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MEMORANDUM

TO: Fish Passage Advisory Committee

FROM: Michele DeHart

DATE: June 7, 2018

SUBJECT: Bonneville Forebay Total Dissolved Gas, Washington Methodology

During the Fish Passage Advisory Committee (FPAC) conference call on Tuesday, June 5, 2018, it was noted that the estimate of 12-hour average Total Dissolved Gas (TDG) in the Bonneville forebay for June 4th was 120%, even though the hourly data for that day were well below 120%. During this discussion, the Fish Passage Center (FPC) staff explained that this was a function of the methodology used by the Washington State Department of Ecology (DOE) to estimate 12-hour average TDG. In response to FPAC's request, we are providing this memorandum as a summary of the background of the Washington methodology and an example of how this methodology recently led to the TDG exceedance at the Bonneville forebay monitor on June 4th. Below is a brief summary of our findings, followed by more detailed information.

- In a 2007 memo to DOE and DEQ, the FPC cautioning against the use of rolling averages to estimate 12-hour average TDG, as it resulted in more instances of exceeding the TDG waiver criteria. This was largely due to a rolling average methodology including TDG data from the previous day (i.e., "edge" hours).
- In a 2008 letter to the Columbia and Snake River Dam Spill Operators, DOE acknowledged that the use of a rolling average would result additional exceedances due to this "double counting" issue. DOE also specified that it would continue to use its enforcement discretion for identified exceedances during these fish spill events.
- Although the rolling average methodology was adopted by DOE in 2008, the COE did not implement it for compliance until 2014.
- The instance identified at the Bonneville forebay on June 4th is an excellent example of this "edge" effect or "double counting" issue.

- For this request, the FPC did not attempt to identify how often the Washington rolling average methodology has led to additional exceedances since its implementation by the COE. However, this review indicates that such a review is warranted to assess how often this has happened in recent years. This is particularly important as the region considers potential operational options that may include managing to spill caps for the future.

Background

In 2007, DOE requested the FPC to evaluate alternative methods of estimating the 12-hour average TDG, compared to the method that was currently being used. At that time, COE and the Oregon Department of Environmental Quality (DEQ) were considering changing the measurement of the 12-hour average from the highest 12 TDG readings in a calendar day (not necessarily consecutive hours) to the average of 12 consecutive hours. In our evaluation of potential alternative methodologies, the FPC recommended that DOE and DEQ not use a rolling average alternative, as this method will artificially produce more days of TDG exceedances, when compared to the current procedure and other procedures that were evaluated (FPC 2007). The increase in exceedances under the rolling average methodology was due to the fact that the reported 12-hour average TDG for a given day may contain hours from the previous day and, therefore, may be influenced by TDG in the “edge” hours from that day. FPC stated concern that this overestimation of TDG exceedances may lead to unnecessary reductions in spill or longer periods of reduced spill for juvenile salmonids.

Oregon DEQ ultimately decided not to change the methodology for estimating the 12-hour average TDG. However, DOE decided to adopt a new methodology, which was based on a series of rolling averages. In a May 21, 2008 letter to the Columbia and Snake River Dam Spill Operators, Washington DOE outlined its rationale for this new methodology, along with a clarification of the methodology (http://pweb.crohms.org/ftp/pub/water_quality/12hr/WA_TDG_Calculation.pdf). Below is an excerpt from this letter, outlining the methodology for calculating the 12-hour average:

Method: Use a rolling average to measure 12 consecutive hours. The highest 12 hour average in 24 hours is reported on the calendar day (ending at midnight) of the final measurement.

- *The first average period of each calendar day begins with the first hourly measurement at 1:00 am. This hour is averaged with the previous day's last 11 hourly measurements.*
- *Each subsequent hourly measurement is averaged with the previous 11 hours until there are 24 averaged for the day.*
- *From the 24 hour averages, the highest average is reported for the calendar day.*
- *Round the 12 hour average to the nearest whole number.*

In this letter, DOE states, “On occasion a rolling average will result in reporting an exceedance occurring on a calendar day using some of the same hours to calculate an exceedance

that occurred on the previous day (called double-counting)”. The letter also indicated that DOE would continue to use its enforcement discretion for identified exceedances during these fish spill events.

Although the new DOE methodology was developed in 2008, it was not implemented for compliance at FCRPS projects until 2014. By this time, DOE and DEQ also had different points of compliance, as DEQ removed forebay monitors as a point of compliance from their TDG waivers. The forebay monitors were retained as a point of compliance in the Washington TDG waiver. Therefore, the Washington methodology is applied at all lower Snake River projects and at the forebay monitors in the Mid-Columbia River (McNary, John Day, The Dalles, and Bonneville). Both the Oregon and Washington methodologies are applied at the tailrace monitors at the Mid-Columbia projects. On any given day, the compliance of the tailrace monitors at the Mid-Columbia projects is determined using either the Washington or Oregon methodology, whichever is the most restrictive.

Recent Example of Extra Exceedance at Bonneville Dam Forebay

Due to flows in excess of hydraulic capacity, spill volumes at the Mid-Columbia FCRPS projects have exceeded the 115%/120% spill caps since late April. As a result, 12-hour average TDG in the tailraces and downstream forebays have generally exceeded the 120% and/or 115% waiver limits. However, in recent days, decreases in flows have resulted in decreases in spill volumes in the Mid-Columbia River, which have led to decreases in 12-hour average TDG levels. By June 4th, the 12-hour average TDG in the John Day (JHAW) and The Dalles (TDDO) tailraces were below the 120% waiver limit and TDG in The Dalles forebay (TDA) was below the 115% standard (Figure 1). However, the reported 12-hour average TDG in the Bonneville forebay (BON) was 120%, which exceeded the 115% waiver limit (Figure 1).

Combined Percent TDG Tracking - Jun 2018																						
Station:	CHJ	CHQW	WSBW	WEL	LWG	LGNW	LGSA	LGSW	LMNA	LMNW	IHRA	IDSW	MCNA	MCPW	JDY	JHAW	TDA	TDDO	BON	CCIW	WRNO	CWMW
Gas Cap %:	110	110		115	115	120	115	120	115	120	115	120	115	120	115	120	115	120	115	120	120	
Method:	Comb	Comb	Comb	Comb	Comb	Comb	Comb	Comb	Comb	Comb	Comb	Comb	Comb	Comb	Comb	Comb	Comb	Comb	Comb	Comb	Comb	Comb
06/01/2018	121	123	120	118	105	118	115	123	124	121	121	123	118	123	117	121	115	119	119	*	122	122
06/02/2018	120	122	119	118	105	117	112	123	123	122	118	125	117	123	117	122	119	121	123	*	125	123
06/03/2018	121	119	119	118	107	115	114	118	124	119	121	120	121	122	117	120	119	120	123	*	125	123
06/04/2018	121	119	119	118	107	115	114	114	120	115	121	119	120	121	116	119	114	114	120	*	121	121
06/05/2018	120	121	119	118	106	115	112	115	115	116	118	119	118	120	117	119	116	117	115	*	119	117
06/06/2018	120	118	118	118	104	115	111	113	114	115	115	119	117	120	117	119	116	118	115	-	118	116
06/07/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/08/2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Figure 1. Screenshot of the “Combined Percent TDG Tracking – Jun 2018” website provided by the COE, as of the morning of June 6, 2018. http://pweb.crohms.org/ftppub/water_quality/12hr/201806.html

During the FPAC conference call on June 5th, it was noted that, the reported 12-hour average TDG for June 4th at the Bonneville forebay was 120%, even though the hourly TDG measurements for that day only ranged from 113.1% to 117.9% (Figure 2). The FPC pointed out that, although the hourly measurements on June 4th were low, the reported 12-hour average was

based on the Washington methodology, which includes up to 11 hours of TDG measurements from the previous day. Below is a more detailed breakdown of the hourly TDG data from the Bonneville forebay monitor from May 31st through June 5th (Figure 2). Data for May 31st are provided because some hourly measurements from this day are used in the rolling averages for June 1st. Along with the hourly TDG data, Figure 4 provides estimates of the Washington methodology rolling averages and the reported 12-hour average TDG, as reported on the COE website (http://pweb.crohms.org/ftppub/water_quality/12hr/201806.html) for June 1st through June 5th. Finally, to illustrate how the use of the Washington methodology lead to an additional exceedance event, we provide estimates of the 12-hour average TDG, based on the Oregon methodology.

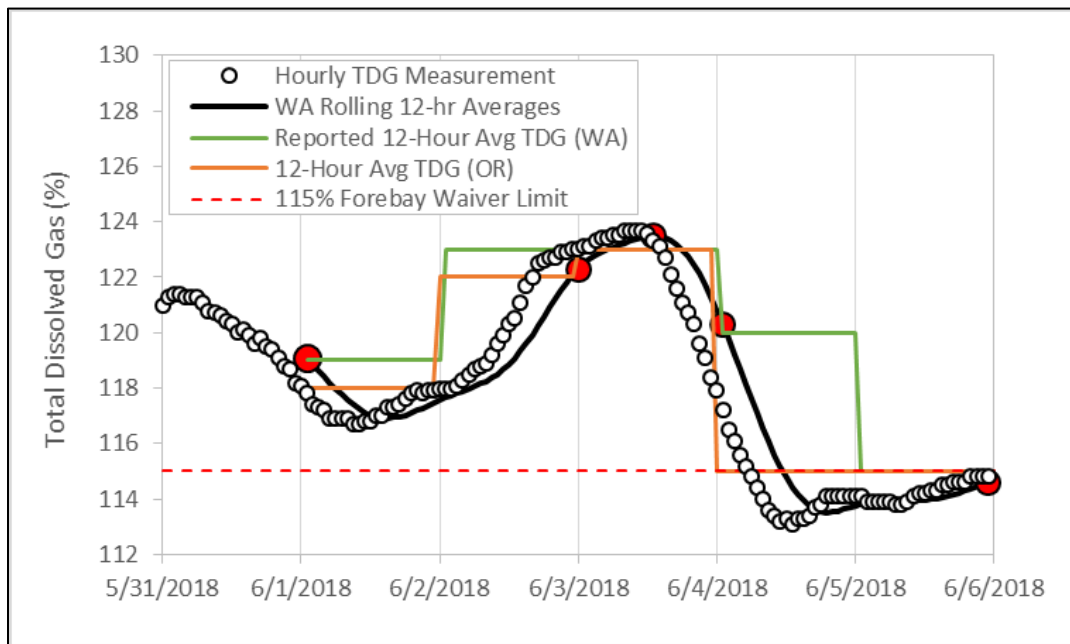


Figure 2. Hourly TDG, Washington methodology rolling averages, reported 12-hour average TDG, and estimated 12-hour average TDG using Oregon methodology at the Bonneville Forebay monitor, May 31 (1300) to June 5 (2400). Red data points are the maximum of the 24 rolling averages. This maximum of the rolling averages is rounded to the nearest whole number and reported as the 12-hour average for compliance.

From these data, a few things are evident. First, it is clear that the Washington methodology resulted in higher estimates of 12-hour average TDG on June 1st, June 2nd, and June 4th, when compared to the Oregon methodology (Figure 2). The 12-hour average TDG for the two methodologies were virtually the same on June 3rd and June 5th. Second, while both methodologies resulted in exceedances on June 1st through June 3rd, only the Washington methodology resulted in an exceedance on June 4th. The hourly TDG measurements decreased rapidly from the afternoon of June 3rd through the afternoon of June 4th (Figure 2). However, hourly TDG measurements did not fall below 115% until 0600 on June 4th. Because the hourly TDG measurements from the afternoon of June 3rd are included in the rolling averages for June 4th, the maximum rolling average (i.e., reported 12-hour average) for June 4th was 120%, which

was based on 11 hours from June 3rd (1400-2400) and one hour from June 4th (0100). The Oregon methodology did not result in an exceedance for June 4th.

Conclusions/Recommendations:

For this request, the FPC did not attempt to identify how often the Washington methodology has led to additional exceedances since it was implemented by the COE. However, this review indicates that such a review is warranted to assess how often this has happened in recent years. This is particularly important as the region considers potential operational options that may include managing to spill caps for the future. For example, if the rolling average methodology results in additional instances of exceedance, than it is possible that reductions in spill caps may be premature or increases may be delayed as a result of this double counting.

Literature Cited:

Fish Passage Center. 2007. Potential ways to calculate total dissolved gas in the Columbia and Snake Rivers to determine compliance with the water quality standard.

<http://www.fpc.org/documents/memos/42-07.pdf>