SYSTEM OPERATIONAL REQUEST: #2005-MT-1

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DATE: July 6, 2005

SUBJECT: ***Updated*** **Libby & Hungry Horse Operations for July through September**

Biological Objectives

The objective of this SOR is to continue implementation of the Northwest Power and Conservation Council's Mainstem Recommendations for operation of Libby and Hungry Horse dams from July through September. This SOR recommends continuation of the July through September operations begun in the summer of 2005. Last summer's operation began partial implementation of the Council's recommended summer operation at Libby and Hungry Horse. The proposed operation will provide habitat that is proposed for "critical habitat" designation by the US Fish and Wildlife Service (USFWS) for listed bull trout and provide improved environmental conditions for other resident fish that inhabit the reservoirs and the rivers above and below Libby and Horse dams without harming ESA listed Snake River fall chinook in the Lower Columbia.

This SOR proposes to implement an evaluation of the physical and biological effects of the proposed operational changes for Libby and Hungry Horse. Physical changes in flows in the Lower Columbia River will also be evaluated. Physical changes in flows and water quality (primarily temperatures) that occur in reservoirs and rivers in Montana and the Lower Columbia River below McNary will be evaluated. Experiments have been designed and are ready to be implemented in Montana to evaluate the biological changes that result from implementation of this SOR.

Specifications

Continue implementation of the Northwest Power Planning Council's Mainstem Recommendations for operation of Libby and Hungry Horse dams during July through September. The following specific operations are recommended:

Hungry Horse

a. Maintain minimum flows for bull trout. Based on this years volume forecast the minimum flows will be 3,250 cfs at Columbia Falls and 483 cfs from Hungry Horse dam.

b. Refill by about June 30.

c. Operations in May and June have insured that there is a high likelihood of filling Hungry Horse reservoir by about the end of June. Following refill, the Bureau of Reclamation will utilize its hydrologic models to estimate a flat flow from Hungry Horse for July through September that will draft the reservoir to 20 feet from full by September 30, 2005. This operation will be monitored throughout the summer to insure that the reservoir draft limit is achieved.

d. Attempt to provide even or gradually declining flows at Columbia Falls during the draft (minimize double peak).

e. Limit spill to avoid exceeding Montana State TDG standards of 110%.

Libby

a. Flows at Libby have increased substantially during June to prevent the reservoir from filling too quickly, thus causing spill. As inflows drop below the current turbine capacity outflow and the reservoir approaches full, establish a flat flow using the Corps hydrologic models. These models are currently estimating a flat flow of 13.6 kcfs would be necessary to draft Libby to the end of September elevation of 2439, 20 feet from full. Last year a flat flow of 12.5 kcfs was maintained for the July through September period and this produced excellent biological conditions for resident fish below Libby dam. This operation will be monitored throughout the summer to insure that the reservoir draft limit is not exceeded.

b. Operate to provide at least minimum bull trout flows through September (USFWS BiOp).

c. Provide even or gradually declining flows during summer months (minimize double peak).

d. Investigate the possibility of a storage exchange with Canada to reduce summer flows from Libby.

Grand Coulee

a. To contribute to providing the conditions necessary to protect spawning and rearing habitat for fish in, and adjacent to, Lake Roosevelt consistent with recommendations of the Spokane and Colville Tribes, the following operations are implemented in 2005.

   i. September refill to no higher than elevation 1285 feet to assure that additional September flows from Libby and Hungry Horse are passed through Lake Roosevelt. This range will be modified in future years to assure flow augmentation water from Montana passes through Grand Coulee and historic elevation levels are achieved at Lake Roosevelt.

Biological Evaluations

Repeat recent radio tracking experiments in the Flathead and Kootenai. This will allow a comparison of changes in fish movement and response to flow fluctuations caused by the dam operations called for in this SOR.

Review the IFIM data and modeling under both the previous operation and under the proposed operation. Actual field observations will be conducted to see how fish are using the habitats at more constant flows and determine any changes from previous measurements.

Evaluate the changed operations by using the existing biological models and validate these simulations with field sampling to determine the change in reservoir productivity. Also evaluate the in-river changes through food web sampling and compare with baseline data.

In the Lower Columbia River existing radio tracking experiments should be continued and combined with pit tag data that will help to compare fish (adult and juvenile) travel times across the range of flows.

Montana Fish Wildlife & Parks has a range of field experiments that will provide useful information on the changes in survival and productivity of bull trout and resident fish below Libby and Horse and in the reservoirs. These experiments will be continued and to the extent possible provide additional biological information on the benefits of the proposed operation for resident fish.

Justification

Biological Justification for Libby & Hungry Horse Operations

The operation proposed in this SOR will result in a summer outflow from Libby dam in the range of 10 to 15 kcfs. The precise value is difficult to determine until current high inflows recede and reservoir storage volumes are better known. Current estimates are that the outflows from Libby would have to be approximately 19 kcfs if the reservoir was drafted to 20 feet from full by the end of August. This SOR proposes a flow reduction over July and August that will provide increased flows in September. The flow changes in Montana will be significant to the productivity of resident fish. As in previous years, it is anticipated that this change in flows at Libby will result in far smaller flow changes at McNary dam due to the attenuation of flows as the water is routed through the Canadian and US reservoirs above McNary.

The biological objective of drafting Libby and Hungry Horse reservoirs during the summer for anadromous fish is based in a belief that increased flows in the Lower Columbia will provide biological survival benefits for listed Snake River fall chinook. This issue has been debated for over ten years. Last years operations at Libby and Horse came close to implementation of the Council's Mainstem Recommendations. Even so there was considerable scientific discussion and debate about the possible affects on resident and anadromous fish in Montana and the Lower Columbia. In response to this uncertainty, NOAA requested that the Council host, and the Independent Scientific Advisory Board (ISAB) conduct, a River Operations/Flow Symposium. This Symposium was held in Portland on November 9 & 10, 2004. The following is a summary of the ISAB's findings with respect to the Council's Mainstem Recommendation for Libby and Horse operations.

ISAB Findings

"Although summer-migrating juvenile fall Chinook salmon from the Snake River have been the main concern for downstream effects of the Montana proposal, there is new information about this stock's life history. Some juveniles are holding over their first winter in fresh water and emigrating as yearlings in the spring (termed the "reservoir" life history, also referred to as the holdover life history). Importantly, a disproportionately large percentage of returning adults are originating from these holdovers… The intent of flow augmentation is to reduce mortality of smolts by speeding their migration to the ocean. With the recent findings of the large adult contribution from migrants exhibiting the reservoir life history, and also for PIT-tagged late fall migrants (NOAA Fisheries, unpublished data), the strategy of using flow augmentation to speed migration should be reassessed."

"Because adults respond negatively to flow increases, the effects of these increases on them, not just on juveniles, need to be considered as well. No existing models seem adequate for evaluating the flow effects from the Montana proposal."

"All indications are that the down-river effects of the shifts in flow associated with the Council's Mainstem Amendments of 2003 will be small… As a result, the Council's hypothesis that the effects on survival of salmonids in the lower Columbia River will be indiscernible is probably reasonable."

"Without a grounding in actual measurements that involve these factors, it is difficult to see how operational changes at Hungry Horse and Libby in August and September can be translated into functionally significant changes in salmon migrations, especially fall Chinook salmon migrations in the lower river, or in any other downstream species."

"The incremental effects of the Montana System Operations Request on the mid-Columbia and lower Columbia, however, are likely to be beneficial at certain times as well as detrimental at others because of the shifting of flows between months, rather than any consistently one-sided net change."

"Using present estimates of both hydrology and biology, we conclude that the effects of the Mainstem Amendment and the Montana System Operations Request on salmonids downstream in the Columbia River are likely to be small."

"Finding a practical and feasible experimental design is difficult because the effects of the Montana proposal are likely to be small, both in terms of water amounts delivered and the resulting effects, if any, on survival… The range of estimates now available, however, suggests a numerically low change in overall salmon survival, with uncertainty over direction."

"For example, in late 2002, the Council staff compared estimates of fish survival derived from SIMPAS (version 9) and CRiSP (Council memoranda dated November 6 and December 2 from Bruce Suzumoto to Council members). For SIMPAS, 11 populations of listed and unlisted stocks were examined; six for CRiSP; High, medium, and low flow regimes were evaluated. Using SIMPAS, the estimated percentage change in survival for Montana operations compared to the BiOp flows were 0, 0.3, 0.2 (high summer flow), -0.7, 0.5, 0 (medium summer flow), and 0, 0.2, and -0.5 (low summer flow) for Snake River fall Chinook, Lower Columbia Chinook, and Hanford Reach fall Chinook, respectively; all less than 1%. The most comparable results from CRiSP showed in-river survivals of 0.035 and 0.021 (high flow), -0.068 and -0.050 (medium flow), and -0.083 and -0.049 (low flow) for Hanford Reach fall Chinook and Snake River subyearling Chinook, respectively; again, all estimates substantially less than 1%. Furthermore, "small" in this analysis ranges from an estimated loss of 7 fish in 1,000 to a gain of 5 fish in 1,000 using SIMPAS, whereas using CRiSP, there is an estimated loss of about 8 fish in 10,000 (less than 1 in 1,000) to a gain of 3.5 fish in 10,000 (less than 1 in 1,000). Although we are reluctant to place high confidence in either of these models, the estimated changes in survival are quantitatively low and of inconsistent sign."

"Council staff estimated the 50-year-average change in flow at McNary Dam to be diminished by 8.3 kcfs in July and 5.6 kcfs in August, but increased by 0.9 kcfs in September. The largest of these estimates (-8.3 kcfs) would yield an estimated change in survival from McNary to John Day of 0.01 percent (1 fish in 10,000) using graphical analysis of the plot shown by Steve Smith of NOAA Fisheries."

"The Council hypothesized in its Mainstem Amendments that certain modifications to current operations at Hungry Horse and Libby dams would significantly benefit resident fish without discernable adverse effects on the survival of juvenile and adult anadromous fish in the lower Columbia River. We conclude the following:

1. Resident fish and fisheries influenced locally by the Hungry Horse and Libby water-release situations may receive important biological benefits from the flow modifications, assuming they are carried out as planned. It is almost certain that the general productivity in the Montana reservoirs and in the immediate downstream reaches will benefit considerably. What are uncertain are the effects on the species of greatest concern (sturgeon and bull trout) when the increased productivity propagates through the community of predators, prey, and competitors. If the effects on these species are very large, they may be detected by future monitoring, but attribution of cause may still be confounded unless the experimental design alternates to provide years when the Montana System Operations Request is implemented and years when it is not.

2. Effects of the Council's Mainstem Amendment and resulting Montana operations proposal on the survival of juvenile and adult anadromous fish in the Columbia River below Chief Joseph Dam will probably be very small. The available data and analytical tools do not allow us to say whether the net effect will be positive or negative for fish present in the river in the August-September period. Other time periods were not addressed in the symposium. Based on the best information now available, the Council was likely justified in its hypothesis that the flow modifications at Hungry Horse and Libby dams outlined in its Mainstem Amendments would lead to effects on survival of juvenile salmonids in the mainstem Columbia River that will be too small to measure practically against both the measurement error itself and real background variation due to other causes.

3. Recognition of the holdover or "reservoir" life history pattern of one of the foremost stocks of concern, the ESA-listed Snake River fall Chinook, complicates assessment of this stock in relation to the flow proposal. Because further research on this life history pattern is so critically needed, it is important to implement monitoring systems that will make it possible to quantify the magnitude of holdover behavior and how that affects estimates of smolt survival and SAR, as well as to reveal what factors affect holdover behavior and overwintering survival in freshwater."

Last fall's Flow Symposium was not the first time that the ISAB was asked to review proposals to modify operations at Libby and Hungry Horse. In a report to the Council by the ISAB on the scientific justification for augmenting flows using limited reservoir storage volumes. The ISAB said:

> "The prevailing flow-augmentation paradigm, which asserts that in-river smolt survival will be proportionally enhanced by any amount of added water, is no longer supportable. It does not agree with information now available."

However, arguments are also made that travel time is also a critical attribute of overall salmon survivals. With respect to the travel time argument the ISAB said:

> "The paradigm that faster movement of smolts to the estuary and ocean is always favorable for survival needs to be evaluated. Most of the reach survival studies we reviewed make this assumption. Increased migration rate and survival in the studied reaches (primarily the lower Snake River) does not ensure survival in lower reaches. The fish have to spend their time somewhere and could experience increased survival rates, the same survival rates, or decreased survival rates."

The ISAB also reviewed the latest in scientific research into the affects of flows on survivals of anadromous fish in the Mid-Columbia and Lower Columbia reaches where it found:

> "Flow appears to be the most influential factor affecting migration speed of steelhead and sockeye; for yearling chinook no effect of flow on migration speed has been found (only level of smoltification affected migration speed); for subyearling chinook no environmental variable was found to affect migration speed in the mid-Columbia. Since 1998, PIT tag and radiotelemetry studies have produced limited data on the survival of yearling chinook. Data on other species is even more limited. The studies-to-date do not indicate any statistically significant effect of flow on survival of juvenile salmonids in the mid-Columbia Reach, other than in the Hanford Reach, where stable flows are the issue. Limited data are available for lower Columbia Reach. Low flows are likely to lead to residualization of steelhead."

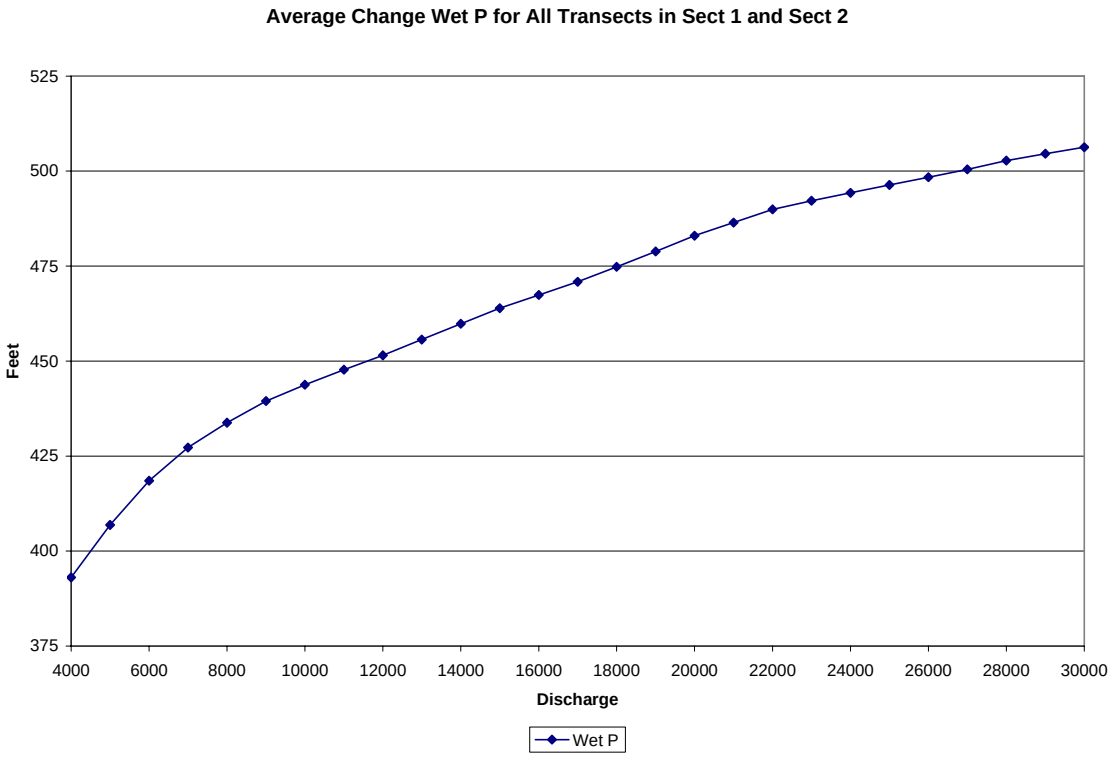
The ISAB also reviewed the status of research into the impact on resident fish of reservoir operations that have been dominated by attempting to meet summer flow objectives at McNary. With respect to the impact on resident fish in Montana the ISAB said:

> "It is a well- established fact that storage reservoir drawdowns result in adverse effects on resident fish populations and their associated fisheries. In earlier reports we recommended that an effort be made to balance the

needs of resident fishes upstream against those of juvenile salmon downstream. We identified the Rule Curves developed in Montana as being reasonable approaches to resolving difficult policy issues with biological implications. The subject of tradeoffs of benefits to salmon versus detriments to resident fishes is one of the subjects deserving high priority action by the Council."

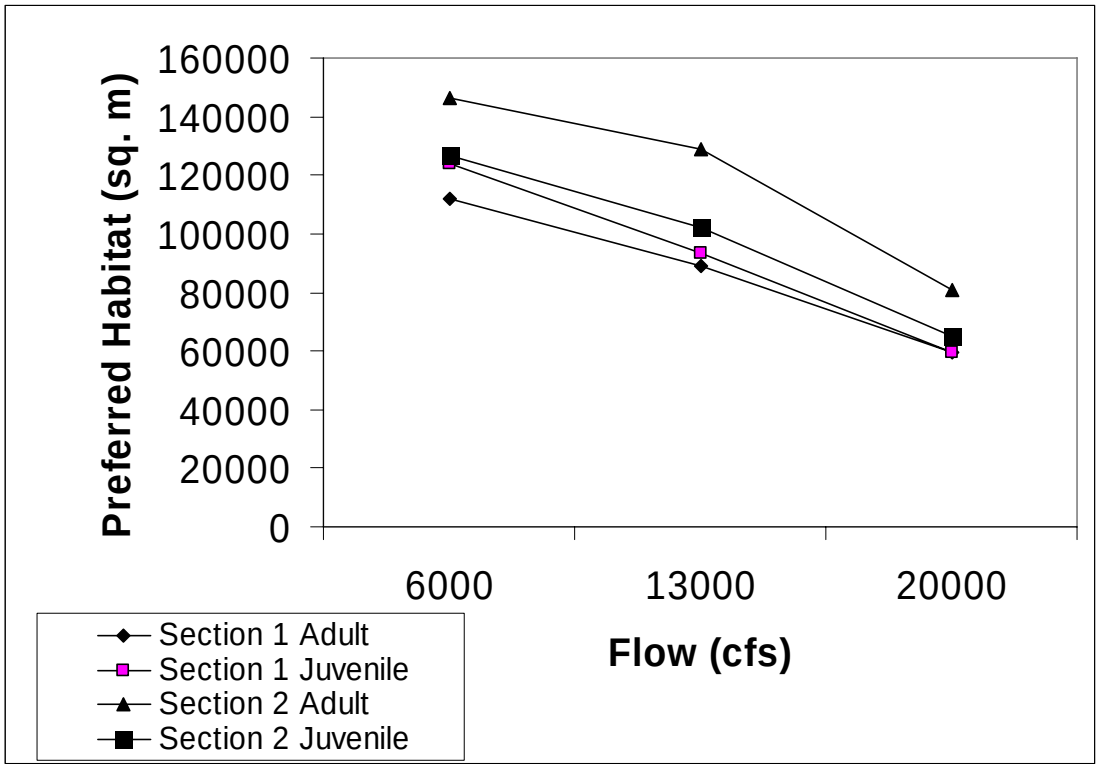
Biological Justification for Resident Fish Impacts in Montana

The biological justification for the expected improvements in riverine biology in Montana is based on field sampling (Fraley and Graham 1982) and quantitative computer models that were designed using a modified form of the Instream Flow Incremental Methodology (IFIM). River models quantify the total availability of various habitats for selected life stages of native fishes (i.e. bull trout and westslope cutthroat trout) under different dam operation scenarios. The IFIM models were developed based on site-specific habitat suitability data collected from the Flathead and Kootenai Rivers downstream of the dams. IFIM studies have provided empirical evidence for seasonal flow limitations and ramping rates (Hoffman et al. 2002; Marotz and Muhlfeld 2000; Muhlfeld et al. 2003). The following figure illustrates the calculated wetted perimeter based on these IFIM models and two typical sections of the Kootenai River.



River fisheries benefit when dams are operated to provide consistent hydrologic conditions (Muhlfeld et al. 2003; Paragamian 2000; Independent Scientific Group 1999; ISAB 1997 and 1997b; Hauer and Potter 1986). Optimal hydrologic

conditions mimic natural processes and minimize impacts on fish and wildlife (Ward and Stanford 1979). For example, Muhlfeld et al. (2003) found that subadult bull trout moved from deep, mid-channel areas during the day, to shallow low-velocity areas along the channel margins without overhead cover at night in the partially regulated reaches of the Flathead River. The authors recommended establishing as stable of a flow regime as possible to protect key ecosystem processes and maintain or restore bull trout populations in the Flathead and elsewhere in the Pacific Northwest (Independent Scientific Group 1999). Conversely, fluctuating stream flows resulting from dam operation directly affect the aquatic environment and associated riparian and wetland habitats downstream of headwater reservoirs. Flow fluctuations increase the width of the varial zone causing it to become biologically unproductive (Perry et al 1986; Hauer et al. 1997; Hauer et al. 1974). Stable or gradually changing river flows benefit all fish species of special concern in Montana. Especially during the productive warm summer months, river flows should gradually decline toward stable summer flows to protect biological production in the rivers downstream of the dams. The relationship between preferred trout habitat and flow was calculated using models of the Kootenai River. The results of this analysis are shown in the following figure. Preferred trout habitat is substantially reduced as flows increase above the optimal level of approximately 6 to 8 kcfs.



The biological justification for the recommended reservoir operations in this SOR are based on quantitative biological modeling of Hungry Horse and Libby Reservoirs (Chisholm et al. 1989; May et al. 1988; Cavigli et al. 1998; Dalbey et al 1997; Zubik and Fraley 1987; Skaar et al 1996). Computer models were constructed using empirical field measurements of physical and biological parameters, as related to dam operations

(Marotz et al. 1996). Conditions in the reservoirs resulting from various dam operation scenarios were assessed beginning with the hydrologic mass balance and thermal structure in the reservoir pool. The models calculate the biological response extending from primary producers (plants) through tertiary trophic levels (fish growth). Fish growth is correlated with survival, fecundity and reproductive success (Chapman and Bjornn 1969).

Nearly all biological production in the reservoir pool occurs during the warm months (Chisholm et al. 1989; May et al. 1988; Marotz et al. 1996). Failure to refill the reservoir each summer impacts reservoir productivity. At full pool, the reservoir presents a large volume and surface area. The sunlit surface layer of the reservoirs produces food (*zooplankton*, a microscopic crustacean that grazes on suspended algae called *phytoplankton*) that forms the base of the food web. The large flooded area produces aquatic insects and the large surface area traps insects from the surrounding landscape. Insects provide the primary food source for westslope cutthroat trout and juvenile bull trout during summer and fall (May et al. 1988). Biological production generally increases with reservoir elevation. Reducing reservoir drawdown (duration and frequency), especially during summer, protects aquatic insect production in remaining wet portions of the reservoirs, assuring an ample food supply for fish. During winter, fish (kokanee, westslope cutthroat and rainbow trout, whitefish, chubs, and suckers) eat mainly *zooplankton*, a microscopic crustacean that grazes on *phytoplankton*, suspended algae.