



# FISH PASSAGE CENTER

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## MEMORANDUM

TO: FPAC

FROM: Michele DeHart

DATE: November 7, 2007

RE: Summer spill volumes and estimated proportion of subyearling Chinook passing in spill at Bonneville Dam under three operational scenarios

The Fish Operations Plan called in 2007 for summer spill volumes of 75 Kcfs during the daytime and spill to the gas cap at night, from July 1 to August 31 at Bonneville Dam. However, it was determined that 75 Kcfs spill during the daytime hours was creating poor tailrace egress conditions potentially contributing to lower project passage survival. To investigate this further, the Action Agencies proposed to conduct research at BON under a different daytime spill volume, which was expected to improve tailrace egress conditions and, thus, survival of subyearling Chinook. There was some initial discussion among the parties as to what the summer spill operations should be. Among the operational scenarios discussed were: 1) 85 Kcfs during daytime hours and 100 Kcfs at night (herein referred to as the '85/100 Plan'), and 2) 85 Kcfs during daytime hours and gas cap spill (assumed to be 120 Kcfs) at night (herein referred to as the '85/120 Plan'). Both of these plans would have run from June 21 to August 31. However, there was disagreement between the Action Agencies and the Salmon Managers regarding these two scenarios as one clearly limited night-time spill, while the other called for more daytime spill than what was outlined in the 2007 FOP. Ultimately, an agreement was reached and the decision was made to operate BON at 85 Kcfs during daytime hours and spill to the gas cap at night from June 21 to July 15, followed by 75 Kcfs spill during daytime hours and spill to the gas cap at night through August 31 (herein referred to as the 2007 Operation).

FPAC requested that FPC staff review 2007 summer spill operations at Bonneville Dam (BON). Specifically, FPAC requested that FPC staff compare the actual 2007 Operation summer

spill volume to what might have occurred under the two different proposed operational scenarios, one with 85 Kcfs spill during daytime hours and 100 Kcfs during nighttime hours (85/100) and one with 85 Kcfs during daytime hours and gas cap (assumed to equal 120 Kcfs) during nighttime hours (85/120). FPAC also requested that FPC staff estimate the proportion of subyearling Chinook passing through spill at BON in 2007, versus the proportion that might have passed under the two alternative operational scenarios.

Below is a brief synopsis of our findings.

- The 2007 operations passed a greater proportion of fish over the spillway than would have occurred under the 85/100 scenario, but less than the 85/120.
- It is likely that the 2007 Operation resulted in less spill than anticipated, due to limitations with the total dissolved gas (TDG) gauge at Camas/Washougal (CAMWAS). If TDG did not limit the 2007 operations a higher proportion of the subyearling Chinook population would have passed through the spillway
- Without dissolved gas limitations, the 85/120 Plan would have resulted in the highest overall volume of spill (13,588 KAF). This spill volume was approximately 572 KAF greater than what was experienced under the actual 2007 Operation.
- Without dissolved gas limitations, the 85/120 Kcfs Plan would have also resulted in the highest proportion of subyearling Chinook passing through spill (59.3%) due to the higher volume of spill under this plan.

### **Spill Volumes:**

FPC staff calculated the total volume of spill (KAF) at BON under the 2007 Operation (June 21-August 31). In order to estimate the spill volumes under the 85/100 and 85/120 Plans, we relied on an assumed spill cap of 120 Kcfs. Under this assumption, these two plans were not limited in their spill volumes by TDG and, thus, were assumed to spill the full night-time volumes, except when low flows and powerhouse minimums did not permit.

Assuming a gas cap of 120 Kcfs, the 85/120 Plan resulted in the highest spill volume (13,588 KAF), followed by the 2007 Operation (13,016 KAF) and the 85/100 Plan (12,782 KAF) (Table 1). The volume of spill attained under the 2007 Operation was limited by the 115% TDG at the Camas/Washougal gauge. From June 21 to August 31 there were 16 days where TDG waivers were exceeded at CAMWAS, whereas there were no exceedences at the Cascade Island gauge (CCIS) during that period. Table 1 contains estimates of the daily average spill (Kcfs) under the three operational scenarios, as well as estimates of daily average percent spill.

**Table 1:** Estimates of total spill volume (KAF), daily average spill (Kcfs), and daily average percent spill under the three operational scenarios (June 21-August 31).

<b>Operation</b>	<b>Total Spill Volume (KAF)</b>	<b>Average Spill Volume (Kcfs)</b>	<b>Daily Average Percent Spill</b>
2007 Operation	13,016	91.3	56.9
85/100 Plan	12,782	89.7	56.1
85/120 Plan	13,588	95.3	59.6

**Percent of Subyearling Chinook Passing Through Spill:**

The COMPASS model includes Bonneville powerhouse 2 (PH2) and spill efficiency curves for spring Chinook and steelhead, but because there is limited data for fall Chinook efficiency curves have not been developed. The FPC reviewed several studies (see detailed list at the end of the memo) for all of the available radio tag and acoustic tag data and tried to apply the same methodology employed by NOAA Fisheries in the development of the spring Chinook and steelhead curves. The limited available data analyzed with the NOAA methodology suggested a relation close to a 1:1 PH2 and spill efficiency curve. At this time sufficient data does not exist to justify deviating from a 1:1 efficiency curves so the 1:1 PH2 and spill efficiency was adopted for this analysis.

Since all three of the operational scenarios involved different daytime (0500-2059) and nighttime (2100-0459) spill volumes, we estimated a diel passage distribution for subyearling Chinook from previously published hourly passage distribution data (Evans et al. 2001, Evans et al. 2006a, and Evans et al. 2006b). From these data, we determined that 58.2% of the daily collection of subyearlings would pass during daytime hours (0500-2059), while 41.8% passed at night (2100-0459).

The total daily population of subyearling Chinook was estimated using the 1:1 PH2 and spill efficiency, the average FGE for PH2 (0.35 based on sources listed below) and the estimates of the river flow through PH2. Under the 85/100 and 85/120 Plans, flow through PH2 was estimated as the difference between total flow and the sum of the estimated spill, powerhouse 1 (PH1) flow, and miscellaneous flow (i.e., adult ladders, juvenile fish facility, etc.). Under these plans, we assumed the same levels of PH1 flow and miscellaneous flow as was seen under the 2007 Operations. With estimates of daytime and nighttime %PH2, we were able to expand the daytime and nighttime PH2 collection counts to estimate the subyearling Chinook population at BON. We then estimated the percent passing through spill by using the daytime and nighttime average percent spill, the estimates for spillway passage efficiency, and the estimates of the subyearling Chinook population at BON.

Results from this analysis can be found below in Table 1.

Table 1: Estimates of percent of subyearling Chinook passing through the spillway under three operational scenarios.

<b>Operation</b>	<b>Estimated CH0 population</b>	<b>Estimated CH0 passing through spill</b>	<b>Percent CH0 passing through spill</b>
2007 Operation	6,170,785	3,436,247	55.7
85/100 Plan	5,886,060	3,166,958	53.8
85/120 Plan	6,856,757	4,068,851	59.3

In summary, the 2007 operation passed a greater proportion of fish over the spillway than would have occurred if nighttime spill was limited to 100 Kcfs. However, if the 115% TDG level at Camas/Washougal were not limiting spill, then the proportion of fish passing in spill would have been greater. Lastly, as expected, the 85/120 Plan, with the highest spill volume would have passed the greatest proportion of subyearling migrants over the spillway.

**Data Sources:**

- Counihan, T., J. Hardiman, C. Walker, A. Puls, and G. Holmberg. 2006. Survival estimates of migrant juvenile salmonids through Bonneville Dam using Radio Telemetry, 2005. Report of U.S. Geological Survey (Contract W66QKZ50458521) to U.S. Army Corps of Engineers, Portland, Oregon.
- Evans, S.D., C.D. Smith, N.S. Adams, D.W. Rondorf. 2001. Passage behavior of radio-tagged Chinook salmon at Bonneville Dam, 2001. Report of U.S. Geological Survey (Contract W66QKX10442576) to U.S. Army Corps of Engineers, Portland, Oregon.
- Evans, S.D., L.S. Wright, R.E. Wardell, N.S. Adams, D.W. Rondorf. 2006a. Passage behavior of radio-tagged subyearling Chinook salmon at Bonneville Dam, 2002: revised for corrected spill. Report of U.S. Geological Survey (Contract W66QKZ20303685) to U.S. Army Corps of Engineers, Portland, Oregon.
- Evans, S.D., L.S. Wright, R.E. Reagan, N.S. Adams, and D.W. Rondorf. 2006b. Passage behavior of radio-tagged subyearling Chinook salmon at Bonneville Dam, 2004: Revised for corrected spill. Report of U.S. Geological Survey (Contract W66QKZ40238289 to U.S. Army Corps of Engineers, Portland, Oregon.
- Ploskey, G.R., M.A. Weiland, S.A. Zimmerman, J.S. Hughes, K. Bouchard, E.S. Fischer, C.R. Schilt, M.E. Hanks, J. Kim, J.R. Skalski, J. Hedgepeth, and W.T. Nagy. 2006. Hydroacoustic evaluation of fish passage through Bonneville Dam in 2005. Report to U.S. Army Corps of Engineers (Contract DE-AC05-76RLO1830).