

**Columbia River Regional Forum
2008 Spill Season TDG Monitoring Year-End Review
November 20, 2008**

1. Welcome and Introductions

The region's annual review of TDG monitoring results for the 2008 spill season was chaired by Jim Adams (COE), with representatives from USGS, COE, NOAA, FPC, BPA, Douglas County PUD, Grant County PUD, and others participating. The following is a summary (not a verbatim transcript) of the topics discussed and decisions made at the meeting. Anyone with questions or comments about these notes should send them to the meeting chair.

The meeting focused on reports of 2008 spill season monitoring results from the COE's Portland, Seattle and Walla Walla districts; the BOR as represented by Columbia Basin Environmental; and Douglas and Grant County PUDs. Representatives of BOR and Chelan County PUD were unable to attend today's meeting.

2. Portland District TDG Monitoring Analysis

Dwight Tanner (USGS) gave a presentation on TDG monitoring of gages at dam forebays and tailwaters along the lower Columbia River. His review covered TDG monitoring at John Day, The Dalles and Bonneville dams, and the Camas-Washougal gage below Bonneville Dam.

The 2008 spill season was a good one, Tanner said. There were some TDG readings above the state standard of 115% in the forebay and 120% in the tailrace, which is typical. Temperatures throughout the river stayed above 20 degrees Celsius from July through September 2008, also typical. Field checks showed the 2008 USGS data to be very reliable – 93 times throughout the year, a side-by-side check of all gages found readings were accurate within 1% degree of saturation, 2 mm of mercury for the barometer check, and 0.2 degrees C for the thermometer check. Altogether, 99.6% of data transmitted in real time in 2008 met USGS's quality control guidelines.

Summer 2008 was a season of high spill and high TDG levels. During May, all sites spilled over 150 kcfs, making that month a focus of concern for high TDG levels. Tanner presented data showing that spill levels above 150 kcfs are consistently associated with TDG levels over 120% in the tailrace. The high spill levels of 2008 meant the Cascade Island gage directly below Bonneville Dam produced TDG saturation levels of up to 150% in May. Overall, TDG values tend to rise as water moves downstream, indicating that the river does not degass itself between sites.

The biggest loss of USGS data in 2008 was 103 hours at John Day tailwater when the gage membrane ruptured and there was no backup measurement. Cascade Island gage also had a broken membrane in 2008, but the data were later retrieved. Warrandale and Camas-Washougal gages had antennae problems during an ice storm and failed to transmit data. Additional data were lost due to ships parking in front of the transformer.

Margaret Filardo (FPC) asked about the variability of readings at the two sensors of Camas-Washougal gage. The site is turbulent and often has high TDG values, but a quality-control check showed the values were real, Tanner replied. Field checks involving side-by-side readings and in-lab testing showed that 99% of the readings in 2008 were accurate within plus or minus 0.5% saturation, Joe Rinella (USGS) said. That's a high level of reliability. Any sensors that don't meet post-checks in the lab are recalibrated, Tanner added.

Winter monitoring continues at three sites below the dams. USGS recalibrates its gages at two-week intervals during summer and at three-week intervals during winter. USGS will publish the data described today in a report, to be available online at the USGS website.

3. Seattle District TDG Monitoring Analysis

Kent Easthouse (COE Seattle) gave a presentation on the COE's monitoring results for Chief Joseph and Libby dams on the Columbia River and Albeni Falls Dam on the Pend Oreille River. This work involves recalibrating monitors at five sites every two weeks. The main hurdle in 2008 has been the switch from using DCP to "Sutron" (SPELLING?) monitoring equipment, which malfunctioned and caused data loss in 2008. This problem most likely has been resolved.

Albeni Falls Dam was on free flow during the summer of 2008. The forebay station sank during free-flow and had to be redeployed. So, unlike USGS, the COE's Seattle district didn't have good TDG data completeness this year for Albeni Falls. The same was true for temperature data, mainly due to programming problems and high flows. There were issues when field barometers drifted, requiring numerous adjustments. The main TDG issue at Albeni Falls appears to be lower spill levels of around 30 kcfs or less. There could also be a problem with undergrowth, meaning not much water is passing through the shallow measuring station.

During summer 2008, Chief Joseph Dam wasn't able to spill through all of its deflectors because of ongoing construction and a cofferdam in the forebay. A pattern emerged at Chief Joseph: when forebay TDG levels were over 125%, tailwater readings were often less than 120%. During most of the time Chief Joseph Dam spilled, tailwater TDG levels were generally lower than forebay levels. It appears the Chief Joseph deflectors work fairly well, to be confirmed by

a formal spill test in spring 2009. Rudd Turner (COE) asked what TDG conditions were like at Wells Dam when gas saturation levels coming into Chief Joseph forebay were over 125%. Readings at Wells Dam were higher than 115% for a few days this spring, Rick Klinge (Douglas PUD) replied. This year, it appeared that gas was entering the system at higher saturation levels than usual, for reasons that are not yet known.

In 2008, TDG levels at Libby Dam exceeded 110% although Libby didn't spill. This could have been caused by a calibration issue, Easthouse said. Monitoring equipment is usually set up in the river by end March, but this year the work got behind schedule. If Libby and Albeni Falls stations aren't destroyed by high flows, they are typically repaired in March when forebay elevations are low, such as the present Libby operating range of 2,051-2,051.5 feet.

Typically the gages below Bonneville Dam, e.g. Cascade Island and Warrandale, are installed by late February or early March as needed for Spring Creek Hatchery operations.

4. Walla Walla District TDG Monitoring Analysis

Bob Kimbrough (COE Walla Walla) gave a presentation. The district operated 15 TDG monitoring stations, of which 6 operate full time and 5 are operated seasonally. Typically these stations equivocate within plus or minus 2 millimeters when checked in the field. If the difference exceeds 2 millimeters, a third gage is deployed to see which reading is correct. The COE Walla Walla district upgraded all DCP's, then changed back to "Sutron" at all projects except Dworshak, due to communication problems with the (NAME?) fish hatchery.

Data completeness was 99.7% for 2008. Barometric pressure and total dissolved gas readings were 99.97% accurate according to field checks. The COE Walla Walla division lost 333 hours of data in 2008, or 0.4% of the total transmitted data for Dworshak Dam, much of it when a gage failed on a Friday and wasn't fixed over the weekend. Of data losses in 2008, 6% were due to bad membranes and 26% were due to DCP failure. There was some discussion of sediment buildup at sites leading to membrane failures.

Field checks showed that all of the 2008 water quality data were accurate within plus or minus 2 millimeters of mercury, and 50% of the data were accurate within plus or minus 0.5 millimeters of mercury. Field checks using hand-held barometers showed that almost all data agreed within plus or minus 1 millimeter of mercury. Water temperature gages also had good agreement with field checks, the two readings being within 0.2 degrees Celsius of each other. Measurements of TDG saturation were in close agreement with field checks, a difference of no more than 0.5% saturation for almost all data. At all 15 sites, just 0.4% of data were missing. This was a very good data-collection year for the COE Walla Walla district.

5. Bureau of Reclamation TDG Monitoring Analysis

John Lemons (Columbia Basin Environmental) gave a presentation on behalf of Norbert Cannon (BOR), who could not attend today. The BOR maintains 4 monitoring sites, one at the international boundary of Lake Roosevelt on the Columbia River, one each at the Grand Coulee Dam forebay and tailwater, and one at the Hungry Horse Dam tailwater at the north fork of the Flathead River in Montana. Every year, an operational change in selective withdrawals at Hungry Horse Dam results in falling temperatures. Data for the international boundary site show how much gas came into the system from upstream. The Grand Coulee forebay is usually maintained at a 60-foot depth, adjusted manually. Elevations vary by as much as 10 feet at Grand Coulee, but this doesn't seem to affect water quality data.

Lemons presented statistics for summer 2008 and for the past 5 summers. All calibration of temperatures gages generally fell within a few millimeters of accuracy. The international boundary site and the two sites at Grand Coulee Dam are maintained and calibrated year-round, while the Hungry Horse site is seasonal, operating from late March to early October. During the summer, gages are calibrated every two weeks; in the winter, once a month.

There was discussion of the SWIMS database, which is under development but still running parallel with the existing database. There are issues with the SWIMS database which is why it's not the official database yet, Laura Hamilton (COE) said. When the Oracle platform becomes operational, possibly by next year, all data for a particular site will be easily accessible, Adams said.

6. Grant County PUD TDG Monitoring Analysis

Ross Hendrick (Grant County PUD) presented quality control and monitoring results for 2008 and explained how Grant PUD applies its 7Q10 waiver (the 7-day, 10-year average flow for a dam, expressed in cubic feet per second). In 2008, Grant PUD got a new fish bypass system at Wanapum Dam as well as a new 44-year FERC license to operate Wanapum and Priest Rapids dams. Grant PUD has its own website where 72-hour data on total flow, spill, percent saturation, and barometric readings are posted with a 2-hour delay from collection time. The website also provides a monthly summary with hourly data for each day.

Grant PUD calibrates its gages every 2 weeks during spill season and every 3 weeks during non-spill season. Existing probe data are compared with the QA/QC probe and a newly calibrated probe to check accuracy. In 2008 Grant PUD spilled from April 30 to Aug. 18 in accordance with its BiOp requirements, which base the start of spill season on the number of fish that have passed Rock

Island Dam. Data were lost this year at the Priest Rapids tailrace site due to software problems, but overall there was only a 1.5% total loss of data for all readings from April 30 to Aug. 18, 2008.

In 2008, Grant PUD began applying new Washington state standards to the calculation of TDG values. There was discussion of the double-counting issue that can occur toward the end of a day when TDG values are calculated consecutively under the Washington state standard. High values at the end of one day can cause exceedances early the next day when exceedances are based on an average of 12 consecutive hours. The WDOE is aware of the double-counting issue, documented in Grant PUD's annual report. In 2008 there were 19 instances of double counting in calculating TDG exceedances at Priest Rapids Dam using the new Washington method.

In 2008, Grant PUD also applied for a 7Q10 waiver. Washington state dissolved gas standards do not apply if streamflows are above a project's 7Q10 flow rate, which is 264 kcfs for Priest Rapids Dam. Grant PUD has questions about how to apply the 7Q10 exemption. How should delays as gas moves downriver be accounted for? If the mean average of daily flows exceeds the 7Q10 rate, does that mean the whole day is exempt? For 2008, Grant PUD used the same method values to calculate average streamflows as was used to calculate TDG exceedances. If the 12 highest consecutive flow values were above the 7Q10 rate, TDG values for that day were excluded from the Grant PUD annual report. This year there were 10 instances of 7Q10 exemption, mostly in spring and summer.

Hendrick presented monitoring results of percent saturation, daily averages, and the 12 highest consecutive hourly values for each day at Wanapum and Priest Rapids dams. There were cases of incoming flows above 115% TDG in Wanapum forebay. Gaps in the data represent periods when the 7Q10 flow rate was exceeded. Late May through early July was the period of the most exceedances, mainly due to involuntary spill. Currently only 9 units are operating at Priest Rapids, which limits outflows to 131 kcfs at maximum turbine discharge. In 2008 the project had difficulties passing existing inflows, and involuntary spill created gas issues in the tailrace. Grant PUD expects in future to be able to keep TDG levels under 115% in the forebay and 120% in the tailrace. In 2012, turbine units will be installed at Priest Rapids using fish-friendly technology, which should help. There were a few TDG exceedances in 2008 at the Pasco gage, the next compliance point downstream of Priest Rapids tailrace, but most of these were due to the effects of Wanapum Dam, not Priest Rapids.

In 2008, Grant PUD constructed a Wanapum Dam bypass unit whose purpose is to pass the amount of fish needed to maintain established survival rates while spilling to TDG standards. Depending on forebay elevations, the bypass unit can spill up to 20 kcfs a day. In the 2008 passage season, it spilled

up to 20 kcfs of surface-oriented spill 24 hours a day from April 30 to Aug. 20. Preliminary survival results look good.

Grant PUD continues to monitor all TDG requirements and has issued a gas abatement plan for WDOE review. The gas abatement plan and annual reports are available on Grant PUD's website. The gas abatement plan is an annual requirement for a Washington state waiver of the TDG standards. Grant PUD's current 401 water quality certificate says Grant shall meet the standards even during fish spill season up to 115% and 120% for all flows under 264 kcfs by 2010. The gas abatement plan allows 10 years for Grant PUD to put a fish bypass and fish-friendly turbines in place, and if that's not possible, to develop other methods that meet the state standards. Meanwhile, Grant PUD does ongoing gas bubble trauma monitoring throughout spill season, and few instances of GBT were reported in 2008.

7. Douglas County PUD 2008 TDG Monitoring Analysis

Rick Klinge (Douglas County PUD) gave a presentation on Wells Dam, the ninth dam on the Columbia and the last to be built. Douglas PUD is beginning the process of relicensing the dam and will soon work with WDOE on waivers and a 401 water quality certificate.

The monitoring season at Wells Dam runs from April 1 to Sept. 15. Fixed stations in the forebay and tailwater are maintained monthly, transmitting temperature and TDG data via radiotelemetry. This was an unusual year for Douglas PUD with regard to data quality. Past years have had 98-99% data reliability, but this year two probes died and a third was lost in the river. Douglas PUD had to deploy three new probes in 2008, and there was a data gap at the forebay and tailwater stations from June 2 to June 17.

During the typical monitoring period, 2008 was an average year, but June was anything but average. Spill levels at Wells were 128% of average in 2008 as a result of very high flows in spring, with a peak daily average flow of 248 kcfs on May 24. The end of May through June was the period of heaviest spill. Generator capacity at Wells is just under 200 kcfs with 10 units operating; any excess becomes involuntary spill. There was a lot of forced spill throughout the 2008 season, and Wells Dam spilled water without generation for 25% of the 2008 spill season. The 7Q10 flow rate for Wells Dam is 246 kcfs. There were 3 days in 2008 that flows exceeded the 7Q10 rate. Through settlement agreements and habitat conservation plans that both Chelan and Douglas PUDs have in place, their projects don't spill to a gas cap, and must meet instead a certain survival rate for fish passage at that project.

There were 40 days in 2008 when TDG saturation levels of more than 115% entered the Wells Dam forebay, and TDG values in the Wells tailrace went

as high as 130% on a few days. Gas levels were definitely higher this year than normal.

As part of preparing for relicensing, Douglas PUD has been testing gate settings at Wells Dam. The assumption that flat spill tends to reduce gas was tested and found useful up to a point, then it just exacerbates the gas levels. At some point it's best to move flows through one gate, or two gates that are side by side. This technique helped to reduce gas during the high spill events of 2008. There was discussion of whether changes in spill patterns can induce mortality.

8. COE Summary of TDG Exceedances in 2008

Jim Adams gave a presentation on daily exceedances at gages the COE maintains on the Columbia and Snake rivers. The 10-year average for the total number of daily exceedances in a year is 267 for all of these gages. In 2008, it was 515 due to involuntary spill – the second highest number of exceedances in the past 10 years, more exceedances than in 2007 but less than in 2006. Most of the 2008 exceedances were at Camas-Washougal and Cascade Island gages in the vicinity of Bonneville Dam, or the forebay gages at Ice Harbor and Lower Monumental dams. The 2008 exceedances were calculated via the Oregon method, which uses the average of the highest 12 hours in a day instead of the new method which uses the 12 highest consecutive hourly readings. The COE continued to use the old method in 2008 because by judicial order 2008 was a rollover of 2007 river operations. The COE included calculations from both methods this year in its annual report. In 2008, 400 of the 515 exceedances on the Columbia and Snake were due to involuntary flows above spill caps, and 21 were due to exceedances upstream. The outage of two units at Lower Granite didn't affect the number of exceedances, Laura Hamilton reported.

Regarding the new Washington state standard, the COE and mid-Columbia PUDs collaborated on a number of methodologies that could have been used in 2008 to interpret the regulation. Of these, Adams said, the state chose to use the methodology that results in the highest number of exceedances. The Fish Passage Center did a similar analysis with similar results. Using the Washington methodology resulted in 550 exceedances for projects the COE managed in 2008, while using the Oregon methodology resulted in only 515 exceedances based on the same gage readings. The COE hasn't yet done a detailed analysis of this phenomenon. The new Washington approach seems to affect forebays the most, Hamilton added. Spill in 2008 continued until July 4 which is quite late, as spill usually ends around May 8.

The TDG annual review closed with wrap-up discussion of lessons learned. Details of ruptured membranes, equilibration time, and equilibration techniques were exchanged. Joe Rinella (USGS) asked whether the COE foresees the states and fishery agencies coming to consensus at some point on water quality standards during spill season. There's always been a conflict

between fulfilling BiOp spill requirements and meeting the survival targets for each project, all while adhering to water quality criteria, Adams replied. It appears unlikely the requirements of both the BiOp and the Clean Water Act can both be fully met in the next 20 years, so this tradeoff will continue to be a balancing act.

9. COE Draft Plan of Action for Dissolved Gas Monitoring in 2009

The COE requested comments by Dec. 1, 2008, on its draft TDG monitoring plan for 2009. This is basically the same document as the monitoring plan for 2008, with the differences highlighted in “track changes” mode for easy identification. This meeting summary prepared by consultant and writer Pat Vivian.

<i>Name</i>	<i>Affiliation</i>
Jim Adams	COE
Rick Klinge	Douglas PUD
John Lemons	Columbia Basin Environmental
Ross Hendrick	Grant PUD
Heather Bragg	USGS
Laura Hamilton	COE
Joe Rinella	USGS
Gary Fredricks	NOAA
Dwight Tanner	USGS
Margaret Filardo	FPC
Dewey Copeland	USGS
Bob Kimbrough	USGS
Brandon Chockley	FPC
Kathryn Tackley	USACE
Jim Britton	COE Portland
Tina Lundell	COE Portland
John Piccininni	BPA
Matt Johnston	USGS
Steve Juul	COE Walla Walla
Kevin Wright	USGS
Kent Easthouse	COE Seattle

Phone:

Rudd Turner	COE
Richelle Beck	DRA