COLUMBIA RIVER TECHNICAL MANAGEMENT TEAM

April 4, 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/

Meeting Minutes and Summaries
The TMT Minutes and Summaries for March 21, 2018 and March 28, 2018 were approved.

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 1454.7 ft. with 6-7 kcfs inflows and 10 kcfs discharge. TDG levels are 117% in the river and 104% in the hatchery. Dave Swank, USFWS, noted that the river TDG was significantly affected when one of the units was shut down and suggested that the group keep this in mind for future situations.

Steve reported that the Corps official April water supply forecast for April to July was 3.04 MAF, with the current RFC's forecast at 2972 KAF with 10 days QPF (precipitation forecast), 2900 KAF with 5 days QPF, and under 2700 KAF with 0 days QPF. He noted that the basin is still holding approximately 3 MAF of run-off. The inflow forecast is currently at 7 kcfs, however, the STP forecast shows a dramatic increase of inflows, going up to 25 kcfs around the 9th or 10th.

Longer range, the 6-10 day meteorological forecast is expected to be normal temperatures with higher than normal precipitation. A similar pattern is expected for the 8-14 day forecast, which is expected to be neutral regarding temperature and an elevated chance of precipitation. For the 30-day forecast, there is an equal chance regarding temperature and above normal chances of precipitation. For the 90-day forecast, the temperature is expected to be slightly cooler than normal, with normal precipitation levels predicted.

Steve presented graphs showing the SNOTEL readings for Snow Water Equivalent (SWE) for 2018 vs. prior years. He noted that the snowpack has deviated from 2011 and is sitting at 115% of normal. Crater Meadows and Hemlock SNOTEL have leveled off below 2012 and Hemlock is tracking 2017. Hoodoo is tracking 2017 and is below 2012. Lolo Pass is still tracking 2011 and 2012 and is above 2017. Lost Lake is tracking with 2014 and 2012 and is substantially above 2017. The 10-day freezing level is predicted at or above 7000 feet. Steve noted that if the forecast holds true, there may be some increased runoff due to lower elevation snowmelt, and then run-off could slow down considerably due to colder temperatures predicted over the weekend and into next week.

Steve presented series of slides showing models of proposed operations using water years 2008, 2011, 2012, 2014 and 2017. Currently, inflows are tracking 2014 most similarly. He noted that they are expecting to intersect the refill curve before April 15 and are limiting discharge to 10 kcfs pending intersection. He also noted that the discharge amount for the future is variable and once the refill curve is intersected, they will reduce discharge to 7.5 kcfs through April, depending on inflows, to reduce TDG. He expects they will keep discharge reduced to this level possibly through May and into June and follow a more normal refill trajectory to get Dworshak full by the end of June.

In response to questions about a difference in the STP information from yesterday to today, Steve noted that this is the toughest time of the year to predict. The RFC develops its STP forecast using inflows and there can be significant changes in forecast between the time when the STP forecast first comes out and TMT meetings. He explained that the National Weather Service (NWS) publishes an updated forecast twice a day, generally 9 AM and 4 PM, which would provide additional information for Salmon Managers.

> Request/Action: Salmon Managers said they primarily rely on the STP forecast to prepare for TMT conversations, so any insights the Corps has would be helpful. Julie Ammann, Corps, indicated that, when the Corps sends out the STP forecast, they will indicate any assumptions they are making regarding the forecast. She invited TMT members to follow-up with any questions.
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> Request/Action: Jay Hesse, Nez Perce, requested that Corp provide 24-hour notice of any reduction in flows to both the hatchery and the acclimation site to avoid dewatering of their pumps. Steve agreed to call and email Jay as changes occur.

Update on LWG JBS Operations
Lisa Wright, Corps, provided a summary of the Lower Granite Juvenile Bypass Operations and SOR implementation, which they have completed. A summary is attached to today's agenda. Condition sampling began on April 1 and they have seen no fish-condition concerns. PNNL will begin post-construction evaluation on Friday, April 6, with releases on Friday, Saturday, Sunday and Monday.

Updated Power Emergency Plan
Tony Norris, BPA, reported that the Salmon Managers provided comments and suggested modifications to the plan. BPA will work internally to review the suggested modifications for feasibility and will put them into a form that is usable for staff. He will then bring the revisions back to TMT members for review.

In the interim, BPA will repost the most recent Emergency Action Plan (shared with TMT members on March 21 and re-dated for today) after removing the MOP/MIP language from the Pre-emptive Actions list. Tony will provide more information regarding the difference between an official power emergency and a contingency action at the April 18 TMT meeting.

Transport Start Date
Paul Wagner, NOAA reported that the Transport Start date will begin with collection on April 23, and the first barge leaving April 24. He and others noted that not all salmon managers supported the start date; however, they will not object. Salmon managers raised concerns about how this issue was raised this year through the FPAC discussion process. As a rationale for the earlier start date, Paul Wagner noted that ISAB has advocated "spreading the risk" and, by starting earlier, they hope a larger proportion of the run can be transported which, later, might help determine whether starting earlier is a benefit to fish. Other salmon managers noted that FPAC discussions did not hit all of the points discussed and the process was different this year with no RIOG discussions, as in prior years. Dave Swank, USFWS, said he would suggest revisions to the FPP Appendix B language for future start of transportation to clarify the process for everyone. Lisa Wright noted that TMT members may suggest changes to the FPP by submitting a change form through FPOM.

Methodologies to Monitor Adult Passage in the Snake River
Russ Kiefer, IDF&G, reported that the FPC has provided a document describing how their methodology will work and examples. He is waiting to receive the BETA version of the FPC methodology and is optimistic that the FPC/DART methodologies are progressing and on the right track. He suggested that the two methodologies may work in concert to help track adult passage: DART will track the average conversion time between projects which should give an indication of delay; and FPC will observe passage of PIT-tagged fish between Ice Harbor and Lower Granite and will look at variables that affect travel time. The hope is that DART will give a heads-up regarding delay and FPC can help explain whether other environmental factors are involved. He expects that both methodologies will be linked to open access Webpages at DART/FPC.

Start of FOP Spring Spill at Snake River Projects
Dan Turner, Corps, noted that the FOP Spring Spill began on April 3 at the four lower Snake River projects. He reviewed 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. He noted that Ice Harbor is operating at minimum generation and the remainder left for spill is below the spill cap of 90 kcfs. Lower Granite was operating at 13 kcfs of minimum generation on some hours; he expects that Lower Granite will move away from minimum generation as flow is forecasted to increase. TDG for Lower Monumental is coming in lower than expected and he expects that there will be an increase in the spill cap. The plan is to make small changes - up to 5 kcfs at a time, to avoid big swings of TDG in the system. TMT members appreciated the level of detail and graphs that were provided.

Operations Review

Reservoirs: Joe Fenolio, BOR, reported on Bureau of Reclamation projects:
- Grand Coulee midnight elevation 1246.7 ft., with inflows 84.3 kcfs, current discharge 113 kcfs. The target for the end of April is 1228 ft, drafting 1 foot per day.
- Hungry Horse midnight elevation: 3493.6 ft., inflows 1.68 kcfs, current discharge 6.9 kcfs; currently targeting 3475 ft. by the end of April

Lisa Wright, Corps, reported on US Army Corps of Engineers projects:
- Libby midnight elevation was 2,357.9ft.; current inflows were 2.1 kcfs; outflows were 6 kcfs.
- Albeni Falls midnight elevation was 2051.95 ft.; yesterday's average inflow was 32.9 kcfs; outflows were 27.1 kcfs.
- Dworshak midnight elevation 1454.9ft.; inflows were 6.2 kcfs; outflows were 8.4 kcfs.
- Lower Granite average outflows were 62.1 kcfs, operating at variable MOP. With inflows at 60 kcfs, the project started MOP+ 1.5 feet. At 80 kcfs, they will transition to MOP+1 foot (approximately April 6) and at 120 kcfs, will transition to MOP (approximately April 12).
- McNary average outflows were 190.6 kcfs.
- Bonneville average outflows were 211.4 kcfs. Lisa noted that 11.8 feet is the minimum tailwater elevation for chum incubation. Given the flows, they have been well above that minimum. As in past years, the chum tailwater restriction will officially end when spring spill begins on April 10.

Also, at Little Goose, Lisa noted an upcoming crest change for the Adjustable Surface Weir (ASW): based on forecasted flow increase above the FPP trigger of 85 kcfs later this week, the ASW will be dropped to a lower crest elevation to pass more water.

Fish:
Paul Wagner reviewed the FPC's fish passage data. He noted that Adult Spring Chinook are starting to arrive slowly (35 YTD, 6% of the 10-year average). Steelhead are doing better with

1731 YTD (73% of the 10-year average). Juveniles are also underway, with Spring Chinook doing very well and Steelhead just beginning to show up. Lamprey were slowing down.

Charles Morrill, WDFW, reviewed website information showing Lower Granite PIT-tag detections. He noted the first juvenile detection 3 days ago and said the Clearwater releases showed up very quickly. TMT members remarked that the website provided useful information.

Power Supply
Tony Norris reviewed two graphs with the group that are available on BPA's website that show BPA Balancing Authority Load and Total Wind, Hydro, Fossil/Biomass, and Nuclear Generation, and BPA Balancing Reserves Deployed. The second graph shows that all reserve deployments to balance intermittent renewables were within planned reserves. He expects to review these graphs in greater detail at the next TMT process meeting on 4/18/18.

Agenda for April 11, 2018 Conference Call
In addition to the regular agenda items, the agenda will include:

1. Lower Columbia and Snake River Spill
2. Official April Water Supply Forecast
3. Report on Fish Conditions

The next regular TMT meeting will be a conference call on April 11, 2018, at 9:00 am.

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 OFFICIAL MINUTES

April 4, 2018
Minutes: Pat Vivian

1. Introduction

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

2. Meeting Minutes for March 21 and 28

Both sets of meeting minutes and facilitator's summaries were declared final.

3. Dworshak Operations

3a. Hourly Data. Steve Hall, COE Walla Walla, reported. Dworshak reservoir is at 1454.7 ft elevation with outflows of 10 kcfs and inflows of 6-7 kcfs, which they have been for a while.

3b.NWRDC Water Supply Forecast North Fork Clearwater – Dworshak Dam. The COE March water supply forecast for April-July was 3.1 maf, which is in agreement with the current RFC forecast of 3.0 maf with 10 days QPF (precipitation forecast) and t 2.9 maf with 5 days QPF. The zero day QPF forecast is just under 2.7 maf. The 10 days QPF forecast is considered most accurate for weather events on the eastern side of the basin, which accounts for the disparity between the 10 and zero day forecasts.

3c. Total Dissolved Gas. Current TDG levels are 117% saturation in the river and 104% in the hatchery due to an increase to 10 kcfs discharge at Dworshak Dam.

3d. NWRFC Dworshak Dam Inflow Forecast. Inflows have been 6-7 kcfs for a while, but a significant increase is forecasted due to precipitation and temperatures. While temperatures are expected to get warmer, forecasted inflows can be off from the prediction. An increase of 25 kcfs inflows predicted around April 9-10 might or might not materialize.

3e. NWRFC Climate Forecast. In the short term, 6-10 days, the RFC predicts equal chances of normal temperatures but an elevated chance of more precipitation than normal. The 14 day outlook follows a similar

pattern of wetter conditions, as does the 30 day outlook. However, the 90 day forecast is for slightly cooler than normal temperatures and equal chances of increased or decreased precipitation.

3f. Snowpack Comparison Graphs. In recent weeks the hydrograph has deviated from 2011, which is good news because that was a big water year. Snowpack is still 115% of normal. This could be peak snowpack if 2018 turns out to be a dry year, or a month away from the peak if it's a wet year.

Hall reported snow water equivalent readings at SNOTEL sites located throughout the basin:

- Crater Meadows SWE has leveled off below the 2012 water year.
- Hemlock Butte has lower SWE than in 2012, but above 2017.
- Hoodoo SWE is tracking closely to 2017 but below 2012.
- Lolo Pass SWE is tracking closely with 2011 and 2012, but above 2017.
- Lost Lake, in the northwest corner of the basin, is tracking 2014 and 2012 water years closely, but has deviated from 2008 and 2011 and is still substantially above 2017.

Charles Morrill, Washington, asked about forecasted freezing levels over the next 7-10 days, particularly in terms of starting runoff. Today's 10 day forecast says freezing level is at 7,000 ft elevation, but that it will freeze in the basin, Hall replied. Because there isn't much territory above 7,000 ft, that's a contradiction. However, by the coming weekend, freezing level is forecasted to be in the 10,000 ft elevation range. If it does get colder this weekend and into next week, that will put a significant damper on runoff. Hall expects runoff to slow down based on this forecast, and Morrill agreed with that perception.

Hall noted that snowpack at high elevations is not yet ripe (i.e., ready to melt). It is currently in the 30% density range and needs to approach 40-50% density before ripening and melting. If precipitation falls as rain, it can rapidly alter snowpack density. In addition, it is very difficult to predict accurately whether precipitation will fall as rain or snow, which has a huge impact on runoff. Hall congratulated the RFC on its efforts to make accurate predictions under these circumstances.

3g. Proposed Operations. Since last week, Hall added the refill curve, which represents 95% probability of refilling the reservoir, to the modeled scenarios of Dworshak operation. Inflows and the intersection of the flood control curve with the refill curve are tracked on a daily basis, although it's hard to predict the refill curve until it has already been intersected. Hall said the refill curve will probably be intersected soon, or

at least before April 15, which is one reason the COE bumped DWR discharges up to 10 kcfs.

The graphs use five analog years to project how 2018 might go:

- If inflows follow the 2008 scenario, Dworshak refill would start around April 8-9.
- If inflows follow 2011, refill would also start around April 8-9.
- If inflows follow 2012, there would be heavy inflows starting April 10-12 through the end of the refill period.
- The 2014 water year differs from this year in that it had very early runoff.
- 2017 was a very low water year.

The take-home message is that Dworshak flood control will probably intersect refill soon, so the COE has limited DWR discharges to 10 kcfs, Hall said. Once flood control ends and refill begins, TMT will need to discuss Dworshak discharges from a refill perspective.

The COE is committed to providing flow augmentation for spring migrants through April. Dworshak discharges should be considered variable depending on conditions at the time. During refill, greater emphasis will be placed on managing TDG levels below 110% absent the necessary state waivers. Hall speculated that discharges will be reduced to 7.5 kcfs during refill in order to manage TDG, depending on the shape of inflows during April. The goal would be to hold 7.5 kcfs out through April as long as this doesn't draft the reservoir too deeply. Then discharges would back off in May and June to follow a more normal refill trajectory, with a goal of meeting the refill elevation target at the end of June.

Hall said the 2014 water year is probably the best graphic to use in contemplating 2018 Dworshak operations going forward; Paul Wagner, NOAA, agreed because the 2014 operation accomplished the twin objectives of meeting refill and stepping discharges down to 6 kcfs in April and mid-May. There will be more conversations on the shape of DWR discharges as refill progresses.

Dave Swank, USFWS, gave two observations on DWR operations going forward:

1. Over the past few days during unit outages for maintenance, in-river TDG levels have been strongly affected by closure of one small unit at Dworshak, resulting in a change of only 2.1-2.2 kcfs in discharges. This has led to surprisingly higher TDG readings in the river. We need to remember this scenario in future years and investigate whether there's an inflection point.

2. Yesterday's STP traces showed Dworshak outflows going to 25 kcfs, which differs from the five scenarios just presented.

Swank asked why the STP projection is so different from the COE proposed operations figures. Aaron Marshall, COE, said the STP forecast was developed based on RFC inflows, while also meeting the April 15 flood control requirement of 1445 ft elevation, but minus the assumptions associated with refill. The inflow forecast and refill curve have both changed since then. Julie Ammann, COE, added that the STP included the April 2 inflow forecast that was over 30 kcfs. Generally the COE models inflows seen in the latest computer run, even if they might be high.

Erick Van Dyke, Oregon, asked whether another STP run is a possibility. He said the STP runs are very helpful and the Salmon Managers rely on them to prepare for discussions at TMT.

The COE will probably wait until next week to run the next set of scenarios because a new set of inflow forecasts to be published April 9 will provide a better indication of whether the predicted snowpack/runoff actually materialized, Hall said.

Van Dyke expressed concern about the "drastic changes" since TMT last talked. This is the hardest time of year to make forecasts, Ammann said, with lots of unpredictability in the start of runoff due to fluctuating temperatures, precipitation, and freezing levels. Most of the uncertainty is in the Snake River basin. Model runs are updated frequently, and TMT members should stay tuned especially at this time of year. TMT members are welcome to call RCC with questions about evolving conditions and plans at Dworshak and Lower Granite.

Wagner asked at what time of day the RFC inflow forecasts for lower Snake projects are updated. The morning forecast is usually published around 9 am and the afternoon forecast around 4 pm unless a big storm is coming, Marshall replied. Some areas are harder to forecast accurately than others. He invited TMT members to call RCC if they have questions about STP forecasting.

Jay Hesse, Nez Perce, asked for 24 hour notice of any reduction in flows from Dworshak so tribal hatchery managers can avoid dewatering the intake pipes at the Peck acclimation site. Hall said he will call and email Hesse to notify the tribe of any future operational changes.

4. Update on Lower Granite JBS Operations – SOR 2018-1 & SOR 2018-2

Last week, TMT discussed how to handle the delay in screen installation and juvenile bypass operation at Lower Granite, Lisa Wright, COE, recalled. The COE received two System Operational Requests (SORs) related to the JBS and implemented them both, summarizing the status of SOR implementation in an email sent to TMT on March 29.

The link to this item on today's agenda outlines actions taken to date and the current status of JBS operation at Lower Granite. The bypass is now fully functioning and sampling is occurring. Collection for fish condition sampling started April 1; sampling started April 2. Post-construction evaluation will begin April 6. Condition sampling doesn't include kelt releases because their inclusion was not supported by the SRWG.

5. Updated Power System Emergency Plan

The Salmon Managers have provided substantial comments and suggestions for modifying the contingency actions list, Tony Norris reported. The suggestions are extensive and valuable enough that it will take a couple of weeks to work through them in collaboration with the Salmon Managers.

In the meantime, BPA will remove the excursion above MOP or MIP from the preemptive actions list and implement the list as is, starting today. The revised list needs to be in a form that's understandable to BPA dispatchers who must make decisions in real-time to implement Salmon Manager priorities. The plan is to re-post the updated contingency actions list without the MOP/MIP provision on the TMT website and move forward with modifications to the list as needed. That list will remain in place until a new list is created.

Also, Norris reminded TMT that language was included in the 2018 Fish Operations Plan (FOP) to more accurately describe how the power system operates and how contingencies are implemented to keep the lights on and prevent a power emergency. BPA duty schedulers must ensure that generation meets load every second, but they don't have the authority to declare an official power system emergency; only regional Reliability Coordinators can do that. Section 4.4.2 of the FOP clarifies protocols regarding transmission system reliability and contingency actions to avoid a power system emergency that are included in the TMT Emergency Plan. John Annasis, BPA, will visit TMT on April 18 to provide further details on the power system.

To date, the Salmon Managers have believed that everything would remain status quo until a power emergency was declared, Wagner observed. Instead, BPA duty schedulers running the system advocate a change when they encounter a load-resource problem in real-time and TMT is notified when any emergency/contingency action has been taken to avoid power disruption.

That actually describes how BPA has been operating for years, Norris replied. The criteria for responding to an impending power system emergency have evolved over time, and specialists in that area will be needed to clarify it with TMT. A lot of things have changed in the power system re: integrating renewables and short-term market sales, as well as coordinating reliability. TMT will always be notified ASAP of any actions taken to keep the lights on that may impact fish spill or other fish-related operations. TMT's input will be implemented to the extent possible, given the location of the dams vs. the problem at the time. There are thousands of variables in terms of how to respond to a power system reliability issue. The list provided by the Salmon Managers is an improvement that may provide better guidance on the best way to implement power system contingency actions.

Van Dyke said this list is a work in progress, and more specificity is needed on what triggers implementation of the contingency actions. Norris emphasized that the contingency actions list is a living document, which can be updated or improved at any time. The updated list without the MOP/MIP action will be in place this afternoon, subject to future collaborative changes.

TMT will spend time discussing sections 4.4.1 and 4.4.2 of the FOP in terms of the contingency actions list and plans the Action Agencies have submitted to the court in relation to the gas cap spill order this spring. TMT will revisit the power system contingency actions list at its next meeting, a conference call on April 11.

6. Transport Start Date

Paul Wagner reported. Collection of fish for transport on the lower Snake River is still scheduled to start April 23, with the first barge departing on April 24. FPAC has discussed this plan, and while not everyone agrees with the start date, no stakeholders chose to object.

Dave Swank reported that USFWS met with NOAA staff on this issue and decided not to object, but is recommending that section 3.1 of Appendix B to the Fish Passage Plan be revised before the start of transport next year. USFWS questions the language regarding intention to transport at least 50% of steelhead when NOAA has explicitly said

that's not a BiOp goal. Swank offered to comment on and revise the transport plan in Appendix B.

Ann Setter and Lisa Wright clarified that modifying the FPP occurs through FPOM. The process for modifying the Fish Passage Plan involves submitting a change form to FPOM, which is reviewed and incorporated if approved. The FPP is a living document that gets updated online, so printed copies will not include these in-season changes.

The idea of transporting at least 50% of steelhead got established when ISAB advised the region to "spread the risk," Wagner explained. The 2008 and 2014 BiOps both referred to a 50% transport goal, but in actuality only 15-20% of steelhead have been transported in recent years. With passage happening earlier in the past several years, most of the fish are already gone by the time transport starts May 1. NOAA's perspective is that transporting 30-40% of juveniles would be an acceptable goal. There never has been a concerted effort to transport 50% of juveniles.

The proposal to start transport early is mainly a response to low percentages of fish being transported when transport doesn't start until May 1, Wagner said. Accelerated migration times mean there are no data on the earliest part of the run. Starting transport earlier will expand the data available to inform in-season decision making.

Van Dyke noted that this regional issue has been referred to RIOG for several years in a row, and there is still disagreement although no one is elevating it this year. He expressed support for USFWS revising the transportation plan in FPP Appendix B.

Collection for this year's transport operation will start at Lower Granite, Little Goose, and Lower Monumental on April 23 and barging on April 24.

7. Methodologies to Monitor Snake River Adult Passage

Russ Kiefer provided an update. The Fish Passage Center has provided no data yet on their methodology, but they did provide a document describing how it works and gave examples. To date, it looks like the FPC and Dart methods are both effective in tracking adult passage, and the work seems to be progressing well.

The DART researchers intend to focus on tracking conversion time between projects, which should provide an indication of adult delay. The FPC methodology is focused on PIT-tag passage between Ice Harbor and Lower Granite but also looks at variables that affect travel time.

Kiefer said he hopes the DART method will serve to raise an alarm if there's an adult passage issue, while the FPC method will help track whether something beyond dam operations (such as environmental factors) might be affecting travel time. The documents will be available via the DART and FPC public websites.

The FPC background information will also provide updates on passage between Ice Harbor and Lower Granite for different groups of hatchery and wild fish to their destination sites, Charles Morrill added. These data could provide insight into environmental variables.

8. Start of FOP Spring Spill at Snake River Projects

Dan Turner, COE, reported on the start of spring spill on the Snake River as of yesterday, April 3, under the Fish Operations Plan. Linked to today's agenda are the usual water quality reports on spill, along with a new graph that summarizes spill operations under the court order to spill to the gas cap for spring 2018 migration season.

8a. Spill Caps. This table shows the spill caps currently in use since spill started at the Snake River projects. This link will also provide information on lower Columbia projects when spill starts there next week.

8b. Daily Spill Report. This report shows actual spill that occurred on the previous day as a 24-hour average. Yesterday the Lower Granite spill cap was 45 kcfs, with daily average spill of 44.4 kcfs due to a few hours of minimum generation.

8c. Daily TDG Report. This page reports TDG levels calculated according to the combined Oregon and Washington methods . On the Snake River, TDG levels rose from 107% on April 2 to 117% on April 3 with the start of spill.

Van Dyke asked about high TDG levels at the Cascade Island gage when Bonneville only has training spill. Turner said he noticed that and will look into it. The high TDG readings could be a result of gage position in relation to spill.

8d. Snake River TDG Overview Table. Snake River spring spill started one minute after midnight on April 3. There is a new online report linked to the TMT homepage that presents an overview of the daily average TDG values associated with gas cap spill at the four lower Snake River projects. There will be a similar table for lower Columbia projects when spill starts there April 10. Turner asked TMT members to let him know if they see any anomalies in the data as this new report is being developed.

The table flags projects that have operated for 6 or more hours at minimum generation or spilled above the spill cap for 6 or more hours. TDG values in bold reflect the most restrictive gage, i.e., the one operating closest to the gas cap. Travel time, or the time it takes for TDG to move from one project to another, affects the arrival of TDG increases at the next downstream forebay. Travel time is always fluctuating with river flows. It is essentially volume divided by flow, but the hydraulics and dispersion of TDG are complex. As a rule of thumb, if river flows double, travel time is halved.

In terms of TDG readings in relation to state water quality standards, Van Dyke asked which gage prevails if there's a tie. Turner said an exact tie is unlikely because numbers in the chart are rounded off, and the actual TDG readings behind the chart are calculated to several decimal points.

Turner summarized conditions at each project, using the table:

- Lower Granite – The spill cap is 45 kcfs; actual 24-hour average spill on 4/3 was 44 kcfs due to some hours of lower inflows and hitting the minimum generation limit (approximately 13 kcfs). Total dissolved gas on 4/3 was 117% in the Lower Granite tailwater and 105% at the next downstream forebay. Currently the travel time from Granite to Goose is estimated at 3.8 days so the tailwater will be the most restrictive gage until TDG increases arrive at Goose.

- Little Goose – The spill cap is 42 kcfs with daily average spill on 4/3 of 42 kcfs. This produced118% TDG saturation in the tailwater and 104% in the next downstream forebay. Travel time from LGS to LMN is currently estimated at 2.8 days.

- Lower Monumental – The spill cap is 40 kcfs with daily average spill on 4/3 of 40 kcfs. This produced 116% TDG in the tailwater and 104% at the next downstream forebay, Ice Harbor. These TDG levels are lower than expected, probably as a result of using the uniform spill pattern, which tends to produce lower TDG values. Lower TDG readings than expected may allow the LMN spill cap to be increased. Travel time to IHR is currently estimated at 2.9 days.

- Ice Harbor – The spill cap is 90 kcfs with daily average spill on 4/3 of 59 kcfs due to the minimum generation requirement. This produced 115% TDG in the tailwater and 103% in the downstream forebay, McNary, which is a long distance away and primarily influenced by the Columbia.

8e. Project Operations Graphs. These graphs depict total flows vs. powerhouse flows, spill rates, and spill caps for each project on the lower Snake. A second graph for each project shows the resulting TDG levels from gas cap spill in relation to state water quality standards.

When setting spill caps, Turner said, the observed and forecasted wind speed at the closest weather station is taken into account. Generally, a wind speed greater than 10 mph tends to result in degassing between the tailwater and the next downstream forebay.

TMT members asked about the locations of weather stations in relation to the dams. The station used for Lower Granite is an AgriMet owned by the BOR, which is not near the dam. The station for Lower Monumental is in Pasco, Washington. Turner said he would look into the location of the station used to predict wind speeds at Little Goose. Wind speed predictions are based on modeled weather data recorded every 3-6 hours over a few days.

Charles Morrill asked whether the graphs typically show which units are being operated because having that information during spill season would be of value to the Salmon Managers in terms of prioritizing units. Lisa Wright said it's safe to assume the units at each project are operating in the priority order defined in the Fish Passage Plan, and the COE will notify TMT if a priority unit goes out of service during spill season. Priority units are not typically taken out of service during fish passage season unless unforeseen issues arise.

Turner walked TMT through the pairs of graphs for each project:

- Lower Granite – Generation flows have dropped to minimum generation of 13 kcfs during some hours, so there might be a decrease in spill if total river flows decrease. The tailwater reacted quickly to the start of spill, but TDG has not yet reached the downstream forebay. Charles Morrill asked if Granite has a TDG gage in the forebay; Turner confirmed it does. Flows are forecasted to increase, based on the Monday STP run, with a peak around April 9. Winds of greater than 10 mph are forecasted for April 7-8. If the wind forecast holds, spill caps might be increased on Friday afternoon, April 6.

- Little Goose – Spill increased on April 3, again influenced by minimum generation. Unit 6 has a min gen requirement of 14 kcfs. Turner noted that increasing spill caps, say by 10 kcfs, doesn't necessarily produce 10 kcfs more spill if the project is operating close to minimum generation.

- Lower Monumental – This project is also bumping against minimum generation for part of the day, but during other parts of the day is spilling to the spill cap when inflows are sufficient. Due to lower than expected TDG levels, the COE is considering increasing the spill cap today by up to 5 kcfs. Small changes in spill will be made because even small things can affect TDG, and the effects of uniform spill patterns in terms of TDG production are unclear.

- Ice Harbor – This project is not spilling to the gas cap because there isn't enough river flow to maintain the 10 kcfs minimum generation requirement and hit the 90 kcfs spill cap. TDG is hovering below 115% in the tailwater.

Paul Wagner asked if these graphs are available online and Turner said no, but they could be. All data are publicly available online, and the graphs could be constructed using data queries. The COE will continue to provide TMT with graphs like these throughout the course of spill season.

9. Operations Review

9a. Reservoirs. Joel Fenolio, BOR, and Lisa Wright, COE, reported.

Grand Coulee is at elevation 1246.7 ft with 113 kcfs releases and 84.3 kcfs inflows. Based on the March water supply forecast, the April 10 elevation is 1246.3 ft. Because the inflow forecast increased over the last week, the end of April flood risk management target will be lower than 1228 ft. As a result, Coulee started drafting 1 ft per day a few days ago in an attempt to meet the unofficial target. The official flood control target for that basin won't be released for 3 more days. Erick Van Dyke asked how low Coulee can draft and Tony Norris said 1208 ft is the bottom of the operating range. More information will be available next week on the end of April Grand Coulee flood control elevation.

At Hungry Horse the April volume forecast for May-September was released yesterday – 2,395 kaf, 140% of average. That's about 100 kaf increase from the March forecast. Current elevation is 3493.9 ft, releasing 8 kcfs with inflows of 3 kcfs. With an April 10 elevation of 3489.5 ft, the end of April flood risk management elevation should be 3475 ft.

Libby is at elevation 2357.9 ft with inflows of 2.1 kcfs and outflows of 6 kcfs. Albeni Falls is at elevation 2051.95 ft with inflows of 32.9 kcfs and outflows of 27.1 kcfs. Dworshak is at elevation 1454.9 ft with inflows of 6.2 kcfs and outflows of 8.4 kcfs. Lower Granite outflows are 62.1 kcfs, McNary outflows are 190.6 kcfs, and Bonneville outflows are 211.4 kcfs.

9b. Fish. Paul Wagner reported.

Adults – At Bonneville, spring Chinook are getting off to a slow start, with 835 passing to date, just 6% of the 10-year average. Steelhead are doing far better than spring Chinook, with a cumulative count of 1,731 to date, which is 73% of the 10-year average. The wild steelhead count is at 730, which is 82% of the 10-year average. Lower Granite is only passing summer steelhead that overwintered last year, and the count of 2,174 reflects that.

Juveniles – Passage is significantly underway, with plentiful yearling spring Chinook appearing at the traps and project monitoring facilities. On April 3, close to 2,000 yearlings were counted at the Salmon River trap, and 1,400 at Grande Ronde. At Lower Granite, 7,000 yearling Chinook passed on April 2 and 16,500 on April 3. At Little Goose, 523 passed according to an index count that reflects spill proportions. McNary has passed 234 yearling Chinook and Bonneville 6,000.

Not nearly as many juvenile steelhead are being counted in the traps as spring Chinook. Few steelhead were counted at Grande Ronde, but 3,700 arrived at Granite on April 2 and 5,700 on April 3. Little Goose has passed 1,359 to date.

This time of year is fry emergence for subyearling fall Chinook.

Juvenile Lamprey numbers at John Day have been in the thousands. As of April 1 the count was 2,612 juvenile lamprey passing John Day and 2,400 passing Little Goose.

Over the past three days, many spring Chinook originating from Dworshak have passed Lower Granite. Migration is underway and PIT-tagged fish are moving downstream. Wagner and Morrill agreed it's surprising such a large proportion of PIT-tagged fish have passed relative to the index count. If this is of interest to TMT members, data could be added to the agenda as a weekly update.

9c. Water Quality. See section 8 of these notes.

9d. Power System. Tony Norris said there was nothing specific to report today. He showed TMT the BPA load balancing authority graph that's continuously available on the BPA website and reports all load in BPA's balancing area in real time. Norris also showed TMT a graph of balancing reserves deployed in the past 7 days to ensure that generation meets load every second, including integration of renewable resources that are highly variable.

A spike prior to April 3 reflects an increase in generation on the BPA system that was deployed as a result of other generators, such as wind, under-generating to their schedule. BPA maintains reserves for both INC (increases) and DEC (decreases) in generation. The graph shows only reserves that are deployed. The power system has to operate with enough flexibility to maintain these types of reserves every second because they are what keep the system reliable.

10. Other TMT Issues

Lisa Wright and Aaron Marshall gave updates on two reservoir operations:

- Little Goose ASW – The crest of the new adjustable spillway weir (now in its first year of operation) will be changed from the high elevation setting for flows below 85 kcfs to the low elevation setting for flows above 85 kcfs when flows exceed the trigger, currently forecasted for later this week. The change to the low crest elevation allows more water to pass through the ASW. FPOM was notified earlier this week that flows are increasing and will likely exceed the trigger on or about Friday.

- Lower Granite Variable MOP Operation – Current inflows are around 60 kcfs which means the project will start fish passage season with a MOP+1.5 operation to maintain navigation safety. Over the next several days, inflows are projected to increase above 80 kcfs, the next threshold. At that time (probably around April 6) the project will transition to a MOP+1 operation. The STP extended forecast shows inflows are likely to exceed 80 kcfs until about mid-year. The COE will keep a close eye on the transitions to variable MOP operating ranges, which are based on inflow forecasts.

Dave Swank reported that all early releases of hatchery fish are done and apparently went well. The only fish remaining at Dworshak Hatchery are steelhead in system 1. They will be released in 10 days, their normal schedule.

The Salmon Managers present today agreed to assume that the chum operation at Bonneville will officially end at midnight on April 9, when spring spill begins at one minute after midnight on April 10, as it typically does. Because current inflows well exceed the volume needed to maintain a minimum protection elevation of 11.8 ft in the BON tailwater, ending the chum operation is purely a symbolic gesture.

11. Next TMT Meeting

TMT will meet next in a conference call April 11. Items on the agenda include the start of gas cap spill at Lower Columbia River projects, continuing gas cap spill at lower Snake River projects, official April water supply forecasts for individual projects, the power system contingency actions list, a Little Goose ASW update, and Lower Granite variable MOP operations.

Name	***Affiliation***
Aaron Marshall	COE
Tony Norris	BPA
Eve James	BPA
Erick Van Dyke	Oregon
Paul Wagner	NOAA
Dave Swank	USFWS
Doug Baus	COE
Eric Chow	COE
Nancy Pionk	DSC
Julie Amman	COE
Dan Turner	COE
Pat Vivian	note taker
Phone:	
Joel Fenolio	BOR
Charles Morrill	Washington
Jay Hesse	Nez Perce
Tom Lorz	CRITFC/Umatilla
Jim Litchfield	Montana
Leslie Bach	NPCC
Michael O'Bryant	CBB
XX	Chelan PUD
Steve Hall	COE Walla Walla
John Heitstuman	COE Walla Walla
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Michelle Yuen	COE
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Ann Setter	COE Walla Walla
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Eric Hockersmith	COE Walla Walla
Ruth Burris	PGE
Tom Iverson	Yakama
Russ Kiefer	Idaho
Lisa Wright	COE
Scott Bettin	BPA