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MEMORANDUM

TO: FPAC

FROM: David Benner, FPC

DATE: March 2, 2009

RE: Review of Reservoir Operations 2008/2009

General Observations:

- Grand Coulee drafts in January significantly exceeded the draft level needed to meet chum flows below Bonneville Dam and flows needed to meet spawning and incubation below Priest Rapids Dam. Grand Coulee is currently at an elevation of 1282.8 feet, which is near the end of March Flood Control elevation of 1283.3 feet. If March river flows below Bonneville Dam do not require additional drafts from Grand Coulee, then the end of March Flood Control elevation is likely to be met. However, if drafting below Bonneville is necessary, then the end of March flood Control elevation will likely be below Flood control. A more conservative January draft operation at Grand Coulee would have provided a higher likelihood of meeting both Grand Coulee Flood Control elevations in March and April and maintaining flows below Bonneville Dam.
- The COE is near the end of February Flood Control elevation at Dworshak based on their forecast, which has estimated a higher runoff volume than the River Forecast Center forecast. If the actual runoff volume is closer to the River Forecast Center volume then the Dworshak elevation may be to low, which may affect the ability to meet future flood control elevations. In addition, the March runoff volume forecast is likely to be lower than the February forecasts causing the flood control elevations to increase. Given this information, the COE could have operated more conservatively and, rather than drafting to the end of February Flood Control, waited until the March projection was issued. The issue of setting flood control based on monthly forecasts with diminished water supplies could be addressed by adopting more frequent (bi-monthly) forecasting with revised flood control.
- Libby is currently at an elevation of 2406.0 feet (3-1-09) and the end of February FC elevation was 2436.4 feet (30.4 feet below Flood Control) primarily because Libby drafted to its December 31st limit of 2411 feet.

- The present Libby operation calls for Libby to draft to 2411 feet by the end of December in most (75%) flow years. Full relaxation of the Libby December draft only occurs in 10% of historical water years. This recent year, the runoff volume appears to be diminishing and its likely that the March Final Forecast will decline relative to the February Final forecast causing the discrepancy between the actual elevation of Libby reservoir and its flood control elevations to increase, worsening the project over draft and decreasing the probability that the spring reservoir elevation target will be met..
- Currently Hungry Horse is at an elevation of 3513.5 feet (3-1-09) and is currently 24 feet below the end of February Flood Control. Hungry Horse has been operating to meet the Columbia Falls minimum flow and therefore has had limited ability to refill closer to flood control.

Grand Coulee

Figure 1 shows how Grand Coulee was operated throughout the winter of 2008/2009 with respect to flood control. Grand Coulee is currently (3-1-09) at an elevation of 1282.8 feet, which is 7.2 feet below the end of February Flood Control elevation. It should be pointed out that the end of January and February Flood Control elevations at Grand Coulee are typically 1290 feet (full reservoir); therefore, Flood Control elevations beyond February are more indicative of the Water Supply during the current Water Year. The end of March Flood Control elevation at Grand Coulee is 1283.3 feet. Additionally, if the Water Supply remains similar to the February Water Supply Forecast and future Flood Control elevations are similar to those calculated in February, the April 10th elevation will be approximately 1283.2 feet this year. At this point in the winter, Grand Coulee appears to at an elevation that will enable operators to achieve future Flood Control elevations if march river flows below Bonneville Dam are such that do not require additional drafts from Grand Coulee.

Despite Grand Coulee currently being in reasonable shape in terms of Flood Control, operators could have limited drafts in January that were well in excess of both those flows needed to meet chum flows below Bonneville Dam and flows needed to meet spawning and incubation below Priest Rapids Dam. If these drafts were performed in a more conservative fashion, operators would have had a higher likelihood of meeting both Grand Coulee Flood Control elevations in March and April and maintaining flows below Bonneville Dam. Figure 2 displays this draft at Grand Coulee as well as flows at both Bonneville Dam and Priest Rapids Dam.

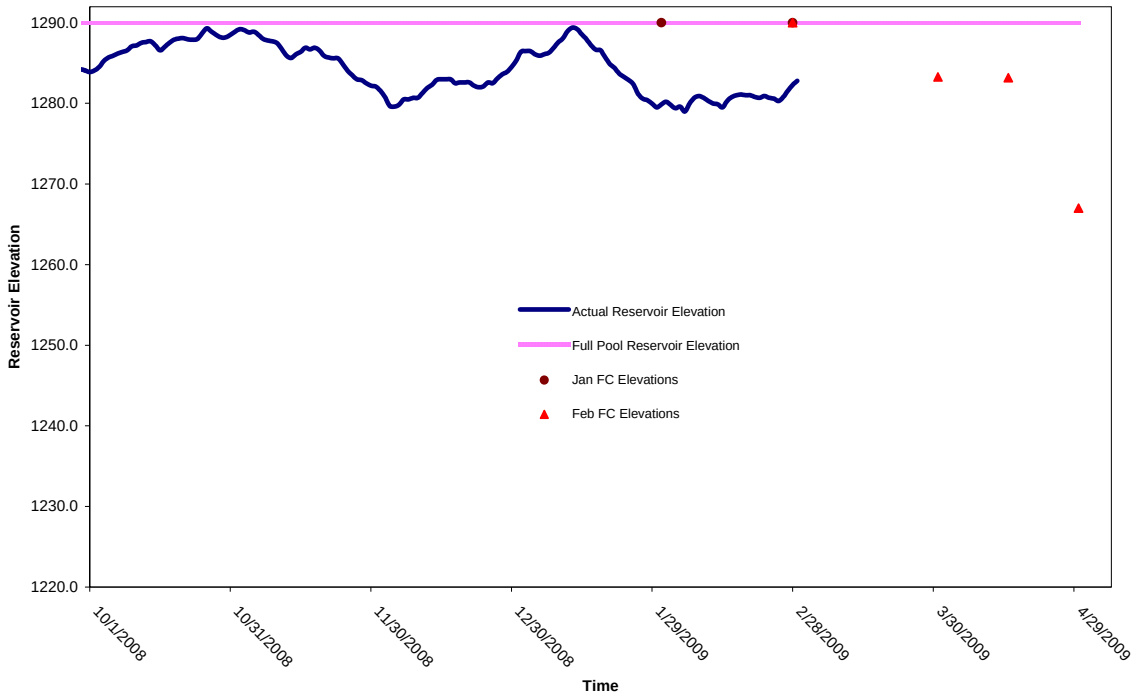

Figure 1. Operations at Grand Coulee over WY 2009.

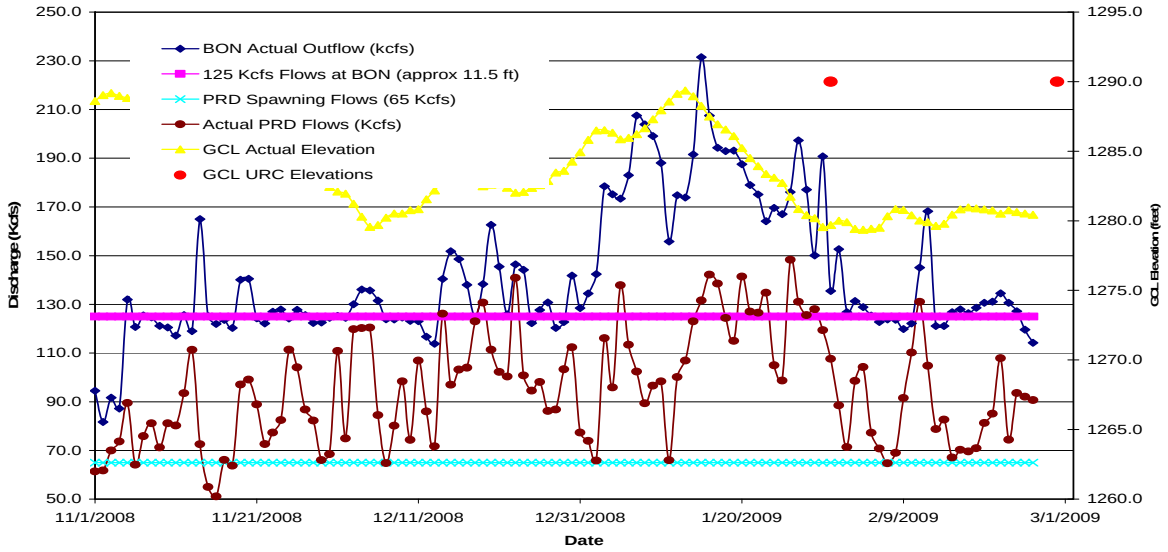

Figure 2. Discharge in the Columbia River below Bonneville Dam and Priest Rapids Dam in addition to Grand Coulee Drafts over the winter of 2008/2009.

Dworshak

Figure 3 shows how Dworshak Dam has been operated throughout the winter of 2008/2009 with respect to flood control. Dworshak is currently (3-1-09) at an elevation of 1524.4 feet, which was very close to the end of February Local Flood Control elevation of 1524.5 feet. The end of March Local Flood Control elevation at Dworshak is 1527.8 feet. Additionally, if the Water Supply remains similar to the February Water Supply Forecast and future Flood Control elevations are similar to those calculated in February, the April 10th elevation (based on Local Flood Control) will be approximately 1533.5 feet this year. At this point in the winter, Dworshak appears to at an elevation that will enable operators to achieve future Local Flood Control elevations.

It should be pointed out that Flood Control elevations based on the March Final forecast at Dworshak are likely to be higher than Flood Control elevations calculated using the February Final COE Forecast. The February COE forecast at Dworshaks was 100% of average, this was the forecast used to calculate the February Flood Control elevations. The February Final Forecast at Dworshak calculated by the River Forecast Center was 94% of average and their subsequent February Mid-Month forecast dropped even further to 84% of average. Snowpack in the Clearwater/Salmon basins is 82% of average (as of 3-2-09). Based on a clearly declining Water Supply Forecast at Dworshak, the winter of 2008/2009 may have benefited from final Water Supply Forecast calculated bi-monthly accompanied by revised Flood Control elevations bi-monthly. Beginning on 2-23-09, the COE has increased outflows from Dworshak to 6.5-8.8 Kcfs to draft to the end of February Local Flood Control elevation of 1524.5 feet. This is draft is unfortunate as the future Water Supply Forecast is likely to decrease which will increase future Flood Control elevations at Dworshak. Again, the use of a bi-monthly final forecasting

procedure and subsequent recalibration of Flood Control bi-monthly would have been beneficial in 2008/2009.

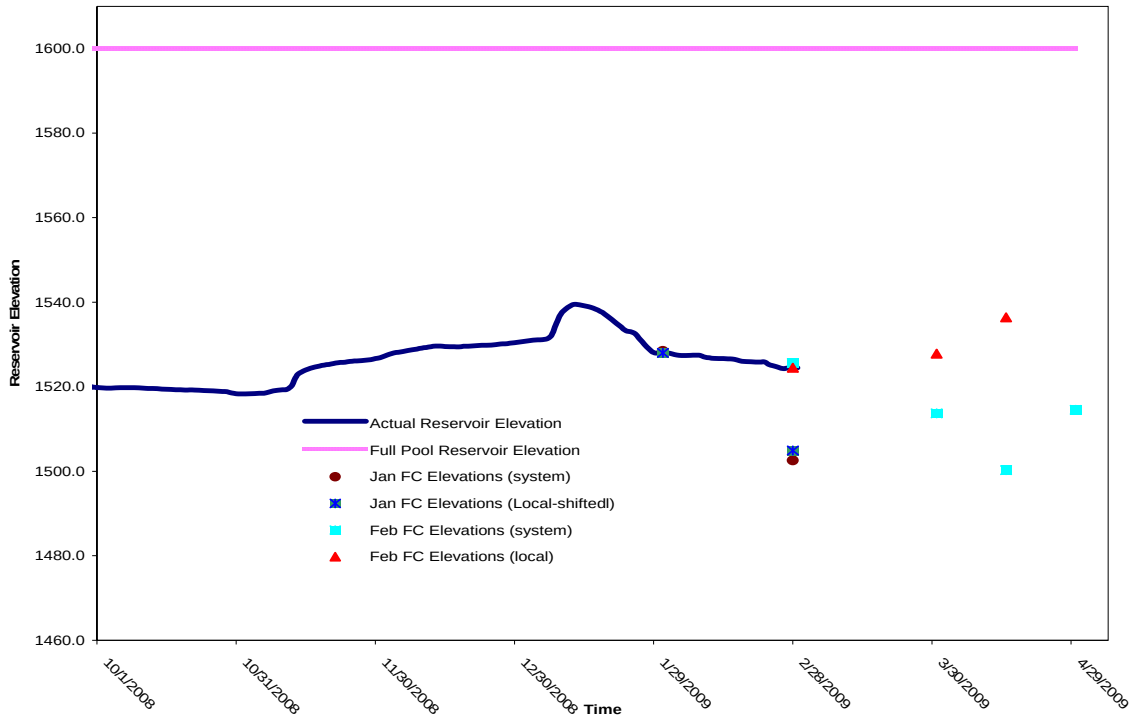

Figure 3. Operations at Dworshak over WY 2009.

Libby

Libby drafted to its December 31st limit of 2411 feet (Figure 4). Table 1 shows the COE Apr-Aug forecasts for Libby from December through April from 2003 to present. From Table 1, it is clear that in most years (5 of 7) the December forecast is greater than what is predicted in forecasts later in each year. In three of the seven years (2004, 2005, and 2009- highlighted yellow) the COE December forecast would have resulted in a draft to 2411 feet (forecast > than 5900 Kaf), however later forecasts dropped to levels that would have set the December draft to approximate 2426.7 feet (forecast < 5500 Kaf). In these type of years, the draft of Libby Dam to 2411 feet by the end of December puts Libby at a disadvantage with respect to meeting later flood control elevations. Such is the case in 2009 (Figure 4), Libby Dam is currently (3-1-09) at an elevation of 2406.0 feet and the end of February FC elevation was 2436.4 feet (30.4 feet below Flood Control). Libby Dam has been on minimum outflows (4 Kcfs) all throughout January and February and therefore has had no opportunity to refill closer to Flood Control. Libby is also in a situation where the March Final Forecast will likely drop relative to the February Final forecast, if this occurs this will further exacerbate the discrepancy between the actual elevation of Libby reservoir and its flood control elevations.

Table 1. COE Apr-Aug forecasts for Libby from December through April from 2003 to present.

	Libby Apr-Aug Forecast (Kaf)				
	Dec	Jan	Feb	March	April
2003	4924	4861	4659	4181	4955
2004	6954	5708	5644	5359	5305
2005	6178	5786	5630	5371	5401
2006	6625	5487	6186	6350	6076
2007	7746	6955	6582	6516	6847
2008	6385	6282	6498	6435	6387
2009	5937	5526	5436		

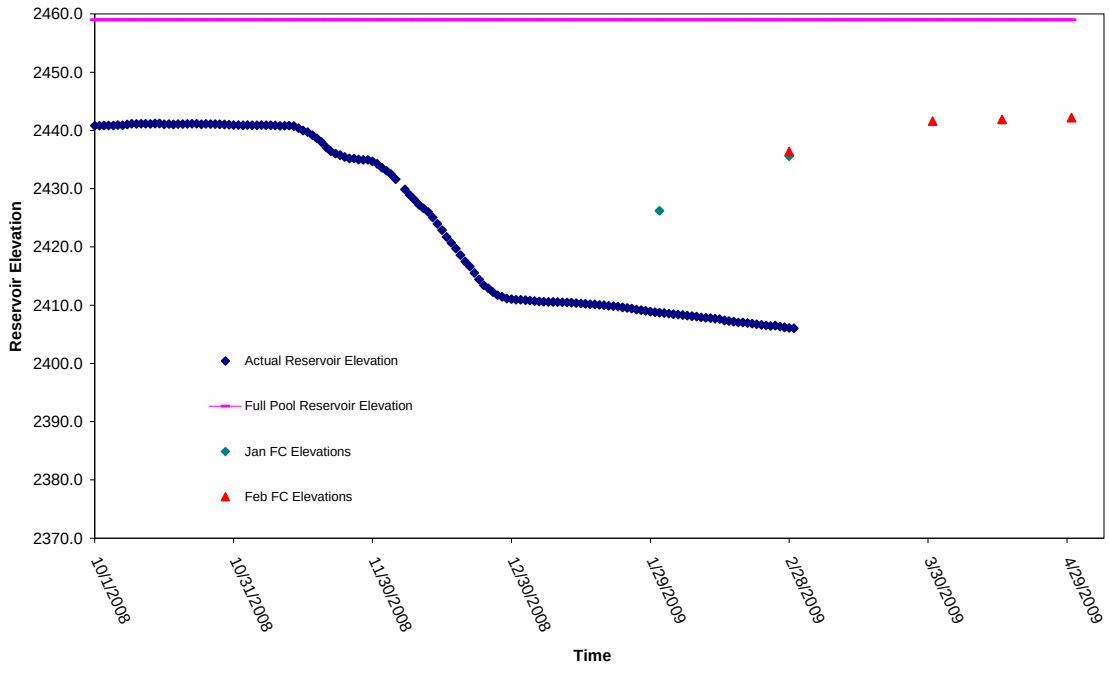

Figure 4. Reservoir operations at Libby Dam during Water Year 2009.

Hungry Horse

Currently Hungry Horse is at an elevation of 3513.5 feet (3-1-09), the end of February Flood Control elevation at Hungry Horse was 3537.5 feet. Although Hungry Horse is currently 24 feet below the end of February Flood Control, Hungry Horse has been operating to meet the Columbia Falls minimum flow and therefore has had limited ability to refill closer to flood control.

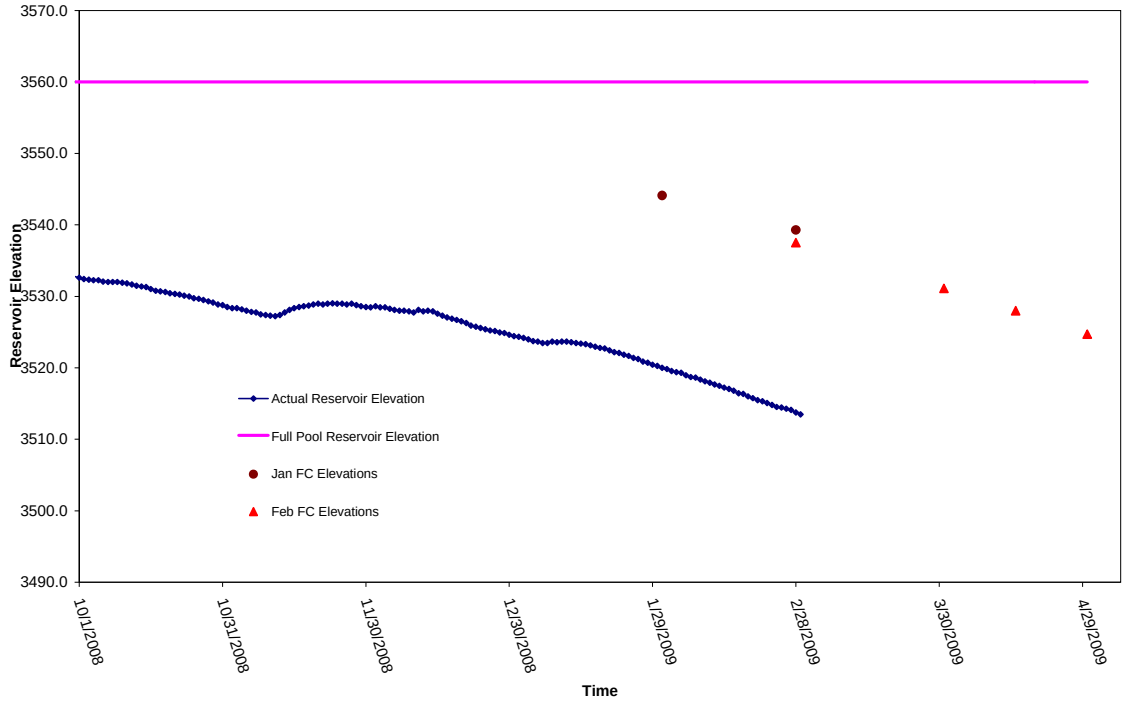

Figure 5. Reservoir operations at Hungry Horse Dam during Water Year 2009.

Brownlee

Brownlee is currently at an elevation of 2054.6 feet (3-1-09) and has refilled 4.1 feet over the last week. The end of February Flood Control elevation at Brownlee was 2058.1 feet. Brownlee also appears to be in a situation where the March Final Water Supply Forecast will decrease relative to the February Final Water Supply Forecast, which will cause future Flood Control elevations to increase. For this reason, it is reassuring to see Brownlee refilling and attempting to get closer to its Flood Control elevations.

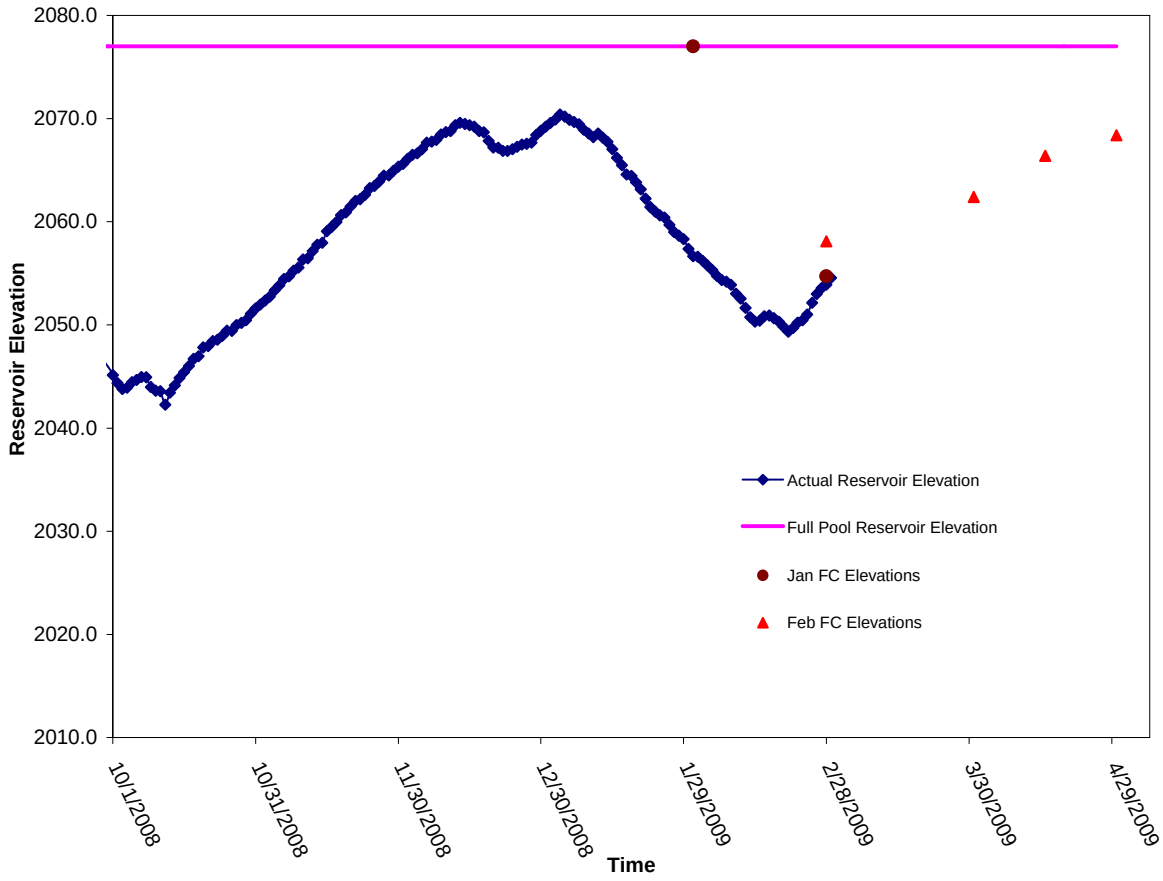

Figure 6. Reservoir operations at Brownlee Dam during Water Year 2009.