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www.crso.info
Federal Action Agency Heads

RE: Columbia River System Operations Draft Environmental Impact Statement

Dear Federal Action Agency Heads:

Thank you for the opportunity to comment on behalf of Northwest RiverPartners ("RiverPartners") regarding the Columbia River System Operations ("CRSO") Draft Environmental Impact Statement ("DEIS").

RiverPartners represents not-for-profit, community-owned utilities across Washington, Oregon, Idaho, Montana, and Wyoming. We also proudly represent supporters of clean energy, low-carbon transportation, and agricultural jobs.

Our mission is to lead the charge for the Northwest to realize its clean energy potential using hydroelectricity as the cornerstone. Our goals for the region are to fight climate change, restore healthy fish populations, ensure that vulnerable communities are included in energy solutions, and maintain an affordable and dependable electric grid.

The focus of this letter is to highlight key areas and substantive information that we encourage you to consider as you move towards a final EIS and to your official Records of Decision.

ACKNOWLEDGEMENTS

First, we want to begin by expressing our respect for the expertise, time, and effort contributed by your respective staffs and the Cooperating Agencies to produce a balanced and detailed analysis. We especially appreciate the work that you and Northwest tribal leaders engaged in to share tribal perspectives regarding Columbia River System operations.

We also appreciate the detailed analyses performed regarding the power generation and environmental implications of the various Multiple Objective ("MO") alternatives. We recognize that since work began in 2016, many of the region's assumptions around power supply have changed, with thousands of megawatts of coal-fired generation now on the path to early retirement.

This new paradigm is critical to consider, and we are pleased that the DEIS included additional outboard analyses to reflect this important change in the region's power supply resource stack.

We also recognize that the science of predicting adult salmon returns is still very uncertain, which makes it highly challenging to predict the relative effect of any particular operation on salmonid populations.

Lastly, we want to acknowledge the special effort that the Action Agencies took to ensure that the public had ample opportunity to comment on the CRSO DEIS, in light of the COVID-19 pandemic. By hosting six different four-hour teleconferences in the month of March, and by providing toll-free access, you made the process highly accessible, while still honoring the importance of moving the process forward. RiverPartners participated in all six teleconferences and appreciated the professional manner in which they were conducted.

We thank you for your efforts.

SUMMARY OF KEY POINTS

This is the first EIS process in 20 years that has examined the potential of breaching the four lower Snake River dams (LSRD) in Eastern Washington state.

The DEIS demonstrates that breaching the LSRD (MO3) could:

- More than double the risk of region-wide blackouts[1]
- Add 3 million metric tons of carbon to the atmosphere each year from electricity production[2]
- Cost up to $1 billion a year in additional power costs and raise Bonneville Power Administration ("BPA") power costs rates by 50%[3]
- Harm the regional economy in the amount of $740 million a year in lost goods and services sold[4]
- Result in the loss of 4,900 jobs as a result of higher electricity rates[5]
- Reduce our ability to safely add new wind and solar power to the grid[6]
- Cost $458 million in social welfare from the loss of irrigated land and jobs for farm laborers[7]
- Add 79,000 semi-trucks to the road each year[8]
- Provide very minimal benefits for salmonids populations[9]

A future with a high risk of blackouts and huge price increases is not one that policymakers should embrace. That future would hit struggling communities the hardest at a time when so many people are already contending with the loss of jobs due to COVID-19 related shutdowns.

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[1] 2020 CRSO DEIS Executive Summary page 25

[2] 2020 CRSO DEIS Executive Summary page 27 (Figure assumes that LSRD would be replaced by natural gas-fueled generation.) 3 million metric tons equates to a 10% increase in the NW electricity sector's entire carbon output.

[3] 2020 CRSO DEIS Executive Summary page 26-27 (Figure assumes the dams' full capabilities are replaced with another carbon-free portfolio).

[4] 2020 CRSO DEIS Chapter 3, lines 28236-28238 (In the scenarios with limited or no coal generation in the region, the economic harm would be significantly higher than this figure.)

[5] 2020 CRSO DEIS Chapter 3, lines 28236-28238 (In the scenarios with limited or no coal generation in the region, the number of jobs lost would likely be substantially higher than this figure.)

[6] 2020 CRSO DEIS Executive Summary page 26. The DEIS notes that, "…replacing the full flexibility and capability of the lower Snake River dams with zero-carbon resources would require substantially more resources, such as additional dispatchable battery technology, than estimated in the base case analysis".

[7] 2020 CRSO DEIS Executive Summary page 28

[8] 2020 CRSO DEIS Chapter 3 lines 33556-33558

[9] 2020 CRSO DEIS Executive Summary page 25. According to the NOAA Fisheries Science Center's Life Cycle Model, salmonids would only see a 14% increase in smolt-to-adult returns as a result of dam breaching, despite the extreme societal costs.

While the numbers above are staggering, RiverPartners' comments will demonstrate that the DEIS analysis does not go far enough to capture the full socioeconomic harm related to MO3 and MO4, which would have destructive and widespread impacts across the Northwest.

RiverPartners' comments will also demonstrate that there is a lack of scientific evidence to support M03, MO4, or the Preferred Alternative's higher proposed spill levels, which will result in the exceedance of 115% Total Dissolved Gas ("TDG") levels.

Lastly, RiverPartners encourages the Action Agencies to work diligently with stakeholders to help threatened and endangered salmonid and orca populations in ways that do not diminish our critical hydroelectric resources. RiverPartners believes that more fully addressing the harmful impacts of avian predation is an excellent opportunity for this partnership. We, as an organization, will diligently work with you in this effort.

ENERGY EQUITY, SOCIOECONOMICS, RELIABILITY, AND DECARBONIZATION

Warning Signs of An Energy Shortage

Regional power planners are in unison that the Pacific Northwest is headed for an electricity shortage. The Northwest Power & Conservation Council[10], the Northwest Power Pool[11], E3[12], and Energy Strategies[13] have all issued significant warnings about a potential energy shortage or even blackouts resulting from the retirement of thousands of megawatts of the region's coal plants. Notably, all these forecasts assume that the LSRD remain in place.

As noted above, as disturbing as this risk is, the CRSO DEIS indicates that removing the LSRD from the resource mix would more than *double* the possibility of blackouts in the region.

In the midst of the coronavirus pandemic, many people have come to realize the critical dependence we have on basic services, like electricity.

Right now, the nation is contending with the lack of hospital beds, medical equipment, personal protective equipment, and cleaning supplies. Imagine how these problems would be amplified by a region-wide loss of electricity. The grid must be ready for emergencies, or we risk making a crisis like this much more severe.

It is also important to note that an energy shortage does not have to result in blackouts to be devasting. During the Western Energy Crisis of 2000-2001, the Northwest did not experience blackouts. However, the efforts to buy power to avoid blackouts cost the region thousands of living wage aluminum industry jobs, and retail energy bills skyrocketed. Even the Bonneville Power Administration had to hike its rates by 45% to cover the increased costs.

In California, where blackouts are already occurring due to climate change and Pacific Gas & Electric's weakened infrastructure, a two-class electricity system has developed. Well-to-do customers who can

[10] 2019-10-31. NWPCC - Pacific Northwest Power Supply Adequacy Assessment for 2024
[11]2019-10. NWPP - Exploring a Resource Adequacy Program for the Pacific Northwest. Page 7
[12] 2019-12-2. E3 Projects Substantial Capacity Shortfall in the Pacific Northwest
[13] 2019-12-10. Energy Strategies & Western Energy Interstate Board- Western Flexibility Assessment Page 20

afford solar rooftops, smart inverters, and backup generation are able to maintain electricity, while poorer communities cannot.[14]

Whether from blackouts or skyrocketing prices, it is imperative that our region is not exposed to the effects of an energy shortage.

Because of the severe consequences that would be felt as a result of an energy shortage, RiverPartners also encourages the Action Agencies not to assume that the current COVID-19 economic slowdown serves as a reliable predictor of longer-term demands for electricity.

It is far too early, and there are too many unknowns to reliably depend on a lower level of long-term demand for electricity, especially as the region contemplates economy-wide decarbonization goals that would likely shift demand from natural gas to electricity.

Because the Action Agencies are directly responsible for grid reliability, it would not be appropriate to plan to a lower level of demand until we have more direct evidence of what the economic recovery will look like.

Vulnerable Communities Across the Northwest Would Be Disproportionately Affected by Dam Breaching or High Spill Levels

As mentioned above, the nation has yet to determine the full effects of the COVID-19 pandemic on public health and on the economy, and it may be a long time before we can do so. However, we do know that hundreds of thousands of employees have been laid off from their jobs in the Northwest alone.

The DEIS shows that dam breaching (MO3) or sustained high spill levels (MO4) would create an unbearable burden for many homes. As referenced above, the DEIS calculates the cost of replacing the full capabilities of the LSRD with a carbon-free portfolio of resources, such as solar, batteries, and demand response to be as high as $1 billion *annually*. This value is very consistent with the third-party analysis performed by a leading energy consulting group, EnergyGPS, earlier this year.[15]

As noted above, the DEIS shows that cost would equate to a 50% increase in BPA's wholesale power rates. Based on a general rule that power supply costs represent roughly half of total retail bills, that would equate to a 25% increase in monthly electric bills for the millions of residential and business customers who get their electricity from BPA requirements utilities.

The DEIS indicates that the financial cost of MO4 would be even higher than breaching. This cost increase is not affordable to most people in the region, especially in light of the massive job losses mentioned above.

Early reports show that the people most affected by job losses related to the COVID-19 pandemic have been lower-wage earners.[16] In a best-case scenario, where the unemployed are able to quickly find jobs

[14] 2019-11-26 *Rich Californians Shell Out $30,000 to Avoid Blackout Pain* Bloomberg.com
2019-10-10 *PG&E's power shutoff in California shows the inequities of climate risks* Vox.com
[15] See Appendix 1 of this document
[16] 2020-03-20 *Low-Wage Workers Face Brunt of Coronavirus Crisis* Wall Street Journal On-Line Edition

after COVID-19 related shutdowns are over, it will still take significant time for these workers to achieve solid financial footing due to months of lost income.

Implementing MO3 or MO4 and thereby substantially raising customer electricity bills would only serve to exacerbate the economic inequalities in the region.

Many Traditionally Underserved Communities Are Dependent on Dams

It is important to understand that communities across the Northwest have come to depend on dams to sustain their communities. Dams protect them from deadly flooding, provide irrigation for farming and jobs for agricultural workers, and create gathering points for recreation.

At a press conference on Monday, March 2, Franklin Public Utility District public relations manager Mike Gonzalez stated that for his community of Pasco, Washington, "Keeping the [lower Snake River] dams is a matter of social justice."

Gonzalez shared that approximately 70% of Pasco's residents identify as Latino/Latina and nearly 30% speak English as a second language. Additionally, Pasco's Latino community provides a crucial source of labor for agriculture, and that irrigation from the lower Snake River dams supports the agricultural jobs that many people in his community rely upon for a secure economic future.

He stated that if the dams were breached, the expected electric bill increase for Franklin PUD's customers would be as much as 30% and described the potential impact as "devastating."

Pasco, Washington is just one example of the diverse communities that depend on hydroelectric dams throughout our region.

Without Ice Harbor Dam, 48,000 acres of farmland could lose access to irrigation in the Tri-Cities region[17]. As the DEIS notes, the loss of this irrigation would result in a $458 million loss to social welfare. It would mean the loss of jobs and homes, and it would deprive communities of a necessary economic base to support schools and social welfare programs.

It is worth noting that during the COVID-19 pandemic, agricultural workers were deemed "essential critical infrastructure workers" by the federal and state governments and that agricultural communities have continued to risk their own health safety to ensure that food is available.

The LSRD Are Critical to Our Clean Energy Future

We live in a carbon-constrained world due to legitimate concerns over climate change. To address these concerns, in 2019 the State of Washington passed a clean energy law that will mean the end of coal-fueled and natural gas-fueled generation in the state. Other regional government agencies have committed to carbon-free energy goals or are examining similar plans.

Additionally, there have been calls for much more penetrating decarbonization goals for the Northwest economy. One such call has been for a requirement for all commercial buildings and new homes to get

[17] 2020 CRSO DEIS Executive Summary page 28

their heating and appliance-related energy from electricity instead of natural gas. According to a 2018 study, such a shift would likely double the region's peak electricity demand.[18]

Even without these calls for economy-wide decarbonization, the challenge of achieving the Northwest's existing clean energy mandates means that thousands of additional megawatts of wind and solar power will be needed.

As you know, in addition to being renewable, wind and solar power share a common trait – they are intermittent. This means their electric output fluctuates based on the availability of wind and sunshine. The problem is that if the supply and demand for electricity aren't in perfect balance every second, blackouts can occur.

As a result, in the region's effort to add new renewables to the grid, hydroelectricity has become even more critical, because dams can store water and release it past hydroturbines to generate electricity when needed. The storage and release of water can be matched perfectly with wind and solar power to safely balance the grid.

As the CRSO DEIS indicates, BPA will often carry up to 25% of its hourly reserves on the LSRD[19]—in part—to balance renewables on the grid.

The CRSO DEIS notes that the LSRD provide roughly 1,100 average megawatts of carbon-free electricity each year, but they can provide over 2,000 megawatts under the right conditions.[20] This flexibility makes the LSRD vital as the Northwest moves to a more renewable generation portfolio.

The DEIS demonstrates that the LSRD capabilities could be replaced by natural gas-fueled resources, but that these fossil-fuel resources would add 3 million metric tons of carbon to the atmosphere each year, which equates to roughly a 10% increase in the entire Northwest power sector carbon emissions. Clearly, that would be a step in the wrong direction given the existential threat that climate change poses.

As a result, it is critical that the Action Agencies do not adopt a plan that diminishes or eliminates the carbon-free capabilities of LSRD.

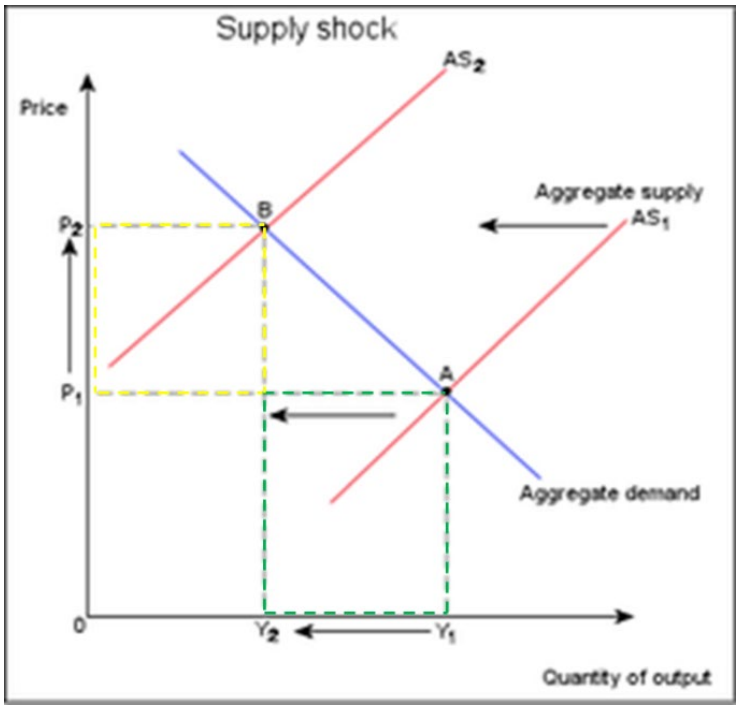
Need for Additional Economic Analysis for MO3

RiverParnters would like to mention one area of specific concern, which is the economic analysis performed for MO3. The DEIS did not evaluate the full amount of lost economic benefit associated with higher transportation from dam breaching (MO3).

[18] 2018-11 E3 Pacific Northwest Pathways to 2050 pp 20-21

[19] 2020 CRSO DEIS Executive Summary page 25

[20] 2020 CRSO DEIS Executive Summary page 25



Economic theory is clear that higher input costs (also known as a "Negative Supply Shock") result in a depressed total volume of goods sold at higher prices (see figure to the left). According to the DEIS, breaching the four lower Snake River dams (LSRD) has the potential to greatly increase transportation rates for shippers who currently rely on barging to get their goods to market.

For farmers, that means that they will be able sell less product and that the price of the product will be more expensive to buyers. This outcome results in a loss of economic value (price times quantity). This loss is depicted in the figure to the left as the difference between the green-dashed box and the yellow-dashed box.

It is very important that the Action Agencies capture this lost value in the EIS analysis. Otherwise, there is a risk of significantly underestimating the costs of MO3.

SCIENTIFIC REVIEW

Hatchery Assumptions

BPA provides funding of mitigation projects—such as hatcheries—in the Snake River Basin. These projects are implemented by local, state, tribal, and federal entities. The funding of many of these programs is directly tied to the operation of the LSRD. Because MO3 would result in the breaching of the LSRD, the DEIS acknowledges continued funding of mitigation efforts for the LSRD may not be required under MO3.[21]

Birgit Koehler, Policy Lead for Power on the Columbia River System Operations Environmental Impact Statement highlighted this point in her public comments, "There would be no line item in BPA's future budgets for Snake River hatcheries and habitat improvement."[22]

We note that the DEIS acknowledges the huge role that hatcheries play for Snake River salmonid populations. The DEIS states,

> *. . . reductions in hatchery fish could reduce the numbers of juvenile Snake River Chinook by as much as 85%. This reduction in the number of hatchery fish would likely [also] result in a reduction of these predicted survival rates of wild Chinook because of increased predation rates*[23]

[21] 2020 CRSO DEIS Chapter 3, lines 16584

[22] 2020-01-07 Washington Governor's LSRD Stakeholders Process public meeting in Clarkston, WA

[23] 2020 CRSO DEIS Chapter 3, lines 16897-16901.

However, the DEIS concedes that, "COMPASS and CSS models do not account for this potential major reduction in juvenile fish production…."[24]

RiverPartners is *highly concerned* that such a major impact was not quantified in the model runs. We note from having participated in all six of the CRSO DEIS public teleconferences that a great many proponents of MO3 have argued that the only way to save salmon and endangered Southern Resident orcas is to adopt MO3. However, their views might be very different if they were aware of the quantifiable impact that the potential loss of hatchery fish could mean for orcas and for cultural, commercial, and recreational fisheries.

As a result, we encourage the Action Agencies to re-run these models to include the reasonable assumption that LSRD mitigation hatcheries could lose their funding as a result of MO3 implementation. The new model runs would give the Action Agency decisionmakers a much more informed basis for determining the best Preferred Alternative for the Columbia River System.

Background on Competing Models

We provide this section on modeling as a brief introduction to the following sections on Latent Mortality and TDG levels.

As referenced above, two models have been relied on in the region to predict the effects of alternative juvenile salmonid passage methods and their effects on Columbia Basin adult salmonid returns. One model is the Life Cycle Model ("LCM") used by the NOAA Fisheries Science Center. The other model is the Comparative Survival Study ("CSS") model used by the Fish Passage Center.

These two models have been at odds, with the CSS model predicting much higher adult salmon returns associated with increased spill levels and/or dam breaching than the LCM model.

One major reason for the disparity between the CSS and LCM model results is that the CSS model depends on a theory referred to as "latent mortality" in its attempt to predict the rate of returning adult salmonids.

The latent mortality theory posits that although juvenile salmon have a very high survival rate—approximately 96-97% average—past each of the lower Columbia River dams and LSRD, that the act of going through fish bypass passage structures and powerhouses negatively impacts the health of juvenile salmonids and results in lower SARs.

This theory suggests that the effects of the dams on salmon are not fully captured by juvenile migration survival rates. Therefore, according to the theory, more spill or dam breaching is needed improve the rate of adult salmon returns, also known as smolt-to-adult returns ("SARs").

CSS Model & the Challenge of Correlation Vs. Cause

A difficulty for proponents of the latent mortality theory is that it is very hard to scientifically prove. The Action Agencies have acknowledged this challenge in the DEIS with the following statement, "The

[24] 2020 CRSO DEIS Chapter 3, lines 16558-16559.

degree to which latent mortality is affecting salmon and steelhead is one of the *critical uncertainties* in this EIS analysis."[25] (emphasis added).

The task of proving the existence of latent mortality—or its corollary that more spill is better for adult returns—is difficult because the ecosystems in which salmonids live are highly complex and constantly changing.

In terms of in-river survival, SARs can be affected by factors including, but not limited to the number and type of salmonid predators, in-river harvest, river flows, river temperatures, pollution, the type and number of competing organisms, and spill levels.

Because salmonids tend to spend most of their lives in the ocean, the model must also contend variables that are even more difficult to track. These variables include but are not limited to the availability of prey, the type and number of predators, the amount of in-ocean harvest, the type and number of competing organisms, pollution, acidity, and ocean temperatures.

These challenges are summarized in the following quote from the Independent Scientific Advisory Board ("ISAB"),

> *It is unlikely that overall changes in SARs [smolt to adult returns] can be isolated to conclude that spill is the causative factor for the system. The CSS approach uses correlations which do not by themselves determine cause and effect. There are many confounding factors and indirect effects of spill on fish survival including predation and other mortality in the reservoirs, deployment of new spillway weirs, delayed mortality, ocean conditions, habitat restoration activities, changes in toxic contaminants and other factors.*[26]

Additionally, as mathematicians have noted, there is an imbedded challenge to isolating the effect of a particular variable when that variable, itself, is highly correlated with other model variables. This statistical concept is known as "multicollinearity", which is defined as,

> *The existence of such a high degree of correlation between supposedly independent variables being used to estimate a dependent variable that the contribution of each independent variable to variation in the dependent variable cannot be determined.*[27]

In this context, it has been documented by NOAA and others that many of the variables assumed to affect adult salmon returns share a high degree of correlation among themselves. For example, shifts in river temperatures and ocean temperatures tend to be closely related. Also, runoff volume, amount of spill, and speed through the hydroelectric system tend to be closely related. Scientists have also noted a correlation between ocean temperatures, prey availability, and the abundance of salmon predators.

In terms of predicting SARs, the challenge that arises is knowing how much each of the highly correlated explanatory variables is associated with changes in adult salmonid returns or if there is a deeper, underlying factor of which the model is not aware.

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[25] 2020 CRSO DEIS Executive Summary page 25

[26] 2014-02 ISAB 2014-02. Independent Scientific Advisory Board "Review of Proposed Spill Experiment". Page 8.

[27] www.merriam-webster.com/dictionary/multicollinearity

A 2016 paper by NOAA Fisheries captures one example of the issue described above. NOAA writes,

> *One concern for salmon is that unfavorable environmental conditions can impact multiple life stages…Large-scale climate phenomena such as the PDO were already known to correlate with terrestrial precipitation patterns, but a new study further explores the relationship of these patterns with seasonal indices of the PDO and sea-surface temperature (SST) across the U.S.*[28]

In support of the statistical difficulties listed above, we site a study written by Dr. John Skalski from the University of Washington School of Aquatic and Fishery Sciences,

> *Over time, numerous investigators have modeled salmonid survival and adult return rates as functions of in-river and/or oceanographic covariates…The majority of the analyses use basic multiple linear regression techniques and ignore higher-order processes, interactions, and the possibility of optima, thresholds, or spline relationships. The multicollinearity of in-river, ocean, and between in-river and ocean covariates makes identification of driving variables difficult at best*[29]*.*

We encourage the Action Agencies to consider these significant challenges to proving the veracity of the latent mortality theory as you determine how much credence to give to the CSS model results.

CSS Model & Simplifying Assumptions

In additions to the shortcomings identified above, the CSS model excludes potentially important variables that could influence its model outcomes.

That issue is acknowledged by the ISAB in the following critique of the CSS model,

> *…six freshwater and marine variables examined by Haeseker et al. (2012) – water transit time (WTT), spill, date of migration, upwelling, sea surface temperature (SST), and Pacific Decadal Oscillation (PDO) – had all been identified as important in other studies, so the choice of these variables has support in the literature (Muir et al 2001, Scheuerell and Williams 2005, Schaller and Petrosky 2007, Petrosky and Schaller 2010). Nevertheless, to address alternative hypotheses additional candidate variables need to be evaluated, for example, biological measures of top-down (predation) and bottom-up (primary and secondary productivity) forcing, individual fish (age, growth, and condition), density-dependent effects, and anthropogenic forcing (habitat, harvest, and hatchery).* [30]

We also note that the CSS model's exclusion of juvenile fish size was identified as a problem in the 2019 NOAA Fisheries Science Center study.[31] (Discussed in more detail in the subsequent section)

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[28] 2016-10 NOAA: Impacts of Climate Change on Salmon of the Pacific Northwest p 9

[29] 2013-08-28. Dr. John Skalski, et al. "Limitations of Correlative Investigations in Identifying Causal Factors in Freshwater and Marine Survival of Columbia River Salmonids"

[30] 2014-02 ISAB 2014-02. Independent Scientific Advisory Board "Review of Proposed Spill Experiment". Pages 3-4.

[31] 2019-08-05 Faulkner, Bellerud, et al. Transactions of the American Fisheries Society. Volume 148, Issue 6 . Associations among Fish Length, Dam Passage History, and Survival to Adulthood in Two At-Risk Species of Pacific Salmon

Another potentially important explanatory variable exclusion is identified in the ISAB reference above. The CSS model explicitly excludes harvest quantities as a model variable. It tacitly assumes that year-to-year changes in harvest levels are not significant, so the model can exclude this variable and still produce meaningful results.

A major problem arises, however, if this tacit assumption isn't accurate. It would mean that the model could conclude a spill regime from a particular year had a more meaningful impact on SARs than was truly the case.

To elaborate, the model might see that some years with higher levels of spill corresponded to higher salmonid returns in later years. However, if the reason for the higher return rates was due to a much smaller harvest quantity, then the model could make false or even inverse predictions for future outcomes.

CSS Model & the Potential for Spurious Results

It deserves notice that the Action Agencies are recommending higher levels of spill as part of the Preferred Alternative, due to CSS model predictions.

Because the CRSO DEIS Preferred Alternative depends on these predictions, we encourage the Action Agencies to carefully test the reasonableness of the harvest assumption, as well as other simplifying model assumptions for which data is available.

If it is scientifically demonstrated that harvest levels represent a substantial and significantly volatile value from year-to-year, such an outcome could invalidate the values produced by the CSS model.

There is already good reason to question some of the CSS model assumptions and conclusions. For example, recent peer-reviewed study from NOAA Fisheries Science Center determined that there is little-to-no evidence of dam-related latent mortality. The study found that fish which go past turbines or through fish passage systems experience about the same estuary and ocean mortality levels as fish that travel through spillways.[32]

The study found that fish bypass structures tend to draw in smaller fish, which inherently have lower survival in the ocean. After controlling for size, these fish survived at about the same rate in the ocean as the fish that go through spillways and turbines. The size of the juvenile fish was the driving factor in ocean survival, not the route of dam passage. [33]

Figure 2 (below) is from a separate peer-reviewed paper published in the *Proceedings of the National Academy of Sciences*. It compares survival of two groups of smolts. One group migrated through the LSRD and the other group migrated from the Yakima River.

[32] 2019-08-05 Faulkner, Bellerud, et al. Transactions of the American Fisheries Society. Volume 148, Issue 6 . Associations among Fish Length, Dam Passage History, and Survival to Adulthood in Two At-Risk Species of Pacific Salmon

[33] 2019-08-05 Faulkner, Bellerud, et al. Transactions of the American Fisheries Society. Volume 148, Issue 6 . Associations among Fish Length, Dam Passage History, and Survival to Adulthood in Two At-Risk Species of Pacific Salmon

The dotted line has a slope of one-to-3.4 (labeled 1:3.4) that reflects the ratio of adult returns for the two groups, while the one-to-one line (1:1) shows the line of no difference in survival[34].

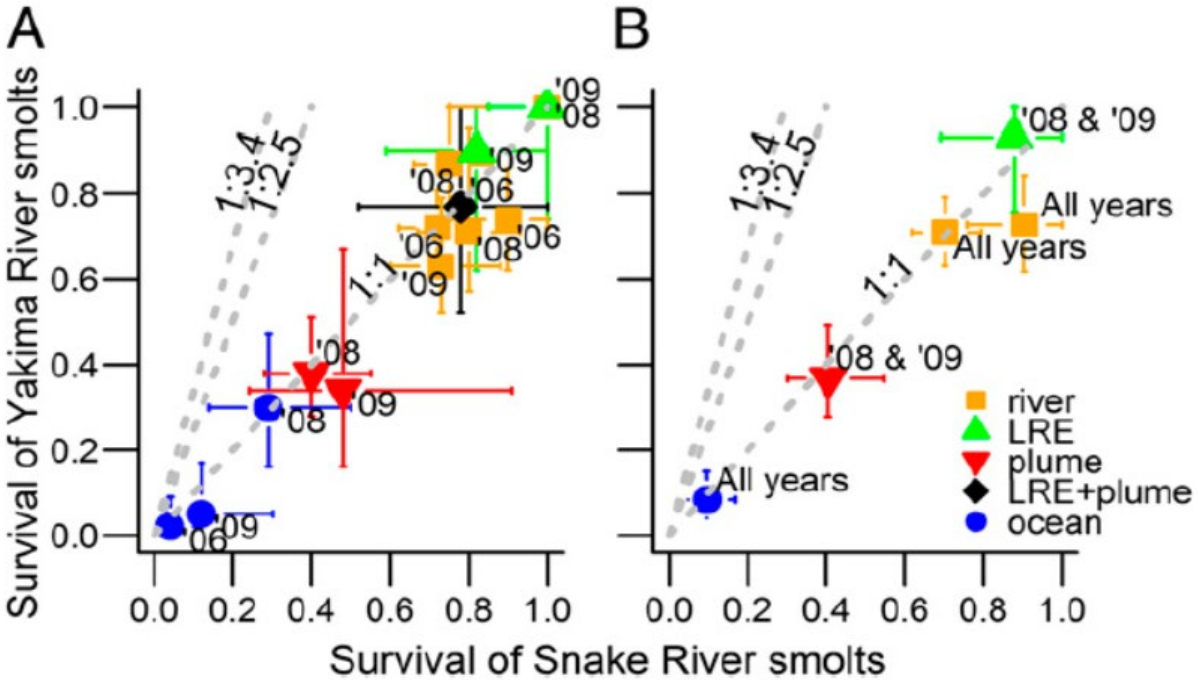

Fig. 2. Comparative survival of acoustic-tagged Snake River and Yakima River spring Chinook salmon smolts in each migration segment (*A*) in 2006, 2008, and 2009 and (*B*) in all years combined. The dashed 1:1 line represents equal survival of both treatment types; data points above the line indicate lower survival of Snake River fish. The 1:2.5 line indicates the survival disparity predicted by the delayed mortality hypothesis, using the ratio of Snake:Yakima adult return rates averaged over 2000–2009. The 1:3.4 line indicates the average survival disparity predicted over the years of our study. "River" estimates are from Lake Wallula to Lake Celilo and from Lake Celilo to McGowans Channel. The Astoria subarray was not deployed in 2006; therefore, LRE survival was combined with plume survival in that year. Error bars, 95% confidence intervals.

The results are consistent with a lack of delayed mortality findings. The smolts from the Yakima River returned as adults at nearly the identical rate of smolts from the lower Snake River. In terms of basing

[34] 2013 Rechisky, E. L., Welch, D. W., Porter, A. D., Jacobs-Scott, M. C., & Winchell, P. M. Influence of multiple dam passage on survival of juvenile Chinook salmon in the Columbia River estuary and coastal ocean. Proc. Nat. Acad. Sci. USA. doi:10.1073/pnas.1219910110

public policy on model-based outcomes, it is critical to note that the CSS model performed very poorly in its predictive capabilities.

Similarly, a separate peer-reviewed paper from March 2014 found no evidence of dam-caused latent mortality in salmonids.[35]

These important findings should encourage the Action Agencies to question assumptions and predictions about the benefits of spill, dam breaching, and the role that the lower Snake River and lower Columbia River dams play in overall salmon mortality.

Further, if evidence mounts that the CSS model is producing spurious results, the Action Agencies must be willing to abandon its advice.

In preparation for this potential outcome, we urge the Action Agencies to maintain, under adaptive management principles, the ability to reduce or eliminate spill for fish, if the basis for fish-related spill is nullified.

Early "Flexible Spill" Results Disappointing

The higher sustained spill operations pursuant to the implementation of the Flexible Spill Agreement in 2019 represented uncharted territory. While there have been periods throughout history with high levels of uncontrolled TDGs, 2019 was the first time in the operation of the Federal Columbia River Power System where TDGs were maintained at levels as high as 120% on a planned and sustained basis for the entire spring spill period.

It will take years before most of the surviving 2019 juvenile migrants return, but the earliest signs point to poor results for both juvenile salmonids and returning adults.

As an example, according to a NOAA Fisheries Science Center memo from September 19th, 2019 on juvenile survival for the 2019 migration season, "The combined yearling Chinook salmon survival estimate from the Snake River trap to Bonneville Dam tailrace was 41.3% (33.8-48.9%), which was below the long-term average of 48.9%."[36]

The memo goes on to note that, "*The combined Snake River steelhead survival estimate from the Snake River trap to Bonneville Dam tailrace was 41.2% (26.1-56.3%), which was below the long-term average of 45.7%."*[37]

We also note that in 2019, adult salmon were stalled repeatedly in their efforts to make it upstream past Little Goose Dam, due to increased spill levels. Correspondingly, Claire McGrath at NOAA presented the attached report to the U.S. Army Corps of Engineers Technical Management Team Meeting on 7/10/2019. According to the TMT meeting minutes, Ms. McGrath concluded,

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[35] 2014 Rechisky, Welch, Porter, Hess, & Narum. Testing for delayed mortality effects in the early marine life history of Columbia River Basin yearling Chinook salmon. Marine Ecology Progress Series.

[36] 2019-09 Preliminary survival estimates for the passage of spring-migrating juvenile salmonids through Snake and Columbia River dams and reservoirs, 2019

[37] 2019-09 Preliminary survival estimates for the passage of spring-migrating juvenile salmonids through Snake and Columbia River dams and reservoirs, 2019

> *…that despite varying results from the data tools, all of the indicators did consistently point to lower than expected conversion rates and slower travel times in the Lower Monumental to Little Goose reach. The 2019 YTD (as of 7/10) conversion of PIT-tagged adult Chinook from Lower Monumental to Little Goose was 96.2%, whereas the historical average for EOY conversion is 98.3%.*[38]

Given that adult spring Chinook are a culturally prized fish with the greatest biological value, and near their spawning grounds in this scenario, this lower conversion rate could represent a significant reduction in survival.

Higher Spill Levels Based on Linear Assumptions

As mentioned previously, the basis for the Action Agencies adopting spill levels in excess of 115% TDG is predicated on CSS model results showing higher adult salmonid return rates. We have already detailed good reasons to doubt the veracity of the CSS model conclusions.

However, there is an additional reason to question the model's output when it comes to spill levels of 120% TDG or higher. A known shortcoming of "multiple linear regression" models, like the CSS model, is that they need a straight line or linear relationship between the independent variables and the dependent variable. Once that linear relationship breaks down and becomes *curvilinear*, the models can lose their ability to accurately predict outcomes.[39]

In the case of spill levels with TDG in excess of 115%, we have a "perfect storm" which could lead to errant results from the CSS model.

To elaborate, while spill levels have occasionally reached or exceeded 125% TDG—the recommended level in the Preferred Alternative—they have never been managed to achieve that level continuously over the entire spring period at all eight lower river dams.

This deficiency of experience means that the CSS model lacks the data to appropriately interpret the relationship between spill and adult salmon returns under this new spill regime. In short, the CSS will assume that the linear relationship for lower levels of spill in its database will hold constant for higher levels of spill beyond the model's experience.

However, we note that the Washington State Department of Ecology ("Ecology") found that spill levels in excess of 115% TDG are known to cause harm to aquatic life. Ecology states,

> *The weight of all the evidence from available scientific studies clearly points to detrimental effects on aquatic life near the surface when TDG approaches 120%. The detrimental effects ranged from behavior changes to high levels of mortality after a few days. There were fewer effects on aquatic life at 115% TDG. Ecology strongly encourages*

[38] 2019-07-10 Columbia River Technical Management Team Draft Facilitator's Summary

[39] 2017-06-06 Bowman, N.A., Trolian, T.L. *Is More Always Better? The Curvilinear Relationships between College Student Experiences and Outcomes*. Innov High Educ 42, 477–489 (2017). https://doi.org/10.1007/s10755-017-9403-1

implementing actions that increase salmonid survival without further increasing total dissolved gas.[40]

This finding tells us there is a significant risk that the CSS model's linear understanding between spill and adult salmon returns may break down in this uncharted territory.

Call for Explicit Direct Tests

If the Action Agencies proceed with spill levels in excess of 115%, we call for explicit direct tests of the effect of high TDG levels on smolt survival in the river and, ideally, in the early marine phase after the smolts leave the river, where predators are abundant. The tests should be conducted with test and control groups. Such a test would be the most scientifically valid way to determine the effect of higher spills levels on SARs.

There is some published observational evidence that smolts exposed to high TDG levels may suffer high sublethal effects not captured in laboratory experiments, possibly because high TDG levels physically impairs smolts and makes them more vulnerable to predators.[41] However, the reported results are purely observational.

We believe that, given the importance of the issue, an explicit scientific experiment testing in-river and nearshore coastal ocean survival of smolt groups exposed to varying levels of TDG is called for. A test focusing on relative smolt survival would directly examine the key issue and also reduce the number of years required for a meaningful analysis.

We also encourage the Action Agencies to include clear language in the Final EIS that allows for adaptive management, should those high spill levels be shown, on a large scale, to be detrimental to either adult or juvenile resident or anadromous fish. Among the possible detriments, the Action Agencies should specifically consider delayed travel times for migrating adults. The language should make clear that spill levels will be reduced to 115% TDG on a permanent basis, should large-scale negative impacts on resident or anadromous fish be discovered.

Mixed Science on Dam-Related River Temperatures

Several public comments from the CRSO DEIS public teleconferences advocated for MO3 in response to high temperatures in lower Snake River reservoirs. It is important for the Action Agencies to recognize that damaging water temperatures are not unique to impounded rivers.

While it was widely reported in 2015 that 250,000 returning adult Snake River sockeye perished during an exceptionally dry and hot summer, mass die-offs have been observed in undammed rivers as well.

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[40] 2009-01 Adaptive Management Team Total Dissolved Gas in the Columbia and Snake Rivers: Evaluation of the 115 Percent Total Dissolved Gas Forebay Requirement. Washington State Department of Ecology and State of Oregon Department of Environmental Quality. January 2009, Publication no. 09-10-002. Page 60.

[41] 2016 Brosnan, I. G., Welch, D. W., & Scott, M. J. (2016). Survival Rates of Out-Migrating Yearling Chinook Salmon in the Lower Columbia River and Plume after Exposure to Gas-Supersaturated Water. Journal of Aquatic Animal Health, 28(4), 240-251. doi:10.1080/08997659.2016.1227398

For example, in 1994, due to record high water temperatures, approximately 466,000 adult fish perished in the undammed Fraser River before reaching their spawning grounds.[42]

More recently, record breaking temperatures in Alaska led to die-offs in several undammed rivers. One event in particular, originally reported by NPR, highlighted the problem. An official estimate was not released, but biologists believe as many as 200,000 to 300,000 fish were in the river during the extreme heat event.[43]

In terms of studies on the direct effect that Columbia Basin dams have on river temperatures, the results are mixed. A 2003 EPA study indicated that dams *may* exacerbate temperature issues on the rivers, but a 2002 peer-reviewed study performed by Pacific Northwest National Laboratory showed that dams within the Columbia and Snake river basins moderate extreme water temperatures.[44]

> *…the reservoirs decrease the water temperature variability. The reservoirs also create a thermal inertia effect that tends to keep water cooler later into the spring and warmer later into the fall compared to the un-impounded river condition.*

Also, in 2002, a team of researchers conducted a water temperature study on behalf of the U.S. Army Corps of Engineers. The team compared pre-LSRD measurements of water temperature from 1955-1958 to measurements taken after the LSRD were constructed. They found no evidence that river temperatures had increased as a result of the dams, and instead appeared to have remained unchanged or slightly lower. The team identified air temperature and flow levels as the biggest influences on temperatures in the river.[45]

In fact, air temperatures have trended upward significantly since 1955. Data available through the University of Washington's climate change tools show that the average air temperature recorded near Kennewick, Washington, has increased at a rate of 0.37 degrees Fahrenheit per decade.

These conditions would suggest higher water temperatures in the river over time, but as noted above the river temperatures have remained unchanged or slightly lower. There have been occurrences of spikes in temperature due to soaring air temperatures during heat waves, but these events are outliers, not the norm.

Appendix 2 of this document includes a graph provided through the University of Washington's Pacific Northwest Temperature, Precipitation, and Snow Water Equivalent Trend Analysis Tool.

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[42] 1997 Foreman, M & B. James, C & C. Quick, M & Hollemans, Peter & Wiebe, Edward. Flow and Temperature Models for the Fraser and Thompson Rivers. Atmosphere-ocean
US Army Corps of Engineers - Lower Snake River Dams https://www.nww.usace.army.mil/Missions/Lower-Snake-River-Dams/
[43] 2019-08-13 NPR - Why Are Salmon Being Found Dead In Rivers Across Western Alaska?
2019-08-07 NOAA - Alaska had its hottest month on record in July,
2019-08-22 Juneau Empire - Warm waters across Alaska cause salmon die-offs
[44] 2002 Summary: Regional Scale Simulation of Water Temperature in the Columbia River Basin
2002 Richmond, et al: Regional Scale Simulation of Water Temperature and Dissolved Gas Variations in the Columbia River Basin
[45] 2002-02-25 Water Temperatures and Passage of Adult Salmon and Steelhead in the Lower Snake River

Based on this evidence, the LSRDs are highly unlikely to cause high water temperatures capable of harming salmonids. Rather, their impoundment effect may actually help buffer against extreme temperatures because larger water volumes are more difficult to heat.

We ask that you consider the weight of this research in continuing to reject MO3 and MO4.

Predation in The Columbia River Basin

Avian

An 11-year study conducted by regional biologists on upper Columbia steelhead smolts found that birds were responsible for between 31% and 53% of juvenile mortality in the river, and for steelhead, avian predation accounted for more mortality than all other sources combined.[46]

Comparatively, a study of lower Snake River steelhead populations produced similar results. To quote from the study, "Avian predation was a major source of mortality in a 6-year study of ESA-listed Snake River steelhead."[47]

This high rate of predation carries on into the lower Columbia River as well. As noted by the ISAB,

> *Smolt predation by Caspian terns and double-crested cormorants downstream of Bonneville Dam were also substantial and ranged from 14% to 28% of upper Columbia River steelhead smolts in the Columbia River estuary. Recently, presenters to the ISAB (Quinn Payton and Allen Evans, RTR, March 1, 2019) demonstrated results from their Joint Mortality and Survival (JMS) model. Using the 10-year dataset and partitioning sources of juvenile mortality, the model (Figure 11) estimated that in the absence of Caspian tern predation, UCR steelhead SARs would have been one (SARs 95% CRI of SARs = 0%-2%) to five percentage points higher (SARs 95% CRI = 3%-8%).*[48]

In a presentation to the ISAB, Dr. Evans and Dr. Payton estimated that SARs, in the absence of terns would be, "3.2 times higher than observed averages" for upper Columbia River steelhead.[49]

From these numbers it is clear that addressing avian predation of salmonids is foundational to healthy ESA-listed fish populations in the Columbia River Basin.

We appreciate the efforts of the co-lead agencies to address avian predator disruption in the Preferred Alternative by including modification of the John Day Reservoir. Specifically, allowing The U.S. Army Corps of Engineers to raise John Day Dam Reservoir levels to decrease avian predation on ESA-listed juvenile salmon and steelhead in the lower Columbia River.

However, much more must be done to control the fish-eating birds that significantly and adversely impact ESA-listed salmon and steelhead in the Northwest. Chapter 5 of the DEIS lacks a suitable level of

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[46] 2019 Evans, A.F., Payton, Q., Cramer, B.M., Collis, K., Hostetter, N.J., Roby, D.D. and Dotson, C., Cumulative Effects of Avian Predation on Upper Columbia River Steelhead. Trans Am Fish Soc, 148: 896-913. doi:10.1002/tafs.10197

[47] 2015 Hostetter, et al, Quantifying Avian Predation on Fish Populations: Integrating Predator-Specific Deposition Probabilities in Tag Recovery Studies. Transactions of the American Fisheries Society 144: 410-422, doi: 10.1080/00028487

[48] 2019-05-03 ISAB 2019-1. A Review of Predation Impacts and Management Effectiveness for the Columbia River Basin. Page 97.

[49] 2019-05-08 Presentation to ISAB by Evans and Payton, Predation Impacts and Management Effectiveness for the Columbia River Basin, slide 55.

specificity. We encourage the Action Agencies, in the Final EIS, to include a thorough and detailed plan so that regional stakeholders can have confidence in your solution.

In terms of specific measures, we reference the Inland Avian Protection Management Plan (IAPMP) which was included as part of the 2008 Biological Opinion and intended to govern Columbia River System operations through 2018.[50] The IAPMP was developed by the US Army Corps of Engineers and calls for management actions at Goose Island (Potholes Reservoir in Grant County, Wash.) and Crescent Island (McNary Reservoir on the Columbia River in Walla Walla County, Wash.) to dissuade Caspian terns from nesting at these locations. [51]

The 2019 Biological Opinion proposed the continuation of IAPMP implementation to reduce the negative impact of avian predators on ESA-listed salmon and steelhead.[52] However, as noted in the July 29, 2019 letter from the Priest Rapids Coordinating Committee ("PRCC") to NOAA Fisheries' Branch Chief Ritchie Graves in Appendix 3 of this document, the IAPMP requirements have not been fulfilled by the Action Agencies.

As a specific example, the PRCC letter notes,

> *In the 2019 BiOp, the U.S. BOR proposes "to maintain the ropes and flagging and to monitor for tern presence" on Goose Island throughout the Caspian tern nesting and salmonid smolt outmigration seasons of 2019 and 2020, until the proposed "new" BiOp is issued in September of 2020. However, the U.S. BOR's proposed action and responsibility to the 2019 BiOp was not fulfilled in 2019.*

We note, for the 2020 season, that the Bureau of Reclamation's budget for its Goose Island plan-of-action is only about 20% of what it had been for 2015-2018.

The data demonstrate full funding for the full implementation of the actions & obligations of the IAPMP should be a top priority for the Action Agencies. We also adjure the Action Agencies to make the IAPMP more comprehensive. The plan should not be site-specific, but rather comprehensive in scope, since avian predators have demonstrated their ability to quickly move from one nesting site to another. The plan should also address other bird predators, such as cormorants, gulls, and pelicans.

Please see Appendix 3.1 of this document for important information related to avian predation in the Columbia River estuary.

Piscivorous Fish

It is notable that both native and non-native piscivorous fish play a significant role in the mortality of juvenile salmonids. For piscivorous fish, and specifically, for Northern Pike, the opportunity exists to recommend that Chapter 5 (Mitigation) and Chapter 7 (Preferred Alternative) of the DEIS focus not only on "ongoing-existing predation actions/programs" but outline specific "new mitigation actions".

New mitigation/measures/actions (above those already being implemented) would include:

- Increase Northern Pike suppression efforts in areas above Chief Joseph Dam

[50] 2014-01 Joint Agency Fact Sheet: Inland Avian Predation Management Plan

[51] 2014, US Army Corps of Engineers "Inland Avian Predation Management Plan Environmental Assessment"

[52] 2019 Columbia River System Biological Opinion, Introduction page 43

- Develop a comprehensive Rapid Response Plan that would be implemented if/when Northern Pike are detected below Chief Joseph Dam.
- Increase early detection measures for Northern Pike in areas below Grand Coulee Dam.
- Reduce the opportunity for Northern Pike to emigrate out of areas above Albeni Falls Dam. This could be accomplished through increased Northern Pike management by the appropriate state and federal regulatory agencies.

**Relevant Northern Pike/Predation Sections of the DEIS:

- 5.2.1.1 Bonneville Power Administration Fish and Wildlife Program-Predation section
- 5.2.1.7 Predation Management
- 5.4 Potential Mitigation for Alternatives- New Mitigation Actions
- Chapter 7 (Preferred Alternative)-Other Fish- line 3851

Pinniped

The up-river migration of California and Stellar sea lions have increased pressure on adult salmonids as well.

New federal laws have granted state and tribal agencies, including Oregon and Washington's fish and wildlife departments, to conduct removal efforts and—in the case of the most problematic individuals—humanely euthanize a limited number of the sea lions.[53]

We point to the successful paradigm that the Columbia River Inter-Tribal Fish Commission (CRITFC) established in working with regional stakeholders and elected officials to amend the Marine Mammal Protection Act. It seems likely that the result of that work was the rebound of Willamette River steelhead seen this year from critically low numbers of recent years.[54]

We encourage the Action Agencies to follow CRITFC's path in addressing other sources of predation noted above.

Salmon Recovery Hinges on Ocean Conditions

Northwest RiverPartners has historically advocated for an "All-H" approach (hydro, habitat, hatchery, harvest) to salmon recovery. These principles still hold true, but we also note that too often, the habitat that gets policy makers attention is in-river habitat.

Scientific research shows that the ocean deserves more attention. Studies have found that the oceans absorb as much as 30% of the climate's excess carbon[55] and 90% of its excess heat.[56] This absorption leads to warmer waters with higher levels of acidity and lower levels of oxygen.

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[53] Website: WDFW – Columbia River sea lion management https://wdfw.wa.gov/species-habitats/at-risk/species-recovery/columbia-river-sea-lion-management

[54] 2020-02-28 Big early return of Willamette steelhead bolsters Oregon biologists' hopes of reversing a major extinction threat - oregonlive.com

[55] 2019-03-15 The oceanic sink for anthropogenic CO_2 from 1994 to 2007, *Science* 15 Mar 2019: Vol. 363, Issue 6432, pp. 1193-1199

[56] 2020 Cheng, L., and Coauthors, 2020: Record-setting ocean warmth continued in 2019. Adv. Atmos. Sci., 37(2), 137–142, https://doi.org/10.1007/s00376-020-9283-7.

The Intergovernmental Panel on Climate Change issued a 2019 report that warned of the highly negative impacts of carbon and heat absorption on marine life and fish populations. The report states,

> *Projected ocean warming and changes in net primary production alter biomass, production and community structure of marine ecosystems. The global-scale biomass of marine animals across the foodweb is projected to decrease by 15.0 ± 5.9% (very likely range) and the maximum catch potential of fisheries by 20.5–24.1% by the end of the 21st century relative to 1986–2005 under RCP8.5 (medium confidence). These changes are projected to be very likely three to four times larger under RCP8.5 than RCP2.6.*[57]

This warning comes at a time when we're already seeing the oceans depleted of critical prey that salmon rely on. As an example, Pacific herring are an important prey species for adult salmon in the ocean. The Washington Department of Fish and Wildlife is studying the decline of Pacific herring in the Salish Sea, which has been trending downward since the 1970s.[58] They, too, are susceptible to poor ocean conditions and have been heavily harvested.

Some Pacific herring stocks have declined by as much as 97%, and there has been a renewed discussion to potentially list these fish as threatened or endangered under the Endangered Species Act.[59]

Given this information, it is not surprising that NOAA Fisheries researcher Lisa Crosier recently stated that scientists worldwide have been documenting, "almost synchronous declines in salmon populations," due to climate change.[60]

News articles this past year confirm the fact that the number of returning adult salmon to rivers from southern Oregon to southeastern Alaska have suffered from hostile ocean conditions.[61] Most of these rivers do not have dams, which points to larger causes driving the declines.

These dire results underscore the fact that climate change must be addressed to restore healthy salmonid populations. The pressure is further increased by warnings that suggest that our oceans may be approaching their threshold for carbon and heat absorption, which could lead to warming as monumental as the event that ended the last ice age.[62]

Given the serious implications of climate change for both marine and non-marine species, removing or diminishing carbon-free resources is a step in the *wrong* direction. This statement is especially true for

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[57] 2019: Summary for Policymakers. In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer Special Report on the Ocean and Cryosphere in a Changing Climate pp 22

[58] 2019-04-11 Encyclopedia of the Puget Sound – The Herring Defenders

[59] 2019-04-11 Encyclopedia of the Puget Sound – The Herring Defenders

[60] 2019-07-24 Crosier, et al. Plos One https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0217711 Climate vulnerability assessment for Pacific salmon and steelhead in the California Current Large Marine Ecosystem

[61] 2020-01-22 BC Harvesters Not Optimistic About Salmon Forecast Undercurrent News
2019-12-08 How Does Water Quality Impact the Salmon in the Puget Sound? Medium
2019-09-09 'Disastrous': Worst sockeye year on record for B.C. News 1130
2019-03-31 'Mystery of ocean survival': Experts trying to figure out why salmon are dying at sea Juneau Empire

[62] 2015-03-30 How Long Can Oceans Continue To Absorb Earth's Excess Heat? Yale Environment 360

the LSRD. As noted above, the ability of the LSRD to store and release water past hydroturbines is needed as we work to safely add intermittent renewables, like wind and solar power, to the grid.

SOUTHERN RESIDENT KILLER WHALES

Southern Resident Killer Whales ("SRKW") are acknowledged icons of the Northwest and especially of the Puget Sound and Salish Sea region. Unfortunately, while many other orca populations across the world are thriving, the SRKW continue to be endangered and decreasing in number.

Due to major concerns over the SRKW, the State of Washington established the Southern Resident Orca Task Force in 2018 to develop a long-term plan for recovering orcas.[63] The next several sections describe different factors impacting the region's orca population.

The Role of the LSRD

NOAA Fisheries has determined that Snake River salmon are not the limiting factor for SRKW populations. According to NOAA Fisheries,

> *Since they feed on many different salmon stocks at different times, though, no one salmon recovery action on a single river, such as breaching dams on the Snake, would itself bring about the recovery of Southern Resident killer whales. In addition, the relative size of the Snake River salmon stocks compared to others on the West Coast means that increases in their numbers, whether from breaching dams or otherwise, would result in only a marginal change in the total salmon available to the killer whales.*[64]

NOAA Fisheries also found that the hatchery Chinook in the Columbia and Snake river basins more than compensate for fish lost as a result of dams in terms of availability for orca whales.[65]

A joint 2018 report by the Washington State Department of Fish & Wildlife and NOAA Fisheries determined that Snake River Chinook salmon were only the 9th most important food source for SRKW. Unsurprisingly, the top priority SRKW food stocks came from the Puget Sound.[66]

In 2018 NOAA Fisheries noted that Puget Sound Chinook salmon populations hadn't seen the improvement experienced by other West Coast Chinook salmon populations in the last decade.

> *The abundance of Chinook salmon returning to Puget Sound rivers has scarcely changed in recent decades, in large part because much of their habitat has been lost entirely or degraded so it cannot support healthy runs as it once did. In addition, many juvenile Puget Sound salmon and steelhead do not make it through their first few months at sea. NOAA Fisheries researchers have further found that young Puget Sound Chinook salmon carry high levels of contaminants of emerging concern such as prescription drugs and antibacterial compounds, likely from local*

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[63] https://www.governor.wa.gov/issues/issues/energy-environment/southern-resident-orca-recovery

[64] 2016-03-16 NOAA PDF: Southern Resident Killer Whales and Snake River Dams

[65] 2018 NOAA PDF: NOAA Fisheries Fact Sheet: Southern Resident Killer & West Coast Chinook Salmon
2016-11 NOAA Technical Memorandum MNFS-NWFSC-135 "Exposure to a Mixture of Toxic Chemicals: Implications for the Health of Endangered Southern Resident Killer Whales"

[66] 2018-06-22 WDFW and NOAA PDF Southern Resident Killer Whale Priority Chinook Stocks Page 6

wastewater, at levels high enough to adversely affect their growth, reproduction, and behavior.[67]

It is critical that more of the region's efforts are focused on restoring Puget Sound Chinook salmon populations, given their importance to the SRKW diet.

The Role of Competition with Other Marine Mammals

Since receiving federal protections, the population of seals and sea lions in the Northwest has exploded. A group of regional scientists estimate that these marine mammals have increased their consumption of salmon by up to nine times the historical amount.[68] The increased competition from other marine mammals could potentially limit the availability of salmon for SRKW.

Further, scientists found that Northern Resident killer whales, whose population is growing, may be directly outcompeting SRKW.[69]

The Role of Toxicity and Exposure to Pollution

Human activity and development have had a direct and severe impact on the health of the Salish Sea and coastal waters of the Northwest. As a result, marine life has been negatively affected by pollution, toxic chemicals, and waste. Many of these pollutants and chemicals cannot be broken down or digested. Instead, they build up over time inside the living creatures that consume them. Through bioaccumulation, predators at the top of the food chain wind up with the most chemicals.

One study found that salmon sampled from the Puget Sound contained 81 drugs and personal care products that included Prozac, Advil, Lipitor, and even cocaine.[70] Additionally, the same study found high levels of contamination from human waste.

A number of these toxic chemicals and pollutants are fat soluble, which means that they are stored in the fat cells. The SRKW population feeds almost entirely on fatty Chinook salmon, targeting the largest fish as referenced above. This means that SRKWs tend to accumulate extremely high levels of toxic chemicals and pollutants.[71]

Though the effects are not fully understood, there are two primary and widely accepted concerns: First, toxic chemicals and pollutants are passed to orca calves during their growth in the womb and after birth when they consume milk from their mother. Second, it is known that when food becomes scarce and orcas begin to burn fat, so the stored-up chemicals are released into their bloodstream.

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[67] 2018 NOAA PDF: NOAA Fisheries Fact Sheet: Southern Resident Killer & West Coast Chinook Salmon Page 7

[68] 2017 *Canadian Journal of Fisheries and Aquatic Sciences*, 2017, 74(8): 1173-1194, https://doi.org/10.1139/cjfas-2016-0203

[69] 2019-12-26 PNAS 116 (52) 26682-26689; first published December 16, 2019 https://doi.org/10.1073/pnas.1910930116

[70] 2016-06 Environmental Pollution Volume 213, Contaminants of emerging concern in a large temperate estuary https://doi.org/10.1016/j.envpol.2016.01.088

[71] 2016-11 NOAA Technical Memorandum MNFS-NWFSC-135 "Exposure to a Mixture of Toxic Chemicals: Implications for the Health of Endangered Southern Resident Killer Whales"

RiverParnters would like to summarize by saying that Southern Resident orcas desperately need and deserve the region's help. That said, the link between orca health and the existence of the LSRD is tenuous at best.

A commonsense approach to improving orca health is to focus the region's efforts on improving the environment where the orcas spend the majority of their time—in the Puget Sound and Salish Sea.

RESPONSES TO PRO-BREACHING REPORTS

EnergyGPS Review of NWEC LSRD Replacement Study

In 2018, the Northwest Energy Coalition ("NWEC") released a theoretical study—produced by Energy Strategies—that indicated the LSRD could be cost-effectively and easily replaced, primarily by wind generation in Montana.[72] The report relied largely on power supply assumptions from 2016.

As mentioned above, since that time, the Northwest Power & Conservation Council, the Northwest Power Pool, and E3 have issued serious warnings over the possibility of regional blackouts.

It is also noteworthy that Energy Strategies has updated many of its assumptions in a more recent analysis performed on behalf of Oregon, Washington, and several clean energy providers. In this updated analysis, Energy Strategies predicts an electricity capacity shortfall for the Northwest, even with the LSRD remaining in place.[73]

Despite the availability of updated information around coal plant retirements, people have continued to point to the NWEC study as proof that the LSRD aren't necessary to the region's clean energy future.

We believe it is potentially dangerous to rely on the NWEC-commissioned study determine the region's energy future, so we commissioned EnergyGPS, a leading energy consulting firm, to provide an analysis of NWEC's 2018 report.

The EnergyGPS critique demonstrates that the NWEC study was thorough but is based on questionable and dated assumptions that cast serious doubts on its conclusions.

One example of a questionable assumption is that the study—in essence—double counts the available transmission capacity freed up by coal plant retirements. The study assumes that the freed-up transmission will be used to import power to replace the LSRD.

The study doesn't consider that the region will likely need those lines to replace the lost coal generation. This oversight means that incremental transmission would be needed to replace the energy from the dams. Transmission projects are both expensive and very difficult to site, which calls into question the viability of that plan.

Importantly, the EnergyGPS analysis appropriately points out that we now live in a "carbon-constrained world." The implication is that—given the legislative and political trends away from fossil fuels—it is likely not practicable to use coal or natural gas-fired power plants to replace the LSRD. Instead, if breached, the LSRD will have to be replaced by a carbon-free portfolio. Energy GPS forecasted that the

[72] 2018-04-27 NWEC - The Lower Snake River Dams Power Replacement Study

[73] 2019-12-10 Energy Strategies & Western Energy Interstate Board- Western Flexibility Assessment

least expensive combination of renewable generation and batteries would result in almost $1 billion in additional costs *annually*, which is very similar to the DEIS finding.

Appendix 1 of this document includes the full EnergyGPS analysis of the NWEC study.

ECONorthwest Critique

In 2019, Vulcan Inc. released the results of a report produced by ECONorthwest. The report indicated that the Northwest would receive economic gains by breaching the LSRD.

Northwest RiverPartners reviewed the ECONorthwest report in-depth upon its release. We found that the report relied heavily on "non-use value" (i.e., a theoretical willingness of survey takers to pay) to reach its conclusion that breaching would provide an economic benefit to the region.[74]

The valuation was determined using a small survey, conducted by a dam breaching advocacy group. The survey question included language that guaranteed the restoration of wild salmon stocks if the dams were breached.[75] It then asked how much the respondents would be willing to pay for that outcome.

ECONorthwest took the average value provided by the respondents and multiplied across the populations of Northern California, Idaho, Montana, Oregon, and Washington to determine the theoretical non-use benefit.

Despite its pro-breaching conclusion, the ECONorthwest report refers to "extreme uncertainty" around the potential benefits of dam breaching for salmon.[76] This finding is a direct contradiction to the promise of guaranteed salmon restoration presented to the survey participants whose answers were used to calculate the non-use value. We believe that this contradiction, itself, invalidates the ECONorthwest analysis.

The ECONorthwest analysis also notes that the population most likely to see a real benefit would be Snake River fall Chinook[77]—a species that is already a candidate for de-listing under the Endangered Species Act.

Without the inclusion of non-use value, the report clearly shows a loss of around $2 billion dollars from breaching.[78]

Further, the report may have significantly overvalued its numbers on the recreational benefits of breaching by relying on studies with extremely limited sample sizes.[79]

Finally, in this section, we point to a separate study commissioned by the Pacific Northwest Waterways Association ("PNWA"). The PNWA study estimates an approximate net present value of $2 billion in harm to the region, just from the loss of barging, if the LSRD were breached.[80] The study did not attempt to capture the costs of other impacts, such as the loss of hydroelectricity and irrigation.

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[74] 2019-07-29 ECONorthwest Lower Snake River Dams - Economic Tradeoffs of Removal Page vi.
[75] 2019-07-29 ECONorthwest Lower Snake River Dams - Economic Tradeoffs of Removal Page 110.
[76] 2019-07-29 ECONorthwest Lower Snake River Dams - Economic Tradeoffs of Removal Page 94.
[77] 2019-07-29 ECONorthwest Lower Snake River Dams - Economic Tradeoffs of Removal Page 95.
[78] 2019-07-29 ECONorthwest Lower Snake River Dams - Economic Tradeoffs of Removal Page vi.
[79] 2019-07-29 ECONorthwest Lower Snake River Dams - Economic Tradeoffs of Removal Page 106.
[80] 2020-01-10 National Transportation Impacts & Regional Economic Impacts Caused By Breaching Lower Snake River Dams

CONCLUSION

We again thank the Action Agencies for this opportunity to provide comments into the CRSO DEIS review process. We greatly appreciate the tremendous effort that went into developing the DEIS and the excellent synopsis provided in the DEIS Executive Summary.

One cannot read through the DEIS without concluding that the LSRD are critical to the region's clean and equitable energy future. This statement is truer now than when the DEIS was released in late February, given the financial hardships many Northwesterners are contending with.

With consideration to the findings outlined in the DEIS, RiverPartners asks that the Action Agencies to reject any Preferred Alternative that includes breaching the LSRD or significantly reducing their capabilities through increased levels of spill. Such options would not fulfill the federally mandated multiple objectives of the Columbia River System and would represent a great hardship to vulnerable communities across the Pacific Northwest.

We caution the Action Agencies against adopting an alternative that increases spill beyond 115% TDG. We issue this caution due to the lack of solid scientific evidence showing higher spill levels lead to higher returns of adult salmonids. On the other hand, we note that scientific evidence does exist which shows spill levels which exceed 115% TDG can cause harm to both anadromous and resident fish.

On this topic, we urge the Action Agencies to conduct explicit direct tests of the effect of high TDG levels on smolt survival in the river and, ideally, in the early marine phase after the smolts leave the river, where predators are abundant. The tests should be conducted with test and control groups. Such a test would be the most scientifically valid way to determine the effect of higher spills levels on SARs.

Additionally, contingencies should be put in place to ensure that if higher spill results in negative impacts on salmonids or other native species of fish, that spill is decreased. The amount of the reduction should be determined based on further research into safe levels of TDG for the Columbia River System.

Lastly, we encourage the action agencies to take additional steps to address the critical issue of avian predation. Such actions could have the greatest near-term improvements for struggling salmonid populations.

We look forward to a continued partnership with the Action Agencies and other Northwest stakeholders in finding ways for both communities and salmon to thrive.

Please see our attached appendices, which include analyses referred to in our comments above, as well as a Change.org petition signed by over 2,300 people in support of a clean and equitable energy future that includes the lower Snake River dams.

Respectfully,

Kurt Miller, Executive Director, Northwest RiverPartners

ENERGYGPS LLC

Northwest RiverPartners Appendix 1: 1/20/2020 EGPS Review of NWEC Study

Summary for Northwest RiverPartners

Comments on:
Northwest Energy Coalition's April 2018 Lower Snake River Dams Power Replacement Study

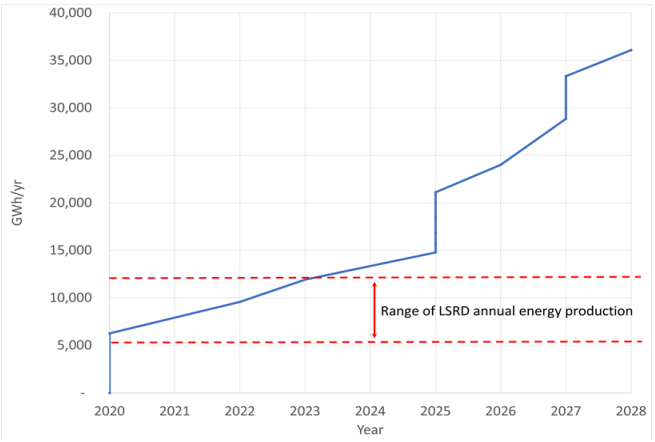
The four Lower Snake River Dams ("LSRD") dams represent a large source of relatively inexpensive, emission-free electricity, supplying over 5.5% of the Pacific Northwest ("PNW") region's electricity supply in a typical year.

The Northwest Energy Coalition ("NWEC"), in April 2018, released the Lower Snake River Dams Power Replacement Study ("NWEC Study"). The study is extensive and, among its findings, states a "portfolio of reasonably available clean energy resources, including solar, wind, energy efficiency, demand-response, and energy storage can effectively replace the most important power attributes the four LSR Dams are forecasted to contribute to the Northwest region." Although not a substitute for the detailed analysis that will be a part of the ongoing Columbia River Systems Operations EIS, as required by the National Environmental Policy Act ("NEPA"), the NWEC Study is receiving attention in the Washington Governor's LSRD Taskforce and other regional dialogs currently underway. Because of its potential to influence ongoing policy dialogs and investigations, the NWEC Study requires examination. Northwest RiverPartners contracted with the consulting firm EnergyGPS Consulting, LLC ("EGPSC") to review the NWEC Study. EGPSC made the following observations and findings:

- The NWEC Study was released over 18 months ago and relied on assumptions from the Northwest Power and Conservation Council's ("NWPCC's") 7th Regional Plan, which is now over 3 years old. As a result, many of the assumptions made by the NWEC are out-of-date and are not reflective of current state and regional energy and climate policies.
- The most significant change since the release of the NWEC Study was the enactment of new decarbonization legislation including, most notably, the passage of Washington's Clean Energy Transformation Act ("CETA"). These laws and policies significantly constrain resource options available to the PNW and larger the WECC region in response to LSRD's removal.
- This new "carbon constrained" reality is most easily measured in terms of the number of announced coal-fired power plant retirements. The most recent NWPCC resource adequacy study assumes that 4,500-6,000 MW of PNW coal-fired power plants will retire in the next 10 years. This is 1,700-3,200 MW higher than the 2,800 MW of

retirements assumed in the NWEC Study. Looking out 15 years (to 2035) at the entire WECC region, the NWPCC expects approximately 20,000 MW of retirements of coal-fired power plants. These retirements will create a large capacity and energy shortfall; one that will be significantly exacerbated by LSRD removal (Figure 1). Faced with these significant capacity and energy constraints and emerging decarbonization policies, the PNW region will have little choice but to seek replacement power from low-carbon or carbon-free resources. The NWEC Study assumptions are simply not aligned with this reality.

Figure 1. Cumulative Energy Impact of Retirements of Coal-Fired Generation Owned or Contracted by PNW Utilities (2020-2028) and Range of LSRD Annual Energy Production

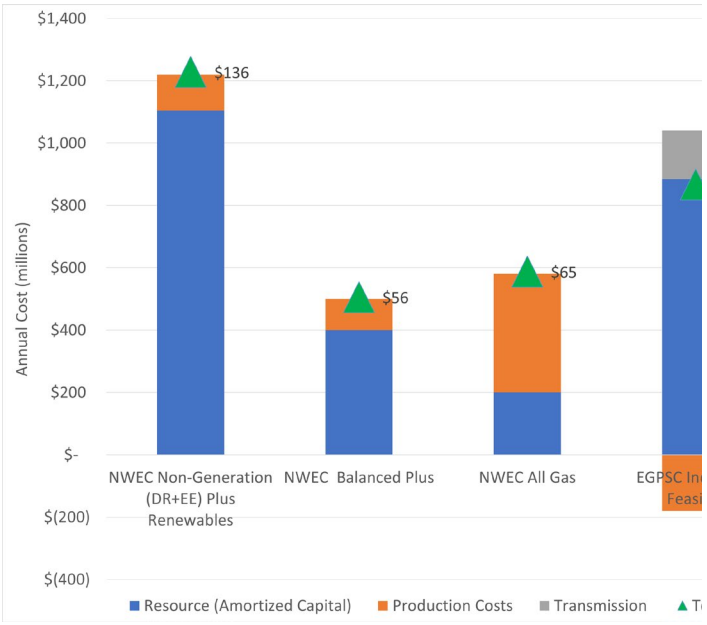


- EGSPC expects that all cost-effective demand response and energy efficiency (DR/EE) resources will be deployed by the region. However, the supply curves used by NWEC indicate that incremental DR/EE on the scale needed for LSRD's replacement will be very expensive. Until there is further development of supply curves for new, incremental DR/EE resources, EGPSC does not recommend relying on DR/EE to be the primary replacement resource for LSRD.
- All of the replacement portfolios developed by NWEC rely unduly on imports to meet energy and capacity shortfalls. NWEC's "Balanced" portfolios, which rely on a mix of DR/EE, wind, and solar resources, do not fully replace LSRD's capacity and energy value. Although new wind resources, most likely to be developed in Montana and Wyoming, can produce energy at capacity factor in excess of 40%, they will have only limited capacity value once many GWs comes online. The NWEC study should be more explicit with regard to how much it relies on imports from outside the PNW to replace LSRD's lost capacity and energy value.
- Except as provided in what it labels as "GHG Policy" sensitivity runs, NWEC does not put a value on incremental carbon emissions, which leads to an in increase in carbon emissions. These are outcomes that are likely infeasible under current and emerging carbon rules and policies. Any realistic replacement portfolio should replace all LSRD

energy with emission-free power or mitigate any incremental emissions by putting a reasonable price on residual carbon emissions.

- The NWEC Study underestimates transmission costs that will be incurred to integrate a large increment of new variable energy resources. The NWEC study effectively assumes that transmission freed up by the retirements at Colstrip 1+2 (614 MW) will free up transmission to deliver Montana wind and that the planned Boardman-to-Hemmingway line will ensure integration of new solar resources from Idaho. To integrate variable energy resources to replace LSRD will require new, incremental transmission for both new wind and solar.
- On balance, the replacement portfolios presented by the NWEC Study are either infeasible or significantly underestimate costs. As an alternative to NWEC's results, EGPSC developed a portfolio that is feasible and does not compromise regional reliability. EGPSC calls this portfolio "Indicative Feasible" (Figure 2, rightmost column). This portfolio relies on grid-scale battery storage and renewable power to supply the capacity and energy shortfall created by LSRD's removal. It also includes an adder for transmission costs so that new renewables can reach load and an adder to reflect the incremental cost of carbon emissions. With these realistic assumptions made, **EGPSC estimates a replacement cost of $860 million/year or $96/MWh.**

Figure 2. NWEC Study GHG Policy Portfolios and EGPSC Indicative Feasible Portfolio (left scale is annual cost, $millions; right scale is cost per unit of replaced energy, $/MWh)



- This cost estimate is approximate—EGPSC's analysis is not meant to be a substitute for a detailed study using more appropriate assumptions. It is significantly higher than NWEC's estimate for its balanced portfolio and, because of this, highlights the need for agreement on common assumptions and further research before any definitive conclusions are made with regard to the future operation of LSRD.

Date: January 20, 2020[1]
To: Northwest RiverPartners
From: EnergyGPS Consulting, LLC ("EGPSC")

Re: Review of the Northwest Energy Coalition's Lower Snake River Dams Power Replacement Study

Executive Summary

ES.1 Introduction

The four Lower Snake River Dams (LSRD)[2] dams represent a large source of relatively inexpensive, emission-free electricity, supplying over 5.5% of the Pacific Northwest ("PNW") region's electricity supply in a typical year.[3],[4]

The four LSRD are being evaluated as part of the Columbia River Systems Operations ("CRSO") Environmental Impact Statement ("EIS"), which, among other objectives, will comply with the requirements of the National Environmental Policy Act ("NEPA"). Breaching the four LSRD is being considered as an alternative mitigation measure in that EIS.[5] The data gathering and analysis that is being conducted as part of the CRSO EIS is the appropriate place to evaluate the impacts of this mitigation alternative. The draft CRSO EIS, including the preferred alternative, is scheduled to be available for public comment in February 2020.

Independent of the CRSO EIS study work, the Northwest Energy Coalition ("NWEC"), during April 2018 released the Lower Snake River Dams Power Replacement Study ("NWEC Study" or "Study").[6] The study is extensive and, among its many findings, states that a " portfolio of

[1] Prior dated memo (December 19, 2020) revised to correct a typographical error.
[2] The LSRD are Ice Harbor, Lower Monumental, Little Goose, and Lower Granite. All are located in southwest Washington and are part of the FCRPS. NWEC Study, page 19.
[3] 1,025 aMW/18,500 aMW; where 1,025 aMW represents average annual production 2007-2015 and 8,500 aMW is total regional electricity demand (NWPPC 7th Plan, 2017).
[4] The dams provide other benefits such as irrigation, transportation, flood control, and recreational benefits. These benefits are not considered in either the NWEC study or this review.
[5] US Army Corps of Engineers, Columbia River Systems Operations Update, "Introducing the Range of Alternatives," September 2019. Available at https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll8/id/4079
[6] The Study was prepared by Energy Strategies, an energy consulting firm (energystrat.com), and is billed as an independent study commissioned by the NWEC.

reasonably available clean energy resources, including solar, wind, energy efficiency, demand-response, and energy storage can effectively replace the most important power attributes the four LSR Dams are forecasted to contribute to the Northwest region." Although not a substitute for the detailed analysis that will be a part of the CRSO EIS (as required by NEPA), the NWEC Study is receiving attention in the Washington Governor's LSRD Taskforce and other regional dialogs currently underway.[7] Northwest RiverPartners ("NWRP") contracted with EGPSC to evaluate the NWEC Study.[8] EGPSC was tasked to evaluate the overall reasonableness of the Study's findings and conclusions. EGPSC did not attempt to replicate the work of the NWEC Study in detail, but instead focused on the Study's overall methodological approach, use of specific models, and key assumptions.

ES.2 EGPSC Observations and Findings

The NWEC Study uses a comprehensive suite of industry-accepted tools. Concerns over results stem from assumptions made or lack of sufficient documentation. The NWEC Study relies on industry-accepted electricity and resource planning models that are used by entities throughout the region. These include the GENESYS reliability planning model (maintained by Northwest Power and Conservation Council, or "NWPCC"), the PowerWorld model using transmission system reliability data provided by ColumbiaGrid, and ABB's GridView production cost model. These are appropriate models for use in such an analysis. Although not all data and assumptions used in the study have been made available, the NWEC Study does a reasonably good job of presenting assumptions that drive many of the results. Given that the NWEC Study relies on appropriate methodologies, EGPSC's comments focus mainly on areas where the model data or assumptions were insufficiently documented or where EGPSC found the assumption to not be reasonable or reflective of the current market or policy realities.

Key assumptions of the NWEC Study are already out-of-date and do not reflect current state policies nor the PNW's forecasted capacity shortfall. The NWEC study assumptions regarding load and available supply and demand-side resources are largely based on the NWPCC's 7th

[7] The NWEC Study appears to be relied as an input by ECONorthwest its source for estimated power replacement costs in its study, Lower Snake River Dams Economic Tradeoffs of Removal, July 29, 2019, Table 4, p. 35.

[8] Energy Strategies, Lower Snake River Dams Power Replacement Study: Assessing the technical feasibility and costs of clean energy replacement portfolios, "An independent study commissioned by the NW Energy Coalition", March 2018 (posted April 2018). Available at: https://nwenergy.org/featured/lsrdstudy/

Power Plan, which was completed nearly three years ago, in 2016.[9] Since the Study's release, significant policy changes have occurred that shift the appropriate baseline to use for any LSRD removal study. The most notable of these shifts is the passage of Washington's Clean Energy Transformation Act ("CETA") in early 2019. This legislation, along with other state and utility actions to decarbonize the electric sector, significantly constrains resource options available to the PNW and the WECC region in response to LSRD's removal.[10] Put simply, the WECC now operates in a carbon -constrained world. This constraint is most easily measured in terms of the number of announced coal-fired power plant retirements. The most recent NWPCC resource adequacy study assumes that 4,500-6,000 MW of PNW coal-fired power plants will retire in the next 10 years.[11] This is 1,700-3,200 MW higher than the 2,800 MW of retirements assumed in the NWEC Study. Looking out 15 years (to 2035) at the entire WECC region, the NWPCC expects approximately 20,000 MW of retirements of coal-fired power.[12] EGPSC estimates that the cumulative energy impact of retirements of coal-fired power plants owned or contracted by PNW utilities will exceed 35,000 GWh/year in the next decade (Figure 1). This is a large energy shortfall, one that will be significantly exacerbated by LSRD removal as its annual energy production varies from 6,500 to 12,000 GWh/year.[13] With these significant capacity and energy constraints, the PNW region will have little choice but predominantly to seek replacement power from increasingly more expensive carbon-free resources. The NWEC Study assumptions are simply not aligned with this level of resource scarcity.

[9] NWPCC, Seventh Northwest Conservation and Electric Power Plan, February 2016. Available at: nwcouncil.org/7thplan/plan

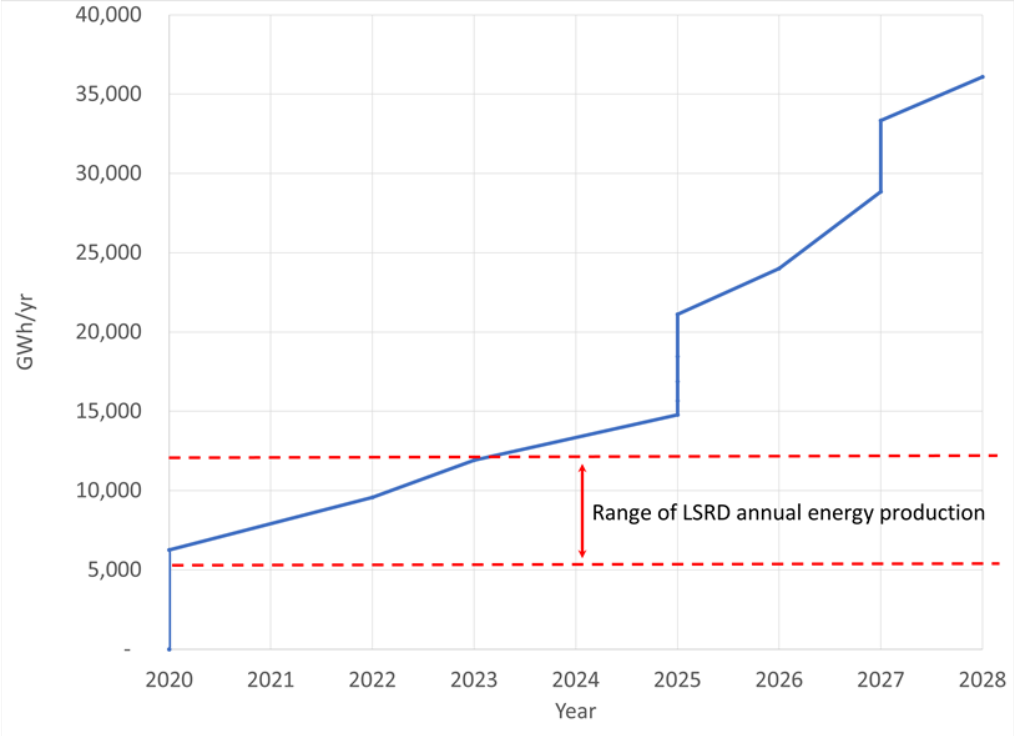
[10] An identification of key legislative/policy activities that have occurred since the NWEC Study was released is in Appendix A

[11] NWPCC, Pacific Northwest Power Supply Adequacy Assessment for 2024, October 31, 2019. Figure 2. The primary difference between the high and low end of NWPCC's range in retirements is associated with Colstrip 3 and 4. There is no announcement to retire these units although CETA will significantly constrain current owners from purchasing power from these projects.

[12] NWPPC (Kujala), Presentation at the NWPP Resource Adequacy Symposium, slide 10, October 2, 2019.

[13] NWEC Study, Figure 11. Historical average production is 9,125 GWh/year.

Figure 1. Cumulative Energy Impact of Retirements of Coal-Fired Generation Owned or Contracted by PNW Utilities (2020-2028) and Range of LSRD Annual Energy Production



The NWEC Study does not adequately discuss the appropriate priority of LSRD replacement resources relative to competing needs for new energy resources. The NWEC Study identifies several preferred replacement portfolios, all of which it describes as containing "reasonably available clean energy resources."[14] Given the multiple policy changes occurring in the region, a basic question that should be addressed is: What priority of resource selection should be given to LSRD replacement resources? Should LSRD replacement resources be selected "first," ahead of the demand created by adopted or likely decarbonization policies, or should they get resources "last"?[15] The implicit assumption of the Study appears to be the latter: that the next available resources in the region go to LSRD replacement, ahead of demand that will be created by various decarbonization policies. Given that certain decarbonization policies are now law, EGPSC generally assumes the former—that only resources reasonably expected to be available

[14] Energy Strategies, "Lower Snake River Dams Power Replacement Study Full Summary Slides", March 2018, p. 6. The NWEC Study also provides an "all gas" replacement portfolio but it is not preferred.

[15] This choice is not unlike the choice made between the common accounting rules of "last in, first out" (LIFO) and "first in, first out" (FIFO).

beyond amounts likely to be committed for the region's ongoing energy transition be associated with LSRD replacement resource. At the very least, the NWEC Study should be clearer about this important assumption.

The NWEC Study energy efficiency and demand response assumptions used in its non-generator alternatives scenarios are costly and are not feasible. EGPSC does not dispute the opportunity for demand response and energy efficiency (DR/EE) and the role it can play in the region's resource plan. However, the magnitude of incremental energy efficiency procured in the Study's two Non-Generating Alternative ("NGA") portfolios are questionable. There is already 3,000 aMW of energy efficiency embedded in the NPPPC 7th Power Plan. The NGA portfolio calls for an additional 237 aMW of energy efficiency with the marginal supply costing close to $100/MWh.[16] The "NGA Plus" portfolio includes an additional 500 aMW of DR/EE where the marginal supply costs exceed $500/MWh.[17] This level of EE is greater than the identified technical potential supply estimated by NWPCC. The high cost of DR/EE is readily apparent in the NWEC Study: Even without adjustment, the NGA Plus portfolio costs $1.2 billion/year or $136/MWh (Figure 2, leftmost column). EGPSC expects that all cost-effective DR/EE, including DR/EE promoted by utilities and regional entities, will be deployed regardless of LSRD's disposition. Until there is further development of supply curves for new, incremental DR/EE (or, econometric modeling of the demand response that will occur from higher regional electricity prices), EGPSC does not recommend relying on the DR/EE to be the primary replacement resource for LSRD.

The NWEC Study unduly relies on imports to meet energy and capacity shortfalls. All of the portfolios presented by NWEC Study rely on imports from outside the region to balance the shortfall created by LSRD removal. In the "Balanced" portfolio, approximately 30% of the shortfall created by LSRD removal is supplied by imports. Although new wind resources, most likely to be developed in Montana and Wyoming, have high annual capacity factors (in excess of 40%), they will have only limited capacity value once many GWs comes online. The prevailing regional capacity need will be for evening ramping capability and wind and solar cannot be expected to provide that to a high degree. The NWEC study appears to rely on imports to provide this capacity on the margin. There is no guarantee that the resources will be there on a firm basis, and,

[16] NWEC Study, Figure B-3. The average cost of DR and EE is $62/MWh (Table 2, below).
[17] The average cost of this block of DD/EE is $229/MWh. As a point of comparison, Energy Trust of Oregon, which implements energy efficiency programs for the majority of electricity load in the state of Oregon, has, since 2002, secured approximately 724 aMW—equivalent to a long-term acquisition rate of 45 aMW/year. Available at: https://www.energytrust.org/wp-content/uploads/2019/04/2018.Annual.Report.OPUC_.pdf

given NWEC's cost assumptions for imports, this reliance on imports leads to an underestimation of LSRD replacement costs.

Incremental carbon emissions should be mitigated or at least priced in all portfolios. Except in specific sensitivity runs, the NWEC does not put a value on carbon, which leads to an underestimate of the cost of LSRD replacement. All of the non-GHG policy portfolios increase GHG emissions. As noted above, the portfolios rely on increased production from existing fossil-fired resources within the region or outside of the region (as imports). The cost of increased GHG emissions is only reflected in the NWEC Study portfolios sensitives labeled "GHG Policy." EGPSC's view is that a realistic replacement portfolio should replace all LSRD energy with emission-free power or mitigate any incremental emissions. At a minimum, any portfolio presented should put a price on incremental carbon emissions.[18]

The NWEC Study underestimates transmission costs that will be incurred to integrate a large increment of new variable energy resources. The NWEC study effectively assumes that transmission freed up by the retirements at Colstrip 1+2 (614 MW) will free up transmission to deliver Montana wind and that the planned Boardman-to-Hemmingway line will ensure integration of new solar resources from Idaho.[19] In EGPSC's view, these identified transmission paths will be used by the region to integrate resources needed to replace retiring coal plants, not LSRD. To integrate variable energy resources to replace LSRD will require new, incremental transmission for both new regional wind and solar. For example, the Montana Renewables Development Action Plan summarized prior studies and indicates that to add substantial amounts of wind *beyond* the amount of MWs that can use transmission "freed up" by retiring Colstrip, will incur $400 million of additional transmission costs.[20] Estimating transmission costs is beyond the scope of this effort but EGPSC recommends that the NWEC study include a placeholder value of at least $35/kW-yr to reflect future incremental transmission costs.[21]

By focusing on regional bill impacts, NWEC Study misrepresents the magnitude of the cost of LSRD replacement. The NWEC Study presented total annualized costs of the replacement portfolios it developed.[22] However, when it put those costs in context, the NWEC study computed impacts on an average regional retail bill. Such a measure greatly dilutes percentage impacts because bills include many non-wholesale power cost components, such as distribution costs. A simpler and more meaningful way to show results is per-MWh-of-replaced-power.

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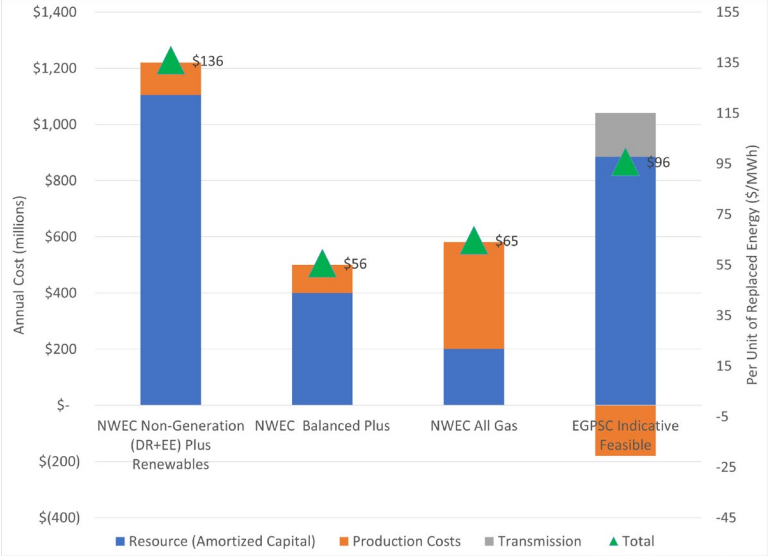
[18] In the NWEC GHG Policy portfolios a GHG adder of $14/MWh is applied.
[19] NWEC Study, p. 44
[20] Montana Renewables Development Action Plan, June 2018 identify the Colstrip Transmission Upgrade, ~$252 million, and the Montana-to-Washington Project, ~$140 million. Page 11 and Appendix A.
[21] Based on an installed cost of transmission of $220/kW and annual capital recovery factor of 16%.
[22] NWEC Study, Figure 14, page 63.

Using this straightforward measure, the NWEC Study portfolios cost between $56 - $136/MWh (Figure 2).[23]

On balance, the NWEC Study portfolios are either infeasible or significantly underestimate costs. EGPSC estimates that the cost of replacing LSRD with feasible resources is on the order of $860 million/year or $96/MWh. As an alternative to NWEC's results, EGPSC developed a portfolio that is feasible and does not compromise regional reliability. EGPSC calls this portfolio "Indicative Feasible" (Figure 2, rightmost column). This portfolio relies on grid-scale battery storage and renewable power to supply the capacity and energy shortfall created by LSRD's removal.[24] As noted above, also It includes an adder for transmission costs and includes a price on incremental carbon emissions that NWEC only included in its GHG Policy Scenarios. In EGPSC's view, this Indicative Feasible portfolio is more representative of the cost of replacing LSRD than the NWEC Study balanced portfolio. This cost estimate is approximate and EGPSC's analysis is not meant to be a substitute for more detailed modeling that should be performed in the future.

Figure 2. NWEC Study GHG Policy Portfolios and EGPSC Indicative Feasible Portfolio (left scale is annual cost, $millions; right scale is cost per unit of replaced energy, $/MWh)



[23] The NWEC portfolio costs are unaltered although only the GHG Policy cost values are shown.
[24] Resource cost assumptions for wind and solar are the same as NWEC's except that wind, on average, was assumed to have a 40% capacity factor (instead of 44%). The effective capacity value of wind and solar was estimated both to be 15%. 350 MW of 12-hour storage was included using per-unit costs of approximately 85% of NWEC's costs. Revenues from excess energy (before inclusion of carbon price) was assumed to be $20/MWh.

ES.3 Conclusion

While the NWEC Study is an ambitious project using industry-accepted models, it fails to present a feasible scenario where LSRD's capacity and energy are replaced with sufficient quantities of carbon-free resources. Instead, the "balanced" portfolios presented have higher emissions and rely on higher imports. Neither assumption is realistic. The study should have addressed the following question: If the LSRD dams are removed and replaced by physical resources with comparable energy and capacity attributes, what would those resources be and how much would they cost? EGPSC endeavored to estimate this value using carbon-free resources (wind, solar, and batteries) more likely to be available in response to LSRD's replacement. Because of the large demand for wind and solar in the region driven by ongoing decarbonization policies, any increment of new wind and solar will also require additional transmission. When factoring in these changes—adequate and feasible replacement resources, new transmission, and carbon costs, EGPGSC estimates that a more realistic estimate of replacement cost will be $860 million/year or $96/MWh. This is a significant cost—one that indicates the need for agreement on common assumptions and further research before any definitive conclusions are made with regard to the future operation of LSRD.

1. Introduction

The four LSRD[25] have a combined nameplate capacity of over 3,000 MW and have an annual median year production of approximately 1,000 aMW. Northwest Energy Coalition, during April 2018 released the Lower Snake River Dams Power Replacement Study ("NWEC Study" or "Study"). The Study was prepared by Energy Strategies, an energy consulting firm, and is billed as an independent study commissioned by the NWEC.

The LSR dams represent a large source of relatively inexpensive, emission-free electricity, supplying over 5.5% of the regions electricity supply in a typical year.[26],[27] The Pacific Northwest, primarily through state legislative action, has adopted ambitious decarbonization targets in the electric power sector. Collectively these polices set ambitious decarbonization targets for the region's power system. Considering this policy backdrop, along with LSR's size and low operating costs, any proposal to remove LSRD should undergo careful study before irrevocable decisions are made to remove them from service.

NWRP engaged EPGSC to review of the NWEC Study.[28] This review is necessarily a high level one—there is no attempt to fully replicate NWEC's study or produce an alternative study at a similar level of precision or detail. Instead this review identifies what it sees as strengths and weakness of the NWEC study. Where significant deficiencies are identified, EGPSC presents alternative assumptions and results that it believes are more supportable. EGPSC also identifies areas for which further documentation by NWEC or further study would be fruitful for analyzing this important question. The following provides a high-level critical review of the April 2018 study.

This balance of this memo is arranged as follows. Key findings are first presented. A few key issues are addressed; namely, regional coal plant retirements and LSRD reliability contributions. The memo then presents an alternative replacement portfolio. An appendix is included that summarizes policy changes made in the region since the NWEC Study was released. To efficiently use available budget, the repeating of NWEC study methods, assumptions, and results is kept to a minimum. Instead, references are provided.

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[25] The LSRD are Ice Harbor, Lower Monumental, Little Goose, and Lower Granite. All are located in southwest Washington and are part of the FCRPS. NWEC Study, page 19.
[26] 1,025 aMW/18,500 aMW. Total regional electricity demand from the NWPPC 7th Plan, 2017.
[27] The dams provide other benefits such as irrigation, flood control, and recreational benefits. These benefits are not considered in either the NWEC study or this review.
[28] Scope of Work Contract C-0318.

2. Overview of the NWEC Study

At the outset, the NWEC study should be recognized as a significant study that relies on industry-accepted electricity and resource planning models. The study uses the following complementary models:

1. GENESYS reliability planning model. This is a model maintained by the NWPCC. More generally, the NWEC study aligns key assumptions to the NWPCC's 7th Power Plan which was released in 2016.
2. ColumbiaGrid's transmission system reliability power flow model, which uses scenarios developed by ColumbiaGrid that run on the PowerWorld model.
3. GridView production cost model. Maintained by ABB, GridView is one of a handful of production cost models widely used in the U.S.

The study is also clearly written and does a reasonably good job of presenting key assumptions used in the model. This said, there are assumptions for which documentation was insufficient and, when significant, EGPSC identifies them in this memo.

The heart of any resource planning study is not its analytical tools or the quality of explication, but the reasonableness of the assumptions used. Accordingly, EGPSC's review focuses on the NWEC's assumptions. For ease of understanding and presentation, the NWEC Study arranges its assumptions in the form of multiple scenarios or "replacement portfolios" that satisfy the replacement of LSR. The portfolios include a mix of resources potentially available to the region. Five portfolios of three general types are presented:

- All Gas. In this portfolio, a mix of combined cycle and reciprocating engines is procured.
- Non-Generating Alternative ("NGA") and NGA Plus. These portfolios rely on an increased level of programmatically secures demand response ("DR") and energy efficiency ("EE"). The two NGA portfolios assume ~ 1 GW of DR and between 320-880 aMW of EE. Specifically, the NGA Plus portfolio increases EE by a factor of 2.75x relative to the NGA portfolio. Both NGA portfolios include a modest amount of battery storage.
- Balanced and Balanced Plus. The balanced portfolios include about half of the DR and EE included in the NGA portfolio. To that level of DR and EE, 750 MW of wind and utility-scale

solar is added. In the Balance Plus portfolio, the level of DR and EE is unchanged but wind and solar is further increased.[29]

Table A of the NWEC study shows the specific MW levels of the replacement resources selected in each portfolio. Furthermore, three of the NWEC study portfolios are modified to include additional carbon pricing in placed on power produced from fossil fuels. Thus, a total of 8 portfolios presented consistently throughout the report.

3. Important Developments in PNW Resource Planning

As a result of technological change and the need to address carbon dioxide and other pollutants created by traditional sources of electric power production, the electric power grid in the west ("WECC")[30] is undergoing significant transformation. Put simply, the WECC now operates in a carbon constrained world. Mostly led by legislation at the state level, the WECC now operates under mandates to significantly reduce the carbon intensity of its power sector. An identification of key legislative/policy activities that have occurred since the NWEC Study was released is in Appendix A. Renewable energy resources are an increasingly large source of electric power. The PNW region continues to progress deploying demand response programs and energy efficiency. The PNW remains a decentralized market consisting of multiple balancing authorities; however, the introduction of the Western Energy Imbalance Market ("EIM") is changing the landscape somewhat. A full review of these changes is beyond the scope of this effort but EGPSC calls out these larger trends to underscore how fast things are changing and how it should come as no surprise that the NWEC study, now over 18 months old, is out of date with respect to certain assumptions. The balance of this section focuses on a key assumption, the retirement of existing fossil fired power plants.

In the WECC, nearly 20,000 MW of coal plants are expected to retire by 2030, approximately 10% of the dependable capacity in the region.[31] A significant fraction of coal plants in the west are contracted or owned by load serving utilities in the PNW. Table 1 indicates that PNW utilities will retire 6,700 MW of coal plants during the period 2020-2030. The recent NWPCC 2024 Resource Adequacy study reports a similar range, between 4,500-6,000 MW—the range mostly depends on assumptions regarding Colstrip 3+4. Across the entire WECC, the NWPCC

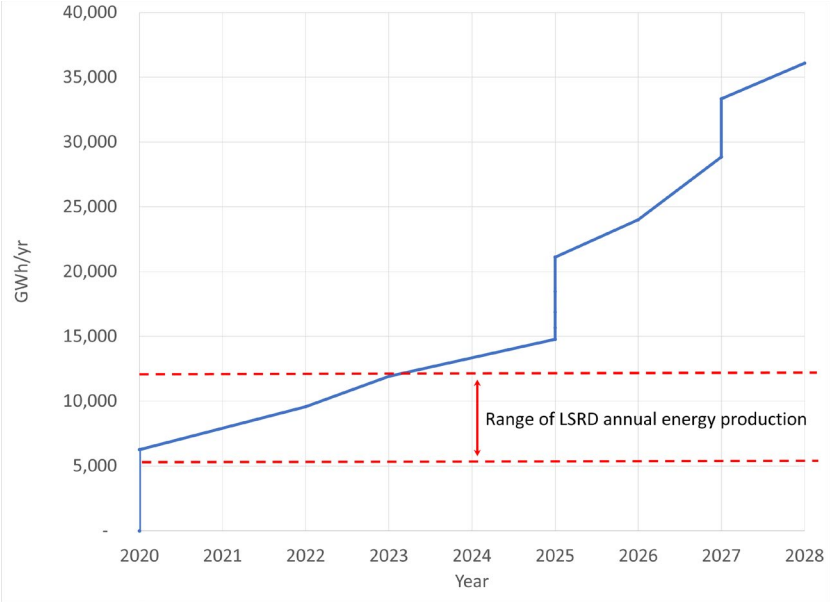
[29] Importantly, the Balanced Plus portfolio is used by ECONorthwest its source for estimated power replacement costs in its study, Lower Snake River Dams Economic Tradeoffs of Removal, July 29, 2019, Table 4, p. 35.
[30] Western Electric Coordinating Council or WECC is commonly used to refer to the synchronized power grid connecting all western US states, western Canadian provinces, and a portion Mexico's Baja Del Norte region.
[31] As reported by the NWPCC at a recent Power Pool Conference. Available at: www.nwpp.org/resources/

expects approximately 20,000 MW of retirements of coal-fired power. Based on this data, EGPSC estimates that the cumulative energy impact of retirements of coal-fired power plants owned or contracted by PNW utilities will exceed 35,000 GWh/year in the next decade (Figure 3). This is a large energy shortfall; one that will be significantly exacerbated by LSRD removal as its annual energy production varies from 6,500 to 12,000 GWh/year.[32] Whether it is from coal or LSRD retirement, all of this energy will require substitution from other resources (Figure 3).

Table 1. PNW Utilities: Generation of Electricity from Coal from Units Where Retirement is Announced or At-Risk

	Total MW	Total MWh		Boardman	Centralia 1	Centralia 2	North Valmy 1	North Valmy 2	Colstrip 1+2	Colstrip 3	Colstrip 4	Jim Bridger 1	Jim Bridger 2	Naughton 1	Naughton 2	Cholla 4	Craig Unit 1	Craig Unit 2
State				OR	WA	WA	NV	NV	MT	MT	MT	WY	WY	WY	WY	AZ	CO	CO
Capacity (MW) (approx)				522	670	670	277	285	614	740	740	600	600	192	256	414	428	428
Annual Generation (MWh) (2018)				1,285,500	2,495,903	2,871,480	571,729	878,195	3,309,915	4,842,055	4,504,712	2,336,327	2,739,466	1,224,135	1,579,434	1,916,020	2,656,155	2,877,335
Current Reitrement Date				2020	2020	2025	2020	2025	2022	2027	2027	2023	2028	2025	2025	2020	2025	2026
Owner:				**Ownership Shares (%)**														
PSE	677	3,991,649							50%	25%	25%							
PGE	818	3,154,853		100%						20%	20%							
Pacificorp/NV Energy	2,329	11,290,583					50%	50%		15%	15%	67%	67%	100%	100%	100%	19%	19%
Avista	148	934,677								10%	10%							
Northwestern	222	1,452,617								30%								
Talen	529	3,006,371							50%		30%							
Idaho Power	681	2,416,876					50%	50%				33%	33%					
Transalta	1,340	5,367,383			100%	100%												
Total	6,744	31,615,009																

Figure 3. Cumulative Energy Impact of Retirements of Coal-Fired Generation Owned or Contracted by PNW Utilities (2020-2028) and Indicative Range of LSRD Annual Energy



[32] NWEC Study, Figure 11. Historical average production is 9,125 GWh/year.

By contrast, the NWEC study identifies only 2,800 MW of coal plant retirements. This is 1,700-3,200 MW lower than the values presented in the recent NWPCC study.[33] The reality of coal plant retirements has put the region into a significant capacity deficiency in the upcoming planning horizon. The NWPP has undertaken a significant effort to address resource adequacy in the region.[34]

4. NWEC Study Key Issues Identified

The following are the most important findings made by EGPSC. Additional notes on EGPSC's review may be found in Appendix B.

1. None of the identified portfolios fully replace LSRD in terms of capacity and energy. This is a significant result that is not adequately highlighted in the NWEC study. As a result, *all* NWEC Study portfolios increase GHG emissions as they effectively rely on increase production from existing dispatchable resources with available capacity (nearly all fossil-fired thermal) within the region or outside of the region; the latter identified as increased "net exports". The NWEC study acknowledges the increased emissions but states that incremental emissions may be addressed with emerging policies that effectively put a price on the incremental emissions. The cost of increased emissions is only reflected in the NWEC Study portfolios sensitives labeled "GHG Policy." A more reasonable replacement portfolio would replace all LSRD energy with emission-free power or fully mitigate any incremental emissions.[35]

2. The Study's preferred portfolio contains an unrealistic amount of DR and EE. The NWEC NGA and so-called "Balanced" portfolios rely on large amounts of incremental DR, and EE. EGPSC believes all of these portfolios are infeasible, even the "balanced" ones. As noted above, the PNW is now in a carbon-constrained era and coal power retirements loom at a level much higher than what was assumed in the NWEC study. To the extent that incremental DR and EE is available, it will be procured by utilities and customers as a matter of course and will not be a discretionary resource available to replace LSRD.

[33] NWPCC, Pacific Northwest Power Supply Adequacy Assessment for 2024, October 31, 2019
[34] NWPP, Exploring a Resource Adequacy Program for the Pacific Northwest, October 2019
[35] A GHG adder of $14/MWh is very modest. In EGSPC's view, the GHG Policy sensitives should become the "primary" cases of the NWEC study and future research should explore new sensitivities with even higher marginal GHG value.

3. The Study appears to underestimate transmission costs from integrating large increment of new variable energy resource additions, effectively assuming that transmission freed up by the retirements at Colstrip will make available transmission for Montana wind and that the presumed committed Boardman to Hemmingway line will allow for integration of new solar resources from Idaho.[36] Similar to the NWEC assumptions regarding DR/EE, such freed up transmission will be used by the region to integrate resources needed to replace retiring coal plants, not LSRD. To integrate variable energy resources to replace LSRD will undoubtably require new, incremental transmission for both new regional wind and solar. And such transmission is not cheap. The Montana Renewables Development Action Plan summarized prior studies and indicates that to add substantial amounts of wind *beyond* the amount of MWs freed up by retiring Colstrip, will incur $400 million of additional transmission costs.[37]

5. Focus on Reliability Needs Created by LSRD Removal

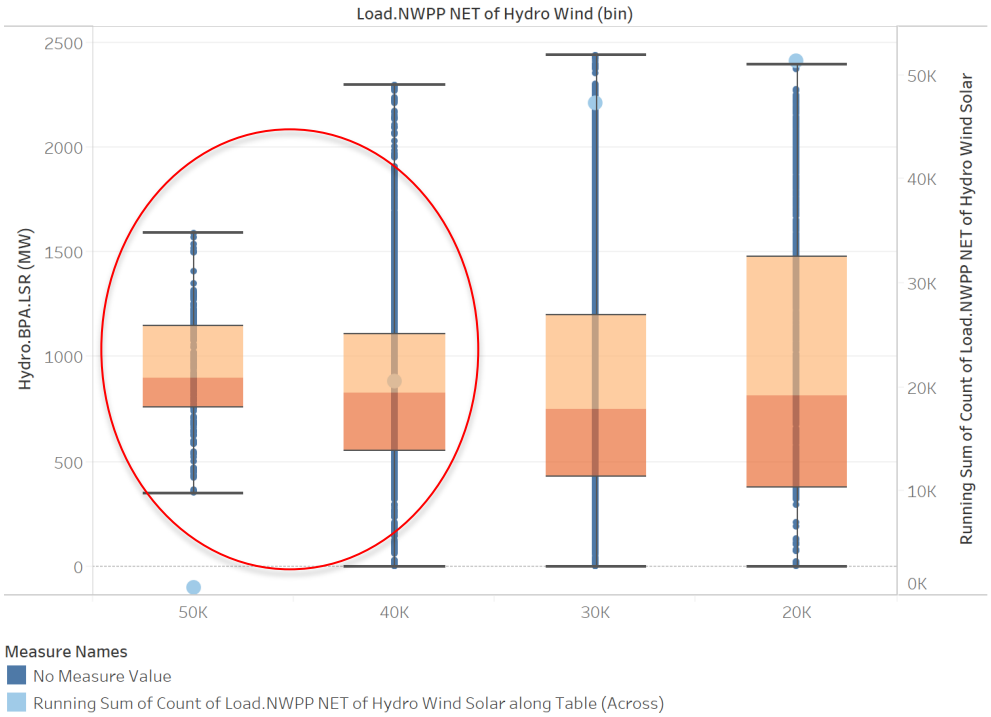
The NWEC study uses the GENESYS reliability planning model developed by the NWPCC. This model is the de-facto standard for long-term reliability planning in the region. The NWEC study claims that it ensured that replacement portfolios adequately replace on a monthly basis the effective capacity decrease created by LSRD removal.

Although EGPSC found no significant methodological gaps in the NWEC Study it, nonetheless, has concerns regarding the is assumptions and results related to reliability. The NWEC study indicates the capacity value of LSRD is approximately 1,500 MW.[38] EGPSC was able to verify the hydro data used by NWEC and performed its own computation of effective capacity value (Figure 4). In this figure, regional load is netted against all hydro and wind.[39] The net load is a reasonable measure of hourly resource need. Seven years of NWPP data were available and used in the analysis, so the variable nature of PNW hydro resources (including LSRD) is

[36] NWEC Study, p. 44
[37] Montana Renewables Development Action Plan, June 2018 identify the Colstrip Transmission Upgrade, ~$252 million, and the Montana-to-Washington Project, ~$140 million. Page 11 and Appendix A.
[38] NWEC Study, Figure A-1.
[39] NWPP load is used as the measure of regional load. An analysis looking at BPA control area loads produced a similar result.

reasonably represented.[40] LSRD hourly production is shown in each net load bin. The highest load bins (circled column on left-hand side) represents ~20% of the highest net load hours in the most critical reliability months (Nov-Feb). Under these conditions, LSRD generates mostly between 600-1200 MW. That's a significant amount and indicates that LSRD has at least some ability to dispatch power when need is high as water resource levels are generally low during these winter months. On balance, EGPSC believes it is appropriate for any replacement portfolio to provide at least 1,000 MW of effective winter season capacity.

Figure 4. LSRD Hourly Production Under Varying Levels of Net Regional Load (Nov-Feb for Years 2013- present)



NWEC appears to make a similar assumption in that it relies on approximately ~1,400 MW of incremental gas capacity and imports in its All Gas portfolio. Less clear is the capacity value it ascribes to wind and solar in its balanced portfolios. It is widely recognized that the capacity value of wind and solar are low. The NWEC Study also shows that the Balanced portfolio significantly increases winter on-peak power imports.[41] The reliance on increased imports

[40] EGPSC also performed a similar analysis using over a decade of BPA data (BPA control area load [including export] and wind) and found a similar result.
[41] NWEC Study, Table C-1 and Figure C-2 show peak flows in the summer and winter

during peak hours is troubling. On balance, EGPSC believes that a more realistic accounting of replacement power capacity values is warranted

6. Indicative Alternative Replacement Portfolio

Although not a substitute for a detailed modeling, it is possible to adjust NWEC's results to reflect a portfolio that is feasible and not compromise regional reliability. EGPSC calls this portfolio "Indicative Feasible". This portfolio has the following characteristics:

7. No reliance on incremental natural gas. Although technically feasible, it is highly speculative to assume that more gas-fired generation will be permitted and procured to replace LSR. Gas-fired generation may very well be part of the mix that will be used to replace coal and other generation retiring in the region. To say, however, that the region will intentionally procure carbon-emitting thermal resources to replace LSRD is speculative. For this reason, the Indicative Feasible portfolio does not include any new gas generation.
8. No reliance on incremental DD and EE. All portfolios considered by NWEC assume that economically achievable DR and EE is pursued. To replace LSRD in the NGA and balanced portfolios, NWEC relies on "technically achievable" DR and EE at levels above what is already procured in the NWPCC's 7th Plan. Such resources are subject to market barriers. Such resources are highly speculative given that, since the NWEC study was issued, ~4,000 MW of *additional* coal plant retirements have been announced in the study period. An examination of the supply curves shown in the NWEC study indicate that the curves are steeply rising in the area that would need to be procured to replace LSR.[42] More generally EGPSC expects that all cost-effective DR and EE will be pursued in the region given its commitment to these resources and the programmatic capabilities of utilities, NGOs, and state agencies. In this context, to assume that there is additional DR /EE to replace LSRD is highly speculative.[43]

[42] EGPSC reduced the capacity factors of new wind and solar slightly to reflect values used for new PNW resources used in other IRPs. DR EE supply curves are shown in the NWEC study at p. 67. New curves are being prepared for the 8th (2020) NWPPC Plan. Although these curves can be examined and may include new, lower-cost DR and EE, EGPSC's view is that all cost-effective DR/EE will be captured before LSRD replacement resources are sought.

[43] EGPSC believes it would be reasonable to factor in the negative demand response that will come from higher prices resulting from replacement. Neither NWEC study nor the Indicative Alternative Portfolio include estimates of such normal price response, but a study update could.

9. Reliance on new in-region wind, solar, and storage resources. Although wind and solar are resources available "at scale" for the region, they are intermittent and require careful modelling to successfully replace a large hydro resource. As noted above, the NWEC Study includes wind and solar in its "balanced" portfolios and, with limited adjustments, EGPSC uses the NWEC Study assumptions for solar and wind resource costs.[44] The Indicative Feasible portfolios use a balance of wind, solar, and storage to a level that replaces the capacity lost by the LSRD.[45] By using higher amounts of wind, solar, and batteries (again, missing from the NWEC Study balanced portfolios), adequate effective replacement capacity is attained, and the portfolio creates an incremental energy surplus which can be sold in the wholesale market. EGPSC assumes a marginal wholesale power revenue of $35 / MWh, which represents a long run value of the excess power from variable energy resources sold into the market of approximately $21/MWh and a carbon adder of $14/MWh.[46] By including carbon in the value of incremental energy, the Indicative Feasible portfolio appropriately reflects the value of carbon emissions, a value that is missing the NWEC Study portfolios except in its "GHG Policy sensitivities"
10. Recognition of incremental transmission costs. As described above, the NWEC Study assumed almost no incremental transmission costs. The cost of integrating Montana wind (at levels above the amounts that can be integrates as a result of Colstrip power plant retirements) is about $363/kW. Assuming this cost is probably too high as there are multiple locations in the region where variable energy resources can be integrated. A resource interconnection cost study is beyond the scope of this analysis, but an order-of-magnitude cost adder of $220/kW, or $35/kW-year, is, in EGPSC's view, a reasonable transmission adder.

[44] The NWEC Study Costs do not include an explicit adder for variable energy resource integration costs. Although EGPSC did not change this assumption, further research into whether integration costs have been sufficiently covered is recommended.
[45] EGPSC assumed that wind and solar's effective capacity value was 15%. For storage, EGPSC assumed that costs would be ~15% lower than NWEC's estimated costs (on a per MWh basis) but that the duration of the battery would need to be 12 hours, rather than 4 hours.
[46] EGPSC used the same carbon adder assumed by NWEC: $34/MTOE which translates into $14/MWh assuming it substitutes for electricity produced by fossil resources at the "unspecified" rate.

Details of the Indicative Alternative portfolio in comparison to the NWEC portfolios are shown in Table 2.[47] Figure 5 shows the overall portfolio costs using a presentation form similar to the one made in Figure 14 of the NWEC Study. All the NWEC GHG Policy Portfolios are shown and the Indicative Alternative portfolio is added in the rightmost column. With Figure 5, few key things become readily apparent:

- None of the portfolios are cheap. When it came to cots, the NWEC study focused on indicative bill impacts. Such a measure, however, greatly dilutes percentage impacts because bills include many non-wholesale power cost components, such as distribution costs. EGPSC believes a simpler and more meaningful way to show results is per-MWh-of-replaced-power. By this straightforward measure, all of the portfolios have a cost of replacement power of $55/MWh or greater.
- The Indicative Alternative portfolio cost is $860 million/year or approximately $96/MWh for the replacement power. This is approximately 80% greater than the cost of NWEC Study "balanced" portfolio. The Indicative Alternative scenario does not increase reliance on imports. In fact, it produces an increment of excess energy which can be sold in the regional market. (This revenues from sale of portfolio excess energy is shown in the figure as the "negative" orange bar.) This cost estimate is approximate and EGPSC's analysis is not meant to be a substitute for more detailed modeling that should be performed in the future.

[47] As noted earlier in this memo, EGPSC's view is that all portfolios should price carbon on the margin. For that reason, only the NWEC "GHG Policy" portfolios are shown in comparison to the Indicative Feasible portfolio.

Figure 5 NWEC Study GHG Policy Portfolios and EGPSC Indicative Feasible Portfolio (left scale is annual cost, $millions; right scale is cost per unit of replaced energy, $/MWh)

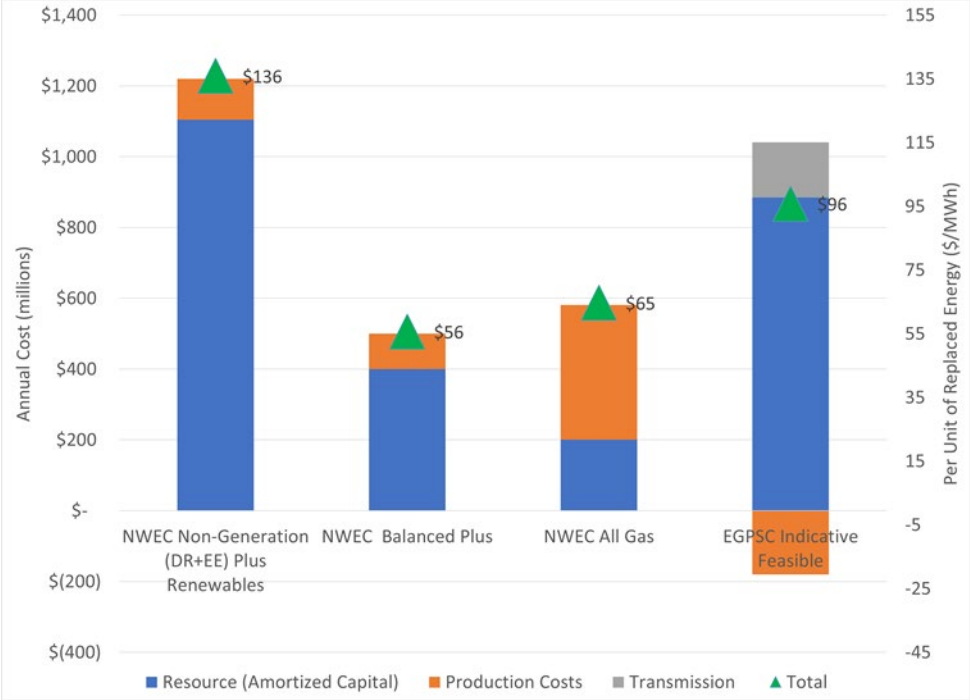


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Table 2. Portfolio Resources (MW and aMW) and Total Costs

	ELCC		ELCC					CF	Scalar MW	Scalar Cost (from 4- to 12-hour less technological change)		ELCC		Scalar						ELCC		Scalar					ELCC		CF		ELCC									$35	35		
	34%		100%					-2%	3.5	2.5		15%		2.0						15%		2.6					100%		32%		100%									Annualized Costs $e6 (Figs.			
Resource Type -->	LSR	LSR	DR+EE	DR+EE SubT2		DR+EE	Storage	Storage	Storage	Storage	Storage	Wind	Wind	Wind	Wind	Wind	Wind	Wind	Solar	Solar	Solar	Solar	Solar	Solar	Solar	New Gas SubTotal	New Gas	New Gas	New Gas	Imports	Imports	PNW Incrmntl Thrml	total Imp+ PNW Thermal	total Imp+Other Thermal		Total Nameplate excluding Imports	Total Effective	Total Energy	Resource (Amortized Capital)	Production Costs	Transmission	Total	Per MWh
Case	MW	aMW	MW	aMW	$e6	$/MWh	MW	aMW	$e6	$/kW	Implied CRF	MW	aMW	$e6	$/kW	Implied CF	Implied CRF	$/MWh	MW	aMW	$e6	$/kW	Implied CF	Implied CRF	$/MWh	MW	$e6	aMW	$/MWh	MW	aMW	aMW	aMW	$/MWh	Total Nameplate MW	MW	MW	aMW	$million	$million	$million	$million	$/MWh
Reference	3,000	1,025																								-							-		3,000	3,000	1,020	1,025					
Non-Generation (DR+EE)			1,464	273	148	61.90	100	(0)	14	1,200	12%																			103	286	466	752	34.17	1,667	1,564	1,667	1,025	$ 162	$ 225		$ 387	$ 43
Non-Generation (DR+EE) Plus Renewab			1,464	743	1,090	167.49	100	(0)	14	1,200	12%																			116	75	207	282	34.03	1,680	1,564	1,680	1,025	$ 1,104	$ 84		$ 1,188	$ 132
Non-Generation (DR+EE) Plus Renewab			1,464	743	1,090	167.49	100	(0)	14	1,200	12%																			116	846	(564)	282	47.00	1,680	1,564	1,680	1,025	$ 1,104	$ 116		$ 1,220	$ 136
Balanced			732	136	49	41.11		-				500	219	103	1,725	44%	12%	54	250	65	32	1,600	26%	8%	56	-				215	213	391	604	40.04	1,697	1,482	1,059	1,025	$ 184	$ 212	$ 1	$ 397	$ 44
Balanced Plus			732	136	49	41.11		-				1,250	547	256	1,725	44%	12%	53	750	198	95	1,600	26%	8%	55	-				273	40	104	144	50.08	3,005	2,732	1,305	1,025	$ 400	$ 63		$ 463	$ 52
Balanced Plus + GHG Policy			732	136	49	41.11						1,250	547	256					750	198	95									273	759	(616)	144	79.49	3,005	2,732	1,305	1,025	$ 400	$ 100		$ 500	$ 56
All Gas																										950	200	300	76	$ 432	267	458	725	52.74	1,382	950	1,382	1,025	$ 200	$ 335		$ 535	$ 60
All Gas + GHG Policy																										950	200	151	151	$ 432	1,164	(290)	874	49.77	1,382	950	1,382	1,025	$ 200	$ 381		$ 581	$ 65
Indicative Alternative + GHG Policy			-				350	(0)	126	3,000	12%	2,500	1,093	512	1,725	40%	12%	53	1,950	516	247	1,600	26%	8%	55	-					(400)	(184)	(584)	35.25	4,800	4,800	1,018	1,025	$ 885	$ (180)	$ 156	$ 860	$ 96

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Appendix A. Recent State Level Legislation and Policies Impacting the PNW Power Sector

The following briefly identifies recent state-level policy changes that press for further decarbonization of the western grid. Many of these developments were not factored in by the NWEC Study as they occurred after 1Q2018.

- **California**. SB 100 was enacted into law on September 10, 2018, after the issuance of the NWEC study. SB 100 moved California to a 60% RPS by 2030 and a 100% carbon-free goal by 2045. California's RPS "bucket" rules which encourage in-state resources over out-of-state (discussed above) remain with respect to the 2030/60% RPS target. However, incremental procurement needs beyond the 60%--i.e., procurement driven by the 2045 100% carbon free goal--do not specific any geographic preferences. The 2024 policy guidelines are only now beginning to take shape with state regulatory activities beginning in 2020. It is reasonable to assume incremental project procurement from out-of-state energy resources, including renewable energy projects in the PNW, will occur as a result of SB 100.
- **Washington**. Although a ballot initiative that would have implemented a carbon tax was defeated in 2018, the Washington State legislature in early 2019 passed the Clean Energy Transformation Act ("CETA", or SB 5116). CETA includes three major mandates on both IOUs and POUs. First, CETA mandates that all coal-fired resources must be eliminated from the portfolio of generation resources used to serve Washington consumers by December 31, 2025. Second, all electricity sold at retail in Washington must be GHG "neutral" by January 1, 2030. As part of the this GHG neutrality requirement, 80% of electricity delivered to Washington customers must be from non-emitting or renewable resources. The remaining 20% may come from unbundled RECs, investments in energy transformation projects, or approved alternative compliance plans. Existing hydro and nuclear resources may count toward this neutrality target but, with respect to new hydro, it can only count if it is constructed on irrigation canals or other artificial waterways. Third, CETA requires that by 2045, 100% of electricity sold in Washington state be produced either from renewable resources or non-emitting generators. CETA also includes cost caps and off-ramps. Generally, a utility may seek exemption if the cost of compliance can be shown to exceed 2% of the utilities' revenues.

- **Oregon**. Oregon's current RPS was passed in 2016 (SB 1547, the Clean Electricity & Coal Transition Act), which expanded the RPS targets to 50% by 2040 for large investor owned utilities and 25% by 2025 for large consumer-owned utilities. The law also includes a 2030 "no coal" requirement on the state's electricity supply. The NWEC Study presumably factors in these RPS requirements.[48]

  During 2018 and 2019, the Oregon Legislature attempted to pass HB 2020, a cap-and-trade bill similar to California's. The program was to be implemented by 2021 and included target carbon emission reduction goals of 45% below 1990 levels by 2035 and 80% below 1990 levels by 2050. Although HB 2020 did not pass during the 2019 legislative session, the bill still has wide support and it, or another similarly aggressive decarbonization bill, is likely to pass in Oregon's 2020 short session or the 2021 regular legislative session. For purposes of any LSRD replacement study, it is reasonable to consider that the demands of Oregon HB 2020, or similarly effective policy, should be considered as part of the reference case.

  Other states and utilities in the West have also enacted stronger decarbonization or RPS laws. These laws all have put upward pressure for the demand for carbon free electricity and increase pressures for coal plant retirements.

[48] NWEC Study, p. 38: "The Reference Case … reflects: (1) achievement of existing state policy for renewable portfolio standards …"

Appendix 2: University of Washington PNW Temperature, Precipitation, and SWE Trend Analysis Tool; Kennewick, WA, 1955-2018

Temperature | Precipitation | Snow Water Equivalent

Year Range
1955 to 2019

Variable Selection
Average Temperature

Time Frame
Annual

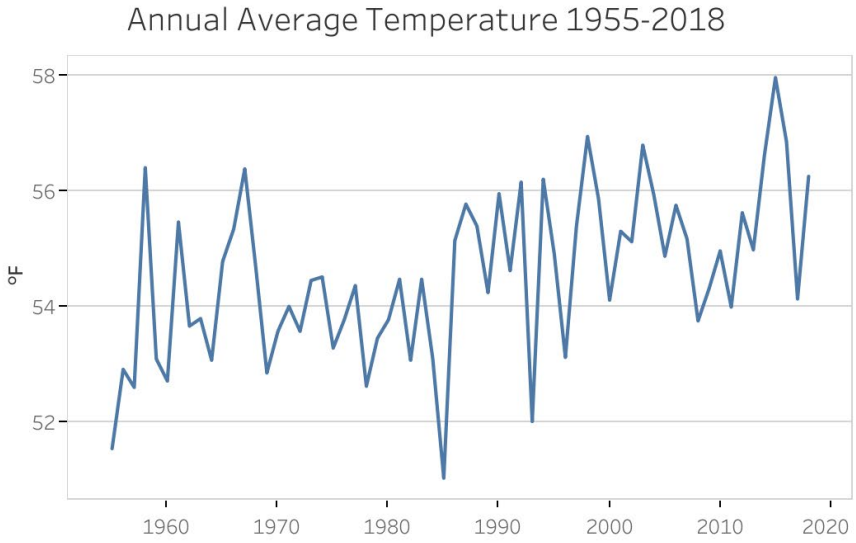
Trend Range
Per Decade

Trend	-	0	+
Significant (S)	●		●
Not Significant (NS)	●	○	●
Insufficient Data (I)	●	●	●

Add to Graph
- (●) None
- ( ) Average
- ( ) Statewide Average
- ( ) Trend Line

Trend Data (°F Per Decade)

Kennewick	WA	S	+	0.37



Station Data Source: NOAA's U.S. Historical Climatology Network version 2.5.5.20190405

Statewide Data Source: NOAA's US Climate Division Dataset (nClimDiv)

Appendix 3: 7/29/2019 PRCC Letter to NOAA Fisheries

PRIEST RAPIDS COORDINATING COMMITTEE

NMFS, CCT, USFWS, YN, GCPUD, CTUIR, WDFW
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July 29, 2019

Mr. Ritchie Graves
Branch Chief, Columbia Hydropower Branch
Interior Columbia Basin Office
NOAA Fisheries, West Coast Region
1201 NE Lloyd Blvd., Suite 1100
Portland, OR 97232

RE: Management of Caspian Terns to Reduce Predation of Juvenile Salmonids on the Columbia Plateau

Dear Mr. Graves:

The Priest Rapids Coordinating Committee (PRCC)[81] is writing to express its concern that the federal Action Agencies (in particular, the U.S. Bureau of Reclamation) have not fulfilled their management responsibilities and are not being held accountable to the proposed actions stated in the 2019 FCRPS Biological Opinion (BiOp; NMFS Consultation Number: WCRO-2018-00152), issued March 29, 2019.

The 2019 BiOp states that the Action Agencies propose to continue actions to reduce the negative impact of avian predators on ESA-listed salmon and steelhead. For the Columbia Plateau region, this would be with the continued implementation of the Inland Avian Predation Management Plan (IAPMP), 2019 BiOp, section 1.3.2.2, Predator Management and Monitoring Actions. As stated in Appendix C, section C.3.1 of the 2019 BiOp, the two main objectives of the IAPMP are (1) reduce predation on ESA-listed salmonids by Caspian terns nesting at Goose and Crescent Islands while (2) taking actions to prevent terns from forming new colonies and/or expanding existing colonies where feasible (USACE 2014).

In the 2019 BiOp, the U.S. BOR proposes "to maintain the ropes and flagging and to monitor for tern presence" on Goose Island throughout the Caspian tern nesting and salmonid smolt outmigration seasons of 2019 and 2020, until the proposed "new" BiOp is issued in September of 2020. However, the U.S. BOR's proposed action and responsibility to the 2019 BiOp was not fulfilled in 2019. This statement is based on the fact that the PRCC has funded **ALL** of the 2019 avian predation work in the

[81] The PRCC consists of representatives from NOAA Fisheries (NMFS), U.S. Fish & Wildlife Service (USFWS), and Washington Department of Fish & Wildlife, Colville Confederated Tribes, Yakama Nation, and Public Utility District No. 2 of Grant County (Grant PUD).

Potholes/Goose Island region, including the Goose Island vegetation project the BOR references in their proposed actions. Now, the PRCC understands that the U.S. BOR will not be fully fulfilling their 2020 BiOp obligations to the IAPMP (e.g. to "prevent terns from forming new colonies and/or expanding existing colonies"). Preventing the formation of new or expanding colonies needs to take place regularly with people on the ground. This monitoring component of the IAPMP/BiOp has not been, but needs to be, built into preliminary plans for the 2020 Caspian tern season. To manage the Potholes/Goose Island region with an approach of waiting until tern colonies are formed and then have deliberations about what to do about them is, in our opinion, a tremendous waste of the millions of dollars and five years of intense work that has already been invested in the dissuasion and relocation of these birds out of the area. During the 2019 Caspian tern nesting season, PRCC-funded crews have been on-site seven days a week conducting active and passive dissuasion, making daily adjustments to their routines, and have been monitoring for new tern colonies. Even with this intense presence 20 tern eggs were laid in the Goose Island area during 2019. In talking with experts on this topic (Real Time Research), they feel extremely confident that without daily interaction, including dissuasion and monitoring in the Potholes/Goose Island area, Caspian terns will quickly re-establish a nesting colony(s).

As the 2019 BiOp states from Collis et al. (2018), annual predation rates on UCR steelhead moving through the mid-Columbia River by Caspian terns nesting on Goose Island in the Potholes Reservoir averaged 15.7% during 2007-2013. If the objective of the BiOp is to protect listed salmonids and aid in their recovery, having another Caspian tern colony(s) re-establish in the Goose Island/Potholes and/or development/expansion of other colonies in the Columbia Plateau is not a step toward recovery.

The 2019 BiOp contains obligations and requirements of the Action Agencies, in this case the continued implementation of the IAPMP (USACE 2014). However, fulfillment and enforcement of the IAPMP BiOp requirements appears to be weak or non-existent. As previously stated, the U.S. BOR did not fulfill its 2019 management obligations in Potholes/Goose Island region. Consequently, to prevent tern recolonization and to reduce subsequent predation on ESA-listed out-migrating juvenile salmon and steelhead, the PRCC stepped in and filled the gaping financial and management void needed to implement the IAPMP in 2019. The concern now is what, if anything will be done by the U.S. BOR during the 2020 Caspian tern nesting and smolt migration season? And, what management requirements can we expect in the forthcoming FCRPS BiOp in September 2020.

Please contact me if you have any questions. We look forward to hearing from you.

Sincerely,

(original signed / U.S. Mail Transmittal)

Denny Rohr, Facilitator
Priest Rapids Coordinating Committee

Cc: PRCC Coordinating Committee
Scott Carlon, NMFS
Kirk Truscott, CCT

Keely Murdoch, YN
Jim Craig, USFWS
Curt Dotson, GCPUD
Tom Skiles, CTUIR
Chad Jackson, WDFW

Appendix 3.1 Northwest RiverPartners Comments on Avian Predation in the Columbia River Estuary

East Sand Island & Columbia River Estuary

Northwest RiverPartners ("RiverPartners") has heretofore focused its comments related to avian predation on the mid and upper Columbia River. In this appendix, RiverPartners wants to expand on the need for downstream predation management—especially in the Columbia River estuary. We would like to thank the Columbia River Inter-Tribal Fish Commission ("CRITFC") for providing the data points referenced below.

Of particular concern, RiverParnters notes that the US Army Corps of Engineers ("USACE") has publicly stated that it considers both the East Sand Island[82] double-crested cormorants and the East Sand Island Caspian tern management actions complete, without further plans to reduce either population.

RiverPartners notes that neither plan has achieved the agreed upon population reduction levels for either species. Without further reductions in nesting habitat on East Sand Island, the Caspian tern population will likely continue to hover in the 4,000 to 5,000 pair range.

This is an unbalanced level of avian predators if the region desires sustainable Columbia Basin salmonid populations. It is believed that every thousand pairs of Caspian terns will consume on average about 740,00 smolts each spring.

Likewise, the double-crested cormorants, based on the last three years of consumption data, averaged 1.4 million smolts per 1,000 pairs of cormorants. This relationship is for the birds on East Sand Island. Birds nesting on the Astoria-Megler Bridge often feed upstream, where the percentage of smolts in their diet can be up to three times greater.

Last year there were approximately 3500 pairs of double-crested cormorants on the Astoria-Megler Bridge. We can conservatively estimate that they ate approximately five million smolts.

For the Columbia River estuary, this issue is especially problematic, because the smolts that make it to the estuary have successfully navigated hundreds of miles of river, numerous hydro projects, a multitude of predators, but then are killed just as they reach saltwater.

Said another way, the smolts that make it to the estuary represent of a minority of all of the smolts in the Basin, so the percentage killed in the estuary will have an outsized effect on the overall percentage of returning adult salmon.

Given this context, we urge USACE to reconsider its previous decision to end monitoring efforts of double-crested cormorants in the Columbia River estuary in 2020.

Need for Lethal Removal Efforts

[82] East Sand Island is a low-lying island near the mouth of the Columbia River in the Columbia River estuary just offshore from the small fishing village of Chinook (WA). East Sand Island is owned and managed by the U.S. Army Corps of Engineers and, despite its proximity to Washington, is in the state of Oregon.

Unfortunately, the millions of dollars spent on bird wires, land and boat-based hazing, and pyrotechnics did not prevent the losses described in the Evans et. al paper noted in the body of our comments.[83] As soon as birds relocate to other areas of the river, these measures are no longer effective.

It is clear that the numbers of predatory birds in the Columbia River must be reduced using lethal measures such as egg oiling and lethal take at the dams. **Those measures should be included within this EIS process and could result in much improved effectiveness of mitigation efforts associated with the Preferred Alternative.**

In support of this point, we reference a letter from the Northwest Power Planning & Conservation Council "Council") to Mr. Jerome Ford, US Fish & Wildlife Service, Assistant Director of Migratory Birds, dated February 28, 2020. In that letter, the Council notes that,

> *From 2015 to 2017, the Fish and Wildlife Service authorized the lethal removal of double-crested Cormorants in the Columbia River estuary. More than 5,000 cormorants were removed and more than 6,000 nests were destroyed. We know that this action, combined with natural predation by other bird species, helped to significantly reduce cormorant predation on juvenile fish. But since that time, only non-lethal methods of harassment have been available, and they only have had the effect of moving cormorants from one place to another in the estuary. The predation continues and, in fact, is increasing.*[84]

We encourage the Action Agencies to reintroduce these lethal removal measures. Without these measures, the region risks undoing all of the good it has worked so hard for in its mitigation efforts. To quote Blaine Parker, biologist for the Columbia River Inter-Tribal Fish Commission ("CRITFC"), "If we do not more effectively address the serious threat of avian predation, we risk turning the region's $17 billion salmon recovery investment into guano."[85]

[83] 2019 Evans, A.F., Payton, Q., Cramer, B.M., Collis, K., Hostetter, N.J., Roby, D.D. and Dotson, C., Cumulative Effects of Avian Predation on Upper Columbia River Steelhead. Trans Am Fish Soc, 148: 896-913. doi:10.1002/tafs.10197

[84] 2020-02-28 NW Power & Conservation Council Letter to US Fish & Wildlife Service

[85] Presentation on avian predation at February 11, 2020 Northwest Power & Conservation Council public meeting in Portland, Oregon.