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Subject: DRAFT 2016 Gas Abatement Plans for Rocky Reach and Rock Island
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[DRAFT 2016 Rocky Reach GAP FN47499.docx](#)

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To: Charlie McKinney, Washington State Department of Ecology
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From: Marcie Steinmetz, Water Resource Specialist
Public Utility District No. 1 of Chelan County (Chelan PUD)

Re: DRAFT 2016 Total Dissolved Gas Abatement Plans for the Rocky
Reach and Rock Island projects

Mr. McKinney and Mr. Peterschmidt:

Attached for your review and comment are the DRAFT 2016 Total Dissolved Gas Abatement Plans for the Rocky Reach and Rock Island projects. Please review and submit any comments you may have on or before 5:00 p.m. March 28, 2016 to me via email at marcie.steinmetz@chelanpud.org.

If you have any questions, please do not hesitate to contact me.

Thank you,

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2016 TOTAL DISSOLVED GAS ABATEMENT PLAN

DRAFT

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

February 2016



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

TERMS AND ABBREVIATIONS

401 Certification	Washington State Department of Ecology 401 Water Quality Certification
7Q10	highest seven consecutive day average flow with a 10-year recurrence frequency
cfs	cubic feet per second
Chelan PUD	Public Utility District No. 1 of Chelan County
CCT	Confederated Tribes of the Colville Indian Reservation
BPA	Bonneville Power Administration
Douglas PUD	Public Utility District No. 1 of Douglas County
Ecology	Washington State Department of Ecology
ESA	Endangered Species Act
FCRSP	Federal Columbia River Power System
FERC	Federal Energy Regulatory Commission
FPC	Fish Passage Center
FPE	Fish Passage Efficiency
FMS	fixed monitoring station
GAP	Gas Abatement Plan
GBT	gas bubble trauma
Grant PUD	Public Utility District No. 2 of Grant County
HCP	Habitat Conservation Plan
HCP CC	Habitat Conservation Plan Coordinating Committee
kcfs	thousand cubic feet per second
JBS	juvenile bypass system
NMFS	National Marine Fisheries Service
MCHCA	Mid Columbia Hourly Coordination Agreement
Project	hydroelectric project
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RRFF	Rocky Reach Fish Forum
TDG	total dissolved gas
TMDL	total maximum daily load
UCR	Upper Columbia River
USACE	United States Army Corps of Engineers
USBR	United State Bureau of Reclamation
USFWS	United States Fish and Wildlife Service
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WQMP	Water Quality Management Plan
WQS	Water quality standards

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EXECUTIVE SUMMARY

This Total Dissolved Gas Abatement Plan (GAP) is being submitted to the Washington State Department of Ecology (Ecology) as required by the 401 Water Quality Certification (401 Certification) for the Rocky Reach Hydroelectric Project (Project) and by Washington Administrative Code (WAC) 173-201A-200. This section of the WAC allows Ecology to temporarily adjust total dissolved gas (TDG) criteria to aid downstream migrating juvenile fish¹ passage past hydroelectric dams when consistent with an Ecology-approved gas abatement plan. Chelan County Public Utility District No.1 (Chelan PUD) has prepared this annual GAP to provide an overview of operational implementation actions Chelan PUD will take at the Project during 2016 to meet TDG requirements, while ensuring the fish passage requirements are met as set forth in the Rocky Reach Habitat Conservation Plan (HCP) and Anadromous Fish Agreement. This GAP includes plans for physical and biological monitoring and is accompanied by the fisheries management plan (HCP), Rocky Reach Operations Plan, TDG Operational Plan, a Quality Assurance Project Plan (QAPP) for Rocky Reach Water Quality Monitoring and Reporting, and the Gas Abatement Annual Report.

WAC water quality standard 173-201A-200(1)(f)(ii) provides a temporary criteria adjustment for hydroelectric dams on the Snake and Columbia Rivers, when spilling to aid in fish passage. To receive this criteria adjustment, an Ecology approved gas abatement plan is required. Section 5.4(2) in the 401 Certification for the Rocky Reach Project defines the non fish-spill season as September 1 through March 31 and the fish-spill season is April 1 through August 31.

The following special fish passage exemptions for the Snake and Columbia Rivers apply when spilling water at dams is necessary to aid fish passage and an Ecology approved gas abatement plan is in place:

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

The goal of the GAP is to implement measures to achieve compliance with the WAC water quality standards for TDG in the Columbia River at the Project while continuing to meet the fish passage and survival standards set forth in the Rocky Reach HCP and Anadromous Fish Agreement. These plans are provided as Appendix A.

¹ Unless otherwise noted “fish” refers to downstream migrating juveniles.

To meet the above stated goal, Chelan PUD plans to implement applicable operational measures specified in Section 5.4.1(b) of the 401 Certification. These measures include, but are not limited to:

1. Minimizing voluntary spill.
2. During downstream migrating juvenile fish passage, managing voluntary spill levels in real time in an effort to continue meeting TDG numeric criteria, using the TDG Operational Plan (Appendix B).
3. Minimizing spill, to the extent practicable, by scheduling maintenance based on predicted flows.
4. Avoiding spill by continuing to participate in the Hourly Coordination Agreement or any successor agreement to which Chelan PUD is a party, to the extent it reduces TDG.
5. Maximizing powerhouse discharge as appropriate up to 212 thousand cubic feet per second kcfs.
6. Implement alternative spillway operations, using gates 2 through 12, to determine whether TDG levels can be reduced without adverse effects on fish passage. If effective, implement to reduce TDG.

Additionally, Chelan PUD proposes to implement the following measures, as required by the 401 Certification:

1. Consult with Ecology if there are any non-routine operational changes that may affect TDG.
2. Monitor for TDG at Chelan PUD's fixed-site monitoring stations. TDG data will be collected on an hourly basis throughout the year and will be reported to United States Army Corps of Engineers (USACE) Columbia River Basin Water Management Division's website.
3. Prepare an annual report summarizing Chelan PUD's fish-spill season regarding; flow, TDG, gas bubble trauma (GBT) monitoring, and fish study results, and, in accordance with the previous (2015) GAP; submit to Ecology by December 31st.
4. Prepare an annual water quality report summarizing Chelan PUD's water quality monitoring (to include non fish-spill season TDG data); submit to Ecology by March 1st.

SECTION 1: INTRODUCTION

Chelan PUD owns and operates the Rocky Reach Hydroelectric Project, located on the Columbia River downstream of Wells Dam (Figure 1-1). The Project is licensed as Project No. 2145 by the Federal Energy Regulatory Commission (FERC). The 401 Certification for the Project was issued by Ecology on March 17, 2006. The 401 Certification terms and conditions are incorporated in the new FERC license to operate the Project which was issued on February 19, 2009. Section 5.4.3 of the 401 Certification requires Chelan PUD to submit an annual GAP in accordance with Ecology's water quality standards for total dissolved gas TDG beginning on April 1 of the year of implementation.

This GAP is being submitted to Ecology according to WAC 173-201A-200(1)(f)(ii) and Section 5.4.3 of the 401 Certification. Chelan PUD respectfully submits this GAP with the goal of receiving a TDG criteria adjustment for commencing with the 2016 fish-spill season. This GAP provides details associated with proposed 2016 operations and activities to achieve TDG standards, a review of any proposed structural TDG abatement measures and technologies, and physical and biological monitoring plans.

1.1 Project Description

The Rocky Reach Hydroelectric Project (Project) is owned and operated by the Public Utility District No. 1 of Chelan County (Chelan PUD). Chelan PUD received a new license (License) from the Federal Energy Regulatory Commission (FERC) on February 19, 2009, authorizing Chelan PUD to operate the Project dam and powerhouse for a period of 43 years.

The Project consists of a reservoir with a surface area of approximately 8,235 acres and a concrete-gravity dam approximately 130 feet high and about 2,847 feet long (including the powerhouse) that spans the river. The dam consists of:

- a forebay wall, which is integral with the dam and is formed by 10 blocks of various heights and widths between the powerhouse and west abutment;
- a powerhouse approximately 1,088 feet long, 206 feet wide and 218 feet high that includes 11 generating units and a service bay;
- a spillway that is integral with the dam and consists of twelve 50-foot-wide bays separated by 10-foot-wide piers, with flow through each bay controlled by a 58-foot-high radial gate;
- two non-overflow east abutment blocks that are integral with the dam, each 125 feet high by 60 feet wide;
- an east bank seepage cutoff, which is a buried structure that extends roughly 2,000 feet from the east end of the concrete portions of the dam and has a maximum depth of about 200 feet and;
- Dryden weir and Tumwater dams' fish ladders and trapping facilities. (These facilities are located some distance away from the Project on the Wenatchee River).

The Rocky Reach Project includes passage facilities for upstream and downstream migrating fish. The upstream migrant fishway has three main entrances. One entrance is located between spillway bays 8 and 9, a second entrance is at the center of the dam adjacent to powerhouse unit

11, and a third entrance is at the powerhouse service bay between turbine unit 1 and the west shoreline. There are also six submerged orifice entrances in operation; three at each end of the powerhouse. Fish pass from the entrances into fish collection and transportation channels, which converge to guide fish to a pool and weir fish ladder. There is a counting station at the fishway exit located near the west shoreline. Attraction water for the powerhouse fishway entrances is provided by three hydraulic turbine-driven pumps with a total capacity of 3,500 cubic feet per second (cfs). A gravity intake provides additional attraction water for the spillway entrance. The juvenile fish bypass system (bypass system) includes a surface collection system, turbine intake screens and collection system for turbines 1 and 2, a bypass conduit to the tailrace, and a fish sampling facility.

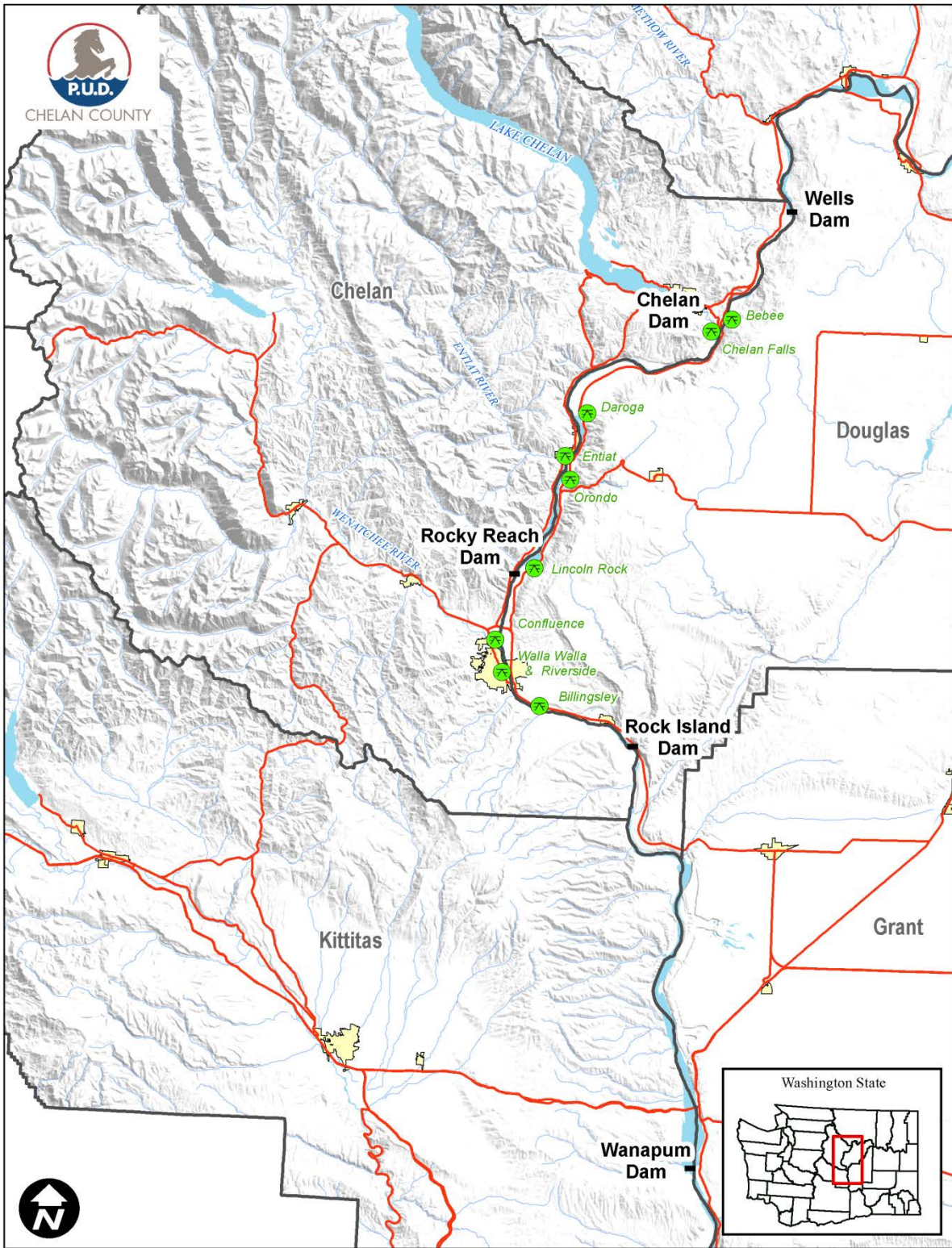


Figure 1-1: Location of Rocky Reach Hydroelectric Project on the Columbia River.

1.2 River Flows

The climate of the Columbia Basin in eastern Oregon, Washington and British Columbia is best described as desert. The major portion of the precipitation experienced within the basin falls in the form of snow during the period of November through March of each year. Runoff usually occurs from mid-April through July, with the historical peak occurring during the month of June. Storage dams in the United States and Canada capture spring and summer high flows to hold for release in the winter months. A comparison of the 10-year average flows to 2015 flows at the Rocky Reach Project is shown below in Figure 1-2.

Mean daily discharge during the 2015 fish-spill season was compared to the 10-year average of mean daily discharge from 2005-2014, as measured at Rocky Reach Project. Mean daily flow discharges during the 2015 fish-spill season were lower than the 2005-2014 average (about 71.6% of average at Rocky Reach Dam) over the entire fish-spill season.

Average flow for all months during the spill season was lower than the monthly 10-year average. The maximum hourly flows observed at the Project during the spill season were 138 kcfs, on April 3. Of the 153 days during the spill season (April 1 through August 31), there were no instances where the daily average flows exceeded the seven-day, ten-year frequency flood stage (7Q10) of 252 thousand cubic feet per second (kcfs).

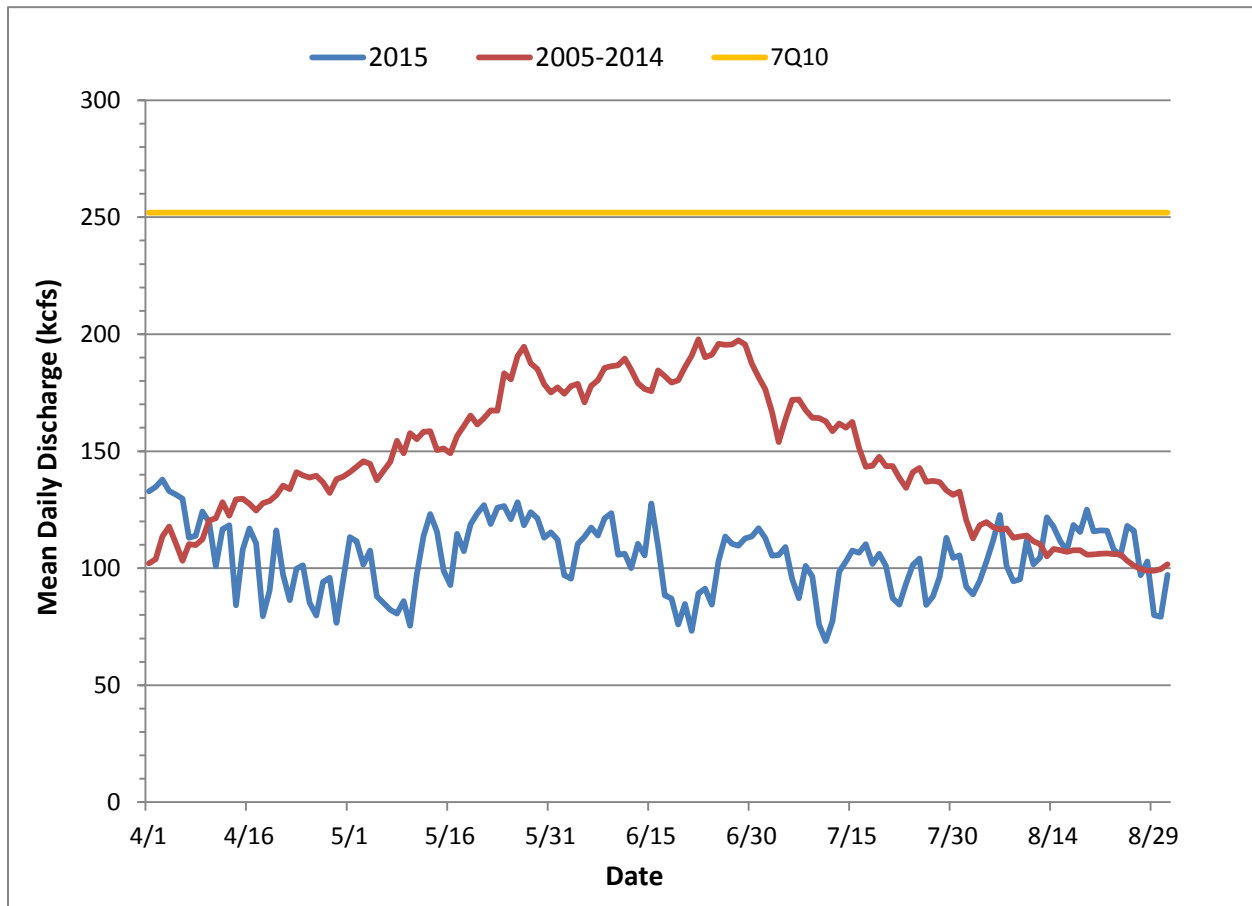


Figure 1-2: Comparison of 2015 vs. previous 10-year average (2005-2015) of mean daily discharge at Rocky Reach Dam.

1.3 Regulatory Framework

1.3.1 Total Dissolved Gas Standards

WAC 173-201A-200(1)(f) address standards for the surface waters of Washington State. Under the water quality standards (WQS), 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 an Ecology-approved gas abatement plan is in place. This plan must be accompanied by fisheries management and physical and biological monitoring plans. Ecology may approve, on a per application basis, a temporary criteria adjustment 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 criteria adjustment. 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). The increased levels of spill resulting in elevated TDG levels are intended to allow increased fish passage without causing more harm to fish populations than caused by turbine fish passage. This TDG exemption provided by Ecology is based on a risk analysis study conducted by the National Marine Fisheries Service (NMFS, 2000).

1.3.2 Fish-spill Season

Section 5.4.2 of the Rocky Reach 401 Certification defines the fish-spill (for downstream migrating juveniles) season as April 1 through August 31 of each year. Non fish-spill season is defined as September 1 through March 31, unless otherwise specified in writing to Ecology following consultation with the Rocky Reach Fish Forum and the HCP Coordinating Committee.

1.3.3 Incoming Total Dissolved Gas Levels

During the fish passage season, TDG concentrations in the Rocky Reach Project forebay are primarily determined by the upstream water management activities of upstream dams.

1.3.4 Flood Flows - 7Q10

WAC 173-201A-200(f)(i) states that the water quality criteria for TDG shall not apply when the stream flow exceeds the seven-day, ten-year frequency flood or 7Q10. The 7Q10 flood flow for the Rocky Reach Project was calculated to be 252 kcfs (Pickett, et al., 2004).

1.3.5 Total Dissolved Gas Total Maximum Daily Load

In 2004, Ecology established a TDG Total Maximum Daily Load (TMDL) for the mid-Columbia River which set TDG allocations for each dam (Pickett, et al., 2004). With the option for a temporary TDG criteria adjustment under an approved gas abatement plan, the TMDL set TDG loading capacities and allocations for the Mid-Columbia River and Lake Roosevelt, both in terms of percent saturation for fish passage and excess pressure above ambient for non-fish passage. Allocations are specified for each dam and for upstream boundaries. Fish passage allocations must be met at fixed monitoring stations. Non-fish passage allocations must be met in all locations, except for an area below each dam (other than Grand Coulee) from the spillway

downstream to the end of the aerated zone. Attainment of allocations will be assessed at monitoring sites in each dam's forebay and tailrace and at the upstream boundaries.

Section 5.4.7 of the Rocky Reach Project 401 Certification states: "*This certification, along with the WQMP and the updated GAP, is intended to serve as the Rocky Reach Project's portion of the Detailed Implementation Plan (DIP) for the Mid-Columbia River and Lake Roosevelt TDG TMDL*".

1.4 Project Operations

The Project is an integral part of the seven-dam Mid-Columbia River Hydroelectric System (Grand Coulee to Priest Rapids). Each of the seven dams is operated in accordance with the terms of the Mid-Columbia Hourly Coordination Agreement (MCHCA), which seeks to coordinate operations for all of the mid-Columbia projects for the best use of flows for generation and to meet fishery (juvenile and adult) and other environmental resource needs.

Under the MCHCA, power operations are coordinated to meet daily load requirements through the assignment of "coordinated generation" through Central Control hosted at the Public Utility District No. 2 of Grant County (Grant PUD). Automatic control logic is used to maintain pre-set reservoir levels in order to meet load requirements and minimize involuntary spill. These pre-set reservoir levels are maintained at each project through management of a positive or negative "bias" which assigns a project more or less generation depending on whether the reservoir elevation should be increased or decreased in order to maximize system benefits and minimize involuntary spill.

In addition to the MCHCA discussed above, the Project operates within the constraints of its FERC regulatory and license requirements, as well as the plans and agreements discussed below.

1.4.1 2016 Rocky Reach Operations Plan

Article 402 of the Rocky Reach License requires an annual Operations Plan be submitted to the FERC by February 15 each year for approval (revised submittal date of March 30). This Operations Plan includes the following: (a) descriptions of fisheries (juvenile and adult) and water quality-related operating criteria for the Project turbines, the downstream fish passage facility, fishways, spillways, and sluiceways; (b) descriptions of fisheries- and water-quality-related protocols for startup, in-season operation, shutdown, and inspection of the Project turbines, the downstream passage facility, fishways (including fish salvage), spillways, and sluiceways; and (c) an annual schedule for operation and inspection of these facilities. The information contained in the annual Operations Plan is relevant to Chelan PUD's TDG abatement activities and is therefore attached for reference as Appendix C to this GAP.

1.4.2 Habitat Conservation Plan

In 2004, the FERC amended the existing license to include the Anadromous Fish Agreement and HCP for the Rock Island Project. The HCP is a programmatic approach developed by Chelan PUD and the fishery agencies and tribes for reducing and eliminating the effects of the Rock Island Project on salmon and steelhead.

The Rocky Reach HCP serves as the foundation for the fisheries management plan at Rocky Reach Dam. It fundamentally describes a 100 percent No Net Impact (NNI) concept with necessary outcomes required for mainstem passage, habitat improvement and protection, and hatchery programming. All measures proposed in the HCP are intended to minimize and mitigate impacts to the Plan species, to the “maximum extent practicable” as required by the Endangered Species Act (ESA). Plan species include: Upper Columbia River (UCR) steelhead, UCR yearling spring Chinook, UCR subyearling summer/fall Chinook, Okanogan River sockeye, and coho salmon. The Rocky Reach HCP provides for optional tools Chelan PUD may implement to aid in juvenile fish passage past the Project, including spill and the use of the JBS. Chelan PUD implements these tools to aid in juvenile fish passage as necessary to ensure success toward NNI.

HCP Phase III (Standards Achieved) has been met for all spring migrants (spring/yearling Chinook, steelhead, and sockeye) at Rocky Reach while operating the JBS exclusively.

1.4.3 Other International and Regional Agreements

The Columbia River is managed, and the Project is operated, for fish (juvenile and adult) habitat and flow by the following international and regional agreements:

- *Columbia River Treaty*: An agreement between Canada and the United States in which Canada has agreed to provide storage for improving flow in the Columbia River to maximize power and flood control.
- *Pacific Northwest Coordination Agreement*: An agreement among the United States Bureau of Reclamation (USBR), the Bonneville Power Administration (BPA), the United States Army Corps of Engineers (USACE), and 15 public and private generating utilities to maximize usable hydroelectric energy. Chelan PUD is a member of this agreement.
- *Mid-Columbia Hourly Coordination Agreement*: An agreement whereby the mid-Columbia PUDs (Chelan, Douglas, and Grant PUDs), the USACE, the USBR, and BPA coordinate operations in order to maximize the output of hydroelectric power. Effects have included reducing forebay elevation fluctuations and spill.
- *The Federal Columbia River Power System (FCRPS) Biological Opinion*: by NMFS, applies to actions by the Corps, the USBR, and BPA for impacts on ESA listed salmon and steelhead on the Columbia River system. A Technical Management Team sets flow releases and other operations of the FCRPS that determines the daily and weekly flows that will pass through the Project.
- *Hanford Reach Fall Chinook Protection Program Agreement*: The three mid-Columbia PUDs, NOAA Fisheries, Washington Department of Fish and Wildlife (WDFW), U.S. Fish and Wildlife Service (USFWS), Confederated Tribes of the Colville Indian Reservation (CCT), and BPA have agreed to river flow management actions to support Grant PUD’s effort to manage flow in the Hanford Reach to protect fall Chinook salmon redds and pre-emergent fry during the spawning to emergence periods (typically October to May).

1.4.4 Spill Operations

1.4.4.1 Spill Gate Configuration

The standard (fish) spill configuration used at Rocky Reach uses gates 2 through 8 with a minimum discharge per spill bay of about four kcfs. The standard spill configuration was designed to create a crown-shaped pattern of turbulent flow below the spillway with decreasing velocities leading toward the upstream migrating adult fishway entrances.

This spill pattern provides favorable guidance conditions for adult migrant salmon and steelhead. This spill configuration and alternate patterns were tested and it was determined this pattern was as good as, if not better than, the alternate patterns for upmigrating salmonids (Schneider and Wilhelms, 2005). The same pattern is used for juvenile downstream migrating fish passage spill. During spill operations, whether for juvenile fish passage, TDG management, or for other purposes, the gates are operated via a computer automated system that follows the spill pattern.

Note that although the above referenced crown-shaped pattern may be as good as, if not better, than tested alternate patterns for upmigrating salmonids, it may not be ideal for TDG. 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, has developed a schedule to make the necessary changes to perform the new spill configuration. During the spring of 2016, computer programming of gates 9-12 for automated use will occur so that the gate configuration can be tested and ready in the fall of 2016. The gate configuration will only be used during the non fish-spill season. 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 shall implement adaptive management in coordination with the RRFF and HCP CC. If operation under the new spill configuration provides significant reduction in TDG, Chelan PUD will incorporate the spill configuration into its regular operations during the non-fish spill season.

1.4.4.2 Spill Scenarios

There are six main scenarios that may result in spill at Rocky Reach Dam. These are described below:

Fish-spill

Spill is an ineffective method of bypassing downstream migrating juvenile fish away from the turbines at Rocky Reach Dam (Steig et. al., 1997) and, consequently, is not considered as the

solution for the long-term fish passage program. To minimize or eliminate the need for fish-spill, Chelan PUD is focusing its efforts on increasing the fish passage efficiency and survival through the juvenile fish bypass system (JBS).

The JBS continues to be the most efficient non-turbine route for downstream migrating juvenile fish passage at the Rocky Reach Project. The JBS does not require spill for its operation.

Spring Fish-spill Operations

Operating the JBS exclusively, Chelan PUD has been able to meet the HCP survival standards for the three spring migrants (spring/yearling Chinook, steelhead, and sockeye). Chelan PUD will continue operating the JBS exclusively, with no voluntary spill, during the spring of 2016.

Summer Fish-spill Operations

Summer spill at Rocky Reach for subyearling Chinook will be nine percent of day average flow. Commencement of summer spill will be determined using run-timing information at Rocky Reach. Summer spill generally begins in early June and ends in mid-August when 95 percent of the migration of subyearling Chinook has passed the Project.

Due to tag technology limitations and uncertainties regarding their life history (outmigration behavior) no survival studies for subyearling Chinook have been conducted since 2004, nor are any planned at this time.

Additional information about the HCP standards, including annual progress reports are included in Appendix A of this GAP.

Flow in Excess of Hydraulic Capacity

The minimal storage and limited hydraulic capacity of the Project occasionally force Chelan PUD to spill water past the Project. This spill is required to maintain headwater elevations within the limits set by the Project's FERC license (707 feet), to prevent overtopping of the Project, and to maintain optimum operational conditions. When spilling for fish or due to excess inflow or generation, the spillway is operated using gate settings that have been shown to limit TDG production and meet fish passage requirements (Schneider and Wilhelms, 2005). To reduce negative impacts of flow in excess of hydraulic capacity Chelan PUD completed and implemented a TDG Operational Plan. This plan is attached as Appendix B. Chelan PUD anticipates implementation of the TDG Operational Plan to be an operational function, requiring no structural modification to the Project.

Plant Load Rejection Spill

This type of spill occurs when the plant is forced off line by an electrical fault, which trips breakers, or any activity forcing the units off line. This is an emergency situation and generally requires emergency spill. When the units cannot pass flow, the flow must be passed by other means, such as spill, to avoid overtopping the dam. During emergency spill, Chelan PUD will implement the TDG Operational Plan. This plan is attached as Appendix B.

Immediate Replacement Spill

Immediate replacement spill is used to manage TDG levels throughout the Columbia River basin. The Technical Management Team (including NMFS, USACE, and BPA) manages this spill. Immediate replacement spill occurs when TDG levels are significantly higher in one river reach than they are in another reach. To balance the TDG levels throughout the basin, spill is reduced and generation increased in the reach with high TDG levels and the energy is transferred to reaches with lower TDG levels where spill is increased. The result is higher generation in the reaches with high TDG levels, increased spill in reaches with lower TDG levels, and equal distribution of TDG levels throughout the basin.

To control TDG levels that may result from immediate replacement spill, Chelan PUD will implement the TDG Operational Plan (Appendix B).

Maintenance Spill

Maintenance spill is utilized for any maintenance activity that requires spill to assess the routine operation of individual spillways and turbine units. These activities include forebay debris flushing, checking gate operation, gate maintenance, and all other maintenance that would require spill. The Federal Energy Regulatory Commission requires that all spillway gates be operated once per year. This operation requires a minimal amount of spill for a short duration annually and is generally accomplished in conjunction with fish passage spill operations.

To control TDG levels that may result from maintenance spill, Chelan PUD will implement the TDG Operational Plan (Appendix B). Chelan PUD anticipates implementation of the TDG Operational Plan to be an operational function, requiring no structural modification to the Project.

Error in Communication Spill

Error in communication with the USACE Columbia River Basin Water Management Division, including computer malfunctions or human error in transmitting proper data, can contribute to spill. Hourly coordination between hydroelectric projects on the river minimizes this type of spill, but it does occur occasionally.

To control TDG levels that may result from error in communication spill, Chelan PUD will implement the TDG Operational Plan (Appendix B). Chelan PUD anticipates implementation of the TDG Operational Plan to be an operational function, requiring no structural modification to the Project.

Reduced Generation Spill

Reduced electric demand on the system can, at times, result in the need to spill water at run-of-the-river projects such as Rocky Reach. Hourly coordination between hydroelectric projects on the river can minimize this type of spill, but it does occur.

To control TDG levels that may result from reduced generation spill, Chelan PUD will implement the TDG Operational Plan (Appendix B), when possible. Chelan PUD anticipates implementation of the TDG Operational Plan to be an operational function, requiring no structural modification to the Project.

1.5 Spill and Total Dissolved Gas Compliance - Previous Year 2015

1.5.1 TDG Compliance 2015

Over the course of the 2015 fish-spill season, there were no exceedances of the total dissolved gas (TDG) numeric criteria in either the forebay or tailrace of Rock Island Dam, nor at the forebay of Wanapum Dam. Information regarding spill for the 2015 fish-spill season are displayed in Table 1-1.

Table 1-1: Average monthly total flow, spill, and percent of total flow spilled for different purposes at Rocky Reach Dam, April 1 through August 31, 2015.

Month	Average Flow kcfs	Average Spill kcfs	Spill Purpose					
			Fish-Spill			Other		
			Spill kcfs	% of flow	% of Total Spill	Spill kcfs	% of flow	% of Total Spill
April	107.4	0.5	0.0	0.0	0.0	0.5	0.4	100.0
May	108.9	0.3	0.0	0.0	0.0	0.3	0.2	100.0
June	103.6	9.6	9.5	9.2	99.0	0.1	0.1	1.0
July	98.4	8.5	8.4	8.5	98.4	0.1	0.1	1.6
August	106.2	2.9	2.1	2.0	72.3	0.8	0.8	27.7

1.5.2 TDG Activities Implemented 2015

As defined in Section 5.4.1(b) of the 401 Certification, Chelan PUD implemented six actions to minimize voluntary and involuntary spill at Rocky Reach in order to meet TDG water quality standards. The primary operational action to reduce spill at the Rocky Reach Project was the implementation of the operational spill programs and the ability to minimize spill through operation of the JBS. These efforts included:

- Minimizing voluntary spill.
- During fish passage, managing voluntary spill levels in real time to meet TDG numeric criteria.
- Minimizing spill, to the extent practicable, by scheduling maintenance based on predicted flows.
- Avoiding spill by continuing to participate in the Hourly Coordination Agreement.
- Maximizing powerhouse discharge as appropriate up to 212 kcfs.
- Contracted with Parametrix to have the data gathered during the 2011 and 2012 testing of alternative spillway configurations analyzed and summarized. The report has been reviewed by Ecology, the HCP CC and the RRFF. The results of the report are briefly summarized in Section 1.4.4.1.

1.5.3 TDG Structural Measures Implemented in 2015

No structural gas abatement measures were proposed or implemented at the Rocky Reach Project in 2015.

SECTION 2: PROPOSED 2016 ACTION PLAN TO ACHIEVE TDG STANDARDS

The following sections describe TDG abatement measures proposed for implementation during 2016 to achieve compliance with TDG water quality standards.

2.1 Operational TDG Abatement Measures

Section 5.4.1(b) of the 401 Certification requires Chelan PUD 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 and Anadromous Fish Agreement². During the 2016 fish-spill season, Chelan PUD proposes to use a combination of the following measures as needed to meet water quality criteria for TDG:

1. Minimize voluntary spill
Success of the JBS has enabled Chelan PUD to reduce spill required for fish passage.
2. Manage voluntary spill in real time
During fish passage, manage voluntary spill levels in real time in an effort to continue meeting TDG numeric criteria, using the TDG Operational Plan (Appendix B). The TDG Operational Plan is updated annually and routed to the Project operators. It provides the operators a list of actions they are to follow if TDG meets the designated thresholds.
3. Minimize involuntary spill
Minimize involuntary spill, to the extent practicable, by scheduling maintenance based on predicted flows.
4. Participate in Hourly Coordination Agreement
Chelan PUD endeavors to avoid involuntary spill by continuing to participate in the Hourly Coordination Agreement, or any successor agreement to which Chelan PUD is a party, to the extent it reduces TDG.
5. Maximize powerhouse discharge as appropriate up to hydraulic capacity
6. Implement alternative spillway operation
Chelan PUD plans to implement the flattened spill configuration in the fall of 2016.

Per Section 5.4(5) of the 401 Certification, operational and structural changes that may affect TDG must be subject to review and approval by Ecology during the design and development phase to assure that such changes incorporate consideration of TDG abatement, when appropriate.

² Additional conditions used to determine compliance with the water quality criteria for TDG can be found in Sections 5.4(1)(d)-(g) of the 401 Certification, as well as Section 4.4 of this Plan.

2.2 Proposed Structural TDG Abatement Measures and Technologies

No structural gas abatement measures are planned at the Rocky Reach Project in 2016. Chelan PUD will continue to monitor and investigate the feasibility of implementing new technologies as they become available.

SECTION 3: PHYSICAL AND BIOLOGICAL MONITORING AND QUALITY ASSURANCE

The following sections describe Chelan PUD's TDG compliance monitoring program. The program includes a fixed-site monitoring program and a QAPP.

3.1 Fixed-Site Monitoring Stations for TDG

Chelan PUD currently maintains two fixed monitoring stations (FMS) at the Rocky Reach Project to monitor hourly TDG levels annually. The fixed monitoring stations are installed to a depth of approximately 15 feet. This depth varies as the forebay and tailrace river elevations fluctuate with river flows. This depth variation is not expected to affect the accuracy of the TDG readings because the instruments are located below the depth where gas bubbles form on the membrane and are deep enough in the water column to not be affected by near surface temperature gradients.

The forebay fixed monitoring station (Figure 2-1) is located on the upstream side of the dam, affixed to the corner between the powerhouse and spillway, approximately mid-channel. The tailrace fixed monitoring station (Figure 2-2) is located approximately 0.38 miles downstream of the dam. The standpipe is affixed to the downstream side of a pier nose supporting the juvenile bypass system outfall pipe. This location is east of mid-channel, and is minimally impacted by powerhouse flows when the Project is passing water over the spillway (Schneider and Wilhelms, 2005).

Chelan PUD has entered into a Professional Services Agreement with Columbia Basin Environmental to perform calibrations and equipment maintenance during the 2016 monitoring season. Calibration and equipment maintenance will be conducted monthly during the fish-spill season, and every other month during the non fish-spill season. It is anticipated at this time that Chelan PUD will continue to contract with CBE into the future. Quality assurance/quality control (QA/QC) measures will be accomplished through training in instrument maintenance, operation, and factory prescribed calibration methods. A detailed log will be maintained for all work done on the monitoring equipment, including monthly maintenance, calibration, exchange of instruments, and any other pertinent information.

TDG levels are recorded at 15-minute intervals and are averaged into hourly readings for use in daily and 12-hour averages, as well as daily high values. The hourly average data is forwarded to the United States Army Corps of Engineers (USACE), Columbia River Basin Water Management Division website where data is posted on an hourly basis. The data can be found on their website by navigating from the USACE home page to the Columbia River Basin Water Management Division web page. From this location, select the Rocky Reach Project from the map and select TDG, Water Quality Data².

². The website for the United States Army Corps of Engineers, Columbia River Basin Water Management Division, Rocky Reach Dam, Water Quality Data, and TDG is currently located at http://www.nwd-wc.usace.army.mil/ftppub/water_quality/tdg/#RRDW Website locations are subject to change. Please contact USACE at (206) 761-0011 for general questions.



Figure 3-1: Location of forebay fixed monitoring station at Rocky Reach Hydroelectric Project.

3.2 Quality Assurance

Section 5.7.3 of the 401 Certification requires Chelan PUD to maintain a TDG monitoring program that is at least as stringent as the QA/QC calibration and monitoring procedures and protocols developed by the USGS monitoring methodology for the Columbia River.

Chelan PUD has developed its QA/QC protocols following established protocols by other resource agencies conducting similar monitoring programs, such as the USGS, USACE, and other mid-Columbia River Dam operators, as well as Hydro Lab Corporation's recommendations. These QA/QC protocols are included in Chelan PUD's QAPP (Appendix D) per Section 5.7(2) of the Rocky Reach 401 Certification.

3.3 Biological (Gas Bubble Trauma) Monitoring Plan

GBT monitoring is not conducted on an annual basis at Rocky Reach Dam. However, Section 5.4(1)(c) of the Rocky Reach Project WQC (Ecology, 2006) requires Chelan PUD to develop and implement a plan to study GBT below Rocky Reach Dam. On April 21, 2014, Chelan PUD received a letter from Ecology postponing the GBT monitoring until such a time as is determined to be appropriate by Ecology. Ecology is currently evaluating the need for future GBT studies below Rocky Reach Dam. Currently, Chelan PUD conducts a Smolt Monitoring Program at Rock Island Dam.

Chelan PUD, in conjunction with the Fish Passage Center (FPC), will continue to conduct GBT monitoring at the Rock Island Bypass Trap. Random samples of 100 spring Chinook, steelhead and subyearling Chinook will be examined two days per week during the sampling season (April 1 to August 31). Examinations for GBT symptoms will follow a standardized FPC protocol (FPC, 2009). The results of this monitoring effort will be included in the Gas Abatement Annual Report (see Section 4.3 below).

SECTION 4: TDG COMPLIANCE REPORTING METHODS

4.1 Water Quality Web-Site

Section 5.7.6 of the 401 Certification requires hourly TDG information be made available to the public via Chelan PUD's website, as close to the time of occurrence as technologically feasible. To meet this requirement, Chelan PUD maintains a link on its website that directs the public to the USACE, Columbia River Basin Water Management Division website where data is posted on an hourly basis. The data can be found on their website by navigating from the USACE home page to the Columbia River Basin Water Management Division web page. From this location, select the Rocky Reach Project from the map and select TDG, Water Quality Data².

4.2 Notifications

Chelan PUD shall notify Ecology, Central Regional Office, Water Quality Program within 48 hours (either before or after) of any TDG spill; this includes the start of spill for fish, as defined in Section 1.2.1 above, and any deviation from the TDG Operational Plan or the fish-spill plan that adversely affects TDG levels. This notification may be either electronic or by letter.

4.3 Annual Report

Chelan PUD will provide Ecology with a draft Gas Abatement Annual Monitoring Report by October 31 of each year for initial review and comment. Chelan PUD will submit the final report by December 31 of that same year. The TDG Annual Report will include:

- Flow over the preceding year (cfs over time);
- Spill over the preceding year (cfs and duration);
- Reasons for spill (e.g. for fish, turbine down time);
- TDG levels during spill (hourly)(to include fish-spill season);
- Summary of exceedances and what was done to correct the exceedances;
- Results of the fish passage efficiency (FPE) studies and survival per the HCP;
- Result of biological monitoring (gas bubble trauma) at Rock Island Bypass Trap (conducted in conjunction with the Fish Passage Center);
- Results of QA/QC implementation
- Analysis of monitoring data for confirmation or refinement of the regression equations in the WQMP³ used to predict compliance with TDG numeric criteria.

³ The WQMP is a response to Ecology's request that the PUD provided the scientific and biological basis for Ecology's Section 401 certification. It is the principal supporting document for the 401. As stated in Chapter 2 of the Comprehensive Plan (Attachment B to the Rocky Reach Settlement Agreement):

"Ecology is a participant in the Settlement Group negotiating conditions for relicensing of the Project, and has requested that Public Utility District No. 1 of Chelan County (Chelan PUD) help provide the scientific and biological basis for Ecology's Section 401 Certification. The Settlement Group has developed a Comprehensive Plan that provides the rationale and details behind proposed license articles that the Settlement Group will recommend for inclusion in the New License to be issued by FERC. The Rocky Reach Water Quality Management Plan is in response to Ecology's request and is contained in this chapter of the Comprehensive Plan.

The WQMP includes Project background; background water quality; management considerations and options investigated; and protection, mitigation, and enhancement measures.

The analysis of monitoring data for confirmation or refinement of the regression equations in the WQMP used to predict compliance with TDG numeric criteria will include the following steps:

- Input relevant 2008 (post relocation of tailrace fixed monitoring site) and 2009-2015 data,
- Analyze to see if the relationship between quantity of spill and TDG yields a similar or different regression than that predicted for site FOP1 (located just downstream and landward of the current tailrace monitoring site (Figure 2)) in Schneider and Wilhelms (2005),
- If regression is different, look for patterns that may explain the difference,
- Determine if any differences in the regression affect the predictions in Schneider and Wilhelms (2005) to meet TDG standards up to 7Q10 flows.

4.4 Determination of Compliance in Year 5

As per Section 5.4(1)(d) of the 401 Certification, 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.

This report was submitted as a Draft to Ecology and the RRFF on October 31, 2014 and the HCP CC on November 25, 2014. The HCP CC requested an additional 30 day comment period extending the final due date to Ecology on January 30, 2015. Ecology approved the extension and final due date. Comments were received and incorporated into the final report submitted to Ecology on January 30, 2015. In a letter to Chelan PUD, dated July 15, 2015, Ecology determined that full compliance with the applicable numeric criteria for TDG had not been met and that aquatic life is not adversely affected at the Rocky Reach Project. Chelan PUD will in 2016, provide a report to Ecology evaluating what measures (operational and structural) may be reasonable and feasible to further reduce TDG production at the Project. Chelan PUD will also implement in the fall of 2016, the flattened spill gate configuration during the non fish-spill season.

SECTION 5: UPDATES TO THE GAS ABATEMENT PLAN

As per Section 5.4(3) of the 401 Certification, the GAP will be revised annually, to reflect any new or improved information and technologies, and submitted to Ecology for review and approval, by April 1 of the year of implementation.

Additionally, beginning in year 10, and every 10 years thereafter, the revised annual GAP shall include a review of reasonable and feasible gas abatement options to incrementally reduce TDG caused by the Project, in light of new information and technology. If any reasonable and feasible measures are identified, Chelan PUD shall present the data and analysis to the RRFF and develop an implementation plan. The implementation plan shall be included in the GAP for review and approval by Ecology.

SECTION 6: CONCLUSIONS

Chelan PUD shall implement the measures presented Section 2 of this 2016 GAP. Implementation of these measures are intended to ensure compliance with the WAC for TDG in the Columbia River at the Rocky Reach Project during the fish-spill season while continuing to meet the fish passage and survival standards set forth in the Rocky Reach HCP and Anadromous Fish Agreement. No structural gas abatement measures are planned at the Rocky Reach Project in 2016. This GAP will be updated annually to reflect any changes in implementation schedules, new or improved technologies, or TDG abatement measures.

SECTION 7: LITERATURE CITED

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- Washington State Department of Ecology (Ecology). 2006. Section 401 Water Quality Certification for the Rocky Reach Hydroelectric Project. Order# 3155 dated March 17, 2006.

APPENDIX A: ROCKY REACH HABITAT CONSERVATION PLAN

APPENDIX B: 2016 ROCKY REACH TDG OPERATIONAL PLAN

2016 Rocky Reach Operational Plan
for Total Dissolved Gas During Fish-spill Season

April 1 through August 31

(All spill between these dates is subject to the actions contained in this plan.)
(Applies only when not spilling for headwater control)

Protocol

1. If tailrace TDG average is greater than ***120% for the 6-hour average***
 - reduce spill by 3 kcfs
 - monitor for 1 hour
 - if the 6-hr average TDG >120%, reduce spill by another 2 kcfs
 - monitor for 1 hour
 - continue reducing spill by 2 kcfs until 6-hr average TDG is less than 120% for one full hour
 - **if after reducing spill to control TDG levels, TDG drops below 118% for one full hour, increase spill by 2 kcfs and monitor****

2. If tailrace TDG is greater than ***125% for 1 hr***
 - follow protocol outlined above, but instead, use **one-hour TDG levels of 125%** as the metric
 - continue until TDG is less than 125% for 1 hr and until the 6-hr average TDG <120%

If you receive a call from RI advising that the RI forebay is out of compliance (greater than 115%) and the RR forebay is 115% or less, reduce spill by 3 kcfs. Two hours after reducing spill, call RI to determine what the RI forebay gas levels are. If still above 115%, reduce spill another 2 kcfs. If after reducing spill for this reason, the Rock Island forebay drops to less than 113%; Rock Island will call again and advise. At this point, increase back to the hourly spill volume target by increasing spill in the reverse order it was decreased. For example, if to bring the RI forebay back into compliance, it was necessary to reduce spill by a total of 5 kcfs, begin by increasing spill by 2 kcfs, wait two hours, and call RI to determine what the forebay TDG levels are. If TDG is still below 115%, increase spill by 3 kcfs (back to the target volume in this case). This will allow for a ramping effect, rather than an open/shut effect which could bump the Rock Island forebay TDG levels back out of compliance (>115%).

**** Note:** It will not be necessary to monitor for one full hour after re-opening gates if it appears that TDG is approaching the upper threshold, rather, the procedure will repeat upon reaching the threshold. It is anticipated that in time, the operators will “get a feel” for how much change in TDG will occur as a result of opening or closing gates and it will be possible to hold the TDG around 118% or 119% or so. Once the operators have this down, instead of closing a gate entirely, it may only be necessary to close partially and vice versa for the opening process.

APPENDIX C: 2016 OPERATIONS PLAN

This document is a draft and will be added when final.

APPENDIX D: 2010 QUALITY ASSURANCE PROJECT PLAN

APPENDIX E: 2015 TOTAL DISSOLVED GAS ANNUAL REPORT

APPENDIX F: RESPONSE TO COMMENTS

Ecology was sent a Draft Gas Abatement Plan for Rocky Reach on February 26, 2016 for review and comment.

Response to Comments on the Draft Rocky Reach Gas Abatement Plan

Section	Department of Ecology Comment	Chelan PUD Response

2016 TOTAL DISSOLVED GAS ABATEMENT PLAN

DRAFT

**ROCK ISLAND HYDROELECTRIC PROJECT
FERC Project No. 943**

February 2016



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

TERMS AND ABBREVIATIONS

401 Certification 7Q10	Washington State Department of Ecology 401 Water Quality Certification highest seven consecutive day average flow with a 10-year recurrence frequency
cfs	cubic feet per second
Chelan PUD	Public Utility District No. 1 of Chelan County
CCT	Confederated Tribes of the Colville Indian Reservation
BPA	Bonneville Power Administration
Ecology	Washington State Department of Ecology
ESA	Endangered Species Act
FCRSP	Federal Columbia River Power System
FERC	Federal Energy Regulatory Commission
FPC	Fish Passage Center
FMS	fixed monitoring station
GAP	Gas Abatement Plan
GBT	gas bubble trauma
Grant PUD	Public Utility District No. 2 of Grant County
HCP	Habitat Conservation Plan
HCP CC	Habitat Conservation Plan Coordinating Committee
kcfs	thousand cubic feet per second
NMFS	National Marine Fisheries Service
MCHCA Project	Mid Columbia Hourly Coordination Agreement hydroelectric project
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RI HCP	Rock Island Habitat Conservation Plan
TDG	total dissolved gas
TMDL	total maximum daily load
UCR	Upper Columbia River
USACE	United States Army Corps of Engineers
USBR	United State Bureau of Reclamation
USFWS	United States Fish and Wildlife Service
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WQMP	Water Quality Management Plan

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EXECUTIVE SUMMARY

This Total Dissolved Gas Abatement Plan (GAP) is being submitted to the Washington State Department of Ecology (Ecology) as required by Washington Administrative Code (WAC) 173-201A-200. This section of the WAC allows Ecology to temporarily adjust total dissolved gas (TDG) criteria to aid downstream migrating juvenile fish¹ passage past hydroelectric dams when consistent with an Ecology-approved gas abatement plan. Chelan County Public Utility District No.1 (Chelan PUD) has prepared this annual GAP to provide an overview of operational implementation actions Chelan PUD will take at the Project during 2016 to meet TDG requirements, while ensuring the fish passage requirements are met as set forth in the Rock Island Habitat Conservation Plan (HCP) and Anadromous Fish Agreement. This GAP includes plans for physical and biological monitoring and is accompanied by the fisheries management plan (HCP), TDG Operational Plan, a Quality Assurance Project Plan (QAPP) for Rocky Reach Water Quality Monitoring and Reporting, and the Gas Abatement Annual Report.

WAC water quality standard 173-201A-200(1)(f)(ii) provides a temporary criteria adjustment for hydroelectric dams on the Snake and Columbia Rivers, when spilling to aid in fish passage. To receive this criteria adjustment, an Ecology approved gas abatement plan is required. In the 401 Certification for the Rocky Reach Project, the non-fish spill season is defined as September 1 through March 31 and the fish-spill season is April 1 through August 31. Chelan PUD assumes the same timeframes for the Rock Island Project.

The following special fish passage exemptions for the Snake and Columbia Rivers apply when spilling water at dams is necessary to aid fish passage and an Ecology approved gas abatement plan is in place:

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

The goal of the Rock Island Total Dissolved Gas Abatement Plan (GAP) is to implement measures to achieve compliance with the Washington state water quality standards for TDG in the Columbia River at the Project while continuing to meet the fish passage and survival standards set forth in the Rock Island HCP and Anadromous Fish Agreement. These plans are provided as Appendix A.

¹ Unless otherwise noted “fish” refers to downstream migrating juveniles.

To meet the above stated goal, Chelan PUD plans to implement applicable operational measures specified in Section 5.4.1(b) of the 401 Certification. These measures include, but are not limited to:

1. Minimizing voluntary spill.
2. During downstream migrating juvenile fish passage, managing voluntary spill levels in real time in an effort to continue meeting TDG numeric criteria, using the TDG Operational Plan (Appendix B).
3. Minimizing spill, to the extent practicable, by scheduling maintenance based on predicted flows.
4. Avoiding spill by continuing to participate in the Hourly Coordination Agreement or any successor agreement to which Chelan PUD is a party, to the extent it reduces TDG.
5. Maximizing powerhouse discharge as appropriate up to hydraulic capacity.

Additionally, Chelan PUD proposes to implement the following measures:

1. Consult with Ecology if there are any non-routine operational changes that may affect TDG.
2. Monitor for TDG at Chelan PUD's fixed-site monitoring stations. TDG data will be collected on an hourly basis throughout the year and will be reported to U.S. Army Corps of Engineers Reservoir Control Center's website.
3. Prepare an annual report summarizing Chelan PUD's fish-spill season flow, TDG, gas bubble trauma (GBT) monitoring, and fish (could include juvenile and adult) study results, and, in accordance with the previous (2015) GAP, submit to Ecology by December 31.

SECTION 1: INTRODUCTION

Chelan PUD owns and operates the Project, located on the Columbia River approximately 12 miles downstream of the city of Wenatchee (Figure 1-1). The Project is licensed as Project No. 943 by the Federal Energy Regulatory Commission (FERC).

This GAP is being submitted to Ecology according to WAC 173-201A-200(1)(f)(ii). Chelan PUD respectfully submits this GAP with the goal of receiving a TDG criteria adjustment for commencing with the 2016 fish spill season. This GAP provides details associated with proposed 2016 operations and activities to achieve TDG standards, a review of any proposed structural TDG abatement measures and technologies, and physical and biological monitoring plans.

A 401 Certification for the operation of Chelan PUD's Rocky Reach Hydroelectric Project was issued by the Ecology on March 17, 2006. The 2016 Rock Island TDG monitoring and reporting will be conducted in a manner consistent with the TDG and Gas Abatement monitoring and reporting requirements within the Rocky Reach 401 Certification.

1.1 Project Description

Rock Island Project is owned and operated by Chelan PUD. The structure is 3,800 feet in length and is constructed from reinforced concrete. The dam is located at Columbia River mile 453.4, about 12 miles downstream from the city of Wenatchee. The Project contains a reservoir extending 21 miles upriver to the tailrace of Rocky Reach Dam and covers 3,300 acres. The Rock Island Project has no significant water storage capabilities. The normal maximum reservoir elevation of Rock Island Project is 613 feet with a tailrace elevation of 572 feet and a head of 41 feet. The Project discharges into a reservoir ponded by Wanapum Dam located 37.6 miles downstream.

The Project consists of two powerhouses. Powerhouse 1 is located on the east bank of the Project at a 45-degree angle from the bank. The powerhouse consists of 10 vertical shaft turbines with a rated output of 212 mega watts (MW). Powerhouse 2 is located on the west bank and is 470 feet wide, housing eight horizontal shaft turbines with a rated power output of 410 MW. The combined hydraulic capacity of both powerhouses is 220 thousand cubic feet per second (kcfs).

The Project configuration includes a spillway of 32 bays with a total length of 1,184 feet. Gates are separated by a middle adult fish ladder (located at bay 15) that divides the spillway into east and west sections. The west (Chelan County side) spillway consists of seven deep bays and ten shallow bays, and the east (Douglas County side) spillway consists of six deep bays and eight shallow bays. Each spillway has two or three crest gates, which are stacked one on top of the other. The crest gates are 30 feet wide and either 11 or 22 feet high. The larger crest gates are positioned closest to the water surface, and when fully raised, spill approximately 10 kcfs.

The deep bays have a sill elevation of 559 feet, which is about 13 feet below the average tailwater elevation of 572 feet. The shallow bays have a sill elevation of 581.5 feet, which is about 9.5 feet above the average tailwater elevation.

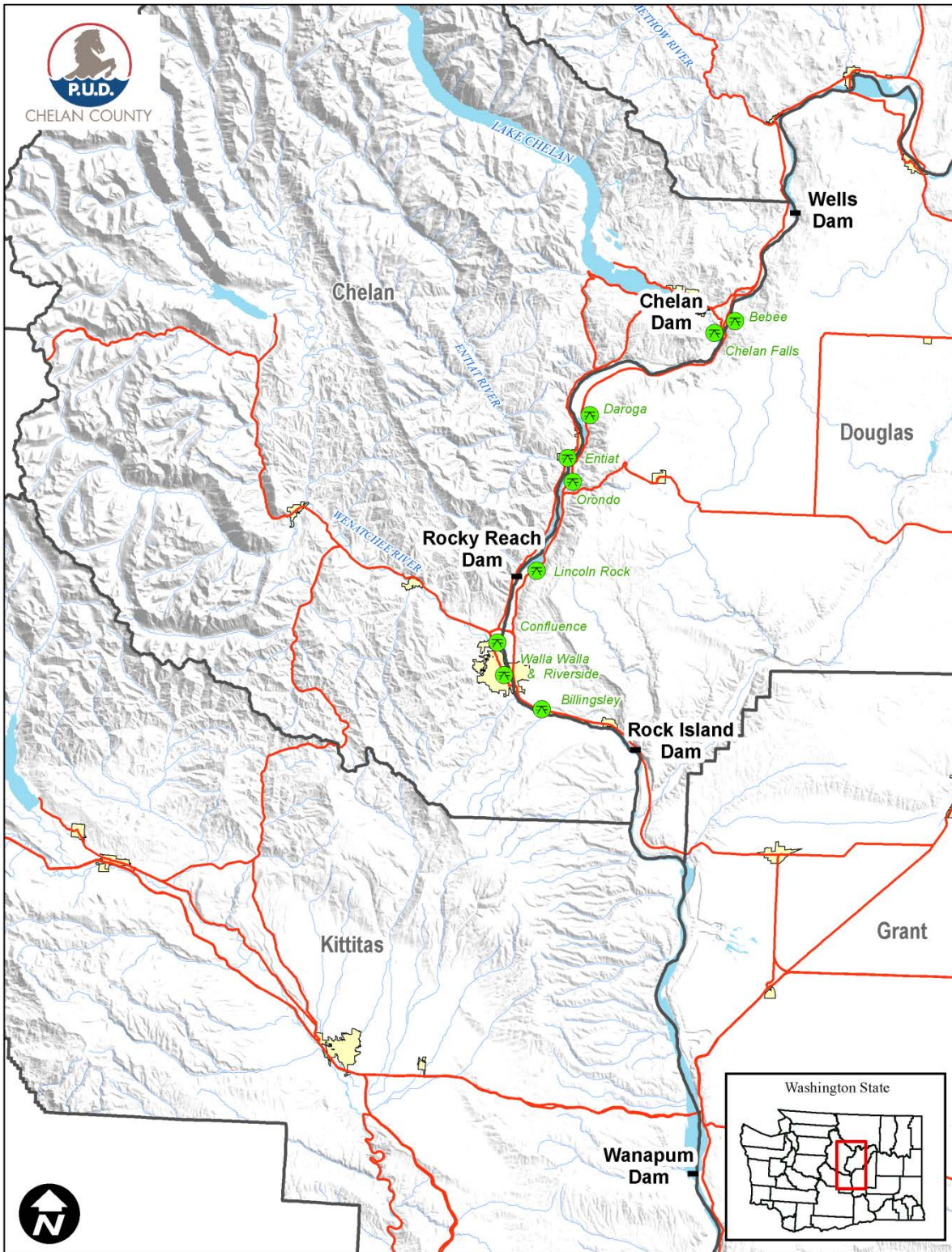


Figure 1-1: Location of Rock Island Hydroelectric Project on the Columbia River.

The focus of juvenile fish bypass at Rock Island Dam has been directed towards optimizing the efficiency of fish passage via spill. To achieve this, nine of the thirty-two spill bays have had their spill gates modified to provide surface spill. Surface spill was accomplished by putting notches in the upper sections of the spill gates. Six of the nine gates have notches that are 8 feet wide by 17 feet deep and can spill up to 2,500 cubic feet per second (cfs). The remaining gates have notches that are smaller and pass less volume (approximately 1,850 cfs). The total amount of water that can be passed through the notched gates is approximately 21,000 cfs. Three of the modified gates have had further modification and now have a “over-under” design which enables surface flow attraction and delivers water in the tailrace towards the surface, thus reducing the uptake of atmospheric gases.

1.2 River Flows

The climate of the Columbia Basin in eastern Oregon, Washington and British Columbia is best described as desert. The major portion of the precipitation experienced within the basin falls in the form of snow during the period of November through March of each year. Runoff usually occurs from mid-April through July, with the historical peak occurring during the month of June. Storage dams in the United States and Canada capture spring and summer high flows to hold for release in the winter months. A comparison of the 10-year average flows to 2015 flows at the Rock Island Project is shown below in Figure 1-2.

Mean daily discharge during the 2015 fish-spill season was compared to the 10-year average of mean daily discharge from 2005-2014, as measured at Rock Island Dam. Mean daily flow discharges during the 2015 fish-spill season were lower than the 2005-2014 average (about 73% of average at Rock Island Dam) over the entire fish-spill season.

Average flow for all months during the spill season was lower than the monthly 10-year average. The maximum hourly flows observed at the Project during the spill season were 147 kcfs, on April 3. Of the 153 days during the spill season (April 1 through August 31), there were no instances where the daily average flows exceeded the 7Q10 264 thousand cubic feet per second (kcfs).

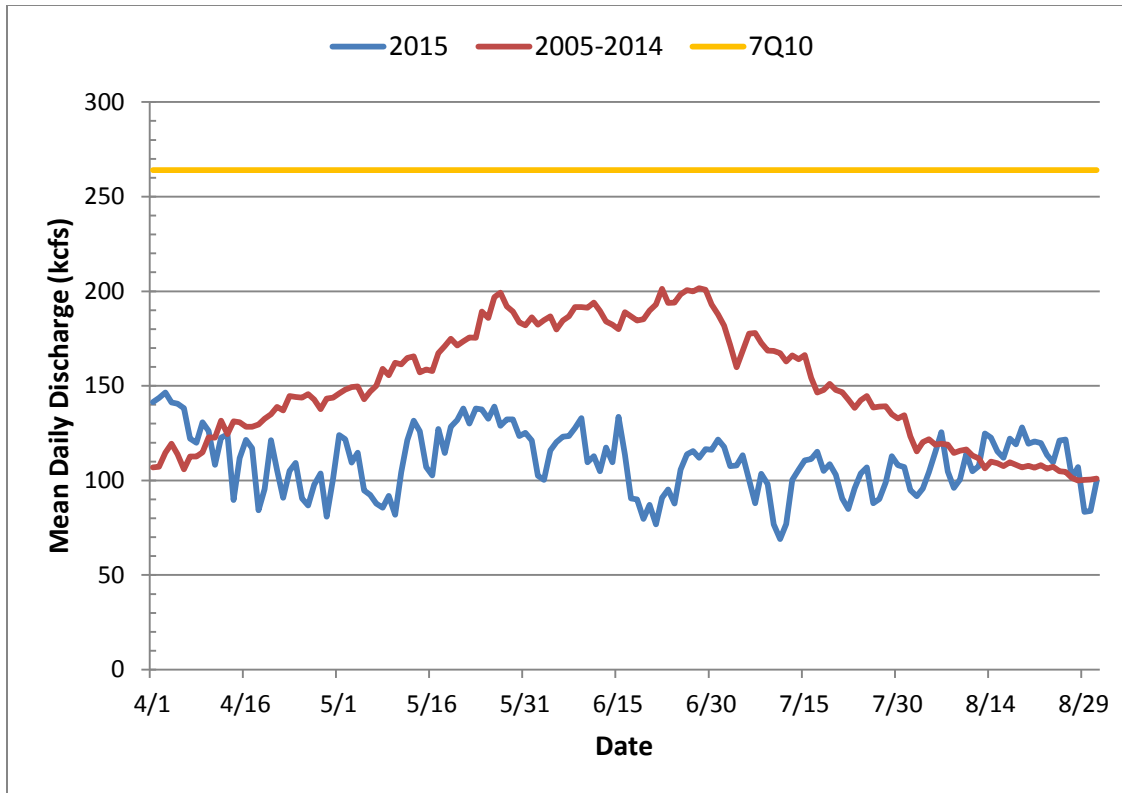


Figure 1-2: Comparison of 2015 vs. previous 10-year average (2005-2014) of mean daily discharge at Rock Island Dam.

1.3 Regulatory Framework

1.3.1 Total Dissolved Gas Standards

WAC 173-201A-200(1)(f) address standards for the surface waters of Washington State. Under the water quality standards (WQS), 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 an Ecology-approved gas abatement plan is in place. This plan must be accompanied by fisheries management and physical and biological monitoring plans. Ecology may approve, on a per application basis, a temporary criteria adjustment 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 criteria adjustment. 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). The increased levels of spill resulting in elevated TDG levels are intended to allow increased fish passage without causing more harm to fish populations than caused by turbine fish passage. This TDG exemption provided by Ecology is based on a risk analysis study conducted by the National Marine Fisheries Service (NMFS, 2000).

1.3.2 Fish-Spill Season

Section 5.4.2 of the Rocky Reach 401 Certification defines the fish-spill season as April 1 through August 31 of each year. Non-fish spill season is defined as September 1 through March 31. Chelan PUD has assumed these dates also apply to Rock Island Dam.

1.3.3 Incoming Total Dissolved Gas Levels

During the fish passage season, TDG concentrations in the Rock Island Project forebay are primarily determined by the upstream water management activities of upstream dams.

1.3.4 Flood Flows - 7Q10

WAC 173-201A-200(f)(i) states that the water quality criteria for TDG shall not apply when the stream flow exceeds the seven-day, ten-year frequency flood stage (7Q10). The 7Q10 flood flow for the Rock Island Project was calculated to be 264 kcfs (Pickett, et al., 2004).

1.3.5 Total Dissolved Gas Total Maximum Daily Load

In 2004, Ecology established a TDG Total Maximum Daily Load (TMDL) for the mid-Columbia River which set TDG allocations for each dam (Pickett, et al., 2004). With the option for a temporary TDG criteria adjustment under an approved gas abatement plan, the TMDL set TDG loading capacities and allocations for the Mid-Columbia River and Lake Roosevelt, both in terms of percent saturation for fish passage and excess pressure above ambient for non-fish passage. Allocations are specified for each dam and for upstream boundaries. Fish passage allocations must be met at fixed monitoring stations. Non-fish passage allocations must be met in all locations, except for an area below each dam (other than Grand Coulee) from the spillway downstream to the end of the aerated zone. Attainment of allocations will be assessed at monitoring sites in each dam's forebay and tailrace and at the upstream boundaries.

1.4 Project Operations

The Project is an integral part of the seven-dam Mid-Columbia River Hydroelectric System (Grand Coulee to Priest Rapids). Each of the seven dams is operated in accordance with the terms of the Mid-Columbia Hourly Coordination Agreement (MCHCA), which seeks to coordinate operations for all of the mid-Columbia projects for the best use of flows for generation and to meet fishery (juvenile and adult) and other environmental resource needs.

Under the MCHCA, power operations are coordinated to meet daily load requirements through the assignment of "coordinated generation" through Central Control hosted at the Public Utility District No. 2 of Grant County (Grant PUD). Automatic control logic is used to maintain pre-set reservoir levels in order to meet load requirements and minimize involuntary spill. These pre-set reservoir levels are maintained at each project through management of a positive or negative "bias" which assigns a project more or less generation depending on whether the reservoir elevation should be increased or decreased in order to maximize system benefits and minimize involuntary spill.

In addition to the MCHCA discussed above, the Project operates within the constraints of its FERC regulatory and license requirements, as well as the plans and agreements discussed below.

1.4.1 Habitat Conservation Plan

In 2004, the FERC amended the existing license to include the Anadromous Fish Agreement and HCP for the Rock Island Project. The HCP is a programmatic approach developed by Chelan PUD and the fishery agencies and tribes for reducing and eliminating the effects of the Rock Island Project on salmon and steelhead.

The Rock Island HCP (RI HCP) serves as the foundation for the fisheries management plan at Rock Island Dam. It fundamentally describes a 100 percent No Net Impact (NNI) concept with necessary outcomes required for mainstem passage, habitat improvement and protection, and hatchery programming. All measures proposed in the HCP are intended to minimize and mitigate impacts to the Plan species, to the “maximum extent practicable” as required by the Endangered Species Act. Plan species include: Upper Columbia River (UCR) steelhead, UCR yearling spring Chinook, UCR subyearling summer/fall Chinook, Okanogan River sockeye, and coho salmon. The RI HCP provides for optional tools Chelan PUD may implement to aid in juvenile fish passage past the Project, including, but limited to, spill and powerhouse operations. Chelan PUD implements these tools to aid in juvenile fish passage as necessary to ensure success toward NNI.

HCP Phase III (Standards Achieved) has been met for all spring migrants (spring/yearling Chinook, steelhead, and sockeye) at Rock Island under 10 percent spill operations.

1.4.2 Other International and Regional Agreements

The Columbia River is managed, and the Project is operated, for fish (juvenile and adult) habitat and flow by the following international and regional agreements:

- *Columbia River Treaty*: An agreement between Canada and the United States in which Canada has agreed to provide storage for improving flow in the Columbia River to maximize power and flood control.
- *Pacific Northwest Coordination Agreement*: An agreement among the U.S. Bureau of Reclamation (USBR), the Bonneville Power Administration (BPA), the U.S. Army Corps of Engineers (USACE), and 15 public and private generating utilities to maximize usable hydroelectric energy. Chelan PUD is a member of this agreement.
- *Mid-Columbia Hourly Coordination Agreement*: An agreement whereby the mid-Columbia PUDs (Chelan, Douglas, and Grant), the Corps, the USBR, and BPA coordinate operations in order to maximize the output of hydroelectric power. Effects have included reducing forebay elevation fluctuations and spill.
- *The Federal Columbia River Power System (FCRPS) Biological Opinion*: by NMFS, applies to actions by the Corps, the USBR, and BPA for impacts on Endangered Species Act (ESA) listed salmon and steelhead on the Columbia River system. A Technical Management Team sets flow releases and other operations of the FCRPS that determines the daily and weekly flows that will pass through the Project.
- *Hanford Reach Fall Chinook Protection Program Agreement*: The three mid-Columbia PUDs, NOAA Fisheries, Washington Department of Fish and Wildlife (WDFW), U.S.

Fish and Wildlife Service (USFWS), Confederated Tribes of the Colville Indian Reservation (CTT), and BPA have agreed to river flow management actions to support Grant PUD's effort to manage flow in the Hanford Reach to protect fall Chinook salmon redds and pre-emergent fry during the spawning to emergence periods (typically October to May).

1.4.3 Spill Operations

It is recognized that achieving regulatory TDG levels may not be possible during spill associated with large flood (7Q10) events. However, at Rock Island Dam it may be possible to achieve current regulatory TDG levels during releases for fish bypass and up to the 7Q10 flows (264 kcfs) by selective operation of spillway bays. The Rock Island Project is unique due to the diversity of variations in how flow is released, which may assist in the development of spill scenarios that could result in a reduction of gas in the tailrace.

There are six main scenarios that may result in spill at Rock Island Dam. These are, but are not limited to:

Fish Spill

As part of the Rock Island HCP, Chelan PUD is required to meet survival standards for fish migrating through the Projects. Juvenile dam passage survival is a key component of Project survival. At Rock Island, spill is still the preferred method of moving fish past the Project, with most of the spill being passed through the modified "notched" spill gates. Results of survival studies conducted at Rock Island have enabled Chelan PUD to reduce voluntary (fish) spill in the spring from 20 percent of the daily average flow to 10 percent of the daily average flow. Summer spill at Rock Island remains at 20 percent of the daily average flow. This summer spill level was set by the HCP in 2002 and will remain at 20 percent until such time Chelan PUD is able to test survival of subyearling (summer) Chinook. To date, Chelan PUD has not been able to test survival due to tag technology limitations and uncertainties regarding the life history (migration behavior) of subyearling Chinook. The 20 percent spill level must be maintained until tag technology becomes available that will enable us to accurately measure survival at the current spill level.

Spring Fish Spill Operations

HCP Phase III (Standards Achieved) has been met for all spring migrants (spring/yearling Chinook, steelhead, and sockeye) at Rock Island under 10 percent spill operations. Chelan PUD will continue spilling 10 percent through the spring migration. Spring fish spill will begin no later than April 17 and will continue until the end of the spring outmigration (95 percent passage point), and subyearling Chinook have arrived at the Project.

Summer Fish Spill Operations

Summer spill at Rock Island for subyearling Chinook will be 20 percent of day average flow over 95 percent of the summer outmigration. Summer spill will commence after the completion of spring spill. Summer spill for subyearling Chinook generally ends no later than August 15 when 95 percent of the migration of subyearling Chinook has passed the Project.

Due to tag technology limitations and uncertainties regarding their life history (outmigration behavior) no survival studies for subyearling Chinook have been conducted since 2004, nor are any planned at this time.

Additional information about the HCP standards, including annual progress reports are included in Appendix A of this GAP.

Flow in Excess of Hydraulic Capacity

The minimal storage and limited hydraulic capacity of the Project occasionally force Chelan PUD to spill water past the Project. This spill is required to maintain headwater elevations within the limits set by the Project's FERC license, to prevent overtopping of the Project, and to maintain optimum operational conditions. With this type of release, flows up to, and in excess of the 7Q10 flood flows (264 kcfs) can be accommodated. To reduce negative impacts of flow in excess of hydraulic capacity Chelan PUD completed and implemented a TDG Operational Plan. This plan is attached as Appendix B. Chelan PUD anticipates implementation of the TDG Operational Plan to be an operational function, requiring no structural modification to the Project.

Plant Load Rejection Spill

This type of spill occurs when the plant is forced off line by an electrical fault, which trips breakers, or any activity forcing the units off line. This is an emergency situation and generally requires emergency spill. When the units cannot pass flow, the flow must be passed by other means, such as spill, to avoid overtopping the dam. During emergency spill, Chelan PUD will implement the TDG Operational Plan. This plan is attached as Appendix B.

Immediate Replacement Spill

Immediate replacement spill is used to manage TDG levels throughout the Columbia River basin. The Technical Management Team (including NMFS, USACE, and BPA) manages this spill. Immediate replacement spill occurs when TDG levels are significantly higher in one river reach than they are in another reach. To balance the TDG levels throughout the basin, spill is reduced and generation increased in the reach with high TDG levels and the energy is transferred to reaches with lower TDG levels where spill is increased. The result is higher generation in the reaches with high TDG levels, increased spill in reaches with lower TDG levels, and equal distribution of TDG levels throughout the basin.

To control TDG levels that may result from immediate replacement spill, Chelan PUD will implement the TDG Operational Plan (Appendix B).

Maintenance Spill

Maintenance spill is utilized for any maintenance activity that requires spill to assess the routine operation of individual spillways and turbine units. These activities include forebay debris flushing, checking gate operation, gate maintenance, and all other maintenance that would require spill. The Federal Energy Regulatory Commission requires that all spillway gates be operated once per year. This operation requires a minimal amount of spill for a short duration annually and is generally accomplished in conjunction with fish passage spill operations.

To control TDG levels that may result from maintenance spill, Chelan PUD will implement the TDG Operational Plan (Appendix B). Chelan PUD anticipates implementation of the TDG Operational Plan to be an operational function, requiring no structural modification to the Project.

Error in Communication Spill

Error in communication with the USACE Reservoir Control Center, including computer malfunctions or human error in transmitting proper data, can contribute to spill. Hourly coordination between hydroelectric projects on the river minimizes this type of spill, but it does occur occasionally.

To control TDG levels that may result from error in communication spill, Chelan PUD will implement the TDG Operational Plan (Appendix B). Chelan PUD anticipates implementation of the TDG Operational Plan to be an operational function, requiring no structural modification to the Project.

Reduced Generation Spill

Reduced electric demand on the system can, at times, result in the need to spill water at run-of-the river projects such as Rock Island. Hourly coordination between hydroelectric projects on the river can minimize this type of spill, but it does occur.

To control TDG levels that may result from reduced generation spill, Chelan PUD will implement the TDG Operational Plan (Appendix B), when possible. Chelan PUD anticipates implementation of the TDG Operational Plan to be an operational function, requiring no structural modification to the Project.

1.5 Spill and Total Dissolved Gas Compliance - Previous Year 2015

1.5.1 TDG Compliance 2015

Over the course of the 2015 fish-spill season, there were no exceedances of the total dissolved gas (TDG) numeric criteria in either the forebay or tailrace of Rock Island Dam, nor at the forebay of Wanapum Dam. Information regarding spill for the 2015 fish-spill season are displayed in Table 1-1

Table 1-1: Average monthly total flow, spill, and percent of total flow spilled for different purposes at Rock Island Dam, April 1 through August 31, 2015.

Month	Average Flow kcfs	Average Spill kcfs	Spill Purpose					
			Fish-Spill			Other		
			Spill kcfs	% of flow	% of Total Spill	Spill kcfs	% of flow	% of Total Spill
April	113.7	5.2	5.2	4.5	100.0	0.0	0.0	0.0
May	117.3	11.5	11.5	9.8	100.0	0.0	0.0	0.0
June	107.5	21.3	21.3	19.8	100.0	0.0	0.0	0.0
July	100.2	19.3	19.3	19.2	100.0	0.0	0.0	0.0
August	109.5	7.5	7.5	6.9	100.0	0.0	0.0	0.0

1.5.2 TDG Activities Implemented in 2015

In 2015, Chelan PUD implemented five actions to minimize voluntary and involuntary spill at Rock Island in order to meet TDG water quality standards. The primary operational action to reduce spill at the Rock Island Project was the implementation of the operational spill programs and the ability to minimize spill through success of survival studies. These efforts included:

- Minimizing voluntary spill.
- During fish passage, managing voluntary spill levels in real time to meet TDG numeric criteria.
- Minimizing spill, to the extent practicable, by scheduling maintenance based on predicted flows.
- Avoiding spill by continuing to participate in the Hourly Coordination Agreement.
- Maximizing powerhouse discharge as appropriate up to hydraulic capacity.

1.5.3 TDG Structural Measures Implemented in 2014

No structural gas abatement measures were proposed or constructed in 2015. However, Chelan PUD continues to utilize the over/under gates that were installed in 2007 to reduce TDG generation at the Project.

SECTION 2: PROPOSED 2016 ACTION PLAN TO ACHIEVE TDG STANDARDS

The following sections describe TDG abatement measures proposed for implementation during 2016 to achieve compliance with TDG water quality standards.

2.1 Operational TDG Abatement Measures

Chelan PUD will 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 sets forth in the HCP and associated Anadromous Fish Agreement. During the 2016 fish spill season, Chelan PUD proposes to use a combination of the following measures as needed to meet water quality criteria for TDG:

1. Minimize voluntary spill
Success of the survival studies have allowed Chelan PUD to reduce spring spill required for fish passage.
2. Manage voluntary spill in real time
During fish passage, manage voluntary spill levels in real time in an effort to continue meeting TDG numeric criteria,
3. Minimize involuntary spill
Minimize involuntary spill, to the extent practicable, by scheduling maintenance based on predicted flows.
4. Participate in Hourly Coordination Agreement
Chelan PUD endeavors to avoid involuntary spill by continuing to participate in the Hourly Coordination Agreement, or any successor agreement to which Chelan PUD is a party, to the extent it reduces TDG.
5. Maximize powerhouse discharge as appropriate up to hydraulic capacity

Operational and structural changes that may affect TDG must be subject to review and approval by Ecology during the design and development phase to assure that such changes incorporate consideration of TDG abatement, when appropriate.

2.2 Proposed Structural TDG Abatement Measures and Technologies

No structural gas abatement measures are planned at the Rock Island Project in 2016. Chelan PUD will continue to monitor and investigate the feasibility of implementing new technologies as they become available.

SECTION 3: PHYSICAL AND BIOLOGICAL MONITORING AND QUALITY ASSURANCE

The following sections describe Chelan PUD's TDG compliance monitoring program. The program includes a fixed-site monitoring program and a quality assurance protection plan.

3.1 Fixed-Site Monitoring Stations for TDG

Chelan PUD currently maintains two fixed monitoring stations (FMS) at the Rock Island Project to monitor hourly TDG levels annually. The fixed monitoring stations are installed to a depth of approximately 15 feet. This depth varies as the forebay and tailrace river elevations fluctuate with river flows. This depth variation is not expected to affect the accuracy of the TDG readings because the instruments are located below the depth where gas bubbles form on the membrane and are deep enough in the water column to not be affected by near surface temperature gradients.

The Rock Island forebay fixed monitoring station (Figure 3-1) is affixed to the Project, located on the west side of the river, near the right bank fishway and Powerhouse 2, approximately 70 feet from the shore. The standpipe is installed to a depth of approximately 15 feet, though this depth varies as the forebay river elevation fluctuates with river flows and project operations. The site was chosen based on accessibility and is thought to be representative of forebay TDG because water is as well mixed and flow is as constant as at any other location in the forebay. No bridge or other permanent in-water structure is available downriver of Rock Island Project on which to attach a monitoring station. For this reason, Chelan PUD developed a monitoring station about 1.5 miles downriver from the Project on the eastern shoreline (Figure 3-2). This FMS has two means of deploying the dissolved gas probe, a carriage system with a cable attached to an ecology block in the river, and a fixed pipe attached to the scaffold that holds the carriage system.

Chelan PUD has entered into a Professional Services Agreement with Columbia Basin Environmental (CBE) to perform calibrations and equipment maintenance during the 2016 monitoring season. Calibration and equipment maintenance will be conducted monthly during the fish spill season, and every other month during the non-fish spill season. It is anticipated at this time that Chelan PUD will continue to contract with CBE into the future. QA/QC measures will be accomplished through training in instrument maintenance, operation, and factory prescribed calibration methods. A detailed log will be maintained for all work done on the monitoring equipment, including monthly maintenance, calibration, exchange of instruments, and any other pertinent information. Redundant measurements with a mobile instrument to verify the accuracy of the in-situ instruments will be conducted during the calibrations.

TDG levels are recorded at 15-minute intervals and are averaged into hourly readings for use in daily and 12-hour averages, as well as daily high values. The hourly average data is forwarded to the United States Army Corps of Engineers (USACE), Columbia River Basin Water Management Division website where data is posted on an hourly basis. The data can be found on their website by navigating from the USACE home page to the Columbia River Basin Water

Management Division web page. From this location, select the Rocky Reach Project from the map and select TDG, Water Quality Data².

². The website for the United States Army Corps of Engineers, Columbia River Basin Water Management Division, Rocky Reach Dam, Water Quality Data, and TDG is currently located at http://www.nwd-wc.usace.army.mil/ftppub/water_quality/tdg/#RRDW Website locations are subject to change. Please contact USACE at (206) 761-0011 for general questions.



Figure 3-1: Location of forebay fixed monitoring station at Rock Island Hydroelectric Project.



Figure 3-2: Location of tailrace fixed monitoring station below Rock Island Hydroelectric Project.

3.2 Quality Assurance

Chelan PUD has developed its Quality Assurance/Quality Control (QA/QC) protocols following established protocols by other resource agencies conducting similar monitoring programs, such as the USGS, USACE, and other mid-Columbia River Dam operators, as well as HydroLab Corporation's recommendations. These QA/QC protocols are included in Chelan PUD's Quality Assurance Project Plan (Appendix D) per Section 5.7(2) of the Rocky Reach 401 Certification.

3.3 Biological (Gas Bubble Trauma) Monitoring Plan

Chelan PUD, in conjunction with the Fish Passage Center (FPC), will continue to conduct GBT monitoring at the Rock Island Bypass Trap. Random samples of 100 spring Chinook, steelhead and subyearling Chinook will be examined two days per week during the sampling season (April 1 to August 31). Examinations for GBT symptoms will follow a standardized FPC protocol (FPC, 2009). The results of this monitoring effort will be included in the Gas Abatement Annual Report (see Section 4.3 below).

SECTION 4: TDG COMPLIANCE REPORTING METHODS

4.1 Water Quality Web-Site

TDG information will be made available to the public via Chelan PUD's website, as close to the time of occurrence as technologically feasible. To meet this requirement, Chelan PUD maintains a link on its website that directs the public to the USACE, Columbia River Basin Water Management Division website where data is posted on an hourly basis. The data can be found on their website by navigating from the USACE home page to the Columbia River Basin Water Management Division web page. From this location, select the Rocky Reach Project from the map and select TDG, Water Quality Data².

4.2 Notifications

Chelan PUD shall notify Ecology, Central Regional Office, Water Quality Program within 48 hours (either before or after) of any TDG spill; this includes the start of spill for fish, as defined in Section 1.2.1, and any deviation from the TDG Operational Plan or the fish spill plan that adversely affects TDG levels. This notification may be either electronic or by letter.

4.3 Annual Report

Chelan PUD will provide Ecology with a draft TDG annual report by October 31 of each year for initial review and comment. Chelan PUD will submit the final report by December 31 of that same year. The TDG Annual Report will include:

- Flow over the preceding year (cfs over time);
- Spill over the preceding year (cfs and duration);
- Reasons for spill (e.g. for fish, turbine down time);
- TDG levels during spill (hourly)(to include fish spill season);
- Summary of exceedances and what was done to correct the exceedances;
- Results of the fish passage efficiency (FPE) studies and survival per the HCP;
- Result of biological monitoring (GBT) at Rock Island Bypass Trap (conducted in conjunction with the Fish Passage Center);
- Results of QA/QC implementation

SECTION 5: UPDATES TO THE GAS ABATEMENT PLAN

Consistent with WAC 173-201A-200(1)(f)(ii), the GAP will be revised annually, to reflect any new or improved information and technologies, and submitted to Ecology for review and approval, by April 1 of the year of implementation.

SECTION 6: CONCLUSIONS

Chelan PUD shall implement the measures presented Section 2 of this 2016 GAP. Implementation of these measures are intended to ensure compliance with the WAC for TDG in the Columbia River at the Rock Island Project during the fish-spill season while continuing to meet the fish passage and survival standards set forth in the Rocky Reach HCP and Anadromous Fish Agreement. No structural gas abatement measures are planned at the Rock Island Project in 2016. This GAP will be updated annually to reflect any changes in implementation schedules, new or improved technologies, or TDG abatement measures.

SECTION 7: LITERATURE CITED

Fish Passage Center (FPC). 2009. GBT monitoring program protocol for juvenile salmonids. FPC, Portland, OR.

National Marine Fisheries Service (NMFS). 2000. Endangered Species Act – Section 7 Consultation: Biological Opinion. Consultation on Remand for Operation of the Columbia River Power System and 19 Bureau of Reclamation Projects in the Columbia Basin. F/NWR/2004/00727. November 30, 2005. Pages 5-6, 5-7, 5-53, 10-9, and Appendix E: Risk Analysis.

Pickett, P.J., H. Rueda, and M. Herold. 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. Section 401 Water Quality Certification for the Rocky Reach Hydroelectric Project. Order# 3155 dated March 17, 2006.

APPENDIX A: ROCK ISLAND HABITAT CONSERVATION PLAN

APPENDIX B: 2016 ROCK ISLAND TDG OPERATIONAL PLAN

2016 Rock Island TDG Operational Plan

During Fish Spill Season (April 1 through August 31)

(All spill between these dates is subject to the actions contained in this plan.)

Protocol

1. If tailrace TDG average is greater than ***120% for the 6-hour average***
 - monitor for 2 hours, re-check 6-hour average
 - if TDG >120% for 6-hr average, shift spill from gate 20 to 27
 - monitor for 2 hours, re-check 6-hour average
 - if TDG >120% for 6-hr average, open gate 20 and close 2 notched gates (closure order is listed below)
 - monitor for 2 hrs; re-check 6-hour average
 - if TDG >120% for 6-hr average, close two more notched gates
 - **if after closing gates to control TDG levels, the TDG 1-hr average drops below 118%, reopen notched gates in the reverse order of closure**

Order of notched gate closure: **29, 24, 18, 16**

2. If tailrace TDG is greater than ***125% for 1 hr***
 - follow protocol outlined above, but instead, use **one-hour TDG levels of 125%** as the metric
 - continue until TDG is less than 125% for 1 hr and until the 6-hr average TDG <120%
3. If forebay TDG exceeds 115% for greater than one hour, call Rocky Reach and advise that the RI forebay is out of compliance. Rocky Reach will then reduce spill, but only if the RR forebay TDG is 115% or less. Once RI forebay TDG levels reduce to 113% call RR again so that they may return to previous spill operations.
4. If it becomes necessary to implement any further actions to attain TDG compliance, **please contact Thad Mosey (661-4451, cell 670-5594) and Marcie Steinmetz (661-4186, cell (509) 280-1955) immediately** so they can determine the next steps to take.

**** Note:** It will not be necessary to monitor for one full hour after re-opening if it appears that TDG is approaching the upper threshold, rather, the procedure will repeat upon reaching the threshold. It is anticipated that in time, the operators will “get a feel” for how much change in TDG will occur as a result of opening or closing gates and it will be possible to hold the TDG around 118% or 119% or so. Once the operators have this down, instead of closing a gate entirely, it may only be necessary to close partially and vice versa for the opening process.

APPENDIX C: 2010 QUALITY ASSURANCE PROJECT PLAN

APPENDIX D: 2015 GAS ABATEMENT ANNUAL REPORT

APPENDIX E: RESPONSE TO COMMENTS

Ecology was sent a Draft Gas Abatement Plan for Rock Island on February 26, 2016 for review and comment.

