

# Order Approving a Modification to Oregon's Water Quality Standard for Total Dissolved Gas in the Columbia River Mainstem

BEFORE THE ENVIRONMENTAL QUALITY COMMISSION

In the matter of modifying Oregon's	)	FINDINGS and
Water Quality Standards for Total Dissolved	)	ORDER
Gas in the Columbia River Mainstem	)	

## Findings

1. The Department of Environmental Quality received a request from the U.S. Army Corps of Engineers (Corps) dated July 9, 2024, to adjust the 110 percent total dissolved gas water quality standard as necessary to spill water over McNary, John Day, The Dalles and Bonneville dams on the Lower Columbia River to assist out-migrating threatened and endangered salmonid smolts during the fish passage season of April 10 to Aug. 31. The request sought approval in alignment with the agreed-to operations in Appendix B of the U.S. Government Commitments in Support of the Columbia River Basin Restoration Initiative of the Resilient Columbia Basin Agreement.
2. Acting under **OAR 340-041-0104(3)** the commission finds that:
  - (a) *Failure to act would result in greater harm to salmonid stock survival through in-river migration than would occur by increased spill:*

Since 1996, the Northwest Power and Conservation Council Fish and Wildlife Program's Comparative Survival Study (CSS) has implemented a large-scale monitoring study to evaluate the effects of the federal Columbia River hydropower system operations on juvenile and adult survival. Of the thirteen Endangered Species Act listed evolutionarily significant units of salmonids that migrate past the Columbia River dams, two ESUs in particular have struggled to meet recovery goals. Based on the CSS juvenile fish passage survival model, Snake River spring/summer Chinook salmon and summer steelhead have fallen short of the 2-6 percent smolt-to-adult return (SAR) target for recovery established by the Northwest Power and Conservation Council. From 1994 through 2021, Snake River spring/summer Chinook salmon SARs have been above 2 percent in only 2 years, with an average SAR of 1 percent, signifying major population declines. From 1997 through 2020, Snake River summer steelhead SARs have been above 2 percent in 8 years with an average SAR of 1.6 percent.

A renewal of the modification allowing for total dissolved gas to be up 125 percent during the spring juvenile salmonid migration will allow the Corps to implement planned voluntary spill operations, passing more juvenile Snake River spring/summer Chinook salmon and steelhead over the spillways and reducing their passage through the turbines and bypass systems, a route collectively referred to as powerhouse

passage. The CSS model finds that increased rates of powerhouse passage negatively impact both in-river survival and early ocean survival of juvenile salmonids.

There were no exceedances of the biological monitoring of juvenile salmonids during spill seasons 2020-2024 and the CSS analyses and modeling show no evidence of detrimental effects of high total dissolved gas levels to salmonids across juvenile migration years 1998-2022. Opportunities to monitor juvenile salmonid exposure to total dissolved gas levels above 125 percent occurs during involuntary spill such as times of high stream flows. Based on observations of gas bubble trauma monitoring of juvenile salmonids, gas bubble trauma threshold of 15 percent gas bubble trauma prevalence has generally been exceeded with exposure to total dissolved gas levels near 130 percent or higher.

If the Commission were to not modify the TDG standard, the statewide standard of 110 percent would apply – requiring significant curtailment of voluntary spill.

Based on these considerations, the Commission finds that failure to approve the modification requested by the Corps would, on balance, result in greater harm to salmonid stock survival than would approval of the modification.

- (b) *The modified total dissolved gas criteria associated with the increased spill provides a reasonable balance of the risk of impairment due to elevated total dissolved gas 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:*

Risk of aquatic life impairment due to elevated total dissolved gas exposure is dependent on factors including species sensitivity to high total dissolved gas and depths where species are located during different life stages. Depth is an important consideration because total dissolved gas is reduced approximately 10 percent for each meter of depth, a phenomenon known as hydrostatic depth compensation. Given the variability of field conditions and life stages it is difficult to generalize relationships of total dissolved gas exposure and gas bubble trauma observed for resident species.

Studies have shown instances when greater than 15 percent of resident fish examined have signs of gas bubble trauma when exposed to 120-125 percent total dissolved gas<sup>1,2</sup>. Recent laboratory studies focused on gas bubble trauma in two species of nonsalmonids at total dissolved gas levels between 120 percent and 130 percent saturation conducted by the U.S. Geological Survey showed that while the prevalence and severity of gas bubble trauma increased with time at all levels of total dissolved gas tested, the relationship between severity and exposure time were weak or nonexistent. Based on monitoring of fish for signs of gas bubble trauma below dam

---

<sup>1</sup> Ryan BA and Dawley EM. 1998. Effects of dissolved gas supersaturation on fish residing in the Snake and Columbia rivers, 1997. Bonneville Power Administration.

<sup>2</sup> Schrank BP, Ryan B and Dawley EM. 1998. Effects of dissolved gas supersaturation on fish residing in the Snake and Columbia Rivers, 1996. Report by National Marine Fisheries Service, to US Army Corps of Engineers, North Pacific Division, Portland, Oregon.

tailraces in the Lower Snake and Columbia Rivers in 2023, the researchers found no apparent relationship between gas bubble trauma incidence rates and total dissolved gas levels. The researchers note that the variability in gas bubble trauma incidence rates is likely due to environmental conditions, fish exposure history to total dissolved gas levels, depth, and species sensitivity to total dissolved gas. The authors state it is difficult to predict the long-term survival, health, and performance of nonsalmonids that showed signs of gas bubble trauma and that past research has largely been unsuccessful in consistently attributing ecological significance to fish displaying signs of gas bubble trauma<sup>5</sup>.

Biological monitoring of juvenile salmonid and nonsalmonid species for gas bubble trauma occurred below McNary and Bonneville Dams during spill seasons under the previous modification order when total dissolved gas limits increased from 120 percent to 125 percent during spring spill. There were no exceedances of biological thresholds that would have required spill to be curtailed. While monitoring of juvenile salmonids showed a modest increase in observed gas bubble trauma compared to previous years, overall incidence rates were low, ranging from 0 percent to 13 percent. Since being initiated in 2021, monitoring of gas bubble trauma in nonsalmonid species has found low incidence levels of gas bubble trauma, ranging from 0 percent to 12 percent.

Increasing the level of total dissolved gas allowed during periods of voluntary spill during the specified periods of the year will increase the risk of impairment to both resident and other migrating fish, as well as to migrating salmon. However, the predicted benefits to survival rates for Snake River spring/summer Chinook salmon and summer steelhead are significant, and reasonably balance the increase in risk.

(c) Adequate data will exist to determine compliance with the standards:

Physical monitoring for total dissolved gas is necessary for evaluating compliance with the standards. The Corps utilizes real-time total dissolved gas observations from fixed monitoring stations located in the tailraces of McNary, John Day, The Dalles and Bonneville Dams. The Corps reviews their total dissolved gas monitoring plan annually and updates it as needed. The plan will be available on the Corps [website](#). Implementation of the total dissolved gas monitoring plan will ensure that data will exist to determine compliance with the standards for the voluntary spill program identified in this Order. The Corps will report each year's physical monitoring results to DEQ.

(d) *Biological monitoring is occurring to document that the migratory salmonid and resident biological communities are being protected:*

Biological monitoring occurs according to the Fish Passage Center 2024 document *Gas Bubble Trauma Monitoring Protocol and GBT.net Data Entry Users Manual*. Juvenile salmonids and non-salmonids are collected at Bonneville and McNary Dams

---

<sup>5</sup> Kenneth F. Tiffan, B. D. Liedtke, and S.L. Benson, "Nonsalmonid Gas Bubble Trauma Investigations," Final Report to the Bonneville Power Administration (Portland, Oregon: U.S. Geological Survey, January 2024), <https://www.cbfish.org/Document.mvc/Viewer/P206973>.

and examined for incidence of gas bubble trauma, and assigned ranks based on severity of their symptoms. The Corps will report each year's biological monitoring results to DEQ.

## **Order**

The Environmental Quality Commission approves the following modification to the statewide standard for total dissolved gas (OAR 340-41-0031(2)) of 110 percent for the lower Columbia River at McNary, John Day, The Dalles and Bonneville dams, as provided for in OAR 340-41-0104(3):

1. The total dissolved gas standard for the Columbia River as measured in the tailraces of McNary, John Day, The Dalles, and Bonneville dams is 125 percent for the period from April 1 through June 15.
2. The total dissolved gas standard for the Columbia River as measured in the tailraces of McNary, John Day, The Dalles, and Bonneville dams is 120 percent for the period from June 16 through Aug. 31.
3. These limits do not apply when the stream flow exceeds the seven-day, ten-year frequency flood.
4. The modified total dissolved gas standards will apply for five years, beginning Jan. 1, 2025, through Dec. 31, 2029 (calendar years 2025, 2026, 2027, 2028, and 2029).
5. The DEQ Director may approve additional periods of application of this modification up to 120 percent total dissolved gas as calculated in 8.a)i., beyond the April 1 to Aug. 31 period, subject to subsections 8.a) to 8.c) for reasons including passing Spring Creek Hatchery fish releases and other voluntary fish passage operations, maintenance activities, and biological or physical studies of spillway structures and prototype fish passage devices. The Corps must notify DEQ in writing at least one week prior to the spill describing the proposed action, including its purpose, and the location and dates of elevated total dissolved gas levels. Spill must be reduced to meet the 110 percent total dissolved gas criterion if requested by the DEQ Director.
6. Application of the tailrace maximum TDG criteria must be accompanied by a DEQ-approved biological monitoring plan designed to measure impacts to fish exposed to increased TDG conditions. Plans must include monitoring for non-salmonid fish species. Gas bubble trauma monitoring may be halted if there is a high mortality risk due to compounded effects of the evaluation procedure and adverse environmental factors such as high stream temperatures.
7. Voluntary fish passage spill during the spring spill season, occurring from April 1 through June 15, is subject to the following conditions:
  - a) Spill at a dam must be reduced when:
    - i. Instantaneous total dissolved gas levels exceed 127 percent of saturation, calculated as the average of any two consecutive hourly TDG measurements in the tailrace of the dam; or
    - ii. The average of the twelve highest hourly TDG measurements in the tailrace of the dam in a calendar day exceeds 125 percent.
  - b) The DEQ Director may halt the voluntary spill program or require reductions in voluntary spill to reduce TDG levels to 120 percent as calculated in 8.a)i. when:
    - i. The calculated incidence of gas bubble trauma in salmonids (with a minimum sample size of fifty fish required weekly) or non-salmonids

(with a minimum sample size of fifty fish required weekly) exceeds gas bubble trauma in eyes or non-paired fins of fifteen percent, or gas bubble trauma in eyes or non-paired fins of five percent and gas bubbles occlude more than twenty-five percent of the surface area of the fin or eyes. If gas bubble trauma exceeds these biological thresholds and spill is reduced, additional monitoring must demonstrate the incidence of gas bubble trauma below biological thresholds before TDG can be increased to the level specified in this order. Gas bubble trauma monitoring data shall be excluded from comparison to biological thresholds when higher than normal river flow contributes to excess spill above 125 percent. This monitoring data exclusion shall apply for one full calendar day after reduced river flow allows attainment of 125 percent TDG levels in the tailrace of the dam.

- c) The tailrace maximum TDG criteria for spring spill in this modification will be applied in a manner consistent with the applicable requirements of the federal Endangered Species Act.
  - d) Physical monitoring must occur and be adequate for implementing the requirements of this order.
8. Voluntary fish passage spill during the summer spill season, occurring from June 16 through Aug. 31, is subject to the following conditions:
- a) Spill at a dam must be reduced when:
    - i. The average of the twelve highest hourly TDG measurements in the tailrace of the dam in a calendar day exceeds 120 percent of saturation; or
    - ii. Instantaneous total dissolved gas levels exceed 125 percent of saturation in the tailrace of the dam, calculated as the average of the two highest hourly total dissolved gas measures in a calendar day.
  - b) The DEQ Director may halt the voluntary spill program or require reductions in voluntary spill to reduce TDG levels if voluntary spill results in biological threshold exceedances when:
    - i. More than 15 percent of salmonids examined show signs of gas bubble disease in their eyes or non-paired fins, or
    - ii. More than five percent of salmonids examined show signs of gas bubble trauma in their eyes non-paired fins where more than 25 percent of the surface area is occluded by gas bubbles.
  - c) Physical monitoring must occur and be adequate for implementing the requirements set out in this order.
9. The Corps must provide written notice to DEQ within 24 hours of any violations of the conditions in the modification as it relates to voluntary spill. Such notice must include actions proposed to reduce total dissolved gas levels or the reason(s) for no action.
10. No later than Jan. 31 following each year of this modification, the Corps must provide an annual written report to DEQ detailing the following:
- a) Flow and runoff descriptions for the spill season;
  - b) Spill quantities and durations;
  - c) Quantities of water spilled for fish versus spill for other reasons for each project;
  - d) Data results from the physical and biological monitoring programs, including incidences of gas bubble trauma regardless of sample size;
  - e) Evaluation of the relationship between observations of non-salmonid gas bubble trauma monitoring and exposure to elevated total dissolved gas levels;

- f) Description and results of any biological or physical studies of spillway structures and prototype fish passage devices to test spill at operational levels; and
  - g) Implementation of gas abatement measures identified through adaptive management.
11. If requested, the Corps must report to the commission on any of the above matters or other matters relevant to this order.
12. The commission reserves the right to terminate or modify this order at any time.

**Adaptive Management**

Implementation of the TMDL for Lower Columbia River Total Dissolved Gas will continue. Oregon may request further studies to determine additional structural and operational gas abatement actions that can be feasibly implemented to reduce total dissolved gas.

Dated: 12/31/24

ON BEHALF OF THE COMMISSION

*Heath Feldon*  
DEQ Director