Gas Supersaturation Monitoring Report during Corner Collector Operation and Spill at Bonneville Dam March 3-7, 2006

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Introduction

To aid the downstream survival of about 7.4 million tule fall Chinook (*Oncorhynchus tshawytscha*) juveniles scheduled for release from the Spring Creek National Fish Hatchery on March 2, 2005, the U.S. Fish and Wildlife Service (Service) reached an agreement with the Action Agencies (Bonneville Power Administration (BPA), and U.S. Army Corps of Engineers (Corps)) in March 2004 for the provision of Bonneville Dam Power House 2 Corner Collector (B2CC) operation, that may or may not include spillway flow, for the March 2005 and 2006 hatchery releases. Sufficient depth for compensation from gas supersaturation, as measured by total dissolved gas (TDG) over listed chum salmon *(O. keta*) redds below the Bonneville Dam project, was requested. It was calculated by Service biologists that the anticipated level of flow and B2CC operation would produce a maximum TDG level not exceeding 120% in the tailrace of Bonneville Dam, and a maximum TDG level not exceeding 105%, when compensated by water depth, at the chum and fall Chinook salmon redds located below Bonneville Dam at the Ives Island complex and across the river along the Oregon shore, principally at the Multnomah Falls area (Figures 1 and 2).

The Service requested a TDG waiver from the Oregon Department of Environmental Quality (ODEQ) and an adjusted dissolved gas standard from the Washington Department of Ecology (WDOE) for spill at Bonneville Dam for a ten day period in March, 2004. These requests were made to allow for TDG saturation up to 115% as measured at the Camas/Washougal monitoring station (RM 122) and 120% in the Bonneville Dam tailrace, as measured at the Warrendale monitoring stations (RM 140) on the Washington and Oregon shores, respectively. The Oregon Environmental Quality Commission approved this request at its February 6, 2004 meeting. The Oregon waiver was a multi-year waiver for spill through March 2007. The WDOE provided the adjusted TDG standard on February 27, 2004. The WDOE adjusted TDG standard expired on February 27, 2005. A new exemption was issued by WDOE in March 2005 to the Corps, which included actions at Bonneville Dam for the March release. This exemption extends through February 2008 and applies to Corps dams on the Columbia and Snake Rivers in Washington State.

This report summarizes the results of the 2006 March release and the monitoring for TDG during the B2CC operation.

Operations

The first release of 2005 brood of tule fall Chinook smolts (7.35 million, 50% of total production) was on Thursday March 2, 2006. The Bonneville Powerhouse 2 Corner Collector (B2CC)/spill operation was to last for a minimum of four days. The Service had requested a six day operation of the B2CC, with spill, for the best passage of the fish. An agreement was reached to operate the B2CC for four days and reevaluate the passage of the tule smolts and, if water were available, to possibly continue the B2CC operation for some extended amount of time. The Service goal was to pass 90-95% of the Spring Creek tule smolts during the B2CC operation period.

It was estimated that the elevated tailwater that was to accompany the B2CC operation would provide the necessary depth compensation to 108%, the estimated level of TDG expected to be generated by the B2CC operation. The operation began Friday morning March 3 at 7 AM. The B2CC was closed at 11:00 AM on Tuesday March 7.

The Service monitored TDG levels from the mainstem Columbia River dissolved gas monitoring network gauges below Bonneville Dam (the tailwater gauge (at Warrendale) and the downstream gauge (at Camas/Washougal)) during the March 3-7 B2CC operational period. To establish the critical tailwater elevations and TDG levels at the chum salmon redd locations, TDG levels and water depth at the redds were measured using a Hydo-Lab Datasonde4 probe (factory calibration).

Results

Biological Monitoring:

No biological monitoring of fish for gas bubble trauma (GBT) was conducted in 2006 as the TDG levels did not exceed the 110% limit. Passage timing of the tule smolts past Bonneville Dam was tracked with combined sub-yearling smolt data collected by the Smolt Monitoring Program at the Bonneville Dam Juvenile Fish Facility. Passage data from 2006, and previous recent years, is shown in Table 1 and listed in Figure 3. By the morning of March 7 it was estimated that approximately 95% of the combined sub-yearling fall Chinook smolts had passed Bonneville Dam. Post season evaluation using passage data into April, and correcting for non-tule Chinook sub-yearling passage, estimated that 90% of the tule fall Chinook smolts released from Spring Creek Hatchery passed Bonneville Dam during the B2CC operation.

Monitoring of Physical Conditions:

The Service monitored tailwater depth and TDG data from the tailrace monitor (Warrendale), and TDG data from the downstream monitor (Camas/Washougal)during

the entire operational period. These data were collected and transmitted automatically for display on the Corps website: http://www.nwd-wc.usace.army.mil/report/total.html

Figure 4 visually compares the TDG readings taken at the Bonneville Dam forebay and the sampling stations downstream of Bonneville Dam from February 26 through March 11 (before, during, and after the B2CC operation). The TDG levels ranged from 100.5% to103.3% in the Bonneville forebay. Recorded TDG levels at the Warrendale monitoring station varied from 101.2% to107.5% during this time period. The TDG levels recorded at the Camas/Washougal monitoring station varied from 100.1% to 106.9%.

Figure 5 shows daily total discharge and spill at Bonneville Dam before, during, and after the spill and B2CC operations. Total discharge varied from 112-218 thousand cubic feet per second (Kcfs). Spill volume ranged from 0-2.4 Kcfs. The Bonneville Dam discharge, spill, and official project tailwater height are retrieved from the Corps data query website: http://www.nwd-wc.usace.army.mil/perl/dataquery.pl

Table 2 summarizes the TDG data seen in Figures 3 and 4, and highlights the four day period (March 3-7) encompassing the actual 48 hour B2CC operation. Ambient TDG levels ranged from 101.4% to 103.3 % in the Bonneville forebay. Neither of the two downstream gauges used for the monitoring of the operation (Warrendal and Camas/Washougal) went above 107.5 % during this time period. TDG levels at the Warrendale monitoring station varied from 101.8% to 107.5% during this time period. The TDG levels recorded at the Camas/Washougal monitoring station varied from 102.1% to 106.9%.

Table 3 lists the measured TDG readings and water depth taken by the Service at the chum redd sites. During the operational period of March 3-7, the lowest tailwater elevation and the highest TDG readings (Table 2) remained below the 105% limit at the Ives Island complex and at the Multnomah Falls site, when factored for depth compensation. There is approximately a 3% TDG compensation for very foot of water above the redds. The 2005 spawning chum salmon were held to spawning areas available at the 11.5 foot tailwater elevation. Flow levels in 2006 were sufficient to provide adequate depth compensation for the effects of TDG, contrary to conditions during the 2005 operation.

Summary

The Service monitored water quality (TDG) from the mainstem Columbia River gauges below Bonneville Dam (Warrendale and Camas/Washuogal) and at the critical chum

salmon redd locations during the March 3-March 7 B2CC operational period.

Total dissolved gas levels recorded at the tailrace monitoring station (Warrendale) did not exceed the 120% waiver limit (107.5% actual). The TDG levels recorded at the Camas/Washougal monitoring station did not exceed the 115% waiver limit (106.9% actual). The TDG levels measured by the Service for shallow redds at the Multnomah Falls site did not exceeded the 105% TDG limit, when factored for depth compensation.

The B2CC operation was ended after four days operation for Spring Creek smolt passage, with a real time estimate of 95% passage of combined sub-yearling fall Chinook smolts. Post season evaluation estimated that 90% of the tule fall Chinook smolts released from Spring Creek Hatchery passed Bonneville Dam during the B2CC operation.

Figure 1. Location of salmon redds from 2005 spawning, and TDG sample sites (March 2006) in the Ives/Pierce area below Bonneville Dam.
chinook spawning site chum spawning site 2 TDG sample site

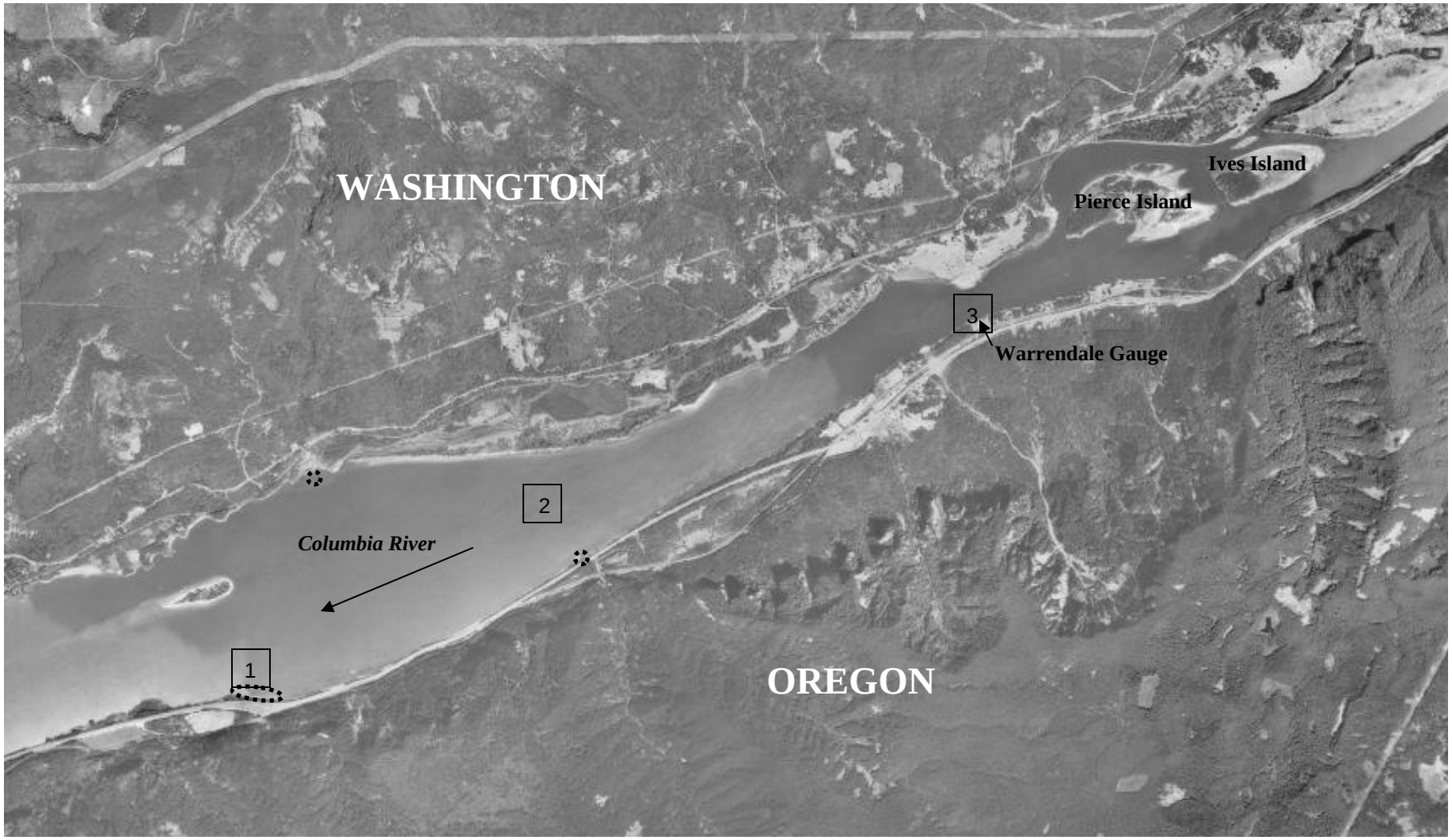

Figure 2. Location of salmon redds from 2005 spawning, and TDG sample sites (March 2006) from Multnomah Falls to Warrendale below the Ives Island Complex.

chum spawning site 1 TDG sample site

Table 1. Fish passage index counts at Bonneville Dam (2002-06), combined subyearling chinook. Index counts are from Power House 2 beginning in year 2000.

Number of days into spill start	Spring Creek Release 03/02/06 B2CC Index Count *	Date	Spring Creek Release 03/02/05 B2CC Index Count *	Date	Spring Creek Release "B" 03/10/04 B2CC Index Count *	Date	Spring Creek Release "A" 03/01/04 Spill Index Count *	Date	Spring Creek Release 03/01/03 Spill Index Count *	Date	Spring Creek Release 03/11/02 Spill Index Count *	Date
-1	57	03/02/05	35	03/02/05		03/10/04	-----	03/01/04	-----	03/09/03	-----	03/11/02
1	55	***03/03/05***	33	***03/03/05***		***03/11/04***	-----	***03/02/04***	-----	***03/10/03***	847	***03/12/02***
2	51,611	03/04/05	8,924	03/04/05	50,260	03/12/04	20,825	03/03/04	256,056	03/11/03	17,434	03/13/02
3	387,150	03/05/05	387,479	***03/05/05***	242,411	03/13/04	173,388	03/04/04	62,621	***03/12/03***	367,558	03/14/02
4	219,703	03/06/05	264,004	03/06/05	52,319	03/14/04	123,449	03/05/04	16,830	03/13/03	187,981	***03/15/02***
5	54,658	***03/07/05***	89,485	03/07/05	18,647	***03/15/04***	26,718	***03/06/04***	5,861	03/14/03	158,610	03/16/02
6	24,241	03/08/05	29,584	03/08/05	7,230	03/16/04	4,464	03/07/04	940	03/15/03	11,607	03/17/02
7	6,284	03/09/05	13,558	03/09/05	7,322	03/17/04	6,740	03/08/04	1,148	03/16/03	5,645	03/18/02
8	2,314	03/10/05	6,037	03/10/05	4,644	03/18/04	3,678	03/09/04	708	03/17/03	3,718	03/19/02
9	1,548	03/11/05	6,785	03/11/05	3,829	03/19/04	2,331	03/10/04	576	03/18/03	1,672	03/20/02
10	1,095	03/12/05	2,846	03/12/05	6,186	03/20/04	2,310	03/11/04	745	03/19/03	2,624	03/21/02
11	1,006	03/13/05	2,898	03/13/05	5,976	03/21/04			386	03/20/03	756	03/22/02
12 Day Total	749,722		811,668		398,824		363,903		345,871		758,452	
5 Day Passage	737,363		779,476		363,637		344,380		341,368		732,430	
5 Day %	98.4%		96.0%		91.2%		94.6%		98.7%		96.6%	

----- no counts taken, no data available

bolded dates are first and last days of spill or Corner Collector operations

* Index counts are based on a 24 hour Smolt Monitoring Program sample collection counted about 8 AM on the listed date.

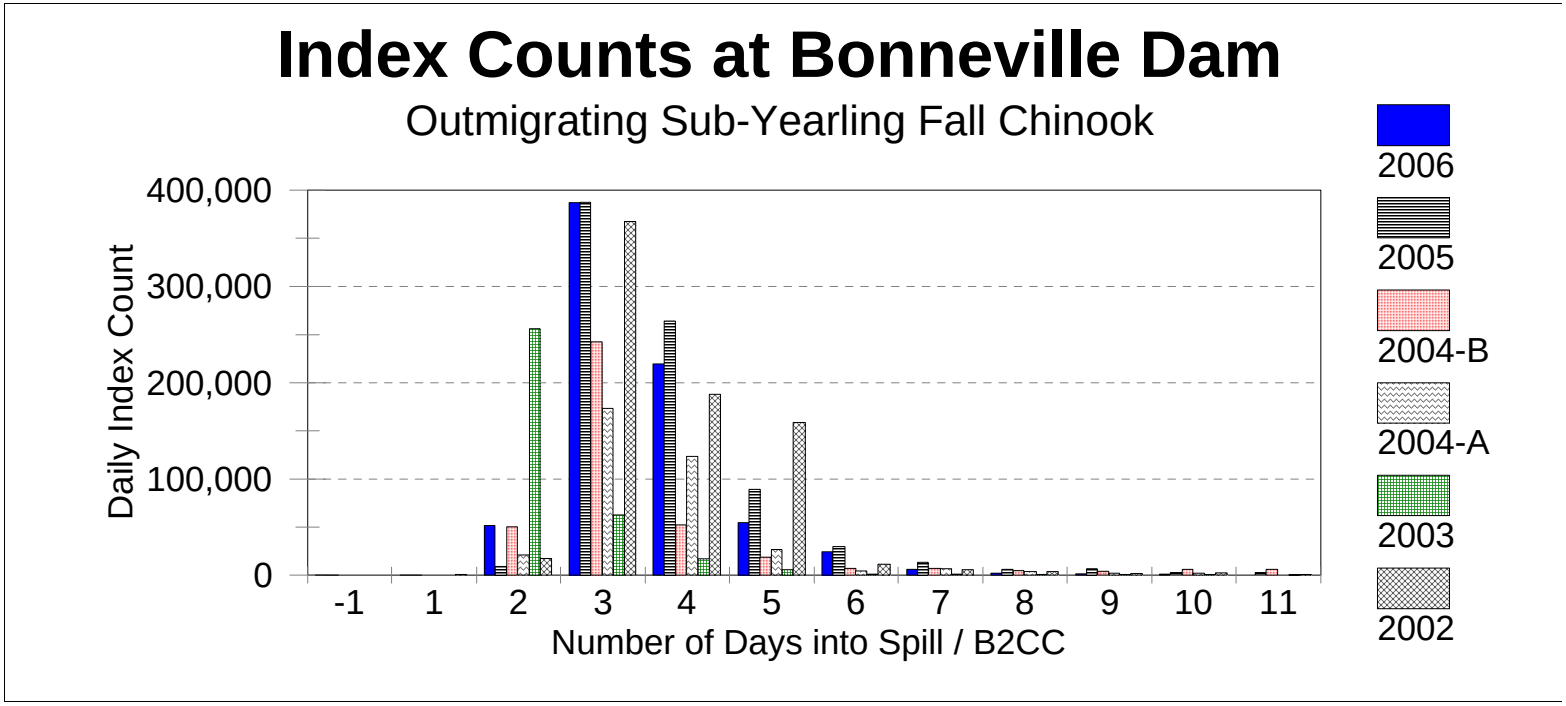

Figure 3. Fish passage index counts before and during spill periods at Bonneville Dam from 2002-2006.

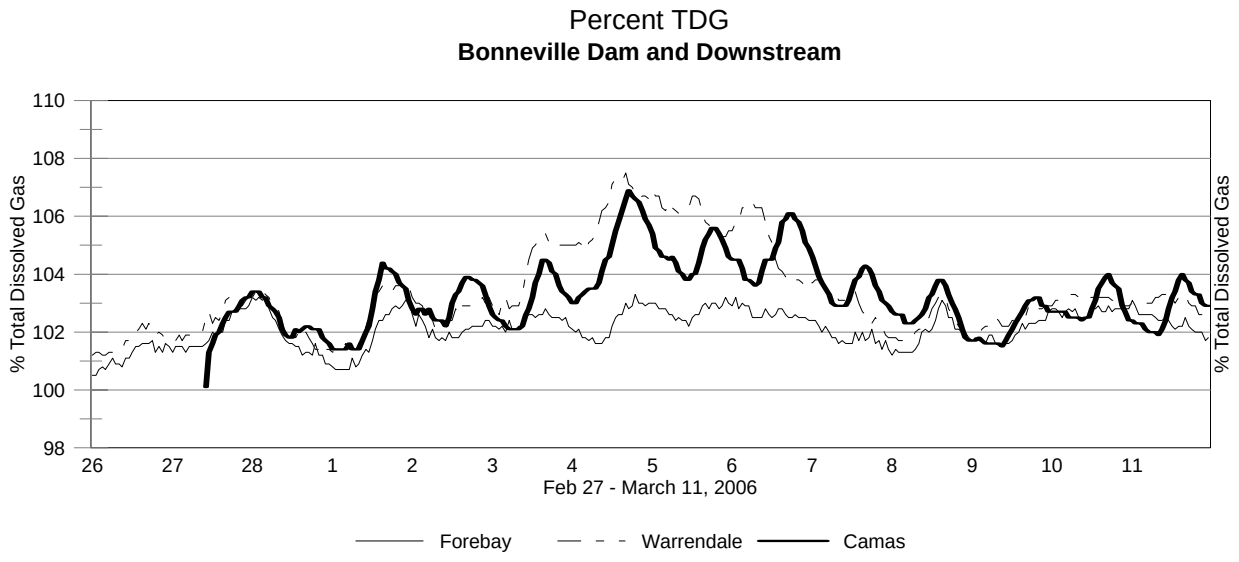

Figure 4. Percent saturation of Total Dissolved Gas at Bonneville Dam forebay and downstream gauges, February 26 through March 11, 2006.

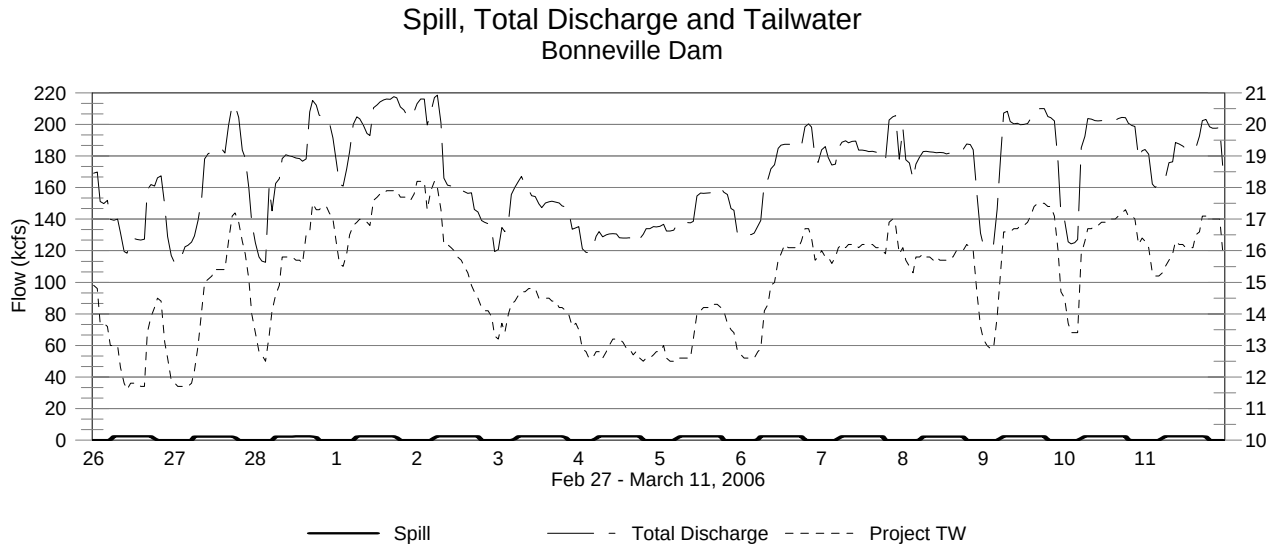

Figure 5. Spill, flow, and tailwater elevation at Bonneville Dam, February 26 through March 11, 2006.

Feb 26-Mar 11, 2006

	SPILL (KCFS)	TOTAL FLOW (KCFS)	Project TW (ft)	TDG % Saturation Bonneville Forebay (BON)	Warrendale (WRNO)	Camas (CWMW)
Average	1.3	168.3	15.1	102.1	103.4	103.3
Minimum	0.0	111.9	11.6	100.5	101.2	100.1
Maximum	2.4	218.5	18.2	103.3	107.5	106.9

Mar 3-Mar 7, 2006

	SPILL (KCFS)	TOTAL FLOW (KCFS)	Project TW (ft)	TDG % Saturation Bonneville Forebay (BON)	Warrendale (WRNO)	Camas (CWMW)
Average	1.4	155.4	14.3	102.4	104.9	104.2
Minimum	0.0	118.8	12.5	101.4	101.8	102.1
Maximum	2.4	205.6	17.0	103.3	107.5	106.9

Table 2. Summary of spill, total flow, tailwater elevation (TW), and percent TDG for a 14 day period (February 26-March 11) before, during and after B2CC operations, and the five day period (March 3 - 7) encompassing the 96 hour B2CC operation.

Table 3. USFWS TDG field measurements below Bonneville Dam during the 2006 Spring Creek release.

Sample Site	Date	Time Probe1 into Water	Time of Sample	Total Depth feet	Probe1 Depth feet	Probe1 Temp °C	Probe1 TDG Pressure mmHG	Baro Pres mmHG Warrendale (WRNO)	%TDG	%TDG Warrendale (WRNO)	Time of Sample
1 Multnomah Falls redds[2]	3-Mar	9:15 AM	9:35 AM	2.0	1.5	4.5	773	757	102.1%	103.0%	10:00 AM
1 Multnomah Falls redds[2]	3-Mar	9:15 AM	9:40 AM	2.0	1.5	4.5	772	757	102.0%	103.0%	10:00 AM
1 Multnomah Falls redds[2]	3-Mar	9:15 AM	9:45 AM	2.0	1.5	4.5	772	757	102.0%	103.0%	10:00 AM
2 Mid-Channel	3-Mar	9:50 AM	10:00 AM	36.0	3.0	4.2	777	757	102.6%	103.0%	10:00 AM
2 Mid-Channel	3-Mar	9:50 AM	10:05 AM	36.0	3.0	4.2	777	757	102.6%	103.0%	10:00 AM
3 Warrendale	3-Mar	10:25 AM	10:35 AM	10.0	3.0	4.2	783	757	103.4%	104.0%	11:00 AM
3 Warrendale[2]	3-Mar	10:25 AM	10:49 AM	10.0	3.0	4.2	781	757	103.2%	104.0%	11:00 AM
3 Warrendale	3-Mar	10:50 AM	10:57 AM	10.0	5.0	4.2	783	757	103.4%	104.0%	11:00 AM
3 Warrendale	3-Mar	10:50 AM	11:01 AM	10.0	5.0	4.2	785	757	103.7%	104.0%	11:00 AM
3 Warrendale	3-Mar	10:50 AM	11:05 AM	10.0	5.0	4.2	786	757	103.8%	104.0%	11:00 AM
3 Warrendale[2]	3-Mar	10:50 AM	11:10 AM	10.0	5.0	4.2	786	757	103.8%	104.0%	11:00 AM
3 Warrendale	3-Mar	11:31 AM	11:36 AM	10.0	5.0	4.2	786	757	103.8%	104.5%	12:00 PM
3 Warrendale	3-Mar	11:31 AM	11:45 AM	10.0	5.0	4.2	788	757	104.1%	104.5%	12:00 PM
3 Warrendale[2]	3-Mar	11:31 AM	11:52 AM	10.0	5.0	4.2	788	757	104.1%	104.5%	12:00 PM
3 Warrendale[2]	3-Mar	11:31 AM	11:55 AM	10.0	5.0	4.2	787	757	104.0%	104.5%	12:00 PM
4 Fish Wheel Pilings*	3-Mar	1:15 PM	1:30 PM	7.0	5.0	4.2	787	756	104.1%	105.0%	2:00 PM
4 Fish Wheel Pilings*[2]	3-Mar	1:15 PM	1:45 PM	7.0	5.0	4.2	785	756	103.8%	105.0%	2:00 PM
5 Ives Slot**	3-Mar	2:00 PM	2:15 PM	3.0	3.0	5.4	803	756	106.2%	105.0%	2:00 PM
5 Ives Slot**[2]	3-Mar	2:00 PM	2:25 PM	3.0	3.0	5.4	804	756	106.3%	105.0%	2:00 PM
3 Warrendale	3-Mar	2:34 PM	2:44 PM	10.0	5.0	4.3	793	756	104.9%	105.2%	3:00 PM
3 Warrendale[2]	3-Mar	2:34 PM	2:54 PM	10.0	5.0	4.3	793	756	104.9%	105.2%	3:00 PM
1 Multnomah Falls redds	3-Mar	3:15 PM	3:30 PM	2.0	2.0	4.8	788	756	104.2%	105.2%	4:00 PM
1 Multnomah Falls redds[2]	3-Mar	3:15 PM	4:01 PM	2.0	2.0	5.2	789	757	104.2%	105.2%	4:00 PM

1 Hydro-Lab Datasonde4 probe was used. Pre-season calabration at factory.

2 Probe stabelized for at least 20 minutes.

* Downstream from the mouth of Hamilton Creek. ** Between Ives and Pierce Islands.