

State of Oregon
Department of Environmental Quality

Memorandum

Date: Aug. 20, 2014

To: Environmental Quality Commission

From: Dick Pedersen, Director *Bruce K. Aldrich for*

Subject: Agenda item K, Informational Item: Response to the commission's questions on the request from U.S. Army Corps of Engineers for a renewal of the total dissolved gas water quality standard modification on the Columbia River for fish passage
Aug. 27-28, 2014, EQC meeting

Purpose of item The purpose of this report is to provide information and address the commission's questions about the U.S. Army Corps of Engineers' spill program as it relates to the total dissolved gas total maximum daily load, causes of spill, historical monitoring results and historical requirements of the TDG standard modification.

Background DEQ presented an informational item during the June EQC meeting on a request from the U.S. Army Corps of Engineers to renew the modification to the Oregon's total dissolved gas standard for voluntary spill operations at the four lower Columbia River dams: McNary, John Day, The Dalles and Bonneville. EQC approved the current total dissolved gas standard modification in 2009 for a five-year period. The standard modification will expire for the purpose of juvenile salmonid migration at midnight Aug. 31, 2014. The requested modification must be in place by April 1, 2015, to allow spill for juvenile salmonid migration. The Corps did not request substantial changes to the current standard modification in the proposal for the 2015 spill season.

Following DEQ's presentation, the commissioners posed questions regarding implementation of the total dissolved gas total maximum daily load, potential regulatory actions at the conclusion of the TMDL implementation phase, causes of spill, historical monitoring results, and requirements of previous TDG standard modifications.

Total dissolved gas TMDL implementation The total dissolved gas TMDL¹ implementation plan specifies different operational and structural modifications to mitigate TDG increases. Phase I of

¹ Pickett, P.J. and Harding, 2002. Total Maximum Daily Load for Lower Columbia River Total Dissolved Gas. Prepared jointly by Oregon Department of Environmental Quality, Portland, OR, and the Washington State Department of Ecology, Olympia WA. Washington State Department of Ecology Publication No. 02-03-004. <http://www.deq.state.or.us/wq/tmdls/docs/columbiariver/tdg/tmdlwqmp.pdf>

the implementation plan involved short-term actions, including structural modifications, which focused on meeting the fish passage performance standards outlined in the National Marine Fisheries Service 2000 Federal Columbia River Power System Biological Opinion through spills that result in TDG no greater than the modified levels of the water quality TDG standards. Implementation of Phase I began following results analysis of the Corps' comprehensive Dissolved Gas Abatement Study, prior to completion of the TMDL. Phase II began in 2011 and will end in 2020. Phase II involves further structural modifications and reductions in fish passage spill if the Biological Opinion specified performance standards are being met and adequate survival is provided for non-listed species.

The Corps initiated the Dissolved Gas Abatement Study in 1994. The study was completed in 2002. This study formed the technical basis of the Lower Columbia River Total Dissolved Gas TMDL. In the course of undertaking the study, a number of structural and operational improvements were identified. The Corps began implementation of these improvements before completion of the study in 2001. A number of modifications identified in the study were incorporated into NOAA Fisheries' 2000 biological opinion and into the Total Dissolved Gas TMDL. Since approval of the TMDL, EQC orders required the Corps to track implementation of the TMDL in its annual report to DEQ. Attachment A is the most recent submission from Appendix M of the 2013 Total Dissolved Gas and Water Temperature Annual Report. The Corps has completed most of the planned structural modifications and operational modifications are ongoing.

The TMDL does recognize that the effectiveness of implementing structural or operational modifications can only be estimated and because of this, long-term compliance with the TMDL will take a significant length of time and must take into account a certain level of inherent uncertainty.

**TMDL
implementation**

The Total Dissolved Gas TMDL regulator and operator meeting July 31, 2014, included representatives from the U.S. Army Corps of Engineers, EPA, Washington Department of Ecology and DEQ. The meeting was held to discuss options for when the TMDL timeline for meeting the 110 percent total dissolved gas water quality standard is met in 2020 but implementation is unsuccessful for actually meeting the water quality standard. Current information indicates that implementation efforts are not successful for the four lower Columbia River dams operated by the Corps. These dams are not expected to meet the total dissolved gas water quality standard during voluntary spill as required by the Federal Columbia River Power System Biological Opinion or during involuntary spill events. The options discussed at the meeting included:

- Allow more time for TMDL implementation
 - Amend the TMDL management plan to provide more time
 - Revise the TMDL and consider a longer period of time for the implementation plan
- Revise the total dissolved gas 110 percent standard
- Issue a NPDES permit to the Corps' dams for total dissolved gas

Through implementation of the TMDL management plan as approved by the EPA in 2002, the state regulatory agencies expected reasonable assurance that the Corps will meet the 110 percent total dissolved gas standard. However, operational and structural changes to the dams were unsuccessful for meeting the standard during voluntary spill to meet the NOAA Biological Opinion voluntary spill targets for fish passage. Given that the Corps' voluntary spill operations are required by the NOAA Biological Opinion and other agreements² during the implementation phases of the TMDL, it is unlikely that the Corps will meet the standard during juvenile salmonid migration.

In 1997, EPA approved Washington's modified water quality standards to allow the application of less stringent seasonal criteria for total dissolved gas to facilitate out-migrating juvenile salmonids. However, at the time of TMDL development less stringent criteria for periods of fish passage was considered temporary and required annual renewal. For this reason, the targets did not incorporate the seasonal 120 percent allowance. Given that Washington's criteria are not temporary and their numeric criteria are written in rule, Washington has indicated that it no longer expects the target of 110 percent criterion within the seasonal spill period to be a realistic goal. However, the TMDL targets for the lower Columbia dams are appropriate because DEQ's TDG criterion remains 110 percent without application of the temporary modification, which is being requested by the Corps.

The Corps has indicated that it has exhausted the initial options for structural modifications to mitigate or prevent increasing total dissolved gas. It may not be legally defensible to reissue a TMDL when there is not reasonable assurance that when the TMDL is implemented the waterbody would achieve the 110 percent targets. Spill is an important component of fish passage. Given the current understanding of the issues discussed above, the TMDL

² The U.S. Army Corps of Engineers currently follows annual Spring and Summer Fish Operating Plans which describes the Corps' project operations for fish passage at its Federal Columbia River Power System dams during the fish migration season. To the extent Corps project operations are not specified in the plans, the dam operations are consistent with the 2014 NOAA Fisheries Supplemental Biological Opinion (2014 Supplemental BiOp), the U.S. Fish and Wildlife Services 2000 and 2006 BiOps, and/or other operative documents, including the 2014 Water Management Plan, seasonal updates, and the 2014 Fish Passage Plan.

management plan, as well as the stated targets, is outdated in the approach to bring the Corps into compliance.

Stakeholders discussed the possibility that the standard may be overly conservative. Revision of the TDG standard received general support from some stakeholders. The scientific community has a better understanding of its effects on salmonids than when EPA developed the standard in the 1970s. However much remains unknown about effects on resident species. If standard revision occurs, it may not be as simple as establishing seasonal criteria in Oregon's rule. There will need to be an assessment of the base 110 percent criteria as well. It was discussed that EPA would be asked to lead an effort to coordinate and develop a modification to multi-state total dissolved gas criteria.

Although some stakeholders expressed interest in revising the standard, efforts to revise the standard will largely depend on EPA's and states' priorities and resources. Any water quality standard change is likely to be very resource intensive. A less resource intensive approach is an amendment of the TMDL through reevaluating implementation activities for adaptive management considering a system wide approach and realistic targets.

Discussions included the option of issuing an NPDES permit to the Corps-operated dams for total dissolved gas. There is some history for this for some operations and pollutants released from dams. However, it is unclear if this would be a better approach than standard modification.

Voluntary and involuntary spill

The U.S. Army Corps of Engineers operates the dams for voluntary spill for the benefit of fish passage. The Biological Opinion establishes minimum spill levels. For the four lower Columbia River dams, these spill levels are specified as either flow rates or percentages of total stream flow rate. The Biological Opinion also states that spill levels are not to result in exceedances of the standard or modified standard. Therefore Oregon's standard modification and Washington's fish passage exemptions establish maximum voluntary spill levels.

The Corps defines involuntary spill as spill that is largely driven by hydrologic capacity at each dam, occurring when water exceeds the dam's capacity to either temporarily store the water or pass the water through its turbines. As with voluntary spill, the Corps attempts to mitigate effects of involuntary spill through balancing spill operations throughout the Federal Columbia River Power System. Causes of involuntary spill include, but are not limited to, outages of hydro power equipment, passing debris, managing reservoirs for flood control and instances when Bonneville Power Administration load

requirements are lower than actual powerhouse capacity, also known as “lack of load.” Since 1996, the Corps tracked factors causing involuntary spill as a requirement of the standard modifications. However, their tracking process lumps spills due to flood control efforts and lack of load into one exceedance type. DEQ does not receive from the Corps the amount of involuntary spill due to power load versus other causes such as flood control. The Corps has stated that considering the different combinations of factors contributing to involuntary spill, it would be a challenging task to differentiate portions of spill caused by lack of load.

Summary of spill and monitoring under the current modification

Between 2010 and 2013, the largest percentage of spill season with exceedances of the modified limit was 40 percent in 2012 and the smallest percentage was four percent in 2013. Over 28,689 smolts were examined during these four years for gas bubble trauma. There were 111 observations of gas bubble disease comprising less than one percent of the smolts examined. Summary tables of exceedances and biological monitoring results are in Table 1 and 2 in attachment B. Additional summary information from previous years under the standard modification will be provided at the time this information item is presented.

History of EQC involvement

Oregon adopted a 105 percent total dissolved gas water quality standard in 1967. In 1976, Oregon revised the standard to 110 percent based on EPA criteria documents. The 105 percent TDG standard remained in place for shallow water. The commission first approved a rule modification in 1994 through issuance of a temporary rule. In 1995, EQC approved current procedural rule language allowing EQC to modify the TDG standard for the benefit of salmonid migration. Oregon Administrative Rule relevant to TDG, including this 1995 rule, is in attachment C. The modified TDG limits have remained unchanged since 1995, with exception of the 2009 removal of the modified 115 percent TDG limit applicable to the forebay.

From 1995 through 2007, EQC considered annual issuance of two separate orders. One for a 10-day period in March that would assist passage of fall Chinook released from Spring Creek Hatchery upstream of Bonneville Dam. The second order was for seasonal spill from April through August. Prior to 2008, the modification request applicable to the Spring Creek Fish Hatchery release came from the U.S. Fish and Wildlife Service and the request applicable to seasonal spill came from NOAA Fisheries. Modification requests began originating from the Corps starting with the 2001 spill season and the 2008 Spring Creek Fish Hatchery release. The two spill periods have been addressed under one EQC order from 2008 onward. Multi-year, although not year-round, modifications were issued beginning with the 2003 spill season.

EQC has also approved modifications for the testing the John Day Dam flow deflectors in 2000 and a spill test at The Dalles Dam to test juvenile salmonid spill survival in 2002.

Changes to biological monitoring requirements

Although a smolt monitoring program was already in place by 1994, NOAA Fisheries began developing a biological monitoring program in 1994 in response to a requirement of Oregon's temporary rule. During the effective period of the 1994 temporary rule, biological monitoring occurred daily with occasional internal examination. During the years the standard modification was initially considered by EQC, biological monitoring requirements were broader, including not only smolts but monitoring of resident fish, invertebrates and adult salmonids. Requirements also included studies of increased TDG affects.

Examination of aquatic invertebrates and internal examination of smolts for gas bubble disease was halted following 1995. EQC found there was no benefit in continuing with invertebrate monitoring based on the previous years of monitoring by NOAA Fisheries, which show no incidences of gas bubble disease in aquatic invertebrate populations. Internal examination of smolts for gas bubble disease did not continue because the examination techniques may have resulted in invalid detection of gas bubble disease signs. After the 1998 spill season, there was no other requirement to monitor resident species. EQC orders have not required adult gas bubble trauma monitoring since 1999 based on the potential for harm and data showing few to no signs of gas bubble trauma in adults under controlled fish passage spill conditions.

During the initial years that the commission considered modification to the total dissolved gas standard, spill was seen as part experiment and part adaptive management. Studies conducted at that time did not provide a clear picture of risk associated with spill as a fisheries management tool. From 1997 onward, annual biological monitoring of smolts has shown less than one percent with visible signs of gas bubble trauma when the modification has been in effect.

A chronology of the requests related to fish spill 1994 to present is included as attachment F.

Next steps

DEQ will issue a public notice opening a 30-day public comment period. The notice will ask for comment on the 2014 request from the Corps, as noted in the background section of this report. This comment period will conclude a month prior to the EQC Nov 5-6, 2014, meeting, when DEQ will present the standard modification request as an action item.

Attachments

- A. 2013 TDG TMDL Implementation Summary from U.S. Army Corps of Engineers' 2013 Dissolved Gas and Water Temperature Report
- B. Summary tables of exceedances and biological monitoring results from 2010 through 2013 seasonal spill
- C. Oregon Administrative Rule relating to the total dissolved gas water quality standards applicable to the main stem Columbia River
- D. Order approving the U.S. Army Corps of Engineers' Request for a Waiver to the State's Total Dissolved Gas Water Quality Standard; effective 2010-2014
- E. 1996 EQC order approving National Marine Fisheries Service's request for a total dissolved gas standard modification to assist out-migrating Snake and Columbia River smolts
- F. Fish spill season chronology: 1994 to 2014

Approved:

Division: _____

Section: _____

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Introduction

This appendix provides a summary of the status of the short-term, operational and long-term Corps TDG TMDL implementation activities recommended in the Summary Implementation Strategy (SIS) of the TDG TMDLs for the lower Columbia River (approved by EPA on November 18, 2002) and the lower Snake River (approved by EPA on September 30, 2003). The SIS incorporates actions described and analyzed by the NOAA Fisheries in the 2000 and 2004 Biological Opinions and by the Corps in the Dissolved Gas Abatement Study (DGAS). The SIS was developed in consultation with NOAA Fisheries, so that TMDL implementation would be coordinated with requirements of the ESA. Both Phase I short-term and Phase II long-term measures are described with specific TDG and spill reduction measures. Phase I was in effect through 2011. Phase II began after 2010 and continues through 2020; however, some action items began before the projected year of 2011. In addition, supplemental activities, which are above and beyond what the TMDL requires, were taken from 2002 to present that provide benefits for TDG and fish survival.

The TMDL Summary Implementation Actions:

The following summary tables provide an overview of the status of the short-term and long-term Corps TDG TMDL implementation activities. Tables M-1 and M-2 provide the current status of the Phase I (short-term) TDG TMDL implementation actions. Implementation actions in Table M-1 are directly related to achievement of the water quality standard, where actions in Table M-2 are indirectly related to this standard. Table M-3 provides the operational implementation actions that are used to minimize TDG. Table M-4 provides the current status of the Phase II (long-term) TDG TMDL implementation activities. Table M-5 provides a summary of supplemental TMDL activities. These supplemental activities were undertaken in addition to Phase I and Phase II measures.

TABLE M-1
PHASE I – SHORT-TERM TMDL IMPLEMENTATION ACTIVITIES
Structural Implementation Actions

2000 Biological Opinion Action Item Description	Status	Estimated Completion Date	Actual Completion Date
Ice Harbor Deflectors	Deflectors in bays 2 - 5 (1996); bays 6 - 9 (1997); and bays 1 and 10 (1998); construction completed.	1998	1998
John Day Deflectors	Deflectors in bays 2 - 19; construction completed.	1998	1998
John Day Deflectors	Deflector in bay 20; construction completed.	2011	2011
All Projects - Survival based spill caps at all dams (e.g. 40% at The Dalles).	Studies are on-going.	N/A	N/A
Bonneville Endbay Deflectors	Deflectors in all interior bays 1-17; construction completed for bays 1-3 and 16-18 in 2002.	2002	2002
McNary Endbay Deflectors	Deflectors in bays 1, 2, 21, 22 construction completed.	2002	2002
Lower Monumental Endbay Deflectors	Deflectors in bays 1 and 8 construction completed. Repairs to bay 2 deflector. Preliminary studies were completed.	2003	2003
Lower Monumental Endbay Deflectors	Post RSW installation testing has been completed.	2009	2009
Little Goose Endbay Deflectors	Construction of deflectors in bay 1 and 8 completed.	2009	2009
Little Goose Endbay Deflectors	Evaluate and test after Temporary Spillway Weir (TSW) installed which was completed in 2009. Testing was planned for two years but was reduced to one year.	2009	2009
Chief Joseph Deflectors	Construction of spill bay deflectors completed October 2008.	2008	2008
Chief Joseph Deflectors	Post-deflector spill test to check TDG exchange properties during spillway discharges completed.	2009	2009
The Dalles Deflectors	No deflectors planned at this time; spillway survival completed 2012.	N/A	N/A
John Day Endbay Deflectors	End bay #20 constructed 2009-2010. Bay #1 not considered, would interrupt fish attraction flow.	2010	2010
Little Goose Spillway Divider Wall	Not under consideration at this time.	N/A	N/A
Divider Walls at Appropriate Dams	(See below for itemized list of divider walls.)		
John Day Spillwall	No spillwall planned at this time since not cost effective due to depth of stilling basin.	N/A	N/A
The Dalles Spillwall	The first spillwall construction completed between bays 6 and 7.	2004	2004
The Dalles Spillwall	Biological evaluations after first spillwall was installed. Full project evaluations occurred in 2004 and 2005; a spillway specific evaluation occurred in 2006. Completed.	2006	2006
The Dalles Spillwall	Construction of a larger and longer spillwall between bays 8 and 9 began in 2008. Completed.	2010	2010
The Dalles Spillwall	Biological evaluations after spillwall construction completed.	2010-12	2010-12

Table M-1 correlates to Table 15 of the 2002 TMDL for Lower Columbia River TDG and Table 18 of the 2003 TMDL for Lower Snake River TDG.

TABLE M-2
PHASE I – ADDITIONAL SHORT-TERM TMDL IMPLEMENTATION
ACTIVITIES
Structural Implementation Actions

2000 Biological Opinion Action Item Description	Status	Estimated Completion Date	Actual Completion Date
Bonneville Powerhouse 2 Corner Collector (B2CC)	Construction of corner collector in powerhouse 2 completed.	2004	2004
Bonneville Powerhouse 2 Fish Guidance Efficiency (FGE) Improvement	Installed turning vanes on Submerged Traveling Screens (STS). Installed ceiling gap closure device.	1997	1997
Bonneville Powerhouse 2 FGE Improvement	Decision document completed FY05 – FGE and in-take improvements. Modified Vertical Barrier Screens (VBS).	2008	2008
Bonneville Powerhouse 2 FGE Improvement	Completed biological evaluations after new designed VBS.	2009	2009
Lower Granite Removable Spillway Weir (RSW)	RSW construction completed.	2001	2001
Lower Granite RSW	Testing of spring and summer migrants after RSW construction was completed. Testing spanned three years from 2005 to 2007.	2007	2007
The Dalles Turbine Intake Blocks	Construction of turbine intake blocks was completed.	2001	2001
The Dalles Turbine Intake Blocks	Testing was performed and results showed that block hydraulics were harmful to fish. All were removed. Completed.	2004	2004
Lower Monumental Bypass Outfall Relocation	Relocation completed. Evaluated in 2012-2013.	2012	2012
The Dalles Sluiceway Outfall Relocation	Not being investigated at this time; current sluiceway being used as is.	N/A	N/A
Bonneville Powerhouse 1 Surface Bypass or Extended Screens	Biological evaluations completed but biological benefits were out weighted by cost, thus suspending progress.	2002	2002
Bonneville sluiceway improvement study	Finished letter report for modification of B1 sluiceway chain gates.	2007	2007
Bonneville sluiceway improvement	Removed the Juvenile Bypass System (JBS) channel.	2009	2009
Bonneville sluiceway improvement	Construction of 3 automated sluiceways begin in 2008. Completed.	2009	2009

Table M-2 correlates to Table 16 of the 2002 TMDL for Lower Columbia River TDG and Table 19 of the 2003 TMDL for Lower Snake River TDG.

TABLE M-3
PHASE I – OPERATIONAL TMDL IMPLEMENTATION ACTIONS

Operational Action	Status
Scheduling routine turbine maintenance and repair during low-power load and river flow periods.	Ongoing
Preventative maintenance of turbines to prevent breakdown.	Ongoing
System management of water release from upstream storage reservoirs to minimize involuntary spill at dams in the TMDL area.	Ongoing
Optimizing power purchasing to allow maximum use of powerhouse capacity and minimization of involuntary spill. This has become more complex with the increase in wind energy in the Columbia River Basin.	Ongoing
Testing various spill patterns to find the most effective for fish passage and TDG production. If spill pattern produces undesirable results, modify spill pattern.	Ongoing

Table M-3 correlates to language on page 73 of the 2002 TMDL for Lower Columbia River TDG and page 76 of the 2003 TMDL for Lower Snake River TDG.

TABLE M-4
PHASE II – LONG-TERM TMDL IMPLEMENTATION ACTIVITIES
Fish Passage Actions That Support TDG Water Quality Goals

2000 Biological Opinion Action Item Description	Status	Estimated Completion Date	Actual Completion
John Day Top Spillway Weir (TSW)	Construction of 2 TSWs completed in bays 15 and 16.	2008	2008
John Day TSW	Moved 2 TSWs from bays 15 and 16 closer to powerhouse in bays 18 and 19.	2010	2010
John Day TSW	Biological testing after TSW construction is completed. Ongoing.	2010-14	---
Removable Spillway Weirs (RSWs) at Lower Monumental, Little Goose and Ice Harbor dams	See Details below	See Details below	See Details below
Lower Monumental RSW	Construction completed.	2008	2008
Lower Monumental RSW	Evaluation and testing after RSW construction completed. Began 2008 and completed 2009.	2009	2009
Little Goose TSW	Construction and Installation of Temporary Spillway Weir (TSW) completed.	2009	2009
Little Goose TSW	Testing occurred during 2012.	2014	---
Ice Harbor RSW	RSW construction completed.	2005	2005
Ice Harbor RSW	Post - construction testing occurred in 2009-2010.	2010	2010
McNary Bypass Improvements (New Outfall Flume)	Completed in 2012, and post-construction testing completed.	2012	2012
McNary Bypass Improvements (temperature)	A prototype model has been developed by M. Schneider to assist with temperature issues.	2013	---
Lower Monumental Extended Screens	Extended screens are suspended because of the cost-to-benefit ratio.	Unknown	Unknown
John Day Extended Screens	Tested prototype performed well. Shelved due to information indicating lower SARs for bypassed fish and high O&M costs.	2003	2003
All Projects - Spill Effectiveness Studies	Ongoing, site-specific as warranted. Study done when performance standard testing is undertaken.	Site-specific	Site-specific
Predator Removal and Abatement	Ongoing at Lower Columbia River projects including avian hazing and wires, pike minnow removal and sea lion hazing (see below).	N/A	N/A
The Dalles Predator Removal and Abatement	Ongoing pikeminnow removal program at Lower Columbia River dams. Funded by BPA. Ongoing.	N/A	N/A
Bonneville Predator Removal and Abatement	Sea Lion Exclusion Device constructed and installed.	2007	2007
All Projects - Improved O&M	Ongoing.	N/A	N/A
Bonneville Powerhouse 1 Minimum Gap Runners	See details below.	See Details below	See Details below
Bonneville PH1 - Unit 10	Construction of unit 10 began in 2009 and was completed in 2010.	2010	2010
Bonneville PH1 - Unit 1-6, 9	Units 1,2,3,4,5,6,9 completed.	1990-2007	1990-2007
Bonneville PH1 - Unit 7	Construction completed on unit 7.	2007	2007
Bonneville PH1 - Unit 8	Construction completed on unit 8.	2008	2008
All Projects - Implement Turbine Survival Program Results	Ongoing. Work being done in support of IHR turbine development in 2014. Biological testing will follow at IHR once new turbine units installed.	N/A	N/A

Table M-4 correlates to Table 17 of the 2002 TMDL for Lower Columbia River TDG and Table 20 of the 2003 TMDL for Lower Snake River TDG.

TABLE M-5
SUPPLEMENTAL TMDL IMPLEMENTATION ACTIVITIES
Fish Passage Actions That Support TDG Water Quality Goals

2000 Biological Opinion Action Item Description	Status	Estimated Completion Date	Actual Completion Date
Ice Harbor Modernization, Turbine Runner Prototype.	Construction of new Turbine Runners. Ongoing Kaplan Runner installation contract award in 2015 for unit 2 with completion in 2016, fixed runner in unit 3 during 2016, fixed runner in unit 1 in 2017-2018.	2015-2018	---
McNary Temporary TSW	Construction of TSW completed on bays 20 and 22.	2007	2007
McNary Temporary TSW	The TSWs were moved to various bays to optimize for surface fish passage. Move spanned two years from 2008 to 2009.	2009	2009
McNary Temporary TSW	Biological testing after TSW construction was completed. Testing spanned three years from 2007 to 2009.	2009	2009
McNary Modernization	Biological testing completed 10/26/07. Testing spanned three years from 2005 to 2007.	2007	2007
Bonneville Powerhouse 2 Behavioral Guidance System (BGS)	Behavioral Guidance System (BGS) for improved guidance for yearling and subyearling chinook to the B2CC installation completed.	2008	2008
Bonneville spillway gate re-design	Bonneville spillway gate re-design of 18 gates began in 2008. Completed.	2009	2009

Table 1. Summary of Parameters Relevant to the 5-year Total Dissolved Gas Waiver Applicable from 2010 through 2014

Year	Dam	April 1 - August 31		Days Exceeding Waiver Limit _c	Portion of Eligible Days the Waiver Limit is Exceeded _d	Biological Monitoring, Smolts Examined _e		
		7Q10 Days _a	Days of Fish Passage Spill _b			Sample Size	Juveniles with Gas Bubble Trauma	Portion of Examined Juveniles with Gas Bubble Trauma
2010	McNary	0	153	23	15%	3775	0	0%
2010	John Day	0	153	0	0%	--	--	--
2010	The Dalles	0	153	0	0%	--	--	--
2010	Bonneville	0	153	27	18%	3503	1	0.03%
2011	McNary	30	123	54	44%	4000	31	0.8%
2011	John Day	36	117	18	15%	--	--	--
2011	The Dalles	29	124	19	15%	--	--	--
2011	Bonneville	31	122	73	60%	3428	10	0.3%
2012	McNary	0	153	74	48%	4038	30	0.7%
2012	John Day	0	153	35	23%	--	--	--
2012	The Dalles	0	153	33	22%	--	--	--
2012	Bonneville	0	153	102	67%	3263	12	0.4%
2013	McNary	0	153	5	3%	3814	21	0.6%
2013	John Day	0	153	0	0%	--	--	--
2013	The Dalles	0	153	0	0%	--	--	--
2013	Bonneville	0	153	21	14%	2868	6	0.2%

Table 2. Yearly Averages and Totals for the Dams Under the 5-year Total Dissolved Gas Waiver Applicable from 2010 through 2014.

Year	Percent of Average Columbia River Flow _f	April 1 - August 31		Average Days of Waiver Limit Exceedances _i	Average Portion of Eligible Days when Waiver Limit was Exceeded _j	Smolts Examined at McNary and Bonneville Dams		
		Average 7Q10 days _g	Average Days of Fish Passage Spill _h			Sample Size	Juveniles with Gas Bubble Trauma	Portion of Examined Juveniles with Gas Bubble Trauma _k
2010	78%	0	153	12.5	8%	7278	1	0.01%
2011	117%	32	121	41	34%	7428	41	0.6%
2012	106%	0	153	61	40%	7301	42	0.6%
2013	101%	0	153	6.5	4%	6682	27	0.4%

a - DEQ does not apply the total dissolved gas criterion during 7Q10 flood flow conditions according to OARS 340-041-0031(2). The 7Q10 flood flow rate is assessed for each dam. The 7Q10 is the flow rate corresponding to the annual peak 7-day average flow that has a 10% probability of occurring in any given year.

b - Number of days from April 1 through August 31 minus the number of 7Q10 days. The maximum number of days waiver is in effect for voluntary spill during the spring and summer outward migration period is 153, or the number of days from April 1 through August 31.

c - The waiver limit is exceeded when the average total dissolved gas concentration of the 12 highest hourly measurements per calendar day exceeds 120 percent of saturation in a dam tailrace or when instantaneous total dissolved gas levels exceed 125 percent of saturation for any 2 hours during the 12 highest hourly measurements per calendar day in a dam tailrace.

d - Number of days waiver limit is exceeded as a percent of days of fish passage spill (i.e. days the total dissolved gas criteria is applicable).

e - Monitoring occurred two days per week at McNary and Bonneville dam and throughout the spring and summer spill programs. Monitored species include Chinook subyearlings, Chinook yearlings and steelhead.

f - Sum of average monthly stream flow as a percentage of the 1971-2000 average flow for the Columbia River at The Dalles. The flows were adjusted to exclude effects of regulation provided by storage reservoirs.

g - Average number of 7Q10 days at the four dams during the spring/summer spill season.

h - Average number of days of fish passage spill at the four dams during the spring/summer spill season, calculated by subtracting the average 7Q10 days from 153.

i - Average number of days that the waiver limit was exceeded at the four dams during the spring/summer spill season.

j - Average number of days that the waiver limit was exceeded as a percent of days of fish passage spill (i.e. days the total dissolved gas criteria is applicable).

k -DEQ will halt the spill program if either 15 percent of the fish examined show signs of gas bubble disease in their non-paired fins, or five percent of the fish examined show signs of gas bubble trauma in their non-paired fins where more than 25 percent of the surface area of the fin is occluded by gas bubbles.

Oregon Administrative Rules
Total Dissolved Gas Standards Applicable to the Main Stem Columbia River

OAR 340-041-0031 - Total Dissolved Gas

- (1) Waters will be free from dissolved gases, such as carbon dioxide hydrogen sulfide, or other gases, in sufficient quantities to cause objectionable odors or to be deleterious to fish or other aquatic life, navigation, recreation, or other reasonable uses made of such water.
- (2) Except when stream flow exceeds the ten-year, seven-day average flood, the concentration of total dissolved gas relative to atmospheric pressure at the point of sample collection may not exceed 110 percent of saturation. However, in hatchery-receiving waters and other waters of less than two feet in depth, the concentration of total dissolved gas relative to atmospheric pressure at the point of sample collection may not exceed 105 percent of saturation.

OAR 340-041-0104 - Water Quality Standards and Policies Specific to the Main Stem Columbia River

- (3) Total Dissolved Gas. The Commission may modify the total dissolved gas criteria in the Columbia River for the purpose of allowing increased spill for salmonid migration. The Commission must find that:
 - (a) Failure to act would result in greater harm to salmonid stock survival through in-river migration than would occur by increased spill;
 - (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;
 - (c) Adequate data will exist to determine compliance with the standards; and
 - (d) Biological monitoring is occurring to document that the migratory salmonid and resident biological communities are being protected.
 - (e) The Commission will give public notice and notify all known interested parties and will make provision for opportunity to be heard and comment on the evidence presented by others, except that the Director may modify the total dissolved gas criteria for emergencies for a period not exceeding 48 hours;
 - (f) The Commission may, at its discretion, consider alternative modes of migration.

Order Approving the U.S Army Corps of Engineer's Request for a Waiver to the State's Total Dissolved Gas Water Quality Standard

BEFORE THE ENVIRONMENTAL QUALITY COMMISSION

In the matter of the U.S. Army Corps)	FINDINGS and
of Engineers' request to spill water)	ORDER
to assist out-migrating threatened)	
and endangered salmon smolts)	

Findings

1. The Department of Environmental Quality received a request from the U.S. Army Corps of Engineers dated January 09, 2009, 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 salmon smolts during the fish passage season of Apr. 1 to Aug. 31. The application sought approval for five years. The public was notified of the request on Feb. 19, 2009 and given the opportunity to provide written comments until 5:00 p.m. on Mar. 23, 2009.
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:

Biological assessments and opinions have concluded that providing project spill for fish passage at levels that result in exceeding the 110 percent total dissolved gas water quality standard is necessary to assure adequate passage conditions for Endangered Species Act listed fish species. The National Marine Fisheries Service Federal Columbia River Power System Biological Opinion concluded that the risk associated with a managed fish passage spill program to a 120 percent total dissolved gas level is warranted by the projected 4 percent to 6 percent increase in system survival of juvenile salmonids. The opinion estimated mortality from fish passing through turbines between 7 and 14 percent, and mortality due to fish passage spill between 0 to 2 percent. Barge and truck transport are alternative modes of fish transport to voluntary spill. The mortality associated with truck and barge transport is difficult to estimate due to the potential for latent mortality. However, the US Fish and Wildlife Service studied the transport of fall Chinook salmon directly from Spring Creek Hatchery by barge to a release site below Bonneville Dam. A high percentage of the adult returns from the barged groups strayed to other hatcheries, and the return rates to Spring Creek Hatchery were significantly lower for the barge test groups than for the voluntary spill control group. The US Fish and Wildlife Service also evaluated the possibility of raising and releasing additional fish to make up for those fish that would be lost to turbines or other causes during passage at Bonneville Dam in the

absence of spill. The USFWS concluded that it would not be possible to raise additional fish because rearing space, water supply, and waste treatment capability are limited. It would also not be feasible to release fish at a later date because of limited hatchery capacity since these fish would continue to grow and exceed hatchery capacity.

(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:

The Fish Passage Center estimates a 1.4 percent incidence of gas bubble trauma in salmon smolts in the Columbia River when total dissolved gas levels are managed to 120 percent in the tailrace. This estimate is based on smolt monitoring information collected between 1995 and 2007.

When the in-river total dissolved gas levels are below 120 percent, few adult fish (in some cases none) display signs of gas bubble trauma. Investigators have observed adult tolerance to total dissolved gas and hypothesized that it was attributable to the migration depth of adult salmonids. Depth-sensitive radio tags used in adult migration studies confirmed that adults migrate at depths up to 4 meters and find depth compensation protection from gas bubble trauma. For every meter below the surface water, a reduction of 10 percent total dissolved gas is measured in the water column. Resident fish and aquatic invertebrates in the Columbia River downstream of Bonneville Dam have been monitored by National Marine Fisheries Service for signs of gas bubble disease from 1993 to 1998. There were no signs of gas bubble disease observed in the aquatic invertebrates examined. There was a low incidence of gas bubble disease (less than one percent) in resident fish examined in 1993 and 1995 while in 1994, 1997 and 1998 none of the fish observed had signs of gas bubble disease. Signs of gas bubble disease were prevalent in 1996 but this was a high flow year with large volumes of involuntary spill and total dissolved gas levels above 120 percent in the tail races of dams. Given the past monitoring of gas bubble disease, the levels requested in this petition strike a reasonable balance between increased survival due to reduced turbine mortality and the risk of mortality from gas bubble disease.

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

Physical in-river total dissolved gas monitoring will be conducted at the tailraces of McNary, John Day, The Dalles, and Bonneville Dams. Hourly data will be available on the Corps' website. The Corps has submitted a physical monitoring plan. The physical monitoring plan of action is available at:
http://www.nwdwc.usace.army.mil/tmt/wq/tdg_monitoring/2010-14_final.pdf
Implementation of the physical 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:*

The corps has submitted a biological monitoring plan. Biological monitoring will occur according to the "Fish Passage Center Gas Bubble Trauma Monitoring Program Protocol for Juvenile Salmonids" document, available at: <ftp://ftp.fpc.org/gbtprogram/>. Juvenile salmonids will be collected at Bonneville and McNary Dams and examined and evaluated for incidence of gas bubble trauma, and will be assigned ranks based on severity of their symptoms. The corps will report each year's biological monitoring results to the DEQ.

Order

1. The Environmental Quality Commission approves a modification to the 110 percent total dissolved gas water quality standard for voluntary fish passage spill at McNary, John Day, The Dalles and Bonneville Dams on the Lower Columbia River, subject to the following conditions:
 - (i) A modified total dissolved gas standard for the Columbia River applies:
 - a) during the voluntary spill period from midnight on Apr. 1 to midnight on Aug. 31 for the purpose of fish passage; and
 - b) during any period of voluntary spill that occurs outside the periods specified in 1(i)(a) above, if the spill is for the purpose of Spring Creek Hatchery fish release, maintenance activities and/or biological or physical studies of spillway structures and prototype fish passage devices, then the U.S. Army Corps of Engineers must have approval from the Department prior to such spill. The corps must notify the DEQ in writing describing the action, the purpose of the action and dates of action at least one week prior to the voluntary spill for the purpose of informing DEQ and having the DEQ make a final determination of approval. The U.S. Army Corps of Engineers will conduct physical and biological monitoring during these periods of voluntary spill.
 - (ii) The modified total dissolved gas criteria will apply for five-years, 2010, 2011, 2012, 2013 and 2014.
 - (iii) Spill must be reduced when the average total dissolved gas concentration of the 12 highest hourly measurements per calendar day exceeds 120 percent of saturation in the tailraces of McNary, John Day, The Dalles, and Bonneville Dams monitoring stations.
 - (iv) Spill must be reduced when instantaneous total dissolved gas levels exceed 125 percent 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.

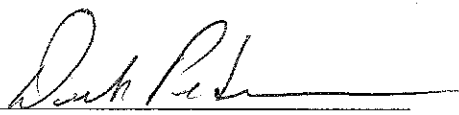
- (v) If either 15 percent of the fish examined show signs of gas bubble disease in their non-paired fins, or five percent of the fish examined show signs of gas bubble trauma in their non-paired fins where more than 25 percent of the surface area of the fin is occluded by gas bubbles, the DEQ director will halt the spill program.
- (vi) 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.
- (vii) No later than Dec. 31 for each year of this waiver, 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;
 - e) description and results of any biological or physical studies of spillway structures and prototype fish passage devices to test spill at operational levels; and
 - f) progress on implementing the gas abatement measures contained in the 2002 Lower Columbia River total dissolved gas total maximum daily load and other gas abatement activities identified through adaptive management.
- (viii) If requested, the corps must report to the commission on any of the above matters or other matters relevant to this order.
- (ix) The commission reserves the right to terminate or modify this modification at any time.

Adaptive Management

The process for reviewing the implementation of the 2002 Lower Columbia River total dissolved gas total maximum daily load will continue. The Washington State Department of Ecology will convene an advisory group with representatives from Oregon DEQ, tribes, federal and state agencies to evaluate appropriate points of compliance for this total maximum daily load. Based on these findings, further studies may be needed, and structural and operational gas abatement activities will be redirected or accelerated if needed.

Dated: 6-24-09

ON BEHALF OF THE COMMISSION



Director

BEFORE THE ENVIRONMENTAL QUALITY COMMISSION

In the matter of the National Marine Fisheries Service's request to spill water to assist out-migrating Snake and Columbia River salmon smolts	(ORDER
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WHEREAS the Department of Environmental Quality received a request from the National Marine Fisheries Service dated January 12, 1996, to adjust the Total Dissolved Gas Standard as necessary to spill over dams on the Columbia River, commencing at midnight on April 10, 1996, and finishing at midnight on August 31, 1996, to assist out-migrating Snake and Columbia River salmon smolts.

WHEREAS the public was notified of the request on January 22, 1996, and given the opportunity to provide testimony at 1:00 p.m. on February 16, 1996, and the opportunity to provide written comments until 5:00 p.m. on February 16, 1996.

WHEREAS the Environmental Quality Commission met on February 23, 1996 and considered the request, justification and public comment, and deferred a decision until its next meeting.

WHEREAS the Environmental Quality Commission met on April 12, 1996 and considered the request, justification and public comment.

THEREFORE the Environmental Quality Commission orders as follows:

1. Acting under OAR 340-41-205(2)(n)(B), the Commission finds:
 - (i) failure to act will result in greater harm to salmonid survival through in-river migration than would occur by increased spill because estimated mortalities for fish passing through turbines is between 10 and 15 percent compared to an estimated mortality of between 2 to 3 percent mortality for fish passing over spillways.
 - (ii) the balance of risk of impairment to fish due to elevated dissolved gas levels needs to be balanced against mortality of turbine passage. It is clear from the netpen mortalities at Ice Harbor in May and June 1995 that elevated dissolved gas levels do result in significant mortality. This is well above the range that instream bioassays indicate that mortalities will occur. Correspondence from Oregon Department of Fish and Wildlife (ODFW) and the Tribes in relation to last year's petition equated the mortality from turbines with elevated dissolved gas at around 120 percent. This is considered a conservative estimate. Given the conservative nature of this estimate along with the data yielded by the netpen mortalities at Ice Harbor, the balance of the risk of impairment at the levels sought in the petition is tipped in favor of granting the variance;


- (iii) NMFS has submitted a detailed physical monitoring plan which is the same as last year. Physical monitoring will occur at 37 sites in the mainstem Columbia, lower Snake and lower Clearwater Rivers in the forebays and tailraces of all spilling dams. The physical monitoring plan seeks to overcome the difficulties encountered last year with equipment failures and unreliable readings through rapid equipment repair including the use of properly calibrated backup equipment, and weekly instrument verification. Hourly data will be posted electronically, as it was last year. Implementation of the physical monitoring plan will ensure that data will exist to determine compliance with the standards;
 - (iv) NMFS has submitted a detailed biological monitoring program which also mirrors that of last year. Significant differences are the resident invertebrates will not be monitored in 1996. The incidence of GBD in resident invertebrate populations was so low in previous years that no benefit is seen from continuing with it. Smolt monitoring will continue as it did last year with examination of smolts being undertaken with 10X to 40X dissecting microscopes. Signs of GBD will be sought on non-paired fins, eyes and lateral lines. The Expert Panel on Gas Bubble Disease suggests that it is unknown whether or not the proposed biological monitoring program will provide data to show that migratory and resident biological communities are being protected. This uncertainty arises from the untested critical assumptions that underpin the monitoring program. Notwithstanding this, the Expert Panel proposes that the monitoring program should be implemented. It is the best available monitoring at this stage, and provides the best possible information within the constraints noted by the Expert Panel. The Expert Panel did, however suggest modifications to the monitoring program that may ameliorate some of these shortcomings. These modifications should be incorporated into the monitoring program.
2. The Environmental Quality Commission approves a modification to the Total Dissolved Gas standard for spill over the Columbia River dams subject to the following conditions:
- (i) Approve a revised total dissolved gas standard for the Columbia River for the period from midnight on April 12, 1996 to midnight on August 31, 1996;
 - (ii) Approve a total dissolved gas standard for the Columbia River of a daily (12 highest hours) average of 115 percent as measured at established monitors at the forebay of the next dam downstream from the spilling dam during this time;
 - (iii) Approve a further modification of the total dissolved gas standard for the Columbia River to allow for a daily (12 highest hours) average of 120 percent as measured at established tailrace monitors below the spilling dams during this time;

- (iv) Approve a cap on total dissolved gas for the Columbia River during the spill program of 125 percent, based on the highest two hours during the 12 highest hourly measurements per calendar day during this time; and
- (v) Require that the Director halt the spill program if *either* 15 percent of the fish examined show signs of gas bubble disease in their non-paired fins, *or* five percent of the fish examined show signs of gas bubble trauma in their non-paired fins where more than 25 percent of the surface area of the fin is occluded by gas bubbles, whichever is the less;
- (vi) Direct the Director to frame questions concerning the benefits of spill and the accompanying monitoring program for the Northwest Power Planning Council's Independent Scientific Advisory Board;
- (vii) Require NMFS to provide funding for the Department to hire a fisheries biologist or fish physiologist to assist in collecting and analyzing data on total dissolved gas and its effect on beneficial uses;
- (viii) Require that NMFS incorporate the modifications suggested by the Expert Panel on Gas Bubble Disease into its biological monitoring program;
- (ix) Require NMFS to incorporate the following conditions into its program:
 - 1. NMFS must provide written notice to the Department within 24 hours of any violations of the conditions in the variance. Such notice shall include actions proposed to reduce TDG levels or the reason(s) for no action;
 - 2. TDG data and incidence of GBD signs in smolts and adults will be reported to the Department daily. Hourly TDG levels collected from the forebays and downstream locations of McNary, John Day, The Dalles, and Bonneville Dams will be reported to the Department daily. Incidence of GBD signs in smolts collected from McNary, John Day, and Bonneville Dams and adults collected at Bonneville and Lower Granite Dams will be reported the Department daily. Signs of GBD in smolts will be measured by using a variable (10X to 40X) dissecting scope. Unpaired fins, eyes, and lateral line will be examined for the presence of bubbles. Smolts will be monitored daily. Signs of GBD in adults will be measured using at least a 2.5X magnification device and examining fins, eyes, mouth, opercula, and body for bubbles. Adults will be monitored at Bonneville Dam three times per week and seven days a week at Lower Granite Dam;
 - 3. The Commission will require that by January 15, 1997 NMFS provide a report to the Department with a draft of the report released for peer and public review no later than December 1, 1996. The report shall contain:

- (a) Statistical evaluation of the available PIT-tag data to determine week-by-week survival changes. Techniques should be used to detect differences between groups with small sample size or maximize the sample size to increase statistical reliability. The association between survival estimates and TDG, temperature, flow related effects, or other phenomena which could affect survivorship will be evaluated;
- (b) An empirical estimate of survival associated with spill;
- (c) Week-by-week estimates of the quantities of voluntary vs. involuntary spill. The factors causing the spill scenario shall be stated i.e. hydraulic capacity, turbine outages, lack of a power market, etc.;
- (d) Survival estimates of transported vs. untransported fish at collector projects;
- (e) Survival and incidence of GBD data from net pens below Bonneville Dam. Care must be taken to avoid areas with excessive flow or elevation fluctuations or to engineer around such problems. Care must be taken to avoid size and species differences within net pens to reduce losses from predation;
- (f) Incidence of GBD signs in adults and estimates of upstream spawning delays of returning adult salmonids from increased spill;
- (g) Incidence of GBD signs in resident fish species collected from below Bonneville Dam. Sampling will occur once each week April 15 through August 31.

Dated: April 12, 1996

ON BEHALF OF THE COMMISSION



Director

Fish spill chronology: 1994 to 2014

1994 spill

EQC began approving modifications to the standard in 1994 in response to an emergency request from the Corps. The short notice to DEQ and EQC resulted from confirmation of extremely low numbers of returning spring Chinook coinciding with the critical period of spring Chinook smolt outmigration. The approval was a temporary rule effective for seven days allowing total dissolved gas up to 130 percent. However, NOAA Fisheries said they expected to remain at 120 percent until a full monitoring program was in place and then increase spill at 2.5 percent increments not to exceed 130 percent. On the last affected day of the temporary rule, EQC considered information provided by an interagency panel to make changes to the temporary rule allowing up to 120 percent through June 20, 1994.

1995 spill

U.S. Fish and Wildlife Services requested a standard modification through an EQC order for ten days in March 1995, for improved passage past Bonneville Dam for the Spring Creek Hatchery release. The petition did not mention that biological monitoring would occur during time period a modification would be in effect. Additionally, EQC found that U.S. Fish and Wildlife Services did not provide adequate information to support findings required in rule to approve a TDG standard modification. Therefore, EQC denied the request. During the time of the request, DEQ staff and EQC expressed concern over the lack of cooperation by NOAA Fisheries to allow access to data and to provide draft materials. Later that spring, EQC approved a standard modification requested by NOAA Fisheries for the seasonal smolt migration period. The modification was for 115 percent in the forebay downstream of the spilling dam and 120 percent in the tailrace of the spilling dam. The limits of this modification were unchanged with each successive EQC order affecting spill until 2009. The 1995 TDG standard modification was the first issued under the procedural rule.

1996 spill

NOAA Fisheries and U.S. Fish and Wildlife Services jointly requested a modification of the standard in 1996. Two distinct parts comprised the request, a nine day period in March to assist Spring Creek Hatchery release and the April through August spill season. Each spill period utilized the same physical and biological monitoring programs, which applied to Bonneville Dam during the March spill and system wide for seasonal spill. EQC approved the modification for Spring Creek Hatchery release and two months later for seasonal spill following release of the final report by the Expert Panel on Gas Bubble Disease convened by NOAA Fisheries. Because DEQ drafted the 1996 order considering the Expert Panel's suggestions, the 1996 order has one of the most stringent monitoring and reporting requirements of the standard modification orders. To compare the current order with the 1996 EQC order, the current order is attachment D and the 1996 order is attachment E. Similarly to 1995, EQC was concerned about the apparent reluctance of the fisheries agencies in sharing their findings regarding elevated total dissolved gas effects.

NOAA Fisheries provided DEQ with the 1996 Annual Report to the Oregon Department of Environmental Quality, which was reviewed by the Independent Scientific Advisory Board.

EQC responded to the annual report with concern over the lack of correlation between spill and increased salmonid survival rates.

1997 spill

To improve the information provided in the annual report, EQC requested DEQ develop an outline with more details and conditions for NOAA Fisheries' 1997 annual report. The outline required an update for ongoing and planned gas bubble research in addition to reporting monitoring results and factors causing spill. EQC also required the 1997 annual report be reviewed by the Independent Scientific Advisory Board and made available for public comment and peer review. This requirement persisted for annual spill reports through the 1999 spill season. EQC approved the standard modification for the two 1997 spill periods, a ten-day period in March for Spring Creek Hatchery release and seasonal spill from April through August.

1998 spill

EQC did not approve U.S. Fish and Wildlife Service's 10-day modification request, which would have allowed more spill for the Spring Creek Hatchery release in March 1998. Some commissioners were concerned that the hatchery fish would further jeopardize threatened and endangered salmonids through completion for critical resources. However, the commission did approve the modification affecting seasonal spill from April through August, 1998. EQC communicated to NOAA Fisheries that they want to see progress made toward identifying the benefits of spill on salmon survival.

1999 spill

EQC approved U.S. Fish and Wildlife Service's request for a 10-day modification in March and NOAA Fisheries' request for a modification allowing seasonal spill from April through August, 1999. Unlike previous EQC orders allowing modifications to assist Spring Creek Hatchery release, the 1999 order required physical and biological reporting. The order included a requirement that the annual report of the spill program include information on the status of the Corps' Columbia River gas abatement program, including the program schedule, Corps and NOAA Fisheries commitments to the gas abatement program, and the efforts to achieve the 110 percent state water quality standard.

2000 spill

EQC issued three orders approving modifications to the total dissolved gas standard in 2000. In addition to modifications for U.S. Fish and Wildlife affecting Spring Creek Hatchery release and seasonal spill, a modification was also approved for the Corps' request to enable testing of the John Day Dam flow deflectors, which were installed in 1997. Because of the late timing the commission received the request affecting Spring Creek Hatchery release, they asked that future requests for Spring Creek Hatchery release be received by September 30 of the year before the effective period of the modification.

2001 spill

In late 2000, EQC approved a modification requested by USFWS for March 2001 spill affecting the hatchery release. Since EQC began considering total dissolved gas standard modifications, 2001 was the first year a modification request was considered in the context of unusually low Columbia Basin water levels and high demand for power production. EQC discussed with DEQ

and representatives of the Corps and NOAA Fisheries how spill and power generation are impacted under these conditions. The Corps received approval for their request allowing seasonal spill; however, the Commission expressed discontent because of the belated request and resulting special phone meeting to consider the modification. The commission added, as a requirement of the modification, that the 2002 spill season request be received by DEQ no later than Dec. 31, 2001.

2002 spill

EQC approved modifications for three different 2002 spill periods. In addition to approving modifications for purposes of Spring Creek Hatchery release and seasonal spill, EQC also granted the Corps a 12-day modification in October for a spill test at The Dalles Dam to test juvenile salmonid spill survival. Conditions of the modification include the same conditions specified in the commission's orders since 1995, 115 percent modification in the forebay and 120 percent modification in the tailrace. However, because of the high amount of spill planned for the test, a 125 percent cap was specified based on the highest six hourly measurements of a calendar day. In anticipation of the Total Maximum Daily Load for Lower Columbia River Total Dissolved Gas, the commission began discussing the potential for a multi-year modification to address multiple spill seasons. EPA approved the TMDL in November 2002.

2003-2007 spill

The commission expressed to DEQ that it would be open to considering a multi-year modification, because biological and physical monitoring reports on the results of past spills have not shown significant adverse impacts on fish survival or water quality. In March 2003, EQC issued the first multi-year modification for to the Corps for seasonal spill affective 2003 through 2007. As the 2003 order is the first order issued during implementation of the Total Dissolved Gas TMDL, requirements included reporting progress on implementing measures contained in the TMDL.

In January 2003, DEQ initially declined presenting to the Commission the U.S. Fish and Wildlife Service's modification request for 2003 hatchery release. The basis of DEQ's response was receipt of the request over three months past the date specified in the 2002 modification. Following an appeal from the service, DEQ reconsidered presenting the request to the commission. The day before the meeting when the commission was to decide the request, U.S. Fish and Wildlife rescinded its request due to low water conditions and the difficult financial situation facing the Bonneville Power Administration.

In February 2004, EQC issued an order modifying the standard for Spring Creek Hatchery release affective for four years, from 2004 through 2007. The expiration in 2007 coincides with the expiration of the USACE's modification for seasonal spill so the Corps could request a modification for the two spill periods, which could be addressed under one EQC order.

2008-2009 spill

DEQ requested the modifications for Spring Creek Hatchery release and seasonal salmonid migration be combined into one. The Corps, with U.S. Fish and Wildlife Service and NOAA Fisheries requested a year-round, five-year modification. However, DEQ recommended the standard modification apply to the historical voluntary spill periods of 10 days in March for the

hatchery release and seasonal spill from April through August. Spill outside of these periods require the Corps to notify DEQ in writing of such actions at least one week prior to the voluntary spill. In addition to the two historical spill periods, the modified criteria also applies to spill for the purpose of biological or physical studies of spillway structures and prototype fish passage devices to test spill at operational levels. EQC approved the request with the DEQ recommendations with exception that the modification be applied to 2008 and 2009 instead of a five-year period. EQC's order also gave DEQ authorization to change use of the forebay monitors upon consulting with the Adaptive Management Team or the Federal Columbia River Power System Water Quality Team or both.

The Adaptive Management Team is an advisory group convened by Washington Department of Ecology comprised of representatives of DEQ, tribes, federal and state agencies to evaluate appropriate points of compliance for the TMDL. Within the framework of the Adaptive Management Team, Washington's Department of Ecology and DEQ produced the document *Adaptive Management Team Total Dissolved Gas in the Columbia and Snake Rivers: Evaluation of the 115 Percent Total Dissolved Gas Forebay Requirement*, released in January 2009. In this document, Ecology report retention of the 115 percent forebay standard to provide an additional margin of safety for chronic protection against gas bubble trauma in all aquatic life considering most aquatic life spends more of their time in the forebays. DEQ found that removal the 115 percent modified standard in the forebay will not result in excessive harm to the beneficial use, aquatic species in the Columbia River, during fish passage spill season because Oregon has a protective 105 percent shallow water standard. DEQ removed the forebay upstream limit in 2009 by a department order based on the findings of the Adaptive Management Team.

2010-2014 spill

In June 2009, the commission approved the current give-year modification. Changes from the previous EQC order include removal of the 115 percent modified standard in the forebay. As with the 2008-2009 request, the Corps asked for a year-round modification and DEQ recommended the standard modification apply to seasonal spill from April through August with DEQ advanced approval for total dissolved gas modification outside of seasonal spill for purposes such as Spring Creek Hatchery release. The current EQC order is attachment D.