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MEMORANDUM

TO: FPAC

FROM: Dave Benner

DATE: March 9, 2017

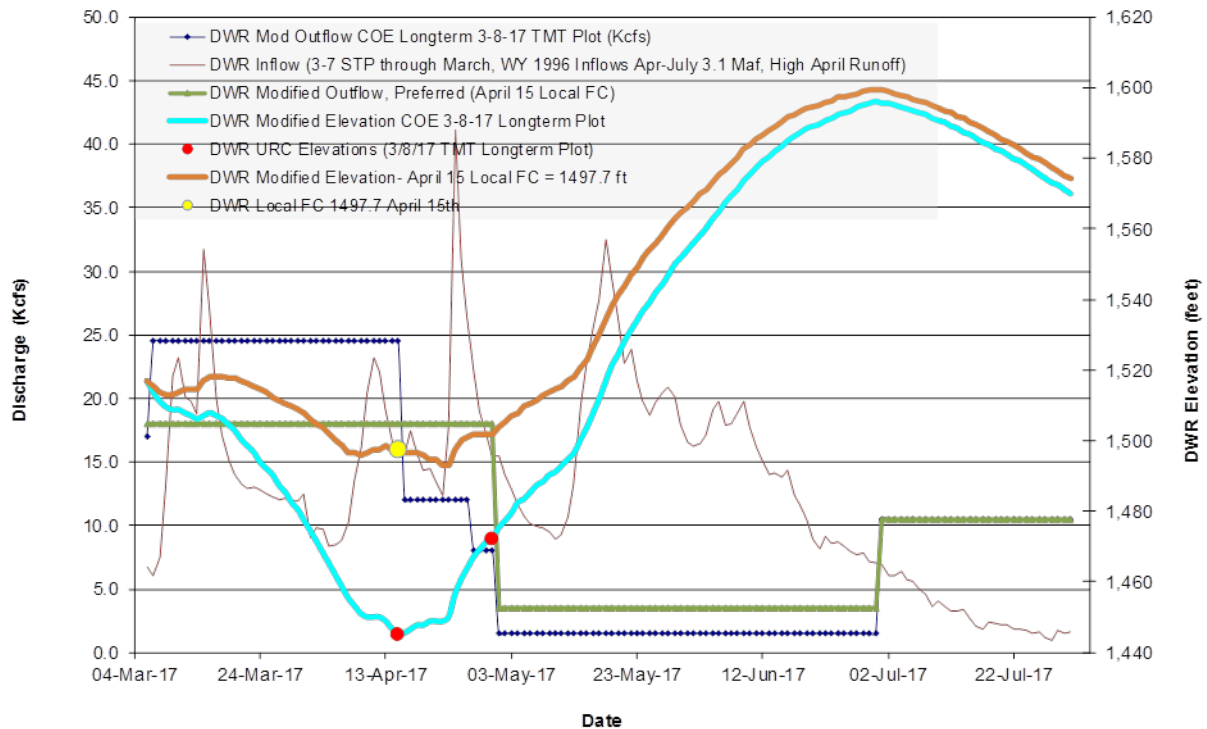
SUBJECT: Dworshak Scenarios

After yesterday's Technical Management Team call there was discussion relative to the long-term Dworshak operations modeled and presented by the COE at the March 8th TMT meeting. The COE's model considered operations meeting the end of March and the April 15th flood control operations, and continued with the expected Dworshak operations through June. The COE chose to model the operations using the 1996 water year, since their early-bird forecasting had predicted the runoff volume would increase to 3 MAF (1996 had runoff volume of 3.1 MAF for April through July) and 1996 also had a high April runoff, consistent with the COE's prediction of a high April runoff in 2017.

1. We were asked to recreate the COE's analysis and then model scenarios aimed at meeting local, rather than system flood control elevations, and operating at the current discharge of approximately 17 Kcfs through April 15th. Both of these scenarios present a drafting of the reservoir until April 15th and then a subsequent refill operation that is similar to the COE's proposed operation. The objective was to illustrate the amount of additional discharge that might occur during the refill period and depict the amount of space that might remain in the reservoir in the event of unforeseen runoff events.
2. There are two plots describing the analysis. Keep in mind all these scenarios model a higher runoff volume, which was proposed by the COE at the TMT meeting based on an early bird unofficial forecast taking into consideration the precipitation over the first week of March. The current official COE runoff volume forecast is 2.87 MAF, while the 1996 runoff volume is 3.1 MAF, an 8% increase in runoff volume. In addition, the April runoff volume is 1.04

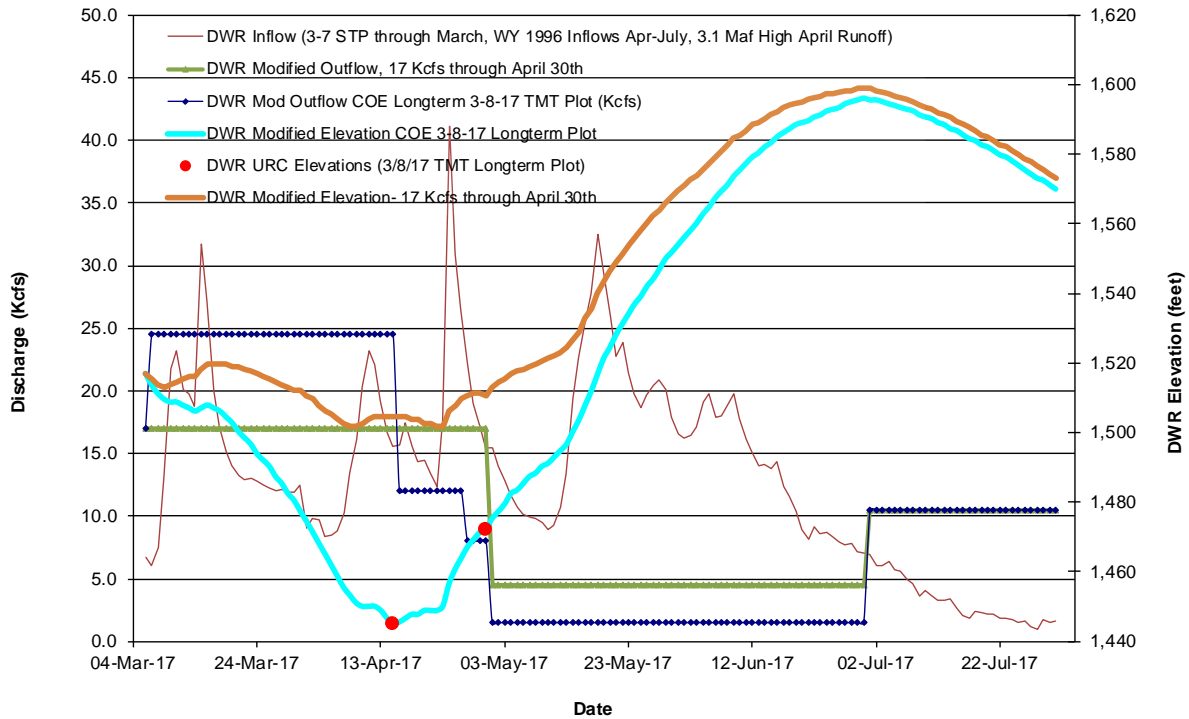
MAF, 34% of the total April through July volume, and the third highest April runoff volume in the 43 years of Dworshak operational records. If the prediction of an early runoff forecast does not materialize, we would expect flows to decrease from those predicted until the project begins refilling, when we might expect a slight increase in flows.

3. Each of the alternative operations is presented along with the COE's operation depicted in the graph they presented, which we were able to reproduce. All plots use the current STP inflow to Dworshak predictions through the end of March and then assume the actual inflows that occurred in 1996.
4. In the first plot flows were expected to be 18 Kcfs through April 15th in order to meet the local flood control elevation. Flows were maintained at 18 through the end of April due to the early runoff pattern, and then drop to 3.5 Kcfs for all of May and June. This discharge is only slightly higher than that modeled by the COE, and is less than the current limited powerhouse capacity.
5. In the second scenario a constant discharge of 17 Kcfs was used until April 30th. The resulting April 15th reservoir elevation was about 7 feet above the local flood control elevation on April 15th. The May and June flows were estimated to be 4.5 Kcfs.
6. There are numerous different ways to model the future Dworshak operations, each dependent on runoff volume and shape. However, what is consistent in these modeled operations is that while there is always risk, the available reservoir volume available is quite large. Consequently, the reservoir would likely be able to handle most all types of unanticipated runoff events that might occur by adjusting discharge above minimums during May and June, without necessitating discharges that may cause very high total dissolved gas supersaturation levels below the project.



Plot 1.

Plot 1: Flood Control Elevations were taken from COE Longterm Plot presented at 3-8-17 TMT Meeting (approximate 1,445 ft April 15th, 1,472 April 30th) and Dworshak Local FC on April 15th of 1,497.7 ft (stated by COE Walla Walla at 3-8-17 TMT). Plot uses 3-7-17 STP Inflows for Dworshak through March, from April through July, actual Inflows from WY 1996 were used (3.1 Apr-July Runoff Volume, High April Runoff Year). The April 15th FC Elevation targeted was 1,445 ft. under COE scenario and 1,497.7 ft (Local FC) under preferred scenario. Under COE scenario, Dworshak outflows were 24.5 Kcfs through April 15th, then decrease to 12 Kcfs and 8 kcfs, followed by decrease to minimum of 1.5 Kcfs all of May and June to refill to within four feet of full. If April-July inflow volume decreases below 3.1 Maf, Dworshak will be that much further below full or delay refill into July, which could impact summer flow augmentation volumes (with current limitations). Under preferred scenario, Dworshak outflows were 18 Kcfs through April 30th (and met April 15th Local FC of 1,497.7 ft), then drop to 3.5 Kcfs for all of May and June. Under preferred scenario Dworshak completely refills and would refill even if April-July volume decreases 240 Kaf.



Plot 2.

Plot 2: Flood Control Elevations were taken from COE Longterm Plot presented at 3-8-17 TMT Meeting (approximate 1,445 ft April 15th, 1472 April 30th). Plot uses 3-7-17 STP Inflows for Dworshak through March, from April through July, actual Inflows from WY 1996 were used (3.1 Apr-July Runoff Volume, High April Runoff Year). The April 15th FC Elevation targeted was 1,445 ft. under COE scenario. Under the alternative scenario, no elevation was targeted, just a flat outflow of 17 Kcfs at Dworshak through April 30th. Under COE scenario, Dworshak outflows were 24.5 Kcfs through April 15th, then decrease to 12 Kcfs and 8 kcf, followed by decrease to minimum of 1.5 Kcfs all of May and June to refill to within four feet of full. If April-July inflow volume decreases below 3.1 Maf, Dworshak will be that much further below full or delay refill into July, which could impact summer flow augmentation volumes (with current limitations). Under alternative scenario, Dworshak outflows were 17 Kcfs through April 30th (with no elevation targeted), then drop to 4.5 Kcfs for all of May and June. Under alternative scenario with constant 17 kcf through April 30th, an April 15th elevation of 1,504.5 was reached. Under the alternative scenario Dworshak completely refills and would refill even if April-July volume decreases 350 Kaf.