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Via Electronic Filing

Honorable Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 1st Street N.E.
Washington, D.C. 20426

February 23, 2021

Subject: 2020 Annual Report - Total Dissolved Gas Abatement Plan – Wells Hydroelectric Project – FERC License Article 401 (b)

Dear Secretary Bose:

Pursuant to Article 401(b) of the Federal Energy Regulatory Commission (FERC) license for the Wells Hydroelectric Project (Wells Project), the Public Utility District No. 1 of Douglas County (Douglas PUD) hereby submits the final Total Dissolved Gas Abatement Plan Annual Report (TDG Report) for calendar year 2020. Article 401(b) requires Douglas PUD to file an annual TDG Report with the FERC by February 28th during each year of the license.

The final 2020 TDG Report is attached as Appendix A to this letter. A draft version of this 2020 TDG report was distributed to the Washington State Department of Ecology (Ecology) and all of the other parties to the Aquatic Settlement Agreement (ASA) including the United States Fish and Wildlife Service (USFWS), Washington State Department of Fish and Wildlife (WDFW), the Confederated Tribes of the Colville Reservation (CCT) and the Confederated Tribes and the Bands of the Yakama Nation (YN). No comments were received during the 30 day comment period. Following review, all parties present during the February 10, 2021 Aquatic Settlement Work Group (Aquatic SWG) meeting approved the 2020 TDG Report. The pre-filing consultation record supporting the review and approval of the 2020 TDG Report can be found in Appendix B.

The enclosed 2020 TDG Report is consistent with (1) the Water Quality Management Plan that is contained within the ASA, (2) Condition 6.7(2)(c)(iii) of Ecology's Clean Water Act section 401 Water Quality Certification (401 Certification), and (3) the National Marine Fisheries Service Endangered Species Act Incidental Take Statement (ITS) Reasonable and Prudent Measure No. 2 for the Wells Project.

If you have any questions or require further information regarding the enclosed report, please feel free to contact me at (509) 881-2323, andrewg@dcpud.org.

Sincerely,

Andrew Gingerich
Natural Resources Supervisor

Enclosure:

1) Appendix A – 2020 Annual Report - Total Dissolved Gas Abatement Plan - Wells Hydroelectric Project

2) Appendix B – Pre-filing consultation record for the 2020 Annual Report – Total Dissolved Gas Abatement Plan - Wells Hydroelectric Project

Cc: Breean Zimmerman – Ecology, Union Gap
Scott Carlon – NMFS, Portland
Wells Aquatic Settlement Work Group
Tom Kahler – Douglas PUD
Shane Bickford – Douglas PUD

APPENDIX A

2020 ANNUAL REPORT TOTAL DISSOLVED GAS ABATEMENT PLAN WELLS HYDROELECTRIC PROJECT

Document Accession #: 20210223-5087 Filed Date: 02/23/2021

2020 Annual Report
Total Dissolved Gas Abatement Plan

Wells Hydroelectric Project

Public Utility District No. 1 of Douglas County
1151 Valley Mall Parkway
East Wenatchee, WA 98802-4331

Prepared for:

Washington Department of Ecology
1250 Alder St, Union Gap, WA 98903

And

Aquatic Settlement Work Group

February 2021

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1 INTRODUCTION

The 2020 Wells Hydroelectric Project (Wells Project) Gas Abatement Plan (GAP) was approved by the Washington State Department of Ecology (Ecology) by email on February 14, 2020 and subsequently submitted to the Federal Energy Regulatory Commission (FERC) on February 26, 2020. The FERC approved the GAP on March 30, 2020. The GAP and its associated measures represent a long-term strategy to achieve compliance with the Washington State Water Quality Standard (WQS) criteria for total dissolved gas (TDG) downstream of the Wells Project while continuing to provide safe passage for downstream migrating juvenile salmonids. This annual report summarizes the results from the 2020 monitoring season and describes the background, operations, and results of GAP implementation at the Wells Project in 2020. In addition, this report contains TDG performance for the Wells Project during the 2020 fish passage season, and TDG performance outside of the fish passage season. Data summarized in this report includes monitoring from January 1, 2020 to December 31, 2020.

1.1 Project Description

The Wells Project is owned and operated by Public Utility District No. 1 of Douglas County (Douglas PUD) and is located at river mile (RM) 515.6 on the Columbia River in the State of Washington (Figure 1). Wells Dam is located approximately 30 river miles downstream from the Chief Joseph Hydroelectric Project, owned and operated by the United States Army Corps of Engineers (USACE), and 42 miles upstream from the Rocky Reach Hydroelectric Project, owned and operated by Public Utility District No. 1 of Chelan County. The nearest town is Pateros, Washington, which is located approximately 8 miles upstream of Wells Dam.

The Wells Project is the chief generating resource for Douglas PUD. It includes ten generating units with a nameplate rating of 774,300 kW and a peaking capacity of approximately 840,000 kW. The design of the Wells Project is unique in that the generating units, spillways, switchyard, and fish passage facilities were combined into a single structure referred to as the hydrocombine. The hydrocombine is 1,130 feet long, 168 feet wide and has a top of dam elevation of 795 feet above mean sea level (msl). Upstream fish passage facilities are located on both sides of the hydrocombine.

The Methow and Okanogan rivers are tributaries of the Columbia River, which drain into the Wells Reservoir. The Wells Project boundary extends 1.5 miles up the Methow River and 15.5 miles up the Okanogan River. The surface area of the reservoir is 9,740 acres with a gross storage capacity of 331,200 acre-feet and usable storage of 97,985 acre-feet at the normal maximum water surface elevation of 781 feet msl.

1.2 Fixed Monitoring Site Locations

Fixed monitoring stations (FMS) for TDG are located above and below Wells Dam. The forebay station (WEL) is located midway across the deck of Wells Dam (47° 56’ 50.28” N, 119° 51’ 54.78” W). The tailrace station (WELW) is located on the left bank of the Columbia River 2.6 miles downstream of Wells Dam (47° 54’ 46.86” N, 119° 53’ 45.66” W). In the spring of 2014, Douglas PUD installed a third FMS at

Washburn Island (WSBW; 48° 5' 17.15" N, 119°40' 33.82" W), located approximately 7 miles downstream of Chief Joseph Dam. Hach® or Hydrotech HYDROLAB MiniSonde (MS5) instruments equipped with TDG and temperature probes are deployed approximately 15 feet below normal surface water elevation and are calibrated monthly. Data from the three stations are automatically transmitted by radio to Wells Dam, stored, forwarded to the USACE, and posted to the Douglas PUD public webpage (www.douglaspud.org). Weather data are recorded by Global Water, Inc. instrumentation, including an electronic barometer located on the deck of Wells Dam at 810 feet elevation. All three FMS are geographically represented by yellow pins in Figure 1.

Figure 1. TDG fixed monitoring stations (yellow pins) above and below Wells Dam

1.3 Regulatory Framework

Washington Administrative Code (WAC) Chapter 173-201A identifies the WQS for surface waters in Washington State. Per the WQS, TDG measurements shall not exceed 110% saturation at any point of measurement in any state water body. The WQS provide for two exceptions to this rule: (1) for spill over dams to increase survival of downstream migrating juvenile salmon; and (2) during natural flood flows. Further, in 2019 the WAC was revised to allow for increased spill during the spring smolt migration period generally recognized by Ecology to be occurring between April and June. The revised WAC is written as follows:

(i) The water quality criteria established in this chapter for TDG shall not apply when the stream flow exceeds the seven-day, ten-year frequency flood. The 7Q-10 flow for the Wells Project is 246,000 cubic feet per second (cfs), based on the hydrologic records from 1930 to 1998 and the USGS Bulletin 17B, "Guidelines for Determining Flood Flow Frequency" (Pickett et al. 2004). When river flow volume exceeds 7Q-10 flows, the WQS established in the WAC do not apply.

(ii) The TDG criteria may be adjusted to aid fish passage over hydroelectric dams that spill for anadromous juvenile fish as of the 2020 spill season. The elevated TDG levels are intended to allow increased fish passage without causing more harm to fish populations than caused by turbine fish passage. The following special fish passage exemptions for the Snake and Columbia rivers apply when spilling water at dams is necessary to aid fish passage:

(A) TDG must not exceed:

- An average of 115% as measured in the forebays of the next downstream dams and must not exceed an average of 120% as measured in the tailraces of each dam (these averages are calculated as an average of the twelve highest hourly readings in a calendar day, relative to atmospheric pressure); and

- A maximum TDG saturation level of 125% calculated as an average of the two highest hourly TDG measures in a calendar day during spillage for fish passage.

(B) To further aid fish passage during the spring spill season (generally from April through June), spill may be increased up to the following levels as measured at the tailrace fixed site monitoring location:

- A maximum TDG saturation level of 125% calculated as an average of the twelve highest hourly TDG measures in a calendar day; and

- A maximum TDG saturation level of 126% calculated as an average of any two consecutive hourly TDG measures.

These TDG criteria may be applied in place of (A) of this subsection during spring spill operations when applied in accordance with the following conditions:

- In addition to complying with the requirements of this chapter, the tailrace maximum TDG criteria at hydropower dams shall be applied in accordance with Endangered Species Act consultation documents associated with spill operations on the Snake and Columbia rivers, including operations for fish passage. The Endangered Species Act consultation documents are those by which dams may legally operate during the time that the adjusted criteria in (B) of this subsection are in use.

- Application of the tailrace maximum TDG criteria must be accompanied by a department approved biological monitoring plan designed to measure impacts of fish exposed to increased TDG conditions throughout the spring spill season. Beginning in the year 2021, plans must include monitoring for nonsalmonid fish species and must continue for a minimum of five years, and thereafter as determined by the department.

- TDG must be reduced to allowances specified in (A) of this subsection if the calculated incidence of gas bubble trauma in salmonids (with a minimum sample size of 50 fish required weekly) or nonsalmonids (with a minimum sample size of 50 fish required weekly) exceeds:

    - Gas bubble trauma in nonpaired fins of 15%; or

    - Gas bubble trauma in nonpaired fins of 5% and gas bubbles occlude more than 25% of the surface area of the fin.

If gas bubble trauma exceeds these biological thresholds, additional monitoring must demonstrate the incidence of gas bubble trauma below biological thresholds before TDG can be adjusted to allowances specified in this subsection. Gas bubble trauma monitoring data shall be excluded from comparison to biological thresholds when higher than normal river flow contributes to excess spill above the ability to meet (B) above. This monitoring data exclusion shall apply for one full calendar day after reduced river flow allows attainment of (B) above.

1.4 Gas Abatement Plan Approach

1.4.1 Structural

No permanent structural modifications were proposed or conducted in the 2020 monitoring season.

1.4.2 Consultation

Consistent with prior consultation requirements, Douglas PUD directs all correspondence related to TDG compliance to Ecology's Hydropower Projects Manager located in the Central Region Office (Union Gap, Washington 98903). In addition, Douglas PUD annually consults with the Aquatic Settlement Work Group (Aquatic SWG) and Habitat Conservation Plan Coordinating Committee (HCP CC) for specific TDG and WQS documents per Douglas PUD's 401 Certification and consults with the FERC all toward

complying with the consultation and approval requirements contained within the FERC license for the Wells Project.

2 OPERATIONS

2.1 Description of Fish-Passage Season Flow

The Wells Anadromous Fish Agreement and HCP required Douglas PUD to provide juvenile fish bypass passage opportunities for greater than 95% of the downstream migrating juvenile fish covered by the HCP (Plan Species). The HCP defined juvenile fish passage season starts April 1st and runs through August 31st of each year. Douglas PUD annually reviews fish passage statistics and uses that information to tune operation during subsequent years toward ensuring that greater than 95% of the juvenile outmigration is afforded a non-turbine passage route around Wells Dam. Based upon prior year information, the juvenile fish bypass was started on April 9 (0:00 hrs.) and ended at midnight on August 19th. As required, TDG performance was monitored during this period and transmitted to the USACE, Northwest Division on a real-time basis (www.nwd-wc.usace.army.mil) and made available on Douglas PUD's public webpage (http://douglaspud.org/wells-project/total-dissolved-gas-and-temperature-monitoring). Historical data continues to be available for download at both of these websites.

Data from 1969 to 2020 show that average monthly flows at Wells Dam range from a September low of 74.4 kcfs to a June high of 163.7 kcfs (Table 1; Figure 2). The ten year average shows higher flows in May through July compared to the historical means recorded during the same months. Flows at the run-of-river Wells Project are determined by upstream storage releases at the Grand Coulee Hydroelectric Project and Canadian storage projects, with typically less than 10% of the total river flow provided by the two rivers that flow into the Columbia River within the Wells Project (Okanogan and Methow Rivers).

Table 1. Monthly average river discharge (kcfs) from the Wells Project, 1969-2020.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
2020	100.4	116.6	80.8	83.6	117.9	202.5	154.2	116.1	70.2	67.0	100.4	98.7	115.4
Average since 1969	108.7	108.5	106.6	118.3	153.7	163.7	133.9	105.6	74.4	74.5	88.1	100.6	111.2
Minimum since 1969	67.4	69.9	56.0	51.9	55.2	73.7	53.4	63.9	53.3	55.4	63.8	72.6	
Maximum since 1969	159.2	180.7	193.9	203.8	266.3	348.7	253.8	181.3	123.0	108.9	110.0	149.0	
10YR mean (2011-2020)	110.1	109.9	110.2	138.3	184.2	176.8	148.2	113.6	68.5	66.3	90.1	99.3	118.0

Observed flows at Wells Dam in 2020 were very close to average. Flows in April appeared to start below average, but finished strong during May through August with these months having higher than average flows. Tributary flows approached average in 2020 and since they make up 10% or less of total flows at

Wells Dam appear unremarkable in the calendar year. Peak flows or freshet flows, while higher than average at Wells Dam in 2020, occurred during the normal period of May through July (Table 1; Figure 2).

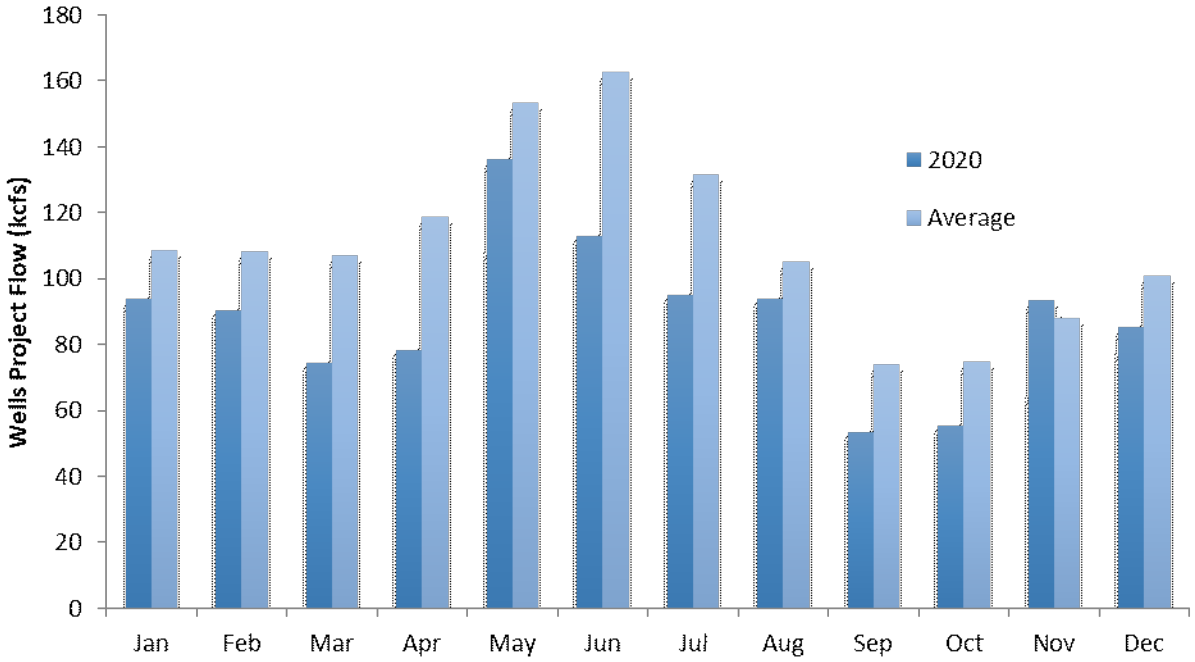

Figure 2. 2020 monthly flows compared to monthly average.

2.2 Fish Bypass Program

Wells Dam is a hydrocombine, where the spillbays are located directly above the turbine intakes. Research at Wells Dam in the mid-1980s demonstrated that a modest amount of spill could effectively guide a high proportion of downstream migrating juvenile salmon away from turbines and into a surface oriented bypass system. A Juvenile Bypass System (JBS) was subsequently developed at Wells in the late 1980s. The Wells Dam JBS was engineered based on biological research and hydraulic modeling, and utilizes constricting flow barriers deployed in five of the eleven spillbays to effectively attract and safely guide fish through the project. The Wells Project JBS has since proven to be the most efficient system on the mainstem Columbia River, providing high levels of fish protection and survival that has met approval from various fisheries agencies and tribes (Skalski et al. 1996). The passage and survival performance measures contained within the FERC-approved HCP have been consistently exceeded for spring migrating plan species (Bickford et al. 2001; Gingerich et al. 2020; see Section 3.1.2 below).

2.3 Fish Bypass Spill Quantities and Duration

The Wells Dam JBS uses up to 2,200 cfs of water for each of the five bypass/spillbays. Under normal conditions, the JBS will use roughly five to eight percent of the total river flow for fish guidance. The increased spill has a small influence on TDG production (~0-2%) while providing a safe and highly effective, non-turbine passage route for over 92% of the spring-migrating and 96% of the summer-

migrating juvenile salmonids. The HCP defined juvenile fish migration period runs from April 1st to August 31st of each year. The HCP CC retains annual operating oversight that includes the potential to operate the JBS as early as April 1 and as late as August 31 to ensure that at least 95% of the spring and summer migration of juvenile salmonids are provided a safe, non-turbine passage route over Wells Dam. Any spill that occurs between April 1st and August 31st is deemed to have a beneficial effect on migrating juvenile salmonids.

From 2003 to 2011 the HCP CC directed the District to operate the JBS on a fixed schedule between April 12 and August 26 in an effort to provide a non-turbine passage route for at least 95% of the spring and summer migration of juvenile salmonids. In 2012, Douglas PUD evaluated past performance of the Wells Dam JBS operating dates relative to observed annual run timing (at the Rocky Reach Bypass) for both spring and summer migrants. With that data, a request was made to and granted by the HCP CC to revise the bypass operating dates in 2012 to start April 9 and end August 19. These new dates were therefore used in 2012-2020 to operate the fish bypass system for migrating juvenile salmonids. Juvenile anadromous salmonids that pass Wells Dam before and after the bypass system is shut down for the year benefit from spill at the Wells Project and therefore Douglas PUD annually develops a GAP and conducts biological and physical monitoring in order to obtain an Ecology approved TDG adjustment for the entire juvenile salmonid migration period (April 1st to August 31st).

3 IMPLEMENTATION RESULTS

3.1 Fisheries Management

3.1.1 Fish Passage Efficiencies

No new fish passage efficiency studies were conducted at the Wells Project in 2020. However, three years of bypass efficiency studies have shown the Wells Dam JBS to be the most efficient juvenile salmonid collection system in the Columbia River with fish passage efficiencies up to 92% for spring migrants and up to 96% for summer migrants (comprised of steelhead, spring Chinook, and sockeye salmon, and summer/fall Chinook salmon, respectively; Skalski et al. 1996).

3.1.2 Run-Timing Evaluation

Based on analysis conducted by Drs. John Skalski and Richard Townsend of Columbia Basin Research, in 2020 Douglas PUD surpassed the HCP requirement to provide bypass operations during at least 95% of the juvenile salmon and steelhead migration taking place at Wells Dam. Data over the last nine years suggests that Douglas PUD is exceeding the 95% requirement particularly at the end of the bypass period. Since 2012 the bypass has ran 10 or more days longer to provide 95% passage for spring and summer migrants.

3.1.3 Survival Studies

Douglas PUD conducted a 2020 Survival Verification Study (SVS) that employed spring migrating yearling Chinook salmon. A total of 105,332 passive integrated transponder (PIT)-tagged Chinook were released

during this study. Fish were released during the months of April and May with release timing closely matching the run of spring migrating Plan Species through the Wells Project. Fish were released during sixteen replicate releases at each of the three specified release locations for a total of 48 releases. Each replicate release group at each of the three release sites was provided nearly identical rearing, collection, tagging, recovery, interrogations, and transportation exposures, to prevent unnecessary covariates in experimental methods and analyses. Survival through the Wells Project (reservoir, forebay, dam and tailrace) was estimated based upon the relative survival of treatment (Okanogan and Methow) and control (tailrace) release groups. The weighted average for survival from the 2020 SVS was $\hat{S}$_W = 0.9517 ($\hat{SE}$ = 0.0142). Historical juvenile project survival estimates were 0.997 ($\hat{SE}$ = 0.015), 0.943 ($\hat{SE}$ = 0.016), 0.946 ($\hat{SE}$ = 0.015), and 0.964 ($\hat{SE}$ = 0.013) for years 1998, 1999, 2000, and 2010, respectively. As such, the Wells Project has one of the highest rates of survival for spring migrating fish on the Columbia and Snake Rivers.

3.2 Biological Monitoring

The 2020 Wells Project GAP includes the National Marine Fisheries Service (NMFS) recommendation to sample for Gas Bubble Trauma (GBT) in juvenile salmon when hourly tailrace TDG levels exceed 125% saturation (NMFS 2000). GBT monitoring took place on June 8, 25, 29, and 30 at Rocky Reach Dam consistent with the 2020 GAP. Monitoring typically took place the day after TDG values in the Wells tailrace broke 125%. Over the sampling days, a total of 62 smolts were examined (Table 2). Only on June 29 was GBT observed at Rocky Reach JBS. Specifically, a single subyearling Chinook salmon had less than 5% of the dorsal fin occluded by bubbles. Given that the TDG exceedances occurred in June (predominately towards the end of the month) and not in April and May the catch at Rocky Reach was very limited and was dominated by wild subyearling Chinook. A summary of juvenile GBT sampling at Rocky Reach JBS is provided below in Table 2.

Table 2. Gas Bubble Trauma sampling on Juvenile salmon captured at the Rocky Reach JBS in 2020 following TDG exceedances in the Wells tailrace.

	8-Jun	25-Jun	29-Jun	30-Jun	8-Jun	25-Jun	29-Jun	30-Jun
Species	**Sampled**				**GBT Observed**			
Chinook (yearling)	0	0	0	0				
Chinook (subyearling)	15	13	17	6	None	None	1^	None
Steelhead	0	0	0	0				
Sockeye	4	1	0	1*	None	None		None
Coho	5	0	0	0	None			
Total	24	14	17	7	0	0	1	0

*Suspected Kokanee
^less than 5% of dorsal fin

In addition, resident fish sampling took place via boat electroschocking in the first 2 miles below Wells Dam on June 29th and 30th as a pilot effort and towards meeting requirements to sample resident fish in 2021. Boat electrofishing appears to be an effective way to sample resident fish in the tailrace of Wells Dam at this time of the year. Collection using this method may have proven more difficult in April and May since seasonal changes may occur with resident fish occupying shallow water habitats once water temperatures are warmer. Very little GBT was observed in resident fish captured below Wells Dam, and when present appeared to be minor in all cases observed in 2020. A summary of resident fish sampling is provided in Table 3.

Table 3. Gas Bubble Trauma sampling on resident fish captured by boat electroshocking in the first two miles below Wells Dam in 2020.

	29-Jun	30-Jun	29-Jun	30-Jun
Species	**Sampled**		**GBT Observed**	
Red Sided Shiner	57	2	0	0
Large Scale Sucker	1	0	0	0
Bridgelip Sucker	3	25	0	2^
Northern Pikeminnow	2	6	0	0
Subyearling Chinook	8	1	0	0
Smallmouth Bass	13	1	0	0
Rainbow Trout	1	0	0	0
Largemouth Bass	0	1	0	1^
Tench	0	2	0	0
Sockeye	0	1	0	0
Chiselmouth	0	2	0	0
Total	85	41	0	3
Percent of Mild GBT			0%	7%

^less than 5% of Caudal fin in all cases (e.g. see Figure 3).

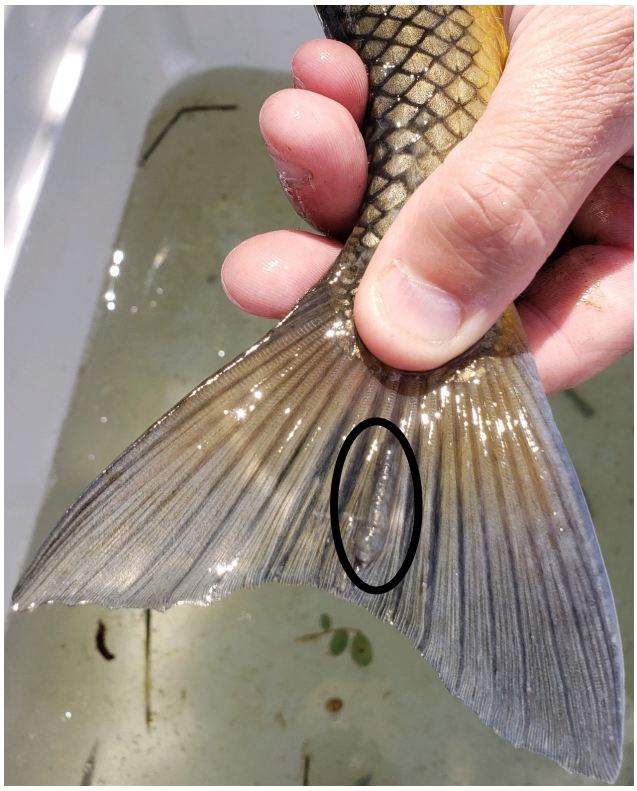

Figure 3. GBT seen in <5% of the caudal fin in a Sucker sp. sampled below Wells Dam on June 30, 2020.

3.3 Water Quality Forums

Douglas PUD has actively participated in regional water quality forums with Ecology, Washington Department of Fish and Wildlife, NMFS, Tribal Agencies, the U.S. Fish and Wildlife Service, the USACE, and other Mid-Columbia PUDs (i.e., Grant and Chelan counties). Specific forums include the Trans-boundary Gas Group, Columbia Basin meetings with Ecology, and the Sovereign Technical Team Water Quality Work Group. These meetings allow for regional coordination for monitoring, measuring, and evaluating water quality in the Columbia Basin and support ongoing Upper Columbia Treaty review analyses that will provide a foundation for Treaty negotiations between Canada and the U.S. Douglas PUD will continue its involvement in water quality meetings for further coordination with other regional water quality managers towards meeting TDG standards.

3.4 Physical Monitoring

3.4.1 Overview

TDG monitoring at the Wells Project has occurred since 1984 when forebay stations were first established. TDG monitoring in the tailrace of Wells Dam began in 1997 by actively collecting data at four points across the width of the river. Based on these data, the location for a FMS was established in 1998. Subsequent analysis verified that both monitoring station locations are appropriate and representative of mixed river condition, particularly during high flows (EES et al. 2007; Politano et al.

2009). TDG monitoring at the Wells Project currently occurs year round as required by Douglas PUD's Wells Project 401 Water Quality Certification (401 Certification). As required by Douglas PUD's Quality Assurance Project Plan for TDG, FMS sensors are serviced and calibrated at least once per month or sooner if calibration issues are observed in the data.

In 2014, an additional reservoir monitoring station was installed at Washburn Island (RM 537.5) to collect TDG data representative of water quality entering the Wells Project from Chief Joseph Dam. The current Chief Joseph Dam tailwater station (CHQW) minisonde TDG sensor is deployed along the right bank of the Columbia River, 0.75 miles downstream from the dam. The river right location of the USACE TDG sensor precludes it from collecting bulk flow data, and instead the sensor monitors spillbay water disproportionally. Under some conditions, water coming from Chief Joseph Dam spillbays is of lower TDG concentration than the powerhouse. For example, when the Chief Joseph Dam forebay has high concentrations of TDG (e.g. greater than 120%) as a result of high spill volumes from Grand Coulee Dam and limited degassing through Rufus Woods Reservoir, water sent through the spillbays at Chief Joseph Dam may actually be stripped of gas via the spill deflectors. However, powerhouse TDG concentrations are essentially identical to those in the forebay and can be missed by the CHQW sensor since powerhouse flows orient to river left rather than river right where the TDG sensor resides. As a result of the CHQW location and the orientation of spill and powerhouse flows, bulk flows leaving the federal system and entering the Wells Project are not accurately monitored. The Washburn Island location installed and operated by Douglas PUD allows water quality managers and the Aquatic SWG Parties to:

1) Better understand TDG degassing in the Wells Project and expected TDG saturation in the Wells forebay.

2) Assure data quality at the Wells forebay TDG sensor since Washburn Island TDG values should correlate predictably with Wells forebay TDG values. Based on the comparison of the sensors at these two locations, technicians can ensure reliable data collection by scheduling sensor servicing when data appears to be erroneous.

3) More accurately assess TDG production from the federal power system upstream of Wells Dam, which may support improved management towards minimizing TDG production in the Columbia River.

3.4.2 Data Evaluation and Analyses

Hourly TDG monitoring data were retrieved from the USACE, Northwest Division for three monitoring locations: the forebay of Wells Dam (WEL), tailrace of Wells Dam (WELW), and forebay of Rocky Reach Dam (RRH) or from the DCPUD.org dataset. The data were partitioned to include only readings obtained during specific time periods of non-bypass (January – March and September – December), spring bypass (April - June), and summer bypass (July and August). Data were stratified by monitoring site, ascending date, and ascending time. Data quality review included insuring TDG sensor data was responding to each data request and not simply repeating data from the previous time interval. Where data was

observed to be frozen, it was removed. Given the complex regulatory criteria, each specific time period was calculated according to the specific requirement (e.g 12-C High, Hourly, 12 hour max daily etc).

3.5 TDG Compliance

During the non-fish passage season, the TDG criterion in the Wells tailrace is 110% (January – March and September – December). During the spring bypass (April - June) season, compliance was calculated using the new regulatory criteria as adopted by Ecology in 2019. Additionally, there were five compliance criteria for the 2020 fish passage adjustment that must be met in association with operation at the Wells Project as described in the 2020 GAP and reviewed in Section 1.3. These five compliance criteria apply differently between spring bypass (April - June) and summer bypass (July - August) seasons.

These compliance criteria are waived when flows exceed the 7Q-10 value for the Wells Project (246 kcfs). For more information refer to WAC 173-201A-200.

3.5.1 Non-Fish Passage Season Compliance (Wells Tailrace 110%)

Per the Douglas PUD's FERC Operating License and 401 Certification, in August 2013 Douglas PUD started collecting TDG data during the non-fish passage season. Non-spill flows at Wells Dam (through the turbine units and fishways) generate little to no additional dissolved gas. Spill outside the fish passage adjustment period is uncommon. There were four days whereby TDG values were observed slightly higher than 110% during calendar 2020 (Figure 4) and were largely associated with the end of bypass season in early September or when turbine unit availability was temporarily reduced for maintenance and testing (e.g. December 3, 2020).

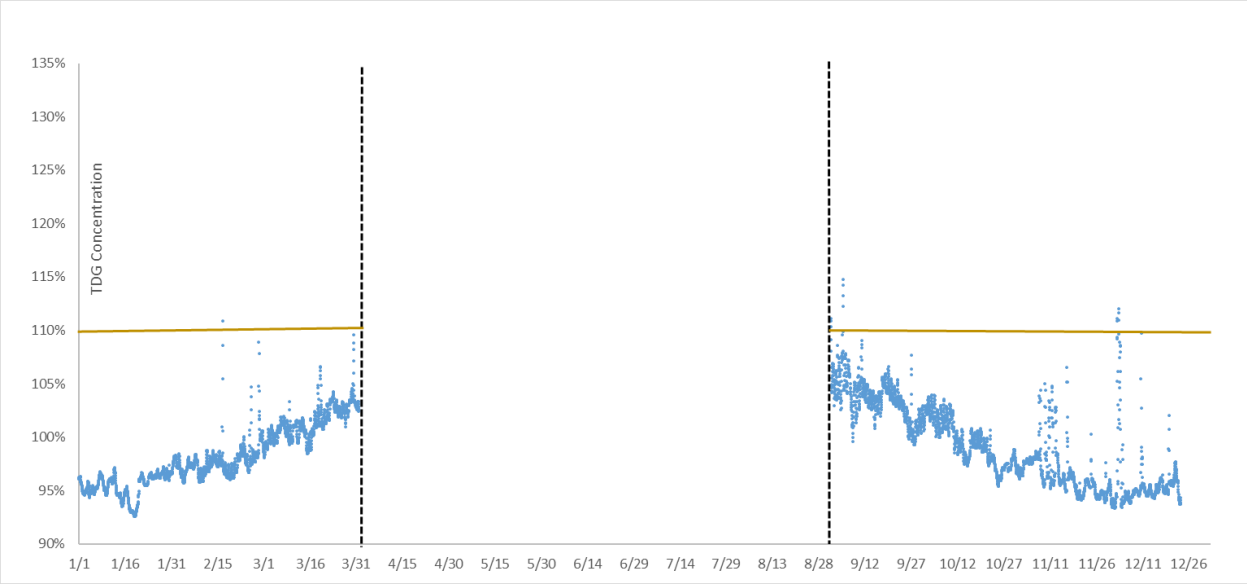

Figure 4. Hourly TDG data for the Wells tailrace during the non-fish bypass season in 2020. Values above the horizontal tan line represent exceedances of the standard.

3.5.2 Spring Fish Passage Season (April through June) Compliance

Wells Tailrace 125% 12-Hour Standard

There were five days in spring 2020 when TDG values of 125%, as calculated as the mean of the highest 12 hourly values in a calendar day, were observed. High flows in excess of turbine unit capacity was the proximate cause of theses exceedances. On one of these days, June 7, 2020, flows in excess of 7Q-10 flows (246 kcfs) were observed over a nine hour period (252.1 kcfs average) whereby TDG standards would not apply. For hourly flow data in June and July see Figure 10.

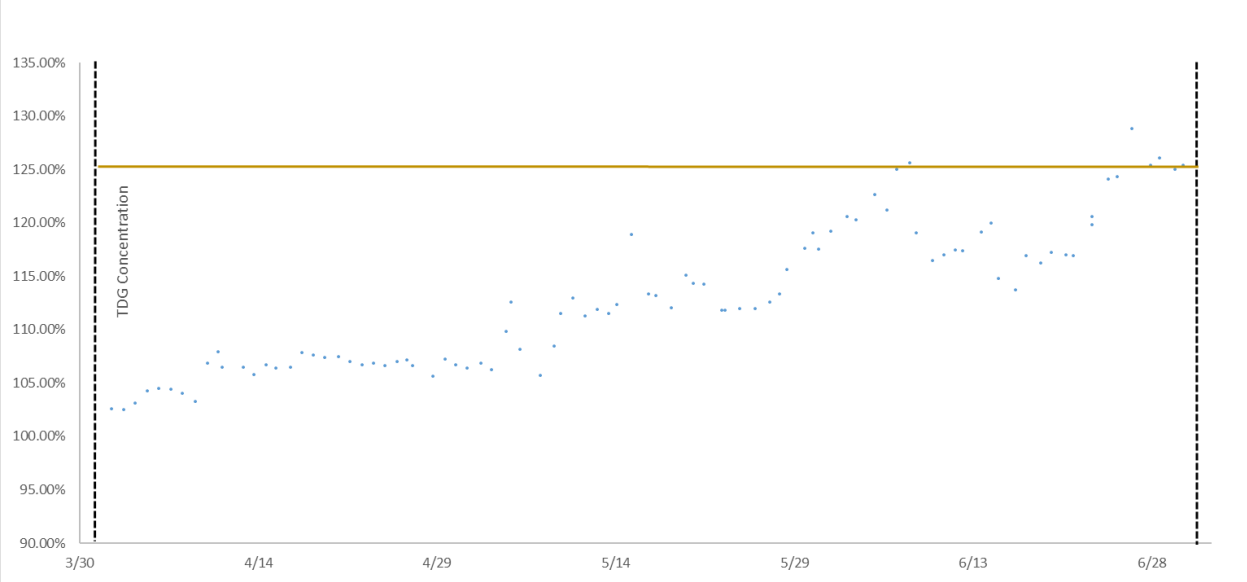

Figure 5. Wells tailrace TDG Compliance with the 125% standard April through June 2020. The horizontal tan line represents the compliance threshold.

Wells Tailrace 126% 2-Hour Standard

There were five days in spring 2020 when TDG values of 126% or greater were observed, calculated as the two highest consecutive hourly values in a single day (Figure 6). High flows in excess of turbine unit capacity was the proximate cause of theses exceedances. One of these exceedances occurred on June 7, 2020 where average flows were 252.1 kcfs at Wells Dam over a nine hour period, which is above the 7Q-10 value of 246 kcfs whereby TDG standards wouldn't apply. For hourly flow data in June and July see Figure 10.

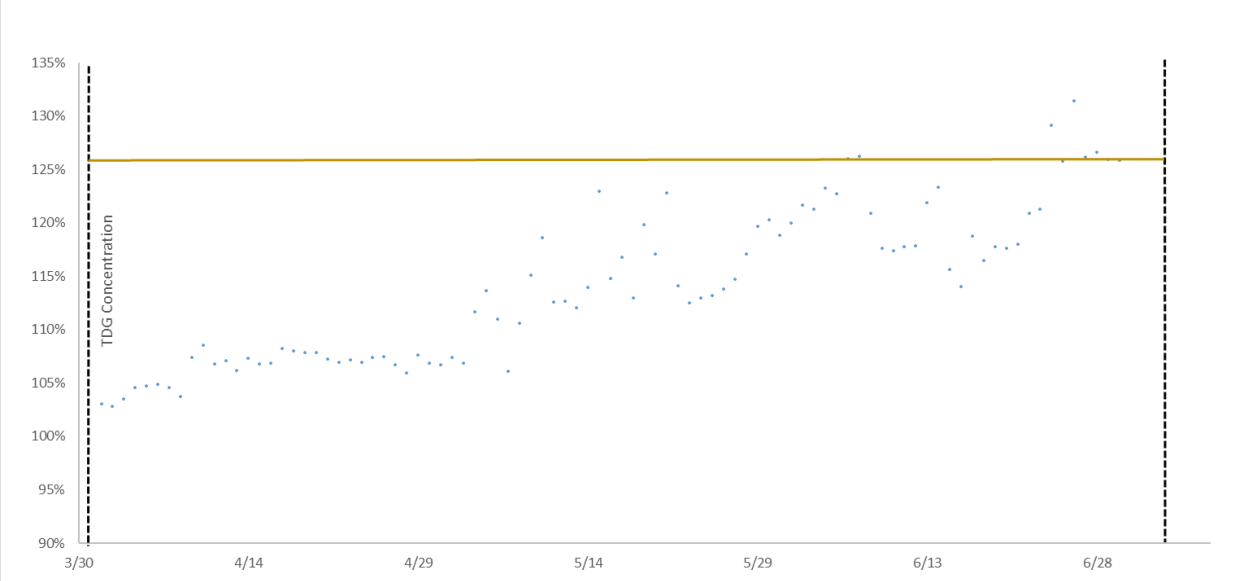

Figure 6. Wells tailrace TDG Compliance with the 126% standard April through June 2020. The horizontal tan line represents the compliance threshold.

3.5.3 Summer Fish Passage Season (July and August) Compliance

Wells Tailrace 125% Hourly Standard

There was one day, July 2, 2020 (Figure 7), in the summer of 2020 when TDG values of 125% or greater was observed (calculated as an hourly average). High flows in excess of turbine unit capacity was the proximate cause of this exceedance.

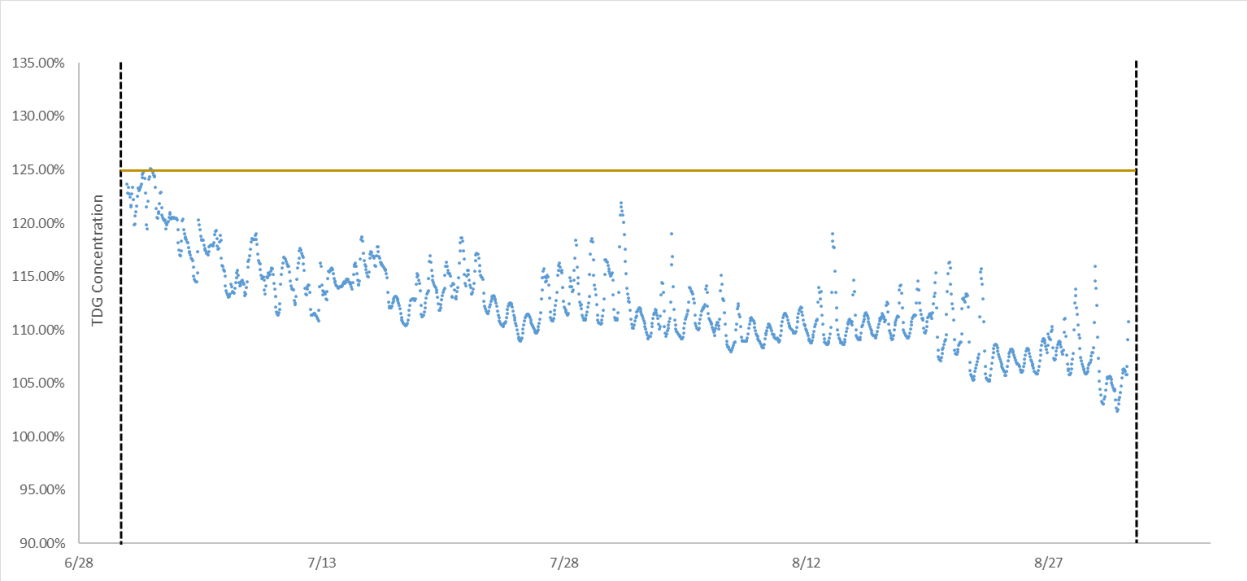

Figure 7. TDG compliance below Wells Dam using the 125% hourly average calculation. Data shown is exclusive to the summer bypass season (July and August). The tan line denotes the compliance threshold.

Wells Tailrace 120% 12C-High Standard

There 3 days where there were observed exceedances of the 120% standard in the Wells tailrace in 2020 (Figure 8) on July 1, 2020 through July 3, 2020. Exceedances of this standard occurred in the first three days following the completion of the spring bypass season (April - June) and were the result of high flows in excess of turbine unit capacity and elevated incoming TDG into the Wells Forebay from the Federal Columbia River Power System above Wells Dam.

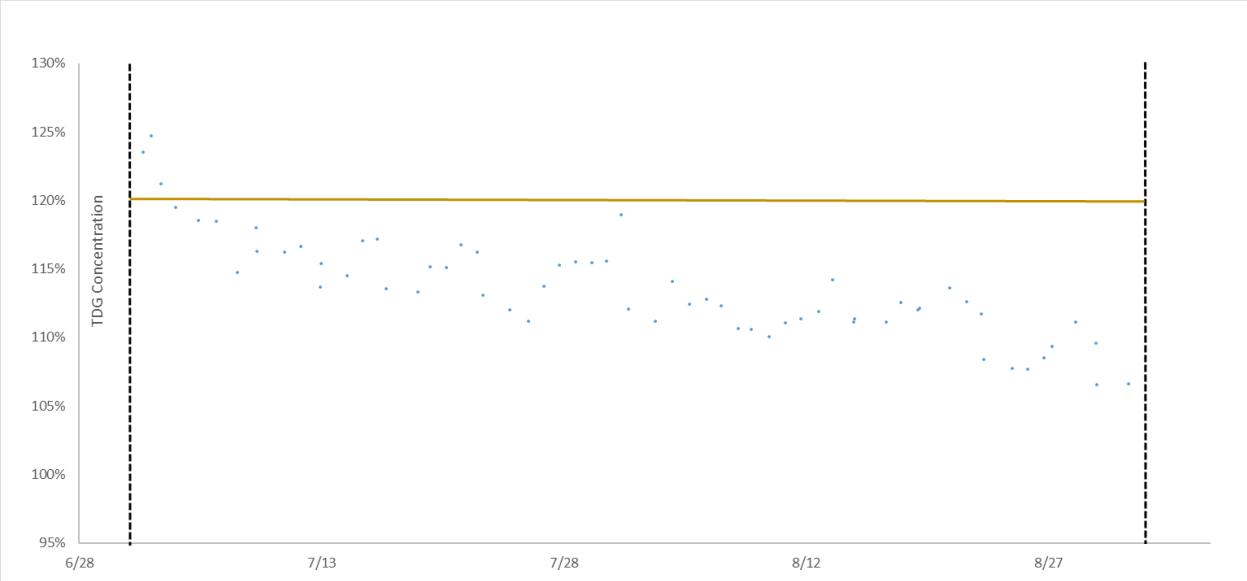

Figure 8. TDG compliance below Wells Dam using the 120% 12C-High calculation. Data shown is exclusive to the summer fish bypass season (July and August). The horizontal tan line denotes the compliance threshold.

Rocky Reach Forebay 115% 12C-High Standard

There 10 days in 2020 when TDG values in the Rocky Reach Forebay, as calculated as the 12C- High, rose above 115%. The majority of these exceedances were immediately following the spring bypass season and were highly influenced by incoming TDG conditions above Wells Dam coupled with high flows in excess of turbine unit capacity at Wells Dam.

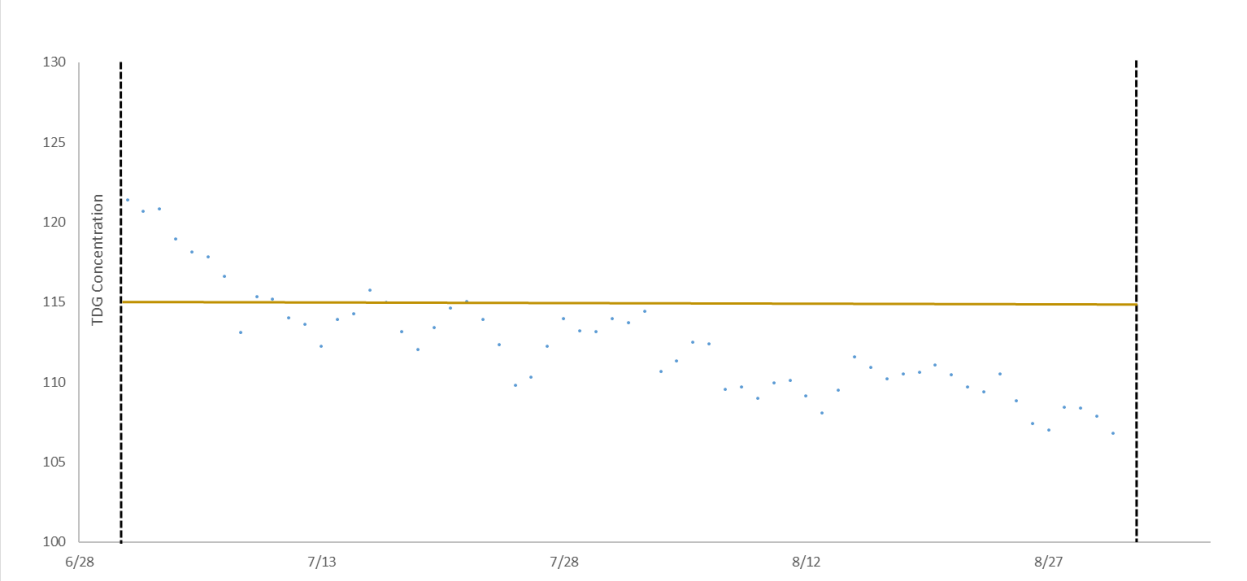

Figure 9. TDG compliance in the Rocky Reach Dam forebay using the 115% 12C-High calculation. Blue dots above the horizontal tan line show dates where exceedances occurred.

3.5.4 Yearly TDG Compliance Summary

Table 4. TDG compliance at the Wells Project for the entire 2020 season. *Removed one day on June 7, 2020 due to flows in excess of 7Q-10 flows.

		Compliance
April - June	**Wells Tailrace 125% - Mean 12 Highest Hourly / Day**	
	Non-compliant days	4
	Total days	90
	DCPUD compliance	**95.6%**
	Wells Tailrace 126% - Two Consecutive Hourly Values	
	Non-compliant days	4*
	Total days	90
	DCPUD compliance	**95.6%**
July & August	**Wells Tailrace 125% Hourly Standard**	
	Non-compliant days	1
	Total days	61
	DCPUD compliance	**98.4%**
	Wells Tailrace 120% 12C-High Standard (one day)	
	Non-compliant days	3
	Total days	61
	DCPUD compliance	**95.1%**
	Rocky Reach Forebay 115% 12C-High Standard (one day)	
	Non-compliant days	10
	Total days	61
	DCPUD compliance	**83.6%**
Jan - Mar & Sept - Dec	**Wells Tailrace <110% Standard**	
	Non-compliant days	4
	Total days	211
	DCPUD compliance	**98.1%**

4 DISCUSSION OF GAS ABATEMENT MEASURES

4.1 Water Quality Attainment Plan Activities

As required by the Wells Project 401 Certification, Douglas PUD developed a Water Quality Attainment Plan (WQAP) that was approved by Ecology and the FERC in 2013. The WQAP provides a detailed strategy for achieving compliance with the TDG state WQS within a required ten-year timeframe (i.e., compliance schedule). The compliance schedule outlines a step-wise approach toward meeting compliance with the TDG WQS. In 2020 (Year 7), the WQAP called for continued adaptive management and implementation of the Spill Playbook, biological monitoring (i.e., GBT monitoring in biota, as needed), and the identification of key Project operating parameters that could be used towards developing a database that would house fine-scale operation data. Future year's data would be used to identify fine-scale operation changes that might improve TDG compliance.

Although allowable by the WQAP no modifications were made to the Spill Playbook. Biological monitoring (i.e., GBT monitoring in biota, as needed) continued in 2020 toward determining the impact of salmonids when exposed to TDG values above standards.

Notably, in the spring of 2016 (year 3) Douglas PUD reviewed Wells Project operations data collection with Wells Dam Hydro Operations staff and the Information Systems Department. The objective of this analysis was to conduct a comprehensive evaluation of both operational and structural data collection that could ultimately improve compliance with the TDG WQS criteria. A fine-scale spill-data collection database was completed in 2017 (year 4). New data includes spillbay "openness" indication on nine of the eleven spillways (most frequently used). In addition, a new energy accounting system was developed in 2017. This new data collection process should allow for Douglas PUD to collect robust operations data over the balance of the WQAP. This new data can be used for subsequent modeling, if necessary, and towards improving compliance. As of 2017, data was being collected to meet the schedule of the WQAP Implementation Plan.

The IIHR TDG model suite (i.e., rigid lid and VOF models) developed during the Wells Project relicensing process in 2008 was operated under a set of assumptions (as required for all quantitative predictive models) for hydrodynamic characteristics such as gas volume fraction, bubble size, various free-surface features, and incoming TDG levels. However, Douglas PUD has no data that supports improving or modifying model assumptions. Rather, over the last five years, spill volume seems to be the most important variable in determining TDG addition at Wells Dam. Improved turbine unit reliability and improved turbine unit capacity is expected to occur once the rebuild of the 10 units at Wells Dam is complete. Having ten units available is expected to improve TDG performance over the next five years, potentially allowing the District to become fully complaint with the WQS when flows are below 7Q-10 volumes. Since 2013 Wells Dam has never had ten units available, since at least one unit has been out for extended unit rebuild each year.

4.2 Operational

Flows at Wells Dam were approximately average in 2020 (Table 1; Figures 2, 10 & 11). Increasing flows towards the end of May and subsquent river forecasting led to the removal of a bypass barrier on May 28 and was subsquently reinstalled on June 16. Higher flows again required its removal on June 26 and subsquenly reinstalled on July 6. Notably these high flows were the proximate cause of most TDG excedances showing in Figures 5 through 8. The removal of the bypass barrier follows the approval Emergency Action Plan, Bypass Operating Plan and GAP for the calendar year. With the bypass system and Spill Playbook operating normally, Douglas PUD was able to demonstrate exceptionally high TDG compliance with Washington State WQS in 2020. System Operator training and additional Energy Accounting System (EAS) enhancements are expected to further improve TDG performance outside of the bypass period when the WQS is 110%.

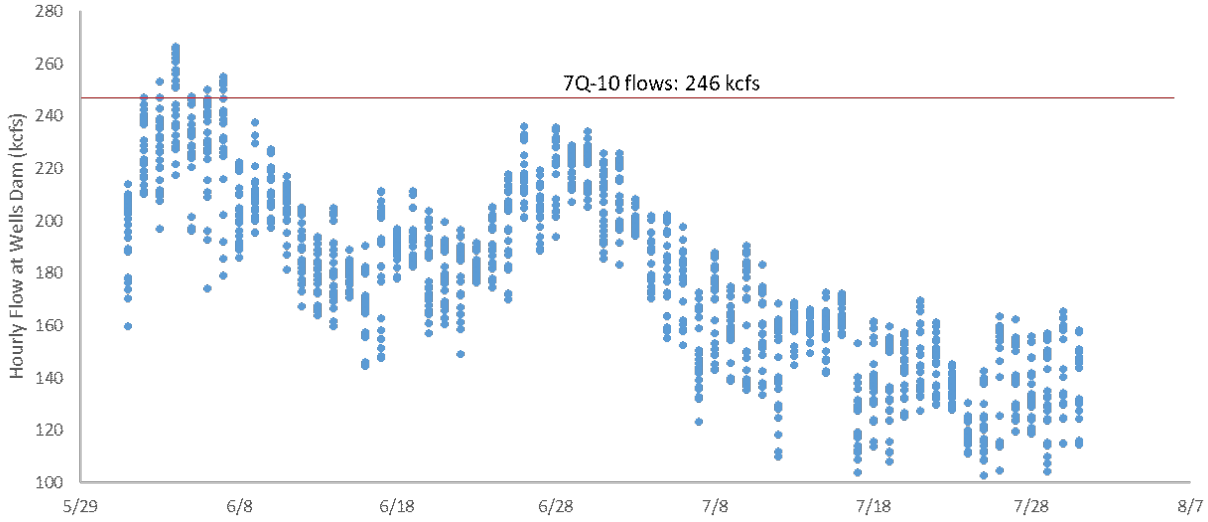

Figure 10. Hourly flow data at Wells Dam in June and July when freshet flows were highest in 2020. Blue dots above the horizontal red line show dates where flows in excess of 7Q-10 flows occurred.

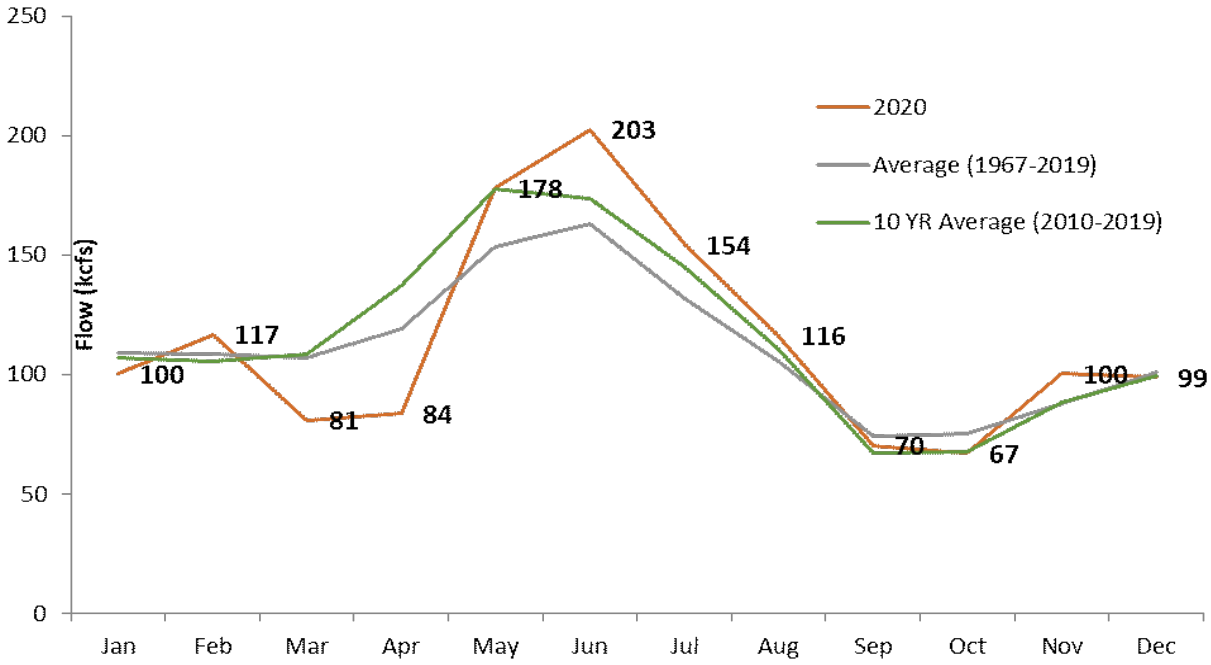

Figure 11. **Average daily flows at Wells Dam during 2020 relative to the ten year and operational average.**

4.3 Structural

No permanent structural modifications were proposed or completed during the 2020 monitoring season.

5 CONCLUSIONS

TDG performance at Wells Dam during the 2020 season was excellent despite high flows in late June of 2020. Results support the continued implementation of the Spill Playbook to manage TDG production through operational means, and suggest future operational performance should result in even higher rates of compliance with TDG standards. Exceedances of the 110% TDG standard occurring outside the bypass period were avoidable and these events are expected to decrease as Douglas PUD puts an emphasis on system operator training, EAS accounting and coordination with control room operators. Douglas PUD will put an emphasis on testing the Spill Playbook in years where ten units are available 95% of the time (normal reliability). The ongoing turbine rebuild project currently only provides 9 out of 10 units for operation during the peak hydrograph, thereby reducing the amount of water that can be passed through the turbine units by approximately 15-20 kcfs and therefore makes compliance more challenging, since this water must be spilled. Despite this challenge Douglas PUD has maintained high TDG compliance with WQS. Douglas PUD will work closely with Ecology towards meeting year round TDG standards in subsequent years.

6 REFERENCES

Bickford, S. A., J. R. Skalski, R. Townsend, S. McCutcheon, R. Richmond, R. Frith and R. Fechhelm. 2001. Project survival estimates for yearling summer steelhead migrating through the Wells Hydroelectric Facility, 2000.

Bickford, S. A., T. Kahler, R. Townsend, J. R. Skalski, R. Richmond, S. McCutcheon and R. Fechhelm. 2011. Project survival estimates for yearling Chinook migrating through the Wells Hydroelectric Project, 2010 (2010 spring migrant survival verification study).

EES Consulting, Carroll, J., ENSR, and Parametrix. 2007. Total Dissolved Gas Production Dynamics Study. Wells Hydroelectric Project. FERC No. 2149. Prepared by EES Consulting, Joe Carroll, ENSR, and Parametrix. Environmental Protection Agency (EPA). 1976. Quality Criteria for Water. PB-263943.

Gingerich, A., S.A. Bickford, T. Kahler, J.R. Skalski, R. L. Townsend, R. Richmond, and S. Anglea. 2020. Project Survival Estimates for Yearling Chinook Migrating Through the Wells Hydroelectric Project, 2020 (2020 Spring Migrant Survival Verification Study). Douglas County Public Utility District. East Wenatchee, WA.

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., H. Rueda, M. Herold. 2004. Total Maximum Daily Load for Total Dissolved Gas in the Mid-Columbia River and Lake Roosevelt. Submittal Report. Washington Department of Ecology, Olympia, WA. U.S. Environmental Protection Agency, Portland, OR. June 2004. Publication No. 04-03-002.

Politano, M., A. Arenas Amado and L. Weber. 2009. An Investigation into the Total Dissolved Gas Dynamics of the Wells Project (Total Dissolved Gas Evaluation). Report prepared by IIHR-Hydroscience & Engineering, University of Iowa, Iowa City, Iowa.

Skalski, J. R., G.E. Johnson, C.M. Sullivan, E. Kudera, and M.W. Erho. 1996. Statistical evaluation of turbine bypass efficiency at Wells Dam on the Columbia River, Washington. Canadian Journal of Fisheries and Aquatic Sciences 53:2188-2198.

Skalski, J. R. 2019. Analysis of Proportion of Outmigration Affected by Bypass Operations at Wells Dam in 2019. Columbia Basin Research. University of Washington School of Aquatic Fishery Sciences. Seattle, WA.

APPENDIX B

PRE-FILING CONSULTATION RECORD FOR THE 2020 ANNUAL REPORT TOTAL DISSOLVED GAS ABATEMENT PLAN WELLS HYDROELECTRIC PROJECT

Document Accession #: 20210223-5087 Filed Date: 02/23/2021

NOTICE TO AQUATIC SETTLEMENT WORK GROUP TO REVIEW THE TOTAL DISSOLVED GAS ABATEMENT PLAN 2020 ANNUAL REPORT

From: Kristi Geris <kgeris@anchorqea.com>
Sent: Tuesday, January 12, 2021 2:07 PM
To: Andrew Gingerich; Chas Kyger; Donella Miller (mild@yakamafish-nsn.gov); Jason McLellan; John Ferguson; Kristi Geris; Laura.Heironimus@dfw.wa.gov; Mark Peterschmidt (mape461@ecy.wa.gov); Patrick Verhey (Patrick.Verhey@dfw.wa.gov); Ralph Lampman (lamr@yakamafish-nsn.gov); Sean Goudy (gous@yakamafish-nsn.gov); 'Steve Lewis'; Zimmerman, Breean (ECY)
Subject: FW: 2020 TDG GAP Annual Report
Attachments: 2021_01_12 Douglas - Draft 2020 TDG GAP Annual Report.doc

Follow Up Flag: Follow up
Flag Status: Flagged

Hi ASWG Reps: please see the email below from Andrew and the attached draft 2020 TDG GAP Annual Report, which is available for review with edits and comments due to Andrew by **Monday, February 8, 2021**, and decision during the ASWG 2/11 conference call.

The attached draft report is also available for download from the Aquatic SWG Extranet Site, under: Documents > All by Mtg Date > 1/13/2021 (instructions below). Thanks! –Kristi ☺

Instructions:

To gain access to the Aquatic SWG Extranet Homepage, please use the following procedure:

* Visit: https://extranet.dcpud.net/sites/nr/aswg/
* Login using "Forms Authentication" (for non-Douglas PUD employees)

You should now be at the Aquatic SWG homepage.

If you encounter problems, or need a login username and password to access the site:
Please feel free to contact me, Andrew Gingerich, or Julene McGregor [jmcgregor@dcpud.org; (509) 881-2236] and we will gladly assist you with questions or issues.

Kristi Geris

ANCHOR QEA, LLC
kgeris@anchorqea.com
C 360.220.3988

From: Andrew Gingerich <andrewg@dcpud.org>
Sent: Tuesday, January 12, 2021 14:37
To: Kristi Geris <kgeris@anchorqea.com>
Subject: 2020 TDG GAP Annual Report

CAUTION – EXTERNAL EMAIL: This email originated from outside of Anchor QEA. Please exercise caution with links and attachments.

Kristi, please find attached a draft 2020 TDG/GAP report for the Wells Project. Like the recently distributed 2021 Gas Abatement Plan and Bypass Operating Plan, the attached report is due to the FERC by Feb 28th of each calendar year.

I will discuss this document during our Aquatic SWG call tomorrow, January 13, 2021. I am hoping that Aquatic SWG membership can send me comments, if any, by Monday February 8, 2021 towards approving this document during the Feb. 10th, 2021 conference call.

Thanks
Andrew

Andrew Gingerich
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Douglas County Public Utility District
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East Wenatchee, WA 98802
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O: (509) 881-2323

FINAL AQUATIC SETTLEMENT WORK GROUP ACTION ITEMS SHOWING APPROVAL OF TOTAL DISSOLVED GAS ABATEMENT PLAN 2020 ANNUAL REPORT

Document Accession #: 20210223-5087 Filed Date: 02/23/2021

FINAL

Conference Call Action Items

Aquatic Settlement Work Group

To: Aquatic SWG Parties **Date**: February 12, 2021

From: John Ferguson, Chair (Anchor QEA, LLC)

Re: Final Action Items of the February 10, 2021 Aquatic SWG Conference Call

[redacted]

Attendees are listed in Attachment A. These action items include the following:

I. Summary of Action Items

1. Douglas PUD will distribute the dimensions (width and thickness) of the metal plating installed to minimize gaps throughout the Wells Dam fishways (Item VI-7).
2. Aquatic SWG members will review the presentation titled, *Summary of Douglas PUD Adult Lamprey Passage Studies 2007-2020*, in preparation to further discuss next steps during the Aquatic SWG conference call on March 10, 2021 (Item VI-9).
3. The Aquatic SWG meeting on March 10, 2021, will be held by conference call (Item VII-1).

II. Summary of Decisions

1. Aquatic SWG members present approved the study plan, *Bull Trout Passage and Take Monitoring at Wells Dam and Twisp River Weir* (2021–2022 Bull Trout Radio Telemetry Study Plan), as revised (Item VI-3).
2. [redacted]
3. Aquatic SWG members present approved the plan, *2021 Total Dissolved Gas Abatement Plan* and appended *Wells Bypass Operating Plan* (2021 GAP/BOP), as revised (Item VI-4).
4. Aquatic SWG members present approved the *2021 Aquatic Settlement Agreement and Workgroup Action Plan* (2021 ASA Action Plan), as revised (Item VI-5).

III. Agreements

1. There were no agreements discussed during today's conference call.

Document Accession #: 20210223-5087 Filed Date: 02/23/2021

FINAL

IV. Review Items

1. The presentation titled, *Summary of Douglas PUD Adult Lamprey Passage Studies 2007-2020*, was distributed to the Aquatic SWG by Kristi Geris on February 10, 2021, and is available for review in preparation for further discussion during the Aquatic SWG conference call on March 10, 2021 (Item VI-9).

V. Documents Finalized

1. The final 2021–2022 Bull Trout Radio Telemetry Study Plan, as revised, was distributed to the Aquatic SWG by Kristi Geris on February 10, 2021 (Item VI-3).
2. The final 2021 ASA Action Plan, as revised, was distributed to the Aquatic SWG by Kristi Geris on February 10, 2021 (Item VI-5).

Document Accession #: 20210223-5087 Filed Date: 02/23/2021

FINAL

Attachment A – List of Attendees

Name	Role	Organization
John Ferguson	Aquatic SWG Chairman	Anchor QEA, LLC
Kristi Geris	Administration/Technical Support	Anchor QEA, LLC
Andrew Gingerich	Aquatic SWG Technical Representative	Douglas PUD
Chas Kyger	Aquatic SWG Technical Alternate	Douglas PUD
Steve Lewis	Aquatic SWG Technical Representative	U.S. Fish and Wildlife Service
RD Nelle	Aquatic SWG Technical Support	U.S. Fish and Wildlife Service
Breean Zimmerman	Aquatic SWG Technical Representative	Washington State Department of Ecology
Patrick Verhey	Aquatic SWG Technical Representative	Washington Department of Fish and Wildlife
Laura Heironimus	Aquatic SWG Technical Alternate	Washington Department of Fish and Wildlife
Monica Blanchard*	Aquatic SWG Technical Support	Washington Department of Fish and Wildlife
Ralph Lampman	Aquatic SWG Technical Representative	Yakama Nation
Jason McLellan	Aquatic SWG Technical Representative	Colville Confederated Tribes

Notes:
* Joined conference call at the end of the *Pacific Lamprey – Past Studies, Translocation, and Study Plan Development* discussion.

Document Content(s)

Final 2020 TDG GAP Annual Report.PDF 1