



LOWER SNAKE RIVER DAMS

ECONOMIC TRADEOFFS OF REMOVAL

Executive Summary • Prepared for Vulcan Inc.

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ACKNOWLEDGMENTS



From left to right: The Ice Harbor, Lower Monumental, Little Goose, and Lower Granite dams on the Lower Snake River

For over 40 years, ECONorthwest has helped its clients make sound decisions based on rigorous economic, planning, and financial analysis. For more information about ECONorthwest: www.econw.com.

ECONorthwest prepared this report for Vulcan Inc. It received substantial assistance from Vulcan Inc. staff, Daniel Malarkey, Dennis Dauble, and Aspect Consulting. Dennis Dauble and Aspect Consulting completed their work independently and did not directly contribute to or review the main report, including sections referencing their work. They should not be considered responsible for any applications of their work by ECONorthwest. Other firms, agencies, and staff contributed to other research that this report relied on. That assistance notwithstanding, ECONorthwest is responsible for the content of this report.

Every effort was made to incorporate publicly available information in an objective, unbiased manner. Some inputs to this study remain a topic of substantial public debate, while others are based on estimates from scientific fields in which we are not experts or sufficient data does not exist. We did not seek to serve as the arbiter of disagreements or scientific uncertainty. Rather, we evaluated the quality of all available information, made judgments on the validity of estimates, and incorporated reasonable ranges where appropriate. ECONorthwest has not independently verified the accuracy of all such information and makes no representation regarding its accuracy or completeness. Any statements nonfactual in nature constitute the authors' current opinions, which may change as more information becomes available.

We recognize that the topic of removing the Lower Snake River Dams has been the subject

of much public debate. Many highly qualified individuals have studied individual aspects of the analysis reported herein. There may be disagreements with the outcome of our analysis, and there may be disagreements with the inputs used. Nevertheless, this report serves as our best estimate of the benefits, costs, and economic impacts of removing the Lower Snake River Dams.

ECONorthwest staff who contributed to this report include Adam Domanski, Mark Buckley, Matthew Kitchen, Marcy Shrader-Lauinger, Laura Marshall, Joel Ainsworth, Jared Rollier, and others.

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NET PRESENT VALUE BENEFITS BY CATEGORY, BILLIONS OF DOLLARS

	Grid Services	Dam Removal	Irrigation	Transport.	Recreation	Potential Non-Use	Total
New Costs	\$(2.95)	\$(1.08)	\$(0.17)	\$(0.10)			\$(4.30)
Reduced Costs	\$2.20			\$0.26			\$2.46
Public Benefits	\$(1.45)			\$(0.07)	\$1.04	\$10.97	\$10.49
Total	\$(2.21)	\$(1.08)	\$(0.17)	\$0.09	\$1.04	\$10.97	\$8.65

Source: ECONorthwest (2018–2045, 2018 dollars, 2.75% discount rate).

The Lower Snake River Dams provide valuable services, however a careful exploration of the range of economic tradeoffs based on publicly available data suggests the benefits of removal exceed the costs, and thus society would likely be better off without the dams. The best available information to date indicates that the substantial non-use and recreational use values gained from removal more than offset the costs of removal, even with increased power and transportation costs. Although the irrigation and transportation benefits of the dams are often touted, a close evaluation finds that they are not substantial relative to the magnitude of other costs

and benefits associated with removal. For irrigation, the surface water and groundwater infrastructure can be upgraded to maintain water withdrawals, as most agriculture in the area is not irrigated. For transportation, the federal appropriations dedicated to operating and maintain the lock system on the Lower Snake River exceed the benefits of barging.

Each of the following sections describe the trade-offs and implications of the dams' removal for regional stakeholders, policymakers, and other individuals who may be directly or indirectly impacted.

BENEFITS

POTENTIAL
NON-USERECREATION &
TRANSPORTATION

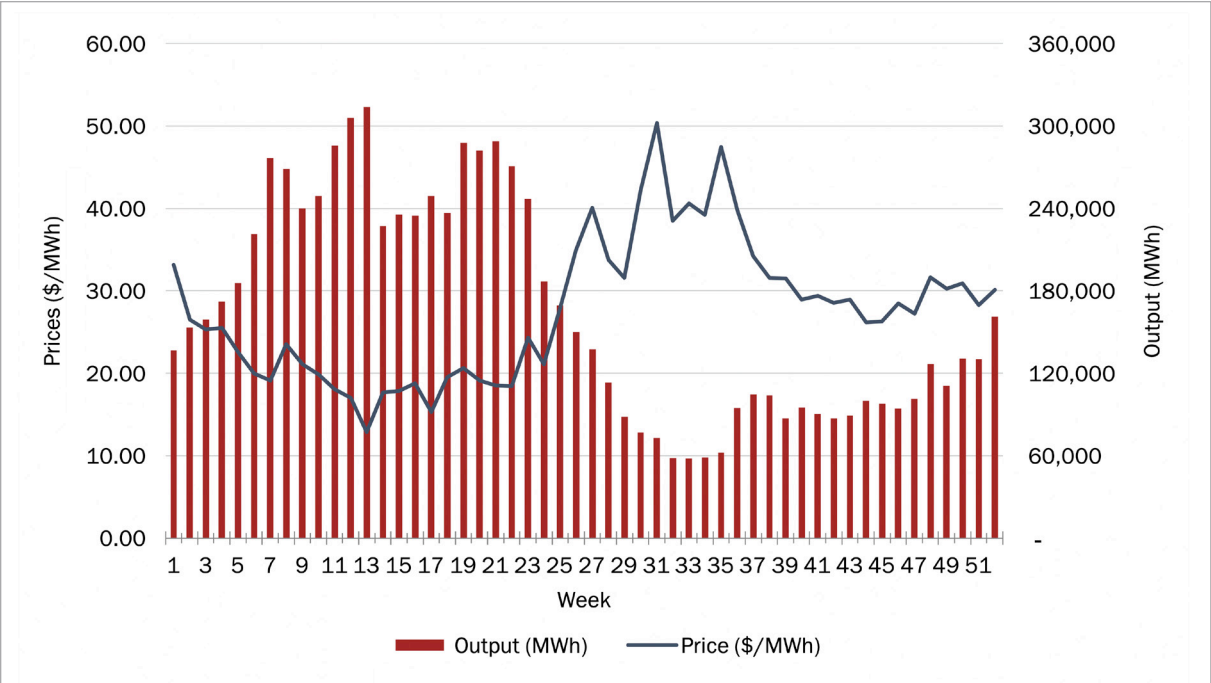
COSTS

IRRIGATION &
DAM REMOVAL

GRID SERVICES

GRID SERVICES

ENERGY PRODUCTION IS HIGH WHEN THE PRICE IS LOW



Source: Created by ECONorthwest with data from USACE. Lower Snake River Dams Average Weekly Output & Mid C Market Price: 2014–2018

The Lower Snake River Dams supply a small share of the energy needs for the Pacific Northwest region, and account for less power than BPA currently exports to other regions, primarily California. With cheaper renewable energy sources entering the market, the conventional wisdom of hydropower generating the lowest-cost electricity is no longer accurate. While the dams add useful capacity to ensure system reliability during certain months of the

year, those capacity services could be provided by other resources at relatively low cost. Some proposed plans to replace the power generated by the dams result in increases in monthly utility bills (\$1-\$2 per month) and slight increases in CO₂ emissions. However, the region could still meet its power needs without any replacement generation, albeit at the expense of higher CO₂ emissions elsewhere in the country and some low-cost adjustments to operating the regional grid.

COSTS

CO₂
EMISSIONS

GRID
SERVICES
VALUE

BENEFITS

BPA OVERHEAD

FISH
MITIGATION

ANNUAL O&M

CAPITAL COSTS

DOWNRIVER FOOD AND FARM PRODUCTS FLOWS



Source: Created by ECONorthwest with data from USACE Lock Performance Monitoring System. Between April 2017 and March 2018.

Approximately 2.2 million tons of agricultural products—mostly grain destined for export—move by barge through the four dams on the Lower Snake River each year. Although barge shipping is more cost-effective than truck or rail, significant federal appropriated funds are dedicated to maintaining the locks that allow barges to travel up and down the river. Even after

accounting for the public costs of increased emissions, changes in accident costs, and the higher prices of shifting to truck and rail, the federal government still spends more money than the public gets back. The benefits produced by the lock system on the Lower Snake River do not justify its continued operation, even without removal of the Lower Snake River Dams.

BENEFITS

FEDERAL APPROPRIATIONS

COSTS

ROAD WEAR & TEAR

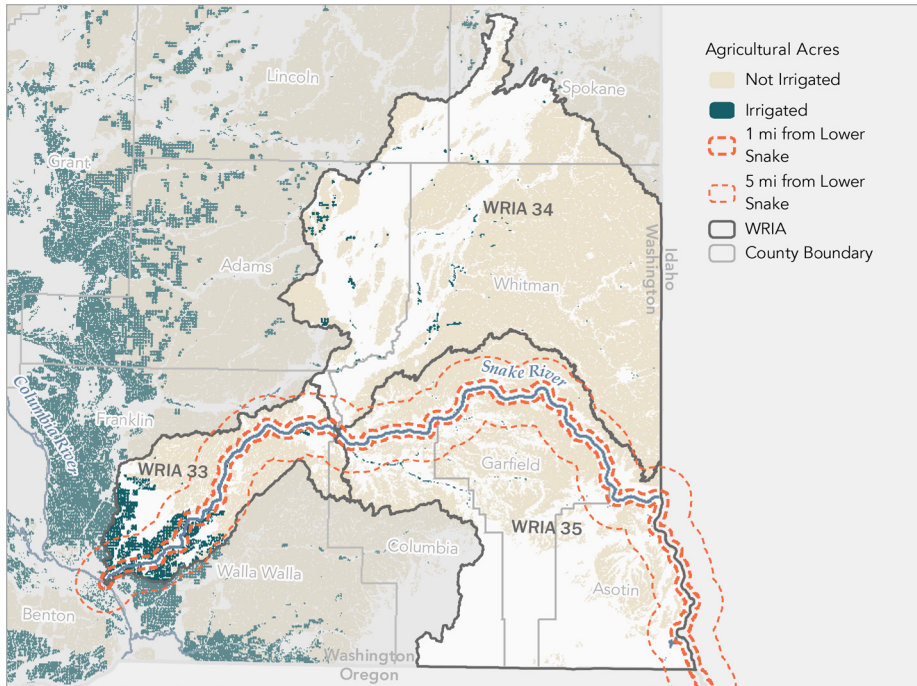
EMISSIONS

CRASH

TRANSPORTATION

IRRIGATION

IRRIGATED AND NON-IRRIGATED LAND NEAR LOWER SNAKE RIVER



Source: ECONorthwest with data from USDA

Only 13 percent of farmland within five miles of the Lower Snake River is irrigated. This land is mostly located at the downstream end near the confluence with the Columbia River where several other water storage and conveyance projects operate or are under development. The loss of irrigation to this area could result in substantial economic losses to some growers irrigating. The costs of upgrading groundwater wells and surface diversions should be less than \$200 million in total, based on an engineering cost analysis. The high rate

of non-irrigated farming in the area suggests such practices are a reasonable choice for farmers. Furthermore, the growing demand for irrigated agriculture activity and storage capacity downstream along the Columbia River suggests that any reduction in water use along the Lower Snake River would likely be used by downstream water users. Depending on funding sources for upgrades to infrastructure and decisions to irrigate, any impacts to the agricultural industry would most likely be distributional in nature.



of farmland within 5 miles of Lower Snake River is irrigated

41 SURFACE-WATER DIVERSIONS

84 WELLS

impacted by dam removal

RECREATION

Numerous recreational access points throughout the Lower Snake River provide opportunities for reservoir-based fishing, hunting, and boating. Some of these activities will no longer occur with removal of the dams, however, restoration of a natural river system will lead to an increase in higher value river recreation trips. These new environmental resources will benefit both the users that enjoy them, as well as the tourism based-businesses in Clarkston, Washington, and Lewiston, Idaho.

SALMON

The primary argument for removing the Lower Snake River Dams is to benefit endangered and threatened salmon and steelhead native to the river, as well as the ecosystems that depend on them. Many factors have contributed to their decline, and there is ongoing scientific debate surrounding the actual population gains expected following dam removal without other interventions. Significant resources have been expended over the years to improve survival of juvenile and adult fish passing through the dams. Efforts include hatchery operations, trucking juvenile fish downstream of dams, improving habitat upstream of the dams, modifying flow through the turbines at specific times of the year, and culling predatory birds and sea lions. Despite these efforts, the wild

populations of salmon continue to struggle. Removing the dams has the potential to improve fish passage, decrease the migration time for juvenile fish, introduce new main-stem spawning habitat for fall Chinook, and lead to reduced extinction risk for threatened and endangered fish stocks.

NON-USE VALUES MATTER

From an economic perspective, the public highly values the protection of salmon and steelhead. Many people are willing to pay money out of their own pocket to protect ecosystems, habitats, and resources. Our analysis shows that these non-use values dwarf the costs that the public would incur from removing the dams.

Benefits accruing to the public from a restored natural river system and a reduced extinction risk of wild salmon outweigh the net costs of removing the dams by over \$8.6 billion. These non-use values have been used to inform policy and litigation outcomes for over forty years. On a per-household basis, we find there a willingness to increase electricity bills by an average of \$39.89 per year to help protect wild salmon. However, removal of the dams would be justified at any value over \$8.44 per year, meaning that removing the dams would create an average of \$31.45 of surplus-value per household, per year.

Net benefits from dam removal

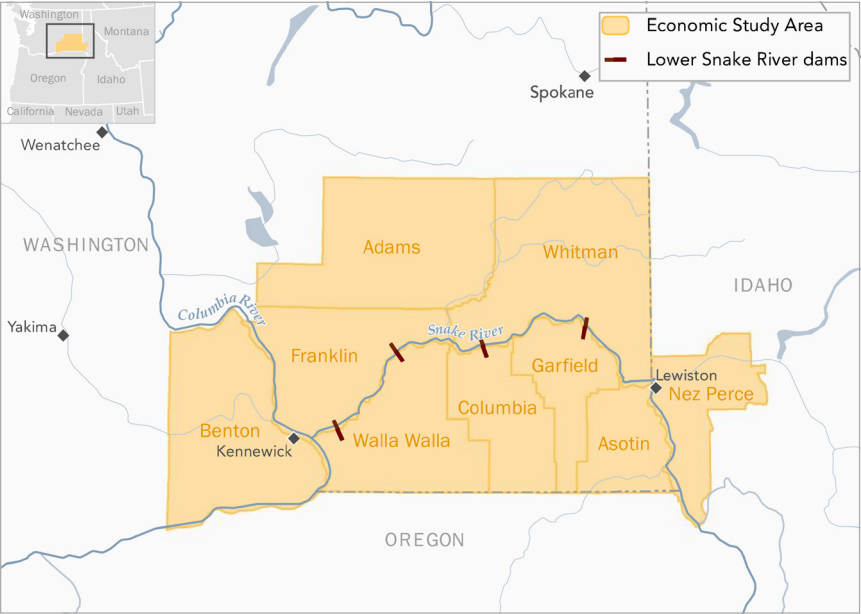
\$8.65B

\$2.32B

of non-use value justifies dam removal

ECONOMIC IMPACTS

ECONOMIC IMPACT STUDY AREA



Source: ECONorthwest

TOTAL NET PRESENT VALUE OF NET IMPACTS, 2018–2045, 2018 DOLLARS

Impact Type	Total Job-Years	Average Annual Job-Years	Labor Income	Value Added	Output
Direct	5666	202	\$289,880,000	\$324,544,000	\$227,968,000
Indirect	459	16	\$6,265,000	(\$41,536,000)	(\$83,439,000)
Induced	2763	99	\$112,207,000	\$208,620,000	\$360,632,000
Total	8887	317	\$408,352,000	\$491,629,000	\$505,160,000

Source: ECONorthwest using the IMPLAN model, 7% discount rate

Note: For consistency and replicability with the 2002 EIS, this analysis uses net present value and assumes that capital and labor ratios are unchanged during the study period.

Analysis of the economic impacts of removal finds that although some sectors of the regional economy will experience a shift, dam removal is fundamentally a massive public works project that will increase regional net jobs, income, and output. Dam removal would result in a reduction in spending in some sectors (e.g. grain farming and dam operations and

maintenance), however the physical costs of removing the dams would also produce a set of positive economic impacts, albeit potentially for a different population. Removing the Lower Snake River Dams will result in a net increase of \$505 million in output, \$492 million in value added, \$408 million in labor income, and 317 annual jobs.

317

Average annual jobs created

\$505
MILLION

Net increase in output



Snake River in Idaho

Analysis of the economic implications of major public policy decisions is critical. The full suite of public and private benefits, costs, and impacts must be considered for informed decision making. Although society will incur substantial costs from dam removal and lost grid services, public benefits relative to costs strongly justify removing the Lower Snake River Dams. In theory, these benefits are large enough to fully compensate any losers from dam removal. Although there are distributional effects on the regional economy if losses are not mitigated or compensated, the surrounding communities in aggregate will experience gains in employment, incomes, and economic output.

WHAT IS DIFFERENT BETWEEN THIS ANALYSIS AND THE 2002 EIS?

Over sixteen years have passed since the Lower Snake River Dams were last evaluated in a comprehensive fashion. Since that time, renewable electricity has gotten cheaper, the economy has become wealthier, and the health of endangered fish populations on the Lower Snake River has continued to decline. One thing that has not changed since 2002 is the framework that the U.S. Army Corps of Engineers uses to evaluate investments in infrastructure. Their guidance on benefit-cost analysis does not include the consideration of non-use values. This is out-of-step with all

other federal agencies, including the Bureau of Reclamation, which used an evaluation of non-use values as a basis for removing four dams on the Klamath River. Based on our analysis, the ongoing EIS is likely to come to the same conclusion as the 2002 EIS. If non-use values and resulting ecological benefits are ignored, then removal of the dams is not justified. However, it is clear now, and was clear in 2002, that **non-use values are the key to measuring the true benefits of dam removal.** These values are valid and must be considered, and overwhelmingly provide a justification for removing the Lower Snake River Dams.

