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Subject: FINAL Total Dissolved Gas: Step One, Year Five Compliance Report
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January 30, 2015

To: Chris Coffin, Washington Department of Ecology
Charlie McKinney, Washington Department of Ecology

From: Marcie Steinmetz, Water Resources Specialist
Public Utility District No. 1 of Chelan County (Chelan PUD)

Re: Rocky Reach Hydroelectric Project No. 2145
License Article 401 – Final Total Dissolved Gas: Step One, Year
Five Compliance Report

Department of Ecology:

In accordance with Article 401 of the Rocky Reach Hydroelectric Project License and the 401 Water Quality Certification (Sections 5.4(1)(d) and 5.4(1)(b)(6)), Chelan PUD submits the Final Total Dissolved Gas: Step One, Year Five Compliance Report. Thank you for your comments on the Draft report. The comments that were provided have been incorporated in the Final Report and are addressed in the Response to Comments Section.

Sincerely,

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TOTAL DISSOLVED GAS: STEP ONE, YEAR FIVE COMPLIANCE REPORT

FINAL

**ROCKY REACH HYDROELECTRIC PROJECT
FERC Project No. 2145**

January 30, 2015



**Public Utility District No. 1 of Chelan County
Wenatchee, Washington**

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TERMS AND ABBREVIATIONS

401 Certification	water quality certification
7Q10	highest seven consecutive day average flow with a 10-year recurrence frequency
cfs	cubic feet per second
CCT	Confederated Tribes of the Colville Reservation
Chelan PUD	Public Utility District No. 1 of Chelan County
CHJ	Chief Joseph dam
Ecology	Washington State Department of Ecology
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
FMS	fixed monitoring station
GBT	gas bubble trauma
GCL	Grand Coulee dam
HCP	Habitat Conservation Plan
HCP CC	Habitat Conservation Plan Coordinating Committee
JBS	juvenile bypass system
kcfcs	thousand cubic feet per second
NMFS	National Marine Fisheries Service
Project	Rocky Reach Hydroelectric Project
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
Report	Rocky Reach Dam Total Dissolved Gas: Step One, Year 5 Compliance Report
RRFF	Rocky Reach Fish Forum
standards	Washington State water quality standards
TDG	total dissolved gas
USFWS	United States Fish and Wildlife Service
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WQMP	Water Quality Management Plan

EXECUTIVE SUMMARY

Public Utility District No. 1 of Chelan County (Chelan PUD) owns and operates the Rocky Reach Hydroelectric Project (Project), located on the Columbia River downstream of Wells Dam. The Project is licensed as Project No. 2145 by the Federal Energy Regulatory Commission (FERC) (FERC, 2009).

Chelan PUD is required to manage spill toward meeting water quality criteria for TDG during all flows below seven-day, ten-year frequency flood stage (7Q10) levels, but only to the extent consistent with meeting the passage and survival standards set forth in the Habitat Conservation Plan (HCP) and Anadromous Fish Agreement. Chelan PUD has been implementing the required total dissolved gas (TDG) abatement measures as well as completing annual monitoring and reporting requirements in accordance with its Washington State Department of Ecology (Ecology) 401 Water Quality Certification (401 Certification) (Ecology, 2006) and the Rocky Reach Water Quality Management Plan (WQMP) (Chelan PUD, 2006).

This Total Dissolved Gas: Step One, Year Five Compliance Report (Report), summarizes the results of all TDG studies performed to date and TDG data recorded from 2009 to 2013.

Determination of Compliance, Year 5, Section 5.4(1)(d) of the 401 Certification

Chelan PUD has prepared this report with the intent to satisfy the first step of Section 5.4(1)(d) of the 401 Certification for Ecology's review and conclusions. This report summarizes the results of all TDG studies performed to date, describes whether compliance with the numeric criteria has been attained and discusses the results of Chelan PUD's study on alternative spillway operations.

During the first five years of the License (2009 through 2013), the total number of Rocky Reach Dam TDG exceedances for the fish-spill season varied from zero in 2009 to 27 in 2012. During this same five year period the total number of hourly exceedances for the non-fish spill season varied from zero in 2009 to 61 in 2012.

The information below regarding Rocky Reach Dam's TDG compliance is summarized in a table below. Overall 5 Year Project compliance or percent time below the 120/115 percent criteria (Rocky Reach tailrace and Rock Island forebay) during the fish-spill season was 93.6 percent (86 daily exceedances/1,352 days).

Overall 5 Year Project compliance or percent time below the 125 percent criteria (Rocky Reach tailrace and Rock Island forebay) during the fish-spill season was 100 percent (0 daily exceedances/32,448 hours).

Overall 5 Year Project compliance or percent time below the 110 percent criteria (Rocky Reach tailrace and Rock Island forebay) during the non fish-spill season was 99.5 percent (124 hourly exceedances/26,256 hours).

Rocky Reach tailrace and Rock Island forebay TDG Compliance Years 2009 through 2013		
% time below 120/115%	% time below 125%	% time below 110%
93.6	100	99.5

Chelan PUD has been effective in their compliance efforts regarding the TDG criterion at the Project by implementing the gas abatement measures identified in the 401 Certification and the WQMP. Although Chelan PUD has not been 100 percent compliant with the TDG standard 100 percent of the time, Chelan PUD will continue to implement the gas abatement measures in accordance with 401 Certification and WQMP. These measures have been successful in reducing TDG within the Rocky Reach tailrace and the Rock Island forebay.

Upon Ecology's review and conclusions of this Report, Chelan PUD shall coordinate and consult with Ecology regarding the next steps required of Section 5.4(1)(d) of the 401 Certification.

TDG Gas Abatement Measure (6), Alternate Spillway Operations, Section 5.4(1)(b)(6) of the 401 Certification

According to Section 5.4(1)(b)(6) of the 401 Certification, Chelan PUD shall study alternative spillway operations using any of gates 2 through 12. In 2011 and 2012, Chelan PUD studied alternative spillway flow distribution patterns, in order to evaluate the potential to reduce total dissolved gas TDG levels, particularly during high spill levels (above 50 kcfs). Generally, all of the three alternative spill patterns studied resulted in lower TDG levels than the standard spill pattern. Of the three alternative patterns, the flat spill pattern (flow distributed evenly between spillway gates) had a slightly better TDG performance than the other two alternative patterns. Chelan PUD has presented these findings to Ecology, the Rocky Reach Fish Forum (RRFF) and Habitat Conservation Plan Coordinating Committee (HCP CC).

Chelan PUD, through the consultation process with Ecology, the RRFF, and the HCP CC, will develop a schedule to make the necessary changes to perform the new spill configuration. This schedule may include but not be limited to; computer automation of spill gates (2015), and/or changes to system operations and monitoring. Chelan PUD will operate the new spill configuration as a pilot or test spill and further evaluate the results for a designated period of time. Chelan PUD shall develop a monitoring schedule to test operations under the new spill configuration. If upon operating under the new spill configuration data show that optimal results are not occurring as previously evaluated, Chelan PUD shall implement adaptive management in coordination with the RRFF and HCP CC.

SECTION 1: INTRODUCTION

The Project, owned and operated by Chelan PUD, is located on the Columbia River in Chelan County, Washington, approximately seven miles upstream of the city of Wenatchee, Washington (Figure 1-1). The Project utilizes the waters of the Columbia River, whose drainage basin extends over substantial portions of northern Washington, Idaho, Montana and into Canada. The Project reservoir (Lake Entiat) extends 43 miles to Douglas County PUD's Wells Dam. The Project consists primarily of an 8,235-acre reservoir; a 2,847-foot-long by 130-foot-high concrete gravity dam spanning the river, including a powerhouse and spillway; an upstream adult fishway, a juvenile fish bypass system, and hatchery facilities.

The FERC issued a new license (License) for the Project on February 19, 2009 (FERC, 2009) authorizing the Chelan PUD to operate the Project for a period of 43 years. The License incorporated the terms of the Rocky Reach Settlement Agreement, which included a comprehensive WQMP (Chelan PUD, 2006), and the terms of the 401 Certification (Ecology, 2006) issued by the Washington Department of Ecology (Ecology) as required by Section 401 of the Clean Water Act (Order 3155).

1.1 Determination of Compliance, Year 5, Section 5.4(1)(d) of the 401 Certification

In accordance with 401 Certification Condition 5.4(1)(d) *Determination of Compliance*, in the fifth year of the effective date of the License, Chelan PUD is required to prepare a report summarizing the results of all TDG studies performed to date, and describing whether compliance with the numeric criteria has been attained. Probable and possible impacts to fish species from such TDG abatement methods will be included in the report. Chelan PUD will also submit a report to Ecology summarizing gas bubble trauma (GBT) monitoring and other relevant information regarding the effects of TDG produced by the Project on aquatic life. Chelan PUD will submit these reports to Ecology, members of RRFF and HCP CC.

In accordance with Section 5.4(1)(d), Chelan PUD submits this Report to Ecology for their review and conclusions. This report summarizing the results of the first five years of TDG monitoring and studies at Rocky Reach Dam, including an evaluation of compliance to date. Chelan PUD has prepared this report with the intent to satisfy the first step of Section 5.4(1)(d) of the 401 Certification.

Chelan PUD has prepared this report with the intent to satisfy the first step of Section 5.4(1)(d) of the 401 Certification for Ecology's review and conclusions. This report summarizes the results of all TDG studies performed to date, describes whether compliance with the numeric criteria has been attained and discusses the results of Chelan PUD's study on alternative spillway operations.

Chelan PUD has prepared this report with the intent to satisfy the first step of Section 5.4(1)(d) of the 401 Certification for Ecology's review and conclusions. This report summarizes the results of all TDG studies performed to date, describes whether compliance with the numeric criteria has been attained and discusses the results of Chelan PUD's study on alternative spillway operations.

During the first five years of the License (2009 through 2013), the total number of Rocky Reach Dam TDG exceedances for the fish-spill season varied from zero in 2009 to 27 in 2012. During this same five year period the total number of hourly exceedances for the non-fish spill season varied from zero in 2009 to 61 in 2012.

The information below regarding Rocky Reach Dam's TDG compliance is summarized in Table 4-1. Overall 5 Year Project compliance or percent time below the 120/115 percent criteria (Rocky Reach tailrace and Rock Island forebay) during the fish-spill season was 93.6 percent (86 daily exceedances/1,352 days).

Overall 5 Year Project compliance or percent time below the 125 percent criteria (Rocky Reach tailrace and Rock Island forebay) during the fish-spill season was 100 percent (0 daily exceedances/32,448 hours).

Overall 5 Year Project compliance or percent time below the 110 percent criteria (Rocky Reach tailrace and Rock Island forebay) during the non fish-spill season was 99.5 percent (124 hourly exceedances/26,256 hours).

Table 1-1: Summary table of TDG Compliance at Rocky Reach Dam

Rocky Reach tailrace and Rock Island forebay TDG Compliance Years 2009 through 2013		
% time below 120/115%	% time below 125%	% time below 110%
93.6	100	99.5

Chelan PUD has been effective in their compliance efforts regarding the TDG criterion at the Project by implementing the gas abatement measures identified in the 401 Certification and the WQMP. Although Chelan PUD has not been 100 percent compliant with the TDG standard 100 percent of the time, Chelan PUD will continue to implement the gas abatement measures in accordance with 401 Certification and WQMP. These measures have been successful in reducing TDG within the Rocky Reach tailrace and the Rock Island forebay.

Upon Ecology's review and conclusions of this Report, Chelan PUD shall coordinate and consult with Ecology regarding the next steps required of Section 5.4(1)(d) of the 401 Certification.

1.2 TDG Gas Abatement Measure (6), Alternate Spillway Operations, Section 5.4(1)(b)(6) of the 401 Certification

In 2011 and 2012, Chelan PUD studied alternative spillway flow distribution patterns, in order to evaluate the potential to reduce total dissolved gas TDG levels, particularly during high spill levels (above 50 kcfs). Generally, all of the three alternative spill patterns studied resulted in lower TDG levels than the standard spill pattern. Of the three alternative patterns, the flat spill pattern (flow distributed evenly between spillway gates) had a slightly better TDG performance than the other two alternative patterns. Chelan PUD has presented these findings to Ecology, the Rocky Reach Fish Forum (RRFF) and Habitat Conservation Plan Coordinating Committee (HCP CC). Chelan PUD, through the consultation process with Ecology, the RRFF, and the HCP CC, will develop a schedule to make the necessary changes to perform the new spill configuration. This schedule may include but not be limited to; computer automation of spill gates (2015), and/or changes to system operations and monitoring. Chelan PUD will operate the new spill configuration as a pilot or test spill and further evaluate the results for a designated period of time. Chelan PUD shall develop a monitoring schedule to test operations under the new spill configuration. If upon operating under the new spill configuration data show that optimal results are not occurring as previously evaluated, Chelan PUD shall implement adaptive management in coordination with the RRFF and HCP CC.

1.3 Project Description

The Rocky Reach Project (Project) is located on the Columbia River approximately seven miles upstream of the city of Wenatchee. Construction of the dam and powerhouse began in 1956 and the Project was completed and put into production in 1961. The impounding structures are reinforced concrete consisting of a forebay wall section about 460 feet long; a combined intake and powerhouse section 1,088 feet long; a non-overflow center dam spillway that is 740 feet long consisting of 12 bays, each controlled by a

50-foot-wide, 58-foot-high radial gate; and a 2,000-foot sub-surface cutoff consisting of a grout curtain and a compacted impervious barrier limits seepage through a terrace forming the east bank.

The forebay wall consists of concrete gravity blocks of various heights, with a maximum height of 118 feet. The service bay connects the forebay wall to the powerhouse. The powerhouse contains 11 units, each 86 feet wide and about 200 feet long. The Project's FERC authorized installed capacity is 865.76 megawatts.

The Project contains an upstream (adult) fish passage facility consisting of a fish ladder located downstream of the forebay wall with three entrances, and a JBS which began operation in 2003 to provide downstream fish passage for juvenile salmon and steelhead.

The JBS consists of; a surface collection system adjacent to the forebay wall, intake screens and a bypass conduit routed along the downstream side of the powerhouse and spillway; a fish collection facility and an outfall downstream of the Project near the dam's left abutment.

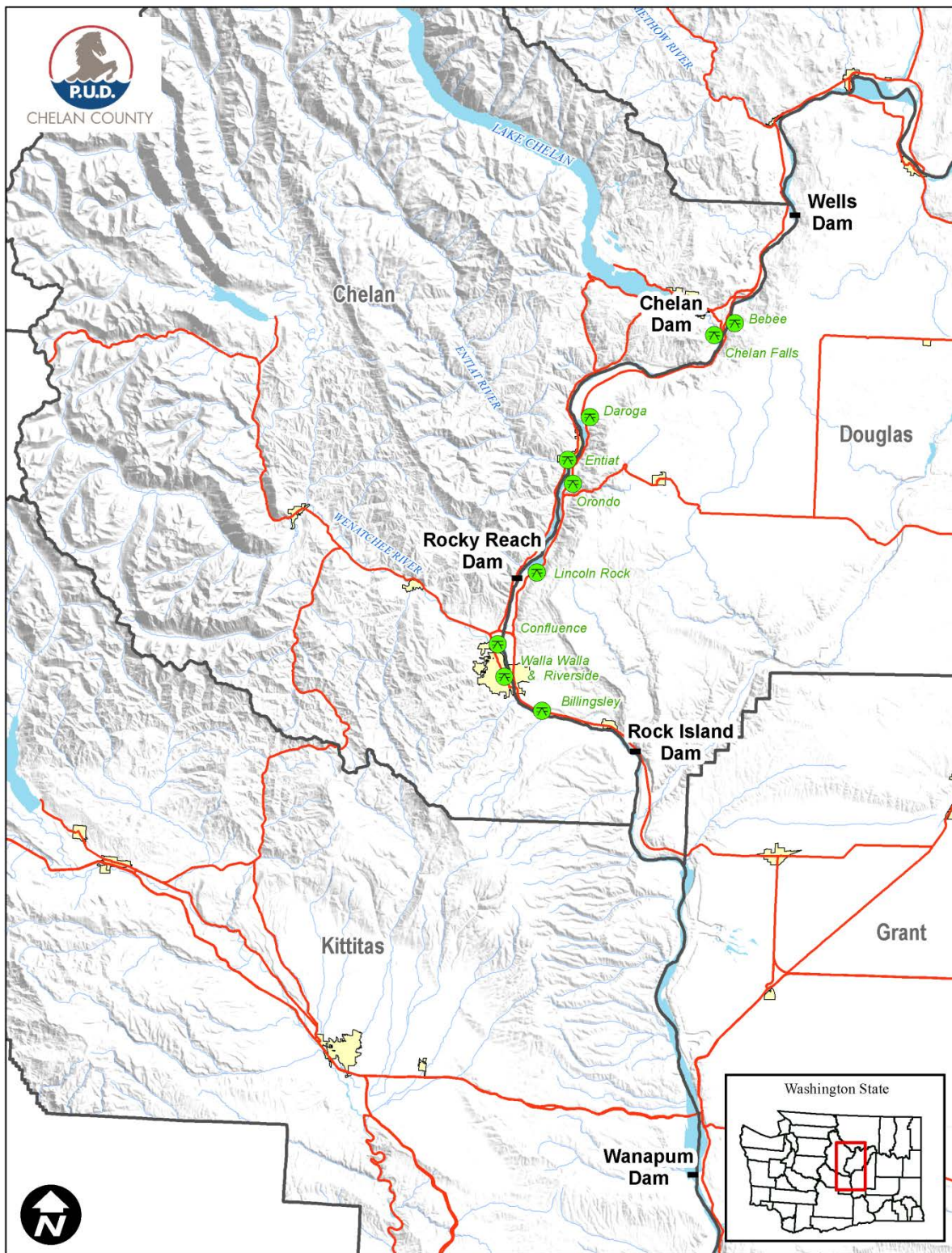


Figure 1-1: Project Location

1.4 Regulatory Framework

The Washington State water quality numeric criteria for TDG (Washington Administrative Code (WAC) 173-201A-200(1)(f)) address standards for the surface waters of Washington State. Under the water quality standards (standards), TDG shall not exceed 110 percent at any point of measurement in any state water body. However, the TDG criteria may be adjusted to aid fish passage over hydroelectric dams when consistent with an Ecology approved GAP. This plan must be accompanied by fisheries management and physical and biological monitoring plans. Ecology may approve, on a per application basis, a temporary exemption to the TDG standard (110 percent) to allow spill for juvenile fish passage on the Columbia and Snake rivers (WAC 173-201A-200(1)(f)(ii)). On the Columbia and Snake rivers, there are three separate standards with regard to the TDG exemption. First, in the tailrace of a dam, TDG shall not exceed 125 percent as measured in any one-hour period. Further, TDG shall not exceed 120 percent in the tailrace of a dam and shall not exceed 115 percent in the forebay of the next dam downstream as measured as an average of the 12 highest consecutive (12C-High) hourly readings in any one day (24-hour period).

It is important to note that the TDG water quality standards identified above are intended to help protect aquatic life designated uses within the Project. This includes Ecology's allowance of higher TDG levels during the fish-spill season, which allow dams to spill water to help meet juvenile salmonid passage performance standards.

Specific passage performance (or survival) standards for the Project are outlined in the HCP for the Rocky Reach Project. Specifically, the HCP provides that Chelan PUD achieve and maintain Combined Adult and Juvenile Project Survival. The Combined Adult Juvenile Survival standard is 91 percent. The ninety-one percent standard is composed of 98 percent adult project passage survival and 93 percent juvenile project survival.

Chelan PUD is currently in Phase III - Standards Achieved (the 91 percent adult-juvenile combined survival standard is achieved) for the spring migrating HCP species; sockeye, spring Chinook, and steelhead. Summer/fall subyearling Chinook are in Phase III - Additional Juvenile Studies, due to limitations on acoustic tag technology for subyearling fish and unpredictable migration behavior of Upper Columbia River subyearling Chinook. Coho, the last Plan species, is in Phase III - Standards Achieved - Interim.

Achieving the survival standards as described above and in addition to meeting TDG numeric criteria as outlined in WAC 173-201A-200(1)(f), are an integral part of meeting the water quality standards (e.g. protection of designated uses) as described in the Project's 401 Certification (Ecology, 2006).

1.4.1 7Q10 Flows

Section 5.4.1(b) of the 401 Certification (Ecology, 2006) and WAC 173-201A-200(f)(i) states that the water quality criteria for TDG shall not apply when the stream flow exceeds 7Q10 flow. The 7Q10 flood flow for the Rocky Reach Project was calculated to be 252 kcfs (Ecology, 2004)

1.4.2 Daily Total Dissolved Gas Compliance Value Calculation Method

Prior to 2008, the method used to calculate the daily TDG compliance value during the fish-spill season was based on the average of the twelve highest hourly values in a twenty-four hour period, starting at 0100 hours and ending at 2359 hours. This method was based on Ecology's 1997 standards. In Ecology's 2006 revision to the standards (which were not approved by the Environmental Protection Agency (EPA), and thus not effective, until 2008) the method for calculating the TDG compliance value was changed. The new method provided that the TDG compliance value be determined by calculating the average of the twelve highest "consecutive" hourly values in a twenty-four hour period. Prior to the 2008 fish-spill season, there were discussion amongst the Columbia and Snake River dam operators on how to properly implement the "rolling average" method, especially as it related to what time the rolling average began. There were concerns related to the addition of the previous day's last eleven hours to the compliance value calculation on the next day.

On May 21, 2008, Ecology requested, via memo, that all Columbia and Snake River dam operators use a rolling average method for calculating the twelve highest consecutive hourly TDG readings in a twenty-four hour period, beginning at 0100 hours, based on Ecology's 2006 revised water quality standards (Ecology, 2008). Using a rolling average method that begins at 0100 hours results in counting the hours 1400 through 2359 twice: in the average calculations on the day they occur and on the next reporting day. As a result, a TDG standard exceedance may be indicated on two separate days based on the same group of hours.

The annual fish-spill season TDG monitoring reports from 2012-2013 Gas Abatement Annual Reports provide examples of how the "rolling average" method could create a TDG exceedance on two separate days based on the same grouping of hourly values during the applicable fish-spill season, and Chelan PUD's method for accounting for those occurrences.

1.4.3 401 Water Quality Certification Condition

The following is the total dissolved gas condition from the 401 Certification (Ecology, 2006) Section 5.4(1)(d).

5.4(1)(d) Determination of Compliance. In Year 5 of the effective date of the New License, Chelan PUD shall prepare a report summarizing the results of all TDG studies performed to date, and describing whether compliance with the numeric criteria has been attained. If Ecology concludes, upon reviewing such report and other applicable information, that the Project complies with the applicable TDG numeric criteria, Ecology, in consultation with Chelan PUD, will determine which measures will be continued for the term of the New License to maintain such compliance. If Ecology concludes that compliance with the TDG numeric criteria has not been attained, Chelan PUD shall prepare a report that evaluates what measures (operational and structural) may be reasonable and feasible to implement to further reduce TDG production at the Project. Probable and possible impacts to fish species from such TDG abatement methods shall be included in the report. Chelan PUD shall also submit a report to Ecology summarizing GBT monitoring and other relevant information regarding the effects of TDG produced by the Project on aquatic life. Chelan PUD shall submit these reports to Ecology, members of the RRFF, and members of the HCP CC.

Chelan PUD has identified several steps within Section 5.4(1)(d) of the 401 Certification. They are as follows:

1. Prepare a report summarizing the results of all TDG studies performed to date, and describing whether compliance with the numeric criteria has been attained,

2. Ecology shall review the report and conclusions regarding the Project's compliance with the TDG numeric criteria,
3. If TDG numeric criteria are met, then Ecology in consultation with Chelan PUD will determine which measures will be continued for the term of the license to maintain compliance,
4. If Ecology concludes that compliance with TDG standards have not been attained, then Chelan PUD shall prepare a report that evaluates what measures (operational and structural) may be reasonable and feasible to implement to further reduce TDG production at the Project. Probable and possible impacts to fish species from such TDG abatement methods shall be included in the report.
5. Chelan PUD shall also submit a report to Ecology summarizing GBT monitoring and other relevant information regarding the effects of TDG produced by the Project on aquatic life.
6. Chelan PUD shall submit these reports to Ecology, members of the Rocky Reach Fish Forum (RRFF), and members of the HCP Coordinating Committee.

Chelan PUD has prepared this report with the intent to satisfy the first step of Section 5.4(1)(d) of the 401 Certification, as identified above. If Ecology concludes that TDG numeric criteria have not been met within five years of the effective date of the new License, further conditions apply. The conditions from Section 5.4(1)(e)-(g) are stated below.

(e) Actions if TDG Numeric Criteria Not Achieved. If compliance with numeric TDG criteria has not been achieved within five years of the effective date of the New License, Ecology will proceed as described below. Such determination shall be based on an analysis of the water quality standard for TDG from the perspective of attainability and biological necessity, as provided in subsections (1) and (2) below:

(1) Aquatic Life Adversely Affected. Upon receipt of the section d) reports, Ecology will determine, based on the monitoring data and analysis provided by Chelan PUD, as may be supplemented by the RRFF and/or the HCP Coordinating Committee, whether aquatic life has been adversely affected, or insufficient information exists to conclude that it has not been adversely affected, by TDG resulting from the Project. If Ecology determines an effect has occurred or insufficient information exists, it shall then further determine, in consultation with Chelan PUD and the RRFF, whether additional seasonable and feasible measures exist to further reduce TDG without significant adverse impact to fish species, and, if so, Chelan PUD shall begin implementation, which may include structural modifications. Ecology retains the right to make the final determination with respect to measures it requires to be implemented to reduce TDG subject to FERC approval, when needed. Nothing limits either Ecology's or Chelan PUD's option to evaluate new, additional or previously evaluated alternatives to abate TDG. Ecology may also require Chelan PUD to perform additional engineering studies of TDG abatement structures or operations. Notice should be given to all parties potentially affected by this decision. If structural modifications are necessary and found reasonable and feasible, Chelan PUD shall provide design, construction and final assessment reports to Ecology in a timely manner as determined by Ecology. If it appears to Ecology, based on the information before it, that no reasonable and feasible TDG abatement measures may exist, Ecology will follow the procedures set forth in subsection (g) below in processing a related rule petition that Chelan PUD may file. If the Corps of Engineers requires a 404 permit, Ecology retains its option to issue a separate water quality certification for construction.

(2) Aquatic Life Not Adversely Affected. If Ecology determines, under subsection (1), that aquatic life has not been adversely affected by TDG resulting from ongoing Project operations, Chelan PUD shall consult with Ecology and the RRFF to determine if any additional reasonable and feasible measures may exist to meet the TDG standards. If Chelan PUD concludes that no other additional reasonable and feasible measures exist to reduce TDG, Chelan PUD may petition Ecology to modify the standards as described below

f) Chelan PUD may petition Ecology for a rule change to the TDG standard after Year 10 or sooner, if Chelan PUD believes that it can demonstrate it has done everything reasonable and feasible to attain the TDG numeric criteria at that time. In evaluating whether all reasonable and feasible measures have been done as part of reviewing such petition, Ecology will, among other relevant factors, consider information regarding biological impacts of TDG caused by the Project and the extent to which the Project has achieved the Biological Objectives. However, to be granted, any petition for a rule change must satisfy any additional legal requirements that are applicable.

g) If, in conformance with the above, Chelan PUD petitions Ecology to modify the standards to eliminate any non-compliance with such standards, and files a timely and scientifically robust petition, Ecology will provide a schedule for the evaluation and completion of action on such rulemaking petition. Such schedule shall provide target dates for Ecology's determination of whether to grant or deny the petition, and, if granted, for submission of proposed rule change to EPA. While such petition is pending before Ecology and EPA, no non-compliance orders or penalties for TDG violations shall be issued against Chelan PUD, as long as Chelan PUD continues to operate in accordance with the GAP and this Certification.

SECTION 2: WATER QUALITY MANAGEMENT PLAN ABATEMENT MEASURES

Upon receipt of the License, Chelan PUD has worked toward TDG compliance in accordance with the conditions of the 401 Certification (Ecology, 2006) and the conditions set forth in Section 4 of the WQMP (Chelan PUD, 2006), including implementation of operational TDG abatement measures, as well as development of annual GAPs and monitoring reports.

In accordance with Section 5.4.1(b), Chelan PUD is required to manage spill toward meeting water quality criteria for TDG during all flows below 7Q10 levels, but only to the extent consistent with meeting the passage and survival standards set forth in the HCP. Further TDG abatement measures are discussed below.

2.1 Operational

In general, during the first five-years of the License, there have not been any major non-routine operational changes at Rocky Reach; however, informal contact with Ecology related to involuntary spill (especially during non-fish spill season), power market conditions, or unscheduled turbine outages that had potential to impact TDG levels has occurred throughout the first five years of the TDG compliance. Annual GAPs and Annual Reports have been submitted to Ecology, in accordance with Section 5.4.3 and 5.4.4 of the 401 Certification, which have included Chelan PUD's planned TDG abatement measures, operational plans, monitoring plans, etc.

Chelan PUD implemented the following operational TDG abatement measures during the first five years of License issuance, in accordance with the conditions of the 401 Certification and Section 4 of the WQMP.

2.1.1 Minimize Voluntary Spill

Following over 15 years of testing and prototype operation, Chelan PUD constructed the permanent JBS in 2002 and began operation of that system at Rocky Reach in 2003 to guide migrating fish before they enter the powerhouse and divert them downstream past the dam. The JBS is a key component of the HCP signed by Chelan PUD, the National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), Washington Department of Fish and Wildlife (WDFW), and the Confederated Tribes of the Colville Reservation (CCT) to meet HCP juvenile fish survival standards. Results of survival studies have allowed Chelan PUD to greatly reduce spill for fish at Rocky Reach Dam. The JBS is now operated exclusively, for spring migrants; and spill during the summer migration has been reduced to nine percent of the daily average flow. The JBS continues to be the most efficient non-turbine route for fish passage at the Rocky Reach Project.

2.1.2 Manage Voluntary Spill Levels in Real Time

Spillway releases to pass water in excess of turbine capability for load requirements; or for fish passage are controlled by computer. The Project's automated functions are backed up with around-the-clock, on duty plant operators who monitor operations and can over-ride computer control if needed. When the headwater level exceeds operator-set maximum points, gates are automatically opened to pass the excess flow.

During fish passage spill operations, the sequence and amounts of gate opening can also be adjusted to maximize the effectiveness of the water being spilled, both for juvenile passage and adult attraction. Based on the daily spill memo sent by the Chelan PUD Spill Coordinator by 10:00 a.m., the plant operators input into the system the volume of spill, begin time, and end time requested. On occasion the

daily spill volumes are revised later in the day based on flows from Grand Coulee and Chief Joseph dams. The computer then determines, based on the program, which gates to open and how far.

Since 2003, the University of Washington has been contracted to provide Chelan PUD with run-timing predictions for spring and summer out migrating salmon and steelhead using the Program RealTime runtime forecasting model. Program RealTime provides daily forecasts and cumulative passage percentiles for steelhead, yearling Chinook, sockeye, and sub yearling Chinook at both Rocky Reach and Rock Island. The program enables the Chelan PUD to better predict the date when a selected percentage of these species will arrive, or when a given percentage of any stock has passed (e.g. the five percent passage point for juvenile sub yearling Chinook at Rocky Reach to trigger summer spill). The program utilizes daily fish counts from the juvenile sampling facility at Rocky Reach and the bypass trap at Rock Island. Estimates of the program's forecast error in daily run projections will be calculated and displayed with the daily predictions at <http://www.cbr.washington.edu/analysis/rt>.

Spill will be provided for juvenile summer Chinook salmonid passage to cover 95 percent of the run at each both the Rocky Reach and Rock Island Projects in accordance with the criteria set forth in the HCP. Spill levels and durations are correlated with operations necessary for meeting the HCP juvenile survival standards and the specific passage studies designed to measure attainment.

2.1.3 Minimize Spill

Operation of the turbines at the Project is automated, including decisions to start, stop and adjust the output of the 11 generating units to achieve maximum efficiency. The Project's automated functions are backed up with around-the-clock on-duty plant operators who monitor operations and can over-ride computer control if needed.

Turbines are inspected as necessary based on hours operated and other associated stresses. To the extent possible, maintenance of priority units has been scheduled outside of fish passage periods. Because units 1 and 2 provide attraction water flows they are important components of the bypass system; long-term outages of the two units will be avoided during the juvenile passage season.

Additionally, to minimize TDG uptake in the tailrace, Chelan PUD has, to the extent practicable, avoided maintenance outages during the high flow periods. When possible, maintenance has been scheduled based on predicted flows.

Scheduled maintenance of the bypass system has occurred in the off-season, which typically runs from September through March of each year. At this time, the various systems that comprise the Bypass System are inspected.

2.1.4 Participate in the Hourly Coordination Agreement

Chelan PUD operates the Project in a manner to avoid spill as much as possible, while meeting the passage and survival standards set forth in the HCP and Fish Management Plans. When spilling for fish or due to excess inflow or generation needs, the spillway is operated using gate settings that have been shown to limit TDG production and meet fish passage requirements (Schneider and Wilhelms, 2005). These gate settings are consistent with Section 5.4(1)(b) of the 401 Certification, which states "*manage spill toward meeting state water quality criteria for TDG during all flows below 7Q10 levels, but only to the extent consistent with meeting the passage and survival standards set forth in the HCP and Fish Management Plans....*"

Chelan PUD participates in regional coordination meetings regarding Columbia River spill and project operations. These meetings occur prior to and during the fish spill season and include representatives

from Natural Resources, Power Marketing, and Hydro Operations staff from Chelan, Douglas, and Grant PUDs, as well as representatives from Bonneville Power Association (BPA) and the USACE. Discussions typically included topics such as:

- Each project's operational limitations, competing regulations, fish studies, and/or other natural resources requirements
- The possibility of shifting generation away from those projects that produce relatively low levels of TDG to those that have the propensity to produce higher TDG levels
- Each project's planned maintenance schedules and how it may limit ability to spill water through spillways and/or pass water through turbine units

2.1.5 Maximize Powerhouse Discharge as Appropriate up to 212 kcfs.

It is important to note that while Chelan PUD attempts to reduce involuntary spill by maximizing powerhouse discharge during periods of high flows, there are other regional constraints that limit the ability to maximize powerhouse flows. These constraints include, but are not limited to:

- Regional renewable energy portfolio standards and federal tax incentives have stimulated investment of variable energy resources. The Pacific Northwest has the highest wind production capacity in the country, which tends to peak during the spring runoff (e.g. higher flow) and lower energy demand periods, which can lead to limited markets for hydroelectric energy, forcing negative pricing and/or involuntary spill.
- Variable market conditions.

2.1.6 Implement Alternative Spillway Operations

Under Section 5.4.1(b)(6) of the 401 Certification, Chelan PUD is required to implement alternative spillway operations, using any of gates 2 through 12, to determine, in consultation with the RRFF and HCP CC, whether TDG levels can be reduced without adverse effects on fish passage. If effective in reducing TDG and not adversely affecting fish passage, Chelan PUD will implement the alternative in coordination and consultation with Ecology, the RRFF and HCP CC.

Chelan PUD has identified four steps or phases necessary in order to complete the condition 5.4.1(b)(6). The identified phases are listed and discussed further below.

Phase 1. Develop and run test scenarios for spill gate configurations, collect data

Phase 2. Analyze the data collected during the test scenarios for TDG reduction

Phase 3. Further analyze the TDG reductions and potential effects on fish passage

Phase 4. If effective in TDG reduction without potentially affecting fish passage, develop an implementation plan in coordination and consultation internally with Chelan PUD operations and externally with the RRFF and the HCP CC

Phase 1. Develop and run test scenarios for spill gate configurations, collect data

Alternative spillway flow distribution patterns were studied in 2011 and 2012 in order to evaluate the potential to reduce TDG levels, particularly during high spill levels (above 50 kcfs). The standard spillway flow pattern, which has been in use for over 20 years, is designed to create a V-shaped pattern of high velocity, aerated water below the spillway that is presumed to lead upstream migrating adult salmon

toward the vicinity of the entrances to the upstream passage fishways. However, the margins of the V-shaped pattern tend to distort at spillway flows above 50 kcfs and appear to have less value for enhancing fish guidance to the fishway entrances. The standard spillway pattern confines spill to 7 gates (gates 2 through 8), leaving gates 9 through 12 unused. Studies of TDG levels at other Columbia River basin hydroelectric projects have shown that TDG levels are typically reduced when spillway flows are spread between more gates, thus reducing the flow per gate. The studies in 2011 and 2012 were planned to test three alternative spill patterns during normal operations to see if TDG levels would be reduced by any of these alternate patterns.

Phase 2. Analyze the data collected during the test scenarios for TDG reduction

The results of the 2011 and 2012 studies (Chelan PUD, 2013) were analyzed from the perspective of absolute TDG levels under different spillway flow volumes and the percentage of increase or decrease in TDG levels in the tailrace below the spillway, compared to the ambient TDG arriving at the Rocky Reach Project's forebay. Generally, all of the three alternative spill patterns resulted in lower TDG levels than the standard spill pattern. Of the three alternative patterns, the flat spill pattern (flow distributed evenly between spillway gates) had a slightly better TDG performance than the other two alternative patterns, which attempted to maintain some semblance of the V-shaped turbulence zone desired for adult salmon guidance. The Parametrix (Chelan PUD, 2013b) analysis did not explore whether there was any disruption of fish passage associated with the use of the alternative spill patterns. Also, since both 2011 and 2012 were high flow years, most of the time the spillway flow was greater than 50 kcfs during these tests, thus any effects on fish passage might have been masked due to the overall effects of high spill, regardless of the spill pattern in use. The standard spill pattern is a required operating procedure for upstream salmon passage, thus prior to changing that pattern for the purpose of reducing TDG an analysis of effects on fish passage is needed. Any decision to permanently change the spill pattern would require approval by the RRFF and HCP CC.

Phase 3. Further analyze the TDG reductions and their potential affect on fish passage

Chelan PUD has conducted some further analysis of the 2011 and 2012 spill and TDG data to determine if there is sufficient potential benefit regarding TDG levels to warrant changing the spill pattern for spill volumes of 50 kcfs or less. Chelan PUD began by looking only at the 2011 data set, as this year was more consistent in the duration and frequency of the test of the flattened spill configuration. In addition, the adult salmon passage data for Chinook and sockeye was examined to determine if there were any apparent adverse effects on daily passage rates during the 2011 study. This analysis indicates that there may be a significant reduction in TDG levels for spillway volumes of 40 kcfs or greater if the flat spill pattern were used rather than the standard spill pattern. There were not sufficient data to determine if the flat spill pattern would significantly reduce TDG for spill levels of less than 40 kcfs. This is, for the most part, consistent with the findings of a previous study (Schneider and Wilhelms, 2005) which found little difference in TDG levels generated with either the standard spill pattern or with spill spread evenly between spillway gates 2 through 12 (roughly equivalent to the flat spill pattern tested in 2011). However, the Schneider and Wilhelms study had very limited data for spill levels above 40 kcfs and no data for spill volumes greater than 60 kcfs. Thus, the ability to detect a reduction in TDG levels using the flat spill pattern was limited during this study.

Chelan PUD grouped the 2011 spill and TDG data for the standard spill pattern (FISH) and the flat spill pattern (FLAT) into increments of spillway flow bands of 10 kcfs. For example, all data for spillway flows greater than or equal to 40 kcfs, but less than 50 kcfs, were analyzed for the standard and flat spill patterns. The TDG data during these spill levels was averaged over 10 minute intervals and the percent TDG saturation was plotted for each ten minute average. The forebay TDG level was also averaged over the same interval and plotted. The graphs for the 40 kcfs – 50 kcfs and 50 kcfs – 60 kcfs spill levels are shown in Figures 2-1 and 2-2. These plots of 10 minute intervals indicate that the flat spill pattern may reduce TDG levels slightly compared to the standard spill pattern. However, the plots also show a

correlation between TDG levels measured at the tailrace monitoring location and TDG levels measured in the forebay. In theory, if the tailrace monitoring location is only measuring TDG from water that passed through the spillway, as opposed to a mixture of water from both the spillway and the powerhouse, the TDG level in spillway flows should be independent from the forebay TDG level. Since this was not the case, the flow passing by the tailrace monitoring location must be receiving a mixture of powerhouse flows and spillway flows. Since forebay TDG was not consistent for the different time periods when the standard and flat spill patterns were being used, the data could not definitively demonstrate that the flat spill pattern reduced TDG levels over the standard spill pattern. In order to determine whether the flat spill pattern indeed reduces TDG, that pattern would need to be observed over a longer time period than under the daily change in spill pattern that was used during the 2011 and 2012 studies.

The use of different spill patterns did not appear to have any adverse effect on adult salmon passage at the Rocky Reach Project. The two species of salmon with peak migrations during the study were Chinook salmon and sockeye salmon. Plots of daily passage counts for these two species did not demonstrate any apparent delays or failures to find the fishway entrances. The daily passage counts of Chinook and sockeye salmon, with the spill pattern in effect each day, are shown in Figures 2-3 and Figure 2-4. Further study of the flat spill pattern, particularly for spill flows less than 50kcfs where the standard pattern creates a well defined V-shaped pattern, would be needed to evaluate whether adult salmon passage is adversely affected by use of the flat spill pattern.

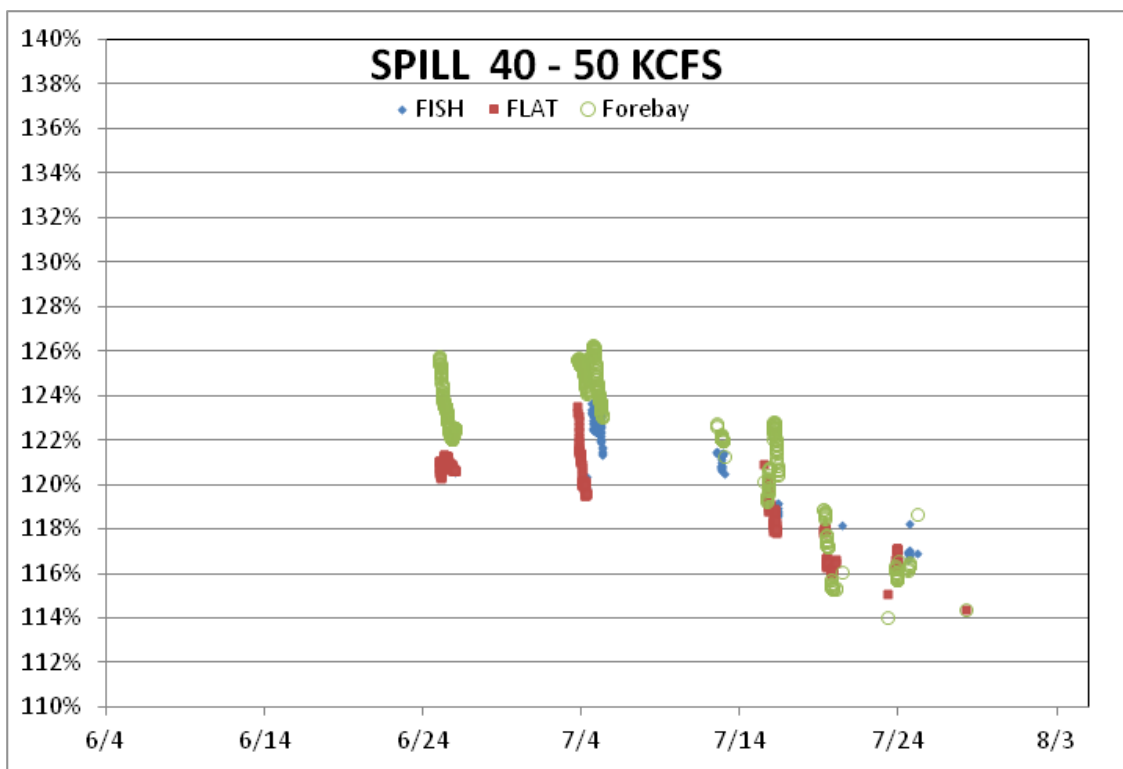


Figure 2-1: TDG levels at the Rocky Reach tailrace monitoring station for spillway flows from 40- 50 kcfs.

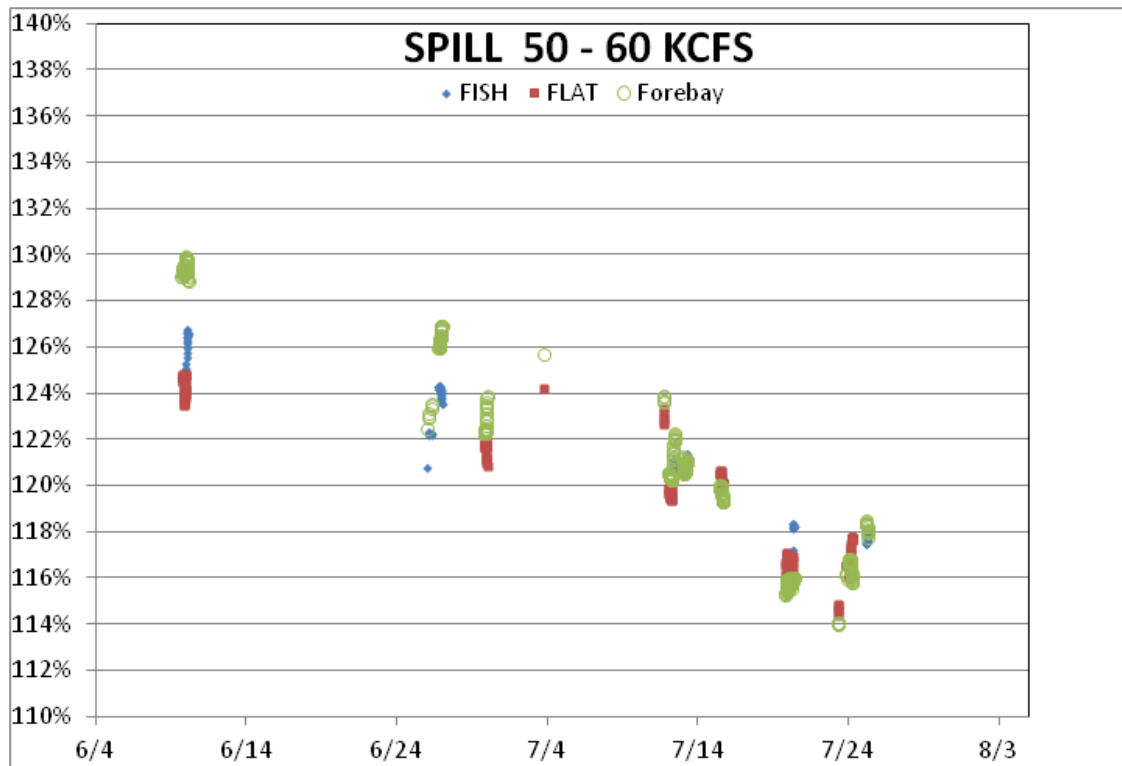


Figure 2-2: TDG levels at the Rocky Reach tailrace monitoring station for spillway flows from 50- 60 kcfs.

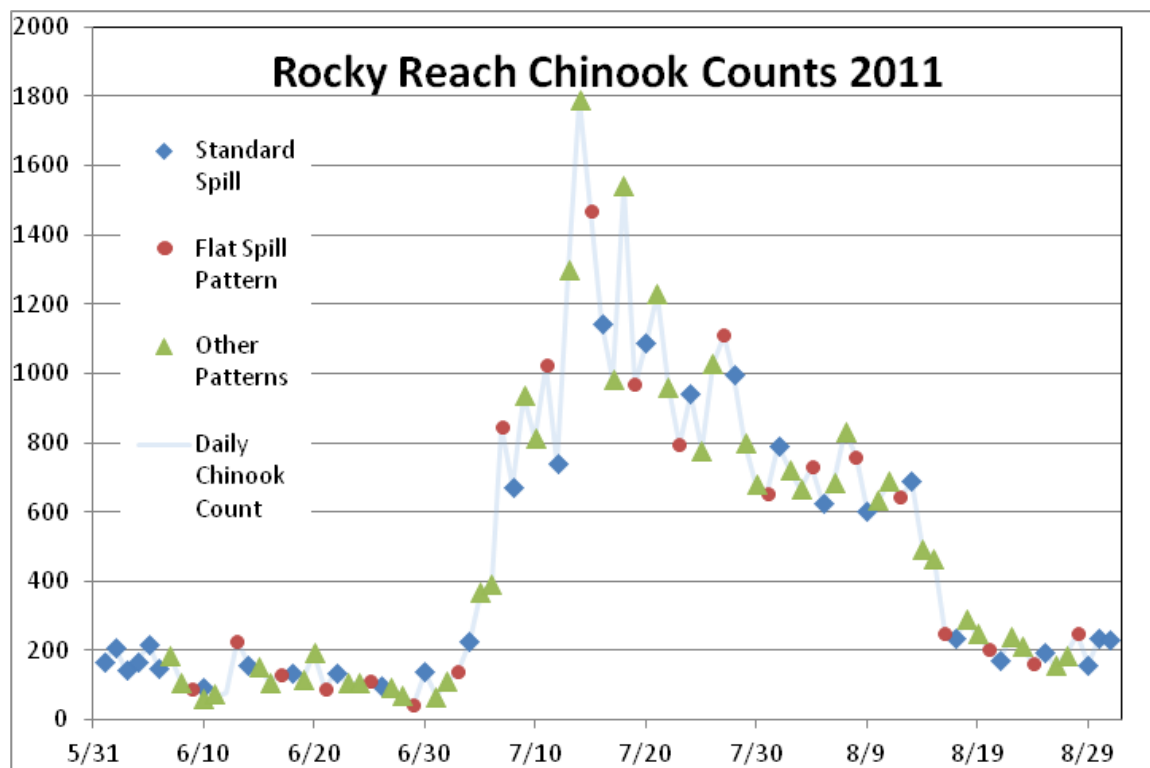


Figure 2-3: Daily passage counts of Chinook salmon at Rocky Reach, with spill pattern in effect that day.

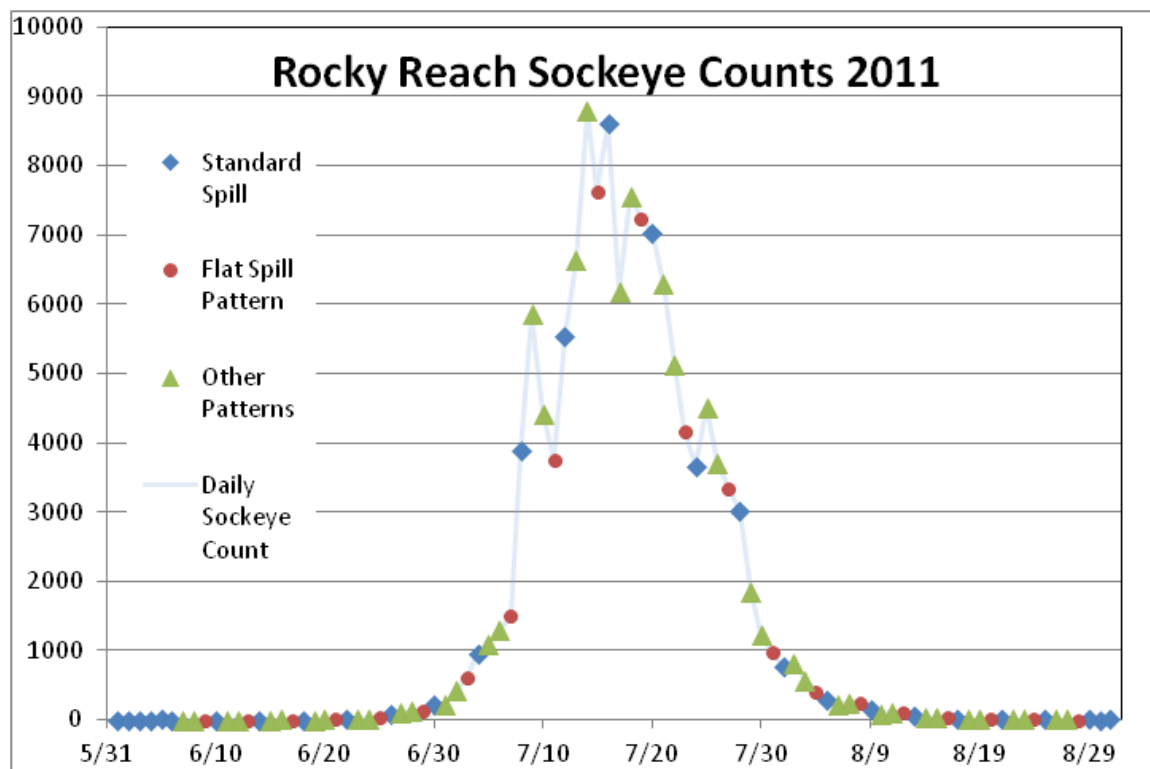


Figure 2-4: Daily passage counts of sockeye salmon at Rocky Reach, with spill pattern in effect that day.

Phase 4. If effective in TDG reduction without potentially affecting fish passage, develop an implementation plan in coordination with various parties

Chelan PUD has presented our findings to Ecology, the RRFF and HCP CC. Through the consultation process with Ecology, the RRFF and HCP CC, Chelan PUD will develop a schedule to make the necessary changes to perform the new spill configuration. This schedule may include, but is not be limited to computer automation of spill gates, changes to system operations, and monitoring. Chelan PUD will operate the new spill configuration as a pilot or test spill and further evaluate the results for a designated period of time. If upon operating under the new spill configuration, data show that optimal results are not occurring as previously evaluated, Chelan PUD will implement adaptive management in coordination with the RRFF and HCP CC.

2.1.7 Total Dissolved Gas Monitoring

In accordance with Section 5.4.1(a) of the 401 Certification (Ecology, 2006), Chelan PUD currently operates and maintains four fixed-site monitoring stations (FMS) that record barometric pressure (millimeters of mercury (mm/hg)), TDG (mm/hg), and temperature (°C). Barometric pressure, TDG, and temperature are recorded at 15 minute intervals, throughout the year in accordance with Chelan PUD's Ecology-approved Quality Assurance Project Plan (QAPP) (Chelan PUD, 2010b).

TDG data enables plant operators to adjust spill volumes to maintain gas levels to reduce the likelihood of exceeding the TDG criteria. These 15-minute intervals are averaged into hourly readings for use in compiling daily and 12-hour averages. All hourly data are forwarded to Chelan PUD headquarters and then onto the USACE Reservoir Control Center and posted at their site on the World Wide Web at www.nwd-wc.usace.army.mil/report/tdg.htm.

The Rock Island forebay FMS is located at a fixed site on the upstream face of Rock Island dam. The Rocky Reach tailrace monitoring station is located approximately one third of a mile downstream of the spillway on the juvenile fish bypass outfall, as required by the 401 Certification (Ecology, 2006). This location was chosen because it was the most feasible location near the end of the aerated zone, which is the compliance point for the Mid-Columbia TDG TMDL. There is not a bridge or other structure downriver of Rock Island Project to which a monitoring station can be attached.

Each Chelan PUD FMS station is equipped with a Hydrolab® Minisonde® 5 enclosed in a submerged conduit. Multi-probes are connected to an automated system that allows Chelan PUD to monitor barometric pressure, TDG, and water temperature on an hourly basis. Probes are maintained and calibrated as outlined in the QAPP. For a complete description of the FMS see the QAPP (Chelan PUD, 2010b).

SECTION 3: DATA SUMMARY

The following sections summarize the hydrological and TDG monitoring results from the 2009 through 2013 time periods. Additional detail can be found in the GAPs, annual reports (GAP Reports) and annual water quality monitoring reports. All of these reports have been submitted to Ecology in accordance with Sections 5.4.3, 5.4.4 and 5.7.8 of the 401 Certification (Ecology, 2006).

3.1 Hydrological

Mean daily discharges for each year from 2009 through 2013 as measured at Rocky Reach Dam are shown in Figure 3-1. In general 2009 and 2010 were the lowest flow years, while 2011 and 2012 were the highest, which corresponded to the highest TDG levels due to the amount of involuntary spill that was required to pass high flows throughout the mid-Columbia River. In 2011 and 2012, the 7Q10 flow was exceeded at Rocky Reach 70 of the 153 days in 2011, and 90 of the 153 days in 2012 of the fish-spill seasons (Chelan PUD, 2011 and 2012).

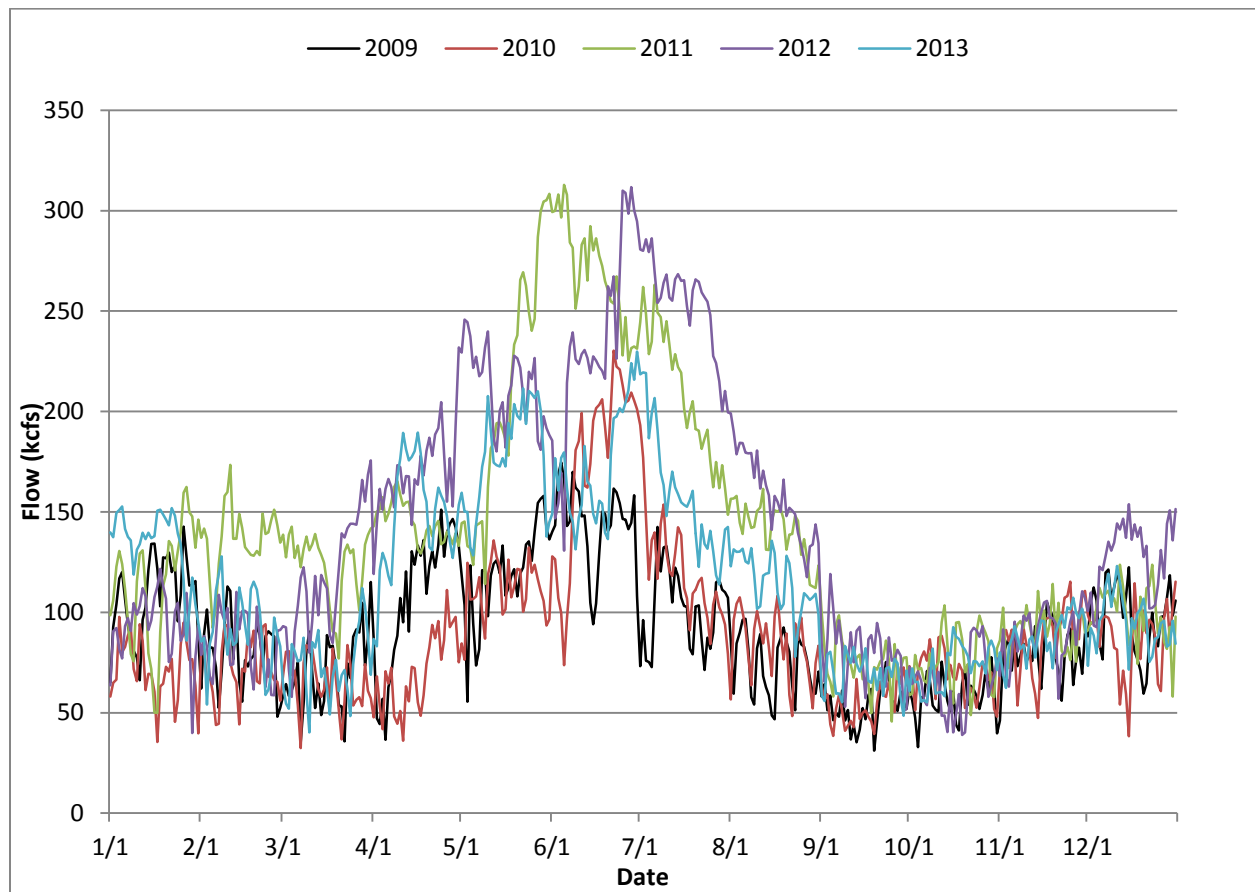


Figure 3-1: Mean daily discharge values as measured at Rocky Reach Dam.

3.2 Gas Bubble Trauma

From 2008-2013, Chelan PUD examined 12,636 smolts for signs of gas bubble trauma (GBT) during the fish spill season (typically between April and August). During the 5-year time period, only 354 showed signs of GBT, or approximately 2.8 percent. The highest percentages of GBT effects occurred between 2011 and 2012, during which the highest flows and highest TDG values occurred as well (Chelan PUD, 2011 and 2012). Table 3-1 provides the summary results of GBT monitoring at Rock Island Dam from 2009 through 2013.

Table 3-1: Number salmon and steelhead smolts examined for external signs of GBT of at Rock Island Dam from 2009-2013.

Year	Species	Number of fish examined	Fish with GBT	
			Number of fish	%
2009	Chinook yearling	609	9	1.48%
	Steelhead	677	4	0.59%
	Chinook Sub-yearling	502	1	0.20%
	Total	1,788	14	0.78%
2010	Chinook yearling	603	3	0.50%
	Steelhead	817	1	0.12%
	Chinook Sub-yearling	1,029	0	0.00%
	Total	2,449	4	0.16%
2011	Chinook yearling	927	18	1.94%
	Steelhead	1,022	230	22.50%
	Chinook Sub-yearling	1,351	31	2.29%
	Total	3,300	279	8.45%
2012	Chinook yearling	818	9	1.10%
	Steelhead	586	10	1.71%
	Chinook Sub-yearling	1283	30	2.34%
	Total	2,687	49	1.82%
2012	Chinook yearling	935	5	1.10%
	Steelhead	454	2	1.71%
	Chinook Sub-yearling	1,024	1	2.34%
	Total	2,413	8	0.33%
5-year Total	Chinook yearling	3,892	44	1.13%
	Steelhead	3,555	247	6.95%
	Chinook Sub-yearling	5,189	63	1.21%
	5-year combined Total	12,636	354	2.80%

3.3 Total Dissolved Gas

Table 3-2, summarizes the number of times TDG levels exceeded the current water quality standards from 2009-2013 during the fish-spill season (April through August) at the Rocky Reach Project tailrace and Rock Island Project forebay. Table 3-3, summarizes the same information for the non-fish spill season (January through March and September through December). Chelan PUD did not begin recording data during non fish-spill until September 1, 2011, when Ecology requested that data be collected annually in their comments on the 2011 Annual Gas Abatement Report (Chelan PUD, 2011). Therefore, Table 3-3 begins on September 1, 2011.

Additional detail can be found in the Final Gas Abatement Annual Reports (Chelan PUD, 2009, 2010, 2011, 2012 and 2013), all of which were submitted to Ecology in accordance with Sections 5.4.4 and 5.7.8 of the 401 Certification (Ecology, 2006).

Table 3-2: Number of fish-spill season total dissolved gas exceedances from 2009-2013 for Rocky Reach Dam

Year	Location ¹	Fish-spill (April 1-August 31)			
		Total	Total # of days ²	% time below 115% TDG	% of hours below 125% TDG
2009	RRTR	0	153	100	100
	RIFB	0	153	100	100
2010	RRTR	5	152	96.7	100
	RIFB	4	110	96.4	100
2011	RRTR	11	121	90.9	100
	RIFB	9	119	92.4	100
2012	RRTR	27	120	77.5	100
	RIFB	20	118	83.1	100
2013	RRTR	8	153	94.8	100
	RIFB	2	153	98.7	100
5-year Total	RRTR	51	699	92.7	100
	RIFB	35	653	94.6	100

Notes:

¹RRTR = Rocky Reach Dam tailrace, RIFB = Rock Island Dam forebay

²Based on total number of available days minus days omitted due to the 7Q10 flood flow being exceeded or TDG membrane failures, multi-probe failures, data transmission errors, and/or electrical issues that resulted in communication errors, or other QA/QC issues

Table 3-3: Number of non fish-spill season total dissolved gas exceedances from 2009-2013 for Rocky Reach Dam

Year	Location ¹	Date	Non-Fish Spill January 1-March 31 September 1-December 31		
			Total	Total # of hours	% time below 110%
2011	RRTR	09/01-12/31	0	2,928	100
	RIFB	09/01-12/31	0	2,928	100
2012	RRTR	01/01-03/31	52	2,184	97.6
		09/01-12/31	0	2,928	100
	Total		52	5,112	99.0
	RIFB	01/01-03/31	61	2,184	33
		09/01-12/31	0	2,928	100
	Total		61	5,112	98.8
2013	RRTR	01/01-03/31	7	2,160	99.7
		09/01-12/31	4	2,928	99.9
	Total		11	5,088	99.8
	RIFB	01/01-03/31	0	2,160	100
		09/01-12/31	0	2,928	100
	Total		0	5,088	100
5-year Totals	RRTR	01/01-03/31	59	4,344	98.6
		09/01-12/31	4	8,784	99.9
	Total		63	13,128	99.5
	RIFB	01/01-03/31	61	4,344	98.6
		09/01-12/31	0	8,784	100
	Total		61	13,128	99.5
Notes:					
¹ RRTR = Rocky Reach Dam tailrace, RIFB = Rock Island Dam forebay					
² Based on total number of available days minus days omitted due to the 7Q10 flood flow being exceeded or TDG membrane failures, multi-probe failures, data transmission errors, and/or electrical issues that resulted in communication errors, or other QA/OC issues					

For the fish-spill seasons, the total number of exceedances varied from zero in 2009 (lowest flow year between 2009 and 2012) to 41 in 2012 (highest flow year between 2009 and 2013). Higher mean daily flows as described in Section 3-3 above in 2011 and 2012, created higher incoming TDG levels. Higher flows in excess of 7Q10 values resulted in increased involuntary spill at Rocky Reach Dam, as well as the rest of the mid-Columbia River projects. These exceedances of the water quality criteria did not necessarily result in noncompliance, as many of the forebay exceedances occurred when the upstream dam's forebay exceeded 115 percent, or flows were in excess of 7Q10 values.

During the non fish-spill season, TDG levels were notably higher in the last few days of March in 2012. In a three-day period from March 29 through 31, 2012, there were a combined total of 113 hourly exceedances of the 110 percent criteria, 52 hours in the Rocky Reach tailrace and 61 hours in the Rock

Island forebay. During these three days, a federal operations spillway test occurred at Chief Joseph Dam (CHJ) upstream of Rocky Reach which created unusually high river flows into the Project. Additionally, one of the generating units at Rocky Reach was out with unavoidable maintenance thereby reducing the generation capability. During these three days, CHJ conducted a spillway test requiring the Project to spill at a 60 kcfs level over and above its normal turbine generating flow (J. Taylor, Mid-C Hourly Coordination Coordinator, 2012). The CHJ spill test required Grand Coulee dam (GCL) to increase discharge to maintain CHJ reservoir elevations during the spill test, and non-federal Projects to pre-draft their reservoirs in order minimize system-wide spill from all Mid-Columbia Projects resulting from increased river flows. The spill test increased inflows into all down river dams in the Mid-Columbia. Mean daily total discharge and spill for Grand Coulee, Chief Joseph, Rocky Reach and Rock Island are represented in Figures 3-2 and 3-3 during the periods when the 110 percent exceedances occurred at Rocky Reach tailrace and Rock Island forebay.

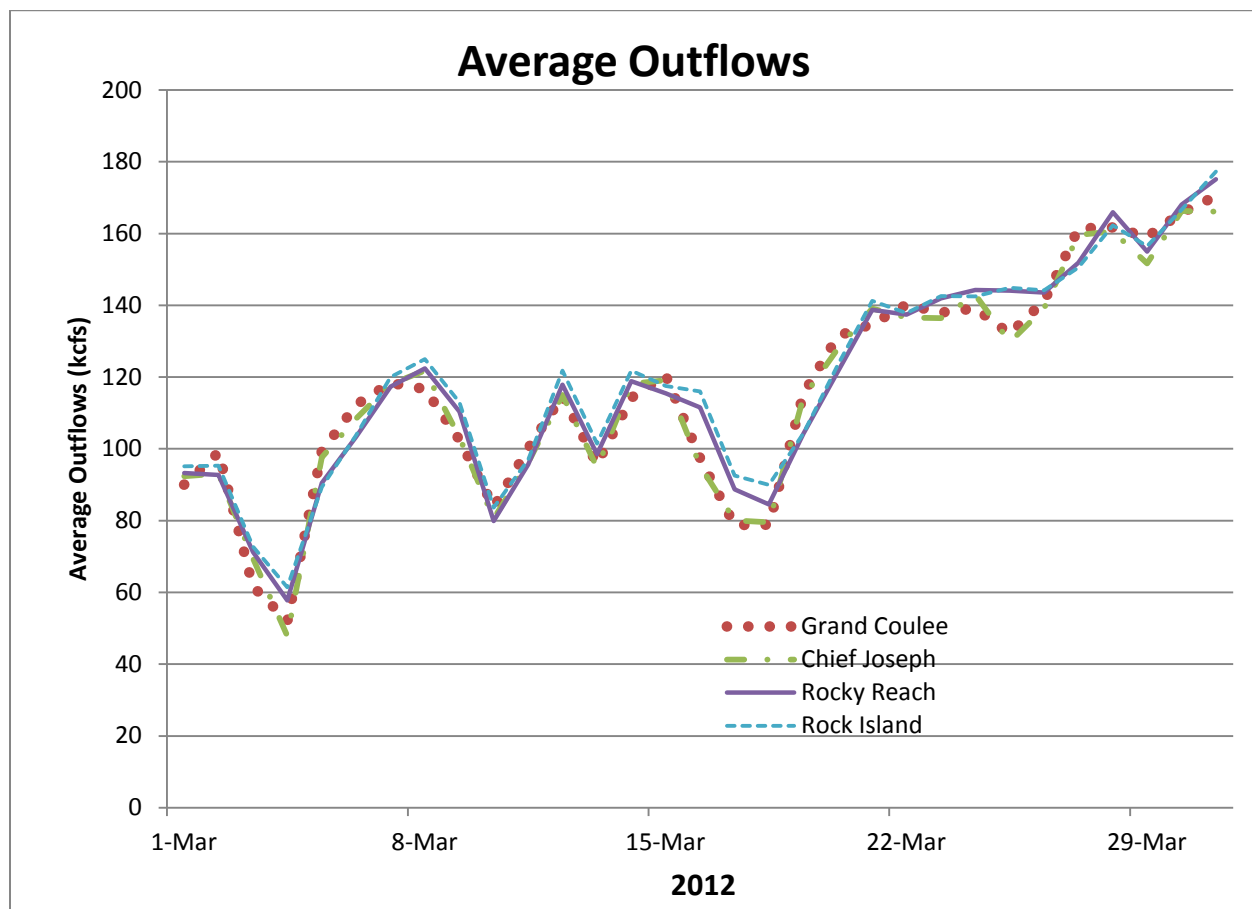


Figure 3-2: Mean daily outflows for Grand Coulee, Chief Joseph, Rocky Reach and Rock Island Dams in March of 2012.

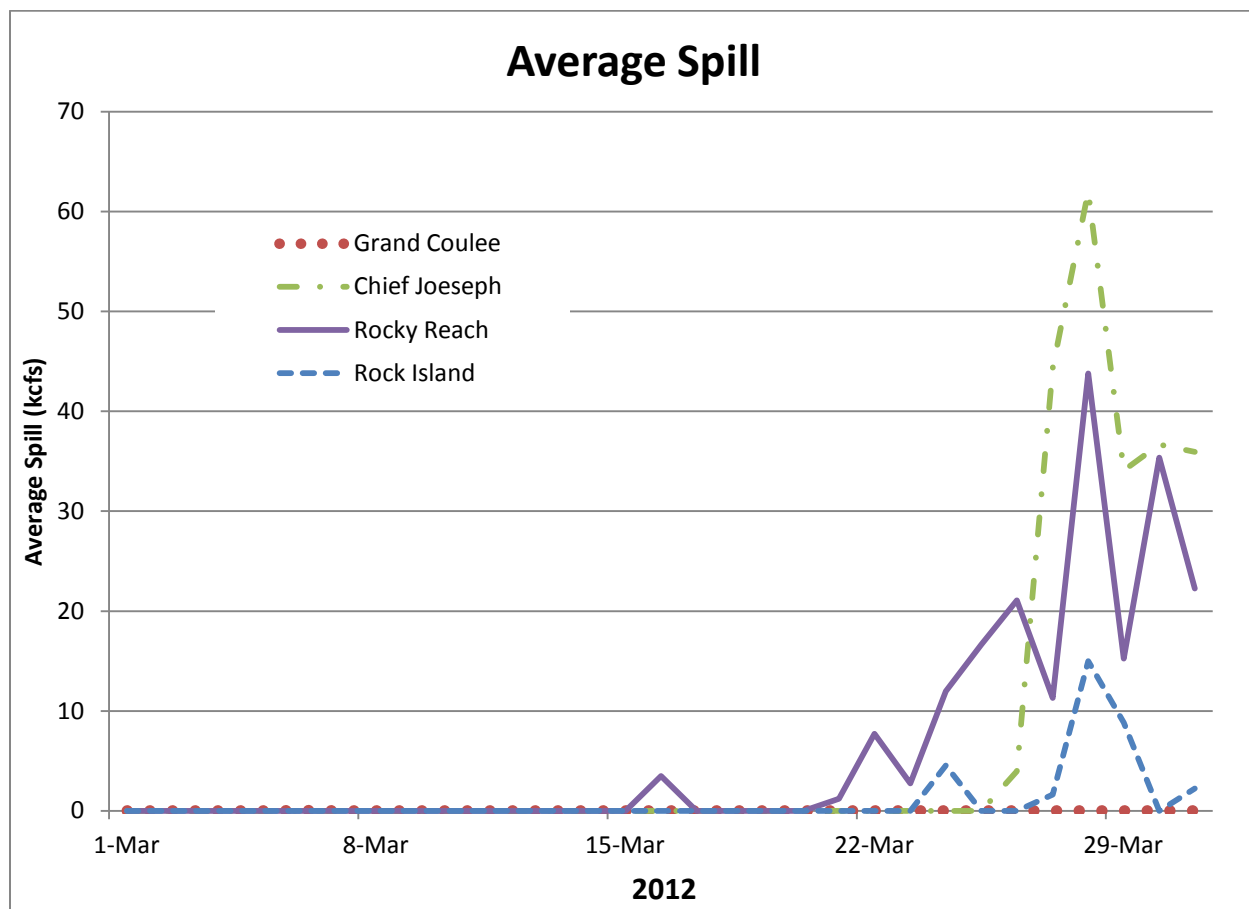


Figure 3-3: Mean daily outflows for Grand Coulee, Chief Joseph, Rocky Reach and Rock Island Dams in March of 2012.

SECTION 4: CONCLUSIONS

4.1 Determination of Compliance, Year 5, Section 5.4(1)(d) of the 401 Certification

Chelan PUD has prepared this report with the intent to satisfy the first step of Section 5.4(1)(d) of the 401 Certification for Ecology's review and conclusions. This report summarizes the results of all TDG studies performed to date, describes whether compliance with the numeric criteria has been attained and discusses the results of Chelan PUD's study on alternative spillway operations.

During the first five years of the License (2009 through 2013), the total number of Rocky Reach Dam TDG exceedances for the fish-spill season varied from zero in 2009 to 27 in 2012. During this same five year period the total number of hourly exceedances for the non-fish spill season varied from zero in 2009 to 61 in 2012.

The information below regarding Rocky Reach Dam's TDG compliance is summarized in Table 4-1. Overall 5 Year Project compliance or percent time below the 120/115 percent criteria (Rocky Reach tailrace and Rock Island forebay) during the fish-spill season was 93.6 percent (86 daily exceedances/1,352 days).

Overall 5 Year Project compliance or percent time below the 125 percent criteria (Rocky Reach tailrace and Rock Island forebay) during the fish-spill season was 100 percent (0 daily exceedances/32,448 hours).

Overall 5 Year Project compliance or percent time below the 110 percent criteria (Rocky Reach tailrace and Rock Island forebay) during the non fish-spill season was 99.5 percent (124 hourly exceedances/26,256 hours).

Table 4-1: Summary table of TDG Compliance at Rocky Reach Dam

Rocky Reach tailrace and Rock Island forebay TDG Compliance Years 2009 through 2013		
% time below 120/115%	% time below 125%	% time below 110%
93.6	100	99.5

Chelan PUD has been effective in their compliance efforts regarding the TDG criterion at the Project by implementing the gas abatement measures identified in the 401 Certification and the WQMP. Although Chelan PUD has not been 100 percent compliant with the TDG standard 100 percent of the time, Chelan PUD will continue to implement the gas abatement measures in accordance with 401 Certification and WQMP. These measures have been successful in reducing TDG within the Rocky Reach tailrace and the Rock Island forebay.

Upon Ecology's review and conclusions of this Report, Chelan PUD shall coordinate and consult with Ecology regarding the next steps required of Section 5.4(1)(d) of the 401 Certification.

4.2 TDG Gas Abatement Measure (6), Alternate Spillway Operations, Section 5.4(1)(b)(6) of the 401 Certification

According to Section 5.4(1)(b)(6) of the 401 Certification, Chelan PUD shall study alternative spillway operations using any of gates 2 through 12. In 2011 and 2012, Chelan PUD studied alternative spillway flow distribution patterns, in order to evaluate the potential to reduce total dissolved gas TDG levels,

particularly during high spill levels (above 50 kcfs). Generally, all of the three alternative spill patterns studied resulted in lower TDG levels than the standard spill pattern. Of the three alternative patterns, the flat spill pattern (flow distributed evenly between spillway gates) had a slightly better TDG performance than the other two alternative patterns. Chelan PUD has presented these findings to Ecology, the Rocky Reach Fish Forum (RRFF) and Habitat Conservation Plan Coordinating Committee (HCP CC).

Chelan PUD, through the consultation process with Ecology, the RRFF, and the HCP CC, will develop a schedule to make the necessary changes to perform the new spill configuration. This schedule may include but not be limited to; computer automation of spill gates (2015), and/or changes to system operations and monitoring. Chelan PUD will operate the new spill configuration as a pilot or test spill and further evaluate the results for a designated period of time. Chelan PUD shall develop a monitoring schedule to test operations under the new spill configuration. If upon operating under the new spill configuration data show that optimal results are not occurring as previously evaluated, Chelan PUD shall implement adaptive management in coordination with the RRFF and HCP CC.

SECTION 5: LIST OF LITERATURE

- Chelan PUD. 2006. Rocky Reach Comprehensive Settlement Agreement, Attachment B, Rocky Reach Comprehensive Plan, Chapter 2, Water Quality Management Plan. Chelan PUD. Wenatchee, WA.
- Chelan PUD. 2009. Gas Abatement Annual Report, Rocky Reach and Rock Island Hydroelectric Projects. Chelan PUD. Wenatchee, WA.
http://www.chelanpud.org/departments/licensingCompliance/rr_implementation/ResourceDocuments/33799.pdf
- Chelan PUD. 2010a. Gas Abatement Annual Report, Rocky Reach and Rock Island Hydroelectric Projects. Chelan PUD. Wenatchee, WA.
http://www.chelanpud.org/departments/licensingCompliance/rr_implementation/ResourceDocuments/35658.pdf
- Chelan PUD. 2010b. Quality Assurance Project Plan Rocky Reach Water Quality Monitoring and Reporting. Chelan PUD. Wenatchee, WA.
- Chelan PUD. 2011. Gas Abatement Annual Report, Rocky Reach and Rock Island Hydroelectric Projects. Chelan PUD. Wenatchee, WA.
http://www.chelanpud.org/departments/licensingCompliance/rr_implementation/ResourceDocuments/38065.pdf
- Chelan PUD. 2012. Gas Abatement Annual Report, Rocky Reach and Rock Island Hydroelectric Projects. Chelan PUD. Wenatchee, WA.
http://www.chelanpud.org/departments/licensingCompliance/rr_implementation/ResourceDocuments/39852.pdf
- Chelan PUD. 2013a. Gas Abatement Annual Report, Rocky Reach and Rock Island Hydroelectric Projects. Chelan PUD. Wenatchee, WA.
http://www.chelanpud.org/departments/licensingCompliance/rr_implementation/ResourceDocuments/41754.pdf
- Chelan PUD. 2013b. Spill Data Evaluation Rocky Reach Dam 2011-2012. Prepared by Weitkamp, D.E. and Sullivan B.D, Parametrix, for Chelan PUD. Wenatchee, WA.
- Federal Energy Regulatory Commission (FERC). 2004. Orders Approving Anadromous Fish Agreements and Applications to Amend License for Public Utility District No. 1 of Chelan County, 107 FERC ¶ 61,280 and 61,281, Washington D.C.
- Federal Energy Regulatory Commission (FERC). 2009. Order Issuing New License for Public Utility District No. 1 of Chelan County, 126 FERC ¶ 61,138, Washington D.C.
- Schneider, Michael L. and Steven C. Wilhelms. 2005. Rocky Reach Dam: Operational and Structural Total Dissolved Gas Management. U.S. Army Engineer Research and Development Center, Vicksburg.
- Taylor, J. 2012. Email from Joe Taylor, Mid-C Hourly Coordination Coordinator, to Mid-C Hydro Project owners explaining requesting special operations for downstream Mid-C projects during the CHJ spill test. March 23, 2012.

Washington State Department of Ecology (Ecology). 2004. Total Maximum Daily Load for Total Dissolved Gas in the Mid-Columbia River and Lake Roosevelt. Submittal Report. Prepared jointly by the U.S. Environmental Protection Agency and the Washington State Department of Ecology in cooperation with the Spokane Tribe of Indians. Ecology Publication Number 04-03-002. June 2004.

Washington State Department of Ecology (Ecology). 2006. Water Quality Certification for the Rocky Reach Project. Order No. 3155 dated March 17, 2006.
http://www.chelanpud.org/documents/RR_Section_401_Water_Quality_Cert.pdf

Washington State Department of Ecology (Ecology). 2008a. Memo to Columbia and Snake River Dam Operators; RE: Clarification of WAC 201A-200(1)(f)(ii), Measuring Total Dissolved Gas (TDG) During Fish Spill on the Columbia and Snake Rivers. Sent by Susan Braley on May 21, 2008.

APPENDIX A: RESPONSE TO COMMENTS

This Report was submitted for review and consultation to Ecology and the RRFF on October 31, 2014 and the HCP CC on November 25, 2014. Chelan PUD received comments from Ecology and the CCT. Comments received and Chelan PUD's responses to those comments are in the following table.

Additionally, Chelan PUD and Ecology had a conference call on December 15, 2014 to discuss their comments. The following responses to Ecology's comments were agreed upon during that conference call. Present during the call were: Chelan PUD, Michelle Smith and Marcie Steinmetz; Ecology, Chris Coffin, Pat Irle, and Charlie McKinney.

Agency Comments		Chelan PUD Response
Ecology		
1.	According to page 7 of the draft report, the purpose of this report is to comply with Section 5.4(1)(d) of the Clean Water Act Section 401 Water Quality Certification (included in the FERC license), which states that Chelan PUD shall “Prepare a report summarizing the results of all TDG studies performed to date, and describing whether compliance with the numeric criteria has been attained.” If this is indeed the purpose of this report, it would be very helpful to have the following additions and changes:	The paragraph 5.4.1(d) contains about 6 steps, all of which need to happen in a successive order, meaning one cannot happen until the others are completed. It is not specific on dates only to state that “In year 5...Chelan PUD shall prepare a report.....”
a.	Could you state the purpose of the report (as described above) in the Executive Summary, the Introduction, and the Conclusions?	The purpose has been clearly stated in each of the three sections.
b.	In the Executive Summary, Introduction and Conclusions, could you describe the TDG studies performed to date? If there have been none, simply say so and describe why. If it is because studies to improve fish passage were still ongoing, it is fine to say so.	A description of the TDG study (flattened spill configuration) has been added in each section.
c.	Also, in each of these three sections, please describe whether you believe compliance with the numeric criteria has been achieved. Note that “the numeric criteria” refers to the State water quality standards found in WAC 173-201A. During the conference on December 15, 2014, Ecology asked that a table be added to show compliance in these sections as well.	It has been stated that 100% compliance with the numeric criteria has not been met in each of the three sections with an additional table explaining the compliance.
d.	It may be helpful to note in the Executive Summary and Introduction (as well as the Conclusions) that the PUD is proposing to implement a study this coming year (2015) to investigate a potential operational change to improve TDG levels.	It has been noted in all sections, that upon the HCP CC recommendation, the process/phased approach of developing an implementation plan for the flattened spill configuration will take place in 2015.

Agency Comments			Chelan PUD Response
	e.	On page 7 of the draft report you state that this report is the first of six steps to comply with Section 5.4(1)(d) of the 401 Certification.	This statement is correct.
	i.	Could you include a brief statement in the Executive Summary, Introduction and Conclusions that describes the steps remaining to ensure compliance with Section 5.4(1)(d). It should be clear that Ecology will review the final (Step 1) report and determine whether the numeric criteria are met.	It has been clearly stated in each section that Ecology will review the report and conclusions and determine whether the numeric criteria have been met.
	ii.	These sections should also include a statement that the PUD will be submitting a second (Step 4) report and third (Step 5) report to Ecology.	It has been stated in each section the process according to the 401 Certification.
	iii.	In the Conclusion, could you provide an estimated time frame for the remaining steps. Note that according to the 401 Certification, these are all to be completed in Year 5.	It has been stated that Chelan PUD will be submitting these reports in a successive order with Ecology approving and making recommendations along each step. These steps will not be completed in Year 5, but a schedule will be developed in consultation with Ecology, the RRF and the HCP CC.
	iv.	Could you change the title to include the phrase “Step 1” (or something like that)?	The title of the report has been changed to: <u>Total Dissolved Gas: Step One, Year Five Compliance Report</u> .
2.	In Section 3.3, two tables summarize the number of exceedances of TDG standards. The text states that “Higher mean daily flows... created higher incoming TDG levels.” Can you discuss the results in more detail (rather than asking the reader to look back to previous reports). Also, is there a correlation to the proposed TDG study, which focuses on higher flows?		Section 3.3 has been expanded to include more detailed discussion of the results.
3.	In Section 3.3, there is a statement that “Higher flows in excess of 7Q10 values results in increased involuntary spill...” The relevance of the second sentence is unclear, because when flows exceed 7Q10, high TDG levels are not counted as exceedances.		Section 3.3 has been expanded to include more detailed discussion of the results.

Agency Comments		Chelan PUD Response
4.	In Section 4, the text indicates that the RRFF and HCP CC will determine if Flattened Spill is to be implemented, by consensus. Please describe the next steps if the group is unable to reach consensus, or if the water quality standards still are not met.	This section of text has been edited to state “The RRFF and HCP CC will be consulted with to determine if the Flattened Spill configuration will be implemented. If implementation is decided upon, then Chelan PUD will develop a schedule to make the necessary changes to perform the new spill configuration. This schedule may include, but is not limited to computer automation of spill gates, changes to system operations, and monitoring. Chelan PUD will operate the new spill configuration as a pilot or test spill and further evaluate the results for a designated period of time. If upon operating under the new spill configuration, data show that optimal results are not occurring as previously evaluated, Chelan PUD will implement adaptive management in coordination with the RRFF and HCP CC.
Minor Comments (mostly editorial)		
1.	In the Executive Summary, third paragraph, it appears that the numbers need to be checked for accuracy.	The reference to the conditions in the 401 Certification have been verified and corrected.
2.	Could you provide more consistency in terminology and abbreviations throughout the report? The terms that stand out to this reader are;	Consistency in terminology and abbreviations throughout the report have been corrected and verified.
a.	Abbreviation used for the Clean Water Act 401 Certification. In previous Chelan PUD documents, “401 Certification” was used (which is probably my preference.) If the PUD would like to change its format, that fine. If so, please be consistent. Note that in this document, sometimes WQC is used and elsewhere 401 WQC.	Consistency with the abbreviation of “401 Certification” has been used.
b.	Another is reference to kcfs or cfs. I personally prefer kcfs. Note that the use of cfs shows up a lot in the discussion in Section 2.1.6	Kcfs has been used where appropriate
c.	There seems to be inconsistent use of abbreviations and terminology in reference to the juvenile bypass system. JBS? JFB (see Section 2.1)? Bypass system and Bypass System (2.1.3).	JBS has been used consistently throughout the document.
d.	A couple of places in the text that refer to “effecting fish passage”, which should be “affecting fish passage”.	The proper use of “effect” and “affect” has been corrected in the document.
e.	Other minor stuff like spelling out TDG, GBT and HCP when these abbreviations are first used.	Abbreviations have been spelled out where they are first used (to include the Executive summary as the first use).

Agency Comments		Chelan PUD Response
CCT		January 21, 2015, Comments from Kirk Truscott
1.	Consider adding the adult fishway to this paragraph describing the Project.	The upstream adult fishway was added to the noted paragraph.
2.	Figure 3-1 doesn't appear to support this statement. From Figure 3-1, the flows during 2011 Jan. - March period appear to be higher than 2012 and 2013. Additionally, flows in all years during Jan. - March were less than the 7Q10 flow, so why the exceedences? Is it entirely related to flow as stated, or did the power market have an influence as well?	<p>Upon review of the comments submitted by Kirk Truscott, an error in Table 3-3 was discovered. The error in the table was regarding the total number of days of data recorded for the 110% criteria. The number of days reported were correct, but the 110% TDG criteria is reported in hours, thereby reporting an incorrect % of time below the 110% criteria. The table has been changed to reflect total number of "hours" of data recorded and the % time below 110% corrected to reflect these hours as opposed to days.</p> <p>In response to the comment, the section has been corrected to describe the appropriate condition that created the 110% exceedances during the January through March time period in 2012 as described below:</p> <p>During the non fish-spill season, TDG levels were notably higher in the last few days of March in 2012. In a three-day period from March 29 through 31, 2012, there were a combined total of 113 hourly (52 hours Rocky Reach tailrace and 61 Rock Island forebay) exceedances of the 110 percent criteria. During these three days, a federal operations spillway test occurred at Chief Joseph Dam (CHJ) upstream of Rocky Reach which created unusually high river flows into the Project. Additionally, one of the generating units at Rocky Reach was out with unavoidable maintenance thereby reducing the generation capability. During these three days, CHJ conducted a spillway test requiring the Project to spill at a 60 kcfs level over and above its normal turbine generating flow (J. Taylor, Mid-C Hourly Coordination Coordinator, 2012). The CHJ spill test required Grand Coulee dam (GCL) to increase discharge to maintain CHJ reservoir elevations during the spill test, and non-federal Projects to pre-draft their reservoirs in order minimize system-wide spill from all Mid-Columbia Projects resulting from increased river flows. The spill test increased inflows into all down river dams in the Mid-Columbia. Mean daily total discharge and spill for Grand Coulee, Chief Joseph, Rocky Reach and Rock Island are represented in Figures 3-2 and 3-3 during the periods when the 110 percent exceedances occurred at Rocky Reach tailrace and Rock Island forebay.</p>