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Review of the SOS Revenue Stream Report

Independent Economic Analysis Board

Task Number 118

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Executive Summary

The IEAB reviewed the “Revenue Stream: An Economic Analysis of the Costs and Benefits of Removing the Four Dams on the Lower Snake River” prepared by the Save Our Wild Salmon (SOS) organization. We prepared a short summary of the content of that report and provide the following five main comments on the report.

- 1. The Revenue Stream estimate of the cost of hydropower replacement if the dams were removed is substantially below the cost estimates reported in the Corps of Engineers Lower Snake EIS in 2000. This is crucial, because the cost of replacement power is potentially a large continuing cost if the four lower Snake River dams were removed. Based upon our review of the Corps of Engineers’ cost estimate, the Revenue Stream report underestimates hydropower replacement costs by enough to invalidate their main result that the region could save money by removing the dams.**
- 2. The Revenue Stream report is not a peer reviewed analysis, the work was not conducted by an open public process, and many of the sources that the report relied on came from reports that were also not products of an open, public, peer reviewed process. Consequently, the IEAB does not have a solid basis to either accept or reject many of the cost and benefit estimates in the Revenue Stream report.**
- 3. The Revenue Stream report does not discount future benefits and costs of dam removal. Discounting recognizes that people give greatest weight to immediate costs and benefits. Because some large costs of dam removal occur immediately, while other costs and benefits occur slowly over many years, lack of discounting could have a significant impact on the conclusions of the report.**
- 4. The Revenue Stream Report estimates the cost of maintaining the salmon program in the Columbia basin with and without the four lower Snake River dams, and then poses the difference between these two costs as a cost saving. The cost estimates reflect a diverse mix of Federal agency budgets and estimated additional salmon recovery costs. It is not clear that the agency budgets reflect full or accurate cost estimates, or that they rely on a common definition of costs.**
- 5. The Revenue Stream report argues that dam removal will have substantial additional benefits due to the recovered fishery. The reported recreational fishery benefits rely heavily on a study by Don Reading (2004), which the IEAB reviewed in December 2005. We concluded that Reading had made a number of methodological errors which seriously biased his benefit estimates upward. The non-fishery recreational benefits are derived from a study by John Loomis (1999) which the IEAB reviewed during our overall review of the Corps’ EIS in 2001. We had significant concerns about some of Loomis’ results as well, and the numbers actually used in the final Corps EIS differed substantially from those presented in the original Loomis study. Hence, the Revenue Stream’s reported benefits from salmon recovery in the Snake River appear unreliable.**

The IEAB concludes that the Revenue Stream report prepared by Save Our Wild Salmon has a number of deficiencies that raise serious questions about its acceptability as an alternative to the

Corps of Engineers Lower Snake EIS. Although it may now be out of date and was not perfect, the Corps EIS has been widely accepted as a credible analysis of the impacts of removing the four lower Snake dams.

The Corps EIS set a high standard as an open, public and peer reviewed analysis that has not been matched by any other study of dam removal, and is certainly not matched by the Revenue Stream report. Because Revenue Stream uses numbers from reports that do not result from an open peer reviewed process, it is difficult to assess the validity of these studies, whether they use appropriate methodology, rely on good data, or use compatible assumptions.

The Revenue Stream report itself reflects some inappropriate methodology choices. SOS's choice to not address the likely distribution of costs and benefits over time or to discount future costs and benefits is a major failing of the report. In other cases, the Revenue Stream report does not clearly document the methodology they used to derive their estimates, making it impossible for us to replicate or critique their numbers.

While the IEAB concludes that there are enough problems with the Revenue Stream report that it cannot be viewed as a credible alternative to the Corps Lower Snake EIS analysis of the impacts of removing the four lower Snake dams, we want to emphasize that the EIS is not necessarily the last word on the topic. When the IEAB served as formal reviewer of the Corps EIS, one of our conclusions was the region should "... invest in improved estimates of economic benefits from dam breaching to reduce the range of uncertainty and to improve confidence in them ...". At the time the IEAB had a number of criticisms and suggestions for how the analysis could and should be improved. Because there are a number of weaknesses to the Corps study, because some of the assumptions and methodologies used by the Corps are controversial, and because the world, especially the power cost world, is a much different place than it was in the late 1990s when much of the Corps analysis was done, it is easy to see why people continue to question whether the Corps EIS is the final word on the topic.

Perhaps it is time for the region to consider doing a follow-on study of the four lower Snake dams that would address some of the weaknesses of the Corps study, and that would update the study to reflect the many changes in the regional economy, regional transportation systems, power generation and transmission, the successes and failures of current recovery efforts, and the improved models of fish biology, dam passage and ocean survival now available.

Review of the SOS Revenue Stream Report

This review of the report “Revenue Stream: An Economic Analysis of the Costs and Benefits of Removing the Four Dams on the Lower Snake River” by Save Our Wild Salmon (2005) was prepared by the IEAB at the request of the Council. The SOS report is available on the web at http://www.wildsalmon.org/library_files/revenuestream8.pdf

Content of the Revenue Stream Report

The Revenue Stream report claims to be an economic analysis of the costs and benefits of removing the four lower Snake dams. In fact the report contains very little new economic analysis. Instead, it is mostly a compilation of numbers from several other economic studies, most notably the Corps Lower Snake EIS (2000), plus several more recent studies, woven into a conclusion that SOS argues supports removing the four dams.

The approach used in Revenue Stream was to look at costs – the costs that would be faced by the region if the dams are kept in place and the costs if the dams were removed. The costs addressed in each case are essentially the same cost categories that were used by the Corps in their Lower Snake EIS. SOS reasoned (as did the Corps) that some costs would be avoided if the dams were removed – especially the O&M costs of the dams, locks and powerhouses, and some of the current spending on salmonid passage and recovery. The dam removal scenario would also involve some costs, most notably the costs of removing the earthen embankments of the dams, shoring up infrastructure that would be impacted by dropping the reservoir pools, transporting commodities by alternative modes following closure of the waterway, and the cost of replacing the hydropower that would no longer be generated by the breached dams.

The cost estimates for Revenue Stream’s with-dam and without-dam scenarios are summarized in Table 1, below. Rather than using annualized costs¹ like most other studies of this kind, SOS presents these costs as the sum of costs for the first ten years, and the sum of costs for the first twenty years. Their table indicates that costs without-dams would be less than the costs with-dams. Thus they conclude that the region could actually save money by removing the dams.

While the primary focus of the Revenue Stream report is on the costs that could be saved by removing the dams, SOS also address the benefits of dam removal. They refer to the estimated \$550 million annual economic benefits of a recovered Idaho salmon sport fishery developed in a study by Don Reading. While they note that Reading’s estimate has been criticized as too high, they take Reading’s estimate as a lower bound of benefits for the entire Pacific Northwest region of the recovered salmon sport fishery.

Thus their conclusion that the dams should be removed rests on their assertion that dam removal would both lower costs and result in large economic benefits from a recovered salmon fishery.

¹ The “annualized cost” of an uneven sequence of expenses is the constant annual payment needed to pay off a loan with a principal equal to the present value of the stream of annual expenses..

Table 1: Numbers from Revenue Stream Report

	Estimate Attributed to	Total for 10 years		Total for 20 years	
		low	high	low	high
<u>Cost of Keeping the Lower Snake River Dams</u>					
2004 Federal and Snake River Salmon Plan	NOAA	6.00	6.00	12.00	12.00
Additional Salmon Recovery Costs with Snake River Dams	Yakima Indian Nation	1.42	2.34	2.84	4.68
Dam operation and maintenance	Correspondence with Corps	0.34	0.34	0.67	0.67
Sediment Control with Snake River Dams	Corps McNary & Lower Snake Mgt Plan	0.03	0.36	0.05	0.71
Major Dam Repairs	Corps Lower Snake EIS	<u>0.06</u>	<u>0.06</u>	<u>0.11</u>	<u>0.11</u>
Totals as reported on page 6 of report		7.84	9.09	15.7	18.2
<u>Cost of Removing the 4 Lower Snake River Dams</u>					
New Federal Columbia and Snake River Plan	SOS synthesis from various sources	3.10	4.50	6.20	9.00
Additional Salmon Recovery Costs after Lower Snake River Dam Removal	SOS synthesis from various sources	0.96	1.16	1.91	2.32
Dam Removal and River Restoration	Corps Lower Snake EIS	0.79	0.79	0.79	0.79
Power Replacement	Rand, NW Energy Coalition	0.79	1.70	1.58	3.40
Transportation Infrastructure Investments, Converting Barge to Rail	American Rivers & SOS	0.02	0.23	0.02	0.23
Increased Shipping Rates	BST Associates 2003	0.07	0.13	0.14	0.26
Irrigation Investments	Corps Lower Snake EIS	0.42	0.42	0.42	0.42
Private Well Modifications	Corps Lower Snake EIS	0.07	0.07	0.07	0.07
Municipal and Industrial Well Use Modifications	Corps Lower Snake EIS	<u>0.01</u>	<u>0.06</u>	<u>0.01</u>	<u>0.06</u>
Totals as reported on page 11 of report		6.19	9.08	11.10	16.60
<u>Benefits with Dams</u>					
Commercial Fishing	IEAB	0.56	0.56	1.11	1.11
Sport fishing	SOS, Reading	0.86	5.56	1.72	11.12
Non-fishing Recreation	Corps Lower Snake EIS	<u>0.37</u>	<u>0.37</u>	<u>0.73</u>	<u>0.73</u>
Totals as reported on page 15 of report		1.78	6.54	3.57	13.10
<u>Benefits if dams were removed</u>					
Commercial Fishing	Institute for Fisheries Resources	1.27	1.27	2.55	2.55
Sport fishing	Reading	5.56	5.56	11.12	11.12
Non-fishing Recreation	Corps Lower Snake EIS	<u>2.23</u>	<u>3.60</u>	<u>4.46</u>	<u>7.20</u>
Totals as reported on page 15 of report		9.09	10.50	18.20	20.90

Comments on the Revenue Stream Report:

- 1. The Revenue Stream estimate of the cost of hydropower replacement if the dams were removed is substantially below the cost estimates reported in the Corps of Engineers Lower Snake EIS in 2000. This is crucial, because the cost of replacement power is potentially a large continuing cost if the four lower Snake River dams were removed. Based upon our review of the Corps of Engineers' cost estimate, the Revenue Stream report underestimates hydropower replacement costs by enough to invalidate their main result that the region could save money by removing the dams.**

Both the Corps EIS and the Revenue Stream report agree that the cost of replacing the hydropower would be a major cost associated with removing the lower Snake dams. The SOS report uses the results from several other reports to construct estimates of this replacement power cost that are much lower than those developed by the Corps.

The Revenue Stream report begins with the 2002 Rand report. That report concluded that replacing the lost generation with energy efficiency and wind power would not impede economic growth in the region and could create as many as 15,000 long-term jobs. Terry Morlan's 2002 review of the Rand report for the Council (based on Council staff efforts) outlined a number of deficiencies of the Rand analysis, including the following. (1) Rand's figures for the amount of conservation potential in the region greatly exceed the Council staff's estimates of how much conservation could be achieved. (2) Rand assumed that this conservation could be achieved much more cheaply than Council staff analysis suggests. (3) Since Rand used regional economic activity (which vastly overstates the benefits of the power) as its criterion, high-cost options, especially those which involve lots of local spending, will appear to look good. The essence of Morlan's review comments is that using renewables and conservation would not reduce cost to replace the lost power below the cost of combined cycle generation, on which the Corps of Engineers based their cost estimate. These criticisms suggest that the Rand study is a shaky foundation on which to build an analysis of the replacement power costs of dam removal.

Revenue Stream then turns to a 2002 NRDC - NW Energy Coalition study "Going with the Flow: Replacing Energy from the Four Lower Snake Dams" for its numbers. We have not been able to document whether the \$79 million lower bound was taken directly from this report. The \$170 million upper bound was apparently the result of some updates and modifications to the NRDC - NWEC report numbers. This upper bound also appears to incorporate some of the same electricity conservation cost assumptions from the Rand report, which were criticized severely in Terry Morlan's memo.

The Corps EIS estimates of power replacement costs were considered at the time to be credible and subject to much less controversy and uncertainty than most parts of that study. The Corps and NPCC analyses of power costs are the result of a transparent, public, peer reviewed processes, which contributes to their credibility. The SOS estimate was based on several studies that were not peer reviewed and not conducted in an open public process. It is very difficult for the IEAB to evaluate the alternative models used in these different studies, based upon different approaches, different assumptions, and different results. The Revenue Stream report risks the appearance that it picked low replacement power cost numbers from various reports that suit their

purposes.

The Corps EIS reported its replacement power costs in three sub-categories. Using a 4.75% discount rate, the annual equivalent cost of the replacement power itself, based on the cost of combined cycle turbine generation, was \$238 million per year. The annual cost impact to replace the transmission reliability provided by the dams would be \$21.5 million, and the annual cost of replacing lost ancillary services would be \$9 million, for a total of \$267.5 million per year. It is unclear whether Revenue Stream's replacement power cost estimates include the transmission and ancillary services costs, which could be even higher for conservation and renewables than for combined cycle generation. If they did not include them, it would be one more major failing of the report.

We note that if the Corps replacement power costs (which the IEAB considers to be the more credible numbers) were inserted into the Revenue Stream report in place of the power costs estimated by SOS -- this change alone would be enough to reverse their results. It would be cheaper for the region to keep the dams.

- 2. The Revenue Stream report is not a peer reviewed analysis, the work was not conducted by an open public process, and many of the sources that the report relied on came from reports that were also not products of an open, public, peer reviewed process. Consequently, the IEAB does not have a solid basis to either accept or reject many of the cost and benefit estimates in the Revenue Stream report.**

In general, an analysis gains credibility if it is conducted in an open public process, and if the results are subjected to formal peer review. This was not the case for the Revenue Stream report, and it was not the case for many of the reports which were used as sources in compiling that report.

We contrast this with the approach used by the Corps for their Lower Snake EIS. The Corps process was open, with many opportunities for stakeholders, agency staff, analytic professionals, and the general public to participate in and comment on the analysis. The IEAB participated in this process, both as informal reviewers during the course of the economic analysis, and as formal reviewers of the final economics results.

The Revenue Stream report raised some legitimate concerns about the results of the Corps EIS. The IEAB also voiced some concerns in its formal review of the economics part of the EIS. However, our advice was as follows:

“Our recommendation to the Council and others regarding the economic appendix is threefold: (1) consider the costs of dam breaching estimated in the economic appendix as the best estimate currently available; (2) invest in improved estimates of economic benefits from dam breaching to reduce the range of uncertainty and to improve confidence in them; and (3) in the meantime make decisions based upon the estimated costs, biological feasibility, and other measures of positive outcomes while relying less on the magnitudes of estimated recreational benefits and existence values for salmon and natural river conditions.” (http://www.nwcouncil.org/library/ieab/ieab04_00.pdf, page 5.)

In order to displace the Corps EIS as the best available economic analysis of the cost of removing the lower Snake River dams, any new study is going to have to also be an open, public, and peer reviewed process. The Corps study would be the likely starting point, but there is ample opportunity to update the analysis to current conditions, to fill in the gaps, and remove some of the uncertainties.

- 3. The Revenue Stream report does not discount future benefits and costs of dam removal. Discounting recognizes that people give greatest weight to immediate costs and benefits. Because some large costs of dam removal occur immediately, while other costs and benefits occur slowly over many years, lack of discounting could have a significant impact on the conclusions of the report.**

The approach used in the Revenue Stream report was simply to add up the costs with the dams in place and the costs if the dams were removed and then compare the two. Two time periods were used for the summations – the first ten years, and the first 20 years. There was no attempt to display the likely distribution of costs and benefits over time or to discount future costs and benefits.

Some costs and benefits would occur immediately with removal, while other costs and benefits would occur only with a time lag of years following removal. If the dams were removed, the removal costs would be immediate, the costs to replace the lost power would start immediately and continue indefinitely, the costs of major dam upgrades and repairs that would be avoided if the dams were removed would be some time in the future, and any benefits and cost savings associated with recovered fish stocks would be spread over time.

The Corps Lower Snake EIS economic appendix noted that:

“For most water-related projects, the bulk of project costs tend to be incurred during project implementation. Benefits, on the other hand, are typically realized as uneven flows of income or monetary benefits over a much longer time.” (Corps EIS, Appendix I, page II-6, http://www.nww.usace.army.mil/lsr/final_fseis/study_kit/main_report/appendix_i.pdf)

To reflect this, the Corps used a discounting procedure in its evaluation of future costs and benefits. This approach is widely accepted for project economic analysis, and is standard for NEPA analyses like the Corps study. The Corps study used three discount rates of 6.875 % (the standard rate used by the Corps), 4.75% (the rate customarily used by BPA), and 0% (a rate requested by the tribes, and used to illustrate the effects of discounting). The Corps then reported these results as annual equivalent costs and benefits.

Revenue Stream’s failure to account for the different future time paths of various cost and benefit streams, and its failure to account for the time value of money by using a discount rate, are major failings of the report, and severely reduce its credibility. Note that the Revenue Stream report actually used some of the annual equivalent cost numbers from the Corps EIS, mixing them in with undiscounted costs estimated from other sources in its ten-year and twenty-year cost totals. This is certainly incorrect methodologically, but it is difficult to sort out what effect this combination of incompatible numbers would have on their bottom line.

- 4. The Revenue Stream Report estimates the cost of maintaining the salmon program in the Columbia basin with and without the four lower Snake River dams, and then poses the difference between these two costs as a cost saving. The cost estimates reflect a diverse mix of Federal agency budgets and estimated additional salmon recovery costs. It is not clear that the agency budgets reflect full or accurate cost estimates, or that they rely on a common definition of costs.**

The costs of continuing the 2004 Federal salmon plan in the basin was constructed from a number of Council, Corps, and other reports. For an estimate of the “with” Snake River dams alternative, SOS used a summary of Federal agency budgets, called the “cross-cut” budget, including expenditures by BPA, Corps of Engineers, Departments of Interior, Commerce (NOAA Fisheries), Agriculture, Energy, and EPA. During FY01 – FY06 the total actual budgets ranged from \$453.1 million to \$640.3 million, and averaging roughly \$600 million/year. Additional costs of recovery funding (reportedly estimated by the Yakima Indian Nation) of \$142 to \$234/yr are added to the Federal costs to obtain a total “with dams” annual cost of \$742 - \$834 million/yr. This cost is then contrasted with estimated costs of continuing salmon programs with the four dams removed.

This cost of the salmon plan “without” the Snake River dams is assembled from a variety of estimates. The Council’s “Human Effects Analysis of the Multi-Species Framework Alternatives. Phase II Final Report” (CH2M Hill, March 2000; Council Doc. 2000-5) is used to estimate the ongoing costs of facility modifications and hydrology strategies (Table 4-10, p. 4-27). Other sources are used to estimate a broader range of costs totaling \$310 - \$450 million/yr. In some unspecified fashion, the report concludes that the overall costs of the salmon plan would drop by 35 – 55% and that the “additional costs” for recovery would drop by 45%, resulting in a total cost “with” dams of \$388.1 to \$578.7 million/yr. [These figures differ from those in the published report, as they incorporate corrections that SOS announced after the report was distributed.]

There are some weaknesses to this approach to estimating cost savings. First, the Federal agency budgets are not necessarily a good measure of costs to society associated with the salmon program. Nor is it clear that the overall program budget would be reduced to the extent suggested by the Revenue Stream report after removal of the 4 lower Snake River dams. Budgeting decisions are clearly influenced by a variety of concerns and issues. Further, some sources of information for the calculations performed in the calculation are not clear or reviewable. And the selection of specific numbers from a variety of unpublished reports makes verification difficult, if not impossible. The failure of SOS to clearly show how it estimated salmon program cost savings is another major failure of the Revenue Stream report.

- 5. The Revenue Stream report argues that dam removal will have substantial additional benefits due to the recovered fishery. The reported recreational fishery benefits rely heavily on a study by Don Reading (2004), which the IEAB reviewed in December 2005. We concluded that Reading had made a number of methodological errors which seriously biased his benefit estimates upward. The non-fishery recreational benefits are derived from a study by John Loomis (1999) which the IEAB reviewed during our overall review of the Corps’ EIS in 2001. We had significant concerns about some of Loomis’ results as well, and the numbers actually used in the final Corps EIS differed substantially from those presented in the**

original Loomis study. Hence, the Revenue Stream's reported benefits from salmon recovery in the Snake River appear unreliable.

The biggest component in Revenue Stream's estimate of benefits was based on Don Reading's \$550 million estimate of the benefits of a recovered salmon and steelhead fishery in Idaho. When the IEAB reviewed the Reading study, it found a number of serious methodological errors. Reading inappropriately used changes in gross economic activity, rather than changes in regional income as his measure of benefits. He also made a modeling error, using total retail spending by fishermen, where he should have used gross margin numbers to drive the calculation of the community multiplier effects of this spending. Both of these errors were very serious and resulted in large overestimates of the benefits of a restored salmon fishery. SOS has severely compromised the credibility of the Revenue Stream report by including Reading's numbers.

The estimates of the benefits to the commercial fishery from the Institute for Fisheries Resources are not peer reviewed, and are not from an open public process, so the IEAB has no way to judge their legitimacy.

Note that in December 2005 the IEAB completed a report on "The Economic Effects from Columbia River Basin Anadromous Salmonid Fish Production." The household personal income resulting from commercial and sport salmon harvest were \$141.6 million per year, under the assumptions that hatchery production, smolt to adult returns, and harvests were at early 2000s levels. Of this about 63% occurred in the Columbia River, 19% in US ocean fisheries, and 18% in Canadian ocean fisheries. These numbers would certainly increase if the fishery were to recover, but whether they would increase by the five times or more necessary to meet the Revenue Stream estimates is questionable.

Note that this brings up the question of exactly how much recovery of fish numbers would follow from removal of the dams. For the Corps EIS, fish biologists used fish life cycle and river passage models to estimate the effects of dam removal on fish numbers that would be available for harvest. It is unclear what returning fish numbers were used by SOS or how they were derived.

Revenue Stream attributes its \$360 million annual value of non-fishing recreation on the free-flowing river following dam removal to a study by John Loomis, commissioned by the Corps as a part of the Lower Snake EIS process. Following considerable discussion of the Loomis methodology and numbers, involving the IEAB and others, the Corps in its final EIS used revised estimates (based on a 4.75% discount rate) of \$38.9 to \$329.2 million per year. These numbers that were actually used in the Corps EIS are substantially below the Loomis river recreation numbers that were used in the Revenue Stream report.

Conclusions

The IEAB concludes that the Revenue Stream report prepared by Save Our Wild Salmon has a number of deficiencies that diminish its credibility. An alternative analysis, the Corps of Engineers Lower Snake EIS, has been widely accepted as a credible analysis of the impacts of removing the four lower Snake dams.

The Corps EIS set a high standard as an open, public and peer reviewed analysis that has not been matched by any other study of dam removal, and is certainly not matched by the Revenue Stream report. Because Revenue Stream uses numbers from reports that do not result from an open peer reviewed process, it is difficult to assess the validity of these studies, whether they use appropriate methodology, rely on good data, or use compatible assumptions.

The Revenue Stream report itself reflects some inappropriate methodology choices. SOS's choice to not address the likely distribution of costs and benefits over time or to discount future costs and benefits is a major failing of the report. In other cases, the Revenue Stream report does not clearly document the methodology they used to derive their estimates, making it impossible for us to replicate or evaluate their numbers.

While the IEAB concludes that there are enough problems with the Revenue Stream report that it cannot be viewed as a credible alternative to the Corps Lower Snake EIS analysis of the impacts of removing the four lower Snake dams, we want to emphasize that the EIS is not necessarily the last word on the topic. When the IEAB served as formal reviewer of the Corps EIS, one of our conclusions was the region should "... invest in improved estimates of economic benefits from dam breaching to reduce the range of uncertainty and to improve confidence in them ...". At the time the IEAB had a number of criticisms and suggestions for how the analysis could and should be improved. Because there are a number of weaknesses to the Corps study, because some of the assumptions and methodologies used by the Corps are controversial, and because the world, especially the power cost world, is a much different place than it was in the late 1990s when much of the Corps analysis was done, it is easy to see why people continue to question whether the Corps EIS is the final word on the topic.

Perhaps it is time for the region to consider doing a follow-on study of the four lower Snake dams that would address some of the weaknesses of the Corps study, and that would update the study to reflect the many changes in the regional economy, regional transportation systems, power generation and transmission, the successes and failures of current recovery efforts, and the improved models of fish biology, dam passage and ocean survival now available.

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