# CHIEF JOSEPH DAM

# DISSOLVED GAS ABATEMENT PROJECT

# FINAL ENVIRONMENTAL ASSESSMENT
# and
# FINDING OF NO SIGNIFICANT IMPACT

**June 2000**

US Army Corps
of Engineers

Seattle District

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## 1.0 PURPOSE AND NEED

The purpose of the proposed project is to provide a mechanism to minimize the harmful effects of spilling water at Chief Joseph Dam (Douglas and Okanogan Counties, Washington) and Grand Coulee Dam (Grant County) on the Columbia River. The goal of the Chief Joseph Dam Gas Abatement Study is to identify means for reducing TDG contributions from Chief Joseph Dam, to the extent economically, technically, and biologically feasible. The preferred alternative nor is not expected to meet a 110% goal. Regional coordination has led to a goal of 120%.

Spill of water over dams can result in high levels of total dissolved gas (TDG), and create supersaturated conditions. Gas bubble disease resulting from supersaturated water is harmful or fatal to aquatic organisms.

Supersaturation of gases in water is caused by the force of the water plunging down the steep spillway face of a dam such as Chief Joseph. Air mixes with the water as it spills; the air contains mostly nitrogen, but also oxygen, hydrogen, carbon dioxide, and a few other gases in minor amounts. The gases are carried deep into the water in the stilling basin at the base of the dam, where they are dissolved in the water at levels too high to be maintained indefinitely under the existing temperature and pressure. That is supersaturation. The higher the pressure, and the lower the temperature, the more gas can be dissolved in water. As pressure is released, the gases bubble out of the water. This is similar to the carbon dioxide in carbonated beverages. Their containers contain higher pressure than the surrounding air. When the container is opened, pressure is suddenly reduced, and the carbon dioxide begins to bubble out.

However, it takes time for nitrogen and other gases to be released from water under supersaturated conditions. As depth (and hence pressure) increases, they are more stable. But the dissolved gases may be taken in through the gills of fish, and if the fish are near the water surface, the gases may come out of solution in the form of bubbles inside their bodies, causing harm and possible death. See Section 2.2 for more specific discussion of these effects.

Current state, Tribal and federal water quality standards for TDG concentrations are 110 percent saturation except when stream flow exceeds a 7-day average, 10-year flood event. The TDG levels downstream of Chief Joseph Dam frequently go above this standard. In particular, very high levels of TDG were observed below Chief Joseph and Grand Coulee Dams in 1996 and 1997.

High levels of TDG produced at one dam tend to persist far downstream. Thus, these high levels of TDG resulting from operation at Chief Joseph Dam remain unaltered as they pass through the powerhouses of downstream dams. This is particularly significant in light of the recent designation of ESA-listed fish stocks within the study area. Chief Joseph Dam is the upper boundary for the Upper Columbia River Evolutionarily Significant Unit (ESU) for steelhead, as well as the Upper Columbia River ESU for spring chinook. These ESUs were listed as endangered under the ESA on August 18, 1997, and March 16, 1999, respectively. Bull trout have also been listed as threatened within the Columbia River basin, which includes the study area.

Concern is underscored by the fact that juveniles of chinook and steelhead are in the river in spring and early summer, the time of greatest likelihood of spill. Juveniles may be more susceptible to effects of high gas levels because of their behavior and relatively shallow location in the river cross-section.

At present, Chief Joseph Dam does not have a means of preventing gas supersaturation under spill conditions. The most effective means of reducing TDG is by limiting how deep water can plunge into the tailrace after passing over the spillway. At other projects on the Columbia and Snake rivers, concrete deflectors have been added at the spillways to minimize this plunging depth. These "flow deflectors" have proven relatively cost effective and efficient at reducing the levels of TDG associated with spill.

There is no voluntary spill at Chief Joseph Dam or at Grand Coulee Dam, because there is no anadromous fish migration past these projects. However, involuntary spill occurs when total river flow is greater than powerhouse capacity. This may happen under conditions of high snowmelt runoff, a storm, or low demand. It may be widespread in the Columbia system after heavy snowpacks have accumulated, as occurred in 1997. At Chief Joseph Dam it might also result from spring drawdown of Lake Roosevelt (Grand Coulee reservoir) for flood control. Grand Coulee Dam spills an average of one in every six years.

The proposed project is one of several efforts at federal dams in the Columbia basin to ameliorate dissolved gas conditions. This effort is directed under the Supplemental Biological Opinion for Operation (BiOp) of the Federal Columbia River Power System (NMFS, 1998a):

> "3.d. The Action Agencies, in coordination with NMFS and the Regional Forum, shall jointly investigate operational and structural **gas abatement measures at Grand Coulee and Chief Joseph Dams** as a part of a system-wide evaluation of gas abatement measures. The Bureau of Reclamation shall submit an interim status report to the NMFS by April 1999 stating the findings of the investigations at Grand Coulee. The Corps of Engineers shall develop and coordinate through the Regional Forum the scope and implementation schedule for a similar investigation at Chief Joseph Dam by October 1998. The Action Agencies shall coordinate with the Dissolved Gas and System Configuration Teams to identify gas abating alternatives, future actions, implementation schedules and future funding requirements for gas abatement at Grand Coulee and Chief Joseph Dams. The Action Agencies shall seek congressional authority and funding, as necessary, to implement the selected preferred alternatives.
>
> "Lower dissolved gas levels from Grand Coulee and Chief Joseph Dams would reduce background TDG levels caused by these projects, which may limit the duration of exposure of adult steelhead to high dissolved gas concentrations. Further, the passage survival of juvenile steelhead would be improved because increased spill would be allowed at downstream projects under the current dissolved gas cap."

The proposed project is supported by the interagency System Configuration Team (SCT) as a priority action. It is authorized under the Fish and Wildlife Coordination Act of 1934 (16 USC 661-666).

The project area is the Columbia River from Lake Roosevelt (Grand Coulee reservoir) through Grand Coulee Dam, Lake Rufus Woods (Chief Joseph Dam reservoir), Chief Joseph Dam, Lake Pateros (Wells Dam reservoir), and downstream to Priest Rapids Dam, because, as is discussed subsequently in this EA, effects are not expected below Priest Rapids (river mile 397). This document will refer to the river below Chief Joseph Dam as the midColumbia by generally-acccepted usage, although reference to stocks of steelhead and chinook salmon below the dam in this part of the river includes use of the term Upper Columbia Evolutionarily Significant Unit (ESU).

This document is intended to meet procedural and documentation requirements of the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) rules (40 CFR 1500-1508), and US Army Corps of Engineers implementing regulations (ER 200-2-2).

## 2.0 INTRODUCTION AND BACKGROUND

Chief Joseph Dam is part of the Federal Columbia River Power System (FCRPS), which comprises 29 dams (Figure 2.0-1). Chief Joseph is located on the Columbia River near Bridgeport, Washington, and is operated by the US Army Corps of Engineers. It was authorized under Public Law 79-525 in 1946, primarily for power production and irrigation. It was completed in 1961, with powerhouse generating units 1-16. Units 17-27 were completed in 1979. A spillway and pool raise were completed in 1981.

Chief Joseph Dam is 52 miles downstream of Grand Coulee Dam, and operates as a run-of-river hydropower project, fluctuating less than six feet in elevation over a normal year. Chief Joseph Dam has no fish ladder. Releases from Chief Joseph Dam are generally coordinated with those of Grand Coulee Dam to optimize power revenues.

Grand Coulee Dam, also part of the FCRPS, is operated by the US Bureau of Reclamation, and is located at Grand Coulee, Washington. Grand Coulee was completed with 18 generating units in 1942, prior to Chief Joseph, and impounded what is called Lake Roosevelt. Pumped storage was added in 1974, the 3$^{rd}$ powerhouse in 1982, and four more pumped storage units in 1984.

Previous NEPA documentation for Chief Joseph Dam operations includes an Environmental Impact Statement (EIS) (USACE, 1971), and a supplemental EIS (USACE, 1975). For Grand Coulee Dam a final EIS (USBR, 1975) was completed for downstream riverbank stabilization related to construction of the third powerhouse. Another EIS (USBR, 1976) was done for the Columbia Basin Project, which included Grand Coulee Dam and focused on the irrigation system construction that began in 1933. For both projects, and the rest of the FCRPS, a Final EIS was completed in 1995 for the System Operation Review (BPA et al., 1995).

Also, as of spring 2000, a Master Plan for Chief Joseph project lands is being prepared. It is due for finalization in autumn 2000.

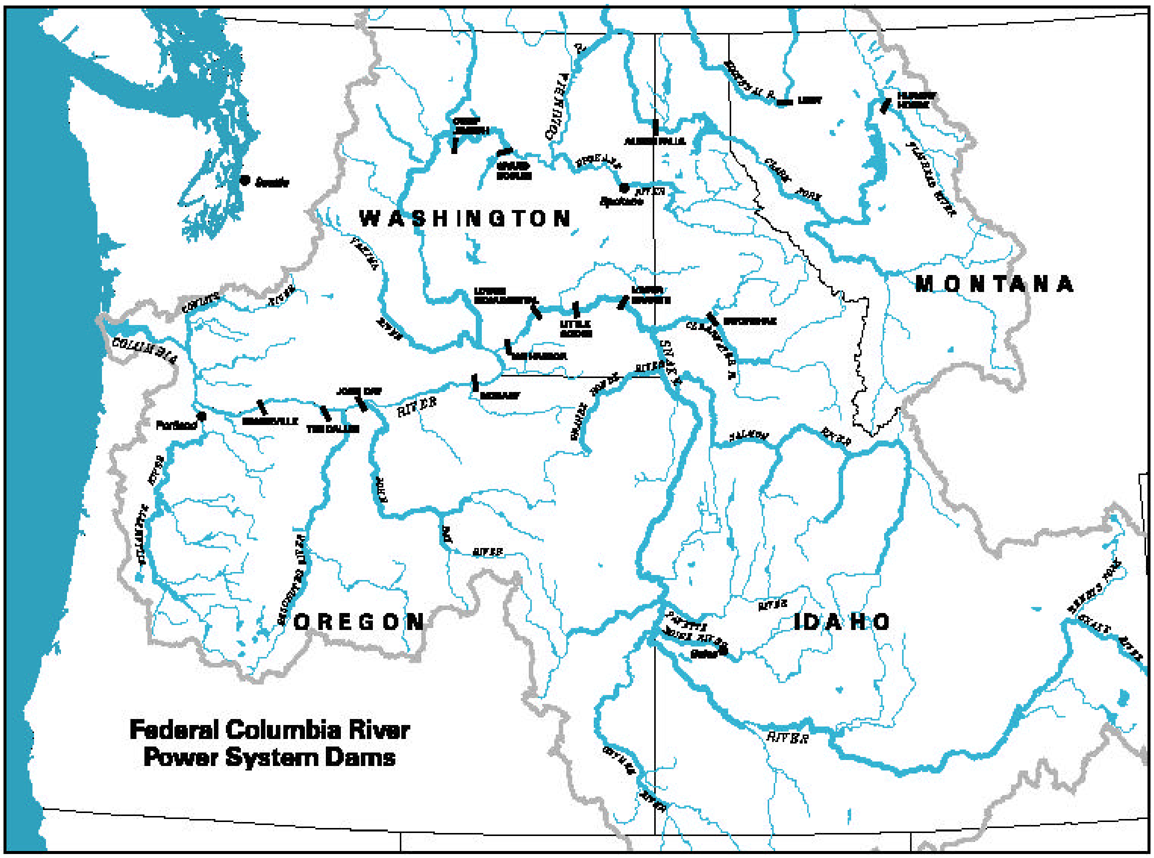


Figure 2.0-1. Map of the US portion of the Columbia River basin including dams of the Federal Columbia River Power System (FCRPS).

2.1 <u>Project operation summaries</u>

2.1.1 <u>Chief Joseph Dam operation</u> The following information summarizes Chief Joseph Dam operation:

*Project Description*

- Sub-basin: Middle Columbia
- Stream: Columbia River
- Location: Bridgeport, Washington
- Owner: Corps of Engineers
- Type of Project: Run-of-river
- Authorized Purposes: Power, Recreation
- Other Uses: Irrigation, Water Quality

*Powerhouse*
- Number of main units....................27
- Nameplate capacity........................2,069 MW
- Overload capacity..........................2,614 MW
- Hydraulic capacity........................219,000 cfs

*Hydrologic Data*
- Drainage area = 75,000 sq mi
- Maximum historical peak discharge = 725,000 cfs (1894)
- Maximum rate of change = No limit
- Lake Elevation
  Maximum pool = 958.8 ft
  Full pool = 956.0 ft
  Minimum pool = 930.0 ft
- Reservoir gross capacity (Elev. 946.0) = 518,000 AF

The elevation of Lake Rufus Woods (the reservoir behind Chief Joseph Dam) fluctuates very little throughout the year. The normal operating range is between elevation 950 feet and 956 feet. Although the project was authorized to fluctuate between elevation 930 feet and 956 feet, a number of constraints make that nearly impossible. A pool elevation below 950 feet will have adverse consequences because irrigation pump intakes will be dewatered (irrigation season extends primarily between 16 May and 15 October), boat docks will become unusable, boat ramps will require cleanup, and obstructions in the river will cause boating hazards. During the goose nesting season, from 15 February through 15 May, elevation 950 feet at Chief Joseph takes on added importance due to the formation of land bridges to nesting sites. These bridges result in increased predation on young birds. Salmon net pens in Lake Rufus Woods may also need to be relocated if the reservoir is drawn down far below the normal minimum elevation. Channel bank instability occurs when the Chief Joseph forebay drops below elevation 950 feet. The most acute bank instability takes place in the Elmer City area below Grand Coulee Dam. The U.S. Bureau of Reclamation has standing orders to keep the tailwater elevation below Grand Coulee Dam at or above elevation 951 feet to prevent bank sloughing. The Chief Joseph forebay elevation directly influences the Grand Coulee tailwater gage. Various combinations of Chief Joseph pool elevations and Grand Coulee discharges can produce a condition where Grand Coulee tailwater drops below 951 ft. For these reasons, elevation 950 feet should be considered the year-round normal minimum forebay elevation for Chief Joseph project.

2.1.2 <u>Grand Coulee Dam operation</u> The following is a synopsis of operation of Grand Coulee Dam:

*General*
- Sub-basin: Upper Columbia
- Stream: Columbia River
- Location: On Columbia River, 28 miles northeast of Coulee City, Washington
- Owner: US Bureau Of Reclamation
- Type of Project: Storage

*Powerhouse* (Consisting of Left, Right, Third, and pump generating plant)

- Number of units...................21
- Nameplate capacity...........6,809,000 kW
- Overload capacity.............7,830,000 kW
- Normal minimum flow........ 30,000 cfs or larger as needed to meet minimum requirement at Priest Rapids
- Hydraulic capacity (full pool)...280 kcfs
- Minimum Tailbay elevation is the higher of a, b, or c as defined below:

a. The average tailbay elevation for the previous 24 hour period minus 11 feet (10 feet if the average exceeds elevation 966 for 5 consecutive days).

b. The average tailbay elevation for the previous 5 day period minus 11 feet (10 feet if the average exceeds elevation 966 for 5 consecutive days).

c. Elevation 951 feet.

- Tailbay hourly drawdown limit:

| | |
|---|---|
| Above 962' | 5 ft/hour |
| 962'-957' | 4 ft/hour |
| 957'-953' | 3 ft/hour |
| 953'-951' | 2 ft/hour |

*Hydrologic Data*

- Drainage area = 74,100 sq mi
- Maximum historic peak inflow = 1,230,000 cfs
- Lake Elevation

  Maximum pool = 1290.0 ft
  Full pool = 1290.0 ft
  Minimum pool = 1208.0 ft
- Usable Storage (1208.0 to 1290.0) = 5,185,400 AF
- Authorized Purpose: Flood Control, Power, Irrigation
- Other Uses: Fishery, Recreation

Grand Coulee Dam is located on the mainstem Columbia River in northeast Washington. The project is authorized for flood control, power production and irrigation and is operated by the US Bureau of Reclamation (USBR). Reservoir (Franklin Delano Roosevelt, or FDR, Reservoir, hereinafter called Lake Roosevelt) releases are also influenced by downstream ESA listed salmon and steelhead runs. Operating guidelines relating to the listed Snake River salmon runs are specified in the 1995 Salmon BiOp on the Federal Columbia River Power System (FCRPS) operations (NMFS, 1995) and in the 1998 supplemental FCRPS BiOp covering listed Columbia/Snake River steelhead stocks (NMFS, 1998a).

The reservoir is managed to refill in April, May, and June while reducing flooding downstream. Complete refill is targeted for June 30. In accordance with the 1995 Salmon Biological Opinion (NMFS, 1995) and the 1998 supplemental Biological Opinion (NMFS, 1998a), Lake Roosevelt will be full on June 30, and then dropped near elevation 1280 feet following Labor Day weekend (first weekend in September). It is usually refilled to elevation 1283 feet or higher by the end of September for resident fish returning to hatcheries. Fall draft is limited to elevation 1265 feet by December 31 to ensure an 85% confidence of refill to the flood control rule curve on the planning date of April 10 per the supplemental Biological Opinion (NMFS, 1998a) and to be consistent with previous operations and studies conducted during ESA consultations. The flood control rule curve is a graphic representation of the maximum reservoir elevation allowable over time, except for emergency operations, in order to ensure space to store high runoff in the reservoir. This is to protect property downstream of the reservoir. Temporary storage of water to elevations above the rule curve is allowed for actual flood control operations, but the extra water must be evacuated as soon as possible within prescribed flow limits downstream. Lake Roosevelt flood control criteria are established by the Corps of Engineers (Figure 2.1.2-1). A minimum space of 500,000 acre-feet (an acre-foot is 43,560 cubic feet) is required starting in January; this requires draft to approximately elevation 1283 feet. Additional draft is required based on water supply forecasts for The Dalles with adjustments made for flood space provided by storage projects upstream of Grand Coulee Dam. The winter draft is generally limited to elevation 1260, 1250 and 1240 in January, February and March respectively unless more is needed for flood control or power emergencies. The Gifford-Inchelium Ferry needs elevation 1225 feet or higher to operate (C. Sprankle, USBR, 1998, pers. comm.).

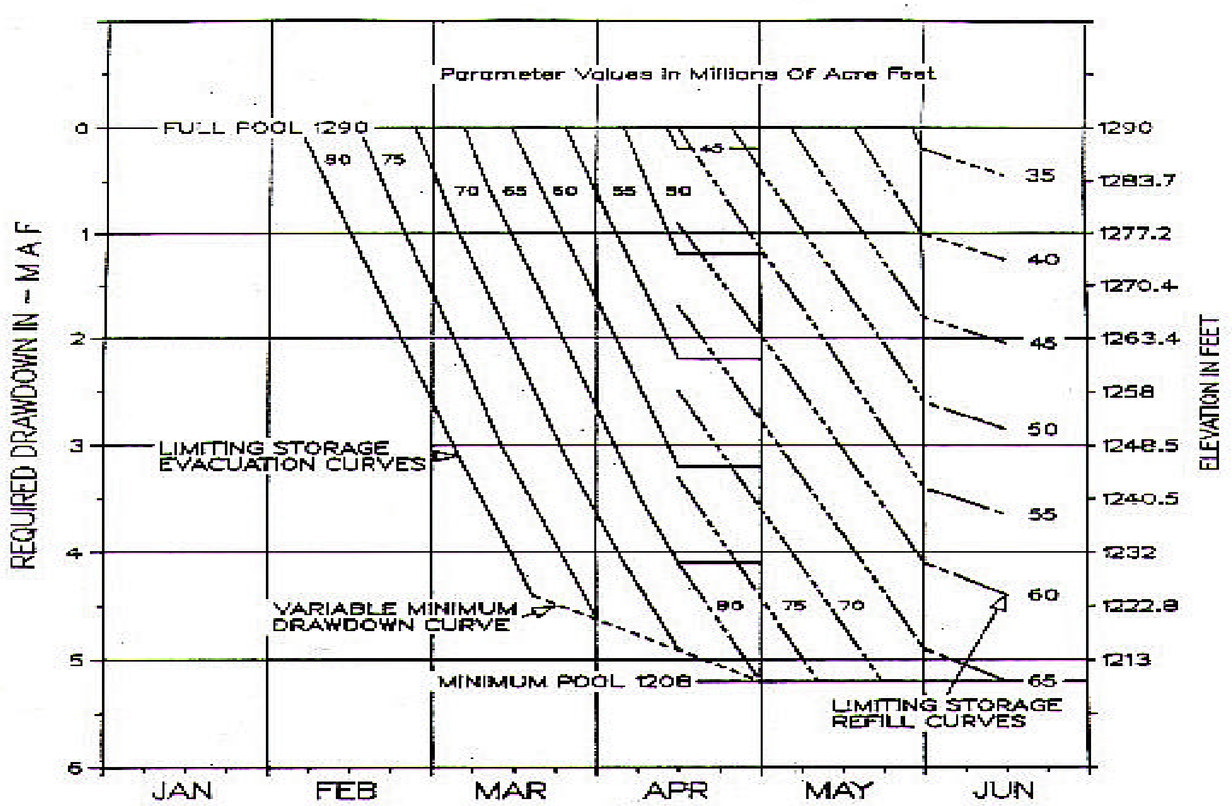


Figure 2.1.2-1. Grand Coulee flood control rule curve drafting requirements. As explained in USACE (1991), "[t]he numbers associated with the slanted drawdown lines represent the forecasted runoff for April-August in millions of acre-feet. The Limiting Storage Evacuation curves define the basic drawdown requirement in anticipation of the spring flood. The Limiting Storage Refill Curves restrict the degree to which the reservoir may be filled after April 15."

There are daily draft limits at Lake Roosevelt for purposes of reservoir bank stability (USBR, 1993). The limit between elevation 1260 and 1290 feet is 1.5 feet per day, between

1240 and 1260 feet is 1.3 feet per day, and below 1240 feet is 1 foot per day. During power emergencies, as declared by Bonneville Power Administration (BPA), draft rates can be as high as 2 feet per day, but only after BPA has clearly demonstrated that all other reasonable actions have been taken to meet the emergency. Aerial inspection of the Lake Roosevelt shoreline is required in these situations.

Grand Coulee Dam has a minimum flow requirement of about 30,000 cfs or larger as needed to meet the minimum flows at Priest Rapids Dam. The Priest Rapids minimum flow is the higher of 36,000 cfs or the Vernita Bar flow requirements. Grand Coulee Dam minimum flow is an average daily flow requirement; instantaneous flows may be less.

Grand Coulee also has limits on the minimum tailbay elevation and hourly tailbay drawdown limits for maintaining stability in the river banks downstream of the dam (USBR, 1995). The allowable minimum tailbay elevation is the higher of a) the average tailbay elevation for the previous 24 hours minus 11 feet; b) the average tailbay elevation for the previous 5 days minus 11 feet; or c) elevation 951 feet. If either the 24 hour average for the 5 day average exceed elevation 966 for 5 consecutive days then 10 feet will be subtracted rather than 11 feet. The tailbay hourly drawdown limit is as follows: 5 ft/hour above 962', 4 ft/hour between 957' and 962', 3 ft/hour between 953' and 957', and 2 ft/hour between 951' and 953'.

Although there are no flow restrictions at Grand Coulee to reduce gas levels, there are priorities for how the water is released, based on operational studies conducted in 1996. Power generation is the first priority. If no power is needed then the second priority is to operate units speed-no-load. If releases are in excess of the power plant capacity, then the water is released in the following order:

1. Spillway gates - the water is to be released evenly across eleven gates. These gates are operational if the reservoir elevation exceeds 1,260’.

2. Outlets - this is the last choice. If water is to be released through the outlets then there are to be releases evenly through upper and lower gates. If only two gates are required then an upper gate and the lower gate immediately below will be used rather than side by side.

The greatest water quality concern related to Chief Joseph and Grand Coulee dams is total dissolved gas (TDG) levels in both Rufus Woods Reservoir and the Columbia River below the dam. Due to the height of the spillway and the configuration of the stilling basin, TDG levels can top the Washington state water quality standard of 110%. During years of high flow, a waiver is usually granted to raise the standard to 120%. This problem is most acute during the spring and summer when both Grand Coulee and Chief Joseph Dams are spilling water due to high runoff, and insufficient power demand does not allow all inflow to pass through the generating units. To address this issue the Corps of Engineers and the US Bureau of Reclamation are currently investigating ways to minimize TDG production at both dams through structural and operational modifications.

Given the presence of fish stocks listed under the Endangered Species Act in the Columbia below Chief Joseph, this project has high regional importance. Spring is when outmigration occurs for juvenile salmon and steelhead—they are entering the Columbia from spawning tributaries such as the Okanogan and Methow. Bull trout are also present in the river below Chief Joseph Dam, as well as in Lake Rufus Woods. Other fish and aquatic organisms are also important to this effort.

2.2 Effects of dissolved gas on organisms Dissolved gas supersaturation in water is of concern to biologists and water quality specialists because of its harmful effects on aquatic organisms. Effects have been documented for fish and aquatic insects (Weitkamp and Katz, 1975, 1980; Weitkamp, 1977, 1998; Bennett et al., 1994; Aquatechnics, 1998; Backman et al., 1999; Ryan and Dawley, 1998; Cochnauer, 1995(?); Fickeisen and Montgomery, undated; others). Fish in supersaturated water may suffer high levels of dissolved gas in their bloodstreams. This gas bubble disease (GBD) or gas bubble trauma (GBT) can cause injury and death. As gas leaves solution in blood vessels (such as in gills), it can block them, restricting blood flow in a condition similar to decompression sickness, or "the bends," in human divers. It may also embolize out of solution into other tissues, such as skin and eyes. Such bubble formation, in addition to causing tissue damage, may also make organisms buoyant, disorienting them and increasing their susceptibility to predation, or allowing them to be swept out of their normal habitat. Captive fish reared in commercial net pens have also experienced inhibition of growth, which Aquatechnics (1998) related to exposure to high TDG levels.

Aquatic insects may also have problems with high TDG levels. Fickeisen and Montgomery (undated) found buoyancy from external bubble adherence to affect some aquatic insects (stoneflies, mayflies and caddisflies) in conditions above 110% dissolved gas saturation in the Kootenai River in Montana. They found symptoms of gas bubble disease in stoneflies at saturation levels above about 130%, but flotation from bubble adherence seemed to be the more prevalent effect. Brammer (1991) found that one genus of mayfly, *Baetis*, was affected at a TDG level of 115% in the Bighorn River; other species there were affected at 124%.

Many of the studies which have been done to date on these phenomena have taken place under controlled laboratory conditions or in confined situations (e.g. Fickeisen and Montgomery, undated; Weitkamp, 1976; Weitkamp and Katz, 1975), but some studies have been done on unconfined fish exposed to high dissolved gas in rivers (Dell et al., 1975; Cochnauer, 1995(?); Backman et al., 1999; Ryan and Dawley, 1998). The US Geological Survey is currently conducting field studies to determine actual effects on fish in the Columbia River below Grand Coulee Dam (A. Maule, USGS, Cook, WA, pers. comm., 1998).

The presence of high TDG does not by itself guarantee that biological impacts will occur. Location and behavior of the organisms in relation to depth is also important (Ryan and Dawley, 1998; Backman et al., 1999). Organisms deeper than one to two meters (the "compensation depth") in the water column may escape the impacts of dissolved gas supersaturation. This is because the solubility of gas increases as depth, and therefore water pressure, increase. The pressure inside an organism is the same as that in its environment. As long as gases can remain in solution in an organism's blood or tissues, it is under decreased risk of bubble formation. A number of factors affect the vulnerability of fish to GBD: TDG level, water temperature, duration of exposure (especially to TDG greater than 120%), recovery time following exposure, fish species, fish life stage and size, fish behavior, and fish location in the water column and river cross-section. Fidler (1998) listed similar variables.

But not all organisms can escape the effects of high TDG, at least for long-term exposure. Those which normally are found near the water surface, or in shallow water, such as near the margins of the water body below a source of high TDG, may be unable to avoid it. Such organisms would include aquatic insects, which live on the substrate, are not very mobile, and are most highly concentrated in well-lit shallow water where primary productivity is highest. Also, fish such as juvenile salmon, and larvae and fry of other species, often are associated with river margins and shallow water, although Rondorf et al. (unpublished data cited in Backman et al., 1999) suggested that up to 96% of migrating smolts may be below 3 meters in depth.

Field studies may not identify many of the fish killed by GBD, because of inherent bias in each type of sampling gear used. "Passive" gear that requires fish to enter or be captured through their behavior (e.g. fyke nets, hoop nets, gillnets, and also angling) will not capture dead or incapacitated fish. "Active" gear (seines, electrofishing, trawling) that moves and actively captures fish may still miss some dead or incapacitated fish. Since GBD injuries may lead to incapacitation or death, it is possible that some of the following accounts have underestimated the percentages of fish affected by GBD.

Cochnauer (1995[?]) sampled fish in the Clearwater River below Dworshak Dam and found low instances of gas bubble disease symptoms in various resident and anadromous species at TDG levels from less than 110% to about 120%.

Ryan and Dawley (1998) conducted net pen observations and sampled fish in the Snake River in 1997. They found few external signs of GBD in resident and anadromous fish sampled from the river when TDG was below 120%. For resident fish, TDG levels of 120-125, 125-130, 130-135, and >135 percent led to average rates of GBD symptoms of about 5, 10, 25, and 45 percent, respectively. Salmonids were more difficult to draw conclusions from, due to low sample size.

Bennett et al. (1994) found no external GBD symptoms among 2,200 fish (salmonids and others) below Lower Granite Dam on the Snake River in conjunction with spill tests. TDG levels were greater than 115%, but the test durations were only 2-3 hours.

Backman et al. (1999) sampled for fish in the Bonneville Dam tailrace during periods of extended spill in May and June of 1998. They found juvenile anadromous fish with gas bubble disease (GBD) symptoms, at a time when dissolved gas levels were between 115% and 126% (24-hr average). These fish were a minority of those sampled (0-4.3%), but sample size was not large there either. Adult fish (chinook, steelhead and sockeye) sampled by Backman et al. (1999) at Bonneville Dam April-June 1998 had no symptoms of GBD, where the range of TDG was 107-126%. A cubic polynomial regression analysis for 1997-1998 data for salmonid smolts in the lower Columbia River indicated that percentages of fish with GBD symptoms increased noticeably above 120% TDG saturation. Values from the regression model were approximately

1% of fish with symptoms at 120% TDG, 4-6% of fish with symptoms at 125% TDG, and more than 16% with symptoms at 130% TDG.

Weitkamp (1998) stated that work he and others had done on the Columbia indicated few unconfined fish with GBD symptoms except in shallow water or under unusual conditions. Confined fish he held within 1 meter of the surface were killed in “significant” numbers at a saturation level of 120% with exposures of 16 hours for 20 days; “substantial” numbers of fish confined to within 2 meters of the surface were killed at a TDG level of 125%. Fish held within 4 meters of the surface exhibited no mortalities at TDG levels of 119-128% over 10-20 days.

Nevertheless, large numbers of fish have been killed as a result of extended spill from Grand Coulee Dam (AquaTechnics, Inc., 1998). In May and June 1997, wild fish were observed dead or dying almost daily with acute GBD symptoms. They included walleye, kokanee, rainbow trout, sculpin, carp, sucker, and whitefish species. Also, well over 100,000 captive steelhead at Columbia River Fish Farms and Global Aqua facilities in Lake Rufus Woods were killed in 1996 and 1997; these losses represented from less than one percent up to 33% of their groups. Daily average TDG measurements in the Chief Joseph Dam forebay ranged from about 122% to 136% from midMay through June 1997.

Dell et al. (1975) documented gas bubble disease symptoms as a result of long-term spill in the five midColumbia Public Utility District reservoirs in 1974. The fish they sampled came primarily from water less than 15 feet deep. Table 2.2-1 gives overall gas level and GBD incidence results. Of all fish sampled (32,289) in the five reservoirs, 10% (3,221) had GBD symptoms. Resident fish numbered 29,273, with 10.6% (3,093) exhibiting GBD symptoms. Juvenile chinook, coho, and sockeye numbered 2,521; of those, 4.2% showed GBD symptoms. Gas levels ranged from 111.7 to 131.3% from May 22 to September 23, 1974, in the Wells Dam forebay. A total of 4,231 fish were sampled in Lake Pateros, in July and August. Of those, 120 (2.8%) had GBD symptoms, and the TDG levels during those months ranged from 114.6% to 131.3%. The most susceptible fish appeared to be northern pikeminnow (28.4% showing symptoms), chiselmouth (22.7%), peamouth (29.2%), whitefish (22.7%) and larger suckers (40%). Chinook fry exhibited a 4.1% symptom rate, coho fry 6.1%, and sockeye 0%.

Table 2.2-1. Gas levels in midColumbia reservoirs in 1974, from Dell et al. (1975).

| Month | Gas saturation levels* | GBD incidence** |
|---|---|---|
| May | 122.6 (117.5-126.9)% | 17.4% |
| June | 126.1 (121.3-131.9)% | 21.0% |
| July | 124.8 (119.5-131.7)% | 9.7% |
| August | 117.4 (106.7-123.8)% | 0.5% |

*Numbers are average for each month, with range in parentheses
** Percent of total fish caught which exhibited GBD symptoms

A numerical model (Fidler, 1998) for gas bubble trauma to juvenile chinook and steelhead at lower Snake River dams was developed for Walla Walla District of the US Army Corps of Engineers. Available data limited development of the model to chinook of 117-120 mm length at 15$^{o}$ C, and steelhead of 180 mm length at 10$^{o}$ C. No attempt was made to use that model for this study because of project-specific limitations.

Because of field data that do indicate impacts, strong concern still exists in most situations where gas supersaturation occurs for extended periods. Such concern is amplified in the Columbia basin by listings of several stocks of resident and anadromous fish, including salmon, steelhead and bull trout, as threatened or endangered under the Endangered Species Act. It is prudent to err on the side of caution in the absence of site-specific verification of smolt behavior.

2.3 Generation of high dissolved gas levels High levels of total dissolved gas are created as a result of high-energy plunges of water—for example, from structures such as dam spillways into a deep stilling basin (USACE, 1999). Gas is forced into solution at levels which may exceed 120% of full saturation. Such conditions can persist for many miles downstream of the generation point. They may pass from one dam to another, and be exacerbated by the second dam; thus, high TDG may be propagated for extended distances where there is a series of dams which are spilling. In 1997, as a result of high spring runoff from snowmelt, involuntary spill at dams was widespread in the Columbia basin, and extensively high levels of dissolved gas were documented (M. Valentine, USACE, pers. comm., 2000).

Agitation of the water is needed for degassing to occur. Such agitation might occur at waterfalls or in rapids. It is also the purpose of structures such as spillway flip-lips, or flow deflectors, which are actually a mechanism for preventing water from plunging and entraining large amounts of gas. These structures prevent plunge and provide aeration by sending the spilled water skimming along the surface of the tailrace. Aeration allows gas saturation to drop or remain below supersaturation levels by creating bubbles or spray. That increases the surface area of the water, increasing the opportunity for gases to leave solution by crossing the water-air interface into the atmosphere.

For a more complete discussion of gas production at a dam, the reader should refer to the Corps' Dissolved Gas Abatement Study (USACE, 1999).

2.4 Dissolved gas standards/NMFS criteria for salmon protection. The Washington state prescribed maximum for dissolved gas is 110% saturation (Washington Administrative Code Chapter 173-201A-030), except when river flow exceeds a 10-year, 7 day average flood event (WAC 173–201A–060 4(a)), which for Chief Joseph is 241,000 cubic feet per second (cfs). The Colville Confederated Tribes standard is 110% saturation for waters of the Colville Indian Reservation, which constitutes much of the immediate project area. This project is also subject to the Clean Water Act, 40 CFR 131.

The 7-day average, 10-year flow to which regulatory agencies refer when discussing TDG levels is a hydrologic statistic commonly used in water quality standards. It refers to the 7-day average flow with a return period of 10 years. To determine this value for Chief Joseph Dam, average daily flows from the years 1974 through 1997 were used. The peak 7-day average for each year was determined. A Log-Pearson analysis was applied to this set of 24 7-day average flows. The expected flow with a 10-year return period for Chief Joseph Dam is 241 kcfs. This EA assumes the same for Grand Coulee since there are no major tributaries between the two.

In 1980, the powerhouse at Chief Joseph Dam was expanded from 16 units to 27 power units. At the time, it was believed that spill at Chief Joseph Dam would be limited to a one-in-ten-year event. In actuality, the dam spills in all years with a median 7-day average flow or greater (a one-in-two-year event). Spill significant enough to impact water quality occurs in years with a one-in-four-year flow or greater , such as 1981, 1982, 1983, 1996, and 1997 (Section 4.5.3). While the analysis in this EA and the General Reevaluation Report (USACE, 2000) focus on 1997, the same trend in reduced TDG levels would be seen in an analysis focusing on the other large spill years. Even though 1997 represents a large flow year, most of the hourly flows passing Chief Joseph and Grand Coulee Dams during the spill season were well within the 7-day, 10-year flow of 241 kcfs to which the Colville Confederated Tribes, the State of Washington, and the Environmental Protection Agency would apply their water quality standards for TDG. Hence, many of the hourly flows in the 1997 spill season can be considered "average," yet the TDG level of 110% was exceeded.

Laboratory studies have indicated that prolonged saturation above that level can be harmful to fish and other aquatic organisms. Corps of Engineers project operators strive not to create higher levels than that. However, because turbine passage mortality may be high, NMFS believes that a standard of 115% TDG allows relatively successful spill passage as a more desireable alternative to turbine passage, resulting in a higher overall system survival rate for juvenile salmon and steelhead (Nordlund, 2000).

In addition, the National Marine Fisheries Service has developed information that suggests that levels up to 120% may be minimally harmful to organisms in the environment, at least if those conditions are not prolonged (Ryan and Dawley, 1998). That information has not resulted in relaxation of state or Tribal water quality standards, but it has allowed more flexibility on a case-by-case basis where voluntary or involuntary spill may be occurring in the lower Columbia and Snake rivers. Nevertheless, argument has been made that some harm is unavoidable at prolonged saturations above 110%, at least if fish cannot escape by sounding (D'Aoust, 1993; Shrimpton, 1985).

2.5 History/system efforts Dissolved gas and its effects have been of concern for a number of years, as evidenced by literature on the subject, and by the fact that specific standards have been legislated by states. Monitoring in the Columbia and Snake systems has been carried out annually by the US Army Corps of Engineers since 1984 (USACE, 1997). The purpose has been to provide information pursuant to voluntary spill for fish, and for compliance with state standards for water quality. That has been done between April 1 and September 15. In addition, since 1996, the USACE has provided information on involuntary spill between September 15 and March 31.

2.6 Columbia Basin System Operation Review and other regional planning In 1995, an environmental impact statement (Bonneville Power Administration et al., 1995) was completed concerning operation of 14 FCRPS dams. The System Operation Review (SOR) Environmental Impact Statement was a large-scale detailed analysis of several system operating alternatives and their effects. The water quality analysis (SOR Appendix M) examined dissolved gas, and predicted that under the preferred alternative, dissolved gas generation by Chief Joseph Dam would not exceed 120% saturation, and would exceed 110% saturation from 18 to 69 days per year. The preferred alternative was adopted as the current operational regime. It is primarily based on the 1995 Biological Opinions of the National Marine Fisheries Service (NMFS, 1995) and the US Fish and Wildlife Service (Dwyer, 1995) concerning effects of dam operation on endangered salmon and sturgeon. Subsequent to the SOR effort, the need for gas abatement at Chief Joseph and Grand Coulee dams was identified in the "Three Sovereigns" process by the Corps of Engineers, National Marine Fisheries Service, US Fish and Wildlife Service, tribes and state fish agencies. The report (Three Sovereigns Senior Staffs, 1998), was distributed to regional decisionmakers.

2.7 Litigation regarding system water quality The Corps of Engineers was named a defendant in a lawsuit in 1999, wherein a group of environmental organizations contended that the Corps was violating Washington state water quality standards for temperature and dissolved gas at the four lower Snake River dams. This case has not yet been decided; a hearing was held in February 2000 and a ruling was due sometime in March. The case has implications for many FCRPS projects.

2.8 Near-field studies of dissolved gas below Chief Joseph Dam Intensive field studies of dissolved gas patterns resulting from spill at Chief Joseph Dam were conducted in June 1999. Gas concentrations were monitored from the Chief Joseph forebay to the Wells Dam forebay 40 miles downstream at river mile 515. Those studies provided data for use by the Corps' Waterways Experiment Station in Vicksburg, Mississippi, in constructing a physical model of the dam towards design of gas abatement structures at Chief Joseph.

The near-field studies showed dissolved gas levels and mixing patterns below Chief Joseph Dam at different levels of spill. They confirmed that spilled water containing high levels of total dissolved gas remains segregated from powerhouse outflow until reaching at least the Brewster Flats area downstream.

2.9 Physical modelling of spill by Waterways Experiment Station The Corps of Engineers' Waterways Experiment Station in Vicksburg, Mississippi, has built and run a 1:40 scale physical model of 3.9 spillbays, and a 1:80 scale model of the entire dam and spillway. The purpose was to derive the best design for the deflectors such that they would function efficiently over the widest and most likely encountered range of flows, and to determine physical effects in the tailrace. The deflector configuration chosen is 12.5 feet horizontally. That is, it represents the length of the upper surface from the front edge to where the horizontal surface would reach the dam face if there were not a curved intersection with the dam. Others tested included an 8-ft deflector and a 17.5-ft deflector.

## 3.0 ALTERNATIVES

Seventeen individual alternatives and one combination alternative for this project were examined under the Initial Appraisal Report (IAR: USACE, 1998b). Alternatives that go beyond the scope of structural or operational measures at Chief Joseph Dam to system-wide operational changes are included in the matrix. Each alternative was put through an initial screening based on a set of nine criteria. Those criteria included cost, percent TDG reduction, fish effects, and likelihood of success. All of the alternatives are discussed generally in the following paragraphs. Not all of the alternatives are being fully considered in this Environmental Assessment because some were either not cost-effective, would be outside the scope of this study, would be damaging to power units, are untested technology, or would have limited gas abatement benefits. The change in order of the alternatives in this document reflects a categorization according to the operational and structural nature of the alternatives.

3.1 No action This alternative involves no structural modifications or modifications to operation of Chief Joseph and Grand Coulee Dams that would be intended to reduce dissolved gas levels due to spill. The no-action alternative is required to be evaluated under NEPA, in order to provide a comparison with the other alternatives selected as reasonable. It is therefore considered in further detail in this document.

3.2 Structural alternatives

3.2.1 Spillway flow deflectors (Initial Appraisal Alternative 1) This measure consists of modifying the spillway with flow deflectors to reduce the plunge depth of spill discharge. Placing the flow deflectors just below the tailwater will generate skimming flows along the water surface of the stilling basin and reduce the amount of gas forced into solution. Deflectors will be required on all of the spillway bays to prevent unstable flow conditions. Nineteen deflectors will provide degassing capability up to the 7-day, 10-year event. A hydraulic model investigation for flow deflectors at Chief Joseph Dam was completed in 1979. The study found that deflectors were effective in producing skimming flow conditions with all flows of a 10-year frequency or less when 18 or more powerhouse units were operating. The Wells Dam pool was assumed to be at elevation 779. The optimum design was a horizontal deflector 12.5 feet long at elevation 775.

This model study is still applicable to the dam structurally; however, the flow frequency may not be accurate due to changes in system management. Additional model studies would be required to refine the design elevation, transition radius, and number and length of deflectors based on current operating criteria. This alternative has proven effective at reducing TDG at other dams and is recommended for further study.

3.2.2 Side Channel Canal (Initial Appraisal Alternative 12) The side channel canal alternative would divert spill through a shallow, gently-sloped canal between the forebay and the river below the dam. Foster Creek is the most obvious location for the canal to flow into the river.

The major drawback to this solution is the high cost. While costs for this alternative at Chief Joseph Dam have not been detailed, the estimated cost for similar structures at other dams can provide some insight to the cost at Chief Joseph Dam. For a smooth side channel to degas 96,000 cfs to 110% at Lower Granite Dam, the cost would be $302 million for design and construction. At Chief Joseph Dam, the design flow would be less, but the channel would be longer to accommodate twice the head. If a baffled side channel is used, the unit flow can be reduced, for a cost of $230 million at Lower Monumental. A baffled side channel at Bonneville

Dam for 150,000 cfs is estimated to cost $706 million.  In either case, the cost is estimated to be at least ten times the cost for flow deflectors.

It also may foreclose on options for later discussion in the context of anadromous fish passage (not part of this action, but being promoted by the Colville Confederated Tribes). Baffled side channels may be incompatible with fish passage.  Fish are likely to get caught in the turbulence and collide with the baffles.  It is unknown if resident fish would be similarly affected at Chief Joseph Dam.  Smooth-crested side channels are less damaging to fish.  Furthermore, preliminary concepts would include the lower reach of Foster Creek, in which an anadromous salmonid (probably a steelhead, listed under ESA) has been observed (R. Fischer, USACE, Chief Joseph Dam, pers. comm. 1999).

The limited real estate opportunities would lead to a complicated and lengthy pre-construction phase.  This should be considered a long-term (greater than ten years) alternative.

This alternative was not recommended for further consideration for this effort.

3.2.3  Degas at Brewster Flats (Initial Appraisal Alternative 16)  It has been suspected that some degassing takes place prior to water reaching the Wells Dam forebay.  The last structural alternative identified in the Corps' initial appraisal study of Chief Joseph Dam was a proposal to raise the riverbed in the Brewster Flats area about 10 miles downstream of the dam. A shallow sill in this area would widen the river, decrease water pressure, and allow dissolved gasses to dissipate.  This alternative may impact the project with an associated loss of power generation due to an increased tailwater.  It may be infeasible due to complicated real estate issues.  It would require extensive flood control studies of the Brewster Flats area.

This alternative does not degas between the dam and Brewster Flats, a 10-mile stretch of the river that includes the mouth of the Okanogan River, an important stream for threatened steelhead.  Under this alternative, adult and juvenile steelhead would need to navigate a short stretch of highly gas-saturated river to enter or exit the Okanogan.  The Columbia River Intertribal Fish Commission (CRITFC) and the Colville Confederated Tribes have expressed concern concern relative to Okanogan fish and spawning fall chinook in the Chief Joseph Dam tailrace, and CRITFC has stated that adult fish passage might be impeded by this option.

This alternative does not reduce gas production at Chief Joseph Dam, although it does reduce TDG levels in the forebay of Wells Dam (30 miles downstream) and beyond.  This alternative is highly unconventional and untested.  Due to the expected high cost and study/design complications, it should be considered a long-term (greater than ten years) alternative, and is therefore not being pursued with this action.

3.2.4  Raised Tailrace (Initial Appraisal Alternative 4)  A shallow tailrace area (depth of 15 feet for all discharges) immediately downstream of the stilling basin would have the effect of increasing the rate at which flows would degas.  The area downstream of the stilling basin would be filled with material sized to withstand the project design flood flows.  This would have the effect of reducing plunge depth, and thus secondary uptake of dissolved gases downstream of the stilling basin.  There would be power losses associated with this alternative.

While several lower head dams have a naturally shallow tailrace, this alternative has not been tested on a dam with the steepness and height of Chief Joseph. This alternative has many uncertainties as to effectiveness, cost, and maintenance based on the geometry of Chief Joseph Dam, and was not recommended for further consideration.

3.2.5 Raised Stilling Basin (Initial Appraisal Alternative 5) Raising the stilling basin to a depth of approximately 20 feet reduces the plunge depth for spill discharge. Chief Joseph Dam has a 167 foot long by 915 foot wide stilling basin with a bottom elevation of 743 feet. The stilling basin would have to be filled with about 20 feet of material and capped with concrete to raise the basin floor to an acceptable depth. A negative step would also be constructed immediately downstream in order to provide effective energy dissipation. There would be power losses associated with this alternative. This alternative has many uncertainties as to effectiveness, cost, and maintenance, and was not recommended for further consideration.

3.2.6 Pumped Storage (Initial Appraisal Alternative 6) In the early 1980s, the Rufus Woods Lake Pumped Storage study looked at constructing a pumped storage project at Jordan Creek, at a cost of $700 million. The project would require construction of a 900-acre upper reservoir located approximately 2 miles east of Chief Joseph Dam. Lake Rufus Woods would be used as the lower reservoir. The project could provide up to 3,000 MW of peak generating capability on a weekly or seasonal cycle. This alternative would provide more project operation flexibility since water could be stored and released when required to avoid spill. Pumped storage projects depend on availability of off peak energy for operation, which would not be a problem with our current energy situation. However, construction of a pumped storage plant is cost prohibitive; therefore, this alternative is not recommended for further consideration.

3.2.7 Increase Powerhouse Hydraulic Capacity (Initial Appraisal Alternative 7) This alternative involves increasing the powerhouse hydraulic capacity by adding an additional unit to the project. Since Chief Joseph Dam is a peaking operation, spill usually occurs when there is a lack of demand for power. Unless demand goes up at night, an additional unit would not reduce TDG levels. This alternative was not recommended for further consideration because of high initial construction costs and limited utility in solving the current TDG problem.

3.2.8 Siphon for Irrigation (Initial Appraisal Alternative 8) Construction of a siphon for irrigation on the right bank would transfer flows from the forebay without increasing the TDG level. The existing irrigation system which is downstream of the dam would be replaced with this system. Unfortunately, the amount of water used for irrigation is negligible in terms of TDG effect for the cost of construction and maintenance. This alternative was not recommended for further consideration.

3.2.9 Unplug Sluices in Spillway (Initial Appraisal Alternative 10) Chief Joseph Dam has 12 sets of low level temporary sluices that were plugged with concrete after original project construction. Each sluice is 8 foot wide by 16 foot high with a bottom elevation of 769 feet. There are no gates or operators associated with these sluices. This alternative would unplug a number of the sluices, and install gates, operators, venting, and a steel liner. An upstream bulkhead and downstream cofferdam would be required to remove the concrete plugs. Extensive concrete removal within the monolith would also be needed to modify the sluices for emergency and regulating gates. This alternative was not recommended for further consideration because of the high construction cost and uncertainty of feasibility.

3.2.10 Baffled Spillway (Initial Appraisal Alternative 15) This alternative consists of adding baffles to the lower portion of the spillway. With this alternative the TDG levels are reduced by stripping gas from solution as water passes down the face of the spillway. With a high forebay, a baffled spillway is one of the best structural alternatives for TDG reduction. However, in the case of Chief Joseph Dam, cavitation damage due to the high velocity ogee crest spillway would be too severe to warrant further consideration of this alternative. Adding baffles to the Chief Joseph Dam spillway would greatly reduce the maximum unit discharge capacity from the current 1,700 cfs to about 200 cfs, thereby compromising the existing Spillway Design Flood discharge (USACE, 1999). Adding baffles to the Bonneville Dam spillway on the Columbia River was estimated to cost over $700 million (USACE, 1999). Even if baffles for Chief Joseph Dam cost half of that ($350 million), it is an order of magnitude higher than flow deflectors. Baffles were considered for Lower Monumental Dam on the Snake River because of their high potential for degassing spilled water, but they were never installed because they are not safe for smolt passage. Therefore, even though there is (as yet) no intentional fish passage at Chief Joseph, there is incidental, unquantified passage occurring. Therefore, use of baffles is difficult to support, and this alternative is not being further considered.

3.2.11 Enclose Stilling Basin (Initial Appraisal Alternative 17) This measure consists of enclosing the stilling basin behind a small dam where flows would be forced over the top of the dam to degas. At Chief Joseph Dam the spillway and powerhouse are separated by a non-overflow section which lessens the impact of adding the dam. This alternative would be able to handle all design flows although it is not known whether the required TDG level can be met. Construction costs would be high due to the size of the cofferdam and amount of material needed to build the dam itself. Additional studies would be required to determine the extent of benefits with this costly alternative. It was not recommended for further consideration.

### 3.3 Project Operational Alternatives

3.3.1 Operate units outside peak efficiency range (Initial Appraisal Alternative 3) This alternative would require the project to operate additional units at lower output, thereby meeting power generation requirements but doing it less efficiently. The result is greater passage of flow for the same amount of electrical output. This alternative may have merit for cases when the flow to be passed is minimal (2,000 to 4,000 cfs). The benefit would be less spill and therefore less supersaturation. However, at the reduced megawatt output levels resulting from operation of the additional units, all units would be close to unstable operation. It has also been determined that this alternative has insignificant benefits for dissolved gas reduction. At best, an additional 4000 cfs could be run through the power units, resulting in a TDG decrease of about one percent. A major drawback to this alternative is increased unit maintenance.

3.3.2 Increase Reservoir Operating Level Fluctuations (Initial Appraisal Alternative 2) Chief Joseph Dam is normally operated within a 6-foot elevation range close to the full pool elevation of 956 feet for the primary purpose of meeting BPA power requirements.

Flexibility to draw the forebay below elevation 950 exists during the 4 winter months (15 October to 15 February). Flexibility is very limited during the eight warmer months because of the large number of conflicting interests. In April 1997, the Water Management office at the Corps' North Pacific Division and Seattle District recommended adoption of the reservoir operating limits of 950 to 956 feet from 15 February to 15 October to address environmental, cultural resource, and erosion concerns. At this time, elevation 930 is the minimum allowable reservoir operating level. If Chief Joseph Dam operated more like a re-regulating dam, project operations could be redefined to allow regular forebay fluctuations of 20 to 30 feet. This change would allow the project to release flows without using the spillway. This alternative has numerous environmental and economic impacts in the forebay and was not recommended for further consideration.

### 3.4 System Operational Alternatives

3.4.1 Spill During Maximum Power Generation/Extend Daily Spill Duration/Market Power at Night (Initial Appraisal Alternative 9) This alternative would require changing operation at Grand Coulee and Chief Joseph to spill more consistently even flows during the day and at night, or to time spills in a more effective manner from a TDG perspective. Total river flow (spill and power release) during the day would be higher than under current operation, while flows at night would be lower. While the overall effect on gas reduction would be small, this alternative would avoid the very high TDG levels associated with short, but very large spills in the early morning hours when demand is low. Larger spill during the day would increase TDG less, because it is diluted by larger powerhouse flow. In addition, it is worth examining market incentives for nighttime power usage, in order to maximize powerhouse operations, thereby minimizing spill. However, upon further evaluation, it was determined that this alternative would fluctuate flows even more dramatically than under current power-peaking operations, resulting in increased risk of damage to the fisheries in the Hanford Reach. An example might be that power generation flows are 200,000 cfs (200 kcfs) during the day and 100 kcfs during the night, and Grand Coulee needs to spill 100,000 acre-feet during that 24-hour period. If all of that water is spilled at night in order to maintain a constant river flow of 200 kcfs, then there is little power generation flow at night to dilute high TDG of spill. If the all of the water is spilled during the day when there is more power generation flow available for dilution, then the daytime river flow would be 300 kcfs and the nighttime flow would be 100 kcfs. There is insufficient storage in the run-of-river reservoirs between Grand Coulee and Priest Rapids to dampen a fluctuation such as this. The 1998 Biological Opinion for salmon and steelhead (NMFS, 1998a) requires that flows in the Hanford Reach of the Columbia River be maintained at as constant levels as possible.

3.4.2 Swap Power for Spill with Downstream Dams (Initial Appraisal Alternative 11) The new ESA listings may require additional spill for fish at downstream projects. Since fish passage is not (yet) an issue at Chief Joseph Dam and since there is the ability to generate more power, a swap might meet many needs. This alternative would involve a power-for-spill swap with either a degassing or a fish passage project downstream. Many of the downstream projects have been, or are about to be, rehabilitated to reduce TDG levels resulting from spill. It may soon be feasible to increase spill at these dams. By maximizing power generation at both Grand Coulee and Chief Joseph, a significant reduction in system TDG levels could be achieved.

Within the midColumbia, system reimbursements for power losses is a standard practice. In the current environment of continual listings of fish stocks under ESA, power production at dams without juvenile fish passage concerns could be viewed as a fish mitigation option. This alternative has been adjusted as the operational change alternative with Grand Coulee Dam that is carried forth in the current analysis. It does not, however, account for possible future anadromous fish passage implementation at Chief Joseph Dam. In any case, implementation of this alternative is already occurring through use of the Spill Priority List to maximize the effectiveness of existing dissolved gas abatement structures. This list includes both federal and non-federal dams in the basin. While swapping power for spill with dams downstream of Chief Joseph was identified as out of scope for this study, it was decided to evaluate further the merits of swapping power for spill with Grand Coulee Dam (upstream) in a combined alternative (see Sec. 3.5.1).

#### 3.4.3 Raise Control Flows at The Dalles (Initial Appraisal Alternative 13)

Raising the control flow at the Dalles could reduce the needed draft from Grand Coulee in the spring. This would help to reduce TDG levels that result from "premature spilling," or "spill now to prevent spill later." Considering the ecological impacts of high TDG levels, this is a relatively simple alternative that deserves further study, particularly in combination with modification of Grand Coulee Dam operation. In fact, this alternative is being considered by the Northwest Division office of the Corps in a new flood control study in response to the 1995 and 1998 Biological Opinions for salmon and steelhead (NMFS, 1995 and 1998a), and is not within the scope of this study. A roughly estimated cost of study has been identified as five million dollars due to the large number of elements involved (including system-wide flow modeling, flood damage assessment, and estimating costs for dike strengthening/extension).

#### 3.4.4 Modify Operation of Grand Coulee Dam (Initial Appraisal Alternative 14)

This alternative would reduce dissolved gas below Chief Joseph Dam by reducing dissolved gas production at Grand Coulee Dam and by reducing the frequency and volume of pre-emptive spill from Grand Coulee that must be subsequently spilled at Chief Joseph. Drawdown for flood control at Grand Coulee would be shifted to a slightly earlier schedule in order to reduce the frequency and volume of spill when the reservoir elevation is below 1260 feet. When the reservoir elevation is between 1260 and 1290 feet, spill would pass through the drum gates. Drawdown of the reservoir below elevation 1260 feet would be achieved primarily with powerhouse flow in order to avoid using the highly saturating sluices (outlet works).

The Bureau of Reclamation has reported that the outlet works at Grand Coulee saturate TDG to a much higher level than the drum gates, 170 percent and 140 percent respectively. In light of this, Grand Coulee Dam should be operated such that the outlet works are rarely, if ever, used and evacuation below elevation 1260 feet should be achieved with powerhouse flow. The ecological cost of high TDG due to using the outlet works (rather than waiting until pool levels allow use of the drum gates) may exceed the benefits for flood control, however this could not be verified without a flood control study of the entire river.

This alternative may have a secondary benefit to temperature management in the Columbia River. Because there is no selective withdrawal structure at Grand Coulee, releases through the powerhouse and sluices may draw deeper, cooler water from Lake Roosevelt.

Alternatively, adoption of this alternative might allow advection of heat by withdrawing warm surface water from the reservoir, thereby preserving the cool water below the thermocline for release later in the summer. This method would essentially be a selective withdrawal system with fixed ports. However, it is possible and perhaps likely, based on recent information, that mixing and short retention times for water in Lake Roosevelt would limit these benefits.

This alternative was reformulated as part of the combination alternative (see Sec. 3.5.1).

3.5 Combination Alternatives

3.5.1 Flow Deflectors and Grand Coulee Operational Modification This alternative is further considered here because it is among the most cost-effective, combining a structural alternative with an operational one. It would have the greatest impact for reducing gas levels in Rufus Woods Lake of all alternatives for either Chief Joseph or Grand Coulee dam. In that sense, it has the very direct effect of providing lower gas levels to Chief Joseph Dam power flows. When power flows mix with spill, they dilute the higher gas levels of spill. In combination with flow deflectors at Chief Joseph, gas levels in spill are dramatically reduced. *This is the preferred alternative.*

3.5.2 Combination of Initial Appraisal Alternatives 3, 11, 13, 14 The combination of these alternatives, each of which may lower gas levels by itself, is aimed at getting a greater reduction in TDG without more-expensive structural modifications. Alternative 3 (Operate Units Outside Peak Efficiency Range) is a project operational change aimed at putting more water through the powerhouse and operating the power units less efficiently. Alternatives 11 (Swap Power for Spill with Downstream Dams), 13 (Raise Control Flows at the Dalles), and 14 (Modify Operation of Grand Coulee Dam) target changes in power distribution and spill in the Columbia Basin. Both Grand Coulee and Chief Joseph would need to be incorporated in the changes in order to achieve the estimated reduction in TDG levels. This alternative contains elements of the operational alternative selected for final consideration.

3.6 Final alternatives The following are the alternatives being carried forward in this study for final evaluation:

- No action
- Flow deflectors
- Operational modification
- Combination of flow deflectors and operational modification (preferred alternative)

These alternatives would involve the following characteristics involving construction and operation.

3.6.1 No Action Operation would remain the same as at present. No construction would be involved. All environmental characteristics and effects would remain unchanged. As stated earlier, the no-action alternative must be fully evaluated under NEPA.

3.6.2 Deflectors As stated in Section 3.2.1, spill deflectors allow spillway flow to skim along the surface of the tailrace, in contrast with the present operation, in which spill involves the water plunging below the surface and entraining air. Spillway flow deflectors would be constructed across the entire face of the spillway with the top surface at elevation 779 ft. Deflectors would be continuous along the 19 bays, except for expansion joints.

Construction would take about 100 weeks, or two continuous years, barring adverse conditions. Construction would involve barges and floating cofferdams, with heavy machinery including a crane and a concrete truck or pumping unit. Figures 3.6.2-1 and 3.6.2-2 show the spillway and floating cofferdam as currently designed, along with a probable sequence for installing the cofferdam (Figure 3.6.2-3). The edges would be sealed against the dam, possibly with grout bags. After completion of sealing, any fish remaining inside would be removed by netting, and released in the river using a large bucket of water or similar container. Then the enclosed area would be pumped dry. When the construction was completed, all spill would pass over the deflectors.

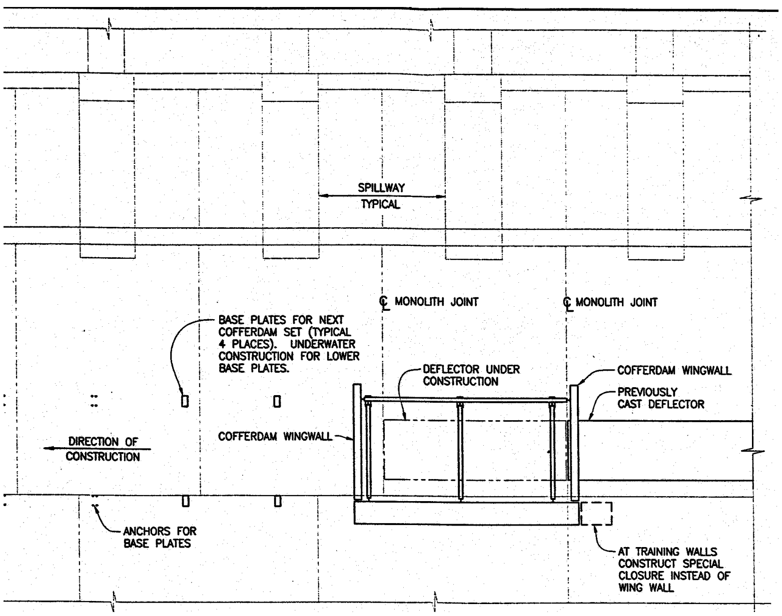


Figure 3.6.2-1. Use of floating cofferdam moving from left side of dam (looking downstream) to right, constructing deflectors in sequence.

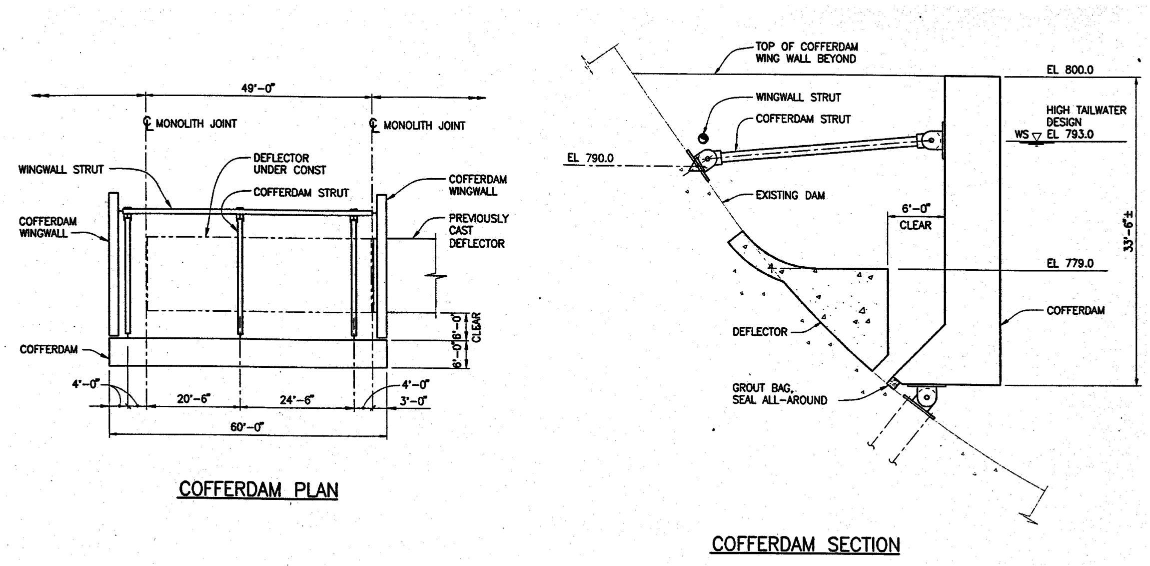


Figure 3.6.2-2. Plan (overhead) view and side view of floating cofferdam structure. Present plan is to seal the base and sides of the cofferdam to the dam face with grout bags after bolting base and struts in place and fixing sidewalls in, and then begin deflector construction.

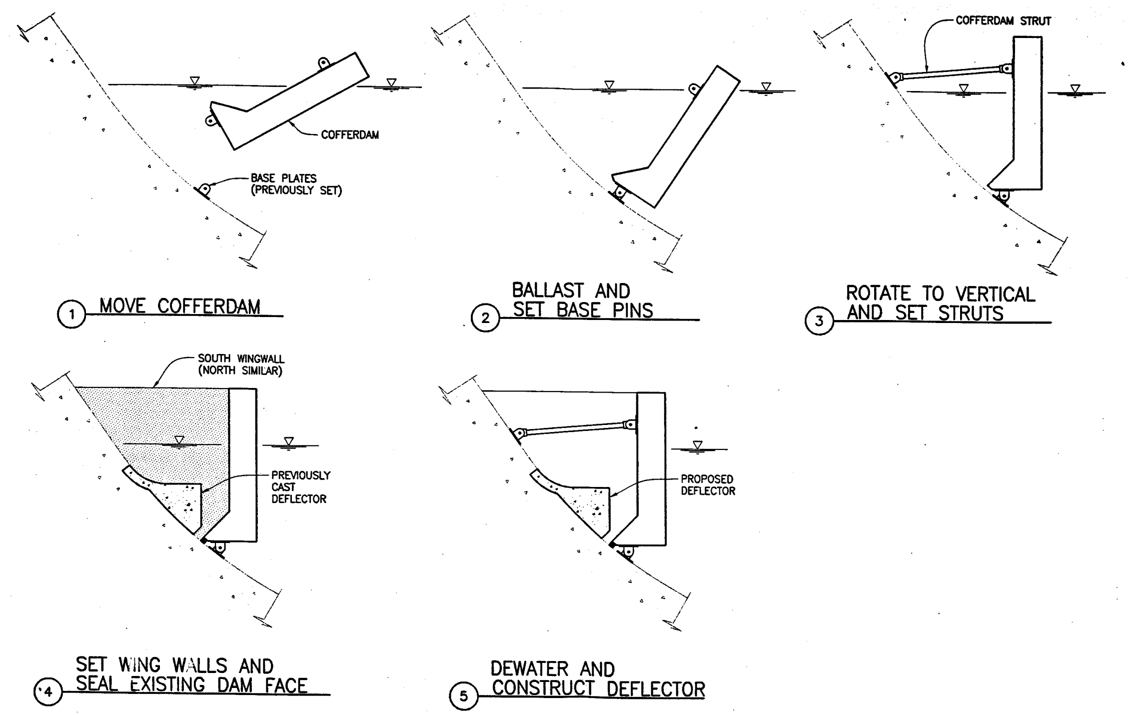


Figure 3.6.2-3. Planned sequence for installing floating cofferdam.

Construction would occupy four contiguous spillbays at one time, including the 2 that would be under construction, and two to either side for the cofferdam. It is necessary to maintain most of the 19 spillbays open to accommodate a 100-year runoff event, so it is not possible to have two cofferdams simultaneously active to accelerate the construction sequence. It is desirable to keep the cofferdam from flooding, but it may happen as a result of heavy runoff and spill in nearby bays. Obviously, it is especially desirable to avoid spilling directly into the cofferdam, because of the likelihood of blowing it off the dam face and destroying work in progress. In the event of a high runoff event, it may be necessary to temporarily halt construction and remove equipment and cofferdams to accommodate spill. No additional TDG uptake is anticipated over the existing condition during construction.

3.6.3 Operational Modification This alternative would mean shifting power generation from Chief Joseph Dam to Grand Coulee Dam during times of spill, and shifting the spill to Chief Joseph Dam, in order to minimize the deleterious effect of spill at Grand Coulee. There are some limitations on this ability to shift, but overall, the sum of power generation between the two dams would not change. This alternative takes advantage of the larger powerhouse capacity at Grand Coulee (280,000 cfs versus 219,000 cfs at Chief Joseph) and the lower gas levels produced by the existing spillway at Chief Joseph Dam. Grand Coulee is able to pass its entire 7-day, 10-year flow of about 241,000 cfs through its powerhouse, while Chief Joseph would need to spill water under those conditions. While the powerhouse capacity at both projects is fairly large, there are often one or more units undergoing maintenance. In addition, Grand Coulee is not at full pool during the spill season. To more realistically analyze this alternative, powerhouse capacities were assumed to be 250,000 and 200,000 cfs.

When power and spill are shifted between the two projects, their differing heads and unit efficiencies must be taken into account. For example, a spill of 10,000 cfs is at Grand Coulee would translate into about 20,000 cfs at Chief Joseph. That same spill of 10,000 cfs at Grand Coulee is equivalent to about 240 megawatts of power that must come from Chief Joseph. Some of the time, there is not a full load of power in the system to run Grand Coulee at full load and it would still spill, albeit a lesser amount. In summary, the analysis of the operation change maintained a “power neutral” status using the actual/observed load from 1997. The analysis did *not* assume that load was available to run full powerhouse capacity.

3.6.4 Combination of Flow Deflectors with Operational Modification (Preferred Alternative) In this alternative, flow deflectors would be constructed as described in Sec. 3.6.2. Operation during times of involuntary spill would favor generation at Grand Coulee and spill at Chief Joseph, making use of the deflectors to reduce or prevent increases in TDG, depending on total flow and levels of dissolved gas arriving at Grand Coulee and Chief Joseph. This alternative takes advantage of the larger powerhouse capacity at Grand Coulee (280,000 cfs versus 219,000 cfs at Chief Joseph). Grand Coulee is able to pass its entire 7-day, 10-year flow of about 241,000 cfs through its powerhouse, while Chief Joseph would need to spill water under those conditions. Construction of a gas abatement alternative at Grand Coulee, due to its more complicated structure and fluctuating reservoir, would be significantly more expensive than at Chief Joseph (USBR, 1998). Construction of these expensive alternatives could be avoided, if load from another dam were shifted to Grand Coulee. Due to the arrangement of power transmission lines, and because Chief Joseph is the only other federal project in the immediate area, Chief Joseph would be the donor of that load. With less load during periods of spill, Chief Joseph would spill more water. With flow deflectors in place, the resultant TDG below Chief Joseph would be less than under current conditions of less spill at Chief Joseph. Because Grand Coulee would not be spilling, or spilling much less, gas levels in Rufus Woods Lake would be significantly less. Again, the operational arrangement is shown in Table 3.6.3-1.

## 4.0 AFFECTED ENVIRONMENT

Chief Joseph Dam is located along the middle Columbia River in eastern Washington. The next dam upstream of Chief Joseph is Grand Coulee; it is the uppermost dam on the mainstem Columbia in the US, and its reservoir, Lake Roosevelt, backs nearly to the Canadian border. The middle Columbia River is considered, in the US, to generally be that portion from Chief Joseph Dam downstream to the confluence with the Snake River. (However, listings of anadromous stocks under the Endangered Species Act have taken the reach from the Wenatchee River confluence to Chief Joseph to be the upper Columbia, and the reach from the confluence of the Yakima River to that of the Hood River in Oregon to be the middle Columbia.) From British Columbia, the Columbia River flows southward into northeastern Washington, then bears generally westward, passing through Grand Coulee Dam. After it flows through Chief Joseph Dam, the middle Columbia River flows erratically southward towards and through the Hanford Reach, and finally makes a semicircle to flow generally westward to the Pacific Ocean.

There are five public utility district dams in the Columbia below Chief Joseph Dam, and above the Hanford reach. These are Wells, Rocky Reach, Rock Island, Wanapum, and Priest Rapids. Two major tributaries enter the Columbia between Chief Joseph Dam and Wells Dam—the Okanogan River, and the Methow River. Both of these tributaries support anadromous fish runs which are discussed in more detail in Section 4.3. Other major anadromous fish-supporting tributaries are the Entiat River, which enters the Columbia between Wells and Rocky Reach dams, and the Wenatchee River, which enters between Rocky Reach and Rock Island dams.

The area around Chief Joseph and Grand Coulee dams is arid and topographically diverse. To the north and west of the river and Chief Joseph Dam are the Okanogan Highlands and the Cascade Mountains. To the south is a shrub-steppe ecosystem, a rolling plateau with channelled scablands. Immediately south of Grand Coulee Dam is Banks Lake, which is situated on the plateau above Grand Coulee, and is operated by the Bureau of Reclamation for power generation (pumped storage) and irrigation to about 650,000 acres of the Columbia Basin Project.

The open plateau and lowlands vegetation consists largely of sage and some grasses with few trees except along watercourses where cottonwoods and willows predominate. The highlands and mountainous areas further from the river support forests comprising primarily ponderosa pine and juniper, with Douglas fir on north-facing slopes.

Irrigation from the river supports a major agricultural industry for potatoes, wheat, and fruit such as apples, pears and apricots, which are shipped worldwide. Fruit orchards are conspicuous on slopes adjacent to the river along the middle Columbia.

4.1 <u>Climate and air quality</u> The climate in the project vicinity is semiarid, typical of eastern Washington. Temperatures range from -20° F. to 110° F., averaging 35° in winter and 75° in summer. Precipitation ranges from 7 to 20 inches annually, with about 1.5 inches per month in the winter and 0.5 inches per month in the summer. Snowfall occurs October-March.

The project is not in a non-attainment or maintenance area under the Clean Air Act, though that is due at least in part to the fact that there is no directed monitoring occurring there so data are not available to make a full determination (S. Billings, Washington Dept. of Ecology, pers. comm., 2000). The eastern half of the state is largely nonurban, with few cities of any size. The closest to the projects is Wenatchee, a moderate-sized community to the southwest. Much of the economy is agricultural. The major exceptions to good air quality are caused by occasional summertime forest fires, especially in the eastern Cascades.

4.2 Noise Noise is generated by traffic, primarily trucks, near the projects. Spill at Chief Joseph Dam and at Grand Coulee Dam creates considerable noise above ambient. This noise increases with spill level. It is a broad-spectrum sound, characteristically called "white noise" in its similarity to the omnispectral quality of white light.

4.3 Visual/esthetic environment The open, semiarid character of the landscape affords large vistas from many viewpoints. From the Highway 17 bridge just downstream of Chief Joseph Dam, an almost unobstructed view of the dam and tailrace is available. A similar situation exists at Grand Coulee Dam with the Highway 155 bridge. There is a vista overlook on a bluff above the town of Grand Coulee, which affords a view of the dam. There is also a city park just to the north of the north end of the Highway 155 bridge. It provides a popular viewpoint for nightly laser light shows on the face of Grand Coulee Dam. The light shows are also viewed from the project visitors' center near the south end of the dam.

4.4 Physical and geologic environment The project area is geologically complex. Effects of continental glaciation and fluvial erosion and deposition were major factors in shaping the local terrain.

Major land surfaces within the valley include: sands and gravels; glacial till composed of compact sand, gravel, silt, and clay; glacial lake deposits consisting of silt, clay, and fine sand; and old landslide deposits. Landslides and erosion are common in the deep canyon, which is partially filled with thick deposits of fine-grain sediments. Glacial lake and old landslide deposits tend to slough more easily than other materials, but well-drained sands and gravels tend to be quite stable, even if of considerable height. Moderate slumping will tend to occur on glacial till undercut by wave action as well as in deposits vulnerable to high ground water levels. Several major prehistoric and historic landslides have occurred in the dam and lake area. In 1970, construction for the third powerplant at Grand Coulee Dam precipitated additional sliding, and riprap was added to control these slides. Furthermore, impoundment of Rufus Woods Lake has caused sloughing near Bridgeport State Park and upstream from China Creek at RM 575 on the south bank. Many areas are sloughing to a lesser degree along the reservoir periphery, some due to reservoir operation and some a result of upland irrigation.

The banks along the river downstream of Chief Joseph are armored with riprap to prevent erosion. The soil behind the armoring is characterized by clean, open-work granular materials. There is a training wall from the end of the spillway on the north bank of the river. Starting behind that, an embayment runs downstream a short distance beyond the end of the wall. The embayment is part of the length of shoreline that is armored with riprap.

## 4.5 Water quality

4.5.1 Nutrients The status of Lake Rufus Woods and the midColumbia has apparently been trending from mesotrophic toward oligotrophic since the 1980s (Rensel, 1989; Rensel, 1996; Beak Consultants and Rensel Associates, 1999). Total phosphorus measurements for Lake Rufus Woods in the 1980s averaged 30 micrograms/liter, versus an average 10 micrograms/liter in 1995. Orthophosphate fell below detection limits. With the closing of the Cominco fertilizer plant in British Columbia, nutrients went from not limiting or possibly nitrogen limiting, to heavily phosphorus limiting.

4.5.2 Temperature Surface water temperatures range from about 3$^{o}$ to 22$^{o}$ C (about 37$^{o}$ to 72$^{o}$ F) over the course of the year in Lake Rufus Woods (Chief Joseph Dam forebay) (Univ. of Washington, 2000). Full-year temperature data were not available for Lake Pateros. Priest Rapids pool (forebay) temperatures range from about 3$^{o}$ to 22$^{o}$ C (about 37$^{o}$ to 72$^{o}$ F).

Temperature stratification in Lake Roosevelt does not occur until most of the runoff has occurred. Therefore there is little difference in temperature between spilled water and that passing through the turbines at Grand Coulee Dam. As seen in Figure 4.5.2-1, there appears little relationship between spill and short-term changes outflow temperature. Reservoir temperature is weakly stratified in spring and early summer (M. Valentine, USACE, pers. comm., 2000). It should be noted that temperature is measured 6 miles downstream; mixing is believed to occur before that point, but influence of solar radiation has not been assessed (T. Vermeyen, USBR, pers. comm., 2000).

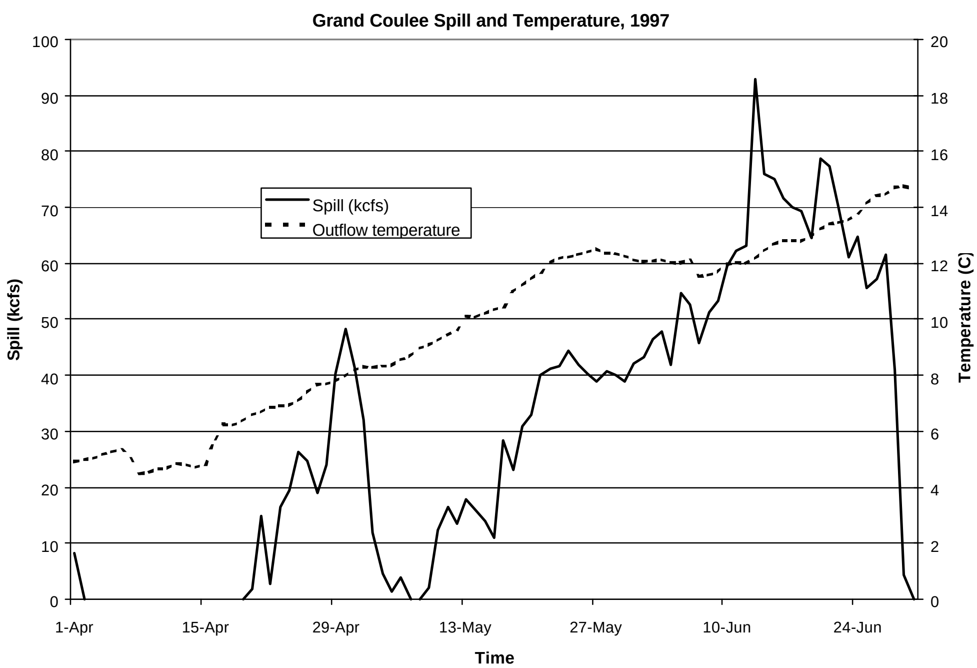


Figure 4.5.2-1. Daily average observed values for spill and outflow temperature at Grand Coulee Dam in spring 1997 (Univ. of Washington, 2000).

Similarly, at Chief Joseph Dam, short-term variation in outflow temperature is not related to spill level (Figure 4.5.2-2).

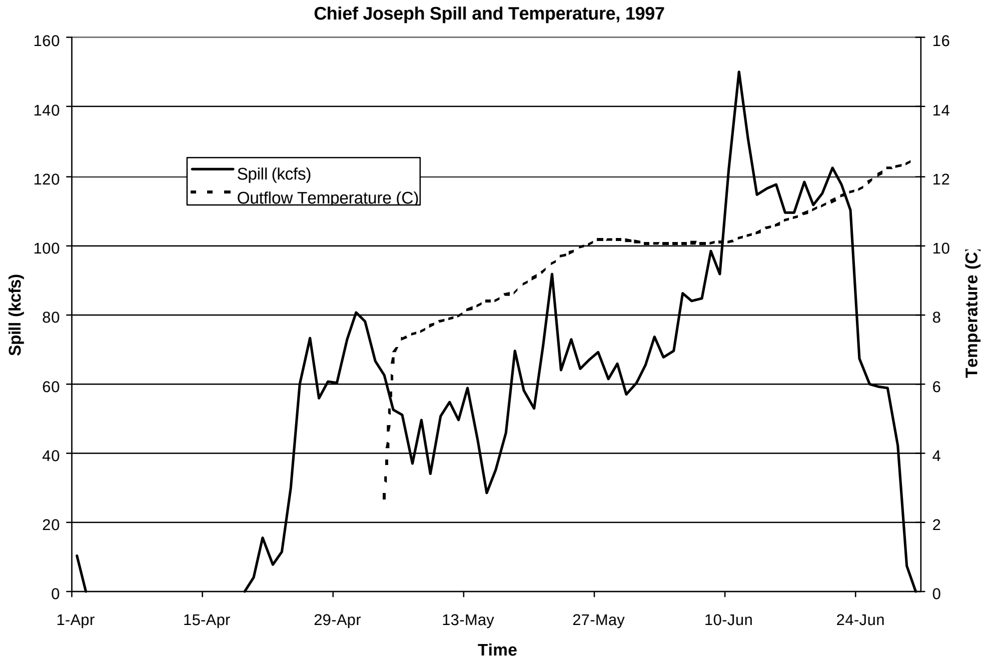


Figure 4.5.2-2. Daily average observed values for spill and outflow temperature at Chief Joseph Dam in spring 1997 (Univ. of Washington, 2000).

4.5.3 Dissolved gases Nitrogen supersaturation occurs as a result of spill at Grand Coulee, Chief Joseph and other dams. At federal dams on the Snake and lower Columbia rivers, voluntary spill is employed per NMFS (1995) direction to move salmon smolts past dams. Involuntary spill occurs when runoff volumes exceed generation capacity or demand. For both voluntary and involuntary spill, high TDG is a concern. Involuntary spill from high runoff does not occur every year. Grand Coulee Dam spills approximately only in one year out of 6 (M. McClendon, USBR, pers. comm. 2000). Figure 4.5.3-1 depicts involuntary spill from 1980 to 1997.

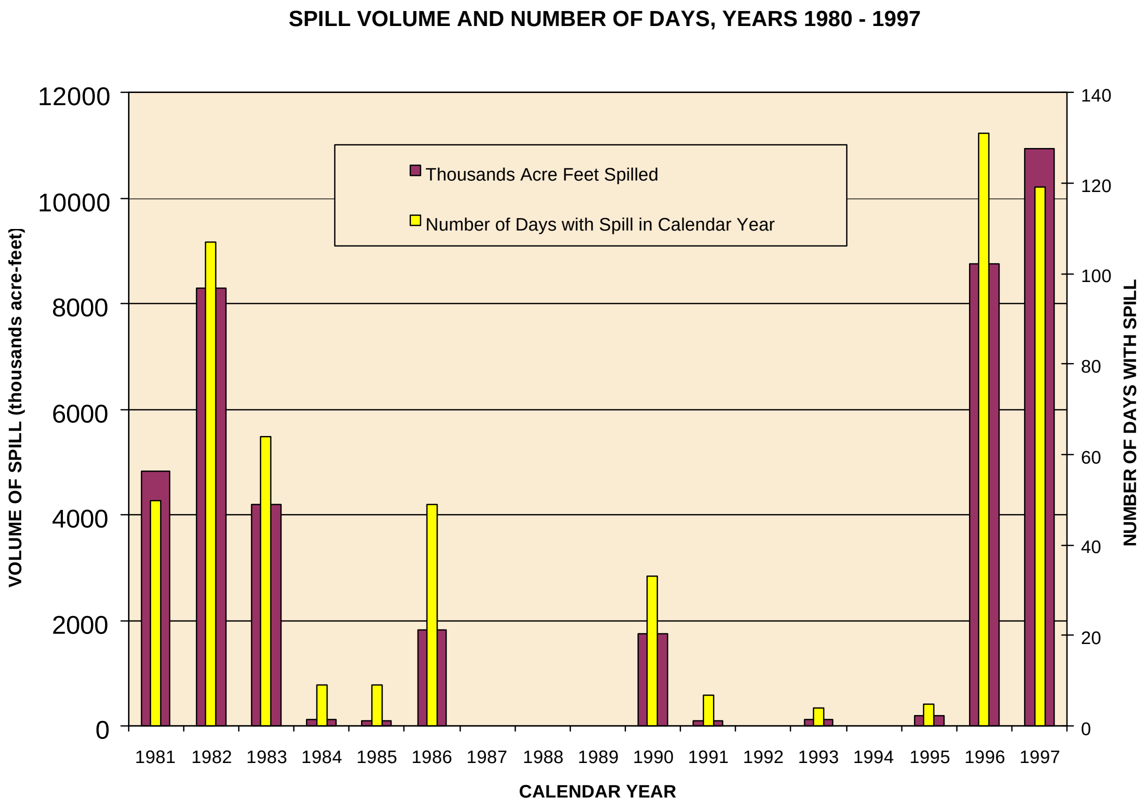


Figure 4.5.3-1. Volume and duration of involuntary spill at Chief Joseph Dam, 1981-1997.

In 1997, a year of high snowmelt runoff, high levels of total dissolved gas characterized much of the system as many projects spilled water involuntarily. Dissolved gas levels from Canadian dams on the Columbia were high; these levels persisted across the border and were still high as that water reached Grand Coulee Dam. Figures 4.5.3-2 and 4.5.3-3 depict observed levels of TDG in Lake Rufus Woods and Lake Pateros, respectively. Spikes approaching and reaching 140% TDG can be seen in the Lake Rufus Woods data at times.

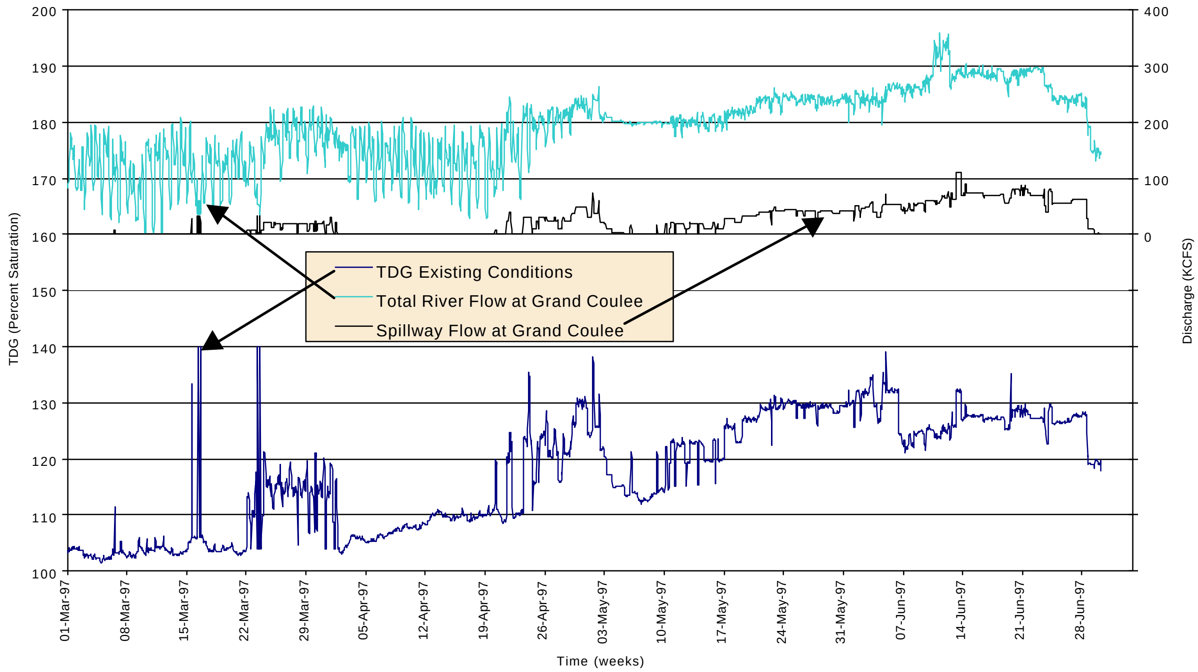


Figure 4.5.3-2. Observed flow and dissolved gas conditions in spring 1997 for water entering Lake Rufus Woods.

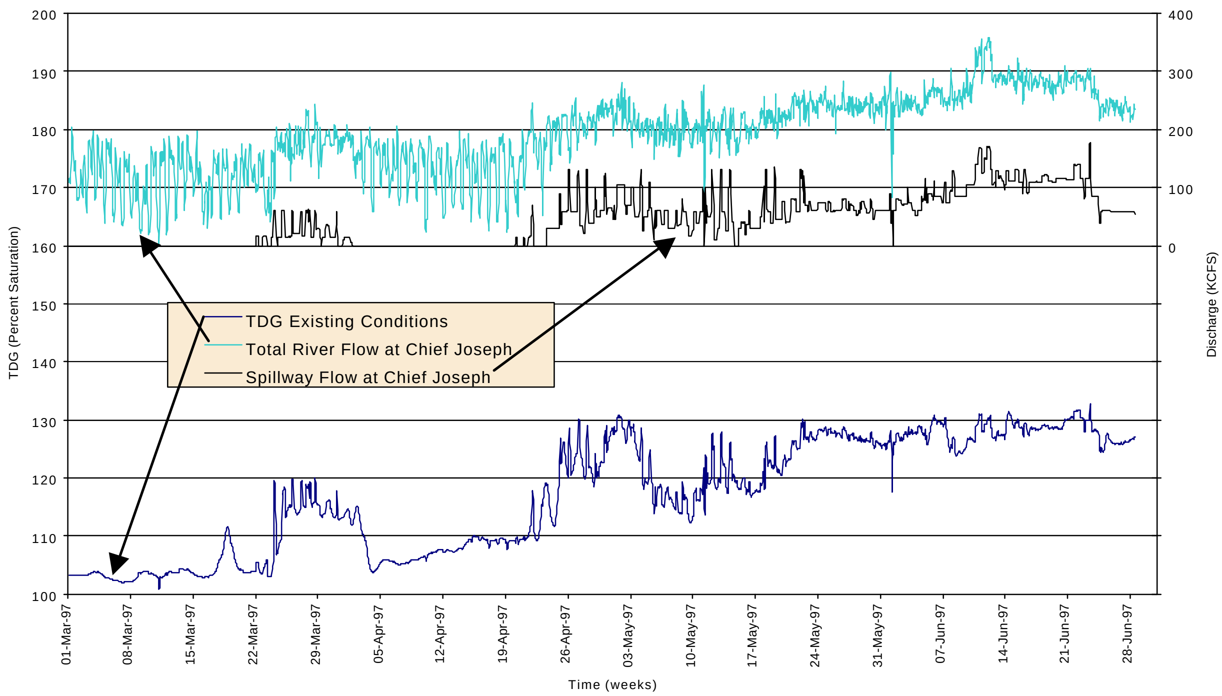


Figure 4.5.3-3. Observed flow and dissolved gas conditions in spring 1997 for water entering Lake Pateros.

For Grand Coulee, Figure 4.5.3-2 is summarized in a statistical sense in Figure 4.5.3-4, and for Chief Joseph Dam, Figure 4.5.3-3 is summarized in Figure 4.5.3-5. From all three of the preceeding figures, it can be seen that there is no one number describing spill as a function of total river flow at either Chief Joseph or Grand Coulee. Hence, a comparison of alternatives in Section 5 is based on numerical modeling of a 4-month time series of flow and TDG at the two projects. This numerical modeling takes into account the unique gas production conditions at each project. Grand Coulee Dam generally spills less than Chief Joseph Dam, because Grand Coulee tends to saturate gases to a higher degree.

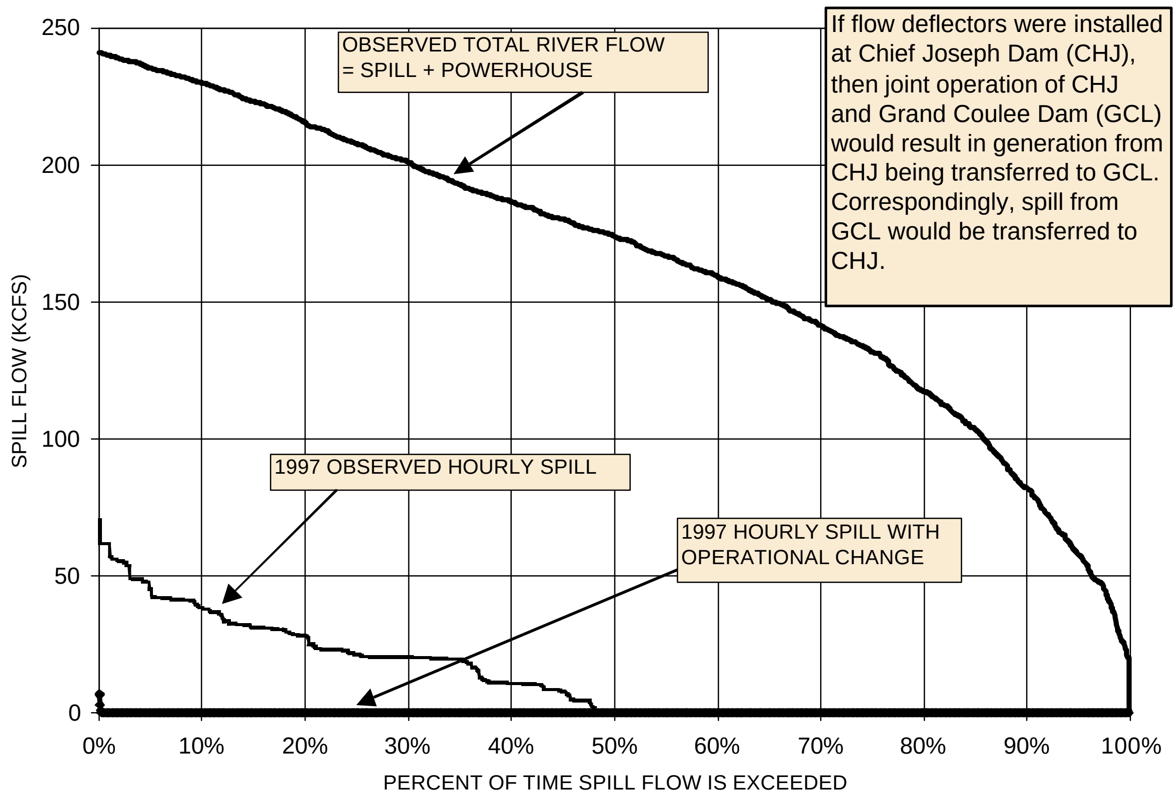


Figure 4.5.3-4. Spill and total river flow frequency curves for March-June 1997 for Grand Coulee Dam based on observed data, as well as with the operational change applied. Curves are with and without the operational modification when total river flow through Grand Coulee Dam was less than the 7-day, 10-year average flow of 241 kcfs.

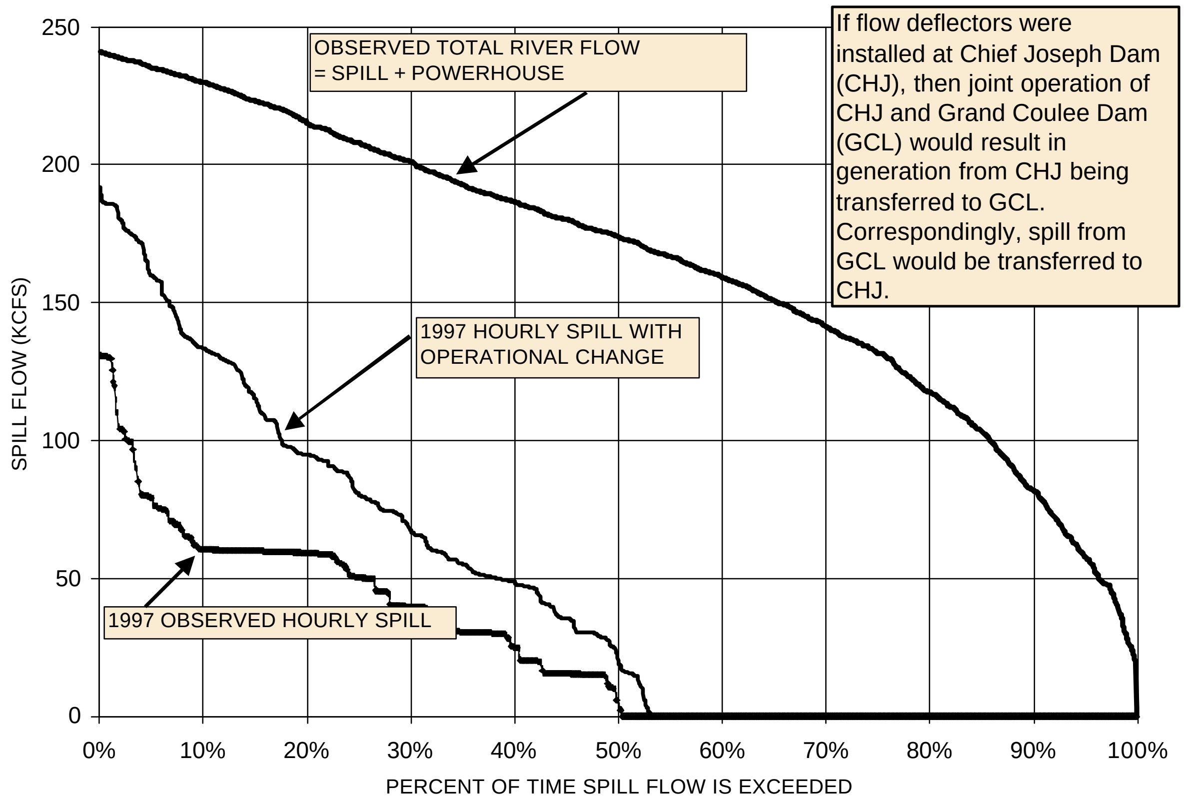


Figure 4.5.3-5. Spill and total river flow frequency curves for March-June 1997 for Chief Joseph Dam based on observed data, as well as with the operational change applied. Curves are with and without the operational modification when total river flow through Chief Joseph Dam was less than the 7-day, 10-year average flow of 241 kcfs.

4.5.4 Sediment and turbidity Lake Roosevelt, Lake Rufus Woods, and the outflows from both Grand Coulee and Chief Joseph Dams are generally low in suspended solids. Spring runoff is likely to be characterized by somewhat elevated levels of suspended solids carried by snowmelt. Spring and summer flows may also carry somewhat higher turbidity levels due to the "bloom" of single-celled plants, or phytoplankton, because of longer daylength and warmer temperatures.

4.6 Biological resources

4.6.1. Fish

4.6.1.1 Noncaptive fish There are several species of fish above and below Chief Joseph Dam; many were introduced from outside the Columbia basin. Appendix Table A-1 lists species presence in the midColumbia River and the three uppermost US mainstem reservoirs.

Some of these species are more subject to gas bubble disease than are others. The salmonids and other pelagic or surface-oriented species would be among these, although studies by Backman et al. (1999) indicate behavior and location in the water column can help fish avoid impacts. Demersal species (eg, sculpins) in the vicinity of the shore where water depths are less than 1-2 meters might also be vulnerable to GBD.

Studies of entrainment of fish through turbines at Grand Coulee Dam from Lake Roosevelt to Lake Rufus Woods have been conducted by the Colville Confederated Tribes (LeCaire, 1999). During the period 1996-1999, fish entrainment through Grand Coulee Dam was examined by powerhouse location, time of year, time of day, and depth of fish in the forebay. The highest entrainment rates were in the third powerhouse and in spring/summer (Tables 4.6.1.1-1 and 4.6.1.1-2, respectively).

Table 4.6.1.1-1. Observed entrainment of fish through the three powerplants at Grand Coulee Dam, 1996-1999 (from LeCaire, 1999).

| **Power plant** | **1996** | **1997** | **1998** | **1999** | **Total** |
|---|---|---|---|---|---|
| **Left** | 10,442 | 33,192 | 26,718 | 9,313 | 79,665 |
| **Right** | 27,316 | 32,811 | 50,706 | 19,741 | 130,574 |
| **Third** | 538,918 | 470,009 | 208,926 | 182,631 | 1,400,484 |
| **Total** | 576,676 | 536,012 | 286,350 | 211,685 | 1,610,721 |

Table 4.6.1.1-2. Observed entrainment of fish through Grand Coulee Dam by month, 1996-1999 (from LeCaire, 1999).

| **Month** | **1996** | **1997** | **1998** | **1999** |
|---|---|---|---|---|
| **January** | | 18895 | 11007 | 12983 |
| **February** | | 6990 | 7782 | 5473 |
| **March** | 7352 | 29786 | 9091 | 5362 |
| **April** | 27174 | 17942 | 25852 | 5610 |
| **May** | 103814 | 207939 | 44614 | |
| **June** | 91650 | 145469 | 33959 | 38155 |
| **July** | 124470 | 49237 | 35654 | 64874 |
| **August** | 136542 | 21168 | 63053 | 57804 |
| **September** | 36071 | 13073 | 31893 | 21425 |
| **October** | 25181 | 9840 | 7104 | |
| **November** | 13898 | 6169 | 10409 | |
| **December** | 10524 | 9485 | 5932 | |
| **Totals** | 576,676 | 536005 | 286347 | 211,684 |

Gillnetting by LeCaire (1999) in the Grand Coulee Dam forebay from 1996 to 1999 revealed the following species, roughly by order of overall abundance: kokanee, rainbow trout, walleye, smallmouth bass, lake whitefish, yellow perch, eastern brook trout, blackmouth (chinook), bridgelip sucker, and burbot. These fish would be subject to entrainment. No bull trout were apparently found in these samples.

Spillway passage at Grand Coulee was studied only in 1999, a year when only minor amounts of spill occurred as part of the nightly laser light show (LeCaire, 1999). Fish were observed in the forebay near the drum gates, but did not appear to be entrained under those conditions. However, the author stated that it was likely that fish would be entrained over the spillway under more intensive spill conditions such as occurred in 1996 and 1997.

There is at this time no intentional fish passage at Chief Joseph Dam, but some (unquantified) resident fish entrainment occurs out of Lake Rufus Woods. Chief Joseph Dam is the upper limit for anadromous fish migration in the Columbia, although it is the desire of the Colville Confederated Tribes that anadromous fish passage be established at Chief Joseph Dam, and ultimately, Grand Coulee Dam.

Counts are kept on anadromous fish transiting Columbia dams. Appendix Table A-2 details recent trends in adults and jacks at four of the five midColumbia public utility dams. Smolt indices by species and dissolved gas levels over time for 1997 and 1999 are shown in Figures A-1 and A-2, respectively, at Rock Island Dam in the midColumbia. Rock Island is the closest project for which data were available under the University of Washington's fish passage web page (Univ. of Washington, 2000). Note on these figures that the vertical scales are different from each other, and that gas levels were higher in 1997 than in 1999, while smolt counts were lower. Table 4.6.1.1-3 shows 5-year average juvenile outmigration totals for chinook (age 0 and age 1), steelhead, sockeye, and coho at Rock Island Dam, below Chief Joseph. Juvenile counts were not available from Wells Dam, between Rock Island and Chief Joseph dams, though chinook and steelhead pass through Wells Dam from the Methow and Okanogan rivers and the Columbia below Chief Joseph Dam. None of these numbers distinguishes between hatchery and wild fish.

Table 4.6.1.1-3. Juvenile outmigration 5-year (1995-99) average index values for Rock Island Dam, based on actual counts.

| **Chinook 0+** | **Chinook 1+** | **Steelhead** | **Sockeye** | **Coho** |
|---|---|---|---|---|
| 18507 | 38447 | 32268 | 18117 | 30282 |

These fish are potentially susceptible to gas bubble disease from Chief Joseph and other projects downstream. Fall chinook spend time rearing in shallow areas of the mainstem river downstream of Chief Joseph Dam, according to Venditti (2000). This makes them more vulnerable to effects of high TDG than are spring chinook, which rear in tributaries.

Appendix Figures A-3 and A-4 show adult fish indices and dissolved gas over time in 1997 and 1999, respectively, at Wells Dam (Univ. of Washington, 2000). Dissolved gas measurements were sporadic in 1999 at the counting station.

Fish with status under the Endangered Species Act in the project area are spring chinook salmon (Upper Columbia Evolutionarily Significant Unit, endangered), steelhead (Upper Columbia ESU, endangered), and bull trout (threatened). See Section 4.6.4 for further information.

4.6.1.2 <u>Fish in net pens</u> Fish are reared commercially in net pens by 2 companies in Lake Rufus Woods. At this time, only rainbow/steelhead trout are reared, though coho and Atlantic salmon (*Salmo salar*) have also been raised. Net pen operators have reported problems with mortality in past years from high TDG below Grand Coulee Dam (Shallenberger, 1997; Aquatechnics, 1998; DeLano, 2000). Figure 4.6.1.2-1 depicts losses in percentage terms reported by Chief Joseph Fish Farms in 1997 in relation to TDG. Losses appeared somewhat more pronounced at TDG levels above 120%, with some occurring at levels between 110% 120% as well. Note, however, that mortalities were not checked each day, so mortality values represent up to several days since the previous check. Aquatechnics (1998) stated that spikes up to about 138% TDG in 1997 contributed to mortality of captive and noncaptive fish in Lake Rufus Woods. Gas data in Figure 4.6.1.2-1 are daily, not hourly, so not all possible spikes appear. Also, it is worth noting that temperatures were reaching levels in the 15-18$^o$ C (about 59-64$^o$ F) range coincident with higher gas levels. As temperatures increase, saturation levels also increase for the same amount of dissolved gas—in other words, gases are less soluble at higher temperatures, and it takes less dissolved gas to saturate the solution. This exacerbates the chances of a biological effect. Temperature spiked to about 24$^o$ C (75$^o$ F) at one point, and though this by itself is stressful to salmonids, net pen losses do not reflect a corresponding increase.

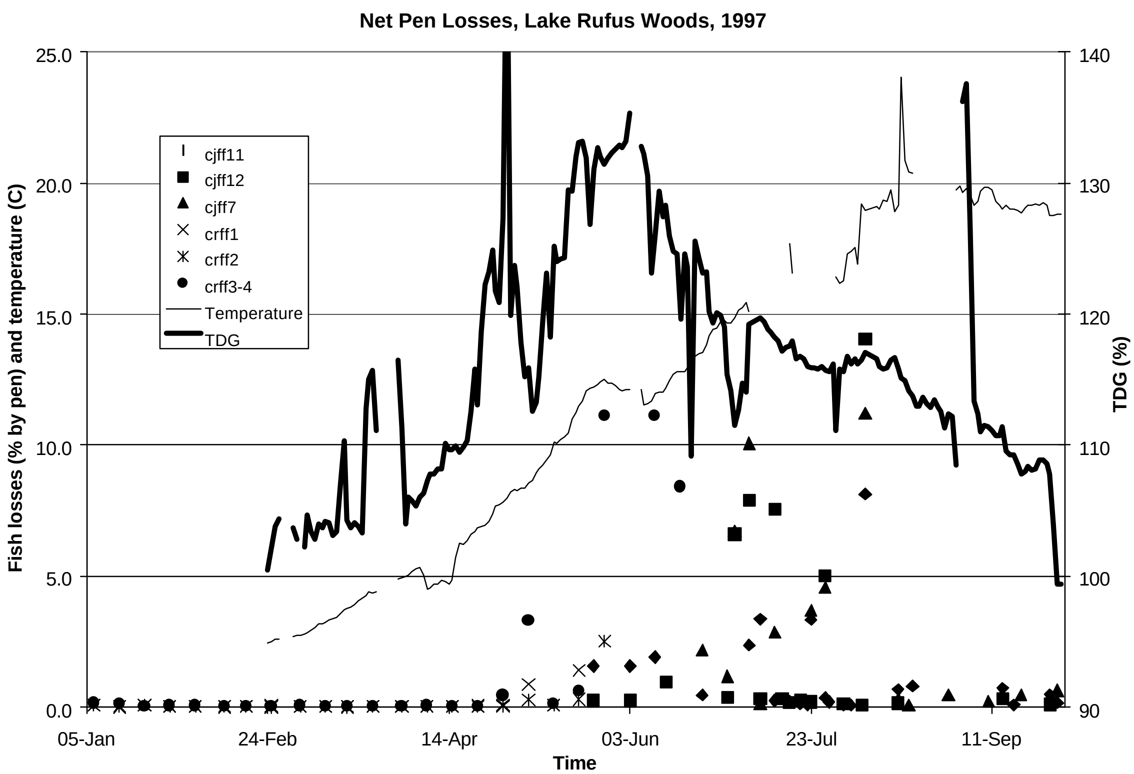


Figure 4.6.1.2-1. Net pen losses (percentage values in individual pens) of farmed steelhead and rainbow trout in 1997 in relation to TDG and temperature (both are daily average observed values) in Lake Rufus Woods for Chief Joseph Fish Farms (DeLano, 2000; E. Shallenberger, Columbia River Fish Farms, pers. comm., 2000; Univ. of Washington, 2000).

According to E. Shallenberger (Columbia River Fish Farms, pers. comm., 2000), growth rates of surviving farmed fish were affected by high TDG in 1996 and 1997, and were lower than in 1994 and 1995 Growth rates in 1998 and 1999 were also lower, but he attributed low growth in 1998 to high water temperatures, and variability in 1999 to experimentation with feed.

4.6.2 Other aquatic organisms Documentation of plant and invertebrate species in the project vicinity is not comprehensive. Plants include both phytoplankton and attached diatoms, macroalgae, and macrophytes. Aquatic macrophytes in Lake Rufus Woods and Lake Pateros include elodea, Eurasian watermilfoil, sago pondweed, curly leaf pondweed, and watercress. Excepting watercress, which has been observed only at mitigation site 16 (RM 575.2) in Lake Rufus Woods, these species have been observed the entire length of the Lake Rufus Woods and along Lake Pateros. The most abundant aquatic plant is elodea, and Eurasian watermilfoil is more abundant than sago pondweed and curly leaf pondweed, at least in Lake Rufus Woods. Eurasian watermilfoil is a nuisance species introduced in 1980 or 1981.Invertebrates include zooplankters and benthic micro- and macroinvertebrates. The phytoplankton, diatoms and other algae and macrophytes are the primary producers. Zooplankton and other invertebrates consume phytoplankton, diatoms and detritus, and in turn are preyed on by larger invertebrates and fish. The macroinvertebrates are susceptible to gas bubble effects under supersaturated conditions.

4.6.3 Terrestrial organisms The project vicinity is host to a number of terrestrial species, including mammals and birds which may use the river for feeding or transportation. Of these, the organisms which feed on aquatic species are potentially affected by dissolved gas conditions, because of short and long term effects on prey species. Those predators include raptors such as osprey and bald eagle, other birds such as mergansers and gulls, and mammals such as otters and mink.

4.6.3.1 Birds Table A-3 lists birds in the project vicinity, as documented from Lake Rufus Woods. Several of them, such as eagles, gulls, crows, and mergansers prey on fish or consume fish as carrion. All known bald eagle nests are near and around Lake Rufus Woods and within the general locations of hatcheries that now exist within the lake. Nesting and roosting trees are few along the banks of Lake Rufus Woods and it is possible that if the few remaining trees were gone the eagles may move on as well.

4.6.3.2 Mammals Table A-4 lists mammals from the project area. Some of them consume fish, and may be subject to indirect effects of actions that harm or kill fish. However, there are no known mammals in this area which depend primarily on fish.

4.6.3.3 Reptiles and amphibians Table A-5 is a list of reptiles and amphibians from the Lake Rufus Woods area. Only one, the Pacific tree frog, is actually an amphibian.

4.6.3.4 Flora Four major plant communities exist within the project area. The most extensive is the big sagebrush and bluebunch wheatgrass community; these are the dominant species. Also of major importance are the threetip sagebrush and Idaho fescue, the riparian streamside plant communities, and a coniferous tree community.

There are sites along Lake Rufus Woods which are planted with a variety of plant species and irrigated as wildlife mitigation measures for the pool raise implemented in the 1980s.

4.6.4 Threatened and endangered species Several stocks of fish and other species are listed under the Endangered Species Act (ESA) in the project area. The aquatic influence of the project is considered for purposes of this EA to include the habitat of listed ESUs or populations of the upper Columbia River. Table A-6 lists Evolutionarily Significant Units (ESUs) and populations of fish which are listed or proposed or candidates under ESA in the Columbia or Snake River.

The following summaries provide general information about threatened and endangered species:

*Bull trout*. Bull trout distribution includes the areas below Chief Joseph Dam in the mid-Columbia and associated tributaries. Critical habitat was not determined with the listing of the Columbia basin Distinct Population Segment (USFWS, 1998). Of the tributaries in the mid-Columbia River, the Wenatchee, Entiat, and Methow Rivers have the best recorded populations of bull trout. Bull trout have also been documented in the Okanogan River in 1953, but little information has come from that drainage recently. Bull trout found in the mainstem Columbia River are typically seen in fish ladder sightings at Wells Dam and other projects downstream. Few if any sightings or other presence information exists for bull trout upstream of the Okanogan River and adjacent to Chief Joseph Dam. Little information has been documented for bull trout habitat resident in the larger river systems of the Pacific Northwest. However, research from small rivers and tributaries does point to specific habitat requirements of bull trout. Temperature, channel stability, winter high flows, summer low flows, substrate, cover, and the presence of migration corridors consistently appear to influence bull trout distribution or abundance (Oliver, 1979; Allan, 1980; Fraley and Graham, 1981; Leathe and Enk, 1985; Thurow, 1987; Ziller, 1992). Bull trout feed primarily along the bottom and up to mid-water levels, consuming insects and other fish species such as suckers, sculpins, minnows, and trout. Mountain whitefish are one of the bull trout's preferred prey (Knowles and Gumtow, 1996). Juvenile bull trout often conceal themselves in cover (substrate and woody debris) during the day and move on or above the substrate at night (Goetz, 1994; Jakober, 1995). This pattern of daytime concealment is more pronounced as water temperatures decline below $7^{o}$ C (Schill, 1991; Jakober, 1995). Bull trout have voracious appetites and take full advantage of food sources available to them. Fish are considered to be the major item in the diet of large bull trout.

*Upper Columbia River steelhead*. The Upper Columbia River (UCR) summer steelhead ESU includes all progeny of naturally spawned populations of steelhead in the Columbia River Basin upstream from (excluding) the Yakima River, Washington, to the U.S.-Canada border. Summer steelhead (and their progeny) from Wells Hatchery stock are also considered part of the listed ESU. Life-history characteristics of UCR steelhead have been reviewed by Chapman et al. (1994) and Busby et al. (1996). The NMFS listed the UCR steelhead ESU as endangered on August 18, 1997 (62 FR 43937).

The return of UCR natural-origin summer steelhead to Priest Rapids Dam declined from a 5-year average of 2,700 beginning in 1986 to a 5-year average of 900 beginning in 1994 (FPC, 1998). The WDFW has set an escapement goal for natural-origin fish of 4,500. The hatchery component is relatively abundant and routinely exceeds the needs of the supplementation program by a substantial margin. Therefore, because of the unnecessary restrictions resulting from their listing, NMFS is currently considering delisting the hatchery component of the UCR steelhead ESU.

The naturally-spawning population of UCR summer steelhead has been augmented for a number of years by straying hatchery fish. Replacement ratios for naturally-spawning fish (natural-origin and hatchery strays) are quite low, on the order of 0.3. This very low return rate suggests that either hatchery strays are largely supporting the population, or that hatchery strays are not contributing substantially to subsequent adult returns and natural-origin fish are returning at or just below the replacement rate, or some intermediate combination of these factors. Given these uncertainties, efforts are underway to diversify broodstocks used for supplementation, minimizing the differences between hatchery and natural-origin fish as well as other concerns associated with supplementation. Assuming that the hatchery broodstock represents the listed ESU, NMFS expects that the early life history survival advantage of hatchery smolts will help stocks to rebuild. However, there are also substantive concerns about the long term effect on the fitness of natural-origin populations resulting from an ongoing, long term infusion of hatchery-influenced spawners (Busby et al., 1996).

*Upper Columbia River spring chinook.* The UCR spring chinook salmon ESU (evolutionarily significant unit) includes all progeny of naturally-spawning populations of stream-type (spring) chinook salmon in all river reaches above Rock Island Dam and downstream of Chief Joseph Dam, excluding the Okanogan River. Chinook salmon (and their progeny) from the following hatchery stocks are considered part of the listed ESU: Chiwawa River (spring run); Methow River (spring run); Twisp River (spring run); Chewuch River (spring run); White River (spring run); and Nason Creek (spring run). Life history characteristics of UCR spring chinook salmon have been reviewed by Myers et al. (1998). The UCR spring chinook salmon ESU was listed by NMFS as endangered on March 24, 1999 (64 FR 14308).

Upper Columbia River spring chinook have a stream-type life history. Adults return to the Wenatchee River during late March through early May, and to the Entiat and Methow rivers during late March through June. Most adults return after spending two years in the ocean, although 20% to 40% return after three years at sea. Like the Snake River spring/summer chinook, UCR spring chinook are subject to very little ocean harvest. Peak spawning for all three populations occurs from August to September. Smolts typically spend one year in freshwater before migrating downstream. This ESU has slight genetic differences from other ESUs containing stream-type fish, but more importantly, ecological differences in spawning and rearing habitats were evident and were used to define the ESU boundary (Myers et al. 1998). The Grand Coulee Fish Maintenance Project (1939 through 1943) may also have been a major influence on this ESU because fish from multiple populations were mixed into one relatively homogenous group and redistributed into streams throughout the Upper Columbia region.

Three independent populations of spring chinook salmon are identified for the ESU including those that spawn in the Wenatchee, Entiat, and Methow river basins (McElhany et al. 1999). Trends for these populations have generally been declining. The NMFS recently proposed Interim Recovery Abundance Levels and Cautionary Levels (i.e, still under review and subject to change). The Cautionary Levels are characterized as abundance levels below which, historically, the population would be expected to fall only about 10% of the time (i.e., determined from the lower end of the spawning abundances exhibited when the population was relatively healthy). Escapements in recent years, especially in 1995, have been consistently below these levels indicating increasing risk and uncertainty about population status. The primary return year for the 1995 brood was 1999 and preliminary return estimates indicate that although returns were low, they were still substantially higher than the brood year replacement levels. The very strong jack returns in 1999 suggest that survival rates for the 1996 brood will be high as well, and 4,500 natural-origin UCR spring chinook are expected to return to the mouth of the Columbia River during 2000. However, the corresponding expected return-to-subbasin for these populations, accounting for expected harvest, inter-dam loss, and prespawning mortality, is expected to be about equivalent to the Cautionary Levels.

As noted, six hatchery populations are included in this ESU; all six are considered essential for recovery and are included in the listing. Risks associated with artificial production programs within the ESU are a concern because of the use of non-native Carson stock for fishery enhancement and hydropower mitigation. However, programs have been initiated to develop locally-adapted brood stocks to supplement the natural populations in the ESU. The Carson stock is being phased out at those facilities where straying and natural stock interactions are problematic. Captive broodstock programs are under way in the Nason Creek and the White River (the Wenatchee basin) and in the Twisp River (Methow basin), to prevent those populations from going extinct. In some recent years, all spring chinook have been trapped at the Wells Hydroelectric Project to begin a composite-stock broodstock supplementation program for the Methow Basin.

In general, a large amount of information about listed and proposed anadromous stocks can be found in the National Marine Fisheries Service's status reports, online under http://www.nwr.noaa.gov/1salmon/salmesa/index.htm. The US Fish and Wildlife Service has some information on resident fish and wildlife species online at http://endangered.fws.gov/stat-reg.html. Both of these sites provide links to Federal Register notices as well.

The bald eagle, a threatened species, is the only other wildlife listed in the project area. It is a fish consumer. It winters regularly along Rufus Woods Lake (October through April). Approximately 35 bald eagles are observed each winter using the snags along the reservoir. In 1998, 5 nests were observed along Rufus Woods Lake (Ray, 1998), and in 1999, 7 nests were observed, with observations of 11 and 6 juveniles, respectively. The eagles feed primarily on chukar, American coots, waterfowl, fish, and carrion. Bald eagles are seldom observed in the area outside of winter.

4.7 Cultural resources Chief Joseph Dam is within the historical ancestral home territory of bands of three member Tribes (Sinkaiuse, Sanpoil/Nespelem, and Sinkaietk) of the Confederated Tribes of the Colville Reservation, which is headquartered in Nespelem, Washington. The entire north half of the project is within the bounds of the Reservation and includes Tribal trust and individual allotment lands administered by the CCT, and the south half is on lands ceded by various Executive and Congressional actions. Historically, the Tribes used the project area for the full range of their annual activities. They continue to exercise hunting, fishing, and gathering rights within it, and maintain special interest in how the Corps manages wildlife and cultural resources.

Since the mid-1970s, the Seattle District has sponsored a program at Chief Joseph Dam to identify, test, and recover data from cultural resource sites that could be affected by construction and operations. Testing at about 100 of the prehistoric sites (there are nearly 300 prehistoric and historic sites) identified their age and importance. This supported a formal determination in 1978 that the Rufus Woods Lake Archeological District, which encompasses the entire Chief Joseph Dam project, was eligible for the National Register of Historic Places. The determination of eligibility provided sufficient protection of the cultural resource sites; therefore, formal nomination was not pursued. Between 1978 and 1980, intensive excavation recovered data from 18 prehistoric sites in the archeological district that were to be flooded or otherwise lost to the immediate effects of construction. The program significantly advanced knowledge of regional prehistory through production of over 25 technical reports and compilation of a large, carefully organized collection of artifacts and data. Since the 1980s, four major sites have received bank protection. One of the more prominent aspects of the past and present program is close coordination and cooperation with the Colville Confederated Tribes.

4.8 Power system operations Power is generated at both Chief Joseph and Grand Coulee dams as well as at the five public utility district dams downstream of Chief Joseph. The power generated by Chief Joseph and Grand Coulee is marketed by the Bonneville Power Administration. See Sec. 2.1.1 for specifics on Chief Joseph Dam operations, and Sec. 2.1.2 for Grand Coulee operations. These two projects are the only ones with power generation possibly affected by the alternatives proposed.

4.9 Flood control Lake Roosevelt is used for system flood control storage for the lower Columbia, primarily the Portland, Oregon and Vancouver, Washington area. The drawdown and storage procedures are described in Section 2.1.2. Lake Rufus Woods is a run-of-river reservoir, and therefore has no flood control purpose.

4.10 Recreation Outdoor pursuits including camping, boating, fishing, hunting, and wildlife viewing are popular in the project area. In addition, Chief Joseph and Grand Coulee dams have visitors' centers and interpretive exhibits where visitors can learn about the projects' development and operation, as well as the natural history of the area. The nightly laser light show on the face of Grand Coulee dam may be viewed from the visitors' center and other spots around the town of Grand Coulee, and attracts a number of viewers each night it runs.

4.11 Other economies The primary economy potentially affected by the proposed actions might be tribal and nontribal net fisheries. For nontribal fishers, this is a commercial economy; for tribes, it is for commercial and subsistence purposes.

4.12 Environmental justice Native American and Hispanic peoples are located in the project vicinity, and could potentially be affected by any project action in this area. The Colville Confederated Tribes are in the immediate vicinity; the Yakama Indian Nation is located in the midColumbia area. Under White House Executive Order 12898 (Feb. 11, 1994), consideration must be given by federal agencies to health and environmental effects of their actions on minority populations.

## 5.0 EFFECTS OF ALTERNATIVES

Table 5.0-1 is a matrix of effects of the screening alternatives, including those rejected. Only the four alternatives selected for further evaluation—no-action, deflectors, operation, and combination—are evaluated in detail. The others will not be discussed after this point.

NEPA documents such as this one are not where cost-benefit analysis is performed. However, it is important to recognize in the discussion of biological effects that traditional cost-benefit analysis cannot be applied to environmental goals. Changed conditions that allow for increased survival, reproduction or other positive effects to populations of fish or other organisms are considered beneficial, even if they cannot be quantified. Except under certain circumstances, such as clear quantification of effects on a commercial fishery, no monetary figures can or should be assigned to benefits. The analysis thus comes down to the most cost-effective means of achieving desired conditions. This EA performs the purpose of evaluating the effects of the alternatives, and leaves discussion of costs and benefits to the General Reevaluation Report, which is being prepared as the Corps' planning document.

In general, reservoir levels are not expected to change under any of the four alternatives from the existing situation. That is, the deflector, operational, and combination alternatives would be the same as the no-action alternative with respect to reservoir levels for both Grand Coulee Dam and Chief Joseph Dam. Table 5.0-2 is a matrix of effects of project alternatives, compiled for relative ease of comparison. However, by necessity, it cannot convey detail, and the reader is referred to the following sections for further elaboration on anticipated effects of the alternatives.

5.1 Climate and air quality Construction of flow deflectors will involve use of towboats, barges, cranes and other heavy equipment at Chief Joseph Dam. Emissions from internal-combustion engines will be generated during the construction period, over about 100 weeks from 2003 through 2004, and will increase carbon dioxide, water vapor, carbon monoxide, and carbon particulates minimally over ambient levels. Dust from vehicles entering and leaving materials sites and travelling on the highway may be somewhat elevated for alternatives involving construction, but a dust control plan will be developed for construction. There are anticipated to be no long-term effects on air quality from implementation of operational or structural modifications. Neither the no-action alternative nor the operation alternative would have any construction-related impacts on air quality relative to the existing situation. The project is not located in a non-attainment or maintenance area under the Clean Air Act.

5.2 Noise Equipment used to construct flow deflectors would raise noise levels over ambient in the vicinity of Chief Joseph Dam during the construction period. In addition, truck traffic carrying construction materials, as well as materials for disposal, may increase road noise levels somewhat. Materials sources and disposal sites are not known at this time, but concrete is expected to come from within about 20-30 miles of the project. Other materials, such as bolts and forms, may need to come from outside the local area. Disposal would be at an approved landfill within about 50 miles of the project. The no-action and operation alternatives would not involve any construction; hence there would be no equipment or added noise.

Table 5.0-1. Matrix of effects of entire list of screening alternatives (from USACE, 2000). Those in bold in the Alternatives column, a combination of the two, and the no-action alternative, are evaluated in further detail in this document.

| Alternative | Objective | Category | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.Spillway Flow Deflectors** | Reduce Air Entrainment | Structural | ● | ○ | ● | ◗ | ● | ◗ | ● | ● | ◗ |
| 2. Increase Reservoir Operating Level Fluctuations | Reduce Frequency of Spill | System Operation | ○ | ◗ | ◗ | ○ | ○ | ◗ | ○ | ○ | ○ |
| 3. Operate Hydropower Units Inefficiently | Reduce Frequency of Spill | Project Operation | ◗ | ● | ○ | ◗ | ● | ● | ● | ◗ | ◗ |
| 4. Raised Tailrace | Reduce Air Entrainment | Structural | ○ | ○ | ● | ◗ | ○ | ○ | ◗ | ○ | ◗ |
| 5. Raised Stilling Basin | Reduce Air Entrainment | Structural | ○ | ○ | ● | ◗ | ○ | ○ | ◗ | ○ | ◗ |
| 6. Pumped Storage | Reduce Frequency of Spill | Structural | ◗ | ○ | ◗ | ◗ | ○ | ○ | ○ | ○ | ○ |
| 7. Add Additional Unit | Reduce Frequency of Spill | Structural | ● | ○ | ○ | ◗ | ○ | ○ | ● | ◗ | ○ |
| 8. Siphon for Irrigation Right Bank | Reduce Frequency of Spill | Structural | ◗ | ◗ | ○ | ◗ | ◗ | ◗ | ◗ | ◗ | ○ |
| 9. Spill During Maximum Power Generation | Reduce Air Entrainment | System Operation | ◗ | ● | ◗ | ◗ | ◗ | ● | ○ | ◗ | ◗ |
| 10. Unplug Sluices | Reduce Air Entrainment | Structural | ● | ○ | ◗ | ◗ | ○ | ○ | ● | ○ | ○ |
| 11. Swap Power for Spill with Downstream Dams | Reduce Frequency of Spill | System Operation | ● | ◗ | ◗ | ● | ◗ | ◗ | ● | ◗ | ● |
| 12. Side Channel Canal | Reduce Air Entrainment | Structural | ● | ○ | ◗ | ◗ | ◗ | ◗ | ◗ | ○ | ◗ |
| 13. Raise Control Flows at the Dalles | Reduce Frequency of Spill | System Operation | ● | ● | ◗ | ◗ | ◗ | ◗ | ◗ | ○ | ● |
| **14. Modify Operation of Grand Coulee Dam** | Reduce Frequency of Spill | System Operation | ● | ● | ◗ | ● | ◗ | ◗ | ◗ | ○ | ● |
| 15. Baffled Spillway | Reduce Air Entrainment | Structural | ○ | ○ | ● | ◗ | ○ | ◗ | ● | ○ | ○ |
| 16. Degas at Brewster Flats | Reduce Air Entrainment | Structural | ◗ | ○ | ● | ◗ | ◗ | ◗ | ◗ | ○ | ◗ |
| 17. Enclose Stilling Basin | Reduce Air Entrainment | Structural | ● | ○ | ● | ◗ | ◗ | ○ | ● | ○ | ○ |
| 18. Combination (3, 11, 13, 14) | Reduce Frequency of Spill | System Operation | ◗ | ● | ● | ● | ◗ | ◗ | ◗ | ○ | ◗ |

CRITERIA: **1)** Project Impact **2)** Cost **3)** Water Quality Benefits **4)** Biological Benefits **5)** Feasibility **6)** Timeliness **7)** Upstream and Downstream Effects **8)** Accepted Solution **9)** Maintenance

IMPACT RATING SCALE: ● Positive ◗ Neutral ○ Negative

Table 5.0-2. Matrix of effects of reasonable alternatives. "C" in the headings stands for construction-related effects; "O" stands for operational (long-term) effects. Effects range from "++" (most positive) to "0" (neutral) to "--" (most negative).

| | **Alternatives** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **No Action** | | **Deflectors** | | **Operation** | | **Combination** | |
| **Area of impact** | *C* | *O* | *C* | *O* | *C* | *O* | *C* | *O* |
| Cost (change from no-action) | $0 | $0 | ~$28M | minor | $0 | $0 | ~$28M | minor |
| Schedule | none | none | ~ 2005 | ~ 2005 | none | immed. | ~ 2005 | ~ 2005 |
| Climate/air quality | 0 | 0 | - | 0 | 0 | 0 | - | 0 |
| Noise | 0 | - | - | - | 0 | - | - | - |
| Visual/esthetics | 0 | 0 | - | 0 | 0 | 0 | - | 0 |
| Physical/geology | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Water quality | | | | | | | | |
| Nutrients | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Temperature | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Dissolved gas | 0 | -- | 0 | + | 0 | + | 0 | ++ |
| Biological resources | | | | | | | | |
| Fish | | | | | | | | |
| Noncaptive | 0 | -- | 0 | + | 0 | + | 0 | ++ |
| Captive | 0 | -- | 0 | + | 0 | + | 0 | ++ |
| Other aquatic organisms | 0 | -- | 0 | + | 0 | + | 0 | ++ |
| Terrestrial organisms | | | | | | | | |
| Birds | 0 | - | 0 | + | 0 | 0 | 0 | + |
| Mammals | 0 | - | 0 | + | 0 | 0 | 0 | + |
| Reptiles/amphibians | 0 | 0 | - | 0 | 0 | 0 | - | 0 |
| Flora | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Threatened/endangered spp. | | | | | | | | |
| Upper Columbia chinook | 0 | -- | 0 | + | 0 | - | 0 | ++ |
| Upper Columbia steelhead | 0 | -- | 0 | + | 0 | - | 0 | ++ |
| Columbia bull trout | 0 | -- | 0 | + | 0 | 0 | 0 | ++ |
| Bald eagle | 0 | - | - | - | 0 | 0 | - | ++ |
| Cultural resources | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power system operations | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Recreation | 0 | 0 | 0 | + | 0 | + | 0 | + |
| Other economies | | | | | | | | |
| Net pen operations | 0 | -- | 0 | + | 0 | + | 0 | ++ |
| Commercial fishing | 0 | 0 | 0 | + | 0 | + | 0 | + |
| Irrigation/agriculture | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Environmental justice | 0 | - | 0 | + | 0 | 0 | 0 | + |
| Cumulative effects | 0 | 0 | 0 | 0 | 0 | 0 | 0 | + |

Spill using flow deflectors would create the same amount of noise as spill without flow deflectors. Spill under existing conditions (no-action alternative) ranges from 0 to over 170,000 cubic feet per second (cfs) at Chief Joseph, and from 0 to more than 110,000 cfs at Grand Coulee. Decreasing spill at Grand Coulee to shift it to Chief Joseph (operation and combination alternatives) would result in spill levels at Chief Joseph ranging from 0 to about 270,000 cfs, and 0 up to about 55,000 cfs at Grand Coulee. That would decrease noise levels at Grand Coulee, and would increase noise levels at Chief Joseph. Since there is no fishing or other river use in the immediate below-dam vicinity during spill, noise effects would not be expected to be significant for any alternative.

5.3 Visual/esthetic environment Construction-related activities would be evident at Chief Joseph Dam during installation of flow deflectors. Observers would see equipment floating at or near the water level along the downstream face of the dam, as well as some supply trucks travelling to and from the dam. Over the long term, the visual character of the vicinity of Chief Joseph Dam would not change significantly. Spill with deflectors would generate more spray than without deflectors, and that would be magnified by increases in spill as a result of shifting spill from Grand Coulee. Thus, conditions downstream of Chief Joseph Dam might become more misty on occasions when spill is necessary. That may promote some growth of plants along the shorelines in the area, but only if spill became much more frequent, which is unlikely under the preferred alternative—in some years there would be no spill at all. Conversely, less spray might be generated at Grand Coulee. The nightly laser light show at Grand Coulee would continue, since the amount of spill required for it is minimal, and does not create dissolved gas problems.

5.4 Physical and geologic environment No effect is expected to physical resources as a result of any alternative, except for the possibility that the deflector, operational or combination alternatives may increase saturation of soils along the right (north) bank below Chief Joseph Dam. However, steps to prevent erosion would be taken if necessary. Those might include raising the existing training wall, placement of additional riprap, or both. In addition, it is possible, though not clear at this time, that the small embayment on the north side of the river immediately downstream of the spillway would need to be further armored to prevent shoreline damage from the increased surface turbulence caused by spill. That will be examined, and if further work is necessary, this Environmental Assessment will be supplemented to document it under NEPA.

5.5 Water quality

5.5.1 Nutrients Nutrient levels are not expected to be altered by any alternative from the existing situation.

5.5.2 Temperature Water temperature is unlikely to be affected by spill below either Grand Coulee or Chief Joseph dam, and any effect from the use of flow deflectors might be difficult to measure. It is anticipated that none of the alternatives would have an effect on water temperature in the Columbia River.

5.5.3 Dissolved gas   Figures 5.5.3-1 to 5.5.3-7 describe effects of proposed operations in comparison with each other.

Effects of flow deflector installation on dissolved gas for Chief Joseph Dam are shown in Fig. 5.5.3-1. TDG maximizes at about 120% with deflectors, versus nearly 140% without. The deflector design presented in the General Reevaluation Report (USACE, 2000) of the gas abatement study for Chief Joseph Dam represents only a 10% design level aimed at determining constructability of deflectors at a high-head dam. Effectiveness of deflectors is based on design details such as length, submergence and tailwater elevation. This gas abatement study is in ongoing discussions with design experts from regional resource agencies to determine design details (based on physical model studies) for the most effective deflector.

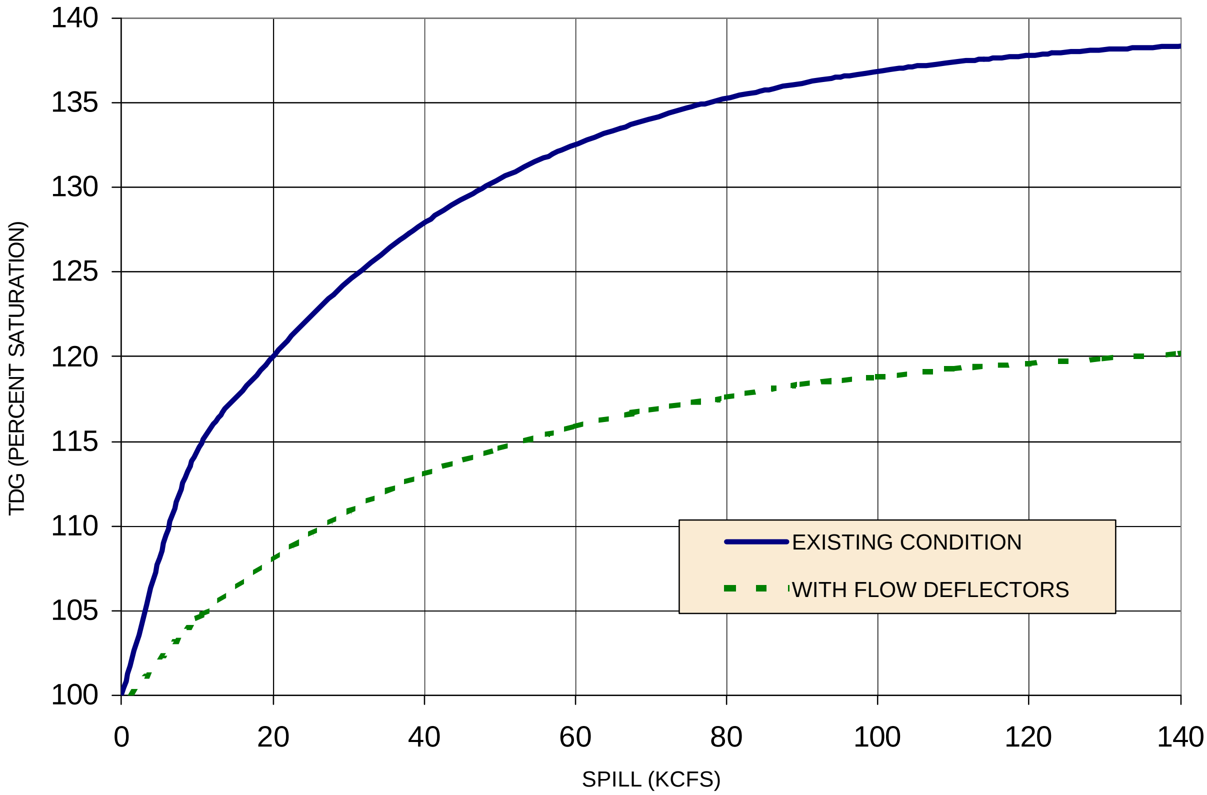


Figure 5.5.3-1. Total dissolved gas production curves for Chief Joseph Dam spillway as a function of spill with and without deflectors. The gas production equation for the existing condition is based on a near-field study conducted in June 1999 (constant tailwater elevation of 788 feet). Gas production equations for the "with deflector" condition are based on observations at Ice Harbor Dam during a spill test of deflectors. Chief Joseph has narrower spillbays. TDG estimates were adjusted for differences in spillbay width (same spill per foot width of spillway). More refined gas production equations for the “with deflector” condition would be developed for Chief Joseph Dam after prototype installation. Both curves are based on uniform distribution of spill across 19 spillbays.

Dissolved gas concentrations at in Lake Rufus Woods and Lake Pateros for each alternative are shown in Figures 5.5.3-2 and 5.5.3-3, respectively. Spill frequency is expected to increase at Chief Joseph Dam and decrease at Grand Coulee Dam under the two alternatives that include operational changes. Under the no-action and flow deflector alternatives, spill frequency would not change. At Grand Coulee Dam, alternatives involving changes in operations would entail less spill and less overall TDG levels from that project. At Chief Joseph Dam, alternatives involving flow deflectors would ameliorate the levels of TDG, even for most instances of spill including shifts of spill from Grand Coulee Dam.

The numerical modeling performed to develop these results used an hourly timestep of operation data as well as hourly boundary conditions. The model calculated gas production at Grand Coulee Dam, routed the resultant TDG through Rufus Woods Lake, and calculated gas production at Chief Joseph Dam. Four months of data were used: March through June 1997. While 1997 was a high flow year, 75% of the hourly flows in that period were less than the 7-day, 10-year average of 241,000 cfs. As such, Washington Department of Ecology would expect gas levels to be closer to their criterion of 110%. TDG levels were well above 110% even when the flow was less than 241,000 cfs. The elevated TDG was caused by a combination of events: high TDG coming into Lake Roosevelt from Canada, high TDG produced by spill at Grand Coulee, and high TDG produced by spill at Chief Joseph.

The operational alternative applied to Grand Coulee and Chief Joseph Dams involved a shift of power and spill between the two projects. While the powerhouse capacity at both projects is fairly large (280,000 and 219,000 cfs respectively), there are often one or more units undergoing maintenance. In addition, Grand Coulee is not at full pool during the spill season. To more realistically examine this alternative, powerhouse capacities were assumed to be 250,000 and 200,000 cfs.

When power and spill are shifted between the two projects, their differing heads and unit efficiencies must be taken into account. For example, a spill of 10,000 cfs at Grand Coulee would translate to about 20,000 cfs at Chief Joseph. That same spill of 10,000 cfs at Coulee is equivalent to about 240 MW of power that must come from Chief Joseph. Some of the time, there is not a full load of power in the system to run Grand Coulee at full load even with the shift and it would still spill, albeit a lesser amount. In summary, the analysis of the operation change maintained a “power neutral” status using the actual/observed load from 1997. The analysis did *not* assume that load was available to run full powerhouse capacity.

At times in 1997 during the spill season, spill did not occur at either Chief Joseph or Grand Coulee Dams. Figures 5.5.3-2 and 5.5.3-3 show the percentage of time that spill occurred under the existing condition and what would occur under the preferred alternative.

Using hourly modeled data, in Lake Rufus Woods, under 1997 conditions for the no-action (existing conditions) and deflector alternatives, TDG might reach 140%, and would exceed 120% about 46% of that entire 4-month time period. For 1997 conditions, under the operational and combination alternatives, TDG would not exceed about 125%, and would exceed 120% only about 10% of the time.

In Lake Pateros under 1997 conditions, maximum TDG might reach 133% for the no-action alternative, but 135% for the operational alternative. This is because without deflectors at Chief Joseph Dam, shifting spill from Grand Coulee to Chief Joseph would exacerbate TDG conditions below Chief Joseph occasionally (when the difference between "without project" and "with project" spill at Chief Joseph is greatest). The deflector and combination alternatives would result in TDG maximums of about 127% and 118%, respectively. During the 4-month time period (the spill season at Chief Joseph) under 1997 conditions, the 120% TDG level would be exceeded about 44% of the time for the no-action alternative, 43% of the time for the operational alternative, and 30% of the time for the deflector alternative. It would not be expected to exceed 120% under the combination alternative. Tables 5.5.3-1 to 5.5.3-4 show durations of TDG levels above a set of thresholds for 1997 conditions with the various alternatives in comparison with the no-action (existing conditions) alternative. Because 1997 was a year of high spill, spill and dissolved gas levels would be lower than the tables show, for most years under all alternatives.

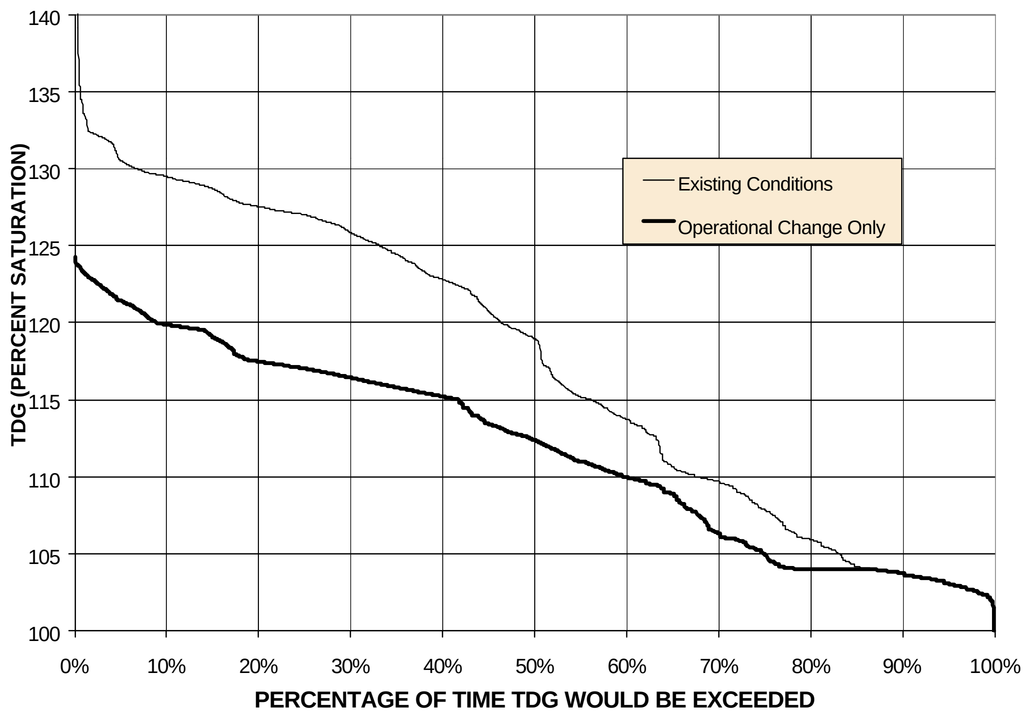


Figure 5.5.3-2. Output of modelled alternatives: total dissolved gas in Lake Rufus Woods, March-June 1997. The lines representing the existing condition and deflector only alternatives are the same, because they involve the same amount of spill at Grand Coulee Dam. The lines representing the alternatives with operational changes are also the same. In order to be consistent at sensor locations, these TDG values represent an average across the river or a mixed-river condition. For purposes of statistical comparison, forebay TDG would be very similar to the tailwater TDG under the preferred alternative, because little spill occurs at Grand Coulee under the operational alternative.

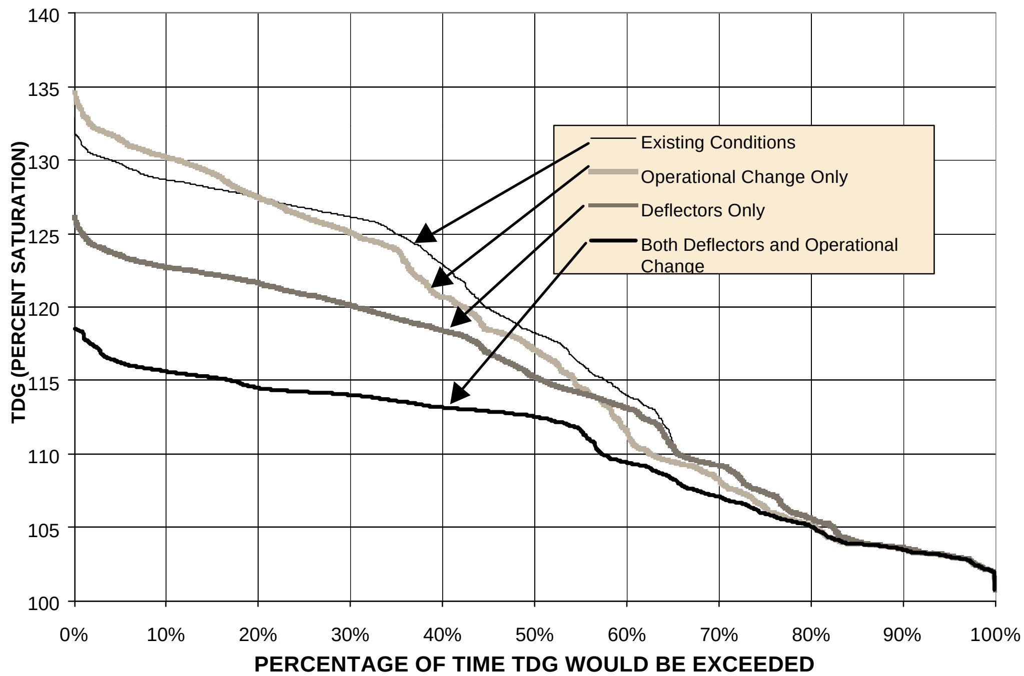


Figure 5.5.3-3. Output of modelled alternatives: total dissolved gas in Lake Pateros, March-June 1997.

Grand Coulee forebay observed TDG in 1997 is shown in figure 5.5.3-4.

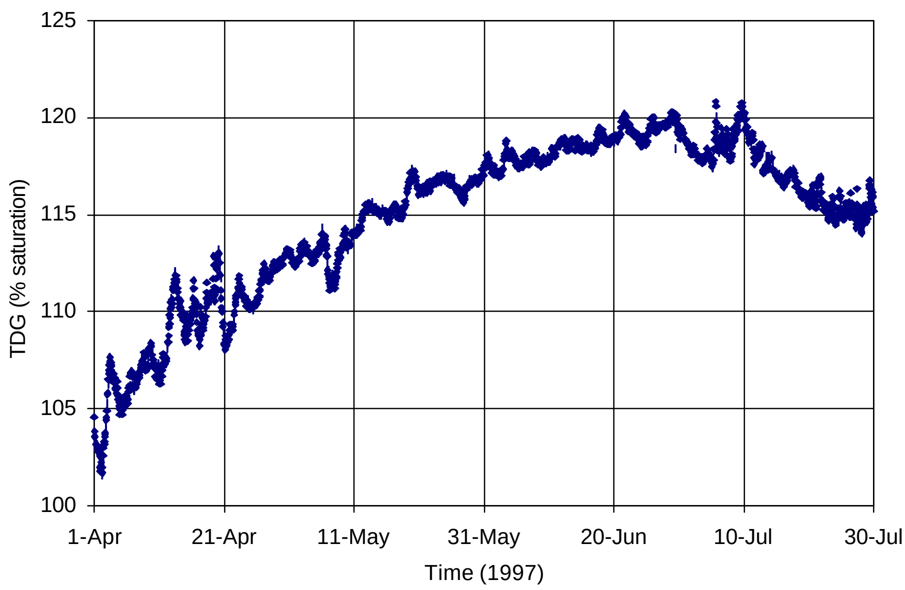


Figure 5.5.3-4. Grand Coulee Dam forebay hourly values for observed TDG.

Figure 5.5.3-5 illustrates reductions from the existing condition (no-action alternative) in time of exceedence of various TDG values (thresholds) in Lake Pateros under the deflector, operation, and combination alternatives.

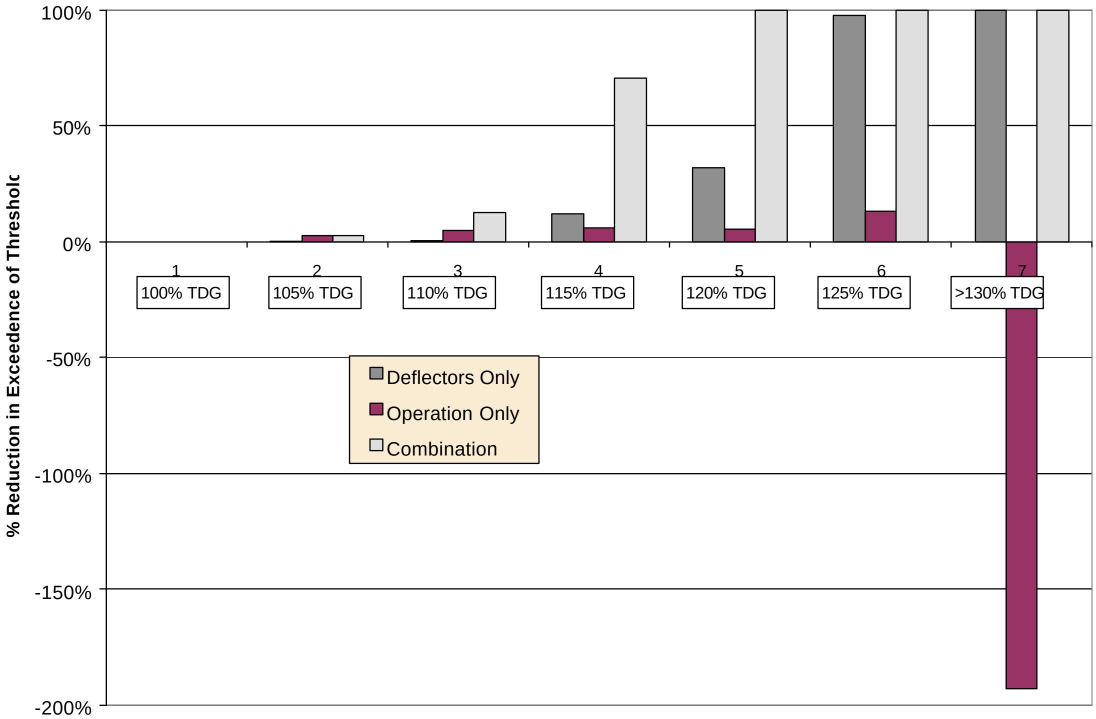


Figure 5.5.3-5. Percent reduction in TDG threshold exceedence below Chief Joseph Dam under deflectors, operational and combination alternatives in relation to no-action alternative. Positive percentages represent a reduction in TDG, and negative percentages represent an increase.

Table 5.5.3-1. TDG threshold durations (days that TDG is greater than a given value) for the no-action alternative (existing conditions) vs. the operational (joint operation) and combination alternatives, for March-June 1997 conditions below Grand Coulee Dam. These data are based on hourly, numerically modeled data for the entire spill season.

| TDG (% Saturation) | Existing Conditions | | With Joint Operation, and Combined Joint Operation and Flow Deflectors | | Net Reduction in Time above Threshold | |
|---|---|---|---|---|---|---|
| | Days | % Time | Days | % Time | Days | % Time |
| 100 | 122 | 100 | 122 | 100 | 0 | 0 |
| 105 | 101 | 83 | 91 | 75 | 10 | 8 |
| 110 | 82 | 67 | 73 | 60 | 10 | 8 |
| 115 | 68 | 56 | 51 | 42 | 18 | 14 |
| 120 | 57 | 46 | 11 | 9 | 46 | 38 |
| 125 | 40 | 33 | 0 | 0 | 40 | 33 |
| >130 | 8 | 7 | 0 | 0 | 8 | 7 |

Table 5.5.3-2. TDG threshold durations (days that TDG is greater than a given value) for the no-action alternative (existing conditions) vs. the deflector alternative, for March-June 1997 conditions below Chief Joseph Dam. These data are based on hourly, numerically modeled data for the entire spill season.

| TDG (% Saturation) | Existing Conditions | | With Flow Deflectors | | Net Reduction in Time Above Threshold | |
|---|---|---|---|---|---|---|
| | Days | % Time | Days | % Time | Days | % Time |
| 100 | 122 | 100 | 122 | 100 | 0 | 0 |
| 105 | 101 | 82 | 101 | 82 | 0 | 0 |
| 110 | 80 | 66 | 80 | 65 | 0 | 0 |
| 115 | 70 | 58 | 62 | 51 | 8 | 7 |
| 120 | 55 | 45 | 37 | 31 | 17 | 14 |
| 125 | 43 | 35 | 1 | 1 | 42 | 34 |
| >130 | 5 | 4 | 0 | 0 | 5 | 4 |

Table 5.5.3-3. TDG threshold durations (days that TDG is greater than a given value) for the no-action alternative (existing conditions) vs. the operational alternative (joint operation), for March-June 1997 conditions below Chief Joseph Dam. These data are based on hourly, numerically modeled data for the entire spill season.

| TDG (% Saturation) | Existing Conditions | | Joint Operation | | Net Reduction in Time Above Threshold | |
|---|---|---|---|---|---|---|
| | Days | % Time | Days | % Time | Days | % Time |
| 100 | 122 | 100 | 122 | 100 | 0 | 0 |
| 105 | 101 | 82 | 98 | 80 | 3 | 2 |
| 110 | 80 | 66 | 76 | 62 | 4 | 3 |
| 115 | 70 | 58 | 66 | 54 | 4 | 3 |
| 120 | 55 | 45 | 52 | 42 | 3 | 2 |
| 125 | 43 | 35 | 37 | 30 | 6 | 5 |
| >130 | 5 | 4 | 14 | 11 | -9 | -7 |

Table 5.5.3-4. TDG threshold durations (days that TDG is greater than a given value) for the no-action alternative (existing conditions) vs. the combination alternative (joint operation and flow deflectors), for March-June 1997 conditions below Chief Joseph Dam. These data are based on hourly, numerically modeled data for the entire spill season.

| TDG (% Saturation) | Existing Conditions | | With Joint Operation and Flow Deflectors | | Net Reduction in Time Avove Threshold | |
|---|---|---|---|---|---|---|
| | Days | % Time | Days | % Time | Days | % Time |
| 100 | 122 | 100 | 122 | 100 | 0 | 0 |
| 105 | 101 | 82 | 98 | 80 | 3 | 2 |
| 110 | 80 | 66 | 70 | 57 | 10 | 9 |
| 115 | 70 | 58 | 21 | 17 | 50 | 41 |
| 120 | 55 | 45 | 0 | 0 | 55 | 45 |
| 125 | 43 | 35 | 0 | 0 | 43 | 35 |
| >130 | 5 | 4 | 0 | 0 | 5 | 4 |

The downstream benefits shown in Figure 5.5.3-6 are the results of a cooperative numerical modeling effort initiated by the Corps, Bureau of Reclamation and Bonneville Power

Administration to examine the effects of gas abatement strategies at Chief Joseph and Grand Coulee on the larger Columbia River. For this exercise, operation of the PUD dams was assumed to be the same as the observed operation during that time period. This modeling effort revealed a zone of influence for gas abatement alternatives undertaken at either dam. Any gas abatement alternative would have diminishing returns as the water moves downstreams and a larger portion of has experienced spill. Each dam adds a little to the level of TDG in the water. Little dissipation of gas occurs in the pooled water between the dam. By the time the water reached Priest Rapids in the model, there was no difference between the preferred alternative and existing conditions. Even if there were a difference between the alternatives below Priest Rapids, that difference would likely narrow as the river takes on more natural characteristics of faster, shallower and more turbulent flow in the Hanford Reach. While 1997 was a large runoff year, the May 1997 flows were largely less than the 7-day, 10-year flow for Chief Joseph and Grand Coulee. As such, the Washington Department of Ecology would expect their gas levels to be closer to 110%. The same is true for May 1996 (Figure 5.5.3-7).

Wanapum Dam recently underwent flow deflector installation which is not reflected in the modeling results in Figure 5.5.3-6 or Figure 5.5.3-7. Future versions of the model may include that modification, particularly if a detailed, post-deflector, spill test is performed at Wanapum. In a qualitative sense, deflectors at Wanapum would improve TDG levels in its tailwater and the reservoir of Priest Rapids Dam. It is possible that the difference would extend to the tailwater of Priest Rapids. Again, any improvements are unlikely to be seen below the Hanford Reach due to the off-gassing features of a more natural river.

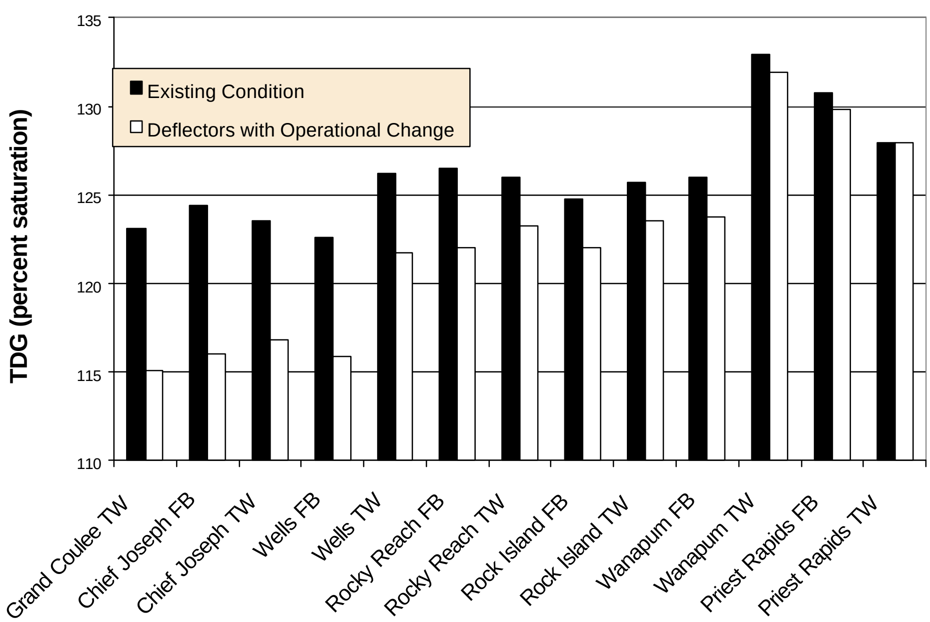


Figure 5.5.3-6. Comparison of modelled dissolved gas conditions at midColumbia River dam forebays (FB) and tailwaters (TW), in succession from Grand Coulee to Priest Rapids. The model used an hourly timestep. The average May 1997 TDG level is shown here.

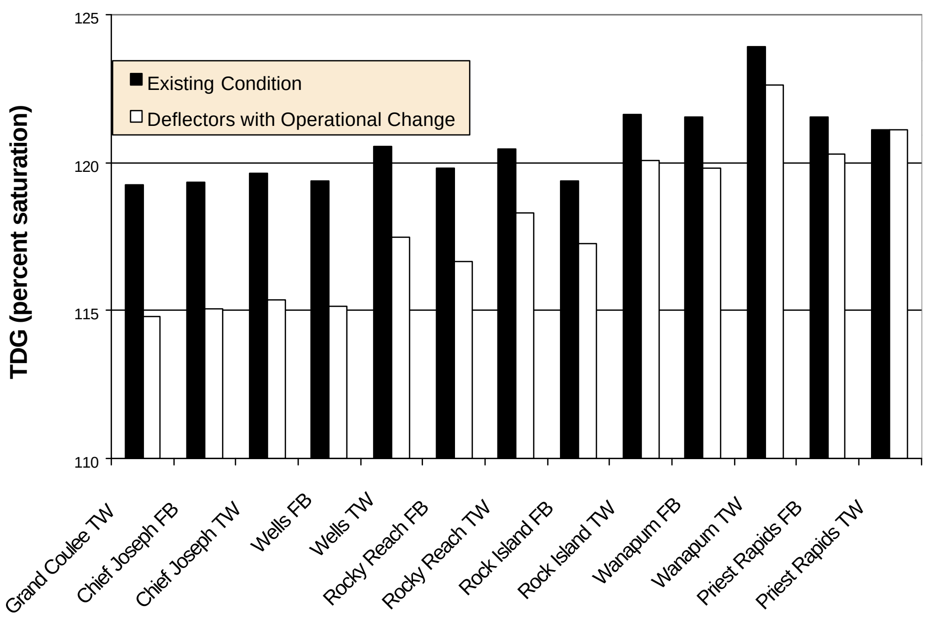


Figure 5.5.3-7. Comparison of modelled dissolved gas conditions at midColumbia River dam forebays (FB) and tailwaters (TW), in succession from Grand Coulee to Priest Rapids for May 1996.

5.5.4 <u>Sediment and turbidity</u> None of the alternatives is expected to make much difference in these variables, either as a result of construction or of general operation.

5.6 <u>Biological resources</u>

5.6.1. <u>Fish</u>

5.6.1.1 <u>Noncaptive fish</u> Because numbers of fish injured or killed by gas bubble disease depends on level of gas saturation, duration of a given saturation level, duration of reduced saturation (recovery time), water temperature, species, life stage, migration timing, behavior, and location in the water column, it is difficult to quantitatively predict numbers of unconfined fish likely to be affected by each alternative. Table 5.6.1.1-1 provides a summary of exposure time for each alternative under 1997 conditions in Lake Rufus Woods and Lake Pateros. Most years would be more favorable than 1997, and many would have no spill at all. Therefore 1997 represents a worst-case analysis given available data. Under the preferred (combination) alternative, conditions are considerably improved over the existing (no-action) alternative, both in Lake Rufus Woods and in Lake Pateros. The operational alternative improves conditions in Lake Rufus Woods, and the deflectors improve conditions for most flow circumstances in Lake Pateros.

For the most susceptible species (whitefish, suckers, pikeminnow, peamouth, chiselmouth), some symptoms might occur in a high-runoff year, even with dissolved gas levels below 120%.

In general, based on previous studies (see Sec. 4.6.1), losses of fish under the no-action and deflector alternatives could be high in some years (though not all) in Lake Rufus Woods. That is because of the extended durations of TDG values above 120%.

The operation and combination alternatives would reduce dissolved gas in Lake Rufus Woods, including the duration of TDG above 120% (from 57 to 11 days for 1997—Table 5.6.1.1-1). Thus, losses of fish in Lake Rufus Woods would be possible, but probably minimal. That would include both juvenile and adult bull trout, in all likelihood.

Table 5.6.1.1-1. Comparison of alternatives for days exceeding the 110% and 120% TDG thresholds below Grand Coulee and Chief Joseph dams for 1997 conditions.

| | | Days exceeding threshold (difference from no-action) | | | |
|---|---|---|---|---|---|
| | TDG Threshold | No-action | Deflectors | Operational | Combination |
| Below Grand Coulee Dam | 110% | 82 | 82 (0) | 73 (9) | 73 (9) |
| | 120% | 57 | 57 (0) | 11 (46) | 11 (46) |
| | >130% | 8 | 8 (0) | 0(8) | 0(8) |
| Below Chief Joseph Dam | 110% | 80 | 80 (0) | 76 (4) | 70 (10) |
| | 120% | 55 | 37 (18) | 52 (3) | 0 (55) |
| | >130% | 5 | 0 (5) | 14 (+11) | 0 (5) |

Figure 5.6.1.1-1 shows smolt timing and modelled Lake Pateros dissolved gas values for 1997, to indicate anadromous fish outmigration in relation to dissolved gas levels. The preferred (combination) alternative is consistently below 120% for the modelled period, April 1-June 30, and values for all alternatives would drop as runoff decreases and allows spill to decrease. Anadromous fish are somewhat vulnerable to TDG levels above 110%, but studies indicate that impacts would be more likely above 120%. The modelled values for dissolved gas do not extend beyond the end of June, but should decrease through the summer because of the gradual reduction in spring snowmelt and resulting decrease in spill. However, although the tail-off of dissolved gas levels might indicate that age-0 (fall race) chinook are least vulnerable, they rear in the mainstem and not the tributaries, so they would be more vulnerable than others to effects of high TDG in spring.

The preferred (combination) alternative would be expected to result in few fish lost in Lake Pateros.

Based solely on the reduction in duration of TDG levels exceeding 110% and especially 120%, losses of fish under the preferred (combination) alternative would be expected to decrease at all locations from Grand Coulee Dam to Priest Rapids Dam, even in high-runoff years. In conditions where TDG exceeds 120%, then fish species, size, behavior and depth would factor in to determine actual losses.

For reservoirs below Wells Dam, some improvements would be expected under all except the most severe conditions for the deflector and combination alternatives (see Figures 5.5.3-5 and 5.5.3-6). Confidence levels for model results below Wells Dam are not as high as for Lake Pateros and Lake Rufus Woods, but benefits are expected nevertheless. These improvements decrease marginally at each dam down to Priest Rapids, below which no further improvement is expected from any alternative. Hence, some margin of improvement in fish health and survival would be expected for those alternatives in each reservoir to the Priest Rapids pool. For the no-action and operation alternatives, no change in dissolved gas levels relative to the existing condition would be expected for the midColumbia below Wells Dam.

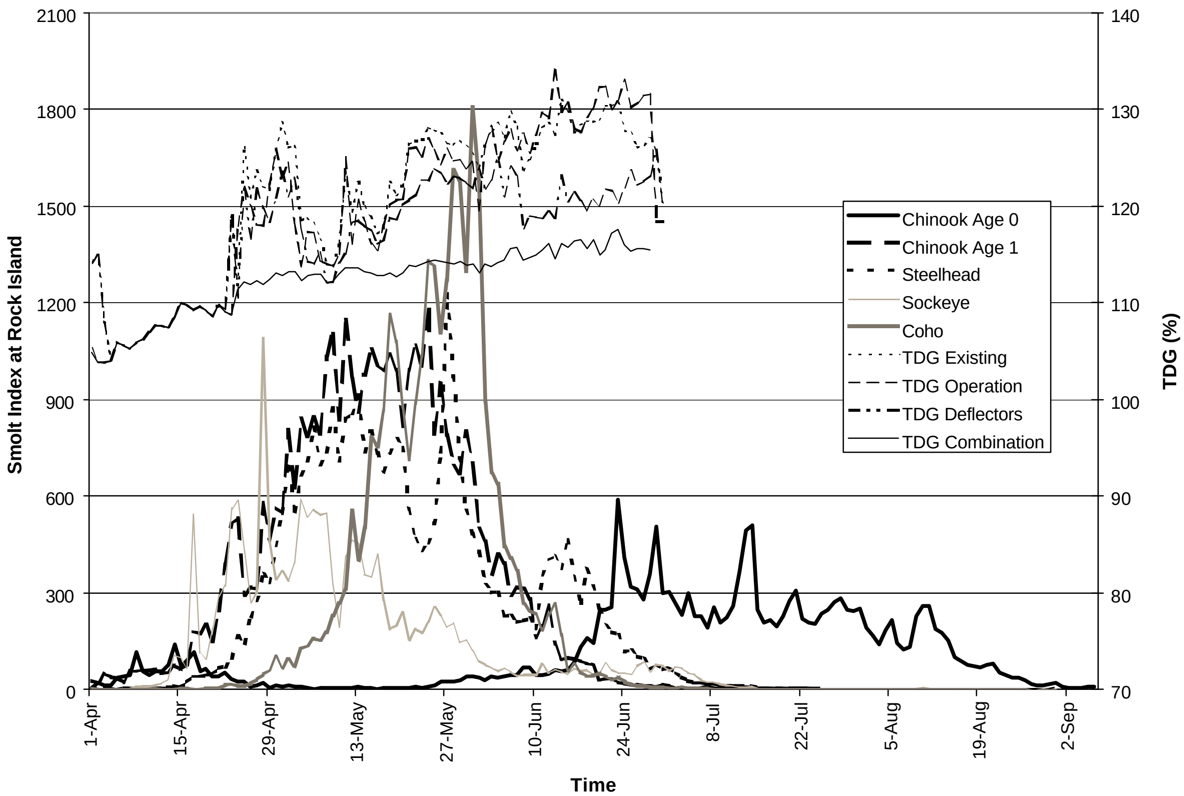


Figure 5.6.1.1-1. Rock Island Dam 5-year (1995-99) average smolt index values, and Lake Pateros 1997 modelled dissolved gas values for each alternative. Spill stops in June, and though dissolved gas levels are not shown here, they are the same for all alternatives following that cessation.

Because spill and dissolved gas generation at Chief Joseph and Grand Coulee dams may limit allowable spill at midColumbia public utility dams, the no-action alternative and the operational alternative may result in increased numbers of adult and juvenile salmonids being forced through turbines instead of passing over spillways at those projects. According to Whitney (1997), this may cause mortality rates of 5-10 times that of spillway passage.

Resident fish entrainment would be expected at Chief Joseph and Grand Coulee dams whether spill occurred or not, but effects might be different. It would not change at either Chief Joseph or Grand Coulee under the no-action alternative or the deflector alternative. Under the operation and combination alternatives, increased use of turbines for periods of time in those years when involuntary spill occurs would result in likely increases in generator entrainment at Grand Coulee, and decreased incidence at Chief Joseph Dam. For those alternatives, Grand Coulee turbine entrainment might increase by a factor of 10 for spring and summer months when involuntary spill occurs. This is based on the numbers in Table 4.6.1.1-2, which show entrainment figures much higher for spring months in 1996 and 1997 compared to 1998 and 1999. Those numbers do not reflect spill, but may be reflective of the higher amount of water which would be used for generation at Grand Coulee. Mortality is difficult to estimate from available data. LeCaire (1999) indicated that daytime entrainment is higher than nighttime entrainment, and daytime would be the period of higher generation relative to nighttime. However, since it is known that trout and walleye pass successfully through Grand Coulee Dam into Lake Rufus Woods, it is likely that turbine passage is successful for many of these fish at least some of the time. If the USBR evaluates and implements means of keeping fish from being entrained through the Grand Coulee turbines, then for the long term, turbine entrainment would be expected to be less of a factor there. Though less quantifiable, spillway entrainment at Grand Coulee would decrease under the operation and combination alternatives, and would not change under the no-action and deflector alternatives.

The National Marine Fisheries Service requires investigation of spill for juvenile fish passage at dams on the lower Columbia River (NMFS, 1998a). Survival of juvenile chinook salmon and steelhead passing over spillways at lower Snake, midColumbia and lower Columbia river dams has been consistently above 90%, and in some cases 100% in certain controlled tests (Normandeau Associates, Inc., and Skalski, 2000). It is anticipated that spillway passage survival at Chief Joseph Dam would be good for juvenile salmonids for alternatives involving deflectors. Passage on spillways without deflectors, or for other fish, is more difficult to predict. The Chief Joseph deflector design incorporates a transition curve from the spillway to the deflector surface. That configuration, plus keeping the flow coming from the deflectors at the tailrace water surface, should aid fish survival.

In general, it is probable that the overall benefits of the preferred alternative, including for bull trout and other listed species of fish downstream, would likely offset impacts from spillway or turbine passage due to accidental entrainment.

5.6.1.2 Fish in net pens For all fish (steelhead/rainbow trout and Atlantic salmon) farmed in net pens in Lake Rufus Woods, benefits would be expected to occur from the operational and combination alternatives—that is, reduced instance and degree of spill and thus TDG. The no-action alternative would not change the status quo, meaning continued vulnerability to spill from Grand Coulee Dam. The flow deflector alternative also would not change the status quo with regard to spill frequency or severity in Lake Rufus Woods, and thus would not benefit fish in Lake Rufus Woods. The operational and combination alternatives would shift spill from Grand Coulee Dam to Chief Joseph Dam, decreasing TDG levels in Lake Rufus Woods, and hence vulnerability of fish confined in pens.

Effects on fish in commercial net pens translate into economic effects on the owners. See Sec. 5.11.

5.6.2 Other aquatic organisms Invertebrates living within 1-2 meters of the water surface in the river where saturation levels are above 110-120% may be affected by bubble formation. These might include aquatic insects especially. Mayflies, stoneflies and caddisflies might be affected by external bubble adherance and uncontrolled buoyancy in depths less than 1-2 meters where saturation levels are above 110%. Stoneflies may be subject to gas bubble disease symptoms from exposure to saturation levels above 130 percent for 10 days. The no-action alternative might thus continue to impact aquatic insects of these orders. Scavenging organisms would have less opportunity to take advantage of fish carcasses under all of the alternatives except the no-action alternative. Nutrients from carcasses would be somewhat less available to primary producers except under the no-action alternative.

Under the no-action alternative, the current rate of impact would continue to invertebrates below both Grand Coulee and Chief Joseph Dams, as well as to those further down in the midColumbia River. The deflector alternative would benefit invertebrates below Chief Joseph and in the midColumbia. The operational alternative would benefit invertebrates below Grand Coulee, but not below Chief Joseph Dam, while the combination alternative would benefit invertebrates from the Grand Coulee tailrace as well as below Chief Joseph Dam and in the midColumbia. Reduced impacts below Grand Coulee would result from lack of spill. Reduced impacts below Chief Joseph and in the midColumbia would come from use of deflectors to reduce TDG when spill occurs.

No effects to aquatic plant species are expected from any alternative.

5.6.3 Terrestrial organisms In general, there would be little if any effect on terrestrial organisms. Their supplemental food supply of fish carcasses would continue under the no action alternative. The other alternatives that may reduce the amount of fish carcasses would cause the terrestrials to shift to another food source, such as carrion of other mammals and birds.

5.6.3.1 Birds Some birds, such as gulls, bald eagles, crows and vultures, are scavengers on carcasses of fish. The alternatives that reduce total frequency of occurrence and/or levels of TDG would be expected to result in less food resources based on scavenging. Thus, the no-action alternative might continue to benefit scavenging birds around Lake Rufus Woods, below Chief Joseph Dam, and in the midColumbia; the deflector alternative could conceivably impact scavengers below Chief Joseph and in the midColumbia; the operational alternative could impact scavengers around Lake Rufus Woods but benefit birds below Chief Joseph Dam; and the combination alternative might impact scavenging birds in all of those locations. One species that may not be much affected by any alternative would be bald eagles, if they are present only during winter, since winter is a time of low likelihood of spill. However, predators such as osprey would possibly benefit from increased survival of fish. The direct benefit to fitness and reproduction of fish-eating birds is difficult to quantify. Resource bases would be unchanged under the no-action alternative. Minor and temporary disturbance to some birds may result during construction.

5.6.3.2 Mammals As with birds, some mammals are scavengers and some are predators on fish. Over the long run, scavengers such as raccoon, mink, and river otter might see reduced food resources from alternatives that increase fish survival, and predators would benefit from such alternatives, while the no-action alternative would not change circumstances for either group.

5.6.3.3 Reptiles and amphibians Little direct effect on reptiles and amphibians is anticipated from any alternative. Generally these animals do not feed on fish or aquatic insects. Some disturbance to rattlesnakes and lizards may be anticipated at quarrying and disposal sites.

5.6.3.4 Flora Increased spray is likely to occur at Chief Joseph Dam as a result of spill under the alternatives involving flow deflectors. This could provide more moisture on a localized basis, and might encourage the growth of vegetation along the riverbank which is less tolerant of dry conditions than most of the other local flora. However, since spill is not anticipated every year, the long-term effect would probably be minimal, if any. At Grand Coulee Dam, there is little evidence of vegetation enhanced by spill there, which is probably because spill does not appreciably increase spray, but rather involves plunge conditions on the spillway. Decreased spill at Grand Coulee is thus thought unlikely to have much effect on terrestrial vegetation.

5.6.4 Threatened and endangered species: Biological Assessment This section constitutes a Biological Assessment for the proposed project under Sec. 7 of the Endangered Species Act of 1977, as amended.

The anticipated effect on fish species listed under the Endangered Species Act (spring chinook, steelhead, bull trout) would be positive under alternatives designed to reduce frequency of spill and gas saturation levels. The no-action alternative would result in no change in frequency of spill or gas saturation levels, and would therefore subject these species to the same risk as now exists—that is, may adversely affect.

Upper Columbia chinook salmon use the Columbia River habitat below Chief Joseph Dam. The no-action alternative *is likely to affect, and may adversely affect* both adult and juvenile chinook because no decrease in dissolved gas is expected to result from Chief Joseph. The operation alternative is expected to result in a potential increase in dissolved gas below Chief Joseph; hence this alternative *is likely to affect, and may adversely affect*, juvenile and adult chinook. The deflector and combination alternatives are *likely to affect, but unlikely to adversely affect* chinook, because of reduction in dissolved gas levels below Chief Joseph Dam.

Upper Columbia steelhead also use the Columbia River below Chief Joseph Dam. Because the no-action alternative results in no reduction in dissolved from Chief Joseph Dam, it *is likely to affect, and may adversely affect* juvenile and adult steelhead. The operation alternative may result in an increase in dissolved gas at times below Chief Joseph dam, and therefore *is likely to affect, and may adversely affect*, juvenile and adult steelhead. The deflector and combination alternatives are expected to reduce dissolved gas below Chief Joseph Dam, and *are likely to affect, but are not likely to adversely affect*, juvenile and adult steelhead.

Bull trout inhabit the Columbia River below Chief Joseph Dam, and also in Lake Rufus Woods. Because the no-action alternative results in no reduction in dissolved gas from Chief Joseph Dam, *it would likely affect, and may adversely affect*, juvenile and adult bull trout below Chief Joseph Dam. The operation alternative may result in an increase in dissolved gas at times below Chief Joseph dam, and therefore *is likely to affect, and may adversely affect*, juvenile and adult bull trout there. The deflector and combination alternatives are expected to reduce dissolved gas below Chief Joseph Dam, and are *likely to affect, but are not likely to adversely affect*, juvenile and adult bull trout. Bull trout in Lake Rufus Woods would *likely be affected* by all alternatives. They *may be adversely affected* by the no-action and deflector alternatives, because those alternatives would not reduce the likelihood of spill and high TDG in Lake Rufus Woods. They would *not likely be adversely affected* in Lake Rufus Woods by the operation and combination alternatives because of the resulting reduction in spill and TDG from Grand Coulee Dam. Entrainment of fish through Grand Coulee Dam generating units that would increase in spill years for the operation and combination alternatives is not likely to include bull trout, based on forebay species composition information from LeCaire (1999).

For bald eagles which might consume fish which are directly affected by the proposed alternative actions, the no action alternative *would likely affect, and may adversely affect*, the peregrine, because of continued incidence of high TDG. The operation alternative *would likely affect, and may adversely affect* bald eagles because of the possibility of increased TDG and fish impacts below Chief Joseph, although above it, impacts would be less. The deflector alternative *would likely affect, and may adversely affect*, bald eagles because of continued spill at Grand Coulee. The combination alternative *would likely affect, but is not likely to adversely affect*, bald eagles at any location along the midColumbia.

5.7 <u>Cultural resources</u> The aspect of the project operations that has the greatest potential to affect cultural resources is change in water surface elevation--sandy banks in which many sites occur cannot withstand repeated saturation and wave attack. The no-action alternative would have no effect relative to the existing conditions. The deflector, operational change, and combination alternatives may improve tribal fishing in the long term by increasing available numbers of fish, but this is difficult to quantify. Changes in operation may have adverse effects on cultural resources if the changes would increase the frequency with which water is able to attack sandy banks. In the absence of detailed models that allow comparison of such alternatives with current conditions, it is not possible to rank the alternatives according to the degree of their effects.

5.8 <u>Power system operations</u> Chief Joseph and Grand Coulee combined net power production would be the same under all alternatives. The operation and combination alternatives would allow the Bonneville Power Administration to focus generation on dams like Grand Coulee that are major gas generators, and spill more at Chief Joseph, which would saturate less than currently with flow deflectors. Table 5.8-1 outlines differences in project operation under the operation and combination alternatives vs. the no action and deflector alternatives.

Table 5.8-1. Expected differences from the no-action and deflector alternatives (represented as existing condition) in spill and power generation for a year like 1997 for the operational modification and combination alternatives (represented as operational change).

| | **EXISTING CONDITION** | | **OPERATIONAL CHANGE** | | | |
|---|---|---|---|---|---|---|
| | *Percent of time spill occurred* | *Volume of water spilled* | *Percent of time spill would occur* | *Volume of water spilled* | *Power Shifted* | *Average Power Shifted* |
| ***Chief Joseph Dam*** | 63% | 10,300 thousand acre-feet | 65% | 18,800 thousand acre-feet | -1,170,000 MW-Hr | -400 MW |
| ***Grand Coulee Dam*** | 60% | 5,800 thousand acre-feet | 17% | 1,100 thousand acre-feet | +1,170,000 MW-Hr | +400 MW |

It is difficult to predict the loading configuration in the power plants at any one time. However, the third power plant (TPP) has approximately 68% of the discharge capacity, while the left power plant (LPP) and the right power plant (RPP) make up the remaining 32%. The hydraulic capacity of Grand Coulee is 280,000 cfs. Typically high flows run in excess of 230,000 cfs. The LPP and RPP combined have a maximum capacity of 90,000 cfs. Therefore, if the flow requirement was 230,000 cfs and the LPP and RPP units were fully loaded, a remainder of 140,000 cfs would be required go through the TPP. Thus, in high flow situations, the majority of the discharge would come from the TPP (S. Sauer, USBR, pers. comm., 2000).

5.9 Flood control None of the alternatives is expected to cause any change from current flood control capability, because reservoir operations will not change, and therefore flood storage capability will not change. Lake Roosevelt would be the only one of the two federal reservoirs affected by this operation that has flood control capability in any case.

5.10 Recreation Little short-term effect on recreation would be expected from any of the alternatives. In the long term, anglers might benefit from the deflector, operation, and combination alternatives through increased survival of fish, including anadromous fish in reaches below the project area along the Columbia.

5.11 Other economies Net pen operations rearing fish commercially in Lake Rufus Woods would see reductions in vulnerability to spill effects from the operational and combination alternatives, but not from the no-action or deflector alternatives. Losses to one fish farm in 1997 were $92,124 for three pens totalling about 117,000 fish to start (pen losses ranged from 16 to 35%). Losses came from feed loss, fish cost loss, and loss of sales. At another fish farm, claiming a 37% overall fish loss in 1997, total losses attributed to high TDG were about $500,000, only part of which was reimbursed by insurance. That operator also claimed chronic losses following subsidence of TDG levels, and an overall drop in production of more than 50% for 1997. Losses from the no-action and deflector alternatives would be less in most years, but some years in which spill occurs may cause a repeat of this type of situation. For the operation and combination alternatives, losses would be less for years of involuntary spill—perhaps only 1/5 of the corresponding losses in a year like 1997 (based on values for the 120% threshold below Grand Coulee in Table 5.6.1.1-1). That assumes the major factor affecting the losses is exposure time, but in reality, there are several other factors (see Section 2.2) which make exact predictions impossible.

Commercial fishing may benefit in the long run through improvements in anadromous fish survival from the deflector, operation, and combination alternatives. These alternatives might also contribute to recovery of anadromous fish species in the mid Columbia which are listed under the ESA, and tribal and nontribal net fisheries would benefit from that. Effects cannot be quantified, however, because of the difficulties in quantifying effects on juveniles, as well as the uncertainties in translating juvenile survival to adult returns.

Irrigation and agriculture would not be affected by any of the alternatives, because flow and water levels would not change.

5.12 Environmental justice Over the long-term, the project alternatives are unlikely to have any impact on minority populations, except that ongoing impacts to fish upon which Native Americans depend will be reduced as described in Sec. 5.6. Thus, the no-action alternative might have some impact on these people, while the other alternatives would provide improved conditions over the existing situation, and potentially bring the fish populations closer to historic levels. Construction-related impacts are likely to be neutral to positive, depending on whether and how employment in deflector construction benefits minority peoples.

5.13 Cumulative effects Hydropower project construction and operation in the inland northwest has cumulatively resulted in impeded upstream and downstream migration of anadromous and resident fish. Higher reservoir temperatures have impacted fish, as have reservoir and tailrace conditions that have provided advantages to predators. Dissolved gas supersaturation has also occurred at many projects not designed or retrofitted to spill without creating such conditions, resulting in injuries and mortalities to fish. These factors have collectively contributed, along with impacts from harvest, hatcheries, and habitat degradation, to reduction of anadromous fish runs by millions of fish in the Columbia basin. Resident fish have also been impacted.

The effect of the no-action alternative would be to preserve the status quo with respect to dissolved gas saturation, and would likely result in further injury and mortality to fish and aquatic organisms. The other alternatives would be expected to improve the overall situation for water quality, fish and other organisms, and would partially reverse the cumulative effects of the hydropower system in the Columbia basin.

Construction related impacts (noise, air quality, esthetics) would incrementally add to the overall accumulation of development related effects in the area. However, they would be temporary. Disposal of excavated concrete from Chief Joseph Dam would involve permanent placement of material in an approved landfill, adding somewhat to the rate at which the landfill became full.

6.0 ENVIRONMENTAL COMPLIANCE A scoping request was mailed in October 1999 to a list of interested agency and tribal representatives as well as private individuals and other organizations. Other legal requirements are being addressed as follows:

6.1 Reservoir Salvage Act; National Historic Preservation Act; Executive Order 11593, Protection and Enhancement of the Cultural Environment Coordination with the Colville Tribal Historic Preservation Officer and the Washington State Historic Preservation Officer will occur throughout the study. If the study finds that Register-eligible cultural resources will be affected by the project, consultation concerning those effects may require a programmatic agreement of memorandum of agreement with the CTHPO or WSHPO and the Advisory Council on Historic Preservation before the project may proceed.

6.2 Clean Air Act This project is not in a nonattainment or maintenance area under the Clean Air Act, so compliance with implementation plans is not applicable. A dust control plan will be formulated and implemented for construction.

6.3 Clean Water Act A Section 404(b)(1) evaluation has been prepared for fill in waters of the United States (flow deflectors).

6.4 Rivers and Harbors Act of 1899 An evaluation pursuant to Section 10 of this act has been prepared.

6.5 Endangered Species Act of 1973, as amended This document incorporates a Biological Assessment pursuant to Sec. 7 of the Endangered Species Act. Consultation has been pursued as part of the review of this document, and species lists will be requested for update prior to construction.

6.6 Wild and Scenic Rivers Act No designated Wild and Scenic Rivers will be affected by the proposed action.

6.7 Fish and Wildlife Coordination Act Appropriate documentation is being pursued.

6.8 National Environmental Policy Act This document is prepared pursuant to NEPA.

6.9 Northwest Electric Power Planning and Conservation Act The proposed project is in compliance with this Act and the fish and wildlife program developed pursuant to the Act.

6.10 Executive Order 11988, Floodplain Management No floodplains will be affected by the proposed action.

6.11 Executive Order 11990, Protection of Wetlands No wetlands will be affected by the proposed action.

6.12 Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations The proposed action will have somewhat positive impacts on Native American people, and neutral to positive impacts on Hispanic and low-income people in the project vicinity.

6.13 Executive Order 13084, Consultation and Coordination With Indian Tribal Governments Tribal governments have been consulted and support the proposed action.

6.14 CEQ Memorandum, Aug. 11, 1980, Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing NEPA No agricultural lands will be affected by the proposed action.

## 7.0 CONSULTATION AND COORDINATION

This document is being coordinated with or reviewed by the persons and entities shown in Appendix B. Comments on the Draft EA, along with responses to those comments, are included in that appendix.

## 8.0 CONCLUSIONS

- Physical effects of any alternative would be primarily observed in dissolved gas values, with the preferred (combination) alternative reducing TDG levels to the greatest extent in Lake Rufus Woods and Lake Pateros, and to some extent in Columbia River reservoirs downstream to Priest Rapids Dam.

- Biological effects may occur indirectly in wildlife that feed on fish—in the long term, animals that feed on fish would be expected to benefit indirectly from the alternatives (deflector, operation and combination alternatives) that increase fish survival and population levels, and would indirectly be impacted to the extent that fish populations are impacted. Other biological benefits would probably be difficult to detect.

- Fish survival would improve with the deflector, operation, and combination alternatives, relative to the no-action alternative. The no-action alternative has the potential to cause substantial losses of fish in the project area in high-runoff years like 1997.

- The combination alternative (preferred alternative) is the most cost-effective alternative for reducing dissolved gas conditions and increasing fish survival over existing conditions (no-action alternative. Furthermore, because Table 5.6.1.1-1 shows 1997 conditions (that is, exceptionally high runoff levels), it can be expected that conditions in most years would be more favorable than those shown, and will in fact increase fish survival.

- The preferred (combination) alternative may affect, but is unlikely to adversely effect, Endangered Species Act-listed species of fish and wildlife in the project area.

- Because of the many factors surrounding the development of GBD in fish, it cannot be stated that all risk will be removed; therefore, the preferred alternative will not constitute a significant impact on the human environment in relation to the existing condition.

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APPENDIX A:  Data on Biological Resources in the Project Vicinity

Table A-1.  Fish species from the Columbia River, Lake Rufus Woods , Lake Roosevelt, and Lake Pateros (Beak Consultants and Rensel Associates, 1999; Bonneville Power Administration et al., 1995; Cates and Marco, 1999; US Army Corps of Engineers, 1998a; Venditti, 2000).

| **Family**<br>**Species**<br>* Indicates species native to the Columbia basin. | **Mid-Columbia** | **Lake Pateros** | **Lake Rufus Woods** | **Lake Roosevelt** |
|---|---|---|---|---|
| Petromyzontidae—Lampreys | | | | |
| Pacific lamprey (*Entosphenus tridentatus)** | X | X | | |
| Acipenseridae—Sturgeons | | | | |
| White sturgeon (*Acipenser transmontanus*)* | X | | X | X |
| Salmonidae—Whitefish, Trout, Salmon, Char | | | | |
| Mountain whitefish (*Prosopium williamsoni*)* | X | X | X | X |
| Lake whitefish (*Coregonus clupeaformis*)* | | X | X | X |
| Cutthroat trout (*Oncorhynchus clarki*)* | | | X | X |
| Rainbow trout (*Oncorhynchus mykiss*)* | X | X | X | X |
| Kokanee (*Oncorhynchus nerka*)* | X | | X | X |
| Sockeye salmon (*Oncorhynchus nerka*)* | X | | | |
| Chinook salmon (*Oncorhynchus tshawytscha*)* | X | X | X | |
| Coho salmon (*Oncorhynchus kisutch*)* | X | X | | |
| Steelhead (*Oncorhynchus mykiss*)* | X | | | |
| Brown trout (*Salmo trutta*) | | | X | X |
| Bull trout (*Salvelinus confluentus*)* | X | X | X | X |
| Brook trout (*Salvelinus fontinalis*) | | | X | X |
| Esocidae—Pikes | | | | |
| Northern pike (*Esox lucius*) (unconfirmed) | | | X | |
| Cyprinidae—Minnows | | | | |
| Chiselmouth (*Arcocheilus aleutaceus*)* | X | X | X | X |
| Carp (*Cyprinus carpio*) | X | X | X | X |
| Peamouth chub (*Mylocheilus caurinus*)* | X | X | X | X |
| Northern pikeminnow (*Ptychocheilus oregonensis*)* | X | X | X | X |
| Speckled dace (*Rhinichthys osculus*)* | | | X | |
| Redside shiner (*Richardsonius balteatus*)* | X | X | X | X |
| Chub (unknown) | | | | |
| Catostomidae—Suckers | | | | |
| Sucker spp. (*Catostomus* spp.)* | | X | | |
| Longnose sucker (*Catostomus catostomus*)* | | | X | X |
| Bridgelip sucker (*Catostomus columbianus*)* | X | X | X | X |
| Largescale sucker (*Catostomus macrocheilus*)* | X | X | X | X |
| Ictaluridae—Catfishes | | | | |
| Black bullhead (*Ameiurus melas*) | X | | | |
| Brown bullhead (*Ameiurus nebulosus*) | X | X | X | |
| Yellow bullhead (*Ameiurus natalis*) | | X | | |
| Gadidae—Cods | | | | |
| Burbot (*Lota lota*)* | | | X | X |
| Gasterosteidae—Sticklebacks | | | | |
| Threespine stickleback (*Gasterosteus aculeatus*)* | X | | | |
| Percopsidae—Troutperches | | | | |
| Sandroller (*Percopsis transmontana*) | X | | | |
| Centrarchidae—Bass and Sunfishes | | | | |
| Black crappie (*Pomoxis nigromaculatus*) | | X | X | |
| Largemouth bass (*Micropterus salmoides* ) | | X | | |
| Smallmouth bass (*Micropterus dolomeui*) | X | X | X | X |
| Pumpkinseed (*Lepomis gibbosus*) | X | X | | X |
| Bluegill (*Lepomis macrochirus*) | X | X | | |
| Percidae—Perches | | | | |
| Yellow perch (*Perca flavescens*) | | X | X | X |
| Walleye (*Stizostedion vitreum*) | | X | X | X |
| Cottidae—Sculpins | | | | |
| Prickly sculpin (*Cottus asper*)* | | X | X | |
| Paiute sculpin (*Cottus beldingi*)* | | | | X |
| Torrent sculpin (*Cottus rhotheus*)* | | | X | |
| Sculpin (*Cottus* spp.)* | X | | | |

Table A-2. Adult fish counts at midColumbia dams, 1994-1998 (USACE, 1998a).

| Year | Species and run | Counts by Project | | | |
|---|---|---|---|---|---|
| | | Wells | Rocky Reach | Rock Island | Priest Rapids |
| 1994 | CHINOOK | 8266 | 12064 | 24364 | 32892 |
| | Spring | 258 | 360 | 2038 | 3127 |
| | Summer | 4991 | 6176 | 13179 | 15500 |
| | Fall | 3017 | 5528 | 9147 | 14265 |
| | Jacks | 948 | 1437 | 3198 | 3097 |
| | STEELHEAD | 2183 | 2818 | 5620 | 6706 |
| | SOCKEYE | 1666 | 1680 | 11368 | 12385 |
| | COHO | 3 | 6 | 18 | 0 |
| | Adults | 3 | 6 | 18 | |
| | Jacks | | | | |
| | SHAD | | | | 19643 |
| 1995 | CHINOOK | 4345 | 9614 | 21571 | 30542 |
| | Spring | 107 | 248 | 934 | 1208 |
| | Summer | 3056 | 4704 | 11319 | 12608 |
| | Fall | 1182 | 4662 | 9318 | 16726 |
| | Jacks | 505 | 1226 | 4680 | 3994 |
| | STEELHEAD | 945 | 1758 | 4175 | 4357 |
| | SOCKEYE | 4892 | 4988 | 9462 | 9186 |
| | COHO | | | 6 | 11 |
| | Adults | | | | 11 |
| | Jacks | | | | |
| | SHAD | | | | 20583 |
| 1996 | CHINOOK | 3694 | 9797 | 18079 | 26836 |
| | Spring | 387 | 569 | 2150 | 2183 |
| | Summer | 2390 | 5230 | 10272 | 11328 |
| | Fall | 917 | 3998 | 5657 | 13325 |
| | Jacks | 427 | 808 | 2211 | 1283 |
| | STEELHEAD | 4127 | 5774 | 7305 | 8376 |
| | SOCKEYE | 17701 | 21741 | 29500 | 29453 |
| | COHO | | | | 6 |
| | Adults | | | | 5 |
| | Jacks | | | | 1 |
| | SHAD | | | | 10267 |
| 1997 | CHINOOK | 4461 | 11352 | 22747 | 33036 |
| | Spring | 971 | 1866 | 6205 | 6788 |
| | Summer | 2723 | 6308 | 11574 | 13616 |
| | Fall | 767 | 3178 | 4968 | 12632 |
| | Jacks | 338 | 1470 | 1496 | 1948 |
| | STEELHEAD | 4107 | 6722 | 7726 | 8948 |
| | SOCKEYE | 25754 | 30485 | 41504 | 45412 |
| | COHO | 8 | | 5 | 26 |
| | Adults | 3 | | 5 | 25 |
| | Jacks | 5 | | | 1 |
| | SHAD | | | | 10314 |
| 1998 | CHINOOK | 5205 | 11804 | 20888 | 29415 |
| | Spring | 30 | 816 | 3241 | 4161 |
| | Summer | 3970 | 7032 | 12854 | 13988 |
| | Fall | 1205 | 3236 | 4793 | 11266 |
| | Jacks | 915 | 792 | 2164 | 2242 |
| | STEELHEAD | 2668 | 4442 | 4962 | 5837 |
| | SOCKEYE | 4669 | 5682 | 9334 | 10769 |
| | COHO | | | | 30 |
| | Adults | | | | 30 |
| | Jacks | | | | 0 |
| | SHAD | | | | 8079 |

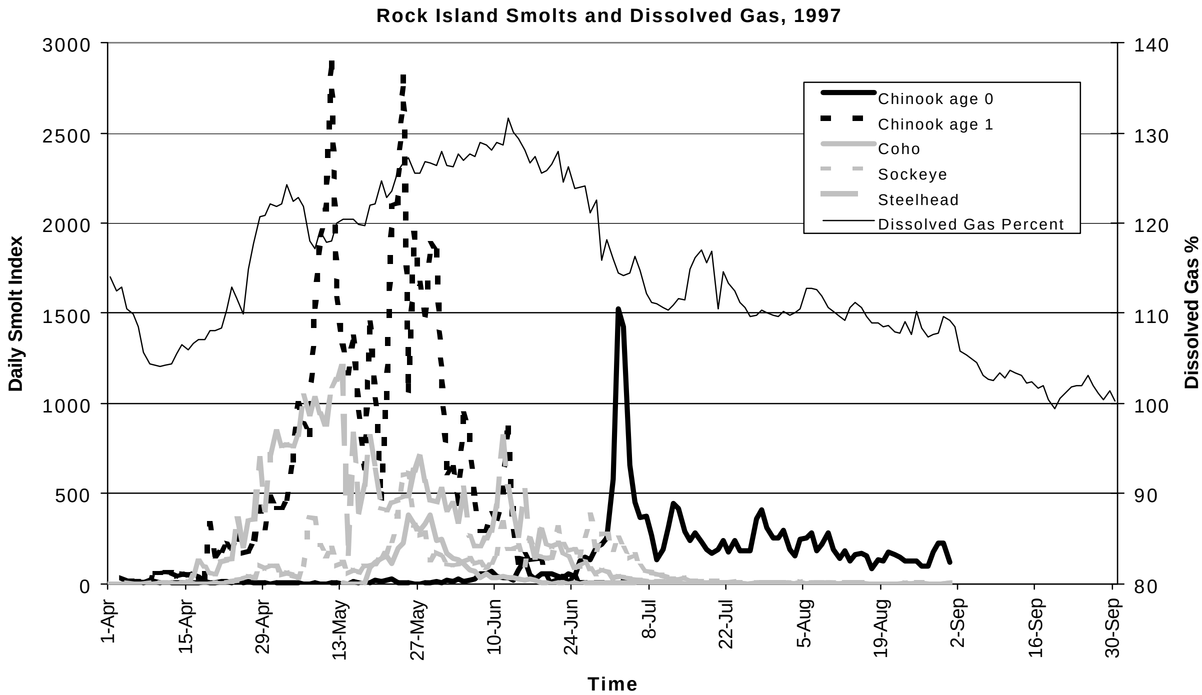


Figure A-1. Combined wild and hatchery smolt index and dissolved gas levels for 1997 at Rock Island Dam in the midColumbia River (Univ. of Washington, 2000). Smolt counts are not available for Wells Dam.

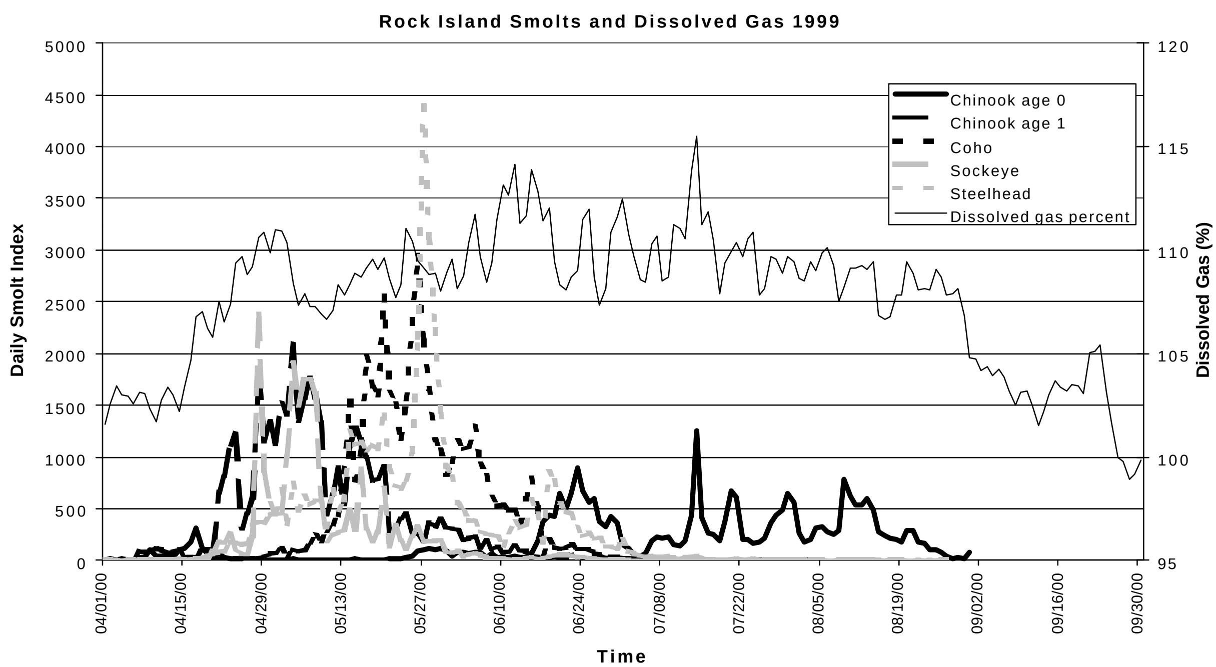


Figure A-2. Combined wild and hatchery smolt index and dissolved gas levels for 1999 at Rock Island Dam in the midColumbia River (Univ. of Washington, 2000). Smolt counts are not available for Wells Dam.

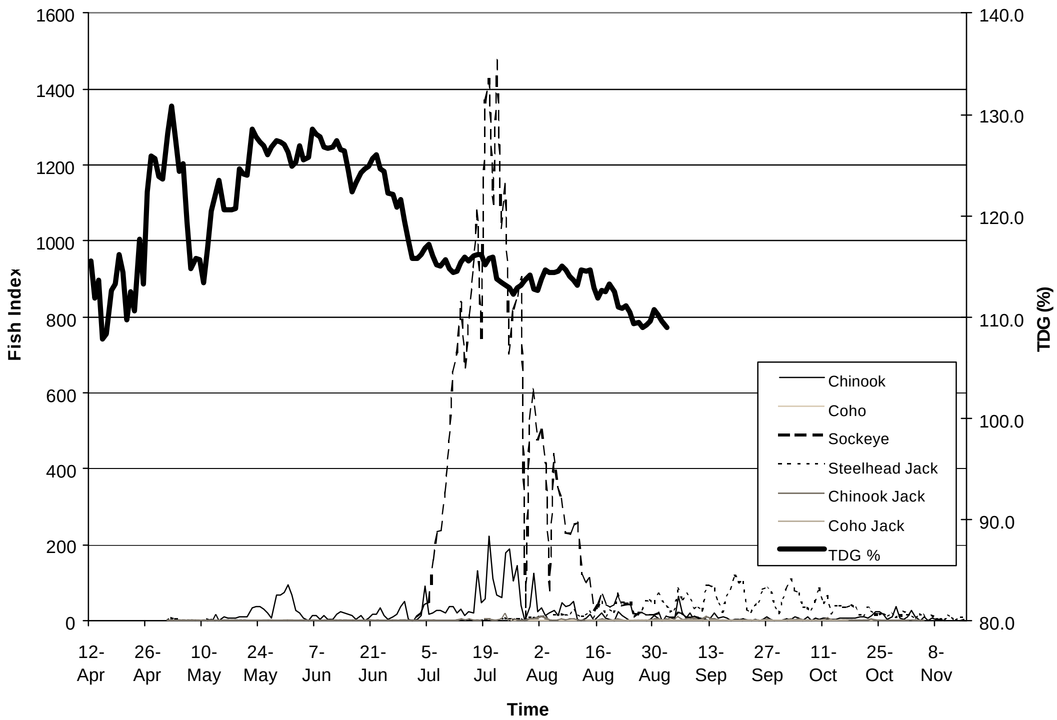


Figure A-3. Adult fish passage at Wells Dam in 1997, with total dissolved gas (Univ. of Washington, 2000).

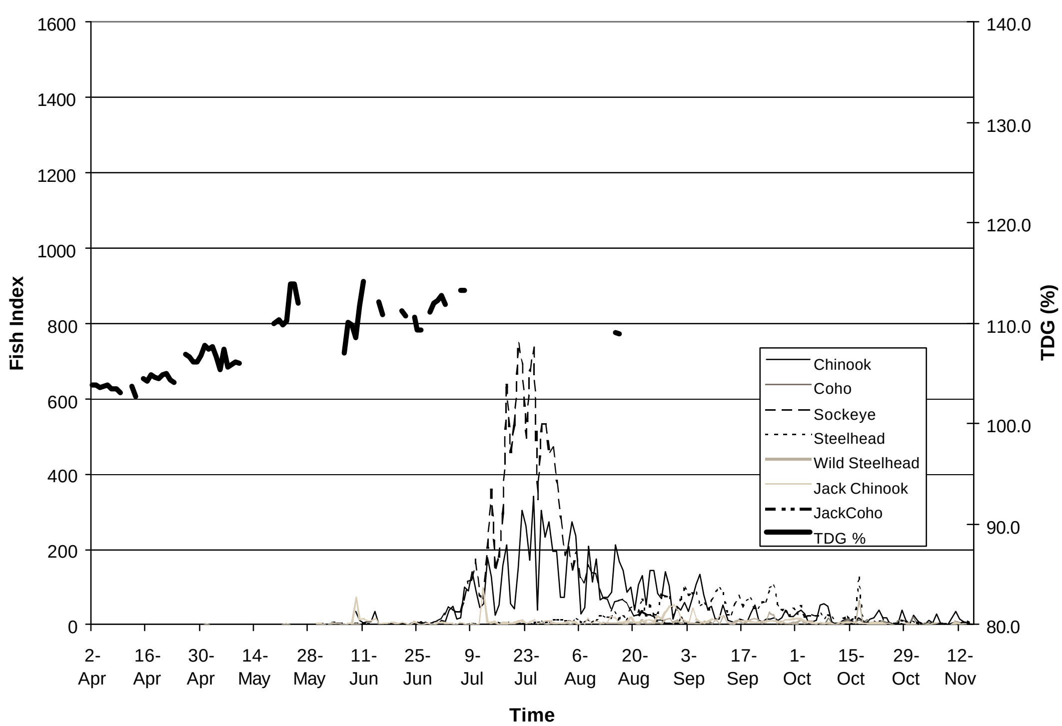


Figure A-4. Adult fish passage at Wells Dam in 1999, with total dissolved gas (Univ. of Washington, 2000).

Table A-3. Birds observed on or near Lake Rufus Woods.

| | |
|---|---|
| Common loon (*Gavia immer*) | Pacific loon (*Gavia arctica*) |
| Red-throated loon (*Gavia stellata*) | Red-necked grebe (*Podiceps grisegena*) |
| Horned grebe (*Podiceps auritus*) | Eared grebe (*Podiceps caspicus*) |
| Western grebe (*Aechmophorus occidentalis*) | Pied-billed grebe (*Podilymbus podiceps*) |
| White pelican (*Pelecanus erythrorhynchos*) | Great blue heron (*Ardea herodias*) |
| Black-crowned night heron (*Nycticorax nycticorax*) | Tundra swan (*Olor columbinus*) |
| Canada goose (*Branta canadensis*) | White-fronted goose (*Anser albifrons*) |
| Snow goose (*Chen hyperborea*) | Mallard (*Anas platyrhynchos*) |
| Gadwall (*Anas strepera*) | Northern pintail (*Anas acuta*) |
| Green-winged teal (*Anas carlinensis*) | Blue-winged teal (*Anas discors*) |
| Cinnamon teal (*Anas cyanoptera*) | American wigeon (*Mareca americana*) |
| Northern shoveler (*Spatula clypeata*) | Redhead (*Aythya americana*) |
| Ring-necked duck (*Aythya collaris*) | Canvasback (*Aythya valisineria*) |
| Greater scaup (*Aythya marila*) | Lesser scaup (*Aythya affinis*) |
| Common goldeneye (*Bucephala clangula*) | Barrow's goldeneye (*Bucephala islandica*) |
| Bufflehead (*Bucephala albeola*) | Surf scoter (*Melanitta perspicillata*) |
| Ruddy duck (*Oxyura jamaicensis*) | Hooded merganser (*Lophodytes cucullatus*) |
| Common merganser (*Mergus merganser*) | Red-breasted merganser (*Mergus serrator*) |
| Turkey vulture (*Cathartes aura*) | Goshawk (*Accipiter gentilis*) |
| Sharp-shinned hawk (*Accipiter striatus*) | Cooper's hawk (*Accipiter cooperii*) |
| Red-tailed hawk (*Buteo jamaicensis*) | Swainson's hawk (*Buteo swainsoni*) |
| Rough-legged hawk (*Buteo lagopus*) | Ferruginous hawk (*Buteo regalis*) |
| Golden eagle (*Aquila chrysaetos*) | Bald eagle (*Haliaeetus leucocephalus*) |
| Northern harrier (*Circus cyaneus*) | Osprey (*Pandion haliaetus*) |
| Peregrine falcon (*Falco peregrinus*) | Prairie falcon (*Falco mexicanus*) |
| Merlin (*Falco columbarius*) | American kestrel (*Falco sparverius*) |
| Blue grouse (*Dendragapus obscurus*) | Ruffed grouse (*Bonasa umbellus*) |
| Sharp-tailed grouse (*Pedioecetes phasianellus*) | Sage grouse (*Centrocercus urophasianus*) |
| California quail (*Lophortyx californicus*) | Ring-necked pheasant (*Phasianus colchicus*) |
| Chukar (*Alectoris graeca*) | Gray partridge (*Perdix perdix*) |
| Sandhill crane (*Grus canadensis*) | Sora (*Porzana carolina*) |
| American coot (*Fulica americana*) | Semipalmated plover (*Charadrius semipalmatus*) |
| Killdeer (*Charadrius vociferus*) | Common snipe (*Capella gallinago*) |
| Long-billed curlew (*Numenius americanus*) | Spotted sandpiper (*Actitis macularia*) |
| Solitary sandpiper (*Tringa solitaria*) | Greater yellow-legs (*Totanus melanoleucus*) |
| Lesser yellow-legs (*Totanus flavipes*) | Pectoral sandpiper (*Erolia melanotos*) |
| Baird's sandpiper (*Erolia bairdii*) | Least sandpiper (*Erolia minutilla*) |
| Western sandpiper (*Ereunetes mauri*) | Sanderling (*Crocethia alba*) |
| Herring gull (*Larus argentatus*) | California gull (*Larus californicus*) |
| Ring-billed gull (*Larus delawarensis*) | Bonaparte's gull (*Larus philadelpia*) |
| Forster's tern (*Sterna forsteri*) | Rock dove (*Columba livia*) |
| Mourning dove (*Zenaidura macroura*) | Barn owl (*Tyto alba*) |
| Great horned owl (*Bubo virginianus*) | Hawk owl (*Surnia ulala*) |
| Burrowing owl (*Speotyto cunicularia*) | Long-eared owl (*Asio otus*) |
| Short-eared owl (*Asio flammeus*) | Saw-whet owl (*Aegolius acadicus*) |
| Poor-will (*Phalaenoptilus nuttallii*) | Common nighthawk (*Chordeiles minor*) |
| Vaux's swift (*Chaetura vauxi*) | White-throated swift (*Aeronautes saxatalis*) |
| Rufous hummingbird (*Selasphorus rufus*) | Calliope hummingbird (*Stellula calliope*) |
| Belted kingfisher (*Megaceryle alcyon*) | Northern flicker (*Colaptes cafer*) |
| Lewis'woodpecker (*Asyndesmus lewis*) | Hairy woodpecker (*Dendrocopos villosus*) |
| Downy woodpecker (*Dendrocopos pubescens*) | Eastern kingbird (*Tyrannus tyrannus*) |
| Western kingbird (*Tyrannus verticalis*) | Say's phoebe (*Sayornis saya*) |
| Willow flycatcher (*Empidonax traillii*) | Dusky flycatcher (*Empidonax wrightii*) |
| Western wood pewee (*Contopus sordidulus*) | Violet-green swallow (*Tachycineta thalassina*) |
| Tree swallow (*Iridoprocne bicolor*) | Bank swallow (*Riparia riparia*) |

| | |
|---|---|
| Rough-winged swallow (*Stelgidopteryx ruficollis*) | Barn swallow (*Hirundo rustica*) |
| Cliff swallow (*Petrochelidon pyrrhonota*) | Steller's jay (*Cyanocitta stelleri*) |
| Black-billed magpie (*Pica pica*) | Common raven (*Corvus corax*) |
| Common crow (*Corvus brachyrhynchos*) | Clark's nutcracker (*Nucifraga columbiana*) |
| Black-capped chickadee (*Parus atricapillus*) | Mountain chickadee (*Parus gambeli*) |
| Red-breasted nuthatch (*Sitta canadensis*) | Brown creeper (*Certhis familiaris*) |
| Dipper (*Cinclus mexicanus*) | House wren (*Troglodytes aedon*) |
| Winter wren (*Troglodytes troglodytes*) | Canyon wren (*Catherpes mexicanus*) |
| Rock wren (*Salpinctes obsoletus*) | Sage thrasher (*Oreoscoptes montanus*) |
| American robin (*Turdus migratorius*) | Varied thrush (*Ixoreus naevius*) |
| Western bluebird (*Sialia mexicana*) | Mountain bluebird (*Sialia currucoides*) |
| Townsend's solitaire (*Myadestes townsendi*) | Golden-crowned kinglet (*Regulus satrapa*) |
| Ruby-crowned kinglet (*Regulus calendula)* | Water pipit (*Anthus spinoletta*) |
| Bohemian waxwing (*Bombycilla garrula*) | Cedar waxwing (*Bombycilla cedrorum*) |
| Northern shrike (*Lanius excubitor*) | Loggerhead shrike (*Lanius ludovicianus*) |
| Starling (*Sturnus vulgaris*) | Solitary vireo (*Vireo solitarius*) |
| Red-eyed vireo (*Vireo olivaceus*) | Warbling vireo (*Vireo gilvus*) |
| Orange-crowned warbler (*Vermivora celata*) | Nashville warbler (*Vermivora ruficapilla*) |
| Yellow warbler (*Dendroica petechia*) | Yellow-rumped warbler (*Dendroica coronata*) |
| Townsend's warbler (*Dendroica townsendii*) | MacGillivray's warbler (*Oporornis tolmiei*) |
| Common yellowthroat (*Geothlypis trichas*) | Yellow-breasted chat (*Icteria virens*) |
| Wilson's warbler (*Wilsonia pusilla*) | House sparrow (*Passer domesticus*) |
| Western meadowlark (*Sturnella neglecta*) | Yellow-headed blackbird (*Xanthocephalus xanthocephalus*) |
| Red-winged blackbird (*Agelaius phoeniceus*) | Northern oriole (*Icterus galbula* ) |
| Brewer's blackbird (*Euphagus cyanocephalus*) | Brown-headed cowbird (*Molothrus ater*) |
| Western tanager (*Piranga ludoviciana*) | Black-headed grosbeak (*Pheucticus melanocephalus*) |
| Lazuli bunting (*Passerina amoena*) | Evening grosbeak (*Hesperiphona verspertina*) |
| Cassin's finch (*Carpodacus cassinii*) | House finch (*Carpodacus mexicanus*) |
| Pine siskin (*Spinus pinus*) | American goldfinch (*Spinus tristis*) |
| Red crossbill (*Loxia curvirostra*) | Rufous-sided towhee (*Pepilo erythrophthalmus*) |
| Savannah sparrow (*Passerculus sandwichensis*) | Grasshopper sparrow (*Ammodramus savannarum*) |
| Vesper sparrow (*Pooecetes gramineus*) | Lark sparrow (*Chondestes grammacus*) |
| Tree sparrow (*Spizella arborea*) | Chipping sparrow (*Spizella passerina*) |
| Brewer's sparrow (*Spizella breweri*) | White-crowned sparrow (*Zonotrichia leucophrys*) |
| Song sparrow (*Melospize melodia*) | Fox sparrow (*Passerella iliaca*) |
| Common redpoll (*Acanthis flammea* ) | Hoary redpoll (*Acanthis hornemanni*) |

Table A-4. Mammals observed on or near Lake Rufus Woods.

| | |
|---|---|
| Big brown bat (*Eptesicus* fuscus) | Western pipistrel (*Pipistrellus hesperus*) |
| White-tailed jackrabbit (*Lepus townsendi*) | Mountain cottontail (*Sylvilagus nuttalli*) |
| Beaver (*Castor canadensis*) | Porcupine (*Erethizon dorsatum*) |
| Least chipmunk (*Eutamias minimus*) | Yellow pine chipmunk (*Eutamias amoenus*) |
| Sagebrush vole (*Lagurus curtatus*) | Yellow-bellied marmot (*Marmota flaviventris*) |
| Striped skunk (*Mephitis mephitis*) | Montane vole (*Microtus montanus*) |
| House mouse (*Mus musculus*) | Bushy-tailed wood rat (*Neotoma cinerea*) |
| Muskrat (*Ondatra zibethica*) | Great Basin pocket mouse (*Perognathus parvus*) |
| Deer mouse (*Peromyscus maniculatus*) | Western harvest mouse (*Reithrodontomys megalotis*) |
| Northern pocket gopher (*Thomomys talpoides*) | Pacific jumping mouse (*Zapus trinotatus*) |
| Coyote (*Canis latrans*) | River otter (*Lutra canadensis*) |
| Bobcat (*Lynx rufus*) | Mink (*Mustela vison*) |
| Raccoon (*Procyon lotor*) | Badger (*Taxidea taxus*) |
| Black bear (*Ursus americanus*) | Elk (*Cervus canadensis*) |
| Mule deer (*Odocoileus hemionus*) | White-tailed deer (*Odocoileus virginianus*) |

Table A-5. Reptiles and amphibians observed on or near Lake Rufus Woods.

| | |
|---|---|
| Western yellow-bellied racer (*Coluber constrictor mormon*) | Western rattlesnake (*Crotalus viridis*) |
| Western skink (*Eumeces skiltonianus*) | Pacific gopher snake (*Pituophis melanoleucus catenifer*) |
| Short-horned lizard (*Phrynosoma douglassi*) | Painted turtle (*Chrysemys picta*) |
| Pacific tree frog (*Hyla regilla*) | |

Table A-6. Fish ESUs and Distinct Population Segments with ESA status in Columbia basin.

| **Species** | **ESU or Distinct Population Segment** | **Status** |
|---|---|---|
| Steelhead | Upper Columbia | Endangered (8/97) |
| | MidColumbia | Threatened (3/99) |
| | Snake | Threatened (8/97) |
| | Lower Columbia | Threatened (3/98) |
| Chinook | Upper Columbia spring | Endangered (3/99) |
| | Snake fall | Threatened (4/92) |
| | Snake River spring/summer | Threatened (4/92) |
| | Lower Columbia | Threatened (3/99) |
| | Snake fall | Proposed threatened (2/98) |
| Chum | Columbia | Threatened (3/99) |
| Sockeye | Snake | Endangered (11/91) |
| Bull trout | Columbia basin | Threatened (6/98) |

APPENDIX B: List of Reviewers

The following is the mailing list for review of this document.

Bob Dach
Endangered Species Coordinator
National Marine Fisheries Service
525 NE Oregon Street, Suite 420
Portland, OR 97232

Robert Hallock, Acting Field Supervisor
US Fish and Wildlife Service
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Steve Sauer
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Sarah McNary
Bonneville Power Administration, KEW
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Yakama Indian Nation
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Environmental Protection Agency
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City of Ione
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City of Kahlotus
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Lincoln County
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Spokane Tribe
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Wellpinit, WA  99040-0100

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U. S. Department of Agriculture
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Leavenworth Ranger District
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Department of Community Development
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APPENDIX C:  Comments received from reviewers of the draft document, and responses to those comments.

**Department of Energy**

Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208-3621

POWER BUSINESS LINE

June 7, 2000

In reply refer to: PGF-6

Ms. Beth Coffey
Department Of The Army
Seattle District, Corps of Engineers
P.O. Box 3755
Seattle, Washington 98124-2255

Dear Ms. Coffey:

Enclosed please find our comments on the Chief Joseph Dam, Gas Abatement Study, General Reevaluation Report, Final Draft report and also the draft Environmental Assessment. These are the hard copy of the e-mails sent to you earlier.

Thank you for allowing us the opportunity to comment on these reports. Please feel free to contact our Water Quality Program Coordinator, Jim Irish, at (503) 230-5914 if you have any questions.

Sincerely,

Roy Fox
Manager, Federal Hydro Projects

Official File – PGF-6

**BPA Staff comments on "Chief Joseph Dam Dissolved Gas Abatement Project, DRAFT Environmental Assessment" of March 2000**

(1) • The report overall reads and is presented well

(2) • The EA is a critical piece in the process which may result in a large expenditure (over $20 million in structural improvements) in the FCRPS where BPA will have to cover 100% of the implementation costs. BPA is therefore very concerned conclusions are based on sound and scientifically based conclusions. If the conclusions are weak they should be described frankly in that light.

(3) • The expenditure of this magnitude is significant and may mean other worthwhile projects in the FCRPS or other public benefits may have to be forgone. To put the CHJ proposal in perspective it's noteworthy the CHJ preferred alternative represents nearly the entire annual budget of BPA's Energy Efficiency and Conservation activities in the Northwest.

(4) • It should be noted that there will be undetermined operational costs in implementing the preferred alternative as well

(5) • The combination of flow deflectors at Chief Joseph (CHJ) with the operational measure of trading generation at Grand Coulee (GCL) for Spill at CHJ is the logical preferred alternative of all those presented in the report when the TDG problem for just GCL and CHJ is evaluated

(6) • Believe the EA Introduction needs a problem statement outlining the severity, magnitude, and incidence of the gas supersaturation problem stemming from Chief Joe, and it's relationship to Grand Coulee TDG production

(7) • Qualifying and quantifying the problem and discussing the Total Dissolved Gas (TDG) production during "average" water years, and also relating them to TDG inflow from GCL and Canada would help put the problem and it's severity into perspective

(8) • There is no cost/benefit analysis of the alternatives or of the preferred alternatives. This may be nearly impossible to describe because the benefits are highly speculative since the science and biology associated with the benefits are in turn sketchy. Clearly describing the cost/benefit challenge and dilemma is worthwhile noting because baseline costs are clearly known but the benefits are not.

(9) • On page 7 the description of the FCRPS should read 29 (not 14) currently producing Federally owned hydroelectric projects in the Northwest

(10) • A expanded discussion of how 7Q10 is calculated by the State of Washington and how it dramatically affects flow deflector design is warranted

(11) • A expanded discussion of the risks and impacts of placing flow deflectors at the wrong permanent (or semi-permanent) elevation is worthwhile because some existing flow deflectors in the FCRPS are apparently sub-optimally placed because of altered river operations and other factors

(12) • It should also be noted that river operations over time may change significantly and it will affect the performance and impacts of CHJ flow deflectors

(13) • The preferred alternative can really only be evaluated thoroughly and completely after comparing it against all of the other gas abatement alternatives in the Columbia River system, not against just the alternatives at CHJ and or GCL, since they will represent only one part of the system

(14) - The optimal evaluation and therefore effectiveness of the preferred alternative also depends significantly on the water levels in the tailrace, and we believe there are questions and concerns over the permanency and predictability of tailrace levels
(15) - The EA does not state if the TDG objective for the installation of flow deflectors should be 110% or 120% (or another figure) for biological reasons, and it doesn't indicate if there is a different optimal elevation and configuration for flow deflectors if the objective is either 110% or 120% or something different
(16) - Table 5.6.1.1-1 is useful, it would also be useful to show similar tables for more representative water years and conditions, not just the high water year of 1997 to help put the TDG problem in perspective
(17) - The Water Quality parameters of TDG, Temperature and Nutrients are discussed but should other parameters like sediments, turbidity, aquatic nuisance plant and animal species also be discussed and considered?
(18) - Under 8.0 "Conclusions" the second to last bullet weakly indicates the preferred (combination) alternative may have some benefit but then more strongly says there's probably no adverse affect. This doesn't seem like a compelling argument to implement the preferred alternative.
(19) - The last bullet under "Conclusions" is not clear

(20) The BPA staff appreciates the work the Corps has invested in this document and the complexity of the problems the EA addresses. It's unfortunate that there's not clear, compelling, and overwhelming environmental benefits associated with the installation of CHJ flow deflectors and that they're not clearly the next best systemwide water quality improvement that can be implemented.

Ji/tf:a:5/16/00

CENWS-PM-PL-ER

Responses to Comments on Chief Joseph Dam Dissolved Gas Abatement Project Draft Environmental Assessment, March 2000

Commenter: Philip Thor, Bonneville Power Administration

| **Comment** | **Response** |
|---|---|
| 1 | Thank you. |
| 2 | We agree. We feel that the conclusions are sound regarding the cost-effectiveness of the alternatives and their applicability to the requirements of the 1998 Biological Opinion. It is not possible to quantify benefits to fish, however, so we must base our conclusions on the ability of the alternative measures to achieve improvements in the dissolved gas situation and judge benefits on that. |
| 3 | Comment noted. However, on an annual basis it is not equivalent to all or even a majority of the amount expended on fish passage measures in the Columbia system, and is not expected to result in operational expenses other than normal maintenance. |
| 4 | Comment noted. |
| 5 | Comment noted. Other system requirements are being addressed through other avenues. |
| 6 | Sec. 1.0 (Purpose and Need) has been modified to provide this information. Please also see Section 4.5.3. |
| 7 | Sec. 1.0 (Purpose and Need) has been modified to provide this information. Please also see Section 4.5.3. |
| 8 | It is not possible to derive quantified biological benefits for this project, given the several factors affecting fish survival for dissolved gas. Although the cost-benefit analysis is normally a function of the planning document (in this case, the General Reevaluation Report), some wording has been added to the EA in Sec. 5.0 (as well as to the GRR) that briefly describes the situation. |
| 9 | Comment noted—change made in text. |
| 10 | Requested information added to Section 4.5.3. |
| 11 | We do not have information on this topic. We have not seen results of the ongoing study that is examining whether there are impacts of this. We believe that the jury is still out on this issue. Flow deflectors at Chief Joseph will be |

placed to best reduce TDG at flows less than the 7-day, 10-year flow of 241 kcfs. They will also have benefits at higher flows.

12 As with all structures designed to function according to a set of specifications, operating conditions could change. However, Chief Joseph Dam's flow deflectors would benefit from greater design experience than in the lower river. We have seen no indication of major changes, such as increased power load at the non-peak times when Chief Joseph and Grand Coulee spill. Short of increased storage above Chief Joseph, and given that no one is building large storage dams anymore, it's unlikely that spring flows will statistically go down.

13 It is true that Chief Joseph and Grand Coulee Dams represent only one part of the FCRPS—the US portion of upper Columbia River. Conversely, however, they are the only two federal projects that can be used to reduce dissolved gas levels in that part of the river, and have been specifically called out in the 1998 Biological Opinion for action to reduce dissolved gas levels. Other actions are being taken elsewhere in the system to reduce overall system dissolved gas levels, but this project is felt necessary because of its unique situation and its specific reference in the 1998 Biological Opinion.

14 This is a "chicken and egg" question. With flow deflectors in place, we would be unlikely to make or allow tailrace changes, such as the previous 2-foot increase in Wells Dam's pool. In any case, this previous change would be within the operating specifications of the current design.

15 Language has been added to Sec. 1.0 to clarify.

16 Language from Sec. 2.4: "While the analysis in this EA and the General Reevaluation Report (USACE, 2000) focus on 1997, the same trend in reduced TDG levels would be seen in an analysis focusing on the other large spill years. Even though 1997 represents a large flow year, most of the hourly flows passing Chief Joseph and Grand Coulee dams during the spill season were well within the 7-day, 10-year flow of 241 kcfs to which the Colville Confederated Tribes, the State of Washington, and the Environmental Protection Agency would apply their water quality standards for TDG. Hence, many of the hourly flows in the 1997 spill season can be considered "average," yet the TDG level of 110% was exceeded."

17 We have added information concerning sediment, turbidity, and aquatic plants; we are unaware of any aquatic nuisance animals in the project area. We anticipate no effect on sediment, turbidity or aquatic plants from any alternative.

18 The overall document includes the Biological Assessments for project effects on anadromous and resident fish species listed under the Endangered Species Act (ESA). The second to last bullet under Conclusions addresses ESA in particular,

and uses terminology with specific meaning in the Biological Assessment process.

19 The last bullet under Conclusions is worded using terminology particular to the National Environmental Policy Act (NEPA), which is the basis for the Environmental Assessment. It states the conclusion that will form the basis for a Finding of No Significant Impact under NEPA—in other words, this is not a significant action as defined under NEPA, and does not require an Environmental Impact Statement.

20 We believe the preferred alternative has been shown to be the best, most cost-effective alternative for Chief Joseph and Grand Coulee Dams. Other actions being addressed elsewhere have been discussed among the alternatives considered but rejected. Again, these two dams are the only federal projects that can benefit dissolved gas in the upper and midColumbia River in the US.

THE CONFEDERATED TRIBES
of
THE COLVILLE RESERVATION
POST OFFICE BOX 150-NESPELEM WASHINGTON 99155 PHONE (509) 634-4711

May 17, 2000

rec'd 5/25/00 in PM-PL-ER -JCL

Colonel Mike Rigsby
P. O. Box 3755
Seattle District, USACE
Seattle, WA 98124

RE: Chief Joseph Dam Dissolved Gas Abatement Project, DEA

Dear Col. Rigsby:

Following are comments submitted by the Confederated Tribes of the Colville Indian Reservation on the Chief Joseph Dam Dissolved Gas Abatement DEA.

General Comments:

(1) Chief Joseph Dam continues to exceed the 110% total dissolved gas standard resulting from spill at the project in most years. This condition results in continuous exposure to high levels of dissolved gas for both resident fish below Chief Joseph Dam and anadromous fish in the Mid-Columbia River reach. Since juvenile anadromous fish bypass at the five Mid-Columbia Hydro-Projects relies heavily on spill as the most effective bypass measure, and since these projects are constrained from spilling above the gas cap even if they fall short of meeting their spill requirements for juvenile passage, it is therefore imperative that total dissolved gas levels entering the Mid-Columbia reach be as low as possible. Without effective juvenile fish passage through spill, passage through other routes such as turbine passage will lead to increased juvenile fish mortality.

(2) The CCT agree with the District to proceed ASAP with the installation of flow deflectors at Chief Joseph Dam. We also support alternatives in the DEA that address the integration of gas abatement at both Chief Joseph and Grand Coulee Dams. During good water years, it might not be enough to only have gas abatement at Chief Joseph Dam, especially if Grand Coulee is gassing the forebay of Chief Joseph to high levels such as were experienced in 1996, i.e. 130% or higher.

(3) Finally, we will support alternatives that do not further increased fish entrainment at Grand Coulee Dam or our ability to pursue effective reintroduction of anadromous fish above Chief Joseph or Grand Coulee Dams.

Specific Comments:

(4) 2.4 State Standards/NMFS Criteria

In addition to State Water Quality Standards, Colville Tribal Water Quality Standards for Total Dissolved Gas of 110% apply to waters of the Colville Indian Reservation. The Federal Clean Water Act, 40 CFR 131 also applies to this project.

(5) 2.7 Water Quality Litigation

In a recent ruling in *National Wildlife Federation et al. v. Army Corps of Engineers* it was ruled that the Corps must comply with the Clean Water Act. We believe this recent litigation should require the Corps add a systemwide alternative to their analysis.

(6) 3.2.1 Spillway Flow Defectors

The Tribe supports this alternative and recommends an expedited schedule to complete flow deflector installation as soon as possible. We recommend that any additional modeling be completed this year and a prototype deflector be ready for testing in 2001. Once the prototype testing has successfully met the criteria, installation should be initiated and completed in time for the 2003 spring migration season.

(7) 3.2.3 Degas at Brewster Flats

CCT does not support this alternative. While this alternative may have some merit, it would allow elevated gas to be present in the river reach between the Chief Joseph Dam tailrace and Brewster Flats. The confluence of the Okanogan River is located in this reach; therefore all anadromous fish migration in the Okanogan River would be subject to elevated gas levels. Additionally, fall Chinook spawning which occurs in this reach would be subject to elevated gas conditions. Tribal fishery resources at Chief Joseph Dam could be negatively impacted.

(8) 3.4.2 Swap Power for Spill with Downstream Dams

The Tribe does not support this alternative as a long-term gas abatement measure because it discounts future anadromous fish production above Chief Joseph Dam. It could be

(8) considered as an interim measure in the next few years until other more permanent gas abatement measures are in place. This would have to be closely coordinated with the CCT.

3.4.3 Raise Control Flows at the Dalles

(9) The Tribe is very supportive of this alternative. As you state in your document, "Raising the control flow at the Dalles by only 10,000 cfs would translate to 1,000,000 acre-feet (1 MAF) less water that need be drafted from Grand Coulee Dam in the spring". Less flood control draft at Grand Coulee would limit the need to prematurely spill at the dam, and when spill is required, the reservoir elevation may be high enough (1260') to use the drum gates which don't appear to raise gas levels to the extent that spilling through the outlet works does. Although this alternative was not recommended for further study because it was considered outside the scope of this study, the Tribe strongly supports the need for a new system flood control study to be conducted by the Corps as soon as possible.

3.4.4 Modify Operations at Grand Coulee Dam

(10) The Tribe again would be very supportive of this operational alternative for reasons stated above. We realize this alternative would require a new system flood control study and strongly support the need to initiate this new study immediately. This alternative will also serve to help reduce fish and nutrient entrainment from Lake Roosevelt, which would benefit the resident fish resources in the reservoir.

3.5.1 Flow Deflectors and Grand Coulee Operational Modification

(11) The Tribe supports this alternative, but are not clear on the specifics of the operational modifications that would be required. For example, when power shifts occur at Grand Coulee, how will that power be generated at Grand Coulee? Fish entrainment data suggest most of the entrainment occurs through the Third Powerhouse. Would we expect to see all increased power generation to occur there or will it be evenly generated at all three powerhouses? This is an important issue for the tribal resident fish resources and needs further clarification.

Thank you for the opportunity to comment on the Chief Joseph Dam Dissolved Gas DEA and the assistance of Marion Valentine who briefed tribal staff on this document. Please contact me if you have any questions concerning these comments at 509-634-2426.

Sincerely,

Gary Passmore, Director
Office of Environmental Trust

Cc: Gene Nicholson, CCT
Business Council, CCT
Joe Peone, CCT
Jeffery Laufle, ~~Corps~~
Marian Valentine, Corps
Chris Maynard, DOE

CENWS-PM-PL-ER

Responses to Comments on Chief Joseph Dam Dissolved Gas Abatement Project Draft Environmental Assessment, March 2000

Commenter: Gary Passmore, Colville Confederated Tribes

| **Comment** | **Response** |
|---|---|
| 1 | Comment noted. |
| 2 | Comment noted—thank you. |
| 3 | Comment noted. We believe that options for fish passage remain open for future consideration with the preferred alternative. |
| 4 | Text has been added to further delineate water quality standards. We will also coordinate with the CCT to meet any further requirements under Tribal water quality jurisdiction for this project. |
| 5 | Actually, no ruling has been made as of this time in NWF et al. v. Army Corps of Engineers. The judge denied all summary judgment motions, and provided a time period during which the administrative record will be submitted and made available to the parties in the lawsuit, after which motions for summary judgment may be filed. The Corps is pursuing options on a systemwide basis, but the 1998 supplemental Biological Opinion for salmon and steelhead has required us to address dissolved gas issues for Chief Joseph and Grand Coulee dams (see Sec. 1.0 of the EA). These are the only two FCRPS projects that are capable of addressing dissolved gas in the upper and mid Columbia River, and we believe our analysis has arrived at the most cost-effective way to do that. |
| 6 | We hope to get approval and funding soon, but will probably not complete construction by the 2003 migration season. Our earlier schedule would not have allowed completion before the end of 2003, and it is possible we will be delayed one year beyond that because of a potential delay in funding for detailed design. The Corps is moving as fast as possible with the schedule. Physical model studies are normally part of the detailed "plans and specifications" design phase, but were front-loaded in this study to determine constructability of flow deflectors on a high-head dam. Our schedule is being driven by regional desire to implement flow deflectors as soon as possible. We are limited by the federal budget process over which the Corps has no control. If the General Reevaluation Report (USACE, 2000) is approved in summer 2000, the soonest it is likely to be funded through the normal budget process is FY 2002 for the "plans and specs" phase. Construction would start in FY 2003 with completion in FY 2004. If regional interests desire a start of one year earlier, a Congressional add would be needed to begin "plans and specs" in 2001. |

7 Language has been added to Sec. 3.2.3 reflecting your concerns about fall chinook and Okanogan River spawners.

8 Comment noted. Trading power for spill with downstream dams is considered outside the scope for this project because the downstream projects are nonfederal. However, on a systemwide basis, the spill prioritization process will account for project dissolved gas effects in any case, and spill at those projects will be adjusted accordingly.

9 Comment noted. Raising control flows at The Dalles may be useful for reducing draft at Grand Coulee and spill at both projects. While we examined a broad range of alternatives in the Initial Appraisal Report (USACE, 1998b) on Chief Joseph Gas Abatement, it has been determined that this is outside the scope of this study. There is considerable controversy in the region about the statements made in the IAR and the first draft of the EA. This alternative has been rejected for that reason.

10 Modification of Grand Coulee operation has been adapted as part of the combination (preferred) alternative.

11 This is difficult to predict based on our current knowledge, but some clarifying language has been added to Sec. 5.8.

**COLUMBIA RIVER INTER-TRIBAL FISH COMMISSION**
729 N.E. Oregon, Suite 200, Portland, Oregon 97232
Telephone (503) 238-0667
Fax (503) 235-4228

May 8, 2000 rec'd 5/15/2000

THIS DOCUMENT FAXED

Mark T. Ziminske
Chief, Environmental Resources Section
Seattle District
Corps of Engineers
P.O. Box 3755
Seattle, Washington 98124-2255

**RE: Comments on Draft EA for Chief Joseph Dam Gas Abatement**

Dear Mr. Ziminske:

The Columbia River Inter-Tribal Fish Commission (CRITFC) appreciates the opportunity to review and comment on the Seattle District's document entitled "Chief Joseph Dissolved Gas Abatement Project, Draft Environmental Assessment, March, 2000"(DEA). CRITFC commends the Seattle District for developing and recommending a dissolved gas abatement strategy that includes a combined operational and structural perspective as a preferred alternative. We offer the following general and specific comments on the DEA.

General Comments

(1) High levels of spill from Chief Joseph and Grand Coulee can exceed the 110% total dissolved gas standard for considerable periods of time. This situation causes anadromous fish in the Mid-Columbia reach continuous exposure to nitrogen saturation as high dissolved gas levels from these projects can cause a large portion of the reach to exceed water quality standards. Additionally, high levels of dissolved gas from these projects can severely limit spill at the Mid-Columbia FERC dams, because high incoming gas levels restrict spill that is necessary for salmon passage over these dams. This results in juvenile and adult salmon being forced through turbines where they experience 5-10 times the mortality of that through spill passage (Whitney et al. 1997). The final EA should include this impact from spill at Chief Joseph and Grand Coulee.

(2) CRITFC believes that DEA alternatives that abate dissolved gas production at both Chief Joseph and Grand Coulee have the most merit. We concur with the District's assessment to proceed immediately with installation of flow deflectors at Chief Joseph. This alternative offers benefits for the short term and should be carried forward to completion. Further, we believe that this is good first step in bringing the project into compliance with the Clean Water Act standard of 110% total gas pressure. Additionally, we recommend

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(3) that the Corps begin a survey of flood control which would 1) allow regulation of mainstem flows to at least 450 kcfs as measured at The Dalles and 2) allow for potential temperature control through the use of additional Grand Coulee storage. Finally, we
(4) support alternatives that do not preclude the efforts of the Colville Confederated Tribes and other tribes to seek reintroduction and restoration of anadromous fish populations above Chief Joseph and Grand Coulee.

Specific Comments

(5) 2.4 State dissolved gas standards and NMFS criteria for salmon protection.

Regional reports and risk assessments indicate that in-river exposure to dissolved gas up to 125% of saturation poses little risk to salmon if they can compensate by seeking depth in the water column (Tribes and Fishery Agencies 1995; Backman et al. 1999). Using a cubic polynomial regression model, Backman et al. (1999) found little elevation in gas bubble trauma symptoms in juvenile salmon exposed to 125% total gas pressure. This information should be included in the final EA.

(6) 2.6 Columbia Basin System Operational Review

Subsequent to the SOR, the need for gas abatement at Chief Joseph and Grand Coulee was identified by the Corps, NMFS, USFWS, state fishery agencies and tribes in the Three Sovereigns Process. The recommendations were issued in a *Future Fish and Wildlife Costs* report and distributed to regional decision makers (Three Sovereigns Senior staffs 1998). This information should be included in the final EA.

(7) 2.7 Litigation regarding system water quality

Judge Helen Frye recently ruled that the Corps must comply with the Clean Water Act in *National Wildlife Federation et al. v. Army Corps of Engineers* (District Court of Oregon). This ruling should appear in the final EA.

(8) 3.2.2 Side Channel Canal

Given that the Walla Walla District is exploring a side channel as a means to abate dissolved gas, CRITFC recommends that the side channel option be expanded to explore adult and juvenile passage past the dam. This modification could then be compatible with a potential strategy to restore anadromous salmonids above Chief Joseph Dam. Currently the District has entered into a study with the upper Basin tribes to study adult and juvenile passage around Chief Joseph. CRITFC believes that a side channel option might be able to provide an access for adults and juveniles if it was designed properly perhaps with a high head adult ladder system.

(9) 3.2.3 Degas at Brewster Flats

Although this alternative could be effective for gas abatement, we are concerned that elevated gas would be present in areas of known spawning for fall chinook in the Chief Joseph tailrace. Further, adult passage over Chief Joseph could be hampered under this alternative. We do not support this alternative.

(10) 3.2.4 Raised Tailrace and 3.2.5 Raised Stilling Basin

CRITFC recommends that these alternatives be left for future consideration. They may be required to be implemented if Chief Joseph and Grand Coulee are to meet the Clean Water Act standard of 110% total gas pressure. They were identified in the Three Sovereigns Report.

(11) 3.3.2 Increase Reservoir Operating Level Fluctuations

We concur that the impacts of this alternative would be detrimental and do not support further investigation.

(12) 3.4.1 Spill During Maximum Power Generation-Fluctuating flows

This operation would exacerbate power peaking and fishery impacts such as stranding Hanford fall chinook and we do not support this alternative.

(13) 3.4.2 Swap Power for Spill with Downstream Dams

This operation appears at odds with eventual restoration of anadromous fish above Chief Joseph. However, over the short term it could provide additional spill at downstream dams critical for salmon survival while reducing dissolved gas influx into the river. We support immediate implementation of this alternative as flood control, fish passage at Chief Joseph and other operational alternative are being studied and until they are implemented.

(14) 3.4.3 Raise Flood Control Flows at The Dalles

CRITFC strongly supports this operational alternative. In the Corps Variable Q report (Corps 1997), this alternative demonstrated both anadromous and resident fish benefits by providing increased critical habitat for production. This alternative should be included in the preferred alternative.

(15) 3.4.4 Modify Operation of Grand Coulee Dam

CRITFC strongly supports this operational alternative. Temperature standards in the mainstem Columbia River are routinely exceeded. This alternative would result in 1) higher spring freshet flows at The Dalles, 2) reduction of dissolved gas from Grand Coulee and 3) temperature control and reduction through a significant portion of the Mid-

(15) Columbia reach. We concur that this alternative should be included in the preferred alternative.

(16) 3.6.1 No Action

Under this alternative, dissolved gas production will continue to violate water quality standards and salmon will be directly and indirectly impacted. We do not support this alternative.

(17) 3.6.2 Deflectors

CRITFC recommends that the Corps complete modeling studies in 2000 and expedite the flow deflector schedule for full installation by 2002. A prototype deflector should be ready for testing in 2001 if the modeling work can be completed this year. If the tests are positive, we propose a two-year installation program. After a successful prototype test, the Corps should begin construction of additional deflectors in 2001 and complete the installation in 2002.

We understand that the physical geometry of Chief Joseph Dam makes deflector installation more difficult than at other Corps dams. However, deflector installation will greatly help control dissolved gas levels in the Mid-Columbia. Elevated levels of dissolved gas from Coulee and Chief Joseph into the Mid-Columbia reduces fish passage spills at the PUD dams. Lack of adequate fish spill at the PUD dams increases juvenile and adult salmon passage thorough turbines. In turn, this undermines the combined efforts of tribal, federal, state and public utility entities to restore salmon and other anadromous fish impacted by the FERC-licensed dams.

Summary

(18) CRITFC supports the District's preferred alternative, immediate installation of deflectors at Chief Joseph combined with operational changes at Grand Coulee to abate dissolved gas. We urge the Corps to include the following operations in the preferred alternative and to work with FERC licensed operators, Reclamation and BPA to:

(19)
- institute immediate power swapping and spill at Chief Joseph and Grand Coulee with lower river dams that pass anadromous fish. The District should implement this operation in conjunction with input from the region's tribes and fishery agencies this year.

(20)
- expeditiously embark upon flood control studies to allow 1) more flexibility in storage at Chief Joseph and Grand Coulee, 2) allow for temperature control from Grand Coulee and
  3) allow for a higher peak in flows for anadromous fish at The Dalles.

21 Further, we recommend that the District being exploration of other structural alternatives such as raised stilling basin, side channel spillways and raised tailraces as the ultimate solutions to reduce total dissolved gas created by Chief Joseph and Grand Coulee.

CRITFC appreciates the opportunity to comment on the DEA. Should you have questions about these comments please contact Tom Lorz at (503) 238-3574.

Sincerely,

Robert Heinith
Hydro Program Coordinator

Cc: Tribal Program managers, FPAC, EPA, state water quality agencies, CCT, Spokane Tribes

References


Backman, T.W.H., A.F. Evans, ane M.S. Robertson. 1999. Symptoms of gas bubble trauma induced in salmon *(Onchorhynchus spp.)* by total dissolved gas supersaturation of the Snake and Columbia Rivers, USA. Project No. 93-008-02 to Bonneville Power Administration. By Columbia River Inter-Tribal Fish Commission. Portland, Oregon.

Corps of Engineers. 1997. Columbia River Basin system flood control review. Preliminary Analysis Report. North Pacific Division. Portland, Oregon.

Three Sovereigns Senior Staff. 1998. *Future Fish and Wildlife Costs.* Report developed by the senior staff of the Three Sovereigns. United States Fish and Wildlife Service. Portland, Oregon.

Tribes and Fishery Agencies. 1995. *1995 Spill and Risk Assessment.* Fish Passage Center. Portland, Oregon.

Whitney, R.R., L.D. Calvin, M.W.Erho and C.C. Coutant. 1997. Downstream passage for salmon at hydroelectric projects in the Columbia River Basin: development, installation and evaluation. Report 97-15. Northwest Power Planning Council. Portland, Oregon.

Responses to Comments on Chief Joseph Dam Dissolved Gas Abatement Project Draft Environmental Assessment, March 2000

Commenter: Robert Heinith, Columbia River Intertribal Fish Commission

| **Comment** | **Response** |
|---|---|
| 1 | We agree that gas saturation levels from Grand Coulee and Chief Joseph dams may exceed 110% and potentially impact anadromous fish in the midColumbia River. We have added text to reflect additional mortality of fish in midColumbia utility project turbines as a result of spill at Chief Joseph and Grand Coulee dams. |
| 2 | Comment noted. |
| 3 | Comment noted. This would not be undertaken by Seattle District and is far outside of the scope of this study. However, we will share the comment with Northwest Division. The 1998 Biological Opinion for salmon and steelhead tasked us with focusing on Grand Coulee and Chief Joseph. While we considered many alternatives in our Initial Appraisal Report (USACE 1998b), we were refocused on the two dams that we can affect. |
| 4 | Comment noted. We feel the alternatives carried forward for detailed study reflect that goal. |
| 5 | We have incorporated the information you cite from studies by Backman et al., but because of the several factors influencing risk of GBD, we would hesitate to accept 125% as an upper limit for our operations; we intend to keep it as low as possible. |
| 6 | We have added your information concerning the Three Sovereigns report. |
| 7 | Actually, no ruling has been made as of this time in NWF et al. v. Army Corps of Engineers. The judge denied all summary judgment motions, and provided a time period during which the administrative record will be submitted and made available to the parties in the lawsuit, after which motions for summary judgment may be filed. |
| 8 | While the Corps explores fish passage with the Colville Confederated Tribes, it must meet the dissolved gas abatement obligation in the NMFS 1998 supplemental Biological Opinion. We do not believe that a side channel canal can serve both needs at once, but rather that it is prudent to pursue fish passage separately, given the high volumes of flow necessary for gas abatement. Ultimately, if some form of side channel is preferred for fish passage, it will remain an option not foreclosed in the gas abatement effort. Language in the EA has been modified to clarify our position. |

9 Comment noted—we are not pursuing degassing at Brewster Flats. We have noted your concerns in the EA, by adding language to Sec. 3.2.3.

10 At this point in time, regional coordination and our study have led to the preferred alternative in the EA and General Reevaluation Report (USACE, 2000). Construction of flow deflectors does not preclude further efforts aimed at meeting the Clean Water Act standard of 110% TDG through other structural means such as a raised tailrace or raised stilling basin.

11 Comment noted.

12 Comment noted. This is the primary reason for rejection of this alternative.

13 Operational changes involving nonfederal dams in the midColumbia is outside the scope of this study, but a modification of this alternative has been made which incorporates a spill-for-power swap with Grand Coulee Dam—the preferred alternative. Sec. 3.4.2 has been further clarified.

14 Raising control flows at The Dalles is being considered by the Northwest Division office of the Corps in a new flood control study in response to the 1995 and 1998 Biological Opinions for salmon and steelhead, and is not within the scope of this study. Sec. 3.4.3 has been clarified.

15 Comment noted.

16 Comment noted.

17 The Corps is moving as fast as possible with the schedule. Physical model studies are normally part of the detailed "plans and specifications" design phase, but were front-loaded in this study to determine constructability of flow deflectors on a high-head dam. Our schedule is being driven by regional desire to implement flow deflectors as soon as possible. We are limited by the federal budget process over which the Corps has no control. If the General Reevaluation Report (USACE, 2000) is approved in summer 2000, the soonest it is likely to be funded through the normal budget process is FY 2002 for the "plans and specs" phase. Construction would start in FY 2003 with completion in FY 2004. If regional interests desire a start of one year earlier, a Congressional add would be needed to begin "plans and specs" in 2001. We also expect that installation of flow deflectors, along with the operational alternative, would allow greater fish spill at the PUD dams.

18 Our current schedule for implementation of the preferred alternative is to have the deflectors installed at Chief Joseph Dam by late 2004 or early 2005. We must complete detailed design and secure funding before construction can begin.

19 The District will discuss the results of this study with the Reservoir Control Center at the North Pacific Region office in Portland. The RCC is responsible for setting spill priority in the region.

20 System flood control in the Columbia River was determined to be far outside of the scope of this study. The 1998 Biological Opinion for salmon and steelhead tasked us with focusing on Grand Coulee and Chief Joseph. While we considered many alternatives in our Initial Appraisal Report (USACE, 1998b), we were refocused on the two dams that we can affect. To describe operation of Columbia River flood control would be an enormous effort that is also far outside of the scope of this study.

21 Comment noted. There are some structural alternatives that have a greater likelihood of reaching 110% but were not as cost-effective as the preferred alternative, and were therefore rejected for purposes of this project. They can be explored in a later study. However, the goal of this study was to identify means for reducing TDG contributions from Chief Joseph Dam to the extent economically, technically, and biologically feasible.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, WA 98101

MAY 12 2000

Reply To
Attn Of: ECO-088

rcd 5/16/2000

Mr. Jeff Laufle
U.S. Army Corps of Engineers, Seattle District
P.O. Box 3755
Seattle, Washington 98124

Dear Mr. Laufle:

We have reviewed the draft Environmental Assessment (EA) prepared for the Chief Joseph Dam Dissolved Gas Abatement Project, pursuant to our responsibilities under the Clean Water Act, the National Environmental Policy Act, and Section 309 of the Clean Air Act.

The project described and evaluated in the EA would move a long way toward compliance with water quality standards by constructing deflectors at Chief Joseph Dam and transferring power production to Grand Coulee Dam. The changes at Chief Joseph Dam are designed to allow excess water to be spilled to substantially reducing the entrainment of total dissolved gas. At the same time, power production would be transferred to Grand Coulee Dam to take advantage of its large power generation capacity and eliminate spill there. Both components of the project should result in improved water quality in the mid-Columbia.

(1) We support these efforts as they move Grand Coulee Dam and Chief Joseph Dam closer to meeting water quality standards within the main stem of the Columbia. However, information in the EA suggests that the proposed project would not, by itself, result in compliance with water quality standards (WQS) and that additional efforts will be necessary to meet the total dissolved gas levels set forth in the WQS of both the State of Washington and the Colville Confederated Tribes. The EA identifies a number of projects that are not being pursued at this time, but appear to be efforts that would potentially lead to even lower gas level when combined with the proposed project. Alternatives 11, 12, 13 and 14 appear to have some real strengths in working toward achievement of WQS. These projects also would help in ameliorating existing temperature and fish passage problems on the mid-Columbia. We strongly urge the Corps of Engineers to pursue these efforts (as well as other alternatives necessary to meet WQS) and recommend that the decision document for this proposed project reflect a firm commitment to do so. Such a commitment would support the issuance of a Finding of No Significant Impact since the proposed project, as a stand alone project, would not result in compliance with WQS.

The enclosed detailed comments are provided in the interests of strengthening and clarifying information/discussions in the EA so that the final version provides the public with a more complete understanding of the relevant information and analyses related to the decision to implement the project.

We support your continuing efforts to meet water quality standards. Should you require any additional information, please call me at (206) 553-8574 or contact Chuck Rice of my staff at (509) 353-2700.

Thank you for the opportunity to comment on the draft EA.

Sincerely

Richard B Parkin

Richard B. Parkin, Manager
Geographic Implementation Unit

cc:

Enclosure

Comments on Chief Joseph Dam Dissolved Gas Abatement Project - Draft Environmental Assessment - March 2000, prepared by the U.S. Army Corps of Engineers (COE).

→ Page 7. Paragraph 1. discusses the downstream limits of benefits due to TDG abatement
(2) measures taken at the project complex. "Effects are not expected below Priest Rapids (river mile 397)." The basis for this statement should be explained to help establish the rationale for overall review of the document. In addition, the recent COE modeling effort done for TDG
(3) production at Grand Coulee Dam (GCD) and Chief Joseph Dam (CJD) (as well as others) and results from that effort should be referenced in this paragraph and presented in greater detail later
(4) in the document (e.g., on page 15). The relationships among gas abatement measures planned or underway downstream should be incorporated into the EA to address "system-wide evaluation."

→ Pages 8 and 10. The hydraulic capacity of the CJD powerhouse is listed as about 40 kcfs less than that of GCD. The EA is not clear whether alternatives evaluated used this difference in capacity as a baseline condition (i.e., how is this lower hydraulic capacity used in determining operational options and in conducting modeling). Since CJD is a run-of-the-river dam, this should be clarified and the power generation relationship between CJD and GCD explained in greater detail in order that the alternatives can be better understood.

(5) For example, if both GCD and CJD are operated at maximum hydraulic capacity at a flow of 260 kcfs (the maximum for the GCD powerhouse) then it appears that CJD would be required to spill inflow equal to the amount exceeding its powerhouse hydraulic capacity, about 40 kcfs. Given these flow and operational conditions, and after installation of deflectors at CJD, the generation of TDG would not be expected to exceed from about 113% to117% (per graph on page 39 and depending on forebay concentration). Operational scenarios, need to be included and explained.

(6) Also, the EA states that the WA state Water Quality Standard (WQS) for TDG is 110% for flows of up to 241 kcfs. The graph on page 39 suggests that, under the same operational and structural conditions noted in the previous paragraph, at a flow of 241 kcfs, CJD would spill about 20 kcfs and the TDG levels would be expected to be between about 107% and 112% (depending on inflow TDG concentration). Evaluation of options such as this would assist in evaluating attaining compliance.

(7) → Page 11. Figure 2.1.2-1 The flood control rule curve for drafting at GCD is presented in graph form. This graph should be more thoroughly explained. Understanding this curve is important to understanding operational requirements and practices at GCD. Further, this curve appears to be a baseline condition assumed in the alternatives evaluated in the EA. To understand the alternatives described in the EA the reviewer should understand Figure 2.1.2-1.
(8) In addition, promising alternatives are rejected in the EA primarily because this rule curve (and for other dams in the system) would need to be revised. To understand the basis of these rejections, this rule curve and its relationship to Columbia drainage flood control, flow augmentation, and operation of other flood control projects should be described. This would

flood control targets (i.e., river levels), locations, and the specific basis for those targets.

(9) → On Pages 10, 11, and elsewhere, the EA discusses flow augmentation required under the 1995 Salmon Biological Opinion (BiOp). These drafting conditions should be described. Operational alternatives under consideration in the EA should be placed in framework complete with constraints and requirements. One of these requirements is the drafting at GCD over the course of the entire year in the context of system operations. Since drafting may cause exceedence of the 110% WQS for TDG, the basis for drafting should be understood by the reviewer of the EA in order to understand the document and alternatives.

(10) → Page 12. Paragraph 3. states, "The greatest water quality concern related to..." CJD and GCD is TDG. This statement should be expanded to include the issue of temperature, whether temperature was considered when developing alternatives, and whether the alternatives (including the preferred alternative) would have a positive, negative, or no effect on Columbia river temperatures downstream of GCD and CJD. (As noted below, at least one alternative implies that summer water temperatures could be reduced downstream if it were adopted). Whether or not TDG control alternatives will preclude the later adoption of measures to help mitigate downstream temperature should be discussed.

(11) The WQS of the state of Washington is recognized and discussed here and elsewhere in the EA. The WQS adopted by the Colville Confederated Tribes (CCT), and the U.S. EPA, should be incorporated and described in a like manner.

(12) → Page 12. Paragraph 4. states that "Bull trout are also present in ... Lake Rufus Woods." The EA should discuss whether this species, especially juveniles, will benefit from the alternatives presented.

(13) → Page 13. Paragraph 3. states that the U.S. Geological Survey (USGS) is conducting a study of effects of TDG on fish below GCD. The time line for this study should be included in the EA along with an evaluation of potential relevance of the findings as they may affect evaluation or adoption of alternatives in this EA. For example, could the USGS findings result in a need for action which is foreclosed by one or more of the alternatives in this EA?

(14) → Page 15 through 17. Sections 2.3 through 2.9 briefly discuss generation of TDG. This discussion needs to be expanded to include a description of concentration, mass loading, and the relationship of these to dam spill, plunge pool, powerhouse, and river configurations and/or geometry. This should include a discussion of the physical and chemical processes and their influence on generation and propagation of TDG downstream. The COE modeling results and study findings on the GCD/ CJD complex should be included in the EA since understanding the EA alternatives and their projected effectiveness downstream is based on an understanding of the physical and chemical characteristics and principles of TDG; its production, propagation, mitigation, and elimination. This would assist the EA reviewer evaluate the larger issues of system wide controls and potential foreclosure of other actions.

(15) → Page 18. Section 3.2.2 Side Channel (Alternative 12). This alternative raises the issue of anadromous fish passage at CJD by stating that construction of a side channel could foreclose on that option. The EA should address combined TDG and fish passage alternatives. A concern identified from review of the EA is that the adoption of the preferred alternative may foreclose or postpone consideration of fish passage at CJD. Evaluation of passage should be included in this EA along with an analysis of whether alternatives being considered will impair or encourage future development/construction of fish passage structures.

(16) → Page 20. Section 3.2.9 Unplug Sluices (Alternative 10). This alternative includes a statement that "...deep withdrawal of cold water in the summertime would impact biological productivity [negatively] downstream." Since high river temperature in summertime is an issue downstream of CJD, the basis for this statement should be explained. Later in the EA, the release of cold water during the summer season is identified as a benefit to anadromous (and possibly other) species (see Section 3.4.4), seemingly contradicting the implied negative effects attributed to this alternative.

(17) → Page 21. Section 3.4.1 Spill During Maximum Power... (Alternative 9). This alternative would reduce TDG loading at both GCD and CJD and could be implemented prior to construction of structural changes. It is rejected on the basis of "...large anticipated daily fluctuations in river levels and flows during maximum power generation periods." The basis of rejection should be clarified.

(18) → Page 21. Section 3.4.2 Swap Power... (Alternative 11). This alternative for maximum power production at the GCD/CJD complex using system reimbursements is promising and is stated to be "...adjusted as the operational change alternative with Grand Coulee Dam that is carried forth in the current analysis." However, it is not clear, when reviewing the preferred alternative, how this operational option has been incorporated. Likewise, it is not clear how this operational change would be implemented. Explanation within the EA would confirm the conclusions of this alternative.

(19) → Page 21. Section 3.4.3 Raise Control Flows at The Dalles (Alternative 13). This alternative is rejected on the basis that it "...may require a new system flood control study with emphasis on the *stage damage*" (italics added for emphasis). This section states that an increase of only 10 kcfs control flow at The Dalles would substantially reduce spring draft at GCD (spring draft being one of the largest contributors of TDG from GCD and CJD). Even though "...outside the scope of this study," this option should be described further. In particular, the basis for the target of 450 kcfs at The Dalles should be clarified. Since achievement of the 110% WQS is central to this review of the EA, options such as this which are promising should be developed for evaluation by the reviewer.

(20) → Page 22. Section 3.4.4 Modify Operation of Grand Coulee Dam (Alternative 14). The last sentence of the first paragraph of this section appears to be worded such that the point made may

20 be confusing to the reader. It is recommended that it be rewritten to explain and clarify that the ecological cost of high TDG due to using the outlet works (rather than waiting until pool levels allow use of the drum gates) likely exceeds the marginal benefits for flood control.

21 As noted earlier, the issue of summer water temperature reduction in the river should be explored, described, and options for dam/reservoir operation clearly stated with regard to temperature and TDG. This section identifies seasonal high temperatures in the Columbia mainstem as a problem which could be positively affected by operational changes at Grand Coulee Dam (when made in concert with changes in system-wide flood control management). This section should be expanded to describe this alternative.

22 → Page 22. Section 3.5.1 Combination Alternatives - Flow Deflectors and Grand Coulee Operational Modification. This is identified as the preferred alternative. This section states that this alternative provides the greatest reduction in TDG in Lake Rufus Woods of all alternatives. Some of the rejected alternatives within the EA for other operational changes at GCD appear to provide equal or possibly better TDG controls. It would be of value to the reviewer to provide a cross comparison (particularly for Sections 3.4.3 and 3.4.4).

23 This alternative states, "When power flows mix with spill, they dilute the higher gas levels of spill." Explaining the relationship between concentration of TDG (addressed by this statement) and mass loading of TDG would be useful. Mass loading in relation to TDG propagation and persistence, as well as down stream dam TDG additive contributions, should be addressed.

24 → Page 25. Section 3.6.4 Combination of Flow Deflectors with Operational Modification (Preferred Alternative). This section describes how the two dams will be operated jointly to limit TDG production. It states, "Operation during times of involuntary spill would favor generation at Grand Coulee and spill at Chief Joseph, making use of the deflectors to reduce or prevent increases in TDG, depending on total flow and levels of dissolved gas arriving at Grand Coulee and Chief Joseph."

This leaves questions unanswered. How will the dams be operated during periods of voluntary spill? How will the balance of generation and spill be determined? Will Chief Joseph be operated to maximize power generation (i.e., use power trading with other dams?) or will CJD simply spill? During periods of high flow and low power demand, what are the anticipated TDG levels in the 50 miles reach below GCD and below CJD? Greater detail in the basic formula for combined operation of the two dams (generation at GCD, spill at CJD) is necessary in order to evaluate the TDG reductions projected in the EA.

25 → Page 27. Section 4.5.2 Temperature. Paragraph two of this section describes the relationship between spill and outflow temperature. Figures 4.5.2-1 and 4.5.2-2 graph spill and outflow temperature for the two dams for the period April 1 through the end of June, 1997.

The temperature graphs show that temperatures below CJD are consistently lower than outflow temperatures below GCD. For example, on about June 28, 1997, outflow temperature below GCD is shown at nearly15 degrees C. On this same date, outflow temperature below CJD is shown to be approximately12.5 degrees C. This apparent decrease in temperature below GCD and between the two dams is consistent over the time period shown on both graphs. The reason for this cooling between sampling locations over this 50 mile stretch of river should be presented.

25 Temperature is a critical parameter for anadromous fish survival and a WQS being routinely violated in the Columbia River drainage. At least two rejected alternatives in the EA discuss summer river temperature reduction effects below the GCD/CJD complex (i.e., decreases due to altered operational/structural schemes). Therefore, the section on temperature should be expanded. It should include data on temperature under current conditions (e.g., expand Figures 4.5.2-1 and -2) for the summer period through September. Then, projections of temperature effects anticipated under the alternatives should be developed and described in the EA, including the magnitude, duration, and extent of downstream propagation of those effects.

Based on the temperature analysis, the EA should discuss whether possible modifications to GCD/CJD for decreasing downstream temperature will be foreclosed or delayed by the preferred alternative.

26 → Page 28. Figure 4.5.2-2. This figure shows spill volume (and outflow temperature) at CJD during spring 1997. The spill flow shown generally exceeds spill at GCD by as much as 55 kcfs. Under similar flow conditions, will the preferred alternative produce higher spill flows at CJD? Under 7Q10 flow conditions, what are the anticipated spill flows at both GCD and CJD? At 7Q10, what are the anticipated TDG levels below both GCD and CJD? These questions recur while reviewing the EA and should be addressed.

27 → Page 30. Figures 4.5.3-2 and 4.5.3-3. These figures show river flow, spillway flow, and TDG levels at/below GCD and CJD, respectively. It appears from these figures that spill flow at CJD, compared to GCD, can be double that shown in figure 4.5.2-2. These figures appear to show that CJD spills up to 100 kcfs more than GCD whereas figure 4.5.2-2 seems to show a maximum difference of about 55 kcfs for this same period. These differences may be important in projecting TDG levels generated under the preferred alternative and should be explained. Since power generation is to be maximized at GCD and spill maximized at CJD under the preferred alternative, are spill flows at CJD anticipated to be higher than those recorded in the past? What spill is anticipated under high flow, low power demand scenarios for both GCD and CJD?

28 → Page 32. Section 4.6.1.2 Fish in net pens. This section briefly discusses the relationship between water temperature and supersaturation. It states that higher water temperatures produce increased saturation levels. Thus, temperature effects of the various alternatives need to be discussed. The EA does indicate that spring high flow spill and outflow temperatures are not closely related (stated to probably be due to lack of pool stratification during this time of year). However, the EA does not address the relationship of temperature and TDG levels for the alternatives and whether this relationship may be important at other times of year and for

(28) voluntary spill. Since both temperature and TDG are WQS of concern and are related, they both should be evaluated in concert in order to determine whether the preferred alternative is, in fact, preferred.

(29) → Page 38. Section 5.5. Water Quality. This section states that water temperature will not be effected by any of the alternatives. The discussion of temperature elsewhere in the EA seems to contradicted this statement. This section should clarify this and note that several of the rejected alternatives would potentially have beneficial water temperature effects below both GCD and CJD.

(30) → Page 39. Figure 5.5.3-1. TDG production curves for CJD with and without deflectors. This figure may be misleading when considering the benefits of deflectors and the preferred alternative. The curves appear to represent projected TDG concentrations below CJD as a function of increasing spill flows ***given a forebay concentration of 100%*** TDG. What would the curve look like if the forebay concentration were, say 105%? Are these curves intended to be predictive of TDG concentrations downstream of CJD based on spill volume? The conditions under which this graph is intended to show CJD additions to TDG and what those additions represent is unclear to the reviewer and have led to different interpretations in this office. The graft should be better explained.

If used as a predictive tool for operations under the preferred alternative, this graph seems to produce results contrary to those found on the next page. On the other hand, if its use is intended to be limited to illustrate a static condition and the associated reduced TDG production with deflectors, this should be stated. As a predictive tool, this graph can be read to predict TDG levels above 110% with almost any spill at CJD. The ambiguity surrounding this graph should be resolved.

(31) → Page 40. Figures 5.5.3-2 and 5.5.3-3. These figures represent the projected percentage of time various TDG levels would be exceeded below GCD and CJD, respectively, given flows of March through June, 1997, under the preferred alternative. These figures show that the WQS of 110% is projected to be exceeded below GCD 60% of the time and about 58% of the time below CJD (given 1997 spring season flows). The actual flow values used for these calculations need to be stated since flow during the 1997 season is shown to be as high as 350 kcfs in Figures 4.5.3-2 and 4.5.3-3 and as low as 0 kcfs. It appears that flow is included as a variable based on 1997 data but this is not clear from the figures or narrative. Since the WA WQS is based on the 7Q10, figures for projected TDG concentrations should be presented using this flow.

(32) The projections in these two figures seem to be at odds with the results shown in the preceding Figure 5.5.3.-1. In that figure, a forebay concentration at CJD at or above 105% combined with an operational preference for spill at CJD suggests that TDG levels below CJD will be higher and will occur more frequently, with TDG levels near or exceeding 110% at spill flows of 10 kcfs and exceeding 120% at spill flows of about 65 kcfs. This apparent contradiction in projected TDG levels under the preferred alternative needs to be addressed.

(33) → Page 41. Paragraph 1 states that TDG levels in Lake Rufus Woods, "For 1997 conditions...," under the preferred alternative, "...TDG would not exceed about 125%, and would exceed 120% only about 10% *of the time during which spill occurs*" (italics added for emphasis). It is not clear whether these projections are based on the entire record from March through June, 1997, or if it pertains to only those periods when spill actually occurred at GCD. This should be clarified.

(34) → General Comment: The location of data collection points (i.e., sampling locations) should be identified in the EA for all data presented in the document. It would assist the reviewer if these locations were also presented in one or more a diagrams.

(35) → Pages 42 and 43. Tables 5.5.3-1 and 5.5.3-4. TDG threshold durations. These tables again present projections of various TDG levels under the preferred alternative (and compared to existing dam operations) using 1997 flow data. However, these tables contains the parenthetical phrase "(Designed for 150 kcfs)" making it unclear if the flow on which the projections are based is 150 kcfs or if this refers to deflectors designed for this flow. The phrase should be explained.

(36) These tables should also include a calculation for a flow of 241 kcfs to make clear how the preferred alternative will perform under maximum WA state WQS flow conditions.

(37) → Pages 43 and 44. Figures 5.5.3-5 and 5.5.3-6. Comparison of modelled TDG conditions at mid-Columbia dams. The flow value (and other constants and variables) used for these figures should be identified in order for the reviewer to understand what conditions the figures represent.

The forebay TDG concentration at GCD should be shown to provide a starting value. Also, a discussion of TDG production characteristics through GCD from forebay to tailwater is needed. This is necessary to understand whether the preferred alternative includes an increase in TDG through GCD at the flows being considered. Although the hydraulic capacity at full pool is listed as 260 kcfs and it is implied that no spill will be necessary or occur at GCD, the EA is not clear about this or about TDG production through GCD.

(38) → Page 46. Figure 5.6.1.1-1. Rock Island 5-year average smolt index values. The various curves for TDG should be extended through the year so that the reviewer can compare TDG, summer flows, and flow augmentation episodes with smolt migration.

CENWS-PM-PL-ER

Responses to Comments on Chief Joseph Dam Dissolved Gas Abatement Project Draft Environmental Assessment, March 2000

Commenter: Richard B. Parkin, Environmental Protection Agency

| Comment | Response |
|---|---|
| 1 | Initial Appraisal alternatives 11-14 have all been rejected for reasons that have been more clearly explained in the EA. A side-channel canal (alternative 12) cannot readily be designed to serve the needs of both gas abatement and fish passage, but remains an option for fish passage should it be addressed in the future. Swapping spill with downstream dams (alternative 11) is outside this scope, but is essentially occurring already through system spill prioritization. Raising control flows at The Dalles (alternative 13) is outside the scope of this study, but is being considered through a new flood control study by the Corps' Northwestern Division office in Portland. Alternative 14 (modification of Grand Coulee Dam operation) was reformulated as part of the preferred alternative in this study. We believe the preferred alternative is the most cost-effective way to lower dissolved gas in the upper Columbia within the scope of this action and within reasonable time and budget. It will not lower gas levels to 110% all of the time, but for Chief Joseph and Grand Coulee operation, it has a good chance of minimizing impacts to aquatic organisms in the upper and mid Columbia. |
| 2 | That is an introductory statement that helps set the project area limits. There is more detailed information in Sec. 5.5. |
| 3 | USACE, USBR and BPA modeling effort has been described in Sec. 5.5. |
| 4 | The only measure we know about in the midColumbia is the new set of flow deflectors at Wanapum Dam. Text in Sec. 5.5 has been modified to describe the qualitative impacts. |
| 5 | It's even more complicated than the comment suggests, because high gas levels below Chief Joseph are also a function of high levels coming in from Canada. Text has been modified to describe operational assumptions. The hydraulic capacity of Grand Coulee has been corrected to 280,000 cfs. More detail was added to Section 5.5. We agree that if inflow to Chief Joseph were at 100% TDG saturation and if there were enough load to run the powerhouse at full capacity all of the time, there would be no problem. However, neither case is true. We were tasked with examining Chief Joseph and Grand Coulee in concert. As long as Grand Coulee spills, Chief Joseph has a water quality problem. In addition, Lake Roosevelt receives high TDG levels from Canada. Text has been modified to describe this. |

6 There is no one number answer to this comment. It is a function of power load, system management, and weather conditions at the time. Chief Joseph sometimes passes 200,000 cfs with no spill and sometimes passes this same volume with 100,000 cfs spill. To clarify, we offer new figures added to Section 5.5. In addition, this EA examines alternatives by comparing the mixed river, or flow-weighted average TDG across the river at the tailwater. Additional language has been added to Section 5.5.3 to clarify.

7 Additional information has been incorporated into the caption of Figure 2.1.2-1 to explain Grand Coulee flood control operation.

8 These alternatives were rejected because it was determined that they are far outside of the scope of this study. The 1998 Biological Opinion for salmon and steelhead tasked us with focusing on Grand Coulee and Chief Joseph. While we considered many alternatives in our Initial Appraisal Report (USACE, 1998b), we were refocused on the two dams that we can affect. To describe operation of Columbia River flood control would be an enormous effort that is also far outside of the scope of this study.

9 Operation of the system is different every year and is determined by a regional body, the Technical Management Team. We have no information other than that supplied in the EA. The 2000 Biological Opinion may change these requirements. The purpose in mentioning this in the EA is to stress that some of the newer gas problems in the river may be attributable to actions taken for the recovery of one or more species.

10 Text has been modified in Section 3.4.4 to reflect that newer information on temperature in Lake Roosevelt suggests that mixing and short retention times for water in Lake Roosevelt would limit temperature benefits of this alternative. This alternative was rejected due to other factors.

11 Text has been modified to incorporate water quality standards of the Colville Confederated Tribes and EPA.

12 We expect some (unquantifiable) benefit to bull trout in Lake Rufus Woods from the operational and combination (preferred) alternatives. Language has been added to the EA to reflect this.

13 The last field season for the USGS study in Lake Rufus Woods is 2001. We believe that the results will not affect the preferred alternative, since spill from Grand Coulee—the only factor in the scope of this action that is addressed by the USGS study—would be curtailed under the preferred alternative.

14 Text has been modified to provide a better reference for the information sought by EPA. For a more complete discussion of gas production at a dam, the reader

should refer to the Corps' Dissolved Gas Abatement Study (USACE, 1999). Corps modeling results for the 2 dams in this study can be found in Section 5.5.

15 We did not intend to convey that the preferred alternative would foreclose or postpone consideration of fish passage at Chief Joseph Dam, because that is not the case. In fact, our concern was to not unduly delay needed implementation of dissolved gas abatement to accommodate prolonged and uncertain fish passage studies, and options such as the side channel canal, which would have little capability to address both needs. We are pursuing gas abatement as a direct result of the NMFS 1998 supplemental Biological Opinion for salmon and steelhead, and at the direction of the region, we are working to ensure speedy implementation of gas abatement measures. Fish passage is an issue that the region will need to determine how it wants to approach, and will require extended policy and technical analysis. Gas abatement must be allowed to proceed independently of those issues. We believe more options for fish passage are kept open by the preferred alternative than if we attempted to incorporate a side channel canal for gas abatement at this time. Flow conditions that encourage fish passage are not necessarily efficient for gas abatement, and vice versa.

16 The sentence about detrimental effects of cold-water withdrawal has been deleted. Cold-water reservoir discharge has been shown to inhibit summertime productivity in the South Fork of the Flathead River in Montana, but that phenomenon may be more applicable to smaller river situations than to the impounded situation below Chief Joseph Dam.

17 Text has been added to clarify Alternative 9 in Section 3.4.1.

18 Explanation of how the operational change would be implemented has been added to Section 5.5.3.

19 These alternatives were rejected, because it was determined that they are far outside of the scope of this study. The 1998 Biological Opinion tasked us with focusing on Grand Coulee and Chief Joseph. While we considered many alternatives in our Initial Appraisal Report (USACE 1998b), we were refocused on the two dams that we can affect. To describe operation of Columbia River flood control would be an enormous effort that is also far outside of the scope of this study.

20 Text is modified in the 2$^{nd}$ paragraph of that section to reflect comment.

21 Temperature management of the Columbia River is outside the scope of this study, as is flood control. The suggestion was made, but obviously would need thorough study to verify. Newer information on temperature in Lake Roosevelt suggests that mixing and short retention times for water in Lake Roosevelt would limit temperature benefits of this alternative. This alternative was rejected due to other factors.

| | |
|---|---|
| 22 | For the alternatives examined in detail in the EA, detailed comparison is available in Section 5.5. A general comparison of alternatives, including those rejected, has been added to Sec. 5.0 of the EA. Dissolved gas effects are not quantified in detail because of the broad range of flows and other conditions that would affect the results. |
| 23 | The EA discusses TDG in terms of percent saturation, rather than mass loading. Percent saturation is a term familiar to larger region. In that light, particularly because there is little difference between the temperatures of spill and powerhouse flow, it is a simple mixing relationship. For more information on the relationships requested, please refer to the Corps' Dissolved Gas Abatement Study, Phase II, 60% report (USACE, 1999). |
| 24 | All spill at Grand Coulee and Chief Joseph dams is involuntary, as stated in the EA, Sec. 1.0. Voluntary spill is employed only for downstream passage of smolts in Columbia and Snake river projects that have anadromous fish passage . |
| 25 | We do not know the reason for this apparent cooling in this stretch of the river. No modification of Chief Joseph Dam for temperature is likely. Our information shows Lake Rufus Woods to be isothermal with a short residence time. Temperature management of the Columbia River is outside the scope of this study, as is flood control. |
| 26 and 27 | There is no one-number answer to this question. It is a function of power load, system management, and weather conditions at the time. Chief Joseph sometimes passes 200,000 cfs with no spill and sometimes passes this same volume with 100,000 cfs spill. To clarify, we offer new figures added to Section 5.5. Spill will always be greater at Chief Joseph Dam, because Chief Joseph Dam (even though it is a big contributor of TDG when spilling large volumes) can spill more water to get to the same TDG level as Grand Coulee Dam. Please refer to the Corps' widely publicized regional spill priority list. |
| 28 | We agree that there is a relationship between temperature and TDG saturation vs. TDG mass, and that relationship affects GBD in fish. However, all the alternatives are affected by essentially the same temperatures. This study is not a temperature study and does not address the enormous challenges of temperature management in the Columbia River that many other agencies are trying to grapple with. Again, there is no voluntary spill at Chief Joseph or Grand Coulee dams. |
| 29 | The alternatives discussed in Section 5 have no significant difference in temperature . Rejection of alternatives was for other reasons, so more detailed temperature discussion was not carried out. |
| 30 | Text has been modified to provide more information. Gas production shown in Figure 5.5.3-1 from the spillway only is largely independent of forebay gas levels. |

The Corps' Dissolved Gas Abatement Study, Phase II, 60% report (USACE, 1999) covers this in more detail. The gas levels in subsequent figures represent a mixed river condition that takes into account TDG in the forebay via generation flows. The curves in Figure 5.5.3-3 represent the entire March-June 1997 period. At times, there was no spill, and early in the season, TDG coming from Canada was low. The low values represent what was passed through the powerhouses of both projects.

31 This is a very good point and clearly more explanation is needed. Text has been modified for clarification. The year 1997 was chosen because most of the flows were less than the 7-day, 10-year average (7Q10) flow specified in Washington water quality criteria, yet most of the TDG values were above 110%. In addition, a large amount of TDG data were available for model calibration and verification, and the river was operated as closely as we could predict future operation. All flows were chosen for numerical modeling purposes, because flow deflectors have benefits at flows higher than the 7Q10 as well. Less than 25% of the hourly flows were above the 7Q10. If daily average flows are considered, the portion less than the 7Q10 is even smaller.

32 Again, the difference is that the spillway production curves represent TDG in spilled water only. The numerically modeled data represents a mixed-river condition, in order to be consistent at all forebay and tailwater locations in the river. It is a long-term debate in the region about just what the various fixed monitoring stations (FMS) measure. For instance, below Grand Coulee Dam, the FMS is measuring a mixed river. This is the only condition possible for Grand Coulee due to its tailwater configuration. Below Chief Joseph, the FMS measures spill water only. Spill and power generation flow do not mix for a few miles. Below Chief Joseph, it is further complicated by tributary inflow and other factors. Below one of the PUD dams, the FMS is in the middle of the river and does not measure *anything* consistently. What it measures is a function of which spillbays and power units are operating.

33 Text in Sec. 5.5.3 has been modified to clarify modeling assumptions and conditions.

34 Text has been modified to clarify sampling locations.

35 This phrase was incorrect and has been removed. Text has been modified in Tables 5.5.3-1, 5.5.3-2 and 5.5.3-4 to clarify that the tables are based on hourly data for the entire spill season.

36 While a single number representing spill under the 7Q10 would be easier to grasp, it would not be representative of real river conditions. There is no one-number answer to this question. It is a function of power load, system management, and weather conditions at the time. Chief Joseph sometimes passes 200,000 cfs with no spill and sometimes passes this same volume with 100,000 cfs spill. In

addition, the mixed river condition below Chief Joseph is dependent not only on spill, but on forebay TDG that is passed through the powerhouse. The State of Washington has not clarified exactly how they plan to apply the WQS. Is it an average across the river? Does it only apply to the spilled portion of the river? Does it apply to an increase over forebay TDG? Is a dam responsible for decreasing TDG coming from upriver?

37 Text has been modified to clarify meaning of data in Figures 5.5.3-5 and 5.5.3-6. The hydraulic capacity of Grand Coulee under full pool is 280 kcfs and has been corrected in the EA. Little spill would be necessary at Grand Coulee Dam and it would occur when flow is above 7Q10, except on the relatively rare occasions when power load is unavailable. A new figure has been added to illustrate reduction in spill at Grand Coulee Dam under the preferred alternative. A new figure with a timeseries of forebay TDG has been added. For purposes of statistical comparison, forebay TDG would be very similar to the tailwater TDG under the preferred alternative, because little spill occurs at Grand Coulee Dam under the operational alternative.

38 Our concern is the time of year (spring and early summer) when involuntary spill would likely occur at Grand Coulee and Chief Joseph Dams and create dissolved gas problems, so little concern exists at other times of year. Spring and summer are also the smolt outmigration periods. Spill at Chief Joseph and Grand Coulee dams was over by the end of June in both 1996 and 1997. In higher flow years, spill generally starts earlier than the smolt outmigration season at both projects, because storage reservoirs are drawing down. We do have gas data through mid-September at both dams. However, there is no spill after June, and once spill stops, the with- and without-project conditions are the same. Dissolved gas data were not available for the entire smolt outmigration period; the caption for Fig. 5.6.1.1-1 has been clarified to reflect that.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
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Rec'd 22 May 2000 -JCL

Mark T. Ziminske
Chief, Environmental Resources Section
Seattle District, Corps of Engineers
P.O. Box 3755
Seattle, WA 98124-2255

RE: Comments on the Chief Joseph Dam Dissolved Gas Abatement Project Draft Environmental Assessment (March 2000).

Dear Mr. Ziminske:

Thank you for the opportunity to review your draft EA (Environmental Assessment) on the *Chief Joseph Dam Dissolved Gas Abatement Project*. Over the past two years, we have periodically interacted with your staff regarding both the design of flow deflectors at the Chief Joseph Dam and the concept of considering both the Chief Joseph and Grand Coulee dams as a composite to abate total dissolved gas. As indicated previously, we support flow deflector construction at the Chief Joseph Dam, with a flow deflector design discharge capacity that allows spill to be shifted away from the Grand Coulee Dam during periods of low power demand. Please redouble your efforts to include our engineering staff throughout the remainder of the design development process.

(1) Although we generally concur that the construction of flow deflectors will not have a significant effect on the human environment, the information contained within your draft EA is insufficient to satisfactorily support your preferred alternative. Specifically, several of your alternatives lack sufficient reasoned analysis to be eliminated from further consideration. Many of the *Project Operational Alternatives* (Section 3.3) appear to be capable of further reducing TDG (Total Dissolved Gasses) at the Chief Joseph and Grand Coulee dams, and could additionally improve the operational flexibility necessary to reduce systemwide levels of TDG. For example, operating units below peak efficiency (Section 3.3.1) was eliminated from further consideration apparently because an analysis of the potential effects was not conducted. All actions that result in lower levels of TDG should be thoroughly evaluated and implemented as warranted.

(2) We are cognizant however, of the potential repercussions that expanding the scope of this EA may have, and would support limiting this effort to specifically addressing structural modifications to abate TDG at the Chief Joseph Dam. Operational modifications relatively independent of flow deflector construction could be handled under a separate action. As written however, the EA is incomplete and confusing as to scope and purpose. If the operational alternatives continue to be included in this effort, we request that additional analysis be provided for alternatives 3.3.1, 3.3.2, 3.4.1, 3.4.3, and 3.4.4. The resulting information should be used to determine if operational flexibility can be further increased over your preferred alternative.

Please refer to the following specific comments on the draft EA:

1. Page 5: The title and purpose of the EA, and the inconsistent inclusion of the Grand Coulee Dam are confusing throughout the document. It is unclear, for example, if the scope of this project includes only the Chief Joseph Dam, all inclusive recommendations for the Chief Joseph and Grand Coulee dams, or modifications to Columbia River hydropower system operations that can be addressed at the Chief Joseph and Grand Coulee dams. As noted above, we suggest simplifying this EA to only address structural modifications at the Chief Joseph Dam.

2. Page 6: We appreciate your efforts to simplify language in the EA to accommodate a general public review, however, some of the information provided in Section 1.0 is not accurate. For example, in the first full paragraph on page 6, replace the last three sentences with: *The most effective means of reducing TDG is by limiting how deep water can plunge into the tailrace after passing over the spillway. At other projects on the Columbia and Snake rivers, concrete deflectors have been added at the spillway to minimize this plunging depth. These 'flow deflectors' have proven relatively cost effective and efficient at reducing the levels of TDG associated with spill.*

3. Page 10, last paragraph: Please explain the flood control rule curve and how it is used to help ensure minimum flow levels in the Columbia River.

4. Page 16, 2.4: Suggest changing M. Valentine references to WDOE (Washington Department of Ecology) and Clean Water Act requirements. In addition, the reference to NMFS (National Marine Fisheries Service) *long term exposure standard* is inaccurate. We acknowledge that there may be detrimental affects to anadromous fish at 115% saturation but believe they are less than those associated with turbine passage. The 115% level is not a standard for protecting salmon, it is more accurately a compromise between TDG and turbine passage mortality that results in a higher level of total system survival.

5. Page 17, 3.0: We suggest adding a matrix to this section that readily compares each of the alternatives. The matrix should include costs and expected TDG levels as well as the effects that each alternative may have on other natural resources.

6. Page 19, 3.2.4: A shallow tailrace area would more accurately reduce the depth water could plunge, reducing secondary TDG uptake that may occur downstream of the stilling basin.

7. Page 20, 3.2.9: The second to the last sentence regarding biological productivity is unclear. Please further clarify this statement.

8. Page 20, 3.2.10: A baffled spillway reduces energy and conversely limits the plunging depth of spilled water. In addition, your references to fish passage are comparatively weak as reasoning for not evaluating this option further. We suggest discussing the significant reduction in spillway capacity as a result of this type of structure and the associated costs.

9. Page 20, 3.3: As discussed above, either delete this section and concentrate on structural modifications or provide additional information and analyses for alternatives 3.3.1 and 3.3.2.

10. Page 21, 3.4: As discussed above, either delete this section and concentrate on structural modifications or provide additional information and analyses for alternatives 3.4.1 and 3.4.3. and 3.4.4.

11. Page 22, 3.5.2: Although this alternative includes components of several operational alternatives, it is unclear both here and in Section 3.6.4 (page 25) exactly which components are included. The combination alternative requires more explanation.

12. Page 23, 3.2.6: Please provide more discussion regarding the potential effects of TDG uptake during deflector construction. For example, if higher levels of TDG will occur during construction due to reduced spillway capacity, we will likely recommend curtailing construction during the fish passage season.

13. Page 37, 5.0: It is difficult to interpret the effects of each alternative given the organization of this section. We suggest you reorganize by alternative and include a matrix that consolidates all of the pertinent information in one location.

14. Page 39, Figure 5.5.3-1: This figure has been oversimplified. It should include tailwater elevation, discharge, and deflector submergence, and show exceedence curves that indicate the preferred operating range. It is probably not necessary however, for the EA to include a description of each flow zone.

15. Page 40, Figure 5.5.3-3: The lines are not distinguishable on this graph.

16. Page 41,2nd paragraph: It is unclear why the operational alternative results in a higher TDG level than the no-action alternative. Please explain.

17. Page 43: Please include support for the level of improvements expected in the Mid-Columbia River, especially for your conclusion that no improvement is expected below the Priest Rapids Dam.

18. Page 52, 8.0: As discussed, these conclusions should be modified to reflect changes in the scope of this EA. As it is currently written, the operational alternatives have not been adequately addressed

19. Page 53, last bullet: Check wording. '[T]he preferred alternative *will does not* constitute a significant impact.'

Again, we appreciate the opportunity to review this EA and support flow deflector construction at the Chief Joseph Dam. To simplify this process and expedite construction of the deflectors, please consider limiting the scope of this EA to structural modifications at the Chief Joseph Dam. Each of the structural alternatives should be evaluated based on effectiveness at reducing TDG, implementation schedule, cost, and on the associated benefits of reducing systemwide TDG. If operational alternatives continue to be included, additional information and analyses should be provided.

If you have any questions regarding our comments, please contact Bob Dach of my staff at (503) 736-4734.

Sincerely,

Bryan D. Nordlund, Chief
FERC and Water Diversions Branch

CENWS-PM-PL-ER

Responses to Comments on Chief Joseph Dam Dissolved Gas Abatement Project Draft Environmental Assessment, March 2000

Commenter: Brian Nordlund, National Marine Fisheries Service

| **Comment** | **Response** |
|---|---|
| *General* | |
| 1 | Further documentation on alternative selection and action has been incorporated into the EA. |
| 2 | NEPA requires us to consider all reasonable alternatives; therefore, nonstructural alternatives must be included in this Environmental Assessment. Again, however, we are incorporating further documentation on nonstructural alternatives that were rejected, so their relative merits are clearer. |
| *Specific* | |
| 1 | See response to General comment 2, above. Grand Coulee Dam is a major generator of dissolved gas, and resulting high TDG may be passed through the Chief Joseph turbines. Grand Coulee Dam is also the only other federal project in the upper Columbia, and is next in line above Chief Joseph Dam. It is prudent to consider operating Grand Coulee Dam, as a federal project, differently in conjunction with any changes at Chief Joseph that might be merited, and therefore to include such consideration in this NEPA document. |
| 2 | Language has been modified as suggested. |
| 3 | Text has been added to explain the flood control rule curve and its purpose. |
| 4 | References have been incorporated. Language has been modified to clarify NMFS dissolved gas standard. |
| 5 | We agree that a comparison matrix is useful for ready comparisons of effects. One is being added. |
| 6 | Language has been modified as suggested. |
| 7 | The sentence has been deleted. Cold-water reservoir discharge has been shown to inhibit summertime productivity in the South Fork of the Flathead River in Montana, but that phenomenon may be more applicable to smaller river situations than to the impounded situation below Chief Joseph Dam. |
| 8 | Wording has been added concerning cost of baffles, and reduction of spillway capacity. However, we believe that baffles and fish passage are not compatible in a spillway situation in any case. |

9 We must consider operational alternatives under NEPA, but have clarified the language to better reflect reasoning for choices of reasonable alternatives.

10 See response to comment 9.

11 Text has been added to clarify this.

12 No additional TDG uptake over the existing situation is anticipated as a result of construction. Construction will be halted, and equipment and cofferdams removed, if it appears full use of the spillway will be required to pass a high runoff event. However, in general, due to the length of the construction time and the effort required to mobilize and demobilize, it is preferred to construct continuously until the project is finished.

13 We have incorporated a matrix for easier comparison of alternatives. However, we also feel that it is easier to judge the effects of alternatives in the narrative by grouping them together according to each area of potential impact, because it eliminates a great deal of flipping back and forth among pages that would be necessary if they were organized by alternative,.

14 We agree that this is a simplified drawing. The details requested are the results of a physical model study and design that has been completed to only the 10% level to determine constructability of deflectors on a high head dam. To the extent possible, the requested details have been added. Text has been modified to better describe origin of the curves. Figure has been modified to reflect newer information.

15 This inadvertant document reproduction problem has been corrected.

16 Wording has been added to state that without deflectors at Chief Joseph Dam, shifting spill from Grand Coulee Dam to Chief Joseph Dam would result in worse conditions below Chief Joseph than under the existing condition.

17 More description of modeling assumptions and diminishing returns as water moves downstream has been added.

18 Changes made to the text as a result of previous comments should clarify the reasoning behind the selection of alternatives.

19 Thank you. Text has been corrected.

20 Regarding scope, please see the response to comment 9. For the included alternatives, information on cost and schedule has been added. TDG effects are detailed in applicable tables and graphs in Sec. 5; it is difficult to summarize them succinctly because of the wide range of conditions influencing them. Systemwide

TDG reduction will occur through the net reduction anticipated for projects from Chief Joseph to Priest Rapids, as shown in Figures 5.5.3-5 and 5.5.3-6.

**United States Department of the Interior**

**U. S. GEOLOGICAL SURVEY**
**BIOLOGICAL RESOURCES DIVISION**
COLUMBIA RIVER RESEARCH LABORATORY
5501-A Cook-Underwood Road
Cook, WA 98605 USA
(509) 538-2299 ext. 265

April 19, 2000 Rec'd 4/20/2000

Jeffrey C. Laufle
US Army Corps of Engineers, Seattle District
Environmental Coordinator
4735 E. Marginal Way S.
Seattle, WA 98134-2255

Dear Mr. Laufle:

I just received and read a copy of the Chief Joseph Dam Dissolved Gas Abatement Project Draft Environmental Assessment (March 2000). I do not know if this draft is still open to comments or not, but I do have some additional information on the species present in Rufus Woods Lake, and one comment on a statement made in the assessment.

(1) I am currently working on a project to assess the prevalence and severity of gas bubble disease in resident fish in Rufus Woods Lake. This is a joint project between the U.S. Geological Survey and the U.S. Bureau of Reclamation. During the spring and summer of 1999 we conducted an extensive study of the littoral fish communities in the reservoir, which consisted of approximately 72 nights of electrofishing and 16 nights of beach seining throughout the reservoir. We collected three additional species from Rufus Woods Lake that could be added to Table A-1 in your assessment. These included brown bullhead *Ameiurus nebulosus*, smallmouth bass *Micropterus dolomeui*, and chinook salmon *Oncorhynchus tshawytscha*.

(2) I also have a comment on your statement (page 45) concerning the relative vulnerability of age-0 chinook salmon. I am assuming you are referring to fall race chinook that emigrate as sub-yearlings. Previously, I have worked with fall race fish in the Hanford Reach of the Columbia River, and in actuality their life history probably makes them more susceptible to high dissolved gas levels than other salmonids. Spring race chinook and others that rear for their first year in the spawning tributaries are generally spared exposure to high dissolved gas levels while rearing, and only encounter high gas levels while emigrating. However, fall race fish spend their first several months rearing in shallow areas of

(2) main-stem rivers. These fish are routinely observed in water less than one meter deep during the months of April-June, and is why I believe these fish could be highly susceptible to episodes of high dissolved gas levels. The combination of structural and operational changes proposed in your assessment should benefit juvenile fall race chinook below Chief Joseph Dam by reducing dissolved gas levels during this rearing period.

Thank you for the opportunity to make these comments, and if you have any questions please feel free to contact me by phone (509-538-2299 ext. 265), or by e-mail at david_venditti@usgs.gov.

Sincerely,

David A. Venditti
Research Fishery Biologist

cc: Alec Maule, Research Physiologist, CRRL

CENWS-PM-PL-ER

Responses to Comments on Chief Joseph Dam Dissolved Gas Abatement Project Draft Environmental Assessment, March 2000

Commenter: David Venditti, US Geological Survey

| **Comment** | **Response** |
|---|---|
| 1 | Thank you. Those species have been added to Table A-1 for Lake Rufus Woods. |
| 2 | Your information concerning rearing habits and location of fall chinook in the upper Columbia has been added to the EA sections on affected environment and effects of alternatives. |

APPENDIX D: Letters of Concurrence Pursuant to ESA Sec. 7 on Biological Assessment, from US Fish and Wildlife Service, and National Marine Fisheries Service.

# United States Department of the Interior

FISH AND WILDLIFE SERVICE
*Upper Columbia River Basin Field Office*
*11103 E. Montgomery Drive*
*Spokane, WA 99206*

May 24, 2000

Mark T. Ziminske
US Army Corps of Engineers
Environmental Resources Section
P.O. Box 3755
Seattle, WA 98124

Subject: Biological Assessment on the Chief Joseph Dam Dissolved Gas Abatement Project (1-9-00-I-99, 341.0000)

Dear Mr. Ziminske:

This responds to your April 7, 2000, letter and accompanying draft environmental assessment (EA)/biological assessment (BA) for the dissolved gas abatement project at Chief Joseph Dam. Your letter requested U.S. Fish and Wildlife Service (Service) review the subject EA and provide comments, and provide consultation on the BA for threatened bull trout (*Salvelinus confluentus*) and bald eagle (*Haliaeetus leucocephalus*). The preferred alternative involves installation of flow deflectors in the Chief Joseph Dam spillway, and shifting project operation such that when involuntary spill is necessary, power generation is increased at Grand Coulee Dam while spill is increased at Chief Joseph Dam. The following comments are provided in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act).

Based on the information provided in your consultation package and a review of information otherwise available to the Service, we concur that the preferred alternative is not likely to adversely affect the threatened bull trout or bald eagle.

This concludes informal consultation pursuant to section 7(a) of the Act. The above project should be re-analyzed if new information reveals that effects of the actions may affect listed species or critical habitat in a manner, or to an extent, not considered in this consultation; if the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this consultation; and/or if a new species is listed or critical habitat is designated that may be affected by this project.

At this time, we are unable to provide comments for the EA. Thank you for your interest in threatened and endangered species. If you have questions on these comments, please contact Scott Deeds in this office at (509) 893-8007.

Sincerely,

Susan B. Martin

Supervisor

cc: WDFW, Region 1
Colville Confederated Tribes

**UNITED STATES DEPARTMENT OF COMMERCE**
**National Oceanic and Atmospheric Administration**
NATIONAL MARINE FISHERIES SERVICE

JUN -8 2000

Mark T. Ziminske
Chief, Environmental Resources Section
US Army Corps of Engineers
P.O. Box 3755
Seattle, WA 98124-2255

RE: Informal Consultation Regarding the Chief Joseph and Grand Coulee Dams Dissolved Gas Abatement Project (Consultation Number I/NWR/2000/00688).

Dear Mr. Ziminske:

Thank you for addressing our May 19, 2000, comments on the *Chief Joseph Dam Dissolved Gas Abatement Project Draft Environmental Assessment* and integrated biological assessment. Based on the new information provided in your May 2000, final EA (Environmental Assessment) and a review of information otherwise available to NMFS (National Marine Fisheries Service), we now concur with your April 7, 2000, conclusions that the preferred alternative, as revised and newly described, is not likely to adversely affect UCR (Upper Columbia River) summer steelhead or UCR spring chinook salmon listed as endangered under the ESA (Endangered Species Act), and will not adversely affect designated critical habitat.

The preferred alternative consists of constructing flow deflectors at the Chief Joseph Dam and transferring spill from the Grand Coulee Dam to the Chief Joseph Dam during times of involuntary spill. As stated in our May 19, 2000, correspondence, we were initially concerned that several of the alternatives that were not fully evaluated in your draft EA may have further reduced TDG at the Chief Joseph and Grand Coulee dams and may have additionally increased operational flexibility throughout the FCRPS (Federal Columbia River Power System), potentially reducing TDG (Total Dissolved Gasses) levels in the lower Columbia and Snake rivers as well. The additional information that you have provided, however, supports your conclusion that the preferred alternative will reduce TDG resulting from the operation of these two projects. Additional alternatives to address FCRPS flexibility are being considered in other on-going ESA consultations, and if implemented will compliment your preferred alternative.

It is also our understanding that flow deflector construction will occur in 2002 and 2003, and that the construction process will not result in elevated levels of TDG. If full use of the spillway is required to control TDG during flow deflector construction, construction will be halted,

OPTIONAL FORM 99 (7-90)

| FAX TRANSMITTAL | # of pages ► |
|---|---|
| To JEFF LAUFLE | From DACH |
| Dept./Agency | Phone # 503 736 4734 |
| Fax # | Fax # |
| NSN 7540-01-317-7368 5099-101 | GENERAL SERVICES ADMINISTRATION |

equipment and cofferdams will be removed, and all of the spillbays will be available and operated as needed to control TDG to the extent practicable. As a result, the construction process will not adversely affect ESA listed species.

As noted in the EA, the proposed design of the Chief Joseph Dam flow deflectors is only 10% complete. Although sufficient to determine the constructability of deflectors at high-head dams, and to determine the potential to affect both ESA listed species and other natural resources, the remaining design efforts should be closely coordinated with our engineering staff to help ensure that the maximum level of TDG control can be achieved from the final product. In addition, we also expect to be actively involved in developing the appropriate post-construction evaluation and long-term physical and biological monitoring plans.

This concludes informal consultation pursuant to section 7(a)(2) of the ESA. You should re-analyze the affects of this project if new information reveals that the action may affect listed species or critical habitat in a manner, or to an extent, not considered in this consultation; if the action is subsequently modified in a manner that may affect listed species or critical habitat that was not considered in this consultation; or if a new species is listed or critical habitat is designated that may be affected by this project.

We appreciate your conscientious efforts to comply with the ESA. If you have any questions regarding this letter, please contact Bob Dach of my staff at (503) 736-4734.

Sincerely,

for William Stelle, Jr.
Regional Administrator

APPENDIX E: Finding of No Significant Impact

CENWS-PM-PL-ER 27 June 2000

# CHIEF JOSEPH DAM
# DISSOLVED GAS ABATEMENT PROJECT

## FINDING OF NO SIGNIFICANT IMPACT

1. An Environmental Assessment (EA) has been prepared under the National Environmental Policy Act, for the Chief Joseph Dam Dissolved Gas Abatement Project, on the upper Columbia River, Douglas and Okanogan Counties, Washington. No significant impacts to the human environment were determined to be likely for the proposed project.

2. The project has been undertaken by direction of the National Marine Fisheries Service's 1998 Supplemental Biological Opinion for Operation of the Federal Columbia River Power System (FCRPS), for effects of the FCRPS on anadromous fish species listed as threatened and endangered under the Endangered Species Act (ESA) in the Columbia River. Listed anadromous species directly affected by the project include the Upper Columbia River Evolutionarily Significant Unit (ESU) of spring chinook salmon (*Oncorhynchus tshawytscha*), and the Upper Columbia River ESU of steelhead (*Oncorhynchus mykiss*), both listed as endangered. In addition, a resident fish species, the bull trout (*Salvelinus confluentus*), is also affected; the Columbia Basin Distinct Population Segment of bull trout is listed as threatened. A number of other fish and aquatic invertebrates are also affected.

3. The alternatives include:

a. no action

b. construction of flow deflectors across the entire spillway of Chief Joseph Dam

c. shifting operations so that when involuntary spill is required due to inflow exceeding power generation load, Chief Joseph Dam spills water that would otherwise be spilled by Grand Coulee Dam, while Grand Coulee generates power that would otherwise be generated by Chief Joseph Dam

d. combining deflectors at Chief Joseph Dam (3.b.) with operational shift (3.c.) (preferred alternative).

The preferred alternative provides increased protection against the effects of dissolved gas supersaturation for fish and other aquatic organisms in Lake Rufus Woods and Lake Pateros, as well as Public Utility District reservoirs associated with 5 dams in the midColumbia below Chief Joseph Dam. It will not reduce dissolved gas saturation levels below the state standards of 110% dissolved gas saturation 100% of the time downstream of Chief Joseph Dam or Grand Coulee Dam, but will achieve it under some spill conditions, and will reduce saturation levels below 120% under many spill conditions. It is not expected to result in any significant effects on the human environment.

4. This project has been coordinated with state and federal agencies, Native American Tribes, and the interested public. The US Bureau of Reclamation is cooperatively involved. The interagency System Configuration Team (SCT) was instrumental in project formulation; the SCT's activities helped toward regional acceptance of the proposed plan. The preferred alternative is the most cost-effective federal project for achieving intended results for the upper Columbia River in the United States.

5. Long term benefits for threatened and endangered fish species, as well as other fish and aquatic organisms, are expected from the preferred alternative. Minor, temporary, and nonsignificant short-term disturbance is expected from construction of deflectors. Effects on threatened and endangered species are likely, but are not likely to be adverse.

6. This FONSI will be available for public review for 30 days before the US Army Corps of Engineers makes its final decision whether to prepare an Environmental Impact Statement. It, and the final Environmental Assessment, may be downloaded from the Internet at http://www.nws.usace.army.mil/hh/gas/index.html. The EA, FONSI and General Reevaluation Report for this project will also be available by mail from the US Army Corps of Engineers, Seattle District, attn: Beth Coffey, P.O. Box 3755, Seattle, WA 98124-3755. The General Reevaluation Report is a project analysis to support funding decisions, and supports the EA.

7. Based on the analysis described above and provided in more detail in the EA, and on precedent for similar projects on Federal Columbia River Power System dams, I believe this project is not a major federal action significantly affecting the quality of the human environment, and therefore does not require preparation of an Environmental Impact Statement.

30 Jun 04
Date

James M Rigsby
James M. Rigsby
Colonel, Corps of Engineers
District Engineer

APPENDIX F: List of Preparers and Contributors

| | |
|---|---|
| Jeffrey C. Laufle<br>Fisheries Biologist<br>*Project Environmental Coordinator* | US Army Corps of Engineers, Seattle District |
| George A. Hart<br>Wildlife Biologist | US Army Corps of Engineers, Seattle District |
| Lawr V. Salo<br>Cultural Resources Specialist | US Army Corps of Engineers, Seattle District |
| Marian L. Valentine<br>Water Quality Specialist<br>Water Manager | US Army Corps of Engineers, Seattle District |
| Jeffrey F. Dillon<br>Fisheries Biologist | US Army Corps of Engineers, Seattle District |
| Monte E. Kaiser<br>Civil Engineer | US Army Corps of Engineers, Seattle District |
| Monte McClendon | US Bureau of Reclamation, Boise, Idaho |
| Steve Sauer | US Bureau of Reclamation, Grand Coulee Dam |