COLUMBIA RIVER TECHNICAL MANAGEMENT TEAM
April 11, 2018
Facilitator's Summary
Facilitator: Donna Silverberg; Notes: Nancy Pionk, DS Consulting

The following Facilitator's Summary is intended to capture basic discussion, decisions and actions, as well as point out future actions or issues that may need further discussion at upcoming meetings. These notes are not intended to be the "record" of the meeting, only a reminder for TMT members. Official minutes can be found on the TMT website:
http://www.nwd-wc.usace.army.mil/tmt/agendas/2018/

April Water Supply Forecast
The Corps and Bureau of Reclamation reported on the official April water supply forecasts:
Joel Fenolio, BOR, reported:

- Hungry Horse inflow forecast:
  - May-Sept: 2.4 MAF (141% of average); the expectation is to reach 3475 feet by the end of April.

Doug Baus, Corps, reported:

- Grand Coulee: April- Aug: 68 MAF with 5 days QPF (121% of average)
- The Dalles: April-Aug: 103 MAF with 5 days QPF (118% of average);
- Lower Granite: April – July: 23 MAF with 5 days QPF (117% of average);
- Libby: April-Aug: 7,189 KAF (122% of average)
- Dworshak: April-July: 3,040 KAF (125% of average)
- Albeni Falls: April-Aug: 18 MAF with 5 days QPF (145% of average).

Doug also reported on the Climate Forecasts:

- Doug noted that the precipitation forecast for the Snake and Columbia River basins is very high, showing a pattern of well above average precipitation and below normal temperatures. He noted that the snow status is also well above average, with the snow water equivalents (SWE) at various gages used to calculate the Libby Dam water supply forecast are 125-175% of average.
- For the 6-10-day forecast, temperatures are expected to be below average and precipitation is expected to be above average.
- For the 30-day forecast, there is an equal chance regarding temperature and above average chance of precipitation.

Doug also reported on the RFC STP Extended Inflow forecasts, noting the volatility in the forecast:

- For Lower Granite Dam current inflows are 110 kcfs which is above average (70 kcfs) for this time of year. Current conditions are well above average and expected to remain there until May 10 and then expected to return to average.
- Current inflows for the Dalles Dam are 250 kcfs which is above average (180 kcfs) for this time of year. Conditions are expected to remain well above average until May 10, after which conditions are expected to return to normal.

Dworshak Operations
Steve Hall, Corps, reported on current and proposed operations at Dworshak. He presented several charts that are available on the TMT web site. Current reservoir elevation is 1461.07 ft. and high inflows ranging from the high teens to 22 kcfs and 7.5 kcfs outflows. He noted that operations dropped to 7.5 kcfs discharge after intersecting the Refill Curve.

TDG levels are 112% in the river and 101.5% in the hatchery. He explained that the April 9-10 increase in TDG was likely due to unit testing occurring because of the governors being replaced. He expects that outflows will continue at 7.5 kcfs to minimize impacts on fish.

The current RFC water supply forecast for the Clearwater Basin is 2.9 MAF. The official Corps water supply forecast is 3.04 MAF. The short-term inflow forecast is 17 kcfs and expected to be 10-11 kcfs for the weekend as cooler weather sets in. Steve noted that the basin is continuing to build snowpack and is tracking 2011 and 2008. They are expecting a decline in inflows through April and then expect inflows to increase. The mid-to-long-range forecast is expected to be colder and wetter than normal, with a later-than-normal run-off predicted.

Tom Lorz asked when Unit 3 might be available to help pick up flows. Steve indicated it was unlikely that the unit would be available before the official schedule of July 1.

Jay Hesse, Nez Perce, reported that, due to the rain and runoff, there was an early release of Fall Chinook at Peck/Big Canyon Creek and Spring Chinook at Kooskia. He appreciated receiving notice from Steve of the change in flow. He noted that the outflow forecast looks ok for natural Fall Chinook production in the river. He suggested that the focus now shift to TDG impacts on natural fish production in the river, noting that fish are most sensitive to TDG post-emergence. He agreed it would be helpful to include a graph showing TDG levels at Peck for future TMT meetings.

ACTION: Steve will include a graph showing TDG at Peck for future TMT meetings.

Start of FOP Spring Spill at Lower Columbia River Projects

Dan Turner, Corps, noted that the FOP Spring Spill began on April 10 at the lower Columbia River projects. He reviewed specific information for the lower Snake and Columbia River projects, using a series of charts and graphs that provided water quality information on Spill Caps, Daily Spill, and TDG, which are attached to today's meeting agenda.

For the lower Columbia River projects, he noted that John Day was above the 120% TDG standard and a spill cap change was made at 1600 hours. There was a decrease in TDG before the spill cap changed; this was due to a change in spill patterns as the temporary spillway weirs (TSWs) became operational. For Bonneville, he noted there is no downstream forebay to measure, so the gas cap is 120% in the tailwater. Consequently, TDG will vary with changes in elevation to the tailwater.

In reviewing the Snake River projects, he highlighted dates where Lower Granite, Little Goose and Lower Monumental exceeded the gas cap, how they responded, and further explained some of their challenges trying to meet but not exceed the gas cap. One challenge is predicting the impact of wind speed on TDG. For example, at Little Goose, the observed wind speed was much lower than the forecasted wind speed. Additionally, drops in barometric pressure appear to be influencing TDG. He noted several days where TDG at the downstream forebay of the projects was higher than TDG in the tailrace, which had not been expected. As barometric pressure drops, they are observing an increase in TDG. He described an equation to consider the impacts of barometric pressure on TDG. He expects to continue to see an up/down pattern of TDG percentages related to atmospheric pressure changes and will keep working to meet the gas cap target. He also noted that fish ladders at Bonneville Dam seem to generate TDG, possibly due to water supply diffuser valves.

TMT members appreciated Dan's efforts and acknowledged the challenge of determining the appropriate amount of spill and the complications of working out the impacts/influences on TDG levels. Erik Van Dyke, Oregon, suggested that Dan also consider whether elevation levels at the forebay gauges are a factor. Paula Calvert, ODEQ, found the information to be very helpful and looked forward to seeing more information in the future. Dan responded that the Corps would be showing at least two graphs per meeting and will continue monitoring and chasing the gas cap levels.

Jim Litchfield, Montana, requested that the Corps lay out the methodology for how TDG monitors function in relation to barometric pressure, wind speed, temperature and biofouling. Julie Ammann, Corps, indicated that the Corps will work toward that goal; however, as staff is currently working full-time to monitor and address the spill caps, they may need to defer until later in the season when things are calmer. She will inquire whether another agency, such as USGS, might be able to provide this information sooner.

> **ACTION:** The Corps will follow-up on a possible presentation on the methodology for TDG monitors at a future TMT meeting.

Tony Norris, BPA, also reviewed two graphs with the group that showed the impacts of increased wind on the power generation system and reserves.

Methodologies to Monitor Adult Passage in the Snake River
Russ Kiefer, IDFG, reported that the Fish Passage Center (FPC) provided a Beta demonstration of their fish passage methodology for tracking adult passage in the Snake River. Russ continues to be optimistic that the combination of this methodology and DART's will provide better information in-season to make decisions in managing adult returns. Other Salmon Managers agreed that the methodology looks promising. Russ expects the information the FPC methodology generates will be discussed at FPAC and TMT meetings. The goal is also to have open-access links on the FPC website. The site currently has links to two memos that describe the FPC's methodology.

Agenda Items for April 18, 2018 Face-to-Face Meeting TMT Meeting:

1. Dworshak Operations
2. 2018 Spring Spill TDG
3. SORs related to sturgeon (if ready)
4. FPC/DART Project demonstration (if ready)
5. Operations Review
6. Fish Review
7. Power Update

The next regular TMT meeting will be a Face-to-Face Meeting on April 18, 2018, at 9:00 am. A DS Consulting Process meeting will follow.

This summary was prepared by the impartial facilitation team of DS Consulting. Please send questions, comments or revisions to nancy@dsconsult.co

Columbia River Regional Forum
TECHNICAL MANAGEMENT TEAM MEETING OFFICIAL MINUTES

April 11, 2018
Minutes: Pat Vivian

1. Introduction

Representatives of the Nez Perce Tribe, BOR, NOAA, BPA, COE, CRITFC/Umatilla, Oregon, Montana, Idaho, Washington and others participated in today's TMT conference call chaired by Doug Baus, COE, and facilitated by Donna Silverberg, DS Consulting.

2. April Water Supply Forecast

2a. Forecasts. Joel Fenolio, BOR, and Doug Baus, COE, gave inflow forecasts for individual projects:

- Hungry Horse (May-September) – 2.4 maf, 141% of average (establishes an end of April flood control elevation of 3475 ft)
- The Dalles (April-August) – 103 maf, 118% of average
- Lower Granite (April-July) – 23 maf, 117% of average
- Libby (April-August) – 7189 kaf, 122% of average
- Dworshak (April-July) – 3040 kaf 125% of average
- Grand Coulee (April-August) – 68 maf, 121% of average
- Albeni Falls (April-August) – 18 maf, 145% of average

2b. NWRFC Precipitation and Temperature Summaries. Precipitation has been significantly higher than normal throughout the Columbia basin, Baus reported. For the current month, precipitation has been:

- 2.63 inches, 247% of average, in the Clearwater River Basin.
- 1.88 inches, 212% of average, in the Flathead River Basin.
- 1.15 inches, 171% of average, on the Columbia River above The Dalles.
- 3.54 inches, 200% of average, on the Cowlitz River in western Washington.
- 3.3 inches, 202% of average, on the Willamette River above Portland.

Temperatures are also below normal. In the Clearwater basin April temperatures have been 4.7 degrees F below average. All indications are that snowpack continues to accumulate throughout the upper Columbia. The mid-Columbia is following the same pattern, with well above average precipitation and below average temperatures.

2c. NWRFC Current Snow Conditions. Snow water equivalents (SWE) are well above average. For example, the SWE at various SNOTEL sites near Libby Dam are 125-175% of average.

2d. Climate Forecast. The NWRFC 6-10 day forecast calls for below average temperatures and above average precipitation. The same is true for the next 8-14 days, but the outlook changes slightly over the next month. According to a March 31 forecast for the next 30 days, there's an equal chance of higher or lower than average temperatures, and a high probability of above average precipitation.

2e. NWRFC Extended Inflow Forecast – Lower Granite Dam. Extended forecasted inflows at Lower Granite are well above average. The 50% climatology at today's date would put Lower Granite inflows at around 70 kcfs. Actual inflows are 110 kcfs. This trend is predicted to persist through May 10, when the current forecast shows inflows dropping to a more normal rate of 90 kcfs.

2f. NWRFC Extended Inflow Forecast – The Dalles Dam. The same trend is evident through May 10, with current inflows of 250 kcfs well above the 180 kcfs average. Average inflows around May 10 are 260 kcfs.

The graphs linked to today's agenda help illustrate that forecasting is extremely volatile at this time of year. The previous forecast called for inflows to peak at 320 kcfs on April 15, while the current forecast is downgraded to 250-260 kcfs. Baus suggested TMT members check the extended inflow forecast, which is updated daily.

3. Dworshak Operations

3a. Hourly Data. Steve Hall, COE Walla Walla, reported that Dworshak reservoir is at elevation 1461 ft. Yesterday outflows were reduced from 10 kcfs to 7.5 kcfs when the flood control curve intersected the refill curve. Inflows peaked at 22 kcfs on April 9 and are now in the high teens.

3b. NWRFC Water Supply Forecast North Fork Clearwater. The current RFC inflow forecast for April-July at Dworshak is 2.9 maf. With a COE official forecast of 3.04 maf, the two forecasts are in close agreement.

3c. Dworshak Hourly TDG Data (tailrace and hatchery). Total dissolved gas saturation levels are down since DWR discharges were reduced to 7.5 kcfs out. The resulting TDG levels are 101.5-102 % in the hatchery. Hall was surprised that hatchery levels remained this high

after outflows decreased. A slight bump in TDG on April 10 was caused by digital governor testing.

3d. NWRFC Dworshak Dam Inflow Forecast. The short term weather forecast calls for cooler weather over the weekend, with a drop in inflows to 10-11 kcfs from their current level of 17 kcfs. This will no doubt affect the rate of refill. The COE will keep an eye on any discrepancy between observed and forecasted inflows in order to prevent the reservoir from refilling too soon.

3e. Snowpack Comparison Graphs. Based on SWE readings from several SNOTEL sites throughout the basin, snowpack is continuing to build in the Clearwater. The overall shape of accumulation continues to resemble 2011 and there is likely to be more snow in April. Hall presented graphs comparing 2018 to five analog years at several key sites:

- Crater Meadows in the south central portion has exceeded 2012 and is tracking 2008 as well as 2011 and 2014.

- Hemlock Butte is a mid-elevation station on the southern edge of the basin. Snowpack has also exceeded 2012 and is tracking 2008, as well as 2011 and 2014.

- Hoodoo is on the northern edge of the basin on the Montana state line. This area has been drier than others but is rapidly catching up to 2012.

- Lolo Pass in the southeastern corner of the basin has exceeded 2012 and is tracking 2011 closely.

- Lost Lake in the northwestern corner of the basin has exceeded 2014 and 2012 and is tracking 2008 and 2011. Snowpack there could start setting records soon.

Generally, a decline in inflows is predicted for the rest of April, followed by an increase in May. The long range forecast is colder and wetter than normal, as is the case elsewhere in the Northwest. Conditions are such that runoff at Dworshak this year is likely to be later than normal if the current pattern persists.

A key operational goal is to moderate the rate of refill because water supplies continue to grow. The decrease to 7.5 kcfs discharges yesterday in response to intersecting the FCRC was also an attempt to reduce in river TDG readings, which are not yet down to 110%. The COE is committed to releasing 7.5 kcfs from Dworshak through the rest of

April. However, if inflows rise, changes might be needed at the end of the month to ensure the reservoir doesn't overfill.

Jay Hesse, Nez Perce Tribe, commented that rain and runoff at high elevations over the weekend forced an early release of fall Chinook near the Peck gage location. Also, spring Chinook had to be released early from the Clearwater anadromous hatchery after being acclimated for a week. Hesse thanked the COE for notifying the hatchery that Dworshak discharges were being decreased.

Tom Lorz, CRITFC, asked for an update on the DWR unit 3 rehabilitation. If inflows rise in mid-May as predicted, will unit 3 be available to help pass increased outflows? Hall said that's unlikely, and while the work is progressing well, the probability of returning unit 3 to service before the official restart date of July 1 is slim.

Hesse said his focus has shifted from conditions in the hatchery to conditions for natural production in the river. From now through the rest of passage season, any TDG spikes will have increasingly adverse effects on natural production. Hall reported that TDG values at the Peck gage were 102-103% yesterday. At Hesse's request he will include the Peck gage in weekly TDG reports to TMT.

Scott Bettin, BPA, asked whether the stage at which fry are most vulnerable to TDG effects is before or after emergence. Hatchery analysis says they're most sensitive post-emergence and safest while they're still in the redds, Hesse replied. At present, fry in the mainstem Clearwater are just starting to emerge from their redds, with peak emergence expected in 2-3 weeks. Hesse will ask hatchery staff further questions about temperature unit accumulation and report back to TMT. As of March, TU accumulation was the same as 2017.

4. Start of FOP Spring Spill at Lower Columbia River Projects

With spill to the gas cap starting April 3 on the Snake River and April 10 on the Columbia, Dan Turner, COE, gave an overview of the operation to date.

4a. Snake River TDG Table. After a full week of spill at the four lower Snake projects, there are TDG exceedances in the tailrace gages and downstream forebays. When a predicted wind storm failed to materialize, high readings at downstream forebays – higher than tailwater readings – were the result at all four projects. The tailrace was expected to be the controlling gage (the one reading closest to the TDG limit), not the downstream forebay.

This is the first spill to the gas cap operation ever implemented, Turner said, and water quality control is turning out to be more difficult than expected due to a number of variables that impact TDG production – mixing, degassing, wind speed, barometric pressure, and travel time. Barometric pressure is especially problematic. Turner highlighted operations at two of the dams.

- Lower Granite – The controlling gage is the Little Goose downstream forebay, which at 117% TDG exceeds state water quality standards. On April 7, the spill cap was increased to produce 120% TDG in the tailrace with the wind storm predicted. But wind speed was less than expected, and the downstream forebays exceeded state standards until April 9, at which point the limit of 115% saturation was finally achieved. The downstream forebay at Goose has consistently had higher TDG readings (up to 120% saturation) than the tailwater.

- Ice Harbor – The project has been at minimum generation over the past few days. The tailwater gage is the controlling gage, so the spill cap has been slowly increased to reach the 120% tailrace saturation limit.

4b. Columbia River TDG Overview Table. Yesterday, April 10, was the first day of spill on the four lower Columbia River projects. Turner presented the first 7-8 hours of data collected:

- McNary – The spill cap started at 190 kcfs and was increased to 195 kcfs. With 6 hours of minimum generation a day, it might not be possible to spill to the 120% TDG limit in the tailrace until river flows increase.

- John Day – The tailrace is at the 120% TDG limit. Gas levels were high this morning so the spill cap was reduced to 135 kcfs.

- The Dalles – Spill started at 123 kcfs, which is generating 118% TDG saturation in the tailrace. With travel time from JDA to BON of 1.2 days, TDG effects in the Bonneville forebay are just starting to appear. Once the gas arrives at BON, the COE will evaluate whether the TDA tailrace or BON forebay is the controlling gage.

- Bonneville – Because there's no forebay downstream, the project is spilling to 120% TDG in the tailwater. Small adjustments were made to hit the 120% limit, but the saturation rate will inevitably fluctuate with the tailwater elevation.

4c. Project Graphs. Turner then showed TMT several project graphs documenting the effects of gas cap spill, particularly the finding of higher TDG in the downstream forebay than in the tailrace at all four Snake River dams. From April 6-8, a drop in barometric pressure corresponded with increased TDG in the downstream forebay.

Turner showed TMT three graphs based on hourly data for each project. The top graph depicts TDG saturation, the middle wind speed, and the bottom barometric pressure, all of which impact TDG production.

- Little Goose – On April 6, tailrace and downstream forebay TDG readings were about equal, but the downstream forebay readings kept rising while the tailrace remained steady. On April 7, TDG readings at the downstream forebay, Lower Monumental, decreased. Observed wind speed was lower than forecasted at the closest weather station, and a lot lower than at other locations. Simultaneously, there was a drop in barometric pressure. This combination caused TDG levels to spike.

- Lower Granite – This graph uses 2016 operations and TDG levels as an example to show how gas cap calculations are done. If there is no change in TDG but the barometric pressure changes, TDG saturation changes too. While correlating TDG levels to barometric pressure involves a straightforward calculation, changes in barometric pressure can change TDG saturation by 2-3%. This finding is raising new questions associated with gas cap spill.

- Lower Monumental – TDG levels in the downstream forebay, Ice Harbor, fluctuated although the Lower Monumental tailrace level stayed steady.

- Ice Harbor – This graph shows barometric pressure of 29.94 inches of mercury was associated with a TDG reading of 115.9 % saturation at the downstream forebay, Ice Harbor. Barometric pressure is predicted to drop tonight, which would result in TDG of 117.4%. Then BP is forecasted to rise until 8 am April 13, peaking at 33.7 inches of mercury, which would result in TDG levels of 114.3% if nothing else changes.

- John Day – Spill to the gas cap bumped up tailwater TDG readings above 120% for the first 7 hours of data collection. A small change in the spill cap at 4 pm yesterday caused a decrease in TDG levels when spill bays 18 and 19 were open. It is believed the drop in TDG was due to changes in the resulting spill pattern. Bays 18 and 19 have temporary spillway weirs that started spill at midnight on April 10 using the non-TSW pattern, Lisa Wright, COE, said. Crews

install the TSWs and shift spill to the TSW pattern as soon as daylight allows.

Turner emphasized that barometric pressure will continue to cause TDG to fluctuate above and below 115% saturation in the next downstream forebay. This week's findings indicate that barometric pressure adds another nuance on top of the degassing effects of wind. If wind speeds exceed 10 mph for most of the day tomorrow, that could result in a drop of 2-3% saturation in TDG levels in the next downstream forebay. Travel time further complicates spill cap calculations.

The COE will provide weekly updates on TDG management and spill cap decisions throughout the rest of spill season. At the next TMT meeting on April 18, Turner will continue to investigate variables in TDG production, particularly the next downstream forebay. He invited TMT members to email him any questions they have or requests for specific information.

Jim Litchfield, Montana, said in future he'd like more information on the methodology of TDG monitors and how they work, particularly in relation to barometric pressure. He also wanted to know more about gage malfunction due to biofouling. The COE will provide this as soon as spill cap and water quality management are not so consuming of staff time, Julie Ammann, COE, said.

Erick Van Dyke, Oregon, noted that the forebay gages are currently measuring at 45 ft depth instead of 15 ft, with adjustments being made to the calculations based on the disparity. This could be a factor in the wide swings in TDG readings.

Turner followed up on two questions Van Dyke raised last week:

1. If TDG readings are tied, which gage is the most restrictive? If this happens, neither reading is bolded in the tables, but that could change.

2. Why were TDG readings in the Bonneville tailwater hitting the 110% water quality limit prior to the onset of voluntary spill? The high levels were probably caused by operation of the fish ladder. The auxiliary water supply valve that supplies water to the diffuser generates TDG.

5. Other Topics

In response to questions last week about BPA's load balancing authority, Tony Norris showed TMT a load/generation graph and a graph of balancing reserves that were deployed when wind generation increased

over the past weekend. When wind generation is less or greater than planned, hydro generation has to be increased (INC) or decreased (DEC) accordingly to maintain critical load/resource balance. Wind generation is highly variable. In the example Norris showed TMT, wind went from 800 MW to minus 900 MW very quickly, resulting in wide power swings.

Russ Kiefer, Idaho, gave an update on efforts to track adult passage in real time on the Snake. Yesterday FPAC got a demonstration of the FPC's methodology. Kiefer said he's cautiously optimistic that the Dart and FPC research will help make in season management decisions easier in terms of adult chinook returns; Wagner agreed the effort is very promising. Ultimately, Kiefer said, there will be links on the TMT web page that anyone can follow to see how adult passage is progressing.

6. Next TMT Meeting

TMT will meet next in person on April 18. Topics on the agenda include an update on spill caps, Dworshak operations, and possibly Dart and FPC adult passage work.

Name	***Affiliation***
Jay Hesse	Nez Perce
Joel Fenolio	BOR
Paul Wagner	NOAA
Tony Norris	BPA
Doug Baus	COE
Tom Lorz	CRITFC/Umatilla
Scott Bettin	BPA
Julie Ammann	COE
Lisa Wright	COE
Erick Van Dyke	Oregon
Jim Litchfield	Montana
Russ Kiefer	Idaho
Nancy Pionk	DSC
Steve Hall	COE Walla Walla
Alfredo Rodriguez	COE Walla Walla
Wayne Jousma	COE Walla Walla
XX	COE Seattle
Michael O'Bryant	CBB
Ruth Burris	PGE
Shane Scott	PPC
Paula Calvert	ODEQ
Charles Morrill	Washington
Dan Turner	COE