SYSTEM OPERATIONAL REQUEST: #2006-MT-1

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FROM: Jim Litchfield, State of Montana

DATE: May 31, 2006

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

Biological Objectives

The objective of this SOR is to implement the Northwest Power and Conservation Council's Mainstem Recommendations for operation of Libby and Hungry Horse dams from July through September. The proposed operation will provide habitat for ESA 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. The Council's recommended operations at Libby and Hungry Horse dams will provide environmental benefits to resident fish in Montana without harming ESA listed Snake River fall chinook as they migrate through the Lower Columbia Reservoirs.

This SOR proposes to implement an evaluation of the physical and biological effects of the proposed operational changes for Libby and Hungry Horse. Fisheries scientists in the lower Columbia River determined that existing research could not isolate changes in fish survival attributable to this operation strategy. 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 being 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 during June through September. The Council's recommended operations will require the following detailed specific operations at each project.

Hungry Horse

a. Maintain minimum in stream flows for bull trout at Columbia Falls and in the river below Hungry Horse dam.

b. Attempt to refill by June 30 while also avoiding the risk of filling too quickly resulting in uncontrolled spill. Even small amounts of spill will likely exceed Montana's water quality regulations for 110% dissolved gas. Therefore, the refill date and outflows should be managed to avoid, if possible, uncontrolled spill.

c. In late June the Bureau of Reclamation will estimate a flat flow from Hungry Horse for July through September period. The flow estimated by the Bureau will be designed to result in a draft of the reservoir to 10 feet from full by September 30, 2006.

d. The Bureau, in consultation with the State of Montana, will monitor this flow throughout the summer to achieve a stable weekly average flow. However, due to inflow forecast uncertainty it will be necessary to adjust the flows either up or down to insure that the reservoir draft limit is achieved. Any changes in flows should be accomplished following the ramp rates and to preserve a stable aquatic environment below the dam throughout the July through September period.

e. Attempt to provide stable or, if necessary, gradually declining flows at Columbia Falls during the draft.

Libby

a. Following the May-June flow operation for sturgeon, the Corps will estimate a flat flow from Libby for June through September period. The flow estimated by the Corps will be designed to result in a draft of the reservoir to 10 feet from full by September 30, 2006.

b. The Corps should attempt to refill Libby while also avoiding the risk

of filling too quickly resulting in uncontrolled spill. Even small amounts of spill will likely exceed Montana's water quality regulations for 110% dissolved gas. Therefore, the refill date and outflows should be managed to avoid, if possible, uncontrolled spill.

c. The Corps, in consultation with the State of Montana, will monitor Libby outflow throughout the summer to achieve a stable weekly average flow. However, due to inflow forecast uncertainty it will be necessary to adjust the flows either up or down insure that the reservoir draft limit is achieved. Any changes in flows should be accomplished following the ramp rates and to preserve a stable aquatic environment below the dam throughout the July through September period.
d. Operate to provide at least minimum bull trout flows through September (USFWS BiOp).
e. Provide even or gradually declining flows during summer months (minimize double peak).
f. Investigate the possibility of a storage exchange with Canada to further reduce the need for reservoir drafts from Libby.

Biological Evaluations

Radio tracking and PIT tag methods will continue in the Flathead and Kootenai Rivers to detect movements and potential downstream displacement of fish. 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.

IFIM river models, benthic biomass models and reservoir modeling will compare previous operations with modified operations. Field observations will be conducted to see how fish respond to new operations to 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 river and reservoir productivity.

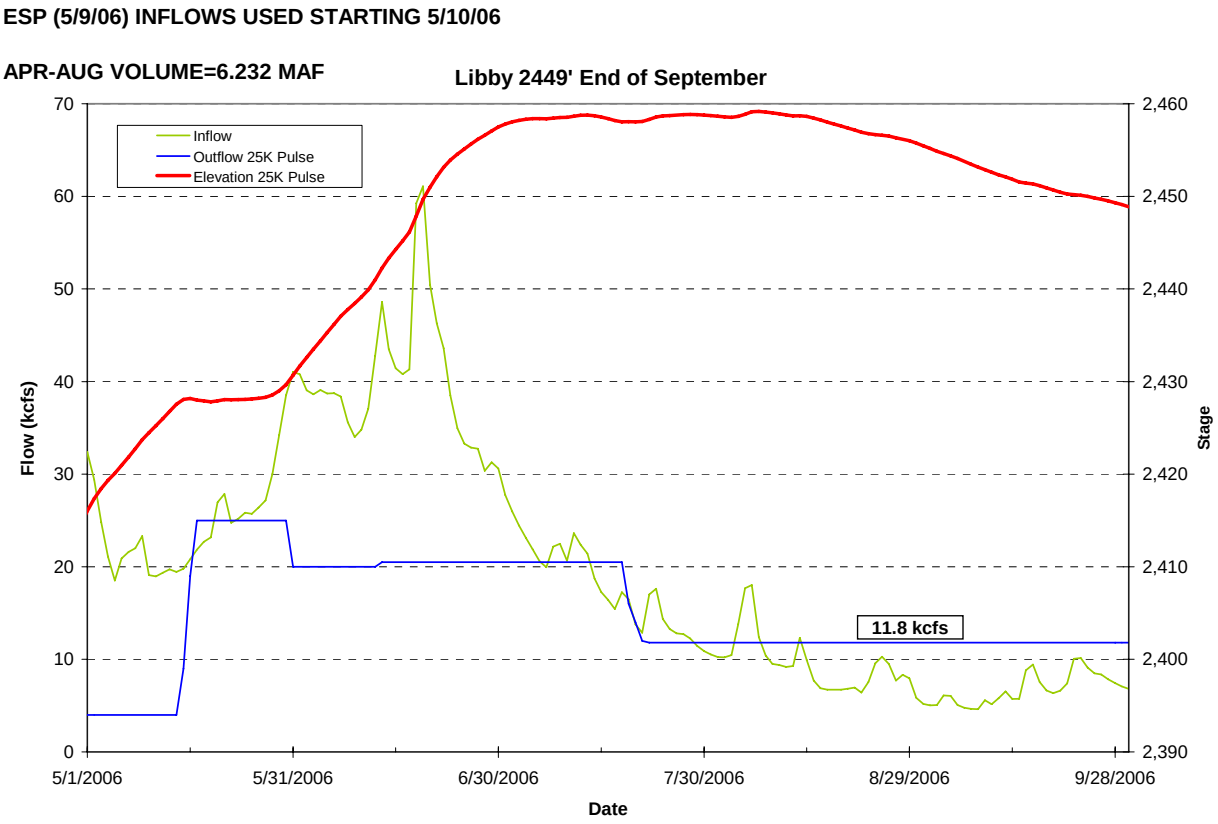
In the Lower Columbia River physical measurements should be continued to determine two-dimensional changes in velocity across the range of flows at longitudinal points along the reservoirs.

Montana Fish Wildlife & Parks has a range of field experiments that will provide useful information on the changes in survival and productivity of trout below Libby and Horse 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 should result in a summer outflows from Libby and Hungry Horse dams that result in small flow reductions in July and August that will provide increased flows in September. The reservoirs will draft more gradually during the biologically productive, albeit short growing season in Montana. The operational changes in Montana were designed to enhance to the productivity of resident fish. The Corps recently modeled the type of operation called for in this SOR at Libby. The following graph illustrates the flows and reservoir elevation that could occur this summer.



The key aspects of this operation are first the management of flows to insure that the project avoids filling too quickly and thereby causing uncontrolled spill. Following the period of time when refill is managed there is a flat flow of 11.8 kcfs that results in drafting the reservoir to elevation 2449.

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. BPA recently conducted hydropower regulation studies of the operation proposed in this SOR. These studies estimated that during water years that have a runoff volume at The Dalles of 94.7 to 111.0 MAF there would be approximately a 3 percent[1] reduction in flows at McNary Dam during July and August.

Judge Redden's Findings

Last fall the Plaintiffs requested in a proposed Preliminary Injunction that Judge Redden order increased flow augmentation for this year. On December 29, 2005

[1] The BPA modeling estimated the average flow at McNary for July through August at 191 kcfs. The flow reduction due to operating to this SOR was estimated by BPA to be approximately 6 kcfs. Current runoff forecast for this year at The Dalles is 109 MAF which is at the high end of the band of runoff years estimated in the BPA modeling.

Judge Redden ruled on the proposed flow augmentation by the Plaintiffs among other issues. In this order he found:

> "3. Best Available Science.
>
> NWF believes that restoration of the Columbia and Snake rivers to a more natural hydrograph will necessarily benefit salmon. In November 2002, the Independent Scientific Advisory Board (ISAB was assigned the task of updating and clarifying its views on the benefits to salmon of flow augmentation. In its report issued on February 10, 2003, entitled Review of Flow Augmentation: Update and Clarification, ISAB noted as a preliminary matter that "many questions remain" regarding the "relationship between river flows and salmon production." In summarizing the present science on the issue, ISAB noted that "the benefit to salmon of . . . incremental adjustments [to flow] has not been well quantified." Id. at p. 2. ISAB then stated:
>
> > "A different perspective emerged from this latest review. We realize that the prevailing rationale for flow augmentation is inadequate. It is neither complete nor comprehensive. There is room for alternative explanations of data that have scientific justification and practical value for managing the hydrosystem for multiple uses including salmon recovery. 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."
>
> Id. at pp. 2-3.
>
> "NWF has failed to establish that the best available science supports its proposal for augmented flow during the summer 2006 migration period. This, coupled with the potential harm to other listed species, militates against granting the extraordinary relief NWF requests by injunction proceeding."
>
> 4. Conclusion.
>
> "I deny NWF's request for an injunction to augment flow during the summer of 2006."

ISAB Findings

The biological objective of drafting Libby and Hungry Horse reservoirs during the summer for anadromous fish is based in a hypothesis 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 failed to implement the Council's Mainstem Recommendations due to concerns over ongoing Biop litigation and objections by CRITFC and the US Fish and Wildlife Service.

The region has struggled with the tradeoffs between operations that will provide benefits to resident fish in Montana and the hypothesized benefits for Snake River fall chinook in the Lower Columbia during the summer. In response to the considerable scientific discussion and debate about the possible affects on resident and anadromous fish 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 scientific findings with respect to implementation of the Council's Mainstem Recommendation for Libby and Horse operations that are reflected in this SOR.

"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 enough operational variability to detect change (e.g. years when the Montana System Operations Request is implemented over a range of water supplies.

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."

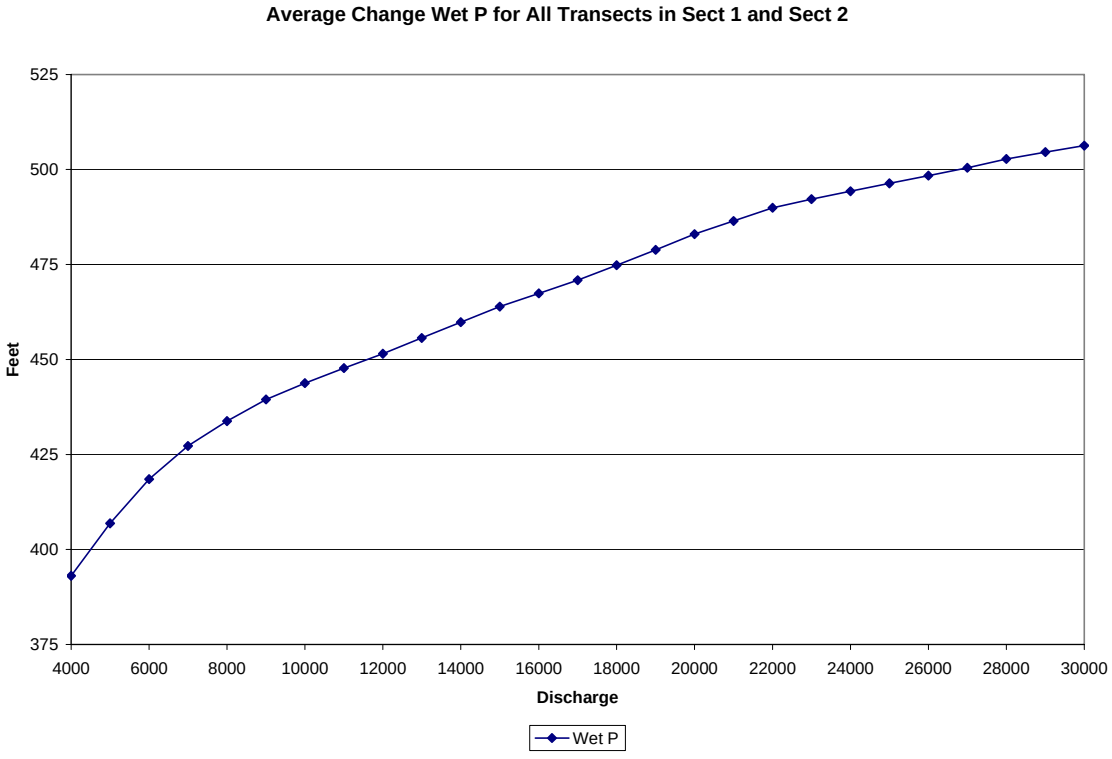
The ISAB also reviewed the status of research into the impact on resident fish of reservoir operations that have been dominated by attempting to meet summer flow objectives at McNary. With respect to the impact on resident fish in Montana the ISAB said:

> "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 [IRCs] 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."

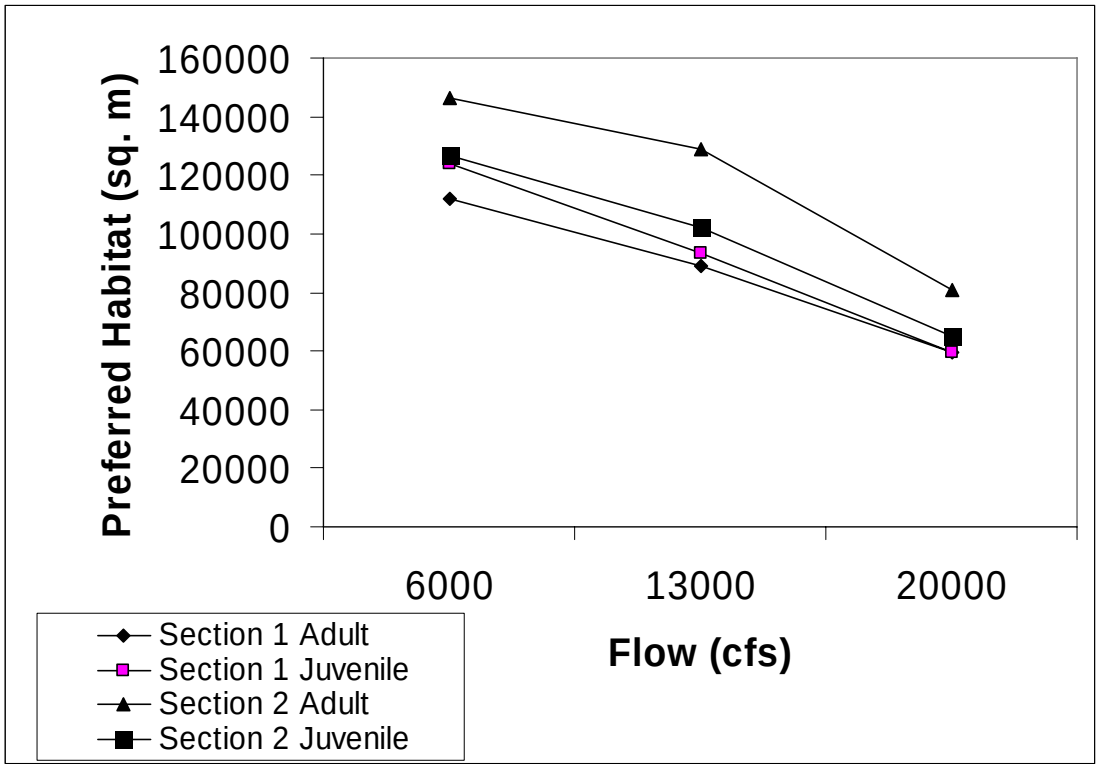
Biological Justification for Resident Fish Impacts in Montana

The biological justification for the expected improvements in riverine biology in Montana is based on field sampling (Fraley and Graham 1982), quantitative computer models that were designed using a modified form of the Instream Flow Incremental Methodology (IFIM, Dunnigan et al. 2004) and benthic biomass models (Marotz and Althen 2005). 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.