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ISRP Preliminary Review

of

Corps of Engineers' Bonneville Decision Document Juvenile Fish Passage Recommendation October 2001

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Background

This report provides the ISRP's preliminary review of the United States Army Corps of Engineers' *Bonneville Decision Document Juvenile Fish Passage Recommendation October 2001 (draft for ISRP Review).* The Corps of Engineers (Corps) and other interested parties will be provided until January 31, 2002 to address the ISRP questions and concerns. Please send your comments to Kendra Phillips at kphillips@nwppc.org; (503) 222-5161. The ISRP will consider the responses and issue a final report by February 22, 2002.

This report is part of the ISRP review of the "reimbursable" projects of the Corps of Engineers. The "reimbursable" review was created by the U.S. Congress' Senate-House conference report on the Fiscal Year 1999 Energy and Water Development Appropriations bill, which directed ISRP to review all fish and wildlife projects, programs, or measures that are included in federal agency budgets and reimbursed by the Bonneville Power Administration. The same standards used for review of projects under the Fish and Wildlife Program are to be used.

Rather than review the entire Corps program, the Council requested that in 2001 the ISRP review and evaluate the Bonneville Dam decision document and its recommended actions. This review request was intended to identify a manageable portion of the large Corps Program amenable to short-term review by the ISRP and to focus on potentially substantial and immediate biological benefits associated with improvements in configurations and operations at Bonneville Dam.

Fish guidance efficiency (FGE) of the intake screens at Bonneville first and second powerhouses have been low. Juvenile bypass system (JBS) mortality has been high at the first powerhouse relative to other locations. These problems pose biological risks because all in-river migrating juvenile fish must pass Bonneville Dam. Improving passage at Bonneville will entail large costs for construction and operations.

The Corps has investigated methods to enhance juvenile salmon passage at the first and second powerhouses for several years. Two powerhouse passage improvement alternatives have been studied in combination with various spill alternatives. The configuration alternatives are to: 1) install extended-length bar screens at the turbine intakes and improve other portions of the Juvenile Bypass System; 2) construct a deep-slot surface bypass system at the first powerhouse or a corner collector at the second powerhouse.

Review Process

The ISRP review began in March 2001 with a site visit to Bonneville Dam. A presentation on the process to select among passage improvement alternatives was made by the Corps, National Marine Fisheries Service (NMFS), and Columbia River Inter-Tribal Fish Commission (CRITFC).

The ISRP, Corps, and the Council agreed that the ISRP review would be most useful at a later stage in the Bonneville decision document. The Corps submitted a draft decision document for ISRP review in October 2001. Comments from CRITFC and NMFS and a memorandum from the Joint Technical Staff of the fishery agencies were included as appendices in the draft document.

On October 29, 2001, the Corps made an oral presentation on the draft document. CRITFC provided oral comments at the presentation. NMFS provided input by way of a telephone conversation between Steve Rainey and Dr. Whitney on November 11, 2001.

These are the primary documents and briefings relevant to this review. The Decision Document synthesizes numerous studies related to survival of juvenile fish. Given the time constraints of the review, the ISRP focused on the Decision Document and the process used to develop it rather than on the numerous studies that provide background to the alternatives.

Introduction

This review is intended to help the Corps of Engineers revise the draft Decision Document for Juvenile Fish Passage Recommendation at Bonneville Dam. This decision document is the first in a series the Corps plans to prepare for other dams in the Snake and Columbia rivers. The review uses criteria established by Congress, the NWPPC, and the NMFS' Biological Opinion of December 2000. In the following sections we consider the questions of whether the draft Decision Document meets the criteria specified by Congress in the Power Act, the Council in the Fish and Wildlife Program (FWP), and NMFS in the BiOp.

Criteria Used in the Review

A. In conducting this review, the ISRP evaluated whether the Bonneville Dam decision Document and recommended actions are consistent with the criteria set forth in Section 4(h)(10)(D) of the Pacific Northwest Electric Power Planning and Conservation Act and the criteria and strategies contained in the 2000 Columbia River Basin Fish and Wildlife Program (Council document 2000-19). In addition, the ISRP referred to the Biological Opinion of December 2000.

The Act requires the Independent Scientific Review Panel to determine whether projects proposed for funding:

- Are based on sound science principles
- Benefit fish and wildlife
- Have clearly defined objectives and outcomes
- Have provisions for monitoring and evaluation of results
- Are consistent with the Council's program.

The 2000 Columbia River Basin Fish and Wildlife Program's section on hydrosystem passage and operations strategies specifies that the ISRP will apply the following principles in its review of "reimbursable" projects including those in the Corps' fish passage program (page 26 or www.nwcouncil.org/library/2000/2000-19/strategies.htm#d6; see also ISAB report at www.nwcouncil.org/library/isab/isab99-4.htm.)

> **Primary strategy**: **[1]** Provide conditions within the hydrosystem for adult and juvenile fish that most closely approximate the natural physical and biological conditions, **[2]** provide adequate levels of survival to support fish population recovery based in subbasin plans, **[3]** support expression of life history diversity, and **[4]** assure that flow and spill operations are optimized to produce the greatest biological benefits with the least adverse effects on resident fish while assuring an adequate, efficient, economical and reliable power supply. (FWP p. 25, bracketed numbers added).
>
> > **Strategy [1]**: Provide conditions in the hydrosystem for adult and juvenile fish that most closely approximate natural physical and biological conditions.
> >
> > - **Protect Biological Diversity**
> >
> > Actions to improve juvenile and adult fish passage through mainstem dams, including the use of fish transportation, should protect biological diversity by benefiting the range of species, stocks and life-history types in the river, and should favor solutions that best fit natural behavior patterns and river processes. Survival in the natural river should be the baseline against which to measure the effectiveness of other passage methods. To meet the diverse needs of multiple species and allow for uncertainty, multiple juvenile passage methods may be necessary at individual projects.
> >
> > - **Juvenile Fish Passage**
> >
> > To provide passage for juvenile fish that closely approximates natural physical and biological conditions, and to increase the energy produced by the hydrosystem, the U.S. Army Corps of Engineers should 1) continue testing and developing surface bypass systems, taking into account the widest range of biological diversity, utilizing an expedited approach to prototype development, and ensuring full evaluation for the developmental phase; 2) relocate bypass outfalls in those circumstances where there are problems with predation and juvenile fish injury and mortality; and 3) modify turbines to improve juvenile survival.

B. The ISRP also referred to the Biological Opinion of December 2000, which contains instructions for the Action Agencies, including the Corps of Engineers, for evaluating the alternatives for improving survival of juvenile salmonids at Bonneville Dam. The most direct is Action 97 on page 9-105 of the BiOp:

> *By January 2002, the Action Agencies shall develop an analysis that compares the relative passage survival benefits of an extended-length, intake screen bypass system, a surface collection bypass system, and hybrid alternatives at Bonneville First Powerhouse. Through the annual planning process, the Corps shall determine which of these configurations to implement.*

The explanation of this action is that one alternative upgrades the existing bypass system (submerged screens), one develops surface attraction and collection technology to pass fish to a new downstream outfall, and a third "may be" a hybrid of the two systems.

Considerable background for this action item is provided in earlier parts of the BiOp. The main points are as follows:

Based on the biological effects analysis presented in Appendix D (Biological Effects Analysis and SIMPAS Model Documentation), Bonneville, The Dalles, and Lower Monumental dams have the lowest juvenile fish survival rates and thus warrant the highest attention (page 9-81).

1. The BiOp presents a prioritized strategy for juvenile fish passage without listing separate Actions. The priorities are, in diminishing order of importance:

   (a) Improving spill passage (page 9-82)
   (b) Surface bypass. (Note that there is a distinction in the BiOp at this point between surface bypass (fish passed directly to the tailwater) and surface collection (fish passed into a collection channel from which the fish may go to any of several passage routes, including transportation), as described on page 9-82.)
   (c) Surface collection (page 9-83).
   (d) Powerhouse intake screen and bypass (the primary powerhouse protection until surface bypass or surface collection is developed and constructed (page 9-83).)
   (e) Turbine passage

2. It is reiterated on page 9-83, in text related to RPA actions, that Bonneville Dam has one of the lowest survival rates for juveniles and, therefore, has the "highest priority relative to the need for improvements." On page 9-84, the text identifies Bonneville First Powerhouse for evaluations of prototype surface collectors and extended submerged intake screens in 2000, followed by the development of one alternative or a hybrid of each, design and construction. It also calls for continuing development to improve the existing fish bypass system, including dewatering screens and outfall locations, minimum gap runners for turbines and debris control measures.

3. The text above is followed by a specific Action (61; page 9-95), which states:

> *The Corps shall complete the ongoing prototype powerhouse system surface collection evaluations at Bonneville First Powerhouse in 2000. The Corps shall compare the prototype with screened bypass systems and, if warranted, design and construct permanent facilities after full consideration and resolution of biological and engineering uncertainties, especially high-flow outfall considerations.*

The text that follows this action states "The full potential of a surface collection and high-flow bypass outfall system has to be identified, then weighed against other alternatives." This text suggests an intent that a "full" comparison of the functional performance of the two alternatives for passing juveniles be done, that is, one that has considerable data on effectiveness. This could be interpreted to mean that the testing and evaluation objectives were not met in 2000,and must be extended. But it could also be interpreted to mean that the evaluation was completed in 2000 and that the decision to design and construct must now go forward.

4. A companion Action directed at the submerged intake screen option follows (62; page 9-95):

> *The Corps shall complete Bonneville First Powerhouse prototype evaluations of extended submerged intake and gatewell vertical barrier screens, including an assessment of fry passage.*

As with Action 61, this action seems to be asking for complete information on the submerged intake screen to complement the full information on the surface collector (or bypass?).

5. The next logical step is the full comparison among alternatives by the Action Agencies embodied in Action 97, page 9-105. Action 97 does not say that the decision to implement must be made by the dates stated, but only that the comparisons must be made. The Action also states that the "relative passage survival benefits" must be compared, not the relative costs, timing, risks, state of design, etc. for implementation that are in the current draft decision document.

ISRP Findings

A. According to the review criteria provided by the 1996 amendment to the Power Act, the ISRP finds:

> 1) *Sound scientific basis:* The Decision Document is a synthesis of numerous individual scientific studies. The ISRP has not had the opportunity of reviewing these for scientific soundness. The focus of this review is the Decision Document, with sidelights on particular issues relevant to juvenile fish passage. A significant scientific issue exists with respect to the employment of the SIMPAS model in the

Document to evaluate relative survival benefits of alternative actions at Bonneville Dam. We provide a more complete statement on this issue below, under the heading of criteria established by the BiOp, since the BiOp specifically requires development of survival estimates for juvenile salmonids, and includes a description of SIMPAS in its Appendix D.

2) *Benefit fish and wildlife:* All identified alternatives will probably benefit juvenile salmonids to various degrees.

3) *Clearly defined objectives and outcomes:* All identified alternatives have clearly defined objectives and outcomes. This may or may not be true of individual studies that form the basis for the document.

4) *Consistency with the Council's FWP:* The Document makes no explicit reference to the Council's FWP. The placement of information relevant to the FWP throughout the document makes the determination of consistency difficult. A discussion should be given as to how well the use of SIMPAS for estimation of survival, for the species and cases considered, meets the Council's Fish and Wildlife Program principles on hydrosystem passage and operations and the resulting strategies listed below.

B. Criteria Spelled out in the Council's Fish and Wildlife Program

1) *Provide conditions within the hydrosystem for adult and juvenile fish that most closely approximate the natural and biological conditions.* We do not find this issue addressed in the Decision Document.

2) *Provide adequate levels of survival to support fish population recovery based in subbasin plans.* Presumably the Corps' consultation with NMFS under the requirements of the Endangered Species Act will have satisfied this criterion. However, the Decision Document provides no specifics on this issue.

3) *Support expression of life history diversity.* This criterion was not addressed in the Decision Document. The ISRP and ISAB have advised the Council on this issue a number of times, particularly with respect to the fact that turbine intake screens are known to be selective as to species and sizes of fish that are diverted from the intakes.

4) *Assure that flow and spill operations are optimized to produce the greatest biological benefits with the least adverse effects on resident fish while assuring an adequate efficient and economical and reliable power supply.* This criterion was addressed to a limited extent in relation to spill levels and gas supersaturation. There was no discussion of other issues, such as availability of bypass systems to support seasonal passage of resident fish.

C. Criteria Spelled Out in the Biological Opinion of December, 2000

1) The Decision Document is apparently designed to be a response to a BiOp requirement (page 5) that Action Agencies develop an analysis comparing the relative passage survival benefits (emphasis added) of an extended-length intake screen bypass system, a surface-collection bypass system, and hybrid alternatives at Bonneville I, and calls for the Corps to determine which of the alternatives to implement. The first sentence of the Decision Document states that the goal of the document (meaning the process used to develop the document) is to reach agreement on what (measures) should be implemented at Bonneville Dam. Apparently what is meant is to reach agreement among the Action Agencies, which in this case are the Corps and Bonneville Power Administration.

2) To develop estimates of relative survival benefits as called for in the BiOp, the Decision Document employs the SIMPAS model. The ISRP referred to Appendix D of the BiOp for description of the SIMPAS model. The SIMPAS model consists of a simple set of deterministic mathematical calculations of by-reach and overall survival estimates of juvenile salmonids as they pass downstream in the Columbia and Snake rivers. Only the Bonneville portion was used in preparing the Decision Document. The model was used for analysis and evaluation of alternative devices intended to improve survival of juvenile salmonids at Bonneville Dam. The model requires explicit specification of fewer assumptions and is more straightforward than the models reviewed by the ISAB in ISAB 2001-1 (www.nwcouncil.org/library/isab/isab2001-1.pdf), but of course the simplicity of this model constitutes a far-reaching implicit (and possibly unexamined) assumption. For example, the SIMPAS model includes no provision for addressing the impacts of fish passage routes on biodiversity of anadromous or resident species. The estimates of survival by size and life cycle stage for multiple resident and anadromous species is well beyond the information available and the capabilities of the model.

In the present case, the model was used to analyze differences in survival that might be "expected" from the several alternatives for improvements of survival of juvenile fish at Bonneville First Powerhouse that are specified in the BiOp of December, 2000, and at Bonneville Second Powerhouse. The model includes no provision for estimating uncertainty of the final estimates. Realistically, such uncertainties could arise because of uncertainties in the user-supplied input quantities, uncertainties with respect to variable environmental conditions, and errors owing to the structure of the model itself. These uncertainties are common to all environmental modeling. It is important that a model used for decision-making communicate these uncertainties, even when the model use is merely a "qualitative" comparison of scenarios. It is important for the decision makers to know how the apparent differences between scenarios compare to the noise, and it is important for decision makers to have access to information about best-case and worst-case possibilities in addition to the predicted "averages." It is quite possible

that the management options will rank differently if considered from the standpoint of their respective best cases, worst cases, and averages.

The "risks" assigned in the Document to different routes of passage and inserted into SIMPAS will not serve the purpose. The risks associated with the passage routes were scored in a rating system according to their anticipated "…ability to meet guidance expectations, ability to meet survival expectations, ability to protect other life histories and species, and the ability to meet guidance and survival goals under all operations." page 20. The result is not amenable to rigorous interpretation in the sense in which we use the term "uncertainty of the final estimates". Uncertainty should be represented as a probability statement incorporating a range of estimates for comparison.

The absence of an uncertainty analysis in the present application is a serious shortcoming that needs to be remedied. This could be accomplished by modifying SIMPAS for this use, or by using a different model. For example, it ought to be possible to run the model for a range of appropriate values such as might be obtained from estimates of confidence intervals for the estimates of survival and other inputs.

Uncertainties arise in part from the variability inherent in the estimates of parameters input into the model, and from the fact that estimates are not available for some of the parameters, which requires use of assumed values or insertion of values obtained from "observations or best professional judgment". Even where legitimate point estimates are available (i.e. averages or other estimators for which estimates of variance and resulting confidence intervals can be developed), some judgment is required in deciding among a set of numbers that might be available for the same parameter. Also, see Whitney et al. 1997 for a discussion of factors that affect FGE and spill effectiveness for example. To use another kind of example from Appendix D of the BiOp, there are survival estimates for yearling chinook in each year from 1994 through 1999 that differ from year to year. To settle on numbers to be used, NMFS employed a Biological Effects Team (page D-1) to develop a table of numbers. Where the team's determinations were incomplete, NMFS' Hydro Program staff made the choices.

3) The Document asserts that to choose among the alternatives specified in the BiOp, it is necessary to consider all the other potential juvenile fish passage alternatives at Bonneville Dam, including those at the second powerhouse. Thus, the document goes beyond the BiOp requirements to include ancillary issues, beyond the issue of survival benefits at B1. This leads to the question of what range of issues the Corps intends to address in its decision documents? The CRITFC letter attached as an appendix to the Document makes the point that total funds are limited, thus proposed improvements at B1 need to be considered in the larger context of improvements at other dams on the river. The letter from NMFS objects to the inclusion of cost considerations, including estimates of power impacts, except in cases where biological benefits are equal.

There is a basic ecological principle that states, "Everything is connected to everything else." We suggest that these connected issues be dealt with by separating them into distinct sections of the Decision Document: 1) the survival benefits called for in the BiOp; 2) discussion of the larger context for decisions on improvements at B1, including B2 and the other dams on the river; 3) estimates of power impacts and other costs.

4) Although the Document is apparently intended to be a response to the BiOp, it is not a full response. It discusses neither the strategies nor most of the Actions specified in the BiOp. This discussion should be provided for the benefit of the reviewers, the Council, and others.

SIMPAS output should be combined with existing information on fish behavior under natural conditions and impacts of various passage routes on biological diversity (FWP criteria [1] and [3]). For example, in recommending deferral of Decision Document recommendations, James Ruff (NMFS/F/NWR 5) made extensive use of additional criteria (memo to Robert Willis, COE Portland District, Sept. 13, 2001, attached as part of Appendix E to the Decision Document). CRITFC made similar appropriate use of additional criteria in framing its recommendations on the subject in a letter from Don Sampson to Col. Randall Butler (COE Portland) of September 24, 2001 (Appendix E attachment).

ISRP Conclusion

The ISRP concludes that the Decision Document should be reorganized and substantially modified, using the BiOp of December 2000 as a framework (including strategies given in the text and actions leading up to Action 97), and the Council's Fish and Wildlife Program principles on hydrosystem passage and operations as guidelines. Doing so will provide information now missing from the document. The Decision Document should include a more complete documentation of the inputs used in the SIMPAS model, along with estimation and discussion of the uncertainty of the final estimates.

Specific Comments

1. The Document needs to be better organized and clearer in its expression. It should describe the process used to reach the stated goal. Early in the text the Document should name the entities involved in the Decision process, and the role played by each. For example, while the oral presentations made it clear that the Decision Document is supported by BPA, this is not mentioned in the text. There is no statement of how the agencies and tribes fit into the process. There should be a description of what the Corps visualizes as the steps involved in applying the Decision Document in the "regional prioritization process" (page 5), and where the "system list" (page 15) fits into the process.

2. The Document should more fully explain the Corps' reasons for choosing alternatives other than those recommended by the agencies and tribes. For example, the proposal from NMFS to delay a decision at B1 until further information on juvenile salmon survival through multiple bypass systems is available, is dismissed with an estimate of the time required to obtain the information, without explaining what the consequences of delay might be. The choice of alternatives ought to be influenced by the Council's criteria [1] and [3], which in our view would favor surface methods of bypass, including improvements in the ice and trash sluiceway, and other surface methods of bypass over the installation of ESBS at B1. This ought to be discussed in the Decision Document.

3. The Document states (p. 19 first paragraph, last sentence) that the guidance and survival estimates for the alternatives produced by SIMPAS were not sensitive to changes in the geographic distribution of the juvenile emigrants among the primary routes of passage (B1, spillway, B2). The intended meaning of this statement is not clear. What is the basis for it?

4. On page 11 the "operational rules" at Bonneville that were used in developing the survival estimates for the alternatives are specified. The focus is on average river flow. While these averages are probably useful for comparison of relative survivals for different alternatives, an additional figure of interest might be a "worst case scenario" that would involve survival estimates under extremes of low and high flow. For example, the extreme low flow experienced in 2001 led to reductions in spill as an alternate bypass route at some projects. What was the effect on survival of fish passing in-river? In choosing among alternatives, the full range of potential river flows should be considered.

Running the model for alternative types of passage improvements and water year types over a continuum of flows representing seasonal patterns (figures 2-6), would provide a better picture of when B1 would operate and the probable effects on juvenile survival.

5. Why are spill deflectors considered in this Decision Document when the decision has already been made to proceed, and they will be installed in 2002, as noted on page 17?

6. Page 19, paragraph 2. It is not clear what is meant by "In the 2000 BiOp the BI Surface Collector was not implemented in the aggressive case"?

7. Page 22 and Table 39. It is not clear how the benefit/cost ratios were calculated. The incremental improvements in survival range from zero to 0.007. Annualized costs are positive numbers, as shown in the far right column to which the reader is referred. Therefore, the benefit/cost ratio must be a number smaller than the range between zero and 0.007. Yet it is said to range from zero to 0.10 for the set of alternatives chosen for an example.