**DRAFT SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT**

**PROTOTYPE SPILL TEST**
**CHIEF JOSEPH DAM DISSOLVED GAS ABATEMENT PROJECT**
Douglas and Okanogan Counties, Washington

March 2007

**Responsible Agencies:** The responsible agency for this project is the Seattle District, U.S. Army Corps of Engineers.

**Summary:** The U.S. Army Corps of Engineers (USACE) proposes to conduct a spill test to determine the effects of dam modifications (monolith joint seal improvements and deflector installation) on foundation uplift pressures at Chief Joseph Dam on the Columbia River in Washington. This test would be conducted sometime between late April and early May 2007. Along with that evaluation, the USACE also proposes to conduct a limited evaluation of dissolved gas abatement from the first set of deflectors. The uplift test would entail use of the two bays with deflectors that have historically shown the highest uplift pressures during spill, with spill amounts of 6,000, 11,000 and 16,000 cubic feet per second (cfs; 6, 11, and 16 kcfs respectively) per bay. Dissolved gas measurements would be taken at increments of 2 and 4 kcfs per bay at the beginning of the uplift test. Effects of the spill test include possible adverse uplift pressure on dam monoliths, some loss of system power generation, increases in total dissolved gas (TDG) temporarily above Washington water quality maximum standards, and potential gas bubble trauma to fish downstream of the dam. Loss of system power generation would be mitigated by conducting the test during a low-demand period, largely at night on a Sunday during spring. TDG levels would be mitigated by limiting duration of the event and by adding power generation flows to mix with and dilute high gas levels.

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# 1 Background and Introduction

The National Marine Fisheries Service's (NMFS, also called NOAA Fisheries) 2000 Biological Opinion concerning operation of the Federal Columbia River Power System (FCRPS) included a number of actions intended to reduce the impact of the operation of the FCRPS on threatened and endangered species. Subsequently, these actions were incorporated into the Bonneville Power Administration (BPA), USACE, and Bureau of Reclamation's (together the Action Agencies) Updated Proposed Action plan which was then adopted in NMFS's 2004 Biological

Opinion,  One designated action was to construct flow deflectors at Chief Joseph Dam on the mainstem upper Columbia River in Washington, to ameliorate dissolved gas levels from involuntary spill, which could be harmful to aquatic life.  Construction began in 2006 on the deflectors, and is scheduled to be complete in 2010.

This environmental assessment is prepared pursuant to Sec. 102(c) of the National Environmental Policy Act (NEPA).  This environmental assessment documents potential effects of a prototype spill test intended to allow measurement of uplift pressure on dam monoliths.  It supplements, and except as specified, hereby incorporates information contained in an Environmental Assessment and Finding of No Significant Impact (USACE 2000; see http://www.nws.usace.army.mil/ers/reposit/Abatement_EA.v3.1.pdf) which were completed in 2000 for deflector construction.

# 2 Purpose and Need

**Need:**  Previous data have shown that uplift pressures under certain monoliths at Chief Joseph Dam increase during spill.  A detailed investigation and stability analysis indicated that the transmission of high surface hydrodynamic pressures through the spillway monolith joints during spill was the most likely mechanism for the observed foundation uplift increases leading to possible exceedence of structural stability criteria.  CJD has undertaken an extensive project to repair the spillway joints, which are located along the center lines of the spillway bays.  A method is needed to determine whether uplift pressures are acceptable during spill for the modified spillway condition (i.e., with deflector installation and monolith joint repair).

**Purpose:**  The purpose of the proposed spill test is to  1) observe whether the seal improvements to the deflector and high pressure zone above the deflector limit the transmission of high surface pressures to the foundation; 2) determine the effect on foundation uplift pressures from changing the pressure distribution on the spillway as a result of deflector installation; and 3) assess deflector degassing performance and verify that there are no “red flags.”

# 3 Alternatives

There are two alternatives for this evaluation which are being evaluated in detail:  spill test and no-action.  Alternatives consisting of scale-model and numerical calculation of uplift pressures, as well as joint core sampling, have been considered and rejected as infeasible.

## *3.1 SPILL TEST*

The spill test would consist of spill from two completed deflector bays (gates 12 and 13 in the monoliths where high uplift values have been observed during previous spills (Monoliths 16, 17, and 18).  See Figure 1.  In addition, total dissolved gas (TDG) measurements would also be collected at lower flows to provide some initial data to assess deflector performance.  Flows would be ramped up in five steps and held for a duration of 4 hours each, for a total test length of 20 hours.  The flow steps would be 2, 4, 6, 11, and 16 kcfs per bay, for a total of 4, 8, 12, 22, and 32 kcfs respectively from the spillway during the test.

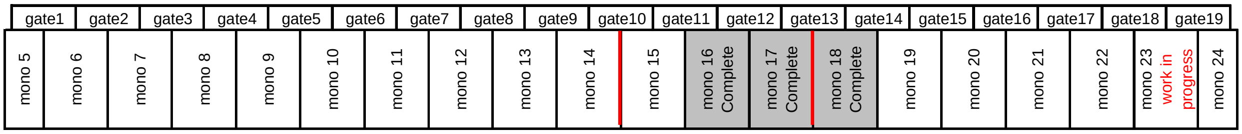

Figure 1. Diagram showing spill gates (bays) 12 and 13, where deflectors have been constructed, and the spill test would occur. The powerhouse is at an angle intersecting the end of the spillway closest to gate 19.

The results of this test would be compared to previous information taken during spill without the deflectors in place, in order to derive an estimate of the effect of the changed (with-deflector) condition and the seal improvements. This is because without the deflectors, the high pressure occurs at the toe of the spillway, whereas with them, the pressure is transferred to the deflector itself. That condition is important to assessing the performance of the seal improvements.

Although there could be involuntary spill when high spring flows exceed generating demand or capacity, this test would be conducted in a planned fashion. That is, it would use voluntary spill, so all measuring and monitoring capability can be put into place with as much preparation as possible. In other words, although involuntary spill could occur during the time of the planned test, it could not and would not be counted on to occur.
*The spill test is the Preferred Alternative.*

## *3.2 NO ACTION*

No planned spill would occur, and no associated measurements of uplift or TDG would be taken. Repairs at a later date would be more costly, and there would be no assurance in the meantime that the joint seal condition would not impact structural soundness of the dam.

## *3.3 ALTERNATIVES CONSIDERED BUT REJECTED*

### 3.3.1 Physical Modeling

It is not possible to effectively determine needed pressure information from a scale model. This alternative is therefore not feasible and was rejected from further consideration.

### 3.3.2 Mathematical Modeling

A stability analysis was done, and that did establish that there was a failure threshold, based on certain assumptions. However, leakage pathways or other factors affecting transmission of high pressures could not be determined using mathematical methods; in other words, the variables associated with the joint seal performance cannot be reliably represented in a mathematical model. Thus a mathematical model alone is too limited to fully determine needed performance information, and was rejected from further evaluation.

### 3.3.3 Joint Core Analysis

This would involve using cores sampled from the joints as a way of evaluating the physical structure of the joints. However, it would be possible to miss leak points, and does not address all mechanisms which might contribute to uplift pressure transmission. This could be done for quality control on future repairs, but would not suffice for the need at hand. This alternative was therefore rejected from further consideration.

# 4 Affected Environment and Effects of Alternatives

The affected environment is limited to the following resources: dam integrity, power generation, water quality (total dissolved gas, but not temperature or turbidity), and aquatic biota. They are discussed in detail in the following:

## *4.1 DAM STABILITY AND UPLIFT*

### 4.1.1 Affected Environment

The integrity of the dam is good, and nothing herein should be interpreted otherwise. But as with any such facility, continued maintenance is needed. A recent investigation of spillway monolith joint condition indicated that the existing bituminous cement seal has deteriorated and failed over large portions of the spillway. Poor condition of monolith joint seals provides a possible pathway for surface hydrodynamic pressures generated during spill to be transmitted to the rock foundation, causing unacceptably high uplift pressures and adversely affecting dam stability. The Corps has determined that a new redundant or dual seal system from the spillway tainter gate seal to the deflector is necessary to prevent hydraulic connectivity between the spillway face and the foundation. The addition of deflectors changes the hydrodynamic pressure distribution on the spillway face, moving the high pressure zone from the toe of the spillway to the horizontal portion of the deflector and the spillway ogee immediately upstream of the deflector.

### 4.1.2 Effects of Alternatives

#### *4.1.2.1 Spill Test*

Although unlikely, it is possible that uplift pressure would exceed dam stability criteria. This would most likely occur at the higher flows of 6, 11 and 16 kcfs per bay. Pressures would be closely monitored to ensure appropriate response to such a condition. If sensors indicate that maximum criteria for uplift pressure are exceeded, the spill test would be terminated immediately. Based on the duration and magnitude of the test, along with continual management during the event, there would be no opportunity for dam safety to be compromised as a result of the test.

#### *4.1.2.2 No Action*

No spill test would be conducted on the first two deflectors. No uplift pressure would be generated and no measurements of uplift pressure or TDG would be done.

### 4.1.3 Mitigation

#### *4.1.3.1 Spill Test*

Dam safety would be protected. If sensors recording in real time indicate that maximum criteria for uplift pressure are exceeded, the spill test would be terminated immediately.

#### *4.1.3.2 No Action*

There would be no activity that could create exceedence of uplift criteria, so no mitigation would be required.

# 4.2 POWER GENERATION

## 4.2.1 Affected Environment

Hydropower generation is scheduled to meet electricity demand (load), and that power is distributed to utilities and other users through a centrally coordinated system. In the case of the FCRPS, of which Chief Joseph Dam is a part, power is distributed by the Bonneville Power Administration. Water that is spilled does not go through turbines, and therefore does not generate power. Depending on the demand, that may result in foregone revenue.

Also, a large part of Chief Joseph Dam's hydroelectric output is utilized for power system support. Hydro generation is far more responsive to demand changes than are other types of generation such as coal plants and other thermal sources, and adds to the flexibility of the system to react.

## 4.2.2 Effects of Alternatives

### *4.2.2.1 Spill Test*

The test would involve spilling water and thus making it unavailable to the turbines for power generation at Chief Joseph Dam. Although water has greater value and potential for power generation the higher in the system it is and the more dams it passes through, this effect would be confined to Chief Joseph Dam only, and not other dams. The total volume of water spilled would equal approximately 25,740 acre-feet (given spill amounts and the fact that one cubic foot per second [cfs] of flow over 1 day equals approximately 1.98 acre-feet).

Because of hydropower's flexibility, Chief Joseph Dam supports load fluctuations throughout the northwest. When spill reduces generating capacity, other generators need to provide this support. Thus, there might be some minor impact to the flexibility of the power system in general from the spill test.

### *4.2.2.2 No Action*

No spill would occur, and the 25,740 acre-feet of water that would otherwise be expended would instead be conserved and used for power generation, unless circumstances not associated with the test dictated involuntary spill.

## 4.2.3 Mitigation

### *4.2.3.1 Spill Test*

The test is being planned for springtime, when normally high flows in the system result from snowmelt. Springtime is also typically a season of low power demand, as winter heating requirements decrease, and summer demand for air conditioning is not yet great. In addition, the test would take place on a Sunday, a time of week when demand is also low compared to weekdays when work-related requirements are highest. The greatest spill during the test would also occur at night, which is the low-demand time of any 24-hour period. Finally, because of high flow volumes and relatively low power demand, rates for hydropower sales are typically low in springtime. All of these factors would combine to minimize foregone revenue, especially given that load requirements can be met elsewhere in the system.

*4.2.3.2 No Action*

No mitigation would be planned or needed if the test were not conducted.

## *4.3 WATER QUALITY*

### 4.3.1 Affected Environment

No water quality constituents other than TDG would be affected by this test.

As detailed in USACE (2000), high levels of total dissolved gas (TDG) in water, especially for prolonged periods, can be harmful or fatal to aquatic organisms. The injuries come from dissolved gas coming out of pressure as bubbles that lodge in the bloodstream (blocking blood flow) and tissues of fish, in a condition similar to decompression sickness, or “the bends” in human divers. Indeed, reducing TDG levels from involuntary spill at Chief Joseph Dam is the reason for the installation of the flow deflectors there. Without spill in the system, the normal levels of TDG are less than 110% saturation, which is not considered harmful.

Ecology has classified the Columbia River above and below Chief Joseph Dam as a salmon and trout spawning non-core rearing and migration aquatic life use water body, while the CCT has classified the Columbia River as a Class I water body above Chief Joseph Dam and a Class II water body below the dam. Water quality standards for TDG and temperature for Chief Joseph Dam are presented in Table 1. At Chief Joseph Dam, the State of Washington and the CCT have a similar TDG maximum standard of 110%. However, Washington allows exceedance of the 110% TDG criterion to facilitate fish passage spills as shown in Table 1. Ecology provided an approval in 2005 for activities at FCRPS projects including tests on gas abatement operations and structures (attached letter dated March 31, 2005 from David Peeler to Karen Durham-Aguilera [Corps] and Dan Diggs [USFWS]). In addition, the TDG criterion established by Washington State and the Colville Tribe does not apply to flows above the seven-day, ten-year frequency (7Q10) flood flow of 222 kcfs.

Table 1. Washington Department of Ecology (Ecology) and Colville Confederated Tribes (CCT) water quality standards for total dissolved gas.

| Parameter/Project | Regulator | Standard |
|---|---|---|
| **Total Dissolved Gas** | | |
| Chief Joseph Dam | Ecology | Shall not exceed 110% of saturation at any point of sample collection, except during spill season for fish passage in which total dissolved gas shall be measured as follows:<br>(1) Must not exceed an average of 115% as measured in the forebay of the next downstream dam.<br>(2) Must not exceed an average of 120% as measured in the tailrace of each dam; TDG is measured as an average of the 12 highest consecutive hourly readings in any one day, relative to atmospheric pressure.<br>(3) A maximum TDG one-hour average of 125% as measured in the tailrace must not be exceeded during spillage for fish passage. |

## 4.3.2 Effects of Alternatives

### *4.3.2.1 Spill Test*

Optimal gas abatement for the design of the deflectors on Chief Joseph Dam is associated with flows less than 7.5 kcfs per spill bay, and would keep TDG levels at or below 120% saturation. Normally, impacts on aquatic organisms from TDG saturation levels less than 120% over limited periods of time are considered minimal (see Sec. 4.4.2.1)

However, this test would be conducted with only two deflectors available, and at higher spill flows than the optimal gas abatement maximum per bay. Thus, TDG levels immediately below the spillway bays in use might be as follows (Mike Schneider, USACE, pers. comm., 2007):

Table 2. Anticipated dissolved gas saturation levels associated with spill during spill test. Each flow increment would last 4 hours.

| Spill level per bay (cfs; 2 bays operating) | TDG saturation |
|---|---|
| 2,000 | 110%. |
| 4,000 | 115% |
| 6,000 | 120% |
| 11,000 | 128% |
| 16,000 | 135% |

These TDG levels would attenuate downstream to some extent as the affected water arrived at the mouth of the Okanogan River and crossed a bar that is there. They would also be diluted to some extent by powerhouse flows (see Mitigation, Sec. 4.3.3.1, below).

### *4.3.2.2 No Action*

No voluntary spill would occur, and TDG levels would be at background levels, most likely below 110% saturation, assuming no involuntary spill was occurring at Chief Joseph Dam or upstream in the system.

## 4.3.3 Mitigation

### *4.3.3.1 Spill Test*

The Bonneville Power Administration (C. Hutchison, B. Barry, BPA, pers. comm, 2007 [phone contact with Carolyn Fitzgerald, USACE, 14 Mar 2007]) is prepared to shift generation to Chief Joseph Dam during the spill test to provide at least twice the flow through generating units that is being spilled. That will provide dilution and mixing as the gas-laden water moves downstream, so that effects will be reduced. The mixing zone should begin at less than 1.3 miles downstream from the spillway; there is s fixed TDG monitoring station at that distance.

### *4.3.3.2 No Action*

Since no voluntary spill would occur, no mitigation is needed.

# 4.4 BIOLOGICAL RESOURCES

## 4.4.1 Affected Environment

### *4.4.1.1 Aquatic Biota*

Various species of fish could be affected by elevated TDG concentrations. The following paragraphs include material taken from USACE (2000).

There are several species of fish above and below Chief Joseph Dam; many were introduced from outside the Columbia basin. Table 3 lists species presence in the mid-Columbia River and the three uppermost U.S. mainstem reservoirs.

Table 3. 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; USACE, 1998; Venditti, 2000).

| **Family**<br>**Species**<br>* Indicates species native to the Columbia basin. | **Mid-Columbia** | **Lake Pateros** |
|---|---|---|
| Petromyzontidae—Lampreys | | |
| Pacific lamprey (*Entosphenus tridentatus)** | X | X |
| Acipenseridae—Sturgeons | | |
| White sturgeon (*Acipenser transmontanus*)* | X | |
| Salmonidae—Whitefish, Trout, Salmon, Char | | |
| Mountain whitefish (*Prosopium williamsoni*)* | X | X |
| Lake whitefish (*Coregonus clupeaformis*)* | | X |
| Cutthroat trout (*Oncorhynchus clarki*)* | | |
| Rainbow trout (*Oncorhynchus mykiss*)* | X | X |
| Kokanee (*Oncorhynchus nerka*)* | X | |
| Sockeye salmon (*Oncorhynchus nerka*)* | X | |
| Chinook salmon (*Oncorhynchus tshawytscha*)* | X | X |
| Coho salmon (*Oncorhynchus kisutch*)* | X | X |
| Steelhead (*Oncorhynchus mykiss*)* | X | |
| Brown trout (*Salmo trutta*) | | |
| Bull trout (*Salvelinus confluentus*)* | X | X |
| Brook trout (*Salvelinus fontinalis*) | | |
| Esocidae—Pikes | | |
| Northern pike (*Esox lucius*) (unconfirmed) | | |
| Cyprinidae—Minnows | | |
| Chiselmouth (*Arcocheilus aleutaceus*)* | X | X |
| Carp (*Cyprinus carpio*) | X | X |
| Peamouth chub (*Mylocheilus caurinus*)* | X | X |
| Northern pikeminnow (*Ptychocheilus oregonensis*)* | X | X |
| Speckled dace (*Rhinichthys osculus*)* | | |
| Redside shiner (*Richardsonius balteatus*)* | X | X |
| Chub (unknown) | | |
| Catostomidae—Suckers | | |
| Sucker spp. (*Catostomus* spp.)* | | X |
| Longnose sucker (*Catostomus catostomus*)* | | |
| Bridgelip sucker (*Catostomus columbianus*)* | X | X |
| Largescale sucker (*Catostomus macrocheilus*)* | X | X |
| Ictaluridae—Catfishes | | |
| Black bullhead (*Ameiurus melas*) | X | |
| Brown bullhead (*Ameiurus nebulosus*) | X | X |
| Yellow bullhead (*Ameiurus natalis*) | | X |
| Gadidae—Cods | | |
| Burbot (*Lota lota*)* | | |
| Gasterosteidae—Sticklebacks | | |
| Threespine stickleback (*Gasterosteus aculeatus*)* | X | |
| Percopsidae—Troutperches | | |

| | | |
|---|---|---|
| Sandroller (*Percopsis transmontana*) | X | |
| Centrarchidae—Bass and Sunfishes | | |
| Black crappie (*Pomoxis nigromaculatus*) | | X |
| Largemouth bass (*Micropterus salmoides* ) | | X |
| Smallmouth bass (*Micropterus dolomeui*) | X | X |
| Pumpkinseed (*Lepomis gibbosus*) | X | X |
| Bluegill (*Lepomis macrochirus*) | X | X |
| Percidae—Perches | | |
| Yellow perch (*Perca flavescens*) | | X |
| Walleye (*Stizostedion vitreum*) | | X |
| Cottidae—Sculpins | | |
| Prickly sculpin (*Cottus asper*)* | | X |
| Paiute sculpin (*Cottus beldingi*)* | | |
| Torrent sculpin (*Cottus rhotheus*)* | | |
| Sculpin (*Cottus* spp.)* | X | |

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. Bottom-oriented species (eg, sculpins) in the vicinity of the shore where water depths are less than 1-2 meters might also be vulnerable to GBD.

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.

Counts are kept on anadromous fish transiting Columbia dams. Smolt indices by species and date are shown in Figure 2, at Rock Island Dam in the mid-Columbia. Rock Island is the closest project for which data were available under the University of Washington's fish passage web page (Univ. of Washington, 2007). 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. Figure 3 shows adult indices spanning the period from 1997 to 2006. None of these numbers distinguishes between hatchery and wild fish. This information indicates that smolts may be in the affected area, and depending on their depth and location relative to spill, could be affected. However, in general, adult anadromous salmonids would not be present during the spill test, except possibly for overwintering steelhead, which may be affected.

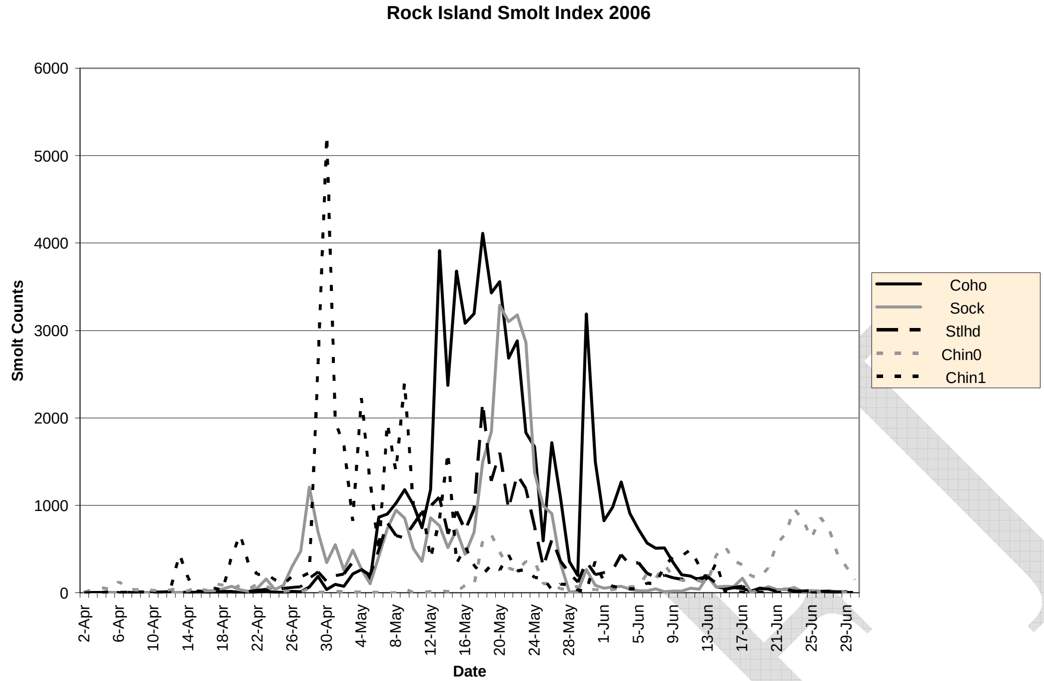


Figure 2. Daily smolt counts for 2006, for coho, sockeye, steelhead, and age-0 (fry) and age-1 Chinook at Rock Island Dam on the mid-Columbia River (Univ. of Washington 2007). No smolt counts are available at Wells Dam, between Chief Joseph and Rock Island dams.

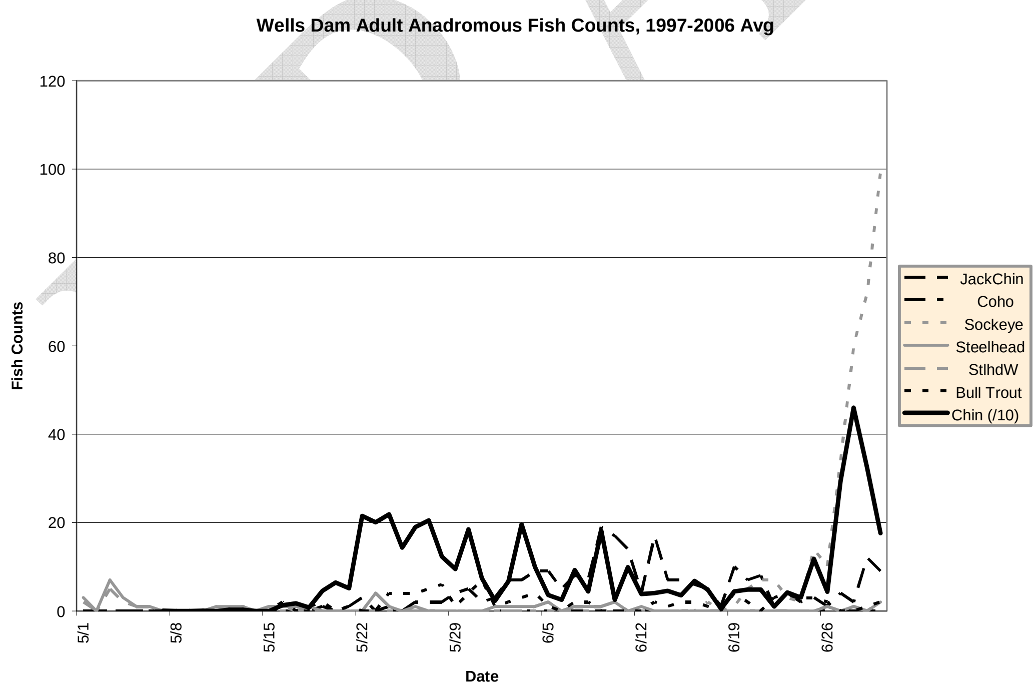


Figure 3. Adult anadromous fish counts at Wells Dam, the project next downstream from Chief Joseph Dam (Univ. of Washington 2006). Adult Chinook (Chin) numbers were divided by 10 to better show the other species on this scale.

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.

#### *4.4.1.2 Threatened and Endangered Species*

Fish with status under the Endangered Species Act in the project area are

- spring Chinook salmon (Upper Columbia Evolutionarily Significant Unit, endangered [70 FR 37160]; critical habitat designated [70 FR 52630])
- steelhead (Upper Columbia Distinct Population Segment, threatened [71 FR 834]; critical habitat designated [70 FR 52630])
- bull trout (Columbia River Distinct Population Segment, threatened [63 FR 31647]; critical habitat designated [69 FR 59995]).

The following summaries provide general information about threatened and endangered species, including updates on status:

*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.

*Upper Columbia River steelhead*. NMFS listed the UCR steelhead ESU as endangered on August 18, 1997 (62 FR 43937), but has downlisted it as the UCR Distinct Population Segment to threatened as of January 5, 2006 (71 FR 834), stating, "The Upper Columbia River steelhead DPS includes all naturally spawned populations of steelhead in streams in the Columbia River Basin upstream from the Yakima River, Washington, to the U.S.-Canada border (62 FR 43937; August 18, 1997). Six artificial propagation programs are considered part of the DPS…: the Wenatchee River, Wells Hatchery (in the Methow and Okanogan Rivers), Winthrop NFH, Omak Creek, and the Ringold steelhead hatchery programs." Life-history characteristics of UCR steelhead have been reviewed by Chapman et al. (1994) and Busby et al. (1996). Main populations in the project area are from the Methow and Entiat rivers.

Concerning status of this DPS, NMFS (71 FR 834) said, "Recent years have seen an encouraging increase in the number of naturally produced fish in the Upper Columbia River steelhead DPS. The 1996–2001 average return through the Priest Rapids Dam fish ladder (just below the upper Columbia steelhead production areas) was approximately 12,900 total adults (including both hatchery and natural origin fish), compared to 7,800 adults for 1992– 1996. However, the recent

5-year mean abundances for naturally spawned populations in this DPS are 14 to 30 percent of their interim recovery target abundance levels."

*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, meaning they are more likely to remain one year in freshwater after hatching than to go to saltwater in their first spring or summer. 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). According to NMFS (2005), "All three existing Upper Columbia River spring-run Chinook salmon populations have exhibited similar trends and patterns in abundance over the past 40 years. The 1998 Chinook salmon status review (Myers et al. 1998) reported that long-term trends in abundance for upper Columbia River spring-run Chinook salmon populations were generally negative, ranging from –5% to +1%. Analyses of the data series, updated to include 1996–2001 returns, indicate that those trends have continued. The long-term trend in spawning escapement is downward for all three systems. Since 1958, Wenatchee River spawning escapements have declined at an average rate of 5.6% per year, the Entiat River population at an average of 4.8% per year, and the Methow River population at an average of 6.3% per year. These rates of decline were calculated from the redd count data series."

As noted, six hatchery populations are included in this ESU; all six are considered essential for recovery and are included in the listing.

Ashbrook et al (2006) have documented Chinook salmon movement in the Columbia and tributaries downstream of Chief Joseph Dam. Chinook approach Chief Joseph Dam, and the proposed Colville Confederated Tribes hatchery site not far downstream on the north (right) side of the river. Ashbrook et al recommended evaluation of possible Chinook spawning in the mainstem Columbia below Chief Joseph Dam.

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.

*Bald eagle*. 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.

## 4.4.2 Effects of Alternatives

### *4.4.2.1 Spill Test*

The TDG levels close to the operating spill bays (12 and 13; see Fig. 1) would be as shown in Table 1. TDG levels above 120% for prolonged periods of time could harm fish within 1-2 meters of the water's surface in the unmixed spill plume. With generation flow added to the spill, there would be reduced risk once mixing occurs. Marotz et al (2006) and Dunnigan et al (2003) observed resident fish impacts in the Kootenai River in Montana from two spill events at Libby Dam, and found that incidence of symptoms depended on TDG level, spill duration, species and location of the fish relative to the spill plume. Rainbow trout, mountain whitefish, bull trout, and kokanee seemed most susceptible. To the extent that fish are in the spill plume and near the surface especially close downstream of Chief Joseph Dam, they may be impacted, but predicting extent of incidences or symptoms is not possible based on existing capabilities.

There may also be entrainment of fish over the spillway. Although some flow deflector systems are considered less harmful than others, the spillway at Chief Josph Dam could result in some unknown amount of injury or mortality to fish entrained during spill.

If fish are impacted, eagles and other fish-eating wildlife may temporarily benefit from them as a food resource. It is not anticipated that there would be a long-term impact in terms of a measurable reduction in food for predators and scavengers of fish.

### *4.4.2.2 No Action*

No fish would be exposed to elevated TDG levels from the test, and none would be harmed unless involuntary spill was elevating TDG levels at Chief Joseph Dam or another dam upriver.

### 4.4.3 Mitigation

*4.4.3.1 Spill Test*

There would be additional flows through the generating units during the spill test. These flows would be at least twice as much as what is being spilled, and would provide mixing and dilution for the elevated TDG levels. That plus the limited duration of elevated TDG levels should serve to minimize possible impacts to aquatic organisms.

*4.4.3.2 No Action*

No spill would occur, and no mitigation would be needed.

# 5 Conclusions

Any indication of unacceptable dam uplift pressure would result in termination of the test. The most likely impacts would relate to water quality and fisheries effects from short-term elevations in total dissolved gas. This would be mitigated by adding powerhouse flow to mix with spilled water and reduce these higher TDG levels. Coordination is taking place with concerned regulatory agencies and Native American tribes to ensure required approvals are obtained and to protect aquatic resources. No significant impacts to the human environment are anticipated from this test.

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**List of Preparers**

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Julie Allen, Hydraulic Engineer, U.S. Army Corps of Engineers, Seattle

March 20 2007

Jeff,

Here you go. we read this as applying to CJ Dam for wato quality/fish improvement-related activities - mostly for fish spill season but also for tests on gas abatement operations and structures

Chris Maynard

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
*PO Box 47600 • Olympia, WA 98504-7600 • 360-407-6000*
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March 31, 2005

**REGISTERED MAIL**

Ms. Karen Durham-Aguilera
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PO Box 2870
Portland, Oregon 97208-2870

Mr. Daniel H. Diggs
Assistant Regional Director
Fisheries Resources
U.S. Fish and Wildlife Service
911 NE 11th Avenue
Vancouver, WA 987232-4181

Dear Ms. Durham-Aguilera and Mr. Diggs:

On January 14, 2005, the U.S Army Corps of Engineers (Corps) and the U.S. Fish and Wildlife Service (USF&WS) requested approval to adjust the Total Dissolved Gas (TDG) criteria to spill water at Corps dams on the Columbia and Snake Rivers in Washington to assist downstream migration of juvenile salmonids. We require approval of gas abatement plans under Washington State Water Quality Standards WAC 173-201A-060(4)(b) in order to apply the adjusted TDG standards to the Columbia River.

The Corps submitted a gas abatement plan (Water Quality Plan for Total Dissolved Gas and Water Temperature in the Mainstem Columbia and Snake Rivers, December, 2003) to Ecology. The Corps and USF&WS also submitted the following.

- TDG physical monitoring plans.
- Biological monitoring plans.

**The Washington State Department of Ecology approves the gas abatement plan.** This approval is based on the following findings:

1. Failure to act will result in more salmonid passage through the hydroelectric dam turbines. Estimated mortality from juvenile salmonids passing through turbines is between ten and fifteen percent; juvenile salmonid passage mortality over dam spillways is between two to three percent.

2. Exposure to elevated TDG as a result of spill is harmful to fish. However, anadromous salmonids experience less harm when exposed to limited concentrations of TDG than the harm experienced by passing through turbines. A risk analysis was performed by the United States National Oceanographic and Atmospheric Administrations Fisheries in 1996 and updated in 2002. Based on this risk analysis, Ecology water quality standards allow higher levels of TDG upon approval of gas abatement plans.
3. The Corps is providing structural and operational improvements at both dams.
4. The forebay monitoring stations discovered negligible TDG bubble trauma in juvenile salmonids.

This approval is subject to the following conditions:

1. This approval shall extend through February 2008, and apply to Corps dams on the Columbia and Snake Rivers in Washington State.
2. This approval means that spill may raise the dissolved gas levels above 110% saturation to aid fish passage but not to exceed 125% saturation as a one hour average. Gas saturation may not exceed 120% in the tailrace and 115% in the forebay of the next dam downstream as measured at the fixed monitoring stations as an average of the twelve highest readings in any one day.
3. The Corps is expected to conduct the following activities:
   a. Investigate and pursue TDG reduction and monitoring improvements as new information becomes available.
   b. Investigate biological effects data gaps for total dissolved gas for all species, especially between the end of the aerated zone and the fixed tailrace monitor at each dam. Plan for studies identified during this investigation. Provide yearly progress reports. Forebay biological monitoring for juvenile salmonids is not required.
   c. Investigate TDG reduction improvements to the outfall of the Bonneville corner collector. Provide a yearly report on the results of this investigation;
   d. Make reasonable attempts to reduce gas entrainment during all flows during the spill season.
   e. Plan maintenance schedules and activities as much as possible to minimize TDG production resulting from spill to within water quality standards. Plan turbine outages as much as possible for outside the high flow season when this will not cause more harm to the environment or to the structural integrity of the dam.
   f. Notify Ecology within 48 hours of initiation of spring, summer and other spills for fish. The notification may be electronic or written.

g. Provide Ecology with an annual written report by December 31 of each year for the activities outlined in this letter and detailing the following:

- Flow and runoff descriptions for the spill season.
- Spill quantities and duration.
- Quantities of water spilled for fish versus spill for other reasons for each project.
- Data from the physical and biological monitoring programs including a summary of exceedances for each dam, and a description of what was done to correct the exceedance.
- Progress on TDG abatement implementation measures.

This gas abatement approval does not limit the conditions placed in future permits, orders, and certifications, issued by this Department.

Please contact me at (360) 407-6405, or Chris Maynard of my staff at (360)407-6484, if you have any questions or comments regarding this approval.

Sincerely,

David C. Peeler
Water Quality Program Manager

cc: Agnes Lutz, ODEQ
Columbia River Water Quality Team
Ecology Regional Water Quality Managers