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MEMORANDUM

TO: Rhett Lawrence, Save Our Wild Salmon Coalition

FROM: Michele DeHart

DATE: April 4, 2011

RE: Estimated reduction in number of total dissolved gas exceedence days if managing to 120% TDG in tailrace monitors

You recently submitted a data request with the following two questions:

1. Based on an analysis of recent data (e.g., 2006-2010, or the last ten years) at the four lower Snake River and four lower Columbia River dams, what is the percentage of TDG exceedences that could have been avoided if spill were managed to the State of Oregon's 120% forebay standard for TDG instead of Washington's 115% forebay standard.
2. Additionally, can you determine what percentage of TDG exceedences could have been avoided if the federal dam system was operated in a manner to help minimize TDG exceedences by shifting the potential for overgeneration around the system, again using the Oregon standard versus the Washington standard?

In response to your first question, the FPC staff has reviewed the past five years of total dissolved gas data at the Federal Columbia River Power System (FCRPS) projects on the Lower Snake River and Lower Columbia River. The total number of days in each year that had exceedences in total dissolved gas under current management practices was estimated. For each year, we also estimated how many of these "exceedence days" may have been avoided if total dissolved gas were managed to 120% in the tailrace only. Below is a brief summary of our findings, followed by a detailed description of our analytical methods and results.

- In each year the total number of TDG "exceedence days" was estimated for each project over a single season. The overall percent of days when the state TDG waivers were exceeded depended on the runoff volume and shape of the runoff.

- Under current management practices, the percent of exceedences for the system as a whole ranged from 11% to 40%. The removal of the forebay waivers decreased the exceedences to 1 to 23% of system-wide exceedence days.
- The effect of the removal of the forebay monitor from TDG management was more extreme at specific projects, rather than for the system as a whole. In some instances all exceedences were eliminated in a single year for specific projects.
- A substantial number of the days under current management where the 115% forebay reading exceeded the TDG criteria, when the upstream tailrace did not exceed the criteria, had tailrace TDG levels less that 119%, suggesting an increased volume of spill could be accommodated.

Historical Context:

Currently, voluntary spill at the FCRPS projects on the Lower Snake River and Lower Columbia Rivers is managed under two water quality waivers for total dissolved gas (TDG): one from Washington Department of Ecology (DOE) and one from the Oregon Department of Environmental Quality (DEQ). Under the current DOE waiver, voluntary spill at each project is managed to 120% TDG at the tailrace monitor directly below the project, or 115% TDG at the forebay monitor at the next downstream project. Under the current DEQ waiver, voluntary spill at each project is managed to 120% TDG at the tailrace monitor only. Under both waivers, TDG is to be estimated as a 12-hour average. However, each agency has a different way of estimating the 12-hour average. The 12-hour average under the DOE methodology is a "rolling average" where the highest of the 12 consecutive hours are used. Under DEQ, the 12-hour average is the average of the highest 12 hours of a day, which may or may not be consecutive hours. The DEQ is for the period of April 1st to August 31st, while the DOE waiver us for the period of "fish passage". Despite the fact that the current DEQ waiver no longer includes the forebay monitors, the FCRPS projects continue to be managed to the more stringent criteria of 120% TDG in the tailrace or 115% TDG in the forebay.

Methods:

For this analysis, FPC staff reviewed TDG data at the FCRPS projects over the past five years (2006-2010) from April 1st to August 31st. Water years 2006 through 2010 were used in this analysis because they represent a wide range of flow conditions (Figures 1 and 2). We reviewed the 12-hour average TDG data at all forebay and tailrace monitors for each of the eight FCRPS projects (16 monitors in all). For this review, we defined an exceedence based on whichever methodology (DEQ or DOE) yielded the highest 12-hour average. These data were downloaded directly from the TMT website for the time periods in our analysis (http://www.nwd-wc.usace.army.mil/ftppub/water_quality/12hr/).

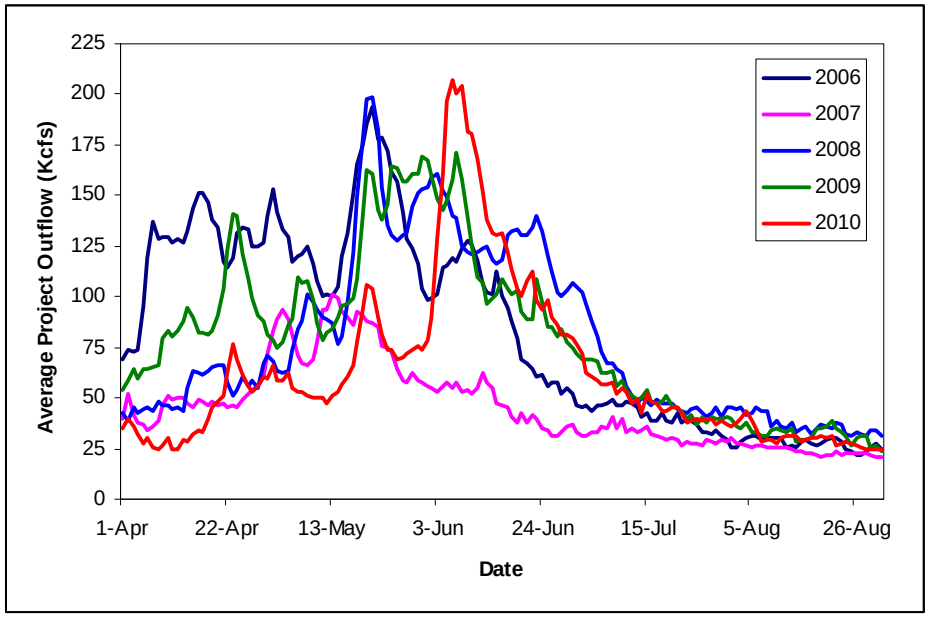

Figure 1. Daily average flows (kcfs) at Lower Granite Dam from April 1st to August 31st (2006-2010)

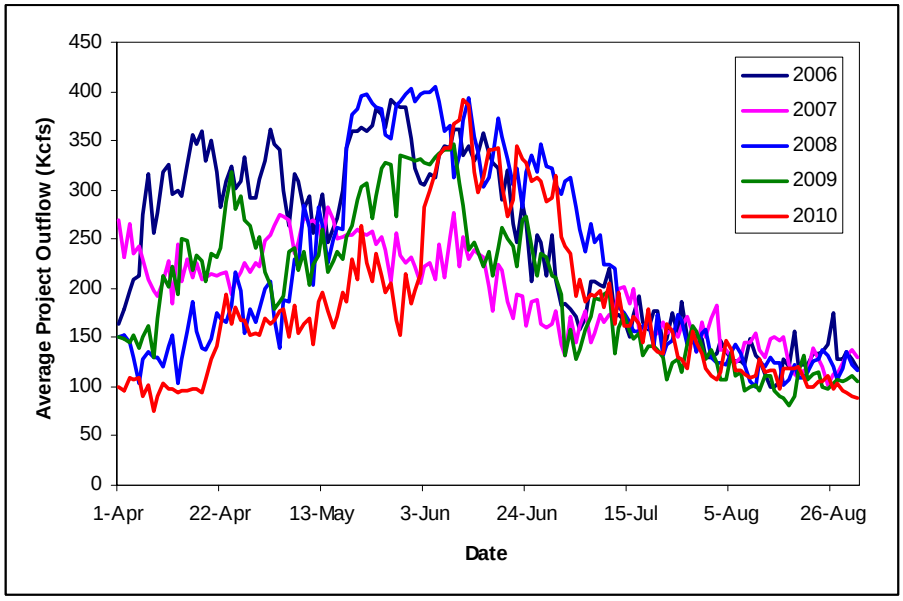

Figure 2. Daily average flows (kcfs) at The Dalles Dam from April 1st to August 31st (2006-2010)

The daily TDG data for each of the monitors was matched with the daily average operational data from the monitor's respective FCRPS project. To match daily spill operations with resulting TDG in the tailrace, we assumed no lag time (i.e., daily average spill resulted in TDG for same day at the tailrace monitor). For the forebay monitors, we estimated a lag time between the daily spill operation and the resulting TDG at the downstream forebay monitor. These lag times were based on daily average project discharge and regressions between average discharge and water transit time.

For each project, daily operations were determined to have resulted in an exceedence or not. An exceedence for the current management scenario was defined as any daily operation that resulted in a 12-hour TDG estimate that was greater than 120% at the tailrace monitor, or 115% at the downstream forebay monitor. This resulted in an estimate of "exceedence days" for each project in each year. For each year, there were a possible 1,224 "exceedence days" (8 projects by 153 days per project). We estimated the number of total "exceedence days" for each year and determined the overall percentage of the days that resulted in exceeding the criteria.

The alternate scenario you asked us to investigate was to remove the forebay monitors and operate only to the tailrace monitors (120% exceedence days scenario). The number of "120% exceedence days" was estimated using the same data as the current management scenario, and was defined as the number of days the criteria were exceeded if the 115% forebay criteria was removed. The results form these analyses are presented in Tables 1-5.

Results:

Of the possible 1,224 system wide exceedence days in a year (8 projects times 153 days) the current management of TDG, using both the forebay and tailrace monitors, results in exceedences occurring 11 to 40% of the time (Tables 1-5). Under current management, the number of exceedence days was highest in a high flow year (2006, Table 1) and lowest in a low flow year (2007, Table 2). Within any given year the most exceedences were recorded at Lower Monumental and Bonneville Dam.

The number of "exceedence days" that could be avoided if the forebay monitors were removed is highly variable, both on a per project basis and on a per year basis. The removal of the forebay monitors for TDG management resulted in reducing the system-wide exceedence days from 11 to 40%, to 1 to 23%. The largest reductions in the numbers of days exceeding the criteria were observed at Lower Monumental and Bonneville dams, suggesting the impact on the curtailment of spill based on the Ice Harbor forebay monitor and the Camas/Washougal monitor.

Table 1. Water year 2006. Estimated system-wide TDG exceedences under Current Management (i.e., 115% in forebay or 120% in tailrace) and to the Modeled Management (120% tailrace only) for the 153 day spill season, over all projects.

Project	Total Days	115/120% Exceedence Days	Percent Days Exceeding Criteria	120% Exceedence Days	Percent Days Exceeding Criteria
LGR	153	40	26%	32	21%
LGS	153	61	40%	19	12%
LMN	153	65	42%	33	22%
IHR	153	58	38%	25	16%
MCN	153	49	32%	39	25%
JDA	153	62	41%	46	30%
TDA	153	58	38%	12	8%
BON	153	99	65%	74	48%
Total	**1224**	**492**	**40%**	**280**	**23%**

Table 2. Water year 2007. Estimated system-wide TDG exceedences under Current Management (i.e., 115% in forebay or 120% in tailrace) and to the Modeled Management (120% tailrace only) for the 153 day spill season, over all projects.

Project	Total Days	115/120% Exceedence Days	Percent Days Exceeding Criteria	120% Exceedence Days	Percent Days Exceeding Criteria
LGR	153	0	0%	0	0%
LGS	153	12	8%	0	0%
LMN	153	42	27%	7	5%
IHR	153	5	3%	0	0%
MCN	153	1	1%	1	1%
JDA	153	16	10%	3	2%
TDA	153	6	4%	0	0%
BON	153	49	32%	0	0%
Total	**1224**	**131**	**11%**	**11**	**1%**

Table 3. Water year 2008. Estimated system-wide TDG exceedences under Current Management (i.e., 115% in forebay or 120% in tailrace) and to the Modeled Management (120% tailrace only) for the 153 day spill season, over all projects.).

Project	Total Days	115/120% Exceedence Days	Percent Days Exceeding Criteria	120% Exceedence Days	Percent Days Exceeding Criteria
LGR	153	42	27%	37	24%
LGS	153	60	39%	23	15%
LMN	153	64	42%	33	22%
IHR	153	43	28%	32	21%
MCN	153	35	23%	29	19%
JDA	153	30	20%	16	10%
TDA	153	36	24%	3	2%
BON	153	101	66%	57	37%
Total	**1224**	**411**	**34%**	**230**	**19%**

Table 4. Water year 2009. Estimated system-wide TDG exceedences under Current Management (i.e., 115% in forebay or 120% in tailrace) and to the Modeled Management (120% tailrace only) for the 153 day spill season, over all projects.

Project	Total Days	115/120% Exceedence Days	Percent Days Exceeding Criteria	120% Exceedence Days	Percent Days Exceeding Criteria
LGR	153	18	12%	16	10%
LGS	153	30	20%	1	1%
LMN	153	53	35%	26	17%
IHR	153	34	22%	29	19%
MCN	153	13	8%	4	3%
JDA	153	22	14%	9	6%
TDA	153	38	25%	0	0%
BON	153	87	57%	25	16%
Total	**1224**	**295**	**24%**	**110**	**9%**

Table 5. Water year 2010. Estimated system-wide TDG exceedences under Current Management (i.e., 115% in forebay or 120% in tailrace) and to the Modeled Management (120% tailrace only) for the 153 day spill season, over all projects.

Project	Total Days	115/120% Exceedence Days	Percent Days Exceeding Criteria	120% Exceedence Days	Percent Days Exceeding Criteria
LGR	153	22	14%	16	10%
LGS	153	17	11%	8	5%
LMN	153	41	27%	15	10%
IHR	153	23	15%	11	7%
MCN	153	26	17%	26	17%
JDA	153	0	0%	0	0%
TDA	153	21	14%	1	1%
BON	153	79	52%	31	20%
Total	**1224**	**229**	**19%**	**108**	**9%**

It can be argued that any time the tailrace is less than 120%; there is some additional water that can be spilled. To provide some idea of the how much room there is to provide additional spill at a project, if the forebay monitor was eliminated from the management criteria, we looked specifically at the days where exceedences occurred under current management, and determined the number of those days that would no longer be considered to exceed the TDG criteria if the forebay monitor was eliminated from the management. We then determined which of those days had TDG of 119% or less, suggesting that TDG was enough below the 120% to allow for a larger volume of additional spill. As can be seen from Tables 6 through 10, the number of "non-exceedence" days, where the TDG was less than 119% in the tailrace, suggests that in many instances an increased volume of spill could be accommodated.

Table 6. Water year 2006. Number of exceedence under current management and the reduction of exceedence days using the tailrace monitors only, as well as the number of Current Management "exceedence days" where TDG was less than 119% in the tailrace.

Project	Exceedences Under Current Mgmt.	Reduction of exceedence days when using only the 120% Tailrace	Number of days that TR was less than 119%
LGR	40	8	4
LGS	61	42	38
LMN	65	32	24
IHR	58	33	23
MCN	49	10	7
JDA	62	16	3
TDA	58	46	27
BON	99	25	18
Total	**492**	**212**	**144**

Table 7. Water year 2007. Number of exceedence under current management and the reduction of exceedence days using the tailrace monitors only, as well as the number of Current Management "exceedence days" where TDG was less than 119% in the tailrace.

Project	Exceedences Under Current Mgmt	Reduction of exceedence days when using only the 120% Tailrace	Number of days that TR was less than 119%
LGR	0	0	0
LGS	12	12	12
LMN	42	35	28
IHR	5	5	5
MCN	1	0	0
JDA	16	13	13
TDA	6	6	5
BON	49	49	49
Total	**131**	**120**	**112**

Table 8. Water year 2008. Number of exceedence under current management and the reduction of exceedence days using the tailrace monitors only, as well as the number of Current Management "exceedence days" where TDG was less than 119% in the tailrace.

Project	Exceedences Under Current Mgmt.	Reduction of exceedence days when using only the 120% Tailrace	Number of days that TR was less than 119%
LGR	42	5	3
LGS	60	37	30
LMN	64	31	18
IHR	43	11	3
MCN	35	6	2
JDA	30	14	5
TDA	36	33	20
BON	101	44	41
Total	**411**	**181**	**122**

Table 9. Water year 2009. Number of exceedence under current management and the reduction of exceedence days using the tailrace monitors only, as well as the number of Current Management "exceedence days" where TDG was less than 119% in the tailrace.

Project	Exceedences Under Current Mgmt.	Reduction of exceedence days when using only the 120% Tailrace	Number of days that TR was less than 119%
LGR	18	2	1
LGS	30	29	26
LMN	53	27	18
IHR	34	5	5
MCN	13	9	1
JDA	22	13	6
TDA	38	38	35
BON	87	62	57
Total	**295**	**185**	**149**

Table 10. Water year 2010. Number of exceedence under current management and the reduction of exceedence days using the tailrace monitors only, as well as the number Current Management "exceedence days" where TDG was less than 119% in the tailrace.

Project	Exceedences Under Current Mgmt.	Reduction of exceedence days when using only the 120% Tailrace	Number of days that TR was less than 119%
LGR	22	6	6
LGS	17	9	8
LMN	41	26	23
IHR	23	12	10
MCN	26	0	0
JDA	0	0	0
TDA	21	20	18
BON	79	48	47
Total	**229**	**121**	**112**

In response to your second question, it would be impossible to determine "what percentage of TDG exceedences could have been avoided if the federal dam system was operated in a manner to help minimize TDG exceedences by shifting the potential for overgeneration around the system, again using the Oregon standard versus the Washington standard?" since this type of management is already imbedded in the collected data. Over the time period we used in this analysis the FCRPS was operated to the court ordered spill levels. Historically, when overgeneration spill occurred in the system during the spring and summer fish migrations, excess generation spill is distributed among projects according to a current "spill priority" list. The current spill priority list is developed pre-season among the Technical Management Team representatives, and primarily reflects the distribution of fish in time and any project specific considerations. The list is modified in-season on an as-needed basis, to reflect changes in fishery or project considerations. In addition, we do not have the information necessary to separate fish spill from overgeneration spill, since overgeneration spill can be used in some instances to meet fish spill requirements.

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DATA REQUEST FORM

Request Taken By: Brandon Chockley **Date:** 16-Mar-2011

Data Requested By:
Name: Rhett Lawrence **Phone:** 503 230-0411 x18
Address: _____ **Fax:** _____
_____ **Email:** rhett@wildsalmon.org
_____

Data Requested:
1) What proportion of TDG exceedances could have been avoided if spill were managed to 120% forebay standard instead of 115%.
2) What percentage of TDG exceedances could have been avoided if FCRPS managed to minimize TDG exceedance by shifting potential for overgeneration around system.

Data Format: **Hardcopy** ☐ **Text** ☐ **Excel** ☐

Delivery: **Mail** ☐ **Email** ☐ **Fax** ☐ **Phone** ☐

Comments:
Request attached

Data Compiled By: _____ **Date:** _____

Request # 24

Brandon Chockley

From: Rhett Lawrence [rhett@wildsalmon.org]
Sent: Wednesday, March 16, 2011 1:22 PM
To: Michele Dehart; Margaret Filardo; Brandon Chockley
Subject: SOS data request

Hello folks,

Sorry to take so long to get this data request to you. We wanted to make sure we were asking the right question and thus needed to do a little more preliminary research ourselves, and then making the actual request just got away from us. Anyway, I think what we'd like for you all to look into is something like the following:

Based on an analysis of recent data (e.g., 2006-2010, or the last ten years) at the four lower Snake River and four lower Columbia River dams, what is the percentage of TDG exceedences that could have been avoided if spill were managed to the State of Oregon's 120% forebay standard for TDG instead of Washington's 115% forebay standard. Additionally, can you determine what percentage of TDG exceedences could have been avoided if the federal dam system was operated in a manner to help minimize TDG exceedences by shifting the potential for overgeneration around the system, again using the Oregon standard versus the Washington standard?

The latter question above might be a little much to ask or might be outside your purview, but generally what we're looking to find out is whether BPA doesn't have other options for managing these overgeneration events by shifting water/power generation around the system. Does that make sense?

Anyway, let me know if you need me to submit this request more formally or in a different format (e.g., an actual hard copy letter or something). Never having done one before, I wasn't quite sure how it needed to happen (and Nicole is out of town, so I can't ask her).

Thanks so much, and please let me know if you have any questions or need more info from us.

Rhett

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