DEPARTMENT OF ECOLOGY
State of Washington

Final Environmental Impact Statement

Short-term modification of total dissolved gas criteria in the Snake and Columbia Rivers

March 2019

Publication 19-10-019

Publication and Contact Information

This document is available on the Department of Ecology's website at:
https://fortress.wa.gov/ecy/publications/summarypages/1910019.html

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Final Environmental Impact Statement

Short-term modification of total dissolved gas criteria in the Snake and Columbia Rivers

Washington State Department of Ecology

Olympia, Washington

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STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
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March 21, 2019

Dear Interested Party:

The Washington State Department of Ecology (Ecology) is issuing this final environmental impact statement (EIS), which evaluated the risks of a short-term modification to the adjusted total dissolved gas (TDG) criteria on the Snake and Columbia rivers in Washington Administrative Code chapter 173-201A, the Water Quality Standards for Surface Waters of the State of Washington.

We intend to issue a short-term modification to the TDG criteria on March 29, 2019 to the following eight federal dams on the lower Snake and Columbia rivers:

- Lower Granite Dam
- Little Goose Dam
- Lower Monumental Dam
- Ice Harbor Dam
- McNary Dam
- John Day Dam
- The Dalles Dam
- Bonneville Dam

The short-term modification will adjust the TDG criteria during the spring water spill season which typically occurs April 3rd through June 20th (April 3rd – June 20th on the lower Snake River and April 10th – June 15th on the Columbia River). Providing a short-term modification could help facilitate increased water spill at dams during portions of the day to help juvenile salmonids migrate downstream to the ocean.

For more information on this final EIS and short-term modification, please visit the water quality standards website at https://ecology.wa.gov/Water-Shorelines/Water-quality/Freshwater/Surface-water-quality-standards/Assistance#mod.

For assistance or questions, please contact Bryson Finch at bryson.finch@ecy.wa.gov or (360) 407-6440.

Sincerely,

Heather R. Bartlett

Heather R. Bartlett
Water Quality Program Manager

Fact Sheet

Title:	Final Environmental Impact Statement: Short-term modification of total dissolved gas criteria in the Snake and Columbia Rivers
Description:	The purpose of the Environmental Impact Statement is to evaluate the risks of adjusting the Washington Administrative Code (WAC) 173-201A-200(1)(f) total dissolved gas (TDG) criteria to allow more spill in the Snake and Columbia rivers. The short-term modification intends to modify TDG criteria for areas on the lower Snake and Columbia rivers during the spring spill season that typically occurs April 3rd through June 20th (April 3rd – June 20th on the lower Snake River and April 10th – June 15th on the Columbia River).
Location:	Lower Snake and lower Columbia rivers
Lead Agency:	Washington State Department of Ecology
Responsible Official:	Heather R. Bartlett, Program Manager Water Quality Program Department of Ecology P.O. Box 47600 Olympia, WA 98504-7600
Lead Agency Contact:	Becca Conklin (swqs@ecy.wa.gov or 360-407-6413)
Date final EIS issued:	March 21, 2019
Date draft EIS issued:	January 29, 2019
Draft EIS comment period:	January 29 - February 28, 2019

Public Hearings:

We held two public meetings during the comment period.

- February 13, 2019: Vancouver, WA
- February 19, 2019: Public hearing via webinar

For more information about this short-term modification, visit https://ecology.wa.gov/Water-Shorelines/Water-quality/Freshwater/Surface-water-quality-standards/Assistance#mod.

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Acknowledgements

Ecology would like to acknowledge and thank the Washington Department of Fish and Wildlife (WDFW) for their contributions to sections that discuss the Flexible Spill Agreement and potential positive impacts of increased spill described in models.

Executive Summary

The Department of Ecology (Ecology) is issuing an environmental impact statement (EIS) evaluating the impacts of issuing a short-term modification to the Washington Administrative Code (WAC) 173-201A-200(1)(f) total dissolved gas criteria for areas on the lower Snake and Columbia rivers. The short-term modification alternatives considered in this EIS apply to the spring spill season at the following eight federal dams on the lower Snake and Columbia rivers:

- Lower Granite Dam
- Little Goose Dam
- Lower Monumental Dam
- Ice Harbor Dam
- McNary Dam
- John Day Dam
- The Dalles Dam
- Bonneville Dam

A Flexible Spill Agreement (herein referred to as Spill Agreement) reached for the 2019-2021 spill operations at the eight federal dams on the lower Snake and Columbia rivers was formally announced on December 18, 2018, and signed by the states of Washington and Oregon, the Nez Perce Tribe, the Bonneville Power Administration, U.S. Army Corps of Engineers, and the Bureau of Reclamation. The Spill Agreement is supported by the states of Idaho and Montana and the Columbia River Inter-Tribal Fish Commission.

The focus and intent of the Spill Agreement is to further improve juvenile salmon and steelhead survival rates as they travel downriver through the eight federal dams on the lower Snake and Columbia rivers. The Spill Agreement seeks benefits to salmonid survival in concert with managing the Columbia River system for multiple congressionally authorized purposes, including power generation to ensure the Pacific Northwest of an adequate, efficient, economical, and reliable power supply. The Spill Agreement also intends to provide for a pause in long-running litigation over the impact of the federal dams on Endangered Species Act-listed salmon and steelhead, at least until the Columbia River System Operations National Environmental Policy Act (NEPA) process is complete and a new long-term biological opinion

(BiOp) for the Federal Columbia River Power System (FCRPS) is released by the National Marine Fisheries Service.

The Spill Agreement is contingent on the implementation of a flexible spill operation that increases spill beyond the levels ordered by a federal court for the 2018 salmon migration season at the times of day when regional energy demand is lower, and reduces spill during times of peak energy demand (early morning and late afternoon/evening) and highest energy market values. Recent trends suggest that such flexibility may become more valuable to energy marketers as solar energy continues to be deployed in California and elsewhere in the western United States. The "duck curve" energy demand graph below illustrates the times of day with higher and lower energy demand across the western United States.

Technical analysis conducted by state and tribal fisheries managers concludes that the spill operations outlined in the Spill Agreement will roughly equal (in 2019) or exceed (in 2020 and 2021) fish survival rates obtained through 2018 court-ordered spill operations, which required spill to existing total dissolved gas (TDG) standards of 115% as measured in dam forebays and 120% as measured in dam tailraces on the lower Snake and Columbia rivers. At the same time, the Spill Agreement operations will maintain or improve power generation revenue relative to 2018 operations.

The Spill Agreement implementation is contingent on Washington, through the process described in this document, raising TDG standards on the lower Snake and Columbia rivers to match Oregon's 120% standard as measured in the dam tailrace for the 2019 salmon migration season. For the 2020 and 2021 migration season, the Spill Agreement is contingent on both Washington and Oregon raising TDG standards to 125%. The short-term modification of TDG standards considered in this EIS would, if adopted, only apply to 2019 operations, and match Oregon's current TDG standards. A separate process will begin this summer to address a potential rule change.

There have been other requests to increase spill similar to the request in the Spill Agreement on December 18, 2018. For example, the Final Report from the Southern Resident Orca Task Force convened by Governor Jay Inslee includes a recommendation encouraging testing the potential of higher TDG standards and attendant spill to improve salmon survival and abundance, while also considering ways to minimize impacts on the Bonneville Power Administration's Fish and Wildlife Program. Task Force Recommendation 8 reads as follows:

- *Recommendation 8: Increase spill to benefit Chinook for Southern Residents by adjusting total dissolved gas allowances at the Snake and Columbia River dams.*
    - *Direct the Department of Ecology to increase the standard for dissolved gas allowances from 115 percent to up to 125 percent, to allow use of the best available science to determine spill levels over these dams to benefit Chinook and other salmonids for Southern Residents.*
    - *Coordinate with the Oregon Department of Environmental Quality to align standards across the two states.*

- *Maintain rigorous monitoring of impacts to juvenile Chinook and resident fish to ensure any changes in spill levels do not negatively impact salmon or other aquatic species.*
- *Work with tribes, salmon recovery regions, Ecology and WDFW to minimize revenue losses and impacts to other fish and wildlife program funds.*[1]

Ecology is considering a short-term modification to the TDG standard on the lower eight dams on the Snake and Columbia rivers (see Figure 1). The Snake and Columbia rivers have an existing special condition within the surface water quality standards for TDG that pertains to fish passage during the spill season:

> "TDG must not exceed an average of one hundred fifteen percent as measured in the forebays of the next downstream dams and must not exceed an average of one hundred twenty percent as measured in the tailraces of each dam (these averages are measured as an average of the twelve highest consecutive hourly readings in any one day, relative to atmospheric pressure); and a maximum TDG one hour average of one hundred twenty-five percent must not be exceeded during spillage for fish passage."

Figure 1. The Columbia River Basin.

Figure 1 depicts the eight lower Snake and Columbia River dams: Lower Granite (LGR), Little Goose (LGS), Lower Monumental (LMN), Ice Harbor (IHR), McNary (MCN), John Day (JDA), The Dalles (TDA), and Bonneville (BON).

[1] See Southern Resident Orca Task Force Final Report, November 2018, at p. 48.

Additional alternatives to the special condition for the TDG standard during the spring spill season in the Snake and Columbia rivers were considered. These alternatives include:

1) No action.

2) Removal of the 115% forebay criterion while maintaining the 120% tailrace criterion.

3) Removal of the 115% forebay criterion and moving to a 125% tailrace criterion.

Studies have demonstrated that outmigrating juvenile salmonids have higher survival rates in the Snake and Columbia rivers when passed through dams via spillways versus through turbines or smolt bypass systems of hydropower projects (Whitney et al. 1997; Muir et al. 2001). Moreover, some models have predicted that the greater the spill over dams, the greater survival of juvenile salmonids (WA DOE, 2009). However, increased water spillage over dams often leads to increased TDG levels, which can be detrimental to aquatic life. The adjusted TDG criteria seek a balance between impacts of fish passage through hydropower projects and adverse impacts due to supersaturated waters as a result of spill.

The short-term modification is based upon information provided by the Comparative Survival Study juvenile fish passage survival model (CSS model), which predicts improvements in salmon survival and abundance as spill is increased up to those levels that would be permitted by a 125% TDG standard. The CSS model is a joint project of the Fish Passage Center, Columbia River Inter-Tribal Fish Commission, U.S. Fish and Wildlife Service, and the Oregon, Washington, and Idaho departments of fish and wildlife/fish and game. Juvenile survival metrics assessed by the CSS model include water transit time (a surrogate for salmon smolt travel time downriver) and powerhouse encounter rates (with powerhouse defined as dam turbines or bypass systems as opposed to a dam spillway, which avoids the powerhouse). The CSS model considers minimizing powerhouse encounters through measures such as spill or dam removal as critical to reducing "delayed mortality" from hydrosystem passage and ultimately increasing adult salmon and steelhead returns. The CSS model predicts a two to 2.5-fold increase in Snake River spring Chinook salmon (*Oncorhynchus tshawytscha*) abundance above 2014 FCRPS BiOp spill levels when spill is increased to 125% TDG 24 hours per day/seven days a week in the spring,[2] and smaller projected increase at 120% TDG 24 hours per day.

The relationship between spill and TDG is important in evaluating risk and benefits to aquatic life. The greater amount of spill over dams, the greater the risk of TDG related impacts to aquatic life. The notion of increased spill and increased survival of juvenile salmonids has been proposed and demonstrated in models. However, continuing to increase spill will eventually lead to diminishing benefits, while increased risk of adverse impacts to aquatic life increases with spill due to TDG levels. This environmental impact statement considers risks of increased spill to aquatic life and data gaps in the science regarding TDG impacts and life history traits of aquatic organisms.

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[2] See CSS 2017 Annual Report at xxxi.

Ecology's decision is to remove the 115% forebay numeric criterion for a period up to three years. This action coincides with the Spill Agreement that aims to benefit salmon and hydropower. Additionally, Ecology will adjust the 12 hour averaging method to match the State of Oregon's method. This would have little effect in the operations of the federal dams and would ease management of spill operations, as well as TDG monitoring and reporting requirements. Washington will require the TDG 12-hour average compliance to be measured using the twelve highest hourly averages in a day (Oregon method) rather than the highest average calculated from twelve consecutive hourly averages (current Washington method).

Given that dam and salmon managers have not previously provided voluntary (fish passage) spill to 120% due to the potential for higher TDG levels resulting in increased symptoms of gas bubble trauma in juvenile salmon, steelhead, and non-listed aquatic species; monitoring for gas bubble trauma will continue to be required.

Comments on the Draft EIS

Ecology opened a public comment period on January 29, 2019. We prepared a draft Environmental Impact Statement (EIS) and draft short-term modification language for public comment. Public notice of comment period was provided via the State Environmental Policy Act (SEPA) Register, Ecology's Water Quality Info ListServ notice, and on our website.

We also held two public hearings during the comment period. The hearings were held:

- February 13, 2019, in Vancouver, WA.
- February 19, 2019 via webinar.

Public comments were received through February 28, 2019. Ecology considered all the comments received during the comment period when developing the final EIS.

A total of 66 persons or groups provided comments regarding the draft documents. Excerpts of the comments, and our responses to each comment, are in Appendix A.

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Introduction

Importance

The Columbia River and its tributaries are one of the most productive salmon producing river systems in the world. However, over the last 150 years or so, salmon and steelhead runs that once numbered from 10-16 million per year have generally declined to 1-2 million per year[3], a value that includes a combination of natural and hatchery origin fish. Today, thirteen populations of Columbia Basin salmon and steelhead are listed as threatened or endangered under the Endangered Species Act.[4]

A number of factors have contributed to the decline, including dams, which block or impede access to and from upriver habitat and result in injuries to juvenile salmonid migrants, habitat degradation from development and resource extraction, harvest and hatchery impacts, pollution, and predation due to ecosystem alterations and introduction of non-native species.

The decline of salmon and steelhead in the Columbia Basin has had numerous economic and cultural impacts, including to Native American Tribes and non-tribal commercial and recreational fishers. But even today, commercial and sport-fishing on Columbia Basin fish (primarily based on, but not limited to, salmon and steelhead fishing) is worth $150 million per year.[5]

Meanwhile, hydropower produced by Columbia Basin dams (including many more dams than the eight dams affected by the decision under consideration in this EIS), is worth in excess of $3 billion per year.[6] Spill to benefit salmon and steelhead at the eight federal dams on the lower Snake and Columbia rivers can cost the Bonneville Power Administration (BPA) tens or hundreds of millions of dollars, depending on the water year and market conditions.[7] The changes in spill included in the Flexible Spill Agreement (herein referred to as Spill Agreement) are designed to be revenue neutral or positive for BPA relative to 2018 court-ordered spill operations (see Flexible Spill Agreement section), despite increases in spill during much of the day.

Flexible Spill Agreement

The Spill Agreement regarding 2019-2021 spill operations at the eight federal dams on the lower Snake and Columbia rivers was formally announced on December 18, 2018, and signed by the states of Washington and Oregon, the Nez Perce Tribe, the Bonneville Power Administration,

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[3] https://www.nwcouncil.org/reports/columbia-river-history/salmonandsteelhead
[4] https://www.nwcouncil.org/reports/columbia-river-history/endangeredspeciesact
[5] The Value of Natural Capital in the Columbia River Basin: A Comprehensive Analysis, Earth Economics, 2017 at p. 71. https://ucut.org/wp-content/uploads/2017/12/ValueNaturalCapitalColumbiaRiverBasinDec2017.pdf
[6] Id., at p. 54.
[7] See, e.g., 2016 Columbia River Basin Fish and Wildlife Program Costs Report, https://www.nwcouncil.org/sites/default/files/2017-2.pdf

U.S. Army Corps of Engineers, and the Bureau of Reclamation. The Spill Agreement is supported by the states of Idaho and Montana and the Columbia River Inter-Tribal Fish Commission.

The focus and intent of the Spill Agreement is to further improve juvenile salmon and steelhead survival rates as they travel downriver through the eight federal dams on the lower Snake and Columbia rivers. The Spill Agreement seeks benefits to salmonid survival in concert with managing the Columbia River system for multiple congressionally authorized purposes, including power generation to ensure the Pacific Northwest of an adequate, efficient, economical, and reliable power supply. The Spill Agreement also intends to provide for a pause in long-running litigation over the impact of the federal dams on Endangered Species Act-listed salmon and steelhead, at least until the Columbia River System Operations National Environmental Policy Act (NEPA) process is complete and a new long-term biological opinion (BiOp) for the Federal Columbia River Power System (FCRPS) is released by the National Marine Fisheries Service.

The Spill Agreement is contingent on the implementation of a flexible spill operation that increases spill beyond the levels ordered by a federal court for the 2018 salmon migration season at the times of day when regional energy demand is lower, and reduces spill during times of peak energy demand (early morning and late afternoon/evening) and highest energy market values. Recent trends suggest that such flexibility may become more valuable to energy marketers as solar energy continues to be deployed in California and elsewhere in the western U.S. The "duck curve" energy demand graph below illustrates the times of day with higher and lower energy demand across the western U.S.

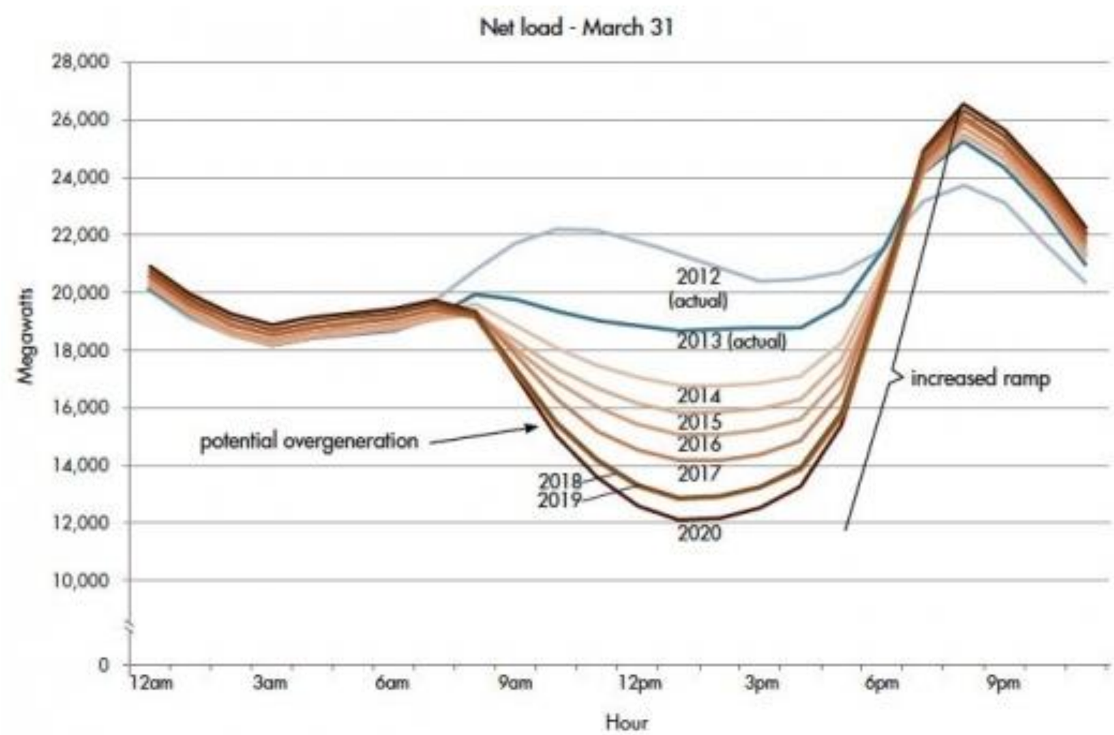

Figure 2. Duck curve energy demand over the course of a day for the western U.S. Courtesy of the California Independent System Operator (CAISO).

Technical analysis conducted by state and tribal fisheries managers concludes that the spill operations outlined in the Spill Agreement will roughly equal (in 2019) or exceed (in 2020 and 2021) fish survival rates obtained through 2018 court-ordered spill operations, which required spill to existing TDG standards of 115% TDG as measured in dam forebays and 120% TDG as measured in dam tailraces on the lower Snake and Columbia rivers. At the same time, the Spill Agreement spill operations will maintain or improve power generation revenue relative to 2018 operations.

The Spill Agreement implementation is contingent on Washington, through the process described in this document, raising TDG standards on the lower Snake and Columbia rivers to match Oregon's 120% standard as measured in the dam tailrace for the 2019 salmon migration season. For the 2020 and 2021 migration season, the Spill Agreement is contingent on both Washington and Oregon raising TDG standards to 125%. The short-term modification of TDG standards considered in this EIS would only apply to 2019 operations and match Oregon's current TDG standards. A separate process will begin this spring to address a potential rule change.

Water Quality Standards

Under Section 303(c) of the Clean Water Act (CWA) and federal implementing regulations at 40 CFR § 131.4, states and authorized tribes have the primary responsibility for reviewing, establishing, and revising water quality standards, which consist primarily of the designated uses of a waterbody or waterbody segment, the water quality criteria that protect those designated uses, and an antidegradation policy to protect high quality waters.

The Environmental Protection Agency (EPA) has compiled a list of nationally recommended water quality criteria for the protection of aquatic life and human health in surface waters. These criteria are published pursuant to Section 304(a) of the CWA and provide guidance for states and tribes to establish water quality standards and provide the foundation for controlling the release of pollutants and identifying impaired waters. The state water quality standards are federally approved by the EPA and describe the level of protection for Waters of the State.

The states of Washington and Oregon have both adopted water quality standards that limit TDG to 110% relative to atmospheric pressure. These water quality standards were placed into state rules based on the Federal EPA recommendations.

Total Dissolved Gas Criteria and Aquatic Life Uses

Studies have demonstrated that outmigrating juvenile salmonids have higher survival rates in the Snake and Columbia rivers when passed through dams via spillways versus through turbines or smolt bypass systems of hydropower projects (Whitney et al. 1997; Muir et al. 2001). Moreover, some models have predicted that further increasing spill levels up to a certain point will result in greater survival of juvenile salmonids. However, increased water spillage over dams often leads to increased TDG levels, which can be detrimental to aquatic life.

Since the 1990's both states have accommodated levels of TDG above 110% for fish passage spill operations for ESA-listed juvenile salmonids at the Corps' projects on the lower Snake and Columbia rivers. During spill operations for fish passage, the states of Washington and Oregon have authorized exceptions (standard modification and criteria adjustment, respectively) to the 110% TDG criteria for the four lower Snake River (WA) and four lower Columbia River projects (WA and OR).

The allowance of TDG levels higher than the 110% water quality criterion seeks a balance between impacts of fish passage through hydropower projects and impacts due to supersaturated waters as a result of spill.

Current Washington Criteria Adjustment

Chapter 173-201A-200(1)(f) WAC provides the maximum TDG criteria for the protection of aquatic life. Table 200 (1)(f) that states: "Total dissolved gas shall not exceed 110 percent of saturation at any point of sample collection." The criteria also address exceptions and adjustments, including a provision allowing for an adjustment of the TDG criteria to aid fish passage over hydroelectric dams when consistent with an approved gas abatement plan. The gas abatement plan must be accompanied by fisheries management and physical and biological monitoring plans.

Chapter 173-201A-200(1)(f)(ii) WAC provides the following adjusted criteria to aid spill for fish passage.

- TDG must not exceed an average of 115% as measured in the forebays of the next downstream dams and must not exceed an average of 120% as measured in the tailraces of each dam (these averages are measured as an average of the 12 highest consecutive hourly readings in any one day, relative to atmospheric pressure); and
- A maximum TDG one hour average of 125% must not be exceeded during spillage for fish passage.

Requirements for approval to apply the adjusted criteria

- This adjustment may be used when consistent with an approved gas abatement plan.
- The gas abatement plan must be accompanied by fisheries management and physical and biological monitoring plans.

In 2009 Ecology and the Oregon Department of Environmental Quality (ODEQ) issued a joint paper to evaluate the 115% TDG compliance which both states required at that time through their respective adjustment and modification procedures. At that time Ecology determined that there would be a potential for a small benefit to salmon related to fish spill if the 115% forebay criterion was eliminated, but there would also be the potential for a small increase in gas bubble trauma from elevated TDG levels. Ecology also recognized that there would be additional administrative procedure requirements because the 115% requirement was adopted as a water quality standard. By contrast Oregon periodically renews the modification to the TDG criteria to aid for fish passage however, the TDG threshold is not stated in the ODEQ water quality standards. The result of the evaluation was different for each state. Ecology maintained the 115% forebay requirement for the four lower Snake River dams and the four lower Columbia River dams. Oregon decided to eliminate the 115% forebay requirement for the four lower Columbia River dams based on a determination that the action would not cause excessive harm to the beneficial uses or aquatic species in the river during the spring spill season. All future TDG modifications approvals have been written without the 115% forebay requirement. Oregon's action did not change the spill operations of the dams because the U.S. Army Corps of Engineers operates voluntary (fish passage) spill operations to meet the more stringent Washington State criteria.

The following describes the Oregon modified TDG criteria requirements which align with the short-term modification Alternative 2 considered in this EIS.

Current Oregon Standard Modification

Chapter 340-041-0031 Oregon Administrative Rules (OAR) provides that;

- Spill must be reduced when the average TDG concentration of the 12 highest hourly measurements per calendar day exceeds 120% of saturation in the tailraces of McNary, John Day, The Dalles, and Bonneville dams' monitoring stations.

- Spill must be reduced when instantaneous TDG levels exceed 125% of saturation for any 2 hours during the 12 highest hourly measurements per calendar day in the tailraces of McNary, John Day, The Dalles, and Bonneville dams' monitoring stations.

Requirements for approval of the modified criteria

- Determination that the failure to allow higher spill would result in greater harm to salmon survival through in-river migration than would occur by increased spill.
- Increased spill will provide a reasonable balance of the risk of impairment due to elevated TDG to both resident biological communities and other migrating fish and to migrating adult and juvenile salmonids when compared to other options for in-river migration of salmon.
- Monitoring is sufficient to determine compliance.
- Biological monitoring occurs to document that the migratory salmonid and resident biological communities are being protected.

Compliance of both states' TDG criteria is measured at TDG fixed monitoring stations in the forebay and tailrace of each of the dams which are managed by the U.S. Army Corps of Engineers and U.S. Geological Survey.

Short-term Modifications

The Washington State Water Quality Standards allow for short-term modifications of water quality standards. This EIS looks at short-term modification alternatives for the TDG criteria in the lower eight federal dams on the Snake and Columbia rivers. The intent of the short-term modification alternatives is to allow criteria to be exceeded on a short-term basis for the increased enhancement of fish passage while still protecting other aquatic resources.

The short-term modification language is Chapter 173-201A-410 and this project will be implemented using 410 (1) and (2).

> **173-201A-410**
> **Short-term modifications.**
>
> The criteria and special conditions established in WAC 173-201A-200 through173-201A-260 , 173-201A-320, 173-201A-602 and 173-201A-612 may be modified for a specific water body on a short-term basis (e.g., actual periods of nonattainment would generally be limited to hours or days rather than weeks or months) when necessary to accommodate essential activities, respond to emergencies, or to otherwise protect the public interest, even though such activities may result in a temporary reduction of water quality conditions.
>
> (1) A short-term modification will:

(a) Be authorized in writing by the department, and conditioned, timed, and restricted in a manner that will minimize degradation of water quality, existing uses, and designated uses;

(b) Be valid for the duration of the activity requiring modification of the criteria and special conditions in WAC 173-201A-200 through 173-201A-260, 173-201A-602 or 173-201A-612, as determined by the department;

(c) Allow degradation of water quality if the degradation does not significantly interfere with or become injurious to existing or designated water uses or cause long-term harm to the environment; and

(d) In no way lessen or remove the proponent's obligations and liabilities under other federal, state, and local rules and regulations.

(2) The department may authorize a longer duration where the activity is part of an ongoing or long-term operation and maintenance plan, integrated pest or noxious weed management plan, water body or watershed management plan, or restoration plan. Such a plan must be developed through a public involvement process consistent with the Administrative Procedure Act (chapter 34.05 RCW) and be in compliance with SEPA, chapter 43.21C RCW, in which case the standards may be modified for the duration of the plan, or for five years, whichever is less. Such long-term plans may be renewed by the department after providing for another opportunity for public and intergovernmental involvement and review.

Implementation of the Short-term Modification Alternatives Considered

The short-term modification alternatives under consideration in this EIS will apply to the spring spill season at the lower Snake and Columbia river dams. This spill season aids the passage of outmigrating juvenile salmonids and aligns with the spring freshet. The Spill Agreement defines the spring spill season as April 3 through June 20. Given the longer duration necessary for this modification, Ecology's action follows Chapter 173-201A-410(2) procedures for modifications requiring a longer duration. Therefore, Ecology conducted a public involvement and review process consistent with the Administrative Procedure Act (chapter 34.05 RCW) and in compliance with Washington State SEPA, chapter 43.21C RCW. This EIS, in part, achieves compliance with SEPA. The concurrent review period of the draft short-term modification and draft EIS, including public hearings, achieves compliance with the Administrative Procedures Act.

Short-term Modification and Application of the Adjusted TDG Criteria

In accordance with Chapter 173-201A-200(1)(f)(ii) WAC, Ecology periodically issues an approval of the U.S. Army Corps of Engineers' Gas Abatement Plan. This approval acknowledges the operation and structural actions the Federal Columbia River Power System

(FCRPS) takes to minimize TDG and allows the federal dams that voluntarily spill to aid fish migration to exceed the 110% TDG criterion. Ecology issued a new gas abatement plan approval in January 2019 that allows the use of adjusted criteria for the 2019, 2020, and 2021 spring spill seasons.

The short-term modification developed in conjunction with this EIS is to be issued to the Corps. The conditions of the short-term modification will modify the current TDG adjusted criteria in the water quality standards. The recently issued gas abatement plan approval notes that the Corps is allowed to spill to the current TDG criteria as well as to any forthcoming modification to the adjusted criteria. The modification to the TDG criteria in the Snake and Columbia rivers may be achieved through the use of the short-term modification process or through a subsequent rulemaking to change the adjusted TDG criteria thresholds in the water quality standards.

Summary

Objectives

The objectives of the short-term modification for the TDG criteria for the Snake and lower eight Snake and Columbia River federal dams is based on:

1) The potential increase in smolt-to-adult returns (SARs) for salmonids by allowing more spill over dams for fish passage,
2) Meeting the Flexible Spill Agreement goals to increase fish benefits, and
3) Developing consistent TDG criteria in the Snake and Columbia rivers between the States of Washington and Oregon.

Purpose

The purpose of the environmental impact statement is to evaluate the impacts of adjusting the TDG criteria for the Snake and Columbia rivers.

Conclusion

Increased spill has been proposed and demonstrated in models to increase the survival of juvenile salmonids outmigrating to marine waters. However, because of the greater TDG related risk to aquatic life it is expected that continuing to increase spill beyond a certain threshold would eventually lead to diminished benefits for salmonids. The increased benefits of spill to salmonids should be weighed against the risk of adverse impacts of increased TDG levels that may accompany greater amounts of spill.

At this time, Ecology's decision is to remove the 115% forebay criterion for a period up to three years. This action coincides with the Spill Agreement that aims to benefit salmon and

hydropower. Additionally, Ecology will adjust the 12 hour averaging method to match the State of Oregon's method. This would have little effect on the operations of the federal dams and would ease the ease spill operations, as well as TDG monitoring and reporting requirements. Washington will require TDG limited by the 12 hour average to be conducted using the 12 highest hourly averages in a day rather than the highest average calculated from 12 consecutive hourly averages.

Given that dam and salmon managers have not previously provided voluntary (fish passage) spill to 120% due to the potential for higher TDG levels to increase symptoms of gas bubble trauma in juvenile salmon, steelhead, and non-listed aquatic species; monitoring for gas bubble trauma will continue to be required

The Regional Debate

Since the 1990s, a significant strand of the regional debate over "dams vs. salmon" has included debate over the best level of spill at the eight lower Snake and Columbia river dams. Questions have involved how much spill benefits salmon migration past the dams and adult returns, especially when factoring in impacts from elevated TDG levels; uncertainty about the effects of higher levels of spill on aquatic life in the river other than salmonids; and concerns about the value of "foregone" power revenue from spill given impacts to electricity ratepayers and/or other potential fish and wildlife investments. In general, conservation and fishing organizations have supported increasing spill, while utility and ratepayer interests have opposed it. This EIS is not related to any dam breaching proposals that the Washington State Orca Task Force recommended to Governor Inslee.

Reasonable Alternatives

Alternative 1: No action. Do not issue a short-term modification. The adjusted TDG criteria for the lower eight dams in the Snake and Columbia rivers will remain at 115% in the forebay and 120% in the tailrace for the spring spill season. A maximum one hour average of 125% TDG should not be exceeded.

Alternative 2: Issue a short-term modification. The adjusted TDG criteria for the lower eight dams in the Snake and Columbia rivers to maintain 120% in the tailrace and remove the 115% forebay criteria. This would only be for the spring spill season. TDG must not exceed an average of 125% as measured over 2 hours during the 12 highest hourly measurements in a calendar day.

Alternative 3: Issue a short-term modification. TDG must not exceed an average of 125% as measured over 2 hours during the 12 highest hourly measurements in a calendar day. This would only be in place for the spring spill season.

Spill Operations

Existing Spill Conditions

The Snake and Columbia rivers hydrology is heavily modified by the presence of hydropower projects that provide energy for the State. The hydropower projects within the Snake and Columbia river system have been designed for upstream anadromous fish passage. However, operations of the hydropower projects is a tightly regulated process. Reservoirs in the forebay of dams are regulated to endure fluctuations in water levels that account for other hydropower operations, climatic shifts, and hydrological changes.

During the spring season, large amounts of runoff from melting snowpack leads to vast inputs of water into the Snake and Columbia river tributaries and leads to high flows within the Snake and Columbia River system, better known as the spring freshet. When hydropower operations cannot pass all of the incoming water through turbines and cannot store water, water is spilled involuntary over dams through spill gates. The spring spill season typically begins on April 3rd in the lower Snake River and April 10th in the lower Columbia River, and ends on June 15th in the Columbia River and June 20th in the Snake River. Voluntary spill is used to pass outmigrating juvenile salmonids downstream though spillways to estuarine and marine waters. Involuntary spill also occurs during the spring freshet depending on snowpack to manage the incoming water at hydropower projects.

In 2008 NOAA issued a 10-year Biological Opinion (BiOp) for the Federal Columbia River Power System (FCRPS) that recommended a reasonable and prudent alternative (RPA) sufficient to avoid impacts for 13 species of salmon and steelhead affected by FCRPS operation. The 2008 FCRPS BiOp describes 10-year operations and configuration plans for FCRPS facilities as well as mainstem effects for other hydroprojects on Columbia River tributaries. The FCRPS actions include additional habitat, hatchery management, predation management, and harvest actions to mitigate for adverse effects of the hydrosystem. The adaptive management implementation plan for the 2008 BiOp, released in 2009, includes accelerated and enhanced action to protect species, enhanced research and monitoring to improve certainty of information, specific biological triggers for contingencies linked to declining abundances of listed fish, contingency actions to improve fish survival, and regional collaboration and independent scientific review to provide ongoing scientific input and actions to support and inform adaptive management decisions.

In 2010 a supplemental FCRPS BiOp was released that summarized and assessed relevant new information and resulted in six new actions to identify and protect against uncertainties associated with climate change, toxics, invasive species, and hatchery fish.

In 2014, a supplemental FCRPS BiOp was released that examined the updated science and data in regards to the biological status of the listed species. The 2014 BiOp concluded that the RPAs are sufficient so as to not jeopardize the continued existence of 13 listed species or modify critical habitat and that additional mitigation actions are not necessary to satisfy the requirements of ESA.

In 2018, a U.S. District Court order mandated hydropower projects to spill water to the 120% tailrace or the 115% forebay gas caps, depending on which was more limiting. The 2018 mandate sought to increase spill for the benefit of fish passage for endangered salmon and steelhead.

Additional Spill for Fish Passage

Threatened Snake River spring/summer Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (*Oncorhynchus mykiss*) returns rebounded from very low population levels in the 1990s during the 2000s and early 2010s, but more recently have declined. According to the Comparative Survival Study's 2017 annual report, smolt-to-adult return ratios (SARs), a key indicator for the abundance and growth trend in these salmonid stocks, remain below the 2-6% SARs (with a 4% average) necessary for recovery according to the NW Power and Conservation Council's 2014 Fish and Wildlife Plan.[8]

Current SARs for Snake River spring/summer Chinook salmon have been 1.1 since 2000.[9] The CSS has modeled expected changes to SARs from spilling to BiOp standards, 115% forebay/120% tailrace, 120% tailrace-only, and 125%. All spill regimes modeled by the CSS are 24 hours, seven days per week. When spill is increased to 125% TDG 24 hours per day/seven days a week in the spring, the CSS predicts a two to 2.5-fold increase in Snake River spring chinook salmon abundance above the levels resulting from 2014 FCRPS BiOp spill levels,[10] and smaller projected increase when spilling to existing gas standards or 120% TDG 24 hours per day. Steelhead SARs are also predicted to increase significantly, but less dramatically than Chinook salmon.

2019 spill operations under the Spill Agreement are predicted to provide a small improvement in survival and SARs compared to the 2018 court-ordered spill operations to spill to existing gas caps.[11] This is based on a projection that 2019 Spill Agreement operations will result in a reduction in smolts' "powerhouse encounter rate," or the number of dam powerhouses (defined as turbines or bypass systems) a smolt encounters while migrating down river. Spillway passage allows smolts to avoid powerhouses.

2018 operations result in an average of 1.76 dam powerhouses encountered by each smolt, while 2019 Spill Agreement operations will result in an estimated 1.73 powerhouse encounters. That compares to 2.98 powerhouse encounters under 2014 FCRPS BiOp operations, and 1.4 to 1.5 powerhouse encounters expected under the operations anticipated in 2020-2021 under the Spill Agreement.

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[8] NW Power and Conservation Council 2014 Fish and Wildlife Program at p. 157. See https://www.nwcouncil.org/sites/default/files/2014-12_1.pdf

[9] CSS 2017 Annual Report at p. 102. http://www.fpc.org/documents/CSS/CSS_2017_Final_ver1-1.pdf

[10] See CSS 2017 Annual Report at xxxi.

[11] Juvenile Chinook salmon PITPH Index estimates based on Comparative Survival Study (CSS) methods (McCann et al 2015) and https://nptfisheries.shinyapps.io/pitph2/ web application tool.

Total Dissolved Gas in Aquatic Systems

Total Dissolved Gas and Hydropower

Total dissolved gas is the summation of the partial pressures of individual gases in solution. The gas content in water bodies is a function of the partitioning of gases between the atmosphere and hydrosphere. The atmosphere is composed primarily of nitrogen (78%) and oxygen (21%). These two elements, with minor contributions of carbon dioxide, comprise the components of TDG measured in water. When gases in the atmosphere and water are in equilibrium, TDG pressure is 100%. Natural processes can deplete gas content in water, for example, oxygen consumption from respiring aquatic organisms (<100% TDG), while other natural processes such as waterfalls can supersaturate gases in water (>100% TDG).

The entrainment of gases in water from the plunging of highly aerated spill water can trap air in water, forming bubbles, facilitating the dissolution of gases into water. The solubility of gases is a function of temperature, atmospheric pressure, and hydrostatic pressure. The solubility of gases increases with water depth due to greater hydrostatic pressure, thus the deeper the plunge of water, the greater dissolution of gases. The portion of gases not dissolved beneath the water will rise to the surface. This degasification process occurs as a result of the lower density of gases compared to water. Degasification occurs in the aeration zone, where gases are removed from the water column. The expanse of the aeration zone can vary depending on bathymetry of the river, climate, water plunge depth, and dam structure. In the area below the aeration zone, gases can remain in the water column due to hydrostatic pressure, resulting in persistently high TDG concentrations.

Hydropower dams can alter the dynamics of gas exchange between the atmosphere and hydrosphere. Dams impede the passage of water, often creating reservoirs. Within these reservoirs, water is diverted through turbines through hydrostatic pressure. When the incoming flow exceeds the capacity of the turbine to pass water, the reservoir can exceed its capacity and the hydropower dam must spill water through gates built into the dam. Spill can result from storm events or operational spill. Operational spills occur when the ability to pass water through the turbine is limited or in a negative market when power demand is low. When dams spill, water is released near the top of the reservoir, falling large vertical distances. These dam spill events are similar to supersaturation that occurs at the base of waterfalls. In most natural waterfall settings the impact of TDG is limited in distance downstream of the waterfall as the river naturally degasses in shallower waters downstream. While the nature of spills at dams can vary depending on their structure, gas entrainment can contribute significantly to TDG in the water system. These supersaturated waters can travel long distances downstream in the deeper reservoir of the next downstream dam. This duration and large area of high TDG conditions in reservoirs has the potential to cause health impairments to aquatic life.

Aquatic Life Hydrostatic Depth Compensation

Total dissolved gas is measured in percent saturation. Percent saturation measures the amount of air that water will hold in equilibrium with the atmosphere at the total pressure present at the water's surface. At the water's surface, atmospheric pressure is the only variable influencing pressure in the water. At increasing depths, both hydrostatic and atmospheric pressure contribute to the equilibrium state of gases in water. The result is increased capacity of water to dissolve gases at greater depths. Thus, aquatic life at depths experience different TDG levels than aquatic life near surface waters. The compensation rate is about 10% of saturation per meter of depth (Weitkamp et al. 2008). For example, a fish swimming at a depth of 2 meters when surface water TDG levels are 120% would experience a saturation level of 100%, while a fish at the surface would experience 120% TDG. Vertical movement of aquatic life within the water column is therefore an important consideration when evaluating risks related to TDG. The figure below by Weitkamp et al. (2008) depicts the concept of hydrostatic depth compensation.

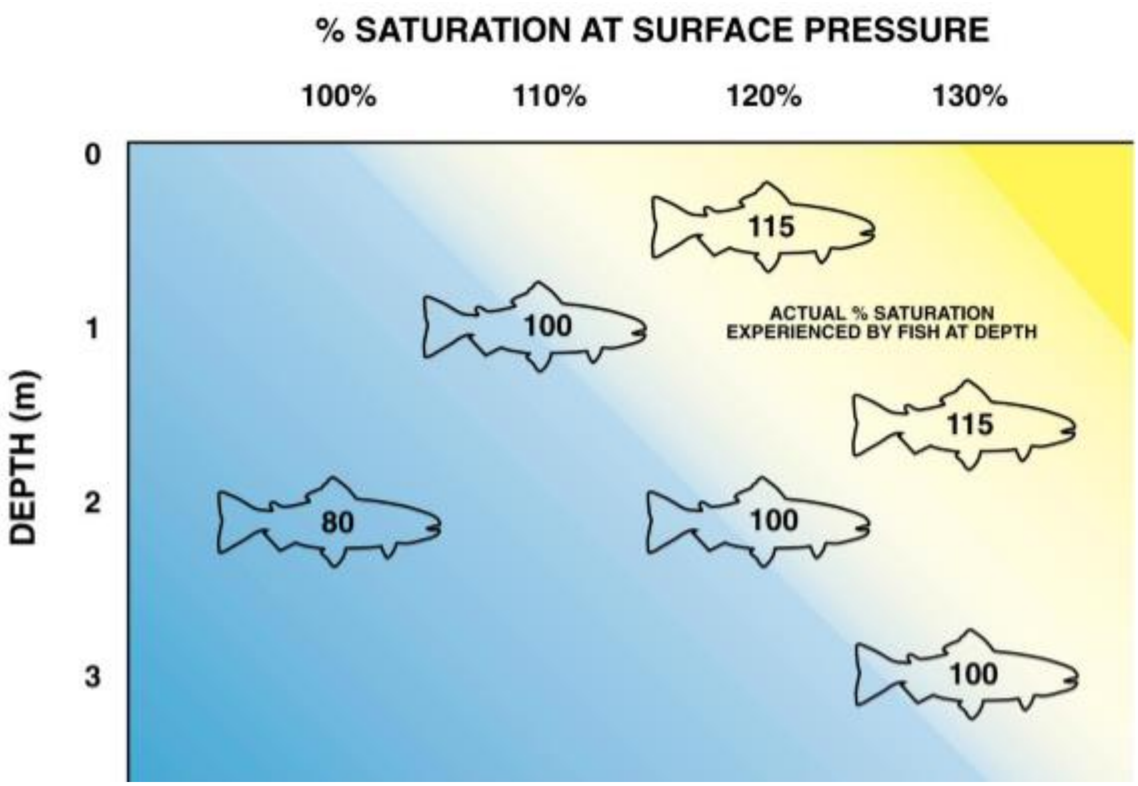

Figure 3. Relationship of measured and actual total dissolved gas levels

Figure 3 shows the relationship of measured and actual total dissolved gas levels experienced by fish at various depths in the river (from Weitkamp et al. 2003a).

Total Dissolved Gas Studies: Laboratory versus Field

Salmonids are often the focal point for impacts of TDG levels in the Snake and Columbia rivers, however, resident fish and aquatic invertebrates should be considered when determining adverse impacts of TDG. When evaluating effects of TDG levels on aquatic organisms, hydrostatic depth compensation should be evaluated. A major criticism of several laboratory studies is the water depth in which studies are conducted. Shallow laboratory studies don't account for depth compensation that is often afforded in deep aquatic systems. Given that some laboratory studies do not allow for hydrostatic depth compensation, effects may be exacerbated compared with field conditions. However, laboratory studies are useful for determining effect levels for different species under controlled conditions. Effect levels determined in laboratory studies can be applied to field conditions to determine if ambient water conditions may be detrimental to particular aquatic species. Field studies represent more realistic exposure scenarios but results are often associated with high data variability, confounding stressors, and uncertainties in study design. Furthermore, little is known about aquatic organism's actual TDG exposures while navigating through aquatic systems. Both laboratory and field studies will be used in this review but limitations of both study types should be noted.

Significant Impacts

Potential Positive Impacts of Increased Spill

Scientific support for increased spill has come primarily from the Comparative Survival Study, a joint project of the Fish Passage Center, Columbia River Inter-Tribal Fish Commission, Washington Department of Fish and Wildlife, Oregon Department of Fish and Wildlife, Idaho Department of Fish and Game, and the U.S. Fish and Wildlife Service. The CSS model predicts steady improvements in juvenile survival and adult returns as spill increases up to at least 125% TDG. Several studies support the information and conclusions of the CSS model (Schaller and Petrosky, 2007; Petrosky and Schaller, 2010; Haesecker et al. 2012; Schaller et al. 2013).

NOAA Fisheries' COMPASS model is less optimistic about the benefits of additional spill compared with the CSS model, largely because of the assumption of latent or delayed mortality due to powerhouse (i.e., non-spillway) passage routes and different conclusions about the relative benefit of fish transportation as an alternative to spill.[12]

The Northwest Power and Conservation Council's Independent Scientific Advisory Board (ISAB) has weighed in on the spill debate at numerous points, critiquing and posing questions of both the CSS and COMPASS models.

The ISAB has not directly compared CSS and COMPASS, but in 2018 reviewed the NOAA Fisheries document A Power Analysis of Two Alternative Experimental Designs to Evaluate a Test of Increased Spill at Snake and Columbia River dams, Using Smolt-to-Adult Returns of Anadromous Salmonids (January 2018 draft). As the ISAB noted, the NOAA analysis "considers

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[12] See, e.g., Issue Summaries of the 2008 FCRPS Biological Opinion, NOAA Fisheries, at pp. 5-7. https://www.westcoast.fisheries.noaa.gov/publications/hydropower/fcrps/2008fcrps_issuesummaries.pdf

two general experimental designs: (1) a before/after design for which there is no variation of spill levels during prospective years and (2) a block design that includes variations between two spill levels during prospective years."[13]

The Spill Agreement described in this document is a version of experimental design (1) above, while NOAA Fisheries was exploring design (2) at the time of the ISAB review. The ISAB review found advantages and disadvantages to NOAA's "block spill design," noting that the "key advantage to the block design is that high year-to-year variation is controlled for by conducting both spill regimes in the same year." At the same time, the ISAB noted that "the advantages [of the block spill design] are somewhat tempered because of several sampling and estimation issues," and that "while a theoretical implementation (i.e., NOAA's block spill paper) may show high statistical power, and implementation may have less power…"[14] ISAB also noted that there was a "[n]eed to acknowledge the consequences of the [block design] experiment on migrant survival compared to full spill for entire seasons at 115/120% or 125% spill," noting that "[i]f survival is lower at lower spill rates, the survival that results from the experiment will be lower for ten years than it would have been with the higher spill throughout the entire spill season each year."[15]

In summary, ISAB seems to find value in both the CSS and COMPASS models, and has generally acknowledged that proponents of each model and of different spill tests have merit. The lack of a definitive opinion from the ISAB created an opportunity to increase spill to benefit salmon while also providing options for increased power generation when power demand and corresponding power revenue is the highest.

Model Predictions for Salmonid and Steelhead Survival

The CSS model predicts improvements in salmon survival and abundance as spill is increased up to those levels that would be permitted by a 125% TDG standard. Juvenile survival metrics assessed by the CSS include water transit time (a surrogate for salmon smolt travel time downriver) and powerhouse encounter rates (with powerhouse defined as dam turbines or bypass systems as opposed to a dam spillway, which avoids the powerhouse). The CSS model considers minimizing powerhouse encounters through measures such as spill or dam removal as critical to reducing "delayed mortality" from hydrosystem passage and ultimately increasing adult salmon and steelhead returns. The CSS model predicts a two to 2.5-fold increase in Snake River spring Chinook salmon abundance above 2014 FCRPS BiOp spill levels when spill is increased to 125% TDG 24 hours per day/seven days a week in the spring,[16] and smaller projected increase at

[13] Review of NOAA Fisheries document: *A Power Analysis of Two Alternative Experimental Designs to Evaluate a Test of Increased Spill at Snake and Columbia River Dams, Using Smolt-to-Adult Returns of Anadromous Salmonids (January 2018 draft)*, at p. 1. See https://www.nwcouncil.org/sites/default/files/isab-2018-2-noaa_spillstatisticalpoweranalysis19march.pdf

[14] Id., at p. 1.

[15] Id., at p. 8.

[16] See CSS 2017 Annual Report at xxxi.

120% TDG 24 hours per day. Potential indirect effects of increasing spill, although not quantified, include reduced predation of outmigrating juvenile salmonid in reservoirs from faster migration travel time and reduced holding times and water temperature[17].

In order to provide revenue neutrality or better for hydropower production and associated revenue, the Spill Agreement calls for spilling to 120% TDG in the spring of 2019 for sixteen hours a day, and spilling to lower "performance" spill levels eight hours per day.[18] The CSS model predicts that this operation would slightly benefit salmon relative to 2018 injunction operations (spill to existing gas caps 24 hours a day/seven days a week), while BPA predicts that it would provide similar power revenue. 2019 operations would be an incremental step toward a flexible spill operation that would be expanded in 2020 to include flexible spill (i.e. 16 hours of higher spill and 8 hours of "performance" spill) to 125% TDG.[19] Flexible spill operations to 125% TDG are predicted by CSS model to benefit juvenile fish survival and adult returns relative to both 2018 court-ordered operations and proposed 2019 flex spill operations to 120%, but not as much as would be predicted for full-time spill to 125% TDG during the spill season.

Potential for Negative Impacts of Total Dissolved Gas

Salmonids

Early Development

Salmonid spawning in the main-stem Snake and Columbia rivers is limited to particular areas due to the lack of suitable habitat and thus, many adults spawn in tributaries of the two rivers and may not be impacted. Dauble and Geist (2000) reported the majority of spawning is concentrated in the Hanford Reach and Hells Canyon reach of the Snake and Columbia rivers. Since the development of hydropower, the fall Chinook salmon habitat has been reduced to 13% and 20% of the historical habitat in the main-stem Snake and Columbia rivers, respectively (Dauble et al. 2003). Chinook salmon are not known to spawn in the area encompassing the lower eight federal dams on the Snake and Columbia rivers.

Tracking early development of salmonids in the natural environment presents several difficulties including the long incubation period (>30 days), monitoring logistics, fluctuating ambient water conditions, and detecting and following egg development. Field studies examining early developmental stages of salmonids are limited in the Snake and Columbia rivers. In one of the first comprehensive studies examining TDG, Meekin and Allen (1974), found that eyed Chinook salmon eggs successfully hatched at 122% TDG, while steelhead eggs experienced mortality at 122%, suggesting sensitivity differences in developing embryos between salmonid species. Jensen (1980) found little effect to embryos, alevins, and fry up to 110% TDG. TDG levels of

[17] Effects of in-river environment on Juvenile Travel Time based on Comparative Survival Study (CSS) methods (McCann et al 2015)
[18] See Agreement, Table 1.1, at p. 17.
[19] The Agreement calls for further refinement of proposed 2020 operations. See Agreement at pp. 5-6 and Tables 1.3.a and 1.3.b, at p. 19.

110-111% in shallow waters led to low incidences of TDG related effects to salmon fry that included burst swim bladders (2.6%) and 1.4% opercular deformities (1.4%).

A few studies have examined TDG effects on early life stages of chum salmon (*Oncorhynchus keta*) in the Columbia River below Bonneville Dam (Geist et al. 2013; Arntzen et al. 2009). Murray et al. (2011) demonstrated that timing of emergence of chum salmon below Bonneville Dam can occur as early as February 10 and can extend to April 9. Thus, early life developmental stages of Chum salmon are likely to be present below Bonneville Dam during fish-spill season.

The most recent study by Geist et al. (2013) examined survival of chum salmon alevins between hatch and emergence (early, middle, and late stages) in shallow laboratory waters at six TDG levels between 100% and 130%. Each life stage was exposed for 49 days (d; early stage), 28 d (middle stage), and 15 d (late stage) through emergence. The estimated median lethal concentration (LC50) was 128.7% for early and middle life stages. The maximum mortality at the 130% TDG treatment for the late life stage was 35%. Early life stage fish were the least sensitive life stage and able to tolerate 120-130% TDG for several days before mortality was observed. Middle and late life stages experienced mortality during the first day of exposure between 120-130% TDG. After 48 hours (h) of exposure to 115% TDG or higher, 20-40% of emerging fish had bubbles in the nares and 50-70% of fish had gas bubbles in their yolk sacs. No gas bubbles in yolk sacs were observed at 100% or 105% TDG. Overall, chum salmon fry exposed to TDG between 100 and 115% survived equally as well to emergence, averaging 92% survival. All developmental stages survival decreased significantly when gas concentrations were at 117% TDG or above. Under field conditions at the TDG levels examined by Giest et al. (2013), early life stage chum salmon will likely be at depths that allow for depth compensation and thus protect developing embryos. Geist et al. (2013) supported existing management guidelines that limit depth-compensated TDG levels to 105% for chum salmon spawning.

In another study by Arntzen et al. (2009), chum salmon spawning sites below Bonneville Dam in the Ives Island and Multnomah Falls areas were monitored to determine environmentally relevant TDG exposure levels. Chum salmon sac fry at Ives Island were exposed to depth-compensated TDG greater than 103% up to 200 h and greater than 105% for up to 100 h primarily during the spring spill. At the Multnomah Falls site, chum salmon sac fry were not exposed to depth-compensated TDG greater than 103%. In the laboratory component of this study, TDG levels up to 113% did not influence survival, growth, or development of chum salmon sac fry (Hand et al. 2009). The first observed effects of TDG to chum salmon fry survival were observed at 121% TDG.

The impacts of TDG to chum salmon sac fry has also been evaluated in-river downstream of Bonneville Dam. Carter et al. (2009) reported that Chum alevins sampled in a wild redds at Ives Island had signs of GBT when depth-compensated TDG exceeded 105%, which also represents the management guidelines to ensure protection of chum salmon. Subsequently, Carter et al. (2009) built an artificial redd north of Ives Island and placed egg tubes to monitoring impacts of developing chum salmon to ambient TDG levels during the Spring season.. The symptoms of GBT, notably bubbles in the eyes, were more prevalent in fish during sampling periods that coincided with depth-compensated TDG at 105% or greater.

Juveniles

Field Studies

Juvenile salmonids outmigration in the Snake and Columbia rivers coincides with high river flows from snowpack melt in the spring. Juveniles passing downstream to the Columbia River estuary and marine waters can incur mortality depending on the route of passage through hydropower dams. Juvenile passage may occur through dam turbines, mechanical bypass facilities, or spillway passage. Of the routes available, studies have shown spillway passage is associated with the lowest mortality (Whitney et al. 1997; Muir et al. 2001). Increasing spill over dams has been proposed as a method for increasing survival of outmigrating juvenile salmonids. However, increasing spill can be accompanied by high TDG levels which may have adverse impacts on salmonids.

The relationship between TDG levels and the incidence of GBT in juvenile salmonids has been recorded in several field studies. Ebel (1969) placed juvenile coho (*Oncorhynchus kisutch)* and Chinook salmon in cages at various depths in the forebay of Priest Rapids Dam for 200-280 h and concluded that at 130-140% TDG, fish must remain below 2.5 m to survive. During the study, coho salmon held between 0.5 -1.5 m experienced 100% mortality and coho in pens at depths of 2-3 m had 70% mortality. In a later study by Ebel (1971), mortality ranged from 45-68% in 4.5 m deep cages containing spring and fall Chinook salmon at 127-134% dissolved nitrogen (N_2) in the forebay of Ice Harbor Dam.

When summer Chinook salmon eggs were exposed to 100 and 122% TDG in shallow waters, both exposure groups had high survival (Meekin and Allen 1974). The surviving fry were exposed to 122% TDG and displayed behavioral changes such as swimming in circles on their backs and sides, and loss of swimming ability. The first fingerling mortality occurred on the 126^{th} d from test initiation (including egg incubation) and mortalities increased abruptly after the 140^{th} d. At 160 d (test termination), 66 of 87 (76%) juveniles did not survive. In a separate experiment, Meekin and Allen (1974) reported significant mortalities at treatment levels between 120 to 135% TDG, with smaller juveniles surviving longer than the larger fish. Observations showed that fry exposed to 122% TDG were not feeding, while feeding was occurring at 112% TDG. In the 67-d experiment, growth of fingerling Chinook salmon decreased with increasing TDG exposure (48.9 mm at 98%, 45.3 mm 107%, 44.0 mm 112%, and 39.5 mm in 122% TDG).

In a long-term biological monitoring study (1996-1999) at 5 different hydropower projects on the Snake and Columbia rivers, fewer than 2% of juvenile salmonids examined displayed external signs of GBT, with most of those with GBT signs having less than 5% fin occlusion (Backman et al. 2002). Of the salmonids examined, steelhead was the most sensitive species to GBT incidences (2.3%), followed by sockeye (1.4%; *Oncorhynchus nerka*), and then Chinook (0.8%) and coho (0.7%). GBT symptoms exceeded 15% GBT when TDG levels approached 130% but at less than 125% TDG, GBT prevalence was well below 15% (15% GBT represents the action criteria established in the 2000 NOAA Biological Opinion). The prevalence and severity of GBT observed was noticeably higher at TDG levels in the range of 125-130% versus 120-125% but the overall incidence rates were relatively low (Backman et al. 2002).

In another field study at sites downstream of Bonneville, Ice Harbor, and Priest Rapids Dams, juvenile salmonid passage was monitored during the spring freshet of 1993 and 1994 (Dawley 1996). In 1993 below Bonneville Dam, 17 species of fish were collected and examined for external signs of GBT. Among the fish examined in 1993, juvenile salmonids were the most sensitive to TDG. Coho salmon had the highest incidence of GBT at 3%, followed by steelhead (2%), and Chinook salmon (0.1%). Most signs of GBT were only observed when the average daily TDG levels exceeded 120%. In 1994 below Ice Harbor Dam, GBT ranged from 12 to 50% for salmonids held in surface cages and from 0 to 37.5% for salmon held in net pens with depths of 0-4 meters. Salmon held in control cages at 1.5 to 2.5 meter depths, had a 10% GBT prevalence when TDG levels averaged 125%.

Biological monitoring at Rocky Reach and Rock Island for juvenile salmonids occurred extensively for a number of years (Mesa et al. 1997; Grassell and Hampton 2001; Grassell et al. 2000a, 2000b; Hampton 2002, 2003; Murdoch and McDonald 1997; Maitland et al. 2003). TDG levels from 110 to 120% was common and resulted in GBT symptoms in 1-5% of juvenile Chinook salmon and steelhead. In 1997, TDG levels exceeded 120% for approximately two months and led to a GBT incidence of 20-80% in juvenile salmon collected at the two dams, suggesting increased risk during chronic exposures.

Sampling of out-migrating juvenile salmon on Priest rapids has occurred over several years. Hagen et al. (1998) reported GBT signs in 21.5% of sockeye salmon, 9.4% of Chinook salmon, and 8.7% of steelhead at TDG levels of 120-135%. During the summer, when TDG levels dropped to 110-125%, Hagen et al. (1998) reported GBT in only 2.3% of Chinook salmon. In a long-term monitoring program from 1996 to 2002, Duvall et al. (2002) found juvenile salmon had an incidence of GBT from 1.7 to 8.3% during spring spill when TDG averaged 113 to 130%. When TDG levels averaged between 113-120% in 1998, GBT incidence ranged from 1.7-5.8%.

During high spill levels in 1997, Ryan and Dawley (1998) monitored juvenile salmonids at Ice Harbor Dam, and downstream from Ice Harbor and Bonneville Dams. From April 20 to June 23 at Ice Harbor Dam, TDG levels remained near 130% for 2 months and then dropped to roughly 120% for the rest of the period. From April 24 to June 10, GBT prevalence was 13.7% of 738 juvenile salmonids collected 15 km downstream from Ice Harbor Dam. During this same period, prevalence of GBT at Ice Harbor Dam in the juvenile bypass system was 5.2%. Steelhead comprised the majority of the juvenile salmon collected. Steelhead downstream of Ice Harbor Dam had an average 49% higher prevalence of GBT than steelhead examined at Ice Harbor Dam. From March 14 to August 22, 0.6% of juvenile salmonids had signs of GBT downstream of Bonneville Dam when average TDG levels did not exceed 117%.

In 4-d net-pen studies downstream from Ice Harbor Dam, juvenile hatchery Chinook salmon were placed in cages at the surface, 0-4 m, or 2-3 m deep (Ryan and Dawley 1998). Signs of GBT were prevalent in 80% of juvenile Chinook salmon in surface cages, 52% in 0-4 m cages, and 6% in 2-3 m cages when weekly average TDG measured between 122% and 130%. In surface cages (excluding data from July 28-Aug 1) at TDG levels between 126-130%, 94% mortality was observed in Chinook salmon, 71% mortality at 122% TDG, and 3% mortality between 117-118% TDG. In the 0-4 m cages (excluding data from July 28-Aug 1), mortality was

30% at TDG exposure levels of 126-130%, 32% mortality at 122% TDG, and 2% at 117-118% TDG. In the deep (2-3 m) cages (excluding data from July 28-Aug 1), mortality was 20% at 126-130% TDG, 25% at 122% TDG, and 4% at 117-118% TDG. The authors noted disparities between GBT incidences in net pens versus river conditions, with lower incidences of GBT of fish collected in-river.

Toner and Dawley (1995) reported that juvenile salmonids were the most sensitive species to GBT among 17 species of fish. The highest incidence on a single day at Bonneville Dam for smolts was 8% for wild steelhead, 11% for hatchery steelhead, 2.7% for coho, 0.7% for sockeye, and 0.2% for Chinook salmon at TDG levels between 120-125%. Toner et al. (1995) examined juvenile salmonids downstream from Ice Harbor when TDG was >130% for 7-11 h each day and observed GBT incidence in 5-10% of fish captured.

In 1996, Hans and Maule (1997) monitored juvenile salmonids when TDG levels exceeded 120% for a period of eight straight weeks. GBT incidence in fish averaged 2-4% for spring Chinook salmon and 6-7% for steelhead. At John Day Dam, GBT prevalence in spring Chinook salmon was 5.5%. Steelhead reached a maximum of 9.9% GBT incidence at Bonneville Dam. Mesa et al. (1997) concluded within the same report that GBT was not a threat to migrating juvenile salmon when TDG levels were less than 120%.

The Fish Passage Center monitored GBT in juvenile salmonids from 2008 to 2017 and reported greater than 15% GBT in three instances out of 1,004 GBT samples[20]. In all three instances, TDG levels were in excess of 125%. In a historical analysis of data collected by the Fish Passage Center from 1995-2018, the 15% GBT criterion has been exceeded in only 37 instances of 2,870 samples and 28 instances occurred when TDG was greater than 125%[21].

Laboratory Studies

In field monitoring studies, it is difficult to control extraneous variables, track the progression and severity of GBT, and measure survival. Laboratory studies enable the isolation of variables that can be effective at determining effect thresholds in a controlled environment. However, laboratory bioassays conducted in shallow water may overestimate effects if aquatic test species are not able depth compensate and move to less harmful TDG conditions.

Ebel (1973) placed juvenile Chinook salmon in 2.4 m deep tanks for 60 d and recorded insignificant mortality at 118% TDG but 100% mortality in fish held in 0.25 m of water. Dawley et al. (1976) placed juvenile Chinook salmon in 2.5 m deep water and reported mortalities of 67% and 97% at TDG levels of 124% and 127%, respectively. When the same study was conducted in 0.25 m depth tanks, the same mortalities (67% and 97%) occurred at 115% and 120% TDG. At 110% TDG at water depths of 0.25 m, 15% mortality occurred, while only 5% mortality occurred in 2.4 m water depths at 120% TDG. These studies suggest that hydrostatic depth compensation is important factor in determining risk in supersaturated waters.

[20] http://www.fpc.org/documents/memos/25-18.pdf
[21] http://www.fpc.org/documents/misc_reports/69-18.pdf

During a 50-55 d chronic exposure at 120 to 130% TDG, juvenile salmon and steelhead experienced 11% and 6% mortalities, respectively, in 2.5 m tanks compared to 80% mortality for both species in 1 m deep tanks (Blahm 1974 and Blahm et al. 1976). Mortality was most prevalent near the end of the experimental period when TDG levels ranged between 123% and 127%. Juvenile cutthroat demonstrated less ability to depth compensate, with 42% mortality at 1 m depth and 27% mortality at 2.5 m. To understand the sensitivity of different aquatic organisms to TDG, further research may be necessary to determine the ability for aquatic species to depth compensate.

In a laboratory study by Mesa et al. (2000), juvenile Chinook salmon and steelhead were exposed to treatments of 110% up to 22 d, 120% up to 140 h, or 130% TDG for 11 h in shallow water depths of 28 cm. The study design did not allow for depth compensation typically accompanying field monitoring studies. At the 110% TDG treatment, the prevalence of GBT in Chinook salmon increased over the exposure period of 22 d, with fin occlusion prevalence reaching up to 60% and no observed mortalities. Juvenile Chinook salmon exposed to 120% TDG resulted in 20% mortality within 40 to 120 h, depending on the trial. Moreover, over 50% mortality was observed in 2 of the 3 trials at 120% TDG. At the 120% TDG exposure level, 100% of fish had GBT signs in their lateral line. At the 130% TDG treatment level, 20% mortality was observed within 3 to 6 h, depending on the trial. At 130% TDG, the prevalence of lateral line bubbles reached 100% within hours. For steelhead exposed to 120% TDG, 20% mortality occurred within 20 to 35 h, with about 60% prevalence of bubbles in gills at the end of the experiment. Over 90% mortality was observed within 60 h in 2 of 4 trials at 120% TDG. At 130% TDG, steelhead mortalities reached 20% after 5 to 7 h. Mortality greater than 50% was observed in all 5 trials at 130% TDG.

Another laboratory study examined the influence of TDG on predator avoidance of juvenile Chinook salmon exposed to 112% TDG for 13 d, 120% TDG for 8 h, or 130% TDG for 3.5 h (Mesa and Warren, 1997). Fish exposed to 130% TDG was the only exposure group that demonstrated a significant increase in susceptibility to predation.

Rainbow trout (*Oncorhynchus mykiss*) exposed to 114%, 118%, 125% at shallow depths (0.25 m) did not show differences in swim bladder over inflation or rupture compared to control fish (Antcliffe et al. 2002). In the 114% treatment group, all fish survived for 6 d and at 110% TDG for 9 d. At 116% TDG, mortality was 9% after 96 h and 42% after 9 d. At the 122% TDG treatment, mortality was 89% after 96 h. At the 140% TDG treatment, mortality was 100% within 24 h. At the 122% and 140% TDG treatment, the mean time to 50% mortality was 55 h and 5.1 h, respectively. When cage depths ranged from 0-1 m at 122% TDG, 96 h mortality was 22% and at cage depths between 0-2.5 m, no mortality observed.

A field laboratory study was conducted using ambient water pumped from the Columbia River and fed into two tanks of different depth containing juvenile Chinook and coho salmon (Blahm et al. 1975). The maximum depth of the shallow water tank was 1 m and the deep test tank had a water depth of 2.5 m. During the 72-d test period in the shallow tank, mortalities of Chinook and coho salmon reached 98.2 and 80.1%, respectively. In the deep tank, mortalities of Chinook and coho salmon were 8.7 and 4.2% respectively. External signs of GBT were first observed in deep tanks when N2 levels reached 120% and above. When N2 levels reached 120-125% and were maintained, the prevalence of GBT symptoms in deep tanks for Chinook salmon ranged between 40-65% in June and 20-55% for coho salmon.

Adults

Field Studies

As mentioned in Backman and Evans (2002), relatively few studies have focused on impacts of TDG to adult salmonids. In one of the first studies on adults by Westgard (1964), Chinook salmon were placed in live boxes at N_2 levels of 104-107% and 116-130%. TDG exposure levels of 116-130% for 10 d resulted in blindness for 34% of fish and 88% of blinded fish died before spawning, whereas only 6% of non-blind fish died before spawning. Effects were not observed in fish exposed to 104-107% N_2.

In 1967, Ebel (1969) monitored 2,300 adult Chinook salmon, 1,600 steelhead, and 1,000 sockeye salmon for GBT symptoms at Bonneville and McNary Dams when TDG levels fluctuated between 104-131%. GBT symptoms were only observed in 1% of sockeye and 0% of Chinook salmon and steelhead.

Meekin and Allen (1974) found that at TDG levels between 125 to 135% occurred from spilling at Grand Coulee Dam and did not equilibrate while passing through Chief Joseph reservoir. Boat searches and aerial surveys found mortalities of unspawned summer Chinook and sockeye salmon during spill season and that these mortalities were not observed after spilling stopped.

In a sampling study in 1995, GBT signs were monitored in an estimated 3-4% of adult salmonids passing Bonneville Dam and reported no visible signs when TDG levels were 114-120% (Fryer 1995). Backman and Evans (2002) examined adult Chinook salmon, sockeye salmon, and steelhead GBT symptoms at Bonneville Dam from 1995 to 1999. Overall less than 2% of salmonids exhibited external symptoms of GBT. Steelhead was the most sensitive to TDG with a GBT incidence of 2.3%, followed by sockeye salmon (1.4%), Chinook salmon (0.8%), and coho salmon (0.7%). Differences in the prevalence and severity of GBT were evident between TDG levels of 120-125% (less than 0.5% of samples) and 125-130% TDG (up to 5% of samples).

In a field spawning study, Gale et al. (2004) exposed mature female Chinook salmon to TDG levels of 114 to 126% in shallow waters (0.5 m) to determine impacts on reproduction. Test exposures were stopped at the first mortality (ranged from 10 to 68 h). No changes to spawning or pre-spawn mortality was observed between controls and TDG treated fish. Fertilization rates and survival of eyed stage salmon were not affected by TDG exposures.

Non-salmonids

Field Studies

While much of the focus of TDG effects in the Snake and Columbia rivers are on salmonids, impacts to resident aquatic species should be considered when evaluating the risk of elevated levels of TDG.

In the Snake and Columbia rivers, smallmouth bass typically spawn during the spring in inshore and slough areas at times corresponding to the annual freshet at depths ranging from 0.7 to 5.6 m (Scott and Crossman 1973; Montgomery et al. 1980). Montgomery and Becker (1980) examined GBT in 179 smallmouth bass (*Micropterus dolomieu*) and 85 northern pikeminnow (*Ptychocheilus oregonensis*) between Lower Monumental Dam on the Snake River and John Day Dam on the Columbia River in May 1975 and May through August 1976. GBT was observed in 72% of smallmouth bass and 84% of northern pikeminnow caught by anglers. GBT was observed when TDG exceeded 115%. In May 1975, TDG levels reached approximately 122% in Ice Harbor and McNary Dams in 1975, whereas Lower Monumental Dam reached approximately 140%. From May to June 1976, average TDG levels were estimated at 125% in Ice Harbor and Lower Monumental Dams, whereas McNary Dam rarely reached 120%. Between July and August 1976, TDG levels were below 120% at all three dams. The authors noted that although resident fish have depth compensating mechanisms, smallmouth bass and northern pikeminnow health condition was reflective of GBT symptoms in a high proportion of fish. The study fails to describe the TDG levels when GBT was observed in fish sampled, making it difficult to determine relationships between TDG and GBT.

In a field monitoring study in 1993 and 1994, resident fish were examined for GBT symptoms. In 1993, less than 1% incidence of GBT was observed in 10 resident species below Bonneville Dam (Dawley 1996). Data indicated that GBT signs were observed when TDG levels exceeded 120%. In 1994, no GBT symptoms were observed in 4,955 non-salmonids sampled below Bonneville Dam. Downstream from Ice Harbor Dam, when TDG levels exceeded 130% TDG, prevalence of GBT was 11.5% in resident fish. Resident fish with the highest prevalence of GBT were smallmouth bass (4.3%), yellow perch (4.0%; *Perca flavescens*), largemouth bass (3.3%; *Micropterus salmoides*), pumpkinseed (3.2%; *Lepomis gibbosus*), and largescale suckers (2.8%; *Catostomus macrocheilus*).

During the spring freshet of 1994-1997, resident fish were collected from reaches of the Snake and Columbia rivers (below Ice Harbor Dam, Priest Rapids reservoir, and below Bonneville Dam) and examined for symptoms of GBT (Ryan et al. 2000). Generally, when TDG was below 120%, GBT signs were not present or observed in less than 1% of fish. When TDG ranged between 120-125%, GBT incidences ranged from 0.9% to 9.2%. When GBT reached 130% or greater, GBT signs were typically around 18%, with daily prevalence reaching 40.8%. In 1996, 1,227 Catostomidae larvae were collected below Bonneville Dam and 14.3% had signs of GBT.

In a study by Schrank et al. (1997) from April to August of 1995, resident fish were collected downstream from Bonneville Dam, in the reservoir and downstream from Priest Rapids Dam, and downstream from Ice Harbor Dam. Downstream from Bonneville, only sculpin (2.6%) had a GBT prevalence greater than 1%. During monitoring TDG reached a maximum of 118%, and GBT incidences in resident fish reached a maximum of 0.7%. At the Priest Rapids Dam reservoir, GBT incidences were most frequent in the sand roller (5.6%; *Percopsis transmontana*), sculpin (4.8%; *Cottus sp.*), and smallmouth bass (1.6%). Daily mean TDG levels reached a maximum of 122% and the highest recorded GBT incidence was 5.4% in resident fish at 121% TDG. Downstream from Ice Harbor Dam, GBT incidence was highest in smallmouth bass (16.5%), crappie (13.6%; *Pomoxis sp.*), brown bullhead (11.8%; *Ameiurus nebulosus*), bluegill (9.2%; *Lepomis macrochirus*), and redside shiner (8.3%; *Richardsonius balteatus*). Daily mean TDG levels between 115-119%, 120-124%, and 125-129% resulted in a GBT prevalence of 2.7-40.8%, 14.3-15.2%, and 10.7-26.6%. The relationship between TDG levels and GBT was inconsistent, making it difficult to discern differences in effects among TDG levels.

Schrank et al. (1998) monitored resident fish species from March to August in 1996 for GBT throughout the lower Snake and Columbia rivers. Downstream from Bonneville Dam, GBT symptoms in resident fish were less than 4%. Downstream of Bonneville Dam, daily mean TDG levels between 115-119%, 120-124%, and 125-129% saturation led to GBT incidences of 0-8.2%, 0-15.8%, and 0-13.8%, respectively. At Priest Rapids reservoir, GBT signs were observed the most frequently in suckers (26.6%; *Catostomus sp.*), bluegill (16.7%), sculpins (15.6%), chiselmouth (6.9%; *Acrocheilus alutaceus*), stickleback (5.9%; *Gasterosteus sp.*), and pumpkinseed (5.1%). Downstream from Priest Rapids Dam, GBT incidences were reported in suckers (13.2%), smallmouth bass (7.7%), chiselmouth (4.5%), and northern pikeminnow (2.1%). Downstream from Priest Rapids Dam and in the reservoir, daily mean TDG levels between 115-119%, 120-124%, 125-129%, and 130-135% resulted in a GBT prevalence of 0-13.7%, 0-23.1%, 0-5.2%, and 6.3-16.7%, respectively. Downstream from Ice Harbor Dam, GBT signs were observed most frequently in suckers (21.6%), sculpin (13.2%), northern pikeminnow (12.3%), yellow perch (12.3%), smallmouth bass (12.0%), and carp (10.9%; *Cyprinus sp.*). Daily mean TDG levels between 115-119%, 120-124%, 125-129%, and 130-135% resulted in a GBT prevalence of 0-35.5%, 3.6-35.3%, 24.3-37.8%, and 18.1-33.3%, respectively. Again, relationships between TDG levels and GBT were difficult to establish, potentially due to highly variability in field studies and fish life history characteristics.

In 1997, Ryan and Dawley (1998) monitored GBT occurrences in resident fish at Ice Harbor Dam reservoir and downstream of Bonneville and Ice Harbor Dams. Prevalence of GBT in Ice Harbor reservoir was highest in bluegill (15.5%), largemouth bass (15.5%), pumpkinseed (14.0%), smallmouth bass (12.3%), sculpin (11.8%), and bullhead (10.8%; *Ameiurus sp.*). When daily mean TDG levels were between 120-125%, GBT prevalence ranged from 0-66.7% in resident fish. Downstream from Ice Harbor Dam, GBT occurrence was highest in bluegill (11.1%), sculpin (8.1%), and pumpkinseed (7.7%), When TDG levels were between 115-119%, 120-124%, and 125-130%, GBT prevalence was 0-20.0%, 0-10.0%, 4.2-30%, respectively. Downstream from Bonneville Dam, the highest occurrence of GBT in resident species was sucker (10.3%), peamouth (7.6%; *Mylocheilus caurinus*), sculpin (5.4%), and northern pikeminnow (5.2%). When TDG levels were between 115-119%, 120-124%, and 125-130%, GBT prevalence was 0-0.9%, 0-18.7%, 11.5-30.1%, respectively.

Laboratory Studies

Meekin and Allen (1974) used hook and line to capture northern pikeminnow from the Columbia River and placed the fish in a 100% TDG control trough or 120% TDG trough in shallow waters (16.5 cm). Northern pikeminnow exposed to 120% became lethargic immediately and had little activity. After 3 d at 120% TDG, bubble formation was observed on fins of all fish. Juvenile Chinook salmon and steelhead (prey) were placed into each trough. Northern pikeminnow at 120% TDG showed no interest in feeding, while all prey were consumed within 48 h in the control trough. After 8 d, the 120% TDG treatment was reduced to 100% and northern pikeminnow immediately became active and started feeding. Saturation levels was increased to 120% TDG again, and fish became lethargic again. After 17 d, no mortalities occurred but northern pikeminnow were in poor condition. In another feeding study, northern pikeminnow food consumption decreased in proportion to increases in TDG levels when held in shallow tanks (0.25 m; Bentley and Dawley 1981). Northern pikeminnows consumed 14.2 g/d at 100% TDG, 6.2 g/d at 117% TDG, and 2.3 g/d at 126% TDG. Both Meekin and Allen (1974) and Bentley and Dawley (1981) studies were conducted in shallow waters, precluding the ability of fish to depth compensate and circumvent TDG related impacts.

In a shallow (26 cm) water laboratory study, resident fish below Grand Coulee Dam were collected and examined for GBT at TDG levels of 115, 125, and 130% (Beeman et al. 2003). At 125% TDG, the most sensitive species was northern pikeminnow, followed by largescale sucker, longnose sucker (*Catostomus catostomus*), redside shiner, and walleye (*Sander vitreus*) and at 130% the order of sensitivity was largescale sucker, northern pikeminnow, longnose sucker, redside shiner, and walleye. Generally, the time to 50% mortality was approximately 2-fold less at 130% as compared to 125% TDG, suggesting duration of exposure is important in evaluating TDG related risks.

When bluegills were acclimated to surface pressures, acute GBT signs were present at 135% TDG and chronic GBT effects at 120% TDG (Abernethy and Amidan 2001). At 135% TDG, bluegill began to die within 10-12 hr. Bluegill exposed to 100, 120, and 135% TDG at pressures simulating 3 m depths had no external signs of GBT. Bluegill were reported as more resistant to TDG effects than fall Chinook salmon or rainbow trout (least resistant).

White sturgeon (*Acipenser transmontanus*) are known to spawn from April to July, during the fish spring spill season when TDG levels are known to increase significantly. Laboratory studies have observed newly hatched white sturgeon larvae swim up in the water column for the first 5 d after hatching and others have captured larvae in plankton nets (Brannon et al. 1985; Parsley et al. 1993). Counihan et al. (1998) exposed white sturgeon larvae to TDG levels of 118% and 131% in laboratory bioassays in shallow water (25 cm). No mortality was observed at 118% TDG for 10 d but 50% mortality occurred at 131% TDG after 13 d (most mortalities were observed by day 4 at 131%). GBT was first observed at stage 34 at 118% TDG and stage 33 at 131% TDG. When GBT signs were first observed, 50% of 20 larvae sampled had GBT at 118% TDG compared with 85% of larvae at 131% TDG. When stage 33 and 34 larvae were exposed to 118% and 131% TDG for the first time, GBT signs developed within 15 min. The authors conclude that little is known about white sturgeon larvae and that the laboratory study results may represent a worst-case scenario, given that the shallow water test conditions preclude depth compensation.

In the only known studies of TDG effects in amphibians, Colt (1984) examined GBT symptoms in bullfrog (*Rana catesbeiana*) tadpoles. Tadpoles placed in shallow water (0.25 m) exhibited gas inflation of the gastrointestinal tract when exposed to TDG supersaturated waters by floating on their sides or upside down. However, these symptoms could be reversed by reducing TDG levels. A 4-d exposure to approximately 122% TDG had no effect on survival but at day 10, increased mortality and the presence of redleg disease was noted. When adult bullfrogs were exposed to TDG of 116.8% for 4-d no mortality was recorded but subcutaneous gas bubbles were observed in webbing and body. Exposures of 132.9% TDG resulted in 40% mortality within one day, while no signs of GBT were recorded in adult bullfrogs exposed to TDG levels of 108.8% for 27 d.

Colotelo et al. (2012) examined juvenile brook (*Lampetra planeri*) and Pacific lamprey (*Entosphenus tridentatus*) to GBT in a laboratory study. Lamprey acclimated to depths of 4.6 m and subject to rapid decompression to a very low pressure. No mortality or GBT signs were observed for lamprey. Colotelo et al. (2012) notes that the lack of a swim bladder may account for the reduced sensitivity to TDG.

Aquatic Invertebrates

Field Studies

In 1994, 23 taxa and a total 4,133 invertebrates were collected near Bonneville (downstream), Priest Rapids (upstream) and Ice Harbor (downstream) dams and evaluated for signs of GBT (Dawley 1996). GBT signs in invertebrate species were rare. Of the invertebrates sampled, only cladocerans (1.5%) had signs of GBT below Ice Harbor Dam. TDG levels exceeded 130% on occasion during the sampling period.

Schrank et al. (1997) examined 804 invertebrates below Bonneville Dam and reported minimal effects to only cladocerans (0.5%) when TDG levels averaged 114%. Below Ice Harbor Dam, only 0.4% of the 499 invertebrates collected showed signs of GBT when TDG levels were recorded between 105-131%. In another study, three species of invertebrates were collected below Bonneville Dam including Asian clams (*Corbicula sp.*), crayfish (*Procambarus sp.*), and dragonfly larvae (*Gomphus sp.*) and no signs of GBT were observed when TDG levels were mostly between 115-125% (Toner and Dawley 1995). Of the 23 taxa collected by Toner and Dawley (1995) in 1994 below Bonneville and Ice Harbor Dam, GBT was only reported in 4% of cladocerans.

White et al. (1991) conducted bioassays with macroinvertebrates at depths less than 1 meter on the Bighorn River in Montana and found that most were affected at TDG levels of 127% or greater. The most susceptible invertebrate was *Baetis tiicaudatus* at 115% TDG, while *Ephemerella inermis* and *Tricorthyodes minutus* showed effects near 118% TDG.

Laboratory Studies

GBT in *Daphnia sp.*, crayfish, and stoneflies (*Pteronarcys sp.*) have previously been reported by Nebeker (1976). *Daphnia magna* were affected by supersaturated waters above 110%. The mean LC50 for Daphnia magna was 122.5% when fed and held in static water. When Daphnia were not fed in flowing water the 96 h LC50 was 114%. The 7-d LC50 was 120% and the 10-d LC50 was 117.5%. In crayfish, effects of supersaturated water were observed at 130% or above. The mean crayfish 96-h LC50 was 147%; the 7-d and 10-d LC50s were 145% and 133%, respectively. The 10-d median effective concentration (EC50) for stoneflies was 135% for *Acroneuria californica*, and greater than 125% for *Acroneuria pacifica*, and *Pteronarcys californica*.

In a laboratory study by Nebeker et al. (1981), the effects of TDG supersaturation were examined on the adult emergence of the mayfly (*Timpanoga Hecuba*), caddisfly (*Dicosmoecus gilvipes*), mosquito (*Culex peus*), and midge (*Cricotopus sp.*). The 96-h median lethal concentration (LC50) for the mayfly was 129% TDG and the median lethal time-to-death (LT50) was 2.7 d. The caddisfly LT50 was 45 d at 135% TDG. The adult midges and mosquitoes emerged at TDG levels greater than 140%, whereas adult mayflies and caddisflies did not emerge or survive at TDG levels of 134% and higher.

Malouff et al. (1972) reported GBT symptoms in bivalves (*Crassostrea virginica, Crassostrea gigas, and Mercenaria mercenaria*) exposed to supersaturated water created by water temperature. A separate experiment indicated that temperature changes do not create GBT symptoms observed. Symptoms included gas-filled conchiolin blisters on valves and gas bubbles in gill filaments in clams and in mantle tissue of oysters.

P. californica, *Isogenus serratus*, *Cloeon ingens*, *Hydropsyche sp.*, Lepidostomatidae, and Tendipedidae were examined for GBT signs after exposure to varying TDG levels at different depths (Fickeisen and Montgomery 1975). The authors found *P. californica* had external bubbles at the 140% TDG level after 1 d and after 5 d at 108% TDG but no mortalities were reported. Hydropsyche, *I. serratus*, *C. ingens* reported high mortality but few signs GBT. Lepidostomatidae reported two mortalities at 140% TDG but no signs of GBT, while Tendipedidae had no signs of GBT up to 140% TDG.

Evaluating Risks of Total Dissolved Gas

Depth Distribution of Migrating Fish

The migration depth of salmonids is important in determining if hydrostatic depth compensation is adequate to relieve salmonids from TDG levels known to cause adverse effects in the Snake and Columbia rivers. This section describes the available depth migration and distribution data of salmonids. Consideration is given to the behavior of outmigrating juveniles, adult migration, and the use of fish ladders.

Adult Salmon

Johnson et al. (2005) found that adult spring and summer Chinook salmon spend the majority of their time deeper than 2 m, with occasional movement shallower than 2 m. The percentage of time adult Chinook salmon spent below 2 m ranged from 66% at Ice Harbor Dam to 85.1% at Bonneville Dam. Fish were deeper than 1 m 90.7% of the time at Little Goose Dam to 97% at Bonneville Dam. The time adult Chinook salmon spent at depths less than 2 m typically ranged from seconds to minutes. However, the maximum duration spent less than 1 m and less than 2 m by an individual fish was 1.3 and 19.5 h, respectively. The authors concluded that there was minimal potential for GBT on adult spring and summer Chinook salmon under average river conditions, despite the fact that fish tissues were likely supersaturated with dissolved gases. Similarly, Gray and Haynes (1977) reported adult spring Chinook salmon spent approximately 89% of their time at depths greater than 2 m in the Snake River downstream of Little Goose Dam when saturation levels were below 130%.

In another study, Johnson et al. (2007) concluded that adult salmon swam at depths sufficient for hydrostatic depth compensation 95.9% of the time in the Bonneville Dam tailrace and 88.1% of the time in the Ice Harbor Dam tailrace. At higher TDG levels of 125-130%, adult Chinook salmon were exposed to supersaturated conditions 70.7% of the time after accounting for depth compensation. When accounting for depth compensation, 46.5% of the time fish experienced 101-110% TDG, 43.1% of the time exposures were 111-115% TDG, and 10.4% of the time experienced TDG was 116 to 120%.

Juvenile Salmon

Juvenile steelhead were tagged and tracked from Ice Harbor to McNary Dam to determine migration depth (Beeman et al. 1999; Beeman et al. 2000). Median depths of 3 juvenile fish ranged from 1.1 to 4.3 m at locations with TDG ranging from 119.8 to 125.8%. In another study at the McNary Dam forebay median depths of yearling Chinook and steelhead were observed at 2.4 and 2.7 m, respectively (Beeman et al. 2000). Beeman et al. (1999) reported the median TDG experienced by fish ranged between 82.4% and 107.4% after accounting for hydrostatic depth compensation. Mean TDG exposures for juvenile Chinook salmon and steelhead were 89.0% and 94.6% (Beeman et al. 1999). Backman et al. (2002) found juvenile Chinook salmon and steelhead spent more than 60% of their time deep enough to compensate for TDG levels as great as 124%.

Ebel and Raymond (1976) concluded that when juvenile or adult salmonids are confined to one meter, mortality may occur at 115% TDG after 25 d of exposure and when salmonids are allowed the option of hydrostatic depth compensation, mortality may occur when TDG levels exceed 120% for more than 20 d. As previously mentioned, the duration of exposure in relation to TDG levels and depth compensation are necessary components when evaluating risk.

In another study, mean migration depths of yearling Chinook salmon in the Columbia River varied by year and ranged from 2.1-2.8 m from 1997-1999. Mean migration depth in the Snake River was 1.5 m (Beeman and Maule 2006). Hydrostatic depth compensation ranged from 12.7%

to 16.9% in the Snake River where TDG was highest and 27.0 to 34.6% in the lower Columbia River where TDG was the lowest. Mean migration depths for juvenile steelhead ranged from 2.0 to 2.3 m. Hydrostatic depth compensation ranged from 16.9% to 21.3% for the Snake River and from 19.2% to 24.4% in the lower Columbia River.

Fish Ladders

When fish migrate through fish ladders they are restricted to a maximum depth of approximately 2 m. Observations have indicated that fish frequently move towards the surface in fish ways but also pass through deep passage orifices between each progressive pool. However, fish ladders often quickly degas and have reduced TDG levels in comparison to the main-stem river (Bouck 1996). The time spent in fish ways can vary drastically depending on the individual fish, fish ladder design, and salmonid species. Spring Chinook salmon tracked at Bonneville Dam took 4 to 57 h (average 22 h) to pass through fish ladders, while those same fish took 3 to 23 h (average 7 h) to pass Dalles Dam (Monan and Liscom 1975).

Timing of Migrating Salmonids

The timing of salmonid migration is an important factor in determining what salmonid species are present and TDG exposure conditions. Adult salmonid species whose migrating timing overlaps with the spring-spill season (typically April 3rd -June 20th in the Snake River and April 10th-June 15th in the Columbia River) include spring Chinook salmon and sockeye salmon. The adult spring Chinook salmon run begins and ends during the spill season and thus reaches maximum abundance when TDG levels become elevated in the Snake and Columbia rivers (Figures 4 and 5). The timing of the vast majority of juvenile salmonids outmigrating corresponds with spring spill season, including subyearling and yearling Chinook salmon, steelhead, sockeye salmon, coho salmon, and chum salmon (chum rarely pass Bonneville Dam; see Figures 5 and 6).

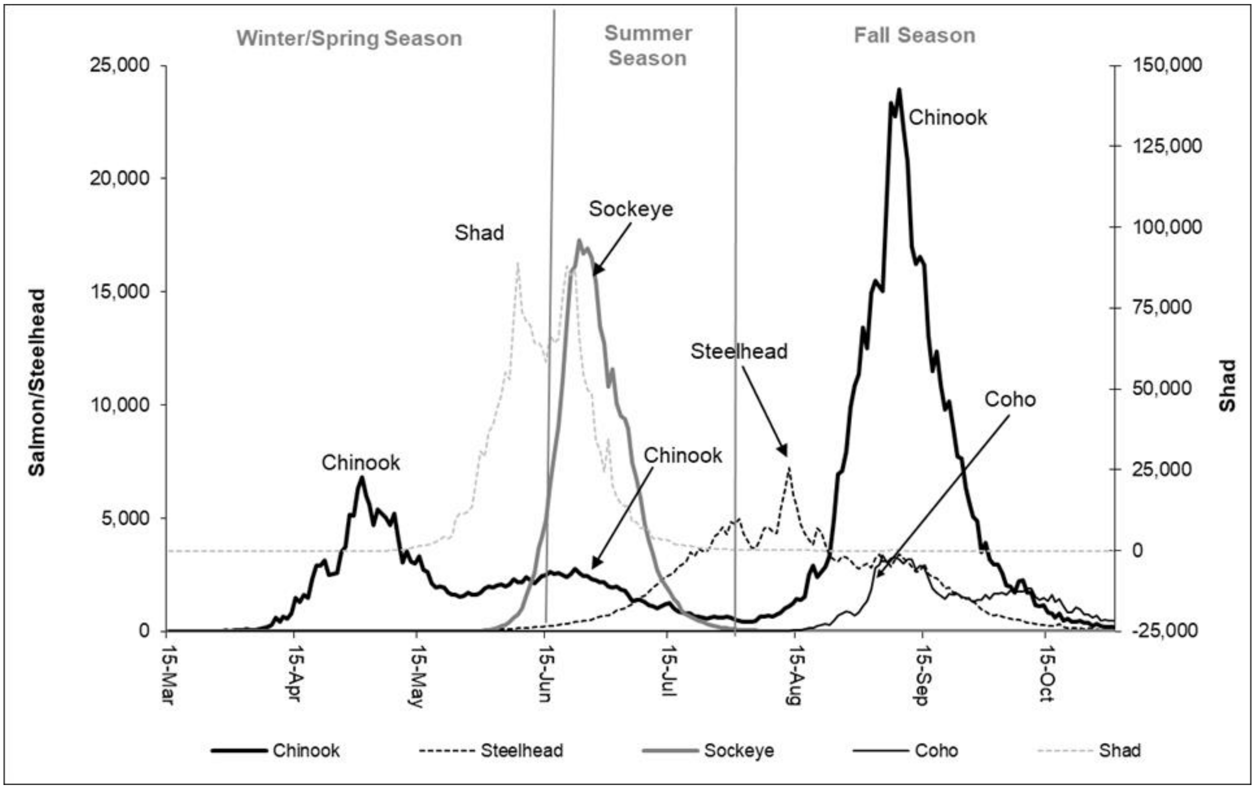

Figure 4. Average daily counts at Bonneville Dam, 2008–2017

Figure 4 shows the average daily counts of salmon, steelhead, and American Shad at Bonneville Dam, 2008–2017 (https://wdfw.wa.gov/publications/01973/wdfw01973.pdf).

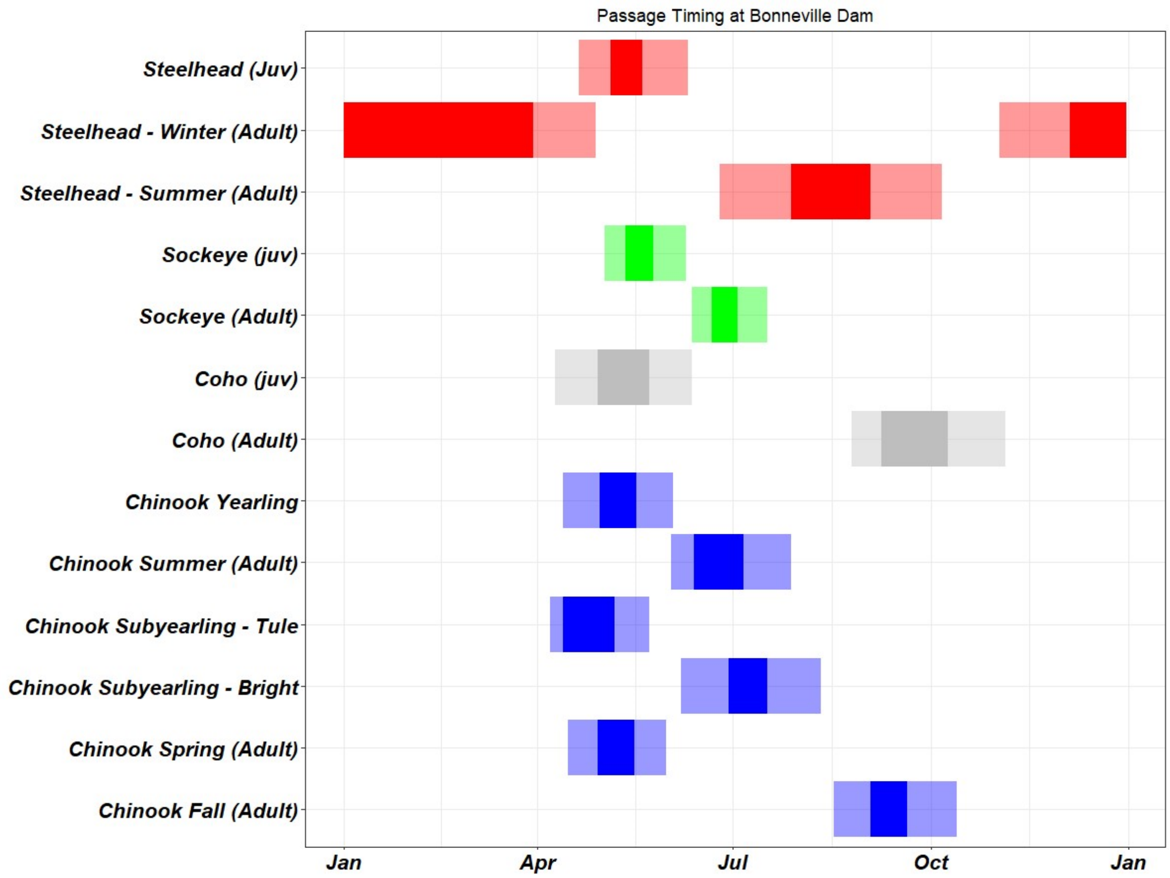

Figure 5. Passage timing by species (and life stage) at Bonneville Dam.

Figure 5 shows the passage timing by species (and life stage) at Bonneville Dam. Shaded regions represent 95% passage (i.e. area between 2.5 and 97.5 percentiles), with darker sections representing the middle 50% of passage (i.e. area between 25 and 75 percentiles). Chinook salmon are represented in blue, coho salmon in gray, sockeye salmon in green, and steelhead in red. Adult timing is indicated by (adult) in y-axis.

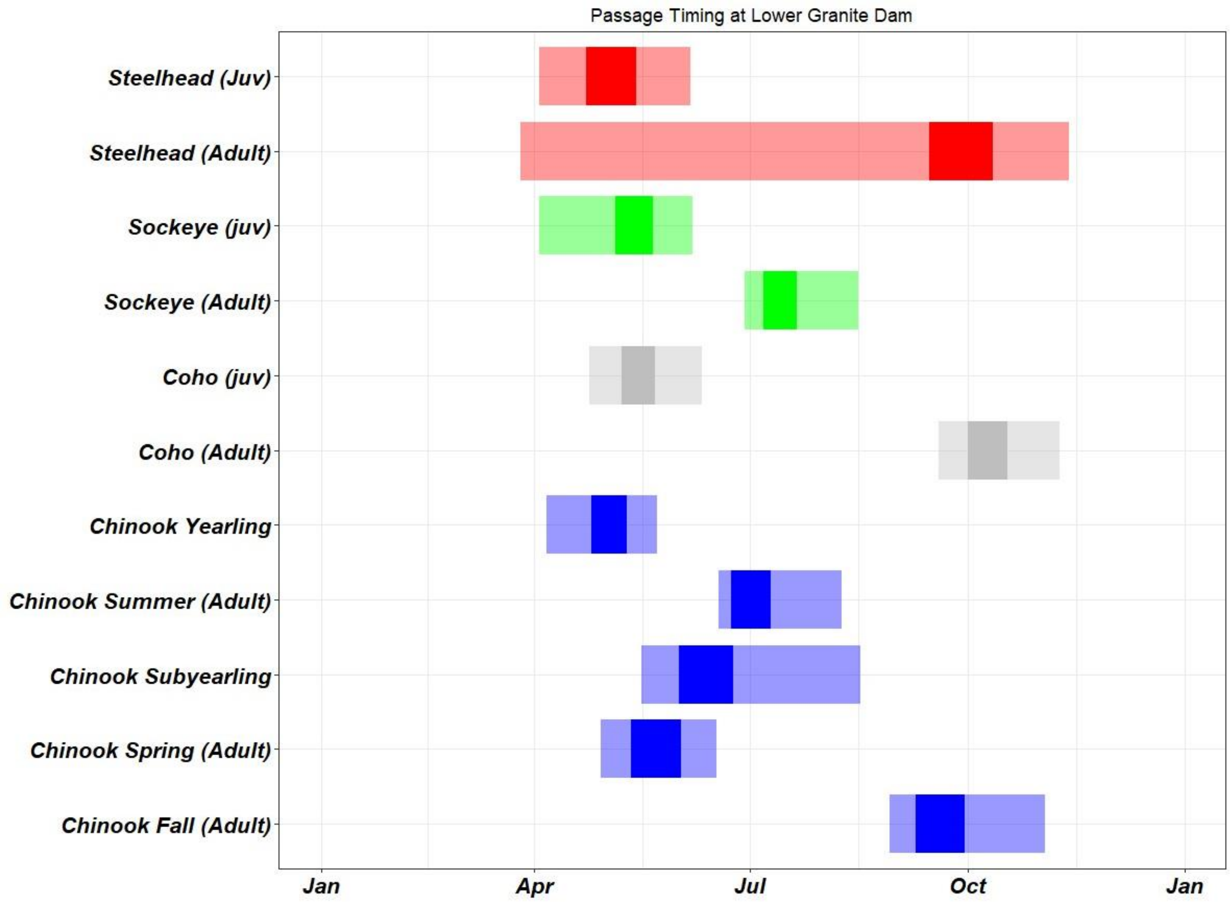

Figure 6. Passage timing by species (and life stage) at Lower Granite Dam.

Figure 6 shows the passage timing by species (and life stage) at Lower Granite Dam. Shaded regions represent 95% passage (i.e. area between 2.5 and 97.5 percentiles), with darker sections representing the middle 50% of passage (i.e. area between 25 and 75 percentiles). Chinook salmon are represented in blue, coho salmon in gray, sockeye salmon in green, and steelhead in red. Adult timing is indicated by (adult) in y-axis.

Fish Movement in Response to Elevated TDG Levels

Several studies have examined behavioral responses of fish exposed to elevated TDG levels and made determinations on whether fish can detect high TDG levels and purposely depth compensate to avoid GBT. There is uncertainty on whether fish have internal mechanisms to detect the need to depth compensate in the presence of high TDG conditions. Shrimpton et al. (1990) described the mechanism of regulating buoyancy in gas supersaturated water. Buoyancy was determined by changes in the volume of the swim bladder which is regulated by pressure. Smaller fish can be subject to positive buoyancy due to the high swim bladder pressure required to force gas out of the pneumatic duct. The smaller the fish, the greater the buoyancy. In smaller fish, swim bladder over-inflation must be compensated by depth compensation to attain neutral buoyancy and decompress the swim bladder. Stroud et al. (1975) observed abnormal buoyancy in juvenile Chinook salmon prior to death. If water depth is not adequate for hydrostatic depth compensation, then mortalities may occur (Ebel and Raymond 1976). Shrimpton et al. (1990) suggested that depth compensation behavior is limited to small rainbow trout, as fish weighing less than 10 g increased depth with increases in TDG. Increasing TDG did not have a constant effect on fish above 40 g; some were higher in the column, some lower, and some did not change their mean depth. Larger fish can vent swim bladders and maintain neutral buoyancy at lower pressures than smaller fish. Positive buoyancy in fish requires large expenditures of energy to swim both vertically and horizontally and overcome the upward force of additional drag by the inflated swim bladder (Alexander 1966). Positive buoyancy requires fish to continuously swim to maintain position in the water column if unable to depth compensate. Further research on energy expenditures to maintain preferred water column depths and the consequences are needed.

Beeman (2006) found that with each increase in 10% TDG, the average migration depth of Chinook salmon decreased by 0.2 m and juvenile steelhead increased by 0.3 m. Stevens et al. (1980) also found differences between salmonid species tendency to avoid supersaturated waters. Juvenile Chinook salmon, coho salmon, sockeye salmon, and rainbow trout avoided TDG levels of 125% and 145%, while steelhead did not avoid any TDG levels.

Beeman et al. (2003) reported no correlation between TDG and depths of tagged fish and concluded that fish do not have the ability to detect or avoid supersaturated waters. In support Lund and Heggberget (1985) found no different in depth distribution between rainbow trout held in a 1.6 m deep tank at 115-125% TDG and control fish held in 100% TDG water. At 114% and 125% TDG, laboratory studies involving rainbow trout did not exhibit behavior different from control fish, however, in 2.5 m deep cages trout were observed schooling at depths > 1 m (Antcliffe et al. 2002). Kokanee held in 9 m deep live cages at TDG levels >120% appeared to vertically migrate through the water column based on diurnal changes in lighting rather than a response to TDG conditions (Weitkamp et al. 2003b).

VanderKooi et al. (2003) reported that resident fish of the Snake and Columbia rivers (redside shiner, northern pikeminnow, largescale sucker, longnose sucker, and walleye) had decreased activity and had a tendency to settle or swim near the bottom of shallow tanks (26 cm) as they developed GBT. Behavioral changes in carp and black bullhead were only noted when TDG levels were at exceedingly high values of 146% in 30 cm deep water (Gray et al. 1982; Gray et al. 1983a). When the Atlantic croaker was exposed 145% TDG, movement initially occurred towards the surface of a 2.5 m deep tank but later, movement oscillated up and down to eventually deeper depths (Chamberlain et al. 1980).

Effects of Repeated Exposures to High TDG Levels

Total dissolved gas levels in the Snake and Columbia rivers fluctuate throughout the spill season. Aquatic life may be subject to highly variability TDG levels on a daily or weekly basis resulting in periods of supersaturation and periods below supersaturation when accounting for depth compensation. Furthermore, a significant portion of both adult and juvenile migrating salmonids and steelhead in the Snake and Columbia rivers have to navigate several hydropower projects where they may be subjected to repeated exposures of high TDG levels followed by periods of reprieve. Few studies have examined the impacts of repeated TDG exposures with relief periods in between TDG exposures but such studies may be applicable to the Snake and Columbia rivers.

Anticliffe et al. (2002) acclimated rainbow trout at 122% or 124% TDG to tanks with depths of 0-2.5 m and cycled fish to the surface (max depth of 0.25 m) and recorded lethal times to 10% mortality (LT10) and time to initiation of mortality. Rainbow trout acclimated to 122% for 3 h in deep tanks had LT10s that were on average 6 h less than fish acclimated to 122% for 6 h. This data suggests that longer acclimation periods reduce the onset of TDG related effects. When fish were acclimated to 124% TDG for 6 h, the mean LT10 was about 11 h less than fish acclimated at 122% for 6 h. When examining the first recorded mortality, the first transfer of fish from deep to the surface took substantially longer to achieve the first mortality than subsequent cycles of fish from depth to the surface. However, the re-initiation of mortality with each depth cycle took longer after the second cycle (cycle 1: 18.2 h, cycle 2: 11.4 h, cycle 3: 13.9 h, cycle 4: 16.0 h).

White et al. (1991) found that juvenile brown trout repeatedly exposed to 118% TDG, with 30 d recovery intervals between exposures, developed more severe GBT with each successive exposure. The formation of gas bubbles from previous exposures appeared to lead to faster onset of GBT symptoms during subsequent exposures and tissue damage from earlier exposures may have weakened fish, resulting in increased vulnerability to TDG.

McGrath et al. (2006) discusses the uncertainties associated with repeated and chronic exposures to supersaturated water conditions. The body of literature can be conflicting, where in some studies previous exposure to TDG followed by depth compensation prolonged mortality (Knittel et al. 1980; Fidler 1988; Antcliffe et al. 2002), while other studies indicate decreased resistance (Ebel et al. 1971; White et al. 1991). Knittel et al. (1980) noted that longer holding times at depth increased survival times when juvenile steelhead were moved to high TDG conditions at the surface.

Recovery from Gas Bubble Trauma

Gas bubble formation under high TDG conditions can result in sublethal and lethal effects to aquatic life. Mortality may be from factors other than GBD itself, such as disease, increased vulnerability to predation, or reduced swimming performance. Rapid dissipation of gas bubbles when aquatic species are removed from supersaturated waters has been reported, suggesting GBT symptoms can be reversed.

Hans et al. (1999) reported rapid disappearance of bubbles in gill filaments (2 h) and lateral line (5 h) after transfer into water at TDG levels of 104%. External bubble formation was largely absent after 48 h, however, some bubbles remained as long as 4 d. Fish activity changed from lethargic to near-normal after 30 min after changing from high to lower TDG conditions. The authors concluded that fish can recover quickly from potentially lethal TDG levels if moved into water in equilibrium with atmospheric gases.

When juvenile steelhead were subject to high TDG levels for durations that were nearly lethal and then moved to deeper depths (3 m), complete recovery occurred in 2 h (Knittel et al. 1980). Elston et al. (1997) reported the disappearance of lateral line bubbles after 30 min, with 50% of bubble coverage absent after 5 min. In gills and fins, gas bubbles were negligible after 5 min and 120 min, respectively. Schiewe (1974) reported normal swimming performances after 2 h in recovery water following 120% TDG treatments.

Northern pikeminnow exposed to TDG levels of 120% N_2 immediately became lethargic and GBT signs appeared on day 3 of exposure at shallow water depths (Meekin and Allen 1974). After 8 d, northern pikeminnow were placed at 100% saturation and immediately became active and resumed feeding.

Some studies implicated mortalities in fish that recovered from exposures to elevated TDG exposures to have acquired fungal infections indirectly resulting from GBT (Weitkamp 1976). Weitkamp (1976) recorded fungal infections in the caudal fin of all dead fish and reported degraded fins in live-cage experiments at Bonneville Dam in peamouth, threespine stickleback (*Gasterosteus aculeatus*), and a largescale sucker. Mortality was 10% for juvenile Chinook salmon that were held at 118-126% TDG for 10 or 20 d and then transferred to 3-4 m depths for 20 d (Weitkamp 1976). Of the 10% of fish that died, most had developed fungal infections of the caudal fin which was attributed to lesions in the region that may have been associated with GBT. Jensen (1974) also suggested GBT lesions may have been associated with fungal infections in largemouth bass. Toner and Dawley (1995) acknowledged that caudal fins may be susceptible to secondary fungal infections of GBT damaged tissues and Lutz (1995) linked fin rot and infection to chronic GBT.

Chronic exposure to high TDG levels has been linked to increased susceptibility to infections that may subsequently lead to mortality. Huchzermeyer (2003) suggested that impact on GBT on vulnerability to fungal infections is underestimated. When rainbow trout were exposed to TDG levels at less than 120% in combination with Renibacterium salmoninarum infection (bacterial kidney disease), time to mortality was shortened (Weiland et al. 1999). Weiland et al. (1999)

noted that bacterial kidney disease has potential to turn sublethal GBT exposure into a lethal exposure.

Efficacy of Biological Monitoring Programs

Hydropower projects have biological monitoring programs intended to sample adult and juvenile salmonids for the purpose of monitoring GBT impacts from spill on the Snake and Columbia rivers. Criticisms on the methods used in the biological monitoring programs have created uncertainty on whether monitoring methods are adequately capturing GBT symptoms. Furthermore, some studies suggest that symptoms of GBT such as bubble formation may be poorly correlated with TDG levels and that monitoring for GBT may not fully represent the impacts of TDG on aquatic life.

Montgomery Watson (1995) reported that pressurization of juvenile Chinook salmon at pressures experienced by smolt monitoring programs at hydropower projects, can significantly reduce GBT prevalence. Furthermore, Elston et al. (1997) found gas bubble reabsorption during pressurization to occur in a matter of minutes and reported significantly less GBT symptoms. The authors state that current monitoring programs may underestimate the prevalence and severity of GBT to smolts due to pressurization in the smolt bypass system.

Conversely, several studies conducted by Backman and others (Backman et al. 2000; Backman and Evans 2002; Backman et al. 2002) have suggested that smolt monitoring programs overestimate GBT compared with in situ river sampling. Elson et al. (1997b) suggested that smolts need to be monitored immediately for GBT symptoms due to potentially misclassifying lipid structures as gas bubbles. Depths of holding tanks and holding times should be considered when evaluating smolts for GBT symptoms.

The relationship between biological effects of supersaturated waters on aquatic life and the presence of GBT has been questioned. Mesa et al. (2000) described four limitations for using GBT to assess effects of gas supersaturation that included differences in susceptibility of individuals within a species, limited knowledge of the relationship between GBT and TDG exposure concentrations as fish migrate through water systems, persistence of GBT symptoms, and inconsistent relationships between GBT and mortality. Monk et al. (1997) noted that dam passage had complex effects on the incidence of GBT and that GBT severity increased in some individuals and decreased in others. Weiland et al. (1999) suggested that measuring GBT alone may underestimate the effects of high TDG due to the presence of multiple stressors, some of which may have synergistic effects.

A concern with the biological monitoring program is the lack of external GBT symptoms when mortalities have been observed in high TDG conditions. Meekin and Allen (1974) reported that juvenile salmonids did not always show external GBT symptoms when acute toxicity was observed. In a live cage experiment with juvenile rainbow and cutthroat trout, Weitkamp et al. (2003b) observed fish that survived more than 2 d exhibited severe signs of GBT but many fish that died from acute toxicity showed minor or no signs of GBT. Additional research on physiological changes to aquatic live in supersaturated waters may be necessary to determine the full spectrum of TDG related effects and to improve biological monitoring of TDG exposures.

Uncertainty Analysis

There are several uncertainties associated with the science examining the impacts of TDG in aquatic life. Margins of safety or safety factors are often applied when there is uncertainty regarding one or more aspects of the science when developing threshold values for the protection of aquatic life. Setting threshold values or criteria at levels that afford no or little margin of safety has potential to result in less than full protection.

While several studies have collected and examined resident fish (i.e. non-salmonids) for GBT trauma or studied various fish indigenous to the Snake and Columbia rivers in laboratories, several data gaps exist on their life history traits. Knowledge on spawning, early life stage development and movement, coping mechanisms for high TDG conditions, foraging needs, and water column preferences for several resident fish are unknown. To examine potential risks of TDG thoroughly, more information is needed in regards to this information to determine TDG exposure frequency and magnitude, which can then be translated into potential effects. While salmonids are often the focus of research studies in the Snake and Columbia rivers, more information is needed on developing embryos for natural spawning fish that do not return to a hatchery. Wild salmonids continue to decline and thus, further research may be necessary to determine if current TDG levels are having an adverse impact on the salmonidsand steelhead populations in the Snake and Columbia rivers as it relates to energetic reserves, behavior, and spawning success. Little data exists concerning the impacts of TDG or changes in hydrology of the Snake and Columbia rivers on the anadromous lamprey.

Several studies have demonstrated that depth compensation is a mechanism that protects aquatic life from TDG related effects. However, there is controversy whether fish can detect supersaturated waters and purposely depth compensate or if they haphazardly move through the water column to a preferred depth. Moreover, some studies suggest that depth compensation is more efficient for some fish than others. Significant differences in mortality for different fish at the same water depths and TDG levels, suggest that coping mechanisms for high TDG conditions may differ depending on the species.

Finally, several studies have suggested that GBT may not be an appropriate metric to measure TDG related effects. Some researchers found poor relationships between GBT observations and elevated TDG conditions that result in mortality (Meekin and Allen 1974; Weitkamp et al. 2003b). This further brings in question, the efficacy of biological monitoring programs at hydropower projects and whether observations of GBT accurately depicts the health of aquatic life passing through dams or the resident species residing above or below dams.

Evaluation of TDG Alternatives

Alternative 1: No action. Do not issue a short-term modification. The adjusted TDG criteria for the lower eight dams in the Snake and Columbia rivers will remain at 115% in the forebay and 120% in the tailrace for the spill season. A maximum one hour average of 125% TDG should not be exceeded.

Alternative 2: Issue a short-term modification which will remove the forebay criteria and adjust TDG criteria for the lower eight dams in the Snake and Columbia rivers to maintain 120% in the tailrace. This would only be in place for the spring spill season. TDG must not exceed an average of 125% as measured over 2 hours during the 12 highest hourly measurements in a calendar day.

Alternative 3: Issue a short-term modification which will adjust TDG criteria for the lower eight dams in the Snake and Columbia rivers to an average of 125% as measured over 2 hours during the 12 highest hourly measurements in a calendar day.. This would only be in place for the spring spill season.

No Action Alternative

The no action alternative assumes that no short-term modification is provided to further adjust TDG criteria for the Snake and Columbia rivers and aquatic life will be as equally protected as in previous years. However, since 2018 a court order mandated hydropower projects to spill water to the 120% tailrace or the 115% forebay gas caps in 2018, depending on which was more limiting. The order to spill to gas caps effectively increased the duration of exposure to TDG at 120% for the lower Columbia and lower Snake River dams. In previous years, the amount of water spilled over dams in the spring season was controlled by FCRPS BiOp requirements pertaining to spill volume, market demand for power generation, and high flow water input into the system. During high power generation, less spill occurs and lower TDG levels result. The no action alternative does not change the allowable TDG levels in the Snake and Columbia rivers but the duration of exposure, an integral part of determining risk, may change depending on hydropower operations and court orders to spill to gas caps.

Removal of 115% Forebay Criterion and Maintain the 120% Tailrace Criterion

Potential Positive Impacts

2019 spill operations under the Spill Agreement are predicted by the CSS model to provide a small improvement in survival and SARs compared to the 2018 court-ordered spill operations to spill to existing gas caps and a larger improvement in survival compared to 2014 BiOp operations.[22] This is based on a projection that 2019 Spill Agreement operations will result in a reduction in smolts' "powerhouse encounter rate," or the number of dam powerhouses (defined as turbines or bypass systems) a smolt encounters while migrating down river. Spillway passage allows smolts to avoid powerhouses.

2018 operations result in an average of 1.76 dam powerhouses encountered by each smolt, while 2019 Spill Agreement operations will result in an estimated 1.73 powerhouse encounters. That compares to 2.98 powerhouse encounters under 2014 FCRPS BiOp operations, and 1.4 to 1.5 powerhouse encounters expected under the operations expected in 2020 under the Spill Agreement.

Potential Negative Impacts

The primary differences between alternatives 1 and 2 is the removal of the forebay standard of 115%. The forebay requirement of 115% primarily serves as a safety factor to ensure dams will not reach or exceed 120% TDG during the hydropower spill season. If TDG enters the forebay at 115%, then the hydropower project is provided a 5% TDG addition as part of hydropower operations as measured in the tailrace downstream of the project (i.e. 120% TDG tailrace requirement). Furthermore, the forebay requirement requires hydropower projects to consider impacts of their operations on downstream projects.

Removal of 115% forebay requirements could allow for additional spill at each upstream dam. The 120% TDG criterion in the tailrace and one hour average of 125% would remain as the maximum TDG level. The TDG levels are anticipated to increase by the removal of the need to meet the 115% TDG forebay target. The increased duration of exposure at TDG levels of 120% may result in an increased risk of GBT to aquatic life, when water depths or organism's life history traits preclude depth compensation.

The body of literature suggests that when adequate water depths are available (generally 1-2 m or greater) at TDG levels of 115-120%, then depth compensation may be sufficient to protect aquatic life from GBT. When aquatic life are present in waters of 1 m or less at TDG levels of 120%, the likelihood of adverse effects increases, especially for chronic exposures.

The removal of the forebay criteria of 115% may slightly increase the risk of TDG related impacts to aquatic life by increasing the duration of exposure at 120% TDG level. Spilling to 120% TDG over long periods is a concern for chronic effects of TDG on aquatic life, given that data suggests that GBT is more prevalent at lower TDG levels when an exposure is prolonged. Literature suggests that fluctuating TDG levels over multi-day periods may provide some relief from TDG symptoms and that chronic TDG levels maintained at the water quality criterion may present greater risk. The Spill Agreement calls for ramping down spill at each dam well below

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[22] Juvenile Chinook salmon PITPH Index estimates based on Comparative Survival Study (CSS) methods (McCann et al 2015) and https://nptfisheries.shinyapps.io/pitph2/ web application tool.

the spill levels creating 120% TDG for eight hours a day every day during the spring spill season.

Removal of the 115% Forebay Criterion and Change to a 125% Tailrace Criterion

Potential Positive Impacts

Current SARs for Snake River spring/summer Chinook salmon have been 1.1 since 2000.[23] The CSS has modeled expected changes to SARs from spilling to BiOp standards, 115% forebay/120% tailrace, 120% tailrace-only, and 125%. All spill regimes modeled by the CSS are 24 hours, seven days per week. When spill is increased to 125% TDG 24 hours per day/seven days a week in the spring, the CSS predicts a two to 2.5-fold increase in Snake River spring Chinook salmon abundance above the levels resulting from 2014 FCRPS BiOp spill levels,[24] and smaller projected benefits when spilling to existing gas standards or 120% TDG 24 hours per day. Steelhead SARs are also predicted to increase significantly, but less dramatically than Chinook salmon.

Potential Negative Impacts

The removal of the 115% forebay and the 120% tailrace criteria and an allowance of a 125% TDG tailrace criterion effectively increasing the maximum TDG level by 5% in the tailrace and 10% in the forebay. This increase in TDG has the potential to cause additional incidences of GBT and TDG related effects in aquatic life. Data suggests that aquatic life at water depths of 2 m or greater may provide adequate protection when TDG levels are at 125%. However, the ability of fish to sense high TDG levels is unknown and thus, there is uncertainty as to whether aquatic life would be fully protected at the 125% TDG level with adequate depth compensation.

Spilling to higher TDG levels than the current standards over long periods would be a concern for chronic effects of TDG on aquatic life, given that data suggests that GBT is more prevalent at lower TDG levels when an exposure is prolonged. Literature suggests that fluctuating TDG levels over multi-day periods may provide some relief from TDG symptoms.

Salmonid Risk

Salmonid spawning in the main-stem Snake and Columbia rivers primarily occurs below Bonneville Dam, in the Hanford Reach of the Columbia River (above the confluence with the Snake and above the lower Columbia River dams), and in the free-flowing Snake River above Lower Granite Reservoir, the uppermost reservoir on the lower Snake River. Field studies examining early developmental stages of salmonids are limited in the Snake and Columbia rivers. Chum salmon spawn below Bonneville Dam during the early spill season and egg

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[23] CSS 2017 Annual Report at p. 102. http://www.fpc.org/documents/CSS/CSS_2017_Final_ver1-1.pdf
[24] See CSS 2017 Annual Report at xxxi.

incubation and rearing occur throughout the spill season. Giest et al. (2013) stated that the location and depth of Chum salmon redds within the tailwater spawning area can be variable and protection from TDG effects is dependent on depth. Carter et al. (2009) reported Chum alevins sampled in wild redds in the Columbia River had GBT symptoms when depth-compensated TDG exceeded 105%. However, to provide protection managers have set water depths to limit impacts on Chum early life stages. If TDG reached 115% at the surface, then to meet the 105% TDG management goal, 1 m of water is required for adequate depth compensation. Arntzen et al. (2007, 2008, 2009) monitored downstream for Bonneville Dam and found that depth compensated TDG levels can exceed the 105% TDG management guideline when water levels were low but usually for short periods of time.

Juvenile salmonid outmigration in the Snake and Columbia rivers coincides with high river flows from snowpack melt in the spring season. Field monitoring studies are highly variable due to fluctuating TDG conditions that can change TDG exposures on an hourly basis. These highly fluctuating conditions make it difficult to determine TDG exposures to aquatic life and therefore broad generalizations must be made on potential effects. Furthermore, long-term field monitoring studies often summarize data over long study periods that have the potential to mask impacts that occurred within a short time period. Field monitoring studies of outmigration juvenile salmonids highlight the importance of depth compensation at low to moderately high TDG levels (Backman et al. 2002; Duvall et al. 2002; Mesa et al. 1997). However, high incidences of GBT in field monitoring studies have been reported. Hagen et al. (1998) reported GBT signs in 21.5% of sockeye salmon, 9.4% of Chinook salmon, and 8.7% of steelhead at TDG levels ranging from 120-135%. During the summer, when TDG levels dropped to 110-125%, GBT was noted in 2.3% of Chinook salmon. Backman et al. (2002) found GBT symptoms exceeded 15% when TDG levels approached 130% and at <125% TDG, GBT prevalence was below 15%. Maule et al. (1997b) concluded that GBT was not a threat to migrating juvenile salmonids when TDG levels were less than 120%. In a historical analysis of data collected by the Fish Passage Center from 1995-2018, the 15% GBT criterion for juvenile salmonids has been exceeded in only 37 instances of 2,870 samples and 28 instances occurred when TDG was greater than 125% [25].

Field studies that utilized live cages at various depths in ambient waters generally reported a higher incidence of GBT and mortalities than in situ monitoring studies. Live cage studies offer the advantage of controlling depth and assessing GBT incidence with the assumption that depth compensation can be achieved. In a live cage study, Ebel (1969) concluded that at 130-140% TDG, fish must remain below 2.5 m to survive. High mortalities have been recorded in live cages when juvenile Chinook salmon were exposed to 127-134% TDG at depths (up to 4.5 m) expected to be adequate for depth compensation (Ebel 1971). Dawley (1996) observed GBT incidences from 12 to 50% for salmonids held in surface cages and from 0 to 37.5% for salmon held in net pens with depths of 0-4 meters below Ice Harbor Dam. Salmon held in control cages at 1.5 to 2.5 meter depths, had a 10% GBT prevalence when TDG levels averaged 125%. In 1 m deep tanks, mortalities for Chinook and coho salmon were over 80%, while mortalities in the 2.5

[25] http://www.fpc.org/documents/misc_reports/69-18.pdf

m deep tank was less than 9% for both species. While it is recognized that depth compensation can be protective of salmonids, the ability to detect supersaturated waters remains unclear.

Resident Aquatic Species Risk

Salmonids and steelhead often receive more emphasis than other aquatic species when evaluating effects of TDG related to spill. Salmonids and steelhead navigate upstream and downstream past hydropower projects to complete their life cycle and thus, have additional impediments to reproduction and survival compared with resident fish species. Moreover, Pacific salmon are an iconic species and a revered natural resource of the Northwest states and tribes. However, resident fish species must be considered as they are also an important part of the aquatic ecosystem.

In a study where anglers used hook and line to sample resident fish, GBT was observed in 72% of smallmouth bass and 84% of northern pikeminnow. GBT was observed when TDG levels exceeded 115%. The authors noted that even though these resident species have the ability to depth compensate, GBT signs were apparent in a large proportion of fish. This study highlights the lack of knowledge on the interactions between resident fish species life histories, tendencies within the water column, and TDG exposures.

GBT signs have been observed in resident fish when TDG levels reach 120% (Dawley 1996). When TDG levels exceeded 130% TDG, GBT reached a maximum incidence of 11.5% in resident fish. Ryan et al. (2000) reported very few signs of GBT in resident fish when TDG was below 120%. When TDG reached 130% or greater, GBT signs were much more prevalent (about 18%). Studies by Schrank et al. (1997) and Schrank et al. (1998) demonstrated the high variability in GBT symptoms among resident fish at varying TDG levels. In one instance, TDG levels averaging 120% led to daily prevalence of 40.8% GBT in resident fish, while most days GBT levels were relatively low at similar TDG levels. Generally, GBT prevalence increased with TDG but the daily incidences of GBT varied greatly. The high variability observed within field studies exemplifies the difficulties of analyzing field data and compiling data from multiple species with distinct life history traits in a fluctuating environment.

Another factor to be considered when aquatic organisms are exposed to supersaturated conditions is feeding behavior and activity. Meekin and Allen (1974) reported a disinterest in feeding and lethargy of northern pikeminnow exposed to 120% TDG in shallow tanks that preclude depth compensation but a return to normal activity when returned to waters at 100% TDG. Food consumption in the northern pikeminnow was also substantially decreased when comparing exposures of 100% TDG to 126% TDG in a shallow water laboratory study (Bentley and Dawley 1981).

Studies examining non-fish resident species is very limited. Amphibian studies by Colt (1984) suggested that amphibians may be vulnerable to GBT. Tadpoles and other amphibians bound to the aquatic environment may be susceptible to GBT, given they remain near surface waters. However, more information is needed on the prevalence of amphibians in the Snake and Columbia rivers and their sensitivity to TDG.

In aquatic invertebrate studies, cladocerans have emerged as one of the more sensitive invertebrates but incidences of GBT were relatively low at environmentally relevant TDG conditions in the Snake and Columbia rivers. Studies have reported successful emergences for several species at high TDG levels (Nebeker et al. 1981) and low incidences of GBT collected in the Columbia River (Schrank et al. 1997). Nebeker et al. (1981) concluded that all insects were more tolerant to TDG than fish.

Mitigation

Timing and Duration of the Short-term Modification

The short-term modification coincides with the spring freshet when large amounts of runoff enter the Snake and Columbia rivers. During this same time period, the majority of juvenile salmon outmigrate to marine waters and adult spring Chinook and sockeye salmon migrate upstream. Studies have demonstrated that outmigrating juvenile salmonids have higher survival rates in the Snake and Columbia rivers when passed through dams via spillways versus through turbines or smolt bypass systems of hydropower projects (Whitney et al. 1997; Muir et al. 2001). Thus, increasing spill during the spring freshet is expected to improve juvenile salmon fish passage downstream.

The short-term modification will apply seasonally during the time when the majority of juvenile salmon outmigrate to marine waters (see Figures 5-6) for the purpose of improving fish passage and increasing the survival of salmon. The short-term modification will apply during the spring spill season which typically occurs from April through June every year (April 3rd – June 20th in the lower Snake River and April 10th – June 15th in lower Columbia River).

Biological Monitoring

The Smolt Monitoring Program has been collecting data on juvenile fish condition and GBT in the Columbia River Basin since 1995. Since the enactment of the GBT monitoring program in 1995, the action criteria for reduction of spill was defined as greater than 15% of fish showing any signs of GBT, or greater than 5% of fish sampled showing severe signs of GBT (NOAA Biological Opinion 2000). Severe signs of GBT are defined as ≥26% of a fin area occluded with bubbles. This action level incorporates a margin of safety based on studies finding significant mortality does not occur in test fish until approximately 60% of a population is showing signs of GBT (Maule et al. 1997a, 1997b). Spill may be curtailed, if possible, when one or both of these action criteria are met.

Aquatic Life Depth Compensation

This short-term modification allows more spill over dams which can increase TDG levels. Aquatic organisms that are mobile or have life history traits with tendencies for deeper habitats in aquatic systems may have the potential to depth compensate to avoid TDG related effects. The ability to depth compensation enables fish to experience reduced TDG levels at deeper depths when compared with TDG levels in surface waters. Therefore, the ability to move vertically in the water column in response to TDG levels may protect an individual from TDG related effects.

Conclusions

Spill Analysis

Spill Agreement spill to a 120% TDG tailrace-only standard would be simpler for the U.S. Army Corps of Engineers to implement, as it is difficult to manage simultaneously to the 115% forebay/120% tailrace standard. In addition, it would harmonize Washington's standard with Oregon's, creating one standard and measurement methodology for the Corps to implement.

In order to provide revenue neutrality or better hydropower production and associated revenue, the Spill Agreement calls for spilling to 120% TDG in the spring of 2019 for sixteen hours a day, and spilling to lower "performance" spill levels eight hours per day.[26] The CSS model predicts that this operation would provide small survival benefits relative to 2018 injunction operations (spill to existing gas caps 24 hours a day/seven days a week), while BPA predicts that it would provide similar power revenue. 2019 operations would be an incremental step toward a flexible spill operation that would be expanded in 2020 to include flexible spill (i.e. 16 hours of higher spill and eight hours of "performance" spill) to 125% TDG.[27] Flexible spill operations to 125% are predicted by CSS model to improve fish survival and returns relative to 2018 court-ordered operations.

Total Dissolved Gas Analysis

Given that the Snake and Columbia rivers are heavily modified for hydropower and that spilling water over dams benefits the passing of juvenile fish downstream, adjustments have been made to the statewide TDG criterion of 110% in the Snake and Columbia rivers. The relationship between spill and TDG is important in evaluating risk and benefits to aquatic life. The greater amount of spill over dams, the greater the risk of potential TDG related impacts to aquatic life. The notion of increased spill and increased survival of juvenile salmonids has been demonstrated in models. However, continuing to increase spill may eventually lead to diminishing benefits.

Water depths in the Snake and Columbia rivers broadly provide adequate depth to circumvent TDG related impacts, but uncertainties exist on the adverse impacts of high TDG levels to resident species, survival of early developmental stages of resident fish and salmonids, prolonged exposures to elevated TDG levels, and the mechanism of depth compensation for aquatic life.

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[26] See Agreement, Table 1.1, at p. 17.

[27] The Agreement calls for further refinement of proposed 2020 operations. See Agreement at pp. 5-6 and Tables 1.3.a and 1.3.b, at p. 19.

The current criteria adjustment of 115% TDG in the forebay and 120% TDG in the tailrace, presents a marginal risk when considering depth compensation. The removal of the forebay criteria may increase the duration of exposure to higher TDG levels but will not necessarily change the maximum allowable TDG level. Studies demonstrate that the effects of TDG and the incidence of GBT in aquatic life are greater at 125% compared with 120% TDG. Spilling to 125% TDG relies heavily on the ability of aquatic organisms to depth compensate to minimize TDG effects. When evaluating risk to aquatic life at 125% TDG, further research that addresses the uncertainties of the science will help to determine if the potential benefits of spill at 125% TDG outweigh the adverse effects of TDG to salmonids and resident aquatic life.

Decision on Short-term Modification

At this time, Ecology's decision is to remove the 115% forebay criterion for a period up to three years (Alternative 2) during the spring spill season. This action coincides with the Spill Agreement that aims to benefit salmon and hydropower. Additionally, Ecology will adjust the 12 h averaging method to match the State of Oregon's method. This would have little effect in the operations of the federal dams and would ease the spill operations, as well as TDG monitoring and reporting requirements. Washington would require TDG limited by the 12 h average to be conducted using the 12 highest hourly averages in a day rather than the highest average calculated from 12 consecutive hourly averages. The maximum TDG level must not exceed an average of 125% as measured over 2 hours during the 12 highest hourly measurements in a calendar day.

Given that dam and salmon managers have not previously provided voluntary (fish passage) spill to 120% due to the potential for higher TDG levels to increase symptoms of gas bubble trauma in juvenile salmon, steelhead, and non-listed aquatic species; monitoring for gas bubble trauma will continue to be required.

Appendix A: Ecology's Response to Comments on the Draft EIS and Short-term Modification Language

Appendix A contains excerpts from comments received during the draft EIS public comment period, and our responses to the comments. The full comments are in Appendix B.

Commenters were grouped, alphabetically, in the following:

- Tribal Government or Agency Comments
- Individual Comments
- Agency Comments
- Organization Comments

Tribal Government or Agency Comments

Columbia River Inter-Tribal Fish Commission (Faron Scissons)

Comment 1: For several decades, CRITFC has closely participated in technical evaluations of the effects of total dissolved gas (TDG) on salmonids. For example, CRITFC engaged in field studies of gas bubble trauma (GBT) from 1995 to 1999. During this period, CRITFC scientists examined adult fish at Bonneville Dam, including 4,667 chinook, 1,878 sockeye, and 1,431 steelhead, to determine the incidence of relative to TDG levels (Backman, 2002)1. Among other conclusions from this study, adult chinook salmon were rarely observed with GBT. Severe bubbles were observed in less than 1% of the sampled populations of sockeye (15 fish) and steelhead (2 fish) and only when TDG exceeded 126%. Consistent with these and numerous other field observations, less than 2% of fish sampled at levels from 121-125% TDG have shown any signs of GBT.

TDG and GBT data collected since 1995 from were considered in the Coordinated Survival Studies (CSS). CSS examined Snake River spring chinook salmon survival from smolt to adult returns associated with spill and powerhouse avoidance. Among other things, CSS analyses considered the effects of varying spill levels on the adult return of salmon whose juvenile life history experienced high TDG. According to the CSS analyses, we would expect more than a two-fold increase in resulting Snake River spring Chinook salmon abundance when spill is provided for juvenile chinook salmon survival at water volumes associated with 125% TDG CRITFC staff have reviewed and support the comments of the Fish Passage Center (FPC) submitted to Ecology on February 14, 2019. At the direction of the Commission's member tribes and the Pacific Northwest States, the FPC has carefully evaluated TDG effects in the mainstem Snake and Columbia rivers for more than 20 years. As part of the state TDG waivers, biological monitoring for GBT is conducted throughout the Mid-Columbia, Snake, and Lower Columbia rivers. The data are reported to the fisheries management entities and water quality agencies of Washington and Oregon and are available to other interested parties through Fish Passage Center weekly reports and daily postings to the FPC website.

http://www.fpc.org/smolt/gasbubbletrauma.html. We urge Ecology to recognize the significant body of TDG and GBT information that is available in the FPC's annual reports. http://www.fpc.org/documents/FPC_Annual_Reports.html.

> **Ecology Response:** *Thank you for your comment. Ecology has included monitoring data from Backman (2002) and based on comments received, added additional information from the smolt monitoring program, specifically a historical analysis of gas bubble trauma data from 1995-2018. "In a historical analysis of data collected by the Fish Passage Center from 1995-2018, the 15% GBT criterion for juvenile salmonids has been exceeded in only 37 instances of 2,870 samples and 28 instances occurred when TDG was greater than 125%."*

Comment 2: Several comments appended to the DEIS urged Ecology to carefully consider TDG effects on invertebrate species. CRITFC is lending its resources to a multi-agency effort to develop and implement TDG monitoring strategies for aquatic invertebrates. We are coordinating with federal, tribal, and state scientific communities to review the methods that were previously implemented in the Columbia River for flexible spill management.

CRITFC has recently inventoried and implemented methods supporting the development of food web metrics from benthic macroinvertebrate data (Sullivan and White, 2017)3 . We believe that methods we have tested in tributary environments will lend themselves to better understanding of the impact of TDG on invertebrate communities.

> **Ecology Response:** *Thank you for your comment. We look forward to receiving more information regarding TDG monitoring strategies for aquatic invertebrates and further understanding of potential impacts of TDG on the invertebrate community.*

Comment 3: Thank you for preparing the Draft Environmental Impact Statement (DEIS) regarding the short-term modification of total dissolved gas criteria in the Snake and Columbia rivers. At the direction and on behalf of its member tribes, CRITFC has sought improvements in juvenile salmon passage as part of the tribes' comprehensive, gravel-to-gravel life cycle approach to restoring and rebuilding anadromous fish populations throughout the Columbia River Basin. The proposed flex spill operations are consistent with and envisioned by Wy-Kan-Ush-Mi WaKish-Wit, the tribes' Spirit of the Salmon Plan. https://plan.critfc.org/2013/spirit-of-the-salmonplan/technical-recommendations/juvenile-salmon-passage/. The operations will require water quality standard modifications from Washington and Oregon, which we strongly support.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Columbia River Inter-Tribal Fish Commission (Rob Lothrop)

Comment 1: And I will say that CRITFC and its member tribes support the flex bill agreement and we are all involved in its development.

I am here today to say that CRITFC's scientists will be working with its -- our state and federal partners to develop facets of an aquatic ecology monitoring program that has been -- or that will be part of what we see as implementation of this flex bill program as well as the total dissolved gas waiver.

I want to thank Heather and her team for putting this draft environmental impact statement out in a timely fashion and we hope you can conclude it in a timely fashion. It is a good work product and we hope to make it better. We will be submitting extensive technical comments in support of your action for the record. That concludes my statement.

> **Ecology Response**: *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers. We look forward to learning more about the aquatic ecology monitoring program and encourage your involvement in future actions related to TDG criteria in the Snake and Columbia rivers.*

Nez Perce Tribe (Shannon Wheeler)

Comment 1: Clarifying that there are frequently periods of involuntary spring spill at and exceeding 125% TDG, and that data has been collected, e.g., DEIS at 5,16-77; 45-48. This clarification avoids the impression that the effects of spill above the level of the existing TDG standards in Washington are unknown or dangerous.

> **Ecology Response:** *Thank you for your comment. In the "existing spill conditions" section, changes to existing language was made to clarify that involuntary spill frequently occurs: "Involuntary spill also occurs during the spring freshet depending on snowpack to manage the incoming water at hydropower projects."*

Comment 2: Clarifying that the existing evidence and data shows that the incidence of GBT in juvenile salmon is well below existing (conservative) action levels at spill that causes TDG up to 125%, e.g., DEIS at 5;45-48.

> **Ecology Response:** *Thank you for your comment. In the "potential negative impacts of increased spill" section within "juveniles" within "field studies," a sentence was added that summarizes a historical analysis of gas bubble trauma data from the Fish Passage Center smolt monitoring program from 1995-2018: "In a historical analysis of data collected by the Fish Passage Center from 1995-2018, the 15% GBT criterion has been exceeded in only 37 instances of 2,870 samples and 28 instances occurred when TDG was greater than 125%."*

Comment 3: Clarifying that the existing evidence and data shows that above 125% TDG the incidence of GBT increases somewhat in some circumstances but usually does not reach levels of concern until TDG is at or above 130%, e.g., DEIS at 5.

> **Ecology Response:** *Thank you for your comment. The circumstances surrounding a particular TDG level and its effects are dependent on a multitude of factors and the aquatic species present. Examining the body of evidence and uncertainties, overarching conclusions such as the one suggested within your comment could be interpreted as an overgeneralization as it may not account for site-specific factors and all aquatic species.*

Comment 4: Clarifying that the biological opinions referenced from 2008-2014 were held illegal by the courts. DEIS at 16-17.

> **Ecology Response:** *Thank you for your comment. The intent of the "existing spill conditions" section is to explain the context of water spill over dams in previous years. We do not intend to explain details of litigation as it is beyond the scope of the EIS.*

Comment 5: Clarifying relevance of studies on the effects of TDG on early salmonid development and on juveniles, e.g., DEIS at 22-25.

> **Ecology Response:** *Thank you for your comment. The first paragraph of the early development section explains the extend of salmonid spawning in the Snake and Columbia rivers:*
>
> *"Salmonid spawning in the main-stem Snake and Columbia rivers is limited to particular areas due to the lack of suitable habitat and thus, many adults spawn in tributaries of the two rivers and may not be impacted. Dauble and Geist (2000) reported the majority of spawning is concentrated in the Hanford Reach and Hells Canyon reach of the Snake and Columbia rivers. Chinook salmon are not known to spawn in the area encompassing the lower eight federal dams on the Snake and Columbia rivers."*
>
> *We believe this description adequately indicates that salmon and steelhead spawning is limited within the reservoirs of the lower eight federal dams. As mentioned, Chum salmon do spawn below Bonneville Dam. The majority of the early development section focuses on Chum salmon. Some additional information is included to evaluate potential effects to early life stages of salmonids. When there is a paucity of data on one species, often surrogate species are used to determine risk. We believe the information provided within this section, although not specific to the species of interest, improves the evaluation of TDG-related risk to early life stages of salmonids.*
>
> *In the "Juveniles" section context and relevance is provided in the first paragraph: "Juvenile salmonids outmigration in the Snake and Columbia rivers coincides with high river flows from snowpack melt in the spring. Juveniles passing downstream to the Columbia River estuary and marine waters can incur mortality depending on the route of passage through hydropower dams. Juvenile passage may occur through dam turbines, mechanical bypass facilities, or spillway passage. Of the routes available, studies have shown spillway passage is associated with the lowest mortality (Whitney et al. 1997; Muir et al. 2001). Increasing spill over dams has been proposed as a method for increasing survival of outmigrating juvenile salmonids. However, increasing spill can be accompanied by high TDG levels which may have adverse impacts on salmonids."*

Comment 6: Clarifying the relationship between the actual conditions juvenile salmon are.likely to experience with laboratory studies involving continuous exposure to elevated levels of TDG for three weeks to two months, e.g., DEIS at 27-28, or other studies, e.g., DEIS at 40.

> **Ecology Response:** *Thank you for your comment. We believe that the section titled "total dissolved gas studies: laboratory versus field" adequately describes the advantages and disadvantages of laboratory and field studies. The 2018 court order mandate for*

voluntary spill to gas caps have effectively elevated TDG levels for longer durations than pre-2018. Spill to gas caps or the maximum allowable TDG level increases the duration of exposure to elevated TDG levels. Further relaxation of the TDG criteria through this short-term modification may even further increase TDG levels in the Snake and Columbia rivers. An evaluation of chronic effects is essential in evaluating the risk of TDG to aquatic species.

Comment 7: Clarifying that the DEIS is examining all impacts (including, for example, those to smallmouth bass) for the sake of thoroughness, and ensuing in its analysis that examining this impact is not intended to suggest a sense of equivalence between, for example, salmon and non-native fish.

Ecology Response: *Thank you for your comment. When developing or revising water quality standards, Ecology must consider protection of all native aquatic species. The Clean Water Act compels the State to protect all native aquatic life when setting water quality standards. All native fish species are protected by the state water quality standards. Additionally, some invasive species are included in this evaluation because they are resident species and serve as a good metric for effects on other resident species but are not intended to suggest a sense of equivalence. The TDG field studies of resident fish in the Snake and Columbia rivers often included invasive species as well as native resident species. We believe that particular species should not be excluded as it would not fully represent the scope and conclusions of studies that include native resident species.*

Comment 8: Clarifying that the adverse impacts at 120% TDG are minimal, e.g., DEIS at 45

Ecology Response: *Thank you for your comment. The circumstances surrounding a particular TDG level and its effects are dependent on a multitude of factors and the aquatic species present. Examining the body of evidence and uncertainties, overarching conclusions such as the one suggested will not be included as it could be interpreted as an overgeneralization without consideration of site-specific factors and aquatic species.*

Comment 9: Clarifying statements to emphasize the relative, and limited, range of uncertainty, e.g., DEIS at 45-48

Ecology Response: *Thank you for your comment. This statement conflicts with the holistic review of the literature surrounding TDG related effects to aquatic life. While many questions have been answered regarding TDG effects on aquatic life in the Snake and Columbia rivers, several uncertainties remain. We will continue to evaluate data and uncertainties but an overarching statement on limited uncertainty will not be included.*

Comment 10: The Tribe remains confident in the Fish Passage Center's Smolt Monitoring Program ongoing monitoring effort for Gas Bubble Trauma (GBT) in salmonids. This monitoring has documented that TDG levels up to 125% result in GBT symptoms well below thresholds of concern. We expect this monitoring to continue. Controlled management of TDG levels at 120% to or 125% will provide opportunity for further study of GBT in non-salmonid species; we are encouraged that Columbia River Inter-Tribal Fish Commission and others are preparing to expand GBT studies.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers and your support for current and continued monitoring of GBT in salmonids.*

Comment 11: The Tribe has long supported voluntary spill of up to 125% TDG as measured at the tailrace during the spring spill season (from approximately April 1 through June 20) while salmon and steelhead are migrating downstream, based on the best available scientific information about the benefits of spill and the effects of TDG levels. Strong benefits to salmon and steelhead smolt-to adult survival and adult abundance are anticipated from increased spill and subsequent decreased powerhouse encounter rate (PITPH). As the DEIS describes, these benefits do come with some uncertainty/risk associated with exposure of fish and other aquatic biota to elevated TDG levels. However, TDG levels of 120% to 125% are commonly experienced by aquatic biota during periods of uncontrolled spill, without apparent adverse impact to their viability; in sum, there are not significant adverse environmental impacts associated with 125% TDG levels.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Individual Comments

Alderton, Janet

Comment: I support the implementation of this plan to help more juvenile salmon survive their passage from above the dams on the Snake and Columbia Rivers to the down-river waters that connect to the Pacific Ocean. The Endangered Southern Resident Orca Whales travel along the outer coast of North America from Northern California, Oregon, and Washington to the marine waters west of Vancouver Island. They follow the salmon, especially the Chinook. When we help salmon, we are helping the orca whales that are balanced on the edge of extinction.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Bockino, Alida

Comment: I urge you to support the Washington Dept of Ecology''s proposal to increase spill levels on the dams. This proposal, also supported by the Washington Orca Task Force and Gov Jay Inslee, is the best way to improve salmon survival which in turn greatly improves the survival of those few remaining Orcas. The salmon and the orcas need your help, please don't let them down.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Booker, Mark

Comment 1: Spill will steal from our children's future by raising electric power cost for the School Districts throughout our State, without benefit to Migrating fish.

> **Ecology Response:** *Thank you for your comment. The Flexible Spill Agreement is aimed at maintaining a balance between energy demand and water spill for fish passage. Changes to electric power costs is beyond the scope of the short-term modification of total dissolved gas levels in the Snake and Columbia rivers.*

Comment 2: Ocean conditions and harvest do have effect upon returning numbers of Migrating Fish. Study should focus on those areas.

> **Ecology Response:** *Thank you for your comment. We agree that ocean conditions invariably have a large impact on salmon and steelhead returns. However, ocean conditions are complicated, highly variable, and beyond the scope of Ecology actions. The primary purpose of this EIS was to evaluate total dissolved gas levels in relation to aquatic life risk in the Snake and Columbia rivers.*

Comment 3: Increasing flows on the river system has been proven to be counterproductive to migrating fish.

Increasing gas levels only makes migrating fish bare more stress, resulting in limiting natural migrating fish ability to avoid/react to predators in river. Therefore more fish will die by the artificial changing of river operations.

It is near certain that changing river operations in a new way will be counter to migrating fish adaptation to current river operation and all adaptation that has taken place over the past century. I cite the catastrophic summer long spill at the Dalles Dam during the 1990s resulting in 80% mortality of migrating fish for the entire term of the spill. Done under the name of Salmon Recovery.

> **Ecology Response:** *Thank you for your comment. We acknowledge you do not support the proposed short-term modification of the total dissolved gas levels in the Snake and Columbia rivers.*
>
> *The goal of the proposed action seeks a balance between impacts of fish passage through hydropower projects and limiting impacts due to supersaturated waters as a result of water spill over dams. There are currently biological monitoring programs that evaluate the health of salmonids and steelhead as they navigate the Snake and Columbia rivers. Gas bubble trauma monitoring has occurred since 1995 and the action level for reducing spill is defined as when greater than 15% of fish show any signs of gas bubble trauma or 5% of fish show severe signs of gas bubble trauma. If the action criteria are exceeded, spill may be curtailed. This safety net helps ensure that spill is not detrimental to migrating fish. These monitoring programs will continue to be in place whether or not any changes are made to total dissolved gas levels.*

Comment 4: Using spill and River Dam spillways to move migrating fish downstream is short sighted for at least the following reasons: 1. The tremendous turbulence of the ninety foot spill down the spillway will damage any migrating fish very likely beyond survival. 2. The spillway volume of spill flow will certainly distract returning migrating fish likely causing the returning migrating fish to fail to return.
Both the above reasons along with many other reasons are counter to the goal of creating returning migrating fish.
The Business of Salmon Recovery is very different from the Business of recovering Salmon. The Business of Salmon Recovery will steal from our children's future all without benefit to migrating fish.
Mark, from the land of the Mighty Columbia!!

> **Ecology Response:** *Thank you for your comment. We acknowledge you do not support the proposed short-term modification of the total dissolved gas levels in the Snake and Columbia rivers. We welcome any additional information that was not included in the EIS that will assist in evaluating aquatic life risk of increasing total dissolved gas levels in the Snake and Columbia rivers.*
>
> *The goal of the proposed action seeks a balance between benefits of water spill for fish passage through hydropower projects and limiting impacts of TDG to aquatic life. There are currently biological monitoring programs that evaluate the health of salmonids and steelhead as they navigate the Snake and Columbia rivers. Gas bubble trauma monitoring has occurred since 1995 and the action level for reducing spill is defined as when greater than 15% of fish show any signs of gas bubble trauma or 5% of fish show severe signs of gas bubble trauma. If the action criteria are exceeded, spill may be curtailed. This safety net helps ensure that spill is not detrimental to migrating fish. These monitoring programs will continue to be in place whether or not any changes are made to total dissolved gas levels.*

Borden, Melissa

Comment: Orca scientists have made it clear that our Southern Resident Orca (SROs) are in a starvation crisis. Because SROs' diet consists of at least 80% chinook salmon, having an ample chinook salmon population is key for their survival, as well as that of many other species, and indeed, the entire PNW ecosystem. The Columbia/Snake chinook population is crashing this year, with fewer than 50,000 expected to return, about 1/10 of the 10-year average. Accordingly, I urge you to exercise Washington's authority under Clean Water Act section 401 to help ensure the Columbia Basin's federal dam operators take action to reduce rising water temperatures, protect salmon, and help save the Southern Resident orcas from extinction.
When river temperatures exceed 70F for several days at a timeas happens with increasing frequency due to climate changesalmon have difficulty migrating upstream and begin succumbing to stress and disease. According to the Fish Passage Center, an independent government agency, "under a climate change scenario, the long-recognized and largely unaddressed problem of high-water temperatures in the [Columbia and Snake rivers] becomes an ever-increasing threat to the survival of salmon."
On the Columbia and Snake Rivers, hydroelectric dams make the heat pollution even worse. Federal dams on the Columbia and Snake rivers have never obtained water quality certifications

under Section 401 of the Clean Water Actleaving Washington without authority to protect its own water quality and fisheries. Until now.
According to EPA's own draft analysis, summer temperatures in portions of the Columbia and Snake rivers are up by 1.5 degrees Celsius since 1960 because of the combined effects of climate change and dams. Temperatures are so high, sometimes exceeding 70 degrees, that they kill migrating salmon, such as in the sustained hot summer of 2015.
The EPA's own analysis also shows that removing the 4 Lower Snake River dams (LSRDs) would have the most impact on reducing temperatures to the salmon survival range. Removing the 4 LSRDs would also assist with lowering the temperatures behind the 4 mainstem Columbia dams.
The 4 LSRDs are no longer needed for hydropower, as they generate only about 3% of the system's power, which is at about 16% surplus. Nor do they provide any flood control. The irrigation provided at Ice Harbor Reservoir to about 37,000 acres can still be provided post dam breaching via lengthened pipes and additional pumps. It is imperative for the sake of having our SROs and salmon survive that the 4 LSRDs are breached in 2019.
I therefore request that DOE enact water temperature standards that will provide incentives for the federal operator, USACE, to breach the 4 LSRDs to come into compliance with the Clean Water Act and Endangered Species Act. Lower water temperatures in the Columbia and Snake Rivers will help save salmon, orcas, and the entire PNW ecosystem. We in WA state must be leaders, where the federal government is failing to protect our irreplaceable environment and wildlife.

> **Ecology Response:** *Thank you for your comment. Temperature is an important component of determining water quality and the health of aquatic organisms that reside in a water body. Actions related to temperature and dam breaching are beyond the scope of the proposed short-term modification. This action seeks a short-term modification of total dissolved gas levels in the lower eight federal dams in the Snake and Columbia rivers.*

Bostick, Mary

Comment: I strongly support the WA DOE's proposal.The Salish Sea's endangered southern resident orcas once thrived thanks to plentiful thousands of Chinook salmon. Today with Columbia River/Snake River Chinook salmon populations in severe decline, the orcas number just 75 individuals. The most effective, short-term means of increasing Chinook salmon numbers is upping spill levels to what is measured as "125% total dissolved gas" starting NOW in 2019.

Washington's Orca Task Force recommended spill be increased, and Governor Jay Inslee supports that recommendation. Now the WA Dept. of Ecology has officially proposed modifying state "total dissolved gas criteria" to allow for an increase in the two rivers.

I add my support for increased spill, since the Columbia watershed affects Idaho as well!

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Brown, Teresa

Comment 1: If everyone is absolutely unwilling to breach them, then this seems like the next best option, but our SRKW's deserve better treatment from us!

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*
>
> *Dam breaching is beyond the scope of the proposed short-term modification. This action seeks a short-term modification of total dissolved gas levels in the lower eight federal dams in the Snake and Columbia rivers.*

Comment: It is too late for the SRKW's to do an EIS at this point in time. What is needed, AND WANTED by the public is the breaching of the lower snake river dams. No more studies. Time is up! If everyone is absolutely unwilling to breach them, then this seems like the next best option, but our SRKW's deserve better treatment from us! PLEASE LEGISLATORS: BREACH THE DAMS!!

> **Ecology Response:** *Thank you for your comment. Dam breaching is beyond the scope of the proposed short-term modification. This action seeks a short-term modification of total dissolved gas levels in the lower eight federal dams in the Snake and Columbia rivers.*

Burr Arnold, Sarah

Comment: I support the proposed Alternative 2 modification of WAC173-201A TDG Criteria for the dams on the Lower Snake and Columbia Rivers during the spring spill season to help the survival of salmon and orcas. It is of vital importance to the environment to preserve top predators such as orcas and the way to do that is to increase the food supply. Studies indicate that increasing the spill over dams would improve salmon abundance and survival thereby improving the food supply for orcas. In addition salmon as a species separate from their food value should be preserved.

I urge The Department of Ecology to adopt and implement Alternative 2.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Clark, Rynda

Comment: Please modify short term dissolvable gasses criteria to allow more spill from the Snake River dams. The salmon cannot survive current conditions without help. The entire ecosystem is near collapse. Please do what we can to save it.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Coleman, Mary

Comment: Orca scientists have made it clear that our Southern Resident Orca (SROs) are in a starvation crisis. Because SROs' diet consists of at least 80% chinook salmon, having an ample chinook salmon population is key for their survival, as well as that of many other species, and indeed, the entire PNW ecosystem. The Columbia/Snake chinook population is crashing this year, with fewer than 50,000 expected to return, about 1/10 of the 10-year average. Accordingly, I urge you to exercise Washington's authority under Clean Water Act section 401 to help ensure the Columbia Basin's federal dam operators take action to reduce rising water temperatures, protect salmon, and help save the Southern Resident orcas from extinction.

When river temperatures exceed 70F for several days at a timeas happens with increasing frequency due to climate changesalmon have difficulty migrating upstream and begin succumbing to stress and disease. According to the Fish Passage Center, an independent government agency, "under a climate change scenario, the long-recognized and largely unaddressed problem of high-water temperatures in the [Columbia and Snake rivers] becomes an ever-increasing threat to the survival of salmon."

On the Columbia and Snake Rivers, hydroelectric dams make the heat pollution even worse. Federal dams on the Columbia and Snake rivers have never obtained water quality certifications under Section 401 of the Clean Water Actleaving Washington without authority to protect its own water quality and fisheries. Until now.

According to EPA's own draft analysis, summer temperatures in portions of the Columbia and Snake rivers are up by 1.5 degrees Celsius since 1960 because of the combined effects of climate change and dams. Temperatures are so high, sometimes exceeding 70 degrees, that they kill migrating salmon, such as in the sustained hot summer of 2015.

The EPA's own analysis also shows that removing the 4 Lower Snake River dams (LSRDs) would have the most impact on reducing temperatures to the salmon survival range. Removing the 4 LSRDs would also assist with lowering the temperatures behind the 4 mainstem Columbia dams.

The 4 LSRDs are NO LONGER NEEDED for hydropower, as they generate only about 3% of the system's power, which is at about 16% surplus. Nor do they provide any flood control. The irrigation provided at Ice Harbor Reservoir to about 37,000 acres can still be provided post dam breaching via lengthened pipes and additional pumps. It is imperative for the sake of having our SROs and salmon survive that the 4 LSRDs are breached in 2019.

I therefore request that DOE enact water temperature standards that will provide incentives for the federal operator, USACE, to breach the 4 LSRDs to come into compliance with the Clean Water Act and Endangered Species Act. Lower water temperatures in the Columbia and Snake Rivers will help save salmon, orcas, and the entire PNW ecosystem. We in WA state must be leaders, where the federal government is failing to protect our irreplaceable environment and wildlife.

> **Ecology Response:** *Thank you for your comment. Temperature is an important component of determining water quality and the health of aquatic organisms that reside in a water body. Actions related to temperature and dam breaching are beyond the scope of the proposed short-term modification. This action seeks a short-term modification of total dissolved gas levels in the lower eight federal dams in the Snake and Columbia rivers.*

Colton, Tim

Comment 1: I'm glad to see WA State increase spill levels through Columbia River System Dams during salmon out-migration. This is an important short term step to increasing salmon populations in the Columbia watershed.

Ecology Response: *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Comment 2: I do believe that more drastic measures, such as dam removal, are necessary to recover the ecosystem and sustain healthy salmon populations in the watershed.

Ecology Response: *Thank you for your comment. Dam breaching is beyond the scope of the proposed short-term modification. This action seeks a short-term modification of total dissolved gas levels in the lower eight federal dams in the Snake and Columbia rivers.*

Fosback, Rodney

Comment: Start with Boundary Dam; doesn't matter who owns it.

Next: Where is all the electricity going to come from for all the electric cars planned, with tax payer money, for the future? And please, don't say more wind mill generators. Those inefficient monsters have destroyed the landscape of Eastern Washington. More Nuke energy? Get real.

I understand public comments are only taken to make what you plan to do legal. Doesn't make it right though.

Short term usually morphs into long term.

Ecology Response: *Thank you for your comment. We acknowledge you do not support the proposed short-term modification of the total dissolved gas levels in the Snake and Columbia rivers.*

Changes to sources of electric power are beyond the scope of the short-term modification of total dissolved gas levels in the Snake and Columbia rivers. Ecology's focus is evaluating the risk of increasing total dissolved gas levels to aquatic life.

Garrett, Howard (Orca Network)

Comment 1: I support increasing the dissolved gas levels to 125% and the duration of spills to help smolts get downstream, despite the potential cumulative deleterious impacts to all fish downstream that may weaken them, impairing their abilities to function, at least temporarily.

Ecology Response: *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Comment 2: The only real solution is to breach the 4 Snake River dams but that is blocked to sustain the massive federal payouts to the Columbia Basin Federal Caucus that in turn supports the regional economy.

Ecology Response: *Thank you for your comment. Dam breaching, which you also referenced in your attached letter, is beyond the scope of the proposed short-term modification. This action seeks a short-term modification of total dissolved gas levels in the lower eight federal dams in the Snake and Columbia rivers.*

Gelegonya, Carrie

Comment 1: I support increasing spill over the dams of the Columbia and Snake Rivers in order to help more salmon to survive. Our Southern Resident Orcas are in immediate danger of starving to death due to lack of salmon.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Comment 2: While breaching the dams would be preferable, increasing spill is a good stopgap measure for the time being.

> **Ecology Response:** *Thank you for your comment. Dam breaching is beyond the scope of the proposed short-term modification. This action seeks a short-term modification of total dissolved gas levels in the lower eight federal dams in the Snake and Columbia rivers.*

Harrison, Angela

Comment: We need to do whatever is necessary to restore our environment. Increasing the spill may be a good start but please consider doing more. This solution seems to be a half hearted and politically motivated.

The environment is the economy and we are ruining it quickly ruining it.

Yes , I am in favor of increasing spill, but we need more now!!

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Home, Cathy

Comment 1: Yew, increase spill on all the dams.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Comment 2: Yes, dam removal on the lower 4 snake river dams is good place to start.

> **Ecology Response:** *Thank you for your comment. Dam breaching is beyond the scope of the proposed short-term modification. This action seeks a short-term modification of total dissolved gas levels in the lower eight federal dams in the Snake and Columbia rivers.*

Iriye, Kelly

Comment 1: Please breach the Snake River in 2019! Otherwise, you are guaranteeing the extinction of the southern resident endangered orcas, followed swiftly by the salmon and steelhead.

Ecology Response: *Thank you for your comment. Dam breaching is beyond the scope of the proposed short-term modification. This action seeks a short-term modification of total dissolved gas levels in the lower eight federal dams in the Snake and Columbia rivers.*

Comment 2: This past year, spill caused Adult mortality because the dissolved gas started causing bubbles under their skin. Then the force of the spilled water and current literally blasted their faces off - why are we trying to save the babies if we're going to kill the adults?

Ecology Response: *Thank you for your comment. We are receptive to additional information that was not included in the EIS that discusses impacts of total dissolved gas to adult salmonids and steelhead. The available biological monitoring data for adult salmon suggests a low incidence of gas bubble trauma at total dissolved gas levels up to 120% when accounting for depth compensation. We will continue to evaluate risks of TDG to aquatic life against the benefits of fish passage.*

Comment 3: Orca scientists have made it clear that our Southern Resident Orca (SROs) are in a starvation crisis. Because SROs' diet consists of at least 80% chinook salmon, having an ample chinook salmon population is key for their survival, as well as that of many other species, and indeed, the entire PNW ecosystem. The Columbia/Snake chinook population is crashing this year, with fewer than 50,000 expected to return, about 1/10 of the 10-year average. Accordingly, I urge you to exercise Washington's authority under Clean Water Act section 401 to help ensure the Columbia Basin's federal dam operators take action to reduce rising water temperatures, protect salmon, and help save the Southern Resident orcas from extinction.

When river temperatures exceed 70F for several days at a timeas happens with increasing frequency due to climate changesalmon have difficulty migrating upstream and begin succumbing to stress and disease. According to the Fish Passage Center, an independent government agency, "under a climate change scenario, the long-recognized and largely unaddressed problem of high-water temperatures in the [Columbia and Snake rivers] becomes an ever-increasing threat to the survival of salmon."

On the Columbia and Snake Rivers, hydroelectric dams make the heat pollution even worse. Federal dams on the Columbia and Snake rivers have never obtained water quality certifications under Section 401 of the Clean Water Actleaving Washington without authority to protect its own water quality and fisheries. Until now.

According to EPA's own draft analysis, summer temperatures in portions of the Columbia and Snake rivers are up by 1.5 degrees Celsius since 1960 because of the combined effects of climate change and dams. Temperatures are so high, sometimes exceeding 70 degrees, that they kill migrating salmon, such as in the sustained hot summer of 2015.

The EPA's own analysis also shows that removing the 4 Lower Snake River dams (LSRDs) would have the most impact on reducing temperatures to the salmon survival range. Removing the 4 LSRDs would also assist with lowering the temperatures behind the 4 mainstem Columbia dams.

The 4 LSRDs are no longer needed for hydropower, as they generate only about 3% of the system's power, which is at about 16% surplus. Nor do they provide any flood control. The irrigation provided at Ice Harbor Reservoir to about 37,000 acres can still be provided post dam breaching via lengthened pipes and additional pumps. It is imperative for the sake of having our

SROs and salmon survive that the 4 LSRDs are breached in 2019.
I therefore request that DOE enact water temperature standards that will provide incentives for the federal operator, USACE, to breach the 4 LSRDs to come into compliance with the Clean Water Act and Endangered Species Act. Lower water temperatures in the Columbia and Snake Rivers will help save salmon, orcas, and the entire PNW ecosystem. We in WA state must be leaders, where the federal government is failing to protect our irreplaceable environment and wildlife.

> **Ecology Response:** *Thank you for your comment. Temperature is an important component of determining water quality and the health of aquatic organisms that reside in a water body. Actions related to temperature and dam breaching are beyond the scope of the proposed short-term modification. This action seeks a short-term modification of total dissolved gas levels in the lower eight federal dams in the Snake and Columbia rivers.*

Jensen, Darrel

Comment: Leave the dams alone!! Shoot the seals!!

> **Ecology Response:** *Thank you for your comment. This comment is outside the scope of the short-term modification to the total dissolved gas levels on the Snake and Columbia rivers.*

Johnson-Choong, Shelly

Comment: I am in favor of the flexible spill agreement for the salmon season of 2019 through 2021 for the eight federal dams on the lower Snake and Columbia rivers. However, I see this as a temporary and short-term solution with the need for the Snake River dams to be completely dismantled.

These dams are not only responsible for endangering the Chinook Salmon runs, which feed the Southern Resident Orca population in the Salish Sea, but they alter the whole ecosystem of the Pacific Northwest, and the ecosystem is crucial to our economy.

These rivers must be restored through dam removal if we are to recover our salmon population and the ecosystem that supports them and the whole of the Pacific Northwest.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*
>
> *Dam breaching is beyond the scope of the proposed short-term modification. This action seeks a short-term modification of total dissolved gas levels in the lower eight federal dams in the Snake and Columbia rivers.*

Jones, Ninette

Comment 1: History reveals that before the construction of the Bonneville Dam that there have always been bottlenecks on the Columbia River where fish would pool and rest and humans and marine mammals could eat them. Historians note log jams, beaver dams, and the great Celilo

Falls is once where the strongest and fastest salmon escaped dip nets and hungry animals from winter until the spring as Chinook salmon ascended the tumultuous river & thunderous & sacred falls. One Hundred and thirty other non human animal species rely on salmon for their very sustenance --not sport. In the Columbia River estuary sea lions and seals could easily feed on fish through the winter until the spring as Mother Nature intended, and there were always enough salmon for the tribal fisheries, abundant populations of bears (grizzly and black), wolves, coyotes, bobcats, lynx, osprey, terns, loons, herons, eagles, mergansers, American dippers, cormorants and on and on that all subsisted in part on differing life histories of salmon and steelhead within the Columbia Basin(B. Mc Millan 2008). Celilo Falls although, created an impassable bottleneck for pinnipeds on the Columbia River.

Moreover, healthy salmon swim faster than sea lions by Mother Nature's design and as history has shown us the Columbia River was once a series of tumultuous swirling, frothy, cold, rolling rapids; rushing to propel, young salmon, down river on their outward migration, towards their adult habitat, the sea. The Columbia River habitat now consists of warming narrow channels and slack water lakes created by the US ACOE hydroelectric dam's reservoirs and now Chinook salmon returning to Idaho's Snake River must pass eight dams twice in their lifetime. National Marine Fisheries now reports a 20% conversion rate for these salmon at each passage facility so the US ACOE providing intentional adequate river flow over the dam in the spring will help push young salmon towards the sea in a timely manner.

Altogether, cold water spilling over the dam helps young fish avoid the dam's turbines, avoid lenthic warming aquatic habitat conditions that now favors non- native piscivorious fish such as small-mouth bass, walleye, channel catfish, northern pike, pike minnow and American shad (NMFS, Sanderson 08) over native cold water fish. Most of the non- native fish- eating fish were and are still intentionally stocked or not, and or released into the Columbia River for sport fishing. And these non native and hatchery fish populations are all well known for competing with the salmon for food and habitat resources and non-native and hatchery fish known for predating heavily on millions and millions of baby salmon as they float down river on their outward migration towards their adult habitat the sea. Non- native fish populations now make up the most abundant populations of fish in the Columbia River estuary. On the other hand what we know about marine mammals is that sea otters, Steller sea lions and southern resident orca populations are all important native key- stone species in the Pacific Northwest bioregion. Sea lions for example are opportunistic eaters and they are breast stroke swimmers and sea lions tend to consume the prey that is most abundant in the estuaries which are now populations of non native and hatchery fish (Sanderson08). The US ACOE observers at the dam have reported that not all sea lions that visit the Bonneville Dam are proficient at catching salmon. In addition, according to sea lion scat samples taken in the lower estuary-- NMFS reports that 90% of the time sea lions diets do not consist of salmon. Sea lions and many other species of marine mammals and Chinook salmon have always called the Columbia River estuary home and both of these species thrived and survived together in huge populations just fine for over ten thousand years in the Columbia River estuary.

In addition, sea lions and other species of marine mammals all have very important jobs to perform in our Pacific Northwest ecology. Attached is a peer reviewed study that compares the difference between human and the sea lion's gut flora and highlights these important differences to show how the sea lion's gut flora are corner stone in the food web for all life in the oceans. Altogether, sea lions have 60 plus micro- biomes that are significantly different than the human micro-biomes and that sea lions and whales are essential nutrient productivity pumps that enhance the health of our rivers, oceans and estuaries. It is now, known, how important top native, non- human animal predators are such as, whales, orcas, wolves, sea otters and steller sea lions that all have the power to potentially influence change across terra and aquatic landscapes down to the plant life, influence the climate, influence the health & distribution of prey, and that removing key stone species can directly influence a river's flow. Native key stone species are very valuable for the Columbia River estuary and losing them will be a great loss for many populations of fish species.

In the end the state of Oregon and Washington waging war on sea lions below the Bonneville Dam and on a Superfund site called the Willamette River undermines the productivity of the food- web in the Columbia River estuary and her tributaries; it does not enhance it (trophic cascades). Top key stone species like steller sea lions, sea otters and southern resident orcas keep the health of the Pacific Northwest ecology in check by predating on the weak, the sick, the old, the injured, NIS and hatchery fish. Steller sea lions and southern resident orca are both important species in providing food for scavengers and for promoting estuary health -- the sea lion's gut flora creates fish food and these animals bring life enhancing nutrients into the estuary and up river. The presence and protection of many populations of marine mammal species in the Columbia River estuary is corner stone in protecting and enhancing the productivity of the food web, and important for strengthening the hearts, minds and strengthening the very genetics of the native wild cold water fish.

> **Ecology Response:** *Thank you for your comment. This comment is outside the scope of the short-term modification to the total dissolved gas levels on the Snake and Columbia rivers.*

Comment 2: As well, the US ACOE intentionally, providing adequate spill of cold flowing river water over their eight dams in the spring is a positive step towards ensuring the survival for many, many human and non-human animal species in the Columbia River estuary for many future generations to come.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Kerr, Laurie

Comment: Orca scientists have made it clear that our Southern Resident Orca (SROs) are in a starvation crisis.
Because SROs' diet consists of at least 80% chinook salmon, having an ample chinook salmon population is key for their survival, as well as that of many other species, and indeed, the entire PNW ecosystem. The Columbia/Snake chinook population is crashing this year, with fewer than 50,000 expected to return, about 1/10 of the 10-year average. Accordingly, I urge you to exercise Washington's authority under Clean Water Act section 401 to help ensure the Columbia Basin's federal dam operators take action to reduce rising water temperatures, protect salmon, and help save
the Southern Resident orcas from extinction.

When river temperatures exceed 70F for several days at a time as happens with increasing frequency due to climate change, salmon have difficulty migrating upstream and begin succumbing
to stress and disease. According to the Fish Passage Center, an independent government agency, "under a climate change scenario, the long-recognized and largely unaddressed problem of high-water temperatures in the [Columbia and Snake rivers] becomes an ever-increasing threat to the survival of salmon."
On the Columbia and Snake Rivers, hydroelectric dams make the heat pollution even worse. Federal dams on the Columbia and Snake rivers have never obtained water quality certifications under Section 401 of the Clean Water Act leaving Washington without authority to protect its own
water quality and fisheries. Until now.
According to EPA's own draft analysis, summer temperatures in portions of the Columbia and Snake rivers are up by 1.5 degrees Celsius since 1960 because of the combined impacts of climate change and dams. Temperatures are so high, sometimes exceeding 70 degrees, that they kill migrating salmon, such as in the sustained hot summer of 2015.
The EPA's own analysis also shows that removing the 4 Lower Snake River dams (LSRDs) would most effectively reduce temperatures to the salmon survival range. Removing the 4 LSRDs would also assist with lowering the temperatures behind the 4 mainstem Columbia dams. The 4 LSRDs are no longer needed for hydropower; they generate only about 3% of the system's power, which is at about 16% surplus. Nor do they provide any flood control. The irrigation provided at Ice Harbor Reservoir to about 37,000 acres can still be brought about post dam breaching via lengthened pipes and additional pumps. It is imperative for the sake of having our SROs and salmon survive that the 4 LSRDs be breached in 2019.
I therefore request that DOE enact water temperature standards that will provide incentives for the federal operator, USACE, to breach the 4 LSRDs to come into compliance with the Clean Water Act and Endangered Species Act. Lower water temperatures in the Columbia and Snake Rivers will help save salmon, orcas, and the entire PNW ecosystem. We in WA state must be leaders, while the federal government is failing to protect our irreplaceable environment and wildlife.

> **Ecology Response:** *Thank you for your comment. Temperature is an important component of determining water quality and the health of aquatic organisms that reside in a water body. Actions related to temperature and dam breaching are beyond the scope of the proposed short-term modification. This action seeks a short-term modification of total dissolved gas levels in the lower eight federal dams in the Snake and Columbia rivers.*

Koch, Jacqueline

Comment: We need action now -- More spill to ensure greater salmon returns. I am a longtime resident and the chinook salmon and orca are our living national treasure. We cannot allow these endangered species face extinction on our watch. Near term, the only option is more spill -- so the orcas don't starve. In collective shock and sadness, last summer we watch a mother orca push her dead calf through the waters of Puget Sound. We must act. Now the Dept of Ecology is in the process of modifying state rules to allow for higher levels of spill starting in 2019 – in time for the spring out-migration of juvenile salmon in early April.

Ecology Response: *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

L�, Aim�e

Comment 1: I support increasing spill over the dams, at 125% total dissolved gas as recommended by Orca Task Force, or at least 120%, of the Columbia and Snake Rivers in order to help more salmon to survive. The dissolved gas would need to be adjusted if other organisms suffer. Our Southern Resident Orcas are in immediate danger of starving to death due to lack of salmon.

Ecology Response: *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Comment 2: Removing the dams should be the next step.

Ecology Response: *Thank you for your comment. Dam breaching is beyond the scope of the proposed short-term modification. This action seeks a short-term modification of total dissolved gas levels in the lower eight federal dams in the Snake and Columbia rivers.*

Lafferty, Amy

Comment: I support increasing the total dissolved gas levels for the Columbia and Snake Rivers.

Ecology Response: *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Margo, JoAnn

Comment: Orca scientists have made it clear that our Southern Resident Orca (SROs) are in a starvation crisis. Because SROs' diet consists of at least 80% chinook salmon, having an ample chinook salmon population is key for their survival, as well as that of many other species, and indeed, the entire PNW ecosystem. The Columbia/Snake chinook population is crashing this year, with fewer than 50,000 expected to return, about 1/10 of the 10-year average. Accordingly, I urge you to exercise Washington's authority under Clean Water Act section 401 to help ensure the Columbia Basin's federal dam operators take action to reduce rising water temperatures, protect salmon, and help save the Southern Resident orcas from extinction.
When river temperatures exceed 70F for several days at a time as happens with increasing frequency due to climate change salmon have difficulty migrating upstream and begin succumbing to stress and disease. According to the Fish Passage Center, an independent government agency, "under a climate change scenario, the long-recognized and largely unaddressed problem of high-water temperatures in the [Columbia and Snake rivers] becomes an ever-increasing threat to the survival of salmon."
On the Columbia and Snake Rivers, hydroelectric dams make the heat pollution even worse. Federal dams on the Columbia and Snake rivers have never obtained water quality certifications under Section 401 of the Clean Water Act leaving Washington without authority to protect its own water quality and fisheries. Until now.

According to EPA's own draft analysis, summer temperatures in portions of the Columbia and Snake rivers are up by 1.5 degrees Celsius since 1960 because of the combined effects of climate change and dams. Temperatures are so high, sometimes exceeding 70 degrees, that they kill migrating salmon, such as in the sustained hot summer of 2015.
The EPA's own analysis also shows that removing the 4 Lower Snake River dams (LSRDs) would have the most impact on reducing temperatures to the salmon survival range. Removing the 4 LSRDs would also assist with lowering the temperatures behind the 4 mainstem Columbia dams.
The 4 LSRDs are no longer needed for hydropower, as they generate only about 3% of the system's power, which is at about 16% surplus. Nor do they provide any flood control. The irrigation provided at Ice Harbor Reservoir to about 37,000 acres can still be provided post dam breaching via lengthened pipes and additional pumps. It is imperative for the sake of having our SROs and salmon survive that the 4 LSRDs are breached in 2019.
I therefore request that DOE enact water temperature standards that will provide incentives for the federal operator, USACE, to breach the 4 LSRDs to come into compliance with the Clean Water Act and Endangered Species Act. Lower water temperatures in the Columbia and Snake Rivers will help save salmon, orcas, and the entire PNW ecosystem. We in WA state must be leaders, where the federal government is failing to protect our irreplaceable environment and wildlife.

> **Ecology Response:** *Thank you for your comment. Temperature is an important component of determining water quality and the health of aquatic organisms that reside in a water body. Actions related to temperature and dam breaching are beyond the scope of the proposed short-term modification. This action seeks a short-term modification of total dissolved gas levels in the lower eight federal dams in the Snake and Columbia rivers.*

Mitchell, Terri

Comment 1: I fully support the proposal to allow more spill in the Columbia and Snake Rivers, at 125% total dissolved gas as recommended by Orca Task Force, or at least 120% if this lower rate would allow the proposal to move forward this year without delay.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Comment 2: In lieu of breaching the lower Snake River Dams, we must pursue all actions that will result in more salmon from these systems.

> **Ecology Response:** *Thank you for your comment. Dam breaching is beyond the scope of the proposed short-term modification. This action seeks a short-term modification of total dissolved gas levels in the lower eight federal dams in the Snake and Columbia rivers.*

Moore, Ellen

Comment: Please do what is needed (permitting salmon to move as freely as possible) to increase their numbers for our orca. Please do this with speed too. Unlike climate change, this is NOT a political issue and we shouldn't take sides. This is something that helps us all.

Ecology Response: *Thank you for your comment. We acknowledge your support for improved fish passage.*

Moore, Samantha

Comment: This is an easy decision to make with big short-term impact. Please make the right call here.

Ecology Response: *Thank you for your comment. We acknowledge your support for increasing*

Nicoletta, Molly

Comment: Yes! More spill! I am in favor of that and breaching Washington dams to save our salmon. Orcas are starving. We need more salmon available for them to survive.

Ecology Response: *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Nystrom, Ranell

Comment: Orca scientists have made it clear that our Southern Resident Orca (SROs) are in a starvation crisis. Because SROs' diet consists of at least 80% chinook salmon, having an ample chinook salmon population is key for their survival, as well as that of many other species, and indeed, the entire PNW ecosystem. The Columbia/Snake chinook population is crashing this year, with fewer than 50,000 expected to return, about 1/10 of the 10-year average. Accordingly, I urge you to exercise Washington's authority under Clean Water Act section 401 to help ensure the Columbia Basin's federal dam operators take action to reduce rising water temperatures, protect salmon, and help save the Southern Resident orcas from extinction.

When river temperatures exceed 70F for several days at a timeas happens with increasing frequency due to climate changesalmon have difficulty migrating upstream and begin succumbing to stress and disease. According to the Fish Passage Center, an independent government agency, "under a climate change scenario, the long-recognized and largely unaddressed problem of high-water temperatures in the [Columbia and Snake rivers] becomes an ever-increasing threat to the survival of salmon."

On the Columbia and Snake Rivers, hydroelectric dams make the heat pollution even worse. Federal dams on the Columbia and Snake rivers have never obtained water quality certifications under Section 401 of the Clean Water Actleaving Washington without authority to protect its own water quality and fisheries. Until now.

According to EPA's own draft analysis, summer temperatures in portions of the Columbia and Snake rivers are up by 1.5 degrees Celsius since 1960 because of the combined effects of climate change and dams. Temperatures are so high, sometimes exceeding 70 degrees, that they kill migrating salmon, such as in the sustained hot summer of 2015.

The EPA's own analysis also shows that removing the 4 Lower Snake River dams (LSRDs) would have the most impact on reducing temperatures to the salmon survival range. Removing the 4 LSRDs would also assist with lowering the temperatures behind the 4 mainstem Columbia dams.

The 4 LSRDs are no longer needed for hydropower, as they generate only about 3% of the system's power, which is at about 16% surplus. Nor do they provide any flood control. The irrigation provided at Ice Harbor Reservoir to about 37,000 acres can still be provided post dam breaching via lengthened pipes and additional pumps. It is imperative for the sake of having our SROs and salmon survive that the 4 LSRDs are breached in 2019.

I therefore request that DOE enact water temperature standards that will provide incentives for the federal operator, USACE, to breach the 4 LSRDs to come into compliance with the Clean Water Act and Endangered Species Act. Lower water temperatures in the Columbia and Snake Rivers will help save salmon, orcas, and the entire PNW ecosystem. We in WA state must be leaders, where the federal government is failing to protect our irreplaceable environment and wildlife.

> **Ecology Response:** *Thank you for your comment. Temperature is an important component of determining water quality and the health of aquatic organisms that reside in a water body. Actions related to temperature and dam breaching are beyond the scope of the proposed short-term modification. This action seeks a short-term modification of total dissolved gas levels in the lower eight federal dams in the Snake and Columbia rivers.*

O'Brien, Daniel

Comment: Please take down the lower snake river dams because we really have to save the chinook salmon and the southern resident orcas who eat them for food. This is an emergency.

> **Ecology Response:** *Thank you for your comment. Dam breaching is beyond the scope of the proposed short-term modification. This action seeks a short-term modification of total dissolved gas levels in the lower eight federal dams in the Snake and Columbia rivers.*

Pinney, Chris

Comment 1: I hesitantly applaud Ecology on their cautious recommendation for maintaining 120% TDG standard in tailwaters, at least for 2019. SAR estimates are informative, but limited due to their complex derivation of most influential causation. FPC and others need to address the reach and systemwide juvenile survivals while incorporating all dam (project) specific survivals for those variations in flow years for which studies are available. My experience and 2018 spill operation (which did not achieve the desired low end PITPH because flows required high powerhouse operation) study indicates that spill up to, but not exceeding 125% TDG with minimal PITPH

> **Ecology Response:** *Thank you for your comment. The information provided will be considered in current and future decisions regarding the total dissolved gas levels in the Snake and Columbia rivers.*

Comment 2: I support the DEIS Alternative 1, and better yet, Ecology taking a more active leadership role for the states of Washington and Oregon in regional salmon and steelhead survival and recovery management forums for wild stock production management by avoiding enhanced ecosystem impacts of any elevated %TDG >110% supersaturation (especially systemwide) by your serious consideration of an Alternative 4 for both water temperature and gas supersaturation regulation in a most haste return to natural river function with re-connection of the channel flow to its subsurface flowing water bodies (water table, hyporheic base flow, spring, acquifer, etc) on as wide of continuum footprints as permanent or seasonally possible.

> **Ecology Response:** *Thank you for your comment. The current science suggests improved fish passage from some level of water spill over dams. However, Ecology seeks to find the balance between benefits of spill for fish passage and limiting impacts of total dissolved gas on aquatic life. We will continue to weigh the risk versus the benefits in evaluating total dissolved gas levels in the Snake and Columbia rivers.*

Pinson, Luan

Comment: Please up the spill level in both the Columbia & Lower Snake River as well as breaching the dams on the 4 LSDs to save Salmon and the Southern Orcas.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*
>
> *Dam breaching is beyond the scope of the proposed short-term modification. This action seeks a short-term modification of total dissolved gas levels in the lower eight federal dams in the Snake and Columbia rivers.*

Rathmann, Pat

Comment: In order to protect the orca population it is necessary to provide adequate salmon. Breaching the lower Snake River dams will accomplish this.

> **Ecology Response:** *Thank you for your comment. Dam breaching is beyond the scope of the proposed short-term modification. This action seeks a short-term modification of total dissolved gas levels in the lower eight federal dams in the Snake and Columbia rivers.*

Richter, Joanne

Comment: I strongly support increasing spill levels at the four Lower Snake River dams to the 125% total dissolved gas limit. The Salish Sea's endangered southern resident orcas once thrived thanks to plentiful thousands of Chinook salmon. Today with Columbia River/Snake River Chinook salmon populations in severe decline, the orcas number just 75 individuals. The most effective, short-term means of increasing Chinook salmon numbers is upping spill levels.

For many years conservationists have pushed for and won settlements to increase spill levels.. Last year, Washington's Orca Task Force recommended spill be increased, and Governor Jay Inslee supports that recommendation. I applaud the WA Dept. of Ecology's proposal to modifying state "total dissolved gas criteria" to allow for an increase in both the Columbia and Snake river systems. This action promises to have a beneficial impact on salmon migration this year.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Roebuck, Lynn

Comment: I support the recommendation of the Orca Task Force to increase the state's TDG rate to 125% and urge you to implement this change for 2019.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Seward, MaryAnn

Comment: I fully support your development of an EIS that, at least in the short-term, modifies WAC 173-201A.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Siler, Elizabeth

Comment: Spill the water. Save the salmon. Save the orcas. Can WA state really afford the awful worldwide publicity of pictures of a starving orca mother carrying a starved dead orca baby for two weeks? These are iconic animals. Do what us needed to SPILL THE WATER AND FEED THEM!

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Smith, Rene

Comment: Increased spill at dams on the Columbia and Snake R. systems is an effective way to increase the number of Chinook salmon moving through these rivers.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Spangrude, Gene

Comment: My comments, including three (3) PDF attachments, are focused towards the 'historical conditions' of the Lower Columbia River Basin, including the Lower Snake River.

Salmon related issues have been long documented and presented in various Reports, including Federal Government documents. Excerpts from two Federal Documents dating from the 1870's and 1890's are part of my submittal; and illustrate the historical presence of these concerns. Included within one report is a map showing the extent of Salmon presence based on field visits made during that era.

In the mid-1870's, 'Water Temperature Data' was briefly collected on the Lower Columbia River downstream of Portland, Oregon; and as can be noted from a table in the report prepared even in the 1870's 'Water Temperatures exceeded 68 Degrees F' on the Lower Columbia River; and no apparent concern was expressed over this condition; which was experienced long before the construction of Lower Columbia or Lower Snake River Projects. This data is included in my 1870's era report attached.

Another attached document lists various publications which have been written since the 1800's about various Salmon issues within the Columbia River Basin.

Another attached document presents several years of Lower Snake River Water Temperature data; which was collected in the 1950's; prior to the construction of the Lower Snake River Projects. Even in its 'un-dammed condition' Lower Snake River water temperatures exceeded 68 Degrees F Standard on an annual basis.

I request that 'historical pre-project information' about the Lower Columbia and Lower Snake Rivers be made a legitimate part of the current Regional Discussions about these two Rivers.

> **Ecology Response:** *Thank you for your comment. While a historical context to water temperature is important, the focus of this action is on the modification to total dissolved gas levels and the risk to aquatic life. Potential indirect effects of increasing spill include reduced water temperature by increased flows (McCann et al. 2015). A temperature evaluation on the Snake and Columbia rivers is outside the scope of the short-term modification to total dissolved gas levels.*

Staples, Brad

Comment: Please look at increased spill through the Columbia River Hydro System to flush migrating Salmon & Steelhead juveniles over the Dam's Spillways, instead of through the turbines. I know that there is a risk of Gas Bubble Trauma that can cause increased mortality, but I believe that the risks are worth it, as that more fish will make it to the Estuary safely.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Stefanoff, Ashley

Comment: Orca scientists have made it clear that our Southern Resident Orca (SROs) are in a starvation crisis. Because SROs' diet consists of at least 80% chinook salmon, having an ample chinook salmon population is key for their survival, as well as that of many other species, and indeed, the entire PNW ecosystem. The Columbia/Snake chinook population is crashing this year, with fewer than 50,000 expected to return, about 1/10 of the 10-year average. Accordingly, I urge you to exercise Washington's authority under Clean Water Act section 401 to help ensure the Columbia Basin's federal dam operators take action to reduce rising water temperatures, protect salmon, and help save the Southern Resident orcas from extinction.
When river temperatures exceed 70F for several days at a timeas happens with increasing frequency due to climate changesalmon have difficulty migrating upstream and begin succumbing to stress and disease. According to the Fish Passage Center, an independent government agency, "under a climate change scenario, the long-recognized and largely unaddressed problem of high-water temperatures in the [Columbia and Snake rivers] becomes an ever-increasing threat to the survival of salmon."
On the Columbia and Snake Rivers, hydroelectric dams make the heat pollution even worse. Federal dams on the Columbia and Snake rivers have never obtained water quality certifications under Section 401 of the Clean Water Actleaving Washington without authority to protect its

own water quality and fisheries. Until now.
According to EPA's own draft analysis, summer temperatures in portions of the Columbia and Snake rivers are up by 1.5 degrees Celsius since 1960 because of the combined effects of climate change and dams. Temperatures are so high, sometimes exceeding 70 degrees, that they kill migrating salmon, such as in the sustained hot summer of 2015.
The EPA's own analysis also shows that removing the 4 Lower Snake River dams (LSRDs) would have the most impact on reducing temperatures to the salmon survival range. Removing the 4 LSRDs would also assist with lowering the temperatures behind the 4 mainstem Columbia dams.
The 4 LSRDs are no longer needed for hydropower, as they generate only about 3% of the system's power, which is at about 16% surplus. Nor do they provide any flood control. The irrigation provided at Ice Harbor Reservoir to about 37,000 acres can still be provided post dam breaching via lengthened pipes and additional pumps. It is imperative for the sake of having our SROs and salmon survive that the 4 LSRDs are breached in 2019.
I therefore request that DOE enact water temperature standards that will provide incentives for the federal operator, USACE, to breach the 4 LSRDs to come into compliance with the Clean Water Act and Endangered Species Act. Lower water temperatures in the Columbia and Snake Rivers will help save salmon, orcas, and the entire PNW ecosystem. We in WA state must be leaders, where the federal government is failing to protect our irreplaceable environment and wildlife.

> **Ecology Response:** *Thank you for your comment. Temperature is an important component of determining water quality and the health of aquatic organisms that reside in a water body. Actions related to temperature and dam breaching are beyond the scope of the proposed short-term modification. This action seeks a short-term modification of total dissolved gas levels in the lower eight federal dams in the Snake and Columbia rivers.*

Valdez, Ursula

Comment: PNW ecosystems have offered important ecosystem services for centuries, millennia and more. Early human inhabitants of this region, learned so well how to manage their resource use without altering ecosystems in significant ways, and were able to use resources for long times. With the current scientific knowledge and tools that we have today, how is it possible that we keep driving many species of our region and failed at maintaining their habitats and protecting their populations. Considering the importance that iconic species of our region, such as Salmon and Orca whales, why aren't we using the accumulated knowledge to design and support actions that protect these species? Please do use the science, the ancestral knowledge and the vision for the future of our native species and ecosystems. Populations of Pacific salmon and resident Orca Whales need urgent attention and mainly action to stop their concerning decrease. If they go, so many ecosystem services will be negatively affected, not to mention the economic and cultural impact that these species have in the region. Please, it is a moral and intelligent decision to work protecting the habitats and populations of these species, for the future of our region and for our own.

> **Ecology Response:** *Thank you for your comment. Ecology seeks a balance between the benefits of water spill for fish passage through hydropower projects and limiting impacts of total dissolved gas to aquatic life.*

Waddell, Jim

Comment: Yeah, my -- my point is this: When these dams were first built in the '60s and '70s, (inaudible). When the last dam was built, it was seen the spill was killing enormous amounts of salmon in the river because of high dissolved gas levels and that's the sole reason that the other 12 (inaudible) were put in. Now here we are 25 or 30 years later or longer and we are talking about more spill.

Now, the CSS studies, the comparative survival studies, is based on a lot of data for multiple assumptions (inaudible) and stuff like that. That is really -- even with all of those assumptions, we are only seeing very marginal improvements in increased salmon numbers. Now, none of that is sufficient enough to recover orca in short-term or actually recover Chinook in any kind of timeframe.

So -- so the spill that is going on right now and documented in 2018 is not going to have any positive effect on orca recovery. The other thing about 2018 spill is that we are now seeing damage (inaudible) through skin embolisms and what is happening is that these adults when they approach the high-spill regimens and the spillways are losing facial tissue and then become, you know, casualties later on.

We are also seeing a lot more fallback on the dams with adults like we haven't seen since the '90s. And so this, too, is making it impossible for some. We don't -- I don't think the number has been calculated, but some or many adults are not making it back to their hatcheries or native springs.

So the -- the upshot of all of this is that spill is having no positive effect. And, yes, it is costing BPA money in terms of (inaudible) production, but I think the most important thing to remember here is that this -- this idea that this is buying us time is really not accurate. We are out of (inaudible). The only one thing that can make a difference is immediate breaching of the dams this year. And so the point is is that as much as we would think that spill is a solution here, it is not even a short-term solution of anything, much less a long-term solution. That's my comment.

> **Ecology Response:** *Thank you for your comment. The current science suggests improved fish passage from some level of water spill over dams. However, Ecology seeks to find the balance between benefits of spill for fish passage and limiting impacts of total dissolved gas on aquatic life. We will continue to weigh the risk versus the benefits in evaluating total dissolved gas levels in the Snake and Columbia rivers.*

Wenham, Sharon

Comment: Please increase the spill by 125% if you are not going to breech the dams the Orcas eat 4yr old salmon give them a fighting chance and do it now not in 6 months time when it could be to late
Extinction is for life and the lives of the Southern residents are in your hands.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*
>
> *Dam breaching is beyond the scope of the proposed short-term modification. This action*

seeks a short-term modification of total dissolved gas levels in the lower eight federal dams in the Snake and Columbia rivers.

Yake, Bill

Comment: While breaching of selected dams (especially those on the Snake River) is a much better long-term solution, strategically increasing spill and closely monitoring the results is better than nothing. So, I support this effort, but hope that eventually the Snake and Columbia are returned to a substantially more natural state.

Ecology Response: *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Dam breaching is beyond the scope of the proposed short-term modification. This action seeks a short-term modification of total dissolved gas levels in the lower eight federal dams in the Snake and Columbia rivers.

Agency Comments

Bonneville Power Administration (Kieran Connolly)

Comment 1: First, Bonneville would like to emphasize spilling due to lack of market does not necessarily represent a negative market condition, consequently, we recommend revising the following language on page 19:

"Operational spills often occur during dam maintenance for when the ability to pass water through turbines is limited or in a negative market when power demand is low."

And replacing it with: "Operational spills occur when the ability to pass water through the turbines is limited; this could be due to turbine availability or lack of market."

Ecology Response: *Thank you for your comment. We have updated the sentence to reflect your suggestion.*

Comment 2: Second, Bonneville suggests replacing "voluntary spill" throughout the EIS with "juvenile fish passage spill, " which more accurately represents the purpose of the spill operations.

Ecology Response: *Thank you for your comment. Rather than replacing voluntary spill, we have placed "fish passage" in parentheses next to voluntary spill to clarify the purpose of voluntary spill. Furthermore, in the "Spill Operations" section we have provided a description of the purpose of voluntary spill. We believe voluntary spill is a well-recognized and acknowledged term.*

Comment 3: Third, the ladders on the lower Columbia and Snake rivers are predominantly pool and weir (with deep openings referred to as orifices). When observing fish moving in a ladder with pools and weirs, it is easier to observe surface passage behavior moving from pool to pool via weir "jumping" or surface swimming acceleration. Due to limited water transparency, it is more difficult, however, to observe fish using the submerged deep orifices, which fish also use to move from pool to pool. Thus, Bonneville proposes revising the language on page 35:

"Observations have indicated that fish frequently move towards the surface in fish ways."

And replacing it with: "Upstream movement through fish ways (e. g., pool and weirs) can occur by surface passage at weirs or through deep passage orifices between each progressive pool."

> **Ecology Response:** *Thank you for your comment. We have updated the sentence regarding fish movement through fish ladders. "Observations have indicated that fish frequently move towards the surface in fish ways but also pass through deep passage orifices between each progressive pool."*

Comment 4: In terms of the applicability of the total dissolved gas criteria, since the short-term modification will only apply during the spring spill season, Bonneville recommends clarifying that the existing total dissolved gas criteria adjustment will be applicable during summer spill fish passage.

> **Ecology Response:** *Thank you for your comment. The administrative order describes the application of the short-term modification during the typical spring spill season. The use of spill to aid fish passage outside of those general dates may apply the current adjusted criteria in rule.*

Comment 5: Finally, Bonneville would like Ecology to consider adopting the State of Oregon's 105% total dissolved gas shallow water standard with the short-term modification to protect aquatic species in shallow spawning areas. Hamilton Creek and the Ives Island area, downstream of Bonneville Dam on the Washington side, are common spawning areas for Chum and Chinook (see first paragraph on page 23 of the EIS). Adopting the 105% total dissolved gas shallow water standard ensures consistency of water quality standards between Oregon and Washington during the spring spill operation.

> **Ecology Response:** *Thank you for your comment. The proposed short-term modification can be applied to particular areas (i.e. lower eight federal dams) within the Snake and Columbia rivers because existing language within the water quality standards adjusts statewide TDG criteria to aid in fish passage in the Snake and Columbia river reaches of Washington State. To use the short-term modification tool, existing rule language in the water quality standards for spawning would need to be established for TDG criteria in the Columbia River. Implementing a new TDG criteria for a specific area for a new reason (i.e. spawning) would require a formal rulemaking.*

Comment 6: Additionally, Bonneville noticed the EIS and the draft Administrative Order to Modify Adjusted Total Dissolved Gas Criteria (Order) do not currently align on the treatment of the 125% total dissolved gas criteria in the short-term modification. The EIS mentions 125% total dissolved gas will be measured on a one-hour basis, while the Order says it will be measured on a two-hour basis. Washington State Department of Ecology (Ecology) staff stated at the February 13, 2019 public hearing that the intent was to align with Oregon's two-hour basis; thus, Bonneville recommends addressing this inconsistency in the EIS.

> **Ecology Response:** *Thank you for your comment. The "reasonable alternatives, evaluation of TDG alternatives, and decision on short-term modification" sections has been updated to align with the Administrative Order and Oregon's total dissolved gas criteria.*

Oregon Department of Fish and Wildlife (Curt Melcher)

Comment 1: In the draft Environmental Impact Statement for short-term modification of total dissolved gas criteria in the Snake and Columbia rivers (draft EIS), several relatively short-term studies assessing the relationship between incidence of gas bubble trauma (GBT) and total dissolved gas saturation (TDGS) are cited. Largely absent, however, is any detailed treatment of data collected by the SMP. Yet, GBT monitoring associated with the SMP represents observations at multiple Federal Columbia River Power System (FCRPS) projects on the Snake and Columbia rivers, over the span of more than two decades and across a broad range of TDGS levels. Below is a series of plots, based on SMP data, characterizing relationships between GBT and TDGS from 1995–2018. These data indicate that relative to the prescribed 15% (Figure 1) and 5% (Figure 2) action criteria1, GBT does not become problematic until TDGS has exceeded–considerably in many cases–125%. As noted on page 49 of the draft EIS, Maule et al. (1997a, 1997b) "found that significant mortality did not occur in test fish until approximately 60% of the exposed population exhibited bubbles in the fins, or 30% displayed bubbles covering 25% or more of any unpaired fin." (NMFS 2000). Accepting the findings of Maule et al. (1997a, 1997b) or the more conservative current action criteria, SMP data indicate strongly that spill up to at least 125% TDGS is biologically safe for juvenile salmon and steelhead (USACE 2018, FPC 2017).

> **Ecology Response:** *Thank you for the additional information. The data used in the EIS was aimed at peer-reviewed published literature. However, we recognize the value of the smolt monitoring program data and have added an additional sentence in the EIS that summarizes an analysis from 1995-2018: "In a historical analysis of data collected by the Fish Passage Center from 1995-2018, the 15% GBT criterion for juvenile salmonids has been exceeded in only 37 instances of 2,870 samples and 28 instances occurred when TDG was greater than 125%." The document that summarizes the smolt monitoring data is also referenced within the EIS.*

Comment 2: The draft EIS discusses potential ramifications of elevated TDGS resulting from increased spill during controlled conditions. Yet, available information includes many years where conditions during the spring outmigration were uncontrolled; even during these periods of involuntary spill, action criteria generally were not exceeded.

Operational limits commonly drive spill beyond levels specified in regionally collaborated management agreements or to levels that precipitate exceedance of modified water quality standards currently in place (i.e., periods of involuntary spill). Although variable in magnitude, stream run-off volume exceeds the hydraulic capacity of Federal Columbia River Power System (FCRPS) dams for periods in nearly every year. Whatever the length of these annual uncontrolled periods, involuntary spill operations have provided information to assess the existence of direct biological impacts associated with elevated TDGS. The regional process that led to the flexible spill agreement was based, in large part, on the understanding that incremental changes in spill that meets without exceeding 120% in FCRPS tailraces during 2019, and meets without exceeding 125% in 2020 and 2021 will provide a sustained conservation benefit for anadromous fish while supporting the authorized purposes of the FCRPS. Empirical information from periods of involuntary spill, suggesting this benefit over a broad time frame, should be considered in the draft EIS.

> **Ecology Response:** *Thank you for your comment. We considered all empirical information that evaluated the relationship between TDG and impacts to aquatic life important in determining risk regardless of whether the total dissolved gas originated from involuntary or voluntary spill. The EIS focused on impacts of TDG from peer reviewed published literature but also considered robust monitoring programs such as the Fish Passage Center smolt monitoring program in the Snake and Columbia rivers. We have added additional information to the EIS from a report that summarized data from the smolt monitoring program from 1995-2018: "In a historical analysis of data collected by the Fish Passage Center from 1995-2018, the 15% GBT criterion for juvenile salmonids has been exceeded in only 37 instances of 2,870 samples and 28 instances occurred when TDG was greater than 125%." Ecology is receptive to additional information that may not be included in the EIS.*

Comment 3: Adaptive management processes that support the flexible spill agreement should be outlined in more detail.

The flexible spill agreement is supported by an adaptive management process including well established monitoring programs and a tested system for conferral. Given the novelty of the operations outlined in the flexible spill agreement (with enhanced spill to 120% or 125% of TDGS), this system of adaptive management is intended to ensure that any potential unintended negative consequences–including those discussed in the draft EIS–can be mitigated in a timely manner. Animal behavior (e.g., hydrostatic depth compensation) that may help mitigate negative impacts of elevated TDGS are discussed at length throughout the document. The system of adaptive management currently in place will also play a vital role, and should be better defined/highlighted in the body of the draft EIS. This is particularly relevant to discussions of increasing to the 125% gas cap. The draft EIS states: "further research that addresses the uncertainties of the science will help to determine if the potential benefits of spill at 125% TDG outweigh the adverse effects of TDG to salmonids and resident aquatic life." Decades of monitoring and the development of models based on empirical data suggest strongly that the benefits of spill up to at least 125% TDGS outweigh any obvious detriment. Remaining points of uncertainty can best be addressed in an adaptive management framework, where the operation in question is applied in practice and adjustments are made when/if issues (i.e., unintended negative consequences) arise. This concept deserves to be highlighted.

> **Ecology Response:** *Thank you for your comment. We commend the Flexible Spill Agreement for the development of an adaptive management process. However, the evaluation of aquatic life risk from exposure to total dissolved gas levels is independent of the conditions of the Flexible Spill Agreement. The focus of developing adjusted total*

dissolved gas criteria in the Snake and Columbia river is aimed to finding a balance between water spill for fish passage and limiting impacts of total dissolved gas levels to aquatic life. While monitoring and adaptive management is an excellent tool or safety net, determining upfront risks is paramount to making and finalizing a decision. The "evaluating risks of total dissolved gas" and "uncertainty analysis" sections within the EIS describes some of the data gaps needed for a more accurate site-specific evaluation. Monitoring and adaptive management provide sidewalls for total dissolved gas impacts but should not be construed as a surrogate for the science.

Comment 4: The monitoring programs currently in place are effective and provide a basis for learning from the operations proposed in the flexible spill agreement.

Some language in the draft EIS seems to suggest that the current biological monitoring programs are not sufficiently reactive to instances where water quality conditions may be having negative effects on aquatic biota. It has been the long-standing position of managers and scientists in the region that any modification in hydro system operations be accompanied by active monitoring to ensure that negative unintended impacts do not result. It has also been the belief of regional interests that current monitoring programs and methods have provided for an effective alert system; a conclusion that has in the past been reinforced by state and federal water quality agencies. In fact, the recent District Court order–upheld on appeal–was supported in part by the ability of theses monitoring programs to help mitigate for unintended impacts. While the Oregon Department of Fish and Wildlife feels current monitoring efforts are adequate to effectively alert regulatory agencies to any unintended negative consequences, we are also fully supportive of further collaborative discussion to refine programs to better learn from the application of novel operations. We recommend this process include coordination among regional water quality agencies (i.e., ODEQ and EPA) and the working group that developed the flexible spill operation agreement.

As was highlighted when the states of Oregon and Washington previously modified TDGS standards, adaptive learning will be essential to more fully identify how modifications in dam operations relate to the status and trends of Columbia River species. Methods employed under the SMP, for example, will continue to provide timely detection of GBT, serving the regulatory process effectively. In addition to relying on fixed-monitoring approaches or instantaneous measures of condition (e.g., associations between GBT and TDGS), to assess the effectiveness of the additional spill, metrics that characterize life-cycle success must be considered to better understand the outcomes for aquatic biota. With this in mind, effects from enhanced mitigation (e.g., flexible spill) should continue to be evaluated using tools currently available (e.g., reach specific survival, powerhouse passage metrics, and Smolt to Adult Returns) in addition to direct monitoring of GBT. Additional monitoring efforts may contribute to our understanding and help support in-season adaptive management, but should not supplant proven monitoring tools.

Ecology Response: *Thank you for your comment. When evaluating risk, uncertainties are an integral part of an analysis. All aspects of uncertainty related to total dissolved gas impacts, physiological indicators of effects, and monitoring are included within this analysis. We did not intend to suggest current biological monitoring programs are* *inadequate. Recognizing uncertainties provide opportunities for future improvements in an adaptive management process.*

Organization Comments

Fish Passage Center (Michele DeHart)

Comment 1: Throughout the Draft EIS, there are several references to the Comparative Survival Study (CSS) model (or technical analyses conducted by the states and tribes) predicting that the flex spill operation would slightly benefit salmon relative to the 2018 court-ordered operations (pg. 2, 10, 18, 22, 44, 50). Many of these references specifically note that survival rates under the Flex Spill operation will roughly equal (in 2019) or exceed (2020 and 2021) those from the 2018 court-ordered operations. To encourage a clear understanding of the experimental flex spill operation, we recommend that all references to CSS model predictions and other analyses of potential benefits of the flex spill operations are based upon predicted reductions of juvenile salmonid powerhouse passage. CSS analyses indicate that reductions in powerhouse passage are associated with increased juvenile survival (McCann et al. 2018) and increased SARs (McCann et al. 2016, McCann et al. 2017).

> **Ecology Response:** *We believe that the CSS model predictions of reductions of juvenile salmonid powerhouse passage is clearly stated here: "The CSS model considers minimizing powerhouse encounters through measures such as spill or dam removal as critical to reducing "delayed mortality" from hydrosystem passage and ultimately increasing adult salmon and steelhead returns. The CSS model predicts a two to 2.5-fold increase in Snake River spring Chinook salmon abundance above 2014 FCRPS BiOp spill levels when spill is increased to 125% TDG 24 hours per day/seven days a week in the spring, and smaller projected increase at 120% TDG 24 hours per day."*
>
> *We reference juvenile chinook salmon PITPH Index estimates based on CSS methods (McCann et al. 2015) several times throughout the EIS in footnotes. We believe this is reference and description is sufficient to explain CSS analyses and predictions.*

Comment 2: The Draft EIS provides a lengthy review of literature on the effects of total dissolved gas (TDG) on resident and anadromous fish. However, this review only briefly mentions results from the GBT Monitoring that is conducted at FCRPS projects, under the SMP (pg. 27). Furthermore, the single reference to GBT Monitoring data references a 2018 FPC memorandum (FPC 2018a) that highlights results from the most recent 10 years of GBT Monitoring data. The FPC has an agreement with the Corps of Engineers (COE) to summarize, annually, the results from the GBT Monitoring Program. The FPC provides this report to the COE. The COE then includes this report as an Appendix in their annual report to the Oregon Department of Environmental Quality (DEQ). These annual reports to the COE are also made available to the public on the FPC website (http://www.fpc.org/documents/FPC_documents.html). We recommend that WA DOE review the 2018 report (FPC 2018b) and use this as a reference in their review of studies on the effects of TDG.

In our 2018 report (FPC 2018b), we provide a Historical Summary (pg. J-18 through J20) of data from the GBT Monitoring Program over the last 20+ years, including an analysis of GBT incidence rates and TDG in the upstream tailrace. Over the 20+ years of data, there were 2,870 total GBT samples that fit our sample size criteria for inclusion in this analysis. Of these 2,870 GBT samples, only 37 had GBT incidence rates that met or exceeded the 15% action criterion. Of these 37, a total of six are considered anomalous and can be attributed to late migrating steelhead smolts or issues with misidentifying deformed fin rays for signs of GBT. The remaining 31 samples where GBT incidence rates exceeded the 15% action criterion all occurred when TDG was greater than 120%. Of these 31 instances, 28 (90.3%) were observed at TDG concentrations greater than 125% (see Figure J-9 of FPC 2018b). It is important to note that, although there were 28 instances where the 15% action criterion was met when tailrace TDG levels exceeded 125%, there were 288 additional GBT samples whose associated tailrace TDG levels were ≥125% that had fin GBT incidence rates below the 15% action criterion. These historical analyses of GBT Monitoring data indicate that the action criterion is generally not triggered at TDG levels less than 120% in the tailrace and even rarely triggered at tailrace TDG levels of 125% or above. As the Draft EIS states, "this action level incorporates a margin of safety based on studies finding significant mortality does not occur in test fish until approximately 60% of a population is showing signs of GBT".

> **Ecology Response:** *Thank you for the additional information. The data used in the EIS was aimed at peer-reviewed published literature. However, we recognize the value of the smolt monitoring program data and have added an additional sentence in the EIS that summarizes the historical analysis from 1995-2018: "In a historical analysis of data collected by the Fish Passage Center from 1995-2018, the 15% GBT criterion for juvenile salmonids has been exceeded in only 37 instances of 2,870 samples and 28 instances occurred when TDG was greater than 125%." We have also referenced the document provided.*

Comment 3: In addition, the CSS has included TDG in recent analyses of instantaneous mortality (see Chapter 3 of McCann et al. 2018). Results from these analyses indicate that the Relative Variable Importance values for the TDG variables (average TDG or maximum TDG) were low compared to other variables, indicating that the TDG variables were not consistently included in the top fitting models for explaining variation in instantaneous mortality. In addition, the modelaveraged coefficients of the effects of TDG were all near zero and confidence intervals overlapped zero for all species and reaches analyzed. This indicates that there was little association between TDG levels and instantaneous mortality rates. We recommend that WA DOE review Chapter 3 of the 2018 CSS Report (McCann et al. 2018) and include this in their review of studies on the effects of TDG.

> **Ecology Response:** *Thank you for the additional information. We have decided not to include this information within the potential negative effects sections for a few reasons. First, this information is based on modeling and not directly experiential or monitoring studies that demonstrate an effect threshold that relays information on changes to the health of a particular aquatic species. Secondly, the observations used in the determination of Relative Variable Importance values were largely at TDG levels under 120% which limits the scope and conclusions of the analysis. Finally, this information is a product of the Comparative Survival Study model which is referenced in the potential*

positive impacts section. A detailed analysis of the model is beyond the scope of an EIS on aquatic species.

Palouse Great Old Broads (Borg Hendrickson)

Comment 1: We urge WA Department of Ecology, specifically, to move forward with its proposal to increase Lower Columbia and Lower Snake dam spill to 120% total dissolved gas level beginning in 2019. We further recommend upgrading the water quality rules in 2019 to allow an increase in spill to a 125% total dissolved gas level.

> **Ecology Response:** *Thank you for your comment. We acknowledge the support for increasing total dissolved gas levels in the lower Snake and Columbia rivers.*

Comment 2: The Palouse Great Old Broads, whose membership includes residents of eastern Washington and north central Idaho, is one of eight networked Oregon, Washington, and Idaho chapters of the national, 6000-member Great Old Broads for Wilderness. Great Old Broads (GOB) throughout the nation advocate for the protection and preservation of wilderness, wild lands and wildlife dependent upon healthy, pristine environments, streams and habitats.

Currently, a regional and national GOB key focus issue is the plight of threatened and endangered Snake River salmon, steelhead and the related plight of the Salish Sea's endangered southern resident orcas. On a national level, we are engaged in education and advocacy efforts to draw attention to this issue. In light of the looming potential for "endangered" to become "extinct," with respect to Snake River Basin salmon and steelhead and to southern resident orcas, we urge all relative government agencies to take bold, urgent action as backed by sound scientific research to ensure a turn-around in the declining populations of these species. We urge WA Department of Ecology, specifically, to move forward with its proposal to increase Lower Columbia and Lower Snake dam spill to 120% total dissolved gas level beginning in 2019. We further recommend upgrading the water quality rules in 2019 to allow an increase in spill to a 125% total dissolved gas level.

We understand that the WA DOE increased-spill proposal is supported by WA Gov. Jay Inslee's budget and correlates with the recently signed "flexible spill" agreement reached by the states of Oregon and Washington, the Bonneville Power Administration, U.S. Army Corps of Engineers and Bureau of Reclamation. We recognize that the WA DOE proposal has the support of the Department of Fish and Wildlife, the Columbia River Inter-Tribal Fish Commission, and a coalition comprised of the Northwest Sportfishing Industry Association, Columbia Riverkeeper, and fifty-five organizational partners of the conservation coalition Save Our Wild Salmon. With this present letter, we add our Palouse Great Old Broads seventy-one, cross-border members' support.

In our region, all eyes are on salmon and steelhead run projections, fishing season options, and related economic impacts of the decline in wild salmon and steelhead, particularly in the Snake Basin and its main tributaries, the Clearwater River and Salmon River. Residents are also aware of and alarmed by the dire circumstances of the Salish Sea's southern resident orcas as a result of their no longer having plentiful food chinook salmon. According to the Oregon and Washington

Departments of Fish and Wildlife February 20, 2019, Joint Staff Report, the Snake River total spring/summer chinook numbers in 2018, which had been projected to be 107,400 fish, numbered 67,596. The forecast total for 2019? Just 48,100 fish. As per the Report, the projected Snake River wild spring/summer chinook number of 18,500 actually came in at only 11,339. The forecast for 2019? A mere 8,200 fish.

The Northwest Power and Conservation Council asserts a goal of overall smolt-to-adult return levels (SARs) in the 2%-6% range, with a 4% average and 2% minimum for federal ESA-listed Snake River and upper Columbia River salmon and steelhead. The Snake River overall geometric mean SAR during 19641969 was 4.3% compared to 1.0% during 19941999 and 1.1% since 2000. The four lower Snake dams were built between 1961 and 1975.

According to data reported in 2017 by the Comparative Survival Study Oversight Committee and Fish Passage Center, the "smolt-to-adult (LGR to GRA, jacks included) of PIT-tagged Snake River wild spring/summer Chinook had a geometric mean of 0.84% and exceeded the NPCC's minimum SAR objective of 2% in only two migration years (1999 and 2008) during the period 1994-2015. ... SARs (LGR-GRA, jacks included) of the unlisted, reintroduced Clearwater River Chinook were somewhat lower (geometric mean 0.53%). ... the trends in the overall SARs (LGR-GRA) of Snake River wild and hatchery Chinook groups were similar and highly correlated (average r= 0.79) during 1997-2015."

The Comparative Survival Study Oversight Committee and Fish Passage Center also stated that "... improvements to fish travel time, mortality rates and survival may be possible through management actions that reduce WTT [in-water travel time] and increase spill percentages. There are only two means for reducing WTT: reducing reservoir elevations and/or increasing flow rates. Currently, only the reservoirs in the lower Snake River are maintained near their minimum operating elevations during the fish migration season. The McNary, John Day, The Dalles and Bonneville projects [on the Columbia River] all operate several feet above their minimum operating elevations during the fish migration season. Even without a change in flow levels, the data indicate that there is opportunity to reduce fish travel time and increase survival through the MCN-BON reach if these four projects were to operate at their minimum operating pools. The data also indicate that there is an opportunity to reduce fish travel time and increase survival throughout the FCRPS through increases in spill levels up to the tailrace dissolved gas limits."

Further, "Regional requests and recommendations to increase spill levels to improve survival for juvenile outmigrants have been countered by concerns over potential detrimental effects of high Total Dissolved Gas levels on juvenile mortality rates or survival probabilities. Using a comprehensive data set of instantaneous mortality rates and survival probabilities collected 1998-2016, we found no evidence that high TDG levels were associated with increased mortality rates or reduced survival probabilities."

Finally, the above report concluded that "Pre-harvest SARs in the range of 4% to 6% are associated with historical levels of productivity for Snake River wild spring/summer Chinook." We find ourselves asking, what are humans willing, in good conscience, to not do to rescue wild salmon and SR orcas from the brink of extinction? the brink to which our dams have brought them.

On that note, the Palouse Great Old Broads urge the WA Department of Ecology to, at the least, proceed with increasing spill to 120% total dissolved gas and to take the further step of increasing water quality rules in 2019 to allow 125% total dissolved gas.

> **Ecology Response:** *Thank you for the information regarding the status of salmon and steelhead returning to the Snake and Columbia River. Ecology considers the health of all aquatic life when evaluating changes to the water quality standards. Ecology seeks a balance between the benefits of water spill for fish passage through hydropower projects and limiting impacts of total dissolved gas to aquatic life. We will continue to evaluate the science examining effects of total dissolved gas levels on aquatic life.*

Friends of the San Juans (Tina Whitman)

Comment: Friends of the San Juans strongly supports Washington Department of Ecology's proposed short term modification of the WAC 173-201A water quality standard at the eight lower Snake and Columbia River dams in support of the new regional agreement for flexible spills operation. Allowing increased experimental total dissolved gas levels is expected to help mimic more natural river conditions by speeding passage times and aiding smolts in avoiding dam infrastructure, improving downstream juvenile salmon condition and survival.
Existing scientific studies as well as extensive expert professional opinion supports implementation of this recommended near term salmon recovery action identified as a priority in the Governor's Southern Resident Orca Task Force recommendations:
Goal #1 Increase Chinook salmon abundance.
Recommendation #8. Increase spill to benefit Chinook for Southern Residents by adjusting total dissolved gas allowances at the Snake and Columbia River dams.
(Southern Resident Orca Task Force Report and Recommendations 2018 pg. 48)
It is imperative that all immediately available actions to recover Chinook salmon are implemented and adaptively managed through careful monitoring, while more long term solutions such as dam removal are explored.
We encourage immediate (spring 2019) implementation of this priority management action in support of Chinook salmon and Southern Resident Orca recovery.
Thank you for your consideration.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Orca Salmon Alliance (Robb Krehbiel)

Comment: Thank you for the opportunity to provide comments to the Department of Ecology (Ecology) about the proposed short-term modifications to the state's total dissolved gas (TDG) standards. We strongly support alternative 3 to increase the state's TDG standards to 125%. Increasing these standards will allow for more water to be spilled over dams on the Columbia and Snake rivers, both of which support critical salmon runs that Southern Resident orcas rely on. Increasing spill is one of the most effective nearterm actions the state can take to provide more salmon for orcas.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers. Ecology seeks a balance between the benefits of water spill for fish passage through hydropower projects and limiting impacts of total dissolved gas to aquatic life. We will continue to evaluate the science examining effects of total dissolved gas levels on aquatic life.*

Earthjustice (Todd True)

Comment 1: DEIS at 1-2: The executive summary describes the recent Spill Agreement as one reason Ecology is considering a short-term modification of the TDG standards. That Agreement is based on elimination of Washington's 115% forebay TDG standard starting in 2019 and continuing through 2021, flexible spill to a 120% tailrace TDG standard in 2019, and similar flexible spill to a 125% TDG tailrace standard in 2020 and 2021 (or until the federal agencies complete new records of decision for dam operations). It is important to recognize that this Agreement does not purport to limit in any way Ecology's authority to consider and adopt a short-term modification that would allow flexible spill to a 125% tailrace TDG standard starting in 2019, nor would such a modification conflict with the Spill Agreement. Implementation of the Agreement and a single step, short-term modification of the Washington TDG standard to allow spill to a tailrace only 125% TDG standard are entirely consistent. There is no need for a second, separate process as the DEIS suggests (DEIS at 2). The DEIS already describes information relevant to adopting a 125% tailrace standard and such a modification is one of the alternatives considered in the DEIS. The DEIS thus already provides a basis for Ecology to take this action and another short-term modification process could be seen as duplicative and financially not warranted.

> **Ecology Response:** *Thank you for your comment. Ecology will continue to evaluate the feasibility of a 125% TDG tailrace criterion in regards to the science, uncertainties / data gaps, and monitoring requirements. Ecology seeks a balance between fish passage and impacts due to total dissolved gas levels in the Snake and Columbia rivers. As mentioned in the EIS, future actions in 2019 will address a potential rule change in which similar alternatives may be considered. We recommend EarthJustice be involved in the public process associated with these future actions.*

Comment 2: DEIS at 4: The DEIS describes as one basis for the proposed short-term modification of the TDG standards analyses by the Comparative Survival Study (CSS). These analyses do indeed strongly support the proposed change in the TDG standard, including an immediate change to a 125% tailrace standard (and of course elimination of the 115% forebay standard). The description of the CSS study in the DEIS, however, understates the level of support the CSS analyses provide for a short-term modification to a 125% tailrace standard in potentially significant ways. First, while the CSS analyses focus on reducing "powerhouse encounters" through increased spill, the analyses omits at least two additional benefits of increased spill: (1) reduced predation of juvenile migrants in reservoirs from faster migration travel time and reduced holding time above dams; and, (2) reduced water temperatures from faster water transit time, especially as the spring season progresses and in lower water years. While the CSS analysis does not attempt to quantify these survival benefits, they do exist as the analyses recognize, and they may be significant. Second, the DEIS suggests that the only benefit of increased spill addressed by CSS is a reduction in "delayed mortality." This is very likely not the only benefit of increased spill for downstream juvenile migrants. And this characterization of the CSS study is potentially confusing and unreasonably limiting given the long-standing discussion of over the precise amount of "delayed mortality" that occurs. Finally, the DEIS fails to acknowledge clearly that the CSS analyses are based on decades of empirical evidence about the effects of spill and TDG levels on juvenile spring migrants, including effects at TDG levels well above 125% (during frequent periods of involuntary spring spill). This empirical evidence includes results measured against well-established "action levels" for gas bubble trauma (GBT). This empirical evidence on GBT indicates that spill to 125% TDG is safe for juvenile salmon. Ecology should revise its description of the CSS analyses to more accurately address these and other aspects of the study and more clearly acknowledge the very strong support the study provides for a 125% tailrace TDG standard.

Ecology Response: *Thank you for your comment. Intuitively additional water spill may increase transit time, reduce predation, and impact temperature, but as mentioned, no quantitative analysis is available to formally evaluate these assertions. Under the "Potential for Positive Impacts to Total Dissolved Gas" section, we have added a sentence describing the potential indirect benefits of reduced predation and water temperatures.*

While "delayed mortality" is specifically mentioned, it is in context of the CSS model minimizing powerhouse encounters and transit time as described within the EIS. The full report is referenced for a more in depth discussion. Ecology has incorporated the potential indirect effects as described above and believe additional information is not needed.

We have added a sentence regarding the historical analysis of gas bubble trauma monitoring from 1995-2018 by the Smolt Monitoring Program under the "Potential for Negative Impacts of Total Dissolved Gas" section within "Salmonids," within "Juveniles," within "Field Studies." "In a historical analysis of data collected by the Fish Passage Center from 1995-2018, the 15% GBT criterion for juvenile salmonids has been exceeded in only 37 instances of 2,870 samples and 28 instances occurred when TDG was greater than 125%."

We have recognized the CSS model predictions of increased spill at 125%, specifically: "The CSS model predicts a two to 2.5-fold increase in Snake River spring Chinook salmon abundance above 2014 FCRPS BiOp spill levels when spill is increased to 125% TDG 24 hours per day/seven days a week in the spring, and smaller projected increase at 120% TDG 24 hours per day." We believe that this description adequately acknowledges the CSS model predictions for the benefits of increased spill at 125%. We reference the CSS model to direct readers to additional details.

Ecology will continue to evaluate the science surrounding impacts of total dissolved gas on aquatic life versus the benefits of fish passage within the Snake and Columbia rivers.

Comment 3: DEIS at 5: The DEIS notes that dam and salmon managers have not previously provided voluntary spill to even 120% TDG (more recently because of Washington's current 115% forebay standard) and implies that this is because of increased symptoms of GBT at spill above existing levels. This statement again appears to misunderstand the existing evidence regarding spill, TDG and GBT. First, there is extensive evidence of the effects of spill and the incidence of GBT at TDG levels well above 120% and well above 125%. This evidence comes from actual data collected during frequent periods of involuntary spring spill over many years. This evidence shows quite clearly that the incidence of GBT in juvenile salmonids is well below existing action levels (which are quite conservative) at spill that causes TDG up to 125%. Above 125%, the incidence of GBT increases somewhat in some circumstances but usually does not reach levels of concern until TDG is at or above 130%. Ecology should rephrase its statement to more accurately reflect the existing evidence about TDG levels and GBT.

> **Ecology Response:** *Thank you for your comment. Ecology specifically mentioned the "potential" for elevated TDG levels to increase gas bubble trauma. Studies have demonstrated that the potential for gas bubble trauma increases with increasing TDG levels. While your comment specifically focuses on salmonids, Ecology must consider all species and life stages, including non-salmonids and aquatic invertebrates. Uncertainties regarding the protection of non-salmonids at various TDG levels exist and should be recognized. While the available information suggests that hydrostatic depth compensation provides salmonids protection from TDG related impacts at most times, information on other species ability to depth compensate needs to be evaluated. No changes were made to this statement.*

Comment 4: DEIS at 8: The Introduction to the DEIS is potentially inaccurate and could be viewed as misleading. First, in describing the cause of salmon decline that have led to ESA listings for most Columbia and all remaining Snake River stocks, the DEIS only appears to acknowledge the harmful effects of the Snake a Columbia river dams on upstream access to upriver habitats without clearly explaining the lethal impacts of the dams and associated reservoirs on all aspects of the salmon life cycle. Nowhere does the DEIS acknowledge the high levels of juvenile mortality at and between the dams from injury, increased disease risk, and other factors. A 2007 analysis in which Washington participated concluded that, for Snake River salmon, some 70% of the human-caused mortality is associated with the dams. Likewise, the introduction overstates in an inaccurate way the potential costs to power production of increased spill. In fact, the modest increases in spill proposed under the Spill Agreement are specifically designed to be revenue neutral as compared to spill in 2017. And spill levels in 201 7 were set by a court order. It is not clear why the DEIS would characterize measures necessary to comply with the law as "costing" hundreds of millions of dollars when complying with the law is not optional.

> **Ecology Response:** *Thank you for your comment. We have included a statement that recognizes the deleterious effects that dams can have on juvenile salmonid migrants in the introduction. "A number of factors have contributed to the decline, including dams, which block or impede access to and from upriver habitat and result in injuries to juvenile salmonid migrants, habitat degradation from development and resource extraction, harvest and hatchery impacts, pollution, and predation due to ecosystem alterations and introduction of non-native species."*

The information regarding costs was obtained from a report by the Northwest Power and Conservation Council that determined the lost revenue due to water spillage for fish. This information does not compare losses in revenue in association with a Flexible Spill Agreement, which has not been implemented and would not be in effect until the 2019 spring spill season. Ecology recognizes the need for a balance between water spill over dams and fish passage. A statement regarding economics of waters spill is within context of the introduction of the ongoing debate over total dissolved gas levels.

Comment 5: DEIS at 16-17: The DEIS' description of the "Existing Spill Conditions" fails to acknowledge the extensive periods of involuntary spring spill during most year when TDG levels can rise to well above 130%. This leaves the misimpression that the only spill levels about which we have available data are from periods of voluntary spill which has been capped by the existing 115% and 120% TDG standards in Washington, with the potential implication that the effects of spill above these levels are unknown and dangerous. It is not clear why the DEIS takes this approach or why the description of biological opinions from 2008 to 2014 fails to mention that each of them was ruled illegal by the courts. This description should be revised to be more complete and accurate.

Ecology Response: *Thank you for your comment. This purpose of the "Existing Spill Conditions" is not to characterize between spill types, since it can vary drastically depending on the year. This section specifically mentions that when water inputs exceed carrying capacity, water is spilled. Furthermore, it is stated that "spill occurs regularly during the spring freshet to manage the incoming water at hydropower projects." We have added the terms involuntary and voluntary to the second paragraph of the "Existing Spill Operations" to clarify that spill occurs in both forms. Regardless of whether spill occurs involuntary or voluntary, the focus of the EIS was to examine the health of aquatic life at all TDG levels.*

The reference to the BiOps is presented primarily to inform of the governing actions related to spill over the past 10 years. Providing details of litigation is beyond the scope of the EIS.

Comment 6: DEIS at 17: The DEIS correctly notes in a phrase that Snake River salmon returns "more recently have declined." The DEIS does not describe the extent of this decline or explain that predicted returns for 2019 are some of the poorest in years. To the extent the DEIS addresses the pattern of salmon returns, it should be more thorough and indicate more clearly, and with appropriate detail, the extent of the current downward trend.

Ecology Response: *Thank you for your comment. We believe that the description in the introduction adequately describes salmon and steelhead population declines: "However, over the last 150 years or so, salmon and steelhead runs that once numbered from 10-16 million per year have generally declined to 1-2 million per year, an estimated value that includes a combination of natural and hatchery origin fish. Today, thirteen populations of Columbia Basin salmon and steelhead are listed as threatened or endangered under the Endangered Species Act."*

The EIS is not intended to focus on historical analyses of salmon and steelhead returns but on the impacts of total dissolved gas impacts on aquatic life. Some historic context is important but specific details are not included as they are not essential in evaluating total dissolved gas levels to aquatic life.

Comment 7: DEIS at 19-20: The DEIS describes both hydrostatic depth compensation and differences between field and laboratory studies generally but provides little analysis here or elsewhere as to how these factors have been taken into account. One consequence is that later in the DEIS, laboratory studies with extended exposures and no depth compensation are given equal billing with more relevant field studies and none of these are evaluated in light of the empirical evidence about the effects of spill and TDG levels up to 125% on salmonids or other aquatic life, leaving the potentially misleading impression that there is considerably more uncertainty about the benefits and risks of spill to this level than the data warrants.

Ecology Response: *Thank you for your comment. We recognize the value of both laboratory and field studies of which have advantages and disadvantages. We have provided the strengths and inadequacies with both study types within the EIS. We specifically made readers aware of water depth and therefore hydrostatic depth compensation that accompanies some laboratory studies. We disagree that studies included in the EIS prioritize specific research in the context of effects at TDG levels of 125%. When evaluating TDG risk to aquatic life, we accounted for both field and laboratory studies. We do not make the assumption that all aquatic species depth compensate and are always at adequate depths to be protected from elevated TDG levels, including 125% TDG.*

The uncertainties included within the EIS are a holistic analysis of the body of science available regarding total dissolved gas, aquatic species life history traits, and biological and water quality monitoring and were not intended to mislead a risk/benefit analysis of spill. The uncertainty analysis was intended to recognize data gaps that could potentially be accounted for via additional monitoring or research.

Comment 8: DEIS at 21: The DEIS states that NOAA Fisheries' COMP ASS model is "less optimistic about the benefits of additional spill" and attributes this to Ecology's understanding that the COMPASS model "does not factor in the same assumptions about delayed mortality as the CSS model." It is not immediately apparent that the CSS model makes any assumptions about delayed mortality. It is based on empirical data about juvenile downstream survival and associated smolt-to-adult return rates. Ecology may want to seek clarification from the authors of the CSS model regarding this statement. Similar statement about the CSS model that may reflect a misunderstanding of it also appear in other places in the DEIS, e.g., at page 22 (indicating that the CSS model considers reducing powerhouse encounters critical to reducing delayed mortality, a specific cause and effect assumption imputed to the CSS analysis that also may not be warranted).

Ecology Response: *Thank you for your comment. Our intent was to distinguish between the incorporation of the assumption of latent or "delayed mortality" in the COMPASS model compared with the CSS model. We did not intend to suggest that the CSS model* *makes assumptions of latent or "delayed mortality" but rather, identify specific assumptions that may differ between the models which lead to differing predictions of spill benefits. We have changed wording to help clarify the confusion. "NOAA Fisheries' COMPASS model is less optimistic about the benefits of additional spill compared with the CSS model, largely because of the assumption of latent or delayed mortality due to powerhouse (i.e., non-spillway) passage routes and different conclusions about the relative benefit of fish transportation as an alternative to spill."*

Comment 9: DEIS at 22-25: The DEIS describes a number of studies of the effects of TDG on early salmonid development and on juveniles. The relevance of the early stage studies described in the DEIS is not apparent. Ecology may want to explain exactly where early stage salmonids are likely to encounter elevated TDG levels of either 120% or 125% from voluntary spill, other than chum salmon below Bonneville dam where there are already measures in place to protect them (which Ecology seems to accept as effective). The studies of the effects of TDG on juvenile salmonids also are not tied to conditions these fish are likely to experience during their downstream migration. One of the more relevant studies, described on page 25, reports that data on the incidence of GBT from five unidentified Columbia and Snake River dams failed to show effects above action levels for GBT set in the 2000 FCRPS BiOp until TDG exceeded 130% but this relevant information is simply reported along with other information and is not then further addressed. Another study reports a much higher incidence of GBT at two mid-Columbia dams where TDG levels apparently "exceeded 120% for approximately two months" but fails to describe when, how often, or how likely these extended conditions occur in the lower Snake and lower Columbia rivers under voluntary spill conditions and so does not provide a basis for assessing the relevance of this study to the short-term modification under consideration.

Ecology Response: *Thank you for your comment. The first paragraph of the early development section explains the extend of salmonid spawning in the Snake and Columbia rivers:*

"Salmonid spawning in the main-stem Snake and Columbia rivers is limited to particular areas due to the lack of suitable habitat and thus, many adults spawn in tributaries of the two rivers and may not be impacted. Dauble and Geist (2000) reported the majority of spawning is concentrated in the Hanford Reach and Hells Canyon reach of the Snake and Columbia rivers. Chinook salmon are not known to spawn in the area encompassing the lower eight federal dams on the Snake and Columbia rivers."

We believe this description indicates that salmon and steelhead spawning is limited within the reservoirs created by the lower eight federal dams. As mentioned, Chum salmon do spawn below Bonneville Dam. The majority of the early development section focuses on Chum salmon. When there is a paucity of data on one species or life stage, surrogate species can be used to determine risk. We believe the information provided within this section, although not specific to the species of interest, improves the evaluation of TDG-related risk to early life stages of salmonids. In the Evaluation of TDG Alternatives section, only Chum salmon spawning is specifically referenced.

Comment 10: DEIS at 27-28: The DEIS describes a number of laboratory studies on these pages, many reporting high incidences of GBT but fails to discuss how these conditions relate to conditions juvenile salmon are likely to experience in the Snake and Columbia rivers during periods of voluntary spill. For example, many of the studies involve continuous exposure to elevated levels of TDG for 60 days, 50-55 days, 40 days, 22 days and so on. Many of these studies also provide limited opportunities for depth compensation. It is not clear that this kind of continuous exposure to TDG at 125% (or 120%) in laboratory conditions is likely to occur during actual voluntary spill operations. Ecology should explain in more detail the relationship and relevance of these studies to river conditions and the flexible spill regime contemplated by the Spill Agreement.

> **Ecology Response:** *Thank you for your comment. Long-term exposure to elevated TDG levels during the spill season have occurred in the past during spill season and will likely occur in the future, as part of voluntary and involuntary spill. While depth compensation is a protective mechanism against elevated TDG effects, 100% protection for all aquatic species (including non-salmonids) should not be assumed.*
>
> *The 2018 court order for voluntary spill to gas caps effectively increased in-river TDG levels and prolonged the duration of exposure at elevated levels. Removal of the 115% TDG forebay requirement, as proposed in the short-term modification, allows hydropower projects to manage TDG levels differently, which has the potential for overall higher TDG levels within the Snake and Columbia river system. The proposed short-term modification removes the 115% TDG forebay criterion in the Snake and Columbia rivers and applies 24 hours per day. While the Flexible Spill Agreement is recognized, we must assume that 120% TDG will be the maximum allowable level 24 hours per day and assess TDG risk at that level. Furthermore, if the spill agreement is implemented, TDG levels will be near 120% TDG approximately 16 hours a day and at some undefined level approximately eight hours per day. There is uncertainty as to the exact TDG levels that will occur during these eight hours focused on power generation and if the eight hours would represent a reprieve period from elevated TDG exposures. Regardless, elevated TDG levels can and often occur over prolonged periods of time during spill season.*

Comment 11: DEIS at 28-29: The DEIS describes a number of studies on the effects of elevated TDG levels on smallmouth bass and other resident fish, including northern pike minnow. Perhaps Ecology is identifying these specific studies in order to use both smallmouth bass and northern pike minnow as stand-ins for species, which may or may not be native and may or may not be predators of salmon. Even if this is the case, smallmouth bass and northern pike minnow (and presumably other native resident species which occupy the Snake and Columbia Rivers) are able to use depth compensation as well as or more effectively than juvenile salmonids to avoid potential adverse impacts from gas super saturation up to and including 125% TDG. Ecology should acknowledge this differential ability and explain why the DEIS focuses on these nonsalmonid species. This is especially important since these fish have thrived in the warm reservoirs above the dams in ways that would not occur in a free-flowing river and the species mentioned in the DEIS are significant predators of juvenile salmonids. Ecology may want to explain, for example, why it is concerned about impacts on smallmouth bass when they are not facing extinction and are actually contributors to the extinction risk facing salmonids, to a large extent because of the advantage an impounded river gives them. As it stands, the DEIS appears to treat risks to salmonids and to resident fish that are predators of salmonids as of equal concern. If that actually is the case, Ecology should say so and explain why and explain why the State has supported measures to limit predation on salmonids by a number of other species, including through lethal means, but is here apparently concerned about effects on other predators.

> **Ecology Response:** *Thank you for your comment. When developing or revising water quality standards, Ecology must consider protection of all native aquatic species. For example, the northern pikeminnow is a voracious predator of salmon but is also native to the Snake and Columbia rivers. The Clean Water Act compels the State to protect all native aquatic life when setting water quality standards. All native fish species are protected by the state water quality standards. Additionally, some invasive species are included in this evaluation because they are resident species and serve as a good metric for effects on other species. TDG field studies examining resident fish in the Snake and Columbia rivers often included invasive species as well as native resident species. We believe that particular species should not be excluded as it would not fully represent the scope and conclusions of studies that include native resident species.*
>
> *While it is acknowledged that resident species have depth compensating mechanisms, much less information is available regarding life history traits, behavior, spawning locations, and depth compensating abilities for resident fish species. This uncertainty is highlighted in the "uncertainty analysis" section. We welcome additional information that may fill data gaps highlighted within the EIS.*

Comment 12: DEIS at 32-33: The DEIS' discussion of aquatic invertebrate notes that in a 1994 field study in the Columbia and Snake, "GBT signs in invertebrate species were rare" even though TDG levels "exceeded 130% on occasion." Another study below Bonneville dam reported "minimal effects." It then goes on to report the results of a number of other studies, most if not all laboratory studies. The DEIS does not describe the spatial distribution of aquatic invertebrates or the likelihood that they will be present in significant numbers in dam tailraces where the current is strong and TDG levels are likely to approach the limits considered in the short-term modification. This context is important and should be addressed in describing the relevance of the laboratory studies of invertebrates if possible.

> **Ecology Response:** *Thank you for your comment. We have modified the EIS to now include separate sections for field and laboratory studies within the "aquatic invertebrates" section." This should help delineate between studies for which conclusions can be based.*
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> *TDG levels often attenuate very slowly at deeper depths as water moves downstream. Given this slow attenuation of TDG at depths, aquatic invertebrates below tailraces and those further downstream may experience similar TDG levels as measured in tailraces, depending on location, bathymetry, and the extent downstream. We currently do not have information regarding invertebrate abundance from surveys in tailraces of the Snake and Columbia river dams. We welcome any information on invertebrate abundance to frame risk to elevated TDG levels.*

Comment 13: DEIS at 34-35: The discussion of a number of studies on depth distribution is another example of the broader DEIS tendency to report study results without discussing their relevance to the short-term modification. The first two studies appear to provide strong evidence that juvenile salmon generally migrate at depths that will readily mitigate for TDG levels up to 125% by providing TDG equivalent level at or below 115%. The DEIS then describes cage study of rainbow trout exposed to very high levels of TDG (140% or more) for 4 days but explain why this study is relevant to consideration of the proposed short term modification to 125% TDG. It then describes a study by Collis regarding differential migration behavior between hatchery and wild juvenile salmonids but it not clear that this study attributed the behaviors that lead to greater risks of bird predation for hatchery fish to TDG exposure. If Ecology believe that cause and effect relationship exists, it should describe the supporting evidence. Reporting on a mix of what appear to be relevant and irrelevant studies without distinguishing among them may not be very helpful to an eventual decision.

> **Ecology Response:** *Thank you for your comment. We agree that the paragraph explaining research by Weitkamp et al. (2003b) examining high TDG levels to caged rainbow trout and Collis et al. (2001) describing differences in behavior between hatchery and wild fish are out of context of the intent of the "depth distribution of migrating fish" section. These paragraphs have been deleted.*

Comment 14: DEIS at 40: While the DEIS reports on a number of studies on the effects of repeated exposures to higher levels of TDG and recovery from GBT, there is little information to relate these results of these studies to conditions juvenile salmon will experience during their downstream migration. If this contextual information is not available, it would seem to limit the relevance of the summarized studies. And in the absence of information to provide context, the empirical results from the CSS analyses would again appear to be the best and most relevant currently available scientific information as these analyses capture the actual experience and consequent mortalities of downstream migrating juveniles over many years at highly variable levels of spill and TDG.

> **Ecology Response:** *Thank you for your comment. In the introductory paragraph within the "effects of repeated exposures to high TDG levels" section, context was added to the Snake and Columbia river systems in regards to the potential for repeated exposures to elevated TDG levels. Salmonids and steelhead have to navigate through multiple hydropower projects with potential for repeated exposures to elevated TDG levels.*

Comment 15: DEIS at 45: The DEIS discussion of uncertainty describes a number of what Ecology apparently considers relevant area of uncertainty regarding the effects of allowing voluntary spill at levels of to 125% TDG on a flexible basis. As with most areas of scientific inquiry, there are always areas of uncertainty that can be identified. The issue is how relevant are these uncertainties to the decision at hand and what the extent of information relevant to the decision at hand available now. The discussion of uncertainty does not address these questions or describe the extent to which the CSS analyses (and other available information) indicate that the relevant uncertainties are not that material to the decision at hand. For example, stating that "further research may be necessary" to determine whether current levels of TDG are having an adverse impact on mainstem salmonid spawning is a somewhat curious uncertainty to identify in the absence of any discussion of where such spawning occurs and how and why a short-term modification of tailrace TDG limits would affect TDG levels in these areas. As noted above, one of the most significant such area is chum spawning below Bonneville dam where mitigation for potential TDG impacts is already in place.

> **Ecology Response:** *Thank you for your comment. The uncertainty section is not specific to voluntary spills at levels of 125% TDG as suggested in this comment. The uncertainty section is aimed at identifying uncertainties in the science surrounding TDG and aquatic species life history traits that inform risk. Presumably, as spill is increased there is diminishing benefits to migrating fish as TDG effects begin to outweigh benefits of fish passage. As spill increases, the uncertainties in the science become more important because no or little margin of safety may exist between risk and benefits. Therefore, an evaluation of uncertainties is necessary in a risk evaluation to determine if additional research or monitoring may help redefine the margin of safety associated with decisions related to spill levels.*
>
> *The CSS model is a model and does not represent empirical evidence. Models are built upon empirical studies and a series of assumptions that are often associated with uncertainty. Models can be useful for answering questions but are not a direct substitute for research that directly disproves hypotheses.*
>
> *The statement that "further research may be necessary to determine whether current levels of TDG are having an adverse impact on mainstem salmonid spawning" is intended to highlight uncertainties associated with the wild salmonid population. Little research has examined if additional flow and TDG levels has an impact on energy reserves, behavior, and spawning success to adults migrating above hydropower projects to spawn in the upper reaches of the river systems. More context has been added to this section to clarify the intent of the statement.*

Comment 16: DEIS at 44-45: The DEIS reports that eliminating the 115% forebay TDG standard and implementing a 120% TDG standard for 2019 on a flexible basis as proposed in the Spill Agreement will lead to a miniscule reduction in power house encounters (and hence presumable a miniscule improvement in survival) as compare to 2018 spill and TDG levels. At the same time the DEIS reports that eliminating the forebay standard and allowing tailrace TDG up to 125% on a flexible basis will reduce powerhouse encounters by about 20%, at larger change that should lead to correspondingly larger survival improvements. Ecology does not explain why it has chosen to make an initial short-term modification with almost undetectable positive effects when the available information indicates that a single-step modification to allow spill to a 125% tailrace TDG standard would provide better protection for downstream migrating juveniles.

> **Ecology Response:** *Thank you for your comment. As indicated in the EIS, a separate process will begin this summer to address a potential rule change to TDG criteria on the Snake and Columbia rivers in which similar TDG alternatives will be considered as evaluated in the short-term modification. While the Spill Agreement is notable, Ecology is proposing removing the 115% TDG forebay criterion without consideration to flexible spill operations of 16 hours of voluntary fish spill and eight hours of performance spill.*

Decisions made by hydropower operators to meet and implement the flexible spill agreement is independent of developing or revising water quality standards.

The proposed short-term modification is a step toward improving fish passage for salmonids and steelhead. We will continue to weigh the risks of higher TDG levels against the benefits to fish passage for all aquatic species within the Snake and Columbia rivers.

Comment 17: DEIS at 45: The DEIS discussion of the potential negative effects of a short-term 120% tailrace TDG standard for 2019 appears to be "grasping at straws," e.g. increased duration of exposure to TDG levels of 120% "may result in an increased risk of GBT to aquatic life" in the absence of depth compensation. The DEIS fails to describe the relevant evidence that indicates this is a meaningful and present risk as opposed to a minor and hypothetical one.

Ecology Response: *Thank you for your comment. The 115% TDG forebay criterion requires hydropower projects to consider impacts of their operations on downstream projects. The removal of the forebay criterion removes this requirement and therefore allows more spill at each upstream dam resulting in elevated TDG levels.*

While depth compensation is a protective mechanism against elevated TDG effects, 100% protection for all aquatic species should not be assumed. While it is acknowledged that resident species have depth compensating mechanisms, much less information is available regarding life history traits, behavior, spawning locations, and depth compensating abilities for resident fish species.

Comment 18: DEIS at 45-48: The DEIS discussion of a short-term modification to allow tailrace TDG levels up to 125% on a flexible basis with no forebay limit explains the potentially significant benefits of this change to juvenile salmon survival (at 45) without explaining the difference between these benefits and the much more minor benefits of a 120% standard (stating only that these benefits would be "smaller"). This lack of clarity potentially obscures the choice between the two alternatives. As with the discussion of a 120% TDG standard, the DEIS also identifies hypothetical, minor, or even non-existent (because mitigated) risks to aquatic life and salmonids (e.g., noting the possibility of TDG impacts to chum salmon below Bonneville but also noting existing mitigation for this risk without any indication that this mitigation is not effective). Similarly, the DEIS reports on elevated levels of GBT but at TDG levels of 120% to 13 5% without distinguishing among the incidence of GBT above 120% but below 125%. That information is available through data collected and analyzed by the Fish Passage Center but it is not reported in the DEIS. Including this information would be helpful to an eventual decision.

Ecology Response: *Thank you for your comment. The predicted benefits between removing the 115% TDG forebay criterion and removing the 115% TDG forebay criterion and the 120% TDG tailrace criterion are described in multiple places throughout the EIS including within the "evaluation of TDG alternatives, potential positive impacts of increased spill, and additional spill for fish passage" sections.*

We understand that presenting a range of TDG levels in relation to gas bubble trauma is *difficult to interpret (i.e. 120-135%) in context to making conclusions at particular TDG levels. However, TDG levels are inherently variable within field studies, which can make it difficult to discern effects at a particular TDG level but this is not a reason to exclude data. The following sentence describes gas bubble trauma at TDG levels below 120% and clearly shows a delineation of effects between two TDG ranges. One of the disadvantages of field studies mentioned within the EIS is highly variable conditions.*

We have included additional information from the Fish Passage Center that includes a historical analysis of gas bubble trauma from 1995-2018 within the potential negative effects of TDG sections within juvenile salmonids and in the risk evaluation section of 125% TDG: "In a historical analysis of data collected by the Fish Passage Center from 1995-2018, the 15% GBT criterion for juvenile salmonids has been exceeded in only 37 instances of 2,870 samples and 28 instances occurred when TDG was greater than 125%." The referenced document demonstrates recorded gas bubble trauma at various TDG levels.

Comment 19: Overall, the DEIS collects and reports on quite a bit of information but appears to make only minimal effort to distinguish between more and less relevant information. The DEIS also appears to misunderstand the most relevant information - the CSS analyses - in potentially important ways. We urge Ecology to address these issues and clarify that there is strong evidence to support an immediate short-term modification of the TDG standards to allow tailrace TDG levels of up to 125% on a flexible basis and little or no relevant evidence to indicate that this change would pose a risk to salmonids or other species of concern.

Ecology Response: *Thank you for your comment. We had no intention of excluding information that was important to evaluating risk of TDG to aquatic life. As mentioned previously and within the EIS, both field and laboratory studies have a purpose in determining effect levels of water quality measures. The limitations of both study types should be and are noted within the EIS. The uncertainty analysis section attempts to address some of these uncertainties and data gaps. The data that EarthJustice considers relevant may not be relevant to another stakeholder.*

We welcome any additional information that will better inform the risk conclusions.

Comment 20: As explained in the above referenced letter of September 13, 2018, there is compelling evidence and a sound legal basis for Ecology to immediately eliminate, on a short-term basis, the current 115% forebay TDG limit at each dam and replace the existing 120% tailrace TDG limit with a limit of 125% for up to at least 16 hours per day or more starting in 2019. Indeed, this is one of the alternatives presented in the DEIS, although it is not identified as the proposed or preferred action. We urge you to reconsider and adopt this single-step alternative as the action Ecology will take.

We recognize that the DEIS already proposes to eliminate the 115% forebay TDG standard on a short-term basis through 2021 and we support this step. For this reason, in the balance of these comments we focus on issues related to adjusting the tailrace TDG standard to 125% starting in

2019.

We believe that upon examination of the best currently available scientific information about the effects of TDG levels up to 125% in the dam tailraces, and analysis of any other alternatives you choose to consider, you will conclude that a short-term modification of the TDG standards to allow TDG up to 125% in the dam tailraces on a flexible basis starting in 2019 is the best alternative to protect beneficial uses in the lower Snake and lower Columbia Rivers and that such a standard poses minimal or no risks to any designated use. It also will not have significant adverse environmental impacts.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers. Ecology seeks a balance between the benefits of water spill for fish passage through hydropower projects and limiting impacts of total dissolved gas to aquatic life. We will continue to evaluate the science examining effects of total dissolved gas levels on aquatic life.*

Comment 21: Voluntarily spilling water over the dams on the Snake and Columbia rivers during the spring juvenile migration season undeniably benefits salmon and steelhead. While spill can pose a risk to salmonids if TDG levels are too high, biological monitoring conducted over the last decade and more, as well as anecdotal evidence, demonstrates that tailrace TDG levels of 125% do not negatively impact migrating salmonids, resident fish, or invertebrates. By contrast, the TDG levels currently allowed under Washington's water quality standards unnecessarily limit the benefits of spill for juvenile salmon and steelhead migrating downstream in the spring. We thus urge you to adopt a short-term modification of water quality standards to eliminate the forebay TDG limit and allow TDG levels up to 125% of saturation in the tail race of each of the eight dams on the lower Snake and lower Columbia Rivers during the spring juvenile salmon migration season beginning in 2019 and continuing through at least 2021.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers.*

Defenders of Wildlife (Robb Krehbiel)

Comment 1: Ecology has stated that it plans to undergo an additional public process this summer to increase TDG standards to 125%. This second public process would be redundant and result in unnecessary delay – to the detriment of both salmon and orcas. The data available to inform this decision will not substantially change (if it changes at all) before this summer. The department has offered no justification for why it believes a second EIS is necessary.

Raising TDG standards to 125% gives Ecology discretion and flexibility when working with partners, like Bonneville Power Administration, to set appropriate spill levels. Increasing TDG standards to 125% does not require Ecology or dam operators to spill up to that level. These standards represent a regulator ceiling, not a floor. By increasing TDG standards to 125%, Ecology can still honor the flexible spill agreement and only spill up to 120% in 2019. In fact, on the four lower Columbia dams, spill would be limited by Oregon's TDG standard of 120%. Currently, Washington's more conservative TDG standards limit spill at these four dams. While spilling up to 125% TDG would maximize benefits to southern resident orcas, dams could spill less than that in 2019. These standards represent a regulatory ceiling, not a floor.

> **Ecology Response:** *Thank you for your comment. Ecology is considering a potential rule change, which is a separate process from a short-term modification. As part of the State Environmental Policy Act (SEPA), if a determination of significance is made, an EIS will be needed. If an EIS is needed as part of a rule change, then the current EIS will be used but may be subject to modification if additional TDG data is obtained that informs risk to aquatic life.*

Comment 2: Thank you for the opportunity to provide comments to the Department of Ecology (Ecology) related to the proposed short-term modifications to the state's total dissolved gas (TDG) standards. Increasing these standards will allow for more water to be spilled over dams on the lower Columbia and Snake rivers. The most recent, best available science suggests that increasing spill over these dams will help boost survival rates of salmon runs that highly endangered southern resident orcas rely on. The flexible spill agreement reached between Oregon, Washington, the Nez Perce Tribe, and Bonneville Power Administration (BPA) is a positive step forward that will help restore endangered salmon and orcas. However, Defenders of Wildlife (Defenders) disagree with Ecology's decision to only raise TDG standards to 120% during the 2019 spring migration.

Increasing spill on the lower Columbia and Snake Rivers is a critically important near-term action to make more salmon available to starving orcas. The evidence presented in the EIS suggests that 125% TDG is a safe and reasonable standard. Increasing TDG standards to this level gives the state more flexibility to adjust spill levels with partners as necessary. Because southern resident orcas face an immediate threat of extinction, Defenders strongly supports alternative 3 to increase the state's TDG standards to 125%.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers. As mentioned in the EIS, Ecology will consider a potential rule change this summer and will evaluate similar TDG alternatives.*

Comment 3: The majority of studies cited in the EIS suggest that spill up to 125% is safe for most native aquatic species, particularly salmonids, despite concerns that increasing TDG and prolonged exposure to saturated water will cause Gas Bubble Trauma (GBT). The studies in the EIS that noted concerns with TDG levels and exposure used net pens and surface cages, preventing salmon from moving to lower TDG areas of the river (i.e. further downstream or deeper in the river channel). The EIS, though, notes that "water depths in the Snake and Columbia rivers broadly provide adequate depth to circumvent TDG related impacts" (page 50) and that salmon can recover from the impacts of GBT after several hours in areas with lower TDG.

It is also worth noting that that vast majority of the studies cited in the section titled "Potential for Negative Impacts of Total Dissolved Gas" are from the 1990s or earlier. The scientific community's understanding of spill and TDG has significantly advanced in the last two decades.

The most recent, best, available science supports efforts to increase TDG standards to 125%. These older studies do not provide a holistic analysis of the impact of increased spill and TDG on salmonids.

While there have been more recent studies demonstrating the benefits of spill, the EIS only contains a brief explanation of the models used by the Comparative Survival Study (CSS) and the National Oceanic and Atmospheric Administration (NOAA) to assess the impacts of spill. Ecology did not cite any other studies in the section titled "Potential Positive Impacts of Increased Spill" despite multiple scientific articles that support increasing spill. Williams (2006) documents multiple studies of how restoring natural processes in rivers, such as increasing flow rates via increased spill, aids in salmon restoration. Other recent studies have shown that management of freshwater systems, such as increasing spill, can affect smolt-to-adult returns, even when taking ocean conditions into account (Schaller et al., 2013; Petrosky and Schaller, 2010; Schaller and Petrosky, 2007; Haesecker et al., 2012). Salmon in the Columbia Basin evolved in a system that included higher levels of TDG. The EIS should also acknowledge that prior to the damming of the Snake and Columbia rivers, a network of rapids and waterfalls in the region naturally increased TDG in the rivers.

> **Ecology Response:** *Thank you for your comment. The objective of the EIS is to present a holistic understanding of TDG risks from a variety of studies. The 1990s represented a time when a wealth of data was produced in an attempt to evaluate effects of TDG to salmonids. We are not aware of any scientific research conducted in the 1990s or prior that was included in this EIS that has been disproved with recent research. When evaluating the science, it is often useful to evaluate original source articles because research objectives are formulated by evaluating existing research and identifying data gaps. To fully evaluate the science of TDG, it was necessary to evaluate all scientific literature to holistically understand TDG related effects and uncertainties. We welcome more recent information that discusses the risk of TDG to aquatic life.*
>
> *In this EIS, a distinction is made between models and empirical research as it relates to TDG effect levels. While the CSS model is based on empirical studies, many assumptions and uncertainties accompany models. Model predictions should be separated from experiential studies. The delineation between research findings in empirical research and predictions from a model is important when evaluating risk. However, we do recognize the utility of models and have aptly described the overlying conclusions of the model in context of TDG and fish benefits.*
>
> *The focus of the EIS was on evaluating TDG related risk to aquatic life and the benefit of fish passage. A study by Williams (2006) is referenced but the full citation is not provided and therefore we are not able to assess the research. However, we contend that increasing spill over the spring spill season is not akin to restoring the natural hydrology of the Snake and Columbia rivers.*
>
> *The references included within this comment are models that are largely represented by the widely accepted CSS model. We believe that the CSS model encapsulates the conclusions that these other models have made and uses more refined and robust methods. However, we will add a sentence to the "potential positive effects of TDG"*

section that references these additional models as supporting information for the CSS model.

Comment: On page 29, the EIS begins discussing the potential impacts of increased spill on non-salmonids. As the EIS stated, there are no studies indicating that 125% TDG impacts invertebrates or native amphibians. According to the most recent data, only non-native species, several of which predate on juvenile salmon, would be impacted by increased TDG. The EIS cites several studies that increased spill would negatively impact northern pikeminnow, largemouth bass, and smallmouth bass. These three species are non-native predators of chinook salmon and other salmonids, and the state is actively encouraging efforts to reduce populations of these fish. While increased TDG is expected to negatively impact these species, this would further benefit the state's goal of recovering salmon and orcas. The EIS should acknowledge this potential benefit. The majority of the other species that would be negatively impacted by increased TDG are also non-native.

Ecology Response: *Thank you for your comment. When developing or revising water quality standards, Ecology must consider protection of all native aquatic species. For example, the northern pikeminnow is a voracious predator of salmon but is also native to the Snake and Columbia rivers. The Clean Water Act compels the State to protect all native aquatic life when setting water quality standards. All native fish species are protected by the state water quality standards. Additionally, some invasive species are included in this evaluation because they are resident species and serve as a good metric for effects on other resident species. Additionally, the TDG field studies of resident fish in the Snake and Columbia rivers often included invasive species as well as native resident species. We believe that particular species should not be excluded as it would not fully represent the scope and conclusions of studies that include native resident species.*

Comment: Southern resident orcas are among the most endangered marine mammals in the world. With only 75 individuals remaining, the population is the lowest it has been in over three decades. The collapse of chinook salmon, the orcas' primary prey, throughout the Northwest have led to the whales starving to death. Pollution from our cities contaminate the few salmon that remain, which can make orcas (particularly calves) sick. And with ever-increasing vessel traffic through the Salish Sea, underwater noise disrupts the orcas' ability to hunt and communication with each other. Without abundant, healthy, and accessible salmon, these orcas may go extinct in a few decades.

Perhaps the greatest change in the orcas' diet has occurred in the Columbia Basin. Prior to European colonization, the Columbia Basin supported millions of salmon, half of which were from the Snake River, providing orcas with a critical source of food. After these rivers were dammed, salmon runs throughout the basin collapsed. Despite billions of dollars invested in recovery, none of these salmon runs have recovered, further jeopardizing orcas. Increasing spill over the lower Snake and lower Columbia dams would benefit seven of the fifteen most important salmon runs in the orcas' current diet (NOAA and WDFW, 2018). The EIS does not explicitly mention the historical and current importance of the Columbia Basin to southern resident orcas, and we suggest this be added to the section on page 8 titled "Importance."

Recovering southern resident orcas will require multiple actions across the orcas' range. The Fish Passage Center estimates that spilling up to 125% TDG for 24 hours a day would result in roughly 146,000 more adult salmon returning to the Columbia Basin every year. There are few other actions that would result in this many salmon within just a few years. In the EIS, the department acknowledges that increasing spill to 120% "would slightly benefit salmon relative to the 2018 injunction operations" (page 22). A slight benefit will not address the urgent nutritional needs of southern resident orcas. Because of this, we strongly urge Ecology to demonstrate bold leadership by increasing TDG standards to 125%.

> **Ecology Response:** *Thank you for your comment. The status of the Southern Resident Orca population is beyond the scope of this short-term modification. The intent of the EIS is to weigh the risk of TDG levels versus the benefits of fish passage in the Snake and Columbia rivers.*

Comment: The EIS also fails to acknowledge the substantial mortality caused by the hydropower network in the Columbia Basin. Without spill, smolts are sent through dam turbines and/or elaborate bypass systems. Dams and their reservoirs kill as much as 70 percent of the out-migrating smolts and more than 15 percent of the returning adults. Some smolts die further downstream as a result of cumulative stress and injury (CSS, 2018). Dams have also reduced water velocity, increased water temperatures, exacerbated predation, prolonged salmon migration, and increased salmon mortality and injury during dam passage (Budy et al., 2002; Scheuerell et al., 2009; Van Gaest et al., 2001). Because the EIS does not include this holistic analysis of salmon survivability in the Columbia Basin, it implies that any mortality attributable to increased spill would be additive. A more thorough analysis should examine the ability of increased spill to decrease other sources of mortality, primarily by increasing the travel time for juvenile salmon to reach the ocean. This reduces the amount of time juveniles spend in potentially lethally hot reservoir water, which is also where they are vulnerable to predation. As written, the EIS presents only one, dated, side of the science around spill.

> **Ecology Response:** *The EIS already provides short description of the higher survival rates recorded for fish passage via spillways versus through the powerhouse: "Studies have demonstrated that outmigrating juvenile salmonids have higher survival rates in the Snake and Columbia rivers when passed through dams via spillways versus through turbines or smolt bypass systems of hydropower projects (Whitney et al. 1997; Muir et al. 2001)."*
>
> *An additional sentence has been added to the "potential positive impacts of increased spill" section: "Potential indirect effects of increasing spill, although not quantified, include reduced predation of outmigrating juvenile salmonid in reservoirs from faster migration travel time and reduced holding times and water temperature."*

Northwest River Partners (Kevin M. Nordt)

Comment: Additionally, per our scoping comments, we would like to reiterate our desire to see a more robust evaluation of the impacts of increased spill on carbon emissions and climate change.

Ecology Response: *Thank you for your comment. The focus of this EIS was to examine the relationship between TDG and aquatic life effects. Impacts of increased spill on carbon emissions and climate change are beyond the scope of the EIS for a short-term modification of the adjusted TDG criteria in the Snake and Columbia rivers.*

Washington Environmental Council (Rein Attemann)

Comment: Of the many recommendations provided by the Orca Recovery Task Force to Governor Inslee, Recommendation 8 to increase spill to benefit Chinook for Southern Residents by adjusting Total Dissolved Gas allowances at the Snake and Columbia River dams, is one of the most effective nearterm actions the state can take to provide more salmon for orcas.

While Alternative 2, increasing the state's TDG standards to 120% for the year 2019, is a good interim measure, WEC supports alternative 3 to increase the state's TDG standards to 125% for the year 2019 as science supports this level and orcas need this standard adjusted sooner verses later. While WEC supports increasing the state TDG standard to 125% based on information shared during the Orca Recovery Task Force, we support both Alternative 2 as an interim measure and Alternative 3 in the long term.

Historically, swift river currents in the Columbia and Snake River basins quickly carried smolts (recently hatched salmon) to the ocean, where they matured and migrated further out to sea. Slackwater created by dams has significantly increased the amount of time it takes for smolts to safely migrate to the ocean and increased their exposure to lethally warm water and predators (particularly invasive piscivorous fish). Spilling water over the dam spillways (instead of through turbines to produce energy) more closely mimics the natural flow of big rivers, like the Columbia and Snake, and delivers smolts more quickly and safely to the ocean. We need more fish that are 'spilled' to have any chance of boosting the number of fish that return to the river as adults to spawn. Scientific research conducted annually since the mid-1990s demonstrates conclusively that additional spill significantly increases juvenile salmon survival and subsequent adult returns.

Washington's current TDG standards no longer reflect the best available science. Recent increases in spill show that we have been overly conservative with our standards. The best available science suggests that spill up to 125% TDG would result in 2 – 2.5 times more adult Chinook salmon returning than current levels without adversely affecting other species. From Ecology's EIS, "When spill is increased to 125% TDG 24 hours per day/seven days a week in the spring, the Comparative Survival Study juvenile fish passage survival model predicts a two to 2.5-fold increase in Snake River spring chinook salmon abundance above the levels resulting from 2014 FCRPS BiOp spill levels, and smaller projected increase when spilling to existing gas standards or 120% TDG 24 hours per day. Steelhead smolt-to-adult returns are also predicted to increase significantly, but less dramatically than Chinook salmon." The studies cited throughout the EIS note that that increased TDG and prolonged exposure to saturated water is detrimental to aquatic life. However, the majority of these studies suggest that spill up to 125% is safe for most native aquatic species, particularly salmonids. The majority of these studies are also from the 1990's and do not reflect the scientific community's current understanding of spill or TDG.

It is important to note that the species that would be negatively impacted by increased TDG are nonnative species, such as northern pikeminnow, largemouth bass, and smallmouth bass. These three species are predators of juvenile salmon, and the state is actively encouraging efforts to reduce populations of these fish through a bill currently in the legislature.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers. Ecology seeks a balance between the benefits of water spill for fish passage through hydropower projects and limiting impacts of total dissolved gas to aquatic life. We will continue to evaluate the science examining effects of total dissolved gas levels on aquatic life.*

Save Our Wild Salmon Coalition (Joseph Bogaard)

Comment: Southern Resident orcas are one of the most endangered marine mammals in the world. The chinook salmon populations these whales once relied on, particularly those in the Columbia-Snake River Basin, are just a remnant of their former levels, leaving these whales with far less food to eat. Columbia and Snake river chinook were once the largest and most abundant salmon anywhere on the west coast, providing Southern Residents with a critical winter food source at a time when there are few other salmon available.

The decline of salmon across the Northwest is complex, but perhaps the most significant degradation of salmon habitat has been the damming of its rivers. Dams and their reservoirs slow adult and juvenile salmon migration, making them increasingly susceptible to predation and lethally warm water. Large reservoirs on the Columbia and Snake rivers make it difficult for young salmon to quickly and safely migrate to the ocean where they can mature into adults. A highly effective near-term step to alleviate at least part of this problem is to increase the amount of water spilled over the federal dams in the Columbia Basin. Decades of scientific research and observation has shown that spill is the safest way for juveniles to migrate past dams and reservoirs to the ocean and that higher levels of spill result in larger adult salmon returns in subsequent years. For over two decades, Washington's total dissolved gas (TDG) standards, which limit the amount of water that can be spilled, have been overly conservative and harmed salmon survival.

The best available science suggests that eliminating the 115% forebay TDG standard as you propose and immediately increasing the tailrace TDG standards to 125% will maximize the benefits of spill without negatively impacting other species or the environment. Spilling up to this level is estimated to result in hundreds of thousands more adult salmon, making spill one of the most effective near-term actions the state can take to provide more food for orcas.

Your department has proposed increasing tailrace TDG standards to only 120% for this spring's out-migration. While this increase may provide very modest help to juvenile salmon en route to the ocean, there is no reason not to raise TDG standards to 125% immediately. The scientific evidence that this level of TDG, especially implemented flexibly as proposed, will not harm juvenile salmon or other aquatic life. More than 20 years of empirical data about the effects of dissolved gas on salmon support this conclusion. This data warrants action now to raise TDG standards to 125%. Southern resident orcas are starving to death and are unable to find enough food to survive and successfully raise new calves. This situation requires an emergency response. I strongly urge you to increase the state's TDG standards to 125% in time for the 2019 outmigration and for 2020 and 2021 as well.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers. Ecology seeks*

a balance between the benefits of water spill for fish passage through hydropower projects and limiting impacts of total dissolved gas to aquatic life. We will continue to evaluate the science examining effects of total dissolved gas levels on aquatic life and are receptive to receiving more information regarding the science.

Northwest Sport Fishing Industry Association (Liz Hamilton)

Comment: So given the status of salmon and steelhead (inaudible) and the orca, our businesses -- in our businesses we are disappointed in a spill agreement that just made a tweak this year. I mean, basically just removing one of the monitoring standards is a tweak. At a time when the Governor asked us to be bold and when the Governor puts a 1.2 billion dollar budget out for orcas, we really wanted to see more than a tweak.

Decades of empirical data modeled by CSS said if we went to -- if we went to 125 24/7, we could see a two-and-a-half fold increase in the return of spring salmon to the basin. That's bold.

Gas level trauma in salmon is sampled throughout the spring outmigration and anyone can look at this data on FPC website. And what I have seen from looking at it over the years is that you don't see any of the action criteria met as long as you stay under 125.

So we are appreciative of the region's effort to change the total dissolved gas standards to provide better protections for salmon and steelhead. We do object to the two-step standard and we are here to testify today that we believe that the standard should just be raised to 125 and not do it all again next year because we already know what the fish need. We already know they are in dire shape and we ask that we do it right now, so thank you. Appreciate the opportunity.

Ecology Response: *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers. Ecology seeks a balance between the benefits of water spill for fish passage through hydropower projects and limiting impacts of total dissolved gas to aquatic life. We will continue to weigh the risk versus the benefits in evaluating total dissolved gas levels in the Snake and Columbia rivers.*

Defenders of Wildlife (Sristi Kamal)

Comment: These dams and reservoirs kill as much as 70 percent of the outmigrating juvenile salmon and more than 15 percent of the returning adults. So as go the salmon, so goes the orcas, which is why I see this agreement as a significant positive step towards salmon and orca recovery.

This is one of the few things that the state can do to provide more salmon for orcas in just a few years. The more fish that are spilled, the more fish that return to the river as adults to spawn.

Adjusting TDG criteria to increase spill would also be consistent with the current recommendations from Governor Inslee's orca task force, may help harmonize water quality standards with Oregon. We are also looking to increase the TDG to 125 percent. And could simplify the U.S. Army Corps of Engineers' implementation of the spill program at its federal dams on the lower Snake and Columbia rivers.

Finally, while the current agreement is a much needed positive move in the direction of salmon and orca recovery, it begs the question of why the agreement didn't aim for 125 percent in 2019 instead of waiting for 2020. Given the recent deaths and the urgency of orca situation, it is critical we do as much as we can and as soon as we can.

Latest science has also shown this our original TDG standards are overly conservative and that we can get to 125 percent without impacting fish and other wildlife.

Additionally, as we embark on this three-year agreement, I urge you to plan ahead and think necessary actions in these three years that will ensure that the standards stay at this level beyond the three years and that both salmon and orcas have a fair chance of survival and recovery in the Pacific Northwest for present and future generations of Washingtonians and Oregonians.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers. Ecology seeks a balance between the benefits of water spill for fish passage through hydropower projects and limiting impacts of total dissolved gas to aquatic life. We will continue to weigh the risk versus the benefits in evaluating total dissolved gas levels in the Snake and Columbia rivers. As mentioned in the EIS, Ecology will consider a potential rule change in 2019 that will consider similar TDG criteria alternatives. We encourage your involvement in future actions.*

Sea Lion Defense Brigade (Ninette Jones)

Comment: I am in support of more spill over the dams to improve the outflow migration for juvenile smolt. What we know is that predation is the highest as juvenile smolts are pushed downstream to their ocean habitat. So what we know that behind the dams are full of walleye, bass, shad, pike minnow, yellow perch, all these nonnative fish -- excuse me -- excluding the pike minnow -- the nonnative fish that have been stuck there for sport fishing that now predate heavily on these juvenile smolts who are stuck in algae-filled warm, slack, lake-filled reservoirs, warm, algaefilled reservoirs behind the dam.

So increasing spill would push these -- aid these smolts who do not swim to the sea but rely on cold-flowing water to push them to the sea. That is my testimony.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers to reduce predation of salmonids and steelhead.*

Whale & Dolphin Conservation (Colleen Weiler)

Comment: Increasing spill is an important component of increasing salmon survival through the eight dams in the Columbia and Snake rivers and adjusting the total dissolved gas criteria gives the Department of Ecology the flexibility to maximize salmon survival.

This action was recommended by the Washington Southern Resident Orca Task Force as one of the best near-term measures to increase salmon survival leading to better abundance for the orcas.

We support extending this action beyond the short-term modification to help salmon survival and request the timing be accelerated to raise the TDG criteria this year to 125 percent. Modeling shows that increasing TDG to the levels of 125 percent increase the small to adult return ratio significantly over the recovery goal of a minimum of two percent. And increasing juvenile salmon survival helps bring more adults back to the area to feed the southern resident orcas.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers. Ecology seeks a balance between the benefits of water spill for fish passage through hydropower projects and limiting impacts of total dissolved gas to aquatic life. We will continue to weigh the risk versus the benefits in evaluating total dissolved gas levels in the Snake and Columbia rivers.*

Sierra Club

Comment: Southern Resident orcas are one of the most endangered marine mammals in the world. The Chinook salmon populations these whales once relied on, particularly those in the Columbia-Snake River Basin, are just a remnant of their former levels, leaving these whales with far less food to eat. The Columbia and Snake river chinook were once the largest and most abundant salmon species anywhere on the west coast, providing Southern Residents with a critical winter food source at a time when there are few other salmon species available. The decline of salmon populations across the Northwest is complex, but the most significant factor is the degradation of salmon habitat--particularly the damming of rivers. Dams and their reservoirs slow adult and juvenile salmon migration, making them increasingly susceptible to predation and lethally warm water. Large reservoirs on the Columbia and Snake rivers make it difficult for young salmon to quickly and safely migrate to the ocean where they can mature into adults. A highly effective, near-term step we can take that addresses part of this problem is to increase the amount of water spilled over the federal dams in the Columbia Basin. Decades of scientific research and observation have shown that spill is the safest way for juveniles to migrate past dams and reservoirs to the ocean and that higher levels of spill result in larger adult salmon returns in subsequent years. For over two decades, Washington?s total dissolved gas (TDG) standards, which limit the amount of water that can be spilled, have been overly conservative and harmed salmon survival. The best available science suggests that eliminating the 115% forebay TDG standard as you propose and immediately increasing the tailrace TDG standards to 125% will maximize the benefits of spill without negatively impacting other species or the environment. Increasing spill to this level is estimated to result in hundreds of thousands more adult salmon, making spill one of the most effective near-term actions the state can take to provide more food for our starving orcas. More than 20 years of empirical data about the effects of dissolved gas on salmon support this conclusion. This data warrants raising TDG standards to 125%. Southern resident orcas are starving to death due to the lack of Chinook salmon. As a result, they are unable to find enough food to survive and successfully raise new calves. This situation requires an emergency response. I strongly urge you to increase the state?s TDG standards to 125% in time for the 2019 outmigration and through 2021 as well.

> **Ecology Response:** *Thank you for your comment. We acknowledge your support for increasing the total dissolved gas levels in the Snake and Columbia rivers. Ecology seeks*

a balance between the benefits of water spill for fish passage through hydropower projects and limiting impacts of total dissolved gas to aquatic life. We will continue to evaluate the science examining effects of total dissolved gas levels on aquatic life and are receptive to receiving more information regarding the science.

Appendix B: Comments on Draft EIS

Ecology held a public comment period from January 29 through February 28, 2019 a draft Environmental Impact Statement (EIS) and draft short-term modification language. Public notice of the draft EIS comment period and public hearings was provided via the SEPA Register, Ecology's Water Quality Info ListServ notice, and on our website.

This appendix contains all the comments received during the draft EIS comment period, excluding reference attachments. Reference attachments are maintained in the official agency file.

Faron Scissons

Dear Ms. Bartlett,

On behalf of the Columbia River Inter-Tribal Fish Commission, thank you for preparing the Draft Environmental Impact Statement (DEIS) regarding the short-term modification of total dissolved gas criteria in the Snake and Columbia rivers. At the direction and on behalf of its member tribes, CRITFC has sought improvements in juvenile salmon passage as part of the tribes' comprehensive, gravel-to-gravel life cycle approach to restoring and rebuilding anadromous fish populations throughout the Columbia River Basin. The proposed flex spill operations are consistent with and envisioned by Wy-Kan-Ush-Mi Wa- Kish-Wit, the tribes' Spirit of the Salmon Plan.
https://plan.critfc.org/2013/spirit-of-the-salmonplan/technical-recommendations/juvenile-salmon-passage/.
The operations will require water quality standard modifications from Washington and Oregon, which we strongly support.

Please find the attached comments from the Columbia River Inter-Tribal Fish Commission.

Thank you for this opportunity to provide these comments.

COLUMBIA RIVER INTER-TRIBAL FISH COMMISSION
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February 28, 2019

Heather R. Bartlett
Program Manager, Water Quality Program
Washington Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600

Dear Ms. Bartlett:

Thank you for preparing the Draft Environmental Impact Statement (DEIS) regarding the short-term modification of total dissolved gas criteria in the Snake and Columbia rivers. At the direction and on behalf of its member tribes, CRITFC has sought improvements in juvenile salmon passage as part of the tribes' comprehensive, gravel-to-gravel life cycle approach to restoring and rebuilding anadromous fish populations throughout the Columbia River Basin. The proposed flex spill operations are consistent with and envisioned by *Wy-Kan-Ush-Mi Wa-Kish-Wit*, the tribes' Spirit of the Salmon Plan. https://plan.critfc.org/2013/spirit-of-the-salmon-plan/technical-recommendations/juvenile-salmon-passage/. The operations will require water quality standard modifications from Washington and Oregon, which we strongly support. Please accept these comments on the DEIS.

For several decades, CRITFC has closely participated in technical evaluations of the effects of total dissolved gas (TDG) on salmonids. For example, CRITFC engaged in field studies of gas bubble trauma (GBT) from 1995 to 1999. During this period, CRITFC scientists examined adult fish at Bonneville Dam, including 4,667 chinook, 1,878 sockeye, and 1,431 steelhead, to determine the incidence of relative to TDG levels (Backman, 2002)[1]. Among other conclusions from this study, adult chinook salmon were rarely observed with GBT. Severe bubbles were observed in less than 1% of the sampled populations of sockeye (15 fish) and steelhead (2 fish) and only when TDG exceeded 126%. Consistent with these and numerous other field observations, less than 2% of fish sampled at levels from 121-125% TDG have shown any signs of GBT.

TDG and GBT data collected since 1995 from were considered in the Coordinated Survival Studies (CSS). CSS examined Snake River spring chinook salmon survival from smolt to adult returns associated with spill and powerhouse avoidance. Among other things, CSS analyses considered the effects of varying spill levels on the adult return of salmon whose juvenile life history experienced high TDG. According to the CSS analyses, we would expect more than a two-fold increase in resulting Snake River spring Chinook salmon abundance when spill is provided for juvenile chinook salmon survival at water volumes associated with 125% TDG

[1] Backman, T.H.W., and A.F. Evans. 2002. Gas Bubble Trauma Incidence in Adult Salmonids in the Columbia River Basin. North American Journal of Fisheries Management 22:579--584.

(McCann, 2017).[2]

CRITFC staff have reviewed and support the comments of the Fish Passage Center (FPC) submitted to Ecology on February 14, 2019. At the direction of the Commission's member tribes and the Pacific Northwest States, the FPC has carefully evaluated TDG effects in the mainstem Snake and Columbia rivers for more than 20 years. As part of the state TDG waivers, biological monitoring for GBT is conducted throughout the Mid-Columbia, Snake, and Lower Columbia rivers. The data are reported to the fisheries management entities and water quality agencies of Washington and Oregon and are available to other interested parties through Fish Passage Center weekly reports and daily postings to the FPC website. http://www.fpc.org/smolt/gasbubbletrauma.html. We urge Ecology to recognize the significant body of TDG and GBT information that is available in the FPC's annual reports. http://www.fpc.org/documents/FPC_Annual_Reports.html.

Several comments appended to the DEIS urged Ecology to carefully consider TDG effects on invertebrate species. CRITFC is lending its resources to a multi-agency effort to develop and implement TDG monitoring strategies for aquatic invertebrates. We are coordinating with federal, tribal, and state scientific communities to review the methods that were previously implemented in the Columbia River for flexible spill management.

CRITFC has recently inventoried and implemented methods supporting the development of food web metrics from benthic macroinvertebrate data (Sullivan and White, 2017)[3]. We believe that methods we have tested in tributary environments will lend themselves to better understanding of the impact of TDG on invertebrate communities.

In conclusion, we observe that Columbia Basin salmon and salmon cultures coexisted in balance for millennia. In the last 200 years, population growth, economic development, and climate change have disrupted the Columbia Basin ecosystem. Returning fish to the tribes' usual and accustomed fishing places as guaranteed in the tribes' 1855 treaties would begin to meet the ceremonial, subsistence, and commercial needs of tribal members. Meeting these obligations benefits the non-Indian public, allowing people to enjoy their legal allotment of harvestable fish and share in a healthier, more natural river system.

If you should have any questions, please do not hesitate to contact Rob Lothrop, Policy Manager at 503-238-0667.

Sincerely,

Jaime A. Pinkham
Executive Director

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[2] McCann, J. et al. 2017. Comparative Survival Study of PIT-Tagged Spring/Summer/Fall Chinook, Summer Steelhead, and Sockeye. Chapter 2 Life Cycle Modeling Evaluation of Alternative Spill and Breach Scenarios. BPA Project #19960200, Contract #74406. http://www.fpc.org/documents/CSS/CSS_2017_Final_ver1-1.pdf We ask that the complete version of this citation be included in the record for the DEIS evaluation.

[3] Sullivan, S.P., and S.M. White. 2017. Methods Supporting the Development of Food Web Metrics from Benthic Macroinvertebrate Data. CRITFC technical report 17-05. Portland, OR: Columbia River Inter-Tribal Fish Commission. https://www.critfc.org/wp-content/uploads/2017/05/17_05.pdf

Cc: Guy Norman, Washington Council Member, NPCC
Ed Bowles, Division Administrator, ODFW
Ben Zelinsky, Senior Policy Advisor (BiOp), BPA
Dave Johnson, Fisheries Program Manager, NPT
John Ogan, Tribal Attorney, CTWSRO
Brent Hall, Tribal Attorney, CTUIR
Pat Spurgin, Tribal Attorney, YN
Dave Ponganis, Director of Programs, Northwest Division, USACE
Michael Tehan, Assistant Regional Administrator, NMFS

WA Dept. of Ecology's Draft EIS and Short-Term Modification to Total Dissolved Gas Criteria for WAC 173-201A

Oral Testimony from Rob Lothrop, on behalf of the Columbia River Inter-Tribal Fish Commission

Received February 13, 2019

My name is Rob Lothrop. I work for the Columbia River Intertribal Fish Commission. You have my contact information in the back as well as plenty of contact information for CRITFC, which is how our organization's name is pronounced.

It was created in 1977 by the Yakima, Umatilla, Warm Springs and Nez Perce tribes. We have about 100 staff. More than half of them are scientific staff. And I will say that CRITFC and its member tribes support the flex bill agreement and we are all involved in its development.

I am here today to say that CRITFC's scientists will be working with its -- our state and federal partners to develop facets of an aquatic ecology monitoring program that has been -- or that will be part of what we see as implementation of this flex bill program as well as the total dissolved gas waiver.

I want to thank Heather and her team for putting this draft environmental impact statement out in a timely fashion and we hope you can conclude it in a timely fashion. It is a good work product and we hope to make it better. We will be submitting extensive technical comments in support of your action for the record. That concludes my statement.

NEZ PERCE TRIBE
TREATY OF 1855

Nez Perce

TRIBAL EXECUTIVE COMMITTEE
P.O. BOX 305 • LAPWAI, IDAHO 83540 • (208) 843-2253

28 February 2019

Maia Bellon, Director
Heather Bartlett, Water Quality Program Manager
State of Washington Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600

Re: ***Nez Perce Tribe's Comments on Draft EIS for Short-term Modification of Total Dissolved Gas Standards for Federal Dams on the Lower Snake and Lower Columbia Rivers and Draft Administrative Order***

Dear Director Bellon and Program Manager Bartlett:

The Nez Perce Tribe (Tribe) appreciates the opportunity to comment on the Draft Environmental Impact Statement (DEIS) and Draft Administrative Order for a short-term modification of total dissolved gas (TDG) water quality standards for the lower Snake and lower Columbia rivers related to spring spill season operations of the federal dams on the lower Snake and lower Columbia rivers.

The Tribe has long supported voluntary spill of up to 125% TDG as measured at the tailrace during the spring spill season (from approximately April 1 through June 20) while salmon and steelhead are migrating downstream, based on the best available scientific information about the benefits of spill and the effects of TDG levels. Strong benefits to salmon and steelhead smolt-to-adult survival and adult abundance are anticipated from increased spill and subsequent decreased powerhouse encounter rate (PITPH). As the DEIS describes, these benefits do come with some uncertainty/risk associated with exposure of fish and other aquatic biota to elevated TDG levels. However, TDG levels of 120% to 125% are commonly experienced by aquatic biota during periods of uncontrolled spill, without apparent adverse impact to their viability; in sum, there are not significant adverse environmental impacts associated with 125% TDG levels.

The Tribe remains confident in the Fish Passage Center's Smolt Monitoring Program ongoing monitoring effort for Gas Bubble Trauma (GBT) in salmonids. This monitoring has documented that TDG levels up to 125% result in GBT symptoms well below thresholds of concern. We expect this monitoring to continue. Controlled management of TDG levels at 120% or 125% will provide opportunity for further study of GBT in non-salmonid species; we are encouraged that Columbia River Inter-Tribal Fish Commission and others are preparing to expand GBT studies.

The Tribe supports implementation of DEIS Alternative 3 and understands that Washington will be considering implementing this alternative in advance of the 2020 spring juvenile fish passage spill season, and understands Ecology is considering Alternative 2 as an intermediate step in 2019. The Tribe believes it would be beneficial to ensure that the characterizations of the benefits and impacts of Alternative 3 are accurate and precise.

Areas that would benefit from refinement, all of which can readily be incorporated in finalizing the EIS, include:

- Clarifying that there are frequently periods of involuntary spring spill at and exceeding 125% TDG, and that data has been collected, *e.g.*, DEIS at 5, 16-17; 45-48. This clarification avoids the impression that the effects of spill above the level of the existing TDG standards in Washington are unknown or dangerous.

- Clarifying that the existing evidence and data shows that the incidence of GBT in juvenile salmon is well below existing (conservative) action levels at spill that causes TDG up to 125%, *e.g.*, DEIS at 5; 45-48.

- Clarifying that the existing evidence and data shows that above 125% TDG the incidence of GBT increases somewhat in some circumstances but usually does not reach levels of concern until TDG is at or above 130%, *e.g.*, DEIS at 5.

- Clarifying that the biological opinions referenced from 2008-2014 were held illegal by the courts. DEIS at 16-17.

- Clarifying relevance of studies on the effects of TDG on early salmonid development and on juveniles, *e.g.*, DEIS at 22-25.

- Clarifying the relationship between the actual conditions juvenile salmon are likely to experience with laboratory studies involving continuous exposure to elevated levels of TDG for three weeks to two months, *e.g.*, DEIS at 27-28, or other studies, *e.g.*, DEIS at 40.

- Clarifying that the DEIS is examining all impacts (including, for example, those to smallmouth bass) for the sake of thoroughness, and ensuing in its analysis that examining this impact is not intended to suggest a sense of equivalence between, for example, salmon and non-native fish.

- Clarifying that the adverse impacts at 120% TDG are minimal, *e.g.*, DEIS at 45.

- Clarifying statements to emphasize the relative, and limited, range of uncertainty, *e.g.*, DEIS at 45-48.

The Tribe looks forward to continuing to work with and assist Washington and Oregon as they consider modification of the current standards up to 125% TDG. The Tribe's comments are offered against this backdrop, and we invite you to contact our staff (David B. Johnson, Director, and Jay Hesse, Research Division, in the Tribe's Department of Fisheries Resources Management) as you finalize the EIS.

We hope these suggested clarifications will be helpful in refining and finalizing the EIS.

Sincerely,

Mr. Shannon F. Wheeler
Chairman

Janet Alderton

I support the implementation of this plan to help more juvenile salmon survive their passage from above the dams on the Snake and Columbia Rivers to the down-river waters that connect to the Pacific Ocean. The Endangered Southern Resident Orca Whales travel along the outer coast of North America from Northern California, Oregon, and Washington to the marine waters west of Vancouver Island. They follow the salmon, especially the Chinook. When we help salmon, we are helping the orca whales that are balanced on the edge of extinction.

Alida Bockino

I urge you to support the Washington Dept of Ecology"s proposal to increase spill levels on the dams. This proposal, also supported by the Washington Orca Task Force and Gov Jay Inslee, is the best way to improve salmon survival which in turn greatly improves the survival of those few remaining Orcas. The salmon and the orcas need your help, please don't let them down.
Thank you
Alida Bockino
Moscow, Idaho

Mark Booker

Increasing flows on the river system has been proven to be counterproductive to migrating fish.

Increasing gas levels only makes migrating fish bare more stress, resulting in limiting natural migrating fish ability to avoid/react to predators in river. Therefore more fish will die by the artificial changing of river operations.

It is near certain that changing river operations in a new way will be counter to migrating fish adaptation to current river operation and all adaptation that has taken place over the past century. I cite the catastrophic summer long spill at the Dalles Dam during the 1990s resulting in 80% mortality of migrating fish for the entire term of the spill. Done under the name of Salmon Recovery

In summary: 1. Spill is just to the rough on migrating fish. 2. Spill will steal from our children's future by raising electric power cost for the School Districts throughout our State, without benefit to Migrating fish.

Ocean conditions and harvest do have effect upon returning numbers of Migrating Fish. Study should focus on those areas.

The Business of Salmon recovery has become much different from the Business of Recovering Salmon. Increasing flows to the detriment of migrating fish and to the detriment to our children's future serves no purpose. Other than promoting and perpetuating the Business of Salmon Recovery. Mark, from the land of the Mighty Columbia!!

Mark Booker

Using spill and River Dam spillways to move migrating fish downstream is short sighted for at least the following reasons: 1. The tremendous turbulence of the ninety foot spill down the spillway will damage any migrating fish very likely beyond survival. 2. The spillway volume of spill flow will certainly distract returning migrating fish likely causing the returning migrating fish to fail to return.
Both the above reasons along with many other reasons are counter to the goal of creating returning migrating fish.
The Business of Salmon Recovery is very different from the Business of recovering Salmon. The Business of Salmon Recovery will steal from our children's future all without benefit to migrating fish.
Mark, from the land of the Mighty Columbia!!

Melissa Borden

Dear Department of Energy,
Orca scientists have made it clear that our Southern Resident Orca (SROs) are in a starvation crisis. Because SROs' diet consists of at least 80% chinook salmon, having an ample chinook salmon population is key for their survival, as well as that of many other species, and indeed, the entire PNW ecosystem. The Columbia/Snake chinook population is crashing this year, with fewer than 50,000 expected to return, about 1/10 of the 10-year average. Accordingly, I urge you to exercise Washington's authority under Clean Water Act section 401 to help ensure the Columbia Basin's federal dam operators take action to reduce rising water temperatures, protect salmon, and help save the Southern Resident orcas from extinction.
When river temperatures exceed 70F for several days at a timeas happens with increasing frequency due to climate changesalmon have difficulty migrating upstream and begin succumbing to stress and disease. According to the Fish Passage Center, an independent government agency, "under a climate change scenario, the long-recognized and largely unaddressed problem of high-water temperatures in the [Columbia and Snake rivers] becomes an ever-increasing threat to the survival of salmon."
On the Columbia and Snake Rivers, hydroelectric dams make the heat pollution even worse. Federal dams on the Columbia and Snake rivers have never obtained water quality certifications under Section 401 of the Clean Water Actleaving Washington without authority to protect its own water quality and fisheries. Until now.
According to EPA's own draft analysis, summer temperatures in portions of the Columbia and Snake rivers are up by 1.5 degrees Celsius since 1960 because of the combined effects of climate change and dams. Temperatures are so high, sometimes exceeding 70 degrees, that they kill migrating salmon, such as in the sustained hot summer of 2015.
The EPA's own analysis also shows that removing the 4 Lower Snake River dams (LSRDs) would have the most impact on reducing temperatures to the salmon survival range. Removing the 4 LSRDs would also assist with lowering the temperatures behind the 4 mainstem Columbia dams. The 4 LSRDs are no longer needed for hydropower, as they generate only about 3% of the system's power, which is at about 16% surplus. Nor do they provide any flood control. The irrigation provided at Ice Harbor Reservoir to about 37,000 acres can still be provided post dam breaching via lengthened pipes and additional pumps. It is imperative for the sake of having our SROs and salmon survive that the 4 LSRDs are breached in 2019.
I therefore request that DOE enact water temperature standards that will provide incentives for the federal operator, USACE, to breach the 4 LSRDs to come into compliance with the Clean Water Act and Endangered Species Act. Lower water temperatures in the Columbia and Snake Rivers will help save salmon, orcas, and the entire PNW ecosystem. We in WA state must be leaders, where the federal government is failing to protect our irreplaceable environment and wildlife.

Thank you,
Melissa Borden

Mary Bostick

I strongly support the WA DOE's proposal.The Salish Sea's endangered southern resident orcas once thrived thanks to plentiful thousands of Chinook salmon. Today with Columbia River/Snake River Chinook salmon populations in severe decline, the orcas number just 75 individuals. The most effective, short-term means of increasing Chinook salmon numbers is upping spill levels to what is measured as "125% total dissolved gas" starting NOW in 2019.

Washington's Orca Task Force recommended spill be increased, and Governor Jay Inslee supports that recommendation. Now the WA Dept. of Ecology has officially proposed modifying state "total dissolved gas criteria" to allow for an increase in the two rivers.

I add my support for increased spill, since the Columbia watershed affects Idaho as well!.

Teresa Brown

It is too late for the SRKW's to do an EIS at this point in time. What is needed, AND WANTED by the public is the breaching of the lower snake river dams. No more studies. Time is up! If everyone is absolutely unwilling to breach them, then this seems like the next best option, but our SRKW's deserve better treatment from us! PLEASE LEGISLATORS: BREACH THE DAMS!!

Sarah Burr Arnold

I support the proposed Alternative 2 modification of WAC173-201A TDG Criteria for the dams on the Lower Snake and Columbia Rivers during the spring spill season to help the survival of salmon and orcas. It is of vital importance to the environment to preserve top predators such as orcas and the way to do that is to increase the food supply. Studies indicate that increasing the spill over dams would improve salmon abundance and survival thereby improving the food supply for orcas. In addition salmon as a species separate from their food value should be preserved.

I urge The Department of Ecology to adopt and implement Alternative 2.

Rynda Clark

Please modify short term dissolvable gasses criteria to allow more spill from the Snake River dams. The salmon cannot survive current conditions without help. The entire ecosystem is near collapse. Please do what we can to save it.

Mary Coleman

Dear DOE,

Orca scientists have made it clear that our Southern Resident Orca (SROs) are in a starvation crisis. Because SROs' diet consists of at least 80% chinook salmon, having an ample chinook salmon population is key for their survival, as well as that of many other species, and indeed, the entire PNW ecosystem. The Columbia/Snake chinook population is crashing this year, with fewer than 50,000 expected to return, about 1/10 of the 10-year average. Accordingly, I urge you to exercise Washington's authority under Clean Water Act section 401 to help ensure the Columbia Basin's federal dam operators take action to reduce rising water temperatures, protect salmon, and help save the Southern Resident orcas from extinction.

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On the Columbia and Snake Rivers, hydroelectric dams make the heat pollution even worse. Federal dams on the Columbia and Snake rivers have never obtained water quality certifications under Section 401 of the Clean Water Actleaving Washington without authority to protect its own water quality and fisheries. Until now.

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I therefore request that DOE enact water temperature standards that will provide incentives for the federal operator, USACE, to breach the 4 LSRDs to come into compliance with the Clean Water Act and Endangered Species Act. Lower water temperatures in the Columbia and Snake Rivers will help save salmon, orcas, and the entire PNW ecosystem. We in WA state must be leaders, where the federal government is failing to protect our irreplaceable environment and wildlife.

Thank you,
M. Colemen

Tim Colton

I'm glad to see WA State increase spill levels through Columbia River System Dams during salmon out-migration. This is an important short term step to increasing salmon populations in the Columbia watershed. I do believe that more drastic measures, such as dam removal, are necessary to recover the ecosystem and sustain healthy salmon populations in the watershed.

Rodney Fosback

Start with Boundary Dam; doesn't matter who owns it.

Next: Where is all the electricity going to come from for all the electric cars planned, with tax payer money, for the future? And please, don't say more wind mill generators. Those inefficient monsters have destroyed the landscape of Eastern Washington. More Nuke energy? Get real.

I understand public comments are only taken to make what you plan to do legal. Doesn't make it right though.

Short term usually morphs into long term.

Howard Garrett

I support increasing the dissolved gas levels to 125% and the duration of spills to help smolts get downstream, despite the potential cumulative deleterious impacts to all fish downstream that may weaken them, impairing their abilities to function, at least temporarily.
The only real solution is to breach the 4 Snake River dams but that is blocked to sustain the massive federal payouts to the Columbia Basin Federal Caucus that in turn supports the regional economy.
Please see attached. Thank you.

February 7, 2019

Dear Orca Recovery Task Force and all concerned,

We appreciate that the Orca Task Force has spent months of incredibly hard work, dedication and collaboration to find ways to help recover these endangered orcas.

To face the task of avoiding the imminent extinction of Southern Resident orcas we must face the reality that we may have already run out of time. Stated bluntly by Kenneth Balcomb, founder and chief scientist at the Center for Whale Research since 1976 and a Task Force member: "There will be extinction with the current trends. We need to change the trends or just write them off…You might have some living whales at the end of this century, but we're likely to have no reproducing whales at the end of a decade" (The Oregonian, September 14, 2018).

Based on input from the three working groups on the Task Force, the revised draft recommendations for action to recover the Southern Resident orcas include *Recommendation 9: Establish a stakeholder process to discuss potential breaching or removal of the lower Snake River Dams for the benefit of Southern Resident orcas.* This conversation is extremely important to a broad range of Washington citizens.

However***, this conversation took place 20 years ago through one of the most expensive and expansive public involvement processes the Corps has undertaken.*** Involving hundreds of stakeholders from every conceivable group or organization, the Corps defined mitigation actions and budgets for those who might be impacted. This can all be found in Appendix O of the 2002 lower Snake River Feasibility study and Environmental Impact Statement that is still the operable EIS for the 4 LSRD's. This document can be found on the Corps Walla Walla District website. These mitigation actions and costs have been updated by engineers and economists, in many cases with very large saving, e.g. irrigation modifications actually cost only $20 million versus $400 million in 2018 dollars.

A stakeholder process remains important to facilitate the transition to a productive economy after breaching (see below) and to determine the best usage of 20,000 acres of reclaimed bottom lands. Recommendation 9 should be refocused in this manner and be conducted in parallel with immediate breaching. The known updated mitigation actions and costs are ready to be implemented commensurate with breaching and funded as part of the breach cost.

Neither the Southern Resident orcas nor the endangered Snake River spring/summer Chinook have time to replicate previously accomplished processes. Distilling four decades of demographic field studies on this dwindling population, along with combined prey, toxin, and hormone studies conducted since their endangered listing under the ESA in 2005, the scientific consensus agrees that for several years ***J, K, and L pods have been experiencing episodic malnutrition due primarily to steadily decreasing numbers, size and weight of their specialized diet of 80% Chinook salmon***, which served them well for tens of thousands of years until the past century or so. In 2018 only 67,596 Snake River Spring/Summer Chinook returned to Lower Granite dam, about 40,000 below estimates. In 2019 only 48,100 fish are expected to return.

Compounding the lack of sufficient food, toxin studies have shown that So. Resident orcas are among the most heavily contaminated species known, laden with highly toxic and persistent organochlorine pollutants. Among other debilitating impacts, these endocrine disrupters and other toxins compromise reproductive systems and impair developing fetuses. Hormone studies on So. Residents have revealed that when insufficient caloric intake is available to maintain essential activities to survive, these toxins are flushed into the bloodstream and become active in the orcas' endocrine system. One result is that ***up to 70% of pregnancies end in miscarriages, often late in the 17-month gestation period***.

These hungry orcas have little or no time to wait before they succumb forever to the lethal effects of food deprivation. Only 19 offspring born since January 2009 are still alive, while 34 Southern Resident orcas have died in that time. A birth/death ratio of 19/34 describes a death spiral for the So. Residents.

The immediate benefit of quickly breaching only the first 2 dams is to prevent the death of 4 million Chinook smolts in the first year. When the other two dams are breached the following year another 4 million smolts will survive that are currently killed by the dams and reservoirs. Breaching is by far the fastest way to deliver several hundred thousand adult salmon to Southern Resident habitat within two years of breaching.

Fortunately there is no need to wait an undetermined number of years for the completion of a new NEPA process and the inevitable litigation to follow regardless of whether or not it calls for breaching the dams. Unbeknownst to many, Army Corps protocol specifies a process to begin breaching the dams within months of issuance of a formal Record of Decision, which could be made at any time. According to Jo Ellen Darcy, then Assistant Secretary of the Army for Civil Works: "[The Corps] is also committed to following the guidance in the 2002 FR/EIS as a framework for its actions, which includes ongoing assessments as to the efficacy of the alternatives it has implemented to date; the results of those assessments will inform our next steps while the NEPA process is underway, and the NEPA process itself."

The verifiable facts available show that the dams are in truth not needed for transportation, hydropower, or irrigation. Inexpensive mitigations are readily available in every instance, relative to the massive federal funding required to keep the dams in place.

All of the claims made by dam proponents are either personal opinions or have been amply rebutted with facts and data. Although dam proponents' claims are widely shared by the key federal and state agencies and career and elected officials, and a broad cross-section of interest groups and individuals, they are easily debunked with research and informed sources.

The historically most bountiful high-altitude orca-sustaining wild salmon in the world are being driven to the brink of extinction due to the dams. Snake River Chinook were some of the biggest, fattest fish on the west coast. Today's hatchery Chinook are much smaller. (10-20 lb avg vs 50+ lb avg). It takes more energy for less calories for orcas to catch today's smaller hatchery fish. Opening the 5500 miles of near pristine habitat above the Snake River dams would allow wild Chinook to recolonize those waters, and restore WILD SUSTAINING populations of Chinook, which, in the long run, would be much cheaper to maintain than the current reliance on hatcheries. Instead, these spring and summer salmon runs are steadily going extinct, and as they disappear the So. Resident orcas are starving to extinction.

All of which begs the question: *why do so many trusted authorities adhere so fiercely to so many unverifiable claims to protect the dams?* Pro-dam passions obviously run deep, even though the stated objections to breaching have little merit.

The dams need to be breached or endangered salmon and So. Residents will go extinct, but the majority of the Task Force will not recommend breaching. Why?

The fundamental truth demonstrated by all the objections listed below to breaching is that ***the dams are vital to the economies of local communities in eastern WA, not for their operations but as a conduit for federal money dispersed into the region.***

Taxpayers are spending close to a billion dollars each year for dam maintenance and operations plus required mitigations and restorations to attempt to save endangered salmon that 5 federal court rulings have found are not working. The fish are still going extinct, as seen in consistently below replacement SAR levels (see CBR graphs below).

For most tax payers and rate payers such an unproductive federal expense would be considered another case of pork barrel politics, or a massive boondoggle. But for residents in the region the influx of federal money to agencies and contractors provides the foundations for regional economies, sustaining local development, governments, schools, libraries, etc. Much of those untold $100s of millions is spent on paychecks in the region to employees at gov't agencies, industries, and bureaucracies, dam operations and maintenance workers, pipefitters, fisheries biologists, mariners, etc. Those employees in turn multiply that money into the regional economy supporting the full range of economic activities, for homes and businesses, etc. Those numbers can't be hard to find by state agencies, but these are the issues that should be examined and described publicly to help plan for the inevitable transitions to life without the dams. Instead, politicians promise and are elected to keep that economic engine in gear, no matter if the dams are no longer producing services or revenues and BPA is unable to produce revenues from the Snake River and is approaching a financial cliff, while salmon and orcas, and so much else, are going extinct as a direct result of the dams. This economic analysis deserves much more examination and emphasis, so that informed decisions can be made.

We can't minimize the financial issues created by the prospect of curtailing this federal influx, though other Army Corps projects, dams, hatcheries, and restoration projects will provide commensurate employment in many cases. **Our challenge is to examine this wider picture of what happens when dam operations and barging cease**.

The question before us is not really whether to breach the four lower Snake River dams. They are decimating endangered species and return insignificant revenues. The real question is how to close or realign the operations and facilities of the agencies collectively known as the Columbia Basin Federal Caucus, which include the Corps, Reclamation, the U.S. Fish and Wildlife Service, the U.S. Forest Service, NOAA Fisheries and other federal and state agencies whose purpose is to maintain the Snake River dams or mitigate for the harm the dams cause to endangered salmon. ***The economic challenges when the dams are breached are the real reason passions in Eastern Washington are so intense in opposition to breaching the dams, and are the issues that must be addressed***.

The implications of a decision to breach the dams by the Army Corps will be unprecedented in many ways, but the closest parallels may be found in the history of military base closures. Since 1988, more than 350 bases have been closed or realigned. Base closures can represent significant economic challenges for communities. The Base Realignment and Closure process was created in 1988 to reduce political opposition from members of Congress that arise when facilities face closure or reductions. The Office of Economic Adjustment (OEA) works extensively with communities to guide them through the process of organizing to effectively plan and diversify their economies, redevelop sites and lands, and minimize the impact of the closure on the community. Some personnel and employees are transferred, or may take new jobs, and programs are established to facilitate those transitions. A similar process is needed to ameliorate the challenges posed by breaching the dams.

With breaching new economic drivers will emerge, such as the rich bottomland able to return to bountiful orchards and vineyards. Fishing, recreation and tourism opportunities will increase dramatically. According to Earth Economics: "...the benefits obtained in a scenario with breached dams far surpasses that of keeping the dams. Review of the 1934 surveys, historical research and other information contained in the FR/EIS shows that 4-5000 acres could be put back into high value agriculture, (e.g., viniculture and orchards). Riverside recreational opportunities and businesses are also likely to flourish.

The choice before us is whether to plan for the transition to life without these four dams, or to participate in the final extinction of the planet's potentially most abundant high-altitude spring/summer Chinook, and the exquisitely evolved and deeply cherished members of the Southern Resident orca community.

The massive and sustained federal payout to the region is where this conversation needs to begin anew. Now is our time to put aside our differences and unite to give the residents of eastern Washington, the Snake River salmon, and the much beloved and endangered So. Resident orcas, a future they need and deserve.

Sincerely,

Howard Garrett
Orca Network
485 Labella Vista Way
Freeland WA 98249
howard@orcanetwork.org

Supplemental notes:

It is often said that only Congress can authorize breaching. This is not correct. Just to clarify and reiterate, the Army Corps, with funding from the BPA drawn from salmon mitigation credits at no cost to tax-payers or rate-payers, has the authority to issue a Record of Decision to select Alternative 4—Dam Breaching from their 2002 FR/EIS: Breach, despite contrary claims.

During the Task Force meeting in Tacoma Oct. 17-18, the points in the hydro fishbowl from those in favor of keeping the dams included the below. Other points have been brought up by others.

- Sedimentation in rivers downstream of Ice Harbor dam could kill salmon or sturgeon, or contaminate the water;
- Infrastructure, such as railways, utilities, and roads are not ready for increased traffic;
- Dams are capacitors for meeting demand during peak;
- Ongoing NEPA process needs to be followed;
- If decision is made to breach, litigation would go on for many years;
- Neighboring states need to be involved;
- Breaching might not produce desired results;
- Breaching would cause harm to local economies;
- Other ACOE projects are more worthwhile, like near-shore restorations, Skykomish, Howard Hanson, dams could be removed, etc
- The dams do not block access for endangered salmon; juvenile fish survival at each of the dams averages 97%, higher than in some undammed rivers. Turbine design, fish ladders, restorations, have resulted in improvements.
- A 15-week closure when barging was not available in 2010-11 caused a 9% increase in CO_2, CO, N, and particulate matter from rail and trucks;
- Drawdown costs would be 100s of millions in corridor improvement costs;
- Over 4.3 million tons of cargo were moved by barge in 2014, which kept 174,400 trucks and 43,610 rail loads off roads already congested;
- Salmon would be stranded along the shores;
- Eastern WA emotions are high; a political Cascade wall would get higher;
- Would remove the food supply that everyone needs to eat;
- Dams are vital to E. WA, to transportation, for farm to market; we depend on agriculture and the dams are part of that;
- No one salmon recovery action on a single river such as breaching the dams on the Snake would itself bring about recovery of SRKWs;
- Not a silver bullet;
- Dams are federal, federally regulated, needed when the wind machines quit producing, the power is needed for these lights. Until at some point we're able to operate without electricity those dams are important;
- Ag is second largest industry in WA. In region Ag is king, and the SR dams are the lifeblood of our community;
- Problems would be created for residents of E WA, but they don't trust gov't to mitigate their problems;
- This conversation is a distraction;
- The cost of dam removal to the local community cannot be swept aside;

- Need to engage local community about how we would actually solve these problems, because they aren't small, while NEPA moves forward;
- Any external process should feed into the NEPA process. Local input should be brought into the NEPA process;
- There is a stable amount of fish coming out of this system now;
- Would actually put short term recovery of SRs at risk if we put this amount of salmon coming out of that system at risk.

The NOAA Fact Sheet "Southern Resident Killer Whales and Snake River Dams" was mentioned often. One key point was that: "Last year's return of Chinook salmon to the Columbia totaled more than 1.3 million fish, the third record year in a row for total Chinook returns." Also, from the Associated Press, NOAA spokesman Michael Milstein said: "returns to the Snake and Columbia rivers have been up in the last 10 years." And: "We do think that the whales have access to the same volume of fish that they would have otherwise," he said. This is clearly false, a fact of which NOAA must be aware.

The available data says 2018 Chinook Adult Passage (Aug-Nov) shows marked decreases with 10-year averages, which itself is a post-dam baseline, as per the CBR data graphs below. ***Multiple sources of unbiased data show that the dams are causing significant lethal effects on migrating salmon, especially smolts.***

The concerns expressed about sediment loads harming salmon are addressed in NOAA's Management Strategies and Actions Recovery Plan November 2017, p. 189: "...if lower Snake River dams are breached...Juvenile travel time through the lower Snake River would be faster; ...and changes in total dissolved gas caused by releasing water through spillways would be eliminated at projects that were breached. Juveniles migrating in the spring would experience highly turbid conditions...Predictions of the effect of increased sediment on the survival of migrating salmon and steelhead would be highly subjective and would depend on flows during the post-dam breaching period." There is no mention of smothering spawning gravels. A positive effect of increased, but temporary, sedimentation would be to obscure smolts from predators, improving smolt survival.

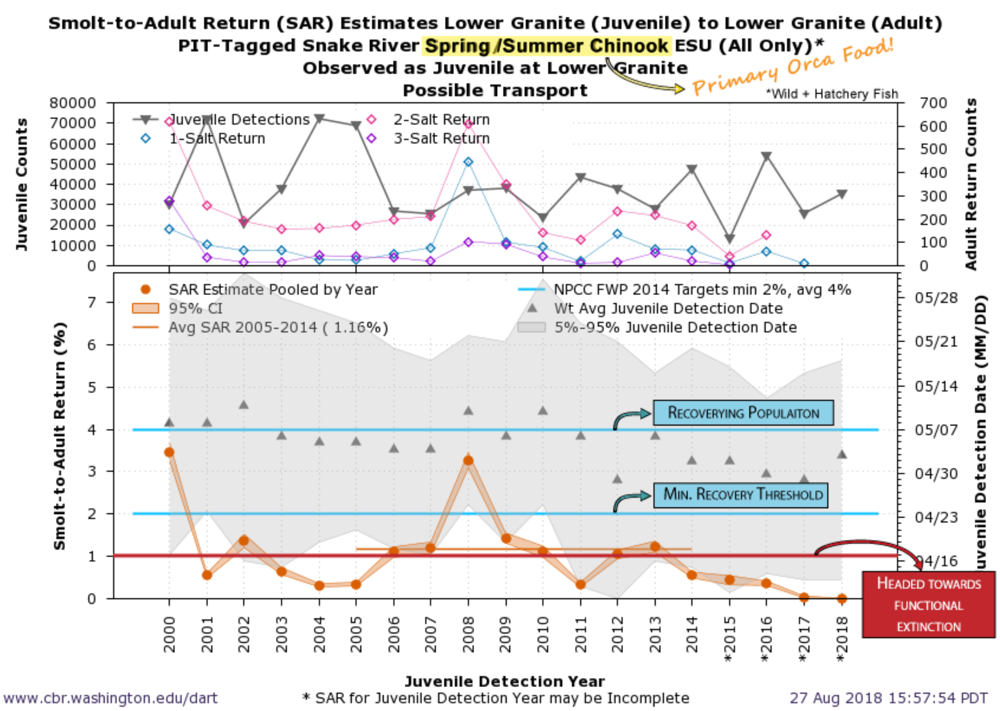
Grain barging on the Snake has steadily decreased for two decades. According to the Idaho Wheat Commission: "Overall, railroads move 36% of Idaho's wheat to market, barges deliver approximately 35% to coastal areas and 29% is trucked directly to end users." Over the past 20 years grain transportation on the Lower Snake River has declined by over 40%, largely because of the unit train loading facilities built by farmer cooperatives in eastern Washington, one close to the Idaho border. A new rail-loading facility for grain in Lewiston will be completed this month (https://www.capitalpress.com/state/idaho/port-of-lewiston-works-to-diversify/article_1416ad8c-025e-11e9-be75-1b62d323ee87.html). Economic analysis pegs the annual cost to taxpayers for LSR freight transportation at a minimum of $18 Million. Each barge of grain on the Lower Snake River requires a taxpayer subsidy of at least $24,000 (Lower Snake River Navigation Study, Rocky Mountain Econometrics September, 2015).

The energy produced by the LSRDs does NOT need to be replaced. Since 2000, natural gas and wind power have added 15,382 annual Megawatts (MW) of capacity to the PNW grid, five times the generating capacity of all four LSRDs. *Actual production* from natural gas and wind in 2016 totaled 6,127 MW, more than six times the average annual LSRD production. California, once a major buyer of

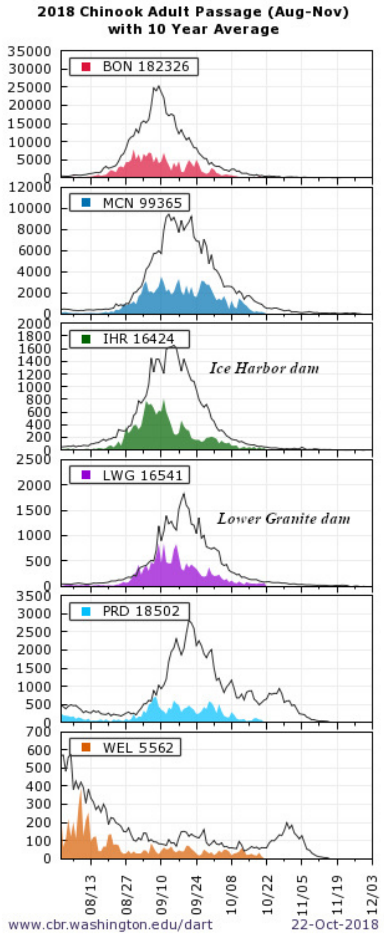
BPA energy, plans to produce by 2020 another 4,000 MW of solar energy and, by 2030, an additional 10,000 to 20,000 MW of solar energy. As of March 2018, BPA's "Interconnection Queue" of energy, already scheduled to come on line in BPA's transmission grid, included 2,905 additional MW of wind energy and 2,341 MW of solar energy—more than five times LSRD hydropower production.

All LSRD production is surplus power, much of it sold for prices below the cost of production. Over the past ten years the price of surplus power has declined over 60% and the California market for BPA energy has also declined significantly, leaving BPA on the edge of a financial cliff. During this same time period BPA has raised its wholesale power price 30% (with another 5% projected to result from the next rate case) and has blown through nearly its entire cash reserve of over $900 million. The agency is $15 billion in debt and is counting on solving its financial crisis by selling more surplus energy into a shrinking market with falling prices, a questionable business practice. The costs of operating, maintaining, and mitigating for the LSRD does not result in revenues above 15% of investment, further draining the coffers of the struggling BPA.

Road and railway upgrades have been done and more improvements are underway or could be for small expenditures, the hydropower has already been replaced six times over by cheaper, renewable alternatives; and inexpensive irrigation retrofits to draw water from river flows can be installed during winter months for less than $20 Million. No agricultural interests need to be disrupted.



Columbia Basin Quick Look



Carrie Gelegonya

I support increasing spill over the dams of the Columbia and Snake Rivers in order to help more salmon to survive. Our Southern Resident Orcas are in immediate danger of starving to death due to lack of salmon. While breaching the dams would be preferable, increasing spill is a good stopgap measure for the time being.

Angela Harrison

We need to do whatever is necessary to restore our environment. Increasing the spill may be a good start but please consider doing more. This solution seems to be a half hearted and politically motivated.

The environment is the economy and we are ruining it quickly ruining it.

Yes , I am in favor of increasing spill, but we need more now!!

Thank you,
Angie Harrison

Cathy Home Cathy

Yew, increase spill on all the dams.
Yes, dam removal on the lower 4 snake river dams is good place to start.
What is good for the salmon is good for all of this fragile eco system.

I live in the San Juan islands and I believe that we need to do all that we can to insure more juvenile salmon survive all the obstacles in their path. Our local Orca population is on the brink of starvation, due to not enough slam, on, especialy chinook.....also toxic loads,plus many many other human caused stressors...we need to do all we can....and I will do my part my consuming less resources, including using less electricity and energy, I already domuch of that and will continue, I ride a bike for commuting and for vacation and I already have decreased my consumption of many of life comforts to make sure our life is sustainable on this planet as well as in my community. Noe it is the part of our govt to work harder to conserve.

Kelly Iriye

Spill, by itself, is not going to result in successful increase in Chinook salmon. This past year, spill caused Adult mortality because the dissolved gas started causing bubbles under their skin. Then the force of the spilled water and current literally blasted their faces off - why are we trying to save the babies if we're going to kill the adults? If we're going to spill (because I know that will be the result of this), than at least spill at fewer dams by breaching the Snake River dams.

I am unable to attach a file - even though it is saved as a .jpg. I also tried as a .png and had no luck. However, the Orca Task Force Webinar on 9/26/2018 had a slide show with a graph showing the SAR percent increase expected for various options. Increasing spill to 125% in the Snake River showed a potential SAR range of 0.9% - 6.8%. However, breaching the 4 lower Snake River dams and spilling at 125% on the Columbia river showed an SAR range of 2.0-11.3%! 11.3% is well above what 6% goal is for recovery and would most assuredly recover this species. This would be equivalent of 1,050,000 fish! Over a million more fish in the river simply by removing unnecessary blockade, such as the Snake River dams.

Please breach the Snake River in 2019! Otherwise, you are guaranteeing the extinction of the southern resident endangered orcas, followed swiftly by the salmon and steelhead.

Kelly Iriye

Dear Department of Energy,
Orca scientists have made it clear that our Southern Resident Orca (SROs) are in a starvation crisis. Because SROs' diet consists of at least 80% chinook salmon, having an ample chinook salmon population is key for their survival, as well as that of many other species, and indeed, the entire PNW ecosystem. The Columbia/Snake chinook population is crashing this year, with fewer than 50,000 expected to return, about 1/10 of the 10-year average. Accordingly, I urge you to exercise Washington's authority under Clean Water Act section 401 to help ensure the Columbia Basin's federal dam operators take action to reduce rising water temperatures, protect salmon, and help save the Southern Resident orcas from extinction.
When river temperatures exceed 70F for several days at a timeas happens with increasing frequency due to climate changesalmon have difficulty migrating upstream and begin succumbing to stress and disease. According to the Fish Passage Center, an independent government agency, "under a climate change scenario, the long-recognized and largely unaddressed problem of high-water temperatures in the [Columbia and Snake rivers] becomes an ever-increasing threat to the survival of salmon."
On the Columbia and Snake Rivers, hydroelectric dams make the heat pollution even worse. Federal dams on the Columbia and Snake rivers have never obtained water quality certifications under Section 401 of the Clean Water Actleaving Washington without authority to protect its own water quality and fisheries. Until now.
According to EPA's own draft analysis, summer temperatures in portions of the Columbia and Snake rivers are up by 1.5 degrees Celsius since 1960 because of the combined effects of climate change and dams. Temperatures are so high, sometimes exceeding 70 degrees, that they kill migrating salmon, such as in the sustained hot summer of 2015.
The EPA's own analysis also shows that removing the 4 Lower Snake River dams (LSRDs) would have the most impact on reducing temperatures to the salmon survival range. Removing the 4 LSRDs would also assist with lowering the temperatures behind the 4 mainstem Columbia dams. The 4 LSRDs are no longer needed for hydropower, as they generate only about 3% of the system's power, which is at about 16% surplus. Nor do they provide any flood control. The irrigation provided at Ice Harbor Reservoir to about 37,000 acres can still be provided post dam breaching via lengthened pipes and additional pumps. It is imperative for the sake of having our SROs and salmon survive that the 4 LSRDs are breached in 2019.
I therefore request that DOE enact water temperature standards that will provide incentives for the federal operator, USACE, to breach the 4 LSRDs to come into compliance with the Clean Water Act and Endangered Species Act. Lower water temperatures in the Columbia and Snake Rivers will help save salmon, orcas, and the entire PNW ecosystem. We in WA state must be leaders, where the federal government is failing to protect our irreplaceable environment and wildlife.

Thank you,
Kelly Iriye
Sequim, WA 98382

Darrel Jensen

Leave the dams alone!! Shoot the seals!!

Shelly Johnson-Choong

I am in favor of the flexible spill agreement for the salmon season of 2019 through 2021 for the eight federal dams on the lower Snake and Columbia rivers. However, I see this as a temporary and short-term solution with the need for the Snake River dams to be completely dismantled.

These dams are not only responsible for endangering the Chinook Salmon runs, which feed the Southern Resident Orca population in the Salish Sea, but they alter the whole ecosystem of the Pacific Northwest, and the ecosystem is crucial to our economy.

These rivers must be restored through dam removal if we are to recover our salmon population and the ecosystem that supports them and the whole of the Pacific Northwest.

Shelly Johnson-Choong

Ninette Jones

History reveals that before the construction of the Bonneville Dam that there have always been bottlenecks on the Columbia River where fish would pool and rest and humans and marine mammals could eat them. Historians note log jams, beaver dams, and the great Celilo Falls is once where the strongest and fastest salmon escaped dip nets and hungry animals from winter until the spring as Chinook salmon ascended the tumultuous river & thunderous & sacred falls. One Hundred and thirty other non human animal species rely on salmon for their very sustenance --not sport. In the Columbia River estuary sea lions and seals could easily feed on fish through the winter until the spring as Mother Nature intended, and there were always enough salmon for the tribal fisheries, abundant populations of bears (grizzly and black), wolves, coyotes, bobcats, lynx, osprey, terns, loons, herons, eagles, mergansers, American dippers, cormorants and on and on that all subsisted in part on differing life histories of salmon and steelhead within the Columbia Basin(B. Mc Millan 2008). Celilo Falls although, created an impassable bottleneck for pinnipeds on the Columbia River.

Moreover, healthy salmon swim faster than sea lions by Mother Nature's design and as history has shown us the Columbia River was once a series of tumultuous swirling, frothy, cold, rolling rapids; rushing to propel, young salmon, down river on their outward migration, towards their adult habitat, the sea. The Columbia River habitat now consists of warming narrow channels and slack water lakes created by the US ACOE hydroelectric dam's reservoirs and now Chinook salmon returning to Idaho's Snake River must pass eight dams twice in their lifetime. National Marine Fisheries now reports a 20% conversion rate for these salmon at each passage facility so the US ACOE providing intentional adequate river flow over the dam in the spring will help push young salmon towards the sea in a timely manner.

Altogether, cold water spilling over the dam helps young fish avoid the dam's turbines, avoid lenthic warming aquatic habitat conditions that now favors non- native piscivorious fish such as small-mouth bass, walleye, channel catfish, northern pike, pike minnow and American shad (NMFS, Sanderson 08) over native cold water fish. Most of the non- native fish- eating fish were and are still intentionally stocked or not, and or released into the Columbia River for sport fishing. And these non native and hatchery fish populations are all well known for competing with the salmon for food and habitat resources and non-native and hatchery fish known for predating heavily on millions and millions of baby salmon as they float down river on their outward migration towards their adult habitat the sea. Non- native fish populations now make up the most abundant populations of fish in the Columbia River estuary.

On the other hand what we know about marine mammals is that sea otters, Steller sea lions and southern resident orca populations are all important native key- stone species in the Pacific Northwest bioregion. Sea lions for example are opportunistic eaters and they are breast stroke swimmers and sea lions tend to consume the prey that is most abundant in the estuaries which are now populations of non native and hatchery fish (Sanderson08). The US ACOE observers at the dam have reported that not all sea lions that visit the Bonneville Dam are proficient at catching salmon. In addition, according to sea lion scat samples taken in the lower estuary-- NMFS reports that 90% of the time sea lions diets do not consist of salmon. Sea lions and many other species of marine mammals and Chinook salmon have always called the Columbia River estuary home and both of these species thrived and survived together in huge populations just fine for over ten thousand years in the Columbia River estuary.

In addition, sea lions and other species of marine mammals all have very important jobs to perform in our Pacific Northwest ecology. Attached is a peer reviewed study that compares the difference between human and the sea lion's gut flora and highlights these important differences to show how the sea lion's gut flora are corner stone in the food web for all life in the oceans. Altogether, sea lions have 60 plus micro- biomes that are significantly different than the human micro-biomes and that sea lions and whales are essential nutrient productivity pumps that enhance the health of our rivers, oceans and estuaries. It is now, known, how important top native, non- human animal predators are such as, whales, orcas, wolves, sea otters and steller sea lions that all have the power to potentially influence change across terra and aquatic landscapes down to the plant life, influence the climate, influence the health & distribution of prey, and that removing key stone species can directly influence a river's flow. Native key stone species are very valuable for the Columbia River estuary and losing them will be a great loss for many populations of fish species

In the end the state of Oregon and Washington waging war on sea lions below the Bonneville Dam and on a Superfund site called the Willamette River undermines the productivity of the food- web in the Columbia River estuary and her tributaries; it does not enhance it (trophic cascades). Top key stone species like steller sea lions, sea otters and southern resident orcas keep the health of the Pacific Northwest ecology in check by predating on the weak, the sick, the old, the injured, NIS and hatchery fish. Steller sea lions and southern resident orca are both important species in providing food for scavengers and for promoting estuary health -- the sea lion's gut flora creates fish food and these animals bring life enhancing nutrients into the estuary and up river. The presence and protection of many populations of marine mammal species in the Columbia River estuary is corner stone in protecting and enhancing the productivity of the food web, and important for strengthening the hearts, minds and strengthening the very genetics of the native wild cold water fish. As well, the US ACOE intentionally, providing adequate spill of cold flowing river water over their eight dams in the spring is a positive step towards ensuring the survival for many, many human and non-human animal species in the Columbia River estuary for many future generations to come.

For the children, marine mammals, salmon, and the Columbia River estuary.

Ninette Jones

Portland, Oregon

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1. http://bioscience.oxfordjournals.org/content/59/3/245.full

2. http://bioscience.oxfordjournals.org/content/59/3/245.full

3. "The volume of plant plankton has declined across much of the world over the past century, probably as a result of rising global temperatures. But the decline appears to have been been steepest where whales and seals have been most heavily hunted. The fishermen who have insisted that predators such as seals should be killed might have been reducing, not enhancing, their catch".

https://www.newscientist.com/article/mg21128201-700-vital-giants-why-living-seas-need-whales/

4. Lichatowich, Jim. "Salmon, People and Place " A Biologist's Search for Salmon Recovery. Corvallis OR: Oregon State University Press, 2013.

5. https://lewisandclarkjournals.unl.edu/search?utf8=&qfie ld=text&qtext=phoca rock

6. https://lewisandclarkjournals.unl.edu/item/lc.jrn.1806-02-23

7. B. Mc Millan 2008 Researching Columbia Sea lion Population

Laurie Kerr

Dear Department of Energy,
Orca scientists have made it clear that our Southern Resident Orca (SROs) are in a starvation crisis. Because SROs' diet consists of at least 80% chinook salmon, having an ample chinook salmon population is key for their survival, as well as that of many other species, and indeed, the entire PNW ecosystem. The Columbia/Snake chinook population is crashing this year, with fewer than 50,000 expected to return, about 1/10 of the 10-year average. Accordingly, I urge you to exercise Washington's authority under Clean Water Act section 401 to help ensure the Columbia Basin's federal dam operators take action to reduce rising water temperatures, protect salmon, and help save the Southern Resident orcas from extinction.
When river temperatures exceed 70F for several days at a time as happens with increasing frequency due to climate change, salmon have difficulty migrating upstream and begin succumbing to stress and disease. According to the Fish Passage Center, an independent government agency, "under a climate change scenario, the long-recognized and largely unaddressed problem of high-water temperatures in the [Columbia and Snake rivers] becomes an ever-increasing threat to the survival of salmon."
On the Columbia and Snake Rivers, hydroelectric dams make the heat pollution even worse. Federal dams on the Columbia and Snake rivers have never obtained water quality certifications under Section 401 of the Clean Water Act leaving Washington without authority to protect its own water quality and fisheries. Until now.
According to EPA's own draft analysis, summer temperatures in portions of the Columbia and Snake rivers are up by 1.5 degrees Celsius since 1960 because of the combined impacts of climate change and dams. Temperatures are so high, sometimes exceeding 70 degrees, that they kill migrating salmon, such as in the sustained hot summer of 2015.
The EPA's own analysis also shows that removing the 4 Lower Snake River dams (LSRDs) would most effectively reduce temperatures to the salmon survival range. Removing the 4 LSRDs would also assist with lowering the temperatures behind the 4 mainstem Columbia dams. The 4 LSRDs are no longer needed for hydropower; they generate only about 3% of the system's power, which is at about 16% surplus. Nor do they provide any flood control. The irrigation provided at Ice Harbor Reservoir to about 37,000 acres can still be brought about post dam breaching via lengthened pipes and additional pumps. It is imperative for the sake of having our SROs and salmon survive that the 4 LSRDs be breached in 2019.
I therefore request that DOE enact water temperature standards that will provide incentives for the federal operator, USACE, to breach the 4 LSRDs to come into compliance with the Clean Water Act and Endangered Species Act. Lower water temperatures in the Columbia and Snake Rivers will help save salmon, orcas, and the entire PNW ecosystem. We in WA state must be leaders, while the federal government is failing to protect our irreplaceable environment and wildlife.

Jacqueline Koch

We need action now -- More spill to ensure greater salmon returns. I am a longtime resident and the chinook salmon and orca are our living national treasure. We cannot allow these endangered species face extinction on our watch. Near term, the only option is more spill -- so the orcas don't starve. In collective shock and sadness, last summer we watch a mother orca push her dead calf through the waters of Puget Sound. We must act. Now the Dept of Ecology is in the process of modifying state rules to allow for higher levels of spill starting in 2019 – in time for the spring out-migration of juvenile salmon in early April.

Aim�e L�

I support increasing spill over the dams, at 125% total dissolved gas as recommended by Orca Task Force, or at least 120%, of the Columbia and Snake Rivers in order to help more salmon to survive. The dissolved gas would need to be adjusted if other organisms suffer. Our Southern Resident Orcas are in immediate danger of starving to death due to lack of salmon. Removing the dams should be the next step.

Amy Lafferty

I support increasing the total dissolved gas levels for the Columbia and Snake Rivers.

JoAnn Margo

Dear Department of Energy,
Orca scientists have made it clear that our Southern Resident Orca (SROs) are in a starvation crisis. Because SROs' diet consists of at least 80% chinook salmon, having an ample chinook salmon population is key for their survival, as well as that of many other species, and indeed, the entire PNW ecosystem. The Columbia/Snake chinook population is crashing this year, with fewer than 50,000 expected to return, about 1/10 of the 10-year average. Accordingly, I urge you to exercise Washington's authority under Clean Water Act section 401 to help ensure the Columbia Basin's federal dam operators take action to reduce rising water temperatures, protect salmon, and help save the Southern Resident orcas from extinction.
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Thank you,
JoAnn Margo
Minnesota

Terri Mitchell

I fully support the proposal to allow more spill in the Columbia and Snake Rivers, at 125% total dissolved gas as recommended by Orca Task Force, or at least 120% if this lower rate would allow the proposal to move forward this year without delay. In lieu of breaching the lower Snake River Dams, we must pursue all actions that will result in more salmon from these systems.

Ellen Moore

Please do what is needed (permitting salmon to move as freely as possible) to increase their numbers for our orca. Please do this with speed too. Unlike climate change, this is NOT a political issue and we shouldn't take sides. This is something that helps us all.

Samantha Moore

This is an easy decision to make with big short-term impact. Please make the right call here.

Molly Nicoletta

Yes! More spill! I am in favor of that and breaching Washington dams to save our salmon. Orcas are starving. We need more salmon available for them to survive.

Thank you.

Ranell Nystrom

Dear Department of Energy,
Orca scientists have made it clear that our Southern Resident Orca (SROs) are in a starvation crisis. Because SROs' diet consists of at least 80% chinook salmon, having an ample chinook salmon population is key for their survival, as well as that of many other species, and indeed, the entire PNW ecosystem. The Columbia/Snake chinook population is crashing this year, with fewer than 50,000 expected to return, about 1/10 of the 10-year average. Accordingly, I urge you to exercise Washington's authority under Clean Water Act section 401 to help ensure the Columbia Basin's federal dam operators take action to reduce rising water temperatures, protect salmon, and help save the Southern Resident orcas from extinction.
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According to EPA's own draft analysis, summer temperatures in portions of the Columbia and Snake rivers are up by 1.5 degrees Celsius since 1960 because of the combined effects of climate change and dams. Temperatures are so high, sometimes exceeding 70 degrees, that they kill migrating salmon, such as in the sustained hot summer of 2015.
The EPA's own analysis also shows that removing the 4 Lower Snake River dams (LSRDs) would have the most impact on reducing temperatures to the salmon survival range. Removing the 4 LSRDs would also assist with lowering the temperatures behind the 4 mainstem Columbia dams. The 4 LSRDs are no longer needed for hydropower, as they generate only about 3% of the system's power, which is at about 16% surplus. Nor do they provide any flood control. The irrigation provided at Ice Harbor Reservoir to about 37,000 acres can still be provided post dam breaching via lengthened pipes and additional pumps. It is imperative for the sake of having our SROs and salmon survive that the 4 LSRDs are breached in 2019.
I therefore request that DOE enact water temperature standards that will provide incentives for the federal operator, USACE, to breach the 4 LSRDs to come into compliance with the Clean Water Act and Endangered Species Act. Lower water temperatures in the Columbia and Snake Rivers will help save salmon, orcas, and the entire PNW ecosystem. We in WA state must be leaders, where the federal government is failing to protect our irreplaceable environment and wildlife.
Thank you,
Ranell Nystrom
Tacoma, WA

Daniel O'Brien

Please take down the lower snake river dams because we really have to save the chinook salmon and the southern resident orcas who eat them for food. This is an emergency.

Chris Pinney

Prior to my retirement I served as a Federal agency Fishery Biologist for the Columbia and Snake river ESA-listed salmon life stage survivals through the hydrosystem, who had direct RM&E design and performance responsibilities for reservoir drawdown experiments, dam breach and return-to-natural river designs and evaluations and scientific/biological justifications, Dissolved Gas Abatement Studies and the spill program's hydraulic and TDG effects on passing salmon and steelhead, as well as water temperature effects on salmon and steelhead life stage survivals including designs to band-aid and emergency action localized and reach specific impact zones with passage temperatures through operational modifications of the spillways and adult ladders.
The regional coordinators for fish operations in the mid- and late-1990s were lead to believe that the spill up to 120% TDG supersaturation waiver from the 110% TDG standard was to be a short-term or 'temporary' modification. Idaho DEQ and the Nez Perce Tribe did not flow with the Snake River arguments by maintaining the 110% standard in the Clearwater River, principally for ecological reasons of disrupting foodweb constituents required for salmon and resident species productivity. After 25 years, where is Ecology on this larger original baseline ruling? Similar to elevated water temperature effects systemwide, it is time to rectify and settle this forgotten rule.
I hesitantly applaud Ecology on their cautious recommendation for maintaining 120% TDG standard in tailwaters, at least for 2019. SAR estimates are informative, but limited due to their complex derivation of most influential causation. FPC and others need to address the reach and systemwide juvenile survivals while incorporating all dam (project) specific survivals for those variations in flow years for which studies are available. My experience and 2018 spill operation (which did not achieve the desired low end PITPH because flows required high powerhouse operation) study indicates that spill up to, but not exceeding 125% TDG with minimal PITPH I support the DEIS Alternative 1, and better yet, Ecology taking a more active leadership role for the states of Washington and Oregon in regional salmon and steelhead survival and recovery management forums for wild stock production management by avoiding enhanced ecosystem impacts of any elevated %TDG >110% supersaturation (especially systemwide) by your serious consideration of an Alternative 4 for both water temperature and gas supersaturation regulation in a most haste return to natural river function with re-connection of the channel flow to its subsurface flowing water bodies (water table, hyporheic base flow, spring, acquifer, etc) on as wide of continuum footprints as permanent or seasonally possible.
I am an independent (retired) fish ecologist (scientist, aka Subject Matter Expert termed by Federal entities) now, upon retirement, so feel free to contact me for any clarifications.
Thank you for the opportunity to comment technically, and again for your recommended adherence in "short-term" hopefully for not exceeding 120% TDG standard.

Luan Pinson

Please up the spill level in both the Columbia & Lower Snake River as well as breaching the dams on the 4 LSDs to save Salmon and the Southern Orcas.

Pat Rathmann

In order to protect the orca population it is necessary to provide adequate salmon. Breaching the lower Snake River dams will accomplish this.

Joanne Richter

I strongly support increasing spill levels at the four Lower Snake River dams to the 125% total dissolved gas limit. The Salish Sea's endangered southern resident orcas once thrived thanks to plentiful thousands of Chinook salmon. Today with Columbia River/Snake River Chinook salmon populations in severe decline, the orcas number just 75 individuals. The most effective, short-term means of increasing Chinook salmon numbers is upping spill levels.

For many years conservationists have pushed for and won settlements to increase spill levels.. Last year, Washington's Orca Task Force recommended spill be increased, and Governor Jay Inslee supports that recommendation. I applaud the WA Dept. of Ecology's proposal to modifying state "total dissolved gas criteria" to allow for an increase in both the Columbia and Snake river systems. This action promises to have a beneficial impact on salmon migration this year. Joanne

Lynn Roebuck

I support the recommendation of the Orca Task Force to increase the state's TDG rate to 125% and urge you to implement this change for 2019.

MaryAnn Seward

I fully support your development of an EIS that, at least in the short-term, modifies WAC 173-201A.

Elizabeth Siler

Spill the water. Save the salmon. Save the orcas. Can WA state really afford the awful worldwide publicity of pictures of a starving orca mother carrying a starved dead orca baby for two weeks? These are iconic animals. Do what us needed to SPILL THE WATER AND FEED THEM!

Rene Smith

Increased spill at dams on the Columbia and Snake R. systems is an effective way to increase the number of Chinook salmon moving through these rivers.

Gene Spangrude

My comments, including three (3) PDF attachments, are focused towards the 'historical conditions' of the Lower Columbia River Basin, including the Lower Snake River.

Salmon related issues have been long documented and presented in various Reports, including Federal Government documents. Excerpts from two Federal Documents dating from the 1870's and 1890's are part of my submittal; and illustrate the historical presence of these concerns. Included within one report is a map showing the extent of Salmon presence based on field visits made during that era.

In the mid-1870's, 'Water Temperature Data' was briefly collected on the Lower Columbia River downstream of Portland, Oregon; and as can be noted from a table in the report prepared even in the 1870's 'Water Temperatures exceeded 68 Degrees F' on the Lower Columbia River; and no apparent concern was expressed over this condition; which was experienced long before the construction of Lower Columbia or Lower Snake River Projects. This data is included in my 1870's era report attached.

Another attached document lists various publications which have been written since the 1800's about various Salmon issues within the Columbia River Basin.

Another attached document presents several years of Lower Snake River Water Temperature data; which was collected in the 1950's; prior to the construction of the Lower Snake River Projects. Even in its 'un-dammed condition' Lower Snake River water temperatures exceeded 68 Degrees F Standard on an annual basis.

I request that 'historical pre-project information' about the Lower Columbia and Lower Snake Rivers be made a legitimate part of the current Regional Discussions about these two Rivers.

Very respectfully,

Gene R Spangrude
Walla Walla, WA

Brad Staples

Please look at increased spill through the Columbia River Hydro System to flush migrating Salmon & Steelhead juveniles over the Dam's Spillways, instead of through the turbines. I know that there is a risk of Gas Bubble Trauma that can cause increased mortality, but I believe that the risks are worth it, as that more fish will make it to the Estuary safely.

Ashley Stefanoff

Dear Department of Energy,
Orca scientists have made it clear that our Southern Resident Orca (SROs) are in a starvation crisis. Because SROs' diet consists of at least 80% chinook salmon, having an ample chinook salmon population is key for their survival, as well as that of many other species, and indeed, the entire PNW ecosystem. The Columbia/Snake chinook population is crashing this year, with fewer than 50,000 expected to return, about 1/10 of the 10-year average. Accordingly, I urge you to exercise Washington's authority under Clean Water Act section 401 to help ensure the Columbia Basin's federal dam operators take action to reduce rising water temperatures, protect salmon, and help save the Southern Resident orcas from extinction.
When river temperatures exceed 70F for several days at a timeas happens with increasing frequency due to climate changesalmon have difficulty migrating upstream and begin succumbing to stress and disease. According to the Fish Passage Center, an independent government agency, "under a climate change scenario, the long-recognized and largely unaddressed problem of high-water temperatures in the [Columbia and Snake rivers] becomes an ever-increasing threat to the survival of salmon."
On the Columbia and Snake Rivers, hydroelectric dams make the heat pollution even worse. Federal dams on the Columbia and Snake rivers have never obtained water quality certifications under Section 401 of the Clean Water Actleaving Washington without authority to protect its own water quality and fisheries. Until now.
According to EPA's own draft analysis, summer temperatures in portions of the Columbia and Snake rivers are up by 1.5 degrees Celsius since 1960 because of the combined effects of climate change and dams. Temperatures are so high, sometimes exceeding 70 degrees, that they kill migrating salmon, such as in the sustained hot summer of 2015.
The EPA's own analysis also shows that removing the 4 Lower Snake River dams (LSRDs) would have the most impact on reducing temperatures to the salmon survival range. Removing the 4 LSRDs would also assist with lowering the temperatures behind the 4 mainstem Columbia dams. The 4 LSRDs are no longer needed for hydropower, as they generate only about 3% of the system's power, which is at about 16% surplus. Nor do they provide any flood control. The irrigation provided at Ice Harbor Reservoir to about 37,000 acres can still be provided post dam breaching via lengthened pipes and additional pumps. It is imperative for the sake of having our SROs and salmon survive that the 4 LSRDs are breached in 2019.
I therefore request that DOE enact water temperature standards that will provide incentives for the federal operator, USACE, to breach the 4 LSRDs to come into compliance with the Clean Water Act and Endangered Species Act. Lower water temperatures in the Columbia and Snake Rivers will help save salmon, orcas, and the entire PNW ecosystem. We in WA state must be leaders, where the federal government is failing to protect our irreplaceable environment and wildlife.

Thank you,
Ashley Stefanoff

Ursula Valdez

PNW ecosystems have offered important ecosystem services for centuries, millennia and more. Early human inhabitants of this region, learned so well how to manage their resource use without altering ecosystems in significant ways, and were able to use resources for long times. With the current scientific knowledge and tools that we have today, how is it possible that we keep driving many species of our region and failed at maintaining their habitats and protecting their populations. Considering the importance that iconic species of our region, such as Salmon and Orca whales, why aren't we using the accumulated knowledge to design and support actions that protect these species? Please do use the science, the ancestral knowledge and the vision for the future of our native species and ecosystems. Populations of Pacific salmon and resident Orca Whales need urgent attention and mainly action to stop their concerning decrease. If they go, so many ecosystem services will be negatively affected, not to mention the economic and cultural impact that these species have in the region. Please, it is a moral and intelligent decision to work protecting the habitats and populations of these species, for the future of our region and for our own.

WA Dept. of Ecology's Draft EIS and Short-Term Modification to Total Dissolved Gas Criteria for WAC 173-201A

Oral Testimony from Jim Waddell
Received February 19, 2019

This is Jim Waddell again. Civil engineer, retired U.S. Army Corps of Engineers.

Yeah, my -- my point is this: When these dams were first built in the '60s and '70s, (inaudible). When the last dam was built, it was seen the spill was killing enormous amounts of salmon in the river because of high dissolved gas levels and that's the sole reason that the other 12 (inaudible) were put in. Now here we are 25 or 30 years later or longer and we are talking about more spill.

Now, the CSS studies, the comparative survival studies, is based on a lot of data for multiple assumptions (inaudible) and stuff like that. That is really -- even with all of those assumptions, we are only seeing very marginal improvements in increased salmon numbers. Now, none of that is sufficient enough to recover orca in short-term or actually recover Chinook in any kind of timeframe.

So -- so the spill that is going on right now and documented in 2018 is not going to have any positive effect on orca recovery. The other thing about 2018 spill is that we are now seeing damage (inaudible) through skin embolisms and what is happening is that these adults when they approach the high-spill regimens and the spillways are losing facial tissue and then become, you know, casualties later on.

We are also seeing a lot more fallback on the dams with adults like we haven't seen since the '90s. And so this, too, is making it impossible for some. We don't -- I don't think the number has been calculated, but some or many adults are not making it back to their hatcheries or native springs.

So the -- the upshot of all of this is that spill is having no positive effect. And, yes, it is costing BPA money in terms of (inaudible) production, but I think the most important thing to remember here is that this -- this idea that this is buying us time is really not accurate. We are out of (inaudible). The only one thing that can make a difference is immediate breaching of the dams this year. And so the point is is that as much as we would think that spill is a solution here, it is not even a short-term solution of anything, much less a long-term solution. That's my comment.

Sharon Wenham

Please increase the spill by 125% if you are not going to breech the dams the Orcas eat 4yr old salmon give them a fighting chance and do it now not in 6 months time when it could be to late Extinction is for life and the lives of the Southern residents are in your hands

Bill Yake

While breaching of selected dams (especially those on the Snake River) is a much better long-term solution, strategically increasing spill and closely monitoring the results is better than nothing. So, I support this effort, but hope that eventually the Snake and Columbia are returned to a substantially more natural state.

Department of Energy
Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208-3621

POWER SERVICES

February 28, 2019

In reply refer to: PGA-6

Via E-Mail

Heather Bartlett
Water Quality Program Manager
Washington State Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600

Subject: Comments on the Draft Environmental Impact Statement for the Short-term modification of the total dissolved gas criteria in the Snake and Columbia Rivers

Dear Ms. Bartlett:

The Bonneville Power Administration (Bonneville) appreciates the opportunity to provide comments on the Draft Environmental Impact Statement (EIS) for the short-term modification of the total dissolved gas criteria in the Snake and Columbia Rivers. Bonneville's comments focus on clarifying language in the EIS and ensuring consistency with the State of Oregon's total dissolved gas criteria.

First, Bonneville would like to emphasize spilling due to lack of market does not necessarily represent a negative market condition, consequently, we recommend revising the following language on page 19:

"Operational spills often occur during dam maintenance for when the ability to pass water through turbines is limited or in a negative market when power demand is low."

And replacing it with: "Operational spills occur when the ability to pass water through the turbines is limited; this could be due to turbine availability or lack of market."

Second, Bonneville suggests replacing "voluntary spill" throughout the EIS with "juvenile fish passage spill," which more accurately represents the purpose of the spill operations.

Third, the ladders on the lower Columbia and Snake rivers are predominantly pool and weir (with deep openings referred to as orifices). When observing fish moving in a ladder with pools and weirs, it is easier to observe surface passage behavior moving from pool to pool via weir "jumping" or surface swimming acceleration. Due to limited water transparency, it is more difficult, however, to observe fish using the submerged deep orifices, which fish also use to move from pool to pool. Thus, Bonneville proposes revising the language on page 35:

"Observations have indicated that fish frequently move towards the surface in fish ways."

And replacing it with: "Upstream movement through fish ways (e.g., pool and weirs) can occur by surface passage at weirs or through deep passage orifices between each progressive pool."

In terms of the applicability of the total dissolved gas criteria, since the short-term modification will only apply during the spring spill season, Bonneville recommends clarifying that the existing total dissolved gas criteria adjustment will be applicable during summer spill fish passage. Additionally, Bonneville noticed the EIS and the draft Administrative Order to Modify Adjusted Total Dissolved Gas Criteria (Order) do not currently align on the treatment of the 125% total dissolved gas criteria in the short-term modification. The EIS mentions 125% total dissolved gas will be measured on a one-hour basis, while the Order says it will be measured on a two-hour basis. Washington State Department of Ecology (Ecology) staff stated at the February 13, 2019 public hearing that the intent was to align with Oregon's two-hour basis; thus, Bonneville recommends addressing this inconsistency in the EIS.

Finally, Bonneville would like Ecology to consider adopting the State of Oregon's 105% total dissolved gas shallow water standard with the short-term modification to protect aquatic species in shallow spawning areas. Hamilton Creek and the Ives Island area, downstream of Bonneville Dam on the Washington side, are common spawning areas for Chum and Chinook (see first paragraph on page 23 of the EIS). Adopting the 105% total dissolved gas shallow water standard ensures consistency of water quality standards between Oregon and Washington during the spring spill operation.

Bonneville appreciates the opportunity to provide comments. Please feel free to contact me or Kim Johnson at kojohnson@bpa.gov or 503-230-3902 if you have any questions or need more information.

Sincerely,

Pam Van Calcar

Pam Van Calcar on behalf of:
Kieran Connolly
Vice President of Generation Asset Management
Bonneville Power Administration

cc: Becca Conklin, WA Ecology, Water Quality Standards Project Manager (swqa@ecy.wa.gov)

Oregon
Kate Brown, Governor

Department of Fish and Wildlife
Office of the Director
4034 Fairview Industrial Drive SE
Salem, OR 97302
(503) 947-6044
FAX (503) 947-6042
odfw.com

February 28, 2019

Maia Bellon, Director
Heather Bartlett, Water Quality Program Manager
P.O. Box 47600
Olympia, WA 98504-7600

Re:Comments on the Draft EIS for Short-term Modification of Total Dissolved Gas Criteria in the Snake and Columbia Rivers

Dear Director Bellon and Program Manager Bartlett:

The Oregon Department of Fish and Wildlife (ODFW) is submitting these comments (attached) in response to the draft EIS issued by the Washington Department of Ecology (Ecology) in January, 2019, for a short-term modification of total dissolved gas (TDG) water quality standards for federal dams on the lower Snake and lower Columbia rivers through 2021. This modification by Ecology is vital for the successful implementation beginning this spring of the Columbia River Flexible Spill and Power Agreement (Agreement) supported by all state, tribal, and federal management partners.

We appreciate the work that went into the draft EIS, and find most material provides sufficient detail and well-articulated rationale. However, we are concerned the focus appears to be on perceived risks rather than the *documented* benefits of increased spill, and are concerned some vital points were overlooked or discounted, especially when considering the efficacy of the current monitoring programs. These concerns are highlighted below and expanded on in the accompanying attachment. ODFW acknowledges development of the EIS is an important step in providing better protections for salmon and steelhead listed under the Endangered Species Act. We encourage Ecology to make appropriate use of all available information in helping secure TDG allowances necessary to implement the state, tribal, and federal Agreement.

- The draft EIS should present and discuss in greater detail data from the Smolt Monitoring Program.
- The draft EIS should consider recent analyses presented to the Independent Scientific Advisory Board by the Comparative Survival Study Oversight Committee regarding associations between total dissolved gas saturation and in-river survival of Chinook salmon and steelhead.
- The draft EIS should discuss historical empirical information from periods of involuntary spill, which suggests strongly the benefits of increased spill outweigh any negative impacts.
- The role of established adaptive management processes in responding to actual system results should be discussed.

- The well-established monitoring programs currently in place are effective and provide a basis for learning from proposed operations to inform adaptive management. This point deserves acknowledgment.

Thank you for this opportunity to comment on the draft EIS. Oregon looks forward to working with Washington to help restore the natural resources that define the Pacific Northwest.

Sincerely,

Curtis E Melcher

Curt Melcher
Director, Oregon Department of Fish and Wildlife

Attachments

cc: Jason Miner, Natural Resources Policy Manager, Governor's Office
Richard Whitman, Director, Oregon Department of Environmental Quality

Attachment

Detailed comments from ODFW concerning the draft Environmental Impact Statement for short-term modification of total dissolved gas criteria in the Snake and Columbia rivers

(1) Data from the Smolt Monitoring Program (SMP) should be presented and discussed.

In the draft Environmental Impact Statement for short-term modification of total dissolved gas criteria in the Snake and Columbia rivers (draft EIS), several relatively short-term studies assessing the relationship between incidence of gas bubble trauma (GBT) and total dissolved gas saturation (TDGS) are cited. Largely absent, however, is any detailed treatment of data collected by the SMP. Yet, GBT monitoring associated with the SMP represents observations at multiple Federal Columbia River Power System (FCRPS) projects on the Snake and Columbia rivers, over the span of more than two decades and across a broad range of TDGS levels. Below is a series of plots, based on SMP data, characterizing relationships between GBT and TDGS from 1995–2018. These data indicate that relative to the prescribed 15% (Figure 1) and 5% (Figure 2) action criteria[1], GBT does not become problematic until TDGS has exceeded–considerably in many cases–125%. As noted on page 49 of the draft EIS, Maule et al. (1997a, 1997b) "found that significant mortality did not occur in test fish until approximately 60% of the exposed population exhibited bubbles in the fins, or 30% displayed bubbles covering 25% or more of any unpaired fin." (NMFS 2000). Accepting the findings of Maule et al. (1997a, 1997b) or the more conservative current action criteria, SMP data indicate strongly that spill up to at least 125% TDGS is biologically safe for juvenile salmon and steelhead (USACE 2018, FPC 2017).

[1] As stated in the draft EIS, the current action calls for a reduction in voluntary spill if 15% of sampled fish on a given day show any bubbles on unpaired fins or if more than 5% of the fish examined exhibit bubbles covering 25% or more of the surface of any unpaired fin.

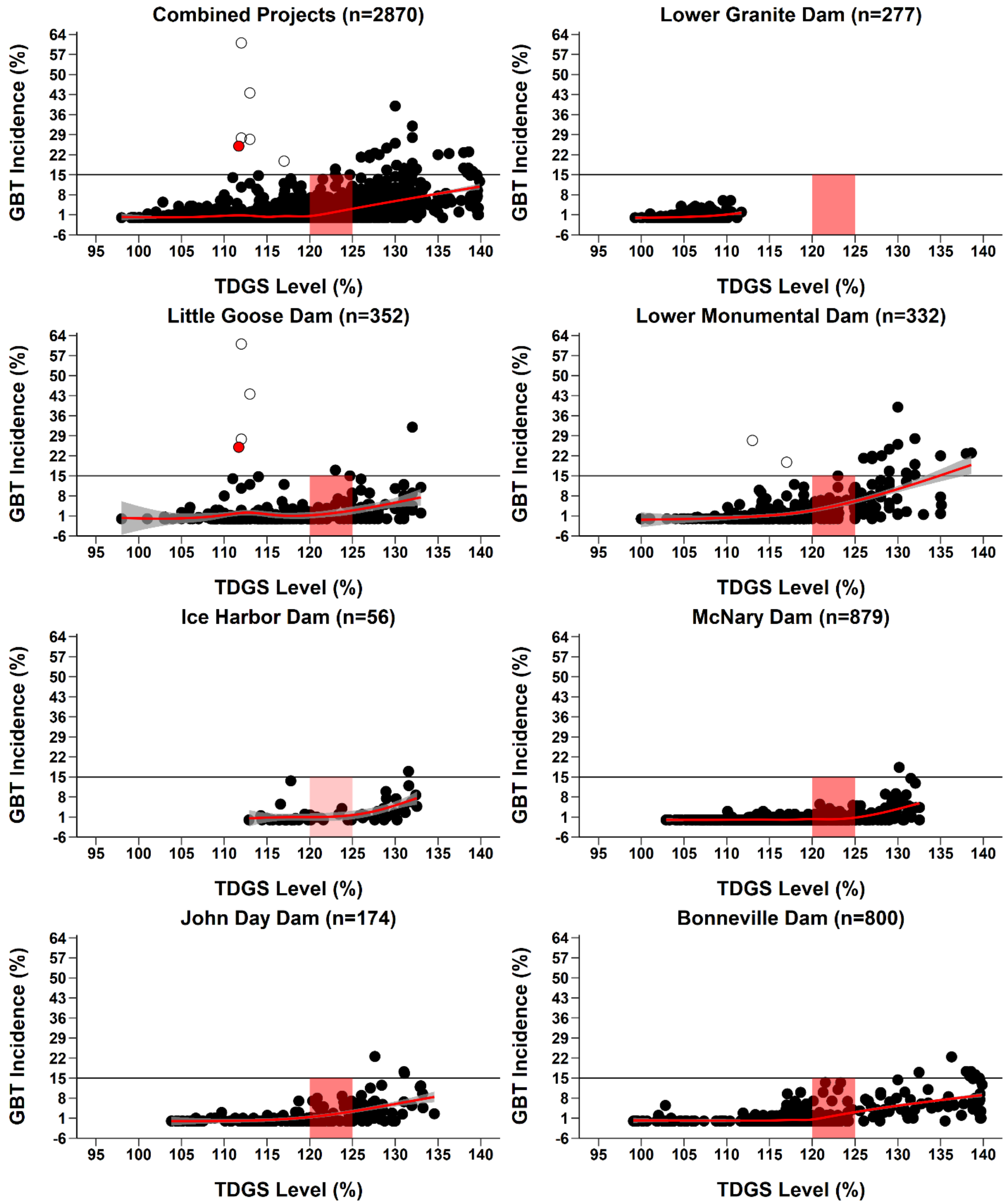

Figure 1. Incidence of Gas Bubble Trauma versus total dissolved gas saturation levels at seven Columbia and Snake River dams and all seven projects combined. Solid horizontal line indicates the current 15% action criteria (see footnote 1). Solid red line represents a Generalized Additive Model (GAM; cubic spline) fit to each data set. Shading around each GAM curve represents the 95% confidence interval. Red/pink polygons highlight the TDGS under consideration as part of the flexible spill agreement. Open circles indicate samples comprised of late migrating steelhead (i.e, residuals) not representative of the population response. The red circle represents a sample where the examiner misidentified incidence of GBT. Points represent samples consisting of ≥ 75 examinations. Data provided by the Fish Passage Center.

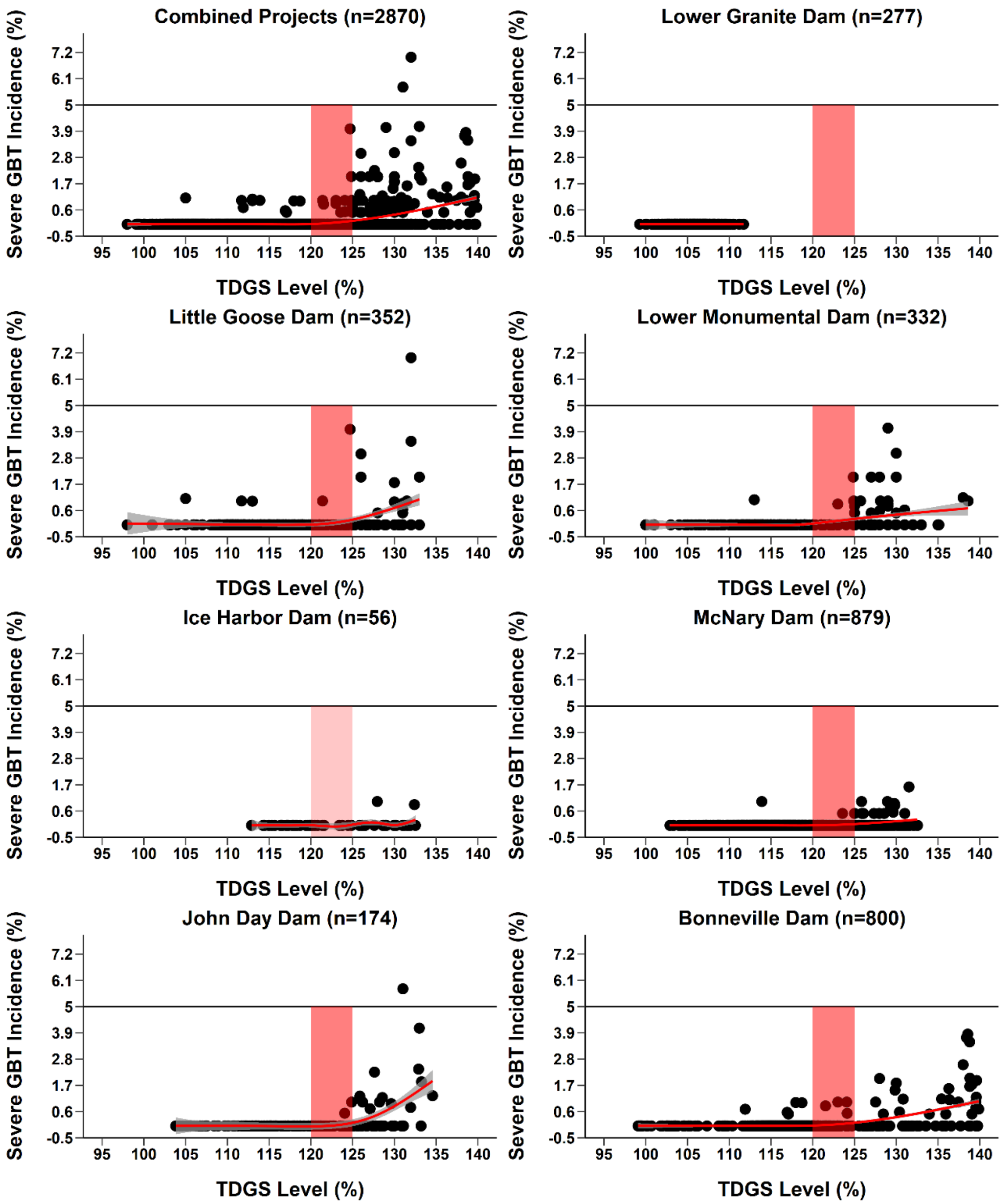

Figure 2. Incidence of <u>severe</u> Gas Bubble Trauma versus total dissolved gas saturation levels at seven Columbia and Snake River dams and all seven projects combined. Solid horizontal line indicates the current 5% action criteria (see footnote 1). Solid red line represents a Generalized Additive Model (GAM; cubic spline) fit to each data set. Shading around each GAM curve represents the 95% confidence interval. Red/pink polygons highlight the TDGS under consideration as part of the flexible spill agreement. Points represent samples consisting of ≥ 75 examinations. Data provided by the Fish Passage Center.

(2) The review should also discuss analyses submitted to the Independent Scientific Advisory Board (ISAB) by the Comparative Survival Oversight Committee (CSSOC) regarding the importance of TDGS in explaining variability in in-river survival.

In 2017, the CSSOC submitted to the ISAB a synthesis report titled "Documentation of Experimental Spill Management: Models, Hypotheses, Study Design, and Response to the ISAB" (CSSOC 2017). The CSSOC provided in that document details on the development of models to evaluate associations between in-river survival for Chinook salmon and steelhead and various explanatory variables including mean and maximum TDGS; where data spanned a range of TDGS levels at times in excess of 125% (i.e., when maximum TDGS was considered). Modeling results, including mean and maximum TDGS levels as covariates, indicated TDGS was not a significant factor in explaining variation in in-river survival for either species. The authors concluded outcomes of the analyses provided "no evidence that TDG[S] levels reduce in-river survival over the range of TDG[S] levels that have been observed during 1998-2015, which have ranged up to average levels of 123% and maximum levels of 133%". Unlike many of the studies cited in the draft EIS, these analyses represent a synthesis of the responses of out-migrating smolts to broad changes in TDGS, across multiple dams and over almost two decades. This type of quantitative treatment also incorporates inherently some of the uncertainty alluded to throughout the draft EIS by considering effects of TDGS on empirical survival and does not rely simply on associations between GBT and TDGS to infer deleterious impacts.

(3) The draft EIS discusses potential ramifications of elevated TDGS resulting from increased spill during controlled conditions. Yet, available information includes many years where conditions during the spring outmigration were uncontrolled; even during these periods of involuntary spill, action criteria generally were not exceeded.

Operational limits commonly drive spill beyond levels specified in regionally collaborated management agreements or to levels that precipitate exceedance of modified water quality standards currently in place (i.e., periods of involuntary spill). Although variable in magnitude, stream run-off volume exceeds the hydraulic capacity of Federal Columbia River Power System (FCRPS) dams for periods in nearly every year. Whatever the length of these annual uncontrolled periods, involuntary spill operations have provided information to assess the existence of direct biological impacts associated with elevated TDGS. The regional process that led to the flexible spill agreement was based, in large part, on the understanding that incremental changes in spill that meets without exceeding 120% in FCRPS tailraces during 2019, and meets without exceeding 125% in 2020 and 2021 will provide a sustained conservation benefit for anadromous fish while supporting the authorized purposes of the FCRPS. Empirical information from periods of involuntary spill, suggesting this benefit over a broad time frame, should be considered in the draft EIS.

(4) Adaptive management processes that support the flexible spill agreement should be outlined in more detail.

The flexible spill agreement is supported by an adaptive management process including well established monitoring programs and a tested system for conferral. Given the novelty of the operations outlined in the flexible spill agreement (with enhanced spill to 120% or 125% of TDGS), this system of adaptive management is intended to ensure that any potential unintended negative consequences–including those discussed in the draft EIS–can be mitigated in a timely manner. Animal behavior (e.g., hydrostatic depth compensation) that may help mitigate negative impacts of elevated TDGS are discussed at length throughout the document. The system of adaptive management currently in place will also play a vital role, and should be better defined/highlighted in the body of the draft EIS. This is particularly relevant to discussions of increasing to the 125% gas cap. The draft EIS states: "further research that addresses the uncertainties of the science will help to determine if the potential benefits of spill at 125% TDG outweigh the adverse effects of TDG to salmonids and resident aquatic life." Decades of monitoring and the development of models based on empirical data suggest strongly that the benefits of spill up to at least 125% TDGS outweigh any obvious detriment. Remaining points of uncertainty can best be addressed in an adaptive management framework, where the operation in question is applied in practice and adjustments are made when/if issues (i.e., unintended negative consequences) arise. This concept deserves to be highlighted.

(5) The monitoring programs currently in place are effective and provide a basis for learning from the operations proposed in the flexible spill agreement.

Some language in the draft EIS seems to suggest that the current biological monitoring programs are not sufficiently reactive to instances where water quality conditions may be having negative effects on aquatic biota. It has been the long-standing position of managers and scientists in the region that any modification in hydro system operations be accompanied by active monitoring to ensure that negative unintended impacts do not result. It has also been the belief of regional interests that current monitoring programs and methods have provided for an effective alert system; a conclusion that has in the past been reinforced by state and federal water quality agencies. In fact, the recent District Court order–upheld on appeal–was supported in part by the ability of theses monitoring programs to help mitigate for unintended impacts. While the Oregon Department of Fish and Wildlife feels current monitoring efforts are adequate to effectively alert regulatory agencies to any unintended negative consequences, we are also fully supportive of further collaborative discussion to refine programs to better learn from the application of novel operations. We recommend this process include coordination among regional water quality agencies (i.e., ODEQ and EPA) and the working group that developed the flexible spill operation agreement.

As was highlighted when the states of Oregon and Washington previously modified TDGS standards, adaptive learning will be essential to more fully identify how modifications in dam operations relate to the status and trends of Columbia River species. Methods employed under the SMP, for example, will continue to provide timely detection of GBT, serving the regulatory process effectively. In addition to relying on fixed-monitoring approaches or instantaneous measures of condition (e.g., associations between GBT and TDGS), to assess the effectiveness of the additional spill, metrics that characterize life-cycle success must be considered to better understand the outcomes for aquatic biota. With this in mind, effects from enhanced mitigation (e.g., flexible spill) should continue to be evaluated using tools currently available (e.g., reach specific survival, powerhouse passage metrics, and Smolt to Adult Returns) in addition to direct monitoring of GBT. Additional monitoring efforts may contribute to our understanding and help support in-season adaptive management, but should not supplant proven monitoring tools.

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February 14, 2019

Heather Bartlett, Water Quality Program Manager
Washington Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600

Re: Comments on Draft Environmental Impact Statement: Short-term modification of total dissolved gas criteria in the Snake and Columbia Rivers.

Dear Ms. Bartlett-

Thank you for the opportunity to review and provide comments on the Draft Environmental Impact Statement for the short-term modification of total dissolved gas criteria in the Snake and Columbia Rivers (Draft EIS). We offer the following comments for your consideration in the development of the final EIS, followed by more detailed discussion.

- The Fish Passage Center has collected and analyzed Gas Bubble Trauma Monitoring data for over two decades. These data are available to the public. These data support the proposed action of removing the 115% forebay criterion and implementing a 120% or 125% tailrace criterion.
- A more extensive and longer time series of GBT Monitoring data is available for inclusion in the EIS, which supports the proposed action. This reference will provide further support for the proposed action.
- In response to recommendations from the Independent Scientific Advisory Board, the Comparative Survival Study Annual Report included an analysis of total dissolved gas and instantaneous mortality. This analysis provides additional scientific basis for the EIS. This reference will provide further support for the proposed action.
- To avoid confusion, the EIS should specify that the objective of the experimental flex spill is to avoid powerhouse passage of juvenile salmonids.

Flex Spill Operations Discussion

Throughout the Draft EIS, there are several references to the Comparative Survival Study (CSS) model (or technical analyses conducted by the states and tribes) predicting that the flex spill operation would slightly benefit salmon relative to the 2018 court-ordered operations (pg. 2, 10, 18, 22, 44, 50). Many of these references specifically note that survival rates under the Flex Spill operation will roughly equal (in 2019) or exceed (2020 and 2021) those from the 2018 court-ordered operations. To encourage a clear understanding of the experimental flex spill operation, we recommend that all references to CSS model predictions and other analyses of potential benefits of the flex spill operations are based upon predicted reductions of juvenile salmonid powerhouse passage. CSS analyses indicate that reductions in powerhouse passage are associated with increased juvenile survival (McCann et al. 2018) and increased SARs (McCann et al. 2016, McCann et al. 2017).

Additional Supporting References from the Smolt Monitoring Program to Consider in Review of Effects of Total Dissolves Gas

The Draft EIS provides a lengthy review of literature on the effects of total dissolved gas (TDG) on resident and anadromous fish. However, this review only briefly mentions results from the GBT Monitoring that is conducted at FCRPS projects, under the SMP (pg. 27). Furthermore, the single reference to GBT Monitoring data references a 2018 FPC memorandum (FPC 2018a) that highlights results from the most recent 10 years of GBT Monitoring data. The FPC has an agreement with the Corps of Engineers (COE) to summarize, annually, the results from the GBT Monitoring Program. The FPC provides this report to the COE. The COE then includes this report as an Appendix in their annual report to the Oregon Department of Environmental Quality (DEQ). These annual reports to the COE are also made available to the public on the FPC website (http://www.fpc.org/documents/FPC_documents.html). We recommend that WA DOE review the 2018 report (FPC 2018b) and use this as a reference in their review of studies on the effects of TDG.

In our 2018 report (FPC 2018b), we provide a Historical Summary (pg. J-18 through J-20) of data from the GBT Monitoring Program over the last 20+ years, including an analysis of GBT incidence rates and TDG in the upstream tailrace. Over the 20+ years of data, there were 2,870 total GBT samples that fit our sample size criteria for inclusion in this analysis. Of these 2,870 GBT samples, only 37 had GBT incidence rates that met or exceeded the 15% action criterion. Of these 37, a total of six are considered anomalous and can be attributed to late migrating steelhead smolts or issues with misidentifying deformed fin rays for signs of GBT. The remaining 31 samples where GBT incidence rates exceeded the 15% action criterion all occurred when TDG was greater than 120%. Of these 31 instances, 28 (90.3%) were observed at TDG concentrations greater than 125% (see Figure J-9 of FPC 2018b). It is important to note that, although there were 28 instances where the 15% action criterion was met when tailrace TDG levels exceeded 125%, there were 288 additional GBT samples whose associated tailrace TDG levels were ≥125% that had fin GBT incidence rates below the 15% action criterion. These historical analyses of GBT Monitoring data indicate that the action criterion is generally not triggered at TDG levels less than 120% in the tailrace and even rarely triggered at tailrace TDG levels of 125% or above. As the Draft EIS states, "this action level incorporates a margin of safety based on studies finding significant mortality does not occur in test fish until approximately 60% of a population is showing signs of GBT".

Additional Supporting References from the Comparative Survival Study to Consider in Review of Effects of Total Dissolves Gas

In addition, the CSS has included TDG in recent analyses of instantaneous mortality (see Chapter 3 of McCann et al. 2018). Results from these analyses indicate that the Relative Variable Importance values for the TDG variables (average TDG or maximum TDG) were low compared to other variables, indicating that the TDG variables were not consistently included in the top fitting models for explaining variation in instantaneous mortality. In addition, the model-averaged coefficients of the effects of TDG were all near zero and confidence intervals overlapped zero for all species and reaches analyzed. This indicates that there was little association between TDG levels and instantaneous mortality rates. We recommend that WA DOE review Chapter 3 of the 2018 CSS Report (McCann et al. 2018) and include this in their review of studies on the effects of TDG.

Again, we thank you for the opportunity to review and comment on the Draft EIS. Please do not hesitate to contact us is you have any questions or concerns regarding our comments. We are happy to work with WA DOE on future issues related this short term modification of TDG standards or potential rule change.

Sincerely,

Michele DeHart

Michele DeHart
Manager, Fish Passage Center

References:

Fish Passage Center. 2018a. Smolt Monitoring Gas Bubble Trauma and River Conditions. May 8, 2018. http://www.fpc.org/documents/memos/25-18.pdf

Fish Passage Center. 2018b. 2018 Annual Report to the Oregon Department of Environmental Quality. http://www.fpc.org/documents/misc_reports/69-18.pdf

McCann J. B. Chockley, E. Cooper, T. Garrison, H. Schaller, S. Haeseker, R. Lessard, C. Petrosky, T. Copeland, E. Tinus, E. Van Dyke, and E. Ehlke. 2016. Comparative Survival Study of PIT-tagged Spring/Summer/Fall Chinook, Summer Steelhead, and Sockeye. 2016 Annual Report. BPA Project #19960200. http://www.fpc.org/documents/CSS/CSS_2016_Final.pdf

McCann J. B. Chockley, E. Cooper, B. Hsu, H. Schaller, S. Haeseker, R. Lessard, C. Petrosky, T. Copeland, E. Tinus, E. Van Dyke, A. Storch,and D. Rawding. 2017. Comparative Survival Study of PIT-tagged Spring/Summer/Fall Chinook, Summer Steelhead, and Sockeye. 2017 Annual Report. BPA Project #19960200. http://www.fpc.org/documents/CSS/CSS_2017_Final_ver1-1.pdf

McCann J. B. Chockley, E. Cooper, B. Hsu, S. Haeseker, B. Lessard, C. Petrosky, T. Copeland, E. Tinus, A. Storch, and D. Rawding. 2018. Comparative Survival Study of PIT-tagged Spring/Summer/Fall Chinook, Summer Steelhead, and Sockeye. 2018 Annual Report. BPA Project #19960200. http://www.fpc.org/documents/CSS/2018_Final_CSS.pdf

Palouse Great Old Broads

February 19, 2019

Attn: Becca Conklin, Water Quality Standards Project Manager, and
Maia Bellon, Director, Washington State Department of Ecology

Re: Proposed WA DOE increased spill at 8 Lower Columbia River & Lower Snake River dams

Dear Manager Conklin and Director Bellon:

The Palouse Great Old Broads, whose membership includes residents of eastern Washington and north central Idaho, is one of eight networked Oregon, Washington, and Idaho chapters of the national, 6000-member Great Old Broads for Wilderness. Great Old Broads (GOB) throughout the nation advocate for the protection and preservation of wilderness, wild lands and wildlife dependent upon healthy, pristine environments, streams and habitats.

Currently, a regional and national GOB key focus issue is the plight of threatened and endangered Snake River salmon, steelhead and the related plight of the Salish Sea's endangered southern resident orcas. On a national level, we are engaged in education and advocacy efforts to draw attention to this issue. In light of the looming potential for "endangered" to become "extinct," with respect to Snake River Basin salmon and steelhead and to southern resident orcas, we urge all relative government agencies to take bold, urgent action as backed by sound scientific research to ensure a turn-around in the declining populations of these species. We urge WA Department of Ecology, specifically, to move forward with its proposal to increase Lower Columbia and Lower Snake dam spill to 120% total dissolved gas level beginning in 2019. We further recommend upgrading the water quality rules in 2019 to allow an increase in spill to a 125% total dissolved gas level.

We understand that the WA DOE increased-spill proposal is supported by WA Gov. Jay Inslee's budget and correlates with the recently signed "flexible spill" agreement reached by the states of Oregon and Washington, the Bonneville Power Administration, U.S. Army Corps of Engineers and Bureau of Reclamation. We recognize that the WA DOE proposal has the support of the Department of Fish and Wildlife, the Columbia River Inter-Tribal Fish Commission, and a coalition comprised of the Northwest Sportfishing Industry Association, Columbia Riverkeeper, and fifty-five organizational partners of the conservation coalition Save Our Wild Salmon. With this present letter, we add our Palouse Great Old Broads seventy-one, cross-border members' support.

In our region, all eyes are on salmon and steelhead run projections, fishing season options, and related economic impacts of the decline in wild salmon and steelhead, particularly in the Snake Basin and its main tributaries, the Clearwater River and Salmon River. Residents are also aware of and alarmed by the dire circumstances of the Salish Sea's southern resident orcas as a result of their no longer having plentiful food chinook salmon. According to the Oregon and Washington Departments of Fish and Wildlife February 20, 2019, Joint Staff Report, the Snake River total spring/summer chinook numbers in 2018, which had been projected to be 107,400 fish, numbered 67,596. The forecast total for 2019? Just 48,100 fish. As per the Report, the projected Snake River wild spring/summer chinook number of 18,500 actually came in at only 11,339. The forecast for 2019? A mere 8,200 fish.

The Northwest Power and Conservation Council asserts a goal of overall smolt-to-adult return levels (SARs) in the 2%-6% range, with a 4% average and 2% minimum for federal ESA-listed Snake River and upper Columbia River salmon and steelhead. The Snake River overall geometric mean SAR during 19641969 was 4.3% compared to 1.0% during 19941999 and 1.1% since 2000. The four lower Snake dams were built between 1961 and 1975.

According to data reported in 2017 by the Comparative Survival Study Oversight Committee and Fish Passage Center, the "smolt-to-adult (LGR to GRA, jacks included) of PIT-tagged Snake River wild spring/summer Chinook had a geometric mean of 0.84% and exceeded the NPCC's minimum SAR objective of 2% in only two migration years (1999 and 2008) during the period 1994-2015. ... SARs (LGR-GRA, jacks included) of the unlisted, reintroduced Clearwater River Chinook were somewhat lower (geometric mean 0.53%). ... the trends in the overall SARs (LGR-GRA) of Snake River wild and hatchery Chinook groups were similar and highly correlated (average r= 0.79) during 1997-2015."

The Comparative Survival Study Oversight Committee and Fish Passage Center also stated that "... improvements to fish travel time, mortality rates and survival may be possible through management actions that reduce WTT [in-water travel time] and increase spill percentages. There are only two means for reducing WTT: reducing reservoir elevations and/or increasing flow rates. Currently, only the reservoirs in the lower Snake River are maintained near their minimum operating elevations during the fish migration season. The McNary, John Day, The Dalles and Bonneville projects [on the Columbia River] all operate several feet above their minimum operating elevations during the fish migration season. Even without a change in flow levels, the data indicate that there is opportunity to reduce fish travel time and increase survival through the MCN-BON reach if these four projects were to operate at their minimum operating pools. The data also indicate that there is an opportunity to reduce fish travel time and increase survival throughout the FCRPS through increases in spill levels up to the tailrace dissolved gas limits."

Further, "Regional requests and recommendations to increase spill levels to improve survival for juvenile outmigrants have been countered by concerns over potential detrimental effects of high Total Dissolved Gas levels on juvenile mortality rates or survival probabilities. Using a comprehensive data set of instantaneous mortality rates and survival probabilities collected 1998-2016, we found no evidence that high TDG levels were associated with increased mortality rates or reduced survival probabilities."

Finally, the above report concluded that "Pre-harvest SARs in the range of 4% to 6% are associated with historical levels of productivity for Snake River wild spring/summer Chinook." We find ourselves asking, what are humans willing, in good conscience, to not do to rescue wild salmon and SR orcas from the brink of extinction? the brink to which our dams have brought them.

On that note, the Palouse Great Old Broads urge the WA Department of Ecology to, at the least, proceed with increasing spill to 120% total dissolved gas and to take the further step of increasing water quality rules in 2019 to allow 125% total dissolved gas.

Cross-border Washington-Idaho Broad regards,

Cynthia Magnuson and Patricia Jessup, Palouse Great Old Broads Co-chairs

cmcindyidaho@gmail.com
jessup.patricia@gmail.com

USPO: Palouse Great Old Broads, %Borg Hendrickson, 1820 Orchard Ave. Moscow ID 83843

Friends of the San Juans

Friends of the San Juans strongly supports Washington Department of Ecology's proposed short term modification of the WAC 173-201A water quality standard at the eight lower Snake and Columbia River dams in support of the new regional agreement for flexible spills operation.
Allowing increased experimental total dissolved gas levels is expected to help mimic more natural river conditions by speeding passage times and aiding smolts in avoiding dam infrastructure, improving downstream juvenile salmon condition and survival.
Existing scientific studies as well as extensive expert professional opinion supports implementation of this recommended near term salmon recovery action identified as a priority in the Governor's Southern Resident Orca Task Force recommendations:
Goal #1 Increase Chinook salmon abundance.
Recommendation #8. Increase spill to benefit Chinook for Southern Residents by adjusting total dissolved gas allowances at the Snake and Columbia River dams.
(Southern Resident Orca Task Force Report and Recommendations 2018 pg. 48)
It is imperative that all immediately available actions to recover Chinook salmon are implemented and adaptively managed through careful monitoring, while more long term solutions such as dam removal are explored.
We encourage immediate (spring 2019) implementation of this priority management action in support of Chinook salmon and Southern Resident Orca recovery.
Thank you for your consideration.
Tina Whitman, Science Director

Friends of the San Juans
360.378.2319 P.O. Box 1344
www.sanjuans.org Friday Harbor, WA 98250

WA State Department of Ecology

February 27, 2019

Friends of the San Juans strongly supports Washington Department of Ecology's proposed short term modification of the WAC 173-201A water quality standard at the eight lower Snake and Columbia River dams in support of the new regional agreement for flexible spills operation. Allowing increased experimental total dissolved gas levels is expected to help mimic more natural river conditions by speeding passage times and aiding smolts in avoiding dam infrastructure, improving downstream juvenile salmon condition and survival.

Existing scientific studies as well as extensive expert professional opinion supports implementation of this recommended near term salmon recovery action identified as a priority in the Governor's Southern Resident Orca Task Force recommendations:

> ***Goal #1 Increase Chinook salmon abundance.***
> ***Recommendation #8. Increase spill to benefit Chinook for Southern Residents by adjusting total dissolved gas allowances at the Snake and Columbia River dams.***
>
> (Southern Resident Orca Task Force Report and Recommendations 2018 pg. 48)

It is imperative that all immediately available actions to recover Chinook salmon are implemented and adaptively managed through careful monitoring, while more long term solutions such as dam removal are explored.

We encourage immediate (spring 2019) implementation of this priority management action in support of salmon and orca recovery.

Thank you for your consideration.

Sincerely,

Tina Whitman

Tina Whitman
Science Director

Recommendation 8: Increase spill to benefit Chinook for Southern Residents by adjusting total dissolved gas allowances at the Snake and Columbia River dams.

Orca Salmon Alliance

Please find the attached comment letter from the Orca Salmon Alliance supporting alternative 3: Increasing TDG standards to 125%.

If you have any problems or questions regarding these comments, please contact Robb Krehbiel at 206-883-7401.

Thank you.

ORCA
SALMON
ALLIANCE

February 28th, 2019

Heather R. Bartlett
Water Quality Program Manager
Department of Ecology
Water Quality Program
P.O. Box 47600
Olympia, WA 98501

Comments submitted electronically

RE: Draft Environmental Impact Statement for Short-Term Modification to Adjust Total Dissolved Gas Levels in the Columbia and Snake Rivers.

Dear Director Bartlett,

Thank you for the opportunity to provide comments to the Department of Ecology (Ecology) about the proposed short-term modifications to the state's total dissolved gas (TDG) standards. **We strongly support alternative 3 to increase the state's TDG standards to 125%.** Increasing these standards will allow for more water to be spilled over dams on the Columbia and Snake rivers, both of which support critical salmon runs that Southern Resident orcas rely on. Increasing spill is one of the most effective near-term actions the state can take to provide more salmon for orcas.

The Orca Salmon Alliance, a coalition of 17 local, state, and national organizations, is working to save Southern Resident orcas by recovering their primary food, Chinook salmon. The single greatest change to the Southern Residents' diet is the collapse of salmon runs in the Columbia Basin. Without bold and immediate actions, the Southern Residents are likely to go extinct within our lifetime.

Historically, swift river currents in the Columbia and Snake river basins quickly carried smolts (recently hatched salmon) to the ocean, where they matured and migrated further out to sea. After European colonization and years of industrial development, salmon runs declined and disappeared throughout the Northwest. Large dams on the Columbia and Snake rivers created warm, slack reservoirs, making the salmon's journey much more difficult, and in some cases impossible. Juvenile salmon rely on natural, cold, free-flowing rivers to carry them safely to the ocean. As dams slowed the rivers, salmon populations in the basin crashed, severely reducing one of the orcas' most critical and abundant sources of food.

Slackwater created by dams has significantly increased the amount of time it takes for smolts to safely migrate to the ocean and increased their exposure to lethally warm water and predators (particularly invasive piscivorous fish). Spilling water over the dam spillways (instead of through turbines to produce energy) more closely mimics the natural flow of big rivers, like the Columbia and Snake, and delivers smolts more quickly and safely to the ocean. The more fish that are 'spilled', the more fish that return to the river as adults to spawn. Scientific research collected annually since the mid-1990s demonstrates conclusively that additional spill significantly increases juvenile salmon survival and subsequent adult returns.

Washington's current TDG standards are outdated, restrictive, and no longer reflect the best available science. Recent increases in spill show that we have been overly conservative with our standards. **The**

Comparative Survival Study suggests that increasing TDG standards to 125 percent would result in 2 – 2.5 times more adult Chinook salmon returning than current levels. The majority of the studies cited in the EIS also suggest that spill up to 125% is safe for most native aquatic species, particularly salmonids.

The species that would be negatively impacted by increased TDG are non-native species, such as northern pikeminnow, largemouth bass, and smallmouth bass. These three species are predators of juvenile salmon, and the state is actively encouraging efforts to reduce populations of these fish. Ecology should note the added benefit of increased spill in helping reduce non-native salmonid predators.

Increasing salmon runs in the Columbia Basin is essential to preventing the extinction of the Southern Resident orcas. During the winter and early spring, these orcas forage on Chinook salmon from Cape Flattery to Monterey Bay. Historically, the Columbia Basin produced the most Chinook salmon on the west coast, providing a large and critical source of food for the orcas over winter. Increasing spill over the Lower Snake and Lower Columbia dams would benefit seven of the fifteen most important salmon runs in the orcas' current diet.

Several recent studies have shown that management of freshwater systems can affect smolt-to-adult returns, even when taking ocean conditions into account. Because the state cannot manage or change ocean conditions, the most effective tool managers have to increase adult returns (particularly in the near-term) is to increase spill.

We greatly appreciate your leadership to recover both salmon and orcas. Increasing spill in the Columbia Basin will further mitigate the impact these dams have had on endangered salmon runs and provide more food to orcas in the near-term. **We strongly support alternative 3 to increase TDG standards to 125% in 2019.** We look forward to working with you and your staff further to prevent the extinction of orcas and salmon.

Sincerely,

Member Groups of the Orca Salmon Alliance:

Center for Biological Diversity
Defenders of Wildlife
Earthjustice
Endangered Species Coalition
Friends of the San Juans
Natural Resources Defense Council
Oceana
Orca Network
Puget Soundkeeper Alliance
Save Our Wild Salmon
Seattle Aquarium
Sierra Club
Toxic Free Future
Washington Environmental Council
Whale and Dolphin Conservation
Whale Scout
Wild Orca

EARTHJUSTICE

February 28, 2019

VIA ELECTRONIC SUBMISSION

Maia Bellon, Director
Heather Bartlett, Water Quality Program Manager
P.O. Box 47600
Olympia, WA 98504-7600

Re: Comments on Draft EIS for Short-term Modification of Total Dissolved Gas Standards for Federal Dams on the Lower Snake and Lower Columbia Rivers

Dear Director Bellon and Program Manager Bartlett:

On behalf of the ten fishing and conservation organizations identified at the end of this letter and their thousands of individual members, we submit these comments in response to the draft EIS issued by Ecology in January, 2019 for a short-term modification of total dissolved gas (TDG) water quality standards for federal dams on the lower Snake and lower Columbia rivers through 2021.

A number of organizations, including some of the organizations signing this letter, submitted to you a request for a short-term modification of the TDG standards on September 13, 2018. We believe that request continues to describe the legal and scientific basis for a short-term modification of the TDG standards at the lower Snake and lower Columbia River dams for the "spring spill season" (from approximately April 1 through June 20) beginning in 2019 and continuing through spring 2021, and we again refer you to it. Likewise, many of the organizations submitting these comments have submitted scoping and other comments (including separate comments on the DEIS) and we also refer you to those.

As explained in the above referenced letter of September 13, 2018, there is compelling evidence and a sound legal basis for Ecology to immediately eliminate, on a short-term basis, the current 115% forebay TDG limit at each dam and replace the existing 120% tailrace TDG limit with a limit of 125% for up to at least 16 hours per day or more starting in 2019. Indeed, this is one of the alternatives presented in the DEIS, although it is not identified as the proposed or preferred action. We urge you to reconsider and adopt this single-step alternative as the action Ecology will take.

We recognize that the DEIS already proposes to eliminate the 115% forebay TDG standard on a short-term basis through 2021 and we support this step. For this reason, in the balance of these comments we focus on issues related to adjusting the tailrace TDG standard to 125% starting in 2019.

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We believe that upon examination of the best currently available scientific information about the effects of TDG levels up to 125% in the dam tailraces, and analysis of any other alternatives you choose to consider, you will conclude that a short-term modification of the TDG standards to allow TDG up to 125% in the dam tailraces on a flexible basis starting in 2019 is the best alternative to protect beneficial uses in the lower Snake and lower Columbia Rivers and that such a standard poses minimal or no risks to any designated use. It also will not have significant adverse environmental impacts.

We offer the following comments and observations on the DEIS in support of this conclusion.

DEIS at 1-2: The executive summary describes the recent Spill Agreement as one reason Ecology is considering a short-term modification of the TDG standards. That Agreement is based on elimination of Washington's 115% forebay TDG standard starting in 2019 and continuing through 2021, flexible spill to a 120% tailrace TDG standard in 2019, and similar flexible spill to a 125% TDG tailrace standard in 2020 and 2021 (or until the federal agencies complete new records of decision for dam operations). It is important to recognize that this Agreement does not purport to limit in any way Ecology's authority to consider and adopt a short-term modification that would allow flexible spill to a 125% tailrace TDG standard starting in 2019, nor would such a modification conflict with the Spill Agreement. Implementation of the Agreement and a single step, short-term modification of the Washington TDG standard to allow spill to a tailrace only 125% TDG standard are entirely consistent. There is no need for a second, separate process as the DEIS suggests (DEIS at 2). The DEIS already describes information relevant to adopting a 125% tailrace standard and such a modification is one of the alternatives considered in the DEIS. The DEIS thus already provides a basis for Ecology to take this action and another short-term modification process could be seen as duplicative and financially not warranted.

DEIS at 4: The DEIS describes as one basis for the proposed short-term modification of the TDG standards analyses by the Comparative Survival Study (CSS). These analyses do indeed strongly support the proposed change in the TDG standard, including an immediate change to a 125% tailrace standard (and of course elimination of the 115% forebay standard). The description of the CSS study in the DEIS, however, understates the level of support the CSS analyses provide for a short-term modification to a 125% tailrace standard in potentially significant ways. First, while the CSS analyses focus on reducing "powerhouse encounters" through increased spill, the analyses omits at least two additional benefits of increased spill: (1) reduced predation of juvenile migrants in reservoirs from faster migration travel time and reduced holding time above dams; and, (2) reduced water temperatures from faster water transit time, especially as the spring season progresses and in lower water years. While the CSS analysis does not attempt to quantify these survival benefits, they do exist as the analyses recognize, and they may be significant. Second, the DEIS suggests that the only benefit of increased spill addressed by CSS is a reduction in "delayed mortality." This is very likely not the only benefit of increased spill for downstream juvenile migrants. And this characterization of the CSS study is potentially confusing and unreasonably limiting given the long-standing discussion of over the precise amount of "delayed mortality" that occurs. Finally, the DEIS fails to acknowledge clearly that the CSS analyses are based on decades of empirical evidence about the effects of spill and TDG levels on juvenile spring migrants, including effects at TDG levels well above 125% (during frequent periods of involuntary spring spill). This empirical evidence includes results measured against well-established "action levels" for gas bubble trauma (GBT). This empirical evidence on GBT indicates that spill to 125% TDG is safe for juvenile salmon. Ecology should revise its description of the CSS analyses to more accurately address these and other aspects of the study and more clearly acknowledge the very strong support the study provides for a 125% tailrace TDG standard.

DEIS at 5: The DEIS notes that dam and salmon managers have not previously provided voluntary spill to even 120% TDG (more recently because of Washington's current 115% forebay standard) and implies that this is because of increased symptoms of GBT at spill above existing levels. This statement again appears to misunderstand the existing evidence regarding spill, TDG and GBT. First, there is extensive evidence of the effects of spill and the incidence of GBT at TDG levels well above 120% and well above 125%. This evidence comes from actual data collected during frequent periods of involuntary spring spill over many years. This evidence shows quite clearly that the incidence of GBT in juvenile salmonids is well below existing action levels (which are quite conservative) at spill that causes TDG up to 125%. Above 125%, the incidence of GBT increases somewhat in some circumstances but usually does not reach levels of concern until TDG is at or above 130%. Ecology should rephrase its statement to more accurately reflect the existing evidence about TDG levels and GBT.

DEIS at 8: The Introduction to the DEIS is potentially inaccurate and could be viewed as misleading. First, in describing the cause of salmon declines that have led to ESA listings for most Columbia and all remaining Snake River stocks, the DEIS only appears to acknowledge the harmful effects of the Snake a Columbia river dams on upstream access to upriver habitats without clearly explaining the lethal impacts of the dams and associated reservoirs on all aspects of the salmon life cycle. Nowhere does the DEIS acknowledge the high levels of juvenile mortality at and between the dams from injury, increased disease risk, and other factors. A 2007 analysis in which Washington participated concluded that, for Snake River salmon, some 70% of the human-caused mortality is associated with the dams. Likewise, the introduction overstates in an inaccurate way the potential costs to power production of increased spill. In fact, the modest increases in spill proposed under the Spill Agreement are specifically designed to be revenue neutral as compared to spill in 2017. And spill levels in 2017 were set by a court order. It is not clear why the DEIS would characterize measures necessary to comply with the law as "costing" hundreds of millions of dollars when complying with the law is not optional.

DEIS at 16-17: The DEIS' description of the "Existing Spill Conditions" fails to acknowledge the extensive periods of involuntary spring spill during most years when TDG levels can rise to well above 130%. This leaves the misimpression that the only spill levels about which we have available data are from periods of voluntary spill which has been capped by the existing 115% and 120% TDG standards in Washington, with the potential implication that the effects of spill above these levels are unknown and dangerous. It is not clear why the DEIS takes this approach or why the description of biological opinions from 2008 to 2014 fails to mention that each of them was ruled illegal by the courts. This description should be revised to be more complete and accurate.

DEIS at 17: The DEIS correctly notes in a phrase that Snake River salmon returns "more recently have declined." The DEIS does not describe the extent of this decline or explain that predicted returns for 2019 are some of the poorest in years. To the extent the DEIS addresses the pattern of salmon returns, it should be more thorough and indicate more clearly, and with appropriate detail, the extent of the current downward trend.

DEIS at 19-20: The DEIS describes both hydrostatic depth compensation and differences between field and laboratory studies generally but provides little analysis here or elsewhere as to how these factors have been taken into account. One consequence is that later in the DEIS, laboratory studies with extended exposures and no depth compensation are given equal billing with more relevant field studies and none of these are evaluated in light of the empirical evidence about the effects of spill and TDG levels up to 125% on salmonids or other aquatic life, leaving the potentially misleading impression that there is considerably more uncertainty about the benefits and risks of spill to this level than the data warrants.

DEIS at 21: The DEIS states that NOAA Fisheries' COMPASS model is "less optimistic about the benefits of additional spill" and attributes this to Ecology's understanding that the COMPASS model "does not factor in the same assumptions about delayed mortality as the CSS model." It is not immediately apparent that the CSS model makes any assumptions about delayed mortality. It is based on empirical data about juvenile downstream survival and associated smolt-to-adult return rates. Ecology may want to seek clarification from the authors of the CSS model regarding this statement. Similar statement about the CSS model that may reflect a misunderstanding of it also appear in other places in the DEIS, e.g., at page 22 (indicating that the CSS model considers reducing powerhouse encounters critical to reducing delayed mortality, a specific cause and effect assumption imputed to the CSS analysis that also may not be warranted).

DEIS at 22-25: The DEIS describes a number of studies of the effects of TDG on early salmonid development and on juveniles. The relevance of the early stage studies described in the DEIS is not apparent. Ecology may want to explain exactly where early stage salmonids are likely to encounter elevated TDG levels of either 120% or 125% from voluntary spill, other than chum salmon below Bonneville dam where there are already measures in place to protect them (which Ecology seems to accept as effective). The studies of the effects of TDG on juvenile salmonids also are not tied to conditions these fish are likely to experience during their downstream migration. One of the more relevant studies, described on page 25, reports that data on the incidence of GBT from five unidentified Columbia and Snake River dams failed to show effects above action levels for GBT set in the 2000 FCRPS BiOp until TDG exceeded 130% but this relevant information is simply reported along with other information and is not then further addressed. Another study reports a much higher incidence of GBT at two mid-Columbia dams where TDG levels apparently "exceeded 120% for approximately two months" but fails to describe when, how often, or how likely these extended conditions occur in the lower Snake and lower Columbia rivers under voluntary spill conditions and so does not provide a basis for assessing the relevance of this study to the short-term modification under consideration.

DEIS at 27-28: The DEIS describes a number of laboratory studies on these pages, many reporting high incidences of GBT but fails to discuss how these conditions relate to conditions juvenile salmon are likely to experience in the Snake and Columbia rivers during periods of voluntary spill. For example, many of the studies involve continuous exposure to elevated levels of TDG for 60 days, 50-55 days, 40 days, 22 days and so on. Many of these studies also provide limited opportunities for depth compensation. It is not clear that this kind of continuous exposure to TDG at 125% (or 120%) in laboratory conditions is likely to occur during actual voluntary spill operations. Ecology should explain in more detail the relationship and relevance of these studies to river conditions and the flexible spill regime contemplated by the Spill Agreement.

DEIS at 28-29: The DEIS describes a number of studies on the effects of elevated TDG levels on smallmouth bass and other resident fish, including northern pike minnow. Perhaps Ecology is identifying these specific studies in order to use both smallmouth bass and northern pike minnow as stand-ins for species, which may or may not be native and may or may not be predators of salmon. Even if this is the case, smallmouth bass and northern pike minnow (and presumably other native resident species which occupy the Snake and Columbia Rivers) are able to use depth compensation as well as or more effectively than juvenile salmonids to avoid potential adverse impacts from gas super saturation up to and including 125% TDG. Ecology should acknowledge this differential ability and explain why the DEIS focuses on these non-salmonid species. This is especially important since these fish have thrived in the warm reservoirs above the dams in ways that would not occur in a free-flowing river and the species mentioned in the DEIS are significant predators of juvenile salmonids. Ecology may want to explain, for example, why it is concerned about impacts on smallmouth bass when they are not facing extinction and are actually contributors to the extinction risk facing salmonids, to a large extent because of the advantage an impounded river gives them. As it stands, the DEIS appears to treat risks to salmonids and to resident fish that are predators of salmonids as of equal concern. If that actually is the case, Ecology should say so and explain why and explain why the State has supported measures to limit predation on salmonids by a number of other species, including through lethal means, but is here apparently concerned about effects on other predators.

DEIS at 32-33: The DEIS' discussion of aquatic invertebrate notes that in a 1994 field study in the Columbia and Snake, "GBT signs in invertebrate species were rare" even though TDG levels "exceeded 130% on occasion." Another study below Bonneville dam reported "minimal effects." It then goes on to report the results of a number of other studies, most if not all laboratory studies. The DEIS does not describe the spatial distribution of aquatic invertebrates or the likelihood that they will be present in significant numbers in dam tailraces where the current is strong and TDG levels are likely to approach the limits considered in the short-term modification. This context is important and should be addressed in describing the relevance of the laboratory studies of invertebrates if possible.

DEIS at 34-35: The discussion of a number of studies on depth distribution is another example of the broader DEIS tendency to report study results without discussing their relevance to the short-term modification. The first two studies appear to provide strong evidence that juvenile salmon generally migrate at depths that will readily mitigate for TDG levels up to 125% by providing TDG equivalent level at or below 115%. The DEIS then describes cage study of rainbow trout exposed to very high levels of TDG (140% or more) for 4 days but explain why this study is relevant to consideration of the proposed short term modification to 125% TDG. It then describes a study by Collis regarding differential migration behavior between hatchery and wild juvenile salmonids but it not clear that this study attributed the behaviors that lead to greater risks of bird predation for hatchery fish to TDG exposure. If Ecology believe that cause and effect relationship exists, it should describe the supporting evidence. Reporting on a mix of what appear to be relevant and irrelevant studies without distinguishing among them may not be very helpful to an eventual decision.

DEIS at 40: While the DEIS reports on a number of studies on the effects of repeated exposures to higher levels of TDG and recovery from GBT, there is little information to relate these results of these studies to conditions juvenile salmon will experience during their downstream migration. If this contextual information is not available, it would seem to limit the relevance of the summarized studies. And in the absence of information to provide context, the empirical results from the CSS analyses would again appear to be the best and most relevant currently available scientific information as these analyses capture the actual experience and consequent mortalities of downstream migrating juveniles over many years at highly variable levels of spill and TDG.

DEIS at 45: The DEIS discussion of uncertainty describes a number of what Ecology apparently considers relevant area of uncertainty regarding the effects of allowing voluntary spill at levels of to 125% TDG on a flexible basis. As with most areas of scientific inquiry, there are always areas of uncertainty that can be identified. The issue is how relevant are these uncertainties to the decision at hand and what the extent of information relevant to the decision at hand available now. The discussion of uncertainty does not address these questions or describe the extent to which the CSS analyses (and other available information) indicate that the relevant uncertainties are not that material to the decision at hand. For example, stating that "further research may be necessary" to determine whether current levels of TDG are having an adverse impact on mainstem salmonid spawning is a somewhat curious uncertainty to identify in the absence of any discussion of where such spawning occurs and how and why a short-term modification of tailrace TDG limits would affect TDG levels in these areas. As noted above, one of the most significant such area is chum spawning below Bonneville dam where mitigation for potential TDG impacts is already in place.

DEIS at 44-45: The DEIS reports that eliminating the 115% forebay TDG standard and implementing a 120% TDG standard for 2019 on a flexible basis as proposed in the Spill Agreement will lead to a miniscule reduction in power house encounters (and hence presumable a miniscule improvement in survival) as compare to 2018 spill and TDG levels. At the same time the DEIS reports that eliminating the forebay standard and allowing tailrace TDG up to 125% on a flexible basis will reduce powerhouse encounters by about 20%, at larger change that should lead to correspondingly larger survival improvements. Ecology does not explain why it has chosen to make an initial short-term modification with almost undetectable positive effects when the available information indicates that a single-step modification to allow spill to a 125% tailrace TDG standard would provide better protection for downstream migrating juveniles.

DEIS at 45: The DEIS discussion of the potential negative effects of a short-term 120% tailrace TDG standard for 2019 appears to be "grasping at straws," e.g. increased duration of exposure to TDG levels of 120% "may result in an increased risk of GBT to aquatic life" in the absence of depth compensation. The DEIS fails to describe the relevant evidence that indicates this is a meaningful and present risk as opposed to a minor and hypothetical one.

DEIS at 45-48: The DEIS discussion of a short-term modification to allow tailrace TDG levels up to 125% on a flexible basis with no forebay limit explains the potentially significant benefits of this change to juvenile salmon survival (at 45) without explaining the difference between these benefits and the much more minor benefits of a 120% standard (stating only that these benefits would be "smaller"). This lack of clarity potentially obscures the choice between the two alternatives. As with the discussion of a 120% TDG standard, the DEIS also identifies hypothetical, minor, or even non-existent (because mitigated) risks to aquatic life and salmonids (e.g., noting the possibility of TDG impacts to chum salmon below Bonneville but also noting existing mitigation for this risk without any indication that this mitigation is not effective). Similarly, the DEIS reports on elevated levels of GBT but at TDG levels of 120% to 135% without distinguishing among the incidence of GBT above 120% but below 125%. That information is available through data collected and analyzed by the Fish Passage Center but it is not reported in the DEIS. Including this information would be helpful to an eventual decision.

Overall, the DEIS collects and reports on quite a bit of information but appears to make only minimal effort to distinguish between more and less relevant information. The DEIS also appears to misunderstand the most relevant information – the CSS analyses – in potentially important ways. We urge Ecology to address these issues and clarify that there is strong evidence to support an immediate short-term modification of the TDG standards to allow tailrace TDG levels of up to 125% on a flexible basis and little or no relevant evidence to indicate that this change would pose a risk to salmonids or other species of concern.

CONCLUSION

Voluntarily spilling water over the dams on the Snake and Columbia rivers during the spring juvenile migration season undeniably benefits salmon and steelhead. While spill can pose a risk to salmonids if TDG levels are too high, biological monitoring conducted over the last decade and more, as well as anecdotal evidence, demonstrates that tailrace TDG levels of 125% do not negatively impact migrating salmonids, resident fish, or invertebrates. By contrast, the TDG levels currently allowed under Washington's water quality standards unnecessarily limit the benefits of spill for juvenile salmon and steelhead migrating downstream in the spring. We thus urge you to adopt a short-term modification of water quality standards to eliminate the forebay TDG limit and allow TDG levels up to 125% of saturation in the tail race of each of the eight dams on the lower Snake and lower Columbia Rivers during the spring juvenile salmon migration season beginning in 2019 and continuing through at least 2021.

Thank you for your consideration of these comments.

Sincerely,

Todd D. True

cc: Joseph Bogaard, Executive Director
Save Our Wild Salmon Coalition
Seattle, WA

Jesse Piedfort, Executive Director
Sierra Club, Washington State Chapter
Seattle, WA

Glen Spain, Northwest Regional Director
Pacific Coast Federation of Fishermen's Associations
Eugene, OR

Kevin Lewis, Executive Director
Idaho Rivers United
Boise, ID

Tom France, Regional Executive Director
National Wildlife Federation
Missoula, MT

Grant Putman, President
Northwest Guides and Anglers Association
Tillamook, OR

Liz Hamilton, Executive Director
Northwest Sportfishing Industry Association
Oregon City, OR

Brett VandenHuevel
Columbia Riverkeeper
Hood River, OR

Colleen Weiler, Jessica Rekos Fellow
Whale and Dolphin Conservation
Newport, Oregon

Wendy McDermott
Director, Rivers of Puget Sound and Columbia Basin
Bellingham, WA 98227

Defenders of Wildlife

Defenders of Wildlife and our members support increasing TDG standards to 125% (alternative 3). Attached is our organizational comment letter and a petition from 527 of our Washington members and supporters in favor of alternative 3.

If you have any questions or issues accessing these documents, please contact me at 206-883-7401.

Thank you.

Northwest Office
1402 Third Avenue, Suite # 930 Seattle, Washington 98101
tel 206.508.5474 www.defenders.org

February 27th, 2019

Heather R. Bartlett
Water Quality Program Manager
Department of Ecology
Water Quality Program
P.O. Box 47600
Olympia, WA 98501

Comments submitted electronically

RE: Environmental Impact Statement for Short-Term Modification to Adjust Total Dissolved Gas Levels in the Columbia and Snake Rivers.

Dear Director Bartlett,

Thank you for the opportunity to provide comments to the Department of Ecology (Ecology) related to the proposed short-term modifications to the state's total dissolved gas (TDG) standards. Increasing these standards will allow for more water to be spilled over dams on the lower Columbia and Snake rivers. The most recent, best available science suggests that increasing spill over these dams will help boost survival rates of salmon runs that highly endangered southern resident orcas rely on. The flexible spill agreement reached between Oregon, Washington, the Nez Perce Tribe, and Bonneville Power Administration (BPA) is a positive step forward that will help restore endangered salmon and orcas. However, Defenders of Wildlife (Defenders) disagree with Ecology's decision to only raise TDG standards to 120% during the 2019 spring migration.

Defenders is a national non-profit conservation organization with over 1.8 million members and supporters nationwide, including more than 24,000 members and supporters in Washington state. Founded in 1947, Defenders is a science-based advocacy organization focused on conserving and restoring native species and the habitat upon which they depend. We have a long history of contributing to agency-led recovery for endangered species. This past year, our staff participated in the Orca Task Force's Prey Work Group, which helped develop the recommendation to increase the state's TDG standards. We have also worked with schools, cities, counties, and state agencies on programs to reduce toxic pollution throughout the Salish Sea, helping to recover orcas and the salmon they depend on.

Increasing spill on the lower Columbia and Snake Rivers is a critically important near-term action to make more salmon available to starving orcas. The evidence presented in the EIS suggests that 125% TDG is a safe and reasonable standard. Increasing TDG standards to this level gives the state more flexibility to adjust spill levels with partners as necessary. Because southern resident orcas face an immediate threat of extinction, **Defenders strongly supports alternative 3 to increase the state's TDG standards to 125%.**

<u>Southern resident orcas cannot wait</u>

Southern resident orcas are among the most endangered marine mammals in the world. With only 75 individuals remaining, the population is the lowest it has been in over three decades. The collapse of chinook salmon, the orcas' primary prey, throughout the Northwest have led to the whales starving to death. Pollution from our cities contaminate the few salmon that remain, which can make orcas (particularly calves) sick. And with ever-increasing vessel traffic through the Salish Sea, underwater noise disrupts the orcas' ability to hunt and communication with each other. Without abundant, healthy, and accessible salmon, these orcas may go extinct in a few decades.

Perhaps the greatest change in the orcas' diet has occurred in the Columbia Basin. Prior to European colonization, the Columbia Basin supported millions of salmon, half of which were from the Snake River, providing orcas with a critical source of food. After these rivers were dammed, salmon runs throughout the basin collapsed. Despite billions of dollars invested in recovery, none of these salmon runs have recovered, further jeopardizing orcas. Increasing spill over the lower Snake and lower Columbia dams would benefit seven of the fifteen most important salmon runs in the orcas' current diet (NOAA and WDFW, 2018). The EIS does not explicitly mention the historical and current importance of the Columbia Basin to southern resident orcas, and we suggest this be added to the section on page 8 titled "Importance."

Recovering southern resident orcas will require multiple actions across the orcas' range. The Fish Passage Center estimates that spilling up to 125% TDG for 24 hours a day would result in roughly 146,000 more adult salmon returning to the Columbia Basin every year. There are few other actions that would result in this many salmon within just a few years. In the EIS, the department acknowledges that increasing spill to 120% "would slightly benefit salmon relative to the 2018 injunction operations" (page 22). A slight benefit will not address the urgent nutritional needs of southern resident orcas. Because of this, **we strongly urge Ecology to demonstrate bold leadership by increasing TDG standards to 125%.**

<u>The most recent, best available science supports increasing TDG standards to 125%</u>

The majority of studies cited in the EIS suggest that spill up to 125% is safe for most native aquatic species, particularly salmonids, despite concerns that increasing TDG and prolonged exposure to saturated water will cause Gas Bubble Trauma (GBT). The studies in the EIS that noted concerns with TDG levels and exposure used net pens and surface cages, preventing salmon from moving to lower TDG areas of the river (i.e. further downstream or deeper in the river channel). The EIS, though, notes that "water depths in the Snake and Columbia rivers broadly provide adequate depth to circumvent TDG related impacts" (page 50) and that salmon can recover from the impacts of GBT after several hours in areas with lower TDG.

It is also worth noting that that vast majority of the studies cited in the section titled "Potential for Negative Impacts of Total Dissolved Gas" are from the 1990s or earlier. The scientific community's understanding of spill and TDG has significantly advanced in the last two decades. The most recent, best, available science supports efforts to increase TDG standards to 125%. These older studies do not provide a holistic analysis of the impact of increased spill and TDG on salmonids.

While there have been more recent studies demonstrating the benefits of spill, the EIS only contains a brief explanation of the models used by the Comparative Survival Study (CSS) and the National

Oceanic and Atmospheric Administration (NOAA) to assess the impacts of spill. Ecology did not cite any other studies in the section titled "Potential Positive Impacts of Increased Spill" despite multiple scientific articles that support increasing spill. Williams (2006) documents multiple studies of how restoring natural processes in rivers, such as increasing flow rates via increased spill, aids in salmon restoration. Other recent studies have shown that management of freshwater systems, such as increasing spill, can affect smolt-to-adult returns, even when taking ocean conditions into account (Schaller et al., 2013; Petrosky and Schaller, 2010; Schaller and Petrosky, 2007; Haesecker et al., 2012). Salmon in the Columbia Basin evolved in a system that included higher levels of TDG. The EIS should also acknowledge that prior to the damming of the Snake and Columbia rivers, a network of rapids and waterfalls in the region naturally increased TDG in the rivers.

The EIS also fails to acknowledge the substantial mortality caused by the hydropower network in the Columbia Basin. Without spill, smolts are sent through dam turbines and/or elaborate bypass systems. Dams and their reservoirs kill as much as 70 percent of the out-migrating smolts and more than 15 percent of the returning adults. Some smolts die further downstream as a result of cumulative stress and injury (CSS, 2018). Dams have also reduced water velocity, increased water temperatures, exacerbated predation, prolonged salmon migration, and increased salmon mortality and injury during dam passage (Budy et al., 2002; Scheuerell et al., 2009; Van Gaest et al., 2001). Because the EIS does not include this holistic analysis of salmon survivability in the Columbia Basin, it implies that any mortality attributable to increased spill would be additive. A more thorough analysis should examine the ability of increased spill to decrease other sources of mortality, primarily by increasing the travel time for juvenile salmon to reach the ocean. This reduces the amount of time juveniles spend in potentially lethally hot reservoir water, which is also where they are vulnerable to predation. As written, the EIS presents only one, dated, side of the science around spill.

Impacts to non-native fish species would further benefit salmon

On page 29, the EIS begins discussing the potential impacts of increased spill on non-salmonids. As the EIS stated, there are no studies indicating that 125% TDG impacts invertebrates or native amphibians. According to the most recent data, only non-native species, several of which predate on juvenile salmon, would be impacted by increased TDG. The EIS cites several studies that increased spill would negatively impact northern pikeminnow, largemouth bass, and smallmouth bass. These three species are non-native predators of chinook salmon and other salmonids, and the state is actively encouraging efforts to reduce populations of these fish. While increased TDG is expected to negatively impact these species, this would further benefit the state's goal of recovering salmon and orcas. The EIS should acknowledge this potential benefit. The majority of the other species that would be negatively impacted by increased TDG are also non-native.

An additional EIS this summer is redundant and unnecessary

Ecology has stated that it plans to undergo an additional public process this summer to increase TDG standards to 125%. This second public process would be redundant and result in unnecessary delay – to the detriment of both salmon and orcas. The data available to inform this decision will not substantially change (if it changes at all) before this summer. The department has offered no justification for why it believes a second EIS is necessary.

Raising TDG standards to 125% gives Ecology discretion and flexibility when working with partners, like Bonneville Power Administration, to set appropriate spill levels. Increasing TDG standards to 125% does not require Ecology or dam operators to spill up to that level. These standards represent a regulator ceiling, not a floor. By increasing TDG standards to 125%, Ecology can still honor the flexible spill agreement and only spill up to 120% in 2019. In fact, on the four lower Columbia dams, spill would be limited by Oregon's TDG standard of 120%. Currently, Washington's more conservative TDG standards limit spill at these four dams. While spilling up to 125% TDG would maximize benefits to southern resident orcas, dams could spill less than that in 2019. These standards represent a regulatory ceiling, not a floor.

Conclusion

We greatly appreciate your efforts to recover both salmon and orcas by increasing spill on the lower Snake and Columbia Rivers. We strongly encourage the department to choose alternative 3 and increase the state's TDG standards to 125%. This would allow spill up to this level at the four lower Snake River dams, which are solely limited by Washington's water quality standards, in 2019. Oregon's lower TDG standards would keep spill to 120% TDG on the four lower Columbia River for 2019. Defenders and our allies are continuing to work with Oregon to increasing their standards to 125% TDG as well. In the meantime, **Washington can show bold leadership and provide immediate relief to southern resident orcas by increasing our standards to 125% TDG.**

We look forward to working with you and your staff further to prevent the extinction of orcas and salmon.

Sincerely,

Robb Krehbiel
Northwest Representative
Defenders of Wildlife

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Dear Director Bellon,

Southern resident orcas are one of the most endangered marine mammals in the world. The salmon runs these whales once relied on, particularly those in the Columbia basin, are a shadow of what they once were, leaving these whales with less food. Columbia and Snake river salmon were once the largest and most abundant on the west coast, providing southern residents with a critical winter food source when there are few other salmon available.

The decline of salmon across the northwest is complex, but perhaps the most significant change to salmon habitat has been the damming of rivers. Dams slow adult and juvenile salmon migration, making them increasingly susceptible to predation and lethally warm water. Large reservoirs on the Columbia and Snake rivers make it increasingly difficult for young salmon to quickly and safely migrate to the ocean where they can mature.

A short-term step to alleviate at least part of this problem is to increase the amount of water spilled over dams in the Columbia Basin. Decades of scientific research and observation has shown that spill is the safest way for juveniles to migrate to the ocean and that higher levels of spill result in more adults returning to the mouth of the Columbia. For years, Washington's total dissolved gas (TDG) standards, which limit the amount of water that can be spilled, have been overly conservative. The best available science suggests that eliminating the 115% forebay TDG standard as you propose and immediately increasing the tailrace TDG standards to 125% will maximize the benefits of spill without negatively impacting other species or the environment. Spilling up to this level is estimated to result in 146,000 more adult salmon, making spill one of the most effective near-term actions the state can take to provide more food for orcas.

Your department has proposed increasing tailrace TDG standards to only 120% for this spring's out-migration. While this increase may help in a small way, there is no reason to not raise TDG standards to 125% immediately. Southern resident orcas are starving to death and are unable to find enough food to successfully raise new calves. This situation requires an emergency response. I strongly urge you to increase the state's TDG standards to 125% for the 2019, 2020 and 2021 juvenile out-migration.

Sincerely,

Gill	Fahrenwald	Olympia	WA
Jeffery	McConaughy	Bellingham	WA
Anna	Bechtel	Bothell	WA
James	Terry	TUMWATER	WA
Mike	Conlan	Redmond	WA
Glenn	Eklund	Oak Harbor	WA
Larry	Lawton	Aberdeen	WA
Summer	Spinks	Lynnwood	WA
Stephanie	Piocos-Lehman	Tacoma	WA
Diane	Weinstein	Issaquah	WA
Mary	Guard	Friday Harbor	WA
Jennifer	Bentzel	Lacey	WA
Stephanie	Trasoff	Blaine	WA

Deborah	Efron	Bellevue	WA
Tracy	Ouellette	Bow	WA
Maureen	Parriott	Oroville	WA
M.	Lish	Marysville	WA
Nora	Davidson	Silverdale	WA
Diann	MacRae	Bothell	WA
Delorse	Lovelady	Kenmore	WA
Michelle	Pavcovich	Seattle	WA
Toni	Howard	Renton	WA
Kathleen	Medina	Anacortes	WA
Terri	Dumala	Mill Creek	WA
Billie	Mann	Ocean Shores	WA
Carol	Else	Lakewood	WA
Selim	Uzuner	Carnation	WA
Ann	Pryich	Mount Vernon	WA
Donna	Stonecipher	Seattle	WA
Roberta	Hutton-Pieti	Anacortes	WA
Jacob	Meyer	North Bonneville	WA
Beth	Call	Walla Walla	WA
Robert	Vanderkamp	Battle Ground	WA
Leila	Jones	Bothell	WA
Elizabeth	Stoltz	Heisson	WA
Brian	Weatherby	Kent	WA
Derby	Judith	Port Townsend	WA
Marc	Daniel	Mount Vernon	WA
Lyn	Meyerding	Sultan	WA
k	g	Orting	WA
Cathy	Wyatt	Bainbridge Island	WA
Peter	Wilsnack	Seattle	WA
Madeleine	Sosin	Seattle	WA
Ranell	Nystrom	Tacoma	WA
Lisa	Halpern	Seattle	WA
Mana	Iluna	Bellevue	WA
Marilyn	Cochran Mosley	Vashon	WA
Ben	Moore	Mountlake Terrace	WA
Shreeraj	Friend of Defenders	Seattle	WA
Wanda	Crawford	Federal Way	WA
Steve	Lovelace	Wilkeson	WA
Ken	Zontek	Yakima	WA
Karine	Werner	Langley	WA
Randall	Daugherty	Aberdeen	WA

Jack	Lockhart	Everett	WA
Tammi	Turner	Issaquah	WA
Lori	Erbs	Acme	WA
Nancy	Jacobs	Bellevue	WA
Carol	Rolf	Colville	WA
Judy	McLain	Oak Harbor	WA
Joann	Riley	Kenmore	WA
Kim	McDonald	Marysville	WA
Suzanne	Hamer	Woodinville	WA
Kyle	Stevenson	Auburn	WA
Linda	Gusch	Spokane	WA
Mary	Riley	Hoquiam	WA
M	Lind	Vancouver	WA
Jean	Jensen	Graham	WA
Randy	Harrison	Eugene	OR
Beth	Hall	Olympia	WA
Leslie	Chertok	Tacoma	WA
Lynn	Tucker	Seattle	WA
Dick	Culp	Bainbridge Island	WA
Larry	Mahlis	Seattle	WA
Susan	Grzadzielewski	Mount Vernon	WA
Richard	Low	Stanwood	WA
Adina	Parsley	Stanwood	WA
Julie	Taylor	Mountlake Terrace	WA
Greg	Puppione	Seattle	WA
Debbie	Thorn	Kirkland	WA
Amelia	Brower	Seattle	WA
Maureen	Belle	Langley	WA
Laurette	Culbert	Seattle	WA
Ardell	Friend of Defenders	Lacey	WA
Joanna	Vintilla	Seattle	WA
Kjersten	Gmeiner	Seattle	WA
Sharon	Fetter	Puyallup	WA
Terry	Lee	Bremerton	WA
Lorraine	Kay	Seattle	WA
Mary	Neptune	Vancouver	WA
Scott	Friend of Defenders	Seattle	WA
Daniel	Zizza	Seattle	WA
Richard	Noll	Port Townsend	WA
J.	Grajczyk	Kent	WA
Linda	Wright	Seattle	WA

Seth	Snapp	Bellingham	WA
Robert	Brown	Tacoma	WA
Desi	Nagyfy	Deer Park	WA
Chasity	Hungerford	Kirkland	WA
Judy	Palmer	Tonasket	WA
Lloyd	Hedger	Tacoma	WA
S.	Jacky	Steilacoom	WA
Graciela	Rodriguez-Sero	Seattle	WA
Barbara	Lamb	Langley	WA
Edward	Brauer	Kent	WA
Barbara	Bonfield	Tacoma	WA
Darlene	Baker	Sammarnish	WA
David	Stetler	Kirkland	WA
Ruth	King	Lacey	WA
Gene	Groom	Orting	WA
Lawrence	Stocks	Lakewood	WA
K.	Youmans	Roslyn	WA
Eric	Fosburgh	Seattle	WA
Mark	Koehnen	Quincy	WA
Shane	Kostka	Spokane	WA
Janice	Kobak	Enumclaw	WA
Kathryn	DeWees	Tacoma	WA
Lyn	Lukich	Spokane	WA
John	Bayer	Washougal	WA
Emily	Austin	West Richland	WA
Suzanne	Steel	Blaine	WA
Brookie	Judge	Seattle	WA
Patty	Bowen	Bellevue	WA
Sarah	Hafer	Vancouver	WA
Julia N	Friend of Defenders	Edmonds	WA
Barbara	Tountas	shoreline	WA
laurie	geller	camas	WA
Kathy	Ruhl	Tacoma	WA
Denise	Beard	Seattle	WA
Debbi	Pratt	Seattle	WA
Julanne	Nowak	Bellingham	WA
Rhonda	Sigman	Hoquiam	WA
Warren	Weissman	Seattle	WA
Marsha	Adams	Shelton	WA
Tina	Stewart	Woodinville	WA
Jerry	Matsui	Seattle	WA
Vicky	Matsui	Seattle	WA

Kristin	Gearin	Seattle	WA
Alice	Tobias	Langley	WA
Lori	Greenfield	Mukilteo	WA
Tricia	Dillard	Issaquah	WA
Amy	Kelm	Everett	WA
Tanya	Harbert	Clarkston	WA
Lorraine	Hartmann	Seattle	WA
Marty	Crowley	Port Townsend	WA
Cathy	Spalding	Olympia	WA
Sarah	Salter	Lynnwood	WA
Audrey	Meade	Seattle	WA
David	Randall	Spokane	WA
Jerry	Kessinger	Lynnwood	WA
Tom	Swoffer	Ravensdale	WA
Julie	Woodman	Seattle	WA
Linda	Seaman	Winthrop	WA
Lorraine	Johnson	Seattle	WA
Lanie	Cox	spokane	WA
Barbara	Wallesz	Bellingham	WA
Sharon	Throop	Spokane	WA
Robb	Krehbiel	Kent	WA
Tika	Bordelon	Seattle	WA
William	Conger	Anacortes	WA
Norman	Husser	Seattle	WA
Brenda	Bailey	Eastsound	WA
Yvette	Goot	Chewelah	WA
Paul	Franzmann	Walla Walla	WA
Kathryn	Ryan	Edmonds	WA
Don	Thomsen	Spokane	WA
Nick	Barcott	Lynnwood	WA
Deborah	Cruz	Ferndale	WA
Monique	Maas	Anacortes	WA
Cathy	Lindsay	Seattle	WA
Sandra	Perkins	Seattle	WA
David	Daniels-Lee	Ocean Shores	WA
Roger	Schmidt	Spokane	WA
Lyle	Collins	Yakima	WA
Deborah	Gandolfo	Kirkland	WA
Michael	Lampi	Bellevue	WA
Norm	Conrad	Mount Vernon	WA
Ray	Couture	Seattle	WA
Esmeralda	Espinaco	Redmond	WA
Stephanie	Almskaar	Everson	WA

Debbie	Mahder	Battle Ground	WA
Karin	Fischer	Seattle	WA
Diane	Sullivan	Oak Harbor	WA
Anna	Liljegren	Kenmore	WA
Steven	Bouchard	Port Townsend	WA
Jan	Luxton	Bremerton	WA
Susan	Burnett	Seattle	WA
John	Lundquist	Auburn	WA
John	Woodworth	Newman Lake	WA
Kelly	Keefer	University Place	WA
Dave	Fairburn	Lakewood	WA
Ron	Sheriff	Bremerton	WA
Rosemary	Perisich	Seattle	WA
Kassie	Wheeler	Deer Park	WA
Nancy	White	Spokane Valley	WA
madelaine	moir	Sequim	WA
Anita	Woodruff	Seattle	WA
Susan	Matteson	Bainbridge Island	WA
Rebecca	Lee	Anacortes	WA
Laura	Hassin	Mercer Island	WA
Paula	Shafransky	Sedro Woolley	WA
Eric	Zimdars	Mill Creek	WA
Jo	Harvey	Pacific	WA
Dennis	Marceron	Seattle	WA
C.	Weil	Gig Harbor	WA
Chad	Evans	Seattle	WA
Michelle	Michaels-Tyner	Ridgefield	WA
Sue	Jarrard	Castle Rock	WA
Terry	Parkhurst	Seattle	WA
Melissa	Rees	Spokane	WA
Brenda	Dewey	Coupeville	WA
Helen	Carrick	Sequim	WA
JoAnna	Redman-Smith	Kent	WA
Amy	Hansen	Franklin	IA
Nina	Lebaron	Fh	WA
Grace	Padelford	Kirkland	WA
Leonard	Hearne	Bellingham	WA
Nancy	DeBusman	Carlsborg	WA
Marco	de la Rosa	Kirkland	WA
Vicky	Hoagland	Ferndale	WA
Donald	Stobbe	Sultan	WA
Gary	Larson	Sequim	WA
C	Martin	Pt Roberts	WA

Magdalene	Bumford	Olympia	WA
Gina	Abernathy	Sammamish	WA
Bianca	Reich	Lynnwood	WA
Asphodel	Denning	Mercer Island	WA
Lynn	Offutt	Everett	WA
Liane	Benson	OCEAN SHORES	WA
Diane	Smith	Bellingham	WA
Miriam	Israel	Seattle	WA
Holger	Mathews	Seattle	WA
Richard	ess	Shoreline	WA
Tara	Leigh	Federal Way	WA
Marie	Weis	Fox Island	WA
Michael	Felber	Port Townsend	WA
Wendy	Pum	Spanaway	WA
Peter	Cassinelli	Vancouver,Wa.	WA
Caroline	Garland	Anacortes	WA
Jack	Stansfield	Stanwood	WA
Mark	Bradley	Sequim	WA
Judith	Cohen	Seattle	WA
Doug	Swansaon	White Salmon	WA
Joe	Wiederhold	Bellingham	WA
Joe	Piecuch	Suquamish	WA
Ken	Mincin	Redmond	WA
Heather	Haverfield	Langley	WA
Valli	Hale	Lakewood	WA
Pamela	Larsen	Camano Island	WA
Chris	Thoma	Spokane	WA
Carolyn	Vaughan	Issaquah	WA
Theresa	Jordan	Pullman	WA
Christina	Frutiger	Gig Harbor	WA
JacqueLyn	Lobelle	Vancouver	WA
Andrew	Barker	Manzanita	OR
Serena	McCullough	Yakima	WA
Grace	Padelford	Kirkland	WA
Dagmar	Fabian	Bellingham	WA
James	Mulcare	Clarkston	WA
Lynette	Ching	Seattle	WA
Gary	Brill	Seattle	WA
Laura	Zerr	Auburn	WA
Mike	Schuster	DEMING	WA
Thomas	Libbey	Seattle	WA
Silvia	De Los Santos	Seabeck	WA
Judith	Swanson	Marysville	WA

Carol	Whitehurst	Tacoma	WA
Jim	Ferrier	Ilwaco	WA
Sara	Dubois	Centralia	WA
Stephen	Buck	Richland	WA
Diana	Covington	Tacoma	WA
Kevin	Hughes	Anacortes	WA
Joanne	Beeson	Blaine	WA
Kate	Ionina	Redmond	WA
Dorothy	Jordan	Lynden	WA
Rick	Taylor	Everett	WA
Vonda	Wolcott	Bellevue	WA
Theressa	Carey	Birch Bay	WA
M	Ransom	Woodinville	WA
Melissa	Eriksen	Seattle	WA
Mark	Hughes	Seattle	WA
Matthew	Boguske	Redmond	WA
Cynthia	Humphrey-hart	Oak Harbor	WA
Catherine	Ross	Edmonds	WA
LeeAnn	Chastain	Eastsound	WA
Kathleen	Lee	Lacey	WA
Patti	Harter	Ephrata	WA
Elizabeth	Lengel	Anacortes	WA
Rebecca	Canright	Rockport	WA
Rosanne	Anderson	Cheney	WA
Kathleen	Furness	Duvall	WA
Andrea	Gruszecki	Renton	WA
Stephen	Bailey	Deming	WA
Suzanne	Wittmann	Seattle	WA
Nicole	Marble	Seattle	WA
Lisa	Agard	Mount Vernon	WA
Shawn	Tuthill	Bothell	WA
Malcolm	Booth	Bellingham	WA
Louise	Hubben Batten	Olympia	WA
Anthony	Anderson	Ashford	WA
Rebekah	Baldwin	Puyallup	WA
Joan	Bowers	Seattle	WA
Bruce	Roberts	Stanwood	WA
David	Hand	Bainbridge Island	WA
Paul	Potts	Raymond	WA
Stacia	Haley	Seattle	WA
Michael	Hill	Mineral	WA
T J	Thompson	Gig Harbor	WA
Ruth	Falcon	Seattle	WA

Eugenia	Patterson	Poulsbo	WA
Angie	Dixon	Seattle	WA
Richard	Morgan	Bellingham	WA
Vanassa	Lundheim	Everett	WA
Annette	F	Arlington	WA
Dave	Roehm	Ocean Park	WA
Sue	Stoeckel	Everett	WA
Lyssa	Mercier	Seattle	WA
Gail	Wagner	Vancouver	WA
Robert	Rice	Redmond	WA
Nick	Szumlas	Seabeck	WA
Sandra	Rodgers	Amboy	WA
Sanja	Futterman	Seattle	WA
Sandra	Gehri-Bergman	Puyallup	WA
Crystal	Schaffer	Lacey	WA
Anna	Gullickson	Cashmere	WA
Travis	Miller	Seattle	WA
Lauren	Baker	Richland	WA
Johanna	Daggett	Longview	WA
Tracy	Hartung	Vancouver	WA
Ursula	Mass	La Conner	WA
Jill	Nunez	Buckley	WA
Ky	Parker	Poulsbo	WA
Michael	Blue	Ellensburg	WA
Christopher	Lawrence	Spokane	WA
Karen	Popoff	Omak	WA
Nadine	Wallace	Tacoma	WA
Mary	Cooke	Seattle	WA
Lawrence	Magliola	Sequim	WA
Alisha	Leviten	Shoreline	WA
John	Elliott	Bremerton	WA
Steve	H	Lakewood	WA
Madalyn	Meyer	Renton	WA
Michael	Manoff	Hoodsport	WA
Tamara	Saarinen	gig harbor	WA
Sharon	McKenzie	Port Townsend	WA
Tristen	Wuori	Kent	WA
Dean	Howe	Bonney Lake	WA
Glen	Anderson	Lacey	WA
Erik	Larue	Burlington	WA
Robin	Dein	Seattle	WA
Sean	O'Dell	Renton	WA
Suzanne	Paterson	Issaquah	WA

Lou	Maxwell	Lynnwood	WA
Julie	Whitacre	Bellingham	WA
Christopher	Flynn	Seattle	WA
Fayette	Krause	Port Townsend	WA
Diane	Falk	Everett	WA
Richard	Johnson	Bellingham	WA
Jeff	Freels	Lacey	WA
Kevin	Chiu	Seattle	WA
Dennis	Bahr	Snohomish	WA
Noah	Ehler	Monroe	WA
Kaija	Jones	Vashon	WA
Faye	Bartlett	Bellingham	WA
Linda	Chung	Bellevue	WA
michelle	trosper	Battle Ground	WA
Mary	Emmons	Leavenworth	WA
Kimberly	Teraberry	Seattle	WA
ron	wike	marysville	WA
Melissa	Clayman	Kirkland	WA
Richard	Yust	Arlington	WA
Steven	Shapiro	Seattle	WA
Jim	Adsley	Langley	WA
Brenna	Berquam	Bainbridge Island	WA
McCree	Williams	Seattle	WA
Saralyn	Montgomery	Moxee	WA
Andrea	Helman	Seattle	WA
Don	Johnson	Sedro Woolley	WA
Paul	von Szalay	Mill Creek	WA
katie	austin	Monroe	WA
Kathryn	Jacobs	Chelan	WA
Erinn	Carey	Gig Harbor	WA
Christina	Kisskeys	Bellingham	WA
Tamela	Roberson	Everett	WA
Maria	Kjaerulff	Gig Harbor	WA
Farnoush	Katouzian	Tacoma	WA
Diane	Edwards	Anacortes	WA
Jeanene	Lorey	Bothell	WA
Vianna	Engel	Rochester	WA
Sonia	Cantu	Seattle	WA
Dan	Schneider	Seattle	WA
Susan	Hampel	Eastsound	WA
sarah	shields	SEATTLE	WA
Molly	Sutor	Spokane	WA
William	Insley	Tacoma	WA

William	Jarcho	Vashon	WA
Greg	Onsel	Arlington	WA
Christina	McCluskey	Kent	WA
Kim	Seater	Seattle	WA
Perry	Wong	Kent	WA
Sabrina	Murphy	Arlington	WA
Dr. Michael	Berres	Bellingham	WA
Nancy	Wilson	OLYMPIA	WA
Margie	Meis	Everett	WA
Bill	Shanks	Seattle	WA
Fiona	Segretti	Port Orchard	WA
Doreen	Alexander	Marysville	WA
Susan	Kane	East Wenatchee	WA
Karen	Berntsen	Poulsbo	WA
Laurie	Manning	Renton	WA
Gerry	Stamper	Clarkston	WA
David	Rishel	Greenbank	WA
Shelly	Ackerman	Langley	WA
Shelley	Blaine	Everett	WA
Daibra	Duncan	Elk	WA
John	Mcgill	Sequim	WA
Ben	Rall	Spokane	WA
Randi	Eicher	Seattle	WA
Debra	Knutson	Sequim	WA
Wylie	Bryant	Friday Harbor	WA
SusanJ	Sheldrake	Bellevue	WA
K	Penn	Clinton	WA
Laura	Sagen-Hughes	Bothell	WA
Clayton	Jones	Tukwila	WA
Monika	Holm	Seattle	WA
Michael	Rooth	Spokane	WA
Jennie	Blake	Orting	WA
Linda	Ward	Bellingham	WA
Patrick	Conn	Kent	WA
Della	Nestlebush	Ferndale	WA
Margaret	Wettergreen	Bellingham	WA
Debbie	Nelson	Duvall	WA
Bryana	Walters	Snohomish	WA
Lisa	Gaspard	La Conner	WA
Tracy	Mosier	Kelso	WA
Bonnie	Lawlor	North Bend	WA
Judy	Brennan	Bellevue	WA
Vicki	Thomas	Bellingham	WA

Glenna	Johnson	Redmond	WA
Eiko	McDonald	Lakewood	WA
Claudia Lee	Miller	Oroville	WA
Mary	Easton	Cosmopolis	WA
Joseph	Pinc	Vancouver	WA
Suong	Huynh	Kirkland	WA
Gail	Dominick	Montesano	WA
Terri	Stromberg	Redmond	WA
Joanna	Stiehl	Olympia	WA
jean	ferrier	Bellingham	WA
Barb	Nichols	Freeland	WA
Roger	Schmidt	Spokane	WA
Catherine	Pierce	Poulsbo	WA
V	Mangum	Spokane Valley	WA
David	Benson	Pullman	WA
Nadine	Cotter	Chehalis	WA
Patricia	Wilson	Belfair	WA
Derek	Benedict	Lynnwood	WA
Donna	Glaser	Dupont	WA
Dianne	Hurst	Lacey	WA
Robert	Curry	Cheney	WA
Arlene	Olson	Olympia	WA
Joy	Gohl	White Salmon	WA
Alex	Berger	Seattle	WA
Ernest	Bellavita	Ferndale	WA
Rita	Carrowwawa	Sequim	WA
Mary jo	Wilkins	Kennewick	WA
Robert	Jacobs	Vancouver	WA
Melinda	Burks	Seattle	WA
Kristi	Hunziker	Yakima	WA
Edith	Gish	Tacoma	WA
Stacy	Starr	Port Orchard	WA
Nicholas	Kovalcik	Newcastle	WA
Taylor	Jackson	Everett	WA
Lesley	Miles	Blaine	WA
Michael & Judi	Hoffman	Kirkland	WA
Karen	Fortier	Monroe	WA
Betsy	Pendergast	Port Townsend	WA
William	Weathersby	Olympia	WA
Jessica	Perez	Redmond	WA
Annie	Rein-Weston	Seattle	WA
Barbara	Rosenkotter	Deer Harbor	WA

Joy	Gardner	Edmonds	WA
Taggart	Howland	Vancouver	WA
Jonthan	Wuori	Kent	WA
Ellen	Ward	Seattle	WA
Jc	Vescio	Bonney Lake	WA
Brenda	Seifert	YAKIMA	WA
Kjirsten	Collier	Renton	WA
erik	johnson	Belfair	WA
Carolyn	Eden	Bainbridge Island	WA
Jan	Weisel	Woodinville	WA
Sherry	Kraft	Seattle	WA
Brett	Kessler	Washington	DC
Marsha	Jollensten	Bothell	WA
Jennifer	Blume	Seattle	WA
Ashley	Holtorf	Blakely	WA
Divya	Rathor	Sammamish	WA
Susan	Evans	Bellingham	WA
Amanda	Cermak	Woodinville	WA
Lynn	Ruelan	Sammamish	WA
Heidi	Mcbride fritts	Edmonds	WA
Jeanne	Turgeon	Seattle	WA
Pat	Stevens	Stanwood	WA
Rosie	Young	Spokane Valley	WA
MaryAnn	Seward	Port Townsend	WA
Cheri	Kunz	Woodinville	WA
John	Maxwell	Port Townsend	WA
Mary	Olheiser	Burien	WA
Marie	Alexander	Ollala	WA
Joan	Peter	Gig Harbor	WA
Julie	Cipale	Olympia	WA
Mieko	Krell	Seattle, WA	WA
Maura	Peterson	Issaquah	WA
Virgene	Link-New	Anacortes	WA
Treena	Millett	Sequim	WA
Janet	Wynne	Bellingham	WA
Renee	Richards	Kirkland	WA
David	Scheer	Bellingham	WA
Michael	Anderson	Olympia	WA
Marcia	Ponto	Shoreline	WA
Rick	Cobos	Tacoma	WA
Jerry	King	Spokane	WA
Karla	Taylor	Olympia	WA
Allison	Ciancibelli	Twisp	WA

Linda	Francis	Olympia	WA
Liz	Nedeff	Renton	WA
Susan	Sargis	Friday Harbor	WA
Colleen	Harpold	Kent	WA

Northwest RiverPartners
For salmon, our economy and quality of life

February 27, 2019

Ms. Becca Conklin
Washington State Department of Ecology
PO Box 47600
Olympia, WA 98504-7600

RE: Comments on Draft Environmental Impact Statement for Short-Term Modification of Total Dissolved Gas Criteria in the Snake and Columbia Rivers

Dear Ms. Conklin:

Thank you for the opportunity to comment on behalf of Northwest RiverPartners ("RiverPartners") regarding the Draft Environmental Impact Statement ("DEIS") for Short-Term Modification of Total Dissolved Gas ("TDG") Criteria in the Snake and Columbia Rivers. Given the significance of this regulatory proceeding as well as subsequent related proceedings, we urge Ecology to move forward thoughtfully and prioritize scientific integrity over desire to enable a politically conceived operational agreement (regardless of its merits). This is a consequential environmental review process with potential knock-on effects that will have outsized impact on the diverse RiverPartners membership including farmers, utilities, ports and businesses throughout the Columbia River Basin including 4 million electric utility customers, 40,000 farmers, thousands of port employees and large and small businesses that provide hundreds of thousands of Northwest jobs.

Purpose of the DEIS

As described in the DEIS's preamble, the "Washington State Department of Ecology ("Ecology") is considering a short-term modification to the total dissolved gas ("TDG") criteria in the Water Quality Standards for Surface Waters of the State of Washington for areas on the lower Snake and lower Columbia Rivers . . . Modifying the TDG criteria using a short-term modification could facilitate more spill at dams to help juvenile salmonids migrate downstream to the ocean."[1] "The purpose of the environmental impact statement is to evaluate the impacts of adjusting the TDG criteria for the Snake and Columbia Rivers."[2]

Significance of Modifying TDG Criteria as Contemplated in the DEIS

While the incremental nature of the modification under consideration appears innocuous, the long-term implications, depending on the outcome, could be significant. Indeed, at a high-level, this environmental

[1] Department of Ecology, State of Washington, Draft Environmental Impact Statement. Short-term modification of total dissolved gas criteria in the Snake and Columbia Rivers. January 2019, Publication 19-10-013. State of Washington, Department of Ecology cover letter.
[2] DEIS (Page 14).

review process is evaluating the risks of adjusting current water quality standards put in place explicitly for the protection of aquatic life and human health in surface waters as required by the Clean Water Act.[3] Given the significance of this regulatory proceeding as well as subsequent related proceedings (specifically, the upcoming evaluation of raising TDG standards to 125% for the 2020 and 2021 migration season),[4] we urge Ecology to proceed carefully and prioritize science over political expediency.

We are highlighting this tradeoff, because this regulatory proceeding although separate and distinct, is an enabling mechanism for a Flexible Spill Agreement ("Spill Agreement"/"Agreement") formally announced on December 18, and signed by the states of Washington and Oregon, the Nez Perce Tribe, the Bonneville Power Administration, U.S. Army Corps of Engineers, and the Bureau of Reclamation ("the Parties"). As the narrative in the DEIS's Executive Summary aptly points out, "The Spill Agreement is contingent on Washington, through the process described in this document . . ."[5]

The symbiotic relationship between the Spill Agreement and the potential modification of state water quality standards being evaluated in this DEIS is noteworthy. While RiverPartners greatly appreciates the spirit of collaboration that led to the Agreement and wants to see it succeed, we are mindful of the considerable pressure that exists on the Parties to execute on the Agreement's terms and "deliver the deal." With sympathy toward this challenging dynamic, we urge Ecology to approach this EIS and subsequent related regulatory processes independent of the merits of the Spill Agreement, with a steadfast commitment to well supported science.

Consistent with this approach, we were pleased to see a commitment by Ecology to a two-step regulatory process that includes independent examination of the following: 1) "Raising TDG standards on the lower Snake and Columbia rivers to match Oregon's 120% standard as measured in the dam tailrace for the 2019 salmon migration season;" and 2) "For the 2020 and 2021 migration season, the Spill Agreement is contingent on both Washington and Oregon raising TDG standards to 125%. The short-term modification of TDG standards considered in this draft EIS would, if adopted only apply to 2019 operations, and match Oregon's current TDG standards. A Separate process will begin this summer to address a potential rule change."[6] Clear delineation and distinctly separate review of each water quality modification signals Ecology's grasp of the consequential nature of any and all changes to existing standards.

Although our comments in this document make a determined point of procedurally separating Ecology's environmental review process from the implementation of the Spill Agreement, we cannot ignore the tangential relationship and Washington State's role in both undertakings. Therefore, we would like to take the opportunity within this set of comments to reiterate RiverPartners' strong support for the three objectives committed to by the Parties at the outset of the Spill Agreement. Specifically, "the Agreement calls for flexible spill operations that meet three objectives: provide additional fish benefits by increasing

[3] DEIS (Page 10).
[4] DEIS (Page 2).
[5] DEIS (Page 2).
[6] DEIS (Page 2).

spill; manage power system costs and preserve hydro system flexibility; and retain operational feasibility."[7]

As beneficiaries of the multipurpose federal hydropower system, RiverPartners' members take the Parties' commitment to these principles seriously. As such, throughout the Spill Agreement's implementation process, we will be working hard to ensure that these policy objectives remain intact. We view our oversight responsibilities as even more critical in the out-years of the Agreement (2020 and 2021) when the implementation roadmap is decidedly more opaque.

Position on Alternatives and Conclusion

RiverPartners appreciates Ecology's consideration of our December 7, 2018 scoping comments as well as the agency's work to develop and evaluate a suite of "reasonable alternatives." RiverPartners will not be taking a position on Ecology's preliminary decision to remove the 115% forebay criterion for a period of up to three years (Alternative 2).[8] However we appreciate Ecology's commitment to continued monitoring based on the following passage in the "Conclusions" section of the DEIS that states, "Given that dam and salmon managers have not previously provided voluntary spill to 120% due to the potential for higher TDG levels to increase symptoms of gas bubble trauma in juvenile salmon, steelhead, and non-listed aquatic species, continued monitoring for gas bubble trauma will occur."[9] Indeed, a rigorous monitoring program is necessary to ensure compliance with any and all water quality adjustments.

Additionally, per our scoping comments, we would like to reiterate our desire to see a more robust evaluation of the impacts of increased spill on carbon emissions and climate change. Governor Inslee has been a national leader in advancing climate solutions and has set ambitions emission reduction goals for the State. Consistent with the Governor's carbon policy objectives, we believe it is important for Ecology to analyze the growth in carbon emissions associated with the increased spill set to accompany the short-term modification being contemplated in this EIS.

Thank you again for the opportunity to comment. RiverPartners looks forward to working with Ecology throughout this and other key regulatory processes.

Best,

Kevin Nordt
Chairman of the Board
Northwest RiverPartners

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[7] BPA.gov: https://www.bpa.gov/efw/FishWildlife/SpillOperationAgreement/doc/Spill-Operation-Joint-Statement.pdf
[8] DEIS (Page 51).
[9] DEIS (Page 51).

WASHINGTON ENVIRONMENTAL COUNCIL

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February 28, 2019

Heather R. Bartlett
Water Quality Program Manager
Department of Ecology
Water Quality Program
P.O. Box 47600
Olympia, WA 98501

Comments submitted electronically

RE: Draft Environmental Impact Statement for Short-Term Modification to Adjust Total Dissolved Gas Levels in the Columbia and Snake Rivers.

Dear Director Bartlett,

Washington Environmental Council (WEC) appreciates this opportunity to provide written comments to the Department of Ecology (Ecology) on the draft Environmental Impact Statement (DEIS) for short-term modification of total dissolved gas (TDG) water quality standards for federal dams on the lower Snake and lower Columbia rivers through 2021. Increasing these standards will allow for more water to be spilled over dams on the Columbia and Snake rivers, both of which support critical salmon runs that Southern Resident orcas rely on.

WEC is a 501(c)(3) organization founded in 1967. Our mission is to protect, restore, and sustain Washington's environment for all, and we are committed to clean water protections for Puget Sound and for all Washington State waters. WEC is a member of Governor Inslee's Orca Recovery Task Force and fully supports the final report and recommendations that were delivered to Governor Inslee in November, 2018.

WEC is also a member of the Orca Salmon Alliance, a coalition of 17 local, state, and national organizations, is working to save Southern Resident orcas by recovering y their primary food, Chinook salmon. We also support Orca Salmon Alliance's comment letter on this issue.

Of the many recommendations provided by the Orca Recovery Task Force to Governor Inslee, **Recommendation 8** to increase spill to benefit Chinook for Southern Residents by adjusting Total Dissolved Gas allowances at the Snake and Columbia River dams, is one of the most effective near-term actions the state can take to provide more salmon for orcas.

While Alternative 2, increasing the state's TDG standards to 120% for the year 2019, is a good interim measure, WEC supports **alternative 3 to increase the state's TDG standards to 125% for the year 2019** as science supports this level and orcas need this standard adjusted sooner verses later. While WEC

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206.631.2600

supports increasing the state TDG standard to 125% based on information shared during the Orca Recovery Task Force, we support both Alternative 2 as an interim measure and Alternative 3 in the long term.

Historically, swift river currents in the Columbia and Snake River basins quickly carried smolts (recently hatched salmon) to the ocean, where they matured and migrated further out to sea. Slackwater created by dams has significantly increased the amount of time it takes for smolts to safely migrate to the ocean and increased their exposure to lethally warm water and predators (particularly invasive piscivorous fish). Spilling water over the dam spillways (instead of through turbines to produce energy) more closely mimics the natural flow of big rivers, like the Columbia and Snake, and delivers smolts more quickly and safely to the ocean. We need more fish that are 'spilled' to have any chance of boosting the number of fish that return to the river as adults to spawn. Scientific research conducted annually since the mid-1990s demonstrates conclusively that additional spill significantly increases juvenile salmon survival and subsequent adult returns.

Washington's current TDG standards no longer reflect the best available science. Recent increases in spill show that we have been overly conservative with our standards. **The best available science suggests that spill up to 125% TDG would result in 2 – 2.5 times more adult Chinook salmon returning than current levels without adversely affecting other species. From Ecology's EIS, "**When spill is increased to 125% TDG 24 hours per day/seven days a week in the spring, the Comparative Survival Study juvenile fish passage survival model predicts a two to 2.5-fold increase in Snake River spring chinook salmon abundance above the levels resulting from 2014 FCRPS BiOp spill levels, and smaller projected increase when spilling to existing gas standards or 120% TDG 24 hours per day. Steelhead smolt-to-adult returns are also predicted to increase significantly, but less dramatically than Chinook salmon." The studies cited throughout the EIS note that that increased TDG and prolonged exposure to saturated water is detrimental to aquatic life. However, the majority of these studies suggest that spill up to 125% is safe for most native aquatic species, particularly salmonids. The majority of these studies are also from the 1990's and do not reflect the scientific community's current understanding of spill or TDG.

It is important to note that the species that would be negatively impacted by increased TDG are non-native species, such as northern pikeminnow, largemouth bass, and smallmouth bass. These three species are predators of juvenile salmon, and the state is actively encouraging efforts to reduce populations of these fish through a bill currently in the legislature.

Increasing salmon runs in the Columbia Basin is essential to preventing the extinction of the Southern Resident orcas. During the winter and early spring, these orcas forage on Chinook salmon from Cape Flattery to Monterey Bay. Historically, the Columbia Basin produced the most Chinook salmon on the west coast, providing a large and critical source of food for the orcas over winter. Increasing spill over the Lower Snake and Lower Columbia dams would benefit seven of the fifteen most important salmon runs in the orcas' current diet.

wecprotects.org
1402 Third Ave, Suite 1400
Seattle WA, 98101
206.631.2600

We greatly appreciate your leadership to recover both salmon and orcas. Increasing spill in the Columbia Basin will further mitigate the impact these dams have had on endangered salmon runs and provide more food to orcas in the very near-term. **Again, WEC supports alternative 2 in 2019 and Alternative 3 in the long run to increase TDG standards to 125%.**

Sincerely,

Rein Attemann
Puget Sound Campaign Manager
Washington Environmental Council

Save Our wild Salmon Coalition

Attached is a letter addressed to Director Bellon and Program Manager Heather Bartlett at the Department of Ecology, signed by more than 1,000 individuals, asking that the Department increase total dissolved gas standards in the Columbia and Snake Rivers to 125% in a single step, in time for the 2019 juvenile salmon out-migration that begins in early Spring.

If you have any questions about this, please contact:
Joseph Bogaard,joseph@wildsalmon.org, 206-300-1003. Thank you.

Below is a letter addressed to Director Bellon and Program Manager Heather Bartlett at the Department of Ecology, signed by more than 1,000 individuals, asking that the Department increase total dissolved gas standards in the Columbia and Snake Rivers to 125% in a single step, in time for the 2019 juvenile salmon out-migration that begins in early Spring.

If you have any questions about this, please contact: Joseph Bogaard, joseph@wildsalmon.org, 206-300-1003. Thank you.

February 28, 2019

Maia Bellon, Director
Heather Bartlett, Water Quality Program Manager
Washington State Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600

Re: Comments on Draft EIS for Short-term Modification of Total Dissolved Gas Standards for Federal Dams on the Lower Snake and Lower Columbia Rivers

Dear Director Bellon and Program Manager Bartlett:

Southern Resident orcas are one of the most endangered marine mammals in the world. The chinook salmon populations these whales once relied on, particularly those in the Columbia-Snake River Basin, are just a remnant of their former levels, leaving these whales with far less food to eat. Columbia and Snake river chinook were once the largest and most abundant salmon anywhere on the west coast, providing Southern Residents with a critical winter food source at a time when there are few other salmon available.

The decline of salmon across the Northwest is complex, but perhaps the most significant degradation of salmon habitat has been the damming of its rivers. Dams and their reservoirs slow adult and juvenile salmon migration, making them increasingly susceptible to predation and lethally warm water. Large reservoirs on the Columbia and Snake rivers make it difficult for young salmon to quickly and safely migrate to the ocean where they can mature into adults. A highly effective near-term step to alleviate at least part of this problem is to increase the amount of water spilled over the federal dams in the Columbia Basin. Decades of scientific research and observation has shown that spill is the safest way for juveniles to migrate past dams and reservoirs to the ocean and that higher levels of spill result in larger adult salmon returns in subsequent years. For over two decades, Washington's total dissolved gas (TDG) standards, which limit the amount of water that can be spilled, have been overly conservative and harmed salmon survival.

The best available science suggests that eliminating the 115% forebay TDG standard as you propose and immediately increasing the tailrace TDG standards to 125% will maximize the benefits of spill without negatively impacting other species or the environment. Spilling up to this level is estimated to result in hundreds of thousands more adult salmon, making spill one of the most effective near-term actions the state can take to provide more food for orcas. Your department has proposed increasing tailrace TDG standards to only 120% for this spring's out-migration. While this increase may provide very modest help to juvenile salmon en route to the ocean, there is no reason not to raise TDG standards to 125% immediately. The scientific evidence that this level of TDG, especially implemented flexibly as proposed, will not harm juvenile salmon or other aquatic life.

More than 20 years of empirical data about the effects of dissolved gas on salmon support this conclusion. This data warrants action now to raise TDG standards to 125%.

Southern resident orcas are starving to death and are unable to find enough food to survive and successfully raise new calves. This situation requires an emergency response. I strongly urge you to increase the state's TDG standards to 125% in time for the 2019 outmigration and for 2020 and 2021 as well.

Sincerely,

Lisandre	Lyon	CA	90740	
Carol	Pearsall	OR	97364	
Joseph	Bogaard	WA	98070	
Rose	Norberg	WA	98370	
Brian	Cochran	OR	97756	
James	Hood	OK	74011	
rick	wieloh	WY	83001	
Miguel	Ramos	WA	98248	
Steve	Iverson	CA	92660	
Richard	Johnson	WA	98227	
Claire	Cohen	OR	97034	
Javier	Rivera	NY	11249	
Robin	Schaef	PA	16327	
Joe	Arenales	WA	98107	
Robin	Schaef	PA	16327	
Caroline	Armon	WA	98250	
Alice	Wong	CA	91776	It is important to save the whales!
Sunny	Thompson	WA	98304	
Jodi	Rodar	MA	01108	
Judith	Scher	ME	04062	
Ryan	Beck	WA	98133	

Neal	Krug	AZ	85621	the Pacific Northwest needs their salmon both for the ecosystems and the people that live in and depend their resources. The Orcas will be gone if you don't act soon. thank you for your consideration. Neal Krug
Sandy	Zelasko	CA	92082	
Paul	Ramos	CA	93460	Protect every species...Everywhere!!!
valerie	ANDERSON	CA	90046	
Daniel	Soulas	AK	33200	
Adam	Deer	WA	98119	
andrew	luk	wa	98199	
Daniel	Soulas	AK	33200	
Cheryl	Ritenbaugh	OR	97135	This is so important to all Americans, not just those in the PNW. Keeping up the salmon fisheries helps the orcas, and fisherman, and even help to fertilize the forests far inland (who knew???). When the dams were built, the ecosystems were intact and we had no idea the widespread destruction that was possible from them. Now we know. Do what you can, Increase dam flow this year, and bring down some of those dams in the future! Thank you!!!
Mary	Dilles	WA	98368	
Patty	Navarrete	NM	87571	
Chris	Stay	WA	98020	
Paul	Russell	NY	12472	
Erinn	Carey	WA	98335	Please don't be the generation responsible for their extinction....
Kelly	Riley	PA	19440	
Blaine	Ackley	OR	97124	
Kathy	Kim	CA	91789	Please protect the voiceless, their starvation and suffering should be reminded every time you eat your next meal
Paul	Rickerson	OR	97520	
Annemarie	Brown	CA	92037	Let us not be responsible for the extinction of a species so dear to us
Elaine	Packard	WA	98122	
Brian	Paradise	FL	32082	
Bob	Steininger	PA	19460	

Jordan	Anderson	WA	98028	We have known about the decline in salmon population and how it would affect the local Orca population since the 1970s, and now we are at that critical moment that if we don't do something now, we will lose that population. The Orcas are part of the northwest and I believe should be saved at any cost. Once the dams are breached, there may be a human toll that needs to be addressed, but it is now or never for those Orcas.
Scott	Tucker	NC	27612	
Diane	Chang	WA	98052	
Norm	Mundhenk	CA	91001	
Mark	Bradley	WA	98122	
Eric	Fournier	MA	02453	
Laura	Ackerman	WA	99224	
Barbara	Aronowitz	ID	83455	
Mark	Lane	TX	77043	PLEASE!!!
thomas	cooney	PA	18702	
Anna	Gullickson	WA	98815	
Shane	Milburn	OR	97035	
Crista	Worthy	ID	83714	
Mark	Bruner	ID	83661	Please save the whales and the salmon runs. The country and the world need this to work. Please set an example for the world. Start with the increased spill and follow up with removal of dams. Thanks.
John	Walton	CA	95445	
sandra	lane	TX	78028	
John	Peppel	WA	98225	
Tracy	Kessler	WA	98146	
James	Mickel	OR	97004	As a custom builder of aluminum fishing boats as well as an avid angler I wholeheartedly support requiring spill at the dams
Whitney	Neugebauer	WA	98011	
Steven	Hawley	OR	97031	
Howe	Crockett	WA	98682	
Natalie	Magnus	ID	83843	
David	Jaffe	OR	97225	
Julia	Paulsen	WA	98115	
John	Watts	WA	98368	These water quality steps are reasonable and should be implemented.

Peter	Hamilton	WA	98281	Lack of food is agreed by governments and proven by science as one of the main threats to the survival of the SRKWs. If you do not act now they will not survive!
Richard	Hieber	None	87700	
Eric	Burr	WA	98833	Please read Wolves in the Land Of Salmon by David Muskowitz
GRACE	NORDHOFF	WA	98115	Please coalesce your knowledge to create policies to preserve and protect orcas and salmon and to design and implement adaptive dams.
Helene	Bank	MA	02139	
Karen	Fabiane	NY	12301	
Robert H.	Feuchter	NY	11432	
Michael	O'Leary	OR	97215	
Darrell	Johnson	WA	98333	
ERIC	POLCZYNSKI	CO	81147	
Emily	Stephens	WA	98506	
Jessie	Bacon	MO	63122	
Aldo	Leiva	TX	78729	Protecting our wildlife is preserving our place on the earth too!
Chris	Lima	ID	83544	
Paul	Daniello	NH	03446	Salmon are the icons of Washington and Oregon. Let's give them a chance. The science is in. The dams harm salmon.
Pamela	Parks	OR	97401	The lower dams on the Snake River MUST COME DOWN. There are no alternatives if we are going to save the Pacific Orca's
Alix	Keast	NY	10025	We need to do everything we can to support and protect our endangered wildlife. Our oceans connect us all. Ocean life impacts all of the world.
Kristeen	Penrod	WA	98199	I strongly support actions to recover imperiled species like salmon and orca.
Amy	Grappone	WA	98110	
Rebecca	Muzychka	FL	33304	
Angie	Dixon	WA	98236	
James	Clark	WA	98258	
John	Woolley	WA	98382	it is a Reality
Walter	Tingle	MD	21035	
Mark M	Giese	WI	53403	
George	Bedirian	WA	99163	
Shel	Grove	DC	20015	
Matt	Deam	CO	81621	

Frank	Klug	CA	95008	
Brian	Forth	WA	98513	
James L	Maves	WA	99347	Thank You Please save the salmon and the Orcas
Richard	Basch	OR	97214	
Thom	Peters	WA	98290	If you are in the department of ecology, please start acting like it and protect our ecology! The proper and right thing to do in that regard is to get rid of those four damn Snake River dams.
Bernadett e	Methven	NJ	08904	Please respond to this environmental emergency by providing more salmon through a dam spill now.
Alan	Poplawsky	ID	83843	
Gregg	Larson	WA	98020	Orcas can't wait, act now!
Patricia	Haworth	MN	48103	
Kate	Busby	OR	97214	
Marcia	Godich	PA	15085	
Michelle	Maki	WA	98199	
Kathe	Garbrick	KS	66503	
Lauren	Devine	FL	33486	
s	smiths	IN	46703	
Carol	Storthz	AR	72202	
Ian	Shelley	OR	97225	
Reese	Bender	OR	97411	
Delaine	Splisbury	NV	89318	
Sandra	Joos	OR	97239	
Susan	Fitzhugh	WA	98070	
Ramsay	Kieffer	DE	19952	
Randi	Eicher	WA	98103	Please help save our orcas. I don’t want to lose them in my lifetime or my niece and nephews’ lifetimes.
Pam	Clark	CA	94558	
William	Blair	ID	83709	
Jacob R.	Raitt	CT	06605	I stood in the water in Anchorage, Alaska, and watched the salmon running there. It must be protected.
Donna	Knipp	NY	10034	
Larry	Anderson	MI	48135	
Cyrus	Christenson	WA	98116	It is do or die, and we need to buy time for the orcas.
Steve	Pettit	ID	83535	Science strongly indicates that providing spill up to the 125% level will improve juvenile survival through the FCRPS.
Paul	Hunrichs	CA	92071	
Scott	Kozoll	IL	60618	

Anne	Remaley	WA	99163	Please implement these measures and look for long-term systemic solutions for restoring salmon.
Claudia Lee	Miller	WA	98844	
Aleks	Kosowicz	WI	54843	
Norman	Baker	WA	98382	
Edwin	Quigley	AL	35661	
Angela	Moran	WA	98075	
Tina	Embree	WA	98056	Without enough food, any other measures are irrelevant. This needs to happen.
Adam	Kaufman	WA	98862	
Laura	Long	IL	60616	
Deborah	Crohn	OR	97213	It will take years and years to remove the lower Snake River damns. Action is needed now in order to have any hope of the Orcas surviving.
Joy	Wang	WA	98006	
Pamela	Bly	ID	83706	There is no choice ... we must save our Salmon for both the Orcas and human kind. Here to help. Pam Bly
Dick	Daniels	WA	98370	Act now. It may already be too late to stop the long term decline of this iconic, beautiful whale.
Sandra	Fucigna	MD	20814	
Marianne	Nelson	OR	97202	
Eileen	Reid	OR	97224	
luise	bolleber	MI	49684	Please do what you can to help orcas immediately. They can't wait for more studies or political hand wringing.
Tom	Iverson	OR	97219	Please act on this important decision for both the Orcas and Snake River salmon. Without this action, we will not have the knowledge and information to protect these important species.
Pam	Borso	WA	98240	
Joshua	Olson	ID	83703	
Paul	Hunrichs	CA	92071	
Harry	Reid	OR	97224	Please do the right thing and increase spill for our salmon and orca. Thank you!
Jim	Dickinson	WA	98121	
Amy	Gulick	WA	98236	Salmon, orcas, and people: we are all connected. When one of us suffers, we all suffer. We don't need to continue to study the issue. We know what the problems are and we know what needs to happen. Act now for the future.
Clifford	Trolin	WA	98368	

ROBERT	BOLAND	MT	59401	Bob Boland
Sarah	Bauman	NE	68502	
Erin	Updegrove	WA	98406	
Mary	Nunan	NY	10024	
Daniel	Roper	ID	83301	
William	Anderson	PA	19072	
Lawrence	Crowley	CO	80027	
James	Loacker	OR	97130	
STEPHANIE	MCLAUGHLIN	HI	96789	
Jenny	Heinz	NY	10024	
Jen	Matthews	OR	97402	
Elizabeth	Hurst	VA	22301	
Lee	Gibson	TX	75206	
Michael	Cochran	WA	99031	
David	Linn	WA	98569	
Reverend jane	Eagle	CA	95444	Breach the dams...or your legacy will be the extinction of the Southern Residents and possible the salmon.
Leonard	Elliott	WA	98002	
Gordon	Ehrman	CA	94904	
Leonard	Elliott	WA	98002	
Michelle	Leggore	CA	95814	
Alis	Kurt	CA	91011	
Benjamin	Thompson	DC	20008	
Linda	Stein	CA	94610	
Peter	Hapke	WA	98144	This increased spill, as well as Lower Snake dam removal, is long overdue. Please change the relevant rules to allow more spill for the April 2019 spring chinook out migration. Thanks.
roy	fuller	NY	12032	
julie	gallichotte	WA	98199	
James	Wong	CA	94133	
Carol	Yost	NY	10011	
David	Hohler	OR	97330	
James	Wong	CA	94133	
Mary	Higgins	WA	98043	
Shawn	McMurdo	CA	95060	
Adam	Blumenthal	PA	15220	
Annie	Roberts	WA	98070	I'm sure you realize that we are late to this solution and must move with the greatest speed and diligence. The Southern pod's demise is not an isolated event and reflects our great environmental problems.
Lorelette	Knowles	WA	98033	

Marguery Lee	Zucker	OR	97403	
Michael	Blumm	OR	97035	The Lower Snake River dams were a bad deal economically in 1945 when they were authorized, a worse deal when the last of the dams went on line in 1975, and a startling costly arrangement, requiring numerous subsidies, 45 years later. The state of Washington needs to support their expeditious removal, which two decades-old studies showed to be economically affordable.
Wesley	Banks	WA	98666	
RICHARD	AMERLING	CT	06443	
M. E.	Braun	OR	97330	
Ernst	Mecke	ot	00150	
Steven	Macdonald	WA	98070	I support the analysis and these recommendations made by Save Our wild Salmon.
arvia	morris	WA	98105	
judy	dutil	CA	95033	Unbelievable, we've deprived these species for so long. Is humanity so gone?
Robert	Burnett	CO	81224	
John	Gieser	WA	98117	
Stacey	Bradley	PA	16646	
Linwood	Laughy	ID	83843	Our rivers are the modern day commons, belonging to all of us. Collapse of our Snake River salmon and steelhead is already happening. Collapse is extinction in slow motion.
Craig	Beach	MD	21136	
Ben	Basin	OR	97214	
Ingmar	Saberi	WA	99163	I can think of very few things that are more important to me than the restoration of ecosystems in the Northwest, especially stream and river habitats. The culture of the Northwest is inseparable from its nature, which is one of the most beautiful and bountiful anywhere on Earth. Speaking narrowly, the value that restored fisheries would provide to Northwest communities enormously exceeds the benefits that current dam infrastructure can deliver. More broadly, though, the health of the natural system of which we are a part is the true measure of the value of any action.
Amanda	Grondin	WA	98368	

Dan	Sherwood	OR	97214	
MaryAnn	Linehan	PA	19087	
Gerry	Milliken	AZ	86326	We have a long way to go and little time to restore species who are critically endangered.
Bridget	LaNoir	NY	12801	
James	Long	FL	33461	
Richard	Spotts	UT	84790	
jonette	bronson	CO	81435	We are running out of time to save the orcas. Act. Now. Please.
Mark	Lewandowski	WA	98223	
T.	Acuna	CA	90230	
Jeremy Nathan	Marks	MD	20853	
Monica	Gilman	OR	97024	
Joshua	Heffron	NY	10028	Save our Salmon
Patricia	Chelmecki	IL	60119	
Jay	Humphrey	OR	97023	
W. Thomas	Soeldner	WA	99036	Salmon is a keystone species in the Columbia River Basin. The result of its demise would be a tragedy for the Northwest and for many other species (at this date, particularly Orca, but with many other plants and animals also involved in the Basin). Restore NW rivers and make provision for the needed additional spill at dams.
Christel	Markevich	CO	80466	
David	Lamiquiz	AZ	85719	
Jeff	Renner	WA	98104	
Philip	McMorrow	CA	91107	
Luan	Pinson	WA	98664	We cannot let our Southern Pod of Orcas continue to live in such dangerous conditions.
Susanne	Mayr	CO	80220	
Maureen	Carlson	WA	98014	I am an avid sport fisher but I recognize if we don’t act NOW to nurture our resources we won’t have them to pass on to our children. We need to increase the spill, improve the water temperature, reduce or temporarily halt fishing (all), improve habitat, and move to other forms of energy to keep this vital piece of out identity.
Jose	de Arteaga	DC	20020	
Chris	Moore	CO	80210	
Nina	Richards	WA	98362	
d	marancik	CA	95125	
Lorraine	Foster	OR	97202	

Borg	Hendrickson	ID	83843	
Barbara	Orr	WA	98499	
JL	Charrier	MN	55391	
Lowell	Young	CA	95338	
R. A.	Larson	WA	98274	
Francis	Schwinger	WA	98146	
Mike	Seyfried	NV	89005	
Kevin	Fistanic	CA	90066	
Chuck	Rohrer	WA	98102	
Hank	Werner	OR	97071	Even though I am not a Washington resident I have going to Washington for one outdoor sports activity or another for over 30 years. Orca's have been one attraction, so Washington rivers and salmon are truly part of my life.
Michelle	MacKenzie	CA	94025	
Bob	Triggs	WA	98368	
Mary	Hahn	WI	53588	Please we need to remove the dams and restore the rivers and salmon populations! In the mean time, please do everything to can to feed the starving Orcas. Thank you.
Anton	Feokhari	NY	11229	
Marc	Chytilo	CA	93105	Restoring salmon runs, and all that this requires, has multiple community and ecosystem benefits.
Gail	Koza	CA	94019	I enjoy traveling to Washington is to see the Southern resident killer whales. I don't want Washington to lose these magnificent sentient creatures. Please take definitive action to increase spill over the dams in the salmon habitats to help salmon populations recover and to help the Southern resident killer whales.
Maureen	O'Neal	OR	97223	
Michael	Garten	WA	98103	
Richard	Ting	WA	98105	
Richard	Ting	WA	98105	
Jeff	Tatom	OR	97526	
Alex	Samarin	OR	97703	
Teri	Wright	WA	98365	
Don	Abing	OR	97103	
Jennifer	Lezak	TX	77479	
Ben	Basar	IL	60134	
Linda	Romero	WA	98034	
John	Wetherbee	WY	82401	
Gary	Cook	OR	97405	
Gary	Cook	OR	97405	

Gary	Cook	OR	97405	
Theresa	Terhark	MN	55109	
Gary	Grube	CA	94588	
Diane	Sullivan	WA	98277	
Reed	Dils	CO	81211	
Susan	Ellerman	MT	59802	
David	Winters	WA	98368	
Wayne	Heckman	CA	95482	
Lindsay	Taylor	WA	98225	Salmon are the keystone species of Pacific Northwest ecosystems - we need them just as much as they need us. Please help them.
Mara	Bohman	WA	98028	
john	musselman	KY	40059	
Martine	Felts	WA	98221	Please don't push this under the rug. The PNW Orca's need our help or there is not going to be anymore of them.
Kara	Stucker	WA	99021	
Elise	Adibi	PA	15217	
Jo Anna	Hebberger	IA	50312	We must do all we can to protect the animals of the oceans as the oceans are huge ecosystems and the animals that live there are vital to the health of the oceans. Life on this planet will cease to exist as we know it if we do not have healthy, functioning ecosystems.
Lee	Haines	WA	98418	
Dan	Esposito	CA	90266	
Barbara	Bernstein	OR	97202	
Mark	Wheeler	OR	97215	
Dennis	Brown	OR	97402	It is foolish to ignore the health of our ecosystem. We depend on this planet for our survival and there is a point at which we must look at the long term health a
Karlan	Kamerer	OH	44302	
Virginia	Douglas	OH	44035	The health of the oceans determines the health of the whole planet - it's all one chain. Please protect!
Joan	LaBow	WA	98052	
Linda	Ball	WA	98116	
Justin	Boucher	OR	97202	
Roy	O'Connor	MT	59802	
Ann	Christensen	ID	83340	
Ann	Bates	WA	98112	
Sara	King	WA	98092	

Marc	Fleisher	ID	83843	Until the Snake River dams are gone migrating salmon need water spilled. What is so difficult to understand? The ecology ofd the northwest, fish and orcas, deserve better than this. Spill.
Rebecca	Rose	WA	98155	
Richard	Simis	MD	21903	Spill
David	Edwards	WA	98506	
Rhonda D.	Wright, MD	GA	30319	
Frank	Ackerman	CA	94595	Prevent the decline of Pacific Salmon NOW.
Laurie	Gogic	WA	98034	
Moina	McMath.Walton	OR	97326	
Lisa	Reddick	WA	98020	
Michael	Denton	CA	94578	
Laura	Lundgren	WA	98112	Please, please help!
Mona	Young	MA	01257	
Joan	Walker	CA	93514	
Bob	Karcich	OR	97504	
MaryAnna	Foskett	MA	02476	
Derek	Gendvil	NV	89117	
Ann	Pryich	WA	98273	
Kirk	Rhoads	AR	72653	
Yvonne	Kuperberg	WA	98070	The ecosystem needs the orcas and the orcas need our help.
Janie	Chodosh	NM	87501	PLease help save the orcas by protecting their food!
K	Jackson	OR	97124	
Linda	Wright	WA	98121	
Harrison	Hilbert	ID	83204	Please increase WA TDG standards to 125% in time for the 2019 outmigration of fish Same for 2020 & 2021.These mammals are too important in the marine ecosystem. Thank you Thank you
Vernon	Homolka	CA	94591	
mary beth	moser	WA	98070	
Alisha	Douglas	WA	98365	
Ken	Cowart	CA	95062	Please allow them to spill more water so the salmon and orcas survive!
Donna	Fabiano	CA	95436	
Mark	Timken	WA	98070	
Michael	Felber	WA	98368	
Robert	Teister	WA	98053	
Carol	Wasielewski	MI	48133	
andre	entermann	WA	98261	

Margaret	Clabby	AK	99901	Scientific data matters. Please make the changes to the TDG standards so that spills can increase at the dams. I'm old, so I remember Snake River salmon in places they don't show up in now, so besides caring about the science, my heart also knows that healthy salmon runs mean that we are taking care of our watersheds. We have messed up in the past. We can at least take meaningful steps now towards sensible water management.
tom	Kovalicky	ID	83530	Its our Future and Heritage
Patricia	Jennings	MA	01890	
Jon	Jauch	FL	33411	
Anna	Jasiukiewicz	ot	63-400	
Evelyn	Fraser	DC	20018	
Amelia	Turnell	WA	98501	Please this is one of the most important things we could do for the Orcas right away that will make an impact.
tina	juarez	CA	94609	Additionally, some humans also are not getting enough salmon! Farmed salmon makes me sick. The whole WORLD needs more wild salmon. choose love,
Kayley	Swan	WA	98122	
Amelia	Turnell	WA	98501	Please approve this. It is so important.
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Juliann	Rule	MN	56310	
Rebekah	Yusko	WA	98406	
Paul	Vesper	CA	94703	
Cindy	Charles	CA	94107	
Mikki	Chalker	NY	13905	
Thomas	Brady	WA	99208	Salmon are the critical species for the Washington state ecosystem and for the economy.
Larry	Franks	WA	98027	Climate change will soon trump most issues in front of this generation. This is a good step in the right direction.
Joshua	Diamond	WA	98503	We humans, in our numbers of 7.6+ billion and rising, are rapidly destroying many habitats, including right here in 'green' Washington state. It just seems a no-brainer to do EVERYTHING we can to help our relatives and friends, the southern resident killer whales. Increase dam spill for 2019-2021!

mark	caso	FL	33755	PLEASE... sAVE THESE MAJESTIC ANIMALS. PLEASE... DO THE RIGHT THING.
Murlin	Goeken	CO	80222	
Brian	Gibbons	MD	20770	
Hilary	Bates	MT	59833	Free the Snake!!!
George	Ben	AK	99705	
Pat	Hanbury	NV	89506	
Lawrence	Novak	IL	60016	Wild Salmon forever
Lela	Perkins	WA	98208	
Lela	Perkins	WA	98208	
Karen	Springer	OR	97225	
Beth	Stanberry	NC	28802	
Shambhavi	Taylor	WA	98125	
Chris	Cottrell	WA	98136	We have to act like this is a crisis because it is. Take bold action now
Carolyn	Clark	FL	33629	Protect the ecology of the Northwest by restoring the rivers. The salmon populations will thrive if we let nature take over. Save the magnificent orcas!
Joan	Weiner	CA	94960	please, killing sea lions isn't the way to go about increasing salmon availability for orcas.
Kathleen	Schaeffer	OR	97381	
Christina	Osborn	CA	93402	
Jennifer	Wittlinger	CO	80487	
Brian	Morton	WA	98208	
Barbara	Phinney	WA	98133	As a WA State resident, I ask the WA Dept of Ecology to improve its water quality rules in early 2019 to allow higher levels of spill for the sake of endangered salmon and starving orca. Governor Inslee needs to see strong public support for his leadership. We need to increase spill now – while we continue to make progress to remove four costly dams and restore a healthy lower Snake River and open up access to more than 5,000 miles of pristine, protected salmon habitat upstream.
Jeannie	Dolan	ID	83823	
Olga	Kachook	WA	98037	
Tara	Atkinson	BC	V7L 1H6	
MaryJo	Fontenot	WA	99362	
Alex	Suarez	WA	98569	
Laura	Napoleon	NY	11362	

Stephen	Pauley MD	ID	83353	It’s your watch. Will you allow orcas to starve to death? Salmon to go extinct? It’s close to happening. Don’t let it!
Kevin	O'Connor	WA	98115	Please consider lowering the flow to safe wildlife
Brent	McFarlane	WA	98133	
Theresa	Day	OR	97222	
Mal	Gaff	CA	93436	
John Paul	Markham	KY	42445	
Victoria	Miller	CA	91436	
Darrin	McBee	BC	V1N4K8	Please protect the ecology of the Pacific Northwest.
Rebecca	Sundberg	MI	48197	
Phil	Lansing	ID	83712	
Candy	Lenigan	ID	83332	
Sally	Hodson	WA	98279	
Sandra	Ciske	WA	98116	Please support this best near-term action to increase salmon populations and help feed our threatened Orcas.
steve	simmons	OH	45434	
Diane	Straus	CA	94530	Orcas are a treasure and bring tourists to the state to see them.
Kathleen	Corby	NY	12567	Food is life! Southern Resident orcas need many more chinook salmon in coastal water in order to survive and recover. Though a restored, freely flowing lower Snake River is the region’s very best opportunity to get starving orca the salmon they need, interim steps must be taken immediately until that can be accomplished. Increased spill at the federal dams on the Snake and Columbia rivers is the most effective near-term option to increase salmon populations – and orca meals. We must increase spill NOW – while we continue to make progress to remove four costly dams and restore a healthy lower Snake River and open up access to more than 5,000 miles of pristine, protected salmon habitat upstream.
eric	nylen	MD	20902	
eric	nylen	MD	20902	
Paul	Moss	MN	55110	
John	Kirchner	IN	46815	

Dianne	Ensign	OR	97219	I'm a lifelong environmentalist dedicated to protecting the earth. Human activity, and structures such as dams, have degraded our planet to the point where all life is at risk. Please do your part to help recover healthy ecosystems.
elyette	weinstein	WA	98501	Don't let politics ignore science.
Robin	Kramer	WA	98506	
Emmanuel	Solis	WA	98008	
Deborah	Woolston	WA	98102	
Gary	Carlson	ID	83805	
Michele	Mont-Eton	NV	89519	
Nan	Corliss	MN	55437	It is time to protect and preserve those living creatures on this earth. If we do not, there will be nothing left for humans to enjoy, no life, not even our own.
Susan	Saul	WA	98664	I support the Department of Ecology's efforts to increase spill at dams to immediately aid salmon in 2019 while continuing to work towards the long-term goal of breaching the four lower Snake River dams and restoring salmon habitat upstream.
Avi	Okin	HI	96743	
Stephen	Oder	OR	97330	
Janet	Alicea	CA	90291	
Gerald	Hopkins	VA	22801	
Kate	Kenner	VT	05301	Oceans and nature have a balance which has been upset by our own species.Orcas are starving for that reason and it is imperative that something be done. If increasing spill lines will help them get food that is what must be done. Dams should only be built by beavers to be honest.
Tim	Rich	WA	98121	
Janet	Castaneda	WA	98008	The Pacific Northwest is unique, its wildlife is like nowhere else. We need to protect what we have now while we can, this can’t wait. We don't want to share stories of amazing Orcas that once lived in the area but eventually starved.
Jim	Martin	OR	97205	
michael	mathis	WA	99206	PLEASE!
Steven	Collins	CA	94107	
S	J	CA	95454	
Donna	Lozano	TX	78552	

April	Brumson	VT	05346	
Andy	Lynn	GA	30135	
Bonnie	Gretz	WA	98239	please do not cull seals and sealions! We don't want to be back at the table trying to save the Transient orcas! It's not the pinnepeds' fault, it is ours!
Kate	Skolnick	NY	11238	
JOSEPH	BAECHTEL	PA	16057	
Danika	Esden-Tempski	OR	97405	
Peter	Chiu	WA	98008	
Mary	Peete	WA	98229	
Elizabeth	Tuminski	CT	06907	
Julie	deRouche	WA	98221	Care for the Orca is care for us! Clean water is a priority, for our generation and the next. Salmon are crucial to the Southern Residents, and we have the ablity to help them reach the ocean and reproduce. Please make this happen.
Kenyatta	Herndon	MI	48176	We must protect our waters for everyone. Many people are employed by the salmon and marine tourists industry. This problem is not just an animal problem but also a human problem
Dale	Ballard	OR	97038	
Chris	Drumright	TN	37130	
Alex	Stavis	NY	10128	
Vince	Mendieta	TX	78745	
Mary	Paterson	WA	98125	
Shannon	Markley	WA	98103	
Mark	Blitzer	WA	98117	
Marty	Jansen	CA	94519	
Tatjana	Walker	TX	78212	Orcas shouldn't starve to death.
David	Hrobuchak	PA	17112	
Jim	Lansing	CA	94133	
Jordan	Ghita	WA	98177	We need to start taking action and save our Orcas!!! We need to take down the Lower Snake River Dam!
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Rebecca	Clark	OR	97203	
Anthony	Donnici	MO	64068	
Kjersten	Gmeiner	WA	98125	
Sandy	Pethan	CA	94062	These are very unique and important species to the ecosystem. Without intervention they will

				die in a short span of tome
Michael	Lampi	WA	98008	
Lyle	Collins	WA	98908	
namita	dalal	CA	94022	
Karen	Collins	WA	98908	
Sara	Libby	OR	97203	
Donna	Davis	WA	98229	
SUZANNE	KAMIYA	WA	98292	Oceans are 85% fished out! Salmon needs to be saved
Alice	Tobias	WA	98260	
j	Alexander	MD	20781	
Don	Morrison	WA	99205	Orcas need salmon, salmon need a free flowing river to get to spawning grounds, juvenile fish need to get to ocean, orca get to eat as more salmon are available! Bypass those dams save the Orcas and 4 species of salmon.
Thomas	Deetz	CA	95076	
Julie	Ford	CA	92649	
Lisa	James	CT	06704	
Dennis	Marceron	WA	98144	
Joan	Palmer	CA	91103	
kaarle	strailey	AK	99709	I am a fisheries biologist who has worked for the Alaska Department of Fish and Game and the Fisheries Department of the Puyallup Tribe of Indians. Chinook salmon systems cannot thrive in isolation facing the pressures of predators and commercial fishing, whether intentional or through bycatch. The benefits of taking the suggested actions will likely spread well beyond the Columbia River and the Southern Residents, who need relief so desperately.
RANELL	NYSTROM	WA	98403	Be bold and remove the 4 Lower Snake River Dams.
Rita	Meuer	WI	53704	
Melissa	Griffus	WA	98516	
David	Guren	WA	98125	These are necessary interim measures prior to total dam removal o the Snake.
Ellen	Glaccum	ID	83278	
Sharron	Anderson	WA	97232	
Jim	Cronin	WA	99201	
Ann	Khambholja	AZ	85756	
Richard	Jackson	VT	05482	

David	Michalek	OR	97031	
Don	McKelvey	OH	44123	This is a no-brainer !
Denise	hoffer	NY	14850	
Maria	White	OR	97007	
Elaine	Hickman	WA	98133	
paulette	gust	WA	98168	
Karyn	Searle	ot	08052	
JEFF	ALEXANDER	HI	96740	
Susan	Helf	WA	98103	
Betsy	Young	ID	83712	
Michael	Wallace	CA	95062	
Melody	Mayer	WA	98516	
Barbara	Bennigson	CA	94301	
Nathan	Petz	WA	98661	
Natalie	Chapin	WA	98225	
Julie	Martin	WI	54837	
Susan	Brown	CO	80631	
Thorsten	Ostrander	CA	92131	
Alice	Bowron	MN	55405	
Richard	Rutz	WA	98028	
Andrew	Sutphin	CA	91362	
Karen	Lamson	OR	97058	
Bert	Sacks	WA	98103	
Maureen	Knutsen	AK	99633	
Tom	Halderman	CA	95073	Data warrants action now! Cooler water and more spill are essential for the health of the salmon and steelhead and for the orcas. Do the right thing, increase spill now, then remove the dams. Thanks!
Lydia	Garvey	OK	73601	
Christeen	Anderson	FL	32539	
Laurence	Buckingham	IL	60068	
LeeAnn	Garton	ID	80376	We kA need salmon. The farmed ones are not nutritious and they cause problems with the wild salmon. We should not be fouling our planet.
Amanda	Niles	MT	59904	
William	Rivers	CO	80503	
Nancy	White	WA	99216	
Denee	Scribner	WA	98926	
Daniel	White	OR	97759	
Lorenz	Steininger	ot	86558	
Robert	Johnson	ID	83843	

Eric	Brooker	SC	29492	Please release more water from the dams in order to protect salmon and orcas
Cody	Dolnick	CA	92252	
Candace	Volz	TX	78703	Just please get more fish for the orcas- can't take having more die of starvation!!!!!!
Onie	Kahn	WA	98115	Please do everything possible to protect our salmon and the Southern resident pod. This is our final chance to save these incredible and wild treasures.
Keller	Adams	ID	83712	
Dianne	Douglas	AZ	85042	
Christopher	Dunham	PA	19053	
fdsaf	afsdf	CA	92020	
Brian	Jokela	WA	99006	
Paul	Brown	WA	98107	
Denise	Beard	WA	98119	
Janine	Bostock	WA	98136	
Ed	Heidel	WA	98036	
Vivian	Gross	WA	98034	
Timothy	Devine	CA	94544	
Kay	Foster	OH	45013	Please, please help the salmon, who are in dire need of your assistance. Thank you!
Scott	Crockett	OR	97439	
Patrick	Annabel	WA	99362	Southern Resident orcas need many more chinook salmon in coastal water in order to survive and recover. Though a restored, freely flowing lower Snake River is our region’s very best opportunity to get starving orca the salmon they need, interim steps must be taken immediately until that can be accomplished. Increased spill at the federal dams on the Snake and Columbia rivers is our most effective near-term option to increase salmon populations – and orca meals.
Michael	Price	OR	97239	
meera	krishnan	TN	38002	
Brad	Nelson	CA	93035	
Robert	Goodrich	WA	99026	
Maradel	Gale	WA	98110	
Karen	Spiegel	CA	91501	
kaylouise	Cook	WA	98125	
Bill	Holt	TX	78736	
Ellen	Williams	WA	98110	
Sally	Hurst	WA	98144	
Sally	Hurst	WA	98144	

Claire	Egtvedt	WA	98275	From 1956-1980 I was Quality Assur. Dir. for Col.River Pkrs. Assoc./Bumble Bee Seafoods in Astoria. This plant was closed down due to lack of SALMON return. The operations of the dams along the Snake R. system caused the last source of salmon to diminish greatly. Transportation downriver is no longer necessary and operations of the dams must be adjusted to favor the survival of the remaining salmon stocks to enable their recovery.
Janet	Jacobson	WA	98075	
Pierluigi	Roncaglione	ot	10062	Free Flow, free river, free sea!
WP Lyssie	Burden	WA	98368	This near-term solution MUST be companioned with action plans to breach the four Lower Snake River dams. PLEASE work with other agencies to make breaching happen this year!
Theresa	Digiannantoni	OH	43230	
Kevin	Pratt	WA	98106	
Gail	Bowers	ot	BB3 3AD	I'm from the U.K, people around the world are aware of this tragic story. You know what needs doing to help these orca please just do it, forget about money and profit for once.
Fred	Luke	HI	96821	
Meryl	Pinque	ME	04401	
Sigrid	Asmus	WA	98199	The Snake River dams are robbing the future of our irrplaceable salmon -- and the orcas that feed on them. I ask that Washington State immediately increase water quality rules in 2019 to allow higher levels of spill - up to 125% total dissolved gas
Julie	Hansen	CA	93953	Please. Let’s do what’s right.
les	roberts	CA	93704	
Cigdem	Capan	WA	99352	Saving the wild salmon is important to me beyond orca recovery because it is the canary in the coal mine and if we allow it to go extinct the ecological and economical ramifications for the pacific northwest will be huge. Thank you for all you do to keep our land&water&air clean, i truly appreciate all the work the Department does under your leadership.
Maria Sol	Caro	CA	91103	
Maria Sol	Caro	CA	91103	
john	canavan	MI	48085	4 lower snake river dams need to be breached
john	canavan	MI	48085	4 lower snake river dams need to be breached

Brian	Carter	OR	97058	
Stephen	Bailey	WA	98244	THIS IS A NO-BRAINER! OUR ORCAS ARE THE 10-TON CANARIES IN OUR INLAND WATERS!! AS GO THEY, SO GO WE!
Sarah	Lincoln	VT	05473	
G Allen	Daily	WI	53222	
Mary	More	PA	19031	
Patrick	Gallagher	NY	12946	
Sylvia	Rodriguez	NY	10003	
Donna	Sevilla	FL	33196	
Amy	Lyons	CO	80421	Protect our precious natural National heritage!
Bette Ann	Schwede	WA	98248	
Ben	Rall	WA	99202	
Timothy	Hunt	CA	92130	
Amy	Hamala	OR	97236	
Peggy	Gilges	VA	22901	I don't live in Washington State, but please know that your decision about the orcas is important to many-- probably most-- Americans. I don't want these wonderful animals to go extinct and we are witnessing a mass extinction which we have caused by destroying and altering natural habitats and food sources and polluting our atmosphere with ghgs that are radically changing the climate. Please increase spill to help the survival of the Southern Resident Orcas!
Beth	Ditto	WA	98121	Please understand how important this issue is to me and many of my friends. We need to get this right !
Thomas	Marshall	WA	98118	
Automne	Mosher	OR	97086	
Doug	Elledge	WA	99181	
Eric	Abrams	NH	03304	
Cath	Carine	WA	98117	
Cath	Carine	WA	98117	Real progress would be doing whatever it takes to ensure that these fellow beings survive and thrive in their home waters.http://www.clallam.net/Parks/SaltCreek.html
John	Koriath	WA	98070	
Nancy	Ruble	OH	44720	

keith	allen	CO	80133	Orcas are sentient creatures. We are committing a type of genocide by starving them to death all because we humans can't let a wee bit more water through the dams? That is morally unjustifiable.
Terrie	Williams	TX	77662	
Victor	Turnell	MO	63304	We have to act to save our precious Orcas!
Ron	Richards	WA	98362	
Dianne	Murray	WA	98199	Please save salmon and Orcas
Pablo	Bobe	NY	10130	
Steven	Bly	WA	98502	It would be a tragedy to loose our salmon runs forever. If the Orcas are in need of salmon as food - think of the many others who rely upon this food source.
bruce	hirayama	CA	90034	
Heidi	Briggs	ID	83642	Please consider the fact that your decision could greatly impact the natural world. If money wasn't involved how would that impact your decision on this matter?
Emily	Ross	WA	98040	
Jack	Stewart	WA	98070	We must do all we can for salmon and orca. We do this not only for the wildlife, we do it for our children and grandchildren, and their children. We must think long term.
Margaret	McCulley	CA	95060	
Matthew	Reid	CA	94515	
Sarah	Lincoln	VT	05473	
Chad	Huntsman	ID	83401	Failing the salmon and the orca would be like dealing a death blow to the spirit of the Pacific Northwest. It cannot and should not happen.
Laura	Arnone	WA	98502	We must protect this incredible ecosystem or it will become the stuff of "remember when"
Sarah	Hafer	WA	98684	
Gabe	Magtutu	CO	81401	
Gayle	Turek	IL	60805	There is no reason not to sign this petition. Two species are struggling to survive due to continued encroachment on the ecosystems they need to survive. It is time to give back, recognize the errors made and provide a means by increasing the spill for the salmon and oceans populations to recovery.
Zac	Kauffman	OR	97535	We need to preserve and protect the the migrations and habitat of Salmon and Steelhead in our rivers and streams
Coral	R.	BC	V8V4L	

Edward	Beaty	WA	99003	It's time to do the right thing to preserve this precious resource. Let's put science in the driver's seat, not politics.
Astrid	Winters	ot	5628DG	
Astrid	Winters	ot	5628DG	I am from the Netherlands. So this goes far. Please save these orca's please
Barbara	Rizzo	OR	97376	
david	knightly	MN	55318	Do you wish to see salmon disappear completely? I used to live in Alaska. Salmon are beautiful & need to be free to live their natural lives. Make that happen.
Jenny	O'Neill	WA	98532	
Kathleen	Grimbly	WA	98284	An ecosystem that is so damaged that it can't support salmon & Orcas will not support humans for long. Stop risking the loss of this unique gene pool, and take down the three Snake River dams. Multiple studies have been done. The Elwha has shown how rapidly life returns after dam removal. Lets act in a way that deserves such grace in the face of our destructive actions.
Patrick	Kelly	WA	98682	
Charles	Schultz	CA	94903	
JIM	HEAD	MI	48237	
Georgina	De Anda Colin	WA	98199	
Sheri	Kuticka	CA	94518	
Michael	Siptroth	WA	98528	Our total environment needs help, forests, shores, waters of all kinds, animals of all kinds, salmon, and orcas too! We've done a lot of damage at enormous costs to our habitat, now we have to do everything we can to restore our Earth!
David W.	Trotter	WA	98146	
Phyl	Morello	TN	37890	PLEASE PROTECT OUR OCEAN LIFE..INCLUDING ORCAS
Catherine	Gumtow-Farrior	OR	97754	this is imperative, we see that a huge portion of our ecosystems are collapsing! This is a urgent cry to action, NOW!
Doris	Warnstedt	ot	50996	
Camille	Coffey	MA	02482	The promise of undaming the Snake River and my previous association with the Save Our Salmon organization has made me especially interested in this matter.

Alicia	Liang	OR	97214	
Bruce	Gage	WA	99202	Increasing spill is a novel step to restoring Salmon and Orca, but the #1, key action needed is the REMOVAL OF THE 4 LOWER SNAKE RIVER DAMS ASAP! Salmon obviously need to get to and from their spawning grounds through as much free flowing cold water as possible. Their populations have been decimated by pollution, dams and over-fishing!
Richard	Weller	WA	98942	At this late point in time, while increased spill over the myriad dams that have turned several great salmon rivers into a series of largely dead water impoundments, it will take several measures conducted in concert to keep the salmon and orca populations at risk around long enough for dam removal on the mainstem of the Snake to have any effect. BS, UW College of Fisheries, 1969
Ronald	Spies	OR	97341	
Earl	Dodds	ID	83638	The Salmon & steelhead are on the verge of extinction now and suction dredging is just one more obstacle to add to their problems!
Susie	O'Keeffe	ME	04941	PLEASE do all you can to save the salmon, the whales, a future worth passing on to the young. Thank you.
Martin	Gibbins	WA	98014	We must take every possible action to reverse the Orca decline. It is our responsibility as citizens of the Northwest.
Automne	Mosher	OR	97086	
Dan	Perdios	CA	92262	
barbara	echo	WA	99224	
Manuel	Camacho	WA	98012	
Richard	Walthers	IL	60626	Step One...Step Two, remove the dams
Rod	Dalager	MN	55412	
Robert	Jensen	WA	98513	We can and should do this! Blessings, Bob Jensen
Yvonne	Carter	OH	44107	You do know,when they are gone,that's it...no magic/illusion nothing....gone!is how you want to be remembert.....some who could save our sea animals but didn't
Barbara	O'Steen	WA	98136	
patrick	grace	NM	87514	

Phillip	Callaway	OR	97336	We must increase spill over the Columbia and Snake River dams and then remove the 4 lower Snake River dams to keep the wild runs of salmon and the Southern Resident orcas from going extinct. Time is running out!
Donald	Coyne	CA	94402	
Luis Josue	Calva Rosales	WA	98121	
Marguerite	Pappaioanou	WA	98122	Protecting our PNW river ecosystems wit urgency, is vital to human, animal, environmental health.. we must act immediately!
Sally	Hurst	WA	98144	
Tim	Manion	WA	98074	They're dying. Slowly. Of starvation. On YOUR watch. You know what is required to give them a fighting chance. Please, for once, can't we find it in ourselves to simply shut up and do the right thing? Is that even left in us?
anne	veraldi	CA	94110	
anne	veraldi	CA	94110	
JEAN	MENDOZA	WA	98952	
Lisa	Banik	CT	06708	
Nancy	Ruble	OH	44720	
Rachel	Wilson	WA	98001	
Daniel	Draheim	WA	98115	
Erik	Hauge	CO	80516	
Denise	Berthiaume	MI	48187	Help the orcas, by allowing nore salmon spill
Diana	Armstrong	ID	83843	Please do the right thing: stop throwing good money after bad in maintaining the aged dams; start the process of restoring the along the Snake and Columbia by restoring the salmon and the creatures that depend on them.
Christine	B.	NC	28056	
Patricia	Hine	ID	83843	
Barbara	Wallesz	WA	98229	
evan	boone	CA	93950	
JOHN	ARMSTROMG	CA	95765	Building the 4 deadbeat dams gave a lot of good employment to people. That's about all they did. Now they should provide good employment for a lot of people getting rid of them!!
H Lynne	Haagensen	ID	83871	It's time to value our natural ecosystem.
Jette	Morache	OR	97707	Please take this important step for now while working to reconnect free flowing stretches of the Columbia River system, allowing

				ecosystems to heal and support life.
RAFAEL	PACHECO Vazquez	WA	98012	
Josue Isai	Garcia	WA	98121	
Donna	Bradberry	ID	83843	We need to see steps taken on these dams to increase the flow rate now. We need to protect the wild Salmon run for Idaho and for the Orcas.
Donna	Bradberry	ID	83843	Let's do it! Restore NW rivers and bring the Salmon count up! Now
Linda	Castell	WA	98232	Give Orcas a chance- bigger spills for the salmon!
Alison	Cable	WA	99352	
Susan	Malone	NM	87107	I live part time in Idaho and totally enjoy my timer recreating along the rivers. Please protect the salmon the orcas and all other Marine creatures who depend on free flowing Rivers. Thank you Susan Malone Albuquerque New Mexico
Joe	Thompson	ID	93843	
stephanie	smith	WA	99210	
David	Barber	ID	83843	
Terry	Friedman	NJ	07645	
Philip	Kritzman	IL	60646	
Margaret	McCulley	CA	95060	
Roy	Ferguson	CO	80017	
Lawrence	Magliola	WA	98382	
jim	prince	WA	98368	
Janet	KewleyAdam	ot	KY8 3AP	
Erin	Barca	CA	94583	
DAVID	GAENICKE	WA	98368	Please take this important step to increase the salmon population for the benefit of all fish and mammals.
Crista	Worthy	ID	83714	
Edward	Bielaus	MD	20852	
David K	Sias Jr	ID	83333	
Bill	Holt	TX	78736	
Gary	Cook	OR	97405	
George	Ben	AK	99705	
Tracy	Kessler	WA	98146	
Hilary	Bates	MT	59833	Free the Snake!!!
Brad	Staples	OR	97068	

jonette	bronson	CO	81435	These whales do not deserve to starve to death.
Pam	Olsen	NY	11793	If we don't start improving our water quality now-when?? When there are no fish left?
Beth	Stanberry	NC	28802	
Richard	Johnson	WA	98227	
John	Walton	CA	95445	
Michael	Aldridge	TX	78029	
Joshua	Kolasch	WI	53570	
Robyn	Ingram	OR	97405	This is one of the most critical issues facing us. Do the right thing
Barbara	Bennigson	CA	94301	
Gary	Grube	CA	94588	
Steven	Netkin	CA	92586	
Chris	Stay	WA	98020	
Linda	Becker	OR	97035	
Liz	Schotman	OR	97031	
Rebecca	Rose	WA	98155	
David	Duncan	MT	59847	
Annie	Roberts	WA	98070	
Murrell	Johnson	VA	24426	Please let the rivers flow naturally. Don’t hinder the salmon.
Courtney	Kahler	TX	75402	Action is needed now!
Bianca	Perla	WA	98079	While there are many long-term options to help salmon and orca recovery there are very few short term practical options that will stay the gap towards extinction before long-term actions mature enough to have benefit. Increasing spill over the dam is one of these critical and extremely important short term actions. Please increase spill and give time for the more longer-term actions to kick in.
Randall	Collins	WA	98119	
CHRIS	BATTIS	WA	98225	
Reverend jane	Eagle	CA	95444	Your legacy will be their extinction unless you act NOW.
Lawrence	Hill	WA	98856	
Stacey	Bradley	PA	16646	
Alice	Bowron	MN	55405	
Michael	Cochran	WA	99031	
Kaylee	Andrews	WA	98119	Please do the right thing and help preserve what we have left.
Miguel	Ramos	WA	98248	
Mike	Brinkley	OR	97405	
Jim	Hanley	CA	95407	
Katherine	Ransel	WA	98120	

Gregory	Topf	WA	98116	
Bill	Erickson	OR	97219	
Deborah	Rossum	AZ	86351	
Robert	Kephart	MT	59802	
Susan	Hittel	NY	10024	
Grant	Wiegert	AZ	86023	Considering the other challenges salmon will face because of climate disruption actions like raising the dissolved gas standards to 125% is a reasonable solution to helping wild salmon. Grant Wiegert
Christopher	Aamot	CO	80304	
Manuel	Camacho	WA	98012	
Marc	Fleisher	ID	83843	Please excuse me if this is the second time signing. The issue is too important. Salmon are sacred. We must do all we can to protect them.
Joshua	Pearlman	MB	R3L 2G2	
Pamela	Johnston	NC	28763	
Whitsitt	Goodson	OR	97233	
Rob	Snowhite	VA	22032	
Jacob R.	Raitt	CT	06605	I am always astonished at the ease by which the human race acts to destroy its ecology and environment. All that I can say is go ahead. Destroy the salmon while destroying the waters. Lose the Orca, and totally dismember the natural evolutionary path of the planet Earth.
Shirley	Blaschke	OK	73112	
Linda	Wright	WA	98121	
Jerry	Myers	ID	83466	We live upstream and are directly affected by decisions related to anadromous fish made by Washington. Spill has been identified as the single most important action that will have immediate positive outcomes for Idaho's ESA listed Snake River salmon and steelhead. We strongly support TDG standards to be increased to 125%. Thank you. Jerry and Terry Myers
Richard	Gill	TX	78212	
Laura	Long	IL	60616	
ROY	OSHITA	CA	91755	
Taylor	Kim	CA	91755	It's important to me that the salmon of the PNW stay accessible and healthy, for my generation adn the future. Please protect our own health and the health of this ecosystem

Dan	Brissenden	UT	84117	
gene	chorostecki	NM	87507	
Jessica	Lunt	NY	12498	
boel	greenberg	CO	80302	
Jeanne	Hyde	WA	98250	Please help the salmon recover. What this river system once was, it needs to be again, and that is a healthy system for salmon survival and recovery.
Kathleen	White	WA	98103	
Brian	Gibbons	MD	20770	
Kate	Kenner	VT	05301	Dams are unnatural and too often detrimental to wildlife . It is because of people orcas are starving thus it is put to people to change that by increasing that dam spill. Animals suffer already from the actions of our own species and all that can be done to help them should be done..
Rob	Switalski	WA	98177	
JIM	HEAD	MI	48237	
Mike	Mahony	OR	97914	
Sandy	Zelasko	CA	92082	
Anne	O'Leary	WA	98070	
Karen	Benson	WA	98225	
Kjersten	Gmeiner	WA	98125	
David	Jaffe	OR	97225	
Mark	Blitzer	WA	98117	Both the salmon and the orca are icons of the Puget Sound. Let's do all we can--while there is still time--to save both. We can do this!
Jacob	Meyer	OR	97239	
Kevin	O'Halloran	WA	98103	
Sally	Hurst	WA	98144	
thomas	letteri	MA	01741	
David	Mierkey	CA	95209	
Sarah	Delerm	CA	94114	
David	Hopkins	CA	94530	
Larry	Franks	WA	98027	Increasing spill is a start on mitigating the impact dams have had on the Columbia River watershed, and then the salmonids. Please make this happen. Larry Franks, BS Fisheries (Salmonid Culture) UW 1979
Jill	Sanoff	CA	92118	
Nancy	Uding	WA	98125	
Jennifer	Nelson	WA	98133	
Edward	Schmitt	AK	99669	
Sarah	Harbert	WA	98103	
martin	chamberlin	FL	34134	

Francis	Schwinger	WA	98146	
Sarah	Hafer	WA	98684	
R. A.	Larson	WA	98274	
Justin	Keesler	WA	98116	
Mark	Rose	OR	97339	
Richard	Spotts	UT	84790	
Victoria	Peyser	DE	19711	
Aleks	Kosowicz	WI	54843	
Erinn	Carey	WA	98335	
James	Long	FL	33461	
Justin	Keesler	WA	98116	
Christopher	Craft	CA	92124	
Georgeanne	Samuelson	OR	97463	
Barb	Andersen	WA	98133	
Rich	Deline	WA	98392	Rich Deline. Bainbridge Island
Sandra	Wilson	WA	98250	
Chris	Drumright	TN	37130	
Dr. E.	O'Halloran	WA	99208	
Richard	Harrington	OR	97045	
Rebecca	Muzychka	FL	33304	
Christina	Dubois	WA	98013	Please do everything in your power to protect salmon runs and orca populations. TIME IS RUNNING OUT FOR THE ORCAS!
Debbie	Rose	WA	98133	
Rylie	Sedustine	WA	98116	
Kelly	Riley	PA	19440	
KEITH	KLEBER	AZ	85743	
James	Wheelwright	WA	98052	
Peter	Von Au	MA	02464	
Thom	Peters	WA	98290	
Phyllis	Farrell	WA	98104	
Randall	Lindstrom	OR	97330	
John	Boyce	NJ	08829	Please restore water into the stream and save salmon and orcas.
Chris	Moore	VT	05055	
Shelby L.	Hood	TN	37064	
Marilyn	Scott	IL	60615	
John	Devoe	OR	97204	
Reese	Bender	OR	97411	
Walt	Ricker	WA	99224	

Kristin	Mahlen	AK	99006	I have commercial fished in Alaska for 9 years. One major difference between the rivers there and the rivers in Washington is that the rivers in Alaska are mostly undammed. Let's bring back the economy of salmon to Washington state. Healthy, resiliant salmon runs support healthy, resiliant communities. While we wait for the Snake River Dams to be breached, let's protect the last runs of real wild salmon by increasing spill rates over the dams when the smolt are coming down the river.
Lois	Yuen	CA	94707	
Anthony	Terranella	WA	98144	
Dan	Lombardo	WA	98404	
Zac	Kauffman	OR	97535	
Carl	Clemons	OR	97055	
Dave	Groves	WA	98501	Please do the right thing
Charles	Ballard	WA	98198	
Nell	Nieves	NY	10803	
Linda &	Crayton	WA	98070	Please do what it takes to protect our Sound.
Rodney	Badger	OR	97520	With plans in the works to bring more oil pipelines to the coast, there will even more threaats to the orcas from tanker traffic and oil spills. They orcas will need robust health and a reliable food supply to withstand these threats.
Brad	Nelson	CA	93035	
Patrick	Gallagher	NY	12946	
John W.	Barto	NH	03263	
Jon	Lund	OR	97401	
Brad	Acker	ID	83703	
Patti	Berg-Dickthiel	WA	99224	This is so important; please support!
Donald	Stuart	WA	98070	
Kathe	Garbrick	KS	66503	
Barbara	Orr	WA	98499	
Barbara	Orr	WA	98499	
Meryl	Pinque	ME	04401	
bruce	hirayama	CA	90034	
Chris	Salp	WA	98589	
Ben	Rall	WA	99202	
Christeen	Anderson	FL	32539	
Judith	Maron-Friend	OR	97220	THE MORE WE INTERFERE WITH NATURE THE MORE ALL CREATURES, WHO INHABIT THE PLANET, SUFFER! IT IS INCUMBENT UPON US TO RIGHT THESE INIQUITIES!!!

Jack	Stewart	WA	98070	
conrad	hohener	CA	92705	
Sharon	London	WA	98115	
Marie	Sprancel	WA	98365	
Willem	Broekhof	WA	98125	
Barbara	Wallesz	WA	98229	
Scott	Grunden	WA	98023	The recommendation this month by Canada's government to expand The Trans Mountain pipeline, in spite of the impact on the southern Orca population, is unbelievable. In a Seattle Times article on 2-22, we are informed that: "The project will likely harm endangered southern resident killer whales, increase greenhouse-gas emissions that worsen the impacts of climate warming, and could cause oil spills that would be damaging to the environment, the board found" The project would increase tanker traffic in the Salish Sea from about six tankers per year to more than 400. It's well proven that ship noise confuses the Orcas in their search for food. However, the more-than-700-mile-long pipeline should be approved by the government anyway, the board found, because it is in Canada's national interest. What about the Orca's interest, and their survival? Please take this step, which is something we can do NOW without huge expense and bureaucratic bickering.
Paul	Sanborn	NH	03224	
Ryan	Shopay	CA	91364	
Astrid	Winters	ot	5628DG	I am from the Netherlands so the care for these animals reaches far. Please help these orca's. They are on this planet before mankind help them please
Blaine	Ackley	OR	97124	
Barbara	Aronowitz	ID	83455	
Alix	Keast	NY	10025	
Lela	Perkins	WA	98208	
Charles	Hammerstad	CA	95120	
ERIC	POLCZYNSKI	CO	81147	
Jesse	Gore	TN	37206	
Vivian	Gross	WA	98034	
LYNDA	ERICKSON	WA	98053	

Shari	Grounds	HI	96734	
Paul	Mopps	WA	98304	Free the Snake, remove the dams.
Joy	Wang	WA	98006	
Jayne	Wallingford	AK	99517	
Aimee	Roos	CO	80015	
Marianne	Nelson	OR	97202	
Lee	Taiz	CA	95060	
Langdon	Cook	WA	98118	
Tom	Crumbaugh	NC	27516	
David	Winters	WA	98368	Remove the Snake River dams
Monica	Gilman	OR	97024	
jack	cohen	FL	33411	
Anthony	Donnici	MO	64068	
Jay	Humphrey	OR	97023	
Marybelle	Hollister	MA	01945	
M J	Caputo	WA	98105	
Coral	R.	BC	V8V4L 4	
Todd	Ferguson	WA	98031	
Maureen	Vaughn Castaneda	WA	98038	Breach the Snake River to save our Salmon
Diane	Sullivan	WA	98277	
Pamela	Haas	SC	29909	
Matthew	Kane	CA	94116	
Diane	Sullivan	WA	98277	
Steven	Brown	WA	98070	
Gerry	Milliken	AZ	86326	
Art	Chippendale	WA	98070	Loss of Chinook has been devastating to the Orca. Loss of the Orca will be devastating to Washington State.
Andrew	Dopieralski	WA	98106	
Melanie	Nakashima	WA	98250	
Ian	Shelley	OR	97225	
Pamela	McMahan	WA	98070	
Donald	Greer	CA	94070	
Amanda	Carman	WA	98119	
Michael	Hughes	CA	94507	Removing the damns will benefit all. Michael J Hughes
Richard	Bertellotti	OR	97123	
Kay	Novak	OR	97333	
Elaine	Packard	WA	98122	

Michael	Garcia	MT	59715	The health now and even more so in the future is critical to all our waterways. I travel all of North and South America and what we still have and need to protect is so precious that we have do all we can to improve the quality of our Environment and our waterways and now we have the technology to make it happen. Stop the GREED conserve all we can by acting now!
Penelope	Campos	WA	98146	
Cyntahi	Logan	VA	24210	
Christoph er	Rimple	WA	98166	
Susie	Schaefer	WA	98020	
Leonard	Elliott	WA	98002	
Michelle	MacKenzie	CA	94025	
Steve	Baker	OR	97034	
Erwin	Bol	CA	94506	
Phil	Lansing	ID	83712	
David	Strahan	OR	97526	
Darran	Bornn	CT	06785	
Jamison	Cavallaro	OR	97206	
Sarah	Bauman	NE	68502	
Joan	Pool	WA	98020	We must increase “spill” to 125% Total Dissolved Gas Standard at the federal dams on the lower Snake and Columbia River dams starting now, in 2019. We must engage stakeholders for solutions involved with removing the four lower Snake River dams. Breaching the four lwr dams on the Snake reopens vast historic habitat for critical salmon runs. This needs to be happening as soon as this year.
RODNEY	Hefley	WA	98632	
Garrett	Minky	WA	98101	
Robin	Schaef	PA	16327	
judith	hazelton	VT	05201	
William	Mattson	CA	94580	Take the dams out and restore the salmon runs so there are enough for man and beast!
jackie	eldridge	FL	32211	
David	Dunneback	WA	98112	Let’s do this! Thank you
Dakota	Bauman	WA	99204	
Claire	Cohen	OR	97034	
Todd	Daniels	WA	98956	
Tim	Womack	WA	98008	
Jenny	Fagan	OR	97756	
Kathleen	Corby	NY	12567	

Kay	Foster	OH	45013	Please, please take action to save the orcas. I was in Alaska this past July and saw only one orca during the trip down the Inside Passage. Thank you.
Fritz	Nichols	WA	99224	
Gilly	Lyons	OR	97211	
Mark	Tilschner	WA	98290	
Elise	Adibi	PA	15217	
Paul	Hunrichs	CA	92071	
Gregory	Fitz	MN	55406	
Katherine	Owens	ID	83404	This must be done!
Jennifer	Lutz	WA	98021	I've commented extensively on this! Without increased spill, we cannot hope for increased salmon runs and therefore cannot hope for restored health to the orca population. The time is long past - ACT on this please!
Cheryl	Ritenbaugh	OR	97135	
Art	Bogie	WA	98221	
Timothy	Devine	CA	94544	
Rob	Bignall	OR	97140	
Mary	O'Farrell	WA	98282	
John	Jagosh	OR	97223	
Anton	Feokhari	NY	11229	
	Schwartz			
Ethel	Bock	NY	10023	
Lynne	Oulman	WA	98225	
Derek	Gendvil	NV	89117	
Sarah Alexander	Nunn	OR	97402	
Dan	Sherwood	OR	97214	
Jessica	Lippert	ID	83704	
Cliff	Stolk	WA	98109	
George	Thomas	WA	98126	
John	Huntsman	WA	98282	
David	Pilkenton	WA	98247	
Pierre	Wolfe	WA	99163	
John	McKean	CO	80524	
Michael	Lampi	WA	98008	
Terrill	Chang	WA	98166	
Ashley	Martens	ID	83843	Salmon survival represent the Northwest's commitment to the Earth. Please take actions to protect them now.
margaret	shermock	MN	55315	Save our natural environment.
MaryJo	Fontenot	WA	99362	
Terrance	Otto	OR	97055	Step up and do what is best for the fish
Gary	Geis	WA	98604	

Paul	Vesper	CA	94703	
JL	Charrier	MN	55391	
Anthony	Carr	IL	60490	We want to return to see these majestic creatures so our tourism dollars matter!
Brian	Carter	OR	97058	
Chris	Lima	ID	83544	
Tom	Hughes	WA	98070	
William	Anderson	PA	19072	
Chris	Rask	OR	97086	
Ted	Eisele	ID	83703	
will	patric	WA	98368	
William	Hutchings	AL	35213	
Doug	Rhodes	MT	59937	
Ken	Mundy	CA	90068	
Mike	Seyfried	NV	89005	
michael	miller	WA	98002	
Stephen	Hauschka	WA	98195	
Maria Sol	Caro	CA	91103	
Christopher	Schlansker	WA	98119	
DANIEL	MCDONLAD	WA	98903	
Marilyn	Hill	MT	59716	
Tom	Me	OR	97225	
Lissett	Tschenscher	BC	V3H0E1	
Joseph	Gilman	NY	10310	
Lisa	James	CT	06704	
David	Edwards	WA	98506	
Chris	Cottrell	WA	98136	
Ramsay	Kieffer	DE	19952	
David	Edwards	OR	97404	This expresses my feelings exactly!
Gary	b	CA	93401	
Steven	Kerrick	OR	97206	
Wayne	Heckman	CA	95482	
Ben	Basin	OR	97214	
Lane	Lindberg	WA	98368	
Aaron	Sullivan	OR	97078	
Genia	Moncada	WA	98119	Time is running out. Let's do this now along with ongoing measures to save salmon, orcas, and the ecosystems that support us all. Every step counts!
Sandra	Joos	OR	97239	
Rebecca	Chadwell	WA	99207	
Richard	Jackson	VT	05482	
Anna	Gullickson	WA	98815	

Michael	Garten	WA	98103	
Frank	Loyd	OR	97054	
Genevieve	Williams	WA	98106	
David	Graves	WA	98115	
Joan	Weiner	CA	94960	As a registered Dietitian, no longer recommending or even writing menus with Salmon until this issue is resolved in favor of a more natural balance, us living with nature.
Diana	Hall	CA	94041	
Karen	Springer	OR	97225	
Elizabeth	Tuminski	CT	06907	
andrew	reimer	NY	13329	
andrew	reimer	NY	13329	
RAYMON D	BINNER	CA	95949	WTF
Kate	Cox	OR	97103	Please maximize spill in order to save orca from extinction.
Jenny	O'Neill	WA	98532	
Michael	Denton	CA	94578	
Michele	Cornelius	CA	96039	
Chris	Robertson	NV	89509	
Ronald	Spies	OR	97341	
Janet	Casey	WA	98221	
James	Casey	WA	98221	
Laurie	Gogic	WA	98034	
Thomas	Hester	OR	97015	
Pam	Clark	CA	94558	
Mal	Gaff	CA	93436	
barbara	echo	WA	99224	Please take steps to improve this situation.
Marni	Hougham	MN	55127	
Philip	Eisenhauer	WA	98007	
Bridget	Shore	WA	98070	
Chad	Price	OR	97007	It’s time to start putting the needs of Salmon and Orcas ahead of short sited human desires.
April	Smith	WA	98368	
Michele	Bogaard	DC	20009	
Karen	Borgardt	CA	95765	I love the Orcas
Lawrence	Crowley	CO	80027	
cynthia	thompson	OR	97222	The current status of not one but three species, salmon, steelhead, and Orca's, should point to a red flag for the condition of river flows and tailrace TDG as they are needed for survival of these species. Do the right thing and increase the flows, raise the tailrace TDG.
Kenneth	Ryan	ID	83201	
Kathleen	Daviscourt	WA	98043	

Susan	Heywood	WA	98408	
Diana	Hall	CA	94041	
Zach	White	OR	97526	
Edward	Vanover	NY	12309	Edward Vanover Guelph, Ontario, CA
s	smiths	IN	46703	
Sara	King	WA	98092	
Mary	Shannen	NM	87111	
Steve	Noble	WA	98249	
Dale	Ballard	OR	97038	
Rebecca	Sayre	WA	98177	The Columbia River system us the main arterial of the Pacific Northwest riparian system - it used to produce the most prolic runs in the world. Our orca are starving and uncreased spill is a small step towards allowing more Chinook to return and feed them. I believe that, ultimately, given the reduced need for emergency power, the increased rail transport and the fact that the dams are falling apart that they are long-past due being taken out. Increased spill is, literally, the least you should do. Your action is needed now.
Luan	Pinson	WA	98664	I would like to see the 4 lower Snake River dams breached.
Viki	Nadol	OR	97034	
Rhonda D.	Wright, MD	GA	30319	
Sally	Wolf	WA	98112	The orcas are hungry. We know how to get food to them. It's time to breach the 4 dams on the Lower Snake River.
Roger	Rankin	ID	83201	Please please save the Salmon1
Richard	Hieber	None	87700	
MaryAnn	Linehan	PA	19087	
Lindy	Marrington	CA	93921	It is long overdue that we protect our waterways and all the inhabitants who dwell there.
Leslie	Raphael	WA	98271	
Tim	Quirante	HI	96839	
Tiffany	Jones	WA	98112	Please save our Pacific Northwest native heritage and preserve our salmon and orcas
Scott	Rainey	OR	97206	
Theresa	Digiannantoni	OH	43230	

Madeline	Buss	OR	97124	We demonstrate our character and values by how we treat those we have power or control over. I grew up in love with the Southern Residents, and I want to be able to tell people that we as a state or culture are willing to protect these animals.
Daniel	Drais	WA	98103	
Robert	Lawrence	WA	98012	
Edward	Dombroski	VT	05465	
henry	sanchez	CA	93023	
Earl	Huff	OR	97846	
Pat	Hanbury	NV	89506	
Tom	Boniello	OR	97113	
Dan	Esposito	CA	90266	
Bill	McMillan	WA	98237	
Virginia	Douglas	OH	44035	
Eowyn	Grecco	GA	30582	
Julie	Whitacre	WA	98226	
John	Harkins	OR	97525	
Janette	Wells	OR	97702	
Thorly	James	WA	98166	Also, please fully fund shovel ready projects like those on the PSAR list, and do whatever it takes to breach the lower four Snake River dams this year, before it's too late. Extinction is forever.
Penny	Blubaugh	IL	60646	
Sharon	Blakney	PA	18224	
Richard	Foley	WA	98008	Keep up the good work to save both salmon and orcas. Richard Foley
Ernst	Mecke	ot	00150	
Christopher	Bidwell	CO	80403	Salmon are a good indicator of the health of a river. Healthy rivers are necessary for us humans for drinking and crops as well as the entire ecosystem that keeps our environment good for us.
Ben	Bama	WA	98250	
Michelline	Halliday	WA	98250	
Daniel	Soulas	AK	33200	
Doris	Warnstedt	ot	50996	
Jenny	Trebing	WA	98296	
Paul	Smith	IL	60047	Please take action!
Stephen	Oder	OR	97330	
Christine	B.	NC	28056	
Monika	Wieland	WA	98250	
Robert	Teister	WA	98053	let's release more salmon for the orcas and keep working on dam removal.

Carol	Storthz	AR	72202	
Kim	Loftness	WA	98155	
Deborah	Carbery	MT	59047	
STEPHANIE	MCLAUGHLIN	HI	96789	
Chaplin				
Kraig	Belz	OR	97218	
T.R.	Speer	WA	98177	
Jo Anna	Hebberger	IA	50312	We must do all we can to keep our ecosystems healthy. Without healthy, functioning ecosystems, life on this earth as we know it will cease to exist.
Sandra	Ciske	WA	98116	
Shannon	Markley	WA	98103	
Sammy	Low	WA	98292	
John	Equitz	CA	90803	
Lou Anne	Gwartney	ID	83616	Saving our free flowing rivers, will save our fish, which we know will have a large impact on whole ecosystem
Dennis	Biggins	OR	97124	
Sarah	Lincoln	VT	05473	
Michael	Koler	OR	97267	
Mona	Young	MA	01257	I have been an avid supporter of all things related to saving our planet since April 1970 when I attended the first Earth Day in New York Cities' Central Park !!!

WA Dept. of Ecology's Draft EIS and Short-Term Modification to Total Dissolved Gas Criteria for WAC 173-201A

Oral Testimony from Liz Hamilton, on behalf of Northwest Sport Fishing Industry Association

Received February 13, 2019

My name is Liz Hamilton and I have the good fortune of being the executive director for Northwest Sport Fishing Industry Association. In full disclosure, we are one of the petitioners for a change to the gas cap levels. We asked for 125 and we ask for the four-bay to be removed as a monitoring standard.

Here in Washington State, the sport fishing industry employs over 15,000 people in service of almost a million anglers, 950,000 license holders and we generate over 2.4 billion in economic output. 200,000 of these individuals buy an extra endorsement in order to fish in the Columbia River. And when you combine that with the Oregon endorsement, it is almost 400,000 people who interact in this basin with fish, salmon and steelhead. But things have been extremely tough for our industry for several years now. We had a drought in 2015. There was a blob off of most of the coast that persisted into '16. Ocean conditions overall have really created a nightmare legacy that persists for today.

This year Columbia River salmon and steelhead are predicted to return at roughly 50 percent of the 10-year average, which is devastating for communities that rely on fishing and is contributing to the dire plight of the southern resident orca.

We know we can do more to turn things around and we appreciate the Ecology's consideration of modifying the gas standard to 125. I'm going to keep saying 125, Heather.

I served on the Governor Inslee's task force prework group where we learned of the critical role the Columbia River spring Chinook play as a food source to southern residents. Fat-laden spring Chinook are one of the only Chinook available during the winter when orca are traveling and/or pregnant. Not surprisingly, they are known to do circles off the mouth of the Columbia River in late February through April when the springers are staging to enter the river. Our prework group had a lot of discussion around this and we landed at 125. I didn't see it on the screen, but that's where we landed from the prework group as a way to increase this source for the orca.

So given the status of salmon and steelhead (inaudible) and the orca, our businesses -- in our businesses we are disappointed in a spill agreement that just made a tweak this year. I mean, basically just removing one of the monitoring standards is a tweak. At a time when the Governor asked us to be bold and when the Governor puts a 1.2 billion dollar budget out for orcas, we really wanted to see more than a tweak.

Decades of empirical data modeled by CSS said if we went to -- if we went to 125 24/7, we could see a two-and-a-half fold increase in the return of spring salmon to the basin. That's bold.

Gas level trauma in salmon is sampled throughout the spring outmigration and anyone can look at this data on FPC website. And what I have seen from looking at it over the years is that you don't see any of the action criteria met as long as you stay under 125.

So we are appreciative of the region's effort to change the total dissolved gas standards to provide better protections for salmon and steelhead. We do object to the two-step standard and we are here to testify today that we believe that the standard should just be raised to 125 and not do it all again next year because we already know what the fish need. We already know they are in dire shape and we ask that we do it right now, so thank you. Appreciate the opportunity.

WA Dept. of Ecology's Draft EIS and Short-Term Modification to Total Dissolved Gas Criteria for WAC 173-201A

Oral Testimony from Sristi Kamal, on behalf of Defenders of Wildlife

Received February 13, 2019

Good afternoon, for the record my name is Sristi Kamal. I am a researcher with a Ph.D. in ecology and I'm the senior northwest representative for Defenders of Wildlife. It is a national nonprofit organization that works to protect and conserve native and imperiled wildlife species and their habitat and has over 1.8 million members nationwide.

Today I would like to take the opportunity to talk about the flex spill agreement among BPA, the U.S. Army Corps of Engineers, Bureau of Reclamation, the states of Oregon and Washington, the Nez Perce tribe, Bureau of -- on increasing the total dissolvable gas standards, or TDGs, by establishing a new spill regime over the water over Columbia and Snake river dams to benefit young salmon in their migration to the sea.

First of all, I would like to express our appreciation over the short-term modification to increase spill standards as the spill has proven to increase juvenile salmon revival to the ocean and increase adult returns. Defenders' focus on salmon and salmon recovery is especially because of its impact on the southern resident orcas. The decline of Chinook salmon populations in the Columbia basin and across the Pacific Northwest marine waters correlates strongly with the decline in orca survival and productive success, especially in the last several decades.

The orca population today is at a 30-year low with only 75 individuals remaining. Decades of industrial development on the rivers of this basin have made the salmon's journey much more difficult and in some case impossible. As dams slow the rivers, salmon population in the basin crash leaving this population of orcas without one of their most critical sources of food.

These dams and reservoirs kill as much as 70 percent of the outmigrating juvenile salmon and more than 15 percent of the returning adults. So as go the salmon, so goes the orcas, which is why I see this agreement as a significant positive step towards salmon and orca recovery.

This is one of the few things that the state can do to provide more salmon for orcas in just a few years. The more fish that are spilled, the more fish that return to the river as adults to spawn.

Adjusting TDG criteria to increase spill would also be consistent with the current recommendations from Governor Inslee's orca task force, may help harmonize water quality standards with Oregon. We are also looking to increase the TDG to 125 percent. And could simplify the U.S. Army Corps of Engineers' implementation of the spill program at its federal dams on the lower Snake and Columbia rivers.

Finally, while the current agreement is a much needed positive move in the direction of salmon and orca recovery, it begs the question of why the agreement didn't aim for 125 percent in 2019 instead of waiting for 2020. Given the recent deaths and the urgency of orca situation, it is critical we do as much as we can and as soon as we can.

Latest science has also shown this our original TDG standards are overly conservative and that we can get to 125 percent without impacting fish and other wildlife.

Additionally, as we embark on this three-year agreement, I urge you to plan ahead and think necessary actions in these three years that will ensure that the standards stay at this level beyond the three years and that both salmon and orcas have a fair chance of survival and recovery in the Pacific Northwest for present and future generations of Washingtonians and Oregonians.

Thank so you much for your time.

WA Dept. of Ecology's Draft EIS and Short-Term Modification to Total Dissolved Gas Criteria for WAC 173-201A

Oral Testimony from Ninette Jones, on behalf of the Sea Lion Defense Brigade

Received February 13, 2019

Thank you for allowing me to come speak today. My name is Ninette Jones. I am with Sea Lion Defense Brigade.

I am in support of more spill over the dams to improve the outflow migration for juvenile smolt. What we know is that predation is the highest as juvenile smolts are pushed downstream to their ocean habitat. So what we know that behind the dams are full of walleye, bass, shad, pike minnow, yellow perch, all these nonnative fish -- excuse me -- excluding the pike minnow -- the nonnative fish that have been stuck there for sport fishing that now predate heavily on these juvenile smolts who are stuck in algae-filled warm, slack, lake-filled reservoirs, warm, algae-filled reservoirs behind the dam.

So increasing spill would push these -- aid these smolts who do not swim to the sea but rely on cold-flowing water to push them to the sea. That is my testimony.

WA Dept. of Ecology's Draft EIS and Short-Term Modification to Total Dissolved Gas Criteria for WAC 173-201A

Oral Testimony from Colleen Weiler, on behalf of the Whale & Dolphin Conservation

Received February 13, 2019

I am here on behalf of the Whale & Dolphin Conservation and you have my contact information as well on the sheet. Thank you for the opportunity to comment today.

Restoring salmon runs is important to many who rely on healthy salmon in the Pacific Northwest and also for the endangered southern resident orcas who rely upon Columbia basin salmon in the late winter and early spring.

These orcas are salmon specialists, particularly on Chinook, and one of the primary threats to this population is a lack of food throughout the range.

Increasing spill is an important component of increasing salmon survival through the eight dams in the Columbia and Snake rivers and adjusting the total dissolved gas criteria gives the Department of Ecology the flexibility to maximize salmon survival.

This action was recommended by the Washington Southern Resident Orca Task Force as one of the best near-term measures to increase salmon survival leading to better abundance for the orcas.

We support extending this action beyond the short-term modification to help salmon survival and request the timing be accelerated to raise the TDG criteria this year to 125 percent. Modeling shows that increasing TDG to the levels of 125 percent increase the small to adult return ratio significantly over the recovery goal of a minimum of two percent. And increasing juvenile salmon survival helps bring more adults back to the area to feed the southern resident orcas.

Thank you.

Dear Director Bellon,

Southern Resident orcas are one of the most endangered marine mammals in the world. The Chinook salmon populations these whales once relied on, particularly those in the Columbia-Snake River Basin, are just a remnant of their former levels, leaving these whales with far less food to eat. The Columbia and Snake river chinook were once the largest and most abundant salmon species anywhere on the west coast, providing Southern Residents with a critical winter food source at a time when there are few other salmon species available. The decline of salmon populations across the Northwest is complex, but the most significant factor is the degradation of salmon habitat--particularly the damming of rivers. Dams and their reservoirs slow adult and juvenile salmon migration, making them increasingly susceptible to predation and lethally warm water. Large reservoirs on the Columbia and Snake rivers make it difficult for young salmon to quickly and safely migrate to the ocean where they can mature into adults. A highly effective, near-term step we can take that addresses part of this problem is to increase the amount of water spilled over the federal dams in the Columbia Basin. Decades of scientific research and observation have shown that spill is the safest way for juveniles to migrate past dams and reservoirs to the ocean and that higher levels of spill result in larger adult salmon returns in subsequent years. For over two decades, Washington?s total dissolved gas (TDG) standards, which limit the amount of water that can be spilled, have been overly conservative and harmed salmon survival. The best available science suggests that eliminating the 115% forebay TDG standard as you propose and immediately increasing the tailrace TDG standards to 125% will maximize the benefits of spill without negatively impacting other species or the environment. Increasing spill to this level is estimated to result in hundreds of thousands more adult salmon, making spill one of the most effective near-term actions the state can take to provide more food for our starving orcas. More than 20 years of empirical data about the effects of dissolved gas on salmon support this conclusion. This data warrants raising TDG standards to 125%. Southern resident orcas are starving to death due to the lack of Chinook salmon. As a result, they are unable to find enough food to survive and successfully raise new calves. This situation requires an emergency response. I strongly urge you to increase the state?s TDG standards to 125% in time for the 2019 outmigration and through 2021 as well.

Sincerely,

Amelia Bryan	Selah	WA	98942
Angie Andersen	Kennewick	WA	99337
Beth Call	Walla Walla	WA	99362
Betty Dickinson	Yakima	WA	98902
Beverly Vonfeld	Yakima	WA	98908
Brenda Lewis	Chelan	WA	98816
Carol Rockstad	Wenatchee	WA	98801
Cherie Warner	Pullman	WA	99163
Cheryn Zimmer	Yakima	WA	98908
Christine Mullie	Winthrop	WA	98862
Christopher Smith	Richland	WA	99352

Clifford Ballard	Mattawa	WA	99349
Crystal Hultberg	Pullman	WA	99163
Darlene Maurer	Cle Elum	WA	98922
Dave Popoff	Colville	WA	99114
Dave Robinson	Curlew	WA	99118
David Benson	Pullman	WA	99163
Denee Scribner	Ellensburg	WA	98926
Diane Dishion	Pasco	WA	99301
Doug Swanson	White Salmon	WA	98672
Dr. James L. Rowland, Ed.D.	Pullman	WA	99163
Elizabeth Johnson	Stevenson	WA	98648
Fay Payton	College Place	WA	99324
Florence Harty	White Salmon	WA	98672
France Morrow	Yakima	WA	98908
Frank Valenti	Leavenworth	WA	98826
Gene Shaw	Clarkston	WA	99403
George Bedirian	Pullman	WA	99163
George Thornton	Oroville	WA	98844
Grant Mcfarland	Chewelah	WA	99109
Gretchen Anna Sand	Kennewick	WA	99336
Harvey Neese	Clarkston	WA	99403
Holly Hewitt	Walla Walla	WA	99362
J. Eggers	Addy	WA	99101
Jacob Meyer	North Bonneville	WA	98639
James Davis	Wenatchee	WA	98801
James Mcbride	Walla Walla	WA	99362
James Mulcare	Clarkston	WA	99403
Janet Lindsey	Kennewick	WA	99336
Javier Madrigal	Pasco	WA	99301
Jeffrey Joswig-Jones	Pullman	WA	99163
Jill LaRue	Cashmere	WA	98815
Jill Ungar	Ellensburg	WA	98926
Joann Zugel	Leavenworth	WA	98826
John Kus	Kennewick	WA	99336
Joy Gohl	White Salmon	WA	98672
Joyce Weir	Newport	WA	99156
Katelyn Scott	Wellpinit	WA	99040
Ken Zontek	Yakima	WA	98908
Lee Musgrave	White Salmon	WA	98672
Lisa Read	White Salmon	WA	98672
Malisa Deochoa	Pasco	WA	99301

Marie Colvin	Kennewick	WA	99337
Mark Johnston	Leavenworth	WA	98826
Mark Koehnen	Quincy	WA	98848
Mary Cahill	Ellensburg	WA	98926
Mary Jo Coblentz	Richland	WA	99354
Mary Jo Fontenot	Walla Walla	WA	99362
Mary Jo Wilkins	Kennewick	WA	99337
Max Archer	Yakima	WA	98908
Melody Beck	College Place	WA	99324
Michael Nails	Malott	WA	98829
Michelle Skylstad	Omak	WA	98841
Mike Goodwin	Richland	WA	99352
Miranda Joebgen	Chelan	WA	98816
Miranda Stoddard	Pullman	WA	99163
Pat Nordby	Winthrop	WA	98862
Patricia Raamot	Pullman	WA	99163
Patti Harter	Ephrata	WA	98823
Paul Franzmann	Walla Walla	WA	99362
Paula Mackrow	Carlton	WA	98814
Robert Schnelle	Ellensburg	WA	98926
Ruth Lewis	Newport	WA	99156
Sandra Robison	Richland	WA	99354
Sharon Walbridge	Pullman	WA	99163
Stacy Parker	Ellensburg	WA	98926
Stacy Lester	Bothell	WA	98011
Stella Day	Leavenworth	WA	98826
Susan Janelle	Walla Walla	WA	99362
Susan Riddell	Yakima	WA	98908
Terry Lockett	Yakima	WA	98907
Tim Durnell	Rice	WA	99167
Tim Lynch	Richland	WA	99354
Yolanda Sayles	Bellevue	WA	98006

Appendix C: EIS Scoping Comments

The State Environmental Policy (SEPA) Scoping process began on November 16, 2018, when Ecology issued a threshold determination of significance on the rulemaking actions. SEPA scoping is the process of soliciting input on a proposal to define the scope of the Environmental Impact Statement. Public notice of SEPA scoping was provided via the SEPA Register, Ecology's Water Quality Info ListServ notice, and on our website.

The comments received during the scoping process were considered as the agency identified significant issues, noted elements of the environment that could be affected, developed alternatives, and prepared the draft environmental documents.

Public comments were received through December 14, 2018. Ten public comment letters were received during the comment period. All EIS scoping comments are provided, in full, in this appendix.

Anonymous Anonymous

If higher levels of TDG are safe for fish and aquatic species, why aren't these levels acceptable for all similar rivers, lakes, streams in Washington? I.e. why is the scope limited to only the lower Columbia and lower Snake areas? Presumably, the current protection levels are in place based on sound science; what has changed? Has TDG research indicated the current protection level is too conservative?

Also, why is only one fish survival model being used for this analysis? The CSS is one fish model, but is not the only one in the region - isn't the purpose of NEPA to disclose anticipated environmental consequences to improve agency decision making? How will a partial biological analysis using just the CSS model align with the purpose of NEPA?

Whale Scout

Spill in the Columbia system is critical to juvenile survival for salmon that can help feed endangered orcas in the near term. The Orca Task Force has recommended this action which garnered broad support. Spill at levels of 125% dissolved gas will also improve water quality which has been a chronic issue in the system. We support increasing spill to levels of 125% and believe this is a vital step in protecting orcas.

Thank you

Defenders of Wildlife

Please find our comments in the attached letter. Please let me know if you have any issues opening the document.

Thank you,

Robb

Northwest Office
1402 Third Avenue, Suite # 930 Seattle, Washington 98101
tel 206.508.5474 www.defenders.org

December 4, 2018

Heather R. Bartlett
Water Quality Program Manager
Department of Ecology
Water Quality Program
P.O. Box 47600
Olympia, WA 98501

Comments submitted electronically

RE: Scope of Environmental Impact Statement for Short-Term Modification to Adjust Total Dissolved Gas Levels in the Columbia and Snake Rivers.

Dear Ms. Bartlett,

Thank you for the opportunity to provide scoping comments to the Department of Ecology (Ecology) related to the proposed short-term modifications to the state's total dissolved gas (TDG) standards. Increasing these standards will allow for more water to be spilled over dams on the Columbia and Snake rivers, both of which support critical salmon runs that southern resident orcas rely on. Ecology has an extremely important role to play in recovering these endangered orcas by reducing stormwater runoff, regulating emerging chemicals of concern, and increasing spill over these dams. Of these actions, increasing spill will provide the most immediate benefits to both salmon and orcas. Defenders of Wildlife (Defenders) strongly supports increasing the state's TDG standards to 125% to provide additional salmon for the southern residents in the near-term.

Defenders is a national non-profit conservation organization with over 1.8 million members and supporters nationwide, including more than 24,000 members and supporters in Washington state. Founded in 1947, Defenders is a science-based advocacy organization focused on conserving and restoring native species and the habitat upon which they depend. We have a long history of contributing to agency-led recovery for endangered species. This past year, our staff participated in the Orca Task Force's Prey Work Group, which helped develop the recommendation to increase the state's TDG standards. We have also worked with schools, cities, counties, and state agencies on programs to reduce toxic pollution throughout the Salish Sea, helping to recover orcas and the salmon they depend on.

As you know, southern resident orcas are one of the most endangered marine species in the United States. Without bold and immediate actions, they are likely to go extinct within our lifetime. While there are several factors that impact southern residents, the most limiting is a lack of their primary prey: chinook salmon. Years of industrial development on rivers in the Columbia Basin caused the precipitous decline and extirpation of salmon runs throughout the region. The large dams and warm, slackwater reservoirs on the Columbia and Snake rivers have made the salmon's journey much more difficult, and in some cases impossible. Juvenile salmon rely on natural, cold, free-flowing rivers to carry them safely to the ocean. As dams slowed the rivers, salmon populations in the basin crashed, severely reducing one of the orcas' most critical and abundant sources of food.

Historically, swift river currents in the Columbia and Snake river basins quickly carried smolts (recently hatched salmon) to the ocean, where they matured and migrated further out to sea. Slackwater created by dams has significantly increased the amount of time it takes for smolts to safely migrate to the ocean and increased their exposure to lethally warm water and predators (particularly invasive piscivorous fish). Spilling water over the dam spillways (instead of through turbines to produce energy) more closely mimics the natural flow of big rivers, like the Columbia and Snake, and delivers smolts more quickly and safely to the ocean. The more fish that are 'spilled', the more fish that return to the river as adults to spawn. Scientific research collected annually since the mid-1990s demonstrates conclusively that additional spill significantly increases juvenile salmon survival and subsequent adult returns (CSS, 2017).

Without spill, smolts are sent through dam turbines or elaborate bypass systems. These dams and reservoirs kill as much as 70 percent of the out-migrating smolts and more than 15 percent of the returning adults. Some smolts die further downstream as a result of cumulative stress and injury. The most recent and best available science suggests that the safest route over dams for smolts is through spill. Other strategies that involve handling and collecting juvenile salmon for transportation down river, such as barging, have been ineffective at meeting salmon recovery goals and in some cases introduce additional stress and mortality (McCann et al. 2016; Budy et al. 2002; Scheuerell et al. 2009, Van Gaest et al. 2011).

Washington's current TDG standards are outdated and no longer reflect the best available science. Recent increases in spill show that we have been overly conservative with our standards. The Comparative Survival Study suggests that increasing TDG standards to 125 percent would result in 2 – 2.5 times more adult chinook salmon returning than current levels (CSS, 2017). In the past, Ecology has expressed concerns that spill up to 125 percent would be detrimental to other aquatic wildlife. This concern is not supported by the most recent science. Data collected by McCann et al. (2017) between 1998 and 2016 found "no evidence that high TDG levels were associated with increased mortality rates or reduced survival probabilities" (CSS, 2018).

Increasing salmon runs in the Columbia Basin is essential to preventing the extinction of the southern resident orcas. During the winter and early spring, these orcas forage on chinook salmon from Cape Flattery to Monterey Bay. Historically, the Columbia Basin produced the most chinook salmon on the west coast, providing a large and critical source of food for the orcas over winter. Increasing spill over the Lower Snake and Lower Columbia dams would benefit seven of the fifteen most important salmon runs in the orcas' current diet (NOAA and WDFW, 2018).

This is one of the few actions that the state can take in the near term to increase the amount of salmon available to these orcas. Several recent studies have shown that management of freshwater systems can affect smolt-to-adult returns, even when taking ocean conditions into account (Schaller et al., 2013; Petrosky and Schaller, 2010; Schaller and Petrosky, 2007; Haesecker et al., 2012). Because the state cannot manage or change ocean conditions, the most effective tool managers have to increase adult returns (particularly in the near-term) is to increase spill.

We greatly appreciate your leadership to recover both salmon and orcas. Increasing spill in the Columbia Basin will further mitigate the impact these dams have had on endangered salmon runs and provide more food to orcas in the near-term. We look forward to providing additional comments on this proposal once the Draft Environmental Impact Statement is released.

Sincerely,

Robb Krehbiel
Northwest Representative
Defenders of Wildlife

References:

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NSIA

On behalf of the Northwest Sportfishing Industry Association, please see attached. Thank you, Liz Hamilton, Executive Director.

NORTHWEST SPORTFISHING INDUSTRY ASSOCIATION
Box 4, Oregon City, OR 97045
503.631.8859 www.nsiafishing.org

November 30, 2018

Director Maia Bellon
C/O Becca Conklin
Washington Department of Ecology
PO Box 47600
Olympia, WA 98504-7600
Via email: http://ws.ecology.commentinput.com/?id=x2M6a

Re: Short-term modification to adjust total dissolved gas (TDG) levels in the Columbia and Snake rivers. Scoping for DEIS

Director Bellon,

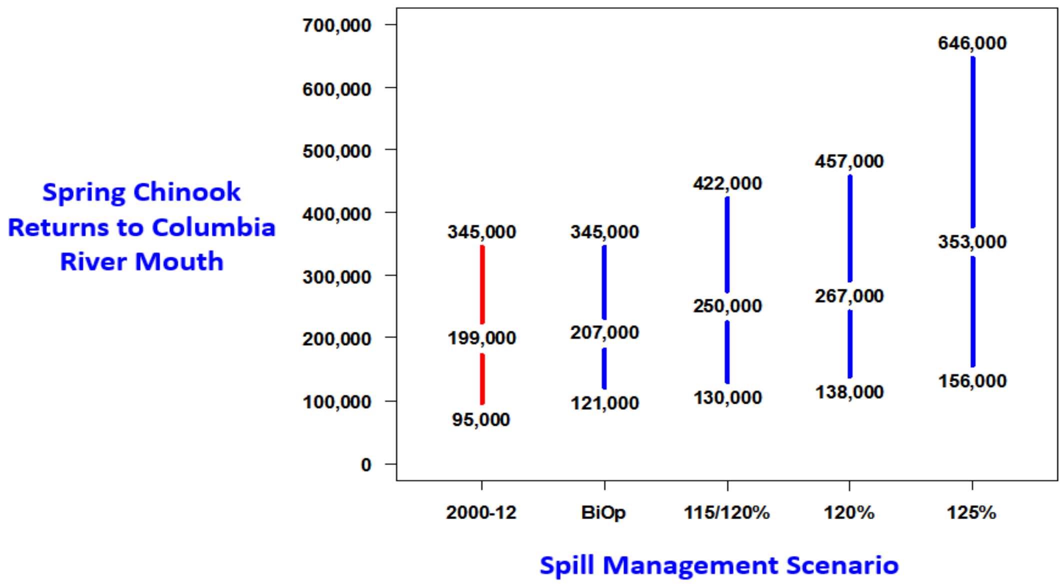
On behalf of the Northwest Sportfishing Industry Association (NSIA), thank you for the opportunity to comment on the scope of your draft Environmental Impact Statement (EIS), which will evaluate potential environmental impacts of a short- modification to adjust total dissolved gas (TDG) levels in the Columbia and Snake rivers. The NSIA consists of hundreds of businesses supporting thousands of family-wage jobs for which the Columbia Basin fisheries are essential to their success.

Specifically, Columbia River Spring Chinook, the primary beneficiaries of the additional spill requested by NSIA, are of critical importance because they are the first salmon of the year. As such, the spring chinook salmon fishery plays an oversized role in enticing nearly 400,000 anglers in Washington and Oregon to purchase an endorsement to fish in the Columbia. For these first salmon, our customers from Illwaco, Washington to Riggins, Idaho spend money to prepare their boats, motors and trailers, purchase fishing gear and licenses with endorsements and start a new year of fishing. Thus, a successful spring chinook season sets the table for a successful year for our industry.

To communities all along the river, Columbia River Spring Chinook are worth their weight in gold. According to the Washington Department of Fish and Wildlife, anglers on average spend over eight days fishing for every Spring Chinook retained. A 2009 study of Columbia River Spring Chinook fishing done by Southwick Associates, calculated that trip expenditures for this fishery weighed in at $115 per trip in 2006 dollars. ***In other words, for every Spring Chinook retained, $920 was spent on trip expenditures by anglers.*** These numbers do not account for boat, motors, trailers and durable goods. It is difficult to overstate the economic importance of Columbia River Spring Chinook to the sportfishing industry.

More recently, our region has learned of the importance of Columbia River Spring Chinook to Southern Resident Orca. SRKW circle off the mouth of the river in March when Spring Chinook are staging to enter the river. The fat-laden Spring Chinook nourish pregnant and traveling SRKW at a time when there are scant other chinook available. But, these spring chinook, so very valuable to communities and critical to Orca are in trouble. The 2018 adult return was the lowest since 2007, and the jack returns were the lowest since 2006, which bodes ill for next year.

Decades of extensive data gathered by the multi-agency, collaborative, Comparative Survival Study (CSS) has demonstrated that the best thing we can do short term to enhance the numbers of returning adult spring chinook is to spill to 125% total dissolved gas. There is no other single action that can be taken in the short term to bring back more salmon. Below is the graph presented to Governor Inslee's SRKW task force by the CSS Manager. It shows clearly the benefits in terms of increased spring chinook returns of allowing TDG levels of 125%.



It is NSIA's firm belief that WADOE must include an alternative that considers TDG levels of 125% in the dam tailraces with no forebay standard in the EIS you prepare. We fully understand that regional discussions are occurring that may decide to utilize a different total dissolved gas level in 2019. Developing, analyzing and considering a 125% TDG alternative will give the region's fishery managers an understanding of the trade-offs among alternative levels of TDG and allow a decision that follows the science. We believe that decision will be to adjust the TDG standards on a short-term basis to allow 125% TDG as it has been clearly demonstrated to provide the greatest benefit to salmonids. Governor Inslee asked us to be bold in our recommendations to increase prey and decrease threats to SRKW. We trust your scoping effort will lead to an EIS that will fully inform managers to you make this important decision.

We thank you for your time and effort on this matter of critical importance to salmon, steelhead, Southern Resident Orca and our industry.

In Service,

Liz Hamilton

Liz Hamilton, Executive Director
NSIA www.nsiafishing.org
503.631.8859

Seattle City Light

Please see attached comments from Seattle City Light.

Thank you,

Lynn Best
Chief Environmental Officer
Seattle City Light

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Seattle City Light

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December 7, 2018

HEATHER R. BARTLETT
WATER QUALITY PROGRAM MANAGER
WASHINGTON STATE DEPARTMENT OF ECOLOGY
PO BOX 47600
OLYMPIA, WA 98504-7600

RE: Scope of Environmental Impact Statement for Short-Term Modification to Adjust Total Dissolved Gas Levels in the Columbia and Snake Rivers

Dear Ms. Bartlett,

Thank you for the opportunity to comment on the scope of Ecology's draft Environmental Impact Statement (EIS) concerning the evaluation of potential environmental impacts of a short-term modification to allowable total dissolved gas (TDG) levels on the Columbia and Snake Rivers.

Seattle City Light (City Light) supports an experimental, temporary increase in TDG standards to facilitate testing the potential benefits of increased spill on smolt-to-adult return rates (SARs) and salmonid population recovery. However, we are also concerned that raising the allowable TDG level up to 125 percent may increase the proportion of juvenile salmonids and other native fish species that would suffer sublethal and lethal effects from gas bubble-related trauma. If TDG-related impacts are deemed unacceptably high during the experimental spill period, Ecology should be prepared to lower allowable TDG levels as appropriate to each river reach. There is a fundamental gap in understanding the tradeoffs between the deleterious population-level effect of higher TDG levels and achieving higher SARs for salmon and steelhead that more spill may enable. The Comparative Survival Study (CSS) reported that increased spill could increase SARs, yet the life-cycle model used did not incorporate the impacts of increased rates of stress and mortality due to elevated TDG levels. Furthermore, the CSS did not address ecosystem impacts resulting from elevated TDG levels, including gas bubble trauma impacts to aquatic invertebrates that represent the forage base for juvenile salmonids and adult steelhead. These impacts could have a long-term negative impact on SARs that are not addressed in the current modeling framework.

Specific to the scoping of the EIS, City Light believes Ecology should include an updated literature review concerning the impacts of TDG in the 120% - 125% range to all aquatic life. Ecology published a comprehensive review on TDG impacts on aquatic life in 2008 which formed the basis for the state's TDG criteria. We encourage Ecology to build upon the 2008 review by adding findings of new research and studies conducted over the last decade, including the results of the CSS modeling effort. This updated review will help develop a better understanding of the anticipated impacts of elevated TDG levels to juvenile salmonids and other aquatic life and provide a basis for developing additional research during the proposed flex-spill test period to fill gaps of knowledge.

During the three-year experimental flex spill period, City Light believes the opportunity must be taken to evaluate the complexities related to TDG effects and the ecological cost-benefit to salmon populations. We suggest the following studies be considered as part of the flex spill test period:

- Establish a study to quantify the immediate and delayed impacts of elevated TDG values on juvenile salmon mortality, integrating elements of the established body of literature to evaluate stress and mortality as they relate to duration of exposure.
- Compare the ecological cost of elevated mortality rates of juvenile salmonids due to increased TDG levels with the potential benefits of increased SARs while correcting for outside factors such as ocean conditions.
- Consider the importance of coordinating the timing of planned increased spill and the diel pattern of juvenile outmigration.
- Assess impacts to other aquatic life present in the affected portions of the Columbia and Snake rivers, including all life stages of salmonids, other native fishes, and important aquatic invertebrates.

Considerable debate remains over the primary factors determining SARs of Columbia River salmon populations and why wild Snake River spring Chinook salmon populations exhibit much lower SARs compared to other spring Chinook salmon populations lower in the Columbia River. We believe an experimental period allowing flex spill provides an opportunity to build consensus among researchers through the rigorous and objective monitoring and evaluation of elevated TDG levels.

Thank you again for the opportunity to comment.

Sincerely,

Lynn Best

Lynn Best, Ph.D.
Chief Environmental Officer
Seattle City Light

Northwest RiverPartners

Northwest RiverPartners's Comments on Scope of EIS For Short-Term Modification of TDG Levels in the Columbia and Snake Rivers

Northwest RiverPartners
For salmon, our economy and quality of life

December 7, 2018

VIA EMAIL

Becca Conklin
Washington State Department of Ecology
PO Box 47600
Olympia, WA 98504-7600

Re: Comments on Scope of EIS For Short-Term Modification of TDG Levels in the Columbia and Snake Rivers

Dear Ms. Conklin:

These comments are submitted on behalf of Northwest RiverPartners ("RiverPartners") in response to the Department of Ecology's ("Ecology") request for scoping comments on a draft Environmental Impact Statement ("EIS"). RiverPartners is an alliance between farmers, utilities, ports and businesses throughout the Columbia River Basin that represents more than 4 million electric utility customers, 40,000 farmers, thousands of port employees, and large and small businesses that provide hundreds of thousands of Northwest jobs.

Ecology is acting expeditiously in response to a request from the Columbia River Inter-Tribal Fish Commission, the Washington Department of Fish and Wildlife, and "non-governmental" groups including plaintiffs in the National Wildlife Federation v. NMFS, Case No., 3:01-cv-00640-SI (D. Or.), seeking to further relax the state's TDG water quality criteria. The purpose of the requested standards modification is to allow increased levels of spill that could produce up to 125% TDG at the tailrace of Lower Snake River and Lower Columbia River federal dams. For reasons outlined in this document below, RiverPartners has serious concerns about the waiver process and the merits of the requested modification and reiterates its request that there be a robust, transparent public process with comprehensive scientific review of the environmental impacts of the proposed waiver. RiverPartners further requests that Ecology extend the public comment period for an additional month to ensure adequate opportunity for stakeholders to submit meaningful comment.

Views on the "Flexible Spill" Proposal

RiverPartners is encouraged by the conceptual proposal animating the proposed standards modification. As we understand it, the proposal is to reduce spill during time periods when carbon-free hydropower is most valuable while also increasing spill during non-peak power generation hours. Given the adverse impacts of the ongoing Federal Columbia River Power System ("FCRPS") litigation, we appreciate the recent collaborative efforts of the states, Tribes and federal action agencies to get out of the courtroom and rally around an operational solution that is good for both the multi-users of the FCRPS and salmon. We appreciate the parties' recognition that it is in everyone's interest to develop a path that will keep BPA competitive so that the agency can continue to meet its statutory obligations to provide reliable, affordable and carbon-free energy to its customers, while funding fish and wildlife programs. We are concerned however that the "devil is in the details" because there is not yet enough information provided in Ecology's scoping document to determine exactly what is being proposed.

It is our understanding that this modified spill operation is due to begin in April of 2019 and continue until the spring spill period ends in June, and that such operations will continue annually for a period of three years. We understand that this proposal is guided by three principles. First, this operation must provide benefits for BPA that will help to preserve the agency's financial health and competitiveness. Second, the proposal will provide benefits for salmon and steelhead survival. And third, this proposed operation will eliminate the need for further litigation of the FCRPS Biological Opinion for the same period. As described more fully below, issues raised by this proposal have been the subject of contentious litigation pending in the District of Oregon Federal Court in *National Wildlife Federation v. NMFS*, Case No 3:01-cv-00640-SI (D. Or), and do not lend themselves to an "easy fix." Along these lines, we have outlined specific procedural and legal concerns below.

Procedural and Legal Concerns

The comment period is too short for adequate evaluation - The time period that Ecology has provided the public for the scoping process is inadequate. As you know, the level and timing of spill required at the federal dams in the Lower Snake and Columbia Rivers has been a very contentious issue in pending litigation challenging the FCRPS BiOp. RiverPartners has been deeply involved in these issues as a party to the federal litigation for the last 13 years. In addition, River Partners has been actively involved in water quality issues surrounding spill, including intervening **in support** of Ecology in past litigation to preserve Ecology's existing TDG WQS and associated "waivers."

According to the best available science from NOAA Fisheries, higher and higher levels of spill at all 8 dams does not significantly improve salmon survivals and is not justified as a blanket solution for all dams. RiverPartners does not support proposals that seek to increase spill, and thus TDG, at any economic and biological cost without a sound scientific basis. Modeling performed by NOAA of increased spill levels show little to no biological benefit from increased spill.

<u>There is a lack of clarity surrounding the process</u> - Ecology's proposed water quality waiver and scoping document consists of one step: analyzing flex spill operations up to 125% TDG beginning in 2019. RiverPartners has heard that the waiver process will occur in two steps: 1) continue federal hydrosystem operations to 120% TDG in 2019; and; 2) "test" flex spill operations up to 125% TDG in 2020 and 2021. We request that Ecology provide clarity about what operations are proposed to be covered by the wavier and when so that parties can effectively engage in the EIS process.

<u>The relationship to USACE waiver process is unclear</u> - The U.S. Army Corps of Engineers (USACE) water quality waivers for operating the federal hydropower system expire this month. The current TDG spill exemption includes a 115% forebay and a 120% tailrace requirement. Ecology's proposal would further increase the exemption to allow for even higher levels of TDG in the tailrace but are unclear about what levels, if any, will be required in the forebay. One component of the proposal would eliminate the forebay requirement, and another would eliminate both components to allow for as much as 125% saturation in the tailrace.

<u>The proposed waiver does not meet the state's standards for a "short term" waiver</u> - Ecology describes the TDG proposal as a "short-term" modification of WAC 173-201A-200(1)(f) (ii), and defines "short-term" to include up to three full years. Ecology appears to be relying on a regulation found at WAC 173-201A-410 entitled ("short-term modifications") as the legal authority for the water quality standard modification itself. But that provision defines "short term" as "hours or days rather than weeks, months or years." *Id*. While we understand that the proposal would allow a variation from the TDG standard for 16 hours each day, the proposed "flex spill" would occur each and every day for 16 hours during the spring months of April, May and part of June. The proposed "short term" increased spill level is then proposed to repeat over a period of three years. That lengthy duration is clearly not what is intended by the plain language of "short term modification" regulation established under WAC 173-201A-410. Accordingly, Ecology's legal authority for the proposed modification appears to be seriously lacking, and RiverPartners is very concerned with the potential precedent this may set for any future proceedings.

<u>Monitoring and metrics</u> - Ecology's scoping document needs to describe how the proposed operations and spill "test" will be monitored and what metrics will be used. A rigorous monitoring program is absolutely essential to gather adequate data to determine whether the waiver is being complied with, and whether migratory salmon and other biological communities are being protected – or harmed. Otherwise, the entire purpose of implementing a waiver to conduct "test" spill operations is undermined. Ecology also needs to make clear what metrics will be used to measure impacts of higher spill levels. Our understanding is that Ecology intends to use the Fish Passage Center's CSS modeling as the basis for the waiver and smolt-to-adult returns (SARs) as a key metric. As described more fully below, RiverPartners has serious concerns with the use of SARs.

Specific Issues or Analysis That Should Be Addressed in the EIS:

- Ecology should identify the biological basis for removing the compliance requirement provided by the forebay monitors. The scoping document states: "Modifying the TDG criteria as described may also facilitate alignment of TDG criteria with Oregon. By doing so, it could simplify implementation of the spill program by the U.S. Army Corps of Engineers." RiverPartners' understanding is the opposite: the USACE relies on Washington's forebay monitors to help control spill levels and impacts on fish as they pass each project. RiverPartners questions why the agency would want to monitor less of a known pollutant that can adversely affect salmon and other aquatic species.

- The impacts of increased spill on carbon emissions and climate change need to be analyzed. Washington's stated policy is to significantly reduce carbon emissions. The Northwest Power and Conservation Council ("Council") conducted an analysis of the impacts of removing the four Lower Snake River dams, "Carbon Dioxide Footprint of the Northwest Power System", Council Document 2007-15 (attached as Ex. A). The Council, modeled a scenario assuming that the Lower Snake dams would be removed, found that carbon dioxide emissions in the western power grid would increase by 4.4 million tons per year. In this study the Council also estimated the impacts of the summer spill program that was under court order at that time. The Council found that the summer spill program increased carbon dioxide production in the west by 2.4 million tons in comparison to a situation where the dams operate *without* summer spill.

- The EIS should include analysis of the impacts of increased TDG on the entire river ecosystem including other critical species such as lamprey, sturgeon, and the entire aquatic food web that salmon depend on.

- As previously noted, the waiver proposal states: "it relies on and will test" the FPC's CSS analysis to gauge anticipated fish benefits. The FPC's proposal to increase spill levels to 125% TDG was submitted to the Independent Science Advisory Board (ISAB) in 2014 for review (attached as Ex. B). The ISAB pointed out the proposal could result in higher juvenile mortality – not less. RiverPartners' understanding is that the FPC has not corrected flaws identified by the ISAB in its analysis, yet Ecology proposes to use it as the basis for the waiver.

Given the ISAB concerns, Ecology also should also evaluate changes in smolt survivals based on NOAA modeling of the entire lifecycle using the COMPASS model. NOAA is the relevant agency responsible for issuing Recovery Plans and Biological Opinions for the ESA listed salmon and Steelhead in the Columbia and Snake Rivers. Their analysis and modeling should be given great weight in the EIS process.

- The use of SARs to measure the effects of spill is flawed. The federal hydrosystem continues to be held wholly accountable for meeting SAR's goals. SARs are affected by far more than the hydrosystem including ocean conditions, predation, habitat, harvest, and hatchery impacts, among other factors. It is well recognized amongst the scientific community that the overwhelming factor affecting adult returns is ocean conditions. We have serious technical concerns with measuring survival benefits from changes in spill with the lifecycle metric of SARs.

- The EIS should review actual reported reach survivals from Lower Granite to Bonneville over the last 20+ years to determine changes in fish survivals during periods of high and low spill. NOAA produces an annual report reporting reach survivals for juvenile salmon and steelhead every year. The latest report (attached as Ex. C) shows that for both 2017 and 2018 juvenile survivals were lower in the last two years than the 10 average except for Snake River steelhead which increased survival in 2018, for no apparent reason. However, spill levels in both years were above the levels ordered by the Court due to unusually high flows that exceeded power generation capability for much of the spring period.

- Evaluate the impacts on adult passage and survival of high levels of spill at each dam.

- Evaluate the impacts of high continuous spill levels on dam safety.

- Evaluate impacts on power and revenue loss and how it will impact BPA's economic viability. This should include analysis of the potential rate impacts on Northwest ratepayers, especially the disadvantaged groups such as low income and tribal members.

In summary, given serious scientific uncertainties, a long history of litigation, and the grave risks posed by ever increasing levels of accumulated TDG on adult and juvenile salmon the scope of the proposed EIS needs to be comprehensive and the analysis needs to be very detailed to properly inform Ecology's decisions. RiverPartners reiterates that it *does* support the goals articulated in Ecology's waiver of improving salmon survivals while keeping BPA's costs contained. However, Ecology's current scoping document is short on critical details necessary to understand and gauge the prospects for a comprehensive EIS to guide future regulatory decisions.

Thank you for the opportunity to comment. RiverPartners' interest is to ensure Ecology procedurally, publicly and scientifically approaches the proposed EIS in a way that recognizes and protects endangered fish and other aquatic species while preserving the critical climate change, renewable energy and other multiple, critical benefits afforded by the federal hydropower and Columbia and Snake river systems.

Very truly yours,

Terry Flores

Terry Flores
RiverPartners Executive Director

EXHIBIT A

CARBON DIOXIDE FOOTPRINT
OF THE
NORTHWEST POWER SYSTEM

November 2007

Northwest Power and Conservation Council

Council Document 2007-15

This report summarizes the results of an analysis of CO_2 production from the Pacific Northwest power system. It compares 2005 CO_2 production to levels in 1990 and to forecast future levels. The analysis explores how future growth in CO_2 production would be affected by various resource development scenarios and other policies of interest.

Summary of Findings

Following a 2006 staff analysis of the marginal carbon dioxide (CO_2) effects of conservation called for in the Council's Fifth Power Plan, the Council requested additional analysis of the CO_2 production of the Northwest power system under various future resource development scenarios. The scenarios included the recommended resource portfolio of the Fifth Power Plan (the base case), a low-conservation scenario in which the conservation targets of the Fifth Power Plan are not achieved, and a high-renewables scenario based on state renewable energy portfolio standards. A scenario based on the resource acquisition recommendations of utilities' integrated resource plans (IRPs) was dropped following the release of several revised utility IRPs that closely matched the recommendations of the Fifth Power Plan. In addition, the Council asked for sensitivity analysis of several specific policies related to hydro system operations to understand how related scenarios could affect the CO_2 production of the power system. The analysis does not address CO_2 production from other sources such as transportation or industrial processes.

The actual CO_2 production of the Northwest power system in 1990 is estimated to have been about 44 million tons.[1] By 2005, production of CO_2 from the regional power system rose to an estimated 67 million tons. However, 2005, unlike 1990, was a poor water year, requiring more than normal operation of CO_2-producing fossil power generation. Under normal water conditions, the CO_2 production in 2005 would have been about 57 million tons, which is a 29 percent increase over the 1990 level. For perspective, the annual CO_2 output of a typical 400-megawatt coal-fired power plant is about 3 million tons, and the CO_2 output of a typical 400-megawatt gas-fired combined-cycle power plant is about 1.2 million tons.[2]

Factors contributing to the increase from 1990 to 2005 include economic growth, the addition of fossil-fueled generating units, lost hydropower production capability, and retirement of the Trojan nuclear plant. The year 1990 is used for comparison because 1990 has been adopted as a baseline by many climate-change policy proposals, including Washington Governor Gregoire's climate-change executive order, Oregon HB 3543, and national legislation proposed by Senators Lieberman and Warner.

Due to the large share of hydroelectric generation in the Pacific Northwest, CO_2 production here is much less than that of other regions when compared to electricity produced. For example, under normal water conditions, in 2005 the Pacific Northwest would have produced about 520 pounds of CO_2 for each megawatt-hour of electricity generated, compared to 900 pounds for the entire Western interconnected power system (WECC). However, because the Northwest has essentially the same set of future resource options available as other areas of WECC, it may be more difficult for the Northwest to maintain or reduce its average per-megawatt-hour CO_2 emission rate. In the base case of this study, which assumes implementation of the Council's Fifth Power Plan, the WECC CO_2 emission rate increases about 3 percent to about 920 pounds per megawatt-hour by 2024, whereas the Northwest rate, with aggressive development of conservation and renewables also increases 3 percent to about 530 pounds.

The future growth rate of annual regional CO_2 production would be even higher if the conservation, wind, and other resource development called for in the Council's Fifth Power Plan were not accomplished. With implementation of the Council's plan in the base case, the annual CO_2 production of the regional power system in 2024 under normal conditions would be about 67 million tons, an 18 percent increase over normal 2005 levels.

This paper explores the difficulty of reducing CO_2 production from electricity generation by assessing the effects of several scenarios on CO_2 production. The scenarios include some that would increase CO_2 production and some that would decrease it. These

[1] Unless otherwise noted, quantities are expressed as short tons (2,000 pounds) of carbon dioxide.
[2] A 400-megawatt pulverized coal-fired plant of 10,000 Btu/kWh heat rate operating at 80 percent capacity factor will produce about 3 million tons per year of carbon dioxide. A 400-megawatt combined-cycle plant fueled by natural gas of 7,000 Btu/kWh heat rate operating at 80 percent capacity will produce about 1.2 million tons per year of carbon dioxide.

scenarios were selected to develop a “scale-of-effects” sensitivity analysis that includes alternative resource development scenarios and hypothetical changes to the hydroelectric system. The hydroelectric sensitivity analyses address two hypothetical river condition alternatives: “no summer spill” and breaching the four lower Snake River dams. The controversial nature of these two scenarios is recognized, but has no relevance in this paper other than the CO2-related data the alternatives generate as a result of their respective scenario parameters.

An important finding of the analysis is that achieving the renewable portfolio standard goals and eliminating all summer spill would reduce the region’s projected growth in power system CO2 production by only 75 percent, even if counting the resulting net CO2 reduction for the entire WECC. Failure to achieve the conservation targets in the Fifth Power Plan, or removing the lower Snake River dams and replacing the power in a manner consistent with the Fifth Power Plan could more than offset the potential savings from the scenarios that reduce CO2 production. The effects of these scenarios, positive or negative, on CO2 production are the equivalent of only one or two coal-fired plants, whereas the forecast regional CO2 production for 2024 in the Fifth Power Plan case exceeds 1990 levels by an amount equivalent to eight typical coal-fired plants.

The findings of this study are depicted in Figure 1 and compiled in Table 1. Figure 1 depicts changes from base case projected CO2 emissions from WECC power systems for each of the scenarios. Table 1 shows the CO2 emissions in 1990, 2005, and projections for 2024 in each scenario, both for the Pacific Northwest and the WECC as a whole. Changes to the 2024 levels are shown in parentheses for each scenario.

These results illustrate the difficulty of actually reducing CO2 production with policies that affect only new sources of electric generation. CO2 production from electricity generation is dominated by existing coal-fired generating plants. To stabilize CO2 production at 2005 levels or to reduce CO2 production to 1990 levels would require substituting low CO2-producing resources or additional conservation for some of these existing coal-fired power plants. In addition, the scenario analysis shows that policy choices that are made for purposes other than CO2 reduction (in this case fish and wildlife policy) can also have significant effects on CO2 production; enough effect to negate policies such as renewable portfolio standards. Such unintended effects often go unexplored in important policy debates that focus narrowly on only one objective.

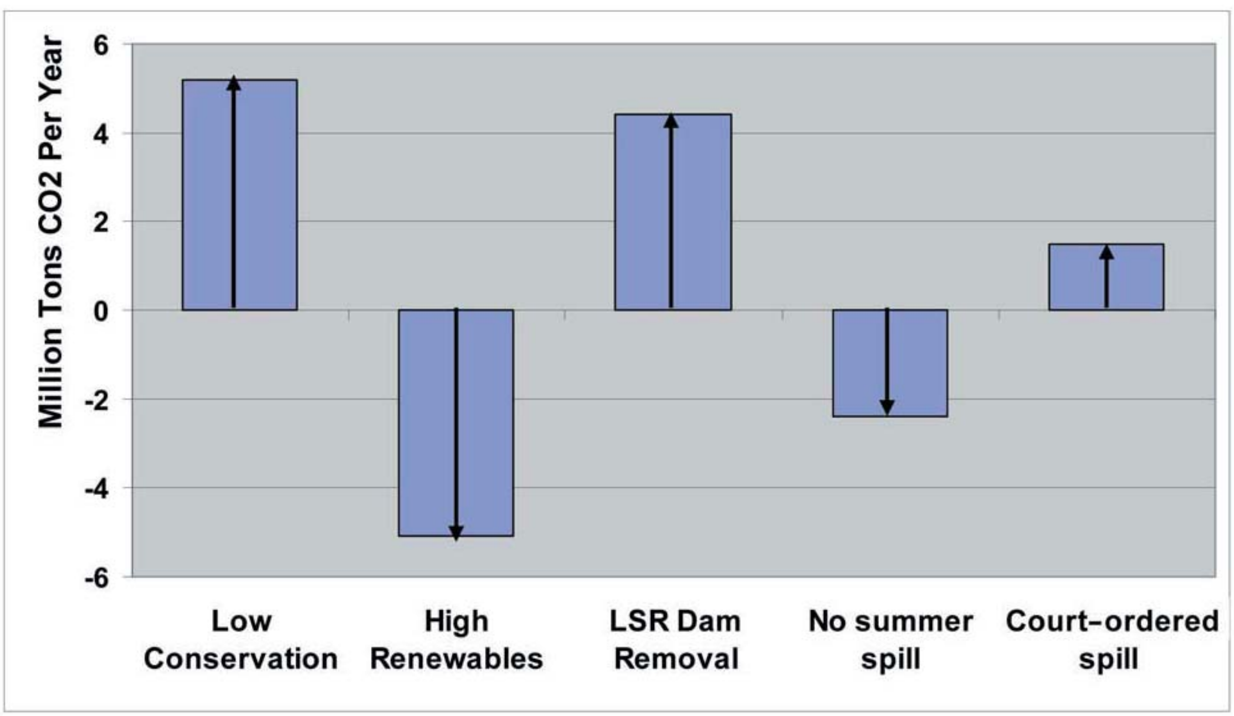

Figure 1: Changes from the base case projected CO2 production in alternative scenarios (WECC)

	Northwest Sources	WECC Sources
Historical values		
Actual 1990	44	Not estimated
Actual 2005	67	Not estimated
Simulated 2005 w/average hydro	57	378
Forecast 2024 rates and change from base case		
Base Case (5th Plan Portfolio)	67	531
Low Conservation	71 (+4.4)	536 (+5.2)
High Renewables	63 (-4.2)	526 (-5.1)
Remove LSR Projects, Replace w/Gas Generation	70 (+3.6)	536 (+4.4)
No Summer Spill	66 (-1.1)	529 (-2.4)
Court-ordered Spill	67 (+0.5)	533 (+1.5)

Table 1: Historical and projected CO_2 production and effects of alternative scenarios

As perspective, it is useful to understand regional CO2 emissions in a global context. In 2005, the world production of CO2 from the consumption and flaring of fossil fuels is estimated to have been about 28,000 million metric tons (30.8 billon short tons). The United States accounted for 21 percent of these emissions. The U.S. production of CO2 per capita is about 5 times the world average, largely reflecting its advanced state of development. However, the U.S. production of CO2 relative to its state of development as measured by Gross Domestic Product is substantially lower than the world average; about 70 percent of the world average.[3]

Electric power generation accounts for about 40 percent of the U.S. production of CO2. The electric power share is much lower in the Western U.S., however, at about 31 percent, and even lower for the Pacific Northwest where the 2004 (a fairly normal water year) share was 23 percent.

Greenhouse gas reduction targets, such as the Western Climate Initiative, typically target all sources of greenhouse gas emissions. Carbon dioxide is the dominant greenhouse gas. It accounted for 84 percent of all greenhouse gas emissions in 2005.[4] Sources of CO2 emissions other than electricity generation will need to be reduced to meet greenhouse gas reduction targets. For the U.S. as a whole, electricity generation is the largest producer of CO2. It is followed closely by the transportation sector, which accounts for one-third of emissions, and then by the industrial sector contributing 18 percent. The residential and commercial sectors combine to account for 10 percent.

Although electricity generation is the largest source of CO2 emissions in the U.S., in the West transportation is the largest. Transportation accounts for 43 percent of the CO2 emission in the West compared to 33 percent in the U.S. as a whole. In the Pacific Northwest, the transportation share is even larger at 46 percent.

The diversity of CO2 emission shares should be an important consideration in structuring CO2 reduction policies. In the West, with a smaller contribution to CO2 emission coming from electricity production, other sectors will need to carry a larger burden in reaching overall CO2 reduction targets. In addition, as discussed later in this paper, the CO2 production for electricity generation in the Pacific Northwest can vary significantly with changing hydroelectric supplies. This variability will need to be accounted for in setting CO2 reduction targets and in any cap and trade allocation system.

Background

Increasing concerns regarding the impact of CO2 production from the electric power system on global climate and heightened prospects of mandatory

[3]Data on CO2 emission from energy are from the U.S. Energy Information Administration.
[4]U.S. Environmental Protection Agency. EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005.

controls on the production of CO_2, led the Council in the summer of 2006 to request a forecast of the CO_2 produced from alternative future resource portfolios. Four scenarios were identified: the recommended resource portfolio of the Fifth Power Plan (the base case), a low-conservation scenario in which the conservation targets of the Fifth Power Plan are not achieved, a high-renewables scenario based on state renewable energy portfolio standards, and a scenario based on the resource acquisition recommendations of utilities' integrated resource plans (IRPs). The utility plans scenario was removed from the final paper following the release of several revised utility IRPs that closely matched the recommendations of the Fifth Power Plan. Two additional sets of studies were subsequently requested: 1) the CO_2 effects of removing the federal dams on the lower Snake River; and 2) the CO_2 effects of summer spill at the lower Snake River and lower Columbia River dams.

The purpose of these alternative scenarios is to quantify the sensitivity of results to plausible changes in the power system and to some related policies that have received attention. No new Council position on any of these policies is intended by this analysis, nor should any be inferred.

Historical Carbon Dioxide Production of the Northwest Power System

The year 1990 is frequently used as a benchmark in policies for the control of greenhouse gases.[5] The 1990 production of carbon dioxide from the Pacific Northwest power system is estimated to have been about 44 million tons, based on electricity production records of that year. Load growth, the addition of fossil-fuel generating units, the loss of hydropower production capability, and the retirement of the Trojan nuclear plant resulted in growing CO_2 production over the next 15 years. By 2005, the most recent year for which electricity production or fuel consumption data are available, CO_2 production increased 52 percent to 67 million tons (Figure 2). This is approximately the CO_2 output of 23 400-megawatt conventional coal-fired power plants, 56 400-megawatt gas-fired combined-cycle plants or about 11.7 million average U.S. passenger vehicles.

The regional CO_2 production estimates from 1995 through 2005 shown in Figure 2 are based on the fuel consumption of Northwest power plants as reported to the Energy Information Administration (EIA). Because fuel consumption data were not available before 1995, estimates for 1990 through 1995 are based on plant electrical output as reported to EIA and staff assumptions regarding plant heat rate and fuel type. Estimates based on plant electrical production are likely somewhat less accurate than estimates based on fuel consumption because of multi-fuel plants and uncertainties regarding plant heat rates. However, the two series of estimates are within 2 percent in the "overlap" year of 1995.

[5]For example, California Assembly Bill (AB) 32, passed by the legislature and signed by the governor in 2006, calls for enforceable emission limits to achieve a reduction in CO_2 emissions to the 1990 rate by 2020. Washington Governor Gregoire's climate-change executive order includes the same target for CO_2 reductions. Oregon House Bill 3543, passed by the legislature and signed by Governor Kulongoski in August, declares that it is state policy to stabilize CO_2 emissions by 2010, reduce them 10 percent below 1990 levels by 2020, and 75 percent below 1990 levels by 2050.

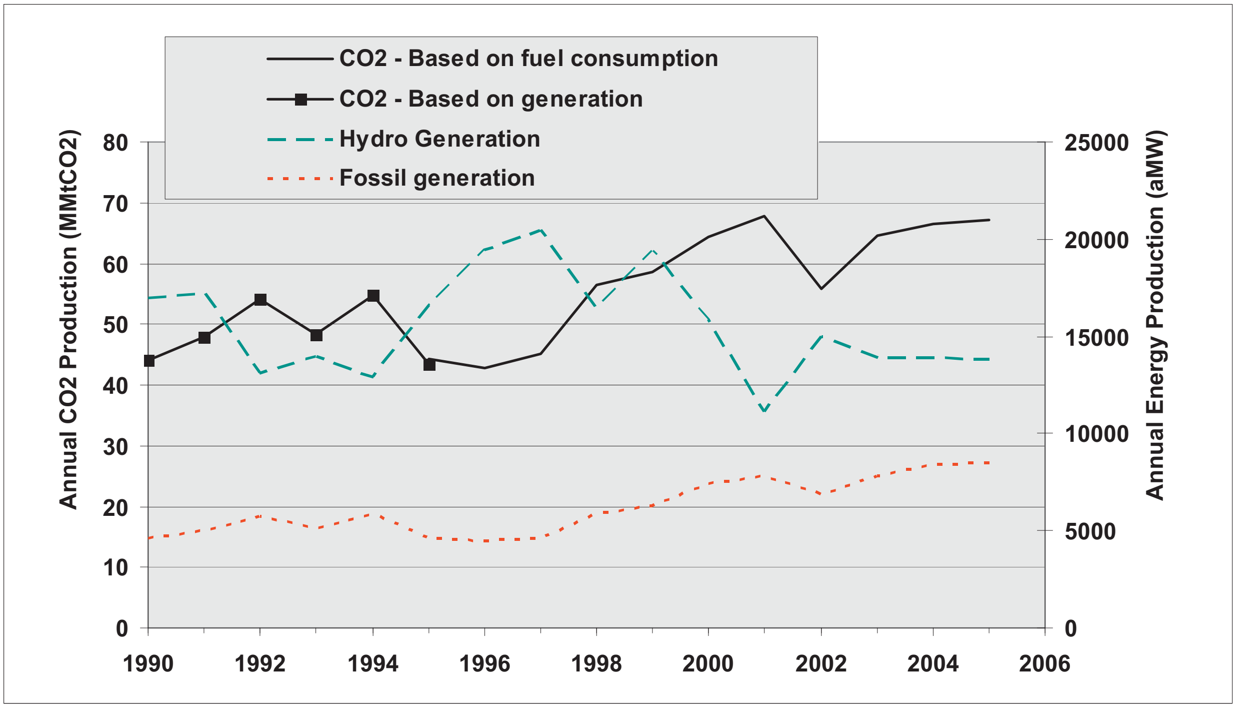

Figure 2: Historical CO2 and energy production of the Northwest power system[6]

Annual hydropower conditions can greatly affect power system CO2 production. Average hydropower production in the Northwest is about 16,400 average megawatts. As shown by the plot of Northwest hydropower production in Figure 2, the 1990 water year was nearly 17,000 average megawatts, slightly better than average. Other factors being equal, this would have slightly reduced CO2 production that year by curtailing thermal plant operation. Conversely, hydro production in 2005 was about 13,800 average megawatts, a poor water year. Other factors being equal, this would have increased thermal plant dispatch, raising CO2 production. The effect of hydropower generation on thermal plant generation and CO2 production is shown in Figure 2.[7]

If normalized to average hydropower conditions, actual generating capacity, and the medium case loads and fuel prices of the Fifth Power Plan, the estimated CO2 production in 2005 would have been 57 million tons, a 29 percent increase over the 1990 rate. This is the value used for comparison in this paper.

The Base Case - The Fifth Power Plan's Portfolio

The recommended resource portfolio of the Fifth Power Plan was used as the base case for all studies. Because the recommended resource portfolio of the Fifth Power Plan is defined in terms of "option by" dates rather than in-service dates, assumptions must be made to translate the portfolio into the fixed resource schedule needed for the AURORA™ model.[8] For this work, the "mean value resource development" schedule of the preferred resource portfolio of the Fifth Power Plan was represented in AURORA. The resulting resource development schedule was then tested against the Resource Adequacy Forum's recently proposed pilot capacity adequacy standard, using the capacity addition mode of the AURORA model. The resulting resource development schedule, illustrated in Figure 3 and enumer-

[6]Estimated CO2 production from 1995 through 2005 is based on power plant fuel consumption as reported to the U.S. Energy Information Administration (EIA). Fuel consumption information before 1995 is not readily available. CO2 production for these years was based on reported generation and estimated plant heat rates. As evident in Figure 1, the two methods result in reasonably consistent estimates for the overlap year of 1995. Incomplete reporting of generation for the increasing amount of non-utility power plant capacity makes comparisons less reliable for subsequent years. Estimates are based on all utility-owned power plants and non-utility plants selling under contract to utilities. Included in the definition of "Northwest" are the Jim Bridger plant in Wyoming and the Idaho Power share of the North Valmy plant in Nevada. The output of this capacity is dedicated to Northwest loads.

[7]In Figure 1, it is evident that Northwest thermal generation does not decline as much as Northwest hydro generation increases in above average water years, e.g. 1994 - 1997. This is likely due to the fact that the abundant hydropower of good water years creates a regional energy surplus that can be sold out of the region where it displaces thermal generation, which often consists of older, less efficient gas-fired units.

[8]The use of the AURORA model in preparing these forecasts is described in the Appendix A of this paper.

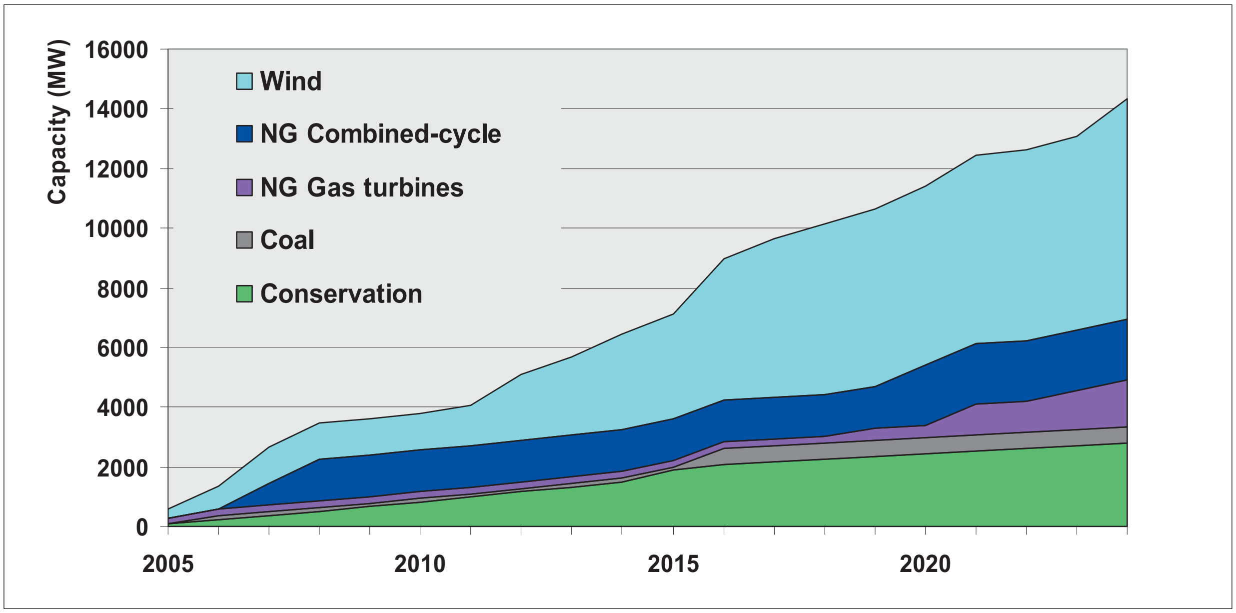

Figure 3: Base case Northwest resource development

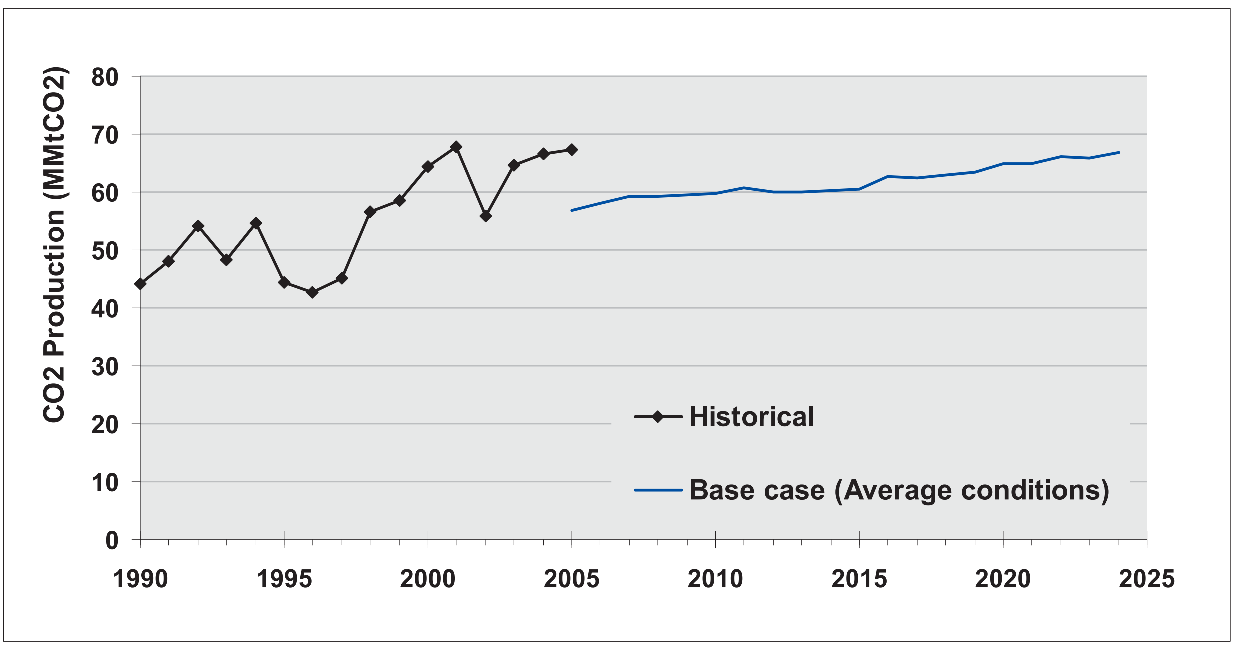

Figure 4: Forecast and historical CO2 production of the Northwest power system

ated in Appendix B, contains additional simple-cycle gas turbine capacity needed to maintain the proposed Northwest pilot capacity reserve standards. The schedule also contains several recently constructed wind projects not included in the resource portfolio of the Fifth Power Plan, so it includes a somewhat larger amount of wind capacity by 2024 than the original Fifth Plan portfolio. The AURORA capacity expansion run was also used to define resource additions and retirements for WECC areas outside the Northwest.

Forecast CO2 production of the Northwest power system for 2005-24 is compared to historical production in Figure 4. The forecast is normalized to average hydro, fuel prices, and loads, leading to the difference between actual and forecast values for the low water year 2005. Annual CO2 production under average conditions is forecast to increase from 57 million tons in 2005 to 67 million tons in 2024. This represents an 18 percent increase over the planning period of the Fifth Power Plan, an average annual rate increase of 0.8 percent. The forecast annual rate

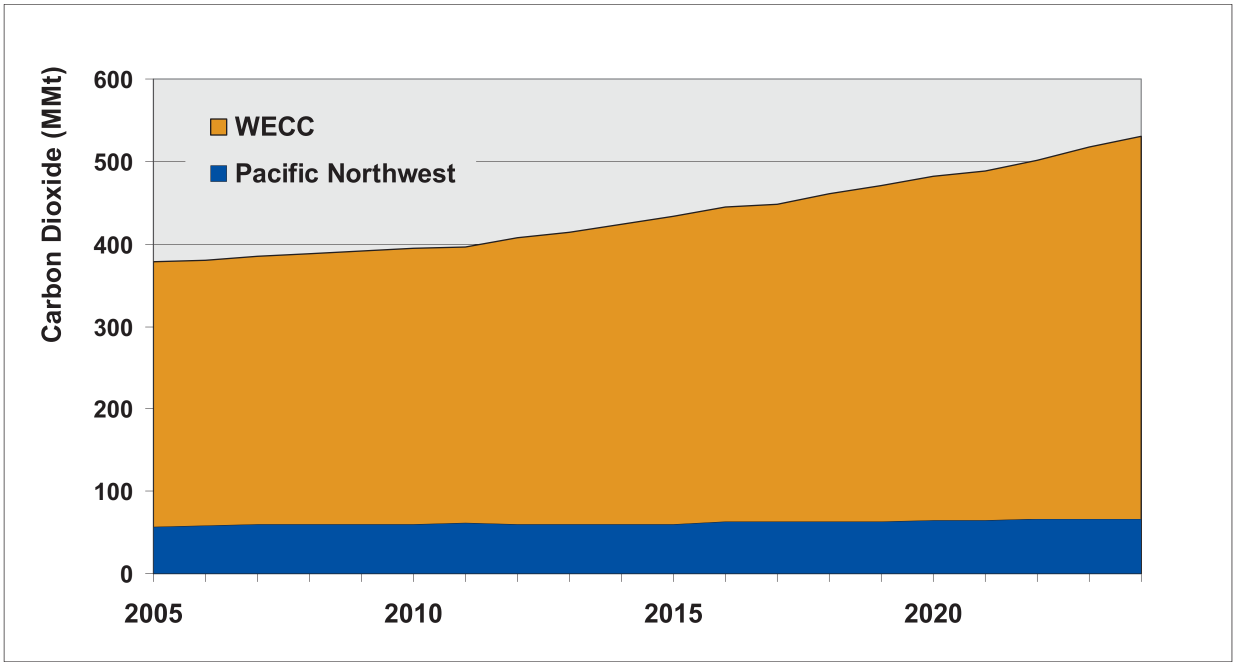

Figure 5: Forecast WECC and Northwest power system CO_2 production

of 67 million tons in 2024 represents an increase of 51 percent over the historical annual rate of 44 million tons in 1990. The forecast average annual rate of increased CO_2 production of 0.8 percent for the planning period of the Fifth Power Plan is half of the 2 percent average rate for 1990 - 2004 (2004 normalized).

Figure 5 compares forecast annual CO_2 production for the Northwest and the WECC as a whole. In 2005, the normalized annual CO_2 production by the Northwest power system represented 15 percent of the total WECC production. Because of its high proportion of hydropower, aggressive development of conservation, and recent additions of wind power and other non-hydro renewable resources, the Northwest enjoys a much lower per-kilowatt-hour CO_2 production rate than WECC as a whole (0.52 lb/kWh vs. 0.90 lb/kWh in 2005). The forecast average annual growth rate for WECC as a whole is 1.7 percent, compared to 0.8 percent for the Northwest, so that by 2024, the production in the Northwest will have declined to 13 percent of the total WECC production. Because these estimates do not include the possible effects of the renewable portfolio standards in place in many Western states (including the Northwest states), the future growth of CO_2 production for WECC may be less than forecast here.

Figure 6 illustrates the source of CO_2 production in the Northwest in the base case forecast. By 2024, and assuming no retirements of existing thermal plants, 79 percent of Northwest power system CO_2 production will be from existing coal-fired power plants, 4 percent from new coal-fired plants, 9 percent from existing gas-fired plants, and 7 percent from new gas-fired power plants. Though the aggressive acquisition of conservation and renewable resources called for in the Fifth Power Plan will hold the rate of growth in Northwest CO_2 production to half the growth rate experienced from 1990 through 2004, serious efforts to reduce or even stabilize CO_2 production beyond 2005 will likely require replacing existing coal-fired power plants with low CO_2-emitting resources.

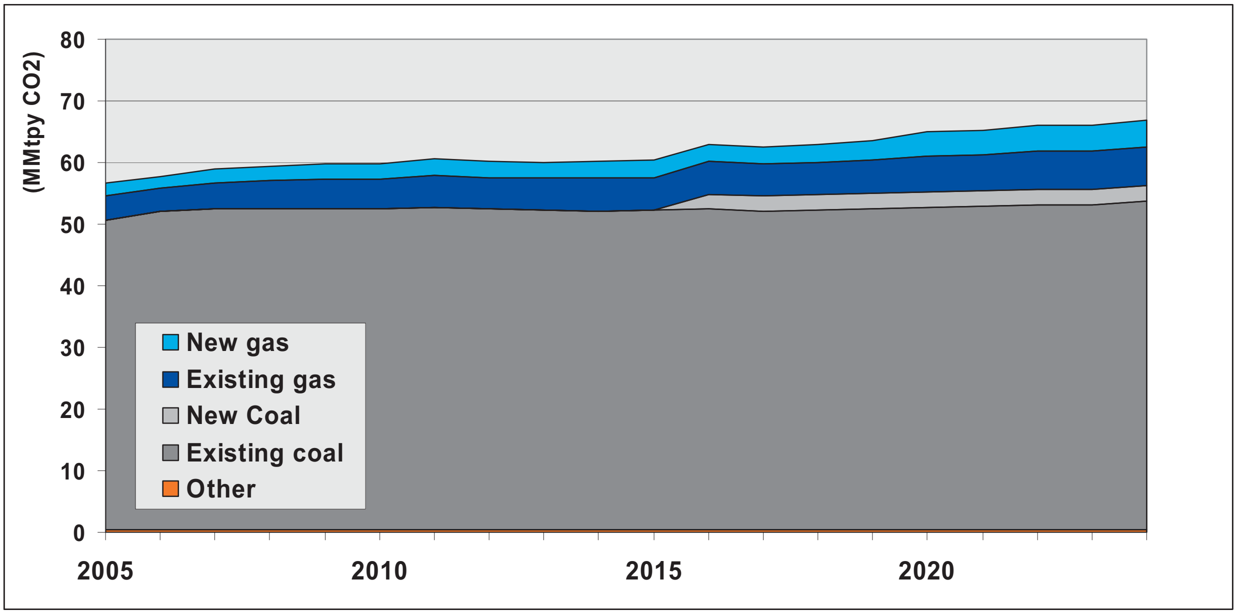

Figure 6: Sources of Northwest power system CO2 production

Alternative Resource Development

The CO2 production of two scenarios of alternative future resource development was forecast and compared to the base case forecast described earlier. The Northwest resource-development assumptions for each scenario are described below. Resource-development assumptions for WECC areas outside of the Northwest are the same as the base case. The impacts of all of the scenarios analyzed in this paper are assessed under average water conditions.

Alternative resource-development scenarios

A low-conservation scenario assumes that only 70 percent of the long-term conservation goals of the Fifth Power Plan are met by 2024. A resource portfolio (the "status quo" portfolio) representing this situation, developed during preparation of the Fifth Power Plan, was adopted for this scenario. As shown in Figure 7, this portfolio includes 800 fewer megawatts of conservation, 200 fewer megawatts of wind, and 275 fewer megawatts of simple-cycle capacity compared to the base case.[9] An additional 275 megawatts of coal and 610 megawatts of combined-cycle capacity make up for the energy and capacity of the unachieved conservation, wind, and gas turbine capacity.

A high-renewables scenario approximates full achievement of the Montana, Oregon, and Washington renewable portfolio standards (RPS). This scenario also includes a hypothetical RPS for Idaho, generally comparable to those adopted by the other states but with a lag of several years. Although these additional renewable resources were not found to be cost-effective in the Council's Fifth Power Plan, their acquisition has been mandated by many states, including Montana, Washington, and Oregon. Renewable-resource acquisitions to meet RPS goals are modeled as a combination of wind and biomass in the approximate proportions of wind currently being developed compared to other renewable energy resources. Though some geothermal, hydropower, solar, and marine energy resources are expected to be developed in response to renewable portfolio standards, the wind and biomass assumed for this scenario adequately represent the performance of the expected mix of intermittent and firm renewable energy resources for this purpose. The conservation-acquisition targets of the Fifth Power Plan were also assumed to be met. New coal-fired generation is excluded from this scenario. As shown in Figure 7, the high-renewables scenario includes an additional 500 megawatts of biomass, 1,600 megawatts of wind,

[9]In Figure 7 and following figures, column sections above the zero line represent resource capacity in excess of the amounts included in the base case, and column sections below the zero line represent resource capacity less than included in the base case. Conservation energy savings are shown as equivalent capacity.

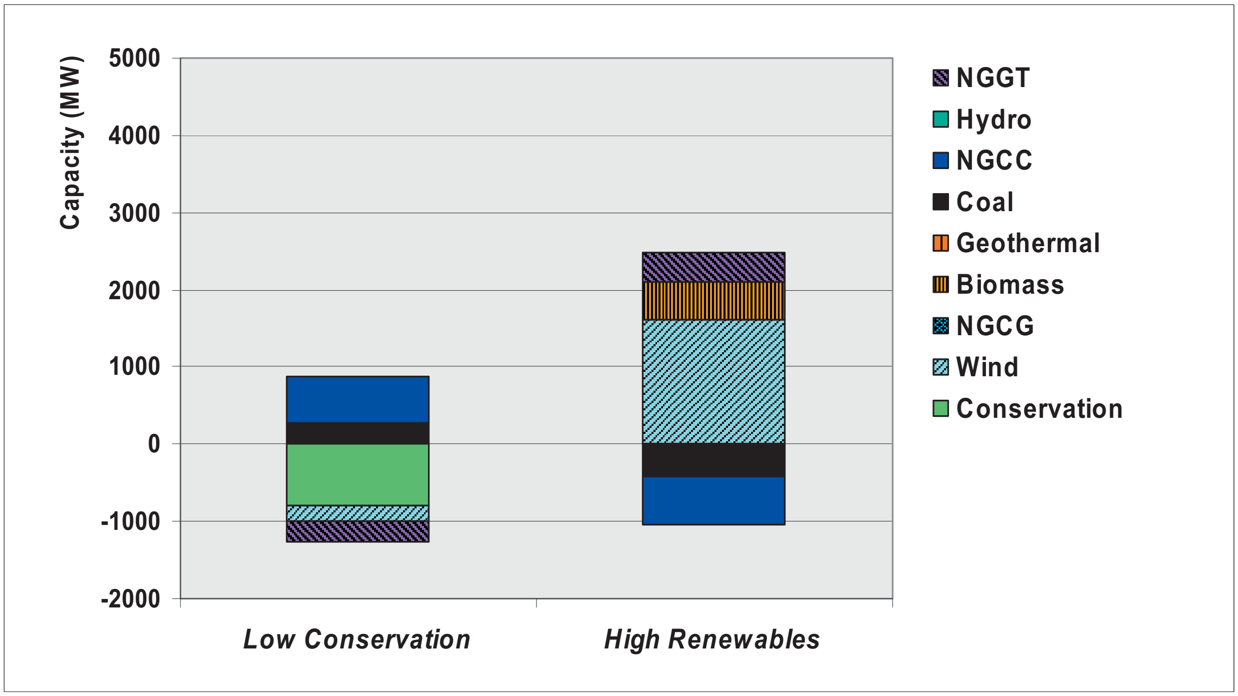

Figure 7: Incremental 2005-24 capacity compared to the base case

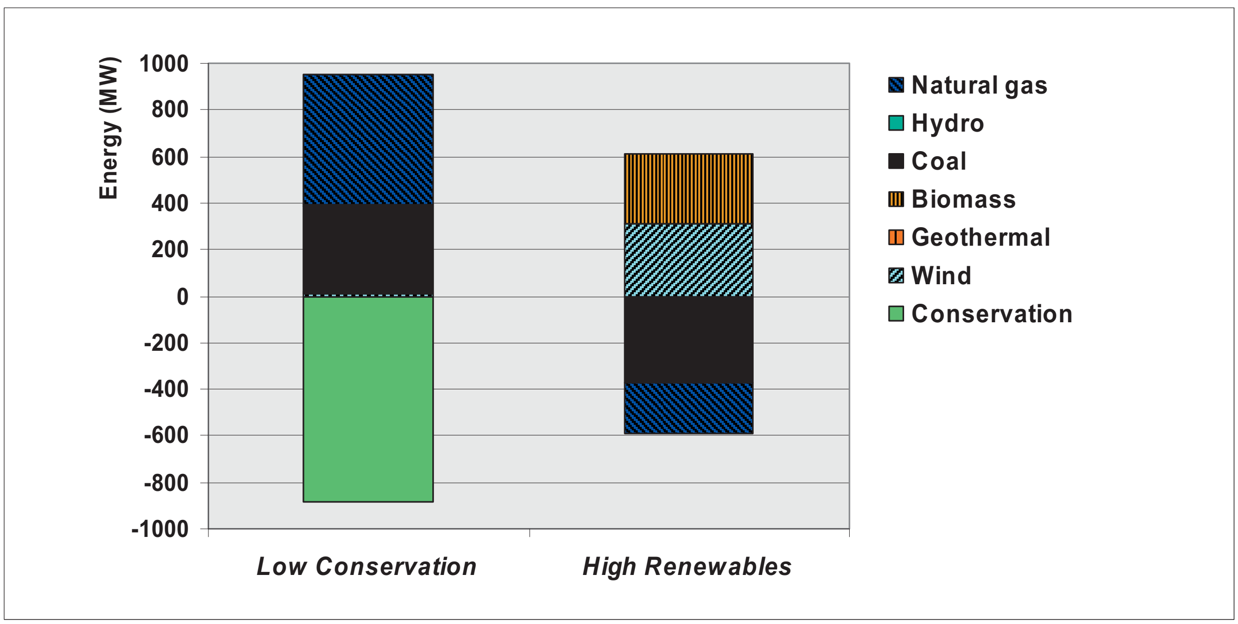

Figure 8: Average annual change in resource output vs. base case (WECC, 2015-24)

and 370 megawatts of gas turbines compared to the base case. The peaking capacity and energy balance of the base case was maintained by eliminating the 425 megawatts of new coal in the base case.

Effects of alternative resource-development scenarios

The production of CO2 is a function of the fuel and efficiency of resources dispatched to meet load. Alternative resource mixes will lead to changes in dispatch because of differing variable costs of operation and physical operating characteristics. Net changes for the entire WECC must be evaluated because of the effects of Northwest resources on resource dispatch in interconnected areas. A comparison of the average annual change in energy production by type of resource for 2015-24 for the two alternative resource-development scenarios compared to the base case is illustrated in Figure 8.

Low Conservation

Additional energy from coal (370 average megawatts) and natural gas (560 average megawatts) substitute for the reduced conservation of the low-conservation scenario. By 2024, annual CO2 production from Northwest sources would be 71 million tons per year (MMtpy), 4.4 million tons greater than the base case and a 61 percent increase over the 1990 rate. Annual net CO2 production for 2024 across the entire WECC system would increase 5.2 million tons compared to the base case, nearly the equivalent of two typical 400-megawatt coal-fired power plants. By 2024, this scenario includes about 770 fewer average megawatts of conservation than the base case. Each average megawatt of unachieved conservation would increase average net annual CO2 production by about 6,700 tons per year.

Wholesale power prices are forecast to be higher on average in the low-conservation scenario compared to the base case. Higher prices result from the dispatch of higher variable-cost resources, such as gas turbines to serve the additional load resulting from lower conservation achievement.

High Renewables

Additional energy from wind (310 average megawatts) and biomass (300 average megawatts) in the high-renewables scenario would reduce energy production from coal by 370 average megawatts and natural gas by 220 average megawatts. By 2024, annual CO2 production from Northwest sources would be 63 MMtpy, 4.2 million tons less than the base case. Although this would reduce the 2005-24 growth of CO2 production rates by 44 percent, the resulting rate still represents a 41 percent increase over the 1990 rate. Annual net CO2 production for 2024 across the entire WECC system would decline 5.1 million tons compared to the base case.

Wholesale power prices are forecast to be slightly lower on average in the high-renewables scenario compared to the base case. Lower prices result from the displacement of high variable-cost resources, such as gas turbines by the additional low variable-cost renewable resources of this scenario.

Removal of the Lower Snake River Hydroelectric Projects

Analysis of breaching the four federal hydroelectric projects on the lower Snake River[10] indicates the loss (on average under current river operations) of about 1,020 average megawatts of carbon-free energy and 2,650 megawatts of sustained peaking capacity. The impact of this loss on the production of CO2 depends on the nature of the replacement resources. The resource replacement depends on the particular resource-development strategy, as illustrated in the resource-development scenarios described earlier.

Resource replacement

Three possible approaches to replacing the reduced hydroelectric output of the dams were considered. These were: replacement with market purchases, replacement with natural gas resources, and replacement with conservation and renewable energy resources and natural gas capacity. The results of the second approach are reported because they are considered the most consistent with the base case and the Fifth Power Plan. Replacement with market purchases would compromise system adequacy and reliability by reducing the amount of resource available to meet load. Replacement of the power lost by breaching the lower Snake River dams by increased acquisition of conservation and renewable energy could, at least in the near term, delay some of the CO2 impacts of dam breaching. However, tying the increased development of conservation and renewables to dam breaching is misleading. If additional conservation and renewables are available and desirable, they should be pursued as part of a regional strategy to reduce CO2 emissions. Thus, the effects of changes in renewable development and conservation achievements have been addressed in the resource-development scenarios discussed earlier. Removal of the lower Snake River dams will not make additional CO2-free energy resources available to meet future load growth or retire any existing coal plants. More than 1,000 megawatts of emission-free generation eventually will have to be replaced unless the supplies of renewables and conservation are considered unlimited. Given the difficulty of reducing CO2 emissions, discarding existing CO2-free power sources has to be considered counterproductive

The lower Snake projects were assumed to ter-

[10]The projects are Ice Harbor, Lower Monumental, Little Goose, and Lower Granite.

minate production on December 31, 2014, and replacement resources were assumed to commence operation on January 1, 2015. This permitted the development of 10-year (2015-24) averages consistent with the other studies of this analysis. Resource-development assumptions for WECC areas outside of the Northwest were held constant.

The analysis assumes that the average energy output of the projects is replaced by natural gas-fired combined-cycle plants. The balance of the sustained peaking capacity of the projects is replaced by natural gas-fired simple-cycle gas turbines. The combined capacity of three combined-cycle units (1,830 megawatts) and 18 simple-cycle gas turbine units (846 megawatts) slightly exceeds the sustained peaking capacity of the four hydro projects. The analysis did not address replacement of ancillary services such as regulation, load following, and power factor control provided by the projects.

Effects of lower Snake dam replacement

When the operation of the changed power system is simulated, the lost hydro energy is replaced with the additional production of 170 average megawatts from existing coal-fired units and about 810 average megawatts from new and existing natural gas units. By 2024, annual CO_2 production from Northwest sources would be 70 MMtpy, 3.6 million tons greater than the base case and a 59 percent increase over the 1990 rate. Annual CO_2 production for 2024 across the entire WECC system would increase 4.4 million tons compared to the base case.

A modest increase in wholesale power prices is forecast, resulting from replacement of the hydro energy with higher variable-cost thermal energy. Significant capital expenditures would be incurred for replacement resources and costs associated with dam removal, which would increase cost-based utility electricity prices. System reliability should be relatively unaffected because of the capacity value and energy capability of the replacement resources. While the supply of ancillary services should be unaffected because of the replacement capacity, ancillary service prices may increase because of the higher operating costs of the replacement thermal resources.

Summer Spill Operations

The summer spill program at the lower Snake River and lower Columbia River hydroelectric projects is intended to facilitate the downstream migration of anadromous fish. The original summer spill requirements date to the 1990s and were incorporated in the 2000 Biological Opinion (BiOp). The 2004 BiOp incorporated the summer spill operation of the 2000 BiOp with minor changes. In 2005 and subsequent years, summer spill was increased further by court order (Preliminary Injunctive Relief Operation). The base case (the Fifth Power Plan portfolio) is based on 2004 BiOp operations, and thereby represents an intermediate level of summer spill.

This study estimates the CO_2 production impacts of the two summer spill regimes by comparing the average Western system dispatch and net CO_2 production for no summer spill operation and court-ordered summer spill operation to the average Western system dispatch and net CO_2 production of the base case (2004 BiOp). The comparison in all scenarios is average dispatch and CO_2 production for the period 2015-24.

The base case is as described earlier and includes summer spill operation as called for in the 2004 Biological Opinion.

The no summer spill scenario is based on the energy shape and output of the hydropower system without summer spill at the lower Snake River and Columbia River projects. In all other respects, the scenario is identical to the base case. About 550 average megawatts of hydropower energy would be gained under this operation compared to the base case.

The additional court-ordered spill scenario is based on the energy shape and output of the hydropower system under 2006 court-ordered spill operation. In all other respects, the scenario is identical to the base case. About 360 average megawatts of hydropower energy are lost under this operation compared to the base case.

No summer spill

In the no summer spill scenario, the additional hydro energy would displace about 190 average megawatts from coal-fired power plants and about 330 average megawatts from natural gas power plants (Figure 9). This would reduce average annual CO_2 production for 2024 from Northwest sources by 1.1 million tons compared to the base case (2004 BiOp). By 2024, 66 MMtpy of CO_2 would be produced directly from Northwest sources, a 48 percent increase over the 1990 rate. Annual CO2 production for 2024 across the entire WECC system would decrease 2.4 million tons compared to the base case.

Sensitivity Cases

Comments on the draft of this analysis requested sensitivity cases on some of the basic assumptions used in all of the scenarios. These included the effects of higher CO2 costs, higher fuel prices, and wind variability.

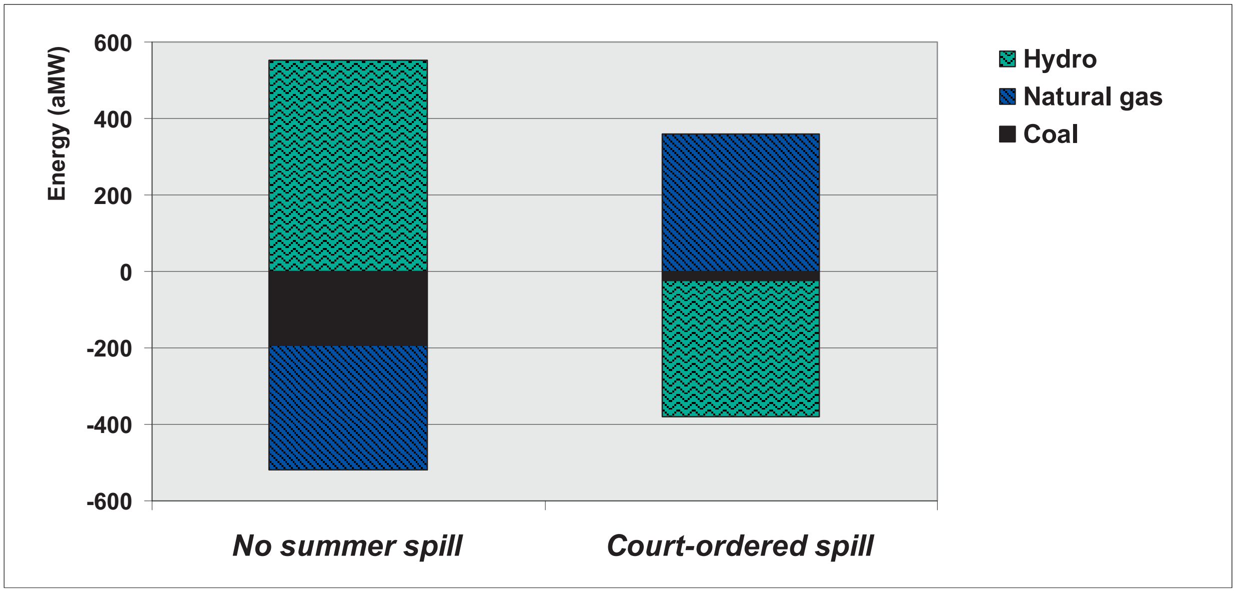

Figure 9: Average annual change in resource output vs. base scenario (WECC, 2015-24o

Court-ordered spill

About 20 average megawatts from coal-fired power plants and about 360 average megawatts from gas-fired power plants are needed to compensate for the lost hydro energy of the court-ordered spill scenario. This increases average annual CO2 production for 2024 from Northwest sources by 0.5 million tons compared to the base case (2004 BiOp). By 2024, 67 MMtpy of CO2 would be produced directly from Northwest sources, a 52 percent increase over the 1990 rate. Annual CO2 production for 2024 across the entire WECC system increases 1.5 million tons compared to the base case.

The overall effect of court-ordered spill compared to no summer spill operation within the Northwest is to increase the average annual CO2 production for 2015-24 by 2.1 million tons. For WECC as a whole, court-ordered spill increases average annual CO2 production 5.2 million tons compared to no summer spill operation.

Higher CO2 costs

All scenarios investigated in this study included the mean value CO2 prices from the portfolio risk assessment of the Fifth Power Plan. This price, representing a carbon tax or the cost of carbon allowances under a cap and trade system, appears in 2009 and gradually rises to about $9.00 per short ton of CO2 by 2024 (2006 dollars). A sensitivity case with doubled CO2 price was run to explore the possible effect of increased CO2 price on resource dispatch and CO2 production. The resource mix was held constant for this case, so the impacts of the higher CO2 prices are generally limited to shifting from coal to natural gas fueled plants. Higher power prices might also induce demand response and load curtailment.

With doubled CO2 prices, WECC-wide dispatch of coal declined 9 percent, with the difference largely met with increased dispatch of natural gas plants. A slight increase in demand response was also observed. Northwest CO2 production in 2024 does not significantly change from the base case, but for WECC in its entirety, 2024 CO2 production declined 9 million tons.

Higher fuel costs

All scenarios investigated in this study were based on the medium case fuel price forecast of the Fifth Power Plan. Current forecasts of fuel prices, including the recent revision of the Council's fuel price forecast, are generally higher than earlier forecasts, including that of the Fifth Plan. Though the Council's revised fuel price forecast had not been adopted when the base case analysis was under development, a sensitivity analysis was run using the medium-high fuel price forecast case of the Fifth Power Plan. North American wellhead gas prices in the Fifth Power Plan medium-high fuel price forecast are $5.20/MMBtu in 2024, compared to $4.60/MMBtu in the medium case (2006 dollars). The equivalent western mine mouth coal prices are $0.67 and $0.59 per MMBtu. The resource mix was held constant for this case, so the impacts of the higher fuel prices are generally limited to shifting between natural gas and coal. As in the higher CO2 price case, higher power prices might also induce demand response and load curtailment.

For WECC as a whole, the overall dispatch of coal and natural gas plants was essentially unchanged in the medium-high fuel price case. A slight increase in demand response was observed, as was increased dispatch of geothermal plants (geothermal plants are modeled as dispatchable with a variable fuel cost). Higher fuel prices did not significantly affect CO2 production in the Northwest or for WECC as a whole.

Windpower volatility and intermittency

Wind is currently modeled in AURORA with a flat energy output equivalent to annual capacity factor. A sensitivity case in which the hourly intermittency of wind was modeled using historic hourly output of several geographically diverse Northwest wind projects resulted in an insignificant change in CO2 production. Further testing of the impact of hourly intermittency may be desirable as more extensive actual and synthetic wind output data becomes available from the Northwest Wind Integration Action Plan.

Though hourly wind volatility did not significantly affect CO2 production in this sensitivity case, it is possible that sub-hourly wind volatility might impact CO2 production. In the later years of the study period, increasing loads and higher levels of wind penetration may increase the demand for regulation and load following services beyond the capability of the hydro system to provide these services. Fossil resources such as simple-cycle gas turbines may be called upon to provide regulation and load following, which would increase CO2 production.

Achieving Significant Reductions in CO2 Production

The findings described in this paper illustrate the difficulty of reducing CO2 production to rates considered necessary for climate stabilization. Current rates of conservation acquisition, and policies such as renewable portfolio standards mandating acquisition of low carbon resources, will help reduce growth of CO2 production. However, as discussed earlier, these activities are likely to be insufficient to maintain current levels of CO2 production, much less to reduce CO2 production to levels sought by greenhouse gas control policies. Achieving these goals will require deep cuts in the CO2 production from existing fossil plants or equivalent offsets from other sectors or geographic areas.

To give some perspective to the challenge of meeting proposed CO2 reduction targets, we have calculated the amount of CO2 emissions that would need to be reduced from the base case (Fifth Power Plan) forecast for 2020. Two cases are illustrated to give some perspective on the size of the challenge. One is the Western Climate Initiative (WCI) target of reducing CO2 emissions to 15 percent below 2005 levels by 2020. Another is to reach 1990 levels by 2020, which is both Washington's target and the target in the proposed Lieberman-Warner "America's Climate Security Act."

Assuming the Northwest power system met similar percentage reductions in its 2020 CO2 emissions, what is the magnitude of the reduction in terms of million tons per year and how can that be put into perspective?

Taking the WCI target first, the required reductions would depend on how the 2005 CO2 emissions were determined. As illustrated earlier, 2005 was a poor water year. Actual CO2 production from the power system was estimated to be 67 million tons per year. The WCI target, if based on actual emissions, would be 57 million tons per year. To reduce the base case forecast of CO2 production in 2020, which is 65 million tons, down to actual 2005 levels would require a reduction of 7 million tons of CO2. However, if based on normal hydro conditions, the WCI target would be 48 million tons per year. Achieving a WCI target based on normal hydro would require a reduction of 17 million tons.

One way to put this into perspective is to calculate how much coal capacity would have to be replaced with a carbon-free source or with conservation, as shown in Table 2. More existing capacity than indicated in the table would require replacement if a portion of the replacement resource were low-carbon, such as coal gasification plants with partial CO2 separation and sequestration. Further analysis would be needed to estimate the amount of replacement capacity needed, as this depends on the CO2 and economic characteristics of the replacement resources.

Policy	2020 Target (MMtCO2)	Reduction Needed (MMtCO2)[11]	Equivalent Coal Capacity (MW)
WCI - 15% below actual 2005 by 2020	57	7	910
WCI - 15% below normal 2005 by 2020	50	17	2330
WA - 1990 by 2020[12]	44	21	2780
OR - 10% below 1990 by 2020	40	25	3300

Table 2: CO2 reductions from base case (Fifth Power Plan) forecast to achieve various 2020 policy targets

A multipronged effort is required for the industry to cost-effectively achieve the goals of greenhouse gas control policies.[13] This effort must include the following elements:

- Reduction in demand through more aggressive improvements in end-use efficiency.
- Shifting new resource acquisitions to low-carbon resources.
- Reducing the CO2 production of existing fossil generation through efficiency improvements, carbon capture and sequestration, and substituting low-carbon baseload generating capacity.
- Marketing and credit transfer mechanisms to help secure CO2 reductions in other economic sectors and geographic areas where cost-effective.

In short, achieving greenhouse gas control targets economically requires broadening cost-effective resource planning and acquisition to consider a global scope of CO2-reduction options.

While developing mechanisms to facilitate cost-effective global CO2 reduction lies largely outside the control of the Northwest power industry, the following options can be cultivated within the industry:

Expand the supply of cost-effective energy-efficiency measures: An expanded inventory of end-use efficiency options will reduce the growth in demand for electricity, thereby reducing CO2 production from generating resources. Historically, conservation has been among the most cost-effective and abundant of new resource options. New conservation opportunities have continued to unfold even as older opportunities are developed. Production of CO2 from power generation can be reduced by aggressive implementation of existing conservation measures and development of new measures with a focus on those most effective during the hours that CO2 -intensive generating resources are on the margin.

Existing low-carbon generating resources: The efficiency, energy output, and operating life of existing low-carbon resources can be improved. For example, each percentage point increase in the capacity factor of Columbia Generating Station will offset approximately 0.05 million tons of CO2 per year.[14] Opportunities to improve the efficiency and capacity, and extend the life of the region's existing biomass, hydropower, and nuclear resources can be explored and pursued where cost-effective.

New renewable generation: Expanding the supply and improving the cost-effectiveness of new renewable resources involves concurrent efforts: First, the

[11] Reduction from base case (Fifth Power Plan) 2020 forecast.
[12] Also the target of the proposed Lieberman-Warner America's Climate Security Act.
[13] A recent study by the Electric Power Research Institute provides a very useful illustration of the challenge to significantly reduce power system CO2 emissions. See EPRI, "The Power To Reduce CO2 Emissions: The Full Portfolio," August 2007.
[14] Based on an average systemwide marginal CO2 production rate of 0.9 lb/kWh as estimated by the Council ("Power System Marginal CO2 Production Factors," Northwest Power and Conservation Council, April 2006).

supply of regulation, load following, shaping, and storage capability needed for integrating intermittent resources such as wind, tidal currents, wave, and solar need to be expanded through the development of improved methods of marketing and transferring these services within the existing system. Because the supply of these services will eventually need to be augmented, options for supplying these services, including generation, storage, and load-side proposals such as plug-in hybrid vehicles need to be better understood. Secondly, the capacity of the existing transmission system to serve new renewable resources needs to be expanded by developing products such as a conditional-firm service that more effectively utilizes the existing transmission capacity. New transmission will be needed to serve increasing amounts of remote renewable capacity and to improve the geographic diversity of wind and other intermittent renewable resources. Mechanisms are needed to facilitate planning, financing, and construction of new transmission, including "merchant" transmission primarily serving new resources. Finally, new renewable resources and technologies, including wave and tidal current power production, low temperature and engineered geothermal resources, dedicated energy crops, and more efficient biomass technologies need to be developed.

New fossil generation: Even with aggressive conservation measures and an expanded supply of renewable resources, new, lower-carbon fossil generation may be the most cost-effective source of baseload power. Moreover, gas turbines may be needed to augment the supply of integration services for intermittent renewable resources. Improving the efficiency of conventional gas turbine and pulverized-coal power plants, and commercializing coal gasification and other advanced coal technologies will extend fuel supplies and lower CO2 production at the source.

Carbon capture and sequestration: CO2 capture technology suitable for coal gasification plants is commercially available. However, while technically feasible, CO2 capture for conventional and advanced coal-steam plants and gas turbine plants is at the early demonstration stage. Development and commercialization of CO2 capture technology for all forms of fossil generation need to be accelerated to provide options for both new and retrofit applications.

Bulk CO2 transportation and sequestration has been demonstrated for depleted oil and gas reservoirs. While some oil and gas reservoirs are present in Montana, a greater potential in the Northwest are the basalt flows of the Columbia Basin and Snake River Plain. Additional Northwest potential may be available in deep coal seams, carbonate saline aquifers, oceanic storage, and soil carbon sequestration in croplands, grazing lands, and forests. Work needs to proceed on investigating and field-testing promising sequestration options for the Northwest.

New nuclear generation: A new generation of nuclear plants could provide bulk quantities of carbon-free baseload power. Approximately 30 new nuclear units are proposed for construction in the United States. The license application for the first two has recently been filed with the Nuclear Regulatory Commission and license applications for additional units are expected in 2008. While the first new units completed are likely to be located in the Southeast (a region with less favorable renewable resource potential than the Northwest) and not be completed until 2014-15, new nuclear plants may become attractive to the Northwest once new units are successfully operating and resolution of the spent fuel disposal issue is achieved.

Appendix A: Methodology and Analytical Issues

The CO2 production of each scenario was forecast using the AURORAxmp™ Electric Market Model. Though primarily used to forecast wholesale electricity prices, AURORA is also capable of forecasting pollutant emissions and CO2 production resulting from system operation. AURORA forecasts power prices by simulating the economic dispatch of individual generating units as needed to meet system load. Fuel consumption is tracked because fuel prices are a major component of the variable cost of electricity production with which plant dispatch is evaluated and power prices determined.

CO2 production was calculated using the following emission factors: natural gas 117 lb/MMBtu, fuel oil 166 lb/MMBtu, coal 212 lb/MMBtu, and petroleum coke 225 lb/MMBtu. Complete conversion of fuel carbon to CO2 was assumed. Biomass fuels, including municipal solid waste, are assumed to produce no net CO2. While some of the combustible content of municipal solid waste fuels is of petroleum or non-closed carbon cycle derivation, the small consumption of municipal solid waste for power production in the

Northwest has a negligible effect on net CO2 production. The CO2 output of fossil-fueled cogeneration units is based on "fuel charged to power" heat rates—the portion of fuel consumption attributable to electricity production.

With the exception of a sensitivity analysis on water conditions, described later, this work was based on 50-year average hydropower conditions, the medium-case fuel price forecasts, and the medium-case load growth forecasts of the Fifth Power Plan. As a result, the CO2 production forecasts are representative of long-term averages (to the extent that forecast fuel prices and demand are realized). Actual CO2 production will vary from the average depending on hydropower conditions, actual fuel prices, and actual loads. As illustrated earlier in Figure 2, CO2 production is sensitive to hydropower conditions, including runoff patterns. In general, hydropower displaces more thermal energy in good water years than in poor. Heavy spring runoff may displace coal-fired power plants during light springtime load periods, whereas delayed runoff may displace natural gas combined-cycle plants during heavier early summer loads. While economically beneficial because of the higher cost of natural gas, the later runoff would have less impact on CO2 production because of the lower carbon content of natural gas and the higher thermal efficiency of combined-cycle plants.

A question has been raised regarding the symmetry of the incremental effects on CO2 production of good and poor hydropower years of equal probability. If incremental CO2 production effects are not symmetrical, the estimates reported here may be biased, as they are based on average water conditions. A comparable effect has been observed, and is adjusted for, in the Council's electricity price forecasting. While time did not permit comprehensive testing, a limited comparison of forecast CO2 production in a very good water year to that of a very poor water year indicated a slight increase in the incremental CO2 production for the poor water year compared to the good water year. While further analysis would be required to confirm the consistency and magnitude of this effect, if true, the CO2 production estimates reported in this paper would tend to be slightly low.

The geographic scope of the analysis is the WECC interconnected system. Northwest resource development and operational decisions result in operational effects outside the Northwest because of transmission interconnections and Westwide markets. For this reason, CO2 production results are reported on a WECC basis. "Northwest" results, where reported, include the CO2 production of units physically located within the four Northwest states, plus the production from large thermal units outside the region dedicated to serving Northwest loads. These include the Jim Bridger plant in Wyoming and the Idaho Power share of the North Valmy plant in Nevada.

The net changes in CO2 production estimated in this study are the direct effects of power plant fuel consumption. Secondary impacts, not assessed here, may be present (e.g., CO2 from diesel oil combustion for the rail transportation of additional coal).

Price elasticity may result in reduction of demand due to higher prices caused by carbon taxes, higher-cost low carbon resources, cost of CO2 allocations, or other factors associated with climate change and policies addressing climate change. While the evaluation of this is beyond the scope of the current study, price elasticity will be considered in the Sixth Power Plan.

California, Oregon, and Washington have adopted policies prohibiting the long-term acquisition by utilities of resources or resource output where the associated CO2 production exceeds certain defined levels (generally exceeding the CO2 production of a natural gas-fired combined-cycle plant). Partial account of these carbon content policies is included in current analysis by permitting no new conventional coal plants to be located in California, Oregon or Washington when using the AURORAxmp capacity expansion feature. However, because AURORAxmp does not permit differentiation by resource type of economic inter-regional transfers, there appears to be no effective method of modeling carbon content policies.

Sufficient simple or combined-cycle gas turbine capacity was added in each scenario to maintain the pilot capacity reserve targets of the Resource Adequacy Forum. (The capacity value of wind power was set at 15 percent for these assessments.) This gas turbine capacity would also provide "system flexibility" suitable for integrating intermittent resources. However, it will not be possible to accurately estimate the amount of flexibility augmentation needed to accommodate the intermittent resources of these portfolios until the capability of the existing system to provide intermittent resource integration is better understood. Estimates of the intermittent resource integration capability of the existing system are being refined as part of the Northwest Wind Integration Action Plan. The needed capacity composition of future resource portfolios can be refined as better estimates of the capabilities of the existing system (and likely flexibility demands of future intermittent resources) become available. This information may also support estimates of the likely CO2 production resulting from possible operation of fossil capacity for intermittent resource integration purposes.

Appendix B

	Conservation (aMW)	Coal (MW)	Gas (MW)	Hydro	Wind (MW)	Other (MW)
2005	96		178 (SC)		300	(26) Oil
2006	136	109 (PC)	47 (SC)	14 Hyd (26) Hyd	487	10 Geo 12 Bio
2007	139		745 (CC)	2 Hyd (29) Hyd	440	20 Bio (32) Oil
2008	147		650 (CC)	(23) Hyd		
2009	150			(23) Hyd		
2010	159			(23) Hyd		
2011	161			(23) Hyd	100	
2012	169			(23) Hyd	900	
2013	172			(23) Hyd	400	
2014	176			(23) Hyd	600	
2015	378			(23) Hyd	300	
2016	185	425 (IGCC)		(23) Hyd	1200	
2017	105			(23) Hyd	600	
2018	93			(23) Hyd	400	
2019	89		184 (SC)	(23) Hyd	200	
2020	86		610 (CC)	(23) Hyd	100	
2021	85		644 (SC)	(23) Hyd	300	
2022	84			(23) Hyd	100	
2023	86		276 (SC)	(23) Hyd	100	
2024	85		276 (SC)	(23) Hyd	900	

Table B1: Pacific Northwest resource development schedule for the base case (MW)[15]

[15]Values in brackets are retirements.

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EXHIBIT B

INDEPENDENT SCIENTIFIC ADVISORY BOARD

Review of the Proposed Spill Experiment

February 20, 2014
ISAB 2014-2

Independent Scientific Advisory Board
for the Northwest Power and Conservation Council,
Columbia River Basin Indian Tribes,
and National Marine Fisheries Service
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Cover photo: McNary Dam spillway by Tony Grover.

ISAB Review of the Proposed Spill Experiment

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ISAB Review of the Proposed Spill Experiment

Review Charge

On December 16, 2013, the Northwest Power and Conservation Council requested that the ISAB review the spill experiment proposed by the State of Oregon, the Nez Perce Tribe, and others for inclusion in the Council's Fish and Wildlife Program. The Council asked that the ISAB consider the following questions:

1. Is the spill experiment proposal, and the postulated increases in fish survival, consistent with scientific methods?[1]

   (a) Does the experiment include an adequately researched hypothesis?
   (b) Is the experiment appropriately designed to test the hypothesis?
   (c) Is the proposed duration of the experiment sufficient?
   (d) Is it possible to isolate spill as the causative factor for changes in fish survival?

2. If not, what adjustments will ensure that the proposal is scientifically based?

3. What are the potential biological risks and/or benefits, particularly focusing on increased total dissolved gas effects on other aquatic species, associated with the proposal?

4. Is the proposed spill experiment likely to add to our existing knowledge regarding spill, juvenile dam passage survival, and adult fish returns (SARs)?

Background

The Council provided the following background information in their review request to the ISAB:

> As part of the Fish and Wildlife Program amendment process, the Council received recommendations, based on CSS studies, from Oregon Department of Fish and Wildlife (ODFW), the Nez Perce Tribe (NPT), the Pacific Fishery Management Council (PFMC), environmental and fishing groups, and individuals calling for implementation of an experimental spill management test. This proposal would increase spring spill levels at each mainstem federal Snake and Columbia River hydropower project up to 125% of total dissolved gas level in the tailrace of each dam or biological constraints, and then monitor survival effects over ten years compared to the current court-ordered spill program. Since 125% total dissolved gas exceeds the Clean Water Act water quality standard, modifications to the standard through regulatory processes by the states of Washington and Oregon would be required.

[1] The ISAB changed the wording of the Council's question from "the scientific method" to "scientific methods."

As proposed, the key elements of the experimental spill management would include:

1. Implementing voluntary spill levels greater than historical levels, particularly in lower flow years. Implementation is proposed to include these facets:
   - What: Increase spill to 125% of total dissolved gas level or biological constraints. As 125% total dissolved gas exceeds water quality criterion, criteria modifications through regulatory processes are required.
   - When: During spring operations (3 April through 20 June) for a period of 10 years with a comprehensive assessment after 5 years.
   - Where: At federal Lower Snake and Lower Columbia River Hydroelectric projects – Lower Granite, Little Goose, Lower Monumental, Ice Harbor, McNary, John Day, The Dalles and Bonneville dams.
2. Utilizing the Comparative Survival Studies (CSS) PIT-tag monitoring framework.
3. Monitoring Smolt-to-Adult survival rates.
4. Comparing survival rates against both past survival rates and prospective model predictions.
5. Evaluating whether empirical observations are consistent with the predicted benefits of higher voluntary spill levels.
6. Inclusion of sideboards or "off-ramps" to ensure hydrosystem power generation viability as well as "on-ramps" that facilitate non-hydro renewable energy sources into the power system to offset impacts from increased spill levels.

Review Approach

To conduct the review, the ISAB received briefings and reviewed scientific documents explaining, supporting, and critiquing the spill study. On November 15, 2013, the Comparative Survival Study (CSS) team presented analyses related to the spill test to the ISAB. This presentation was part of the ISAB's ongoing role in reviewing CSS and Fish Passage Center reports and analyses, primarily annual reports. This presentation occurred before the Council's December 2014 review request but proved effective in introducing the ISAB to the spill study and supporting analyses. On January 17, 2014, the Bonneville Power Administration (BPA) and the U.S. Army Corps of Engineers (COE) briefed the ISAB on the performance standards, monitoring efforts, and study results related to dam and reach specific survival. Dr. John Skalski also briefed the ISAB on the results of his statistical analysis of the proposed spill test. The ISAB created a file accessible to the public containing the ISAB's review materials. This proved effective in creating a dialogue and facilitating sharing of literature among the ISAB and entities involved in salmon passage studies, hydrosystem operations, and dissolved gas regulation. The ISAB greatly appreciates the briefings, literature shared, and robust exchange of information.

Overview

Potential Biological or Other Benefits

- Prospective modeling of the proposed spill test by the CSS team suggests that increasing spill levels up to 125% total dissolved gas may enable smolt-to-adult-return ratios (SARs) to reach the 4% biological goal for steelhead and approach the 4% goal for Chinook.
- Knowledge gained through experimental spill management could be generalized to inform operations at other dams.

Potential Biological or Other Risks

- The spill test may *not* result in increased SARs as the justification for the proposed test is based on correlative models that do not establish causality.
- There may be inadequate information gained to justify the cost due to study design limitations and lack of a detailed study and monitoring plan.
- The spill test could result in unintended consequences, including:
    - greater adverse gas bubble disease (GBD) effects on salmonids, native resident fish and/or aquatic life;
    - increased delay and/or predation of juvenile fish in tailraces;
    - increased fallback and/or passage delays of adult salmon at the dams;
    - difficulty in holding spill levels at desired levels, for example in a low water year;
    - increased spillway erosion problems;
    - possible navigation issues for commercial and juvenile fish transportation barges at dams;
    - possible effect on Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp) operations or smolt transportation actions because increasing spill will reduce the number of fish collected for transportation;
    - future engineering changes to juvenile fish passage at dams could confound results from this spill test.

Additional Issues

- A detailed study plan needs to be developed by the proponents. The lack of details and lack of synthesis in the material presented leads the ISAB and others to raise questions (see unintended consequences listed above) that might have otherwise been addressed if a comprehensive study plan was developed.
- The Oregon and Washington water quality standards for total dissolved gas (TDG) would need to be modified with NOAA Fisheries concurring.
- Regional work and agreement would be needed on:
    - the study design including how long the test should run to provide convincing evidence of an increase in SARs that is due to increased spill;
    - an monitoring and evaluation plan for TDG, biological and physical parameters; and
    - changes to dam-specific spill patterns.

ISAB Answers to Council Questions

1. **Is the spill experiment proposal, and the postulated increases in fish survival, consistent with scientific methods?**

   (a) Does the experiment include an adequately researched hypothesis?

The spill experiment proposal does not provide enough evidence for the ISAB to conclude that the experiment includes an adequately researched hypothesis. A complete study design, including detailed hypotheses and review of the literature, was not presented to the ISAB. Additional effort is needed to fully vet the experimental spill hypotheses and methodology. An action of this importance requires development of a complete description of the study design that addresses issues presented in this ISAB review and those raised by other stakeholders in the region (Skalski et al. 2013; BPA/COE 2014 and Skalski 2014, presentations to the ISAB).

The effects on salmonids of passing through dam spillways, turbines, and fish bypass routes have been investigated for decades including analyses by CSS that are documented in annual reports and peer-reviewed publications, reach survival studies by NOAA Fisheries, and dam passage survival evaluations by the Corps of Engineers. The results of these studies need to be synthesized and integrated into a more complete proposal as a means to evaluate the regression analyses and modeling presented by the CSS.

In the proposed spill test, recent regression analyses (Haeseker et al. 2012) are used to support the hypothesis that an increased percentage of water spilled over dams leads to higher survival of in-river migrants. Presumably, the experimental spill hypothesis is that increasing spill targets up to 125% TDG will lead to higher SARs of spring-summer Chinook and steelhead compared with SARs observed in years leading up to the spill test period, after adjusting for confounding variables such as ocean conditions and other juvenile fish passage improvements at the dams. Simulation modeling, based on recent peer-reviewed models and assumptions within, suggests that increasing spill levels up to 125% TDG in each of the dam tailraces would lead to considerably higher SARs of spring-summer Chinook and steelhead compared with observed SARs and SARs estimated based on simulations of BiOp operations (see Fig. 1 below from Schaller PPT to ISAB, Nov 15, 2013). This modeling effort, based on existing data, should be used to establish specific quantitative hypotheses for testing. The model simulations should be updated with recent years of data prior to beginning the potential spill test. Furthermore, the degree to which the hypotheses rely on extrapolation should be discussed. For example, in the published modeling reports, how frequently were SAR estimates available when spills were at or near 125% TDG? Also, it may be worthwhile to compare model predictions with expectations from studies directly examining survival of salmonids passing through spill, turbines, and the bypass system (Muir et al. 2001, Marotz et al. 2007, WA Dept. of Ecology 2008). The extent to which results from the CSS simulation studies are consistent with the findings in other studies should be evaluated.

Further scrutiny of the analyses and interpretation of the data and models used to justify the spill test is warranted. The spill test was generated primarily in response to regression models that showed that changes in spill percentage were correlated with increases in SARs. There is a potential problem in using the results of a regression equation as the basis for an experiment, especially if sample sizes are small. Regression models based on small sample sizes often overfit the data so the resulting relationships are not applicable to other sets of data. Selection of explanatory variables for multiple regressions must be carefully considered (Skalski et al. 2013) and the resulting models should be interpreted with caution. That said, 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).

Some of the explanatory variables in the model operate at the year level (e.g., PDO, upwelling and SST) whereas others operate at the week or period of release level. A more complex model including multiple random effects is likely needed to fully account for the internal correlation structure. By ignoring the multi-level variation, estimates of residual error are likely underestimated, which also may lead to errors in model predictions.

It is assumed that the survival rate experienced by each release group within a year was independent of survival rates experienced by other groups within the same year. However, in reality, survival rates are likely correlated among groups within the same year, as well as autocorrelated over time. Such correlations reduce the effective sample sizes in tests of statistical significance, and failure to account for these effects will increase the uncertainty of the model predictions. The Durbin-Watson test is not appropriate to evaluate autocorrelation as it fails to account for the two levels of explanatory variables needed in the model.

Despite these concerns with the statistical analyses used to support implementation of the spill test, it appears that the increased spill hypothesis stands as a possible candidate for testing. Other changes to hydrosystem operations have so far been inadequate to meet SAR targets required to conserve endangered salmon populations, even with structural changes that have been made at the dams such as surface spill weirs. It appears that increasing the amount of water spilled at lower Columbia and Snake River dams has merit as a hypothesis to test, but additional review of literature and analysis of data would be worthwhile.

Increasing spill is expected to allow a greater proportion of migrants to avoid the powerhouse intakes and speed their migration through forebays. It is uncertain if the proportion of fish that avoid powerhouse intakes continues to increase as spill increases, and how this proportion is affected by changes in flow. That is, how does each project’s spill efficiency change with changing flow conditions, and is there a point of diminishing returns in terms of spill and percentage of fish passed over the spillway?

Hypotheses should be developed for how increasing spill levels will affect returning adult salmonids, downstream-migrating steelhead repeat spawners (kelts), adult and juvenile lamprey, and sturgeon that may be influenced by TDG and changes in hydraulic flow patterns at the dams. The level of effort to monitor gas and adult migration effects would depend on a review of the literature and resulting uncertainty about potential adverse effects. The CSS and others presented the ISAB with some ongoing review of TDG effects, but this information should be summarized and presented in the proposal. As well, the spill test should consider whether effects from the proposed increase in spill might compromise the results from other ongoing studies in the basin.

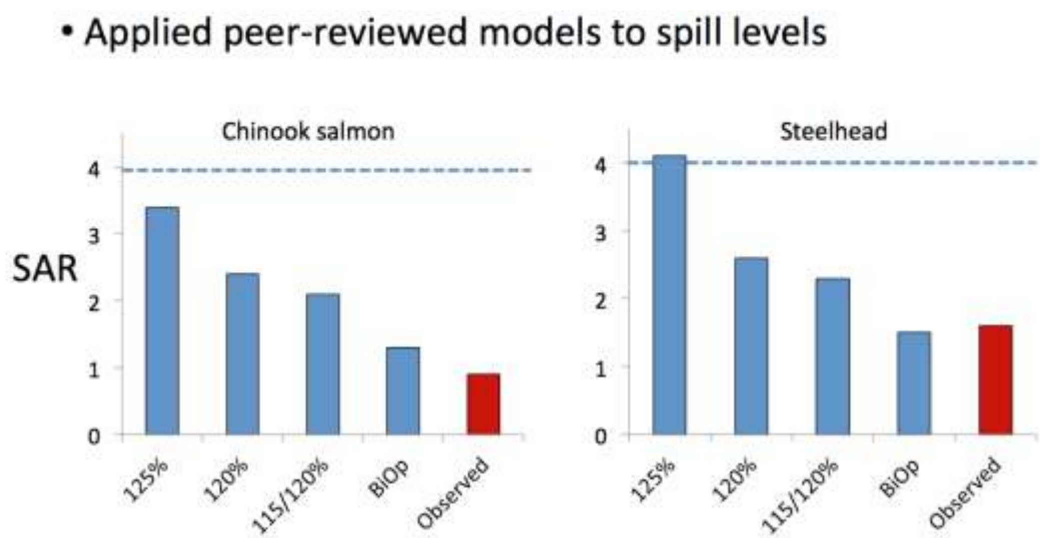

Fig. 1. Modeled SAR estimates of spring Chinook and steelhead in relation to spill levels, based on recent publications by CSS members. Source: Schaller PPT to ISAB, Nov 15, 2013. These charts presumably describe the spill hypothesis. Values in these charts should be updated with the latest data.

(b) Is the experiment appropriately designed to test the hypothesis?

Details of the proposed experiment are not adequately described or documented in a written proposal, so it is premature for the ISAB to determine if the study design is appropriate. First, as discussed above, the specific hypotheses to be tested are not adequately described. Second, due perhaps to practical limitations in devising controls for treatments, what is proposed is not a rigorous experiment but a test of a management action whose effects, ideally, will be evaluated.

It is not clear why a more rigorous experiment with controls has not been proposed. The proposed action is limited to levels of spill at each dam which result in 125% TDG in the tailrace rather than to vary the spill more systematically or consider designing a regime of alternating high/low spill years. This proposal does not discuss the merits of alternative designs, for example varying the level of spill in some years or split-spill studies where only some dams have increased spill. Such a discussion would illustrate the constraints under which such experiments operate and why some may not be feasible. If these and other experimental designs have been considered and discarded, then these efforts should be noted and the reasons for dismissing them identified.

A problem in comparing SARs during the experimental period (with spill targets set at 125% TDG) to SARs during the pre-spill test period is that the pre-spill test period may not be an adequate control because ocean and environmental conditions are likely to be considerably different. Ocean conditions have a major impact on SARs beyond in-river factors. The models attempt to account for ocean effects with independent variables such as the PDO, but considerable variability undoubtedly remains, which will lower the power and reliability of the test. The CSS may be aware of this, but it would be worthwhile to discuss the issue in a proposal and justify the use of SARs to assess results and testing hypotheses in a realistic time frame. Presumably, in-river survival also will be measured, as in past CSS studies. In-river survival estimates are more direct measures of the spill effect, though they cannot detect changes in delayed mortality.

Multiple lines of evidence based on different approaches should be considered. SARs for John Day, Mid-Columbia, and Snake populations could be compared to better estimate the magnitude of the effect of higher spill on reach survivals and SARs. SARs for John Day River populations (passing 3 dams) and Snake River populations (passing 8 dams) were previously compared to infer the deleterious effects of dams. Although this historical comparison was potentially confounded by other factors associated with location in the basin and stock differences, an experimental contrasting manipulation of spill levels that changed SARs in the predicted direction would provide some evidence of the influence of spill. In addition, other modeling approaches should be considered such as using the ratio of SAR for transported fish to SAR for in-river fish (TIR). Although transported fish are influenced by in-river conditions upstream of the transportation collection site and below Bonneville Dam that are positively correlated with percentage spill, most of these fish do not directly experience any spillway passage.

The proposed study offers an opportunity to use adaptive management that might improve SARs of threatened and endangered salmon ESUs and increase knowledge for future decisions. This situation seems to fit the criteria for true adaptive management, as outlined in papers like those by Kendall (2001), Runge (2011) and Tyre et al. (2011). First, there is certainty about the goal (increase SARs), but uncertainty remains about the ecological in-river and ocean survival processes that affect SARs. Therefore, the project should be designed to reduce critical uncertainties. Second, there are competing models that make contrasting predictions. Alternative actions could be identified and applied, and then the models updated periodically, using for example Bayesian analysis, leading to learning that feeds back to management.

(c) Is the proposed duration of the experiment sufficient?

The question of whether the study duration is sufficient to conclude that increased spill to the 125% TDG provides a meaningful increase in SARs for spring/summer Chinook and steelhead should be evaluated by the CSS in a study proposal. Existing data and hypothesized effects can be used to evaluate whether 10 years is adequate.

Ocean conditions are not controllable, so some estimate of the expected change in SARs due to increased spill under poor, average, or good ocean conditions is needed. For example, suppose that a warm phase of the PDO was to begin at the start of the test and last for many years. Or, what if a PDO regime shift occurs several times during the 10-year study period? Would this improve or hinder the chances of detecting effects after 10 years?

(d) Is it possible to isolate spill as the causative factor for changes in fish survival?

It is unlikely that overall changes in SARs 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.

Nevertheless, multiple lines of evidence including correlations can help support or refute whether spill is a major factor affecting survival of salmonids. Experimental studies in the Basin provide additional information on survival of salmonids passing through spill versus turbines versus the turbine bypass (e.g., Muir et al. 2001). What do these experimental studies tell us and are differences in survival consistent with the CSS study results?

2. If not, what adjustments will ensure that the proposal is scientifically based?

The proponents should be encouraged to prepare a more complete and detailed proposal that addresses issues and concerns that have been put forward by the Action Agencies and stakeholders, partly because details of the study have yet to be described in a document. Several iterations of the proposal may be needed to fully vet issues while providing a rigorous scientific review. The main conceptual issues are 1) lack of an experimental control group, and 2) low statistical power to detect effects given empirical estimates of variation in survival estimates and the survival process itself.

The ISAB appreciates that some options for improving whole system survival cannot be tested with rigor because of practical limitations (they lack controls and sufficient power or sample size). However, such limitations should not, in principle, negate consideration of less rigorous tests. Regardless, proposed actions and monitoring opportunities should be thoroughly considered, with strong adherence to a strategy for adaptive management. Development of a detailed monitoring plan is recommended and needed, especially for areas of high uncertainty, such as the following:

(a) improving detection rates to get better estimates of smolt survival estimates through the hydropower dams and reservoirs. Estimates of the survival of juvenile fish passing the dams via spill or other passage routes are available through COE funded acoustic tag (JSATS) studies of dam passage survival, although dam performance standard studies are not conducted every year. Association of direct juvenile survival past dams with spill should be discernible with appropriately designed monitoring;

(b) monitoring to assess condition of juvenile fish after various passage options to see if the increased spill is having a detrimental effect on fish condition. The issue of possible selectivity of the bypass system whereby fish that enter the dam bypass facility may be injured or somehow weaker than those that pass dams through other passage routes should also be examined;

(c) monitoring of adult salmonids, steelhead kelts, and other fish and other aquatic life to determine the impact of a long period of increased spill and increased total dissolved gas;

(d) evaluation of the proportion of fish passing via spill and all other routes with increased spill;

(e) evaluation of the effect of increased levels of spill on upstream passage of adult fish. New spill patterns could be tested in the hydraulic scale models at Vicksburg and also monitored at the dams during the spill period. Advance testing of the effects of increased spill in hydraulic scale models would be useful not only for estimating impact on upstream fish passage but also for identifying paths that juvenile fish might prefer and to reduce predation risk to juvenile fish in downstream eddies and tailwaters;

(f) related to (d), monitoring predation risk of fish in relation to increased spill;

(g) at this time models probably cannot predict fish survival at 125% TDG levels since empirical data on such high spill levels over the 2.5 month spring migration period are not available. However, collecting appropriate data that can be used in models will enable predictions in the future.

3. What are the potential biological risks and/or benefits, particularly focusing on increased total dissolved gas effects on other aquatic species, associated with the proposal?

The proposed spill test should consider the potential impact on other species, such as fall Chinook and sockeye salmon, sturgeon, lamprey, and other aquatic life. Hypotheses should be developed on how spill maintained at 125% TDG for several months might affect each species and life stage, and a detailed biological monitoring plan should be developed to test the hypotheses.

Consideration of potential biological risks will not be easy because the effects of TDG are influenced by variables in the physical environment and the development and behavior of animals of concern. Foremost among these variables is the depth at which the organisms are exposed. Generally, one meter of depth protects aquatic organisms from the effects of 10% TDG via hydrostatic compensation (Weitkamp et al. 2003). For example, if TDG is 120% at the surface, fish at a depth of 2 m will experience 100% TDG. Backman et al. (2002) found that juvenile salmon collected from the forebays (where TDG was 115%) or tailraces (TDG = 120%)

of Columbia River dams had fewer signs of gas bubble disease (GBD) than did fish from the bypass systems of those dams. The authors attributed this disparity to the shallow water in the bypass systems. Steelhead kelts might be particularly affected as the majority passes FCRPS dams through traditional spill routes and spillway weirs (Colotelo et al. 2013). Fish depth behavior may protect them from adverse effects when they come to the surface. That is, time spent at depth protects fish from time spent at the surface (Knittel et al. 1980). This relation between GBD and depth also confounds interpretation of field and laboratory studies because most aquatic organisms are collected in shallow water (Weitkamp 2008) and, in order to control for the effects of hydrostatic compensation, most laboratory studies have been completed in shallow water tanks, for example depths of 0.25m (Mesa et al. 2000; Beeman et al. 2003).

Field studies can offer some insight into potential biological risks associated with high levels of TDG on aquatic organisms, especially fish. Field studies using cages in which fish were able to go to various depths attempt to approximate fish in the wild. Kokanee fry in 9-m deep cages suffered no mortalities even though TDG reached 125% (Weitkamp et al. 2000 cited in Weitkamp 2008, page 10). Schrank et al. (1997, 1998) held juvenile salmonids and several non-salmonid resident fish species in cages with various depths and found that even at TDG as high as 130 to 138%, GBD was low (~6%) in fish held 2 to 3 m deep for four days. Backman et al. (2002) looked at GBD in over 20,000 juvenile salmonids collected from the Snake and Columbia rivers and dams and regressed the incidence of GBD against TDG that varied from 100% to greater than 130%. Their regression suggests that at 125% one would see GBD in fewer than 5% of the fish. Backman and Evans (2002) examined over 8,000 adult steelhead, sockeye, and Chinook salmon below Bonneville Dam when TDG varied between 111% to greater than 130% and found less than 1% with GBD until TDG exceeded 126%. When TDG was between 126% and 130%, incidence of GBD increased in steelhead (~4%) and sockeye (~8%), but in Chinook salmon incidence of GBD stayed < 1%.

Uncontrolled spill at the high-head Libby Dam resulted in TDG between 124% and 131% (Martoz et al. 2007). Signs of GBD in five resident salmonid species and four non-salmonids increased to greater than 90% over the 19 days of spill. However, there were no differences in population estimates or growth of bull trout or *Oncorhynchus* spp. sampled two years before and a year after the high spill (Marotz et al. 2007). Weitkamp (2008) pointed out that, in most studies, signs of GBD are poorly correlated with rate of fish mortality. He points out, however, that historically when TDG has caused significant mortalities in the wild, dead fish were seen. In the Columbia River, a low proportion of fish have been observed with GBD, and it is unlikely that significant mortalities have occurred. However, it is possible that fish condition or health is compromised leading to increased predation.

Studies that have tracked fish depth using radio telemetry showed that juvenile salmonids emigrate at 1.5 to 3.2 m depth (Beeman and Maule 2006), adult salmonids immigrate greater than 2 m deep (Johnson et al. 2005) and a variety of resident fish were found between 2 to 6.8 m deep (Beeman et al. 2003). Thus, it appears that the migratory behavior of juvenile and adult salmonids will help protect them from adverse effects of TDG. There is, however, recent research conducted during uncontrolled spill in 2011, when water below Bonneville Dam had

TDG as high as 134%. The researchers used acoustic telemetry to examine survival of juvenile salmonids in two tests: (1) fish were collected, tagged and transported from Lower Granite Dam then released approximately 10 km below Bonneville Dam into water with TDG at about 115% (low exposure) or about 125% (high exposure); and (2) fish were collected, tagged and released at Bonneville Dam into water with TDG about 118% (low) or about 132% (high). In the Bonneville Dam comparison, daily mortality rate in the lower river was higher in fish when TDG was greater than 130%. In the transported groups, daily mortality rates did not differ in fish as they migrated in the lower river. Daily mortality rates of the high exposure groups were higher than that of the low exposure group in both tests during the fish's migration in the Columbia River plume (Ian Brosnan, Cornell University, personal communication of unpublished data). While these data have not yet been published (they are in review for publication), they suggest that mortality of smolts exposed to TDG greater than 125% may lead to decreased survival beyond the Columbia River, that is, delayed mortality.

Few studies have considered the effects of TDG on amphibians, invertebrate species, or other fish species. Colt et al. (1984, 1987) studied effects of elevated TDG and reported no mortalities in tadpoles (*Rana catesbeiana*) held at about 122% TDG for 4 days. Adult bullfrogs suffered no mortalities at about 117% after 4 days, but 40% died after 1 day at about 132%. Several studies indicated that aquatic invertebrates are much less sensitive to high TDG than are fish (Nebeker et al. 1981; Schrank et al. 1997; Ryan et al. 2000). Ryan et al. (2000) collected over 5,400 invertebrates from the Columbia and Snake rivers at depths less than 0.6 m. They reported finding signs of GBD in only 7 (0.1%) individuals when TDG ranged from 120% to more than 135%. White et al. (1991, as cited in McGrath et al. 2006) found a shift in abundances of some invertebrate species before and after exposure to TDG. However, these effects could have been the result of increased water velocity or changing water temperature (White et al. 1991 as cited in Weitkamp 2008). There is also concern for larval/fry fish in shallow areas with elevated TDG. Studies have shown that bubbles formed in sturgeon larva (Counihan et al. 1998) and sucker fry (Schrank et al. 1998) and interfered with their buoyancy, which could lead to displacement in the habitat or increased vulnerability to predation. While it is assumed that lamprey migrate near the benthos, it is not clear if studies have documented the depth at which lamprey migrate and, thus, the degree to which hydrostatic compensation protects them from GBD.

4. **Is the proposed spill experiment likely to add to our existing knowledge regarding spill, juvenile dam passage survival, and adult fish returns (SARs)?**

It is likely that a spill test would enhance knowledge about spill, juvenile passage survival, and SARs. A spill test could also increase knowledge in other ways if appropriate monitoring is conducted. The ISAB agrees with the 2013 CSS Workshop conclusion that the experimental design and implementation should "focus on maximizing the amount of learning that can be achieved," where "learning" is the "likelihood of detecting a response." Here again, this situation seems to fit the need for true adaptive management as mentioned above. Alternative covariates and analytical approaches need to be identified and discussed. A preferred alternative action could be identified and applied, and then the models updated periodically, leading to learning that feeds back to management.

Currently, water quality standards and the desire to produce hydropower constrain the amount of water spilled over the dams. CSS annual reports and published papers, however, suggest that increased spill will lead to higher survival of spring Chinook and steelhead. This is a reasonable hypothesis. Nevertheless, as noted under Question 1.A., a detailed and adequately researched hypothesis for the spill experiment is needed, including consideration of alternative hypotheses. Given the potential importance of this study and concerns raised by the Action Agencies and a variety of stakeholders, further vetting of the study design and methodology in a study proposal would be worthwhile as a means to maximize knowledge gained by an experiment. Without a carefully designed experiment that reflects consideration of all possible alternative outcomes, an unexpected result might preclude drawing firm conclusions about the effect of increasing spill.

The ISAB cannot assess whether the ten-year study proposed by CSS is sufficient to detect a meaningful improvement in salmon survival because a detailed proposal has yet to be prepared. However, if adequate monitoring is implemented along with the spill, there should be increased knowledge regarding spill, juvenile salmonid dam passage survival, impacts on adult fish passage and other species, and total dissolved gas effects.

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EXHIBIT C

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September 19, 2018

MEMORANDUM FOR: F/NWR5 – Ritchie Graves

FROM: F/NWC3 - Richard W. Zabel Richard W. Zabel

SUBJECT: Preliminary survival estimates for the passage of spring-migrating juvenile salmonids through Snake and Columbia River dams and reservoirs, 2018

This memorandum summarizes conditions in the Snake and Columbia Rivers and preliminary estimates of survival of PIT-tagged juvenile salmonids passing through reservoirs and dams during the 2018 spring outmigration. We also provide preliminary estimates of the proportion of Snake River smolts that were transported from Snake River dams in 2018. Our complete detailed analyses and report for the spring migration will follow this memo at a later date. As in past years, changes in the database between the time of our annual summer memo and the publication of our final report may result in differences of up to 3 or 4% in estimated survival values.

Summary of Research

For survival studies funded by BPA in 2018, NOAA Fisheries PIT tagged 20,249 river-run hatchery steelhead, 15,396 wild steelhead, and 11,823 wild yearling Chinook salmon for release into the tailrace of Lower Granite Dam.

Survival estimates provided in this memorandum are derived from data from fish PIT tagged by or for NOAA Fisheries, as described above, along with fish PIT tagged by others within the Columbia River Basin. Note that for technical reasons, the statistical model for survival estimation can produce estimates that exceed 100%. When this occurs, we report the actual estimate, but for practical purposes these estimates should be interpreted as representing survival probabilities which are less than or equal to 100%.

We have estimated survival probabilities for migrating PIT-tagged salmonids since 1993. In this memo, we compare 2018 estimates in various river segments to averages over periods of years. Estimates are not available for every reach in every year. Unless otherwise noted, when we refer to a long-term average for a particular river segment, the average is across all years for which estimates are available.

PIT-tagged yearling Chinook salmon have been released from the seven Snake River Basin hatcheries Dworshak, Kooskia, Lookingglass/Imnaha Weir, Rapid River, McCall/Knox Bridge, Pahsimeroi, and Sawtooth every year from 1993 through 2018 (except Pahsimeroi in 1996). Across these “index” hatcheries, the annual mean estimated survival from release to Lower Granite Dam has been relatively stable since 1998 (Figure 1, Table 1). In 2018, the mean was 64.8%; this estimate is close to last year’s mean survival to Lower Granite of 65.0% and the overall mean from 1998 through 2018 of 65.1%. The annual mean has ranged from 49.4% in 1997 to 71.7% in 2016 (Figure 1).

Downstream of Lower Granite Dam, mean estimated survival for Snake River yearling Chinook salmon (hatchery and wild combined) in 2018 was slightly above average in the Lower Granite to Little Goose and the Lower Monumental to McNary reaches, and close to average in the Little Goose to Lower Monumental reach (Table 2, Figure 2). However, estimated survival in the McNary to John Day and John Day to Bonneville reaches was substantially lower than average (Table 2, Figure 3). These estimates resulted in average survival from Lower Granite to McNary, but below average survival in the remaining combined reaches of interest (Table 3).

Mean estimated survival for yearling Chinook salmon from Lower Granite Dam tailrace to McNary Dam tailrace in 2018 was 73.3% (95% CI: 68.4-78.2%). Mean estimated survival from McNary Dam tailrace to Bonneville Dam tailrace was 59.0% (50.2-67.8%). Mean estimated survival for yearling Chinook salmon from Lower Granite Dam tailrace to Bonneville Dam tailrace was 43.2% (36.2-

50.3%). Estimated survival for the Lower Granite project (head of reservoir to tailrace) was 88.0%, based on fish PIT tagged at and released from the Snake River trap. The combined yearling Chinook salmon survival estimate from the Snake River trap to Bonneville Dam tailrace was 38.1% (31.6-44.6%), substantially below the long-term average of 48.9%.

For wild Snake River yearling Chinook, mean estimated survival from Lower Granite Dam tailrace to McNary Dam tailrace was 76.0% (95% CI: 69.9-82.1%), and from McNary Dam tailrace to Bonneville Dam tailrace was 76.2% (48.0-104.4%). Estimated survival from the Snake River trap to Lower Granite Dam tailrace was 87.1%, which resulted in estimated survival from the Snake River trap to Bonneville Dam tailrace of 50.4% (31.0-69.9%). This estimate is above the long-term average of 44.8%.

For Snake River steelhead (hatchery and wild combined), mean estimated survival in 2018 was above average in every individual reach and all resulting combined reaches, though the estimate for the John Day to Bonneville reach was very uncertain (Table 4, Figures 2 and 3). Mean estimated survival for steelhead from Lower Granite Dam tailrace to McNary Dam tailrace was 73.3% (95% CI: 67.2-79.4%). Mean estimated survival from McNary Dam tailrace to Bonneville Dam tailrace was 72.7% (50.8-94.7%). The combined Snake River steelhead survival estimate from the Snake River trap to Bonneville Dam tailrace was 52.4% (35.8-69.0%), which was above the long-term average of 45.6% (Table 5).

For wild Snake River steelhead, mean estimated survival from Lower Granite Dam tailrace to McNary Dam tailrace was 73.6% (95% CI: 58.9-88.3%), and from McNary Dam tailrace to Bonneville Dam tailrace was 82.2% (55.5-108.9%). Estimated survival from the Snake River trap to Lower Granite Dam tailrace was 84.8%, which resulted in estimated survival from the Snake River trap to Bonneville Dam tailrace of 51.3% (30.5-72.1%).

For PIT-tagged hatchery yearling Chinook salmon originating from the upper Columbia River in 2018, estimated survival from McNary Dam tailrace to Bonneville Dam tailrace was 74.9% (95% CI: 60.2-93.2%; Table 6), which was below the long-term average of 81.4%.

For PIT-tagged hatchery steelhead originating from the upper Columbia River in 2018, estimated survival from McNary Dam tailrace to Bonneville Dam tailrace was 116.1% (95% CI: 85.0-158.6%; Table 6). This estimate has high uncertainty; however, unlike Columbia River Chinook, even the low end of the confidence range is above the long-term average of 77.4%.

For fish released from upper Columbia River hatcheries, we cannot estimate survival in reaches upstream from McNary Dam (other than the overall reach from release to McNary Dam tailrace) because of limited PIT-tag detection capabilities at Mid-Columbia River PUD dams.

Estimated survival in 2018 of Snake River sockeye salmon (hatchery and wild combined) from the tailrace of Lower Granite Dam to the tailrace of Bonneville Dam was 64.3% (95% CI: 30.4-50.8%; Table 7). Estimated survival in 2018 of Columbia River sockeye salmon (hatchery and wild combined) from the tailrace of Rock Island Dam to the tailrace of Bonneville Dam was 66.7% (40.7%-61.5%; Table 7). Both estimates were above their respective long-term averages of 40.6% and 51.1%.

Our preliminary estimates of the percentage transported of non-tagged wild and hatchery spring-summer Chinook salmon smolts in 2018 are 44.1% and 45.4%, respectively. For steelhead, the estimates are 47.5% and 46.4% for wild and hatchery smolts, respectively. These estimates represent the percentage of smolts that arrived at Lower Granite Dam that were subsequently transported, either from Lower Granite Dam or downstream at Little Goose or Lower Monumental Dam.

Discussion

For Snake River yearling Chinook salmon in 2018, estimated survival from Lower Granite Dam tailrace to Bonneville Dam tailrace was 43.2%; this estimate is substantially below the long-term (1999-2018) average of 52.1%. Yearling Chinook survival through the hydropower system has been consistently below the mean for the past four years, despite a range of different environmental conditions within these years. These low system survival estimates seem to be driven mostly by poor survival in the McNary to Bonneville reach.

For Snake River steelhead in 2018, estimated survival from Lower Granite Dam tailrace to Bonneville Dam tailrace was 53.3%; above the long-term mean of 47.0% (Table 5). This above-average estimate follows three consecutive years of survival estimates below the mean.

Estimated survival of Snake River sockeye between Lower Granite Dam and Bonneville Dam tailrace was 64.3%, which is the third highest estimate we have in our time series (1998-2018). The component survival estimates for the Lower Granite Dam to McNary Dam reach and the McNary Dam to Bonneville Dam reach were both above average. This above-average estimate follows three consecutive years with very low survival. The Idaho Department of Fish and Game has adjusted their acclimation methods this year in order to address the causes of the low Snake River Sockeye survival from the past three years; their efforts almost certainly contributed to the higher survival estimate this year. Survival of juvenile Upper Columbia River sockeye in the McNary to Bonneville Dam reach was also above average.

Environmental conditions in 2018 resulted in a year with average water temperatures, but high flow and very high spill for most of the migration season. Mean flow at Little Goose Dam in 2018 during the main migration period (1 April–15 June) was 110.8 kcfs, which was well above the long-term (1993-2018) mean of 92.6 kcfs. Daily flow values were above long-term daily means for most of the migration period; daily flow approached the mean for a brief period in early May and fell below the mean after the beginning of June (Figure 4). Mean water temperature at Little Goose Dam in 2018 during the migration period was 11.5 °C, which was near the long-term mean of 11.2 °C. Daily water temperatures generally tracked the long-term daily mean, alternating between slightly above and slightly below the mean through April and May, then remaining slightly above the long-term mean during June (Figure 4).

Mean spill discharge at the Snake River dams during the 2018 migration was 41.3 kcfs, which was substantially above the long-term (1993-2018) mean of 27.7 kcfs. Daily spill discharges remained above the long-term daily mean throughout April and May, with peaks in early May and again near the end of May (Figure 5).

Spill as a percentage of flow at Snake River dams averaged 37.2% in 2018, which was above the long-term (1993-2018) mean of 27.2. Daily mean spill percentages in 2018 were above the long-term daily means for almost the entire migration period (Figure 5), with higher percent spill during early April than in any previous year.

Estimated percentages of yearling Chinook salmon and steelhead transported from Snake River dams in 2018 were substantially higher than in most recent years; 2018 saw one of the highest transportation rates since 2006 (Figure 7). This reversed the recent trend of very low transportation rates seen from 2015-2017.

In 2018, collection of transportation began on 23 April at Lower Granite, Little Goose, and Lower Monumental Dams, which was 8 days earlier than the May 1st start date from most recent years, and the earliest start date for the transportation program since 2006. We estimate that 45% of the annual total passage of wild yearling Chinook and 24% of hatchery yearling Chinook occurred at Lower Granite Dam before transportation began (Figure 6), compared to averages between 2006-2014 of 42% and 31%, respectively. It is worth noting that the percentages passing in 2018 are near average, despite the fact that transportation began earlier in 2018 than in any year in that period except 2006. We estimate that 38% of wild steelhead arrived before transportation began in 2018 (Figure 6), versus the 2006-2014 average of 29%, and 24% of hatchery steelhead versus the average of 33%.

After the beginning of transportation in 2018, higher-than-average proportions of smolts were collected for transportation. This was due to the combination of spill operations and river conditions experienced by the fish as they passed the collector dams. The combination of early transportation start date and relatively higher collection proportions during transportation resulted in the increased percentages of smolts transported in 2018.

Median estimated travel times for both species between Lower Granite Dam and Bonneville Dam in April in 2018 continued the trend from recent years and were substantially shorter than the long-term mean for most of the migration period (1997-2017; Figure 8). These short travel times coincided with the generally high flows and spills in 2018. When flow levels declined at the beginning of June, travel times converged with the mean of recent years.

Since the institution of court-ordered spill in 2006, and the concurrent installation of surface collectors at four additional federal dams during that period, travel times have decreased on average between Lower Granite and Bonneville dams for steelhead, but the effect is less apparent for Chinook (Figure 8). Differences in travel times for low-flow years versus other years are not so well pronounced for either species (Figure 8). Day in season is a stronger predictor of travel time for Chinook than either flow or spill. Some of the lowest flow years were also low-spill years that occurred before the new spill regime, so the effect of average flow on travel time is difficult to separate from that of spill by simply inspecting the figures without the assistance of a statistical model. Flow and spill also vary within season, so categorizing years by seasonal averages is not optimal, but it does allow for some simple visual comparisons.

cc: F/NWC3 – Faulkner
F/NWC3 – Marsh
F/NWC3 – Smith
F/NWC3 – Widener
F/NWC3 – Zabel

Table 1. Estimated survival and standard error (s.e.) for yearling **Chinook** salmon released at Snake River Basin and Upper Columbia River hatcheries to Lower Granite Dam tailrace (LGR) and McNary Dam tailrace (MCN), 2016 through 2018.

	2016		2017		2018[a]	
Hatchery	Survival to LGR (s.e.)	Survival to MCN (s.e.)	Survival to LGR (s.e.)	Survival to MCN (s.e.)	Survival to LGR (s.e.)	Survival to MCN (s.e.)
Dworshak	0.714 (0.007)	0.538 (0.014)	0.693 (0.013)	0.402 (0.015)	0.744 (0.015)	0.546 (0.023)
Kooskia	0.684 (0.012)	0.499 (0.029)	0.565 (0.025)	0.351 (0.040)	0.633 (0.030)	0.438 (0.044)
Lookingglass (Catherine Cr.)	0.371 (0.005)	0.300 (0.016)	0.420 (0.014)	0.303 (0.024)	0.314 (0.008)	0.232 (0.024)
Lookingglass (Grande Ronde)	0.429 (0.016)	0.326 (0.044)	0.398 (0.032)	0.352 (0.096)	0.347 (0.013)	0.238 (0.043)
Lookingglass (Imnaha River)	0.704 (0.007)	0.526 (0.022)	0.585 (0.020)	0.438 (0.041)	0.651 (0.012)	0.429 (0.034)
Lookingglass (Lostine River)	0.586 (0.017)	0.419 (0.039)	0.553 (0.029)	0.409 (0.067)	0.600 (0.014)	0.418 (0.057)
McCall (Johnson Cr.)	---	---	---	---	0.487 (0.029)	0.370 (0.104)
McCall (Knox Bridge)	0.654 (0.006)	0.514 (0.014)	0.700 (0.012)	0.528 (0.021)	0.702 (0.011)	0.519 (0.026)
Pahsimeroi	0.772 (0.008)	0.512 (0.026)	0.746 (0.012)	0.560 (0.041)	0.634 (0.015)	0.342 (0.034)
Rapid River	0.815 (0.005)	0.632 (0.015)	0.652 (0.010)	0.528 (0.020)	0.651 (0.009)	0.491 (0.023)
Sawtooth	0.676 (0.006)	0.474 (0.015)	0.606 (0.010)	0.466 (0.025)	0.519 (0.013)	0.372 (0.029)
Entiat	---	0.631 (0.024)	---	0.639 (0.040)	---	0.572 (0.037)
Winthrop	---	0.577 (0.022)	---	0.578 (0.031)	---	0.587 (0.046)
Leavenworth	---	0.501 (0.016)	---	0.540 (0.022)	---	0.658 (0.038)

a. Estimates are preliminary and subject to change.

Table 2. Annual weighted means of survival probability estimates for yearling **Chinook** salmon (hatchery and wild combined), 1995–2018. Standard errors in parentheses. Reaches with asterisks comprise two dams and reservoirs (i.e., two projects); the following column gives the square root (i.e., geometric mean) of the two–project estimate to facilitate comparison with other single–project estimates. Abbreviations: Trap–Snake River Trap; LGR–Lower Granite Dam; LGO–Little Goose Dam; LMO–Lower Monumental Dam; IHR–Ice Harbor Dam; MCN–McNary Dam; JDA–John Day Dam; TDA–The Dalles Dam; BON–Bonneville Dam. Simple arithmetic means across all available years (1993–2018) are given.

Year	Trap–LGR	LGR–LGO	LGO–LMO	LMO–MCN*	LMO–IHR IHR–MCN	MCN–JDA	JDA–BON*	JDA–TDA TDA–BON
1995	0.905 (0.010)	0.882 (0.004)	0.925 (0.008)	0.876 (0.038)	0.936	NA	NA	NA
1996	0.977 (0.025)	0.926 (0.006)	0.929 (0.011)	0.756 (0.033)	0.870	NA	NA	NA
1997	NA	0.942 (0.018)	0.894 (0.042)	0.798 (0.091)	0.893	NA	NA	NA
1998	0.925 (0.009)	0.991 (0.006)	0.853 (0.009)	0.915 (0.011)	0.957	0.822 (0.033)	NA	NA
1999	0.940 (0.009)	0.949 (0.002)	0.925 (0.004)	0.904 (0.007)	0.951	0.853 (0.027)	0.814 (0.065)	0.902
2000	0.929 (0.014)	0.938 (0.006)	0.887 (0.009)	0.928 (0.016)	0.963	0.898 (0.054)	0.684 (0.128)	0.827
2001	0.954 (0.015)	0.945 (0.004)	0.830 (0.006)	0.708 (0.007)	0.841	0.758 (0.024)	0.645 (0.034)	0.803
2002	0.953 (0.022)	0.949 (0.006)	0.980 (0.008)	0.837 (0.013)	0.915	0.907 (0.014)	0.840 (0.079)	0.917
2003	0.993 (0.023)	0.946 (0.005)	0.916 (0.011)	0.904 (0.017)	0.951	0.893 (0.017)	0.818 (0.036)	0.904
2004	0.893 (0.009)	0.923 (0.004)	0.875 (0.012)	0.818 (0.018)	0.904	0.809 (0.028)	0.735 (0.092)	0.857
2005	0.919 (0.015)	0.919 (0.003)	0.886 (0.006)	0.903 (0.010)	0.950	0.772 (0.029)	1.028 (0.132)	1.014
2006	0.952 (0.011)	0.923 (0.003)	0.934 (0.004)	0.887 (0.008)	0.942	0.881 (0.020)	0.944 (0.030	0.972
2007	0.943 (0.028)	0.938 (0.006)	0.957 (0.010)	0.876 (0.012)	0.936	0.920 (0.016)	0.824 (0.043)	0.908
2008	0.992 (0.018)	0.939 (0.006)	0.950 (0.011)	0.878 (0.016)	0.937	1.073 (0.058)	0.558 (0.082)	0.750
2009	0.958 (0.010)	0.940 (0.006)	0.982 (0.009)	0.855 (0.011)	0.925	0.866 (0.042)	0.821 (0.043)	0.906
2010	0.968 (0.040)	0.962 (0.011)	0.973 (0.019)	0.851 (0.017)	0.922	0.947 (0.021)	0.780 (0.039)	0.883
2011	0.943 (0.009)	0.919 (0.007)	0.966 (0.008)	0.845 (0.012)	0.919	0.893 (0.026)	0.766 (0.080)	0.875
2012	0.928 (0.012)	0.907 (0.009)	0.939 (0.010)	0.937 (0.016)	0.968	0.915 (0.023)	0.866 (0.058)	0.931
2013	0.845 (0.031)	0.922 (0.012)	0.983 (0.014)	0.904 (0.022)	0.951	0.938 (0.058)	0.827 (0.043)	0.909
2014	0.905 (0.015)	0.940 (0.007)	0.919 (0.010)	0.894 (0.017)	0.946	0.912 (0.053)	0.752 (0.104)	0.867
2015	0.909 (0.103)	0.857 (0.036)	0.964 (0.057)	0.802 (0.033)	0.896	0.724 (0.069)	0.937 (0.160)	0.968
2016	0.936 (0.015)	0.956 (0.006)	0.912 (0.100)	0.872 (0.013)	0.934	0.796 (0.039)	0.871 (0.047)	0.933
2017	NA	0.916 (0.009)	0.908 (0.013)	0.912 (0.024)	0.956	0.720 (0.041)	0.871 (0.200)	0.933
2018[a]	0.880 (0.022)	0.942 (0.013)	0.917 (0.019)	0.877 (0.036)	0.936	0.770 (0.074)	0.743 (0.100)	0.862
Mean[b]	**0.930 (0.008)**	**0.928 (0.006)**	**0.922 (0.009)**	**0.863 (0.011)**	**0.929 (0.006)**	**0.860 (0.019)**	**0.806 (0.024)**	**0.896 (0.014)**

a. Estimates are preliminary and subject to change.
b. For each river segment, simple arithmetic mean is across all years for which estimates are available for that segment. Annual estimates for 1993 and 1994 are omitted from the table for space.

Table 3. Hydropower system survival estimates derived by combining empirical survival estimates from various reaches for Snake River yearling **Chinook** salmon (hatchery and wild combined), 1997–2018. Standard errors in parentheses. Abbreviations: Trap–Snake River Trap; LGR–Lower Granite Dam; MCN–McNary Dam; BON–Bonneville Dam.

Year	Trap–LGR	LGR-MCN	MCN-BON	LGR–BON	Trap–BON
1997	NA	0.653 (0.072)	NA	NA	NA
1998	0.924 (0.011)	0.770 (0.009)	NA	NA	NA
1999	0.940 (0.009)	0.792 (0.006)	0.704 (0.058)	0.557 (0.046)	0.524 (0.043)
2000	0.929 (0.014)	0.760 (0.012)	0.640 (0.122)	0.486 (0.093)	0.452 (0.087)
2001	0.954 (0.015)	0.556 (0.009)	0.501 (0.027)	0.279 (0.016)	0.266 (0.016)
2002	0.953 (0.022)	0.757 (0.009)	0.763 (0.079)	0.578 (0.060)	0.551 (0.059)
2003	0.993 (0.023)	0.731 (0.010)	0.728 (0.030)	0.532 (0.023)	0.528 (0.026)
2004	0.893 (0.009)	0.666 (0.011)	0.594 (0.074)	0.395 (0.050)	0.353 (0.045)
2005	0.919 (0.015)	0.732 (0.009)	0.788 (0.093)	0.577 (0.068)	0.530 (0.063)
2006	0.952 (0.011)	0.764 (0.007)	0.842 (0.021)	0.643 (0.017)	0.612 (0.018)
2007	0.943 (0.028)	0.783 (0.006)	0.763 (0.044)	0.597 (0.035)	0.563 (0.037)
2008	0.992 (0.018)	0.782 (0.011)	0.594 (0.066)	0.465 (0.052)	0.460 (0.052)
2009	0.958 (0.010)	0.787 (0.007)	0.705 (0.031)	0.555 (0.025)	0.531 (0.025)
2010	0.968 (0.040)	0.772 (0.012)	0.738 (0.039)	0.569 (0.032)	0.551 (0.038)
2011	0.943 (0.009)	0.746 (0.010)	0.687 (0.065)	0.513 (0.049)	0.483 (0.046)
2012	0.928 (0.012)	0.790 (0.016)	0.802 (0.051)	0.634 (0.042)	0.588 (0.040)
2013	0.845 (0.031)	0.781 (0.016)	0.792 (0.071)	0.622 (0.052)	0.525 (0.048)
2014	0.905 (0.015)	0.768 (0.015)	0.715 (0.107)	0.549 (0.083)	0.497 (0.075)
2015	0.909 (0.103)	0.680 (0.035)	0.629 (0.043)	0.428 (0.037)	0.389 (0.055)
2016	0.936 (0.015)	0.752 (0.011)	0.672 (0.060)	0.505 (0.046)	0.473 (0.043)
2017	NA	0.743 (0.019)	0.643 (0.157)	0.478 (0.117)	NA
2018[a]	0.880 (0.022)	0.733 (0.025)	0.590 (0.045)	0.432 (0.036)	0.381 (0.033)
Mean[b]	**0.930 (0.008)**	**0.738 (0.012)**	**0.695 (0.019)**	**0.521 (0.020)**	**0.489 (0.020)**

a. Estimates are preliminary and subject to change.
b. For each river segment, simple arithmetic mean is across all years for which estimates are available for that segment. Annual estimates for 1993-1996 are omitted from the table for space.

Table 4. Annual weighted means of survival probability estimates for **steelhead** (hatchery and wild combined), 1995–2018. Standard errors in parentheses. Reaches with asterisks comprise two dams and reservoirs (i.e., two projects); the following column gives the square root (i.e., geometric mean) of the two–project estimate to facilitate comparison with other single–project estimates. Abbreviations: Trap–Snake River Trap; LGR–Lower Granite Dam; LGO–Little Goose Dam; LMO–Lower Monumental Dam; IHR–Ice Harbor Dam; MCN–McNary Dam; JDA–John Day Dam; TDA–The Dalles Dam; BON–Bonneville Dam. Simple arithmetic means across all available years (1993–2018) are given.

Year	Trap–LGR	LGR–LGO	LGO–LMO	LMO–MCN*	LMO–IHR IHR–MCN	MCN–JDA	JDA–BON*	JDA–TDA TDA–BON
1995	0.945 (0.008)	0.899 (0.005)	0.962 (0.011)	0.858 (0.076)	0.926	NA	NA	NA
1996	0.951 (0.015)	0.938 (0.008)	0.951 (0.014)	0.791 (0.052)	0.889	NA	NA	NA
1997	0.964 (0.015)	0.966 (0.006)	0.902 (0.020)	0.834 (0.065)	0.913	NA	NA	NA
1998	0.924 (0.009)	0.930 (0.004)	0.889 (0.006)	0.797 (0.018)	0.893	0.831 (0.031)	0.935 (0.103)	0.967
1999	0.908 (0.011)	0.926 (0.004)	0.915 (0.006)	0.833 (0.011)	0.913	0.920 (0.033)	0.682 (0.039)	0.826
2000	0.964 (0.013)	0.901 (0.006)	0.904 (0.009)	0.842 (0.016)	0.918	0.851 (0.045)	0.754 (0.045)	0.868
2001	0.911 (0.007)	0.801 (0.010)	0.709 (0.008)	0.296 (0.010)	0.544	0.337 (0.025)	0.753 (0.063)	0.868
2002	0.895 (0.015)	0.882 (0.011)	0.882 (0.018)	0.652 (0.031)	0.807	0.844 (0.063)	0.612 (0.098)	0.782
2003	0.932 (0.015)	0.947 (0.005)	0.898 (0.012)	0.708 (0.018)	0.841	0.879 (0.032)	0.630 (0.066)	0.794
2004	0.948 (0.004)	0.860 (0.006)	0.820 (0.014)	0.519 (0.035)	0.720	0.465 (0.078)	NA	NA
2005	0.967 (0.004)	0.940 (0.004)	0.867 (0.009)	0.722 (0.023)	0.850	0.595 (0.040)	NA	NA
2006	0.920 (0.013)	0.956 (0.004)	0.911 (0.006)	0.808 (0.017)	0.899	0.795 (0.045)	0.813 (0.083)	0.902
2007	1.016 (0.026)	0.887 (0.009)	0.911 (0.022)	0.852 (0.030)	0.923	0.988 (0.098)	0.579 (0.059)	0.761
2008	0.995 (0.018)	0.935 (0.007)	0.961 (0.014)	0.776 (0.017)	0.881	0.950 (0.066)	0.742 (0.045)	0.861
2009	1.002 (0.011)	0.972 (0.005)	0.942 (0.008)	0.863 (0.014)	0.929	0.951 (0.026)	0.900 (0.079)	0.949
2010	1.017 (0.030)	0.965 (0.028)	0.984 (0.044)	0.876 (0.032)	0.936	0.931 (0.051)	0.840 (0.038)	0.917
2011	0.986 (0.017)	0.955 (0.004)	0.948 (0.010)	0.772 (0.014)	0.879	0.960 (0.043)	0.858 (0.051)	0.926
2012	1.001 (0.026)	0.959 (0.006)	0.914 (0.011)	0.811 (0.022)	0.901	0.814 (0.048)	1.021 (0.148)	1.010
2013	0.973 (0.032)	0.921 (0.020)	0.977 (0.020)	0.739 (0.031)	0.860	0.799 (0.025)	1.026 (0.154)	1.013
2014	1.018 (0.028)	0.953 (0.009)	0.947 (0.024)	0.836 (0.032)	0.914	1.082 (0.080)	0.982 (0.147)	0.991
2015	0.874 (0.046)	0.848 (0.039)	0.834 (0.060)	0.939 (0.073)	0.969	0.792 (0.066)	0.842 (0.050)	0.918
2016	0.998 (0.016)	0.990 (0.007)	0.918 (0.016)	0.813 (0.025)	0.902	0.927 (0.074)	0.709 (0.071)	0.842
2017	NA	0.962 (0.008)	0.943 (0.015)	0.849 (0.022)	0.921	0.941 (0.020)	0.643 (0.040)	0.802
2018[a]	0.983 (0.025)	0.953 (0.007)	0.950 (0.016)	0.823 (0.036)	0.907	0.847 (0.068)	0.949 (0.137)	0.974
Mean[b]	**0.952 (0.011)**	**0.930 (0.010)**	**0.909 (0.012)**	**0.775 (0.027)**	**0.876 (0.018)**	**0.833 (0.038)**	**0.804 (0.032)**	**0.893 (0.018)**

a. Estimates are preliminary and subject to change.
b. For each river segment, simple arithmetic mean is across all years for which estimates are available for that segment. Annual estimates for 1993 and 1994 are omitted from the table for space.

Table 5. Hydropower system survival estimates derived by combining empirical survival estimates from various reaches for Snake River **steelhead** (hatchery and wild combined), 1997–2018. Standard errors in parentheses. Abbreviations: Trap–Snake River Trap; LGR–Lower Granite Dam; MCN–McNary Dam; BON–Bonneville Dam.

Year	Trap–LGR	LGR-MCN	MCN-BON	LGR–BON	Trap–BON
1997	0.964 (0.015)	0.728 (0.053)	0.651 (0.082)	0.474 (0.069)	0.457 (0.067)
1998	0.924 (0.009)	0.649 (0.013)	0.770 (0.081)	0.500 (0.054)	0.462 (0.050)
1999	0.908 (0.011)	0.688 (0.010)	0.640 (0.024)	0.440 (0.018)	0.400 (0.017)
2000	0.964 (0.013)	0.679 (0.016)	0.580 (0.040)	0.393 (0.034)	0.379 (0.033)
2001	0.911 (0.007)	0.168 (0.006)	0.250 (0.016)	0.042 (0.003)	0.038 (0.003)
2002	0.895 (0.015)	0.536 (0.025)	0.488 (0.090)	0.262 (0.050)	0.234 (0.045)
2003	0.932 (0.015)	0.597 (0.013)	0.518 (0.015)	0.309 (0.011)	0.288 (0.012)
2004	0.948 (0.004)	0.379 (0.023)	NA	NA	NA
2005	0.967 (0.004)	0.593 (0.018)	NA	NA	NA
2006	0.920 (0.013)	0.702 (0.016)	0.648 (0.079)	0.455 (0.056)	0.418 (0.052)
2007	1.016 (0.026)	0.694 (0.020)	0.524 (0.064)	0.364 (0.045)	0.369 (0.047)
2008	0.995 (0.018)	0.716 (0.015)	0.671 (0.034)	0.480 (0.027)	0.478 (0.028)
2009	1.002 (0.011)	0.790 (0.013)	0.856 (0.074)	0.676 (0.059)	0.678 (0.060)
2010	1.017 (0.030)	0.770 (0.020)	0.789 (0.027)	0.608 (0.026)	0.618 (0.032)
2011	0.986 (0.017)	0.693 (0.013)	0.866 (0.038)	0.600 (0.029)	0.592 (0.030)
2012	1.001 (0.026)	0.698 (0.020)	0.856 (0.196)	0.597 (0.138)	0.598 (0.139)
2013	0.973 (0.032)	0.645 (0.026)	0.798 (0.112)	0.515 (0.075)	0.501 (0.075)
2014	1.018 (0.028)	0.740 (0.021)	1.023 (0.088)	0.757 (0.069)	0.771 (0.073)
2015	0.874 (0.046)	0.628 (0.033)	0.663 (0.039)	0.416 (0.033)	0.364 (0.034)
2016	0.998 (0.016)	0.730 (0.020)	0.608 (0.040)	0.444 (0.032)	0.443 (0.032)
2017	NA	0.759 (0.019)	0.605 (0.037)	0.459 (0.030)	NA
2018[a]	0.983 (0.025)	0.733 (0.031)	0.727 (0.112)	0.533 (0.085)	0.524 (0.085)
Mean[b]	**0.952 (0.011)**	**0.660 (0.028)**	**0.677 (0.038)**	**0.470 (0.035)**	**0.456 (0.038)**

a. Estimates are preliminary and subject to change.
b. For each river segment, simple arithmetic mean is across all years for which estimates are available for that segment. Annual estimates for 1993-1996 are omitted for space.

Table 6. Estimated survival and standard error (s.e.) through reaches of the lower Columbia River hydropower system for hatchery yearling **Chinook** salmon and **steelhead** originating in the upper Columbia River, 1999–2018. Abbreviations: Rel–Release site; MCN–McNary Dam; JDA–John Day Dam; BON–Bonneville Dam.

	Yearling Chinook Salmon				Steelhead			
Year	Rel–MCN	MCN-JDA	JDA-BON	MCN–BON	Rel–MCN	MCN-JDA	JDA-BON	MCN–BON
1999	0.572 (0.014)	0.896 (0.044)	0.795 (0.129)	0.712 (0.113)	NA	NA	NA	NA
2000	0.539 (0.025)	0.781 (0.094)	NA	NA	NA	NA	NA	NA
2001	0.428 (0.009)	0.881 (0.062)	NA	NA	NA	NA	NA	NA
2002	0.555 (0.003)	0.870 (0.011)	0.940 (0.048)	0.817 (0.041)	NA	NA	NA	NA
2003	0.625 (0.003)	0.900 (0.008)	0.977 (0.035)	0.879 (0.031)	0.471 (0.004)	0.997 (0.012)	0.874 (0.036)	0.871 (0.036)
2004	0.507 (0.005)	0.812 (0.019)	0.761 (0.049)	0.618 (0.038)	0.384 (0.005)	0.794 (0.021)	1.037 (0.112)	0.823 (0.088)
2005	0.545 (0.012)	0.751 (0.042)	NA	NA	0.399 (0.004)	0.815 (0.017)	0.827 (0.071)	0.674 (0.057)
2006	0.520 (0.011)	0.954 (0.051)	0.914 (0.211)	0.871 (0.198)	0.397 (0.008)	0.797 (0.026)	0.920 (0.169)	0.733 (0.134)
2007	0.584 (0.009)	0.895 (0.028)	0.816 (0.091)	0.730 (0.080)	0.426 (0.016)	0.944 (0.064)	0.622 (0.068)	0.587 (0.059)
2008	0.582 (0.019)	1.200 (0.085)	0.522 (0.114)	0.626 (0.133)	0.438 (0.015)	NA	NA	NA
2009	0.523 (0.013)	0.847 (0.044)	1.056 (0.143)	0.895 (0.116)	0.484 (0.018)	0.809 (0.048)	0.935 (0.133)	0.756 (0.105)
2010	0.660 (0.014)	0.924 (0.040)	0.796 (0.046)	0.735 (0.037)	0.512 (0.017)	0.996 (0.054)	0.628 (0.038)	0.626 (0.033)
2011	0.534 (0.010)	1.042 (0.047)	0.612 (0.077)	0.637 (0.077)	0.435 (0.012)	1.201 (0.064)	0.542 (0.101)	0.651 (0.119)
2012	0.576 (0.012)	0.836 (0.035)	1.140 (0.142)	0.953 (0.115)	0.281 (0.011)	0.862 (0.047)	1.240 (0.186)	1.069 (0.159)
2013	0.555 (0.013)	0.965 (0.050)	1.095 (0.129)	1.056 (0.117)	0.384 (0.020)	0.957 (0.071)	0.974 (0.104)	0.932 (0.099)
2014	0.571 (0.013)	0.974 (0.047)	0.958 (0.122)	0.933 (0.114)	0.468 (0.043)	0.883 (0.124)	0.807 (0.153)	0.712 (0.130)
2015	0.512 (0.015)	0.843 (0.043)	1.032 (0.081)	0.870 (0.062)	0.351 (0.019)	0.807 (0.084)	0.707 (0.073)	0.570 (0.043)
2016	0.610 (0.009)	0.857 (0.027)	0.942 (0.068)	0.807 (0.055)	0.416 (0.011)	0.771 (0.037)	0.633 (0.046)	0.487 (0.032)
2017	0.582 (0.013)	0.853 (0.030)	1.107 (0.142)	0.944 (0.120)	0.437 (0.025)	0.880 (0.062)	1.095 (0.210)	0.964 (0.188)
2018[a]	0.608 (0.016)	0.914 (0.044)	0.820 (0.096)	0.749 (0.084)	0.416 (0.021)	0.942 (0.062)	1.232 (0.194)	1.161 (0.186)
Mean[b]	**0.559 (0.012)**	**0.900 (0.022)**	**0.899 (0.042)**	**0.814 (0.031)**	**0.419 (0.014)**	**0.897 (0.029)**	**0.872 (0.057)**	**0.774 (0.050)**

a. Estimates are preliminary and subject to change.
b. For each river segment, simple arithmetic mean is across all years for which estimates are available for that segment.

Table 7. Estimated survival and standard error (s.e.) for **sockeye** salmon (hatchery and wild combined) from Lower Granite Dam tailrace to Bonneville Dam tailrace for fish originating in the Snake River, and from Rock Island Dam tailrace to Bonneville Dam tailrace for fish originating in the upper Columbia River, 1996–2018. Note that this table represents all available data on sockeye; estimates are provided regardless of the precision, which in some years was very poor. Abbreviations: LGR–Lower Granite Dam; MCN–McNary Dam; BON–Bonneville Dam; RIS–Rock Island Dam.

	Snake River Sockeye			Upper Columbia River Sockeye		
Year	LGR-MCN	MCN-BON	LGR-BON	RIS-MCN	MCN-BON	RIS-BON
1996	0.283 (0.184)	NA	NA	NA	NA	NA
1997	NA	NA	NA	0.397 (0.119)	NA	NA
1998	0.689 (0.157)	0.142 (0.099)	0.177 (0.090)	0.624 (0.058)	1.655 (1.617)	1.033 (1.003)
1999	0.655 (0.083)	0.841 (0.584)	0.548 (0.363)	0.559 (0.029)	0.683 (0.177)	0.382 (0.097)
2000	0.679 (0.110)	0.206 (0.110)	0.161 (0.080)	0.487 (0.114)	0.894 (0.867)	0.435 (0.410)
2001	0.205 (0.063)	0.105 (0.050)	0.022 (0.005)	0.657 (0.117)	NA	NA
2002	0.524 (0.062)	0.684 (0.432)	0.342 (0.212)	0.531 (0.044)	0.286 (0.110)	0.152 (0.057)
2003	0.669 (0.054)	0.551 (0.144)	0.405 (0.098)	NA	NA	NA
2004	0.741 (0.254)	NA	NA	0.648 (0.114)	1.246 (1.218)	0.808 (0.777)
2005	0.388 (0.078)	NA	NA	0.720 (0.140)	0.226 (0.209)	0.163 (0.147)
2006	0.630 (0.083)	1.113 (0.652)	0.820 (0.454)	0.793 (0.062)	0.767 (0.243)	0.608 (0.187)
2007	0.679 (0.066)	0.259 (0.084)	0.272 (0.073)	0.625 (0.046)	0.642 (0.296)	0.401 (0.183)
2008	0.763 (0.103)	0.544 (0.262)	0.404 (0.179)	0.644 (0.094)	0.679 (0.363)	0.437 (0.225)
2009	0.749 (0.032)	0.765 (0.101)	0.573 (0.073)	0.853 (0.076)	0.958 (0.405)	0.817 (0.338)
2010	0.723 (0.039)	0.752 (0.098)	0.544 (0.077)	0.778 (0.063)	0.627 (0.152)	0.488 (0.111)
2011	0.659 (0.033)	NA	NA	0.742 (0.088)	0.691 (0.676)	0.513 (0.498)
2012	0.762 (0.032)	0.619 (0.084)	0.472 (0.062)	0.945 (0.085)	0.840 (0.405)	0.794 (0.376)
2013	0.691 (0.043)	0.776 (0.106)	0.536 (0.066)	0.741 (0.068)	0.658 (0.217)	0.487 (0.155)
2014	0.873 (0.054)	0.817 (0.115)	0.713 (0.096)	0.428 (0.056)	0.565 (0.269)	0.242 (0.111)
2015	0.702 (0.054)	0.531 (0.151)	0.373 (0.037)	0.763 (0.182)	0.446 (0.200)	0.340 (0.130)
2016	0.523 (0.047)	0.227 (0.059)	0.119 (0.030)	0.807 (0.082)	0.545 (0.126)	0.448 (0.144)
2017	0.544 (0.081)	0.324 (0.107)	0.176 (0.055)	0.719 (0.113)	0.611 (0.181)	0.500 (0.332)
2018[a]	0.684 (0.061)	0.940 (0.151)	0.643 (0.088)	0.560 (0.112)	0.839 (0.095)	0.667 (0.144)
Mean[b]	**0.628 (0.034)**	**0.566 (0.070)**	**0.406 (0.052)**	**0.668 (0.031)**	**0.729 (0.074)**	**0.511 (0.053)**

a. Estimates are preliminary and subject to change.
b. For each river segment, simple arithmetic mean is across all years for which estimates are available for that segment.

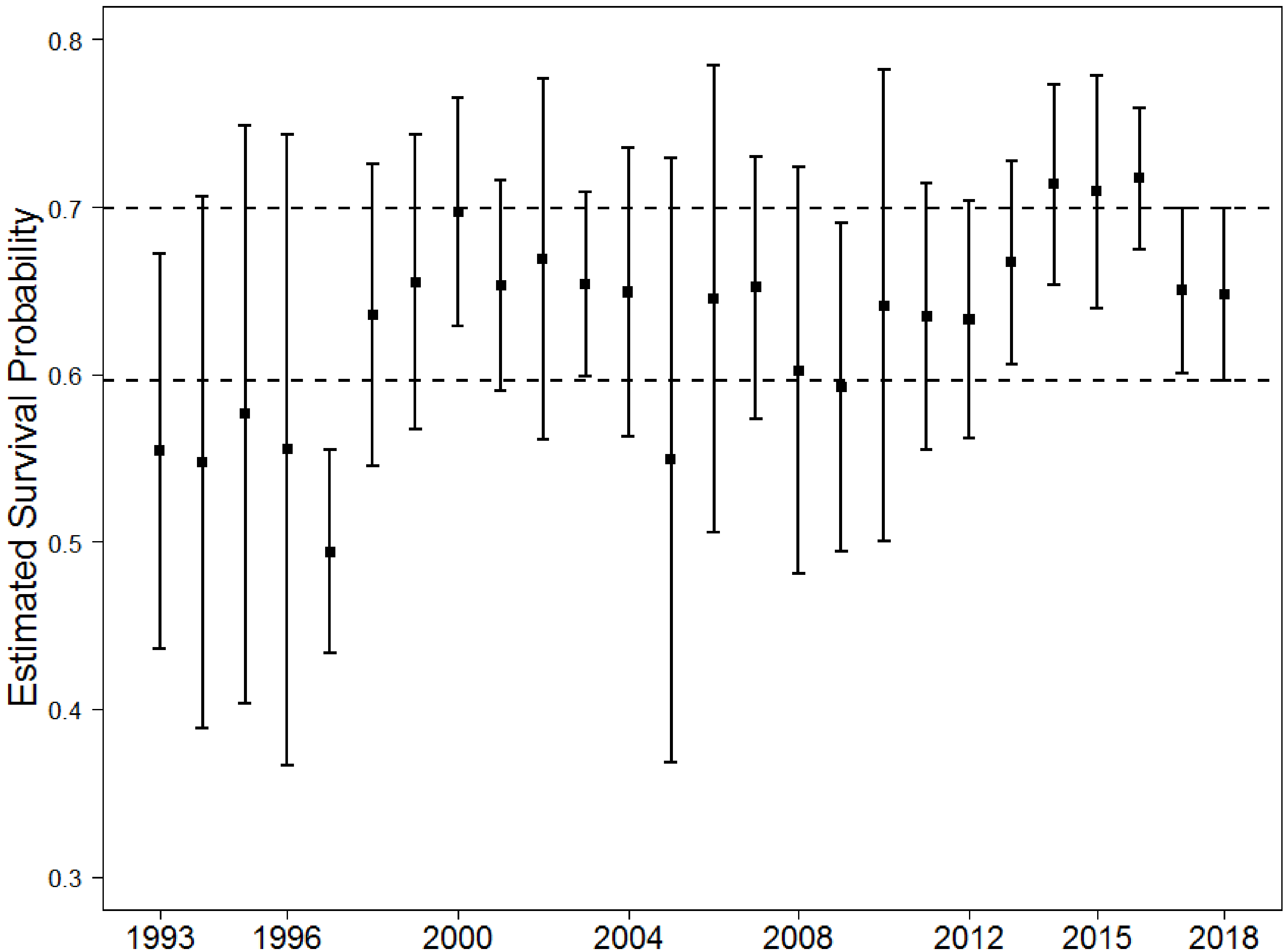


Figure 1. Annual average survival estimates from release to Lower Granite Dam for PIT-tagged yearling **Chinook** salmon released from Snake River Basin hatcheries, 1993-2018. Hatcheries used for average (index groups) are those with consistent PIT-tag releases through the series of years shown. Vertical bars represent 95% confidence intervals. Horizontal dashed lines are the 2018 confidence interval endpoints and are shown for comparison to other years.

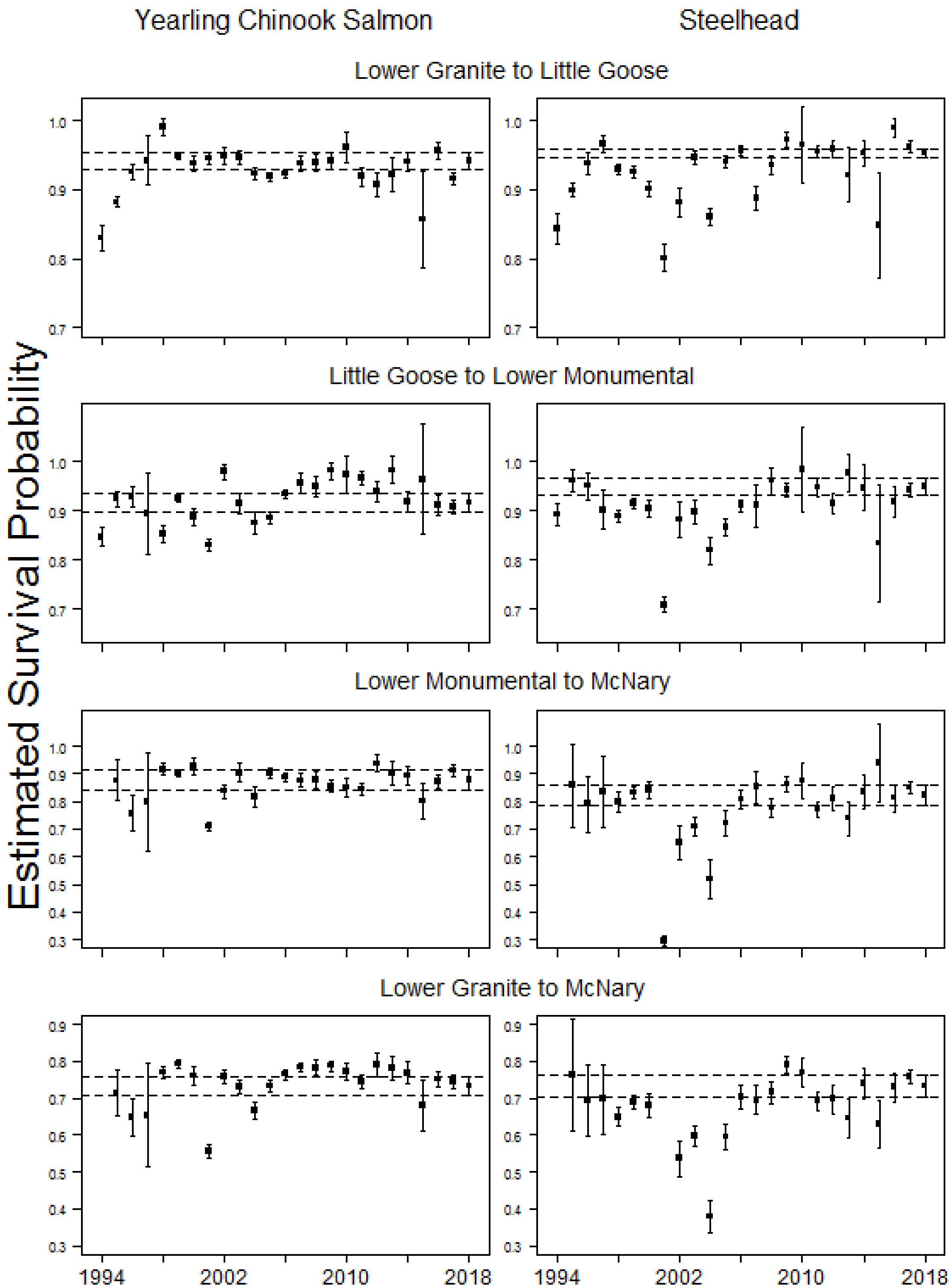


Figure 2. Annual average survival estimates for PIT-tagged yearling **Chinook** salmon and **steelhead**, hatchery and wild fish combined. Vertical bars represent 95% confidence intervals. Horizontal dashed lines are 95% confidence interval endpoints for 2018 estimates.

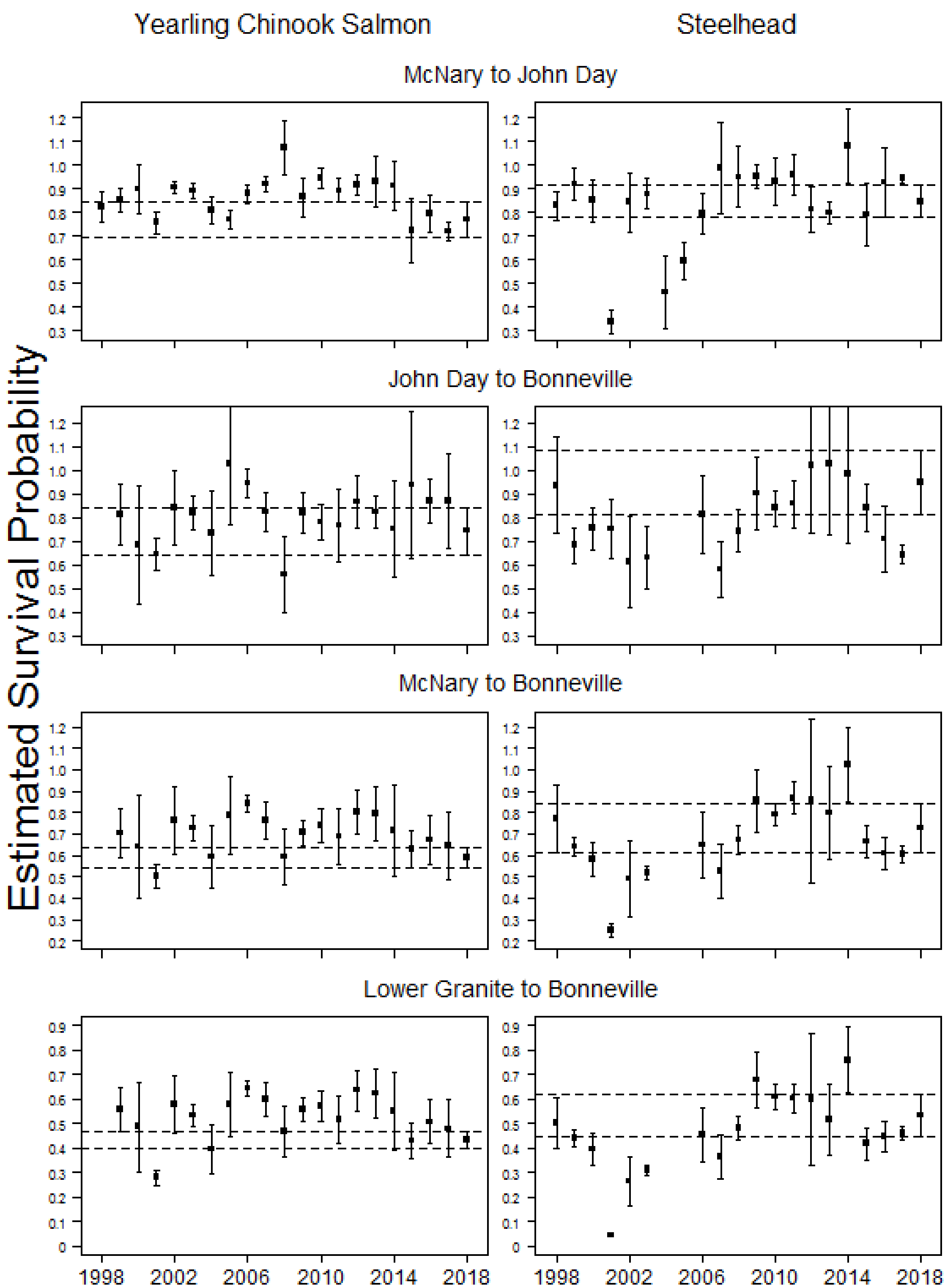
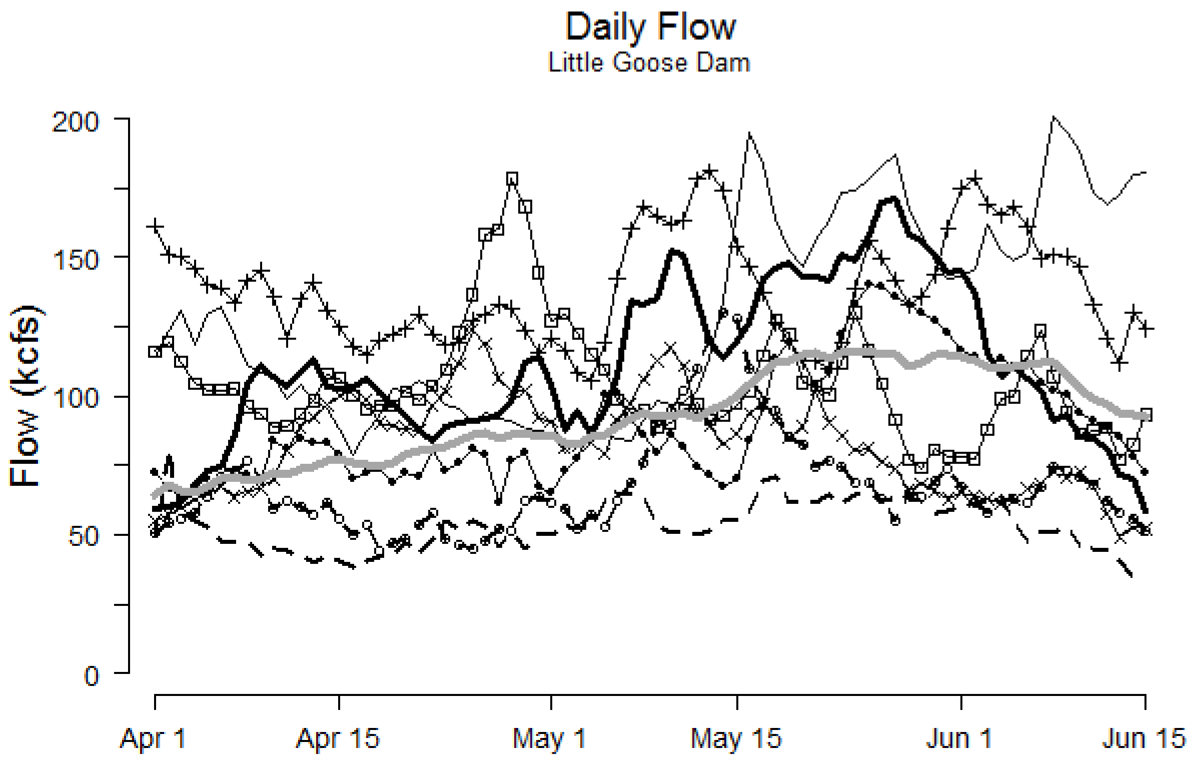


Figure 3. Annual average survival estimates for PIT-tagged yearling **Chinook** salmon and **steelhead**, hatchery and wild fish combined. Vertical bars represent 95% confidence intervals. Horizontal dashed lines are 95% confidence interval endpoints for 2018 estimates.



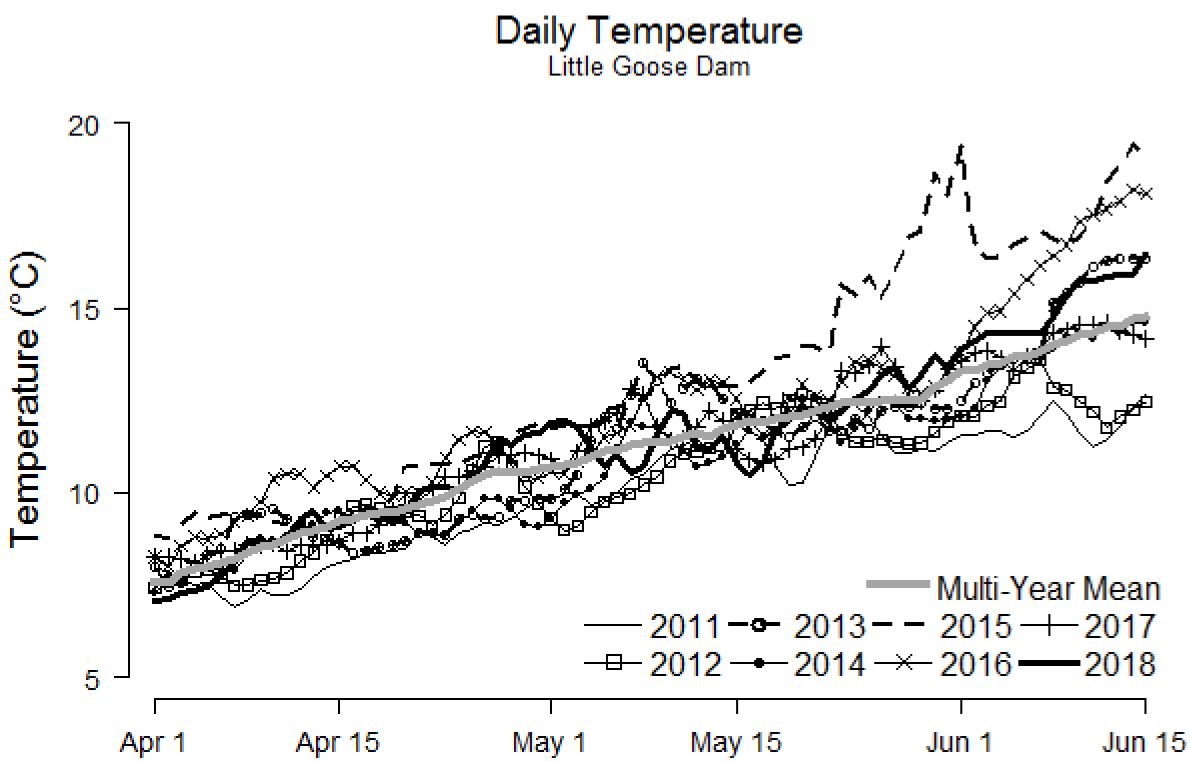


Figure 4. Snake River flow (kcfs; top panel) and water temperature (ºC; bottom panel) measured at Little Goose Dam during April and May, 2011-2018, including daily long-term means (1993-2018).

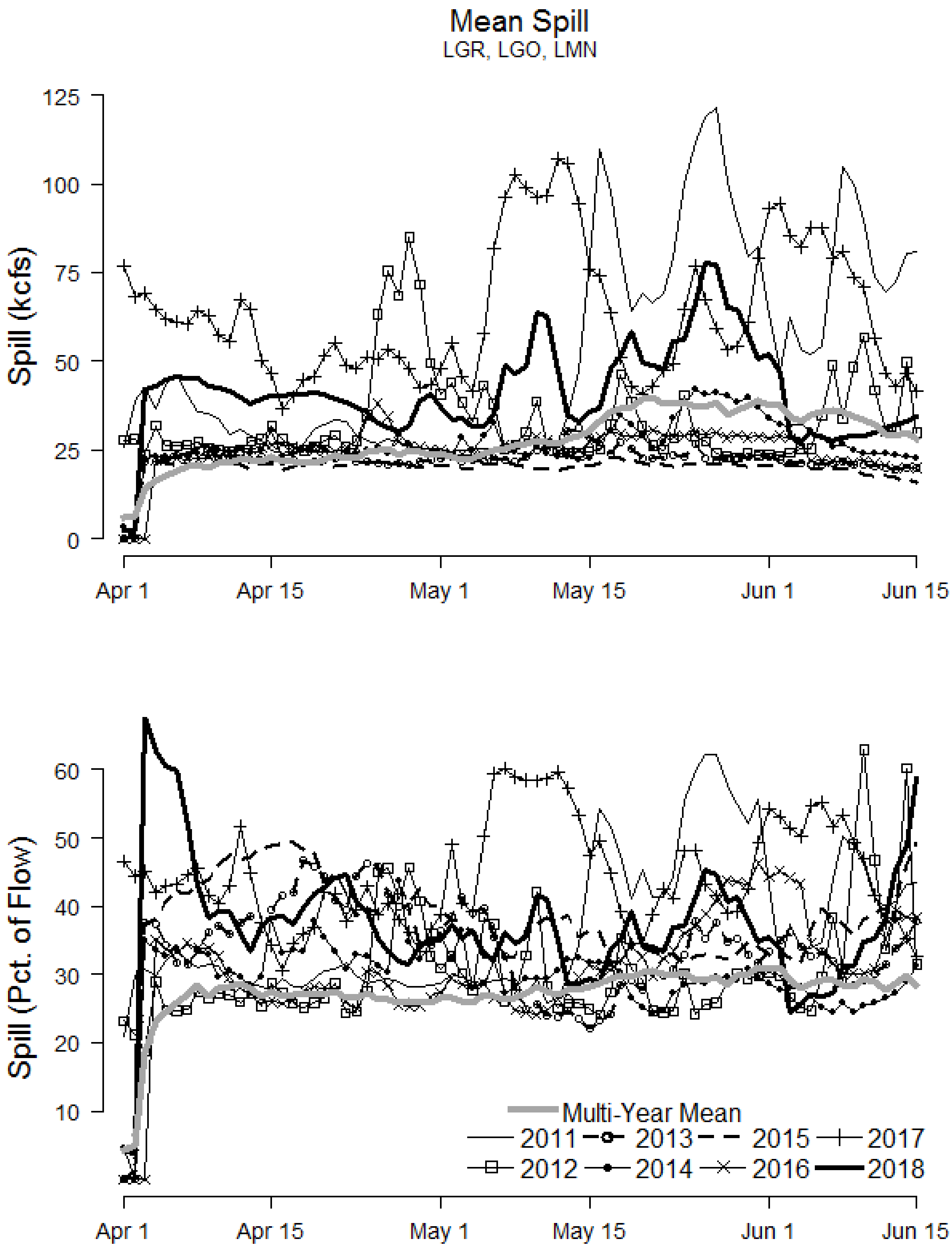


Figure 5. Mean spill (top panel shows kcfs; bottom panel shows percentage of total flow) at Snake River dams during April and May, 2011-2018, including daily long-term means (1993-2018).

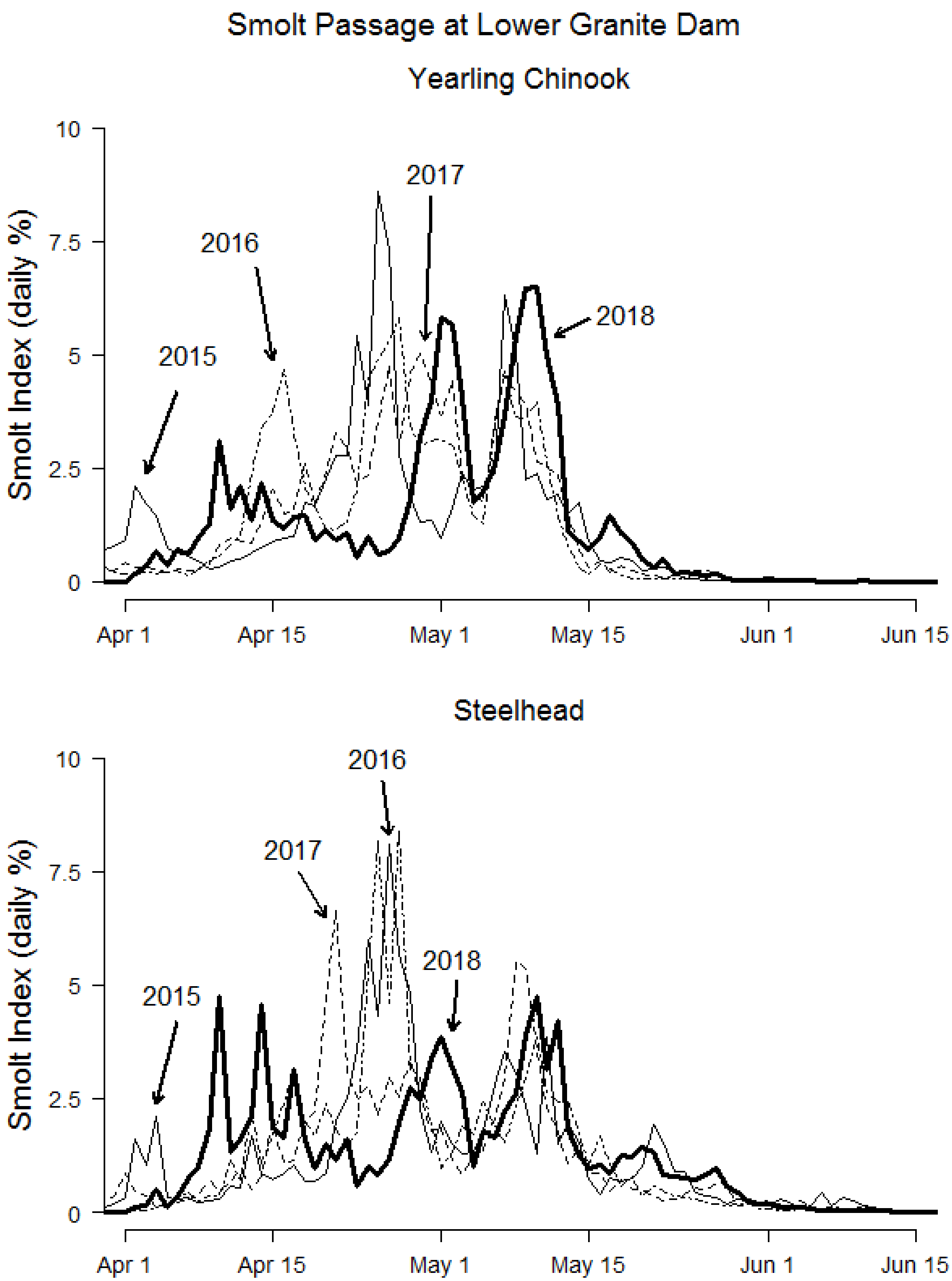


Figure 6. Smolt index as daily percentage of total passage at Lower Granite Dam 2015-2018 for hatchery and wild combined yearling **Chinook** and **steelhead**.

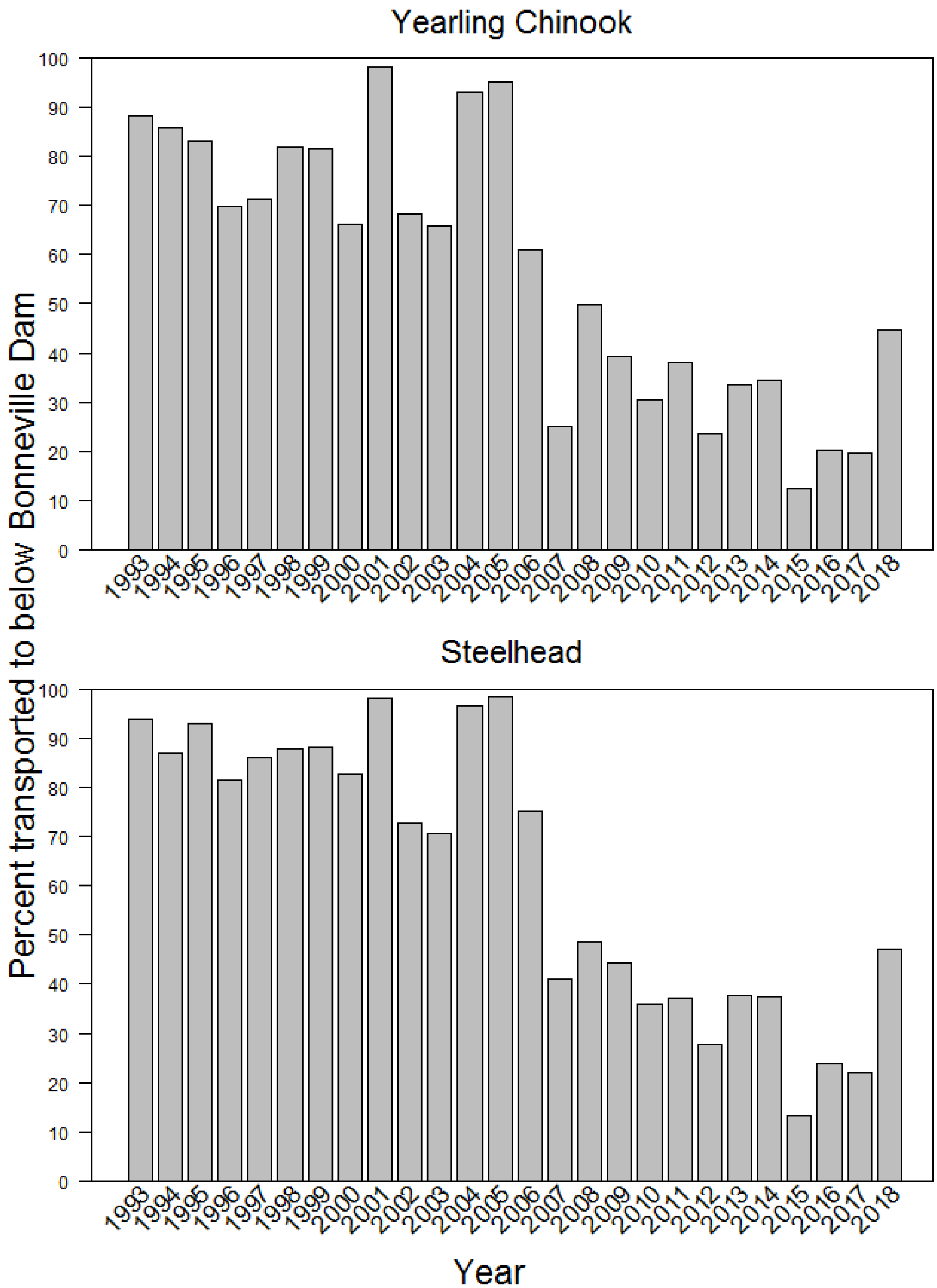


Figure 7. Estimated percent of yearling **Chinook** salmon and **steelhead** (hatchery and wild combined) transported to below Bonneville Dam by year (1993-2018).

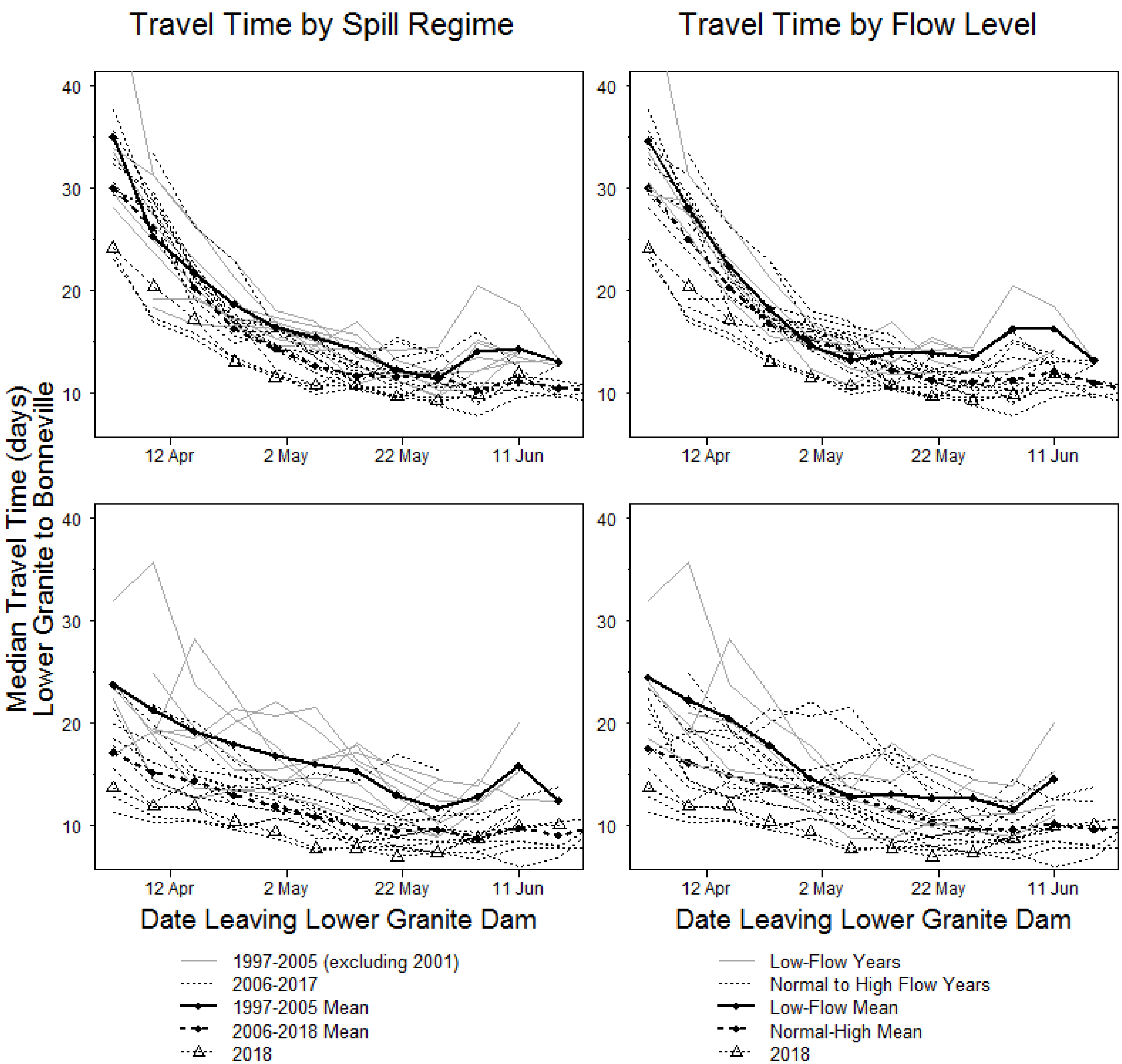


Figure 8. Median travel time from Lower Granite Dam to Bonneville Dam for yearling **Chinook** salmon and **steelhead** by spill regime (left) and mean flow category (right) in the period 1998-2018 (excluding 2001), with long-term mean for the same period. Here spill regime is defined by court-ordered spill starting in 2006 and the concurrent installation of additional surface collectors, and low-flow years are those with mean of 70 kcfs or less for the period of 1 April through 15 June. The 2001 migration year is excluded from the individual years and means due to its unusual combination of low flow and no spill and the influence that has on the group means.

American Rivers ◆ Center for Law and Policy ◆ Columbia Riverkeeper
Institute for Fisheries Resources ◆ National Wildlife Federation
Natural Resources Defense Council ◆ Northwest Sportfishing Industry Association
Pacific Coast Federation of Fishermen's Associations
Save Our wild Salmon Coalition ◆ Sierra Club

December 7, 2018

Maia Bellon, Director
Heather Bartlett, Water Quality Program Manager
P.O. Box 47600
Olympia, WA 98504-7600

Re: Scoping Notice for Short-term Modification of Total Dissolved Gas Standards for Federal Dams on the Lower Snake and Lower Columbia Rivers (Nov. 16, 2018)

Dear Director Bellon and Program Manager Bartlett:

The undersigned organizations submit these scoping comments in response to your Department's scoping notice of November 16, 2018 for a short-term modification of total dissolved gas (TDG) water quality standards for federal dams on the lower Snake and lower Columbia rivers through 2021.

A number of organizations, including some of the organizations signing this letter, submitted to you a request for a short-term modification of the TDG standards on September 13, 2018. A copy of that request is attached to these scoping comments and incorporated into these comment by this reference. We believe this letter describes the legal and scientific basis for a short-term modification of the TDG standards at the lower Snake and lower Columbia River dams for the "spring spill season" (from approximately April 1 through June 20) beginning in 2019 and continuing through spring 2020 and 2021.

As explained in that letter, your Department should eliminate on a short-term basis the current 115% forebay TDG limit at each dam and replace the existing 120% tailrace TDG limit with a limit of 125% for up to at least 16 hours per day or more starting in 2019. We urge you to include such an alternative in the forthcoming environmental impact statement pursuant to the above referenced scoping notice. We believe that upon examination of the best currently available scientific information about the effects of TDG levels up to 125% in the dam tailraces, and analysis of any other alternatives you chose to evaluate, you will conclude that a short-term modification of the TDG standards to 125% starting in 2019 is the best alternative to protect beneficial uses in the lower Snake and lower Columbia Rivers and that such a standard poses minimal or no risks to any designated use. It also will not have significant adverse environmental impacts.

As you acknowledge in your scoping notice, such a short-term modification is consistent with requests from the Washington Department of Wildlife, the Columbia River Inter-Tribal Fish Commission and recommendations from the Governor's Southern Resident Killer Whale Task Force. It could also easily be coordinated with a parallel modification of TDG standards by the State of Oregon that affect the federal dams on the lower Columbia River. Oregon's standards currently already allow TDG up to 120% as measured in the tailrace of the lower Columbia River dams on a 24-hour basis (the only dams directly affected by Oregon's standards). We understand that Oregon is in the process of considering increasing this tailrace TDG level to 125% on a flexible basis. Even if Oregon does not complete this change in time for the 2019 spring spill season, we expect it will complete such a change in time for the 2020 and 2021 spring spill seasons. In any event, a change in the TDG standards in Washington to allow spill up to 125% starting in 2019 on a flexible basis would still benefit juvenile salmonid survival and protect designated uses.

Basis for Considering a Short-term Modification of Water Quality Standards to Allow TDG Levels of Up to 125% on a Flexible Basis During the Spring Juvenile Salmon Migration Season Beginning in 2019 Through 2021.

We briefly summarize below our basis for asking you to develop and consider an alternative that would eliminate the current forebay TDG standard and allow TDG levels of up to 125% on a flexible basis below.

First, recent analyses by the Fish Passage center (FPC) confirm that voluntary spring spill at TDG levels of 125% in the tailrace of each dam is safe for downstream migrating juvenile salmon and steelhead and will further improve juvenile survival – and ultimately adult return rates – as compared to the lower levels of spill allowed under the current TDG exemptions. The most recent such analysis is set out in the FPC's Comparative Survival Study (CSS) 2017 Annual Report, especially in Chapter 2, "Life Cycle Modeling Evaluation of Alternative Spill and Breach Scenarios" and Chapter 3, "Effects of the In-River Environment on Juvenile Travel Time, Instantaneous Mortality Rates and Survival." As explained in this report, the CSS analysis is based on extensive data collected over many years and life cycle modeling that has been developed and reviewed by experts within the region since at least 2013. Rather than fully summarizing the technical details of this analysis here, we refer you to the CSS 2017 Annual Report which is available at: http://www.fpc.org/documents/CSS/CSS_2017_Final_ver1-1.pdf, and http://www.fpc.org/documents/CSS/CSS_2013_Workshop_Report_-_FINAL_w_presentations.pdf (containing detailed smolt-to-adult returns at various spill levels, flows and ocean conditions). As that analysis explains, allowing TDG of up to 125% in the tailrace of each dam would lead to a significant increase in smolt-to-adult return rates for Snake River spring/summer Chinook.[1] In addition, the 2017 CSS analysis concludes that TDG levels well above 125% are only a weak or non-factor in instantaneous mortality rates. Together, these conclusions are (a) more robust than similar conclusions Ecology has previously reviewed in connection with requests to modify its TDG standards; (b) have been reviewed by the Independent Scientific Advisory Board with suggestions for additional steps to strengthen the conclusions but without any fundamental disagreement with the CSS findings; and, (c) confirm that a short-term modification of Ecology's current TDG water quality standards for the lower Snake and lower Columbia River dams is scientifically well supported.

We would also refer you to the draft 2018 CSS Annual report for additional information. It is available at http://www.fpc.org/documents/CSS/DRAFT2018CSSReportv1-1.pdf. We would encourage you and your staff to schedule an in-person meeting with staff from the FPC to discuss any questions you may have about their analysis. After you review all of this evidence, we believe you will conclude that the spill volumes allowed by TDG levels up to 125 percent would provide the best and safest route of passage for juvenile and adult salmon and steelhead by allowing them to avoid higher turbine and screen bypass mortalities, reducing passage delay, and dispersing predators. Even though excessive spill *can* cause excessive TDG levels, which can in turn harm fish and other aquatic life, we believe state and federal laws require Ecology to set TDG limits that maximize

[1] *See* CSS 2017 Annual Report at 50 (Figure 2.10).

salmon survival by balancing the benefits of increased voluntary spring spill with the minimal or non-existent risks of harm from Gas Bubble Trauma ("GBT") to salmonids and other species.

Moreover, we are not aware of any scientific study in the last ten years or any anecdotal evidence that any non-salmonid aquatic biota in the Snake or Columbia Rivers have suffered harm from TDG levels above 125% even though these levels of TDG occur frequently in the lower Snake and lower Columbia rivers in the spring due to involuntary spill. This absence of evidence of harm suggests risks to any non-salmonid biota if TDG levels up to 125% is minimal or non-existent. In the absence of compelling new field evidence that the risks of higher levels of TDG, including 125 percent of saturation, are harmful to non-salmonid aquatic biota, the more robust evidence of the benefits to salmonids of increased spill as a result of a short-term modification of Ecology's TDG standards to 125 percent in the tailrace of each dam should lead Ecology to develop and choose an alternative in its SEPA process that approves a short-term modification of water quality standards to allow TDG up to 125% of saturation on a flexible basis during the spring salmon migrations season starting in 2019.

Of course, salmon are not the only anadromous species migrating through the hydrosystem. Pacific lamprey (*Lampetra tridentata*), for example, may also benefit from the short-term modification of the forebay and 120 percent tailrace TDG standards, a benefit to aquatic biota that Ecology may not have previously fully considered. Pacific lamprey have shown widespread decline since the 1960s in the Columbia River system due to habitat loss, water pollution, ocean conditions, and problems with dam passage.[2] Lamprey decline is of particular concern in the Northwest because of their importance to Native Americans' cultural heritage and tribal fisheries.[3] In fact, the lamprey's situation is perilous enough that the Oregon Natural Resources Council petitioned the USFWS to list the species under the Endangered Species Act in 2002. Although the USFWS denied the petition, claiming a lack of information, the USFWS has continued to voice concern over the status and distribution of Pacific lamprey.

We recognize that little information is available about precise juvenile lamprey survival benefits from increasing spill levels. However, it is highly likely that juvenile lamprey will benefit indirectly from increased spill. Juvenile lamprey are frequently impinged, and are injured or die, on the turbine intake screens meant to divert juvenile salmon into the bypass system; one study estimated a juvenile lamprey mortality rate of as high as 25 percent at dams with extended-length turbine intake screens.[4] When spill is reduced, more juvenile lamprey are forced through the screened bypass routes.[5] Indeed, the FPC has highlighted that reducing spill during spring lamprey migration:

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[2] Close, D.A., M. Fitzpatrick, H. Li, B. Parker, D. Hatch & G. James. 1995. Status report of the Pacific lamprey (*Lampetra tridentata*) in the Columbia River Basin.

[3] *Id.*; *see also* Nez Perce, Umatilla, Yakama and Warm Springs Tribes. 2008. Tribal Pacific Lamprey Restoration Plan for the Columbia River Basin. Formal Draft, p. 4.

[4] CRITFC, Pacific Lamprey Passage Design, Project No. 2008-524-00. FY 2008-2009 F&W Program Accords (MOA) Proposal Review. pp. 10 – 11; *see also* BioAnalysts, Inc. 2000. A Status of Pacific Lamprey in the Mid-Columbia Region. Rocky Reach Hydroelectric Project. FERC Project No. 214, pp. 26–27.

[5] Fish Passage Center, "Review of the NOAA Transportation analyses and potential effects of reducing spill for fish passage in May and beginning the transportation program earlier in the spring and supporting analyses". Feb. 9, 2010. pp. 2, 10–12. Available online at: http://www.fpc.org/documents/memos/15-10.pdf.

will be detrimental to lamprey, since elimination of spill will result in additional juvenile lamprey passage through screened power house bypass systems (Starke and Dalen 1995,1998; Moursand et al., 2000, 2001, 2002, 2003; Bleich and Moursand, 2006). Impingement of juvenile lamprey on turbine intake screens is a serious regional problem.[6]

We would encourage you to consult with the FPC and with the Nez Perce and other Tribes about the benefits of increased spill for lamprey as you develop your EIS for a short-term modification of the TDG standards.

As reflected in the recommendations of Governor Inslee's Orca Task Force, the increased spill allowed by a short-term modification of TDG standards to allow TDG up to 125% on a flexible basis would also provide immediate benefits for endangered Southern Resident Killer Whales. These whales rely on adult chinook salmon from the Columbia and Snake Rivers as an important prey resources at certain times of the year and these whales are nutritionally stressed. Whale scientists believe that increasing prey availability for these whales is crucial to halting and reversing their decline. Attached to this letter is a letter from a number of leading orca scientists addressing the importance of increased spill to orca survival. As they explain, allowing higher levels of TDG, and in turn higher levels of voluntary spring spill, will lead to higher juvenile survival and increased adult chinook return to the Columbia, especially spring/summer chinook, a priority prey resource for the whales.

A Short-Term Modification of Water Quality Standards to Allow TDG Levels of Up to 125% on a Flexible Basis is Consistent With and Supported by Washington law.

A short-term modification of WAC 173- 201A-200(1)(f)(ii) to allow TDG levels of up to 125% is consistent with the requirements of the regulations that allow such a modification. First, the modification is short-term. It is for a period of approximately 120 days each year for the next three years at each of the eight lower Snake and lower Columbia river dams. The actual periods of higher and lower TDG (and spill) pursuant to the short-term modification at each dam would depend on the details of the annual Spring Fish Operation Plan (FOP) for these dams developed and adopted in collaboration with the State of Washington and other sovereigns by the relevant federal agencies each year. The short-term modification would provide the flexibility for longer periods of spill to the higher 125 percent TDG level and other, shorter, periods of lower spill, likely during peak electricity demand hours. In addition, and in accordance with WAC 173-201A- 410(2), the duration of the short-term modification would only be for the spring juvenile salmon migration season, which may run from about March 1 to about June 30 each year depending on the details of the Spring FOP, and the modification would only be in place for three years or until Ecology adopts any permanent modification of the requirements of WAC 173- 201A-200(1)(f)(ii), whichever occurs sooner.

Second, a modification of the TDG standards to allow spill up to 125% is necessary to accommodate the essential activity of securing beneficial dam passage conditions for migrating juvenile salmon and steelhead in the spring while also allowing appropriate hydropower generation. Most of the salmonids that pass the dams and would be affected by the short-term modification have been listed as threatened or endangered under the Endangered Species Act for many years. As described above, increasingly robust scientific evidence indicates that increased spill, up to at least 125% TDG, increases salmonid survival. For this reason, a short-term modification also is in the public interest.

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[6] *Id.* at 10.

Third, a short-term modification to allow TDG levels up to 125% is conditioned to minimize or eliminate any degradation of water quality, existing uses, and designated uses in the affected waters. The modification would only apply during the spring juvenile salmonid migration season. During this time, TDG levels in the tailrace of each dam are often 125 percent or higher anyway, because of involuntary spill resulting from high spring runoff and low electricity demand. We are not aware of any field evidence that these annually occurring high levels of TDG—which vary from year-to-year depending on weather, snowpack and other factors—have significantly harmed water quality or existing or designated uses. Accordingly, due to the frequent unavoidable exceedances of the current TDG standards, the short-term modification we seek would likely affect dam operations and TDG levels for a considerably shorter time than indicated by the terms of the proposed modification.

Fourth, a short-term modification to allow TDG levels up to 125% in the dam tailraces would not reduce or remove the Corps' responsibility to otherwise comply with Washington's water quality standards at all times not subject to the short-term modification or alter the Corps' obligations and responsibilities under other federal, state, or local rules and regulations. In fact, such a short-term modification may help facilitate dam operations over the next few years under a biological opinion developed pursuant to the federal Endangered Species Act in order to avoid jeopardy to species of salmon and steelhead that are protected by that Act.

CONCLUSION

Voluntarily spilling water over the dams on the Snake and Columbia rivers during the spring juvenile migration season undeniably benefits salmon and steelhead. While spill can pose a risk to salmonids if TDG levels are too high, biological monitoring conducted over the last decade and more, as well as anecdotal evidence, demonstrates that tailrace TDG levels of 125 percent do not negatively impact migrating salmonids, resident fish, or invertebrates. By contrast, the TDG levels currently allowed under Washington's water quality standards unnecessarily limit the benefits of spill for juvenile salmon and steelhead migrating downstream in the spring. We thus urge you to develop and carefully consider in your EIS a short-term modification of water quality standards to allow TDG levels up to 125% of saturation in the tail race of each of the eight dams on the lower Snake and lower Columbia Rivers during the spring juvenile salmon migration season beginning in 2019 and continuing through at least 2021.

Thank you for your consideration of these scoping comments. Please contact Joseph Bogaard (joseph@wildsalmon.org / 206-300-1003) if you have any questions.

Sincerely,

Joseph Bogaard, executive director
Save Our wild Salmon Coalition
Seattle, Washington

Wendy McDermott, Salish Sea and Columbia Basin Director
American Rivers
Bellingham, Washington

Trish Rolfe, executive director
Center for Law and Policy
Seattle, Washington

Brett VandenHeuvel, Executive Director
Columbia Riverkeeper
Hood River, Oregon

Glen Spain, Northwest Regional Director
Institute for Fisheries Resources
Pacific Coast Federation of Fishermen's Associations
Eugene, Oregon

Giulia Good Stefani, attorney
Natural Resources Defense Council
Mosier, Oregon

Tom France, Regional Executive Director
National Wildlife Federation
Missoula, Montana

Liz Hamilton, executive director
Northwest Sportfishing Industry Association
Oregon City, Oregon

Bill Arthur, Northwest Salmon Campaign Director
Sierra Club
Seattle, Washington

COLUMBIA RIVERKEEPER®

Save Our wild Salmon

NSIA NORTHWEST SPORTFISHING INDUSTRY ASSOCIATION

September 13, 2018

Via Email and U.S. Mail

Ms. Maia Bellon, Director
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State of Washington
PO Box 47775
Olympia, WA 98504-7775

Ms. Heather Bartlett
Water Quality Program Manager
Department of Ecology
State of Washington
PO Box 47775
Olympia, WA 98504-7775

RE: Request for Short-Term Modification of WAC 173-201A-200(1)(f)(ii)

Dear Ms. Bellon and Ms. Bartlett:

Pursuant to WAC 173-201A-410(1) and (2), the Northwest Sportfishing Industry Association, Columbia Riverkeeper, and Save Our Wild Salmon (hereinafter collectively referred to as "NSIA") respectfully request that the Washington State Department of Ecology ("Ecology") grant a short-term modification of WAC 173-201A-200(1)(f)(ii), which Ecology promulgated pursuant to RCW 90.48.035. The existing rule sets water quality standards ("WQSs") for total dissolved gas ("TDG") in Washington's fresh surface waters. Generally, the rule requires that TDG levels not exceed 110 percent saturation. However, the rule includes exemptions to facilitate fish passage past hydroelectric dams on the Snake and Columbia rivers as follows:

The following special fish passage exemptions for the Snake and Columbia rivers apply when spilling water at dams is necessary to aid fish passage:

> TDG must not exceed an average of one hundred fifteen percent as measured in the forebays of the next downstream dams and must not exceed an average of one hundred twenty percent as measured in the tailraces of each dam (these averages are measured as an average of the twelve highest consecutive hourly readings in any one day, relative to atmospheric pressure); and a maximum TDG one-hour average of one hundred twenty-five percent must not be exceeded during spillage for fish passage.

By this letter, NSIA seeks a short-term modification of this particular provision pursuant to WAC 173-201A-410(1) and (2) to allow more flexibility in the management of total dissolved gas levels at eight dams on the lower Snake and lower Columbia rivers in order to aid fish passage and hydropower generation while minimizing interference with or injury to other aquatic resources. This request will also aid the efforts of Governor Inslee's Orca Task Force by increasing downstream juvenile salmon survival through higher levels of spill and, consequently, increase abundance of adult salmon that are important prey for orcas.

This request is made in the context of on-going discussions among the State of Washington and other entities about increasing the allowable levels of total dissolved gas to improve juvenile salmonid passage survival, provide flexibility for increased power generation during periods of peak demand, an increase orca prey availability at critical times—all goals that NSIA supports, so long as the actions taken actually improve upon past operations and increase salmon returns.

Specifically, NSIA asks Ecology to adopt a short-term modification that would (a) eliminate Washington's current forebay TDG standard at all eight lower Snake and lower Columbia river dams; and, (b) allow voluntary spring spill up to 125 percent TDG (as read at tailrace) during some or all non-peak power generation hours at some or all of the eight dams, beginning March 1, 2019, and continuing as described below for a period of at least three years or until replaced by a permanent change to the TDG standards through appropriate rulemaking. The goal of this short-term modification is to create a new TDG ceiling for voluntary spring spill operations without requiring spill to a specific level at all times, thus allowing increased upward flexibility for both voluntary spill and power generation.

Rather than specify the exact details of such a short-term modification, we suggest below one version of such a modification that we believe would be appropriate and achieve both better fish passage at the dams (by providing more spill at certain times than is allowed under current TDG standards) and provide more flexible power generation (by allowing periods of lower spill during peak demand hours):

> Between March 1 and June 30 each year, TDG may not exceed an average of one hundred twenty-five percent as measured in the tailrace of each dam on the lower Snake River in Washington and the lower Columbia River to which WAC 173-201A-200(1)(f)(ii) currently applies. This average is measured as an average of the twelve highest consecutive hourly readings in any one day.
>
> During the period from March 1 through June 30, TDG also should remain at lower levels as measured in the tailrace of each dam for a limited number of hours in each twenty-four-hour period to accommodate increased hydropower generation.

We believe there may be other versions of a short-term modification, starting in 2019, that would also accomplish our goals, so long as TDG levels up to 125 percent of saturation are allowed on an appropriate basis.

We seek this short-term modification for a period of no more than three years, or until such time as Ecology completes a rulemaking to permanently modify WAC 173-201A-

200(1)(f)(ii) to eliminate the existing 115 percent TDG limit in the forebay of each dam and allow TDG levels up to 125 percent in the tailrace at each dam.

The basis for this request for a short-term modification of WAC 173-201A-200(1)(f)(ii) pursuant to WAC 173-201A-410 is set forth below.

BACKGROUND

I. SPRING SPILL IS VITAL TO SALMON AND STEELHEAD PROTECTION.

There is broad and longstanding scientific agreement that voluntary spill past eight federal dams on the lower Snake and lower Columbia rivers provides substantial survival benefits to endangered salmon and steelhead. Indeed, Ecology has acknowledged that spill is important for salmon and steelhead.[1] We review some of this evidence below, including recent evidence that spill to 125 percent of saturation in the tailrace at each of the lower Snake and lower Columbia river dams is beneficial to salmon and steelhead survival.

For juvenile salmon and steelhead migrating in the Snake and Columbia rivers, non-powerhouse passage (spill and powerhouse surface passage) indisputably provides the safest passage through the Federal Columbia River Power System ("FCRPS") dams.[2] Substantial evidence also shows that spill can be managed to avoid impeding adult salmon and steelhead passage though dams.[3] Allowing increased water over the spillways at these dams allows juvenile salmon to avoid traveling through the power turbines—a passage route that increases mortality by subjecting these fish to rapid pressure changes and direct impacts with turbine blades. Increased spill also results in lower mortality than the practice of diverting fish from the turbine intakes and "bypassing" them through a series of screens, pipes, and tunnels to return to the river on the lower side of the dam.[4]

Experience underscores the beneficial effects of spill. Court injunctions have required the U.S. Army Corps of Engineers ("Corps") to spill additional water at the FCRPS dams to aid downstream fish passage. Court-ordered spill has allowed more juvenile salmon to migrate in the river under better conditions and has had a positive effect on smolt to adult return rates according to analyses by the Fish Passage Center ("FPC").[5]

The FPC's conclusions were questioned by the National Marine Fisheries Service/NOAA Fisheries ("NOAA"), which conducted a separate review concluding that the high sockeye returns in 2008 were generally due to favorable ocean conditions. In response, FPC reviewed

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[1] Department of Ecology. August 10, 2009. Response to Petition for Rulemaking – Chapter173-201a WAC – Water Quality Standards. Response to Petition Issue 1.

[2] *See* NMFS 2000 Federal Columbia River Power System Biological Opinion ("2000 BiOp") at 6-17.

[3] *See* CRITFC. July 3, 2008. Memorandum to the AMT, Review of Adult Passage Through Different Dam Passage Routes.

[4] 2000 BiOp at 9-83.

[5] FPC Memo (July 14, 2008) at 2. The "years analyzed" in FPC's analysis were 1998–2007.

NOAA's analysis, carefully reexamined its own findings, and concluded that:

> There is no doubt that ocean conditions are important, but this does not reduce the importance of migration conditions and fish survival in-river . . . . The NOAA conclusion that attributes the 2008 high return of sockeye salmon to the marine/estuary conditions while discounting the effect of higher in-river survival, lower proportion transported and improved in-river conditions, is flawed because it fails to recognize that fish must reach the oceans/estuary alive to benefit from good ocean conditions. Even the best ocean conditions will not resurrect dead fish.[6]

FPC has also reviewed NOAA's analysis of juvenile steelhead reach survival for 2009, confirmed the agency's findings of 66-69% in-river steelhead survival rates from Lower Granite to Bonneville dams, and concluded that:

> based upon multi-year analysis the most important variables explaining variability in reach survival for steelhead were spill proportion and water transit time (i.e. flow). Higher spill proportions, particularly for the Snake River, are likely the primary factors contributing to the higher juvenile survivals and faster juvenile travel times which occurred in 2007, 2008, and 2009.[7]

Indeed, NOAA has previously acknowledged that, along with removable spillway weirs, "[h]igher survival for in-river migrants in 2006 was likely the result of higher flows and greater volumes of water spilled."[8] NOAA had also concluded as long ago as 2000 that "measures that increase juvenile fish passage over FCRPS spillways are the highest priority" for passage improvements.[9]

More recent analyses by the FPC confirm that voluntary spring spill at TDG levels of 125% in the tailrace of each dam is safe for downstream migrating juvenile salmon and steelhead and will further improve juvenile survival – and ultimately adult return rates – as compared to the lower levels of spill allowed under the current TDG exemptions. The most recent such analysis is set out in the FPC's Comparative Survival Study (CSS) 2017 Annual Report, especially in Chapter 2, "Life Cycle Modeling Evaluation of Alternative Spill and Breach Scenarios" and Chapter 3, "Effects of the In-River Environment on Juvenile Travel Time, Instantaneous Mortality Rates and Survival." As explained in this report, the CSS analysis is based on extensive data collected over many years and life cycle modeling that has been developed and reviewed by experts within the region since at least 2013. Rather than fully summarizing the technical details of this analysis here, NSIA refers Ecology to the CSS 2017 Annual Report which is available at: http://www.fpc.org/documents/CSS/CSS_2017_Final_ver1-

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[6] FPC Memo to Ed Bowles, ODFW (Feb. 18, 2009) at 1. Available online at: http://www.fpc.org/documents/memos/18-09.pdf.

[7] FPC Memo to Ed Bowles, ODFW (Sept. 29, 2009) at 1–2. Available online at: http://www.fpc.org/documents/memos/157-09.pdf

[8] NMFS, Northwest Fisheries Science Center, Preliminary Survival Estimates 2006 Spring Juvenile Migration at 1-4 (Aug. 30, 2006).

[9] 2000 BiOp at 9-82.

1.pdf, and http://www.fpc.org/documents/CSS/CSS_2013_Workshop_Report_-_FINAL_w_presentations.pdf (containing detailed smolt-to-adult returns at various spill levels, flows and ocean conditions).

Briefly, however, the 2017 CSS analysis indicates that, relative to spilling to the current Washington TDG caps of 115% in the forebay and 120% in the tailrace at each dam, allowing TDG of 125% in the tailrace of each dam as requested herein would lead to a significant increase in smolt-to-adult return rates for Snake River spring/summer Chinook.[10] In addition, the 2017 CSS analysis concludes that TDG levels well above 125% are only a weak or non-factor in instantaneous mortality rates. Together, these conclusions are (a) more robust than similar conclusions Ecology has previously reviewed in connection with requests to modify its TDG standards; (b) have been reviewed by the Independent Scientific Advisory Board with suggestions for additional steps to strengthen the conclusions but without any fundamental disagreement with the CSS findings; and, (c) confirm that a short-term modification of Ecology's current TDG water quality standards for the lower Snake and lower Columbia River dams is scientifically well supported.

In short, the spill volumes allowed by TDG levels up to 125 percent would provide the best and safest route of passage for juvenile and adult salmon and steelhead by allowing them to avoid higher turbine and screen bypass mortalities, reducing passage delay, and dispersing predators. Even though excessive spill *can* cause excessive TDG levels which can harm fish and other aquatic life, we believe state and federal laws require Ecology to set TDG limits that maximize salmon survival by balancing the benefits of increased voluntary spring spill with the risks of harm from Gas Bubble Trauma ("GBT") to salmonids and other species. The short-term modification NSIA requests meets this requirement as explained in more detail below.

II. A SHORT-TERM MODIFICATION OF WAC 173-201A-200(1)(f)(ii) WOULD NOT INTEREFERE WITH OR INJURE OTHER AQUATIC RESOURCES.

Based on the evidence described above, NSIA believes that a short-term modification of Ecology's existing TDG standards would better protect migrating juvenile salmon and steelhead and increase adult returns. Based on the discussion below, NSIA also believe that this modification would not interfere with or injure other aquatic biota.

NSIA recognizes that, in the past, Ecology has given weight to the potential for harm to non-salmonid aquatic biota from higher levels of TDG. A 2009 Adaptive Management Team sponsored by Ecology and the Oregon Department of Environmental Quality ("ODEQ") looked in detail at the relationship between increased TDG levels due to spill and the incidence of GBT in aquatic organisms. A joint report by Ecology and ODEQ[11] described three independent literature reviews conducted by Ecology, NOAA Fisheries, and Parametrix. Each review examined the effects of TDG on aquatic life and took special notice of species other than

[10] *See* CSS 2017 Annual Report at 50 (Figure 2.10).

[11] Adaptive Management Team, Total Dissolved Gas in the Columbia and Snake Rivers; Evaluation of the 115 Percent Total Dissolved Gas Forebay Requirement. 2009. Washington State Department of Ecology and State of Oregon Department of Environmental Quality. Publication No. 09-10-002. p. 68 (hereinafter "AMT Evaluation").

salmonids. NOAA and Parametrix both concluded, at that time, that removing the 115% forebay TDG requirement would have negligible harmful effects on aquatic life.[12] Ecology, however, reached a different conclusion: while it recognized that any aquatic life living deeper than one meter would not be affected if TDG increased to 120 percent, Ecology concluded at that time that there was a potential for a small increase in impacts to aquatic life within one meter of the water surface.[13]

As NSIA and others pointed out in a subsequent petition to Ecology, a number of other studies supported a different conclusion. In addition, the information in some of the studies Ecology did consider may not have been fully addressed. For example, Ecology based its conclusion that invertebrates and other surface-dwelling aquatic life would be harmed by removal of the 115 percent forebay standard on the mortality rates found in experimental studies, and, in NSIA's view, did not give sufficient weight to field studies reaching contrary conclusions.[14] As multiple such field studies have noted, because TDG levels in captive fish can be substantially higher than levels found in the field, these experimental data can systematically overestimate the risk of GBT. NSIA urges Ecology to reconsider this information in light of the requirements applicable to this request for short-term modification discussed below. Such a review should lead Ecology to conclude that the short-term modification requested herein is appropriate.[15]

In addition, NSIA is also not aware of any anecdotal evidence that any non-salmonid aquatic biota have suffered harm from TDG levels above 125% even though these levels of TDG occur frequently in the lower Snake and lower Columbia rivers in the spring due to involuntary spill. This absence of data of harm suggests any non-salmonid biota that may be affected by higher levels of TDG are able to avoid these areas before adverse effects occur. In the absence of compelling new field evidence that the risks of higher levels of TDG, including 125 percent of saturation, are harmful to non-salmonid aquatic biota, the more robust evidence of the benefits to salmonids of increased spill as a result of a short-term modification of Ecology's TDG standards to 125 percent on a twelve-hour basis in the tailrace of each dams should lead Ecology to approve the short-term modification requested herein.

III. ALLOWING HIGHER LEVELS OF TDG WOULD ALSO BENEFIT OTHER SPECIES.

Salmon are not the only anadromous species migrating through the hydrosystem. Pacific lamprey (*Lampetra tridentata*) may also benefit from the short-term modification of the forebay and 120 percent tailrace TDG standards requested herein, a benefit to aquatic biota that Ecology may not have previously fully considered.

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12 *Id*. at 59.

13 *Id.*

14 *Id.* at 46–47.

15 *See, e.g.*, Ryan, Brad A., E.M. Dawley, & R.A. Nelson. 2000. Modeling the effects of supersaturated dissolved gas on resident aquatic biota in the main-stem Snake and Columbia Rivers. North American Fisheries Management 20:192–204.

Pacific lamprey have shown widespread decline since the 1960s in the Columbia River system due to habitat loss, water pollution, ocean conditions, and problems with dam passage.[16] Lamprey decline is of particular concern in the Northwest because of their importance to Native Americans' cultural heritage and tribal fisheries.[17] In fact, the lamprey's situation is perilous enough that the Oregon Natural Resources Council petitioned the USFWS to list the species under the Endangered Species Act in 2002. Although the USFWS denied the petition, claiming a lack of information, the USFWS has continued to voice concern over the status and distribution of Pacific lamprey.

NSIA recognizes that little information is available about precise juvenile lamprey survival benefits from increasing spill levels. However, it is highly likely that juvenile lamprey will benefit indirectly from increased spill. Juvenile lamprey are frequently impinged, and are injured or die, on the turbine intake screens meant to divert juvenile salmon into the bypass system; one study estimated a juvenile lamprey mortality rate of as high as 25 percent at dams with extended-length turbine intake screens.[18] When spill is reduced, more juvenile lamprey are forced through the screened bypass routes.[19] Indeed, the FPC has highlighted that reducing spill during spring lamprey migration:

> will be detrimental to lamprey, since elimination of spill will result in additional juvenile lamprey passage through screened power house bypass systems (Starke and Dalen 1995,1998; Moursand et al., 2000, 2001, 2002, 2003; Bleich and Moursand, 2006). Impingement of juvenile lamprey on turbine intake screens is a serious regional problem.[20]

Even if lamprey do not pass through the spillway, lamprey are less susceptible to injury or mortality from turbine passage compared with other, particularly larger, fish.[21] Moreover,

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[16] Close, D.A., M. Fitzpatrick, H. Li, B. Parker, D. Hatch & G. James. 1995. Status report of the Pacific lamprey (*Lampetra tridentata*) in the Columbia River Basin.

[17] *Id.*; *see also* Nez Perce, Umatilla, Yakama and Warm Springs Tribes. 2008. Tribal Pacific Lamprey Restoration Plan for the Columbia River Basin. Formal Draft, p. 4.

[18] CRITFC, Pacific Lamprey Passage Design, Project No. 2008-524-00. FY 2008-2009 F&W Program Accords (MOA) Proposal Review. pp. 10 – 11; *see also* BioAnalysts, Inc. 2000. A Status of Pacific Lamprey in the Mid-Columbia Region. Rocky Reach Hydroelectric Project. FERC Project No. 214, pp. 26–27.

[19] Fish Passage Center, "Review of the NOAA Transportation analyses and potential effects of reducing spill for fish passage in May and beginning the transportation program earlier in the spring and supporting analyses". Feb. 9, 2010. pp. 2, 10–12. Available online at: http://www.fpc.org/documents/memos/15-10.pdf.

[20] *Id.* at 10.

[21] Moursund, R.A., M.D. Bleich, K.D. Ham, and R.P. Mueller. 2003. Evaluation of the Effects of Extended Length Submerged Bar Screens on Migrating Juvenile Pacific Lamprey (*Lampetra tridentate*) at John Day Dam in 2002. Final Report prepared for the U.S. Army Corps of Engineers, Portland Oregon under Contract DE-AC06-76RL01830 at p. 4.3.

juvenile lamprey move downstream primarily at night, so increasing nighttime spill would increase juvenile lamprey dam passage when such passage is safest due to the closure of the bypass system. Additionally, if sufficient salmon pass via spill, allowing screens to be removed or lifted at some projects during parts of the year, lamprey mortality due to screen impingement could be reduced even further.

In addition, the increased spill allowed by the requested short-term modification of TDG standards would also provide immediate benefits for endangered Southern Resident Killer Whales. These whales rely on adult chinook salmon from the Columbia and Snake Rivers as an important prey resources at certain times of the year and these whales are nutritionally stressed. Whale scientists believe that increasing prey availability for these whales is crucial to halting and reversing their decline. In this context, allowing higher levels of TDG, and in turn higher levels of voluntary spring spill, will lead to higher juvenile survival and increased adult chinook return to the Columbia, especially spring/summer chinook, a priority prey resource for the whales.

In short, Ecology should also consider the potential benefits to both endangered Southern Resident Killer Whales and Pacific lamprey in deciding to modify TDG standards as requested.

IV. ECOLOGY SHOULD GRANT NSIA'S REQUEST FOR A SHORT-TERM MODIFICATION OF WAC 173-201A-200(1)(f)(ii).

In relevant part, WAC 173-201A-410 provides as follows:

> The criteria and special conditions established in WAC 173-201A-200 through 173-201A-260, 173-201A-320, 173-201A-602 and 173-201A-612 may be modified for a specific water body on a short-term basis (e.g., actual periods of nonattainment would generally be limited to hours or days rather than weeks or months) when necessary to accommodate essential activities, respond to emergencies, or to otherwise protect the public interest, even though such activities may result in a temporary reduction of water quality conditions.

(1) A short-term modification will:

(a) Be authorized in writing by the department, and conditioned, timed, and restricted in a manner that will minimize degradation of water quality, existing uses, and designated uses;

(b) Be valid for the duration of the activity requiring modification of the criteria and special conditions in WAC 173-201A-200 through 173-201A-260, 173-201A-602 or 173-201A-612, as determined by the department;

(c) Allow degradation of water quality if the degradation does not significantly interfere with or become injurious to existing or designated water uses or cause long-term harm to the environment; and

(d) In no way lessen or remove the proponent's obligations and liabilities under other federal, state, and local rules and regulations.

(2) The department may authorize a longer duration where the activity is part of an ongoing or long-term operation and maintenance plan, integrated pest or noxious weed management plan, water body or watershed management plan, or restoration plan. Such a plan must be developed through a public involvement process consistent with the Administrative Procedure Act (chapter 34.05 RCW) and be in compliance with SEPA, chapter 43.21C RCW, in which case the standards may be modified for the duration of the plan, or for five years, whichever is less. Such long-term plans may be renewed by the department after providing for another opportunity for public and intergovernmental involvement and review.

The short-term modification of WAC 173-201A-200(1)(f)(ii) that NSIA requests in this letter meets these requirements.

First, consistent with the above requirements, NSIA requests a short-term modification for a period of approximately 120 days each year, at each of the eight lower Snake and lower Columbia river dams. The actual periods of higher and lower TDG (and spill) pursuant to the short-term modification at each dam would depend on the details of the annual Spring Fish Operation Plan (FOP) for these dams developed and adopted in collaboration with the State of Washington and other sovereigns by the relevant federal agencies each year. The short-term modification would, however, provide the flexibility for longer periods of spill to the higher 125 percent TDG level and other, shorter, periods of lower spill, likely during peak electricity demand hours. In addition, and in accordance with WAC 173-201A- 410(2), the duration of the short-term modification would only be for the spring juvenile salmon migration season, which may run from about March 1 to about June 30 each year depending on the details of the Spring FOP, and the modification would only be in place for three years or until Ecology adopts any permanent modification of the requirements of WAC 173-201A-200(1)(f)(ii), whichever occurs sooner.

Second, the modification requested herein is necessary to accommodate the essential activity of securing beneficial dam passage conditions for migrating juvenile salmon and steelhead in the spring while also allowing appropriate hydropower generation. Most of the species that pass the dams and would be affected by the short-term modification have been listed as threatened or endangered under the Endangered Species Act for many years. As described above, increasingly robust scientific evidence indicates that increased spill, up to at least the levels NSIA seeks in this short-term modification, increases salmonid survival. For this reason, the short-term modification also is in the public interest.

Third, the short-term modification NSIA seeks is conditioned to minimize any degradation of water quality, existing uses, and designated uses in the affected waters. The modification would only apply during the spring juvenile salmonid migration season. During this time, TDG levels in the tailrace of each dam are often 125 percent or higher anyway, because of involuntary spill resulting from high spring runoff and low electricity demand. NSIA is not aware of any evidence that these annually occurring high levels of TDG—which vary from year to year depending on weather, snowpack and other factors—have significantly harmed water quality or existing or designated uses. Accordingly, due to the frequent unavoidable exceedances of the current TDG standards, the short-term modification NSIA seeks would likely affect dam operations and TDG levels for a considerably shorter time than indicated by the terms of the proposed modification.

Fourth, the short-term modification NSIA seeks would not reduce or remove the Corps' responsibility to otherwise comply with Washington's water quality standards at all times not subject to the short-term modification or alter the Corps' obligations and responsibilities under other federal, state, or local rules and regulations. In fact, the short-term modification NSIA seeks may help facilitate dam operations over the next few years under a biological opinion developed pursuant to the federal Endangered Species Act in order to avoid jeopardy to species of salmon and steelhead that are protected by that Act.

CONCLUSION

Voluntarily spilling water over the dams on the Snake and Columbia rivers during the spring juvenile migration season undeniably benefits salmon and steelhead. While spill can pose a risk to salmonids if TDG levels are too high, biological monitoring conducted over the last decade and more, as well as anecdotal evidence, demonstrates that tailrace TDG levels of 125 percent do not negatively impact migrating salmonids, resident fish, or invertebrates. By contrast, the TDG levels currently allowed under Washington's water quality standards unnecessarily limit the benefits of spill for juvenile salmon and steelhead migrating downstream in the spring.

For the reasons above, NSIA hereby requests that Ecology approve the short-term modification of WAC 173-201A-200(1)(f)(ii) requested herein under the provisions for such modifications set forth in WAC 173-201A-410(1) and (2), effective on or about March 1, 2019, for a period of three years or until Ecology permanently changes the TDG standards that apply to the lower Snake and lower Columbia rivers.

Respectfully submitted,

Liz Hamilton

Liz Hamilton, Executive Director
Northwest Sportfishing Industry Association

Brett VandenHeuvel

Brett VandenHeuvel, Executive Director
Columbia Riverkeeper

Joseph Bogaard, Executive Director
Save Our Wild Salmon

cc: Richard Whitman

October 15, 2018

Governor Jay Inslee
Office of the Governor
P.O. Box 40002
Olympia, WA 98504

Ms. Stephanie Solien, Co-Chair
Mr. Thomas (Les) Purce, Co-Chair
Southern Resident Killer Whale Task Force
c/o Puget Sound Partnership
326 East D St.
Tacoma, WA 98421

Delivered via e-mail and regular mail

Dear Governor Inslee, Co-Chairs Solien and Purce, and Southern Resident Orca Recovery Task Force Members,

We are writing as scientists and researchers with many decades of collective experience and a deep familiarity with the life history and current status of the Southern Resident Killer Whales. We have also been particularly attentive to, and in certain instances directly involved in, the urgent conversations regarding orca protection and recovery strategies and programs. We offer our expertise and insights as the Southern Resident Orca Task Force compiles its initial list of recommendations this Fall.

While we do not specialize in fisheries biology, we know from studying the Southern Resident Killer Whales that increasing the abundance of spring, summer, and fall populations of Chinook salmon in Northwest marine waters is vital to ensure orca survival. We write to emphasize several critical details about Chinook abundance that at this time may be underappreciated by Task Force members but are nevertheless essential to the success of its work.

Because the Southern Residents need access to abundant chinook salmon on a year-round basis, increasing a wide variety of chinook salmon as quickly as possible must be the top priority for the Task Force and regional policymakers. Vessel-related interference and food chain toxins -- threats in and of themselves -- are intensified by the current prey shortage. While both of these threats also demand immediate action, ensuring an abundant supply of prey will help to minimize and mitigate these other recognized causes of decline. For example, when orcas are forced to metabolize their blubber in times of prey scarcity, they mobilize toxins stored in these fats. This increases rates of reproductive failure, compromising the population's ability to grow. While abundant prey does not eliminate these stored toxins, it does help ensure that they remain stored in the orcas' fat reserves. In fact, that may be why transient killer whales are doing so well compared to southern residents. The transient's rich prey source appears to buffer them from toxin impacts, despite having markedly higher toxin loads relative to southern residents.

Put simply, Orca need more Chinook salmon available on a year-round basis, as quickly as possible. Lack of prey has caused a steady increase in mortality and orca pregnancy failure. These two factors in combination have led to the recent decline in the Southern Resident Orca population which today stands at just 74 individual whales – a 35-year low. The low number of reproductive-age females left – 27 – with less than half of these successfully reproducing in the last ten years, underscores just how little time we have to turn this trajectory around with urgent and effective action.

The Orca Task Force may not yet fully appreciate the important role spring Chinook in particular play in the life history of the Southern Resident orcas. Spring Chinook populations in Northwest watersheds have played a critical role in diet and range of Southern Resident orca due to their historically large numbers, large size, high fat content, and the timing of their return in the winter and early spring months when other Chinook populations are unavailable. These are foremost among the salmon that Southern Residents leave the Salish Sea to hunt for along the west coast in the winter and spring months.

Because spring Chinook require cold, clear, tributary streams to spawn, these salmon have been particularly hard-hit by habitat destruction from human activities like dams, culverts, logging, mining, and urbanization. There are very few watersheds left in the Northwest that support healthy (or potentially healthy) populations of these salmon.

Spring chinook from the Columbia Basin warrant special attention. Once among the largest spring Chinook salmon producing watersheds on earth, the Columbia Basin's spring Chinook have suffered steep declines over the past century from damming and habitat destruction. Despite these impacts, this vast watershed still supports– and has the demonstrated potential to support far more – spring Chinook. Even with the diminished numbers of spring Chinook compared to historic levels, multiple studies demonstrate that the Southern Resident orcas still gather along the Washington State coast and at the mouth of the Columbia River between January and April. Prey event sampling and scat surveys have demonstrated that the orcas are there to feed on the large, fatty adult spring Chinook staging in this area before they return to the Columbia river in search of their natal spawning beds. Rebuilding the spring Chinook population in the Columbia Basin – a fish that we know the Southern Residents depend upon in the winter months – should be a top priority for the Orca Task Force and orca conservation efforts generally. The early spring run also replenishes the whales after a long winter and sustains them until the Fraser River Chinook peak in mid-August.

We recommend two key measures to increase Chinook abundance from the Columbia/Snake system. These measures are described more fully in a recent letter to the Task Force from more than thirty salmon biologists: (1) an immediate increase in spill levels at the federal dams on the Snake and Columbia Rivers to 125% total dissolved gas and (2) permanently restoring the Snake River by removing the lower Snake River dams. These measures will reduce heavy dam-caused salmon mortality for fish throughout the basin and re-establish productive access for Chinook and other salmonids to more than 5,000 miles of upstream stream habitat in the Snake River basin.

Though spring Chinook once inhabited the Columbia River deep into Canada, the Snake River Basin historically produced nearly one-half of all the spring Chinook in the entire Columbia Basin. Unlike many other parts of the Columbia Basin today where habitat restoration is badly needed, the majority of the habitat that supported this abundance – high elevation, cold water streams deep in protected wilderness in central Idaho – remains intact and fully functioning.

In short, the Snake River basin offers the best potential for large-scale spring Chinook restoration in our region. Protecting and restoring salmon access to and from this habitat will have a significant benefit for spring Chinook and should be a top regional priority for addressing orca prey needs.

Of course, Chinook restoration is needed throughout the orcas' year-round range, but based on what we know about the Southern Resident's historic and current reliance on spring and other Chinook salmon in the Columbia Basin, we believe that restoration measures in this watershed are an essential piece of a larger orca conservation strategy. Indeed, we believe that Southern Resident orca survival and recovery may be impossible to achieve without it.

Based on the science and the urgency of the current threats confronting the Southern Residents, we urge the Task Force to recommend to Governor Inslee that he take appropriate steps to change Washington's water quality standards to allow increased spill to 125% of saturation and also convene a process to recommend steps for lower Snake River dam removal as soon as possible as top priorities for orca protection.

We thank you for the opportunity to submit this letter and for your consideration. If you have questions or we can be of assistance, please contact Deborah Giles, giles7@gmail.com / 916-531-1516.

Sincerely,

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Val Veirs, PhD
Professor of Physics/Environmental Science – Emeritus, Colorado College
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Dr. Scott Veirs, PhD
President, ***Beam Reach, SPC***
Seattle, WA

CC:
Northwest Governors
Northwest Members of Congress

Resources:

NOAA Fisheries, *Species in the Spotlight, Survive to Thrive, Recovering Threatened and Endangered Species* (2015), http://www.nmfs.noaa.gov/stories/2015/05/docs/noaa_recoveringspecies_report_web.pdf.

Ford, JKB, et al., *Linking Killer Whale Survival and Prey Abundance: Food Limitation in the Ocean's Apex Predator?* 6 BIOLOGY LETTERS 141 (2010), p. *3, http://rsbl.royalsocietypublishing.org/content/early/2009/09/14/rsbl.2009.0468. See also NOAA Fisheries, *SRKW Recovery Planning and Implementation* (2011), p. 2.

Ayres KL, et al. (2012) *Distinguishing the impacts of inadequate prey and vessel traffic on an endangered killer whale (Orcinus orca) population*. PLoS One 7: e36842, http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0036842.

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NOAA Fisheries, (2014) *Federal Columbia River Power System Biological Opinion*, http://www.westcoast.fisheries.noaa.gov/fish_passage/fcrps_opinion/federal_columbia_river_power_system.html.

See e.g., *Nat'l Wildlife Fed'n v. Nat'l Marine Fisheries Serv.*, 839 F. Supp. 2d 1117, 1131 (D. Or. 2011) ("[T]here is ample evidence in the record that indicates that the operation of the FCRPS causes substantial harm to listed salmonids. . . . NOAA Fisheries acknowledges that the existence and operation of the dams accounts for most of the mortality of juveniles migrating through the FCRPS.")

U.S. Fish and Wildlife Service. Species profile for Chinook Salmon (*Oncorhynchus tshawytscha*), http://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=E06D.

Hanson et al., Assessing the Coastal Occurrence of Endangered Killer Whales Using Autonomous Passive Acoustic Recorders (November 2013), 3486, 134 J. Acoust. Soc. Am. 5, http://oceanwidescience.org/cms/wp-content/uploads/2014/12/Hanson-et-al-2013.pdf

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10 Northwest Fisheries Science Center, NOAA Fisheries. 2013 Southern Resident Killer Whale Satellite Tagging, http://www.nwfsc.noaa.gov/research/divisions/cb/ecosystem/marinemammal/satellite_tagging/blog.cfm;
2015 Southern Resident Killer Whale Satellite Tagging, http://www.nwfsc.noaa.gov/research/divisions/cb/ecosystem/marinemammal/satellite_tagging/blog2015.cfm;
2016 Southern Resident Killer Whale Satellite Tagging, http://www.nwfsc.noaa.gov/research/divisions/cb/ecosystem/marinemammal/satellite_tagging/blog2016.cfm.

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Hanson, Brad et al, *Species and stock identification of scale/tissue samples from southern resident killer whale predation events collected off the Washington coast during PODs 2009 cruise on the McArthur II*, BB0149, unpublished memo, 2010.

Wasser, Sam et al, *Population growth is limited by nutritional impacts on pregnancy success in endangered Southern Resident killer whales (Orcinus orca)*. PLOS ONE. June 29, 2017

Lacy, Robert C. et al, *Evaluating anthropogenic threats to endangered killer whales to inform effective recovery plans.* Scientific Reports, 7:14119. October 26, 2017

John K.B. Ford, *Chinook salmon predation by resident killer whales: seasonal and regional selectivity, stock identity of prey, and consumption rates.* Research Document 2009/101. Fisheries and Oceans Canada, Pacific Biological Station, 2009.

Montgomery, David et al, *Scientists Letter to the Southern Resident Orca Task Force*, August 2018.

Williams, Richard, editor, *Return to the River*, 2006.

Orca Salmon Alliance

Defenders of Wildlife
Save Our wild Salmon Coalition
Washington Environmental Council
Natural Resources Defense Council
Endangered Species Coalition
Whale and Dolphin Conservation
Center for Biological Diversity
Earthjustice

Orca Network
Oceana
Seattle Aquarium
Toxic Free Future.
Whale Scout
Puget Soundkeeper
Sierra Club

December 7, 2018

Maia Bellon, Director
Heather Bartlett, Water Quality Program Manager
Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600

Re: Scoping Notice for Short-term Modification of Total Dissolved Gas Standards for Federal Dams on the Lower Snake and Lower Columbia Rivers (11.16.2018)

Dear Director Bellon and Program Manager Bartlett:

The member organizations of the *Orca Salmon Alliance* submit these scoping comments regarding the Department of Ecology's scoping notice (November 16, 2018) for a short-term modification of total dissolved gas (TDG) water quality standards for federal dams on the lower Snake and lower Columbia rivers through 2021. We support a short-term rule change allowing for an increase in spill up to 125% TDG until Ecology permanently changes those TDG standards, whichever occurs sooner.

Orca Salmon Alliance (OSA) was founded in 2015 to prevent the extinction of the Southern Resident orcas by recovering the wild Chinook salmon populations upon which the whales depend for their survival. OSA members include *Orca Network, Defenders of Wildlife, Save Our wild Salmon Coalition, Washington Environmental Council, Oceana, Natural Resources Defense Council, Sierra Club, Earthjustice, Endangered Species Coalition, Whale and Dolphin Conservation, Puget Soundkeeper, Center for Biological Diversity*, *Seattle Aquarium*, *Whale Scout and Toxic Free Future*.

Southern Resident orcas were listed as endangered under the United States Endangered Species Act in 2005. After 15 years of recovery efforts, they are continuing to decline and in 2018 the population dropped to just 74 individuals, the lowest number in over three decades. Their main threats include prey availability, namely a decline in their primary prey, Chinook salmon; environmental contaminants; and vessel interference. Of these threats, lack of prey is the biggest limiting factor in their recovery. Salmon depletion has led to changes in pod structure, decreased presence in their core summer feeding areas, an increase in stress hormones and a miscarriage rate of almost 70%. There has not been a surviving calf in the population for three years.

As you are aware, Governor Inslee's Orca Task Force recommended Ecology "immediately eliminate the current 115% standard" and allow for increased spill up to 125% TDG on a flexible basis in order to deliver near-term benefits to endangered Southern Resident Killer Whales. These whales are nutritionally stressed and rely on adult Chinook salmon from the Columbia and Snake Rivers as an important prey resource at certain times of the year when their preferred prey can be exceptionally hard to find. Whale scientists believe (link to letter below) that increasing prey availability for these whales is crucial to halting and reversing their decline. As they explain, allowing higher levels of TDG, and in turn higher levels of voluntary spring spill, will lead to higher juvenile survival and increased adult Chinook return to the Columbia, especially spring/summer Chinook, a high-fat priority prey resource for the Southern Residents. *OSA* strongly supports this important advice from the scientific community.

A number of organizations submitted to you a request for a short-term modification of the TDG standards in September. We believe this letter describes the legal and scientific basis for a short-term modification of the TDG standards at the lower Snake and lower Columbia River dams for the "spring spill season" (from approximately April 1 through June 20) beginning in 2019 and continuing through spring of 2020 and 2021.

OSA strongly supports the elimination on a short-term basis of the current 115% forebay TDG limit at each dam and replacement of the existing 120% tailrace TDG limit with a limit of 125% for up to a minimum of 16 hours per day or more starting in 2019. We urge you to include such an alternative in the forthcoming environmental impact statement pursuant to the above referenced scoping notice. We believe that based upon the best currently available scientific information about the effects of TDG levels up to 125% in the dam tailraces, and analysis of any other alternatives you chose to evaluate, that a short-term modification of the TDG standards to 125% starting in 2019 is the best near-term alternative to better protect salmon and other species in the lower Snake and lower Columbia Rivers.

As reflected in your scoping notice, a short-term modification is consistent with requests from the *Washington Department of Wildlife*, the *Columbia River Inter-Tribal Fish Commission* and recommendations from the *Governor's Southern Resident Killer Whale Recovery Task Force*. It could also easily be coordinated with a parallel modification of TDG standards by the State of Oregon that affect the federal dams on the lower Columbia River. Oregon's standards currently allow TDG up to 120% as measured in the tailrace of the lower Columbia River dams on a 24-hour basis (the only dams directly affected by Oregon's standards). We understand that Oregon is in the process of considering increasing this tailrace TDG level to 125% on a flexible basis. Even if Oregon does not complete this change in time for the 2019 spring spill season, we expect it will in time for the 2020 and 2021 spring spill seasons. In any event, a change in the TDG standards in Washington to allow spill up to 125% starting in 2019 on a flexible basis would still benefit juvenile salmonid survival and protect designated uses.

Below we briefly summarize our basis for asking you to develop and consider an alternative that would eliminate the current forebay TDG standard and allow TDG levels of up to 125% on a flexible basis between 2019 and 2021 to benefit juvenile salmon during their out-migration to the ocean – and the critically endangered Southern Resident orcas that rely upon them for their survival and reproduction.

Recent analyses by the *Fish Passage Center* (FPC) confirm that voluntary spring spill at TDG levels of 125% in the tailrace of each dam is safe for downstream migrating juvenile salmon and steelhead and will further improve juvenile survival – and ultimately adult return rates – as compared to the lower levels of spill allowed under the current TDG exemptions. The most recent such analysis is set out in the FPC's **Comparative Survival Study (CSS) 2017 Annual Report.**

As this analysis explains, allowing TDG of up to 125% in the tailrace of each dam would lead to a significant increase in smolt-to-adult return rates for Snake River spring/summer Chinook. These findings are (a) more robust than similar conclusions Ecology has previously reviewed in connection with requests to modify its TDG standards; (b) have been reviewed by the *Independent Scientific Advisory Board* with suggestions for additional steps to strengthen the conclusions but without any fundamental disagreement with the CSS findings; and, (c) confirm that a short-term modification of Ecology's current TDG water quality standards for the lower Snake and lower Columbia River dams is scientifically well supported.

We also refer you to the **draft 2018 CSS Annual Report** for additional information. After review of this evidence, we believe you will conclude that the spill volumes allowed by TDG levels up to 125 percent would provide the best and safest route of passage for juvenile and adult salmon and steelhead by allowing them to avoid higher turbine and screen bypass mortalities, reducing passage delay, and dispersing predators. Even though spill *can* increase TDG levels, which can in extreme cases harm fish and other aquatic life, we believe state and federal laws require Ecology to set TDG limits that maximize salmon survival by balancing the benefits of increased voluntary spring spill with the minimal or non-existent risks of harm from Gas Bubble Trauma ("GBT") to salmonids and other species.

Further, we are not aware of any scientific study in the last ten years or any anecdotal evidence that any non-salmonid aquatic biota in the Snake or Columbia Rivers have suffered harm from TDG levels above 125% even though these levels of TDG occur frequently in the lower Snake and lower Columbia rivers in the spring due to involuntary spill. In the absence of compelling field evidence that the risks of higher levels of TDG, including 125% of saturation, are harmful to non-salmonid aquatic biota, the more robust evidence of the benefits to salmonids of increased spill as a result of a short-term modification of Ecology's TDG standards to 125% in the tailrace of each dam should lead Ecology to develop and choose an alternative in its SEPA process that approves a short-term modification of water quality standards to allow TDG up to 125% of saturation on a flexible basis during the spring salmon migrations season starting in 2019.

Of course, salmon are not the only anadromous species migrating through the hydrosystem. Pacific lamprey (*Lampetra tridentata*), for example, may also benefit from the short-term modification of the forebay and 120% tailrace TDG standards, a benefit to aquatic biota that Ecology may not have previously fully considered. Pacific lamprey have shown widespread decline since the 1960s in the Columbia River system due to habitat loss, water pollution, ocean conditions, and problems with dam passage. Lamprey decline is of particular concern in the Northwest because of their importance to Native Americans' cultural heritage and tribal fisheries. In fact, the lamprey's situation is perilous enough that the *Oregon Natural Resources*

Council petitioned the USFWS to list the species under the Endangered Species Act in 2002. Although the USFWS denied the petition, claiming lack of information, the USFWS has continued concern over the status and distribution of Pacific lamprey.

We encourage you to consult with the *FPC* and the Nez Perce and other Tribes about the benefits of increased spill for lamprey as you develop your EIS for a short-term modification of the TDG standards.

A short-term modification of WAC 173-201A-200(1)(f)(ii) to allow TDG levels of up to 125% is consistent with the requirements of the regulations that allow such a modification. First, the modification is short-term: approximately 120 days each year for the next three years at each of the eight lower Snake and lower Columbia river dams. The actual periods of higher and lower TDG (and spill) pursuant to the short-term modification at each dam would depend on the details of the annual Spring Fish Operation Plan (FOP) for these dams developed and adopted in collaboration with the State of Washington and other sovereigns by the relevant federal agencies each year. The short-term modification would provide the flexibility for longer periods of spill to the higher 125% TDG level and other, shorter, periods of lower spill, likely during peak electricity demand hours. In addition, and in accordance with WAC 173-201A- 410(2), the duration of the short-term modification would only be for the spring juvenile salmon migration season, which may run from about March 1 to about June 30 each year depending on the details of the Spring FOP, and the modification would only be in place for three years or until Ecology adopts any permanent modification of the requirements of WAC 173- 201A-200(1)(f)(ii), whichever occurs sooner.

Second, a modification of the TDG standards to allow spill up to 125% is necessary to accommodate the essential activity of securing beneficial dam passage conditions for migrating juvenile salmon and steelhead in the spring while also allowing appropriate hydropower generation. Most of the salmonids that pass the dams and would be affected by the short-term modification have been listed as threatened or endangered under the Endangered Species Act for many years. As described above, increasingly robust scientific evidence indicates that increased spill, up to at least 125% TDG, increases salmonid survival. For this reason, a short-term modification also is in the public interest.

Third, a short-term modification to allow TDG levels up to 125% is conditioned to minimize or eliminate any degradation of water quality, existing uses, and designated uses in the affected waters. TDG levels in the tailrace of each dam are often 125% or higher already during spring juvenile salmon migration due to involuntary spill resulting from high spring runoff and low electricity demand. We are not aware of any field evidence that these annually occurring high levels of TDG—which vary from year-to-year depending on weather, snowpack and other factors—have significantly harmed water quality or existing or designated uses.

Fourth, a short-term modification to allow TDG levels up to 125% in the dam tailraces would not reduce or remove the Corps' responsibility to otherwise comply with Washington's water quality standards at all times not subject to the short-term modification or alter the Corps' obligations and responsibilities under other federal, state, or local rules and regulations. In fact, such a short-term modification may help facilitate dam operations over the next few years under a biological opinion developed pursuant to the federal Endangered Species Act in order to avoid jeopardy to species of salmon and steelhead that are protected by that Act.

CONCLUSION

Voluntarily spilling water over the dams on the Snake and Columbia rivers during the spring juvenile migration season delivers important near-term benefits to Chinook salmon that, in turn, are critically important to Southern Resident orcas. Improving salmon survival directly benefits the orcas by increasing prey availability during lean winter months when the orcas forage on chinook from the Snake and Columbia Rivers. Biological monitoring conducted over the last decade and more demonstrates that tailrace TDG levels of 125% do not negatively impact migrating salmonids, resident fish, or invertebrates. The TDG levels currently allowed under Washington's water quality standards, however, unnecessarily limit the benefits of spill for juvenile salmon and steelhead migrating downstream in the spring. We urge you to develop and carefully consider in your EIS a short-term modification of water quality standards to allow TDG levels up to 125% of saturation in the tailrace of each of the eight dams on the lower Snake and lower Columbia Rivers during the spring juvenile salmon migration season beginning in 2019 and continuing through at least 2021, while permanent changes to TDG standards are developed. Thank you for your consideration of these scoping comments. Please contact Robb Krehbiel (rkrehbiel@defenders.org), if you have questions or we can be of assistance in any way.

Sincerely,

Robb Krehbiel, Washington State Representative
Defenders of Wildlife
Seattle, WA

RESOURCES:

2017 Comparative Survival Study Annual Report
http://www.fpc.org/documents/CSS/CSS_2017_Final_ver1-1.pdf

Draft 2018 Comparative Survival Study Report
http://www.fpc.org/documents/CSS/DRAFT2018CSSReportv1-1.pdf.

Close, D.A., M. Fitzpatrick, H. Li, B. Parker, D. Hatch & G. James. 1995. ***Status report of the Pacific lamprey (Lampetra tridentata) in the Columbia River Basin.***

Id.; *see also* Nez Perce, Umatilla, Yakama and Warm Springs Tribes. 2008. ***Tribal Pacific Lamprey Restoration Plan for the Columbia River Basin***. Formal Draft, p. 4.

Orca Scientists' Letter to the Southern Resident Orca Recovery Task Force (Oct. 2018)
https://www.documentcloud.org/documents/5002547-Orca-Scientists-Letter-10-15-18-Final.html

Salmon Biologists' Letter to the Southern Resident Orca Recovery Task Force (Aug. 2018)
http://www.wildsalmon.org/images/factsheets-and-reports/2018-Scientist-Ltr-Orca-TF-Aug27.pdf

DEPARTMENT OF ECOLOGY
DEC 10 2018
WATER QUALITY PROGRAM

Washington State Senate

December 5, 2018

Becca Conklin
Washington State Department of Ecology
PO Box 47600
Olympia, WA 98504-7600

Re: Scope of Draft EIS for Modification of Total Dissolved Gas Levels

Dear Ms. Conklin,

We appreciate this opportunity to comment on the scope of the draft environmental impact statement for the department's proposal to modify total dissolved gas levels in the Columbia and Snake rivers. As Washington State Senators, we represent people who will be affected by the increased spill at hydroelectric dams that is the intended result of your proposal to adjust TDG.

Our comments can be summarized in three points:

(1) The immense cost of increased spill should lead the department to conclude that the proposal to modify TDG must be abandoned;

(2) The process the department has initiated to modify TDG is superfluous due to the ongoing federal Columbia River System Operations review; and

(3) Modifying TDG carries a high risk of unintended consequences for fish.

We have already seen the major cost impact of increased spill at hydroelectric dams in Washington. The Bonneville Power Administration's average annual cost to meet increased spill requirements exceeds $38 million.[1] In 2018, BPA redirected $20 million away from fish and wildlife programs to help cover the cost of spill.[2] Increasing spill also affects the price of electricity on the wholesale market throughout the Pacific Northwest because it forces hydroelectric facilities to forgo opportunities to produce electricity, resulting in costs that directly translate into higher electricity bills for Washingtonians.

Furthermore, we question the timing and necessity of the environmental review you are initiating. The ongoing federal CRSO review has been accelerated to meet a new 2020 completion date under the Presidential Memorandum on Promoting the Reliable Supply and

[1] Bonneville Power Administration, Final FY 2018 Spill Surcharge (June 21, 2018).
[2] *Id.*

Delivery of Water in the West.[3] It is probable that the federal process will conclude before the department's EIS is complete, meaning the process you have initiated will be moot.

Finally, we call your attention to the important discussion of the unintended consequences of adjusting TDG contained in the minority report submitted to Governor Inslee by Commissioner Pittis and Mr. Chandler as part of the Southern Resident Orca Task Force Recommendations.[4] The minority report asserts that modifying TDG levels could increase the risk of gas bubble trauma in salmon.[5] The department must carefully consider how modifying TDG levels might actually work against salmon recovery by creating hazards for the very fish we want to recover.

Modifying TDG levels is a significant policy decision that would have wide-ranging effects for people and fish. Even if your analysis is not superseded by federal actions, we believe that your review will show the costs and flaws of your proposal are too substantial to make it viable by any objective measure.

Sincerely,

Mark G. Schoesler

Sen. Mark Schoesler
9th Legislative District

Sharon R. Brown

Sen. Sharon Brown
8th Legislative District

Jim Honeyford

Sen. Jim Honeyford
15th Legislative District

Judith M Warnick

Sen. Judy Warnick
13th Legislative District

Tim Sheldon

Sen. Tim Sheldon
35th Legislative District

[3] Presidential Memorandum on Promoting the Reliable Supply and Delivery of Water in the West (Oct. 19, 2018).
[4] Southern Resident Orca Task Force Report and Recommendations p.94 (Nov. 16, 2018).
[5] *Id.*

TIDEWATER
TRANSPORTATION & TERMINALS

December 10, 2018

Becca Conklin
Department of Ecology
PO Box 47600
Olympia, WA 98504-7600

RE: Draft Environmental Impact Statement – Columbia and Snake Rivers
SEPA No. 20806404

Dear Ms. Conklin:

Thank you for the opportunity to provide comments on the scope of the Draft Environmental Impact Statement – Columbia and Snake Rivers ("DEIS"). These comments are submitted on behalf of Tidewater Transportation and Terminals ("Tidewater"), which is headquartered in Vancouver, Washington.

Tidewater has been in business since 1932 and operates a fleet of tugboats, barges and several marine terminals on the Columbia and Snake Rivers. Tidewater has over 280 employees and is the largest inland marine transportation company west of the Mississippi River. Its vessels safely move millions of tons of freight every year on the commercially navigable 465 miles of the Columbia and Snake Rivers, reducing congestion and wear and tear on the state's highways and railroads while producing far fewer pollutants and carbon emissions than trucks and trains transporting equivalent tonnage.

Tidewater has always strongly supported robust salmon recovery efforts, including improvements to hydro, habitat, harvest and hatchery concerns. That being said, we are very concerned with the State of Washington's proposed DEIS for the following reasons:

> First, we believe the State of Washington's DEIS is duplicative of the Columbia River Systems Operations Environmental Impact Statement ("CRSO EIS") process that is already two years underway by the federal agencies. The CRSO EIS is a regional, comprehensive effort to evaluate a range of operational alternatives for the federal hydropower facilities, including spill levels, that exist along the Columbia and Snake Rivers. The CRSO EIS process includes multiple opportunities for public engagement. The State of Washington is already a cooperating agency in this process, which will include an evaluation of the Columbia and Snake Rivers. Furthermore, the result of DEIS effort will not be as comprehensive as the current federal effort, and it is unlikely the DEIS effort will yield new information that would inform the CRSO EIS process or other species recovery activities in the Pacific Northwest.

Second, the DEIS is not necessary as the perceived need to adjust the total dissolved gas ("TDG") levels in the Columbia and Snake River Dams are contrary to sound science. These projects are already among the most advanced, fish-friendly projects in the entire country. For example, the juvenile fish survival rates past the Snake River Dams averages 97%. Major improvements in turbine design, optimized river flow, fish ladders, and habitat restoration have resulted in improvements to salmon returns. Please see the enclosed Snake River Dams Fact Sheet for more information.

Tidewater urges the State of Washington to forgo conducting the DEIS and continue its participation in the existing CRSO EIS process.

Thank you for your time.

Sincerely,

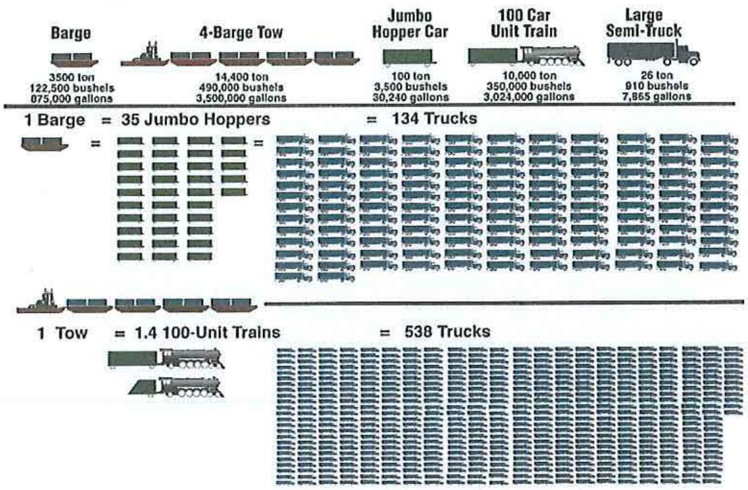
Robert A. Curcio
President & CEO

12/10/18

Enclosure (1)

Snake River Dams

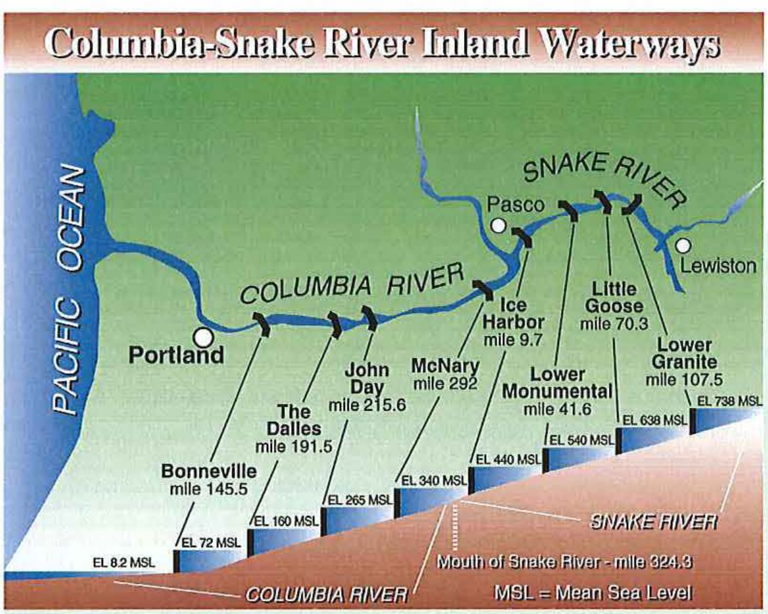
Freight Comparison of Barges, Trains and Trucks



Barging is the most efficient and environmentally friendly mode of cargo transportation

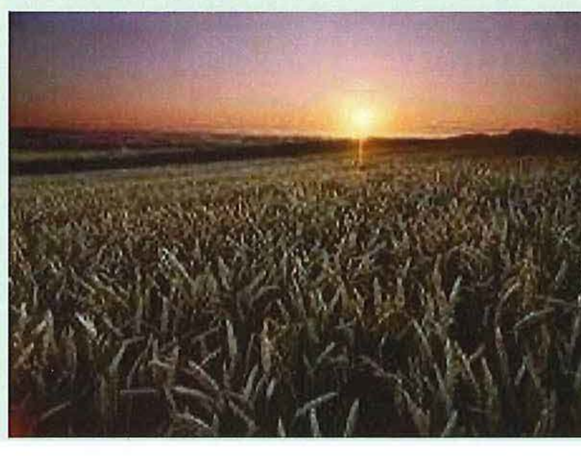
In 2014, it would have taken 43,610 rail cars or 174,440 semi-trucks to move the cargo that went by barge on the Snake

The Columbia Snake River System is a 465-mile commercial waterway that provides farmers as far as the Midwest access to international markets



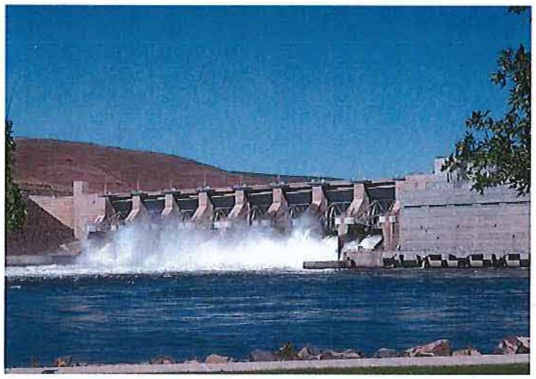
The Columbia Snake River System is the top wheat export gateway in the U.S.

In 2014, nearly 10% of all U.S. wheat exports moved through the Snake River dams



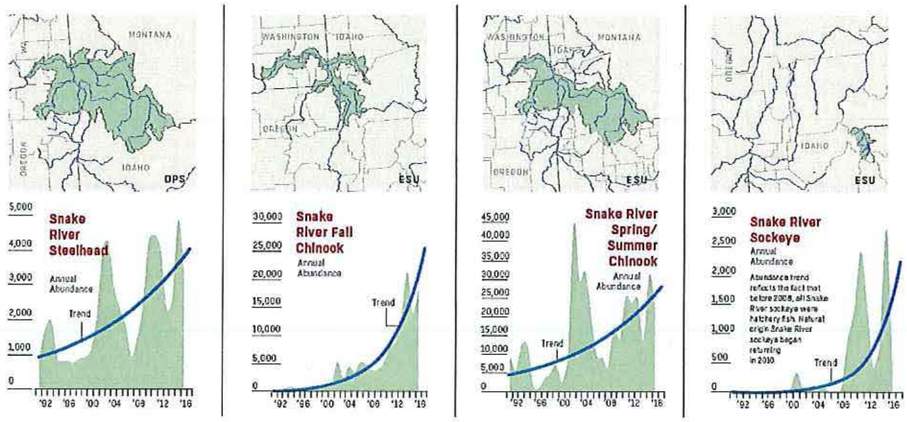
Barging information courtesy of Texas Transportation Institute
Wheat information courtesy of U.S. Department of Agriculture and U.S. Army Corps of Engineers

Snake River Dams



The four Snake River dams provide enough clean energy to power 1.87 million homes

Dam investments have resulted in improved fish returns and a 25 year sustained increase in salmon populations



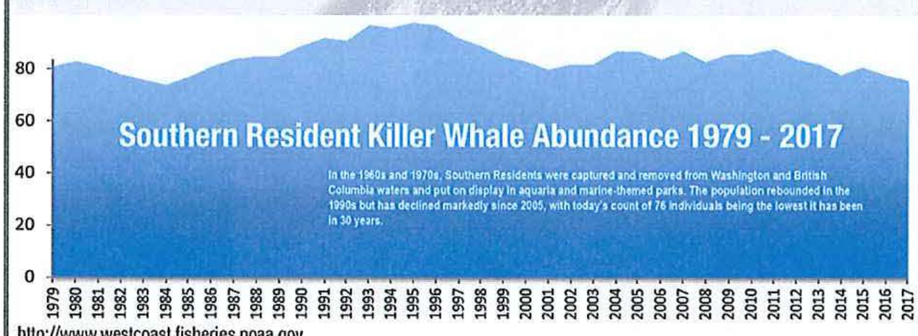
Spotlight on Orcas

The three Southern Resident Killer Whale (SRKW) orca pods have declined since the 1800s

In the 1960s, 47 SRKW orcas were captured for aquarium display, leaving only 67 remaining

Snake and Columbia River Chinook stocks have rebounded, yet orcas continue to decline

Recent NOAA research has highlighted Northern and Southern Puget Sound Chinook as priority orca prey stocks



http://www.westcoast.fisheries.noaa.gov

Juvenile fish survival rates past each of the eight federal dams are between 95% and 98%

Between 2002 and 2011, average wild Chinook salmon populations more than tripled, and average wild steelhead populations doubled

Energy information courtesy of BPA
Salmon and orca information courtesy of BPA, U.S. Army Corps of Engineers, NOAA Fisheries

Appendix D: Executive Summary of the Comparative Survival Study

Appendix D contains the Executive Summary of the annual report of smolt-to-adult salmon and steelhead survival through dams on the Snake and Columbia rivers completed by the Fish Passage Center. The full report, called "Comparative Survival Study of PIT-tagged Spring/Summer/Fall Chinook, Summer Steelhead, and Sockeye, 2017 Annual Report" is available online at http://www.fpc.org/documents/CSS/CSS_2017_Final.pdf.

Comparative Survival Study of PIT-tagged Spring/Summer/Fall Chinook, Summer Steelhead, and Sockeye

2017 Annual Report

BPA Project #19960200
Contract #74406

(12/16-11/17)

Prepared by

Comparative Survival Study Oversight Committee and Fish Passage Center:

Jerry McCann, Brandon Chockley, Erin Cooper, and Bobby Hsu, Fish Passage Center
Howard Schaller and Steve Haeseker, U.S. Fish and Wildlife Service
Robert Lessard, Columbia River Inter-Tribal Fish Commission
Charlie Petrosky and Tim Copeland, Idaho Department of Fish and Game
Eric Tinus, Erick Van Dyke and Adam Storch Oregon Department of Fish and Wildlife
Dan Rawding, Washington Department of Fish and Wildlife

Project Leader:
Michele DeHart, Fish Passage Center

December 2017

EXECUTIVE SUMMARY

The 2017 Comparative Survival Study Annual Report continues to update the historical time series life-cycle monitoring data and includes enhancements to analyses based upon review comments and recommendations from the fishery management agencies, tribes, and the Northwest Power and Conservation Council's Independent Scientific Advisory Board (ISAB).

This CSS Annual Report includes 22 years of SAR data for wild Snake River spring/summer Chinook (1994–2015), 19 years of SAR data for Snake River hatchery spring/summer Chinook (1997–2015), 18 years of SAR data for Snake River wild and hatchery steelhead (1997–2014), and seven years of SAR data for Snake River sockeye (2009–2015). There are seven years of SAR data for Snake River hatchery fall Chinook (2006–2012), and seven years of Snake River wild fall SAR data spanning the years 2006–2011. For mid-Columbia and upper-Columbia fall Chinook there are varying numbers of years available. There are 15 years of SAR data for Hanford Reach wild fall Chinook (2000–2014), four years of SAR data for wild Deschutes River fall Chinook (2011–2014), and seven years of SAR data for both Spring Creek NFH and Little White Salmon NFH fall Chinook (2008–2014). Spring and summer Chinook and sockeye returns from outmigration year 2015 should be considered preliminary, as they include only 2-salt returns and may change with the addition of 3-salt returns next year. Similarly, 2014 migration year fall Chinook returns include only 2-salt adults. The CSS has actively provided Passive Integrated Transponder (PIT) tags for most of these groups since outmigration year 1997.

Mark groups in 2017 were consistent with groups utilized in past years. In addition to overall smolt-to-adult return rates (SARs) for aggregate Snake River wild steelhead and Chinook salmon, the CSS has continued to pursue the development of SAR and life cycle metrics at the Major Population Group (MPG) level when sample size was adequate. These MPG-level SARs are provided for both Lower Granite to Lower Granite and from Lower Granite to Bonneville with and without jacks (1-salt) for Chinook salmon. In addition, Chapter 4 now includes estimates of overall SARs (MCN-to-MCN) for Yakima River wild Chinook salmon, Yakima River hatchery Chinook salmon (i.e., Cle Elum Hatchery), and Yakima River wild steelhead. The CSS continue to strive to improve life cycle monitoring metrics for wild populations of time, instantaneous mortality rates, and survival probabilities for hatchery sockeye in the LGR-MCN reach.

Overall SARs are the net effect of SARs for the different routes of in-river passage and juvenile transportation. Overall SAR and route of passage SARs are consistent with past year's findings. None of the passage routes have resulted in SARs that met the NPCC SAR objectives for Snake River wild spring/summer Chinook and steelhead. The relative effectiveness of transportation has been observed to decline as in-river conditions and survival rates improve. PIT-tag SARs for Middle Columbia wild spring Chinook and wild steelhead generally fell within the 2%–6% range of the NPCC SAR objectives. Incorporating the 2016 adult returns in this Annual Report shows that the trends seen in all but two past years of CSS monitoring continue. The overall SARs for Upper Columbia and Snake River populations of salmon and steelhead are not meeting the 2%–6% regional goal, while middle Columbia populations are meeting the regional SAR goals in most years.

In this report the analyses of SARs relative to estimates of population productivity which began in the 2015 CSS Annual Report has been expanded and is presented in Chapter 5. In 2016 the CSS began a comparison of Snake River SARs and steelhead population productivity for Fish Creek (Clearwater Major Population Group (MPG)) and Rapid River (Salmon MPG), which complement those for Snake River spring/summer Chinook. We have added comparable data for Pahsimeroi River steelhead (Salmon MPG) in this report. In 2017 we have also updated the analysis of pre-harvest SARs and historical productivity for Snake River spring/summer Chinook salmon. This represents the continuation of a longer-term effort, which will incorporate effects of density dependence on observed productivity to evaluate population responses relative to SAR rates. Analyses in this Chapter support objectives of the Columbia River Basin Fish and Wildlife Program (NPCC 2014), encouraging a regional review of the NPCC SAR objectives relative the survival of populations needed to achieve salmon and steelhead recovery and harvest goals. Major population declines of Snake River wild spring/summer Chinook were associated with SARs less than 1% and increased life-cycle productivity occurred when SARs exceeded 2%. Snake River wild steelhead population declines were associated with brood year SARs less than 1%, and increased life-cycle productivity occurred in the years that brood year SARs exceeded 2%. Pre-harvest SARs in the range of 4% to 6% are associated with historical levels of productivity for Snake River wild spring/summer Chinook. Although there are fewer SAR estimates for John Day River spring Chinook, historical levels of productivity appear to be achieved with pre-harvest SARs in the range of 4%-7%

Results of analyses of smolt to adult return, TIR, and delayed mortality for fall chinook were consistent with past year's analyses. These results indicate that the smolt transportation program for juvenile fall Chinook salmon does not adequately mitigate for the adverse effects of development and operation of the Snake and Columbia rivers hydropower projects on fall Chinook survival and adult return. Consistent with past years analyses, overall SARs of fall Chinook salmon were low compared to SARs for spring/summer Chinook salmon and steelhead. As in past years, the need to increase marking of fall chinook in order to address the entire passage distribution and population is needed. The CSS continues to work with the Nez Perce Tribe to improve fall chinook marking coverage.

An update of earlier analyses of age-at-maturity is included in this report. Both stock effects and common year effects were important factors for explaining patterns in mean age-at-maturity and the proportion returning at Age-3, Age-4, and Age-5. Stocks with the highest proportions returning at Age-5 included the wild stocks from the Snake and John Day rivers and hatchery stocks from Leavenworth and Dworshak hatcheries. Stocks with the lowest proportions returning at Age-5 included the Cle Elum, Imnaha, and Catherine Creek hatchery stocks. Across stocks, the proportions returning at Age-5 decreased over the 1997- 2011 juvenile outmigration years analyzed. There was considerable year-to-year variability in age-at-maturity that was shared across stocks, with the oldest age-at-maturity occurring in the 2000, 2004, and 2005 juvenile outmigration years and the youngest age-at-maturity occurring in the 2007, 2008, and 2010 juvenile outmigration years.

New in this CSS Annual Report is analyses of adult upstream migration success. The Comparative Survival Study (CSS) has been assessing adult salmon and steelhead upstream migration success through the Federal Columbia River Power System (FCRPS) beginning with the 2010 Annual Report. These analyses were included in response to regional concerns regarding high stray rates of Snake River steelhead (Oncorhynchus mykiss) and salmon that were transported as juveniles. Early analyses indicated that salmon and steelhead that were transported downstream in the smolt transportation program had lower upstream migration success and higher stray rates. This was considered problematic for some middle Columbia River listed steelhead stocks which were affected by Snake River steelhead straying. National Oceanic and Atmospheric Administration (NOAA) has established performance standards for adult salmon migration success in the Biological Opinions for the FCRPS. In the earlier Biological Opinions, NOAA included Reasonable and Prudent Alternatives that addressed water temperature thresholds for salmon migration corridors. In addition, the Environmental Protection Agency began a basin wide evaluation to establish Total Maximum Daily Load (TMDL) for water temperature. All three species in our analyses showed that the upstream survivals for transported fish were lower than fish that had migrated in-river as juveniles. In addition survival of fish transported as juveniles started to decrease at a lower temperature compared to fish that migrated in-river. These analyses indicate that summer chinook upstream survival began to decrease when water temperatures exceeded 17 degrees centigrade and sockeye and steelhead survival began to decrease when water temperature began to exceed 18 degrees centigrade.

salmon and steelhead, and continue to work with fishery managers to improve tagging coverage of wild populations from tributary traps.

The long-term objective of the CSS is to link stages of the salmon life cycle, the factors influencing survival at each life stage, and understanding how each factor affects survival at later life stages, resulting in smolt-to adult return rates. The analyses presented in Chapter 2 utilize the life cycle model to predict the long-term effects of four experimental spill alternatives under a dam breach scenario of the four lower Snake River dams, and a non-breach scenario, on population recovery. The experimental spill levels are defined in terms of the limits of total dissolved gas (TDG) produced at each project. The prospective analyses considered the relative benefit in adult return and smolt-to-adult return of four operation scenarios, the BiOp, 115%/120%, 120%, and 125% spill levels under high, average and low flow conditions. The analyses do not predict absolute SARs but rather examines the relative change among the four scenarios with increasing spill for fish passage under breach and non-breach scenarios. This analysis predicts that average return abundances and SARs increase at higher levels of spill and when dams are breached, owing to the empirical finding that survival is higher when powerhouse passage and water transit times are lower. The predicted outcomes represent approximations of the relative magnitude of increased survival and return abundance that are predicted relative to expected passage and water transit time values under flow, spill, and breach conditions. In a fully impounded river, we predict a 2-2.5 fold increase in return abundance above BiOp spill levels when spill is increased to 125% TDG. If the lower four Snake River dams are breached and the remaining four lower Columbia dams operate at BioP spill levels, we predict approximately a 2-3 fold increase in abundance above that predicted at BiOp spill levels in an impounded system, and up to a 4 fold increase if spill is increased to the 125% TDG limit. This analysis predicts that higher SARs and long-term abundances can be achieved by reducing powerhouse passage and water transit time, both of which are reduced by increasing spill, and

The time series analyses 1998-2016 of juvenile fish passage characteristics, including fish travel times, instantaneous mortality rates, and reach survival probabilities relative to environmental variables, were updated to include data from the 2016 juvenile outmigration year. Multiple regression analyses, mixed effect model structures, and multi-model inference methods were utilized to evaluate juvenile fish passage characteristics relative to environmental variables. These data time series incorporate a high degree of contrast in the environmental conditions and juvenile fish passage metrics, both within- and across-years. New in this report is the inclusion of Total Dissolved Gas as an environmental variable. Analyses indicated that total dissolved gas was not an important variable affecting instantaneous mortality or survival probabilities. Consistent with past years' findings, conclusions from the 2017 analyses of 2016 migration conditions and migration metrics are that water travel time, spill proportion, Julian date, and water temperature are important variables for predicting fish travel time, instantaneous mortality, and reach survival probability. One exception to this was the 2016 Springfield Hatchery sockeye mark group. The instantaneous mortality rate for Snake River sockeye in 2016 was the highest rate ever observed and was much higher than the average rate in 1998-2014. The survival probability for Snake River sockeye in 2016 was about half the average survival probability 1998-2014. Concerns have been raised over the poor condition and survival of sockeye released from the Springfield Hatchery in 2015 and 2016 (Hassemer 2016). Due to these concerns, only data from 1998-2014 was used to examine the effects of environmental variables on fish travel

Appendix E: References

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