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Lower Snake River Dams
Breach Mitigation Plan & Cost

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Image of Lower Granite post-breach river channelization, from the 2002 *Lower Snake River Juvenile Salmon Migration Feasibility Study and EIS.* USACE Walla Walla.

This report outlines various mitigation features that will or could be required upon breaching the four lower Snake River dams (LSRDs). Mitigation is based on the assumption that all four dams are breached by removing their earthen berms and, with two of the dams, part of the earthen abutment to the berms. This is the well-developed plan put forth by the Corps of Engineers in the 2002 LSRD Feasibility Study and EIS (02 EIS) to improve juvenile salmon passage over the 4LSRDs[A]. The 02 EIS laid out various mitigation measures and costs. Additional mitigation found to be appropriate was identified by a small group of Corps retirees and volunteers who in 2016 developed a Reevaluation (REval) of the 02 EIS Breach Plan (Appendix D Natural River Drawdown Engineering)[C]. The report included added and corrected mitigation costs. The team here further corrected/updated the plan and costs for mitigation in 2020. Note that the 2020 EIS for the Columbia River System did not utilize the updated information in these reports. Instead, the 2020 EIS took the original breach cost in the 02 EIS and converted it to 2020 dollars, which increased the overall cost of the breach alternative, (identified in the 2020 EIS as Multiple Objective 3)[D]. This perpetuates faulty assumptions and unnecessary cost. Corrected breach costs plus predicted mitigation costs intended to keep everyone whole, were found to be much less than the overall costs stated in the 02 EIS, and thus the 2020 EIS estimate. Further savings can be anticipated, and $500 million is an approximate price tag that will vary based on agency decision making and field conditions.

Mitigation Features

Mitigation is intended to address the indirect effects of breaching on specific stakeholders. Table 8 below, from the 2016 REval, identifies the type of mitigation (in red), the original cost as stated in the 02 EIS, the corrected cost as identified in the 2016 REval, and the difference between the two.

Table 8: Four Dam Totals
(Costs shown in the tables are in thousands of 1999 dollars**)**

	Original Cost	Corrected Cost	Difference
Grand Totals (thousands of dollars)	**$858,939**	**$255,026**	**$603,913**
Power House Turbine Modifications	$31,707	$6,341	$25,366
Dam Embankment Removal	$161,930	$83,000	$78,930
River Channelization	$148,202	$54,000	$94,202
Temporary Fish Handling Facilities	$37,754	$0	$37,754
Project Dam Decommissioning	$6,009	$6,009	$0
Railroad Relocations	$20,182	$18,705	$1,477
Bridge Pier & Abutment Protection	$51,858	$11,371	$40,487
Reservoir Embankment Protection	$178,815	$15,104	$163,711
Drainage Structure Protection	$8,556	$8,556	$0
Railroad/Roadway Damage Repair	$130,007	$3,000	$127,007
Recreation Access Modification	$15,743	$12,594	$3,149
HMU Modification	$10,060	$7,626	$2,434
Reservoir Revegetation	$33,644	$13,458	$20,186
Cultural Resource Protection	$6,826	$6,826	$0
Cattle Watering Facilities	$6,861	$6,861	$0
Excess Property Disposal	$1,075	$1,075	$0
Lyons Ferry Hatchery Modifications	$9,710	$500	$9,210

Table 8: Adjusted costs for Snake River dam removal from page 28 of the REval. Mitigation costs appear in red.

The sum of the corrected costs is $255,026, with the portion attributable to mitigation equaling $104,101 million. To predict mitigation cost in 2020 dollars the total amount is compounded at a 3% inflation rate, equaling ***$194,589 million.***

Cost Savings

The 2016 REval contains a detailed discussion of the basis for the cost savings[C]. Cost savings occur where mitigation measures are unnecessary, overestimated, or already in place. For example, the

02 EIS based railroad/roadway damage repair costs on predicted damage. Yet, a more precise cost estimate is available based on railway/roadway damages that occurred in the 1992 Drawdown Test. The 2016 REval took the actual costs of the repairs from the Drawdown Test[E]. The adjusted cost of repairs is over $100 million less than the Corps 02 EIS estimate to prevent damage.

Image A. Lower Granite Dam year 1970.

Estimated construction costs for river channelization dikes is another example of cost savings. River channelization is unnecessary since the Corps built construction areas and dikes 20 feet above normal river flow as part of dam construction (see image A), the image does not show natural river, instead the head waters of the next lower dam. With breaching the water elevation will be about 20 feet lower, thus no need for further channel diking around the remaining dam structure.

"Non-federal" Mitigation

In addition to the mitigation costs, the breach alternative of the 02 EIS identified the cost of non-federal modifications, set forth in Table 8-1 below[A]. Cursory review indicates that non-federal modifications had unusually high contingencies and escalation. Additionally, no data is available to check the validity that these modifications are still relevant. For example, it is likely some of the groundwater wells have been abandoned. Besides irrigation system, costs in table 8-1 have not been corrected, and may remain overestimated in present estimates. The sum of total costs (minus irrigation system mitigation) from table 8-1 are included in the 2016 REval and the present cost estimate. This equates to $90,228 million in 1999 dollars or ***$167,851 million*** in 2020 dollars (at 3% inflation).

Table 8-1. Non-Federal Modifications Summary of Costs, in $1,000

Project	Direct Costs	Contingency	Escalation	Total
Ice Harbor Project				
Irrigation System	$224,216	$67,264	$54,693	**$346,174**
Groundwater wells	$9,188	$9,185	$3,450	**$21,823**
Lower Monumental				
Groundwater wells	$6,233	$6,228	$2,339	**$14,800**
PGE Gasline Crossing	$5,916	$2,071	$1,573	**$9,560**
Little Goose				
Groundwater wells	$3,901	$3,896	$1,461	**$9,258**
Lower Granite				
Groundwater wells	$8,909	$8,906	$3,346	**$21,161**
Private water users	$551	$166	$133	**$851**
Potlatch water intake and effluent diffuser	$7,912	$2,772	$2,091	**$12,775**

Table 8-1: Non-Federal Modifications or mitigation features, uncorrected. From the 02 EIS Appendix D D8-1

Irrigation Mitigation

The 02 EIS provided an estimate of $346 million to modify the irrigation system as a result of drawdown of Ice Harbor pool (table 8-1), which was twice the assed value of the farmland[A] . As such the EIS concluded that these 14 farmers would be bought out, contributing to an antagonistic view toward breaching. However, it was known at the time the $346 million was very high and speculative because of faulty assumptions, but again, corrections were not made for the lack of more study funds and time. In 2018, a report calculating the cost of pump and pipe modifications to continue current irrigation post-breach and keep farmers in business, found that irrigation mitigation could be accomplished for $18 million in 2016 dollars or ***$20,259,000*** in 2020 dollars at 3% inflation[G]. Because available pipe and pump sizes inevitably lead to larger system capacities, these modifications could have the added benefit of making irrigation accessible to an additional 5,000 to 7,000 acres, further increasing jobs and income not accounted for in the 02 EIS.

Sediment Mitigation

Sediment mitigation refers to the impacts of sediment no longer held back by the dam post breach. For example, impacts to water supply/irrigation intake screens were seen during the Elwha River dam breach, until they were remedied with standard design approaches. Luckily the sediment levels are much lower and manageable on the Snake River when compared to the Elwha, due to the proximity of the LSRDs to the Hells Canyon dam complex upstream, and differences in the sediment composition. According to the U.S Geological Survey (USGS) fast-moving water moves large sediment particles more easily than slow-moving water. River water flowing through hydropower reservoirs moves too slowly to keep sediments suspended, and sediments are deposited on the river bottom upon reaching the reservoir pool, upstream of the dam[K].

With all four dams breached, the small sediments (fine silts) will move downriver, into the McNary dam complex reservoir pool. Over a 50-year period this movement will create a multiple inch sediment layer behind McNary Dam, thus covering radionuclides embedded in riverbed sediment from Hanford Nuclear Power Plant[L]. Ironically the multi-billion-dollar problem of radioactive pollution at this location could be remedied for free.

The heavy sediments, now deposited at the head of Lower Granite Pool at Lewiston (which currently heightens flood risk at Lewiston), will move down river and be deposited upon reaching slow moving water at the *head* of McNary pool, also known as Lake Wallua. Because McNary pool extends upriver of the site of Ice Harbor Dam (the 4th dam built on the lower Snake), deposition after a four-dam breach would occur before the confluence of the Snake and Columbia Rivers. For this reason, no sedimentation mitigation costs were predicted in the breach alternative of the

02 EIS. The 2020 EIS incorrectly includes dredging of Lake Wallula as navigation mitigation for a port downriver of the Snake and Columbia confluence[D]. Upon review of Snake River sedimentation dynamics, no sedimentation mitigation costs or navigation mitigation related to sedimentation, are incorporated into this plan.

Railroad Mitigation

Additional mitigation measures not identified in the 02 EIS or 2020 EIS are primarily rail related and would involve further improvements to short line railroads, unit train grain loaders, Washington State's grain shuttle service, rail sidings, etc., The railroads do not have enough crews and locomotives currently on hand to quickly pick up all the tonnage associated with breaching the LSRDs. However, in a couple months, necessary upgrades can be completed. It is important to note that recent rail upgrades have created enough capacity to take on all grain shipments along the Snake River. As pointed out in research done by the Columbia-Snake River Irrigators Association, the 2020 EIS omitted this important assessment[J].

To further expedite barge to rail shipments the following mitigation measures may be needed[1]:

- Upgrade of the rail line between Dayton and Prescot WA owned by the Port of Columbia estimated at $29 million.
- Improvements to rail siding, handling facilities at grain elevators, and perhaps a unit train loading facility along this line, $5-37 million.
- Upgrade of 2 miles of rail line in Idaho to the Lewis and Clark Grain Terminal along with expansion of siding and handling facilities, $5-32 million.

Low and high totals for estimated improvements range from **$39 million to $98 million.**

Hydropower Mitigation?

Viewing hydropower capability as a potential loss to Bonneville Power Authority (BPA) in a breach alternative, would permit a mitigation cost. The proposed replacement cost of the ~1,000 average annual MW of the LSRDs range from $0, to the latest figures found in the 2020 EIS of $801 million/year (table 3-164)[D]. $0 is based on the assumption that all Snake River power is surplus and does not need to be replaced to serve BPA's tier one/preference customers, although some ancillary benefits may need to be replaced. For example, the 02 EIS does not include hydropower mitigation as a breach cost, but does include costs of ancillary benefits of the LSRDs, assigning a value of $7 million and $465,000 for Reserve power and Automatic Generation Control Capabilities, respectively[1]. In 2020 dollars these values are approximately $16 million and $1 million. However, this is likely an exaggeration since modern day spill requirements currently limit reserve power and AGC capabilities. Based on current BPA load and resource projections, generation data, price of secondary sales (the LSRDs should be analyzed based on this price since

[1] Assessment made by civil engineer Jim Waddell.

they cost at least 40% more to produce power than the other major dams in the Federal Columbia River Power System), the amount of renewables projected in BPA's congressional budget document, and the limited amount of ancillary benefits on the dams[H], it is safe to say that the replacement cost is ***somewhere between 0$ and $17 million.*** The loss of revenue from breaching (approximately 200 million to 230 million[F,M]) is less than the present cost of dam operation (excluding navigation costs)[I]. BPA will recover money from breaching alone without mitigation, which can be used on other hydropower assets, the transmission system, or as a refund to ratepayers.

Total Cost of Breach Plus Mitigation

Updated costs for original mitigation, non-federal mitigation, irrigation mitigation, low and high estimates for railroad mitigation and low and high estimates for hydropower mitigation were summed for a total of $421,699,000 and $480,716,000, respectively. It is safe to say overall cost for mitigation today is approximately **$500 million.**

The actual cost of mitigation could easily be far less given the fact that some of the mitigation measures may not be needed or are already in place. All of them have contingences ranging from 30 to 100 percent.

Mitigation costs will add to the breach cost to attain an overall cost of pursuing a breach alternative. By adding together non-mitigation costs from table 8, and adding 3% inflation, the 2020 cost of breaching is approximately $155 million. This brings the total of breach plus mitigation to about **$655 million in 2020 dollars.** This cost could likely be lower if agencies identify further savings or breaching field conditions reveal less need for mitigation work.

Course of Action

Except for some rail conveyance modifications and upgraded sidings, most of these mitigation measures are not required prior to initial breaching of Lower Granite Dam. This exemplifies the swiftness of action in the dam breach alternative once the Corp of Engineers makes the decision to place the project into a non-operational status.

High costs of breaching and mitigation in the 2020 EIS prevent the breach alternative from even being considered as preferred. Realistic, appropriate, and considerate breach mitigation costs are essential, but absent from current conversation. Lack of this evaluation represents a bottleneck in the course of action for agencies struggling to recover salmon populations protected under the Endangered Species Act and to remove a significant financial burden for BPA ratepayers.

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