SYSTEM OPERATIONAL REQUEST: #2004-MT-2

The following State, Federal, and Tribal Salmon Managers have participated in the preparation and support this SOR: Montana Fish Wildlife & Parks

TO: B. G. Grisoli COE-NWD
William Branch COE-Water Management
Cindy Henriksen COE-RCC
Witt Anderson COE-P
LTC Charles S. Markham COE-Portland District
LTC Kertis, Jr. COE-Walla Walla District
J. William McDonald USBR-Boise Regional Director
Stephen J. Wright BPA-Administrator
Greg Delwiche BPA-PG-5

FROM: Jim Litchfield, State of Montana

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

Biological Objectives

The objective of this SOR is to implement a staged multiyear experiment to evaluate the effects of more stable flows out of Libby and Hungry Horse during July, August and September. Implementation of this SOR for Libby and Hungry Horse reservoirs is consistent with the Northwest Power and Conservation Council's recommendations for Mainstem operations of 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 near Libby and Horse without harming ESA listed fish 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. The primary objective of this SOR is to test and evaluate the physical changes in flows and water quality that occur in reservoirs and rivers in Montana and the Lower Columbia River below McNary. 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

Implement the Northwest Power Planning Council's Mainstem Recommendations for operation of Libby and Hungry Horse dams and evaluate the resulting physical and biological changes in water qualities and quantities and the affects on the aquatic environment in Montana and in the Lower Columbia River from McNary to below

Bonneville dam. Because this water year falls in the lowest 20th percentile, the Council recommends drafting both Libby and Horse to an elevation that is 20 feet from full by the end of September using a flat weekly average flow adjusted as actual inflows change. The following specific operations are recommended:

- Establish a stable flow objective for Libby dam that is expected to draft the reservoir to elevation 2439 by the end of September.
- Based on the latest COE models this flow objective is approximately 10 kcfs.
- Adjust Libby's weekly flow objective as necessary so that Libby drafts to elevation 2439 by the end of September. It is preferred that weekly average outflows are held as flat as possible or, if necessary, are reduced gradually from July through September.
- Establish a stable weekly average outflow objective at Hungry Horse dam that will result in drafting Hungry Horse to elevation 3545 by the end of August. This elevation is the maximum allowable elevation necessary to permit scheduled maintenance to proceed in September. The expected out flow is approximately 4.4 kcfs which will be adjusted on a weekly basis to achieve 3545 at the end of August. This operation is contrary to the long-term strategy recommended by the Council for Hungry Horse however, it is recommended this year to allow the planned maintenance.
- Draft the remaining 5 feet of storage from Hungry Horse in September. This is expected to provide approximately 2.3 kcfs of stable weekly outflows with the reservoir ending September at elevation 3540.
- As with Libby, it is preferred that weekly average outflows are held flat or are reduced gradually from July through September and all changes in outflows will follow the ramp rates in the Bull Trout BiOp.
- Maintain flows out of Libby and Hungry Horse that are at least the minimum flows for bull trout. Minimum bull trout flows are a higher priority than the recommended ending reservoirs at the end of September.
- The Corps and BPA will pursue concluding an agreement with Canada that will assure that the increased flow from Libby in September will result in increased inflows to Lake Roosevelt during September.
- Refill of Grand Coulee in September will be limited to elevation 1284, plus or minus one foot. This is consistent with past refill volumes and will assure that the increased flows in September out of Libby and Horse are passed downstream to the Lower Columbia.
- Continue to implement bull trout and other aquatic research to measure changes in fish survival and productivity.

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

Libby & Hungry Horse Operations

The Corps conducted several model studies of possible operations of Libby dam through the months of June through September. The operation recommended in this SOR for Libby is shown in Figure 1. This figure illustrates that the likely flat flow from now until the end of September that will draft Libby 20 feet from full, elevation 2439, is approximately 10 kcfs. This operation is designed to balance the improved ecological conditions in the Kootenai River with the impacts on Libby reservoir of failing to refill.

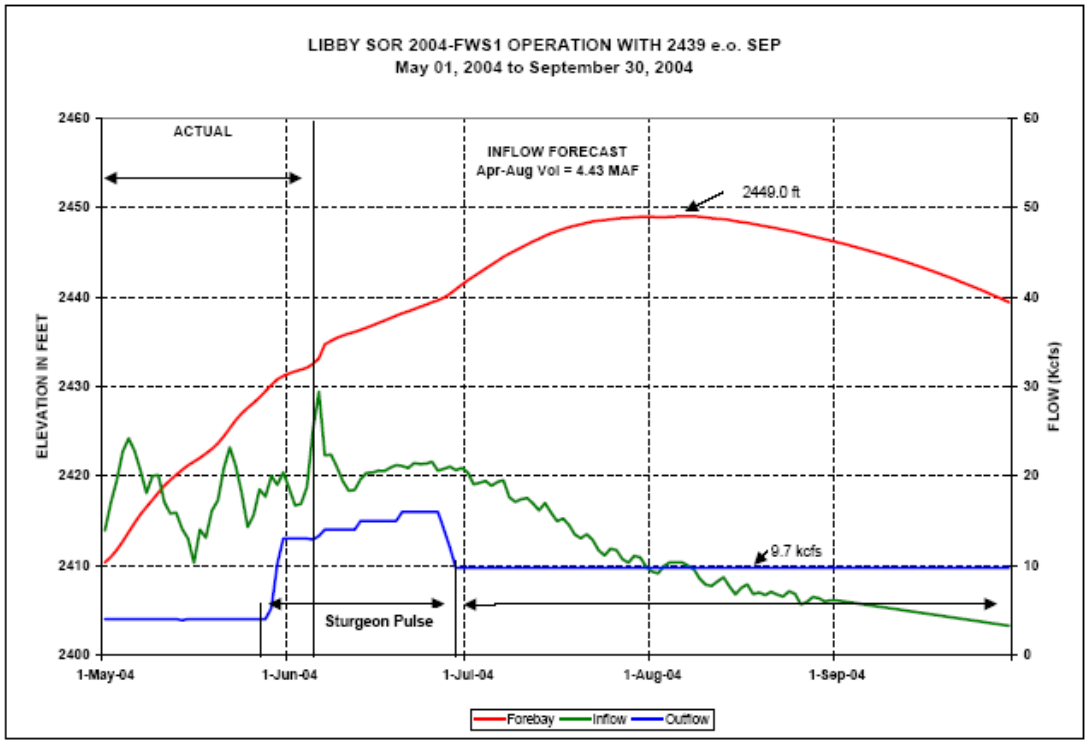

Figure 1 – SOR Operation with a flat summer flow of 10 kcfs

The operation proposed in this SOR will result in a reduction in current outflows at Libby dam of approximately 2.5 kcfs. This is small flow reduction over July and August will provide substantial biological benefits to resident fish in September. It is anticipated that this limited change in flows at Libby will result in far smaller flow changes at McNary dam due to the attenuation of flows that occurs as the water is routed through the Canadian and US reservoirs above McNary. This SOR also proposes reducing the outflow at Horse by approximately 0.8 kcfs. This flow reduction will shift five 5 feet of draft into September and allow supporting a declining hydrograph while also allowing the scheduled maintenance to occur in September.

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).

River fisheries benefit when dams are operated consistent with normative hydrologic conditions (Muhlfeld et al. 2003; Paragamian 2000; Independent Scientific

Group 1999; ISAB 1997 and 1997b; Hauer and Potter 1986). Normative 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 restoration of the most natural and stable flow regime 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). Normalized 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 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.

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 belief was challenged by the ISAB in a recent report to the Council 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."

While there is little information on the survival of Snake River fall chinook in the Lower Columbia it is known that only a small percentage of the population actually migrates through the lower river due to the transportation program. The vast majority of listed Snake River fall chinook are transported therefore these fish cannot benefit from flow augmentation or spill. The majority of transported fish survive to below Bonneville while the fish that are left to migrate through the Lower Columbia experience high mortality rates due to a host of factors including higher dam passage mortality, water temperatures and predation rates.

The recommended changes to operation of Libby and Hungry Horse reservoirs cannot affect the survival of fall chinook that are barged to below Bonneville dam. For this reason the benefits of flow augmentation in the lower river will be very difficult to measure through scientifically valid experiments. Scientific experiments are further complicated by the increasing water temperatures that make it virtually impossible to handle and mark fish during August without creating unacceptable levels of direct mortality. For all these reasons, Montana recommends that biological survival experiments continue to be designed and implemented to better understand the factors that affect survival in the Lower Columbia River during the June though September period.