles below Elwha Dam; reservoirs inundate habitat which was riverine and used by fish before the dams were built. These conditions would largely continue under the **No Action, Dam Retention** (with mitigation), or **Removal of Elwha Dam** alternatives.

Removal of the Glines Canyon Dam would restore habitat in the middle stretch of river between the dams and allow natural transport of nutrients and debris as far as Elwha Dam. **Removal of the Elwha Dam** would release up to 4 million cubic yards of sediment deposited in Lake Aldwell, but would not affect the significant amounts of sediments, nutrients, and woody debris trapped in Lake Mills. Gravel released by removing Elwha Dam would probably wash out to sea, returning the lower river to its current armored condition.

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If the **Proposed Action** were implemented, habitats would improve to pre-dam conditions over the long-term for all species except sockeye salmon. Sockeye require a freshwater lake to complete their life cycle; the only one accessible from the Elwha River, Lake Sutherland, has been degraded by development along its shoreline. Removing the dams would only improve the riverine habitat for this species.

Ability to Withstand Fishing Pressure- Of the four factors evaluated, fishing pressure is a regional concern which is not directly addressed in the Elwha Restoration Act. Some specific information on fishing pressure or ability to manage harvest to achieve restoration is presented throughout this section. More generalized information on the additive impact of fish pressure in the marine environment is detailed in the cumulative impacts section.

Achieving the restoration goals for the Elwha would require the prudent management of intercepting fisheries in order to ensure that the necessary number of fish survive to spawn each year. The ability to take the realistic management actions to get fish back to the spawning grounds depends in large part on the size of each run. Under any of the scenarios where the dams remain in place, the dams themselves reduce the number of fish, leaving fewer salmon and trout for harvest, thus reducing management flexibility.

If either one or both dams remain in place, the ability to adjust fishing pressure to meet the needs of pink and chum salmon is rated as "unfavorable" or "marginal". Although the fishing pressure on these species is generally very low, the high numbers of fish destroyed by the dams as well as the poor habitat conditions leave virtually no fish for harvest, and allow for no realistic management actions to occur. Coho salmon also have a rating of "unfavorable" or "marginal" if at least one dam remains. Although the number of fish surviving over the dams is relatively high, the number of fish caught in the ocean is also high. Therefore, to ensure adequate numbers of coho return to the river to spawn would require major changes in marine fisheries and a complete closure of the river fishery. Such large scale modifications to fisheries would be very difficult to achieve.

Most other species are rated as "marginal" under any dam retention alternative. That is, the number of fish lost to the dams can be more or less accommodated by realistic changes in fisheries management. For summer and winter steelhead, cutthroat trout, and native char, the effect of fishing pressure is rated as "favorable" under all alternatives. This is because almost all of the harvest of these fish takes place in the river where the flexibility to manage fisheries is the greatest.

Under the Proposed Action, the effect of fishing pressure is rated as "favorable" for all species except coho salmon, which is rated as "marginal". The "marginal" rating is due to the need to move from a hatchery-based fishery (which does not require as many spawning fish) to a natural stock fishery (which requires more spawning fish). Making this change in management strategy might take several years.

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Restoration Potential and Harvest Restrictions of Elwha Salmonids

The Department of the Interior used the same Ricker spawner/recruit models as in the Draft Staff Report with modifications to predict recovery for six major salmon and steelhead runs in the Elwha River (summer/fall chinook, coho, chum, pink, winter steelhead and summer steelhead). Ricker models can predict recovery time, given the number of initial spawners, maximum escapement (i.e., no harvest), rate of increase for each stock, and optimum harvest rate. Interior modifications to the Draft Staff Report analysis reflect present stock conditions and updated harvest rates for Strait of Juan de Fuca stocks, and do not presume any outplanting or hatchery production. The effects of outplanting on the restoration timeframe are noted in the text. The status and recovery of the remaining anadromous salmonid species (spring chinook, sockeye, searun cutthroat and char) is summarized in relation to these models and best available information.

These models of recovery were compared to results at Sunset Falls, an area of stream habitat made available in 1958 by the Washington Department of Fish and Wildlife to anadromous fish in the South Fork Skykomish River. Full utilization--comparable to recovery in the Elwha River--was typically between three and five cycles for most species. Data are presented in tabular form in Table 3.

Summer/fall chinook salmon

The Elwha stock of summer/fall chinook is currently sustained by both natural and hatchery production. Using Ricker curve-based recovery models, peak returns of chinook could occur in five cycles (21-25 years) if the **Proposed Action** were implemented. Total new production would equal approximately 31,360 chinook per year. This modeling assumes no outplanting or hatchery involvement. If both were used to speed restoration of this run in the Elwha, recovery time would fall by one-half.

Under the **No Action** alternative, no new chinook production would result. Adopting the **Dam Retention** alternative would require 29-32 years to recover, adding 16,000 new fish annually. Recovery under the **Remove Glines Canyon Dam** alternative would occur in 29-33 years, creating new production of approximately 25,670 fish per year. **Removing only Elwha Dam** would produce an estimated 20,000 chinook per year after a 29-33 year recovery period.

There are presently no in-river commercial or sport fisheries for chinook salmon in the Elwha River. As many as 150 chinook have been taken from the Elwha in past years during test fisheries, or incidental to fisheries for other species. An additional few are caught in the Strait of Juan de Fuca sport fishery and in net fisheries just to the west of the river mouth. Approximately 61% of the Elwha chinook run is harvested in commercial fisheries in the marine environment (Elwha Report, p.16).

Under the **Proposed Action**, existing chinook harvest restrictions in the Elwha would likely be in place for the first three complete cycles (10-12 years). Additional harvest restrictions in localized marine fisheries (e.g., area closures in the Freshwater Bay vicinity) might be necessary during the same time period. Harvest restrictions in other Washington sport and commercial fisheries or Canadian fisheries to specifically accommodate Elwha restoration are not probable, as the depressed status of many other native Western Washington and Columbia River chinook stocks is likely to have a larger influence in shaping fisheries for the foreseeable future. Elwha chinook will benefit from management actions aimed at rebuilding these other stocks. Under any of the other options, the above harvest restrictions could be in place indefinitely.

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Spring chinook salmon

Elwha spring chinook, if present, are likely only in small numbers. However, Interior scientists predict that some summer/fall chinook entering the Elwha would swim much farther upstream. These individuals would, over several decades, give rise to a spring run. Active outplanting of eggs and young juveniles in the upper river could accelerate the process. Under the **Proposed Action**, no additional harvest restrictions for this stock beyond those already in place for other rebuilding Puget Sound spring chinook stocks would likely be needed. Harvest restrictions under the other alternatives were not examined, as the anticipated recovery time far exceeds the ability to foresee harvest options.

Coho salmon

Elwha coho are currently sustained by both natural and hatchery production, although hatchery fish predominate. Using Ricker models to predict recovery rates, peak returns of wild coho (approximately 34,570 fish per year) could occur in as few as five cycles (15-18 years) if the **Proposed Action** were implemented. Outplanting would reduce recovery time by one-half.

Under the **No Action** alternative, no new coho production would result. The **Dam Retention** alternative would annually produce an estimated 24,960 coho in 29-32 years. Recovery under the **Glines Canyon Dam removal** alternative would yield approximately 31,190 fish per year by 22-25 years. **Removing the Elwha Dam** would annually produce an estimated 27,680 fish in 26-29 years.

Under the **Proposed Action**, and presuming continued hatchery augmentation during the rebuilding phase (Elwha Report, Appendix G), harvest restrictions in the Elwha River would be relatively minor and designed to mitigate impacts suffered during the deconstruction and post-deconstruction period (approximately five years). Harvest restrictions similar to those required for chinook salmon in marine fisheries (e.g., area closures in the Freshwater Bay area) might be necessary during the same five-year period. Also, as with chinook, harvest restrictions in other Washington sport and commercial fisheries or Canadian fisheries to specifically accommodate Elwha restoration are not probable, as the depressed status of other Western Washington and

Columbia River coho stocks is likely to have a larger influence in shaping fisheries for the foreseeable future.

Under any of the other alternatives, the length of time harvests in the Elwha River and adjacent marine waters would need to be curtailed is extended. Also, specific accommodation of the Elwha River restoration process might be needed in the Pacific Salmon Treaty forum if present negotiations between the United States and Canada regarding other coho stocks of concern do not result in adequate reductions of fisheries.

Winter steelhead
The early returning portion of the winter steelhead run is heavily supported by hatchery production. The late portion of the run is wild and is considered depressed due to loss of habitat related to the dams. Based on Ricker models (with no outplanting or hatchery influence), peak production (10,100 fish per year) of wild steelhead could occur in as few as five cycles (15-18 years) under the **Proposed Action**. Outplanting of eggs or alevins in the upper watershed would reduce this time by one-half. Harvest restrictions, such as catch and release of wild steelhead, would likely be in place until sufficient numbers of spawners return to the river (12-16 years). No harvest restrictions are anticipated for marine areas.

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Under the **No Action** alternative, no new production would result. Under the **Dam Retention** alternative, new annual production would be up to approximately 7,300 fish in 29-32 years. Recovery under the **Glines Canyon Dam removal** alternative would yield an estimated 9,000 winter steelhead per year in 30-35 years. **Removing only Elwha Dam** would produce approximately 8,270 fish within 30-35 years. Under any of these alternatives, catch and release sport fisheries could be required in perpetuity. In addition, in-river net fisheries would need to be limited from present levels, to varying degrees. Again, no restrictions would be anticipated for marine fisheries.

Summer steelhead
The outlook for restoration of summer steelhead would be similar to that of winter steelhead, although the restoration period might be longer (20-25 years) for the **Proposed Action.** Similarly, the restoration period under each of the other alternatives would be similar to the winter steelhead, but extended one or two cycles more. Under the Proposed Action, harvest restrictions would consist of catch and release of wild summer steelhead, as already implemented throughout the state. Monitoring of adult returns would determine when harvest restrictions could be lifted. Under any other alternative, it is anticipated that the catch and release restriction would be in place indefinitely.

Pink salmon
Elwha pink salmon are a native, wild stock of critical status, as evidenced by chronically low escapements (four returning fish in 1989, none in 1993). Brood stock might come from the adjacent Dungeness River stock, depending on its status. At Sunset Falls (Skykomish River), returns remained low until a population threshold of 2,000 adults was reached, after which numbers increased rapidly. Similarly, new pink production within the Elwha would likely remain low until a minimum threshold was reached. Ricker curve modeling predicts peak production of 274,286 pink salmon occurring in 8-10 cycles (16-20 years) if **Proposed Action** is implemented. Outplanting or remote incubator sites would enhance this effort, shortening the time needed for recovery.

Under the **No Action**, **Dam Retention, and Glines Canyon Dam removal** alternatives, no increase in the pink salmon population is expected. Some production of pink salmon would be expected to accompany the **Remove Elwha Dam** alternative, but habitat in the lower and middle river would remain in poor condition, limiting the pink salmon as a harvestable resource within the watershed.

The Elwha River is now closed to the harvest of pink salmon. Under the **Proposed Action,** no additional harvest restrictions in marine areas would be anticipated, as the harvest rate is already at the level needed for restoration purposes. Monitoring for pink salmon would determine when in-river fisheries for pink salmon could begin.

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Under any of the other alternatives, passage mortality and habitat limitations are likely to drive the Elwha pink salmon stock to extinction. There are no realistic harvest management measures which may be taken to prevent this from occurring.

Chum salmon

The Elwha chum salmon population is estimated at 200-500 returning adults. Chum population dynamics and life histories are similar to that of pink salmon in that spawning occurs over a relatively short period, the eggs incubate concurrently, hatching and emerging from the gravel at approximately the same time. Migration to salt water is accomplished passively and en masse in an attempt to numerically overwhelm predators. However, this requires the production of large numbers of alevins before substantial population increases occur. Like Sunset Falls pink salmon, Elwha chum could remain at low numbers until a large increase in survival allowed rapid population increases. Under the **Proposed Action**, Ricker models predict chum recovery (36,000 fish) in as few as six cycles (18-21 years) without enhancement (outplanting or hatchery) efforts. Outplanting or remote incubator sites would significantly help and shorten the time needed for recovery.

Under the **No Action, Dam Retention**, or **Glines Canyon Dam Removal** options, no increase in the chum salmon population would be expected. Some production of chum would be expected under the **Removal of Elwha Dam** alternative, but habitat in the lower and middle river would remain in poor condition, limiting the chum as a harvestable resource within the watershed.

Under the **Proposed Action**, it would be necessary to close the sport and commercial harvests of chum salmon in the Elwha during the early years of restoration. This is not considered a significant restriction since the present harvest in the river is estimated to be only in the tens of fish. No additional restrictions of marine fisheries would be expected.

As with pink salmon, passage mortality and habitat limitations under any of the other alternatives are likely to drive the Elwha chum salmon stock to extremely low levels or extinction. There are no realistic harvest management measures which may be taken to prevent this from occurring.

Sockeye salmon

Elwha River sockeye salmon are essentially extinct. Of the various options, only the **Proposed Action** and **Remove Elwha Dam** alternatives would allow sockeye access to

Lake Sutherland. Because sockeye require a lake environment to successfully rear, the other alternatives do not restore sockeye salmon to the Elwha River. Sockeye restoration would probably require augmentation of the anadromous component of kokanee (landlocked sockeye) that reside in Lake Sutherland or the importation of a suitable stock. Since the recovery rate of sockeye was not addressed in the Draft Staff Report, a rebuilding curve based on Sunset Falls chum was used to simulate a sockeye recovery. Once sufficient numbers of brood are secured, recovery could occur rapidly, as much as 6,500 adults per year in 3-5 cycles. A remote site incubation station would help boost production of this stock.

Since there is no stock of sockeye in the Elwha at this time, harvest restrictions have not been determined. Restrictions would depend on the recovery success of sockeye in the river and the timing of the stock's return. Harvest restrictions under both the **Proposed Action** or **Remove Elwha** alternative would be identical. As recovery is not likely due to passage and stock constraints for the other options, no attempt to evaluate harvests was required.

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Searun cutthroat

The status of Elwha River anadromous cutthroat trout is unknown, although a small population is believed to persist. Since resident cutthroat in the upper Elwha probably produce seagoing smolts, similar to that of resident rainbow trout, restoration is expected to occur naturally. However, the restoration timeframe is unknown for this stock. Under any of the options, a closure of the in-river sport fishery might be needed until the population size has significantly increased.

Table 3. New Wild Production (Number of fish/year) for Salmon and Steelhead and Time (Years) to Recovery*

	No Action**	Dam Retention	Glines Canyon Dam Removal	Elwha Dam Removal	Proposed Action
Chinook	1,500-2,000 fish+	16,060 fish 29 – 33 years	25,670 fish 29 – 33 years	20,020 fish 29 – 33 years	31,360 fish 21 – 25 years
Coho	<500 fish +	24,960 fish 29 – 33 years	31,190 fish 22 – 25 years	27,680 fish 26 – 29 years	34,570 fish 15 – 18 years
Chum	200 – 500 fish	0	0	Negligible	36,000 fish 18 – 21 years
Pink	0 – 50 fish	0	0	Negligible	274,286 fish 16 – 20 years
Steelhead	<500 fish	7,297 fish 29 – 32 years	9,017 fish 30 – 35 years	8,272 fish 30 – 35 years	10,100 fish 15 – 18 years
Sockeye	0	0	0	6,500 fish 12 – 20 years	6,500 fish 12 – 20 years

* Assuming no outplanting. Outplanting may reduce recovery time by as much as half.

** No Action (existing conditions) would not result in any new wild salmon or steelhead. These figures are estimates of current production of wild anadromous fish in the Elwha River (P. Crain, Lower Elwha S'Klallam Tribal Hatchery, personal communication, 1995).

+ All Elwha chinook and coho are considered a composite of wild and hatchery stocks.

Searun char (Dolly Varden and bull trout)
The status and restoration of Elwha River anadromous char are similar to that of searun cutthroat trout, although there is a larger population of char than cutthroat in the upper river. Restoration of this stock is expected to occur naturally. Under any of the options, a closure of the in-river sport fishery might be needed until the population size has significantly increased.

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Species-Specific Impacts
This section will examine impacts and restoration potential in more detail than the summaries presented above for each run of salmon or seagoing trout known to historically inhabit the Elwha River. Although this document addresses some species separately, runs that would experience similar problems in traversing the dams are analyzed as groups. The following impact sections generally compare effects resulting from passage first and then to habitat for each of the alternatives. Since stock availability remains constant regardless of the alternative, it is presented in the affected environment portion. Ability to withstand harvest pressure is summarized by run in Table 2 and discussed further in the cumulative impact section of fisheries.

Pink and Chum Salmon
Affected Environment. Pink salmon enter the river from July through September, chum in October and November (see Table 4). Both spawn almost immediately, using smaller sized gravels. The traditional spawning grounds for pink and chum salmon are thought to be primarily the first 16 miles of mainstem Elwha River, as well as tributaries such as Indian Creek and Little River. It is unknown whether these species occupied areas farther upstream. Both pink and chum generally spawn in low gradient side channels and tributaries. Since the two dams block the transport of spawning gravel, habitat downstream of them for pink and chum salmon has been effectively eliminated.

Juveniles swim toward the sea within hours or days of hatching, and usually do not feed on their journey. Because they are so small, they cannot swim as well as older juveniles of other species and are (generally) passively swept to the river mouth by the downstream current. Juveniles of both species usually spend up to two months maturing in estuaries, brackish pools at the mouth of rivers, or nearshore marine habitat. This habitat on the Elwha River is also degraded and reduced in size as a result of the dams blocking natural sediment transport.

Chances of finding the original native stock for pink salmon are considered unfavorable, although the neighboring Dungeness River supports two stocks of pink salmon, at least one of which could flourish in the Elwha River. A small population of native chum remains in the Elwha River, although pink and chum historically represented the largest contribution to the fish biomass returned through the system to the upper watershed.

Impacts. The impacts to pink and chum salmon under the **No Action** alternative have been near elimination of both species. It is estimated that fewer than 50 Elwha pink salmon return in odd years (this species returns only in odd years), but only four were found in 1989, and none in 1993. The total annual chum salmon returns to the river are measured in hundreds (Elwha Report, p.14). Under any alternative, chum may be unable to clear a low diversion structure at river mile 3. Mitigation options or redesign of the structure to resolve this or other potential problems with the diversion intake would be part of the Implementation EIS.

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For the **Dam Retention or single dam removal alternatives**, the continuing presence of the reservoirs would present an enormous downstream passage problem for juvenile pink and chum salmon. These small fish cannot navigate their way quickly through either reservoir because the currents do not have the water velocity needed for juvenile migration. A portion would starve before reaching the spillways while many others would be susceptible to predation. Although screens to keep fish from being sucked into the turbines at each dam could potentially be sized to keep juvenile pink and chum salmon out, a survey of dams in the Pacific Northwest revealed no self-sustaining populations of pink or chum salmon above major impoundments (J. Meyer, Olympic National Park, personal communication, July 1994). Regardless of efforts to accommodate upstream migration by spawning adults, extremely poor reservoir passage would be expected to eliminate any chance these species have for restoration in the Elwha River if either the **Dam Retention** or **Removal of the Glines Canyon Dam** alternative is implemented.

Table 4. In-River Life Cycle Stages of Elwha Salmonids (Scan)

With **Removal of the Elwha Dam**, several miles of unobstructed river would be opened to pink and chum in their traditional spawning grounds. Although these species might fare slightly better under this scenario than either the **Removal of the Glines Canyon Dam** or **Dam Retention** (with mitigation) alternative, available habitat would still be nearly devoid of spawning-sized gravel due to the continued presence of Glines Canyon Dam.

For these reasons, the chances of restoring pink and chum salmon are rated as "none/poor" or "poor" under all alternatives except the **Proposed Action**, where each is given a "good" chance for restoration.

Searun Cutthroat Trout and Char (Dolly Varden and Bull Trout)

Affected Environment. Cutthroat primarily use tributaries to spawn and rear whereas char may use tributaries or the mainstem river. Except for portions inundated by the two reservoirs, the tributaries are generally in excellent condition. However, the mainstream habitat below Glines Canyon Dam is in poor condition as a result of trapped gravel in the reservoirs, elevated water temperatures, and the limitation of nutrient and woody debris flow.

It is unknown whether original native stock exists for these species. A large population of resident (no sea migration) native char and a smaller population of cutthroat trout exist above Lake Mills. Some of these residents apparently retain the ability to produce juveniles which undergo physiological changes allowing them to exist in a saltwater environment (become smolts); these, in fact, may be descendants of the original Elwha sea going race. These resident populations may be usable as brood stock to reestablish sea going runs of both of these species. Because there is a larger population of char than cutthroat in the Elwha River, Interior has rated stock availability as "marginal" for searun char and "unknown" for cutthroat.

Impacts. Searun cutthroat and native char (Dolly Varden and bull trout) are present in the river (**No Action** alternative, or current conditions) below Elwha Dam in low numbers. A small population of land-locked cutthroat and a larger population of native char exist above the Elwha Dam. These species could have problems passing over the dams. Adults, smaller than native anadromous salmon, might not be able to ascend the ladder designed for larger fish at Elwha Dam (Elwha Report, p.56). Additional investigation is necessary to determine the passage criteria for these fish.

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Neither cutthroat nor char adults necessarily die immediately after spawning, but instead often return to the sea. Cutthroat trout may swim upstream without spawning, return to the ocean, and come back the next summer or fall to spawn. Fish screens proposed by the Federal Energy Regulatory Commission and the joint fish and wildlife agencies (U.S. Fish and Wildlife Service, Bureau of Indian Affairs, National Park Service, National Marine Fisheries Service, Washington Department of Fish and Wildlife, Point No Point Treaty Council, and the Lower Elwha S'Klallam Tribe) to prevent juvenile salmon and trout from entering the turbines may not work well for adult-sized trout, so losses are expected in their downstream migration as well, i.e., for either Dam Retention or **single dam removal** alternatives. No tests have been performed to determine whether these seagoing trout can negotiate the dams, and so their ability to withstand passage is "unknown."

The availability and condition of habitat is a potential problem if the dams remain in place. Some of the prime tributaries for cutthroat trout are blocked or inundated by Lake Mills, or lie between the dams. **Removal of the Elwha Dam** or the **Proposed Action** would allow cutthroat access to the tributary habitat between the dams. Habitat is rated at a higher quality with these alternatives than with removal of Glines Canyon Dam.

Although char prefer main channels, this habitat is in poor condition in both the lower and middle river and would not be fully restored unless both dams are removed. Habitat is rated as "marginal" with both dams in place and "marginal" to "favorable" if one is removed.

Chinook and Coho Salmon and Steelhead Trout

If the dams are removed, each of these species would have either a "good" or "excellent" chance for restoration. The pre-dam Elwha River supported early runs and later summer and fall runs of chinook salmon. The same is true for winter steelhead, which swim up the Elwha from December through February, and summer steelhead that swim up in March through August. Summer and winter steelhead and spring and summer/fall chinook are distinct "races" of fish.

The Federal Energy Regulatory Commission estimates that the Elwha once produced more than 31,000 wild chinook (FERC, p. 4-150). Currently, 2,000-4,000 hatchery chinook return to the river, but are restricted to the 4.9 miles below Elwha Dam. This creates crowded conditions for the spawning adults, with approximately five times the density of redds per river mile as in other streams (FERC, p.3-33).

Chinook, coho, and steelhead are all produced in hatcheries in the Elwha River. Coho have been raised in hatchery operations since 1965, which include plantings from the Dungeness River from 1967 to 1976. The state rearing channel was used to rear and release coho from 1974 to 1982. The Elwha tribal facility has been releasing coho since 1977, and has been the only source of hatchery coho since 1983. Since 1977, coho returns have ranged from 5,000 to 18,000 per year, with the majority being hatchery fish.

Because of the hatchery operation, the Lower Elwha S'Klallam Tribe operates a commercial in-river fishery for steelhead. Steelhead harvests average 1,600 fish per year for the tribe (Elwha Report, p. 17). Approximately 3,800 winter adults enter the river from an average of 80,000 hatchery smolts released each year (FERC, p.3-41). Sports fishers harvest an estimated 1,150 winter and 460 summer steelhead each year.

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Chinook

Affected Environment. Before the dams were built, it is believed that chinook entering the river in the spring swam farther upriver and spawned upstream of Carlson Canyon Falls at river mile 34. Fish entering in the late summer or fall spawned downstream of river mile 34.

Chinook require cool water (below 14 C) and medium-size spawning gravel. They usually lay their eggs in a main channel of the river rather than its side channels or tributaries. Adult chinook die within weeks of spawning, and the juveniles may stay in the Elwha for three months to more than a year before migrating to the sea. All juveniles spend some time in the estuary as they grow and adapt to salt water. Estuary size is shrinking, however, due to sediment trapped behind the dams.

A suitable stock of summer/fall chinook is presently available since this variety is maintained in Washington State hatchery facilities. However, a separate spring entry of spring chinook could be missing altogether in the Elwha River. The genetics of Elwha spring chinook presumably remain intact in the summer/fall stock (Brannon and Hershberger, 1984). Fully restoring the summer/fall run and making spring chinook habitat available upstream of river mile 34 is considered likely to result in separation of the two stocks. For all alternatives, the stock availability for summer/fall chinook was classed "favorable" and for spring chinook as "unfavorable/marginal" (see Table 2).

Impacts to chinook. Juvenile chinook would be expected to experience relatively high mortalities passing through the reservoirs and over both Elwha and Glines Canyon dams. These juveniles need a swift current, not created in reservoirs, to help them navigate their way to the ocean. Resident trout in these reservoirs would feed on the juvenile chinook, reducing the population during the downstream migration. Elevated water temperatures under the **No Action** or **Dam Retention** (with mitigation) alternative would continue to result in increased adult mortalities from diseases in the lower river.

Spring chinook, particularly sensitive to handling after entering the freshwater environment, would encounter the trap-and-haul process at a point 13 miles upstream (Elwha Report, p.54) under the **Dam Retention** or **Removal of Elwha Dam** alternatives. Some summer/fall chinook that enter the river when flows are low and temperatures are high would die as a result of handling.

More chinook losses would be expected at Glines Canyon Dam and Lake Mills than from Elwha Dam and Lake Aldwell. While no passage would occur under the **No Action** alternative, the **Dam Retention** (with mitigation) alternative would result in losses estimated in the 50% range for both spring and fall chinook. **Removal of the Elwha Dam** would reduce this to approximately 30% (FERC p.4-192), while **Removal of the Glines Canyon Dam** would reduce losses to approximately 15% (FERC, p.4-164). The **Proposed Action** would result in no fish lost through dam passage or in reservoirs.

Habitat for the spring chinook is relatively intact since it is upstream of both dams. However, sections of the river below the dams in which fall chinook would normally spawn are nearly devoid of spawning-sized gravel. Higher than pre-dam water temperatures in the summer and early fall can kill chinook eggs and aggravate *Dermocystidium,* a potentially lethal disease for fish.

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Higher than normal water temperatures would continue to be a problem under all alternatives except **Removal of Glines Canyon Dam** or **Proposed Action**. Spring chinook spawning habitat would remain in favorable condition but inaccessible or marginally available due to passage problems. With the **Proposed Action**, habitat would be fully restored along the entire length of the river, including the reintroduction of spawning gravel and lower water temperatures.

Removal of the Elwha Dam could temporarily send sediment into the lower river and result in fish kills, but it would also alleviate crowded conditions and possibly reduce incidence of *Dermocystidium.* **Removal of Glines Canyon Dam** would release sediment into the middle stretch of the Elwha River, reseeding the area with spawning-size gravel and allowing temperatures to return to pre-dam conditions (Elwha Report, p. 46). No spawning gravel would make it to the lower river, however, and the transport of nutrients and woody debris would continue to be limited.

Overall chances for restoring fall and spring chinook in the Elwha are rated "poor" if both dams are retained, "fair/good" if only Glines Canyon Dam is removed, and "poor/fair" if only Elwha Dam is removed. Restoration potential increases to "good" for spring chinook and "excellent" for summer/fall chinook if both dams are removed.

Coho

Affected Environment. Coho enter the Elwha River from August through December and spawn in the late fall and winter. Juveniles live in the river longer than a year after hatching before they migrate to sea in their second spring. Adults spawn in tributaries and mainstream river channels (with slopes no more than an average 1-3%) and die shortly after spawning. Juveniles live in pools, ponds, and backwater areas before they leave the river. Suitable stock, available both in the river and in the hatchery, is rated "marginal" by Interior.

Impacts to Coho. Like chinook, adult coho would be expected to experience some losses passing the fish ladder at Elwha Dam and undergoing the trap-and-haul procedure at Lake Mills. Some juveniles would remain in the reservoirs (residualize) and many would not make it to the dams before they were eaten by predators. A percentage of those fish arriving at the dams would be lost either going over the spillways or through the turbines. Estimates of 30% losses from passage of adult and juvenile coho passing both dams compared to approximately 50% for chinook are found in FERC (p. 4-22). Interior rates the coho's ability to survive passage as "marginal" under the **Dam Retention** (with mitigation) alternative.

The Eicher screens proposed by the commission to route salmon and trout away from Elwha Dam turbines were generally successful in tests involving juvenile coho, so losses from downstream migration would be expected to be lower if this dam, rather than Glines Canyon, remained. However, additional tests of the Eicher screen with smaller coho are needed to determine passage effectiveness for these fish. Screens proposed by Interior and other agencies for the Glines Canyon Dam intake would reduce losses of juvenile coho, but losses from navigating the spillways and residualism (disorientation and delay in the reservoir) would remain (Elwha Report, p.35). Ability to withstand mortality from passage is rated as "marginal" for both single dam alternatives. In the **Proposed Action,** passage problems would be eliminated for all fish.

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Although coho prefer spawning in tributaries that are not too steep, they will also use the main river and particularly side channel habitat. Coho habitat now exists in the river upstream of the Lake Mills delta, but much of the habitat in the middle and lower reach not inundated by the reservoirs is either too steep or does not have the small gravel needed for spawning. Under the **No Action** or **Dam Retention** (with mitigation) alternative, the water in the middle reach also would be warmer, contain fewer nutrients, and would not have the large logs and other debris that juveniles seek for winter cover.

Removal of the Glines Canyon Dam would reseed the middle reach with small gravel and, in the long-term, provide several miles of low gradient spawning habitat in the main channel. Woody debris needed for overwintering juveniles would be released naturally throughout most of the river, but would be limited in the lower Elwha. For adult coho that passed over Elwha Dam, nearly 65 miles of tributary and main channel habitat (coho would not be expected to pass Carlson Canyon Falls) would be available for spawning (FERC, p.4-24). At present, only the 4.9 miles of mainstream river are available for coho to spawn and rear, and the habitat in these miles is in very poor condition.

Removal of the Elwha Dam would provide some gravel to the lower Elwha River, eliminate passage mortality up to Glines Canyon Dam, restore 2.8 miles of currently inundated, low gradient river, and allow access to 8.5 additional miles of habitat. The entire middle stretch would remain gravel deficient and the lower stretch would eventually return to its present poor condition as sediments from behind Elwha Dam washed out to sea.

For both the **No Action** and **Dam Retention** (with mitigation) alternatives, the habitat problems described above become additive. The middle and lower river would remain gravel starved with important tributary space inundated; woody debris would continue to be blocked and unavailable for juvenile coho wintering in the Elwha River. Habitat is rated as "marginal" for coho under either alternative.

Overall chances for restoration are: "None" for No Action; "fair" for **Dam Retention** (with mitigation); "fair/good" for **Removal of the Glines Canyon Dam;** "fair" for **Removal of the Elwha Dam;** and "good/excellent" for the **Proposed Action.**

Steelhead

Affected Environment. Steelhead are, essentially, a searun race of rainbow trout. Winter steelhead enter the Elwha December through February, and summer steelhead migrate upstream from March through September. Both races spawn in the spring. Most juveniles rear in the river for two years before migrating to the ocean, although some may rear for one to three years. Approximately 5% of adults migrating upstream have spawned before. Adults that spawn and return to the ocean are called "kelts" on their trip out to sea.

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Steelhead adults use a wider size range of spawning gravel than coho or chinook. They are also able to spawn in mainstream rivers or tributaries. Steelhead are not expected to have trouble negotiating Carlson Canyon Falls; like chinook, the falls are presumed to be the pre-dam separation point of winter and summer runs. The summer run uses habitats upstream of these falls for spawning, the winter run downstream of the falls.

The Elwha has been stocked with hatchery steelhead since 1965, but a native Elwha River winter steelhead run remains. It is identified by its later entry than hatchery stock, February through March, into the river. Although the native Elwha River winter steelhead is differentiated from hatchery stock by its late entry, summer steelhead stock is not as easy to identify since there is no apparent seasonal separation of transplanted, non-native, hatchery stock. Interior is investigating the possibility of using rainbow trout from the Elwha River above the dams to create a summer steelhead run. These fish are native to the Elwha and may be descendants of summer or winter steelhead. Stock availability for winter steelhead is rated "marginal/favorable" and "marginal" for summer steelhead.

Impacts to Steelhead. Steelhead would be expected to withstand passage losses from **Dam Retention** (with mitigation) as well as coho salmon. Outmigrating steelhead juveniles would be relatively large, strong swimmers not expected to be heavily preyed upon in the reservoirs. Adult losses during upstream fish passage would be about the same as the coho. Kelts that migrate back to sea after spawning may encounter low flow conditions and, consequently, some losses. As with coho, steelhead juveniles would experience some mortality from predation and other factors as they mature in the river, and some would residualize in the reservoirs. Some mortalities would occur during passage past fish screens (FERC, p.4-25).

Removal of the Glines Canyon Dam would resupply the middle stretch of the Elwha with spawning gravel as well as woody debris. However, the lower Elwha would continue to be gravel starved, and important riverine habitat inundated by Lake Aldwell would not be restored. As with coho salmon, this combination results in a "marginal to favorable" rating for steelhead habitat under this alternative.

Removal of the Elwha Dam would resupply the lower river with gravel from the sediments built up behind Elwha Dam resulting in a short-term improvement in habitat before sediments eventually washed out to sea. Gravel, some woody debris, and nutrients would remain trapped behind Glines Canyon Dam and 2.8 miles of riverine habitat would remain inundated by Lake Mills. Although summer steelhead habitat above Glines Canyon Dam would remain intact and in excellent condition, adults and juveniles would need to negotiate poor quality habitat in the lower and middle reaches. For these reasons, habitat is rated as "marginal" for both winter and summer steelhead.

The **Proposed Action** would eliminate problems with passage and fully restore the habitat for winter and summer steelhead.

Chances of restoring winter steelhead are "excellent" for the **Proposed Action**, "fair" for either the **Dam Retention** or **Remove Elwha Dam** alternative, and "good" for the **Remove Glines Canyon Dam** option. For summer steelhead, chances for full restoration if **Proposed Action** is implemented are "good," "fair" for either **Remove Elwha Dam** or **Retain Both Dams** and "good" for the **Remove Glines Canyon Dam** alternative.

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Sockeye Salmon

Affected Environment. Sockeye salmon require a freshwater lake or lake-like environment to complete their reproductive cycle. The only natural lake accessible from the Elwha River is Lake Sutherland. It is drained by Indian Creek, a tributary of the Elwha which enters at river mile 7.5, between the two dams. Since Lake Sutherland has been developed, spawning habitat in the lake or in tributaries upstream is in poor condition. For this reason, habitat for sockeye is rated as "unfavorable/marginal" under all scenarios.

Although a stable population of naturally spawning kokanee, or landlocked sockeye, remains in the lake, Interior is investigating whether the kokanee has the characteristics needed as brood stock for Elwha River sockeye. Some of these kokanee may be descendants of Elwha River sockeye, but this is unknown and complicated by the many lake plantings of non-native kokanee. Chances of locating an appropriate stock are rated as "unfavorable/marginal."

Impacts. Sockeye smolts tend to lose scales more easily than other native anadromous salmon (FERC, p.4-31), and would have more trouble negotiating the fish screens proposed for Elwha Dam. With **Removal of the Elwha Dam**, passage problems would be entirely eliminated since this species would veer off toward Lake Sutherland and not continue upriver to Glines Canyon Dam.

Passage under the **Removal of the Elwha Dam** or the **Proposed Action** is considered "favorable;" it is considered "unfavorable/marginal" for the **Removal of the Glines Canyon Dam** and **Dam Retention** (with mitigation) alternatives, and "none" for the **No Action** alternative. Only **Removal of Elwha Dam** or the **Proposed Action** results in a "fair" chance for sockeye salmon restoration, with all other alternatives rating either "poor" or "none."

Resident Species

Affected Environment. Rainbow trout, native char, and small populations of cutthroat and brook trout occupy the upper Elwha. Rainbow trout also use the reservoirs and middle reach of the river. These are nonanadromous populations of trout, although the impulse for rainbow or native char to migrate to sea may remain.

Impacts. Since reintroduction of native anadromous trout and salmon would increase competition for available food and habitat, resident populations would be expected to decline to historically low population levels. In the **Proposed Action** alternative, this loss would be completely offset through improved habitat and the increased number of native anadromous trout and salmon available for fishers. However, in the **Dam Retention** (with mitigation) alternative, the restoration of native anadromous species would not make up for the loss of resident trout and native char (FERC, p.4-68).

Cumulative Impacts
Overall harvest of salmon and trout, warmer than normal waters caused by El Nino, logging, development, water diversions, agricultural activities, removal of riparian vegetation, and bank hardening to protect roads and private and public property in the river all have a cumulative, or additive, effect on fisheries. These stresses, in addition to the loss of 93% of the Elwha River drainage after the Elwha Dam was built in 1910, have resulted in depressed catches of many species of salmon and seagoing trout in the Puget Sound area.

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Dwindling or even decimated populations of salmon occur in spots along the entire west coast. Most small streams on the West Coast have been damaged from urbanization, water withdrawals, or other land management activities (Nehlsen et al. 1991). This is true with the large rivers, as well. As a result, very few pristine watersheds are left in the United States. Unlike most Peninsula streams, the area above Lake Mills provides salmon and steelhead pristine spawning and rearing habitat because it has been spared the adverse, long-term impacts from recent timber harvest, water use and human development that many other Peninsula streams are now experiencing. The habitat within the park will also be preserved, as this is mandated by federal law.

The impact of these actions is evident in reduced catches and the more frequent listing of anadromous fish species as threatened or endangered. As an example, the National Marine Fisheries Service (NMFS) recently (March, 1995) proposed wild steelhead runs from the Klamath River, California north to Port Orford, Oregon be listed as threatened under the Endangered Species Act because of population declines resulting from these factors. Degradation of habitat caused by dams and water withdrawals has led to listings (as threatened or endangered) of salmon stocks in the Columbia River Basin and Sacramento River in California.

Salmon and anadromous trout, including those which are able to outmigrate from the Elwha River, experience impacts in the marine environment as well, in the form of commercial fishing pressure and environment changes such as El Nino. A small percentage of Elwha River chum (5 to 15%), and larger portions of pink (60-75%), chinook (60%) and coho (approximately 77%) are taken by commercial and sport marine fishermen before they return to the Elwha River.

The impact extends beyond the U.S. border, as Pacific Coast fish produced in one area not only traverse the waters of many states, but are captured by Canadian fishermen as well. U.S. fishermen also capture fish produced in Canada. Because of this, harvest management occurs on the international (Pacific Salmon Treaty) level as well as on a national (Pacific Fisheries Management Council), and local (State of Washington and treaty tribes) level. The number of fish of U.S. origin which can be caught by Canada is controlled by the Pacific Salmon Treaty. The purposes of the Treaty are to: "prevent overfishing and provide for optimum production" and to "provide for each Party to receive benefits equivalent to the production of salmon originating in its waters." High seas drift net fisheries, which have had a large impact on salmon fisheries worldwide, were banned internationally on December 31, 1992. Fishing vessels, closely monitored by the U.S. Coast Guard and Canadian Pacific Maritime Forces in 1993 and 1994, have committed very few violations of the ban.

Regional, national and international fisheries management has helped to prevent overharvest of most stocks, although this does sometimes occur. However, it remains true that most population declines of these fish have occurred because of diminished and degraded habitat.

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Conclusion

Taking **No Action** would continue to limit salmon and trout to 4.9 miles of poor quality habitat. These populations would require management through hatchery supplements and would never be self-sustaining. In the case of pink and chum salmon, it is very likely that the populations will become extinct in the foreseeable future if present conditions continue.

Dam Retention, with Interior-specified fish passage measures over both dams, would allow access to the middle and upper Elwha for some species, but would not improve habitat for fish in the middle or lower river. Coho and winter and summer steelhead have a "fair" chance for restoration if this alternative were implemented. The chance for restoration for all other species is either "none," "poor," or "unknown." As with the No Action alternative, Elwha pink and chum are likely to face extinction under this alternative.

Removal of the Glines Canyon Dam would improve habitat quality in both the lower and middle river, and would eliminate passage mortality from the larger dam and reservoir. Mortality from Elwha Dam and Lake Aldwell would remain. Chances for restoring steelhead are "good" under this alternative; both chinook and coho runs would have "fair" to "good" possibilities for restoration if fish passage measures were installed on Elwha Dam. Cutthroat and char (Dolly Varden and bull trout) have "unknown" chances for restoration. Chances for fully restoring sockeye, pink or chum salmon are "none" or "poor," with pink and chum likely to become extinct.

Removal of the Elwha Dam would give sockeye salmon better chances of restoration than either the **Removal of the Glines Canyon Dam** or **Dam Retention** (with mitigation) alternative. However, most runs would experience difficulty passing over Glines Canyon Dam or utilizing the poor habitat in the middle stretch of river if the **Removal of the Elwha Dam** alternative were chosen. Chances of chinook, coho, pink, chum and steelhead restoration are rated "poor" to "fair" if the Glines Canyon Dam remains and Elwha Dam removed. The possibilities for reestablishing seagoing cutthroat trout or char are "unknown" for this alternative.

For the **Proposed Action**, passage mortality would drop to zero and habitat along the entire river would be restored, including the 5.3 miles now inundated by the reservoirs.

All runs for which native stock is readily available have "excellent" chances for restoration, including winter steelhead and summer/fall chinook salmon. Chances for restoring coho are "good" to "excellent," and "good" for all remaining runs except sockeye salmon. Since suitable sockeye stock is questionable and lake habitat is poor, chances for sockeye restoration are rated "poor" to "fair."

Living Marine Resources

Affected Environment

Living marine resources include shellfish, echinoderms, marine algae, fish, and mammals. Hardshell clams, such as littleneck, butter, and horse clams, are the most commonly pursued species in the area, although the season is often closed due to persistent red tide incidents (FERC, p.3-47). Littleneck and butter clams prefer gravel- to boulder-sized substrate, while horse clams prefer sandy substrate. Although species composition and abundance prior to dam construction is not known, clams may have been more abundant than at present because of substrate changes due to bedload sediment starvation (Elwha Report, p.15).

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At the river mouth, the nearshore environment is composed primarily of cobbles and boulders, while the offshore bottom is mostly sand and gravel (Schwartz, 1994). A suspended sediment plume from the river's discharge drifts to either the northwest or to the northeast depending on tide and currents. To the east of the river mouth for approximately one mile, the upper beach is steep with high wave energy, and plant and animal use is limited. This beach area is composed primarily of cobbles with some gravel. The lower beach supports a healthy community of marine flora, including more than 20 species of brown, red, and green algae and a number of attached animals, such as snails, limpets, barnacles, mussels, and chitons (letter from G. Ging, USFWS, August 1994). Starting near river mile 1, a natural band of actively eroding bluffs contributes large amounts of suspended sediments to the surf.

In general, the nearshore marine community includes fish such as salmon, greenling, flatfish, rockfish, sculpins, clingfish, sand lance, herring; more than 50 species of marine algae (including kelp); birds, including gulls, common murres, marbled murrelets, rhinoceros auklets, and harlequin ducks; and mammals including the Pacific harbor seal and, infrequently, Steller and California sea lions, orcas, and gray whales (Calambokidis et al., 1987; USFWS, 1994). Nearshore substrates composed of boulders and cobbles support species that prefer rocky environments, such as kelp, many species of red algae, red and yellow sponges, red rock crab, barnacles, mussels, limpets, chitons, and periwinkles. Local kelp beds are particularly important as habitat for various species of baitfish, which are prey species for salmon.

Impacts

Clam populations have been reduced by the steepening of beaches and the loss of sands and gravels due to the trapping of sediments behind the dams (Elwha Report, p.60). For the **No Action**, **Dam Retention** (with mitigation) or **Removal of Glines Canyon Dam** alternatives, there would be no changes in the river's sediment output, and thus no changes in existing clam populations would be expected (FERC, p. 4-34). The nearshore marine environment would continue to be dominated by species that prefer a rocky environment--kelp, rock crab, barnacles, and mussels. Removing only Elwha Dam would create a temporary increase in sand and gravel. Long-term natural sediment transport would continue to be blocked by the presence of Glines Canyon Dam.

Currently, the Elwha River has very little estuary. The river flows almost directly into salt water with little salinity transition area or characteristic estuarine habitat types (e.g., eel grass beds, shallow fine sediment pools). Less than 300 feet of river mouth area has estuarine characteristics, and there is little use as a fish nursery. This condition would continue under the **No Action**, **Dam Retention**, and **Removal of Elwha Dam** alternatives, as re-establishing the Elwha River estuary requires the return of natural sediment transport conditions.

With **Removal of Glines Canyon Dam**, stored sediments could be flushed out naturally and fill Lake Aldwell within 40-50 years. If the Elwha Dam remains, sediment could eventually fill Lake Aldwell and require pumping or dredging around the dam to prevent wear on the turbines. Although this is likely to be unreasonably expensive for the dam owners (see Response to Comments for more information), impacts from this alternative to marine resources could be similar to **Proposed Action** in the very long term.

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If the **Proposed Action** were selected, the short term impacts to marine resources would depend on the sediment management option selected. A range of options would be examined in detail in the Implementation EIS. These options include allowing sediment to erode naturally, stabilizing it in place, mechanical removal (probably by dredge and slurry via pipeline). If sediment naturally eroded, 9-12 million cubic yards of stored sediment would eventually washout into the river, delta, and Strait of Juan de Fuca. Mechanical removal may require a marine outfall for fine-grained sediment and sand.

Suspended sediment would wash out of the reservoirs during dam removal and for a period of six months following dam removal, depending on weather and sediment management methods. Bedload (sand, gravel, cobbles) would be transported to the river mouth over a period of years, and the coarser cobbles and boulders would take decades to disperse downriver.

Sand, gravel, and cobbles stored behind the dams would erode downstream, eventually reaching the mouth, rebuilding the pre-dam delta. Current estimates are that the delta would build 100-500 feet seaward from the river mouth. Waves, tidal currents, and river discharge would re-form the sediment deposited offshore into typical estuarine conditions with barrier bars and shallows. Areas within the bars would receive fresh water from the river and saltwater flows during flood tides. The inflowing salt water would carry nutrients supporting the rich ecology typical of estuaries. This transition area would be essential to complete restoration of Elwha River salmonids whose juveniles require a brackish environment before they begin their lives in salt water, as well as to other marine species that use or reproduce in an estuarine environment (including Dungeness crab). Plant and animal components would change accordingly (e.g., from kelp, rock crab, barnacles, and mussels to eelgrass, Dungeness crab, and flatfish).

Upriver from the mouth, deposits of sand and larger sediment would result in the mainstem channel splitting into several channels, similar to the way the river appeared on early maps of the area. Sand would be supplied at a rate greater than the pre-dam Elwha River for the first several years after the dams are removed. This would rapidly increase the amount of sand to beaches in the nearshore area at the river mouth and begin net longshore transport to the east. Species most likely to be affected in the short term include macrophytic algae, barnacles, mussels, and others with limited mobility. In the long term, the replacement of sand in the nearshore would likely increase the net area of productive intertidal habitat.

Finer silt and clay would mostly remain in suspension and become rapidly diluted with the large volume of marine water during this flushing out period. If this material is naturally eroded, the river would appear very turbid during the removal. This could cause intense short-term impacts on the nearshore area east of Freshwater Bay by smothering vegetation and animals and causing high turbidity in bay waters (Elwha Report, p.40). In the near term, the abundance of macrophytic algae could drop in response to the higher turbidity, but should return to its previous level within a few years of dam removal.

Pg. 64 = pg. 65&66

Over time, populations of all three hardshell clam species probably would increase in the nearshore due to the increased sand and gravel sediment loads (FERC, p. 4-121). In addition, surf smelt should benefit from the increase in spawning habitat that would result from additional sand gravel beaches. Marine mammals would not be expected to be impacted by short-term, increased sediment loads. Salmon and trout might be adversely affected by suspended silt and clay as they swim from the bay up the Elwha (see section on "fish" in this document).

As one means of mitigation for the short-term impacts to marine resources from dam removal, the Implementation EIS would examine using concrete rubble from the dams to create artificial marine reefs in the Strait of Juan de Fuca and/or other locations.

Cumulative Impacts to Marine Resources

Marine life well east of the Elwha River mouth has been affected by reduced sediment not only from the Elwha River, but also from the armoring in 1930 and again in 1958 of eroding sea bluffs to the east of the river mouth. The cliffs originally supplied approximately 270,000 cubic yards of sediment to the nearshore environment each year. This was reduced to an estimated 90,000 cubic yards annually when the bluffs were stabilized to protect a water supply line into Port Angeles. Since the waves in the vicinity have the ability to transport 270,000 cubic yards of material per year, beaches and the nearshore habitat have been steepened and now provide a greatly reduced intertidal zone. The intertidal zone is important for many species of fish because of its high production of prey items. Now, larger substrate and the marine life that traditionally occupy this kind of rocky habitat (kelp, rock crab, barnacles) have replaced the original species (eelgrass, flatfish, juvenile lingcod, cragon shrimp, and Dungeness crab).

Regionally, with the significant exception of salmon stocks, there are few sources of negative impacts on marine resources. Most of the coastal strip on the west side of the Olympic Peninsula is protected by Olympic National Park and two national wildlife refuges. The north side of the peninsula, although not in protective land status, is relatively natural, affected primarily by sediment input from coastal logging activities. The east side on Puget Sound is affected by logging, residential, and industrial activities. The return of natural Elwha River salmon runs and the restoration of the river's estuary would positively affect the overall health of the marine environment.

Conclusions

If **No Action** is taken, or the **Dam Retention** (with mitigation) or the **Removal of Glines Canyon Dam** alternatives are adopted, the nearshore marine community would continue to be dominated by species, such as kelp, rock crab, barnacles, and mussels, that prefer a rocky environment. **Removal of Elwha Dam** could flush 2-3 million cubic yards of material into the Strait of Juan de Fuca; the **Proposed Action** could send up to 942 million cubic yards into the Strait. Either of these alternatives might cause short-term impacts from sediment settling on to sessile (immobile) biota, such as shellfish or vegetation. In the long term, removing both dams could change the nearshore and estuarine community to favor species, such as eelgrass, Dungeness crab, flatfish, and hardshell clams, that require a sandy substrate.

Vegetation

Affected Environment

The project area is within the western hemlock zone, the most extensive vegetative type in western Washington and Oregon (FERC, p. 3-48). Forests are generally dominated by western hemlock and Douglas fir. The Elwha drainage supports a mix of plant species that is transitional between the wet western peninsula and the comparatively dry eastern peninsula. Other common woody species include Pacific madrone, grand fir, red alder, bigleaf maple, and manzanita. Eight vegetated land cover classes have been mapped in the vicinity: conifer forest, mixed forest, hardwood forest, deciduous shrub, grassland, palustrine (wetland) forest, palustrine shrub, and palustrine emergent. At least 64 non-native plant species have been documented in the Elwha drainage within the national park (Elwha Report, p. 18). Much of this vegetation lies along the riverbank and/or has adapted to the moist soil in the vicinity of the river. This riparian vegetation is an important habitat for many species of wildlife.

Pg. 65 = pg. 66&67

Wetlands, or areas which are periodically saturated, in the project area are limited to the three palustrine land cover classes--forest, shrub, and emergent. Approximately 50% of their total acreage is in Sweets Bottom (an area along the river near the park boundary), while the largest wetland area, 38 acres, is at the upstream end of Lake Aldwell (FERC, pp.3-51 and 4-125). Wetland values include flood moderation, bank stabilization, sediment and nutrient retention, and wildlife habitat.

Impacts

Impacts from the **No Action** and **Dam Retention** (with mitigation) alternatives would be similar. Under both alternatives, 684 acres of potential natural vegetation would remain inundated and 31 acres unavailable due to the dams and associated project facilities. This acreage includes more than five linear miles of low elevation riparian communities and natural wetlands. With **Dam Retention** (with mitigation), vegetation would be removed for construction of fish passage facilities at each dam site (Elwha Report, p.58), and an additional 189 acres of vegetation around Lake Aldwell would be modified for wildlife mitigation. Both these alternatives would continue the loss of an estimated 48 acres of wetland vegetation and 533 acres of riparian habitat. Of these 533 acres, 52 acres of deciduous riparian forest, and 65 acres of cobble riparian habitat remain lost through inundation or direct development.

Under the **Removal of Glines Canyon Dam** alternative, a total of 425 acres--416 acres at Lake Mills and 9 acres at the Glines Canyon Dam site--would be reclaimed and eventually returned to pre-dam conditions. A 4.7-acre wetland in the vicinity of the boat launching area on Lake Mills appears to be maintained by seepage from upslope areas and probably would not be affected by removal of the dam and reservoir. An estimated 26 acres of new wetlands would be established along the reclaimed river channel. Riparian vegetation would also be restored, with an estimated 287 acres returned under this alternative. Of this 287 acres, 28 acres of riparian hardwood and 35 acres of cobble/gravel riparian habitat would be reestablished.

A minimal amount of vegetation would be lost at the Elwha Dam with the construction of a fish passage facility. The James River Corporation has proposed modifying land at Lake Aldwell for wildlife mitigation, including the creation of eight acres of wetlands, as part of their Federal Energy Regulatory Commission licensing process (these mitigation measures have been assumed as part of the action alternatives which leave one or both dams in place). A new campground at Lake Aldwell proposed by James River, if built, would disturb an additional five acres (Elwha Report, p.47; FERC, pp. 4-165 and 4-46).

Pg. 66 = pg. 67&68

Under the **Removal of Elwha Dam** alternative, 268 acres at Lake Aldwell and 22 acres at the Elwha Dam site would be recovered to natural conditions. A portion of the 38 acres of wetlands at the delta of Lake Aldwell could be lost, although most of this wetland is located far enough away from the delta that it would not be destroyed should the dam be removed. Approximately 22 acres of new wetlands would be established along the reclaimed river channel. Approximately 246 acres of riparian vegetation, including at least 24 acres of riparian hardwoods and 30 acres of cobble/gravel riparian habitat, would be restored. A minimal amount of vegetation would be lost at Glines Canyon Dam with the construction of a trap-and-haul facility for fish mitigation.

The **Proposed Action** would lead to the restoration and revegetation of approximately 715 acres (FERC, p.4- 23), 684 acres of which are now inundated by the two reservoirs. Following dam removal and initial sediment management, remaining sediment could be either moved out of the floodplain (the stabilization alternative) or left in place (the natural erosion and mechanical removal alternatives). Much less material would remain in the reservoir and delta lands under the latter two alternatives than if stabilization were used. In all three scenarios, lands within Olympic National Park would likely be hydroseeded with grasses that would immediately help control erosion and start the successional process. Scientists estimate the sediment remaining in the reservoir and delta areas would begin to appear natural within three years, and be stabilized enough to mimic pre-dam levels of erosion within 6-10 years.

These areas could return to native plant communities similar to those that existed prior to dam construction. Natural, early successional forests would return quickly, with mature forests taking several hundred years. Most upland stands would be dominated by western hemlock and Douglas fir, while riparian stands would contain red alder, bigleaf maple, black cottonwood, grand fir, and willow. Establishment of non-native plants might be an initial concern at some sites, and mitigating measures to control these species would be identified in the Implementation EIS.

The **Proposed Action** could eliminate or degrade some portion of the 43 acres of existing wetlands, but reestablish 48 acres of recovered wetlands in either palustrine forest or palustrine shrub communities (FERC, p.4-125). Most of the 43 acres of wetland associated with the reservoir is on or just upstream from the Lake Aldwell delta, and would not be destroyed by either the natural erosion or mechanical removal alternatives for managing sediment. An additional 122 acres of wet channel/river and gravel bar wetlands, and as many as 533 acres of riparian vegetation would be restored. Of the 533 acres, an estimated 52 acres of riparian hardwood vegetation, and 65 acres of riparian cobble habitat would return.

The loss of wetlands at the reservoirs would be fully offset by the wetland habitat gained. In addition, riparian and upland habitat would be restored and used by wildlife. The 48 acres of wetlands would establish along side channels, sloughs and tributaries, and on a portion of the low terraces. The natural development of palustrine emergent wetlands could occur in a few years, with palustrine shrub and forested wetlands taking 10 and 20 years to develop, respectively.

Pg. 67 = pg. 68&69

Before any dam removal scenario would be implemented, the U.S. Army Corps of Engineers would require inventory and mapping of wetlands, and would consider options for mitigating any that may be lost. This could include replacement in kind, creating additional wetlands within former lake beds or other appropriate areas, or possibly determining that the net gain in wetlands is mitigation enough. Mitigation would be further explored in the Implementation EIS and in the permitting phase of the project.

Cumulative Impacts to Vegetation

Filling of the reservoirs destroyed more than five linear miles of low elevation (less than 600 feet) riparian and wetland communities. Many other low elevation riparian communities on the Olympic Peninsula have been impacted through the removal of natural forest vegetation. Most areas are in various stages of forest regrowth, but remain in active logging rotations. With the exception of some west side rivers, no low elevation riparian areas on the peninsula are managed for natural conditions and long-term protection.

Recovered river bottom lands in Lake Mills and Lake Aldwell would be managed for long-term protection under the **Proposed Action.**

Conclusions

If **No Action** is taken, 715 acres of potential native forest and more than 5 linear miles of low riparian and wetlands communities would continue to be inundated by the reservoirs or affected by the dams and their facilities. If the **Dam Retention** (with mitigation) alternative is selected, these lands would continue to be affected, although 189 acres of vegetation around Lake Aldwell would be modified for wildlife mitigation.

The **No Action** alternative has resulted and would continue to result in the loss of an estimated 48 acres of wetland, and as many as 533 acres of riparian vegetation, including at least 52 acres of hardwoods, and 65 acres of riparian cobble habitat. The **Dam Retention** alternative would continue these same losses. Both of these alternatives may have helped to create some portion of the 43 acres of wetlands near the two reservoirs, although most recent evidence suggests the portion attributable to the reservoirs may be quite small. With **Removal of Elwha Dam,** 290 acres of land would be revegetated, a portion of the 38 acres of wetland associated with Lake Aldwell lost, and 22 acres of wetlands recovered. Most of the remaining area, 246 acres, would return to riparian vegetation, with at least 24 acres of riparian hardwood and 30 acres of riparian cobble habitat restored. **Removing Glines Canyon Dam** would add 425 acres of terrestrial habitat and 26 acres of wetlands. It may degrade or eliminate 4.7 acres of wetland habitat, although recent evidence suggests it would not. It would likely restore 287 acres of riparian vegetation, including 28 acres of riparian hardwoods and 35 acres of riparian cobble habitat. If the **Proposed Action** is selected, 715 acres of habitat, including 48 acres of wetlands, would be restored. Removing the dams could degrade or eliminate some of the existing 43 acres of wetlands near the reservoirs, but recent evidence suggests only a small portion are tied to the existence of the reservoirs. An additional 122 acres of wet channel and gravel bar wetlands and up to 533 acres of riparian vegetation, including 52 acres of riparian hardwoods, and 65 acres of riparian cobble would be restored if the dams were removed. Scientists estimate the sediment remaining in the reservoir and delta areas would begin to appear natural within three years of dam removal, and be stabilized enough to mimic pre-dam levels of erosion within 6-10 years.

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Wildlife

Affected Environment

The Elwha area supports a variety of birds, large and small mammals, amphibians, and reptiles. One of the large mammals is Roosevelt elk; important elk calving areas are at the mouth of Cat Creek, at the upstream end of Lake Mills, and near Altaire Campground just below Glines Canyon Dam (Elwha Report, p.19). Small mammals include beaver, mink, river otter, and pine marten. Birds include numerous passerines, waterfowl, raptors, and marine species. In the upper Elwha, populations of fish-eating (or carcass-eating) wildlife species probably decreased when salmon and trout were blocked by the dams, although records were not kept at the time. At least 22 species feed in whole or in part on salmon or their carcasses, including black bear, bald eagle, mink, river otter, Pacific fisher, pine marten, long-tailed weasel, belted kingfisher, and common merganser.

On Lake Aldwell, while neither threatened nor endangered, a wintering population of trumpeter swans is of local concern. These swans, also known to use Lake Mills, have recently numbered up to 60 (letter from L. Gillette and M. Jordan, The Trumpeter Swan Society, Maple Plain, Minnesota, May 14, 1994). They are part of the Pacific Coast population, currently numbering an estimated 13,500 birds, with 2,000 wintering in western Washington. They use a variety of habitat types including agricultural fields, forested wetlands, ponds, lakes, and estuaries. Although this species was hunted to near extinction by the early 1930s, conservation efforts have slowly rebuilt population levels. As a result, trumpeter swans appear to be relatively stable or increasing in numbers. In 1990-1992, sightings of trumpeters in winter index areas of the Pacific Coast region were already above year 2001 North American Waterfowl Management Plan goals of 10,000 birds.

In addition to wintering in open water areas surrounded by forest, trumpeter swans occupy wet agricultural lands. Individual colonies of wintering swans move from field to field or from one forest pond or bay to another. Attributes of winter habitat that trigger movement from one area to another, or which make an area attractive to a colony, are not well understood. Lake Aldwell, only recently utilized by the swans, is not high quality or natural habitat for this species.

Impacts

Under the **No Action** alternative, a total of 684 acres of terrestrial wildlife habitat would remain inundated and another 31 acres unavailable due to dam and facility use. Important bottom land riparian habitat would continue to be unavailable for winter elk use. No wildlife mitigation would be done under this alternative. In the upper and middle drainage, up to 22 wildlife species that use salmon as food would continue to be adversely impacted. Swans and other waterfowl would continue to use the reservoirs as winter habitat, although the reservoirs provide low quality habitat because the shoreline is steep and most of the water is deep.

Dam Retention (with mitigation) would be the same as the **No Action** alternative except that 189 acres of lands around Lake Aldwell would be managed to benefit wildlife species, and the partial restoration of salmon runs would benefit wildlife that feed on salmon carcasses, live fish, or fish eggs. (Elwha Report, p.59; FERC, p.4-47).

Pg. 69 = pg. 71&72

Impacts to wildlife from either the **Removal of Glines Canyon Dam** or **Removal of Elwha Dam** would be similar. Removing Elwha Dam would result in the eventual restoration of 268 acres under Lake Aldwell, while removing Glines Canyon Dam would restore 415 acres under Lake Mills. These areas would return to bottom land riparian vegetation, important as winter elk range. Both alternatives would likely restore some salmon stocks, with expected restoration more beneficial to wildlife species that use carcasses, live fish or eggs if Glines Canyon Dam is removed. Under both alternatives, 189 acres near Lake Aldwell would be managed to benefit wildlife. Swans would continue to use Lake Aldwell as winter habitat if Glines Canyon Dam were removed, but would lose this habitat if Elwha Dam were removed. (FERC, pp.4-167 and 4-196).

The Federal Energy Regulatory Commission used a habitat evaluation procedure to model habitat changes for nine representative species: elk, deer, mink, beaver, Douglas squirrel, Cooper's hawk, lesser scaup, pileated woodpecker, and yellow warbler. In a study area including the reservoirs and some surrounding lands, net habitat would increase under the **Proposed Action** for all species except the lesser scaup (FERC, p.4-131). Species that prefer lake habitat, such as scaups, mallard ducks, bufflehead, Barrow's goldeneye, merganser, and river otter, would suffer some negative impacts; species preferring river, riparian, and upland habitats would be positively affected. A swift-flowing stream filled with salmon is important habitat for beaver, muskrat, and river otter. To varying degrees, most species now using the reservoirs would also use riverine habitat. The removal of both dams and reservoirs would benefit many more species of wildlife than would be adversely affected.

Restoration of native anadromous fish runs and the subsequent availability of salmon as prey in the middle and upper Elwha would benefit at least 22 wildlife species known to use this food source (Elwha Report, p.59). If **Proposed Action** were implemented, total biomass from returning salmon would increase to approximately 12 times more than the current level (FERC, p.4-135). Salmonid eggs, fry, and juveniles will benefit a variety of native wildlife. As nutrients from salmon carcasses returned to the river, aquatic insects and species that feed on them would be expected to return; these species include amphibian larvae, spotted sandpipers, dippers, and harlequin ducks. Birds and mammals that feed on young fish include mergansers, great blue herons, belted kingfishers, otters, and mink.

Increases in visitor use which would accompany the restoration of the salmonid recreational fishery in the Elwha River could have some adverse impacts on wildlife and species of special concern in the park. However, these would be more than offset by the return of 715 acres of habitat to natural riverine conditions.

Draining the reservoirs and revegetating the restored lands would create more elk habitat, including important bottom land riparian areas. It would also extend the elk migration corridor connecting high elevation subalpine park lands with low elevation forests farther down the Elwha valley.

The trumpeter swan winter habitat that Lake Aldwell and, to a lesser extent, Lake Mills provides would be lost if **Proposed Action** or **Single Dam Removal** alternatives were chosen. In the context of the Pacific Coast population of swans, which comprises roughly 75% of the entire North American population, this impact would be minor. However, if both reservoirs were drained, the local population would be forced to relocate. Mitigation options for the loss of this habitat, if required, will be explored in the Implementation EIS.

Pg. 70 = pg. 72&73

Cumulative Impacts

Based on habitat modeling, existing elk winter forage in the project vicinity is limiting, and habitat quality is low (FERC, p.3-53). Subpopulations are considered vulnerable due to their low numbers and to increasing development on winter range adjoining the national park. In the reservoir areas, short-term recovery of grazing habitat and long-term recovery of mature forest stands for thermal cover (an essential component of winter habitat) would benefit the local elk subpopulation. Various wildlife species in the vicinity of the northern park boundary would be increasingly impacted through the conversion of land use from natural conditions to human activities. The revegetation and long term protective management of 425 acres at Lake Mills in Olympic National Park and river corridor lands through Lake Aldwell would benefit many wildlife species.

Conclusions

Wildlife would benefit from the revegetation of reservoir lands and reintroduction of salmon and seagoing trout into the Elwha River ecosystem. The **Proposed Action** would restore the greatest number of acres and highest levels of fish, with the greatest positive impact on wildlife of all the alternatives. Wildlife would benefit progressively less from the (1) **Removal of Glines Canyon Dam,** (2) **Removal of Elwha Dam,** and (3) **Dam Retention** (with mitigation) alternatives.

Species of Special Concern

Affected Environment

Four federally threatened species inhabit the area--the northern spotted owl, marbled murrelet, bald eagle, and Steller sea lion. One federally protected species, the peregrine falcon, migrates through the area. Three additional species have been petitioned for federal listing--the Elwha pink salmon, coastal coho salmon, and coastal steelhead. Species which are candidates for federal listing are the Pacific fisher, harlequin duck, northern goshawk, Cotton's milk-vetch, and bull trout. Candidates for state listing are the pileated woodpecker, common loon, and Vaux's swift. State-monitored species in the area are osprey, great blue heron, barred owl, turkey vulture, Pacific harbor seal, orca, and grape fern (Elwha Report, p.19; WDFW 1993; FERC, p.3-60).

Five sensitive plant species may occur in the area (FFRC, p.3-63): porcupine sedge, tall bugbane, giant helleborine, water lobelia, and branching montia. Surveys conducted in July and August 1990 located nine giant helleborine plants between the road to Whiskey Bend and the bypass reach in the area of Glines Canyon Dam (FERC, p.3-64). Additionally, 14 plant species reported to occur in the Elwha valley are considered rare or extremely rare within Olympic National Park boundaries (C. Hoffman, personal communication, August, 1994).

Northern spotted owl surveys have found seven pairs between the Elwha headwaters and the national park boundary (FERC 3-59), two active nests located within 2.2 miles of the river and Lake Mills, and at least one additional nest between U.S. Highway 101 and Lake Aldwell (USFS, personal communication, June 1994).

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Bald eagles are observed year-round in the area, and two nest sites are just east of the mouth of the river (FERC, p.3-58). Eagle densities generally decrease farther from the sea. Prey are primarily marine birds, chinook salmon carcasses in the lower river, resident fish in the reservoirs, and carrion, particularly elk and heron.

Marbled murrelets are primarily marine birds although they nest in semi-colonial aggregates in inland, old-growth forest stands (Federal Register 1992) and feed on fish and invertebrates in nearshore marine waters. Significant numbers of marbled murrelets feed in Freshwater Bay. Murrelets surveyed from March through September 1990 were estimated at 15 pairs in the upper Elwha River valley or tributaries during the breeding season (FERC, p. 3-59). From Krause Bottom above Lake Mills to the river mouth, the river appears to be used primarily as a travel corridor, with little nesting along the path. However, there were possible nest sites in stands along Boulder, Cat, and Stukey creeks, and above Altaire Campground. No murrelets were observed on either reservoir.

Surveys for spotted owls and marbled murrelets are ongoing. However, neither the developed areas where the hydroelectric project facilities are located nor the open water habitat offered by the reservoirs are considered suitable habitat for the spotted owls or murrelets. Survey data supports that there are no northern spotted owl nests within approximately one mile of either dam. Because of the distance between the dams and spotted owl nest sites, it is unlikely that owls would be affected by project removal activities, particularly with equipment modified to reduce noise levels. If required, such modifications or other mitigation measures would be developed in the Implementation EIS or permitting phase of the project, could include timing restrictions and/or routing access roads to avoid nest sites. The basis of determining which mitigation is required will be a biological assessment submitted to the U.S. Fish and Wildlife Service.

Impacts

In the short term, marbled murrelets could be affected by increased turbidity following dam removal or installation of fish passage measures if the muddier water makes it more difficult for them to see and catch prey or reduces the number of prey (small fish and crustaceans). In the long term, additional forest acres (**Single Dam Removal** or **Proposed Action**) in the reservoir areas would have a beneficial effect on northern spotted owls and marbled murrelets. The renewed availability of salmon carcasses would be expected to increase the number of wintering bald eagles along the middle sections of the river.

Fish species petitioned for listing under the Endangered Species Act could be negatively affected in the short term if sediment management resulted in pulses of sediment carried downriver. Mitigation for these impacts would be analyzed in the Implementation EIS.

Both the **No Action** and the **Dam Retention** (with mitigation) alternatives would continue to negatively impact several federally listed species by inundation of habitat and dramatically reduced salmon and trout as prey. Bald eagles, for example, eat salmon; spotted owls and marbled murrelets use mature forests for nesting. Coho and pink salmon and steelhead would continue to be directly affected by the loss of freshwater habitat.

Although **Removal of Glines Canyon Dam** or **Removal of Elwha Dam** would improve conditions for these species of special concern, these alternatives would not restore the fisheries or habitat to pre-dam conditions, thus sustaining some negative impacts on the species. (Elwha Report, pp. 47 and 51; FERC, pp. 4-172 and 4-200). Only **Proposed Action** would fully restore the species's natural freshwater habitat in the Elwha River.

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Cumulative Impacts

Spotted owls and marbled murrelets have been impacted primarily through the logging of old-growth and mature forest communities. The consequence of continued logging activity in their habitat is currently an issue of local, regional, and national debate (USFS and BLM, 1994). However, it is mainly fragmentation of old-growth forests at issue. Since all alternatives except the Proposed Action would continue to prevent restoration of natural successional (and eventually old-growth) forests, they would have added negative impacts on owls and murrelets.

Bald eagle populations, recovered from their lowest levels in the 1970s, have been upgraded from endangered to threatened species status. Restoration of the salmonid fisheries in the Elwha River would support this trend.

The petitioned and candidate fish species would probably suffer some short-term adverse effects from alternatives involving dam removal. If lake levels were drawn down, the middle and lower reaches of the Elwha River would carry more sand and silt, covering the gravel substrate that these species use for spawning. Over the longer term, however, dam removal and river restoration would offset cumulative impacts to these species elsewhere on the Olympic Peninsula. Causes of cumulative impacts that have lowered populations of petitioned and candidate species to critical levels are not certain but include sedimentation, overharvesting, and water pollution.

Conclusions

In the short term, construction noise and suspended sediment in the river have the potential to impact nesting owls and murrelets, Elwha pink and coastal coho salmon, coastal steelhead, and bald eagles. Mitigation measures would be developed through consultation with the U.S. Fish and Wildlife Service and other federal and state agencies, and addressed in the Implementation EIS or permitting phase of one project. In the long term, the **Proposed Action** would improve conditions for spotted owls, marbled murrelets, and bald eagles. Spotted owls and marbled murrelets would benefit from the restoration of forest habitat, and eagles from the restoration of native anadromous fish as prey. Coho and pink salmon and steelhead would benefit directly from the recovery of riverine habitat. All other alternatives would continue to exert negative impacts on these species, with **No Action** the most severe through continued habitat inundation and the absence of salmon runs as a source of prey. The **Dam Retention** (with mitigation) alternative would restore a limited number of salmon and trout to benefit federally listed species more than **No Action**. Single dam removal alternatives are slightly better, with the **Removal of Glines Canyon Dam** restoring more fish and more upland habitat than the **Removal of Elwha Dam.**

Cultural Resources

Affected Environment

Research has revealed the presence of many more resources within the project area than described (P. Gleeson, Olympic National Park, personal communication, August 1994) by either the Draft Staff Report or the Elwha Report. Cultural resources include structures, landscapes, traditional cultural properties, ethnographic sites, ethnohistoric sites, and archeological sites, representing a continuous occupation from centuries past. They also demonstrate the importance of the Elwha River, which provided sustenance to the valley's inhabitants and served as a transportation corridor into the heart of the Olympic Peninsula.

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The Elwha River is central to the culture of the Lower Elwha S’Klallam Tribe. As shown by archeological evidence and oral tradition, the Elwha S'Klallam were living along the Elwha River and coastal portions of the river basin long before the arrival of Euro-Americans. S'Klallam villages were located adjacent to important fishing stations at Ediz Hook, the mouth of the Elwha River, and at the confluence of Indian Creek and the Elwha in the upper Elwha valley. Seasonal camps for fishing and other subsistence activities were located along the Elwha River and its tributaries, and along the shores of Freshwater Bay and Ediz Hook. Trails used by the S'Klallam followed the Elwha and its tributaries into the high country of the Olympic Mountains, where the S'Klallam sometimes met with the Skokomish, Quinault, and other tribes during hunting and berry picking expeditions. The river, the fish, and certain locations along the river were central in the cultural life of the Elwha S'Klallam. S'Klallam were still living at the confluence of Indian Creek and the Elwha River when construction of the Elwha Dam began.

Euro-American settlers were drawn to the resources of the river valley and began to homestead in the mid 19th century, but found climate and the tenacity of natural vegetation limiting. The S'Klallam, who at that time were not U.S. citizens, initially found themselves unable to obtain legal papers for homesteads on their ancestral homelands. With the assistance of Euro-American homesteaders and passage of an effective Indian homestead law in 1884, tribal members overcame the legal obstacles; by 1894, ten family heads received trust patents to approximately 1,300 acres of land in the lowlands of the Elwha valley and on Freshwater Bay. Prior to the destruction of the anadromous fish runs by the dams, the Elwha River fisheries remained the mainstay of the S'Klallam economy.

In 1890, Thomas T. Aldwell moved from Canada, by way of Seattle and Port Townsend, to Port Angeles. In 1894, Aldwell recognized the potential for a power site on a claim he had purchased on the Elwha River and began acquiring lands necessary to build a hydroelectric dam and reservoir. In 1910, Aldwell and George A. Glines formed the Olympic Power and Development Company to build a dam and power plant. Backed by eastern financiers, construction got underway that same year. Despite failure of the Elwha Dam's original foundation in 1912, the dam and power plant were completed in 1914. From 1926 to 1927, a second dam and power plant were constructed at Glines Canyon, 8.5 miles upriver from the Elwha Dam. Despite existing state laws requiring fish passage, neither dam included such measures. For some members of the Port Angeles community, the dams became part of their family history because family members worked on the construction or lived in the valley during construction. The dams' place on the National Register of Historic Places is a source of pride to some residents.

While the hydroelectric developments provided power for consumers in Port Angeles, the character of the river and the valley was radically changed. The dams destroyed anadromous salmon and trout. Loss of the Elwha as a free flowing river cut to the core of S'Klallam spiritual existence and damaged a fishery vital to their economy. Tribal members lost access to sacred sites where the Creator made the Elwha S'Klallam and where they went to purify themselves and receive spiritual guidance. The reservoirs behind the dams inundated at least one S'Klallam settlement site, seasonal camps, and possibly burial grounds as well as habitat for many resources including fish, land game, and plants used for food, medicine, and raw materials.

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S'Klallam and non-Indian residents suffered significant losses when the dam failed during construction in 1912. A primary bridge crossing over the Elwha was washed away and a mill was damaged. All of one Indian homesteader's property was swept away by the resulting flood. Other homesteaders had topsoil washed away and farm fields covered with debris. Some people later moved their houses to higher ground.

Operation of the power plants not only blocked fish access to most of the Elwha River, but affected fish in the river downstream of the dams through the periodic reduction in flows. Spawning grounds were left without water, and fish stranded away from the river. Today, cultural resources considered historically important include the hydropower projects themselves, home sites, Elwha Ranger Station, Elwha and Altaire campgrounds, the one-lane Elwha River Bridge, and the two dam complexes. Elwha and Glines Canyon dams are listed on the National Register of Historic Places, significant for their associations with the rapidly evolving technology of power generation and the organizations that were formed to develop and distribute power. In addition, the Elwha River plant is an example of a low head hydroelectric system and a rare, early multiple-buttress type dam. The Elwha River Hydroelectric Power Plant Historic District includes the dam and both spillways, the five penstocks, and powerhouse. Glines Canyon Hydroelectric Historic District includes the dam and spillway, intake, powerhouse, gate house, and surge tank.

Impacts

Under the **No Action** alternative, no changes would take place in the Elwha River Hydroelectric Power Plant Historic District, Glines Canyon Hydroelectric Historic District, or other historic sites. Members of the Lower Elwha S'Klallam Tribe would continue to suffer the loss of important tribal resources integral to their traditions and culture; sacred land would remain inundated or inaccessible through continued damming of the river. Fluctuations in lake level could also result in the further erosion of archeological sites.

Under the **Dam Retention** (with mitigation) alternative, both dams would be modified: the Elwha Dam with a fish ladder and Glines Canyon with the addition of trap-and-haul facilities. These actions, compatible with hydroelectric use, would not be expected to affect the dams' listings on the National Register. Fish ladders would improve survival rates for some stocks, but not sufficiently to provide substantial fish harvests for tribal members, commercial fishers, and recreationists. Access to inundated traditional use and spiritual sites would continue to be denied.

Removal of Elwha Dam would result in the loss of a property listed in the National Register of Historic Places--"a historically significant example of a low head hydroelectric system in Washington State from the early 20th century. The blowout and reconstruction of the original dam foundation is noteworthy because it represents a failure of early engineering and a successful response to that failure" (Elwha Report, Appendix L). This alternative would require modification of Glines Canyon Dam to allow fish passage, an action which is not expected to affect its eligibility for listing.

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Removal of Glines Canyon Dam would eliminate a dam historically important because of "its association with the evolution of power plant design and contribution to the development of the automation of hydroelectric installation... It marks the closing of an era which characterized early hydroelectric development within the state." This alternative would also require modification of Elwha Dam to allow fish passage, an action which is not expected to affect its eligibility for listing.

The Washington State Office of Archeology and Historic Preservation would be consulted in developing standards for mitigation to preserve the history of the dams and associated project facilities should any or all be removed. Any mitigation would include complete documentation of the projects according to the standards of the Historic American Engineering Record, including a history of each, measured drawings of designated features, and photographs and archival copies of important engineering records and drawings. Other mitigation measures could include onsite interpretation of remaining features of the projects and the removal process (Elwha Report, Appendix J).

Cultural or archeological sites in the immediate vicinity could be uncovered or damaged by construction during removal of either or both dams. To identify and avoid cultural sites, a survey would be conducted prior to construction activity. Wherever possible, construction would be routed to avoid sensitive areas and rerouted if unexpected sites were uncovered during construction. The Department of the Interior would consult with the State Historic Preservation Officer and the Advisory Council on Historic Preservation to determine the best mitigation tactics. A programmatic agreement among federal and state agencies and the Tribe for protecting cultural resources has been drafted to ensure cooperation in managing and protecting cultural resources. The Elwha Ranger Station Historic District and the one-lane Elwha River bridge could be affected if flooding increased in this section of the river as a result of dam removal. The nature of the impact would be more precisely defined in the Implementation EIS.

Several known sites sacred to the Elwha S'Klallam are inaccessible because of the Elwha Dam and Lake Aldwell, and there may be others to which access is denied by the Glines Canyon Dam and Lake Mills. **Removing Elwha Dam** or implementing the **Proposed Action** would potentially make them available to the tribe.

Implementing the **Proposed Action** would affect present day cultural resources by reestablishing the native anadromous fisheries, thereby returning a traditional economic and cultural element to the tribe. The S'Klallam people would benefit from long-term restoration of ceremonial, subsistence, and commercial fishing. Traditional fishing sites would again be accessible, eliminating crowding with non-tribal fishers at the mouth of the river. Shellfish habitat at the river mouth would be replenished by sand and upstream nutrients carried to the sea. Restoring the free-flowing river and native anadromous fisheries would have positive impacts on the material and cultural well-being of tribal members (Elwha Report, p.44).

The free-flowing Elwha might meander more widely or frequently across the floodplain, causing localized flooding and damage to historic sites from water and sediment deposits. The Elwha Ranger Station Historic District and Elwha River bridge are both recognized historic sites downstream of the dams. Others may exist, and an inventory to identify them is presently underway. Archeological resources such as villages or seasonal camps located outside the floodplain are not expected to be affected by increased meander. Such sites could be affected by construction activities associated with dam removal. Since the pre-dam river changed course frequently, it may have already eroded less protected sites on the floodplain (Elwha Report, Appendix L).

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Cumulative Impacts

Cumulative impacts are those which have had an additive negative impact on cultural resources when combined with losses attributable to either the presence of the hydroelectric projects or their removal. A number of cultural resources on the Olympic Peninsula have been lost in the past as a result of development. Removal of the Elwha and Glines Canyon dams might result in additional loss of cultural resources. Documenting these resources before major changes are made would contribute to the future preservation of their historical significance.

The cultural fabric of the Lower Elwha S'Klallam Tribe has been adversely affected by the presence of the projects and ensuing loss of fisheries resources. In the late 19th and early 20th centuries, other events also adversely affected the culture of the tribe, including boarding schools which discouraged or banned the use of the native language, Indian agents who prohibited traditional religious practices, and the logging or development of streams which further reduced salmon runs.

Conclusions

The free-flowing Elwha and its native salmon fisheries are central to the culture of the Lower Elwha S'Klallam Tribe. Benefits to the tribe would increase in direct proportion to the degree of restoration of the river and native fisheries. Only the **Proposed Action** would restore the river and fully reestablish the native fisheries lost almost a century ago. Removing either dam or installing fish passage measures would only partially restore the fisheries. Sacred sites would remain buried beneath the Elwha Dam and Lake Aldwell, possibly under Glines Canyon Dam and Lake Mills as well.

The dams are historically significant examples of early hydroelectric systems. Though their features would be inventoried, photographed, and recorded, the dams and power plants would be lost if the **Proposed Action** were implemented. This would also be true of single dam removal alternatives.

Recreation, Esthetics and Land Use

Affected Environment

The Elwha River valley traditionally has been used for recreation, timber production, fish harvest, power production, and residential purposes. The portion of the middle reach inside Olympic National Park and the upper reach of the Elwha is dedicated to park uses, such as hiking, fishing, camping, picnicking, or wildlife observation. The lower and portion of the middle reach outside the park experience mixed use, including limited Native American cultural and subsistence uses, recreation, boating and hunting and trapping.

Certain parts of the valley have limited road access, but none is as easy to reach as more developed regional sites (FERC, pp. 3-78 to 3-79). Visitors can access the river or reach the reservoirs in a few places by road. Above Lake Mills, the river is accessible only by trail and the shoreline inaccessible in several areas due to steep banks and deep gorges (FERC 3-80). All of the river valley upstream of river mile 9.5 lies within Olympic National Park in the Elwha subdistrict. Although this region is relatively little-used compared to the neighboring Hurricane and the more famous Lake Crescent subdistrict, approximately 700-900 people boat the river annually (FERC, p.3-83) in spring and summer, and an estimated 5,000-8,000 stay in the Altaire and Elwha campgrounds on the river each year. Some sports fishing is done, and several thousand people hike the Elwha subdistrict backcountry each year.

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The Washington Department of Fish and Wildlife reported angler catches of 127-157 summer steelhead and 1,000-2,300 winter steelhead per year from 1987 to 1989 on the Elwha. A small state ramp on Lake Aldwell, accessible from U.S. Highway 101, provides a place to launch canoes and other small boats and to fly fish along the eastern shoreline and north end of the lake. The James River Corporation boat ramp on Lake Mills also is used to launch small water craft. From July to September in 1981 and 1982, anglers spent 8,500-9,500 hours fishing both lakes (FERC, p.3-83). Recreationists spent an average of 22,000 hours per summer fishing primarily for rainbow trout in the lakes and middle reach of the river (FFRC, p. 3-44).

Marine recreational fishing exists in the Strait of Juan de Fuca, where chinook, coho, and pink salmon are taken off Ediz Hook during the late summer months (FERC, p. 3-82). Several charters from Port Angeles operate to support recreational fishing. (For further information on marine fishing for salmon and trout in the area, see Elwha Report, pp. 16-17, and "Cumulative Impacts" in the fisheries section of this document).

Nine trailheads in the Elwha drainage basin provide access to approximately 20 backcountry trails. Five of the nine trailheads also allow access to day hike trails of up to three miles. Records have not been kept for day hikes, but 8,000-14,000 visitors camped overnight in the backcountry each year, 1985 to 1989 (FERC, p.3-83). Segments of the old Elwha River Trail through Smoky Bottom are now under Lake Mills.

Although there are no formal viewing pulloffs of the Elwha River from the highway or road, some informal viewing spots exist (FERC, pp.3-87 to 91).

Within the park and upstream of Lake Mills, the Elwha River is pristine and considered eligible for designation as a wild and scenic river. The Glines Canyon Gorge is a dramatic site, as are other locations in the project area. Water quality, fish habitat, riparian habitat, and scenic and esthetic values are as they were when the first European settlers arrived. The river valley here retains its character as a lush rainforest.

Outside the park boundary, some of the forest adjacent to the river has been logged and developed into homesites and farms. The middle and lower sections of river land are a patchwork of public (US Forest Service, Washington departments of Natural Resources and Fish and Wildlife) and private ownership (including 574 acres of tribal land at the mouth of the river). Some of these lands have been and will continue to be logged. Parcels of land between the reservoirs are used for transmission corridors, support for the power production of the dams, municipal and industrial water intake, and state and tribal fish hatcheries.

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Plans or policy statements for the management of these lands and river resources have been prepared by Olympic National Park, National Marine Fisheries Service, Pacific Fishery Management Council and Clallam County, as well as other governing agencies including the Lower Elwha S'Klallam Tribe, Point No Point Treaty Council, and Washington Department of Fish and Wildlife. Many of these plans and policies address the restoration of the native anadromous fisheries. Others deal with managing coastal, recreational, and wildlife resources. (For more detailed information on each of these plans, see FERC, pp.3-64 and 3-68 to 3-77.) The Puget Sound Salmon Management Plan (administered by area Indian tribes and the Washington Department of Fish and Wildlife) sets objectives for habitat preservation, production levels, and escapement of each salmon species for the Pacific Coast. In Puget Sound rivers, the plan promotes the restoration and natural production of species, particularly coho and chinook, to optimum levels.

Impacts

Recreational Fishing. Under the **No Action** alternative, the impacts to recreation would be primarily on sports fishing, both in the river and the marine environment. The Elwha River was historically one of the largest producers of salmon and steelhead on the Olympic Peninsula, yet current runs are only a small portion of their former size. This is because the dams block upstream migration of fish and downstream flow of spawning gravels and nutrients. The reservoirs have inundated more than five miles of important riverine habitat, and releases from the reservoirs result in water temperatures 2 to 4^{o} C higher than normal during summer months. These conditions have reduced the number of harvestable salmon for recreationists both in the Elwha and in the marine environment. Presently, in-river recreational fishing opportunities for native anadromous species are limited to a 100-400 fish summer steelhead fishery. River anglers catch primarily rainbow trout or native char (Dolly Varden and bull trout) in the middle and upper Elwha River or in the two reservoirs (see previous "Affected Environment" section).

In the short term, removing either dam could affect river fishing because of the initial need to protect native populations as they reestablish and rebuild; this could curtail recreational fishing for several years. In the long term, however, the **Proposed Action** would restore the native fisheries in the Elwha, reducing the need for harvest restrictions (see "Native Anadromous and Resident Fisheries" section of this document, or Elwha Report p.35).

Reintroduced salmon and native anadromous trout would likely compete with resident trout and native char for food and habitat, lowering numbers of the resident fish. All dam removal alternatives would result in more fishing opportunities, but a slight overall decrease in fish available to anglers is predicted if both dams are retained with fish passage measures installed and hatchery operations phased out (See "...Fisheries" section of this document and FERC, p.4-68). This is primarily due to the requirement for greater escapement (fish allowed to spawn) to maintain wild stocks rather than hatchery stocks and to supplement losses at passage facilities.

Under **Dam Retention** (with mitigation), with fish passage measures installed, coho salmon and winter and summer steelhead runs would have a fair chance of restoration, but none would have "good" or "excellent" chances. The reservoirs would remain for use by flat-water boaters.

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Removal of Elwha Dam would completely eliminate passage problems for sockeye salmon. Coho and steelhead would have a "fair" chance for restoration, but pink, chum, chinook and sockeye would have “poor” or “poor to fair" chances. The natural balance from a reintroduction of native anadromous salmonids would most likely reduce populations of resident trout and char. Lake Aldwell would be eliminated as a recreational resource for flat-water boaters, but would be replaced with 2.8 stream miles available to whitewater recreationists and river anglers.

Removal of Glines Canyon Dam would raise the probability of restoration for steelhead from "fair" to "good," and for chinook and coho to "fair" or "good." With the Elwha Dam still in place, however, sockeye, pink, and chum all would fare worse, their chances for restoration dropping to "none" or "poor." Resident trout and char populations would also grow smaller. Lake Mills would be eliminated as a recreational opportunity for lake anglers and others who now boat on the reservoir. Approximately 2.5 stream miles would be restored and become usable by whitewater boaters and stream anglers.

Removal of both dams would eliminate passage problems for all native Elwha anadromous fish and fully restore habitat for all except sockeye salmon. The Elwha sockeye require a freshwater lake for their life cycle and depend on the highly developed Lake Sutherland. Restoring river habitat would not repair the condition of Lake Sutherland, but would improve chances of full restoration from "none" under present conditions to "poor" or "fair." Like all other alternatives that reintroduce native anadromous fish, the **Proposed Action** would also result in a population reduction of resident trout and char. Although all flat-water recreational opportunities would be lost, more than 5 miles of river recreation would be added.

Camping, Hiking, and Whitewater Boating. All dam removal alternatives involve the loss of at least one reservoir and associated recreation, including boating, camping, fishing, and viewing. Visitors seeking flat-water recreational experiences would use other nearby locations, such as Lake Crescent, or choose river or other recreation options. All action alternatives would have direct and indirect short-term construction impacts on recreation through road and campground closures due to noise, dust, in-stream sediment, and the temporary loss of a quiet, natural environment.

In the long term, each removal alternative would create new recreation opportunities for anglers, whitewater boaters, and visitors seeking a natural, high quality outdoor experience. If both dams were removed, 5.3 stream miles would be added to the Elwha. If only Glines Canyon Dam were removed, 2.5 miles would be added, and 2.8 miles of river if only Elwha Dam were removed. The Department of the Interior has stated its commitment to ensuring recreational access through lands it may acquire, and the Elwha Restoration Act asks any future landowner of the Aldwell lands to also plan for public access. A possible trail connecting Olympic National Park with the Port Angeles waterfront trail, as well as other recreational and interpretive opportunities, are mentioned in the Elwha Report, and would be further examined during or following the Implementation EIS.

The present owner of the dams, James River Corporation, has proposed three boat-in campsites, trails, and an overlook at Lake Aldwell, and improvements to the boat launch facility at Lake Mills. These would increase reservoir recreational opportunities if either or both of the dams were retained.

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In the short term, all action alternatives entail construction and its accompanying noise, dust, sediment, road closures, and general disruption. Installing fish passage measures on each dam could take one to two years. Removing both dams would probably be done in two years, but may take as long as four.

Removing the dams and draining the reservoirs would uncover trees and stumps, as well as hundreds of acres of barren land (415 acres under Lake Mills; 267 under Aldwell, FERC, pp. 4-177 and 4-207). Revegetation would be well-established within three years, and the scene would naturally evolve into a varied landscape with multiple terraces. Roosevelt elk might graze these open areas providing wildlife viewing opportunities for visitors. Gorges such as those at the bases of both dams would be restored to their natural conditions.

Land Uses. Lands inside park boundaries acquired by Interior, specifically those behind Glines Canyon Dam, would be managed according to Olympic National Park policies (Elwha Report, pp.117-120, Appendix I). These policies include restoring, "…natural aquatic habitats and the natural abundance and distribution of native aquatic species, including fish, together with the associated terrestrial habitats and species," (NPS Management Policies, 1988) and "...conserve maintain, and restore, where possible, the primary natural resources of the park and those ecological relationships and processes that would prevail were it not for the advent of modern civilization" (Olympic National Park Statement for Management, 1989).

The Lower Elwha S'Klallam Tribe is interested in trust ownership of Elwha project lands, including those currently beneath Lake Aldwell. Some of this reclaimed land could be used for housing and economic development by the tribe. If the secretary of the interior chooses to remove both dams, Interior would examine different land disposal options for any acquired lands outside the park boundaries. These options are specified in the Elwha Restoration Act: held in trust for the tribe's use, included as part of Olympic National Park, managed by the U.S. Fish and Wildlife Service as a wildlife refuge, or used and managed by the state. Cooperative management among two or more of these agencies is also possible. Acquired river banks within project boundaries would be managed in a free-flowing state.

Solid waste would be produced by any dam removal alternative. If disposed of on land, 3 acres are estimated as needed for rubble from the Glines Canyon Dam, 33 acres for rubble from the Elwha Dam. A possible disposal site for rubble was examined in the Draft Staff Report, but alternative sites and options for using the concrete (including ocean disposal and the creation of artificial reefs) would be examined in the Implementation EIS.

The **No Action** alternative would not generate solid waste, but would be inconsistent with all agency plans, including National Park Service and Olympic National Park management plans and policies, the Fishery Management Plan (National Marine Fisheries Service and Pacific Fishery Management Council, 1989), and the Clallam County Comprehensive Plan.

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The National Park Service policy to restore "natural aquatic habitats and the natural abundance and distribution of native aquatic species, including fish, together with the associated terrestrial habitats and species," and Olympic National Park policy, "conserve, maintain, and restore, where possible, the primary natural resources of the park and those ecological relationships and processes that would prevail if not for the advent of modern civilization," would both be in conflict with any decision that does not fully restore the Elwha River ecosystem. Since the **Proposed Action** is the only alternative which would accomplish this goal, it is the only alternative consistent with these policies. **Removal of Glines Canyon Dam** would restore only those natural ecosystem processes in the park; it could not restore native anadromous fisheries and wildlife to pre-dam conditions.

The Puget Sound Salmon Management Plan (administered by area Indian tribes and the Washington Department of Fish and Wildlife) sets objectives for habitat preservation, production levels, and escapement of each salmon species for the Pacific Coast. In Puget Sound rivers, the plan promotes the restoration and natural production of species, particularly coho and chinook, to optimum levels. None of the alternatives except the **Proposed Action** could fully accomplish this objective; in fact, the **No Action** alternative is inconsistent with it. To the extent that partial restoration of the fisheries would occur, each of the other action alternatives, **Removal of Elwha Dam**, **Removal of Glines Canyon Dam**, **Dam Retention** (with mitigation), would be partially consistent with the Puget Sound Salmon Management Plan policies.

The Clallam County Comprehensive Plan emphasizes protecting and enhancing recreational resources that attract visitors to the area to support the local economy (FERC 3-76). Although the **No Action** and **Dam Retention** (with mitigation) options would continue to provide some recreation through the reservoirs, alternatives that enhance ocean or river salmon and trout populations would also attract sports anglers and visitors to the area. The Dam Retention alternative would supply fewer harvestable salmon and steelhead than under current conditions, primarily due to the requirement for greater escapement to maintain wild stocks rather than hatchery stocks and to supplement unmitigated losses at passage facilities. Fewer trout would also result, due to new competition with salmon and steelhead in the upper basin. The reduced available salmon, steelhead, and trout would make this action largely inconsistent with the county plan.

No Action would continue to negatively impact native anadromous salmon and trout and recreational fishing by restricting habitat to the lower 4.9 miles of the Elwha River. This alternative is also inconsistent with the stated priorities of the county plan. Single dam removal alternatives would partially restore the fisheries and hence attract fishing-related visitors, but only the **Proposed Action** would completely restore the fisheries.

Only the **Proposed Action** is consistent with rights in riparian lands reserved by the Point No Point Treaty and upheld by the U.S. Supreme Court. This 1855 treaty retains the tribe's right to capture up to 50% of the harvestable anadromous fish returning to their usual and accustomed fishing places. The court defined these fishing places for the S'Klallam, including all tributaries in the drainage extending from Hoko River on the west to the mouth of the Hood Canal on the east (R. Busch, Evergreen Legal Services, personal communication, Feb.1995).

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Cumulative Impacts

The Olympic Peninsula has many recreation areas managed by government agencies and private landowners (FERC, p.3-79). Olympic National Park has approximately 1,000 developed campsites and the Olympic National Forest, 379. Anglers fish for salmon, steelhead, and other trout in the Elwha and other peninsula rivers (FERC, p. 3-78) and whitewater boaters use five rivers. Lake Sutherland and Lake Crescent are within a few miles of the Elwha.

Construction associated with all alternatives except **No Action** might temporarily restrict access for hikers, campers, and anglers in the Elwha subdistrict of the national park, perhaps creating more crowded conditions at neighboring campgrounds, lakes, rivers, and on hiking trails. Although camping, hiking, and fishing are available in the nearby Hurricane and Soleduc subdistricts, whitewater boaters would have to use the Soleduc or Bogachiel rivers or travel more than 75 miles to the Queets, Quinault, or Humptulips rivers.

If native anadromous fish were restored to the Elwha through any dam removal scenario, there would be a one- to three-decade period during which fishing restrictions for one or more runs would be in effect. This would be followed by a much better fishing future. A wider range of fishing opportunities could gradually increase the number of visitors to the Elwha subdistrict.

Conclusions

The Elwha River basin provides hiking, camping, fishing, and boating opportunities. Fishing, primarily for resident trout and steelhead, takes place both in the river and from small boats on Lake Mills and Lake Aldwell. Most of this basin in the Olympic National Park is in pristine condition, less used by recreationists than other neighboring subdistricts. Noise, dust, and road closures during construction of fish passage measures and/or removing either or both dams would have short-term negative impacts on recreationists. Short-term harvest restrictions necessary for restoration would also negatively impact anglers. However, to the extent each alternative would restore native anadromous fisheries in the long run, it would have positive impacts for anglers and to those seeking wilderness recreation experiences. Reservoir recreation would no longer be available on the Elwha River if **Proposed Action** were implemented, and would **be confined to a single reservoir if either the Remove Elwha Dam or** Remove Glines

Canyon Dam alternative were selected.

Removing the dams and draining reservoirs would uncover barren lands at the reservoir bottoms, but would offer a unique visual experience as these lands begin the natural successional process toward a mature forest. Scenic vistas such as Glines Canyon Gorge would be restored to natural conditions if the dams were removed.

Only the **Proposed Action** is consistent with all relevant plans and policies for the area, including the Puget Sound Salmon Management Plan, Clallam County Comprehensive Plan, Olympic National Park, and the Point No Point Treaty.

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Socioeconomics

Department of the Interior Methodology

In this environmental impact statement, the Department of the Interior uses a combination of data from the Draft Staff Report and more recent information available since 1993 when the report was printed. On the cost side, these data affect direct project cost and cost for purchase of alternative energy. On the benefits side, they most alter Federal Energy Regulatory Commission numbers on the economic impact of increased tourism in Clallam County. The socioeconomic method used here also differs from the Draft Staff Report by considering a more extended project period (100 years), estimating impacts over a range of discount rates (from 0 to 7%), and following recommendations by the Office of Management and Budget (1992) in using real rather than nominal values in analysis. Use of real prices and rates removes inflation from all calculations, but accounts for price changes caused by changes in factors of demand and supply. After consultation with the Bonneville Power Administration, Interior has revised assumption of real increase in regional cost of purchased energy from the coal-based estimates used by the Federal Energy Regulatory Commission to conform to expected increases in the price of natural gas.

Data and assumptions underlying principal socioeconomic findings are contained in "Elwha River Restoration Project - Economic Analysis" (Meyer et al., 1995).

Affected Environment

Clallam County encompasses an area from just east of the city of Sequim westward along the Strait of Juan de Fuca to the most westerly point of land in the continental United States, Cape Flattery, and south to include the town of Forks. Port Angeles is the largest city in the county. The county also contains a major portion of Olympic National Park. For much of its length, the Elwha River flows northward within the boundaries of the national park before emptying into the Strait of Juan de Fuca west of Port Angeles. Four treaty tribes: the Lower Elwha S'Klallam, the Jamestown S'Klallam, the Makah, and the Quileute, have reservation lands in Clallam County. The Elwha drainage area is an important part of the traditional territory of the Lower Elwha S'Klallam Tribe, whose reservation lies adjacent to the river mouth.

Clallam County population was 56,464 at the 1990 census, an increase of 9% from 1980. Caucasians make up 93% of the population, with 2,695 Native Americans representing the largest county racial minority. An estimated 556 Native Americans resided on or near the Lower Elwha S'Klallam reservation in 1990. Total county population is projected to reach approximately 63,000 by 2000, and 71,000 by 2010 (White, Stalheim, and James, 1992).

Most of the county population is concentrated around Port Angeles and Sequim. Port Angeles continues to be the population center of the county, accounting for over 32% of the total. Factors that contribute to this concentration include industrial- and recreation / tourism-based activity associated with Port Angeles' deep water harbor, the "rain shadow" which makes climate in the east end of the county more attractive, and land ownership patterns which put most of the south and west areas of the county in large commercial timber holdings and in Olympic National Park.

For most of this century, the economy of Clallam County has been dominated by its natural resources and the drawing power of its environmental amenities. The large timber resource base has made the timber industry a traditional economic mainstay--with approximately 56% of the county's 1.13 million acre land base managed for this purpose in 1992 (White, et al., 1992). Over the past two decades, forest-based productivity in northwestern Washington State has flattened and then declined: first, in the processing sector due to anticipated timber supply shortfalls and, more recently, in the harvest sector. The decline is primarily due to supply shortfalls, restrictions on export of raw logs, and environmental concerns (Haynes, Richard W., 1990).

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Commercial fishing and shellfish harvesting have also been important traditional activities for the county. Like the timber industry, activity in this sector has declined in recent years, principally due to declines in available fish harvests. Other resource-based industries of importance include agriculture and mining.

A growing tourism industry serves the many visitors drawn to the county by Olympic National Park, ferry access to Victoria, British Columbia, salmon fishing, and opportunities to enjoy the varied scenic and recreational amenities in this area. More recently, the county's growing retirement community has created employment gains in the service sector of the economy (White, et al., 1992).

Income, Employment, and Poverty

At the 1990 census, Clallam County per capita income was estimated at $12,755, while county unemployment stood at 8%. Median household income increased from $16,890 (1980) to $25,434 (1990). Consistent with national trends, earned income from employment in the county has declined from 59% to 50% of all income, 1980 to 1988. (Clallam County Economic Development Council, 1994).

County employment was estimated at 23,310 persons out of a workforce of 25,500 in May 1992. (White et al., 1992) The highest growth in employment between 1985 and 1990 was in government, retail/wholesale, and construction sectors. Clallam County has lagged behind the state in employment growth, but has exceeded the state in retail/wholesale and government sectors. Tourism, a growing older population, and establishment of a new state corrections center at Clallam Bay have been significant contributors to this trend. Major employers in the county, as of 1992, are listed in Table 5.

Poverty levels in Clallam County were almost 2% higher than for Washington State as a whole at the 1990 Census. Members of the Lower Elwha S'Klallam Tribe are in a far more adverse position than county residents in general with respect to all economic indicators discussed in this section. Comparative 1990 census data for Washington, Clallam County, and the Lower Elwha S'Klallam Tribe for income, unemployment, and poverty are presented in Table 6.

Table 5. Major Employers in Clallam County

Employer	Persons
Olympic Memorial Hospital	546
Port Angeles School District	502
ITT Rayonier	434
U.S. Coast Guard	400
Clallam County	345
Daishowa America	320
Clallam Bay Correction Center	317
Sequim School District	247
Quillayute School District	202
City of Port Angeles	197
Peninsula College	180
K-Ply	130
Olympic National Park	130

SOURCE: White et al., 1992

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Table 6. Comparative Statistics on Economic Status

	Lower Elwha S'Klallam Tribe	Clallam County	Washington State
Per capita income	$5,000	$12,755	$14,923
Percent in poverty	35%	9.5%	7.8%
Percent unemployed	35%	8.0%	5.7%

These data underestimate tribal unemployment for some months when the unemployment rate may rise as high as 80% (FERC p. 3-99)

SOURCE: 1990 Census

Public Infrastructure, Services, and Utilities

The government of Clallam County operated on a 1993 budget of $14.8 million (Gerden, Ruth, 1994). Of this amount, $4.3 million came from property taxes while $2.1 million was generated from sales tax payments to the county general fund. The county's combined state and local tax rate is 7.9%. The state retail sales and use tax portion is 6.5%; the county's sales and use tax portion equals 1.4%, and provides revenue to the county general fund (1.0%), the transit system (0.3%), and the criminal justice system (0.1%). An optional tax of 2% on sales of hotel/motel rooms is also received. This tax is not additive with state/local sales tax, but is credited against the state's 6.5% portion of those taxes. The anticipated 1994 property tax from structures associated with Glines Canyon dam is $116,000. The anticipated 1994 property tax on structures at Elwha dam is $114,000 (Gerden, 1994).

Water is supplied by Clallam County Public Utility District #1, the cities of Port Angeles, Sequim, and Forks, and by private irrigation districts, water associations, and community well systems. Port Angeles's water supply is drawn from the Lower Elwha Ranney well. Five reservoirs, situated around the city, receive water through 24-inch lines along the old railroad grade. The storage capacity of the existing reservoir is 11 million gallons. More than 7,000 customers consume 4 million gallons per day (White, et al., 1992). Dry Creek Water Association wells, which supply a small group of rural users, are located adjacent to the lower Elwha River.

Electric power in the county is generally provided by Bonneville Power Administration via two local utilities, Clallam County Public Utility District #1 and Port Angeles City Light. Port Angeles City Light assesses an 11% overhead charge on Bonneville power provided through their system (FERC, p.2-42). Elwha and Glines Canyon dams provide an average of 172 gigawatt hours/year of electricity to the Daishowa mill. This is approximately 43% of the mill's requirement.

Port Angeles's deep water harbor is protected from storms by Ediz Hook, a natural sand barrier that encircles the harbor from west to east. Ediz Hook was formed with material eroded from adjacent sea bluffs and from Elwha River sediment deposition. Over the years, construction of dams on the Elwha and erosion control measures on the sea bluffs have substantially reduced natural recruitment of material to Ediz Hook; consequently, today, the Hook loses more material to wind and wave action than it receives. As a result, in 1978, the U.S. Army Corps of Engineers installed a rock-based blanket to reduce erosion of Ediz Hook at a cost of $5.6 million. Repair and maintenance costs approaching $100,000 per year are expected to control further erosion (personal communication, M. Scuderi, U.S. Army Corps of Engineers, November 1994).

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Clallam County's major medical center, a 126-bed facility, is the Olympic Memorial Hospital in Port Angeles. A smaller hospital is located at Forks and a rural primary medical clinic at Clallam Bay. The Indian Health Service operates a health center at Neah Bay. Tribal health clinics are situated at Quileute and (recently) on the Lower Elwha S'Klallam reservation.

Table 7. Estimated Annual Economic Value of Elwha Salmon and Steelhead–1990/1991

Type of Catch	**Catch in Fish**[A] (thousands)	**Fish Size**[A] (pounds)	**Catch in Pounds** (thousands)	**Net Economic Value Market** (thousands of dollars)	**Net Economic Value Non-Market** (thousands of dollars)
Commercial & Tribal Chinook	5.5	11.5	63.2	175*	
Sport Chinook	2.8			73~	180**
Commercial & Tribal Coho	19.3	6.5	125.4	292[B]	
Sport Coho	2.6			68~	167**
Tribal	1.8	7.0	12.6	46[C]	

Steelhead					
Sport Steelhead	1.8			47~	116**
	33.8			**701**	**463**

Notes:
[A] From FERC (1993), p. 3-103.
* Based on 1988-1990 average ex-vessel price of $1.85/lb., +52% increment for processor marginal net economic value.
~ Based on marginal net economic value of $26.22 per fish, -50%gross sport angler expenditure per fish
** Based on 1988-1990 non-market surplus of $64.31 per fish.
[B] Based on 1988-1990 average ex-vessel price of $1.53/lb., +52% increment for processor marginal net economic value
[C] 1988-1990 sockeye ex-vessel proxy value of $2.43/lb, + 52% increment for processor marginal net economic value.

Prices used in this table are based on data from Washington Department of Fish and Wildlife and from Pacific Marine Fisheries Commission. Fishery net economic value conventions and non-market values are from Bonneville Power Administration (1986).

Fishing expenditure data are derived from The Research Group (1991).

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Housing

The 1990 census showed 25,225 housing units in Clallam County--an increase of 15% from 1980. Of these units, 17,479 were single family homes. Average household size in the county has declined from 2.54 persons in 1980 to 2.4 persons in 1990. A 1991 study by the Clallam County Assessor estimated that 20% of county housing stock is in poor to fair condition. Sixty-four percent of housing units in the county are owner occupied, 27% rented, and 9% are vacant. Between 1980 and 1990, there was an 18% increase in homeless households and a 28% increase in homeless individuals in Clallam County (White et al., 1992).

The Lower Elwha S'Klallam Tribe has a total of 80 housing units available to tribal families; there are 87 additional families on the tribal housing waiting list. Average tribal household size is reported to be 3.7 persons. Only two of the families presently occupying tribal housing earn sufficient income that housing subsidies are not required (Lower Elwha S'Klallam Tribe, staff data, 1994).

Fisheries and Fish Processing

Commercial and recreational fishing have been a cornerstone of the Clallam County economy. Construction of Elwha Dam in 1910 preempted Treaty fish resources secured to the Lower Elwha S'Klallam, Port Gamble S'Klallam, Jamestown S'Klallam, and Makah tribes in 1855, initiating a substantial decline in Elwha River fish stocks (FERC, p.3-101). More recently, reduced commercial and sport fisheries have continued in the Strait of Juan de Fuca, but with only low-level contributions from Elwha River hatchery-supported stocks (FERC, p.3-103). The Federal Energy Regulatory Commission estimated fishery catches from Elwha stocks for the period 1990/1991 (FERC, p.3-103); estimates of net economic value associated with these catches are presented in Table 7.

The economic figures in Table 7 do not include tribal subsistence fishing, nor do they incorporate tribal ceremonial or cultural values of Elwha fisheries. These are discussed in the following section.

Finally, it should be noted that fish harvests have declined substantially from the 1990/1991 conditions underlying Table 7--with attendant major losses for Clallam County residents (Brown and Hodges, 1994). Commercial fishermen in this area (and others) received federal disaster relief in 1994 when a large area of the Pacific coast was entirely closed to salmon fishing. It is unclear at this time whether this signals a further longer term decline from 1990/1991 conditions, or a more temporary condition such as the El Nino current.

Tribal Circumstances

In 1854-55, the United States entered into land cession treaties with native tribes and bands in the Washington Territory. The Elwha S'Klallam were a party to the Treaty of Point No Point signed in January 1855. Under the terms of the treaty, the Elwha S'Klallam retained the right to fish at their "usual and accustomed" fishing places, but they were not provided with reserved lands accessible to those fisheries. Instead, they were expected to live on the Skokomish River at the south end of Hood Canal, an arrangement unworkable and unacceptable to the S'Klallam. They remained in their own territory while successive Indian Department officers urged the necessity of providing an Indian reservation for these people within their own homeland. The United States eventually purchased lands in the lower Elwha valley for this purpose in the 1930s, although the lands were not given formal status as an Indian Reservation until the 1960s. Removal of the dams would allow tribal members to restore their traditional economic and spiritual relationship with the river.

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In 1910, construction on Elwha dam began. Although this structure, and the one that followed at Glines Canyon in 1926, provided electricity for milling of forest products at Port Angeles, it also preempted the greatest part of the salmon resource secured to the Lower Elwha S'Klallam by the Treaty of Point No Point and severely affected the tribe's social and economic well-being. Preemption by Elwha and Glines Canyon dams of the treaty fisheries secured to the tribe has combined with an almost total lack of effective access to alternative economic opportunity to leave Lower Elwha S'Klallam people today as the most economically disadvantaged group in Clallam County (Table 6).

Tribal social circumstances have paralleled economic difficulties. Tribal society exhibits significant social support for its members, particularly on reservations and through extended families. However, Bachtold (1982), specifically referencing the Lower Elwha S'Klallam and other northwest Tribes, reports strong linkages among economic well-being, health, and self-worth and concludes that continuing economic deprivation creates overwhelming stress among tribal members.

Despite these difficulties, and the currently depressed level of fish harvests, Elwha fisheries continue to play a central role in tribal economic activity, culture and ceremony, and to offer hope for their improved future. This is perhaps best expressed by tribal chairperson, Frances Charles:

> I hate to think of the future, especially for our children, if our resources aren't there--the fish, the nature, the wildlife, the plants-- which have always been

provided for us. Our ancestors were raised to protect the river. They raised us to protect the river. We must be even stronger in the future--protecting what was given to us for our children, and for our children's children-- and valuing what we have.—

Frances Charles

The tribe continues to operate a fish hatchery for chinook, coho, and steelhead on the lower Elwha that produced 63,000 pounds of salmon in 1987. The tribe considers the fishery potential of the Elwha River its most significant economic asset. Most tribal fishers presently rely on the river's fisheries to some degree to obtain a relatively small amount of income and/or food each year.

Power Production for Daishowa Mill

Elwha and Glines Canyon dams annually produce an average of 172 gigawatt hours of power, or about 43% of the total for the Daishowa mill through the Bonneville Power Administration/Port Angeles City Light system. Daishowa mill currently employs approximately 320 persons (Table 5). Operating and maintaining Elwha and Glines Canyon dams employs approximately 10 persons.

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The estimated 1996 cost of power production from Elwha and Glines Canyon dams, without any improvement expenses, is 12.29 mills (FERC, 2-38 to 39). The estimated real priority firm power rate, or the rate Daishowa mill would actually pay for additional purchased power, for Bonneville customers in 1996 is 26.7 mills (BPA, 1993). The estimated real avoided cost for power production, or the cost of supplying additional power from Northwest regional power sources in the Bonneville region in 1996 is 33.3 mills (Meyer, et al., 1995). Bonneville's real priority firm power rate is expected to remain essentially unchanged through the year 2014. BPA's regional avoided cost of energy production is estimated to reach 47.5 mills by the year 2014 (BPA, 1993).

Impacts

Under the **No Action** alternative, there would be little change in the economic circumstances of Clallam County. County population is expected to approach 60,000 by the year 2000, with higher than state average unemployment and poverty and lower than state average income likely to continue. Tribal unemployment and poverty would continue to greatly exceed that of the rest of the county, and tribal income and health status would remain substantially lower. There would be no positive impact on tribal culture.

Presently, the county collects $230,000 in property taxes annually on the two hydropower projects.

All alternatives except No Action require Daishowa Mill to absorb additional costs for the portion of the 172 gigawatt hours of power it would lose. The real cost per year of providing this power at local preferred customer rates and at regional avoided costs, expressed in 1996 dollars, are provided in Table 8. These rates are calculated based on Bonneville Power Administration energy supply costs and on what the dam owner would incur in installing fish passage mitigation measures. Because the cost of fish passage is incorporated into the replacement power cost, it is not also included in the construction cost figures for each alternative when comparing costs and benefits (Tables 10 and 11).

Although the power would be provided to Daishowa mill (the user of the electricity now) at the local preferred rate, Bonneville Power Administration would eventually need to bring other sources on line to make up for hydropower lost at a higher cost than this. The cost to Bonneville of supplying this additional power is the regional avoided cost in Table 8. The real cost of the 172 gigawatt hours of power provided by the two dams to Daishowa mill under the No Action alternative would be $2.1 million per year in 1996 dollars.

Net business benefits are derived by enterprises involved in commercial and sport fishing-related activities. For the **No Action** alternative, net business benefits are estimated at $840,000 per year from hatchery operations (Table 10). Future associated sport and commercial fishing and business benefits would likely remain consistent with present trend lines.

Retention of the Two Dams with fish mitigation installed could increase county property tax-based revenue by $639,000, if all fish passage improvements were included in the assessment base (see Table 1). Surcharges on additional purchased power would increase revenue to the local power utility by an estimated $37,000 per year. This alternative would provide an estimated 37 person-years of employment during the construction (of fish passage mitigation measures) period.

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Installing required fish mitigation measures would cost $38 million (See Table 9). This plus annual purchase of 12 gigawatt hours to replace energy production lost by the dams is estimated to increase annual costs of power to the mills four-fold to $8.1 million. Over a 100-year period, this translates to an additional $196.7 million (at a 3% rate of discount).

Table 8. Estimated Annual Real Energy Cost for Replacement Power (172 Gwh) for Daishowa Mill ($ million per year in 1996 dollars)

Alternative			
A. Using Local Cost of Purchased Power			
	1997	2000	2010
1. No Action	2.1	2.1	2.1
2. Dam Retention	8.1	8.1	8.1
3. Remove Glines	9.3	9.4	9.3
4. Remove Elwha	6.7	6.8	6.7
5. Proposed Action	4.8	4.9	4.8
B. Using Regional Avoided Cost of Purchased Power			
1. No Action	2.1	2.1	2.1
2. Dam Retention	8.1	8.2	8.2
3. Remove Glines	10.0	10.1	11.0
4. Remove Elwha	7.2	7.4	8.0

5. Proposed Action	5.8	6.2	7.6

Annual net business benefits from fisheries restoration would slowly increase and eventually reach $1.1 million (see Table 10). Allowing for the slow rate of stock recovery associated with this alternative (see fisheries section), the **Dam Retention** option would provide fewer benefits than the **No Action** alternative, when returns for all future years are discounted and totaled to a single present value estimate of benefits. Annual net economic benefits to business from fishery restoration are summarized, for each alternative, in Table 10. These estimates reflect full recovery to the extent permitted by each alternative. Rate of recovery will be faster for the Proposed Alternative than for other action alternatives.

Other recreation, not associated with fishing, would remain within future trend lines under this alternative. All action alternatives would likely impose fishing restrictions on salmon and trout in the short term to facilitate restoration.

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Removal of Glines Canyon Dam, while retaining Elwha Dam with fish passage mitigation, could increase county tax revenue by $243,000 and would provide 172 person-years of employment during the deconstruction period (see Table 1; from FERC, p.4-178). Revenue to the local power utility would increase due to surcharges charged on replacement power. Removal of Glines Canyon dam would increase the annual real cost of 172 gigawatt hours of power to Daishowa mill to $9.3 million. Regional replacement cost of that energy would increase five-fold over the No Action scenario to $10.0 million per year in 1997, and would increase to $11.0 million per year by 2010 (see Table 8). This increased level of cost reflects the combined costs of increased mitigative requirements at Elwha Dam and the purchase of energy to replace power production from Glines Canyon Dam. Over 100 years (at a 3% rate of discount), this amounts to $282 million (see Table 12).

Fish harvests would recover slowly, eventually generating net business revenue to the commercial (tribal and nontribal) and sport fishing sectors of $2 million per year (see Table 10). Over the 100-year period beginning in 1996, these increases amount to $11.6 million, expressed in present value terms.

Table 9. Estimates of Capital Expenditures

	No Action	**Dam Retention**	**Glines Canyon Dam Removal**	**Elwha Dam Removal**	**Proposed Action**
Acquisition	---	---	$15M[B]	$14.5M[B]	$29.5M
Construction	---	---	$40.3M*	$25.6M*	$45.5-71M**
Fish Passage/Mitigation	---	$38M[A]	$31M[A]	$25M[A]	---
TOTAL	**---**	**$38M**	**$86M**	**$65.1M**	**$75-101M**

Notes:

* Construction costs taken from Draft Staff Report.

**Preliminary estimate; taken from Meyer et al., 1995 and the Elwha Report, updated by Bureau of Reclamation, March 1995; includes water quality and flood protection costs.

[A] Assumes state-of-the-art screens (i.e. no Eicher Screens) and relocated intake at Glines (if Glines remains); state-of-the-art (i.e. no Eicher Screens) screens at Elwha Dam (if Elwha Dam remains). Water quality protection costs taken for Draft Staff Report and may underestimate true cost of protection.
[B] Assumes acquisition costs would be split roughly evenly and total $28.5 million.

This figure is constrained by slow recovery of stocks and the fact that future benefits estimates are reduced by discounting. Losses from fish passage at Elwha Dam and reservoir, condition of fish habitat downstream from Elwha Dam, and inundation of fish habitat by Lake Aldwell would prevent full fish restoration under this alternative. Some nature-based recreation benefits would be restored in Olympic National Park, while recreation on Lake Mills would be eliminated. There would be marginal positive benefits for tribal culture.

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Capital costs to implement this alternative are estimated to be $86 million. Of this total, construction costs associated with the removal of Glines Canyon Dam account for $40.3 million (see FERC, p. 2-27). Acquisition would add to this. Although acquisition costs would need to be negotiated, the Department of the Interior presumed they would be split roughly evenly between the two projects to total $29.5 million (the price specified for purchase of both projects in the Elwha Restoration Act) for the purposes of this document, for a total construction cost of approximately $55 million. Mitigation measures for fish passage required by Interior account for $31 million (mitigation costs are integrated into the regional energy cost line item in Table 8).

Table 10. Estimated Annual Net Business Benefits from Elwha Fish Restoration-After Completion of Fisheries Rebuilding

	No Action	**Dam Retention (w/mitigation)**	**Glines Canyon Dam Removal**	**Elwha Dam Removal**	**Proposed Action**
Chinook					
Commercial Non-Tribe	0.09	0.10	0.20	0.13	0.25
Commercial Tribal	0.38	0.39	0.81	0.57	1.06
Sport Business	0.09	0.10	0.19	0.13	0.24
Coho					
Commercial Non-Tribe	0.05	0.09	0.14	0.12	0.16
Commercial Tribal	0.11	0.22	0.33	0.26	0.38
Sport Business	0.05	0.09	0.12	0.14	0.16
Pink					
Commercial Non-Tribe	---	---	---	0.08	0.29

Commercial Tribal	---	---	---	0.09	0.32
Sport Business	---	---	---	0.02	0.07
Chum					
Commercial Non-Tribe	---	---	---	0.02	0.13
Commercial Tribal	---	---	---	0.03	0.15
Sockeye					
Commercial Non-Tribe	---	---	---	0.03	0.03
Commercial Tribal	---	---	---	0.04	0.04
Steelhead					
Commercial Tribal	0.05	0.05	0.10	0.07	0.13
Sport Business	0.02	0.02	0.04	0.03	0.05
TOTAL ANNUAL BENEFITS	**0.84**	**1.07**	**1.97**	**1.57**	**3.46**

Removal of Elwha Dam and retaining and mitigating Glines Canyon Dam would provide 84 person-years of employment during the deconstruction period. County tax revenue would increase by $166,000 with Elwha Dam removed due to installation of increased mitigation at Glines Canyon Dam (see Table 1). Revenues to the local power utility from surcharges on replacement power would increase by $241,000.

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Removal of Elwha Dam would increase annual real costs for 172 gigawatt hours of electricity to $6.7 million. Annual regional avoided cost would be $7.2 million in 1997 and would increase to $8.0 million in 2010 (see Table 8). This increased cost reflects increased mitigative requirements at Glines Canyon Dam and purchase of energy to replace power production from Elwha Dam. Over the 100-year period, the regional avoided cost of replacement power (at a 3% discount rate) totals $188 million (see Table 12).

As with the previous two alternatives, fish stocks would recover slowly, and would be limited by the continued presence of Glines Canyon Dam and Lake Mills. Eventually, this option is estimated to generate an additional $1.6 million in direct annual net revenues to the commercial and sport fish business sectors. The slow recovery period and poor chances of full recovery for most stocks mean this alternative only generates an additional $5.6 million in total fisheries-related revenue, expressed in present value terms, over the 100 years following dam removal (see Table 11). Some added benefit would also accrue to nature-based recreation in the river corridor downstream of Glines

Canyon Dam. This option would provide only marginal improvement to tribal economic conditions.

Capital costs for this alternative are estimated in the $65 million range (see Table 9). Construction costs account for $25.5 million (see FERC, p. 2-28), and acquisition presumed $14.5 million, for a total of $40 million. Mitigation and fish restoration would account for $25 million of this total. Again, these mitigation costs have been integrated into regional energy cost estimates in Table 8.

The **Proposed Action** would reduce county property tax revenue by $230,000 per year and increase revenue to the local power utility by an estimated $561,000. Annual real costs to Daishowa mill for 172 gigawatt hours of power would be increased to $4.8 million. Regional avoided cost would be $5.8 million in 1997, increasing to $7.6 million by 2010 (see Table 8). Over the 100-year period, additional regional avoided cost for replacement power would total $171.9 million (presuming a 3% discount rate). Despite this increase, the impact on the electric energy bill of the average regional consumer would be negligible under this or any other alternative.

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Fishery net economic benefits to commercial and sport fish business sectors would reach $3.5 million per year under this option (Table 10). With both dams removed, fisheries restoration would be completed more quickly than with other action alternatives. Over the 100 years following dam removal, additional fisheries benefits (discounted at 3%) would total $34.6 million, expressed in present value terms.

The cost (including water supplies and flood protection) of the **Proposed Action** is estimated to be between $45.5 million and $71.5 million, plus a cost of $29.5 million for acquisition of the two structures. Although the acquisition costs are set by Congress, construction costs are still preliminary estimates which would be refined in the Implementation EIS.

Removal of the two dams would return the fishery resources secured by the Elwha S'Klallam people in their treaty with the United States at Point No Point, and would have a major beneficial effect upon presently adverse levels of tribal poverty, employment, income, health, and upon the ability of the tribe to secure and renew its cultural future.

Local Benefits of the Proposed Action

Partly in response to comments and questions about long-term benefits associated with the Proposed Action which were received during the public review of the draft environmental impact statement (see Response to Comments, "Socioeconomics" section), additional information was developed for the Proposed Action only. It is summarized below:

Elwha River restoration activities would have specific economic effects on the economy of Clallam County. After restoration was complete, 446 annual jobs and a payroll of $4.6 million would be generated in the Clallam County recreation and tourism sector, increasing local sales taxes by $296,000 per year. It is presently estimated that between $45.5 million and $71.5 million plus a $29.5 million acquisition cost would be spent to remove both dams. These expenditures are expected to generate between $40 and $55 million in business activity in Clallam County over the 10-year period of river restoration activity and an additional $21-$29 million in personal income (payroll plus returns from savings and investments made). Updated estimates since the Draft Staff Report indicate that from 760 to more than 1000 total jobs would be generated as a result of construction (Meyer et al., 1995).

This alternative, unlike any other, would restore natural sediment processes in the entire river and into the marine area. It would increase natural sediment available to Ediz Hook, reducing maintenance costs by an estimated $28,000 per year.

Present Net Values
The present net economic value (e.g. total present value for a 100-year period) measures net change from the No Action option of costs and market benefits associated with each action alternative, calculated over 100 years of project life and discounted at 3 percent. Estimated comparative business benefits and project costs are summed and displayed on this basis as single present dollar totals in Tables 11 and 12. For Proposed Action, benefits from increased recreation and tourism would amount to $133 million over the life (100 years) of the project. The $3.5 million per year of net economics benefits after fish stocks were restored would amount to $30 million over the 100-year project life (and discounted at 3%).

Table 11. Summary of the Net Present Value of Elwha River Restoration Market Benefits over Project Life-at 3% Rate of Discount

	Dam Retention (w/mitigation)	**Glines Canyon Dam Removal**	**Elwha Dam Removal**	**Proposed Action**
Business (or Market) Benefits: **(in millions of dollars)**				
Commercial Fisheries (Tribal & Non-Tribal)	-3.7	9.5	5.2	30.1
Sport Fish Business	-1.0	2.1	0.4	4.5
Ediz Hook	---	---	---	0.9
Recreation and Tourism*	---	---	---	132.6
TOTAL MARKET BENEFITS	**-4.7**	**11.6**	**5.6**	**163.6****

Notes:
* Negligible benefits from recreation and tourism for alternatives which do not restore the river, fisheries or ecosystem are assumed.
** Excludes Sport Fish Business net revenue to avoid double counting.

These totals do not include an important feature of restoration projects such as the Proposed Action called **non-market values**. Non-market values are estimates of what people would be willing to pay over and above the market price of a product or service to use it. For instance, sport fishers attach a benefit to the recreational pleasure associated with catching a fish which exceeds the price per pound the fish would bring on the open market.

The non-market value of fully restoring the Elwha River ecosystem and native anadromous fisheries was assessed in a recent (1995) study by Dr. John Loomis of Colorado State University. This value measures what citizens of the United States would be willing to pay in increased federal taxes over a ten year period to fully restore the river-- even if they did not plan to visit the area personally. This estimate was based on a consultant survey of over 300 residents of Clallam County and more than 1300 U.S. citizens in total. Averaging responses, and assuming that persons who did not return the survey would pay nothing, the total non-market value of restoring the Elwha River native anadromous fisheries and ecosystem was estimated to be $3.5 billion annually for 10 years.

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Although the study of non-market values was developed and conducted carefully and conservatively, non-market estimates of value may by nature be less reliable than market estimates. To put them in perspective, the study team calculated how far "off" the estimated $3.5 billion non-market value would have to be to invalidate the conclusion that the benefits of dam removal outweigh costs (i.e., that the benefit/cost ratio was smaller than one). They found even crediting minuscule proportions (one-half of one percent or more) of the non-market benefits reported by Loomis would yield a positive benefit-cost ratio under all discounting scenarios.

Table 12. Summary of Net Present Value of Elwha River Restoration Project Costs over Project Life-Discounted at 3 percent

	Dam Retention (w/mitigation)	**Glines Canyon Dam Removal**	**Elwha Dam Removal**	**Proposed Action**
Impact Costs: (in millions of dollars)				
Project Acquisition	---	15.0[1]	14.5[1]	29.5
Construction -Estimate 1	---	40.3[2]	25.6[3]	45.5
-Estimate 2	---			71.5
Regional Energy Cost	196.7	281.6	187.6	171.9
TOTAL COSTS –estimate 1	**196.7**	**336.9**	**227.7**	**246.9**
-estimate 2				**272.9**

Notes:
[1] These estimates will depend on negotiation. They are arbitrarily assigned between “Glines Canyon Dam Removal” and “Elwha Dam Removal” in this table to sum the “Proposed Action” figure of $29.5 million.
[2] From FERC-93, p. 2-27.
[3] From FERC-93, p. 2-28.

Cumulative Impacts

Clallam County is in transition. Rural in nature, lumber and fish dependent for most of its history, it is now experiencing fairly rapid change with recent declines in its traditional resource-based activities, particularly in the Port Angeles to Forks Highway 101 corridor--increases in tourism, retirement settlement, and service-based jobs, notably from its eastern boundary at Sequim westward to the city of Port Angeles. A recent analysis points out that, with such changes, rural populations may be placed at risk due to limited structural diversity, a feeling of vulnerability to economic and political forces over which they exert little control, periods of inmigration and outmigration that may contribute to a population with limited attachment to local community and a draining of persons capable of enriching the community (U.S. Forest Service, 1993). The potential effects of such changes have been summarized with specific reference to recent reductions in timber harvest in Clallam County and other areas of the Pacific Northwest:

A sudden drop in the harvest levels creates more than an economic shock or the sudden loss of jobs. It creates a social shock that can reduce the ability of a community to respond to economic change. "Persistent poverty, increased commuting, emigration of community members, the breaking up of family and community support networks, changes in leadership, low morale, uncertainty, heightened conflict among groups within communities, deep cuts in school budgets are all factors that result ... if community needs are not addressed" (U.S. Forest Service, 1993).

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The same authors point out that such social stresses may be relatively short-term, and can be at least partially mitigated. However, Clallam County has been experiencing such stress the past five or six years, and it is against this backdrop that social effects of Elwha River restoration should be evaluated.

Social circumstances of members of the Lower Elwha S'Klallam Tribe are significantly more adverse. Where negative economic circumstance underlying social difficulties for the county as a whole have been fairly recent, substantial numbers of tribal members have been living in poverty for more than half of this century.

Removal of both dams would provide short-term economic impetus for recovery due to the construction project, and longer-term additions to business revenue, personal income, and local tax revenue from recreation and tourism. This alternative would also provide needed longer-term stimulus to tribal and non-tribal commercial fishing sectors and to businesses based on sport fishing.

Conclusions

Total benefits of the **Proposed Action** greatly exceed total costs. Business benefits associated with recreation and tourism, including sport fishing, would total $133 million over 100 years of project life (at 3% rate of discount (See Table 11). Commercial fishermen would obtain $3.5 million per year of net economic benefits after fish stocks were restored, amounting to $30 million over project life. Approximately $4 million over the life of the project would be saved in erosion control costs at Ediz Hook, and shellfish harvest would be more abundant. Removal of both dams would also substantially improve material and cultural circumstances of the Lower Elwha S'Klallam Tribe.

Activity associated with removal of both dams would generate between 760 and 1,067 jobs in Clallam County, $21-29 million of personal income, and between $40 and $55 million in business activity in Clallam County over the 10-year period of river restoration activity. A recent survey suggests non-market benefits of the **Proposed Action** may approach $3.5 billion for this same 10-year period. After restoration was complete, 446 annual jobs and a payroll of $4.6 million would be generated in the Clallam County recreation and tourism sector, increasing local sales taxes by $296,000 per year.

The **Dam Retention** alternative would generate 37 jobs during construction, increase property tax revenue by $639,000, and generate $1.07 million in fisheries business benefits. The increased cost of power would add $196.7 million over the 100-year life of the project.

Removing Glines Canyon Dam only would provide 172 person-years employment, increase property tax revenue by $243,000, and increase fisheries benefits to $1.97 million after restoration was complete.

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Removing only Elwha Dam would provide 84 person-years of employment, increase tax revenues by $166,000, and increase fisheries benefits to $1.57 million after restoration was complete.

The **Proposed Action** would increase fisheries benefits to $3.5 million much more quickly than other action alternatives, as restoration would be completed more quickly without passage losses imposed by the dams and reservoirs. Although property tax would decline by $230,000, payments to the local energy utility would increase $561,000. Only the Proposed Action is consistent with federal trust responsibilities to the four affected Indian tribes or would substantially reduce material and cultural damages suffered by the Lower Elwha S'Klallam Tribe as a result of construction of the dams.

Safety

Dam Safety

Affected Environment

Glines Canyon and Elwha dams have undergone testing to measure their structural integrity under normal operating conditions. A procedural history of these tests and measures taken to improve safety of the dams are found in the Draft Staff Report, pp. 2-5 to 2-10. Both have high hazard potential because of possible loss of life and significant property in the event of dam failure. Because of this, the Federal Energy Regulatory Commission has required additional measures to meet the probable maximum flood loading conditions. In November 1989, the Glines Canyon Dam spillway was so modified through the addition of post-tension anchors.

The U.S. Army Corps of Engineers considered Elwha Dam potentially unsafe for floods greater than 40,000 cubic feet per second in 1978, and recommended a variety of measures to repair and strengthen it. The commission agreed; in 1982, additional anchors were required in the north spillway and intake sections. Both were satisfactorily completed. The James River Corporation has submitted emergency action plans to the commission since the 1970s under the dam safety program. During the first years, the commission accepted all such plans on an interim basis. For the past 10 years, the Elwha plans have been "fully accepted" by the commission (letter from James River Corporation, Dec.21, 1994). Part of the plan for the Elwha River dams requires James River to notify the Lower Elwha S'Klallam Tribe, Clallam County Sheriff, Point No Point

Treaty Council, and others when releases from the dams exceed 3,000, 8,000, and 13,0000 cubic feet per second. Although the feasibility of installing sirens to notify citizens using the river at the time of a release was examined, James River concluded this would be ineffective without secondary confirmation and instead chose to use the phone contact approach (personal communication, O. Campbell, Jan.1995).

Recently, geologists have discovered deep subduction faults on the Juan de Fuca Plate in the vicinity of Port Angeles and a shallow crustal fault (the Whidbey Fault) along the Admiralty Inlet just north of Port Townsend. Both faults were found after the last inspections for the Elwha and Glines Canyon dams. The U.S. Geological Survey and the Washington Department of Natural Resources are currently evaluating the potential hazard each of these faults poses. When these evaluations are concluded, the dams may need to be reinspected and hazard potential re-evaluated.

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Impacts

Changes made to Glines Canyon Dam in 1969, 1977 and 1978, and 1989 have increased its stability and the Federal Energy Regulatory Commission now considers it able to withstand the probable maximum flood. The Washington State Department of Ecology Office of Dam Safety has indicated that both dams currently meet state safety standards for both probable maximum floods and earthquakes. New information on the seismic hazard posed by the two newly discovered faults and re-examination of criteria to determine earthquake danger may ultimately require the dams' owner to prepare an updated risk assessment. This, in turn, could lead to the need for further retrofitting of both dams to increase stability under earthquake loading (personal communication, C. Lavassar, M. Schaefer, Washington Department of Ecology, Dec.1994).

Removing the Elwha Dam might cause safety problems if not properly conducted since the dam's alluvial foundation failed in 1912 while the dam was being built. Although the spillways and power penstocks are supported by bedrock, the concrete gravity portion of the dam rests on sand and gravel. To ensure the dam would hold while being removed, a large mass of gunnite capped fill, which acts to keep the foundation relatively dry, must be protected until much of the reservoir is drawn down (Elwha Report, Appendix F).

Flooding

Affected Environment

Average annual discharge from the Elwha River is approximately 1500 cubic feet per second. Flooding can occur during winter and spring, particularly October through March. Flood discharges have ranged from 4,680 cubic feet per second in 1936 to 41,600 in 1897. The greatest recorded discharge in recent years was 28,700 cubic feet per second in 1990 (J L. Lencioni, U.S. Army Corps of Engineers, personal communication, August 1994).

A frequency analysis of yearly peak discharges shows a flood of 5,000 cubic feet per second has a 97% chance of returning each year; a 13,000 cubic feet per second flood has a 50% chance of returning each year. The highest measured flood of 41,600 cubic feet per second has a 71-year return period, or a 1.4% chance of returning each year.

Both Elwha and Glines Canyon dams are operated in a "run-of-the-river" mode. This means that very little of the water entering the drainage is stored or released differently from the way it was before the dams were built. As a result, and because the reservoirs have little flood storage volume, the dams provide very minimal flood protection and only during short duration events (storms or snowmelt).

The 700-acre floodplain and Lower Elwha S'Klallam Tribal Reservation structures near the mouth of the river are protected by a federal levee at the far eastern edge of the historic meander belt. This eastern levee is built to withstand the current 200-year flood (i.e., with the dams). A 600-foot-long privately owned and operated levee on the west side of the floodplain extends downstream from the high natural bluff line which naturally constrains westward migration of the river channel.

Impacts

Because the dams are operated as "run-of-the-river," there would be little or no change in the frequency, duration or intensity of most floods along the Elwha River if the dams were removed. The greatest impact of **Dam Removal** on flooding would result from the release of deposited sediment and reintroduction of natural sediments into the river channel downstream of the dam sites. This increase in bed load, or aggradation, would cause the river to rise, with localized flooding and more frequent meandering across the entire floodplain. The degree of aggradation and change in the meander activity would vary depending on the steepness of the river and whether large, stable vegetation had become established in the floodplain.

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Flooding from the rising riverbed could be mitigated through the modification of existing levees, construction of new levees, monitoring and dredging as needed, purchase of flood insurance, or other measures. Based on preliminary information, the U.S. Army Corps of Engineers estimates the federal levee which now protects the reservation would need to be raised 2-4 feet and armored with riprap to maintain its current level of protection if the dams are removed. Mitigation measures for impacts from flooding will be examined in the Implementation EIS.

These same phenomena, aggradation and a more active meander, would occur in places along the stretch of river between the dams if **only Glines Canyon Dam was removed**, as natural sediment transport from upstream would be restored as far downstream as Elwha Dam. It could occur briefly in the lower river if **only Elwha Dam was removed**, but the continued presence of Glines Canyon Dam would prevent the long-term natural transport of sediment.

Hazardous Materials

Affected Environment

A team of Department of the Interior experts from the Bureau of Reclamation and U.S. Fish and Wildlife Service inspected both dams and accompanying facilities in May 1994 for the presence of hazardous materials. Since the dams were built in the early l900s, the team was particularly looking for asbestos in the building materials and polychlorinated biphenyls (PCBs) in the transformers and other electrical components.

Team members found asbestos in the exterior siding of the Elwha Dam office, in the floor tile and interior wall plaster of the Glines Canyon Dam residence, and throughout the insulation for electric cables in both powerhouses (DOI, "Elwha Dam and Glines Canyon Dam Hazardous Waste Status", May 19, 1994).

Numerous soil samples taken from the Glines Canyon switchyard and one at the base of the power pole just outside the fence of the Elwha power pole storage yard have been tested; the presence of PCBs in one soil sample was detected. The PCBs were present in an amount (0.63 ppm) below what would require cleanup under state regulations (1.0 ppm). Other petroleum hydrocarbons not considered hazardous were present in the switch yard soil and will require cleanup. Samples of transformer oil were not taken, as the inspection team relied on Daishowa's test reports. Capacitors and oil-filled electrical bushings have not been tested for the presence of PCBs, but are presumed to contain them and would be disposed of as hazardous material.

Impacts
Removal of the dams, powerhouses, and facilities could result in some asbestos, PCB-laden soil or capacitors, and other hazardous materials associated with power plant operations being transported offsite to a hazardous waste facility. Neither asbestos nor PCBs would enter the river during dam removal if required methods of containment were used.

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Construction would be required for all alternatives except **No Action**. Heavy construction equipment may leak oil or require refueling at the site, possibly resulting in minor amounts of oil or diesel fuel entering the reservoirs or water.

Cumulative Impacts
There is a natural danger of flooding to all who live in the Elwha River floodplain, even with both dams in place. The dams are currently operated in a natural flow or run-of-the-river mode. Danger from periodic flooding now exists and will continue if the dams are removed. No other known sources of hazardous materials exist in the Elwha river corridor.

Conclusions
The Washington State Department of Ecology Office of Dam Safety has indicated that Glines Canyon Dam and Elwha Dam currently meet state safety standards for both probable maximum floods and earthquakes. Determining whether current standards should be changed and whether two newly discovered faults pose additional threats to the dams from earthquakes may require additional analysis and mitigation on the part of the dam owner.

Proper safety precautions would be taken if the dams were removed to prevent a blowout of the sand and gravel on which a portion of Elwha Dam now sits.

Removing Glines Canyon Dam or both dams would create a more free-flowing, dynamic river which would meander over a wider range and hence cause more frequent flooding at certain places along the river.

Asbestos has been found at both dam sites. One sample of soil at Glines switchyard indicated low levels of PCBs. Although transformer oil, capacitors, and bushings will not be tested for PCBs, they may be treated as if they were contaminated and disposed of as hazardous material. Switchyard soil would require cleanup due to high concentrations of petroleum hydrocarbons.

Elwha River Ecology

An area's ecosystem is composed of physical and biological components which interact and are mutually dependent upon one another. Fully restoring an area's natural ecology or ecosystem begins with restoring the natural physical processes which, in the case of the Elwha River, are flow and transportation of sediments and organic material. It also includes restoring biological ecosystem processes, such as the abundant salmon and trout which once provided food for terrestrial inhabitants and essential nutrients to the river's aquatic life.

Affected Environment

Before the dams were built, the Elwha River looked different from what it does today. In places where the river gradient was not as steep (much of the middle and lower river), the main channel actively meandered, forming side channels and pools. The riverbed was a mix of sand, gravel, cobbles, and fine-grained sediments. When the coarser grained material moved at high flows, it had a scouring effect on vegetation attempting to sprout on in-river islands or bars of sediment. Water contained both particulate and large woody organic debris, and was cloudy during the rainy seasons. Much of the river and its tributaries upstream of the dams are still this way, but the 15 miles below the head of Lake Mills are very different. The middle and lower stretches of the Elwha are now largely devoid of smaller gravels and sand. The sediment that has washed down from the upper river and tributaries is trapped behind Glines Canyon Dam. A smaller portion lies behind Elwha Dam. Some debris and organic material is also blocked, with less flowing into the middle and lower river than under pre-dam conditions.

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As sand and gravel washed out, the elevations of the riverbed and the river dropped in many places. The riverbed is now armored with large cobbles that move downstream only under high flow conditions, and flow is more often contained within the channel boundaries (i.e., does not overtop the channel or flood at lower flows). Because the scouring effect of the smaller-sized bedload material is missing, vegetation has taken hold and matured on gravel and sand beds. The river is still turbid during the rainy season, as clay and much of the silt stay suspended in the water as it flows through the reservoir of each dam. Reservoir releases have raised water temperatures by 2 to 4^{o} C. in some seasons.

The dams have also eliminated more than five miles of riverine habitat through inundation by the reservoirs. Since the river is less active, fewer side pools or channels now form, and the estuary at the river's mouth has decreased from its much greater size prior to the construction of the Elwha Dam in 1910. Now, only a very small zone near the river mouth, probably less than 300 feet wide, has any estuarine characteristics. Before the dams, the Elwha estuary extended north and eastward another 1000-2000 feet, and consisted of a gradually sloping intertidal beach which facilitated the mixing of the fresh water of the river with the salt water of the Strait. Since the river now flows almost directly into salt water with no transition area from low to high salinity, there are no habitat types typical of brackish water areas. These depleted habitats are important for many fish and wildlife species and are essential for successful anadromous fish rearing.

To survive and breed, the native anadromous salmon and trout, which used the Elwha River before the dams were built, require spawning gravels, nutrients, and organic debris.

In addition to limiting nutrients and keeping spawning gravels away from the fish, the dams have blocked the possibility of access to the natural, high quality habitats that remain upriver. Neither dam was built with fish ladders or other means of passage, and the populations of all species of native anadromous fish have declined dramatically over the intervening 80-plus years.

In the pre-dam Elwha, salmon and trout brought nutrients from the sea in the form of body weight or biomass all along the river and its tributaries. Most adult salmon die within days or weeks of spawning in the river; before the dams were built, their carcasses fed at least 22 species of birds and mammals. This food source was especially important during the late fall and winter when other food is scarce. The river was well used by the 10 runs of native anadromous salmon and trout; there was no month of the year when one or another was not migrating upstream, spawning, rearing, or passing juveniles out to sea (see Table 4, In-River Life Cycle Stages of Elwha Salmonids).

In addition to feeding an abundance of wildlife species, native anadromous fish also returned important minerals and nutrients to the river. Two nutrients, phosphorus and nitrogen, often limit biological productivity in Northwest streams. Yet, each year, decomposition of the salmon carcasses probably provided more than 13,000 pounds of these essential nutrients to the Elwha River under natural conditions. (Elwha Report, p.36). The nutrients, absorbed by aquatic plants and animals, formed the base for an in-stream food chain which fed, among others, the juvenile salmon and trout.

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Impacts

If **No Action** is taken, the dams would continue to block the downstream flow of organic material and sediment, as well as the upstream migration of salmon and trout. The entire river would remain unnaturally low in native fish biomass. Populations of at least 22 species of wildlife would be smaller than the area could otherwise support.

The stream ecology would remain unnatural as well, with armored and relatively immobile channels, and with limited nutrients to support aquatic productivity. Water temperatures would remain elevated. Hatchery fish, which make up the bulk of the spawning native anadromous fish in the Elwha, would remain crowded, physiologically stressed, and subject to disease. The abundance and diversity of aquatic insects upon which fish feed would be less below the dams than above, as recent surveys have shown (P. Crain, Lower Elwha S'Klallam Tribe, personal communication, August 1994).

Under the **Dam Retention** (with mitigation) alternative, some native anadromous fish would be able to climb both ladders at Elwha Dam, survive the trap-and-haul process at Glines Canyon Dam, and repopulate the middle and upper river. These fish could supply as much as 109,700 pounds of salmon biomass and 1,800 pounds of nitrogen and phosphorus to the Elwha River (See Table 13).

Salmon and trout species would not be distributed in the river throughout the year as under pre-dam conditions, since only coho and steelhead have even a fair chance for restoration. Also, although wild coho and winter steelhead would be able to pass over the dams and populate a longer reach of the river, hatchery operations would be phased out. Ultimately, the overall numbers of salmon in the Elwha would drop below what the hatchery now produces.

Sediment and nutrients would still be trapped behind the reservoirs, continuing to degrade the value of habitat in the middle and lower river. Water temperatures would remain elevated. River habitat would remain inundated by the reservoirs. The mainstream channel of the Elwha would meander less and form fewer side pools and channels, and the estuary would remain reduced in size. Aquatic insect populations would probably continue to be less diverse and abundant. Both reservoir deltas would continue to grow in size and cover more habitat formerly available to wildlife.

With **Removal of Glines Canyon Dam** and with fish passage facilities installed at Elwha Dam, sediment and nutrients would be restored to the middle river, but would build up behind Elwha Darn until the reservoir filled. The estuary would remain smaller than under pre-dam conditions, but much of the other habitat for juveniles, such as side channels, pools, and debris-covered areas, would be restored in the middle section of the river. Removing the dam would introduce approximately 284,000 pounds of salmon carcass biomass and 4,770 pounds of nitrogen and phosphorus into the ecosystem (Elwha Report, p.36). Pink and chum salmon would not be restored under this alternative, which would represent a substantial 289,000 pound loss of late fall and winter biomass compared to natural conditions.

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Table 13. Potential Carcass Biomass (in pounds) contributed to Elwha River ecosystem from runs with at least fair restoration potential. (Elwha Report, p. 36)

	No Action	**Dam Retention**	**Removal of Glines Dam**	**Removal of Elwha Dam**	**Proposed Action**
Spring Chinook	0	0	35,000	35,000	35,000
Fall Chinook	0	0	135,700	135,700	140,400
Coho	0	109,700	113,700	113,700	117,600
Chum	0	0	0	0	236,000
Pink	0	0	0	0	261,200
Sockeye	0	0	0	27,600	27,600
TOTAL	0	109,700	284,400	312,000	817,800

Stream flows in the middle river would approximate those under pre-dam conditions. Since most of the temperature elevation is from Lake Mills, removing it would reduce downstream temperatures to near normal. The reintroduction of sand and gravel would cause the river to meander over a wider range and to flood locally. A natural stream flow regime and distribution of sediment would not, however, return to the lower river; more than two miles of riverine habitat would continue to be inundated by Lake Aldwell. The Lake Aldwell delta would grow larger and bury more potential wildlife habitat.

Removal of Elwha Dam with fish passage facilities installed at Glines Canyon Dam would result in clear passage for sockeye salmon to migrate to the sea from their freshwater habitat at Lake Sutherland. Annually, this would add 27,600 pounds of sockeye carcass biomass to the Elwha River for a total of approximately 312,000 pounds, and would introduce approximately 5,200 pounds of nitrogen and phosphorus into the ecosystem.

Since Glines Canyon Dam would still be in place, sediment, nutrients, and debris would be blocked from the middle and lower river; habitat, therefore, would remain in a degraded condition. Fish would be lost in passage from both the Glines trap-and-haul process and downstream migration through Lake Mills, and the pre-dam species distribution would not be reestablished.

River morphology would continue to be altered by the presence of Glines Canyon Dam; the channel would remain armored and stabilized, without side pools or channels. Water temperatures would remain elevated, and fish populations affected as a result.

The estuary would remain smaller than under pre-dam conditions, since sediment would be blocked by Glines Canyon Dam. The Lake Mills delta would grow larger and bury additional potential wildlife habitat.

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In the **Proposed Action**, the Elwha River would return to its natural dynamic flow. Sand and gravel would build up the riverbed, causing more frequent river course changes and localized flooding. Parts of the middle and lower river would return to their pre-dam actively meandering condition. More than five miles of riverine habitat would be returned for use by fish and aquatic organisms.

Salmon and trout would travel unimpeded through cool water and high quality habitat along the entire 45-mile Elwha River and its accessible tributaries. Nutrients, spawning gravels, and woody debris would be distributed along the river's entire length. Side channels, pools, and backwater areas would be available for juvenile rearing, as would a much larger estuary at the river mouth.

Over time, pre-dam levels of trout and salmon would return to the Elwha, distributing nutrients, collected from the ocean in the form of fish biomass, throughout the valley over the entire year. Wildlife species that find food scarce in the fall or winter would return as an abundant source of food became available. Other species, limited by sources of food, would be expected to move into the forest lands of the Olympic National Park bordering the middle and upper river. Removing both dams is expected to introduce more than 800,000 pounds of salmon biomass and 13,000 pounds of nitrogen and phosphorus into the ecosystem, more than twice the contribution in any other alternative.

Some short-term impacts to the ecosystem would result from construction noise impacts on wildlife and from sediment releases into the river (See sections on "Impacts to Wildlife," "Species of Special Concern," and "Fisheries" in this document).

Cumulative Impacts

Other changes to the Elwha River ecosystem include the diversion of some of its water for private, public, and industrial use (see Affected Environment, Water Quality section); logging and agricultural development along tributaries to the river; and the placement of flood-control levees to protect tribal and non-tribal residences near the river's mouth. Development has had a direct cumulative effect on area wildlife, as well as indirectly through water diversions and pollution of Elwha water quality. The levees constrain the natural floodplain. The levee on the west side of the river is a 600-foot extension of the natural bluff line that naturally constrains the river and has had no impact on the river's meander. None of these impacts has significantly affected the Elwha River Valley ecosystem or would preclude full restoration if the dams were removed.

Many efforts, including habitat restoration and controls on fishing, are underway in similar ecosystems in the Pacific Northwest to salvage salmon runs. Since 83% of the Elwha River basin lies within Olympic National Park boundaries and is in relatively pristine condition, full restoration of the Elwha River ecology is attainable and provides an excellent opportunity for fish restoration.

Conclusions

Restoring the natural ecology depends on restoring natural stream flows and the native anadromous fisheries in the Elwha River. The **Proposed Action** would accomplish both and add approximately 800,000 pounds of salmon and trout biomass to the river. Removing only Glines Canyon Dam would partially restore both, but approximately 500,000 fewer pounds of fish biomass would be added to the upper and middle Elwha than by removing both dams. Removing only Elwha Dam would not restore natural flows or transport of nutrients, woody debris, and gravel the fish require. Approximately 500,000 fewer pounds of fish biomass would be added than with removal of both dams. Mitigation measures installed at Glines Canyon Dam would result in some salmon in the upper river. Mitigation measures on both dams would not return the river to its original flow and transport regime, but would provide approximately 100,000 pounds of salmon and trout biomass to wildlife species along the mid and upper Elwha. Taking **No Action** would continue to keep all salmon and seagoing trout from the middle and upper Elwha, and would prevent the Elwha River from returning to natural flow, sediment transport, and water quality conditions.

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Required Impact Sections

Impacts on Energy Consumption

The implementing regulations of the National Environmental Policy Act require that environmental impact statements discuss energy requirements and conservation potential of alternatives. Much of this information is embodied in the economic analysis of replacement power, located in the Impacts to Socioeconomics section of this document, as well as in the adopted and incorporated sections of the Draft Staff Report and Elwha Report.

In this section, the Department of the Interior details how much power the Daishowa mill, the sole current user of power generated by the dams, would need to replace if either or both dams were removed and/or if fish passage measures were installed. Daishowa uses 172 average annual gigawatt hours of power from the dams, and approximately 400 overall. The mill would require 400 gigawatt hours regardless of alternative, but the amount available through Elwha River hydropower would vary. If **Dam Retention** were selected, 160 gigawatt hours would be available from the dams. If **Elwha Dam were removed**, 93 gigawatt hours would be available; if **Glines Canyon Dam were removed**, 67 gigawatt hours; if **both were removed**, no power would be produced from the plants. The mill would receive replacement power, which could be generated from a variety of existing or new sources from the Bonneville Power Administration grid (FERC Appendix A, Part 9). For purposes of costing only, Interior presumed the hydropower supplied by the dams would be replaced by sources of energy available to the Bonneville grid--and at costs estimated for regional replacement of power by Bonneville. These costs are estimated to increase over the next 20 years at rates equivalent to increases in the real cost of natural gas.

Since Daishowa instituted conservation measures in 1989, accounting for an annual savings of 26.6 gigawatt hours, conservation potential at the mill is minimal. An energy audit conducted for the City of Port Angeles Light Department in 1991 identified potential additional savings of 9.6 gigawatt hours annually, approximately 5.5% of the current power production of the dams. These savings could be realized by installing adjustable speed drives, high efficiency motors, and a system of motor shedding of refiner lines that would reduce eddy current coupling. Other energy saving items were identified, but their cost effectiveness was not determined in the audit.

Regionally, the Northwest Power Planning Council has estimated conservation potential of 1,500-4,000 megawatts (Elwha Report, p.124; FERC, Table 2-12). Through efficiency improvements, another estimated 370 megawatts would be available. Cogeneration, or the use of one fuel source to generate power for use and also heat or steam for re-use, is available both regionally and at the mill. At the mill, wood waste could be burned in a boiler to produce approximately 15 megawatts (based on the size of the boiler and availability of wood waste). Regionally, up to 2,200 megawatts may be available (FERC, Table 2-12).

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Unavoidable Adverse Impacts

If the Proposed Action is implemented, there would be an unavoidable average annual loss of 172 gigawatt hours of hydropower. Both reservoirs and the recreation they support (flat-water fishing and boating) would be lost. The loss of the reservoirs would also displace wintering trumpeter swans and some other wildlife at Lake Aldwell.

The dams and associated buildings are considered historically important as examples of early hydropower production facilities. Although inventorying and recording features of both projects through the Historic American Engineering Record and other measures would provide mitigation, the structures would be lost.

The restoration of natural transport of upstream sediment could also have impacts. A marine biotic community that has adapted to the lack of sediment in the nearshore area at the mouth of the Elwha River would be changed over time to one that prefers sandy substrate. The river elevation would rise in some places as bedload material was restored, resulting in a wider meander and more frequent localized flooding that could affect both private and cultural properties. Water downstream of the dams would have more organic material and nutrients than it does today. This would increase productivity of the aquatic and terrestrial ecosystem, but might require mitigation to protect human users.

In the short term, construction would create traffic and noise that could affect wildlife, species of special concern, and recreationists. Roads within Olympic National Park might need to be periodically closed during dam removal and strengthened to withstand high loads.

If material were removed from the dams, disposal on land would require an estimated 36 acres. A slurry pipeline to carry sediment from behind the dams might need to be temporarily located on land or in the riverbed if this sediment management option were selected. (The Implementation EIS would evaluate impacts of sediment management alternatives in detail.)

The release of sediment from behind the dams could severely affect aquatic life or water quality in the short term if unmitigated. Some sediment management methods would greatly reduce the amount released into the river. Others releasing large amounts would require greater protection for fish or water quality.

Short-term uses vs. long-term productivity

This section compares the short- and long-term environmental effects of decisions. Although traditionally, projects result in short-term gains and long-term losses, the restoration of the Elwha River ecosystem and native anadromous fisheries would do the reverse.

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Short-term impacts from construction and sediment release on fisheries, water quality, flooding, wildlife, living marine resources, recreation, land use, and esthetic resources would last between six months and three years. Dam removal, and hence impacts from construction noise and traffic, would be completed in 18 to 36 months. Sediment loads of suspended solids would largely wash out in the first six months, leaving the river available for anadromous fish. Although the Mount St. Helens eruption added 50 million cubic yards of debris to the South Fork Toutle River in 1980, the stream was nearly clear three years later. The first steelhead returned in three months and the river population exceeded agency goals within five years. Since silt and clay stored behind the two Elwha dams are only a small portion of that deposited in the South Fork of the Toutle, fish are expected to recover well within these time frames. Revegetation of the reservoir shoreline would start immediately, and be clearly visible within three years.

In return for these impacts (and other, long-term losses described in the section "Unavoidable Adverse Impacts"), the Elwha River native anadromous fisheries would be restored to pre-dam conditions. The terrestrial and aquatic Elwha River valley ecosystem, subtidal and nearshore marine area at the river mouth, natural sediment transport regime, 715 acres of terrestrial wildlife habitat, and many cultural resources including several sites sacred to the Lower Elwha S'Klallam Tribe would be restored. In addition, a restored and uninterrupted river recreation corridor and increased long-term economic health for both the local community and tribe would result.

Although it is commonly believed that critically depressed salmon and steelhead populations in Olympic Peninsula rivers cannot be restored, this is not true. Elwha River native stock or closely related sources of all 10 runs of salmon and seagoing trout are available. Anadromous fish do experience some stress from fishing and other factors, such as warming caused by El Nino, in their marine environment; but, data from North Coastal rivers in relatively good condition show spawning fish exceed agency goals in most years (See Response to Comments; "Fisheries" section).

The destruction of the species' freshwater habitat--not overfishing--is primarily responsible for declines of specific runs. Agricultural, residential, and industrial development, as well as logging, roads, and recreational use, send sediment and pollutants into spawning rivers. Surface water withdrawals, channeling rivers for flood protection, development of estuary habitat, and drought have also added to habitat degradation for anadromous fish. Dams that totally or partially block upstream and downstream fish migration from spawning grounds, such as those on the Elwha, have had major impacts on salmon and seagoing trout populations.

When completed in 1914, the Elwha Dam immediately eliminated 93% of the historic freshwater habitat for the river's native anadromous fish species. Since the vast majority of the Elwha drainage is within Olympic National Park and protected by preservation policies, removing the dams would immediately return this habitat largely unaltered to these species. Interior estimates that more than 380,000 salmon and steelhead would occupy the river after the dams were removed and restoration complete.

These fish, which were an integral part of the Elwha River valley ecosystem, would furnish a missing link for the restoration of that ecosystem. The dead and dying salmon, as well as juveniles, would fill the river throughout the year, providing a dependable and constant source of prey and river nutrients. Insect and aquatic invertebrate production would return to pre-dam levels, providing a base for the river's aquatic food chain. More than 22 native wildlife species would benefit when their prey source was reestablished.

Pg. 109 = pg. 118&119

Irreversible and Irretrievable Commitments of Resources

This section is meant to articulate any resources which would be lost either temporarily (such as the logging of a forest which will grow back) or permanently as a result of taking action. The resources permanently lost if action were taken as proposed would be an average annual generation of 172 gigawatt hours of hydroelectric power, the project facilities, and the two reservoirs. The projects are considered historically important because they represent early hydropower developments. Inventorying and recording the dam and power plant features in the Historical American Engineering Records would mitigate this loss. Recreation and wildlife habitat associated with the reservoirs also would be permanently lost. Short-term impacts, from six months to three years, on wildlife habitat, fisheries habitat, and water quality would also ensue from the release of sediment and construction noise.

Consultation and Coordination

History of Public Involvement

The Federal Energy Regulatory Commission indicated its intent to write an environmental impact statement on whether to issue licenses for the Elwha and Glines Canyon dams by a Notice of Intent in the Federal Register on August 17, 1989. Formal scoping, or the early effort to involve agencies and the general public, was initiated in December 1989. Commission staff contacted interveners, state and federal agencies, Native American organizations, and members of the public who were potential sources of information. Two public scoping meetings held in Washington State identified issues and solicited comments. After review of public comments, the commission wrote a scoping document that identified objectives, issues, and alternatives including **Dam Retention** (described in FERC) and the **No Action** alternative, which was later eliminated as unreasonable.

The commission prepared and distributed a draft environmental impact statement to affected agencies and interested members of the public in February 1991; a Notice of

Availability was published in the Federal Register March 1, 1991. Comments on the draft environmental impact statement were reviewed and responded to in a two-volume document that normally would have been the final environmental impact statement. This "Draft Staff Report," dated March 1993, was never made available to the general public by the commission, but was used by the Department of the Interior to aid in preparation of the "Elwha Report" as mandated by Congress.

A draft of the Elwha Report was available for public review and comment from October 4 to November 8, 1993. An October 1993 open house to discuss the Elwha Report in Port Angeles was attended by approximately 200 people. Staff from the agencies responsible for preparing the report (departments of the Interior and Commerce and the Lower Elwha S'Klallam Tribe) answered questions and recorded comments of attendees. The report was completed in January 1994 and submitted to Congress in June 1994. Portions of the report were modified as a result of some comments; Appendix M of the final document contains direct responses to other comments.

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The National Park Service has prepared this final environmental impact statement to assist the secretary of the interior in deciding whether to remove the two dams. A Notice of Intent published in the Federal Register described the two environmental impact statements approach (see Introduction). The National Park Service is responsible for the coordination and writing of both statements. Four public workshops to receive comments on the draft environmental impact statement and the material Interior is adopting were held in Seattle and Port Angeles in November 1994. In addition, interested parties were invited to submit written comments during the 60-day public review and comment period.

Concurrently, scoping for the second, or Implementation, environmental impact statement began. Public scoping sessions were held in conjunction with the public meetings for the draft environmental impact statement. Public meetings and a 60-day review and comment period on the draft document would be part of the public input process for the Implementation EIS.

Both environmental impact statements prepared by the Department of the Interior depend heavily on analysis provided by the federal agencies and the Lower Elwha S'Klallam Tribe, considered cooperating agencies under the National Environmental Policy Act. Cooperating federal agencies are the U.S. Fish and Wildlife Service, U.S. Bureau of Indian Affairs, U.S. Bureau of Reclamation, and the U.S. Army Corps of Engineers. The agencies have provided extensive review and comments on this environmental impact statement, and will conduct the bulk of analyses required for the Implementation EIS.

Public review of the draft environmental impact statement/comments and responses

Comments were received orally and in written form following the release of the draft environmental impact statement in October 1994. All comments were examined and considered by the National Park Service according to the requirements of 40 CFR 1503 (the implementing regulations for the National Environmental Policy Act). Those which were "substantive," and not simple statements pro or con the proposal, were responded to in the section "Response to Comments."

Record of Public Comment

A Notice of Availability was published in the Federal Register on October 21, 1994, for the Elwha River Ecosystem Restoration Draft Environmental Impact Statement. Approximately 1000 copies of the draft were distributed (See List of Recipients) to government agencies, businesses, special interest groups, and individuals.

Four public workshops were held in Port Angeles and Seattle, Washington, in November 1994. Notices of the public meetings were sent to each recipient of the draft document, published in local newspapers, and broadcast over local radio stations. The 60-day period to accept written comments ended December 23, 1994.

Public Meetings

The purposes of the meetings were to provide opportunities for the public to (1) ask questions about the draft and submit oral and written comments on it and (2) serve as formal public scoping for the Implementation EIS. The team captain, Heidi West, a consultant to the National Park Service, was facilitator for the meetings. A brief introduction of the project history, the environmental impact statement process, content of the draft environmental impact statement, and dam removal and sediment management alternatives for the Implementation EIS were presented. Six groups (general/land use, fisheries, sediment management/dam removal, water quality/flooding, wildlife/ threatened and endangered species, socioeconomics/recreation) were arranged in the meeting room with experts available to answer the public's questions. Facilitators in each group summarized and recorded issues, questions, and comments. Responses to substantive public comments received during the public meetings, organized by subject matter, are included in the question and answer section of this document. Locations of the public workshops and numbers of people in attendance are as follows:

Port Angeles, Washington, November 14, 1994, 1:30 pm - 180 people
Port Angeles, Washington, November 14, 1994, 5:30 pm - 109 people
Seattle, Washington, agency public meeting, November 15, 1994, 1:30 pm - 4 people
Seattle, Washington, November 15, 1994, 5:30 pm - 91 people

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Written Comments

During the comment period, 615 letters were received from governing bodies, government agencies, businesses, special interest groups, and individuals. Of these, 121 contained substantive issues that required clarification of information in the draft environmental impact statement, modification of the text, or direct responses. Since many substantive comments were similar in content, they are addressed by subject matter in a question and answer section. All of the comment letters received by the end of the response period are reprinted in this document.

"Implementation Environmental Impact Statement" Scoping Issues

Oral comments on scoping issues for the Implementation EIS were recorded at the public meetings in Port Angeles and Seattle in November 1994 and were received in writing during the public comment period. A summary of major scoping issues, organized by subject matter, follows. These substantive issues would be fully analyzed in the Implementation EIS as appropriate.

Socioeconomics. Commentors requested further study and refinement of project costs, including assessing the costs to remove the dams, manage the sediment, and restore the ecosystem. The majority of respondents requested that these studies pursue all possible cost-saving opportunities in restoring the Elwha River and its ecosystem.

Thorough economic analyses of the impacts of dam removal on tourism, recreation, and jobs were requested. The public also recommended that the socioeconomic analyses include the value of enhanced fish runs and shellfish harvest, cost savings in maintenance of Ediz Hook, economic and recreational values to the Lower Elwha S'Klallam Tribe, and regional recreational values if the dams are removed. Much of this information is now part of the final version of the first environmental impact statement (i.e. this document).

Commentors proposed that a funding consortium be formed if the dams are not removed. This group would include all parties that could be negatively impacted--city, county, state, and federal governments, Daishowa America, James River Corporation, Bonneville Power Administration, environmental and sport fishing groups, and the Tribes. The group could help pay litigation costs and other expenses required to mitigate for the presence of the dams.

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Dam removal. Dam removal issues centered around finding the least expensive way to remove the dams. Suggestions ranged from leaving the dams in place, removing only parts of the dams, phasing removal of the dams, to dynamiting both dams at one time. Several meeting participants proposed that the environmental impact statement team study the costs and engineering solutions from other dam removal projects. An investigation of separating dam removal costs from other expenses, such as sediment management and stabilization of sediments, was also recommended.

Many participants requested further evaluation of waste disposal sites for dam refuse. Marine disposal of waste materials (except for possible offshore reefs) was discouraged by one commentor.

Sediment management. Concerns were raised about the impacts of river erosion on fisheries, wildlife, and downstream flooding. Thorough studies and mitigation strategies were requested for these issues.

Respondents requested further detailed analyses of the short- and long-term impacts on marine organisms of the delta building process and outfall site scenarios. Particular concerns were the short-term impacts of suspended silt and clay sized fractions on the productivity of the marine communities. Participants advised investigating land disposal of the fines instead of slurrying the sediments and suggested selling or using dredged fines as a soil amendment.

Water quality and quantity. Members of the public want water quality mitigation measures to ensure continued protection for all users including Daishowa America, Dry Creek Water Association, and the City of Port Angeles. The environmental impact statement team was asked to consider the total and continuing costs to protect and maintain water quality for surface and groundwater users. The team was also asked to conduct studies of groundwater supplies and provide mitigation for users who would be adversely affected if the dams were removed. Investigating alternative groundwater sources was also requested. They asked that the risk of failure to protect water quality associated with each mitigation measure be determined and be based on actual field data, assessing conditions during and after dam removal.

Studies of alternative water sources and possible water conservation measures were requested. One respondent suggested that the mill could recycle their water. Others suggested investigating use of Morse Creek water, if necessary.

The Environmental Protection Agency stated that implementation of the project must comply with state water quality standards and requested baseline water quality data and quantitative analysis to demonstrate that each alternative will comply with existing state standards. The agency noted that Best Management Practices should be employed to protect water quality, monitored for their effectiveness and modified if necessary

Fisheries. Further study of alternatives to dam removal, such as installation of state-of-the-art fish passage measures, was recommended. Many respondents also suggested studying other dams that have successful fish passage facilities and rivers in the area that have undergone restoration efforts.

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Several technical suggestions were made to enhance fisheries restoration. These included providing aquatic life egg boxes in nearby rivers, opening the slough at the mouth of the Elwha, and moving large rocks to provide spawning areas for the returning salmon. Further studies were suggested to assess escapement, rehabilitation of the estuary at the mouth of the river, and future plans for the hatcheries.

To allow natural restoration of the ecosystem, it was suggested that outplanting not be done, that only the native stocks of salmon be reintroduced in the river. Studies were suggested to determine how long fish would need to be protected and fishing restricted to ensure complete restoration of the ecosystem.

Ecosystem. In order to ensure complete restoration of the ecosystem, a three-phase process was advised: removal of dams, disposition and/or management of project lands, and a comprehensive ecosystem management planning process that would initially involve all interested parties. Collecting baseline data, analyses of external influences on the restoration, and a monitoring program for 20 or more years following dam removal were also recommended.

Wetlands and vegetation. The public requested quantification of impacts to wetlands and riparian vegetation in the Implementation EIS, with delineation of the wetlands, determination of their aquatic resource functions, and a compensatory mitigation plan developed. The plan should consider direct, indirect, and cumulative impacts and incorporate Best Management Practices to minimize impacts to existing wetlands and riparian vegetation. Also, different ways to revegetate the area to return it most quickly to its natural appearance should be examined.

Living marine resources. Many participants suggested using dam rubble to build an artificial reef in the Strait of Juan de Fuca. Others requested further analyses of the impacts on marine organisms from discharging slurried sediments into the Strait or other marine waters.

Wildlife. Participants requested further investigation of the effects of dam removal on wildlife, including species of special concern.

Flooding. Many questions were received about the need for the levees along the lower river and their impacts on the ecosystem. Some respondents think the levees are inconsistent with the primary goal of ecosystem restoration and suggested mitigating rather than improving them. Others stated that the levees should be removed altogether.

Ensuring the safety of those living in the floodplain of the Elwha was a concern. Some stated that, without the dams, there would be no flood protection. Further studies of the flooding problem and possible solutions were suggested. Some landowners requested that mitigation include stabilization of the riverbanks adjacent to private land. Constructing setback dikes to accommodate channel migration was also suggested.

The Washington Department of Natural Resources stated their rights to the original bed and shores of the Elwha River up to river mile 14. A legal agreement to dredge sediments in the deltas may be required. Additionally, the state may assert ownership of the sediments and request their assay for valuable minerals.

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Land use. Participants and respondents stated that they prefer the lands to remain in a natural or semi-natural state to preserve the biological integrity of the entire river corridor and compensate for wildlife losses during the last 80 years. They also suggested restricting economic, mixed, and residential uses to already disturbed areas. Others stated that the lands should be managed to comply with the Wild and Scenic Rivers Act, and recommended recording this on future easements. Many want information made available on the disposition of the project lands and an opportunity to comment on this information.

Access issues were raised at the public meetings and in the comment letters. Citizens want public fishing and recreational access, with boat ramps from the head of Lake Mills to the mouth of the river, and foot trails and interpretive facilities along the river corridor and beach. The Washington Department of Natural Resources also wants access for fishing, recreation, navigation, and commerce. The department may be interested in acquiring/managing Lake Aldwell lands for these purposes, with possible cooperative management with the tribe.

Power. Many participants were concerned that, with dam removal, there would be increased power costs and no emergency power for Port Angeles. Rather than installing a third Bonneville transmission line, replacing lost power through conservation or utilizing local sources was preferred by many participants.

Transportation. It was suggested that further studies are needed to assess impacts to roads from heavy equipment and the transport of sediment and dam debris from the sites. Costs to strengthen the access roads before dam removal and rebuilding them after dam removal need to be determined.

No substantive written or oral suggestions were received for additions to analyses proposed for the Implementation EIS on any other resource (including cultural, recreation, etc.).

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Carol Kahler – Freelance Artist, drawings on pages 75, 86,88

List of Recipients

List of Agencies and Organizations Who Received Copies of the Final Environmental Impact Statement

Federal Department, Agencies, Committees and Laboratories
Department of the Interior
Environmental Protection Agency
Federal Emergency Management Agency
Federal Energy Regulatory Commission
General Accounting Office
House Fisheries and Wildlife Committee
House Natural Resource Staff
Idaho National Engineering Laboratory
National Biological Service
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
National Park Service - Olympic National Park
Natural Resources Conservation Service
President's Council on Sustainable Development

Senate Energy & Natural Resources Committee
U.S. Army Corps of Engineers
U.S. Bureau of Indian Affairs
U.S. Bureau of Land Management
U.S. Bureau of Mines
U.S. Bureau of Reclamation
U.S. Coast Guard
U.S. Fish and Wildlife Service
U.S. Forest Service - Olympic National Forest
U.S. Geological Survey

Tribal Governments and Organizations
Columbia River Intertribal Fisheries Commission
Confederate Tribe of the Umatilla Reservation
Covelo Indian Community - Round Valley Reservation
Jamestown S'Klallam Tribe
Lower Elwha S'Klallam Tribe
Lower Elwha Fisheries
Makah Indian Tribe
Northwest Indian Fisheries Commission
Port Gamble S'Klallam Tribe
Puyallup Indian Tribe
Puyallup Fisheries Department
Quileute Indian Tribe
Skokomish Indian Tribe
Shoshoni Bannock Tribe
Shoshoni Bannock Fisheries Department
Point No Point Treaty Council
Yakama Nation

States Agencies and Organizations

State of California
Department of Fish and Game

State of Maine
Department of Natural Resources

State of Michigan
Department of Natural Resources Fisheries Division

State of Montana
Environmental Quality Control

State of New York
Power Authority

State of Oregon
Department of Fish and Wildlife

State of Washington
Department of Community Development
Department of Ecology
Department of Fish and Wildlife
Department of Health
Department of Natural Resources

Department of Trade and Economics
Department of Transportation
Governor's Office
Historic Preservation Office
Parks and Recreation Commission
State Energy Office

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State of Wisconsin
Department of Natural Resources

Congress People
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Honorable Jennifer Dunn
Honorable Diane Feinstein
Honorable Slade Gorton
Honorable Richard Hastings
Honorable Jim McDermott
Honorable Jack Metcalf
Honorable Patty Murray
Honorable George Nethercult
Honorable Linda Smith
Honorable Randy Tate
Honorable Rick White

County and Local Governments

City of Forks
City Council's Office
City Planner/Attorney

City of Port Angeles
City Council's Office
City Manager
City Attorney's Office
Planning Department
Utilities Department
City Light

City of Sequim
City Council's Office
Planning Department

Clallam County
Commissioner's Office
County Administrator
County Attorney's Office
Department of Community Development
Department of Roads and Public Works
Clallam County Public Utility District #1
 Commissioner's Office
 General Manager
Port of Port Angeles
 Commissioner's Office
 Executive Director

Organizations and Business
Adele McCall
Agriculture
American Rivers
American Whitewater Affiliation
Appalachian Mountain Club
Aquaculture Research Institute
Battelle Northwest
Beak Consultants
Bonneville Power Administration
Buchanan Ingersoll
Carolina Denver and Light Company
Century 21 Harbor Lights
Chinook Northwest Inc.
Clallam County - Sekiu Chamber of Commerce
Clallam County Grange
Clallam County Historical Society
Clallam County Public Utility District #1
Columbia Basin Fish & Wildlife Authority
Common Sense Resource League
Crescent West Inc.
Cutter and Stanfield
Daishowa America Inc.
Decision Data
Dorsey & Whitney
Dry Creek Grange #646
Dry Creek Water Association
Enserch Environmental Corp.
Evergreen Legal Services

First Federal Savings and Loan
Fish Pro
Fisheries Dept.-Shoshoni-Bannock Tribe
Fletcher Far Ayotte
Forks Chamber of Commerce
Forks High School
Foster Wheeler Environmental
Friends of the Cowlitz
Friends of the Earth
Friends of the Eel
Friends of the Elwha
Gehrke's Gink
Glen Canyon Environmental Studies
Greater Ecosystem Alliance
Green Crow Partnership
Harza Engineering
HDR Engineering, Inc.
Hood Canal Environmental
Hung West & Associates, Inc.
Hydro-Triad Limited
Indian Creek Campground
Infotec Research Inc.
International Rivers Network
James River Corporation
Jones & Jones
Klahane Club
Lane & Lane Associates
Lighthawk
Log Cabin Resort
McGavrick Graves Attorney at Law
Mendocino Environmental Center
Meyer Resources, Inc.
NW Conservation Act Coalition
National Outdoor Leadership School
National Park Foundation
National Parks & Conservation Association
National Wildlife Federation
North Olympic Land Trust
North Olympic Salmon Coalition
North Peninsula Home Builders Association
Northrop, Devine and Tarbell
Northwest Chapter - Wilderness Watch
Northwest Economic Association
Northwest Hydraulic Consultants
Northwest Power Planning Council
Northwest Rivers Council

Okanogan Resource Council
Olympic National Resources Center
Olympic Rivers Council
Olympic Outdoor Sportsmen's Association
Olympic Park Associates
Olympic Park Institute
Olympic Peninsula Audubon
Olympic Raft & Guide Service
Outside Connection
PacifiCorp
Pacific Power and Light Company
Pacific Rivers Council
Parametrix
Perkins Coie
Port Angeles Chamber of Commerce
Port Angeles-Victoria Visitor Bureau
Port Townsend Chamber of Commerce
Preston, Gates, Ellis & Raivela Meeds
Preston, Gates and Ellis
Puget Sound Power and Light Company
Radin and Associates Inc.
Rainier Evergreen Inc.
Rayonier Inc.
Recreational Equipment Inc.
Redwoods Science Lab
Rescue Elwha Area Lakes
Riddell, Williams, Bullitt & Walkinshaw
Ridolfi Engineering & Associates
Rio Grande Restoration Project
Rivers Council of Washington
Rivers Network
Robbin B. Sotir & Associates
SCS Engineers
Seattle Audubon Society
Sequim Chamber of Commerce
Seattle Water Department
Sierra Club
Sierra Club Legal Defense Fund
Simpson, Thacher & Bartlett
Smith, Brucker, Winn & Elhert
Sol Duc Hot Springs Resort
St. John's River Water Management District
Stone and Webster
Summit Technology
TQ NEPA
Tacoma Public Utilities

Tetra Tech
The Mountaineers
The Rockey Company
The Wilderness Society
Trout Unlimited
Trumpeter Swan Society
Twanoh Group Sierra Club
U.S. Savings Bank of Washington
Van Ness Feldman
Washington Appellate Defenders
Washington Environmental Council
Washington State Grange
Washington State Sportsman's Council
Washington Wilderness Coalition
Roy F. Weston, Inc.
Wilkinson Barker
Winthrop, Stimson, Putman and Roberts
Wise Use Movement
Woodward Clyde
Wrong Mountain Wildlife Preserve

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Libraries

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Renton Public Library
Seattle Public Library
Tacoma Public Library
University of Washington
Washington State Department of Fish & Wildlife
William G. Reed Branch Library

Academic Institutions
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Northwestern University
Peninsula College
Pitzer College
The Evergreen State College
University of California
University of Colorado
University of Montana
University of Washington
University of Wyoming
Western Washington University
Williams College

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Out West Newspaper
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Peninsula Gateway News
Port Townsend Leader
San Francisco Chronicle
Seattle Post Intelligencer
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U.S. Weekend Magazine

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Radio/TV Stations
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KBWK Radio
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KMPS Radio
KOMO Radio and TV
KONP
KPLU
KQEU
KRKO
KSTW TV
KUOW
KVAC /KLLM
KVOS TV
KXRO/KDUX
National Public Radio
Northland Cable News

Responses to Substantive Comments on the Draft Environmental Impact Statement

Purpose and Methodology

The final environmental impact statement is to be an accurate analysis of impacts of the proposed action and its alternatives. Public and agency review of the draft statement helps to ensure quality.

The Department of the Interior received more than 600 comment letters on its Elwha River Ecosystem Restoration programmatic draft environmental impact statement, in addition to many questions and comments delivered orally at four public workshops held in November 1994. The National Park Service and cooperating agencies reviewed and responded to all comments that were not simple statements for or against the proposal, i.e., those requiring additional explanation or analysis of data and those that debated facts or conclusions reached in the draft environmental impact statement. These are called "substantive" comments.

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Many comments were received about the scope of a proposed second environmental impact statement on the Elwha Restoration project, referred to as the Implementation EIS. The Department of the Interior was asked to include information on site-specific impacts from dam removal and was questioned how these impacts would be analyzed or mitigated. A summary of these comments is in the "Consultation and Coordination" section of this document. Since there is some overlap of these concerns with those relevant to the decision to remove the dams, responses are provided in this, the programmatic environmental impact statement, wherever possible.

Substantive comments were either answered in this question and answer section, through changes in the text of the environmental impact statement, or in both places. Since many comments were duplicative, the substantive comments were summarized by resource concern ("Flooding," for example), then further defined by the issues and topics as they were presented in letters and at the workshops. This allows the reader interested in a particular topic to review the substance of the issue and the environmental impact statement team's responses.

A commentor will be able to find the response to a particular question by consulting the topic in the question and answer section. In some cases, summaries of agency responses have been integrated in the text, so that anyone reading this document will have a complete picture of the overall proposal, its alternatives, and their impacts.

Organization of Comments and Responses

The "Index of Commentors, by Topic" presents the major topic or resource of concern followed by a listing of each author and the corresponding number of the comment letter on that particular topic or resource. Comment letters containing substantive issues in more than one category are included in each category. Responses to comments are organized alphabetically by resource topic, i.e. "Alternatives, Cultural Resources," etc.

This is followed by the "Table of Contents for Responses to Comments Section." Interior's responses to substantive comments are organized by impact topics.

In the "Comment Letters" chapter, the "Index by Author" precedes the reprinted letters and lists commentors by category or type of group: Public Agencies; Interest Groups; Business and Industry; and Private Individuals. The authors in each category are then presented alphabetically, with an assigned number. (These numbers correspond to the number on the upper-right-hand corner of the correspondence. The numbers are in order of time received by the National Park Service; some numbers may be out of numeric order since they were subsequently re-ordered by commentor category.) The author's name is then followed by a code word or topic pertaining to the major topic of the question or resource concern, i.e., "Fisheries," presented to the environmental impact statement team. The reader can find the response to her or his comment by referring to the "Fisheries" section of the question and answer section.

In addition to written comments, Interior also received many verbal substantive remarks at each of the four public workshops held in November, 1994 (See Consultation and Coordination section). Some of the speakers also sent in written responses, and are part of the written record and indexing system described above. Some only responded at the workshop; hence, their comments are not indexed, but are responded to if considered substantive.

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Responses to Comments

Alternatives in the Draft EIS

Issue: Additional alternatives to be considered in the draft EIS and/or the Implementation EIS to address public concerns

1. Use state-of-the-art fish passage measures
2. Alternatives to control sediment and flooding
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River

See Comment Letters: Fouts, Stanley - C326; Johnson, Lee - C327; Olympic Park Associates – C612; Powne, Bob - C540; Pulkownik, Susan - C334

Issue: Additional alternatives to be considered in the draft EIS and/or the Implementation EIS to address public concerns

1. Use state-of-the-art fish passage measures; strive to balance fish and power.

Q: Many commentors would like a state-of-the-art fish passage scenario developed as is being tried on the Baker Dam. They argue that the Federal Energy Regulatory Commission plan is 20 years old and suggest exploring "fish-friendly turbines," collection and bypass systems for juveniles, and outplanting fish before removing the dams to see if the habitat would support them.

A: The fish passage facilities (including fish collection and bypass systems) and measures the commission included in the Draft Staff Report are not "20-year-old designs;" they are state-of the-art.

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In the mid-1980s, when the licensing process became more active, the dam owners' fish passage consultants (Hosey & Associates, now Harza Northwest) worked with the fish and wildlife agencies' fish passage experts and the Lower Elwha S'Klallam Tribe (who hired their own fish passage engineers) to design state-of-the-art passage facilities for both dams, including the testing of an Eicher screen, an experimental juvenile fish passage technology. Since that time, there have been no major advances in fish passage technology that would significantly benefit the Elwha projects. The Baker Lake fish collection system cited by the commentor was designed in 1959 (Warner, 1961).

We are unaware of specific "fish friendly" turbines, although some turbines (such as propeller types with adjustable blades) result in fewer fish mortalities than others. The Walla Walla District of the Army Corps of Engineers has initiated a multi-year study exploring ways to reduce turbine fish mortalities (on the mid-Columbia projects in particular). The mid-Columbia public utility districts of Grant and Chelan are also investigating ways to reduce turbine mortalities. Regardless, improvements in turbine design would not overcome problems associated with high head dams, such as Glines Canyon, where fish are under extreme pressure as they pass through the penstock. Nor would new turbines eliminate the fish passage problems of increased predation, migration periods, and residualism in the reservoirs.

Outplanting has already been tested on the Elwha River. A relatively early study, 1971, by the Washington Department of Fish and Wildlife revised by James River Corporation in 1988, documented the amount of habitat available in the Elwha and the amount of habitat affected by the dams. As part of the licensing process, the U.S. Fish and Wildlife Service conducted a number of studies of fish passage and survival that involved outplants of coho and chinook salmon and steelhead. These studies found that the fry-to-smolt survival rates of coho salmon (Wunderlich, et al. 1989) and steelhead (Wunderlich and Dilley 1986) were high compared with rates in other streams in the region. Juvenile chinook salmon survival was similar to other streams (Dilley and Wunderlich 1990). The Fish and Wildlife Service is currently assessing Lake Sutherland to update estimates of sockeye salmon production. Collectively, these studies demonstrate the high productive potential of the Elwha River for anadromous fish.

Q: Commentors asked that ways be found to "balance power and fish," i.e., increasing efficiency of the power plants, installing slower moving turbines with slower moving water that might not result in such high fish losses.

A: When trying to balance competing uses, there must be tradeoffs. The Elwha Report illustrated why retention of the dams is incompatible with restoration goals for the Elwha River ecosystem and native anadromous fisheries. Any provision for retention of hydropower production at either or both dams would mean that the ecosystem would not be restored and only a portion of the native anadromous fisheries could be produced (Elwha Report, Table 1, page 35).

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The efficiency of the power plants could be very slightly increased, but this would have no benefit for the fisheries, and so would not help "balance" fish and power needs. In order to generate power from water, the water must fall from a higher level to a lower level. The amount of the fall is referred to as "head." The higher the head (the greater the distance of the fall), the more power can be generated. The purpose of the Elwha dams is to create this head. However, a viable fishery requires that the spawning fish be able to move upstream past the dam and the juvenile fish be able to move downstream past the dam.

2. Alternatives to control sediment and flooding

Q: Use controlled erosion to transport sediments downstream, i.e., open them for a period, then close and let the water run clear. Create a small hole in the dam to let sediment and water out. V-slash/planks in front could provide flood management benefits as well.

A: Releasing the sediments in short bursts would have impacts on fisheries and water quality which are different from releases over a long period of time. Suspended sediment levels are increased during short bursts, but water quality is allowed to partially recover. Prolonged releases reduce the maximum suspended sediment levels, but do not allow periods of water quality recovery. These issues would be more fully analyzed in the Implementation EIS.

Excavating one or more holes through Glines Canyon Dam for releasing the reservoir water and sediment has been considered. The costs and safety concerns are greater than one might initially think. A number of factors would have to be overcome to accomplish this. For example, in order to control the excavation of holes through the dam without damaging the remaining structure, sophisticated construction practices would be needed. In addition, much underwater work and the placement of bulkheads or cofferdams would be required to excavate the last section of concrete for each hole on the upstream face. Installation of a gate to control the discharges would be required. An underwater survey and an underwater video were used to determine the conditions along the upstream face of the Glines Canyon Dam. This information indicates that there may be up to 50 feet of sediment that includes a large quantity of woody debris at the dam. The excavation of one or several holes through the dam would require reinforcing the arch dam section either during or following the drawdown process to ensure the safety of the structure during construction and for the long term. Therefore, while the concept of excavating one or more holes through the dam is technically feasible, the costs and difficulties of this method are not competitive with other methods being investigated. Elwha Dam has much more material, called "fill" in this statement, behind it.

With regard to flood management benefits, the reservoirs are currently operated by passing the inflows. This means there are little, if any, flood control benefits now. Without the dams in place, there would probably not be noticeable effects in the volume of discharges downstream. By modifying the dam to accommodate an opening at the base of the structure, flood peaks may be reduced, but not without increased costs to the entire project.

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3. Alternatives for revegetation

Q: Use vegetation for stabilizing sediment instead of mechanically removing and/or moving material around to create open meadows

A: If all sediment were left in place and reseeded, the natural meander of the river would eventually erode much of it. This might mean the release of large, unnatural, "doses" of sediment into the river over many years--a potential problem for fish, aquatic life, and perhaps for water users as well. The Implementation EIS will address this problem by examining plans that move sediment out of the immediate floodplain. Revegetation of remaining sediment with native early successional species is likely, and will be further investigated.

4. Alternatives to restore gravel while keeping dams in place

Q: Transport stored gravel around the Glines Canyon Dam, but leave both dams in place in combination with fish passage measures.

A: The Federal Energy Regulatory Commission and the Elwha Report examined this suggestion as a mitigation measure should both dams be kept in place. The commission estimated that replacing the amount of bedload carried annually by the Elwha River would be between $500,000 and $700,000 per year with gravel supplied from a local gravel pit (FERC, page F-718). Using gravel from the river and deltas above the dams would be more expensive and add impacts in the building of access roads and intakes. Transporting gravel would also not result in the full restoration of the ecosystem or fisheries. For these reasons, Interior considers this alternative unreasonable.

5. Remove one dam first, study results, then remove the other.

Q: Commentors suggested removing the Elwha Dam first and sluicing or dredging the sediment out. Use the knowledge gained by doing this to then remove the Glines Canyon Dam.

A: The option of timing removal of one dam to control sediment releases and then remove the other is under consideration for the Implementation EIS.

6. Alternatives for funding the project

Q: Commentors suggested several different funding scenarios for the project, including: James River Corporation would set aside money each year for restoration and experiment with fish passage measures at the dams until the money was accumulated to remove the dams; James River be offered fair market value for the dam, reservoir, and the corridor below the dam "the Park wants so badly;" or that dam owners contribute by donating the dams and associated lands they own--the Glines to the park service and the Elwha to the state of Washington.

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A: With the exception of offering the dam owners a set price for the hydropower project lands, which is the scenario spelled out in the Elwha Act, the Department of the Interior does not consider these reasonable alternatives. The Elwha Restoration Act requires public acquisition of the dams and associated lands for a set price of $29.5 million.

Fish passage technology has been refined for decades; additional experiments are not needed to further demonstrate that fish passage will not restore the ecosystem.

The park has not indicated that it wants Aldwell project lands. These lands qualify for national park status should Congress decide to add them. If the dams were removed, the Glines lands would be managed in accordance with national park authorities and policies as stipulated by the Elwha Restoration Act. This management would ensure the return of the river to its natural conditions. Removing the dams would increase biodiversity and use of the area as a recreational resource and create wetlands in addition to those created by the reservoir.

7. Alternatives to dam removal

Q: Several alternatives to dam removal involving the Elwha S'Klallam Tribe were suggested:
- Tribal ownership and operation of the dams--sell electricity to Port Angeles
- Ownership by a public utility district, with tribe operating the dams
- Tribe should consider developing land near Highway 101 for commercial uses (casino was suggested) rather than depend on fish restoration

A: These alternatives are outside the scope of the Elwha Restoration Act. The Tribe's choices about its economic development strategies rest with the Tribe, not with the Department of the Interior or this environmental impact statement.

8. Cogeneration of electricity at the mills to reduce the cost of replacement power

Q: Commentors suggested using co-generation at the mills to reduce the cost of replacement power.

A: Cogeneration is the production of useful electrical energy as a byproduct of another type of energy production, such as steam or hot air. Cogeneration using wood waste is a potential resource option for the Daishowa mill. However, because of the size of the wood-waste fuel boiler and the availability of wood-waste fuel, cogeneration potential would be limited to approximately 15 megawatts. Potential cogeneration energy approximates the power that is supplied to the mill by the dams at any given time. But, based on an electrical efficiency review conducted at the mill in 1991 by CRS Sirrine Engineers, Inc., several factors, such as retrofitting or reconstructing the boiler, weigh against cogeneration as an economical option at this time (FERC, A141).

9. Use the reservoirs to propagate the fish instead of the river

Q: Commentors suggested the use of stocking to increase numbers of anadromous fish in the Elwha River instead of removing the dams.

A: Stocking of Lake Mills (and Lake Sutherland) has been done. The U.S. Fish and Wildlife Service planted approximately 50,000 rainbow trout per year into Lake Mills until the mid-1970s. These plants resulted in put-and-take fisheries of short duration but few of the fish appeared to grow and survive past the first year. Peninsula College students conducted an assessment of the reservoir's trout population in 1975 and found that the fish "were in extremely poor condition." They also found that the gills of the trout were heavily infected with a parasite. The poor condition of these fish is probably attributable to or aggravated by the low productivity of the reservoir and high summer water temperatures. Additionally, current policies of the National Park Service do not support fish stocking, but favor natural production.

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The same problems encountered by resident trout--high summer temperatures and cold winter temperatures, turbid water, low aquatic productivity and limited shallow water habitat--would prevent anadromous fish from doing well.

10. Examine raising user fees to help offset the cost of the project

Q: Could Olympic National Park offset the cost of restoration through dam removal by raising user fees?

A: Federal regulations govern the collection and expenditure of user fees. User fees collected by the National Park Service contribute to the federal government's general fund and could not be applied to specific National Park Service projects, including Elwha River restoration without specific federal legislation.

11. Reconsider replacing the dams if removal has not accomplished the degree of restoration expected

Q: Would Interior replace or rebuild the dams if the degree of restoration expected is not achieved?

A: Removing the dams and returning the river to a natural condition along most of its length would restore access to more than 70 miles of high quality mainstem habitat and tributaries to anadromous salmonids. Stocks of Elwha native or closely related anadromous fish are available for all runs. If the excellent spawning and rearing habitat of the Elwha River is restored, the fish will return.

Rebuilding the dams after taking them down would be expensive, and would again keep the salmon and trout from entering the river, thereby violating trust responsibilities to the S'Klallam and Makah tribes and preventing the return of a naturally functioning ecosystem, i.e., all of the cost and none of the benefit. The Department of the Interior, therefore, considers this alternative unreasonable.

12. Restoration of other rivers by the Department of the Interior instead of the Elwha River

Q: Commentors asked why the Department of the Interior was focusing on the Elwha River for restoring native anadromous fisheries instead of other river systems in the area (See responses under the "Fisheries" section for additional information related to this comment).

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A: Although the sometimes high profile of the Elwha restoration proposal suggests Interior is focusing on this project, this is not the case. Interior agencies are involved in community and regional efforts to restore anadromous fish in other rivers on the Olympic Peninsula, including the Dungeness, Quileute, Hoh, Queets, and Skokomish. These efforts include studies to assess fish populations, outplanting to reseed underutilized areas, habitat improvements, and fishery management. A major commitment also has been made by Interior agencies to work with the U.S. Forest Service, state of Washington resource agencies, tribes, and local citizens in watershed analyses required under the President's Northwest Forest Plan. These comprehensive assessments are in the Quilcene, Dungeness, Soleduck, and Queets watersheds.

Interior and other federal agencies also participate in local watershed planning activities conducted by local governments for the purpose of improving both water quantity and water quality as well as stream, riparian and wetland habitat. This involvement is for the purpose of restoring fisheries and natural processes to the extent possible in each watershed.

Cultural Resources

Issues:

- Cultural importance of dams to local history
- Effects of dam removal on historic structures and cultural resources
- Impacts on the Lower Elwha S'Klallam Tribe's sacred sites from dam removal
- Cumulative impacts on the Lower Elwha S'Klallam Tribe

See Comment Letters: Booth, Beatrice and Bill - C219; Clark, Robert J. - C599; Julian, Tony -C478; Olympic Park Associates - C612; Sargent, Joan K. - C450

Issue: Cultural importance of dams to local history

Q: Commentors requested additional information on the cultural linkages among the river, dams, and local community.

A: For some members of the Port Angeles community, the dams are part of their family history because family members worked on the construction or lived in the valley during construction. The dams on the National Register of Historic Places are a source of local pride to some residents.

The Elwha River Hydroelectric Plant, completed in 1914, and the Glines Canyon Plant, completed in 1927, furnished power to the Port Angeles area for domestic, commercial, and industrial use. Much of this power supported the paper and pulp industries in Port Angeles. In addition, area residents may have enjoyed recreational activities such as boat excursions operated by the Waumila Lodge on Lake Mills. None of the buildings remains from the lodge, which operated from the 1930s to the 1960s. Studies needed to complete the Implementation EIS may uncover additional links between Port Angeles and the Elwha River's dam and power plant complexes.

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Although Euro-Americans were drawn to the Elwha valley, in large part, because of the resources the river provided, the Lower Elwha S'Klallam Tribe has occupied the valley since prehistoric times. The tribe's relationship with the river has had longer to develop; for example, place names in the S'Klallam language exist for sites along the river from its mouth upstream into the Olympic Mountains. Among these are several sacred sites including the Creation site where the first ancestors of the present day S'Klallam people are said to have originated. S'Klallam villages were located adjacent to important fishing stations at Ediz Hook, the mouth of the Elwha River, and at the confluence of Indian Creek and the Elwha River in the upper Elwha valley. Seasonal camps for fishing and other subsistence activities were located along the river and its tributaries, and along the shores of Freshwater Bay and Ediz Hook.

In 1854-55, the United States entered into land cession treaties with native tribes and bands in Washington territory. The Lower Elwha S'Klallam were party to the Treaty of Point No Point signed on January 26, 1855. Under the terms of the treaty, the S'Klallam retained fishing rights at their usual and accustomed fishing places. These rights were upheld in federal court in 1974. (U.S. v. Washington, 384 F Supp. 312 (1974) at p.355-357 and 401).

Where the hydroelectric projects may have helped Euro-American residents by providing power for industries, jobs, and recreation, they had a substantial negative impact on the tribal fisheries.

The Elwha Dam eliminated access to over 90% of the freshwater habitat Elwha River salmon and trout need to complete their life cycle (see fisheries section of this EIS), and fisheries numbers fell dramatically as a result. The Lower Elwha S'Klallam tribal culture and its economy both suffered when the projects were completed and continue to suffer today, at least in part because of the lost fisheries resources of the Elwha River.

While the tribe maintains a salmon hatchery on the Elwha River, the catch is a fraction of the total produced by the river before the dams. Approximately half of the registered tribal fishermen now have gross fishing incomes of less than $1,000 per year. Approximately 90% gross less than $15,000 per year.

Alternative employment is not readily available to tribal members, and tribal unemployment and poverty rates far outstrip those of Clallam County and Washington state residents generally. This lack of economic well-being has been linked to overwhelming stress and poor health (Bachtold, L.M., and Washington, State Department of Health, 1992), including high rates or mortality, infectious disease. and chronic health problems.

Despite the damage done by the projects, an undiminished "spiritual" linkage maintained for generations by members of the Lower Elwha S'Klallam tribe, continues. It was perhaps best expressed by a former tribal chairperson, Carla Elofson, when she spoke before the Senate Committee on Energy and Natural Resource, June, 1992: "Our Creator gave us the fish to live on...and we cherished it, and we respected it. We didn't waste it, we used every bit of it. I may not see the abundance of fish come back in my lifetime, but I would like to see it come back for my grandchildren, my great-grandchildren, and the rest of my people, the following generations to come. It was a gift from our Creator; it was our culture and heritage."

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Issue: Effects of dam removal on historic structures and cultural resources

Q: Some commentors noted that the dams and associated structures are historically significant and would be destroyed or damaged if the dams are removed, which would be a permanent loss of these resources.

A: The Historic American Building Survey/Historic American Engineering Record is a national program that documents the nation's historic architectural and engineering resources. The Elwha River Power Plant and the Glines Canyon Hydroelectric Plant are listed in the National Register of Historic Places; therefore, the National Park Service would prepare the highest level of documentation for both dam complexes. This would include written histories; large-format photographs; ink-on-mylar measured architectural, engineering, and industrial process drawings; and copies of historic drawings and photographs.

Q: Commentors asked whether historic resources other than the dams would be affected by dam removal and how those effects would be mitigated.

A: Section 106 of the National Historic Preservation Act requires that the head of any federal agency "take into account the effect of the undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register." The National Park Service and Lower Elwha S'Klallam Tribe have begun an ambitious multi-year program to identify and evaluate under national register standards the ethnographic, archeological, and historical resources in the area that could be affected by dam removal and subsequent sediment flows. Information on whether and the degree to which these resources might be affected will be part of the Implementation EIS.

In response to Section 106 requirements, the National Park Service and Lower Elwha S'Klallam Tribe have consulted with the Washington State Historic Preservation Officer and Advisory Council on Historic Preservation and have developed a programmatic agreement that will stipulate appropriate measures to mitigate the loss of historic properties. Examples of mitigation include documentation and interpretation.

Issue: Impact on the Lower Elwha S'Klallam Tribe's sacred sites from dam removal

Q: Commentors asked what the impact from dam removal would be on the tribe's creation site, burial site, and other resources important to the tribe.

A: As stated in the final EIS, the spot where the Creator formed the Elwha people is presently inundated by Lake Aldwell (see EIS, impacts to cultural resources, and Elwha Report, p.205). Alternatives that drain Lake Aldwell and remove accumulated sediments (Proposed Action and Remove Elwha Dam) would restore access to this site. All other alternatives would continue to deny the tribe access to its creation site.

The reservoirs behind the dams inundated at least one S'Klallam settlement site, seasonal camps, and possibly burial grounds as well as habitat for many resources including fish, game, and plants used for food, medicine, and raw materials.

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Issue: Cumulative impacts on the Lower Elwha S'Klallam Tribe

Q: What other actions have negatively affected the tribe as the dams have done.

A: The tribe has suffered many additional impacts to its culture and economy. These forces, described in the socioeconomics and cultural resources sections of the final EIS, include unemployment for many tribal members, the additional impacts on salmon and migrating trout such as logging, etc.

Dam Removal and Technology

Issues:

- Increasing power production from the dams and similar dam removal projects and their impacts
- Long-term future of the dams under the re-licensing scenario; rate of sediment filling the reservoirs and sediment effect on power production
- Past efforts to pass fish at Glines Canyon Dam
- Dam removal impacts on local roads and land use from removal of rubble

See Comment Letters: Dinius, Burton - C496; Hoyle Jr., Robert - C154; Markley, Jack, C141; McCune, Calmar A - C91; Pulkownik, Susan - C334; Warber, Brenda – C151; Warth, John F. - C203

Issue: Increasing power production from the dams and similar dam removal projects and their impacts

Q: A number of comments were received suggesting that the dams be upgraded to produce more power as opposed to removing them.

A: The Federal Energy Regulatory Commission (1993) considered the expansion of power production at Glines Canyon Dam as technically feasible, but not cost-effective. The amount of power that can be generated at a hydroelectric site is based on the vertical distance the water drops at that site (head) and the amount of water flowing in the river at that site (flow). At the present time, the head is all being used; flow, dictated by nature, cannot be increased. At certain times of the year, when flows are high, some water may be passed over the spillway and not through the turbine. To use all the flow, the dam and reservoir would probably have to be enlarged to capture the water when the flow is high, and release it when the flow is low. Updating (uprating) the turbine units could increase the efficiency by only a small amount (approximately 5%; US Bureau of Reclamation estimate). More than a 5% increase in power requires additional turbines and generators. Although it is possible to make these changes, the increase in power would not offset the increase in cost, hence the conclusions reached in the Draft Staff Report.

Q: Some commentors asked whether dams have been removed in other areas of the country and what the results were, particularly in flooding impacts.

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A: Numerous dams have been removed throughout the United States; however, the majority of these dams were smaller (10 to 40 feet in height) and had less sediment stored behind them than is behind the Elwha and Glines Canyon dams. In general, dam removal projects are required to remove a sufficient portion of the dam to permit the safe passage of floods down the watercourse across which the dam and reservoir were located. Reservoir sediments are often stabilized in place, and basin areas are revegetated. Where dams have been completely removed to return the stream and reservoir basin to pre-dam condition, as is proposed for the Elwha River, the flood potential returns to what occurred naturally before the dam was built. In the case of the two dams on the Elwha, the reservoirs are not operated to dampen floods, so the present "run-of-the-river" operation will continue whether the dams are in place or not. (See responses under the "Flooding" topic.)

Impacts from this and other dam removal projects could come from large sediment sources. Generally, if the supply of sediment is increased short term and then stopped, the river system recovers in 6 to 12 years. If large sediment sources continue, however, the stream takes on a channel form that responds to the increased sediment supply. It can take 7 to 20 years for the bedload (sand, gravel, and cobbles) portion of large sediment influxes to move down a river system, depending on its length. Suspended sediments, which are potential problems for fish and other aquatic life, flush out of the system more quickly. Although fish in Pacific Northwest rivers are used to high suspended sediment loads for short periods (from landslides and other natural causes), high mortalities may result from long-term suspended sediment influxes if they cannot move to an area with better water quality (such as tributaries of the Elwha River or the mainstem river above Lake Mills). In general, however, fisheries resources have responded positively to dam removal (See also, "Fisheries" section of Response to Comments).

Issue--Long term future of the dams under the re-licensing scenario; rate of sediment filling the reservoirs and sediment effect on power production

Q: Commentors wanted to know what would happen to the hydroelectric projects if they were not removed, but were instead retained and relicensed. Could licenses be granted immediately to either the present owners or a public utility district to operate the dams.

A: If the dams are not removed, the Federal Energy Regulatory Commission licensing process could begin again, although congressional authorization would likely be needed. The commission has granted annual operating licenses for the Glines Canyon Dam from 1976 when the original license expired. The Elwha dam has never been licensed. Other than the issuance of annual licenses, the commission (or any other agency) has no authority to grant "temporary" licenses to the dam owner or a public utility district.

Congress established the Elwha River Ecosystem Restoration Act (Public Law 102-495) in October, 1992 to help develop solutions for many long-standing unresolved fisheries and wildlife issues. Operation of the dams by another entity as an alternative to the present situation would not resolve these issues.

Q: Commentors questioned how long it would take for the dams to fill with sediment and whether maintenance would ever be a problem if the projects stayed in place.

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A: If the current level of maintenance was continued to the projects, they would exist as is until the reservoirs filled with sediment and began to wear on the turbine runners and other mechanical components (see below). Annual costs for operating and maintaining the dams now, included in the costs for providing power to the mills, are estimated at $1.1 million in the Draft Staff Report. It would take a total of (from 1926) approximately 300-400 years to fill Lake Mills, and 200-300 years (from 1911) to fill Lake Aldwell.

Whether the power plant would be able to function as the reservoirs filled would depend on measures the dam owners would be willing to employ. The penstock or water intake for Glines Canyon Dam power plant is now approximately 60 feet from the surface. As sediment reached that level, the intake would need to be relocated or the sediment would need to be washed, dredged, or sluiced. Since the intake for Elwha Dam power plant is nearer the surface, filling will not affect power production as quickly. The ability of the power plants to continue to produce the same amount of power would not be affected until the penstocks were covered or coarse sediment began to enter them in quantity, since the head would remain the same. When sand or gravel began entering the power plant intakes, the owners would need to change the location of the intakes and/or dredge sediment or periodically replace turbine runners and other mechanical components to continue power production. This would probably make operation of the power plants economically infeasible.

Q: Commentors asked whether dam removal would affect emergency power supplies.

A: The power plants do not have adequate capacity to provide power to large portions of the city during emergencies, although electricity from the dams has been used in the past to power critical services. Replacement sources could either be generated locally (such as through cogeneration) or taken from the Bonneville grid.

Issue--Past efforts to pass fish as Glines Canyon Dam.

Q: Some commentors noted that fish passage measures may have been used in the past on the Glines Canyon dam and asked why these measures were removed.

A: Since Glines Canyon Dam was constructed upstream of Elwha Dam, which had no provisions for fish passage, little consideration was given to providing fish passage facilities at Glines Canyon. The EIS team is unaware of any attempts to install fish passage facilities at Glines Canyon Dam, although the original sluiceway used during dam construction has at times been mistakenly referred to as a fish passage measure.

Issue--Dam removal impacts on local roads and land use from removal of rubble

Q: With regard to specific issues of dam removal, some commentors questioned what the impact would be on the Olympic Hot Springs Road, Altaire Bridge, and other local roads in carrying out the concrete from dam removal. Some suggested erecting a cement recycling plant at the site of the dam and using the crushed cement to improve the road and extend it into the park.

A: These issues will be analyzed in the Implementation EIS, including estimated costs to upgrade and rebuild local roads. A concrete recycling plant at the site is being considered by the EIS team. Disposal of dam rubble is covered in the "Impacts to Land Use" section of this document. The Federal Energy Regulatory Commission staff estimated that 36 acres of land would be needed to dispose of the rubble, and had identified a possible location not far from the dams (Kelly Mountain). Other alternatives will be examined in the Implementation EIS, including other disposal locations, using some of the rubble to create marine reefs, and usefulness or commercial value of the concrete and/or stored sand or gravel. Extending roads into the park where not related to dam removal are not examined in this statement, nor would they be in the Implementation EIS.

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Dam Safety

Issues:

- The ability of the existing dams to withstand damage from earthquakes and the potential for downstream impacts should the dams fail
- The safety and stability of the Elwha Dam during removal
- Potential for downstream damage from sudden releases of water from the dams

See Comment Letters: Homenko, Deborah, and White, Jerry - C54; McCune, Calmar - C108, C91

Issue: The ability of the existing dams to withstand damage from earthquakes; the potential for downstream impacts should the dams fail

Q: Some commentors suggest that, when the dams were built, little was known about dam safety and earthquake danger. Now that new fault zones have been identified, commentors asked what would happen to either dam in the event of an earthquake and the cost to make the Elwha Dam able to withstand earthquakes in the area. It was suggested that this cost and all costs to maintain the dams and keep them safe be factored into the costs of No Action or Dam Retention alternatives.

A: According to the Washington State Dam Safety Coordinator, there are no seismic concerns at the present time with either of the Elwha River dams (personal communication, M. Schaefer).

However, deep subsurface (subduction) faults on the Juan de Fuca Plate have been recently identified in the vicinity of Port Angeles. Typically, these types of faults cause more damage to earthen dams than to concrete dams. An earthquake of large enough magnitude with an epicenter close to the dam site could, nonetheless, cause considerable structural damage to the Glines Canyon Dam or to the concrete portion of the Elwha Dam.

A shallow crustal type fault, the Whidbey fault, also has recently been discovered by the U.S. Geological Survey; it lies southeast to northwest along Admiralty Inlet just north of Port Townsend. Although this type of fault poses a greater hazard to concrete dams than the deeper subduction type faults, the regional hazards of the Whidbey fault have yet to be quantified.

In addition to data gathering on existing faults and the hazards they present, geologists from the U.S. Geological Survey, the University of Washington, and other entities are currently evaluating whether seismic criteria for the Olympic Peninsula area should be more stringent, and are updating their Probabilistic Ground Motion Maps. If these criteria are changed, the dam owner would be required to re-evaluate the seismic analyses for both structures in light of the more stringent criteria and correct any deficiencies identified as a result of the analyses.

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If and when the criteria and safety rating for the dams are changed, the costs of any structural changes to them can be calculated; until this information is known, costs cannot be predicted.

Failure of either dam would pose a severe threat to downstream residents, hence both have a high hazard rating. For this reason, and because the Elwha Dam is built on sediment which saturated and "blew out" during construction in 1912, the Lower Elwha S'Klallam Tribe continues to be concerned that an earthquake could result in liquefaction and failure of the Elwha Dam foundation (J. Bohman, personal communication, 1995).

Issue: The safety and stability of the Elwha Dam during removal

Q: Given problems encountered during its original construction, how safe is the Elwha Dam now.

A: The Elwha Dam is currently considered safe by the agency that performs inspections. The problems encountered during construction were overcome by the placement of a significant amount of material upstream of the concrete gravity section, which has controlled seepage and provided stability. If the Elwha Dam is taken down, removal of this protective material must be carefully controlled to prevent saturation and safety problems. The Bureau of Reclamation is currently developing a site-specific engineering plan for dam removal. This plan would be part of the Implementation EIS.

Sudden releases of water during the removal of Elwha Dam is a danger the Bureau of Reclamation would design to avoid. Specifications for removing both dams would require that these releases be controlled to prevent damaging flows during deconstruction. Flow increases would occur often during dam removal. These fluctuations in flow would be controlled, and sufficient warning time provided.

Issue: Potential for downstream damage from sudden releases of water from the dams

Q: Commentors were concerned there may not be adequate warning for anglers downstream when water is now released from the dams.

A: As required by the Federal Energy Regulatory Commission, James River Corporation (owner of both dams) has a comprehensive, formal emergency action plan. When there are sudden releases of water from the dams, James River notifies the Lower Elwha S'Klallam Tribe, Clallam County Sheriff, Point No Point Treaty Council, and others. Phone contact is made whenever releases exceed 3000, 8000, and 13000 cubic feet per second. James River studied the feasibility of installing sirens to notify citizens in the event of an emergency and concluded that they would not be effective without secondary confirmation; instead, a phone contact list was chosen.

Additionally, James River and Daishowa maintain a U.S. Geological Survey automated gauging station at the MacDonald Bridge.

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Ecosystem Management

Issues:

- Need for long-term ecosystem management planning to monitor resource effects of dam removal; replacement of and impacts on existing ecosystem
- Feasibility of restoring the Elwha River ecosystem; restoration to a "pristine" condition
- Cumulative impacts to the ecosystem

See Comment Letters: Caltrider, Melanie J. - C97; Clark, Robert J. - C599; Loucks, J. &. M. -C63; Main, Jerrine and Earnest - C336; Murray, Floyd - C70; Olympic Park Associates - C612; Payne, Randall D - C30; Rescue Elwha Area Lakes - C333; Schwagler, Albert J. - C561; Towslee, Charles E. - C199; Tveit, Gary - C462; Washington Department of Natural Resources - C577

Issue: Need for long-term ecosystem management planning to monitor resource effects of dam removal; replacement of and impacts on existing ecosystem

Q: Commentors recommended that a comprehensive long-term ecosystem management plan be developed to monitor and manage resources after the dams are removed. Some suggested that the plan be jointly developed and implemented by a partnership of state, local, federal, and tribal entities.

A: A comprehensive resource management plan for acquired lands is important. In the Implementation EIS, the Department of the Interior would analyze impacts of general land uses proposed by each of the entities that may receive lands--Olympic National Park, the Lower Elwha S'Klallam Tribe as lands held in trust, and the state of

Washington. Once ownership has been determined, more precise planning for use of these lands can begin.

Q: Commentors asserted that the Department of the Interior would be replacing the reservoir ecosystem with the river ecosystem.

A: Interior's proposal is not to replace, but to remove the impediments to a naturally functioning ecosystem that existed for thousands of years prior to construction of the dams. Given the same habitat and environmental conditions, the same group of species tends to occur. Therefore, returning the Elwha River habitat to its pre-dam condition would result in the natural complement of species, including salmon and seagoing trout that lived there for centuries.

Issue: Feasibility of restoring the Elwha River ecosystem

Q: Commentors asked whether the river ecosystem could be restored to a pristine or pre-dam condition.

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A: The vast majority of the Elwha River valley is within Olympic National Park boundaries and is in pristine condition. Some development on tributaries has sent silt and other pollution into the river. However, non-point sources of pollution, such as agricultural and urban run-off, have a minor influence due to the small number of farm operations or development within the river basin (BOR, 1995a). The waters remain "Class AA," of very high quality, much as they were before the dams were built. Elwha River water is used by residents and industries in Port Angeles, but the diversion for this use is only three miles upstream of the mouth of the river, so water quantity is the same as before the dams were built along most of its length.

Existing levees protect property from flood damage. However, the largest levee is located on the Elwha S'Klallam Reservation and was designed to prevent the river from meandering over only the very widest piece of the floodplain, thereby minimizing impacts to the natural system.

Although water diversions, levees for flood protection, and development of lands for residential or other (logging, etc.) use will continue outside the park whether or not the dams are removed, they are not impediments to the physical or biological processes required for ecosystem restoration. The presence of the dams is.

The entire terrestrial and aquatic ecosystem of the Elwha Valley has been altered from building the dams and precluding anadromous fish from entry beyond the first five miles, inundating important terrestrial and river habitat, and restricting sediment, nutrient, and woody debris transport (see Impacts to River Ecology section of this EIS). In addition, because of concerns over precipitous population declines and the potential for additional extinctions, hatcheries were built on the river in the mid- 1970s to artificially rear salmon and steelhead. However, hatcheries generally produce fish less adapted to the natural environment as a result of inbreeding (producing large numbers of fish from few parents) and rearing in a manufactured environment. The Proposed Action would phase out the use of hatcheries, and phase in reliance on wild salmonids to populate the Elwha River. It would also restore physical and biological processes such as sediment transport and fish passage, thereby both fully restoring the native anadromous fisheries and Elwha River ecosystem.

Q: Some commentors observed that local residents may not see fisheries restoration as a national issue, or be aware of the opportunity the Elwha River provides for restoration because of its relatively pristine surroundings.

A: Interior agrees problems salmon are experiencing reach far beyond the Elwha River or Puget Sound. In fact, many species have recently been listed as threatened or endangered, or are proposed for listing. For example, on March 10, 1995, the National Marine Fisheries Service (NMFS) proposed wild steelhead runs from the Klamath River, California north to Port Orford, Oregon be listed as threatened under the Endangered Species Act because of population declines resulting from habitat destruction, such as logging, mining, and irrigation, as well as recent El Nino weather patterns. This action follows listings of salmon stocks in the Columbia River Basin and Sacramento River, California largely as a result of habitat degradation including dams and water withdrawals. NMFS is continuing its review of Pacific Northwest salmon and steelhead populations, including those of Washington. Restrictions necessary to restore listed species can have ramifications far beyond the boundaries of the immediate watershed.

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Salmon and steelhead restoration is not only a regional issue, but a national and even international one as well. Fish produced in the U.S. traverse the waters of many states and are captured throughout their range, including by Canadian fishermen as the fish move south from Alaska. U.S. fishermen also capture fish produced in Canada. Harvest management occurs on the international (Pacific Salmon Treaty), national (Pacific Fisheries Management Council), and local (State of Washington and treaty tribes) levels. Although overharvest does at times occur, most population declines of these fish result from diminished and degraded habitat. Small streams produce relatively few fish but their combined production is large. Unfortunately, most small streams on the West Coast have been damaged from urbanization, water withdrawals, or other land management activities (Nehlsen et al. 1991). This is true with the large rivers, as well. As a result, very few pristine watersheds are left in the United States. The Olympic Peninsula is unusual in having several with large portions intact, primarily due to the management policies of Olympic National Park. These streams support healthy populations of salmon and steelhead (WDF et al. 1993). With dam removal and fish access to existing pristine and restored habitat currently inundated by the two reservoirs, the Elwha River could once again be one of the premier salmon producing streams in Washington and benefiting the region.

Issue: Cumulative impacts to the ecosystem

Q: Commentors asked for more analyses on the cumulative impacts of each alternative on a variety of resource topics, e.g., wildlife, living marine resources, fisheries, ecosystem management.

A: The text in this document has been expanded to provide further analyses of cumulative impacts.

Fisheries

Issues:

- Probable success of fish restoration
- Factors that limit salmon and trout populations
- Positive cumulative impacts
- Definition of full restoration and the length of time to achieve it
- The Department of the Interior's assumptions/methods for full restoration; hatcheries, harvest restrictions, escapement
- Tribal fishing practices
- The effect of dam removal on water temperature; fish disease present in the lower part of the Elwha River
- Use of modern technology to pass fish through the dams, as is used on the Baker River system
- Enhancement vs. restoration
- Use of experimental dredging and sediment deposition below both dams to increase certainty of the effects of sediment on the fisheries
- Restoration and/or passage of pink and chum salmon
- Indirect impacts of power generation from other sources on salmon population
- Use of Elwha River as a pilot program area to raise salmon as is now done in the Cowlitz hatchery
- Historical access; data

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See Comment Letters: Anderson - Huber, Noni M. - C102; Bussell, Eldon - C431; Caltrider, Melanie J., C97; Chadd, Edward - C545; Childs, Phyllis and David – Cl05; Clark, Robert J. - C599; Cole, Jollefern M. - C34; Copeland, Delbert - C280; Dalton, Robert - C74; Dart, Richard - C604; deBord, Linda - C564; Diimmel, Denise - C84; Doull, Robert H. – Cl11; Dry Creek Grange #646- C596; Ensor, Lavonne - C560; Erickson, Dale - C519; Federation of Fly Fishers - Cl82; Gehrke's Gink - C148; Goin, Dick - C414; Graf, Thomas G. - C300; Hampton, Haidie M. - C107; Henry Sr., William P. - C249; Hilt, Dowell -C477; Johnson, Buck - C603; Johnson, David Sirrine - C93; Johnson, Gladys B. - C600; Julian, Tony - C478; Ladley, Russ - C310; Latuala, L. F. – C15; Lonn, Benjamin - C335; Machenheimer, Fred &. Nora - C139; Main, Jerrine and Earnest - C336; Maupin, Eddie - C48; McAfee, Carey - C87; McHenry, Michael – C518; McHone, Larry & Laura - C77; Mohr, Chris - Cl97; Murray, Floyd - C70;
North Peninsula Home Builders and Building Industry Association of Washington - C449; O'Sullivan, J. M. - C606; Okanogan County Citizens Coalition - C552; Olympic Park Associates - C612; Philpott, Bob - C117; Pulkownik, Susan - C334; Reed, Sandra E. - C562; Rescue Elwha Area Lakes - C333; Santos, Thomas - C556; Sargent, Joan K. - C450; Schmitt, Francis J. - C68; Schwagler, Albert J. - C561; Schwagler, Jacqueline - C598; Smith, Cheryl - C555; Smith, Leland - C455; Stachorek, Richard W. - C243; Tobin, Eric - C59; Towslee, Charles E. - C199; Tveit, Gary - C462; Tveit, Larry R. – C142; Tveit, Marcella - C291; Tveit, Mrs. Larry - C413; Warber, Garry - C62

Issue: Probable success of fish restoration

Q: Many commentors questioned the feasibility of removing the dams and restoring the native anadromous fisheries, the degree to which the fisheries could be restored, the cost, and methods to mitigate fisheries impacts during and after dam removal. Many asked whether anything like this had been done before, and wondered whether fish would survive the release of stored sediment. Some cited Mount Saint Helens as a comparative example.

A: Other dams have been successfully removed, and for a variety of reasons. The Harpster Dam on the South Fork Clearwater River in Idaho was an arched concrete structure 440 feet long and 56 feet high. This Washington Water Power Company dam was removed in 1963 because the equipment was obsolete and it was in the public interest to remove it. Removing the dam was also in keeping with the established Idaho Department of Fish and Game fisheries rehabilitation program. The Sweasey Dam, approximately 55 feet high on the Mad River in California, was removed in 1969 because the reservoir had completely filled with sediment, rendering it useless for water storage. These dams were removed simply by dynamiting, with no provision for sediment management. Fish passage was restored at both sites and salmon and steelhead runs have benefited (Winter, 1990).

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As to whether fish can withstand or recover from the release of suspended sediment, the eruption of Mount Saint Helens serves as an interesting comparison. The May 18, 1980, eruption caused a debris torrent that sent an estimated three billion cubic yards of material into the upper 17 miles of the North Fork Toutle River basin and approximately 50 million cubic yards into the South Fork Toutle River (Lucas, 1985). Approximately 90% of the upper North Fork and tributaries previously accessible to salmon were buried to depths up to 213 yards by the mud flow. Corresponding numbers for the South Fork were 89% and 10 yards, respectively (Jones and Salo, 1986). Also, the eruption blast wiped out riparian vegetation, resulting in significant increases in water temperatures (Lucas, 1985). Efforts to restore the riparian areas are an important aspect of habitat recovery in the Toutle drainage (Martin, et al., 1984; Jones and Salo, 1986).

In contrast, the total estimated sediment that would be released from behind the dams is 9 to 12 million cubic yards, and riparian vegetation would be largely unaffected by sediment releases.

Even though the eruption devastated most of the anadromous fish habitat previously available in the Toutle, natural fish recovery quickly began. Initially, many adult fish avoided the Toutle River because of high sediment loads and strayed to other Columbia River tributaries (Lucas, 1985). However, the first adult summer steelhead was observed in the North Fork Toutle River in August 1980, only three months after the eruption. Steelhead redds were observed in Alder Creek, a North Fork tributary, in the spring of 1981. That spring also saw steelhead redds in many South Fork Toutle River tributaries and fry were later captured in these tributaries, indicating successful reproduction (Rawding, 1995). The numbers of yearling and older steelhead increased ten-fold from 1981 to 1984 in a South Fork tributary (Lucas, 1985). Fish in the Elwha basin would have access to clean water tributaries or the watershed above Lake Mills during dam removal, and so would be expected to have at least similar, and probably better, responses.

Stober et al. (1981) characterized much of the material released by the eruption of Mount Saint Helens as "solid glass or obsidian-like pieces, or more porous-looking particles." These particles are abrasive to fish gills and are different from the glacial sediment stored in Lake Mills and Lake Aldwell. However, fish populations are thriving both in the Toutle River drainage and in Pacific Northwest glacial streams.

Another example of a successful fish restoration project is the South Fork Skykomish River near Seattle. No anadromous fish populated the river above an impassable natural barrier. Notably, no reservoirs hindered the downstream migration of juveniles. The Washington Department of Fish and Wildlife developed salmon and steelhead runs above the barrier, initiating salmon production by releases of coho fry and fingerlings into the upper watershed from 1952 to 1958. Coho are now the most abundant anadromous salmonid in the South Fork; the adult run has increased steadily from 1,561 in 1958, when the last planting of hatchery-produced juveniles took place, to 30,000 in 1979 (Seiler et al., 1981).

Q: To what extent will the loss of indigenous salmon gene pool affect restoration of Elwha River stocks.

A: Brannon and Hershberger (1984) claimed that the indigenous stock of Elwha River chinook salmon, including genes for "100 pounders," has been maintained at the state's rearing channel on the river. No large fish are seen because of the hatchery environment suppression of factors that produce large fish (e.g., slow early growth rates). Once this stock of fish is allowed to rear in the natural environment, large fish should grow over time, as should the different run times (spring, summer, fall).

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The indigenous coho salmon stock has largely been maintained at the tribe's hatchery on the river, although Dungeness River coho salmon have been introduced into the Elwha River a number of times. Recent genetic stock identification work by the tribe and the U.S. Fish and Wildlife Service indicates that the early returning chum salmon are related to indigenous Strait of Juan de Fuca chum--more likely to be Elwha River native stock than an earlier introduced stock of Hood Canal chum. Pink salmon returns are very low and the subject of an Endangered Species Act petition. However, it is possible that Elwha River pink salmon are part of the same "evolutionarily significant unit" that includes indigenous Dungeness River pink salmon; Elwha and Dungeness pink salmon may very well be genetically identical. Elwha River sockeye salmon are generally considered to be extinct, although the Department of the Interior is investigating the possibility that Lake Sutherland kokanee (land-locked sockeye salmon) are descended from Elwha sockeye.

Winter run steelhead are reared in the tribe's hatchery. It is not clear how much the hatchery fish have influenced a later return of naturally spawning winter run fish. However, a source of native Elwha steelhead may be available in the river population of resident rainbow trout, as these fish are a freshwater race of steelhead. Reisenbichler and Phelps (1989) suggested that the upper river rainbow trout are descended from the indigenous Elwha River steelhead. Steelhead smolts have been documented migrating past the dams although no steelhead were planted upstream (Stone and Webster Engineering Corporation, 1991). Summer run steelhead may also be related to the upper river rainbow trout. Indigenous populations of cutthroat trout and char (Dolly Varden and bull trout) exist in the upper Elwha and may also be producing seagoing smolts. The availability of indigenous Elwha or related (e.g., Dungeness) fish stocks would allow full restoration of the Elwha native anadromous fisheries.

Q: The EIS rates availability of some stock as less than favorable. How can a run be restored if this is the case.

A: The availability of all stocks is rated as: favorable (summer/fall chinook); marginal/favorable (winter steelhead); marginal (coho, summer steelhead, chum, searun char); unfavorable/marginal (spring chinook, pink, and sockeye); or unknown (searun cutthroat). The environmental impact statement notes that the sockeye salmon stock is probably extinct, but that kokanee (land-locked sockeye) in Lake Sutherland may be descended from the native sockeye run.

Although stock availability is significant, other factors such as access to and recovery of habitat also figure importantly in eventual restoration success. In nearly all cases, stock availability is not the overriding factor because alternate brood sources exist. The Elwha Report (Appendix G) lists 28 different options for restoring the 10 original Elwha fish stocks. Of these, only sockeye salmon have significant import restrictions because of the potential for disease introduction. To ensure that brood sources are eventually available, surveys are currently underway for all identified sources (both Elwha remnant and non-native stocks) so that brood collection and development can be undertaken if needed before dam removal. These surveys currently cover the Elwha River (for remnant spring chinook and winter and summer steelhead, the Dungeness River (for pink salmon), and certain other coastal Olympic Peninsula streams (for summer steelhead).

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Issue: Factors that limit salmon and trout populations

Q: Commentors asked whether Elwha River anadromous fisheries could be restored when other North Coast Rivers with no dams, such as the Hoh, have few fish.

A: It is a common misperception that most salmon and steelhead populations in Olympic Peninsula rivers are critically depressed. Most fish stocks, including those in the Hoh River, are not dying out. The status of each species varies, but chinook salmon and winter steelhead in the Hoh (and most other North Coastal rivers) are considered to be in good condition. In the 18-year period from 1976 (when good information on population size became available) through 1993, spawning escapement, the number of fish needed for spawning to perpetuate the runs, of Hoh spring/ summer chinook exceeded agency goals in every year but three. During this same period, fall chinook abundance exceeded the spawning requirement in each year. During the 17-year period from 1976 through 1992, spawning escapement of winter steelhead exceeded agency goals in all but four years.

Although the Hoh River coho salmon stock is considered healthy, returns for this species have not been as strong as desired. Returns have been within ranges set by agencies for escapement, but rarely exceed the upper end. Principal factors influencing returns of coho are suspected to be heavy ocean interceptions, especially in Canadian fisheries, and adverse land-use activities.

The Washington Department of Fisheries et. al. (1990) determined that nine fish stocks in the Strait of Juan de Fuca are healthy, 14 depressed, five critical and the status of 12 unknown because of limited data. For the Washington North Coast, 35 stocks are healthy, four depressed, none critical, and the status of 33 unknown. The reasons for the depressed conditions of stocks vary by species and river system.

Within the Hoh River watershed, extensive timber harvest and the associated road system have significantly impacted salmon and steelhead spawning and rearing areas. Other adverse practices within the Hoh are agricultural activities and bank hardening to protect roads and private and public property. Lower salmon productivity of essentially all rivers due to adverse land-use practices is widely evident and the most serious long-term threat to the state's anadromous fisheries resources.

Q: To what extent is restoration a function of restoring Elwha habitat vs. other factors such as overfishing.

A: The Elwha Report contained the following quote by Lower Elwha S'Klallam Tribal elder, Mr. George Bolstrom:

"It's not just about taking the dams out, or even just putting the fish back. It's about the whole picture, the human population, marine predators, overfishing, the works. If the whole system is addressed, then maybe restoration will work."

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Unfortunately, it is not possible to place a significance value (in terms of contribution to fish declines) on each of the factors. However, it is reasonable to state that the presence and operation of the dams, more than any other factor or combination of factors, have resulted in the greatest declines of Elwha River anadromous fish. The dams block access to or inundate more than 93% of the historic fish habitat. Reducing the productive capacity of any river by this amount would seriously threaten any fish stocks. In addition, elevated water temperatures resulting from heat storage in the reservoirs exacerbate fish diseases in the lower river, seriously impacting the remaining chinook salmon population. Blockage of the natural sediment transport regime has resulted in an armored river bottom and reductions in fish spawning success, threatening all remaining fish stocks. Lower sediment supply has reduced the size and complexity of the estuary, which also impacts all fish stocks. Although fish harvest must be properly managed, dam removal and the resulting habitat restoration would allow the historic fish runs of the Elwha River to be restored.

Q: Comments were received stating that the salmon population decline is related more to the activities and fishing pressures on salmon in the ocean, not the presence of the dams. Since these fish spend 80% of their life in salt water, aren't causes of their decline ocean-based? The commentors cite the Elwha Report, saying that only 10% of the salmon spawned by the hatchery would return and they believe this is further evidence that the problem is not the dams, but drift nets and other pressures. Commentors stated that a return of 300,000 fish is pure speculation. They also asked when the hatcheries first started and how low the salmon population was at that point. What is the effect of an overall warming of ocean water that adversely impacts all fish?

A: We respectfully disagree that "the problem is in the ocean." The destruction of the species' freshwater habitat--not overfishing--is primarily responsible for declines of specific runs. Agricultural, residential, and industrial development, as well as logging and roads send sediment and pollutants into spawning rivers. Surface water withdrawals, channeling rivers for flood protection, development of estuary habitat, and drought have also added to habitat degradation for anadromous fish. Dams that totally or partially block upstream and downstream fish migration from spawning grounds and inundate habitat have had major impacts on salmon and seagoing trout populations. Some forces in the marine environment, such as fishing and the warm El Nino current, also affect salmon, although marine survival rates for chinook and coho salmon appear to be improving as the warm El Nino waters leave the Pacific Northwest coast.

Also, it is inaccurate to state that "these fish spend 80% of their life in salt water." Natural steelhead generally spend two years in freshwater and two years in the ocean; coho spend one year in freshwater and two years in the ocean; and chinook may spend either several months or one year in fresh water and three to fours years in salt water. Low hatchery return rates do not signify "that the primary case lies in the ocean." Rather, many factors, including reduced fitness of hatchery fish, diseases, and increased stress in fresh water from higher water temperatures and reduced habitat quality, contribute to low return rates of hatchery fish.

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The Department of the Interior believes that the comment that the Elwha River had "lots of salmon for 50 years after the dams were installed" is an overstatement. The almost instantaneous elimination of 93% of the historic habitat by Elwha Dam had immediate and dire consequences to Elwha salmon and steelhead. Sockeye salmon, cut off from their nursery lake (Lake Sutherland), were probably eliminated within a matter of a few years. Spring chinook salmon, a stock that enters early and penetrates upper river areas, probably followed soon after sockeye, as would have summer steelhead. The remaining stocks decreased in time as Lake Aldwell trapped needed spawning gravels, Glines Canyon Dam construction impounded Lake Mills and elevated water temperatures, and extreme river fluctuations during the 1930s and 1940s stranded adult and juvenile fish in the lower river. Unfortunately, fish were not counted then to document long-term declines. The 1975 mitigation agreement between the Washington Department of Fisheries and the construction of the tribal hatchery were both responses to unacceptable declines in Elwha River fish from the presence and operation of the two dams.

Removal of the dams would result in the potential production of more than 380,000 salmon and steelhead and escapement of an estimated 140,000 fish (FERC, 1993). These estimates are based on comparisons to other western Washington streams that are not in pristine condition as is most of the Elwha. If high quality habitat is provided and harvest is managed, the fish will return.

Q: Many commentors questioned what the impact of the practice of high seas drift netting is on the fisheries. They also allege that seals are the reason for decreasing fish stocks on the Olympic Peninsula. Some commentors think that commercial trawlers must also be controlled to allow salmon to be restored.

A: An international ban on high seas driftnet fishing went into effect on December 31, 1992 and is widely held to have been effectively enforced. For instance, in 1993, the U.S. Coast Guard and Canadian Pacific Maritime Forces conducted surveillance activities in the North Pacific routinely fished by driftnet vessels. Coast Guard cutters logged 148 vessel days at sea and Coast Guard aircraft 829 patrol hours as a part of the program (Secretary of Commerce, 1993). Canadian aircraft provided an additional 180 patrol hours. United States units located four vessels equipped for driftnet fishing. Three of these were boarded and had driftnets on board but no fish. All three were turned over to authorities of the Peoples Republic of China which took appropriate action under their law. The fourth was a Honduran-flagged vessel that departed the area before a boarding could take place. An additional six vessels were sighted in transit by Canadian forces, but it could not be confirmed whether four of these were rigged for driftnet fishing. Patrol activities provided no evidence of any unauthorized driftnet fishing (secretary of commerce, 1993).

In 1994, U.S. Coast Guard cutters logged 146 vessel days at sea and Coast Guard aircraft put in 223 hours as a part of the monitoring program (Steve Springer, National Marine Fisheries Service, Office of Enforcement, Silver Spring, Maryland, personal communication, 1995). Canadian Pacific Maritime Forces aircraft contributed seven one-week patrols to the effort. One vessel in transit with a driftnet on board was observed by Canadian Forces. Patrol activities in 1994 provided no evidence of unauthorized driftnet fishing. No nets were observed in the water in either 1993 or 1994, suggesting that there has been a high rate of compliance with the international moratorium in the North Pacific.

In terms of marine mammals, the impact to salmonid populations in the Puget Sound area is generally from sea lions, rather than seals. The following is from NOAA et al. (1992):

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"Many of the salmonids consumed by sea lions in Puget Sound are likely removals from fishing gear, especially gill nets used in salmon and steelhead fisheries in various locations around Puget Sound (Gearin et al., 1988.).

"Although sea lions are known to prey on free swimming salmonids, the high frequency of such predation has been documented only in the area of the [Ballard] Locks to date. The problem at the Locks is the most severe sea lion-fishery interaction documented to date and only at this location has it been demonstrated that sea lion predation on free swimming fish is excessive and is threatening the viability of run of wild fish."

Recent modifications of the Marine Mammal Protection Act allow the killing of nuisance animals such as those at the Ballard Locks.

Another source of potential impact to salmon mentioned by commentors is trawling. Trawl gear (mid-water, bottom, and shrimp) takes nearly 96% of all ground fish in the U.S. fisheries, and salmon are sometimes inadvertently part of the catch. This salmon "bycatch" (the accidental take of non-targeted species) has been well monitored by the National Marine Fisheries Service Fishery Observer Program since 1977, which has focused on the foreign, joint venture, and at-sea domestic whiting fishery. The whiting fishery represents more than 70% of Pacific coast ground fish landings and is the principal mid-water trawl fishery (National Marine Fisheries Service, 1992). Additional bycatch information was obtained through mesh size experiments conducted on trawlers during actual fishing operations off California, Oregon, and Washington.

From 1977 to 1991, with the exception of 1986, the annual salmon catch in the U.S. whiting fishery ranged from 2,300 to 16,000, averaging 9,500. The salmon catch in 1986 exceeded 40,000. Chinook salmon comprised 82 to 98% of the salmon bycatch in the 1986-1990 U.S. joint venture whiting fishery; most of the remainder were chum and coho (National Marine Fisheries Service, 1992). Although salmon are found in approximately

27% of all whiting tows, approximately 2% of the tows result in 50% of the salmon bycatch.

It is difficult to project the magnitude or distribution of salmon bycatch in the whiting fishery for future years. Bycatch will depend on the abundance of salmon and the success of management measures designed to reduce bycatch without unduly constraining the whiting fishery. It is likely that the Pacific Fisheries Management Council will continue to experiment with management actions that can be used to reduce salmon bycatch (National Marine Fisheries Service, 1992).

Q: To what extent do conditions in the marine environment versus freshwater habitat affect salmon?

A: Habitat degradation is a long-term problem that reduces the capacity of the freshwater environment to produce fish at its full production potential. Fewer fish migrating to sea as smolts results in fewer adult fish being produced for catch and spawning escapement. Further, freshwater habitat recovery is slow, often taking decades as the stream adjusts to altered channel, flow, wood and sediment conditions, resulting in a protracted period of lower fish productivity and stock recovery. Should marine survival be unusually low, as has been the case for the last few years, even fewer adults are produced.

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Unlike freshwater habitat degradation, marine conditions can improve dramatically in a short period of time, returning ocean survival to higher, more typical rates. Marine survival rates for chinook and coho salmon appear to be improving as the warm El Nino waters leave the Pacific Northwest coast.

Unlike most Peninsula streams, the area above Lake Mills provides salmon and steelhead pristine spawning and rearing habitat because it has been spared the adverse, long-term impacts from recent timber harvest, water use, and human development that many other Peninsula streams are now experiencing. The habitat within the park will be preserved as mandated by federal law.

Q: What is the effect of overappropriation of water in the Elwha River on the decline of salmon stocks.

A: Since a minimum flow for the Elwha River has not been established, it is difficult to state whether the river has been overappropriated. Nonetheless, water withdrawals during the low flow period in the late summer and early fall probably negatively impact fish stocks. With removal of the dams, fish will be able to migrate past the affected reach quickly (approximately the lower three miles of the river) and into a natural flow regime.

Issue: Positive cumulative impacts

Q: What has been the regional positive impact on salmonids from watershed restoration, fishing restrictions, etc. Conversely, what are the cumulative negative impacts of logging, habitat development and destruction, and harvest on the decline the species have exhibited since the dams were built. Are there restoration projects in the region that have contributed to salmon population increases.

A: Negative cumulative impacts are discussed above. For a summary of large-scale restoration projects in the Pacific Northwest, see pages 20-21 of the Elwha Report.

More locally, some smaller restoration projects such as the addition of instream structures, have shown positive changes in juvenile fish abundance. For example, the Washington Department of Natural Resources (J. Cederhold, personal communication, 1995) has been conducting experiments in a small south Puget Sound stream and has demonstrated that juvenile salmon populations significantly increase following restoration of some of the instream habitat (large woody debris placement). Likewise, experimental placement of brush piles in the mainstem of a Washington coastal river, the Clearwater, was found to increase the density of juvenile coho salmon there.

Most freshwater habitats in the region for salmon and trout are in developed and/or degraded conditions. Repairing watershed damage requires extensive mitigation, much of which entails long-term, continuing costs. Also, on private land, there are no long-term guarantees that restored habitat will remain restored, that additional sources of water pollution will not surface, or that other alterations will not be made. In contrast, most of the Elwha watershed is within Olympic National Park, where it would be maintained in its present pristine condition in perpetuity.

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Issue: Definition of full restoration and how long would it take to achieve it

Q: Commentors asked whether the fisheries could be fully restored, and, if so, how long it would take.

A: When we speak of full restoration, we are referring to pre-dam levels (but not to "Jurassic Park" or "pre-Columbian" as some have postulated). Essentially, unimpeded fish passage must be provided and inundated habitat and natural physical and biological ecosystem processes restored. In so doing, the conditions necessary for fish and wildlife populations to recover and the ecosystem to be restored would be provided.

Restoration timing would vary by stock and some harvest restrictions are already in place. Let's examine each stock individually.

1. Summer/fall chinook salmon: The Elwha stock of summer/fall chinook is currently sustained by both natural and hatchery production. Using Ricker curve-based recovery models, peak returns of chinook could occur in five cycles (21-25 years). This type of modeling assumes no outplanting effort. With outplanting, recovery time is shortened by one-half. Chinook harvest restrictions in the Elwha would probably be in place for the first two complete cycles (8-10 years). Additional harvest restrictions in localized marine fisheries (e.g., area closures in the Freshwater Bay vicinity) might be necessary during the same time period. Harvest restrictions in other Washington sport and commercial fisheries or Canadian fisheries to specifically accommodate Elwha restoration are not likely, as the depressed status of many other native Western Washington and Columbia River chinook stocks would probably have a larger influence in shaping fisheries for the foreseeable future. Elwha chinook would benefit from management actions aimed at rebuilding these other stocks.

2. Spring chinook salmon: Elwha spring chinook, if present, are likely present only in small numbers. It would be expected that, with restoration of summer/fall chinook stocks, a spring component would ensue; individual fish migrating to the upper reaches of the river and entering earlier would eventually form an isolated sub-population of spring chinook. The time frame for this is probably in terms of decades. Active outplanting of eggs and alevins in the upper river could speed up the process. No additional harvest restrictions for this stock beyond those already in place would likely be needed.

3. Coho salmon: Elwha coho are sustained by both natural and hatchery production, although hatchery fish predominate. Using Ricker models to predict recovery rates, peak returns of coho could occur in as little as five cycles (15-18 years). Assuming continued hatchery augmentation during the rebuilding phase, harvest restrictions in the Elwha River would be relatively minor and designed to mitigate impacts suffered during the deconstruction and immediate post-deconstruction period (5 years). Harvest restrictions similar to those for chinook salmon in marine fisheries (e.g., area closures in the Freshwater Bay area) might be necessary during the same five-year period. Also, as with chinook, harvest restrictions in other Washington sport and commercial fisheries or Canadian fisheries to specifically accommodate Elwha restoration are not likely, as the depressed status of other Western Washington and Columbia River coho stocks would probably have a larger influence in shaping fisheries for the foreseeable future. Elwha coho would benefit from management actions for rebuilding the other coho stocks.

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4. Winter steelhead: The early returning portion of the winter steelhead run is heavily supported by hatchery production. Harvest restrictions would be minimal, based on run return strength. The late portion of the run is wild and considered depressed due to loss of habitat related to the dams. Based on Ricker models (no outplanting or hatchery influence), peak returns of wild steelhead could occur in as little as five cycles (15-18 years). Outplanting of eggs or alevins in the upper watershed would reduce this timeframe by one-half. Freshwater harvest restrictions, such as catch and release of wild steelhead, would probably be in place until sufficient numbers of spawners returned to the river (12-16 years). No restrictions would be anticipated for marine fisheries.

5. Summer steelhead: The outlook for restoration of summer steelhead is similar to that of winter steelhead, although the restoration period may be longer (20-25 years). Harvest restrictions would consist of catch and release of wild summer steelhead, as have already been implemented throughout the state. Monitoring of adult returns would determine when harvest restrictions could be lifted.

6. Pink salmon: Elwha pink salmon are a native, wild stock of critical status, as evidenced by chronically low escapements (four returning fish in 1989, ten in 1991, none seen in 1993). Broodstock would probably come from the adjacent Dungeness River stock, depending on its status. Using the Sunset Falls example, returns remained low until a population threshold (2,000 adults) was reached, after which numbers increased rapidly. Ricker curve modeling predicts peak production occurring in 8 to 10 cycles (16 to 20 years). Outplanting or remote incubator sites would enhance this effort immensely. The Elwha River is already closed to the harvest of pink salmon. No additional harvest restrictions in marine areas are anticipated, as the harvest rate is already at the level needed for restoration purposes.

7. Chum salmon: The Elwha chum salmon population is estimated at between 200 and 500 returning adults. Chum population dynamics and life histories are similar to that of pink salmon in that spawning occurs over a relatively short period, the eggs incubate concurrently, hatching and emerging from the gravel at approximately the same time. Migration to salt water, done passively and en masse, tends to swamp predators. This strategy requires the production of large numbers of alevins before substantial population increases occur. Like Sunset Falls pink salmon, Elwha chum could remain at low numbers until a large increase in survivorship allows rapid population increases. Ricker models predict chum recovery in as few as six cycles (18 to 21 years). Outplanting at incubator sites would help shorten the time needed for recovery. Harvest restrictions would require closure of the sport harvest of chum in the Elwha during the early years of restoration, although the present harvest in the river is estimated in the tens of fish. No additional restrictions of marine fisheries would be expected.

8. Sockeye salmon: Elwha River sockeye salmon are essentially extinct. Sockeye restoration would probably require augmentation of the anadromous component of kokanee (landlocked sockeye) that reside in Lake Sutherland or the importation of a suitable stock. Once sufficient numbers of brood were secured, recovery could occur rapidly (3-5 cycles; 12-20 years). Since the recovery rate of sockeye was not addressed in the Draft Staff Report, a rebuilding curve based on Sunset Fall chum was used to simulate a sockeye recovery. A remote site incubation station would help boost production of this stock. Since there is no harvest of sockeye in the Elwha at this time, potential harvest restrictions would depend on the recovery of the species and the timing of the stock's return.

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9. Searun cutthroat: The status of Elwha River anadromous cutthroat trout is unknown, although a small population is believed to persist. Since resident cutthroat trout in the upper Elwha River probably produce seagoing smolts, similar to that of resident rainbow trout, restoration is expected to occur naturally. However, the restoration timeframe is unknown for this stock. No additional harvest restrictions would be anticipated for this stock.

10. Searun char (Dolly Varden and bull trout): The status and restoration of Elwha River anadromous char is similar to that of searun cutthroat trout, although there is a larger population of char in the upper river than cutthroat trout. Restoration of this stock is expected to occur naturally and no additional harvest restrictions are anticipated.

Issue: Interior's assumptions/methods for full restoration; hatcheries, harvest restrictions, escapement

Q: To what extent will the Department of the Interior use hatcheries or other artificial means to restore or maintain fisheries.

A: The Department of the Interior is investigating the use of alternative fish habitat to mitigate the immediate short-term impacts that would result from the sediments should they be naturally eroded--for example, the feasibility of using springs as a water source for a downstream side channel now used by spawning chum salmon. Netting off the entrances and exits to existing off-channel pools in the upper watershed for use as acclimation ponds also is being considered. Fish reared in a hatchery could be placed in these ponds to acclimate to the waters of the upper watershed before being allowed to migrate downstream, thus accelerating and increasing the numbers returning to the upper watershed as adults. These measures and others would be described in the Implementation EIS.

Hatchery involvement in the Elwha River restoration process would reflect three primary needs. First, Elwha spring chinook, pink, and chum salmon stocks may not be present or may be in such low numbers that hatcheries may be needed to develop brood sources either from (1) the remnant fish in the Elwha or (2) the nearest compatible brood sources outside the basin. For stocks of winter and summer steelhead, cutthroat trout, and native char, existing resident populations may be producing seagoing smolts sufficient for restoration, or they could be placed in hatcheries to increase their numbers. More detailed descriptions of stock status are available in Appendix G of The Elwha Report. In developing hatchery brood sources, measures will be taken to protect the genetic integrity of the donor stock and the hatchery stock introduced into the Elwha. Second, continued hatchery production in the lower river may be needed during dam removal to maintain existing stocks of coho salmon and steelhead if adverse water quality conditions arose from sediment releases. Third, hatcheries might serve as brood sources for salmon and steelhead outplanting in the upper river after dam removal. Outplanting could accelerate restoration of anadromous fish without adversely affecting the long-term genetics and success of the restoration program (Wunderlich and Pantaleo, 1995). Refinement of methods and sunset clauses on hatchery restoration would be further investigated in the Implementation EIS.

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Q: Commentors asked what the impact of large amounts of sediment loading on fish would be and whether fish would find "refuge" in pools created by river channels.

A: Although some fish might find refuge from high sediment loading of the river, it is primarily the finer or smaller particles--silt and clay--that affect them. These fine particles are likely to be in suspension through the water column, and would be difficult for fish or other aquatic life to avoid. Several options for protecting immigrating fish from sediment washing downstream, such as catching them during clean water times and moving them to off-river clean water areas or creating holding areas within the river that would not be subject to the sediment loads (above the dams, for instance) would be fully analyzed in the Implementation EIS.

Q: One commentor suggested that the slough at the mouth of the Elwha should be reopened to the river as an excellent smolting area for the "dog salmon."

A: The slough (Bosco Slough) area directly east of the mouth is accessible to and from the mainstem Elwha River. Bosco Slough was historically very important as spawning and rearing habitat for chum salmon and other species. The Flwha S'Klallam Tribe is presently working to improve the habitat in the slough by routing more water through it, flushing fine sediment out of the upper end, and restoring high quality spawning areas for natural fish production.

Q: Why restore native anadromous fish, rather than counting on hatcheries to supplement populations? The Department of Fisheries is taking only a certain quota of spawning chinook from the Elwha. Why does the state take only some of the eggs and let other spawn in the river if taking more eggs would produce larger runs?

A: Hatcheries and other artificial production facilities can accommodate only a certain number of fish. This production level may be the result of physical space limitations, water limitations, or budget constraints. Artificial fish production also may be limited to minimize impacts to naturally spawning fish populations in adjacent streams or rivers. In the Elwha, the Washington Department of Fish and Wildlife egg takes have been limited by the numbers of adult chinook salmon returning to the river. Although the department has always supplemented the egg take from fish that return to the channel trap by gaffing spawning chinook in the river, they seek to avoid taking too many naturally spawning fish so that production occurs both in-river and in the channel.

Naturally spawning fish are subject to natural environmental regulators that result in the unique genetic characteristics of fish stocks. In contrast, animal husbandry (e.g., raising fish in a hatchery) imposes constraints, either intentional or unintentional, that result in an organism poorly adapted to the natural environment. After a few generations, a highly inbred population may result (Davidson et al., 1989). It has been demonstrated that hatchery trout stocks have genetically changed from the indigenous source populations (Reisenbichler and McIntyre, 1977; Allendorf and Phelps, 1980). Maintenance of naturally spawning populations in the Elwha River help maintain natural genetic selection, as well as avoiding the risk of losing the chinook stock through the loss of hatchery production. For example, since the Elwha facility is not equipped to raise fish from egg to smolt, the eggs used to be shipped to the Solduc Hatchery. When diseased fish were found in the Solduc facility, one brood year of Elwha chinook had to be destroyed to prevent disease transference back to the Elwha. Naturally spawning fish in the Elwha maintained that brood year.

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Q: Will fish be affected by sediment releases; if so, how will fish be collected for removal to clean water areas?

A: Some fish could die from sediment releases resulting from dam removal. However, the numbers (if any) would depend on the sediment methodology. Sediment releases can be managed by how the dams are removed and how fast. It may also be true that the Elwha fish would be less sensitive to sediment than conservative estimates. A case in point is the recorded return of an adult steelhead captured through electroshocking in the North Fork Toutle River only three months following the eruption of Mount Saint Helens when the river was still highly turbid.

Fish are commonly captured in rivers by electroshocking, whereby an electric current is used to stun fish. Electroshockers can be mounted either on a backpack or on a boat. Other methods include hook-and-line, beach seining, and trapping. Gill netting can also be used to capture adult fish without injury; a mesh small enough is used so that the fish get their snouts and teeth hooked in the net without allowing the mesh material to reach the gills. Gill netting in this manner has been previously used on the Elwha River (see Winter, 1989). Many of these options for capturing and temporarily relocating anadromous fish, if needed, would be explored in the Implementation EIS.

Q: In the EIS, the Department of the Interior states that some management of the fisheries is needed, including a complete closure of the coho commercial fishery, to restore Elwha stocks. Interior does not have the power to enforce these needed management measures. How will these cuts in the catch of tribal, recreational, and commercial fisheries be implemented?

A: The environmental impact statement does not state that commercial fishing for Elwha River coho salmon would be closed; it states that hatchery production would be "phased out" over a number of years to move to a natural stock fishery. In fact, additional closures on any of the stocks would be minimal. (See the question in this section on time to achieve full restoration for additional information.)

Harvest management within Washington State waters is primarily conducted by the Washington Department of Fisheries and Treaty Tribes (see also The Elwha Report, p.15) consistent with the Puget Sound Salmon Management Plan, although federal agencies provide input. The Department of the Interior has met individually with both the state and the Lower Elwha S'Klallam Tribe and is satisfied that additional harvest restrictions, if any, necessary to restore the Elwha River would be implemented.

Q: How will Interior set target escapement numbers and how will it commit to achieving them.

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A: Interior would consult and coordinate annually with the other fisheries managers (the state and tribe) to set escapement goals for each fish stock. These goals would vary (usually upward until restoration was achieved) based on restoration response of the stock and, for some, on the rate of phasing out of hatchery production. Each of the fisheries management agencies and the tribe are committed to providing adequate escapement to fully restore the native anadromous fisheries.

Issue: Tribal fishing practices

Q: What are the Lower Elwha S'Klallam Tribe's rights to Elwha River fish?

A: Treaty tribes are entitled to up to 50% of the harvestable surplus of salmon and steelhead returning to their treaty-reserved fishing places. In the state of Washington, the tribes collect data and develop fish run size estimates in consultation and coordination with the Washington Department of Fish and Wildlife consistent with the Puget Sound Salmon Management Plan. Over the years from 1989 to 1992, tribal and non-tribal fisheries in Washington have harvested:

Year	Non-Tribal	Tribal
1989	4,855,000	4,752,000
1990	3,078,000	2,968,000
1991	4,788,000	4,040,000
1992	1,999,000	1,772,000

(Hoines, 1994, 1995, and Washington Department of Fish and Wildlife, January 1995)

The Elwha Tribe, and all Treaty Tribes of western Washington, are bound by the decision of U.S. vs. Washington in that they must take any steps "reasonable and necessary" to meet the burden of conservation. This responsibility is shared equitably with the state of

Washington.

Q: Commentors asked Interior to explain the impact of the Boldt decision, full-mouth netting, and escapement on current and future Elwha River fishing stocks.

A: Cutting off approximately 93% of the accessible habitat by installing the Elwha Dam caused immediate and tremendous reductions in fish production. Nevertheless, many salmon and steelhead continued to return to the river, but their numbers decreased with time. Although commentors suggested that the Boldt decision, upholding Treaty Tribes' right to 50% of the harvestable salmon and trout, resulted in large decreases, no evidence was found that fish numbers in the Elwha declined abnormally following the Boldt decision.

The Boldt decision requires both the Treaty Tribes and non-Indian management agencies to maintain fish stocks by allowing adequate escapement (fish allowed to spawn). While non-Indian commercial and recreational fishermen capture a large portion of their harvest in marine areas before the fish return to the rivers, most Treaty Tribes prefer to take much of their harvest share in the rivers. In the Elwha, treaty fishermen often use gill nets hung from lines stretched across the river. Individuals viewing this activity may mistakenly believe that the line across the river represents a net hung fully across the river or its mouth; closer examination reveals that the net is hung across only half or less of the river width. The tribe limits the stretch across the river, the distance between the nets, the time, and the place of fishing to provide for adequate escapement.

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Although the Boldt decision resulted in increased economic benefits from fish harvest for the tribes, they were historically major harvesters of the Elwha River fish stocks. Prior to the arrival of European settlers, harvest of the fish was "economic" and cultural. The economic value of harvest to the tribe prior to the Bolt decision is not known, but some of the fish could be harvested and sold. Had the dams not been present, there probably would have been more tribal harvest of these fish.

Issue: The effect of dam removal on water temperature; fish disease present in the lower part of the Elwha River

Q: How does removing dams cure fish disease?

A: Removal of the dams would not cure fish diseases, per se, but would improve conditions that influence its occurrence. Higher water temperatures generally exacerbate fish diseases. The two reservoirs store heat, resulting in elevated water temperatures downstream, primarily during the late summer and early fall (Draft Staff Report p.3-23). Chinook salmon returning to the river at this time of the year are most susceptible to diseases and the compounding effects of higher water temperatures. Removal of the dams would reduce water temperatures as much as 4 degrees C in the summer. In addition, removal of the dams would allow the chinook (the spring run, in particular) direct access to the upper watershed to hold in deep, cool pools and to spread out, thereby avoiding the crowded conditions of the lower 4.9 miles of river. Crowding results in further stress to the fish and greater conveyance of diseases from one to another.

Issue: Use of modern technology to pass fish through the dams, as on the Baker

River system

Q: Commentors challenged whether removing the dams would be more effective than fish passage measures such as those on the Baker River System.

A: (Also see Alternatives section) Approximately 16,000 sockeye salmon returned to the Baker River system in 1994, the largest returns on record. However, it only tells one small part of the story.

The Baker Lake fish collection barge was first put into operation in 1960 (Warner, 1961). By artificially creating waterflow through the barge exceeding that of the surrounding reservoir water, fish are meant to be attracted into the barge and collection system for transport around the dam. The effectiveness of the system is measured as the "fish guidance efficiency"--the percentage of those smolts migrating downstream that are captured in the trap. It is estimated each year by releasing a known number of marked hatchery coho salmon smolts above the trap and recovering those that enter the trap.

Prior to 1988, the apparent fish guidance efficiency was between 2 and 12%. Since 1988, following the installation of a barrier net that stretches bank to bank and from the water surface to the reservoir bottom, the efficiency has ranged from 27 to 73%, averaging 50%. Therefore, of the smolts migrating downstream, only half on average are captured to transport downstream.

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Additional losses of fish occur as a result of the transport process. The Washington Department of Fisheries marked coho salmon smolts captured in the Baker trap and released below the dams. These fish were recaptured in a trap on the Skagit River at only a 70% rate of marked fish captured and released in Skagit River tributaries upstream of the Baker River. Much of this difference can be accounted for only by mortalities (Dave Seiler, personal communication, Washington Department of Fish and Wildlife, Olympia, Washington, 1995).

Supplementation, the release of hatchery fish to augment the numbers of naturally produced fish (see questions on hatchery fish in this section for additional information on associated problems), is necessary to achieve a desired escapement of approximately 4,000 coho to the Baker system. For the brood years 1989 to 1993, an estimated 30% of the returning coho were from natural production while 70% were from hatchery production. Chinook salmon do not appear to sustain themselves either (Steve Fransen, personal communication, U.S. Fish and Wildlife Service, Olympia, Washington, 1995). The Baker system has generally not been managed for the natural production of steelhead.

The fish guidance efficiency for pink and chum salmon is very poor. For example, 6,123 adult pink salmon of the 1993 brood were transported to the upper Baker. During the 1994 spring outmigration period, only 45 juvenile pink salmon smolts were collected and transferred downstream. Nine adult chum salmon were transported upstream and no juveniles were collected.

The fish passage systems described in this document for the Elwha River (see Dam Retention alternative) provide much greater passage efficiency than that of the Baker system. The Department of the Interior expects that the Baker fish collection and transport system will require extensive review and comparison with more current technologies during the upcoming relicensing process for that project.

Q: Would less expensive Eicher screens work on the Elwha River dams?

A: The Department of the Interior participated in the extensive testing of the experimental Eicher screen at Elwha Dam. Although the Eicher testing program was never completed by the Electric Power Research Institute and James River, the results indicate that this experimental technology offers promise for passing fish past Elwha Dam and projects with similar configurations. Conventional screen and bypass systems can provide results similar to or better than the Eicher screen system, but generally at greater cost. The dam retention alternatives propose the installation of Eicher screens at Elwha Dam with a failback to conventional screens if the expected performance is not achieved by the Eicher system. Because of the high head at Glines Canyon Dam (the greater the fall of water, the greater the head of pressure produced within the penstock), the Eicher screen was not proposed to pass fish at Glines. Additional testing would be necessary if the Eicher screen was proposed for Glines Canyon Dam.

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Regardless of the screen system used, juvenile fish must reach the dam in order to be screened and bypassed. Most juvenile pink and chum salmon would not pass through the reservoir and reach the dam to be bypassed. Losses of other salmon in the reservoirs also occur, but in lower numbers. Neither installation of Eicher screens nor other technology at either dam would solve this problem.

Issue: Enhancement vs. restoration

Q: Some commentors believe that full restoration is impossible and fisheries enhancement is a more accurate term and goal for the Elwha River.

A: Removal of the Elwha and Glines Canyon dams would be a restoration, not an enhancement project. Removal of dams and restoration of fish runs is not an "unproven theory." Dam removal and fish restoration has been done on the South Fork Clearwater River in Idaho and the Mad River in California (Winter, 1990). Fish runs have been established in habitat previously barren of anadromous fish (as the upper Elwha is now) in the South Fork Skykomish River and Deschutes River (Seiler et al., 1981). Fish are being restored in the Toutle River following the eruption of Mount Saint Helens (Lucas, 1985).

The Department of the Interior is currently assisting the Washington Department of Fish and Wildlife and area tribes in restoration efforts on the Dungeness and Hoh rivers. The problems in the Dungeness River include too much gravel and too little water; the Hoh has been impacted by timber harvest activities. While enhancement is the common terminology applied to such efforts, restoration of the runs would be more descriptive. (See Issue titled "Definition of full restoration and how long would it take to achieve it" above for more information.)

Issue: Use of experimental dredging and sediment deposition below both dams to increase certainty of the effects of sediment on the fisheries

Q: Comments were received about experimental dredging and deposition to restore downstream silt and gravel migration below both dams to a degree beneficial for fisheries. Commentors noted that mimicking nature with maximum bedload movement during peak flows may not always be beneficial for fish egg or alevin (early juvenile) survival. By the same token, excess deposition during low flow periods may accumulate to exaggerate impacts of bedload movement during subsequent peak flows.

A: Sediment could be transported below both dams, but would not result in fish restoration. Pink and chum salmon cannot be restored as long as Lake Aldwell remains, regardless of whether gravel is provided to the middle or lower river. Such a scheme also would be expensive and have additional impacts to the park and potentially to species listed under the Endangered Species Act (e.g., noise effects on spotted owls and marbled murrelets).

Salmon and steelhead have evolved in fluctuating and unstable environments. While high bedload movement during peak flow could result in mortalities during the incubation period, salmonid populations are generally dispersed enough to overcome such losses. Also, deposition does not occur during low flow periods, so does not exaggerate the impacts of bedload movement during later peak flows.

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Issue: Restoration and/or passage of pink and chum salmon

Q: Commentors noted that the Federal Energy Regulatory Commission goal was not full restoration and that their fish passage measures never included those for pink and chum, including increasing drawdowns. The commission focus for fish passage was the "high-value" chinook, coho, and steelhead, and not "lower value" pink and chum.

A: Two of the Federal Energy Regulatory Commission's "three principal resource objectives" were "(1) restoration of anadromous fish production throughout the Elwha River Basin" and "(2) restoration of natural environmental conditions within [Olympic National Park]" (FERC, 1993). The commission addressed fish passage for all species, including pink and chum salmon, and concluded, consistent with federal, state and tribal fish and wildlife agencies and the consultants for James River, that extremely poor reservoir passage would preclude restoration of pink and chum salmon with the retention of Elwha Dam, regardless of any fish passage facilities at the dam. Experiments on the Columbia River to assist the downstream migration of chinook and sockeye salmon smolts involve reservoir drawdowns to as closely as possible mimic the natural river velocities. Since water withdrawal at Elwha Dam is by means of a surface diversion, drawdown to increase velocities is not possible for this reservoir. To maintain river flow in the event of a turbine shutdown, Lake Mills cannot be dropped below the level of the spillway. Interior was a full participant in the commission's fish passage deliberations and incorporated all practical measures that would aid the passage of all species, including pink and chum salmon through the reservoirs.

The statement that pink and chum salmon are of lower economic value so "there has been less emphasis in designing passage facilities to accommodate their special needs" is not true. Both the Washington Department of Fish and Wildlife and the National Marine Fisheries Service have developed fish passage criteria for the equally important species of pink and chum salmon. These criteria are constantly upgraded as new information and technology becomes available, as is true for all salmon species. New fish screens for the Yelm Hydroelectric Project were based on the needs of pink and chum salmon, species that require more stringent fish passage designs than other salmon because of their comparatively reduced swimming abilities. In addition, the fish ladder designed for that project adequately passes adult pink salmon. Once again, fish passage facilities are not the problem; getting juveniles through the reservoirs is.

Q: Public comments during The Elwha Report process suggested construction of a channel or tube to bypass fish around the reservoirs, particularly pink and chum.

A: This alternative has several significant problems associated with it (see Elwha Report, p.226 of Appendix M). Passing fish down an artificial channel offers no particular engineering problems, assuming a feasible channel route could be located. However, fish would have to be directed from the Elwha River into the artificial channel, and this would be difficult. To be effective, a large amount of screen attached to a low dam would need to be built. The surface area and porosity of screen required varies; for pink and chum, current screen criteria require that water velocities approaching the screen not exceed 0.4 feet per second. Based on mean average daily flows during the outmigration months of March to June, more than 4,200 square feet of screen would be required. Since fish would migrate downstream during the entire year, the diversion facility would probably be designed to pass the relatively common flow of 10,000 cubic feet per second. To ensure velocities would not exceed the required 0.4 feet per second, 25,000 square feet of screen arranged in a deep "V" would be needed to direct pink and chum into the channel. Potential icing problems and litter washing down the river would present a virtually impossible task of keeping the structure clean enough to maintain velocity criteria and prevent screen failures. Because of this and cost, Interior does not consider building a channel around Lake Mills or Lake Aldwell to be a practical alternative.

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Q: A comment was received stating that there are no self-sustaining populations of pink or chum above dams or reservoirs because these species historically spawn in lower river areas, and dams are in the upper rivers.

A: We respectfully disagree. Pink and chum populations can be found above dams with small backwater areas (e.g., the Yelm Hydroelectric Project on the Nisqually River in South Puget Sound), but they are not maintained above large impoundments even when fish passage facilities are provided (e.g. Baker Lake).

Q: Clarification was requested of EIS findings implying that passage of pink, chum, and sockeye is not feasible. Commentors note that the Skagit system, Lake Washington, and Fraser River have had success using fish passage measures for these species.

A: For pink and chum salmon, see response above. The environmental impact statement does not imply that sockeye salmon fish passage is not feasible. Sockeye passage at Elwha Dam is estimated as unfavorable to marginal. The Eicher screen is proposed for Elwha Dam, a technology that can result in greater smolt contact with the screen surface. Because sockeye salmon smolts tend to lose their scales as smolts more so than any other salmon (Elwha Report, 1994), fish passage for this species was rated down, but not out.

Issue: Indirect impacts of power generation from other sources on salmon population

Q: A request was received that the environmental impact statement include the indirect impact on other salmon populations from power sources that would be used to replace the power now provided by the Elwha dams. The commentor thought that other dams providing replacement power would need to release more water for salmon to migrate.

A: Because of the relatively small amount of energy produced, no specific project has been identified to replace the power from the Elwha and Glines Canyon projects. Rather, a mix of resources, including energy conservation, would make up the difference (see Elwha Report, p.123). Also, hydropower projects are required to produce power within the framework of their individual mitigation requirements. If those requirements adequately mitigate the impacts of the project, there would effectively be no additional impacts to other salmon populations.

Issue: Use of Elwha River as a pilot program area to raise salmon as now used in the Cowlitz hatchery

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Q: A suggestion was received that the Elwha River should be used for a pilot program to maximize egg production, fertilization, hatching, and growth of naturally smart smolt that would return to the sea past dams and impoundments; the entire returning run could be used for commercial products while still maximizing egg production. The commentor suggested that a system used in the Cowlitz hatchery be installed for total capture, sorting, ripening, and spawning of salmon for fertilized eggs as close as possible to the river mouth. All non-spawners would be sold and the spawners would be ripened in ponds. Carcasses would be smoked and sold. The commentor notes that this system does not require fish ladders.

A: This scenario would not restore the ecosystem and would be inconsistent with treaty reserved fishing rights of affected tribes. A "pilot program" is unnecessary since we already have hatchery propagation in lieu of fish passage measures at other locations, including the Cowlitz River. Also, ladders are not necessary for Cowlitz River fish to return to that hatchery.

Issue: Historical access; data

Q: To what extent have salmon and trout had access historically to the upper reaches of the Elwha River given the presence of falls below the dams.

A: There is no documented record of any falls below either dam that permanently blocked adult upstream migration of salmon or steelhead. Historical access to areas above Glines Canyon Dam is not completely known for all species. It is possible that the rapids in the reach above Lake Mills (Goblins Gate area) may have inhibited or stopped upstream migration of pink and/or chum salmon since these two species do not pass barriers as well as some other salmon and steelhead stocks. A falls at river mile 33.7 on the mainstem river (18 miles above the Glines Canyon Dam), at times, may have stopped upstream passage of chinook and coho salmon. Successful passing of these falls would have been dependent on the flow at the time the fish were attempting to pass and condition of the fish. "Partial" barriers such as this can lead to the spatial separation of a species resulting in distinct run timing (e.g., spring and summer/fall chinook salmon). Steelhead are unlikely to have been impeded by these falls and would have had access to all of the mainstem Elwha River.

Q: Any historical fishing records for the Elwha? Please provide.

A: Summary data is available in the Draft Staff Report.

Flooding

Issue: Condition and management of existing levee system and flood impact to downstream structures

See Comment Letters: Caltrider, Melanie I. - C97; City of Port Angeles - C43; Craker, Marion F. &. Helen - C85; Dry Creek Grange #646 - C596; Ensor, Lavonne - C560; Hampton, Haidie M. -C107; Hartford, Kenneth - C471; Johnson, David Sirrine - C93; Ladley, Russ - C310; Lauderbaugh, Jack and Besteman, Laurie - C26; Main, Jerrine and Earnest - C336; Okanogan County Citizens Coalition - C552; Olympic Park Associates - C612; Philpott, Carol – C116; Warber, Brenda - C151; Washington Department of Natural Resources - C577

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Issue: Condition and management of existing levee system and flood impact to downstream structures

Q: A number of questions were raised about the effect of dam removal on large floods and river "aggradation" or increases in riverbed elevation. Commentors wanted to know whether their property would be flooded, and whether impacts would be mitigated.

A: Flooding is a source of concern at the Elwha River mouth, with or without the dams in place, as levees on both the east and west side of the lower river indicate. Lake Mills and Lake Aldwell capacities' for flood control are small to none; they provide only minimal flood protection and only for short duration events. The dams are operated in a run-of-river mode most of the year, mimicking natural flow regime. Although hydrologic information shows there were some differences in pre- and post-dam flows (small floods were slightly larger before the dams were built), they are very small in comparison to their absolute magnitudes.

Both magnitude and frequency of flood events would change somewhat with removal of the dams because the riverbed and surface water elevation would rise (or aggrade) to approximate pre-dam levels (i.e. what it would be if the dams had never been built). In some places, the river might overflow its banks more often, causing localized flooding. Also, the channel could migrate more with greater erosion and sediment deposition along its length. Since flood level is a function of several factors (channel area, discharge, slope, channel roughness, velocity, and channel form), an increase in the volume of riverbed material does not cause a linear increase in flood elevation. More work would be required to determine where local flooding would occur if the dams were removed. Modeling is now underway to more specifically predict the degree of riverbed aggradation; this information would be available in the Implementation EIS.

Q: Commentors questioned the methodology used to predict the degree of flood that could occur if the dams are removed.

A: The methodology in predicting flood stages after dam removal is directly related to the sediment transport modeling, which was covered in the Draft Staff Report. To summarize the modeling approach used by the Federal Energy Regulatory Commission, observed water surface elevations were available at 1,568 cubic feet per second and 3,481 cubic feet per second for the lower river and were measured at 248, 1,200, and 12,000 cubic feet per second at 18 middle reach cross-sections. Calibration of the hydraulic model in the lower reach was a compromise between matching the observed low-flow water surface elevations and duplicating the original U.S. Army Corps of Engineers calculation for flood flows along the set-back levee at the river mouth. The Elwha hydraulic model was converted to a sediment transport model (HEC-6) that was intended to estimate sediment transport and flood levels; calibration was for the higher flow range.

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Hydraulic modelers hope to mimic observed conditions within approximately 0.5 foot in hydraulic models. Model calibration in the lower Elwha River at cross-sections upstream of tidal influence was within 0.5 foot of observed elevations for both flows at four cross-sections, within 1 foot at one flow and one cross-section, and within 2 feet of observed water surface elevation at one flow at two cross-sections. The middle reach consists of a sequence of high gradient riffles and lower gradient pools that would have required far more surveyed cross-sections than were practical to obtain at the time. Calibration at most of the middle reach cross-sections was within 0.5 and 2 feet. At several cross-sections, the calibration was poor, but considered adequate for routing sediment delivered from upstream, which was the main purpose of the model. Additional modeling of the potential impacts is being analyzed based on new cross-sections surveyed by the Bureau of Reclamation and Corps of Engineers.

The modeling approach and calibration are presented in Appendix C, Section C.2.l of the Draft Staff Report (Volume I). When sediment transport is added to the HEC-6 model, flood levels depend on how fast sediment is released, how fast it moves down channel, and on the hydrology during the decade after sediment release. The models provide examples of what could occur. The models also allow us to compare how the river could respond to various alternatives.

Mitigation, including upgrades to the levee and water supplies, is discussed in this document, and would be more fully analyzed for public review in the Implementation EIS. The flooding and sediment analysis in the Implementation EIS would include the timing of lowering the reservoirs incrementally, both to control flooding and for worker and resident safety.

Q: Many specifically questioned the structural integrity of the existing levee system and how it would be modified to protect residences, historic structures, the fish hatchery, etc. from increased flooding.

A: The federal levee, constructed to U.S. Army Corps of Engineers specifications at the mouth of the river, was designed to provide a 200-year level of protection. No evidence of failure has been observed to date. The possibility of a major flood exceeding design capacity and causing a big washout is very remote. Mitigation for any impact to the levee from dam removal to ensure its original design level of protection would be explored and analyzed in the Implementation EIS. The Corps of Engineers is also investigating the west side levee and other flood protection measures and would recommend any structural changes necessary to maintain the present level of protection.

Q: One commentor noted that there was a bad storm in December 1993 and thought that, without the dams, the lower Elwha would be under water.

A: The two dams on the Elwha River did not provide any reduction in discharge to the lower Elwha valley during the December storms. Conditions during the storm would have been the same with or without the dams.

Q: A number of commentors advocated that the existing levees be removed so that natural flood events would not be artificially controlled, but questioned the effect of levee removal. Some view levee improvements in the lower river as potentially inconsistent with the restoration of the braided delta habitat that was a key component of the system's historic anadromous salmonid production.

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A: The largest levee is the federal one on the east side of the river near the mouth. This structure protects 700 acres and much of the Lower Elwha S'Klallam Tribal reservation from a 200-year or less flood. However, it is set back a distance from the river, well out of the range of the natural meander. Because of the setback, the construction of the federal levee did not significantly affect channel morphology, wetlands, or the riparian vegetative zones in the lower river. The levee on the west side of the river constrains westward migration of the river channel and cuts off a relatively small portion of the former estuary. Although the removal of this levee on the west bank would restore this portion of the estuary and probably result in a larger post-project estuary, its removal is not necessary to fully restore the ecological functions or anadromous fisheries of the Elwha River. Removal of the levees is not authorized by the Elwha Act and is not being pursued.

Indian Trust Assets

Issues:

- Fulfillment of the federal government's legal responsibilities now and in the future to protect resources that may be impacted by the removal of the dams and restoration of the ecosystem
- Commitment from Lower Elwha S'Klallam Tribe to abide by fishing restrictions

See Comment Letters: Henry Sr., William P. - C249; Tveit, Mrs. Larry - C413; Hilt, Dowell - C477

Issue: Fulfillment of the federal government's legal responsibilities now and in the future to protect resources that may be impacted by the removal of the dams and restoration of the ecosystem

Q: Some commentors asked for more details about how the federal government would fulfill its legal mandate to protect resources impacted by the project for tribal use now and into the future. Some maintained that the tribes needed to take specific actions to protect the fishery during river restoration.

A: Maintenance of the restored ecosystem and fisheries in consultation, coordination, and co-management with the tribe would protect treaty resources following dam removal. The tribe has indicated its intention to undertake the actions necessary to protect the fishery during restoration.

Q: Some questioned the economic gain to the Lower Elwha S'Klallam Tribe if the Elwha River were restored and whether this would be in the tribe's best interest. (Also see responses under the "Alternatives," "Cultural Resources," and "Socioeconomic" sections)

A: The tribe's valuation of the "gain" that would be achieved includes non-economic gains such as restoration of cultural and religious sites in addition to tangible, traditional economic values. Whether it is in the tribe's best interest is for the tribe, and not this environmental impact statement, to determine.

Authorization of the two dams, which preempts tribal treaty fisheries in the Elwha River, violates the Treaty of Point No Point and the federal trust responsibility to protect treaty fisheries as well as other trust resources. The Proposed Action would fully restore the Elwha River ecosystem and native fisheries, and uphold the federal trust responsibility to affected Indian Tribes. All other action alternatives would partially restore the ecosystem and native fisheries in varying degrees, but would not uphold the federal trust relative to the fisheries resource and access to usual and accustomed fishing places.

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Q: One commentor alleged the draft environmental impact statement was in error to state Klallams were party to the Treaty of Point No Point, as the Jamestown Band was not given treaty rights until 1981.

A: It is incorrect to state that the Jamestown Band was given treaty rights in 1981. All of the three federally recognized Klallam Tribes-Elwha, Jamestown, and Port Gamble--are successors to the Klallam signers of the Treaty of Point No Point. By that treaty, the Klallams reserved hunting, fishing, and gathering rights to which the United States promised to give legal protection. The Jamestown Tribe was recognized by the federal government in recent times as having continued its governmental existence since the treaty. Its fishing rights were affirmed in federal court.

Issue: Commitment from Lower Elwha S'Klallam Tribe to abide by fishing restrictions

Q: Commentors were concerned that the tribe would not abide by any fishing restrictions necessary to complete fishery restoration. Some suggested the tribe commit in writing to honor any such restrictions.

A: It would not be appropriate for the tribe to commit to fisheries restrictions in an environmental impact statement. As a practical matter, the tribe, as is the state of Washington, is bound by federal law and the rulings of the court in United States v. Washington to those fisheries restrictions necessary to conserve and improve anadromous fisheries (see responses to related issues in the "Fisheries" section). The Department of the Interior is satisfied that the tribe and the state will manage fisheries to meet restoration goals.

Land Use
Issues

- Future management plans for project lands; how private property might be affected by future management of project lands
- Mitigation of impacts to public and private lands and property.
- Impact of dam removal on uses of Ediz Hook and consequences of transferring property there to the Lower Elwha S'Klallam Tribe
- Access to the river corridor after dams are removed
- Acknowledgment of Glines Canyon Gorge as an esthetic resource
- Development of interpretive opportunities after dams are removed for public education
- Impact of disposal of demolition waste material

See Comment Letters: Hartford, Kenneth - C471; Michalczik, Joe - C578; Washington Department of Fish and Wildlife - C577; Washington Department of Natural Resources - C577

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Issues: Future management plans for project lands; how private property might be affected by future management of project lands

Q: Commentors asked for clarification how the project lands would be managed and what entity would be responsible for management in the future. Some commentors had suggestions for who should manage project lands once the dams are removed. Washington Department of Natural Resources indicated it would like to ensure that the lands are managed to achieve objectives of the proposal and comply with Wild and Scenic Rivers Act. The department also said it may be interested in acquiring some of the land if public access provisions are not guaranteed and/or may now be interested in acquiring some of the Lake Aldwell lands and cooperatively managing them with the tribe.

A: Several options for management of lands associated with the Glines and Elwha hydroelectric projects would be explored in the Implementation EIS. Lands acquired that are now part of the Elwha Dam project may be managed by Olympic National Park, by the state of Washington, held in trust for and used by the Lower Elwha S'Klallam Tribe, or co-managed by multiple entities. Projected land uses and impacts for each of these scenarios would be examined in the implementation EIS. A fourth option, to be placed in a wildlife refuge and managed by the U.S. Fish and Wildlife Service, has been rejected by that agency (the Elwha project lands are not believed to be large enough for a suitable refuge). More information on land use options and their impacts would be part of the Implementation EIS.

The Department of the Interior is aware of the Washington Department of Natural Resources interest and involvement in the land issues and plans to continue dialogue in areas of mutual concern.

Q: The Washington Department of Fish and Wildlife asked that the majority of project lands remain in a natural or semi-natural state to preserve biological integrity of the river corridor and compensate for wildlife resources lost for the 60-80 years since the dams were built. It recommended economic, residential, or mixed use be minimized and confined to already disturbed areas, and asked that criteria to preserve land in its natural state include low gradient areas as well as land with steeper slopes.

A: The Implementation EIS would further examine land use options. However, criteria for management of the lands may be a third stage of planning outside the jurisdiction of the Department of the Interior, within the control of the newly designated owner or manager.

Q: Some commentors suggested that the National Park Service acquire James River land at the state rearing channel to convert these lands within the floodplain to their original use. Others suggested that the Park Service buy a large corridor north of Highway 101 and turn the land over to the tribe for economic development.

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A: The Elwha Restoration Act authorizes only the acquisition of project (dams and reservoir-related) lands owned by the James River Corporation. Any addition to a national park must be approved by Congress. The Department of the Interior is not seeking to acquire additional lands to provide a "land corridor" along the Elwha River. Interior will not manage any lands outside the project boundaries. The Lake Aldwell lands are currently managed by James River and Daishowa America for hydropower production and timber management. Future management of these lands will depend on disposition (to the state of Washington, to Olympic National Park, or held in trust for use by the Lower Elwha S'Klallam Tribe, according to the Elwha Restoration Act).

To date, the National Park Service has not expressed any specific interest in the lands mentioned except to state ecosystem restoration should not be threatened by future uses of the land. The Elwha Report documented that the Aldwell project lands would qualify for inclusion in the national park system. Whether these lands are transferred to Olympic National Park is up to Congress.

Q: Commentors asked why the Olympic National Park boundary could not be changed to place the Glines Canyon Dam on private land outside the park boundary.

A: Removal of the Glines Canyon project from the park would not meet requirements of the Elwha Restoration Act to restore the ecosystem and native anadromous fisheries, and would not uphold treaty obligations of the federal government to affected Indian Tribes. In addition, a national park boundary revision requires an act of Congress--even land exchanges with Olympic National Forest. The 1986 land exchange between the park and the forest was authorized by Public Law 99-635.

Q: One commentor asked whether the Park Service was going to buy the "third dam site" above Glines Canyon Dam (a 121-acre site, Goblin Gate's, owned by Crown Zellerbach).

A: Crown Zellerbach owned approximately 121 acres in the Rica Canyon/Goblin's Gate area. The National Park Service purchased this parcel in 1984. The only private parcel in this area is owned by James River for the Glines Canyon project.

Issue: Mitigation of impacts to public and private lands and property

Q: Some commentors asked if public and private properties would be prioritized differently for mitigation

A: Public and private properties would not be prioritized differently for mitigation. The Department of the Interior does not contemplate any loss of property, although the U.S. Army Corps of Engineers has not yet completed their flood analysis study. Appropriate mitigation is currently being identified for private wells that could be adversely impacted by dam removal. The feasibility of establishing a contingency fund to cover mitigation costs for unanticipated well impacts is also under investigation.

Issue: Impact of dam removal on uses of Ediz Hook and consequences of transferring property there to the Lower Elwha S'Klallam Tribe

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Q: Some commentors noted that Ediz Hook is used for a variety of purposes (fishing, picnicking, boat launching, log storage, etc.) and wanted to know how these uses would be impacted by dam removal and by the tribe's management of Ediz Hook.

A: Section 6 of the Elwha Restoration Act authorizes Interior to issue a lease to the city of Port Angeles for the lands currently included under the existing lease and to lease lands to the tribe. Under the Act, the tribe would have a long-term lease on 600 feet of the inside of the Hook on which to located a cultural facility. Although this development would have absolutely no effect on other activities occurring on the Hook, the act also explicitly provides for public access to the beach, construction and maintenance of a waterfront trail, and specifies that parking shall be open to the public at all times.

Issue: Access to the river corridor after dams are removed

Q: Comments were received about access to the restored lands after the dams are removed. One commentor asked that a legal easement for an Elwha public trail be developed along the river from the Elwha Dam site to the McDonald bridge crossing. Other suggestions for trails and access were also received and reviewed. The Washington Department of Natural Resources would like public access protected and addressed in any plan for disposition or management of lands acquired. The Department of Natural Resources would like to help develop provisions for public access in the second EIS (for trails, boat ramps, interpretive facilities).

A: Access to the project lands now include both the Elwha and Glines Canyon dams, boat launch sites at the south end of Lake Aldwell and the north end of Lake Mills, and hiking trails along limited sections of the reservoirs' shorelines. The Elwha Report states "with the removal of both dams and the potential connection of trails within Olympic National Park with the City of Port Angeles' waterfront trail, hiking and possibly biking opportunities would increase. Such a trail could become an important interpretive corridor...." (p.44). Olympic National Park proposes interpretive programs with facilities possible at several sites within Glines Canyon project lands if they are acquired. The possibility of access would be generally examined in the Implementation EIS, and explored in even greater detail in a post-EIS planning process.

Issue: Acknowledgment of Glines Canyon Gorge as an esthetic resource

Q: Commentors noted that much of the river corridor can be considered as an esthetic resource, especially the Glines Canyon Gorge.

A: The Glines Canyon Gorge is a dramatic site--as are other locations in the project areas. The specific impacts to this and other selected esthetic sites during dam removal would be part of a visual analysis in the Implementation EIS.

Issue: Development of interpretive opportunities after dams are removed for public education

Q: Many commentors suggested that, if the dams are removed, sites be used to interpret the Elwha River story to the public through educational programs.

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A: There would be extensive opportunities to interpret restored natural systems, at the river, riparian areas, and reservoir sites, if the dams are removed. Additional interpretive themes could include the deconstructed dam sites, the natural and cultural history of the Elwha River valley, impacts on fisheries and wildlife from dam construction, and the history of the dams. The Elwha Report (Appendix J) has more information on interpretive opportunities, as would the Implementation EIS.

Issue: Impact of disposal of demolition waste material

Q: What will be the effect of disposing of dam rubble, in particular on the marine environment and productive forest lands?

A: Options for the disposal of dredged silt and clay to an upland site to avoid impacts to the marine and freshwater environments may be further assessed in the Implementation EIS. The use of concrete rubble and rock from the removal of the two dams for restoration projects and for other beneficial uses, e,g., nearshore reef, would be considered during the evaluation of possible disposal options.

Living Marine Resources

Issues:

- Impacts of an increase in sediment on living marine resources in Freshwater Bay
- Increased sediment impacts to the Elwha River estuary
- Armoring the marine cliffs as a contributing factor in affecting living marine resources

See Comment Letters: Olympic Park Associates - C612; Schmitt, Francis J. - C68; Warber, Garry - C62

Issue: Impacts of an increase in sediment on living marine resources in Freshwater Bay

Q: Comments were received about the potential impact of increased turbidity during and after dam removal on Freshwater Bay, particularly to the bay's living marine resources. Some commentors asked that an outfall to pump slurried sediment, should this method of sediment management be selected, be strategically located to have minimal impacts on living marine resources.

A: A decision whether to pump sediments into the marine environment, or where an outfall would be located if the slurry option were selected, would not be made until all reasonable sediment management alternatives were examined in the Implementation EIS. The Department of the Interior and its bureaus are still reviewing recommendations and concerns from the state and federal resource agencies and the general public, as well as additional biological and hydrological information. This information would be used to provide a sound biological basis for locating a pipeline outfall, should that be the method selected to remove sediment, in an area that would result in the least impact to important biological resources.

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The impacts to plants and animals from pumping sediments into the marine environment would be primarily from smaller sized sediment. Sediment transported by pipeline and discharged to the Strait of Juan de Fuca would consist primarily of silt, clay, and lesser amounts of fine sand. Most silt and clay would not settle out but would instead remain suspended in the marine environment and be widely dispersed throughout the Strait, ultimately settling in deeper areas of the Strait. Fine sand also would be dispersed, but not as rapidly as silt and clay, by the relatively strong bottom currents. If the pipeline outfall were located on or near the shore, an even greater proportion of the fine sand would be transported in an easterly direction along the shore toward Ediz Hook.

Under the natural erosion alternative, silt and clay would mostly remain in suspension and become rapidly diluted with the large volume of marine water. The river and marine environment at the river mouth would appear very turbid during removal.

Larger grained sediment, which is likely to be sent into the marine environment via natural erosion, would initially settle out at the river mouth. Without tidal or littoral currents, deposition of this stored sediment could result in an area stretching approximately one-half to one mile out from the present river mouth, developing into a river delta in the first three years or so after dam removal. Since strong currents and wave energy exist at the mouth of the delta, sediment would subsequently redistribute into deeper water and along the coast.

Barrier bars would develop in front of the delta as they did historically. These bars would change form and be breached periodically depending on river flow and ocean conditions. Such activities are natural events of river mouths with high energy ocean conditions, and would continue after the sediment load returned to natural levels. These conditions are typical of occurrences at other river mouths, such as the Dungeness, under natural conditions.

Q: Commentors asked which species are most likely to be affected, and in particular how will clams fare?

A: The Draft Staff Report and this environmental impact statement predict the probable return of three hardshell clam species--littleneck, butter, and horse clams--in greater abundance than at present. The pre-dam species composition and abundance of these species is not known. However, all thrive on sandy or gravel-sized substrate which would be expected to return if the dams were removed (See Impacts to Living Marine Resources section of this document and FERC, p.4-121).

Species most affected by the temporary increase in larger grained sediment would be sessile and benthic organisms currently within a quarter to a half-mile of the existing Elwha delta, although the actual range of effects may be greater. Species would include organisms such as attached macrophytic algae, clams, and polychaete worms. During the first few years of development, this zone might experience substantial loss of these types of organisms; but, marine life would reestablish within a short period. Mobile organisms such as crabs and fish would be less directly affected because they would be able to move out of the area and later return. However, the food source supplied to these organisms initially might be lost.

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In the longer term, as the existing rocky substrate was replaced with a more sandy bottom, organisms such as large macrophytic algae and various types of snails, mussels, barnacles, and other crustaceans would remain in low abundance. A different set of organisms, such as horse clams, smaller algae species, eel grass, and crustaceans adapted to sandy conditions and possibly lower salinity, would replace these.

Issue: Increased sediment impacts to the Elwha River estuary

Q: What would be the extent of impact to the estuary and its function as a fish nursery, and how long would recovery take if the dams were removed?

A: The Elwha River now has a limited estuary. Only a very small zone near the river mouth, probably less than 300 feet wide, has any estuarine characteristics. Since the river flows almost directly into salt water with no transition area from low to high salinity, there are no habitat types typical of brackish water areas (e.g., eel grass beds, shallow fine sediment pools, and channels). Thus, there is little estuarine habitat to be impacted. The original fresh-salt water interface at the mouth of the Elwha River is estimated to have been at least 1000-2000 feet larger than it is today. This interface was an important habitat for all species of salmonids using the river, as well as for many other aquatic animals and plants.

The increased sediment load and turbidity of dam removal would initially impact the use of this small region, burying much of it in fine sand. When the initial load of sand reached the estuary, currents would begin to distribute sediment, and the development of a new and larger nursery habitat would begin.

Initially, the quantity of sediment may be large, but the wave transport capacity along the coast is high. The U.S. Army Corps of Engineers estimate that waves and currents in the area of the Elwha River mouth and Ediz Hook can move between 250,000 and 350,000 cubic yards per year--the same order of magnitude as the river's estimated pre-dam sediment supply. With the addition of approximately 6 million cubic yards of sand now stored behind the dams, sediment would initially deposit in an area 100 to 500 feet off shore. Coastal currents would immediately start to spread this material into a spit-like landform that would eventually extend 1000 to 2000 feet to the east, forming elongated offshore bars. The net eastward transport would tend to force the main river channels to turn in that direction. During storms or watershed floods, breaks would form in the offshore bars. Areas within the offshore bars receive fresh water from the river and saltwater flows during flood tides. In-flowing salt water contains large amounts of nutrients that support the rich ecology typical of estuaries.

In addition to fueling the growth of the estuary, increases in sand would replenish the nearshore area at the Elwha River mouth. Beaches would be wider with lower beach profile slopes and more offshore bars, adding to the total area within the intertidal zone. Beach conditions would change farther along the coast over many years as the net longshore sediment transport distributed the sand along the coast. Sediment would be completely redistributed along the coast in 15-20 years.

Issue: Armoring marine cliffs as a contributing factor in affecting living marine resources

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Q: One commentor asked that cumulative impacts to Freshwater Bay living marine resources include those which resulted from armoring marine cliffs and the resultant reduction in sediment load.

A: Impacts have been and would be largely to the east of the Elwha River, avoiding impact to Freshwater Bay except during ebb tides.

The Corps of Engineers, during its investigation of the erosion of Ediz Hook, estimated that, prior to the 1914 completion of Elwha Dam, the total sediment supply to the hook from the Elwha River and the eroding sea bluffs to the east was approximately 320,000 cubic yards annually. Of this total, the Elwha is estimated to have supplied 50,000 to 80,000 cubic yards annually, and the eroding bluffs, 240,000 to 270,000 cubic yards annually. The construction of a wooden bulkhead in 1930 and the placement of riprap in 1958 to protect the water supply line reduced the sediment supply from the sea bluffs to approximately 90,000 cubic yards. Corps analysis indicates that waves in the vicinity of Ediz Hook have the ability to transport approximately 270,000 to 350,000 cubic yards annually, which far exceeds the present sediment supply. The sediment transport capacity in the area immediately to the east of Angeles Point would presumably be considerably less because of its more protected location. Because the transport capacity exceeds the present sediment supply, the beach slope has eroded and steepened and now consists of larger substrate and marine species that prefer this kind of habitat. With the return of the sediment supply from the Elwha, some beach areas to the east of Angeles Point would probably return to pre-dam conditions over time, i.e., more gradual slopes consisting primarily of sand and pebbles. As a result, nearshore habitat more suited to such marine plants and animals as sea lettuce, eel grass, flatfish, juvenile lingcod, cragon shrimp, and Dungeness crab would increase.

National Environmental Policy Act Process and Other Legal Issues
Issues

- General NEPA issues; the NEPA process and No Action

- Public participation in the EIS process; tribal role in NEPA.
- Ownership of the dams and the expiration of the Federal Energy Regulatory Commission's license

See Comment Letters: Caltrider, Melanie J. - C97; Clallam Bay/Sekiu Chamber of Commerce -C463; deBord, Linda - C564; Doyle, Genelle A. - C61; Dry Creek Grange #646 - C596; Fant, Karen M. - C547; Hartford, Kenneth - C471; Hulse, Clinton - C153; James River Corporation - C479; Mogck, Cal - C89; North Peninsula Home Builders and Building Industry Association of Washington - C449; Pulkownik, Susan - C334; Reed, Sandra E. - C562; Rescue Elwha Area Lakes - C333; Schwagler, Jacqueline - C598; Tveit, Gary - C462; Tveit, Mrs. Larry - C413; Wise Use Movement - C521

Issue: General National Environmental Policy Act issues; NEPA Process and No Action

Q: Commentors with doubts about the success of ecosystem restoration questioned how a decision could be made without all the "answers."

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A: It is rare that any entity, public or private, proposing any major project understands all possible impacts and the extent, duration, timing, etc. of those impacts. Environmental science deals with complex natural and living systems, yet the National Environmental Policy Act asks federal agencies to do their best to predict impacts and outcomes. This document does that--it uses the best science and specialists available to predict the outcome, knowing that a high degree of complexity and variability is inherent in the project.

Q: Some argued that the "No Action" alternative should be fully analyzed and considered a reasonable, selectable alternative, regardless of whether the Elwha Restoration Act asks for a determination of full restoration of the ecosystem.

A: Analysis of the No Action alternative is required by the National Environmental Policy Act to be a part of any environmental impact statement, and it is fully analyzed in this document. The No Action provides the baseline or environmental yardstick against which to compare action alternatives. The No Action alternative describes conditions as they are now, i.e., with the dams in place and no provisions for fish passage. The impacts of No Action are therefore the impacts the hydroelectric projects have caused. These impact are significant and adverse both in the short and long term. No Action also does not meet the congressional mandate as defined in the Elwha Act or Interior's objectives in fulfilling that mandate. It is Interior's least preferred option for these and other reasons.

Q: Commentors asked for clarification on the impacts of the No Action alternative on the potential for continued litigation, loss of jobs, etc.

A: If the dams remain in place without fish passage measures, litigation over final disposition of the projects and the potential violation of tribal trust rights and laws requiring fish passage would probably ensue. If lengthy litigation was resolved in favor of leaving both dams standing but required the owners to obtain a license to operate, Federal Energy Regulatory Commission-imposed mitigation would cost between $17-$34 million, plus annual operation and maintenance costs. Assuming these costs are passed on to the mill, there might be economic consequences, such as loss of jobs, etc.

Issue: Public participation in the environmental impact statement process; tribal role in NEPA

Q: Some commentors believed there had not been adequate opportunities for involvement in the Elwha Restoration planning process.

A: Public information and opportunities for involvement have been available and extensively advertised since the Federal Energy Regulatory Commission began its formal licensing process in August 1989 and include: two commission scoping meetings, a scoping document sent to all who attended or were interested, a draft environmental impact statement, a draft Elwha Report (later submitted to Congress), an open house to answer questions on the Elwha Report, public workshops for the Department of the Interior draft environmental impact statement, a scoping workshop for the Implementation EIS, extensive periods to submit written comments on all documents, and thousands of pages of material in response to those questions. Notice of these opportunities and paid advertisements were placed in local and regional newspapers; copies of documents were mailed to a very long list of interested parties; and every effort was made to include all interested in the project. The Department of the Interior regrets having missed any interested resident.

Q: Some thought that the method for obtaining public input at the public meetings held in November, 1994 did not allow sufficient opportunity for public comment. Commentors thought that only one side was heard at the meetings. Some asked why meetings were held in Seattle, Washington.

A: The purpose of public workshops, hearings, open houses, or other involvement efforts on environmental impact statements is primarily to gain insight on issues and determine information gaps in the document. Traditionally, agency staff conduct the involvement effort, collect and respond to comments, and rewrite the draft as completely as possible before it is finalized and sent to the agency decision-maker. In some cases, all comments, even if they are not substantive but argue for or against the proposed project itself, are made available to the decision-maker. This is National Park Service policy, and a copy of each letter received within the allotted time period has been included in this environmental impact statement.

Since it is the staff and not the decision-maker who conduct the public workshop or hearing, debate on the pros and cons of the proposal would be misdirected. This is why the Park Service provided a comment form for participants to complete and mail, thereby ensuring that their opinions become part of the record presented to the decision-maker.

The Department of the Interior specifically and deliberately chose the public workshop format, rather than hearings, to encourage public comment. Agencies that routinely conduct public hearings are often criticized for overly formalizing the process by using hearing officers, restricting comment time, requiring commentors to arrive at a certain time and sign up to speak, and using microphones and court reporters. Many members of the public find this combination overwhelming and intimidating, and decline to comment as a result. The workshop was specifically designed to be a comfortable place for all to comment and get answers to their questions. The comments heard at each workshop were recorded, summarized, and are responded to in this final environmental impact statement.

Restoration of the Elwha River is of local, regional and national concern. It involves Olympic National Park lands, which belong to all citizens of the United States. Therefore, workshops were held in Seattle, and information about the environmental impact statement was published in the U.S. Federal Register, a document which is distributed nation-wide.

Q: Comments were received questioning the role of the tribe in the EIS process.

A: The Lower Elwha S'Klallam Tribe is one of several agencies cooperating with the National Park Service in the preparation of the environmental impact statement and the Implementation EIS.

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Issue: Ownership of the dams and the expiration of the Federal Energy Regulatory Commission's license

Q: One commentor asked whether ownership of the dams wasn't supposed to revert to the tribe or a public utility district since their "licenses had expired."

A: The Federal Energy Regulatory Commission, pursuant to the Federal Power Act as amended by the Electric Consumers Protection Act of 1986 and the U.S. Department of Energy Organization Act, is authorized to issue licenses for terms from 30 to 50 years for the construction and operation of non-federal hydroelectric developments. The Elwha Dam has never been licensed; the Glines Canyon Dam license expired in 1976 and it has since operated under annual licenses.

The two dams on the Elwha River are owned by James River Corporation and operated by Daishowa America. The Elwha Restoration Act specifies acquisition of the dams by the federal government.

Q: It was suggested that, in the event the selected alternative does not require removal, a provision should be made in the license to finance the removal of the dams if and when a future decision was made requiring dam removal.

A: This comment would be appropriate to pass on to the Federal Energy Regulatory Commission, should the projects not be acquired by the Department of the Interior and the licensing process reinstated.

Power Generation

Issue:

- Sources and costs of replacement power

See Comment Letters: Caltrider, Melanie J. - C97; Childs, Phyllis and David – C105; Copeland, Delbert - C280; deBord, Linda - C564; Hampton, Haidie M. - C107; Hartford, Kenneth - C471; Julian, Tony - C478; Maupin, Eddie - C48; North Peninsula Home Builders and Building Industry Association of Washington - C449; Okanogan County Citizens Coalition - C552; Pirie, Ken - C284; Rescue Elwha Area Lakes - C333; Schwagler, Jacqueline - C598; Swinford, D. G. - C76; Tisch, Edward L. - C55; Tveit, Mrs. Larry - C413

Issue: Sources and costs of replacement power

Q: Commentors wanted to know the conservation potential at the mill.

A: Daishowa began to rebuild and upgrade conservation measures in 1989. These measures have accounted for an annual savings of 26.6 gigawatt-hours (Draft Staff Report, p. A-137). For the sake of comparison, the two dams on the Elwha River provide approximately 172 gigawatt-hours; the mill's annual requirement is about 400. Power generated by the Elwha and Glines Canyon dams provides approximately 43% of that required to operate Daishowa mill. An energy audit conducted for the Port Angeles Light Department in 1991 identified additional potential savings of 9.6 gigawatt-hours annually, approximately 2% of the mill's load. The source of these savings could be realized by installing adjustable speed drives, high efficiency motors, and a system of motor shedding on refiner lines that would reduce eddy current coupling. Other energy saving items were identified, but their cost effectiveness was not determined in the audit.

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For comments about use of "co-generation" of power at the mill as an energy conservation measure, please see the "Alternatives" section.

Replacement power for the Elwha and Glines Canyon projects would come from any of a wide variety of conservation and electrical generating resources. Recent proposal requests for new power sources by regional utilities have received responses from various conservation projects, hydroelectric facilities, and cogeneration gas projects. Because of the mix of new power sources and the small size of replacement power needed (only about one-third of the mill's power), there would be no significant changes in the regional power supplies (or, as one questioner asked, in the national balance of payments).

Q: Commentors questioned whether costs of providing replacement power would be prohibitive and cause the mill to go out of business. They also asked what the environmental costs of replacement power would be.

A: Loss of hydroelectric generation would represent a marginal decrease in regional energy supply. This deficit would be made up from combined sources available to the regional energy grid and provided to Daishowa at Bonneville Power Administration's preferred industrial rate. Associated environmental consequences might be localized, as in the case of specific generating projects, or widely distributed, as with conservation programs or across Bonneville's regional supply. There would be a slight increase in power plant emissions from the replacement source, depending on the type of facility generating the power. Air emissions are associated with combustion turbines, cogeneration installations, and coal-fired power plants. Both the Draft Staff Report (pps 4-213 to 215) and Elwha Report (pps 128-129) contain additional information on environmental impacts of replacement power sources.

Q: Commentors were concerned about the impacts of a third trunk line potentially needed to supply replacement power to the mills.

A: Bonneville Power Administration intends to construct the trunk line regardless of the outcome of the river restoration project.

Recreation

Issues

- Current use of area and mitigation for loss of reservoir recreation
- Access into the park during dam removal
- Increased use of park lands after fishery is restored and efforts to maintain the "wilderness" character of the park

See Comment Letters: Clark, Robert J. - C599; King, David - C393; Okanogan County Citizens Coalition - C552; Olympic Rivers Council - C271; Rescue Elwha Area Lakes - C333

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Issue: Current use of area and mitigation for loss of reservoir recreation

Q: Some commentors disagree with statements that the Elwha River and/or Lake Mills and Lake Aldwell are not well known for recreation and ask that data on current use be updated.

A: The Elwha area of Olympic National Park is not as heavily visited as other areas in the Park, such as Hurricane Ridge, Lake Crescent, the Hoh River rain forest, or the Pacific shoreline at Kalaloch. To quote the Draft Staff Report, "The Elwha subdistrict generally receives less recreational use than most other subdistricts within ONP. The Elwha district generally receives one-fourth as many annual visitors as the neighboring Hurricane subdistrict, and only one-twentieth the Lake Crescent district."

Current uses on the reservoirs are oriented around fishing and boating. The Draft Staff Report states that anglers spent between 8,500 and 9,500 hours fishing both lakes in the summer of one year. Impacts from these activities include the taking of fish, noise from boat motors, and those of providing access to the reservoirs. Current uses do not create significant environmental impacts, although this document reveals that the reservoirs have had a serious negative impact on the Elwha River ecosystem and native anadromous fisheries.

User numbers and characteristics were investigated and discussed in the Draft Staff Report (p. 3-86) and are included in this document (see "Impacts to Recreation, Esthetics and Land Use" in this document). Other uses of the area are acknowledged, such as surfing at the mouth of the Elwha River, but these dispersed uses were not considered significant. More current user numbers would be provided in the Implementation EIS, if available from federal, state, or local recreation providers.

Q: A number of comments were made about the impact of dam removal on recreational use of the two reservoirs, expressing the belief that mitigation for loss of this use is required.

A: Reservoir recreation would be irretrievably lost or displaced to other reservoirs or lakes in the region. This recreation would be replaced by river recreation activities under the Proposed Action--for instance, river paddle sports would be enhanced. Other area lakes, particularly Lake Crescent, would continue to provide slack water recreational activities. The Implementation EIS would further quantify the economic and social impacts of loss of reservoir recreation and that of increased river recreational opportunities.

Issue: Access into the park during dam removal

Q: Commentors asked whether the Elwha subdistrict of the park would be closed during construction.

A: Access into the national park up the Olympic Hot Springs Road into the upper Elwha River valley during dam removal would probably be restricted to shuttle buses or tours to avoid conflicts with the large amount of construction traffic on the narrow park roads. Also, during the dam removal phase and for the first year thereafter, large sediment loads and increased woody debris or a slurry pipeline along part of the river may make boating use on the river less attractive. Restrictions expected to be in effect for six months to two years might be seasonal, daily, or otherwise staggered. Additional study would be a part of the Implementation EIS and/or the permitting and design phases of the project. (Additional information on access can be found in the question and answer section on Land Use).

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Issue: Increased use of park lands after fishery is restored

Q: How will increased use affect efforts to maintain the "wilderness" character of the park?

A: The wilderness nature of the park would be reinforced through the restoration of the salmon and steelhead runs to the upper Elwha River and the animals that feed on them. Olympic National Park anticipates that restoration of the ecosystem would draw many who are interested in observing restoration in progress and those who would like to fish in an undisturbed, natural setting. The Elwha basin would be like other popular areas of the park that now receive high use. Proper management would prevent overuse.

Sediment Management
Issues:

- Dam Removal impacts on Ediz Hook
- Impact of dam removal on sediment supply and methods and costs for controlling sediment
- Time required to restore landscape
- State ownership of riverbed
- Investigation of options for disposal of concrete debris
- Rate at which sediment would fill Lake Aldwell if only Glines Canyon Dam were removed

See Comment Letters: Henry Sr., William P. - C249; Johnson, Edwin – C115, C287; Ladley, Russ - C310; Loucks, J. & M. - C63; Maupin, Eddie - C48; Mossman, Barbara E. - C75; Olympic Park Associates - C612; Rescue Elwha Area Lakes - C333; Stachorek, Richard W. -C243; Tutton, Thomas A. &. Mary Ann - C99; Washington Department of Natural Resources - C577

Issue: Dam removal impacts on Ediz Hook

Q: Commentors questioned the draft environmental impact statement conclusions on the impact of dam removal on Ediz Hook: How the existing dams and reservoirs and the marine bluffs affect the sediment supply to Ediz Hook and the current and projected costs of maintaining Ediz Hook with and without the dams.

A: Material from the historic Elwha delta helped to create and feed Ediz Hook, an above-surface extension of sand, gravel, and cobbles that forms the bayward side of Port Angeles Harbor (FERC, p.3-20). This material has also nourished beaches and nearshore areas. The drastic reduction in sediment supply from the river has caused some erosion of both beaches and the western edge of Ediz Hook.

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The U.S. Army Corps of Engineers, which spends approximately $100,000 annually to control further erosion of Ediz Hook (U.S. Army Corps of Engineers, Jan.1995), estimates contribution from the river before the dams were built to have been between 50,000 and 80,000 cubic yards per year. Currently, the river contributes a negligible volume of sediment to the Hook. A set of marine cliffs east of the river mouth also helped form and sustain Ediz Hook, but this source, too, has been vastly reduced. In 1930 and again in 1958, the cliffs were stabilized to control erosion and protect the city water supply line at their base. These actions reduced total sediment loads to the area's coastal zone by approximately 55%. Sediment from the Elwha River before the dams were built contributed an estimated 35% of that supplied to the coastal zone.

Q: One commentor suggested that a report by Galster and Schwartz (Ediz Hook--A Case History of Coastal Erosion and Rehabilitation) be reviewed by the environmental impact statement team since it apparently conflicts with the draft environmental impact statement findings on the erosion rates of the marine bluffs and Ediz Hook, as well as the composition of Ediz Hook. The commentor suggested Ediz Hook was composed primarily of Elwha River, and not marine cliff, sediments.

A: The environmental impact statement team, which includes Maurice Schwartz, co-author of the cited study, notes that the reported one-foot-per-year bluff recession rate is an approximate long-term average based on the interpretation of former coastline locations over the past 5,000 years as the current sea level was established. Based on historical maps and photos, the Corps estimated erosion to be 4 to 5 feet per year in recent years (U.S. Army Corps of Engineers, 1971, 1976).

The long-term average rate is a very rough estimate that does not show periods of increased or reduced erosion caused by changing coastal conditions. The Corps estimate reflects erosion since about 1884 when the first maps of the coast were prepared. Rates in the past 110 years may be more rapid than in earlier years or the long-term estimate may be inaccurate.

The marine cliffs consist of glacial outwash and till that are a mix of silt, sand, gravel, and cobbles. Erosion of the bluffs was a major source of sediment to the coastal zone along with sediment from the Elwha River. Based on an update of the Corps report, which used more complete estimates of the Elwha River sediment yield, Elwha sediments have contributed a larger portion of Ediz Hook than the draft environmental impact statement estimated. The Corps (a cooperating agency) has updated its estimate and now believes the dams have reduced sediment to the coastal area from the Elwha River mouth to Ediz Hook by 35%, and armoring the marine bluffs by 55%.

Issue: Impact of dam removal on sediment supply and methods and costs for controlling sediment

Q: Some commentors asked for more clarification on how the sediment stored behind the dams would react and/or the impacts it would have. Some asked for results of reservoir drawdown tests that agencies have conducted. One commentor asked that the amount of sediment that would be expected in the Elwha after dam removal be compared with that in a river after a clearcut. Others asked to what extent natural processes would remove the sediment behind the dams and whether artificial stabilization was really needed.

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A: Two reservoir drawdown tests have been conducted to assess how fast the delta sands and gravels would erode should the dams be removed. Both tests indicate that the deltas would erode as quickly as the reservoir can be drawn down. Both the tests and drawdowns to augment low summer flows have redistributed sediment to a point farther downstream and closer to the dam, as well as resulted in channel erosion of the delta. Finer grained sediment (silt and clay) is expected to erode even quicker than the delta sands and gravel.

Releasing sediment would affect water quality, fisheries, and the marine environment in the short term. Although now only 20 to 40% of the fine grained sediment in the Elwha River is captured in the reservoirs (the rest flows to sea), approximately 9 million cubic yards of this material has accumulated behind the two dams.

Although releasing this much sediment at once would exceed yields typically following timber cuts, impacts to the main river channel from timber cuts are similar to impacts from dam removal. A study of the Huelsdonk Ridge, Hoh River, indicates approximately 9,000 cubic yards of material per square mile per year was mobilized in the basin following a clearcut (Logan et al., 1991). Of this amount, an estimated 3,200 cubic yards of material per square mile per year was delivered to the main channel; this compares to the estimated natural upstream sediment supply of the Elwha River of approximately 1,200 cubic yards per square mile per year. The impacts of dam removal would be of much shorter duration than those from clearcutting a watershed. Whereas a portion of the material that has accumulated in the reservoirs would wash downstream in one or two years, the effects from a typical clearcut watershed may persist over decades.

Suspended fine sediment would wash into the river and marine nearshore environment of Freshwater Bay and Puget Sound. Some of this silt and clay as well as the coarser sand and gravel would build up on the river mouth delta similar to pre-dam conditions, typical of river mouths. Some would be actively transported east by the dominant littoral currents, or by ebb flow to the west into Freshwater Bay. Freshwater Bay would evolve toward a natural river mouth condition.

As stated in this environmental impact statement, cost estimates of sediment management vary, depending on the option. The Department of the Interior estimated reasonable upper and lower limits of cost for the full range of possible scenarios. In the Implementation EIS, this range would be refined and narrowed. Some of the more costly scenarios presented in the Elwha Report will probably be eliminated since they do not protect important resources, such as the returning fish, water quality, or private property along the river, to a greater degree than the less expensive options. In this document, costs are updated as the result of new information; cost numbers will continue to be refined in the Implementation EIS.

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Q: Some commentors stated that activities and costs associated with mitigation of dam removal impacts are peripheral and should be secondary to restoration of the ecosystem.

A: The Department of the Interior does not consider sediment stabilization or removal, or protection of water quality, to be peripheral to the project, even though the main goal is to restore the Elwha anadromous fisheries and ecosystem. Dam removal itself accounts for approximately $20 million of the estimated $75-$100 million to restore the fish and ecosystem. Other costs, such as $29.5 million to acquire the dams and those for sediment management and water quality protection, are delineated in the Elwha Report and this environmental impact statement. As stated above, these costs are being refined as more is learned.

Issue: Time required to restore landscape

Q: Commentors asked that the environmental impact statement elaborate on the time it would take to restore the river channel after removing the dams.

A: The rate for most of the sediment to be transported out of the system would vary depending on weather conditions and erosion control efforts. Bedload sediment stored along the river channel would take between 1 and 20 years to move downstream depending on grain size; cobbles and boulders move most slowly. Major impacts from the fine lake bottom sediment would cease within the first year. More sediment and woody debris would be exposed along the river and on the bar tops because of the increased sediment and woody debris delivered from upstream; however the river would look like most rivers in the region. Within 3 years, pioneer plants on reservoir and delta sediments would be established.

Issue: State ownership of riverbed

Q: The state of Washington has stated that it owns (exclusive of tribe-owned lands or lands held in trust for the tribe) the beds and shores of all navigable waters in the state, including those of the Elwha River, up to and including the line of mean high tide and/or the line of ordinary high water or permanent vegetation up to river mile 14. The state would like assays conducted for valuable minerals, and multi-agency planning and legal agreements in place before sediments are removed.

A: The environmental impact statement team is working with the Washington Department of Natural Resources to assess the nature of the sediment and locate markets or uses for it. If appropriate, these options would be presented in the Implementation EIS. Delta sediments have been preliminarily checked for hazardous materials; none were found. Assays for valuable minerals are not planned. Based on the geology of the basin and past investigations of the area, commercial quantities of minerals are unlikely. Regardless, the Department of the Interior intends to comply with all legal and permit requirements, including those of the state.

Issue: Rate at which sediment would fill Lake Aldwell if only Glines Canyon Dam is removed

Q: How long would it take to fill Lake Aldwell with sediment released from Glines Canyon Dam if only it is removed?

A: If the Glines Canyon Dam is removed, 7 to 9 million cubic yards of sediment (one-half to two-thirds of the total) stored in Lake Mills would end up in Lake Aldwell, reducing its capacity by 40% to 60%. The remaining storage would fill in 40 to 50 years.

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Socioeconomics

Issues

- Reducing costs or increasing benefits
- Economic and environmental costs of replacement power
- Effects of relicensing scenarios on costs and the cost of fish passage measures for dam retention alternatives
- Cost of hatchery operations
- Future benefits of restoring the Elwha River ecosystem and fisheries; future costs of No Action
- Economic impacts to those potentially affected: private property owners, Clallam County, shellfish industry, Lower Elwha S'Klallam Tribe, park concessionaires.
- Evaluation of other potential economic opportunities for the tribe
- Economic impacts of potentially listing additional salmon species on the Endangered Species list
- Cost of restoring the Elwha River ecosystem compared to costs of salmon restoration projects in other areas of the Pacific Northwest
- Historic or past economic impact of the dams on the decline of the fishery
- Use of survey to measure public opinions about restoration of the Elwha River Ecosystem
- Cost of flood protection and mitigation of impacts to wells as a result of dam removal
- Quantification of the cost to rebuild roads to accommodate construction equipment, i.e., Olympic Hot Springs Road
- Potential marketability of gravel and/or silt recovered during dam removal

Comment Letters: C118; American Whitewater Affiliation - C576; Beil, Ronald - C119; Bender, Tom - C36; Bussell, Eldon - C431; Caltrider, Melanie J. - C97; Chadd, Edward -

C545; Childs, David - C52; Clallam Bay / Sekiu Chamber of Commerce - C463; Clark, Robert J. - C599; Copeland, Delbert -C280; deBord, Linda - C564; Dry Creek Grange #646 - C596; Ensor, Lavonne - C560; Erickson, Dale - C519; Evans, Daniel J. - C609; Friends of the Earth -C542; Gehrke's Gink - C148; Grover, Kelly -C483; Hewes, Patrick - C433; James River Corporation - C479; Latuala, L. F. – C15; Lombard, John A. - C248; Lonn, Benjamin - C335; Lydiard, Harry - C109; Main, Jerrine and Earnest - C336; Mantooth, Roberta T. - C426; Mazamas - C610; McNulty, Tim - C549; Mossman, Barbara E. - C75; North Peninsula Home Builders and Building Industry Association of Washington - C449; Okanogan County Citizens Coalition - C552; Olympic Park Associates - C612; Olympic Rivers Council - C271; Pirie, Ken - C284; Powne, Bob - C540; Pulkownik, Susan - C334; Reed, Sandra E. - C562; Rescue Elwha Area Lakes - C333; Roline, Les - C86; Santos, Thomas - C556; Schwagler, Albert J. -C561; Schwagler, Jacqueline -C598

Issues: Reducing costs or increasing benefits

Q: Comments were received requesting that Interior clarify its conclusions about economic costs of the project compared to the benefits gained from dam removal and ecosystem restoration. Commentors requested that the document break out costs for sediment management, dam removal, rubble disposal, water quality mitigation, etc. Cost estimates seem too high in the Elwha Report for removal ($180-$300 million) based on dams removed on the Clearwater River in Idaho.

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A: Additional discussion on costs and benefits is in the socioeconomic section of the document. Cost estimates will be refined for specific dam removal and sediment management project alternatives in the Implementation EIS. The U.S. Bureau of Reclamation heads the project cost estimation team and regularly designs, costs, and supervises projects of the scale described here. If dam removal is selected, the bureau will manage dam removal and disposition of stored sediment.

Based on recent estimates, total costs for the Proposed Action are expected to be between $75 and $101 million; this includes the $29.5 million to acquire the dams, a price determined by the Elwha Restoration Act. Approximately $20 million of the total cost would be for engineering design and dam removal, including disposal of rubble. Another $4 to $31 million would be spent to manage the sediment stored behind the dams (i.e., erode, pump out and slurry, or recontour and stabilize on site), and between $7 to $35 million to ensure adequate mitigation for municipal and industrial water quality. Costs to protect water quality are inversely related to those required to manage sediment. A further breakout of relative costs is in the appendixes to the Elwha Report (Section VII, beginning on p.133). More precise estimates of sediment management and water quality costs would be available in the Implementation EIS, but this information would not be expected to change total project costs beyond the range reported here.

The dams removed from the Clearwater River in Idaho are not comparable in cost. The Harpster Dam on the South Fork Clearwater River was much smaller (56 feet in height) and was simply dynamited with no provision for sediment management (Winter, 1990). Lewiston Dam was removed from the mainstem Clearwater River, again with no provision for sediment management. In contrast, provisions of the Elwha Act require protection of resources and so would require expenditures not part of the Clearwater dam removals.

Q: Many commentors asked for more clarification on the methodology for estimating project costs and made suggestions about what to include in the analysis (i.e., comparison of costs and benefits in real financial terms to include paying going interest rates on the unamortized amounts outstanding).

A: To clarify, this document provides cost and benefit comparisons in real rather than nominal terms and makes appropriate adjustment for the opportunity cost of capital. Other assumptions are spelled out in the methodology and impact to socioeconomic sections of this document.

Q: Precise costs of the proposed dam removal are not given as required by law. Additional costs, especially those of the many bureaucracies involved, are hidden. Agency costs are unquantified in the EIS and will continue after the EIS process, i.e. the living laboratory will go on for years and cost more money (Elwha Report, pps 121-122).

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A: Post project study costs have been removed. If any such studies are undertaken, they will be proposed for funding from agency budgets approved by Congress. This document has been modified accordingly. Also, costs will be refined as the environmental impact statement team discovers additional information and modifies alternatives based on this information. For instance, it is now clear based on modeling results that larger sized sediment will not be as problematic for fish as originally thought, and so can erode naturally in all alternatives. This reduces costs of sediment management for all alternatives, and lowers overall project costs.

Q: A commentor suggested re-evaluating the need for compensating owners of the dams (they have already reaped the benefits of the power) and property owners (they must have been aware of the risks of building on such sites).

A: Congress has already decided the owners should be compensated, and has agreed to pay them up to $29.5 million in the Elwha Restoration Act. Impacts to and mitigation for damage to property owners will be evaluated as appropriate in the Implementation EIS.

Q: How will the loss of property taxes and other tax losses due to employment and businesses lost be offset by a restored fishery.

A: The socioeconomic analysts saw no reason to expect increases in unemployment, and actually predict hundreds of construction jobs and employment to support increased spending in the community as a result of dam removal (See Socioeconomics section of the text for more information).

Issue: Economic and environmental costs of replacement power.

Q: Commentors requested the clarification of methodology used in determining costs of replacement power at the mills and wondered who would be responsible for bearing increased costs.

A: Assumptions and methods underlying estimates of cost of replacement power are fully outlined in the documents, "Discussion and Extended Analysis of Energy Portions of the FERC Draft Staff Report on Glines Canyon and Elwha Hydroelectric Projects, Washington." by Meyer Resources (1994) and "Elwha River Restoration Project: Economic Analysis," by Meyer et. al. (1995). A summary of those assumptions and methods appears in the "Impacts to Socioeconomics" section of this environmental impact statement. Power replacement cost calculations are based on the latest data supplied by Bonneville Power Administration, and have been reviewed by a multi-agency economic team to ensure validity. Factored into the cost of replacement power is the cost of fish passage and mitigation which would be required before either or both dams could ever be licensed.

Under the Proposed Action, Daishowa America would pay for its replacement power, which it would obtain from the Bonneville system through Port Angeles City Light. The rate the mill would pay is consistent with the rate Bonneville has traditionally charged major industrial customers in the Pacific Northwest. Impacts on the electric energy bill of the average regional consumer would be negligible under any of the options considered.

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Q: Commentors challenged replacement power cost figures as understated and not including cost increases already projected by BPA. One commentor claimed that approximately $16.5 million of electricity would be lost annually if the dams are removed and states that this assumes replacement power costs of 9.6 cents per kilowatt hour rather than the 2.4 cent rate Bonneville is currently charging Daishowa America.

A: Energy costs assumed for the Proposed Action or any other alternative are calculated both at the rate at which energy would be locally available from Bonneville Power Administration (local power cost), and at which Bonneville could produce additional required power in its grid (regional avoided cost). After consultation with Bonneville, Interior presumed hydropower supplied by the dams would be replaced by sources of energy available to the Bonneville grid at costs estimated for regional replacement of power by BPA. These costs are estimated to increase over the next 20 years at rates equivalent to increases in the real cost of natural gas. The Socioeconomics section of this environmental impact statement has more information on these costs and assumptions, by the latest data supplied by Bonneville and reviewed by a multi-agency economic team (see Meyer, et. al. 1995) including Bonneville, are used. The data are considered correct.

Q: Some commentors asked for clarification of how costs were estimated for the No Action alternative. They questioned how costs of replacement power for the Proposed Action (removal of both dams) could be lower than that of taking No Action (leaving the dams in place).

A: Costs for power under the No Action alternative are lower than for Proposed Action, however they are not lower than for the Dam Retention alternative. This is because the Federal Energy Regulatory Commission and other regulatory agencies have indicated that substantial improvements would need to be made to the two dams for fisheries and other reasons as a condition of licensing and that continuing the operation of the dams without fish passage is unlikely. The energy cost estimate for the Dam Retention alternative includes costs to install fish passage measures, which is why it is more expensive.

Q: Commentors asked for more information on the costs to the mills under the No

Action alternative vs. the Proposed Action, particularly related to potential for loss of jobs.

A: Under the No Action alternative, dam owners would not meet requirements stated in the recent Federal Energy Regulatory Commission licensing review, and could be affected by future legal action for fisheries trust violations and by further restrictions should any Elwha salmon species be listed under the Endangered Species Act. Altogether, these potential effects would likely raise energy production costs for dam retention alternatives higher than the energy costs shown for any option in the environmental impact statement, and could imperil continued operation of the dams as energy producers. Daishowa America would then need to seek an alternative energy supply. In the event that Daishowa was unsuccessful, 320 mill jobs could be lost. Since county taxes are assessed on land and improvements, rather than jobs, it is unclear what the associated tax loss to the county would be under this scenario.

The Proposed Action would resolve these issues, and is expected to create up to 1,000 construction jobs, as well as many more to support increased spending by construction forces in the community.

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Q: Commentors asked whether the "energy drought" in the region would mean Bonneville might be unable to supply replacement power to the mills if the dams are removed

A: The environmental impact statement team reviewed the situation and finds that Bonneville Power Administration does not consider itself in a supply-deficient status for the immediate future. It has, however, adjusted its energy avoided cost projections to allow for some regional loss of generating capability due to drawdown (to help mitigate impacts from other dams). The environmental impact statement uses Bonneville's data, and therefore compensates for this possible effect to cost.

Q: Commentors asked whether Bonneville would need to bring in replacement power via a new transmission line if the dams are removed.

A: An additional trunk line to the study area is planned by Bonneville, whether or not the dams are removed. Although removing the dams may change the time line for the implementation of the trunk line by as little as one year (Tony Rodriguez, Bonneville, personal communication, April 1995), it would not have more than a very slight impact on costs for power, since Bonneville sets its rates on a regional basis.

Issue: Effect of relicensing scenarios on costs and the cost of fish passage measures for dam retention alternatives.

Q: Commentors asked what difference changing the relicensing period from 20 to 50 years would make in amortizing the cost of installing the fish passage system.

A: Extending the payback period would reduce annual payments for an element of cost. Whether this would be practical would likely depend on whether fish passage costs were paid by dam owners or by public entities. Assuming straight-line amortization over the lifetime of the project, annual depreciation costs would decrease, but total costs remain constant.

Issue: Cost of hatchery operations

Q: How will costs of hatchery operations be affected if the dams are removed?

A: Under the proposed action, hatcheries would be used to assist restoration in initial years, and then be phased out of use for planting fish in the Elwha watershed. Capital costs for this program are included in the draft environmental impact statement. Hatchery and fish passage costs recommended by the Federal Energy Regulatory Commission and/or quantified in the Elwha Report are included in assessment of the two dam retention option. The potential to incur such additional costs is identified in this environmental impact statement, but the magnitude of these costs has not been quantified. (See the "Fisheries" section of the EIS text for more information.)

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Issue: Future benefits of restoring the Elwha River ecosystem and fisheries; future costs of No Action

Q: What are the economic values of enhancing the natural ecosystem over the very long term. People will visit the area for decades. What is the vicarious value of the project for people who will never visit the area but place a value on a natural restoration of this kind.

A: In many cases, important resources do not lend themselves to quantification. For instance, the value of restoring wilderness or a wild and scenic river is not economic, but is invaluable for those persons who seek such an increasingly rare experience. The National Environmental Policy Act requires analysis of environmental pros and cons of an agency proposal and states that federal agencies must try to determine impacts on all resources, to "insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical considerations" (Sec. 102(B)).

One such amenity is the very long-term benefit or vicarious experience that citizens might enjoy simply knowing the river ecosystem and native anadromous fisheries have been fully restored.

A recent study (Loomis, 1995) polled residents in the local area, in Washington State, and across the country to determine the "non-market" value they attributed to restoring the river ecosystem and native anadromous fisheries. Economists sometimes define this as the value people associate with a good or service over and above its selling price. The study analyzed more than 1300 surveys and found that U.S. citizens value restoration of the Elwha River at an amount equivalent to between $3.5 and $6.3 billion, even if they never visit the area. These data are included in the Socioeconomics section of this document.

Specific estimates of the value of restored fish runs to commercial, sport, and tribal fishers are included in this document. Estimated values for recreation and tourism are also reported.

Q: Commentors asked that the economic analysis account for the values, both in the river and ocean, of the restored wild fish runs that would result from the removal of both dams. The value of a restored shellfish harvest in a restored delta and the cost avoidance by the Corps of Engineers in maintaining Ediz Hook should also be included. The recreation values to both the local tribes and the larger region should be included as well as the value to the local tribes for food and ceremonial purposes.

A: The socioeconomics section includes these values. Removing both dams would result in a $3.46 million annual fishery. Recreation and tourist visitors would spend an estimated additional $133 million in Clallam County over the life of the project (discounted at 3%). This would be expected to generate additional in-county payroll of $4.6 million per year, 446 additional in-county permanent jobs, and additional local tax revenue of $296,000 per year.

Q: What is the relative value of tribal and non-tribal fisheries?

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A: Table 10 in the Socioeconomics section estimates the value of fisheries for each alternative. Total annual fisheries benefits for the No Action alternative are $840,000; for the Dam Retention alternative, $1.07 million; for removing Glines, $1.97 million; for removing Elwha Dam, $1.57 million; and for the Proposed Action, $3.46 million. Benefits are divided approximately equally among tribal and non-tribal fishers.

Q: In an article in the local paper, Daishowa America expressed uncertainty over its ability to license and operate the dams if they aren't removed and may have to close the mill (from a Peninsula Daily News article, Oct.25, 1994).

A: Relying on the dams for power, when they continue to operate on a year-to-year basis without a permanent license and in violation of Olympic National Park policy, may not provide the stability Daishowa America mill requires. There may be a potential for downsizing or closing because of this. However, many unknowns preclude meaningful analysis of this possibility in this document.

Q: In determining the benefits of leaving the dams in place, has Interior factored in the useful life of the projects (i.e., with safety considerations, silt filling in, etc.)

A: Project costs and benefits were calculated out to 100 years. This is within the operational life of both reservoirs.

Issue: Economic impacts to those potentially affected: private property owners, Clallam County, shellfish industry, Lower Elwha S'Klallam Tribe, park concessionaires

Q: Commentors expressed concern that property values in the Elwha Valley area would drop if the dams are removed.

A: Property values would depend on the perceived benefits of owning property in the area. There is no evidence that residential property values would fall under the proposed action; in fact, given increased recreation and tourism interest, they would likely increase. The only commercial property affected is the motel/trailer park facility at the Highway 101 bridge. It would probably incur some moderate expense to re-establish access trails to the restored river corridor. Information on property tax lost under each of the alternatives is presented in the section "Impacts to Socioeconomics" in this environmental impact statement.

Q: What are the economic benefits to the shellfish industry from dam removal?

A: Restoration of a broader estuary would change nearshore species of shellfish. On balance, the economic impact on shellfish gathering is expected to be positive, particularly for hardshell clams. Since pre-dam levels of shellfish are unknown, the Department of the Interior has not been able to quantify the increase expected if the dams were removed and sediment transport restored.

Q: Much of the growth predicted for Clallam County is from recreation and tourism. With the loss of recreation areas created by the reservoirs and the destruction of several historic sites (i.e., the dams, and potential flooding of the Elwha Historic District structures), these industries could suffer. What is the impact on rural residents?

A: The restoration of the Elwha River ecosystem and fisheries would be expected to bring a great deal of economic vitality to Clallam County, both from increased catches of fish and from the direct and indirect dollars spent by tourists who would visit the river to fish, view the restoration process, and see where the dams were removed. The restoration of the river would provide a unique opportunity for river-based recreation and wildlife viewing, although reservoir recreation and tourist income would be lost. Highly valuable salmon and steelhead would be added to the commercial fishery. This project would affect rural lives, particularly of fishermen, in a very positive way.

Construction benefits to Clallam County associated with the Proposed Action are estimated to produce a total of $40 to $56 million of business revenue, between $21 and $29 million in income, and 763 to 1,067 jobs over the 10-year construction period. At full restoration, recreation and tourism spending is estimated to produce $4.6 million in payrolls, $296,000 in taxes, and 446 jobs each year in Clallam County. An estimated $133 million in additional revenues from tourism and recreation are expected over the 100-year life of the project.

Q: The summer of 1994 was slow for visitors to Port Angeles and Clallam County. Can we afford to eliminate two of our tourist attractions--Lake Mills and Lake Aldwell?

A: Although some recreationists will go to nearby reservoirs, the economic analysis predicts a significant net gain of $133 million in recreation and tourism dollars if the dams are removed.

Q: Commentors were interested in whether removing the dams would be a project set aside for local construction firms.

A: Federal regulations preclude limiting competition for the contracts to local contractors. Likewise, federal agencies would be constrained from requiring contractors to give local preference in hiring or subcontracting. Nevertheless, using local labor as much as possible would reduce contractor costs over that of "imported" labor.

Q: One commentor questioned whether dam removal would change the negative economic trend in Clallam County

A: Clallam County is in transition from an economy based on the consumptive use of natural resources to one based on tourism, retirement, and associated service-based industries. Removing the dams would generate additional recreation and tourism dollars, as well as business revenue, personal income, and local tax revenue in the long term. In the short term, money spent on deconstruction would directly and indirectly boost the local economy.

Q: What mitigation or compensation will be offered to the Lower Elwha S'Klallam Tribe for lost fishing opportunities while construction is ongoing and restoration efforts underway?

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A: Although the extent of any additional loss of the tribe's fishery resources cannot be predicted at this time, the tribe has not requested compensation as one of the associated costs and has stated that it welcomes any positive steps toward meeting the United States' Treaty obligation. Potential mitigation for short-term losses of tribal fisheries would be assessed in the Implementation EIS as appropriate.

Q: Some commentors suggested that concessionaires (primarily rafting operations) temporarily impacted by dam removal be compensated for loss of business.

A: This is under consideration by the National Park Service.

Issue: Evaluation of other potential economic opportunities for the tribe

Q: Several commentors suggested the tribe pursue options other than restoring the anadromous fisheries in the Elwha River, i.e., casino or tribal operation of the dams to sell power.

A: These issues are outside the scope of the Elwha Restoration Act and this environmental impact statement. The tribe's opportunities for and its choices about its own economic development rest with the tribe, not with the Department of the Interior or this document.

Issue: Economic impacts of potentially listing additional salmon species on the Endangered Species list

Q: How would listing Elwha salmon species as endangered affect fishers in the region.

A: The economic impacts of endangered species listings would depend on the fish stock listed and the harvest restrictions necessary to restore it. Please see the fisheries section of this document for examples of these kind of issues (stocking and harvest restrictions).

Issue: Cost of restoring the Elwha River ecosystem compared to costs of salmon restoration projects in other areas of the Pacific Northwest

Q: How do costs of restoring the Elwha River ecosystem compare to costs of salmon restoration projects in other areas of the Pacific Northwest.

A: Although analyzing specific costs for restoration projects in the northwest is outside the scope of this analysis, most freshwater habitats for salmon and trout are in developed and/or degraded conditions. Repairing watershed damage requires extensive mitigation, much of which entails long-term, continuing costs. Also, on private land, there are no long-term guarantees that restored habitat will remain restored, that additional sources of water pollution will not surface, or that other alterations will not be made. Interior believes there is no better restoration opportunity on the Olympic Peninsula than the Elwha River. (See page 20 of the Elwha Report for more information).

Issue: Historic or past economic impact of the dams on the decline of the fishery

Q: Commentors asked for information and quantification of how much, in dollars, the dams have cost the Port Angeles economy from loss of fishing resources since they have been in place.

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A: We know of no published estimates of historic fish losses due to Elwha dams. Comparison of annual fishery benefits, in this document, between the Proposed Action and the No Action option probably understates such losses, but gives an order of magnitude estimate.

Issue: Use of survey to measure public opinions about restoration of the Elwha River ecosystem

Q: A comment was received about a public survey released in 1994 with information about the economic impacts of the project.

A: This survey by "Decision Data" was part of a just-completed study of economic impacts of the Proposed Action by Dr. John Loomis of Colorado State University. That survey did provide estimates of expected fish recovery to respondents, and also indicated that full recovery would not be expected for 20 years.

Issue: Cost of flood protection and mitigation of impacts to wells as a result of dam removal

Q: (See also issues under the topic of "Flooding.") Commentors asked for clarification of costs to provide flood protection.

A: Flood protection, expected to be provided primarily through levee upgrades and strengthening, is estimated to cost approximately $2 million. Costs for mitigation of anticipated impacts to groundwater systems are estimated at $1 million.

Issue: Quantification of the cost to rebuild roads to accommodate construction equipment, i.e., Olympic Hot Springs Road

Q: Commentors noted that reconstruction of the Sol Duc road was approximately $8 million, and would be at least $20 million today.

A: Figures for modifications to roads, should they be required, would be developed as part of the Implementation EIS and/or design and permitting phase of the project. Estimates are included as part of total project costs reported in this document.

Issue: Potential marketability of gravel and/or silt recovered during dam removal

Q: Some commentors believe that gravel and silt should be considered a resource that could be sold to offset project costs.

A: This is being investigated; findings would be presented in the Implementation EIS. Much of the gravel would be required to reseed the riverbed from Glines Canyon Dam to the mouth of the river to help fisheries restoration. Although some gravel and silt may be worth money, it lies in lenses or pockets in the delta and upper lake bed sediments and is not easily accessible.

Pg. 204 = pg. 205&206

Vegetation and Wetlands

Issues:

- Threatened or endangered plants in impact area
- Impacts to wetlands and riparian vegetation
- Potential inability to revegetate sediment due to presence of fines or unstable material
- Length of time required to restore the river corridor and vegetation

See Comment Letters: Philpott, Bob - C117; Environmental Protection Agency - C438; Page, Timothy D. - C557; Olympic Park Associates - C612

Issue: Avoiding major mechanical means to stabilize sediment

Q: Commentors suggested that revegetation of areas uncovered during reservoir removal would be preferred to use of major mechanical means to stabilize sediment.

A: The Department of the Interior generally agrees that major efforts to stabilize sediments with heavy equipment or artificial means would be both unnecessary and ineffective. Some regrading and recontouring of material remaining after sediment management efforts are complete is likely, as is initial revegetation of delta sediments. These options would be more fully analyzed in the Implementation EIS.

Issue: Threatened or endangered plants in impact area

Q: Are there any protected plant species in the area; if so, how will they be protected during removal?

A: There are sensitive plant species in the area, including porcupine sedge, tall bugbane, giant helleborine, water lobelia, and branching montia; however, these species would not be expected to be impacted by the project. (See Affected Environment section for species of special concern in this environmental impact statement for additional information)

Issue: Impacts to wetlands and riparian vegetation

Q: A number of commentors wanted more detail on the amount of wetlands and/or riparian vegetation in and around the project area, how these would be impacted, and what mitigation would be required and implemented to replace them.

A: As part of the evaluation of habitat within the project area during the relicensing process, the applicant estimated a total of 43 acres of wetlands presently associated with or close to the reservoirs. However, recent information indicates it is likely only a small portion of those wetlands would be eliminated or degraded should the dams be removed and reservoirs drained.

Approximately 38 of these 43 acres are on or just upstream from the Lake Aldwell delta. Review of the substrate composition study conducted by the U.S. Geological Survey and the habitat composition mapping by consultants for James River Corporation indicates that the majority of these wetlands are not on the Aldwell delta and, therefore, would not be destroyed by either the relocation or the natural erosion of the delta sediments. Some reduction in the size of this wetland, however, may occur if the water table dropped following the removal of Lake Aldwell. A large drop would not be expected as the proximity of the Elwha River and Indian Creek channels would moderate the change.

Pg. 205 = pg. 206&207

The remaining five-acre wetland is located near the boat launching area on Lake Mills. Preliminary analysis indicates it is maintained by seepage from upslope areas and, therefore, would not be affected by the removal of the reservoir.

In addition to affecting some of the wetlands associated with the reservoir, the Proposed Action would create streamside wetlands. The Draft Staff Report estimated 48 acres of wetland forest or shrubland would be restored and another 122 acres of wet channel/river and gravel bar wetlands created. Over time, these wetlands would establish along side channels, sloughs, and tributaries, and on a portion of the low terraces. The natural development of palustrine emergent wetlands could occur in a few years, with palustrine shrub and palustrine forested wetlands taking perhaps 10 and 20 years to develop, respectively.

Opportunities to restore or create wetlands within the lakebeds following dam removal would be considered, although restoration of the sediment transport and hydrologic processes is expected to naturally re-establish more wetland acreage than would be lost as a result of the removal of the two reservoirs. The percentages of sediment to be flushed, mechanically removed, or stabilized would be determined after the Department of the Interior completes its evaluation of a number of factors including fish and wildlife needs, water supply protection, the potential for increased flooding, and cost; these percentages would be presented in the Implementation EIS.

Before any dam removal affecting wetlands is implemented, the U.S. Army Corps of Engineers must permit the project. Any suspected wetlands must be inventoried and mapped. Required mitigation could include replacement in-kind, additional wetland creation, or possible determination that dam removal in itself is mitigation for their past construction. Inventory, impact analysis, and mitigation options would be included as part of the Implementation EIS and/or permitting process with the Corps.

The portion of restored vegetation that would be defined as riparian is difficult to estimate because the distinction between riparian and upland is gradual and somewhat arbitrary. Comparing the reservoir areas to a reference site, Krause Bottoms, which was considered similar to the pre-dam sites now inundated by the reservoirs (1988 HEP Analysis done by FERC), much of the reservoir area would return to riparian vegetation. Removing Glines Canyon Dam would restore 287 acres; Elwha Dam, 246 acres; and Proposed Action, 533 acres.

Of these acreages (for Proposed Action), at least 52 would be riparian deciduous forest and 65 cobble/gravel habitat.

Issue: Potential inability to revegetate sediment due to presence of fines or unstable material

Q: Concerns were expressed about the potential inability to establish vegetation on sediment remaining after dam removal. Commentors asked that long-term stability of sediment be carefully considered in the Implementation EIS.

Pg. 206 = pg. 207&208

A: Our vegetation specialists do not believe the fines would make revegetation of slopes impossible, but that the fines would probably need to be mixed with larger size sediments such as sand to prevent the formation of an impervious layer. Sediment left in place if the dams were removed would probably be stabilized initially through hydroseeding and then through the planting of native vegetation. For more information, see appendix H of the Elwha Report. These options would be more fully analyzed in the Implementation EIS.

Issue: Time required to restore the river corridor and vegetation

Q: Commentors asked how long it would take to restore the river channel and vegetation to its natural state.

A: Active erosion control measures would be implemented to reduce erosion during the first year and to speed the establishment of pioneer plant species. Within three years, vegetation would be well enough established that the area would begin to appear natural. It is estimated that it would take six to ten years for the river in the reservoir areas to establish natural channel structure and for the vegetation to become established enough to reduce erosion to pre-dam levels.

Development of the full range of original aquatic and terrestrial species along the river, in wetland areas, and at the restored estuary at the river mouth could take decades. However, many species would be present even within the first few years because of the natural ability of plants and animals to spread into newly available areas.

Water Quality and Quantity

Issues:

- Impact to local surface and groundwater supplies, now and future

- Protection and costs of water quality for Port Angeles, the hatcheries, and the mill; Best Management Practices

- Current practices of Port Angeles mills
- Field data to substantiate effectiveness of mitigation measures to protect industrial water supplies

See Comment Letters: City of Port Angeles - C43; Daishowa America, Port Angeles - C392; Dry Creek Grange #646 - C596; Ensor, Lavonne - C560; Environmental Protection Agency - C438; Graf, Thomas G. - C300; Loucks, J. &. M. - C63; Maupin, Eddie - C48; Mossman, Barbara E. - C75; North Peninsula Home Builders and Building Industry Association of Washington - C449; Okanogan County Citizens Coalition - C552; Philpott, Carol - C116; Pulkownik, Susan - C334; Sargent, Joan K. - C450; Schmitt, Francis J. - C68; Stachorek, Richard W. - C243

Issue: Impact to local surface and groundwater supplies, now and future

Pg. 207 = pg. 208&209

Q: Comments were received from the City of Port Angeles, local home owners, the mill operators, and others concerned about the impacts of dam removal on surface and groundwater quantity, particularly in a summer drought. More information was requested on how impacts were assessed and what mitigation measures were being considered to offset impacts.

A: The amount of Elwha River discharge available for municipal/industrial water supply would not change if the dams were removed. Since neither Lake Mills nor Lake Aldwell is used to store water for municipal/industrial supply purposes, their removal would not impact any present or future source of water.

The reservoirs are currently operated in a "run-of-the-river" mode in which natural flow volume conditions are mimicked. There is some deviation in summer droughts, when additional releases from Lake Mills augment downstream flows in an attempt to alleviate high water temperatures (although fisheries have benefited little) or prevent problems in the event of turbine shutdown. This additional water would be unavailable if the dams were removed. If the reservoirs were eliminated, fisheries would benefit by the return of water temperatures to natural levels.

If flows drop below 50 cubic feet per second in the lower river, the Port Angeles municipal supply may be affected. However, based on U.S. Geological Survey statistics of the Elwha River gauge at McDonald Bridge, daily streamflows drop below 50 cubic feet per second, on average, only once every five to ten years. This low-flow return period was estimated from observed streamflows from 1928 to 1979. In 1992, a recent dry year, the lowest daily streamflows was 245 cubic feet per second on September 20. September is typically the lowest flow month averaging 618 cubic feet per second (1898 to 1992), with a minimum monthly average flow of 330. The monthly average flow for September 1992 was 388. The 30-day low flow at the gauge at McDonald Bridge drops below the 1992 mean September flow about once every five years. The 10-year, 30-day low flow is approximately the same as the minimum average September flow. Removing the dams would have a very minor impact on summer flows.

Municipal customers are served by means of an underground Ranney well. The river is currently migrating away from the Ranney installation, reducing capacity or yield. If the dams were removed, the width of the river's meander might increase and migrate farther from the city's well, further reducing yield. Movement toward the Ranney well is a concern only from a flooding perspective, and the Corps of Engineers is studying the need for specific flood mitigation measures for the Implementation EIS.

Water supply mitigation options are presented in this document, but would be further analyzed in the Implementation EIS.

Q: Commentors asked whether removing the dams would affect water supplies in the future.

A: The city of Port Angeles currently holds a water right for 200 cubic feet per second on the Elwha. Of that, 50 cubic feet per second, or 32 million gallons per day, are held for municipal purposes. The Ranney collector, the city's sole domestic supply, presently pumps a maximum of less than 11 million gallons per day, approximately one-third of that to which it holds rights. The city would retain the right to enough water to facilitate quite a bit of new growth and development subject to limits imposed by natural flows and existing water rights. This is true whether the dams are in place or removed.

Pg. 208 = pg. 209&210

Q: Commentors asked whether local wells would be affected.

A: The bedrock underlying both reservoirs is nearly impermeable and the groundwater gradient (flow direction) is toward the river. Therefore, reservoir water is not recharging the surrounding upland aquifers where most of the private wells are located. The Elwha does recharge the sand and gravel (alluvial) aquifer in the river valley; changes of river stage would change groundwater levels within the alluvial aquifer.

A few wells located above Lake Aldwell, completed in the river alluvium in the confluence basin of Indian Creek and the Elwha River, might have lower water levels if Lake Aldwell were drained. The water levels in wells located in the Elwha River valley would be expected to have greater and more frequent fluctuations if the river returned to a more dynamic natural state. Wells in the lower Elwha valley, on and near tribal land, would be expected to have slightly higher water levels due to riverbed aggradation and higher river levels.

A few wells located downstream of the dams in the Elwha River valley would be subject to greater flood hazard if the dams were removed. Some of the wellheads could be extended and sealed to prevent flood damage. A few others would likely be relocated to facilitate access during high water events. More information on which of these wells may be at risk would be available in the Implementation EIS.

Issue: Protection and costs of water quality for Port Angeles, the hatcheries, and the mill; Best Management Practices

Q: How will industrial water quality be protected from short-term sediment loading during the period of dam removal?

A: Water from the Elwha River is periodically turbid now, especially during winter and spring flooding. The Federal Energy Regulatory Commission estimates that 99% of the very fine particles (clay) and much of the silt escape through the penstocks and over the spillways. The long-term turbidity of the water would probably be similar to what it is now.

There could be short-term (six months to two years) significant periodic or continuous increases in suspended solids that would affect surface water users, such as the state rearing channel and the mills, during dam removal. If fine-grained material is slurried out by pipeline, higher than average suspended sediment concentrations could still be associated with construction or dredging activities. Impacts to these users would be mitigated as required by the Elwha Restoration Act. Some mitigation options being analyzed for the Implementation EIS include alternative intakes that do not rely on surface water, pretreatment improvements such as a settling basin at the intake, more frequent backwashing of pretreatment filters, and a full-scale treatment plant. Mitigation measures would be selected to ensure the mills a continued supply of the same volume and quality of water they now have. Some commentors suggested using Morse Creek as a backup water supply during the dam removal; however, the Port Angeles city engineer indicates that Morse Creek is not an option for an alternate water supply during restoration.

Pg. 209 = pg. 210&211

Q: Commentors asked what the cost would be and who would pay for water quality and quantity mitigation measures required by the Elwha Act.

A: Costs for mitigating impacts to the city's municipal and industrial supply and to other users would be inversely related to costs to manage stored sediment, and depend on the amount of water available to wash out sediment at the time the dams were removed (i.e., from snowpack or rainfall). A range of possible water quality mitigation costs to protect Port Angeles municipal and industrial water quality is $7-$35 million. These costs are included in total project estimates in this document. Options for protecting the municipal quality range from a relatively simple add-on, in-line filtration system to a temporary package treatment plant to a full water treatment plant, with combinations, permutations, or new solutions possible.

The Elwha Act specifies costs to design, construct, operate and maintain these facilities to mitigate against impacts from dam removal "...will be federal costs at the discretion of the Secretary of the Interior" (Section 4(3)(b). Water supplies, rights, and use would remain the same if the dams were removed. Revenue from water sales would presumably continue to be used to maintain and upgrade the systems. Further information on water quality mitigation is in this document, Elwha Report (sections V and VI) and the Draft Staff Report. Dam removal would have no impact on the ability of the city of Port Angeles or the local public utility district to finance new facilities.

Q: The Environmental Protection Agency asks that the Department of the Interior use standard Best Management Practices criteria to protect water supplies.

A: Every effort has been and will continue to be made to coordinate with the state and federal agencies having regulatory responsibilities that impact the project. All state, federal, and local requirements will be met. Several items (such as (a) and (c) in the EPA letter) would be addressed in the Implementation EIS. Language pursuant to the Best Management Practices criteria in the letter would be included in contracts for dam removal and sediment management as well as the monitoring plan.

Issue: Current practices of Port Angeles mills

Q: One commentor asked if it would be feasible for the mills to recycle their process effluent thereby reducing their amount of water demand.

A: There are zero-discharge mills, although they were designed to operate that way from inception. Retrofitting the mills is probably neither economically feasible nor logical at this time. It would be extremely expensive to construct new systems, and the mills might not be able to tolerate the down time and resulting loss of market share. Forthcoming regulations will force all pulp and paper mills to evaluate the potential for effluent reduction through process water recycling.

Q: To what extent does dioxin released from the mills in Port Angeles affect fish?

Pg. 210 = pg. 211&212

A: The Washington Department of Ecology requires discharge permits, sets limits, and monitors waste streams of industrial operations discharging to waters within the state. According to the department, only one mill releases any dioxin, and those releases are within permitted levels and presumed not to be contributing to the decline of the Elwha salmon.

Issue: Field data to substantiate effectiveness of mitigation measures to protect industrial water supplies

Q: One commentor asked whether field data existed to support predictions on the degree to which proposed mitigation for industrial water supplies would work.

A: Data exist for all mitigation options mentioned in this environmental impact statement. Any mitigation proposal that impacts existing discharge permit allowances would necessarily require relief under the permit for additional project-related loading. More specific information about mitigation measures to protect industrial water quality from the adverse effects of dam removal would be available in the Implementation EIS. It is worth noting that the additional multiple Ranney well option to supply water for the mills is no longer under consideration for site-specific logistical, hydraulic, and hydrologic reasons.

Wildlife and Species of Special Concern

Issues:

- Restoring the ecosystem as opposed to taking a species-by-species approach
- Impacts to species of special concern (spotted owls, marbled murrelets, fish)
- Conflict in protection of Steller sea lions and native anadromous fishery
- Impact from dam and reservoir removal to other wildlife of interest--trumpeter swans, amphibians, elk.
- Impact to wildlife from stabilizing sediments and/or changing the river channel; impact to wildlife migration (deer, elk) corridors from changing river channel

See Comment Letters: Clark, Robert J - C599; North Peninsula Home Builders and Building Industry Association of Washington - C449; Okanogan County Citizens

Coalition - C552; Olympic Park Associates - C612; Roberts, Donald L. - C57; Smith, Leland - C455; Winthrop, Judith L. - C190

Issue: Restoring the ecosystem as opposed to taking a species by species approach

Q: Commentors were concerned that agencies would focus on particular species, not on restoring the ecosystem.

A: The Elwha River Restoration Act specifically directs the Department of the Interior to develop a plan for the full restoration of the ecosystem and native anadromous fisheries. The department and its bureaus are following an ecosystem approach to restoration. Some species, however, will receive greater emphasis or discussion because of other laws and regulations, e.g.,. Endangered Species Act, or because of the need to adequately address comments and concerns received from the public and other groups.

Issue: Impacts to species of special concern (spotted owls, marbled murrelets, fish)

Pg. 211 = pg. 212&213

Q: A number of comments were received about the potential impact of dam removal equipment on species of special concern. Heavy equipment and human activity were primary concerns. More information was requested on the mitigation measures to protect these species. Some commentors requested more analysis of cumulative impacts from multiple activities in the region.

A: Noise and human activities associated with dam removal and sediment management required by the proposed action could disrupt nesting northern spotted owls and local movements of marbled murrelets if they are in the area. Field studies are being conducted in the Glines Canyon and Elwha dams areas to determine current nesting locations of these species. At this time, it appears adverse effects would not involve any long-term loss of habitat, and would instead be considered "interference with use of existing habitat" if they exist.

Over the long term, the proposed action would increase old-growth and mature forest habitat for these species, and thus help offset the cumulative impacts from continuing loss and fragmentation of old-growth forest habitat elsewhere in the Olympic Peninsula.

Survey information shows no nesting spotted owls within one mile of either dam. Because of the distance between the dams and spotted owl nest sites, it is unlikely that owls would be affected by project removal activities except for blasting and the removal of concrete rubble. The noise level from blasting can be greatly reduced by reducing the size of individual charges and using percussion blankets. Conscientious scheduling of work activities and modifying equipment could reduce noise to acceptable levels to avoid impacts to spotted owls.

A biological assessment pursuant to the Endangered Species Act would be prepared to detail the effects that implementation of the Proposed Action would have on spotted owls and other federally listed species. If the biological assessment indicates that removal of hydroelectric projects would potentially or definitely adversely affect the spotted owl, the Department of the Interior would take the necessary actions to ensure compliance.

Q: What will be the effects on threatened or endangered fish species and fisheries.

A: Petitioned and candidate fish species would probably suffer some short-term adverse effects from alternatives involving dam removal. As lake levels were drawn down, the middle and lower reaches of the Elwha River would carry more sand and silt, which would cover the gravel substrate that these species use for spawning. Over the longer term, dam removal and river restoration would offset the cumulative impacts to these species elsewhere on the Olympic Peninsula. The cause or causes of cumulative impacts to petitioned and candidate fish species that have lowered populations to critical levels include loss of freshwater habitat through development, damming, sedimentation, pollution, over harvesting, and natural changes (such as El Nino) in the marine environment.

Q: Some commentors believe that the restoration of the Elwha River ecosystem might help avoid additional listing of salmon on the Endangered Species list; prevention of listing should be considered a benefit of the project.

Pg. 212 = pg. 213&214

A: In the long term, the only option for avoiding potential listing of Elwha salmon species is through dam removal. Restoration planning and implementation may be sufficient to avoid listing Elwha fish.

Issue: Conflict in protection of Steller sea lions and native anadromous fishery

Q: Commentors were concerned that the Department of the Interior is protecting the Steller sea lions that eat the salmon and contribute to the overall decline of the salmon population.

A: Interior's overall goal is to restore the Elwha River ecosystem and the native anadromous fisheries. The utilization of salmon by the Steller sea lion and other native mammals is consistent with that goal and would not be considered a problem, unless unnatural conditions from human activity resulted in a significant imbalance in predator-prey relationships within the ecosystem. For example, unnatural migration bottlenecks, such as the ladder at the Ballard Locks in Seattle, could create conditions conducive to increased sea lion predation.

Issue: Impact from dam and reservoir removal to other wildlife of interest--trumpeter swans, amphibians, elk.

Q: What are the general impacts of dam removal to wildlife.

A: As riverine and fast-flowing stream habitats replace existing lakeshore and lake habitats, wildlife populations in the Elwha valley would change. Species dependent in part on salmon, such as bald eagles, black bears, and various carrion feeders, would likely increase. Amphibian larvae, important stream predators that actively feed on aquatic insects, fish eggs, and fry, would benefit from increased food due to salmon restoration. Birds that feed on young fish include mergansers, great blue herons, and belted kingfishers; dippers, spotted sandpipers, and harlequin ducks also feed on aquatic insects that would increase with stream nutrient enrichments resulting from salmon restoration. Native mammals that feed on young fish include otters and mink. These species are expected to benefit from dam removal.

Similarly, species dependent on swift streams, such as harlequin ducks, would gradually replace species more closely linked to lakes and more slowly moving waters. The Elwha restoration project would provide extraordinary opportunities to learn more about the interactions among wildlife and habitat, particularly as salmon populations returned and vegetation reverted from managed timber to old-growth forest.

The removal of the dams and reservoirs would benefit many more species of wildlife than would be adversely impacted by the loss of lake-like habitat provided by the reservoirs. The two reservoirs provide relatively low value habitat because the shoreline is steep and most of the water is deep. The restoration of a free-flowing river with its riparian corridor would provide more productive habitat for a far greater number of wildlife species. Refer to both the fish and wildlife sections in this document for details.

Full restorative changes to native wildlife populations within the project area would begin after dam removal and continue for a decade or two.

Q: What would the impacts be to trumpeter swans, and how would Interior mitigate for those impacts?

A: Trumpeter swans are one of the few species that would be negatively impacted over the long term if the Elwha dams and associated reservoirs were removed, but impacts would be localized and minor when considering the species' status across its range. The swans currently utilize Lake Aldwell, particularly around the delta, as wintering habitat. Recent counts indicate that between 20 and 70 individuals use the area between November and April.

Habitat requirements for the trumpeter swan vary and are not well understood. The Pacific Coast population, comprising roughly 75% of the entire population in North America, has been observed wintering in wet agricultural lands and open water surrounded by forest. Individual colonies of wintering swans move around from field to field or from one forest pond or bay to another. Attributes of winter habitat that trigger movement from one area to another are unknown, which makes it difficult to identify specific factors that constitute acceptable or quality winter habitat for this species.

Trumpeter swans were historically abundant in the continental United States, but intensive hunting pressure led to their near extinction by the early 1930s (remnant flocks were known in Alaska and Canada). Conservation efforts including habitat protection, propagation, relocation, and protective status have slowly rebuilt population levels to relatively stable or increasing numbers. Recent data provided by the governments of Canada, Mexico, and the United States (1994 Update to the North American Waterfowl Management Plan) indicate that the status of the swan in the Pacific Coast region is above winter index goals and increasing. From 1990 to 1992, 13,500 trumpeters were observed in winter index areas. This number is 3,500 above the plan's goal for the year 2001.

The Elwha reservoirs are a very limited and only recently utilized wintering area for trumpeter swans; neither is native habitat for the species. It is expected that a free-flowing Elwha River would support some lower level of trumpeter swan rearing needs. Mitigation measures, including obtaining comparable native habitat for swans elsewhere on the north Olympic Peninsula to offset any apparent losses by dam removal, would be examined as appropriate as part of either the Implementation EIS or post-EIS permitting,

Q: What would impacts be of dam removal on amphibians.

A: It is generally accepted that amphibian populations would benefit if a free-flowing Elwha River were restored. The loss of 684 surface acres of reservoir would be more than offset by the creation and re-establishment of approximately five miles of a natural river corridor and riparian zone. Surveys would be conducted to determine amphibian status in the area and any mitigation steps necessary to ensure their protection during dam removal would be implemented. There would be significant opportunities for restoration of amphibian habitat within the restored riparian and upland forest of the reservoirs; measures would be incorporated in habitat management plans. The utilization of accumulated woody debris in the two reservoirs is one component of amphibian habitat that could be incorporated in the restoration plan.

Pg. 214 = pg. 215

Q: One commentor noted there is a regional cumulative impact from conversion of former elk habitat (local Elwha area subpopulation) to residential and commercial uses and the loss of elk habitat due to inundation of habitat from the two reservoirs.

A: Removal of the dams and revegetation of exposed sediments would affect local elk population in two ways. The migration corridor connecting higher elevation subalpine parklands with low elevation forests would be extended down the Elwha valley. Although benefits of increased access to lowland forests and meadows would be curtailed by development of these areas to residential and commercial use, some portion of lowland habitat would be protected by the Olympic National Park and more accessible to migrating elk.

Dam removal would also create more elk habitat in the former lake areas. Alder scrub-shrub developing on exposed sediments would evolve into deciduous forest over 10 to 20 years. The additional 400 to 550 acres of high quality forage habitat would probably support a few more elk, which would help offset population declines resulting from conversion of other lowland areas to residential and commercial uses.

Issue: Impact to wildlife from stabilizing sediments and/or changing the river channel; impact to wildlife migration (deer, elk) corridors from changing river channel

Q: Commentors perceived that stabilizing large volumes of sediment would restrict the channel or change the course of the restored river and thereby change wildlife habitat or animal migration patterns.

A: It is not likely stabilizing large volumes of sediment in the riverway would be attempted, as natural erosion would undo human efforts. Some recontouring and revegetating may be possible, but these probably would not affect Roosevelt elk or black-tailed deer movement or migration patterns. Removing the reservoirs and restoring riparian and upland habitat would reestablish migration corridors and provide deer and elk forage--a positive impact on these species.