Gas Supersaturation Monitoring Report for Spill Below Bonneville Dam March 10-13, 2001

U.S. Fish and Wildlife Service
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Introduction

To aid the downstream migration of 5.3 million tule fall chinook juveniles scheduled for release from the Spring Creek National Fish Hatchery on 8 March 2001, State, Tribal, and Federal Salmon Managers requested in System Operational Request (SOR) 2001-02 spill of 55 thousand cubic feet per second (Kcfs) at Bonnevile Dam for an 11-day period, March 9-19. Additional water for spill was not available, therefore the spill would be shaped within the existing total flow. Based on the total low volume of flow from Bonneville Dam and the managed 11.5 foot tailwater elevation, it was calculated that the requested level of spill would produce a maximum total dissolved gas level of 120% in the tailrace of Bonneville Dam and a maximum total dissolved gas level of 105% above the chum and fall chinook salmon redds below Bonneville Dam at the Ives Island complex (Figure 1).

The Technical Management Team (TMT) met and discussed the SOR and recommended the SOR be implemented except capping spill at 50 Kcfs and limiting the duration of the spill to three 12-hour nighttime periods; 1800 hours - 0600 hours on the nights of March 10, March 11, and March 12. These restrictions were cited as necessary to conserve water during an evolving low runoff year.

The US Fish & Wildlife Service (USFWS) requested a total dissolved gas (TDG) waiver from the Oregon Department of Environmental Quality 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, 2001. These requests were made to allow for TDG saturation up to 115% as measured at the Camas/Washougal monitoring station (river mile 122) and 120% in the Bonneville Dam tailrace, as measured at the Skamania and Warrendale monitoring stations (at river mile (RM)141 on the Washington and Oregon shores, respectively). The Oregon Environmental Quality Commission approved this request at its November 30, 2001 meeting. The WDOE provided the adjusted TDG standard previously on March 8, 1999. The adjusted TDG standard expires in the year 2003. One of the conditions of the approved waiver and adjusted TDG standard was that the USFWS conduct biological and physical monitoring downstream of Bonneville Dam during the spill period and to provide reports of this monitoring.

The USFWS Columbia River Fisheries Program Office (CRFPO) monitored water conditions and examined fish collected below Bonneville Dam for signs of Gas Bubble Trauma (GBT) during the March 2001 spill period. This report summarizes the results of this monitoring program.

Operations

Spring Creek National Fish Hatchery, located along the Columbia River at RM 167.2, released 5.3 million tule fall chinook salmon on March 8 at 0800 hours. Bonneville Dam (RM 146) began spilling water over the spillway gates on March 10 at 1800 hours.

The Salmon Managers requested that the Bonneville Dam Second Powerhouse (PH2) have first use priority for power generation during the spill period. The Salmon Managers believed that greater use of the second powerhouse would direct water with lower TDG levels along the Washington side of the river where the salmon redds were located.

The number of juvenile fish observed passing Bonneville Dam during and after the spill periods is detailed in Table 1 and Figure 2.

Biological Monitoring

The biological monitoring program included collecting at least 100 fish (juvenile salmonids and resident fish) each of two sampling days during the period of spill and examining them for signs of GBT. Sampling was conducted on March 12 and March 13. Personnel from the USFWS who examined fish for signs of GBT had been trained on examination techniques by staff from the Fish Passage Center. Jerry McCann, the Fish Passage Center staff member who trained USFWS staff, also examined fish with CRFPO staff on March 12.

Fish were captured by Washington Department of Fish and Wildlife (WDFW) and Oregon Department of Fish and Wildlife (ODFW) personnel using a 100-foot-long beach seine in near shore areas of the Columbia River and Ives Island (RM 142.5, approximately) side channel at sampling sites that they continuously monitor for emerging and stranded fry. Figure 3 displays the locations of WDFW/ODFW beach seining sites. Biologists used microscopes to examine captured fish for signs of GBT. A minimum of 10x magnification was used for viewing fins and a minimum of 15x magnification was used for viewing the lateral line. As in the March 2000 sampling procedure, the same ranking system used to rank unpaired fins was also used to rank percent of gas bubbles observed in the lateral line.

A total of 214 fish were examined for signs of GBT (Table 2). Of this total, 104 fish were examined on March 12 and 110 fish were examined on March 13. A total of two chinook and one pike minnow had signs of GBT. This equates to a 1.4% level of incidence. All signs of GBT were a single bubble, placing them within the lowest ranking of occurrence. The one pike minnow had a single bubble in the dorsal fin and one bubble in the anal fin. One of the chinook had a bubble in the anal fin near a large tear.

Monitoring of Physical Conditions

Biologists from the USFWS used a Hydrolab Minisonde meter to take real time TDG measurements (Table 3) at various locations (Figure 3) from a boat on the Columbia River during the spill period 1800 hours March 10 through 0600 hours March 11. Water

depth data were collected from a depth sensor (gauge 1) deployed at the head of the Ives/Pierce Island side channel. Water depth data were collected and transmitted to the CRFPO every other hour for display on the Fish Passage Center's Internet website (www.fpc.org).

Results:
Figure 4 displays percent TDG in the Bonneville Dam forebay. Ambient TDG levels ranged from 101.9-105.7 % from March 10-16.

Figure 5 shows total discharge and spill at Bonneville Dam during the spill period. Total discharge varied from 108-157 Kcfs. Spill volume remained almost steady during each of the three spill periods at about 47 Kcfs. Tailwater elevations varied from 10.8-11.4 feet, and averaged 11.1 feet from March 10-13. The depth levels recorded by the USFWS pressure gauge 1 near Ives Island during the spill period ranged from 0.43-1.13 feet. During the spill period the maximum depth over the chum redds varied from a few inches over the redds on the margins of the wetted area, to1.5-2 feet over the redds in the deeper area.

Figure 6 compares the TDG readings taken at the USGS sampling stations downstream of Bonneville Dam. None of the readings went above 114.3% from March 10-16. At the Skamania monitoring station recorded TDG levels varied from 102.3% during non-spill periods, to a high of 110.4% during spill perods. Recorded TDG levels at the Warrendale monitoring station varied from 102.1% during non-spill periods, to a high of 117.5% during spill periods. The TDG levels recorded at the Camas/Washougal monitoring station varied from 101.3% from the non-spill periods, to a high of 112.7% from the spill periods. There was about an 18 hour travel time for the water mass passing the Skamania and Warrendale monitoring sites to the Camas/Washougal monitoring site.

PH2 had first use priority over Powerhouse 1 (PH1) during the March 2001 spill. The TDG levels recorded at Skamania were lower than the TDG levels recorded at Warrendale. These results were similar to those in 2000. During the March 2000 spill, when PH2 had greater use priority, TDG levels recorded at Skamania were lower than the TDG levels recorded at Warrendale. The new fish bypass system at PH2 allowed for the change of first use priority to PH 2 rather than PH1. In previous years PH1 had first use priority. During the March 1999 spill when PH1 had greater use priority the TDG levels recorded at Skamania were higher than the TDG levels recorded at Warrendale.

<u>Summary</u>
In summary, the USFWS collected and examined fish for signs of gas bubble trauma, and monitored water quality in the mainstem Columbia and over salmon redds during the March 10 to 13 spill period at Bonneville Dam. Biological sampling was conducted on March 12 and 13. Biological monitoring showed that three of the fish that were collected and examined exhibited the lowest level indicator of gas bubble trauma.

Total dissolved gas levels recorded at the Skamania and Warrendale monitoring stations near the Bonneville Dam tailrace did not exceed 120%. TDG levels recorded at the Camas/Washougal monitoring station (RM 122) did not exceed 115%.

The fall chinook and chum salmon spawning areas along the Ives Island complex are on the Washington side of the Columbia River just upstream of the Skamania monitoring site. First use priority of PH2 over PH1 appeared to help reduce TDG levels along the Washington side of the Columbia River at the Skamania monitoring station when compared to TDG levels recorded for the same time period at the Warrendale monitoring station along the Oregon side of the Columbia River.

Figure 1. Location of salmon redds through December 24, 2000 surveys. chinook chum

Table 1. Fish passage index counts at Bonneville Dam, combined subyearling chinook. Index counts were from Power House 2 in 2001 and 2000. In all other years index counts were from Power House 1.

Number of days into spill start	Spring Creek Release 03/08/01 Index Count	Date	Spring Creek Release 03/09/00 Index Count	Date	Spring Creek Release 03/18/99 Index Count	Date	Spring Creek Release 03/13/98 Index Count	Date	Spring Creek Release 03/13/97 Index Count	Date	Spring Creek Release 03/14/96 Index Count	Date
-1	-----	03/09/01	47	03/08/00	23	03/17/99	50	03/12/98	-----	03/12/97	112	03/13/00
1	-----	***03/10/01***	139	***03/09/00***	-----	***03/18/99***	67	***03/13/98***	-----	***03/13/97***	322,727	***03/14/00***
2	-----	03/11/01	1,228	03/10/00	270,179	03/19/99	68,537	03/14/98	-----	03/14/97	123,436	03/15/00
3	-----	03/12/01	516,102	03/11/00	18,237	03/20/99	97,799	03/15/98	-----	03/15/97	20,297	03/16/00
4	59,454	***03/13/01***	1,104,556	03/12/00	18,197	03/21/99	29,807	03/16/98	-----	03/16/97	8,726	03/17/00
5	31,679	03/14/01	47,187	03/13/00	5,315	03/22/99	11,368	03/17/98	8,815	03/17/97	1,819	03/18/00
6	18,041	03/15/01	22,308	03/14/00	1,355	03/23/99	9,790	03/18/98	9,054	03/18/97	546	03/19/00
7	5,075	03/16/01	7,019	03/15/00	1,197	03/24/99	3,740	03/19/98	5,424	03/19/97	341	03/20/00
8	4,760	03/17/01	7,286	***03/16/00***	394	***03/25/99***	2,211	03/20/98	1,764	***03/20/97***	457	03/21/00
9	3,024	03/18/01	3,236	03/17/00	177	03/26/99	1,261	03/21/98	1,156	03/21/97	243	***03/22/00***
10	2,531	03/19/01	2,275	03/18/00	184	03/27/99	809	03/22/98	1,916	03/22/97	208	03/23/00
11	4,782	03/20/01	2,108	03/19/00	445	03/28/99	676	***03/23/98***	984	03/23/97	66	03/24/00
12 Day Total	129,346		1,713,491		315,703		226,115		29,113		478,978	
5 Day Spill Total	91,133		1,669,212		311,928		207,578		8,815		477,005	
5 Day %	70.5%		97.4%		98.8%		91.8%		30.3%		99.6%	

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

bolded dates are first and last days of spill

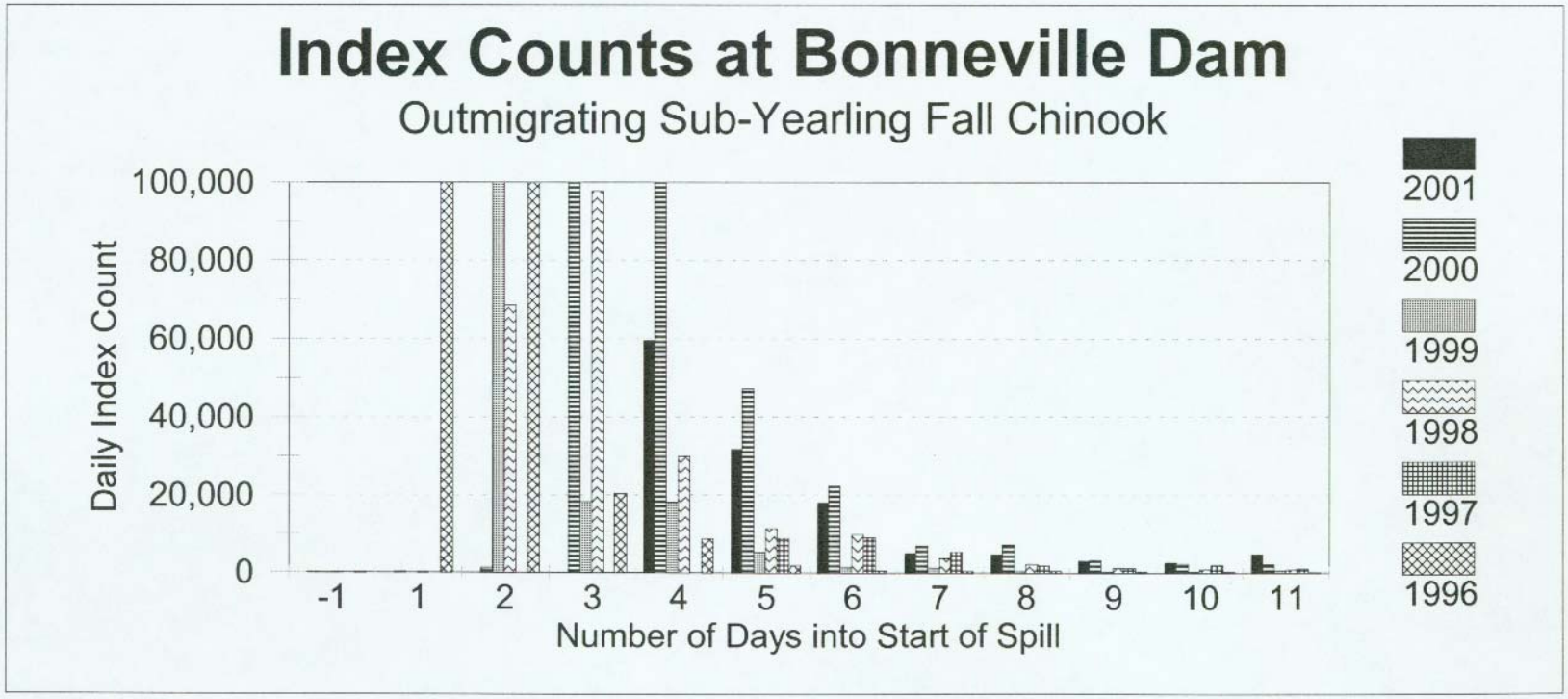

Figure 2. Fish passage index counts before and during spill periods at Bonneville Dam from 1996-2001.

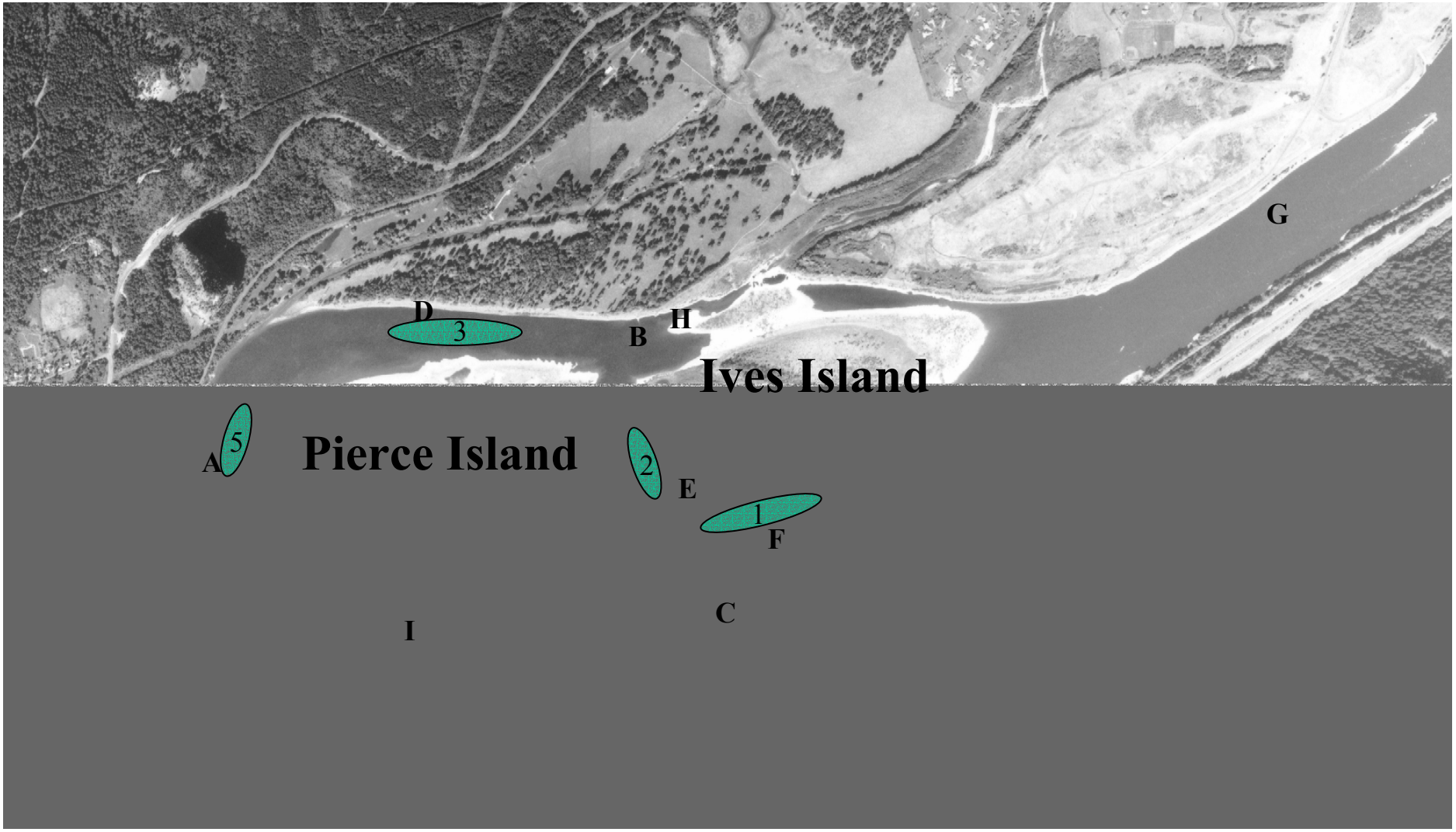

Figure 3. Location of WDFW/ODFW juvenile sampling sites (numbered) and USFWS TDG sampling sites (lettered) below Bonneville Dam, March 2001.

Table 2. Summary of fish sampled for signs of gas bubble trauma (GBT) below Bonneville Dam - March 2001. A total of two chinook and one pike minnow had signs of GBT. All signs of GBT were a single bubble. The one pike minnow had a single bubble in the dorsal fin and one in the caudal fin.

Species	Size Range in mm	# of fish examined for signs of GBT	Number of fish with observed bubble in structure				
			LL*	DF*	AF*	CA*	EY*
Chum	37-44	19	0	0	0	0	0
Chinook - wild	40-43	3	0	0	0	0	0
Chinook - hatchery	53-79	182	1	0	1	0	0
Chinook - hatchery	121-154	2	0	0	0	0	0
Coho	127	1	0	0	0	0	0
Northern Pike Minnow#	57-63	2	0	1	0	1	0
Peamouth	67	1	0	0	0	0	0
Sculpin	54-82	2	0	0	0	0	0
Shiner	82	1	0	0	0	0	0
Stickleback	59	1	0	0	0	0	0
Totals		214	1	1	1	1	0

* LL = lateral line, DF = dorsal fin, AF = anal fin, CA = caudal fin, EY = eye
# One pike minnow had both the caudal fin bubble and the dorsal fin bubble.

Table 3. Total dissolved gas measurements, March 10-11, 2001.

Date	Time	Site #	Location	Hydrolab# % TDG	Temp. °C	Skamania Station % TDG	Skamania Station Time	Warrendale Station % TDG	Warrendale Station Time
03/10/01	20:00 hrs	A	Beacon Rock Boat Ramp	100.5	-----	104.8	20:00 hrs	105.2	20:00 hrs
03/10/01	21:00 hrs	B	mid chum channel fyke trap	100.4	-----	104.9	21:00 hrs	105.3	21:00 hrs
03/10/01	23:10 hrs	C	Oregon shore	115.9	-----	109.4	23:00 hrs	106.5	23:00 hrs
03/10/01	23:50 hrs	B	mid chum channel fyke trap	101.7	-----	109.6	24:00 hrs	110.7	24:00 hrs
03/10/01	00:06 hrs	D	chum channel upstream of Hardy Creek	101.8	-----	109.6	24:00 hrs	110.7	24:00 hrs
03/11/01	01:30 hrs	B	mid chum channel fyke trap	100.5	-----	110.4	01:00 hrs	111.6	01:00 hrs
03/11/01	01:58 hrs	E	split between Ives/Pierce	101.4	5.4	110.2	02:00 hrs	112.6	02:00 hrs
03/11/01	02:38 hrs	C	Oregon shore	116.1	4.5	109.6	03:00 hrs	113.9	03:00 hrs
03/11/01	03:20 hrs	F	main stem, mid channel - Bonneville outflow	116.0	4.5	109.6	03:00 hrs	113.9	03:00 hrs
03/11/01	03:40 hrs	G	Washington shore boat ramp	104.5	4.5	110.0	04:00 hrs	114.3	04:00 hrs
03/11/01	04:31 hrs	H	chum channel downstream of Hamilton Crk	100.9	-----	110.0	04:00 hrs	114.3	04:00 hrs
03/11/01	04:43 hrs	B	mid chum channel fyke trap	100.4	5.2	109.5	05:00 hrs	114.2	05:00 hrs
03/11/01	05:13 hrs	I	main stem - off Pirece	105.2	-----	109.5	05:00 hrs	114.2	05:00 hrs
03/11/01	05:41 hrs	C	Oregon shore	114.0	4.5	109.4	06:00 hrs	114.0	06:00 hrs

Hydrolab Minisonde

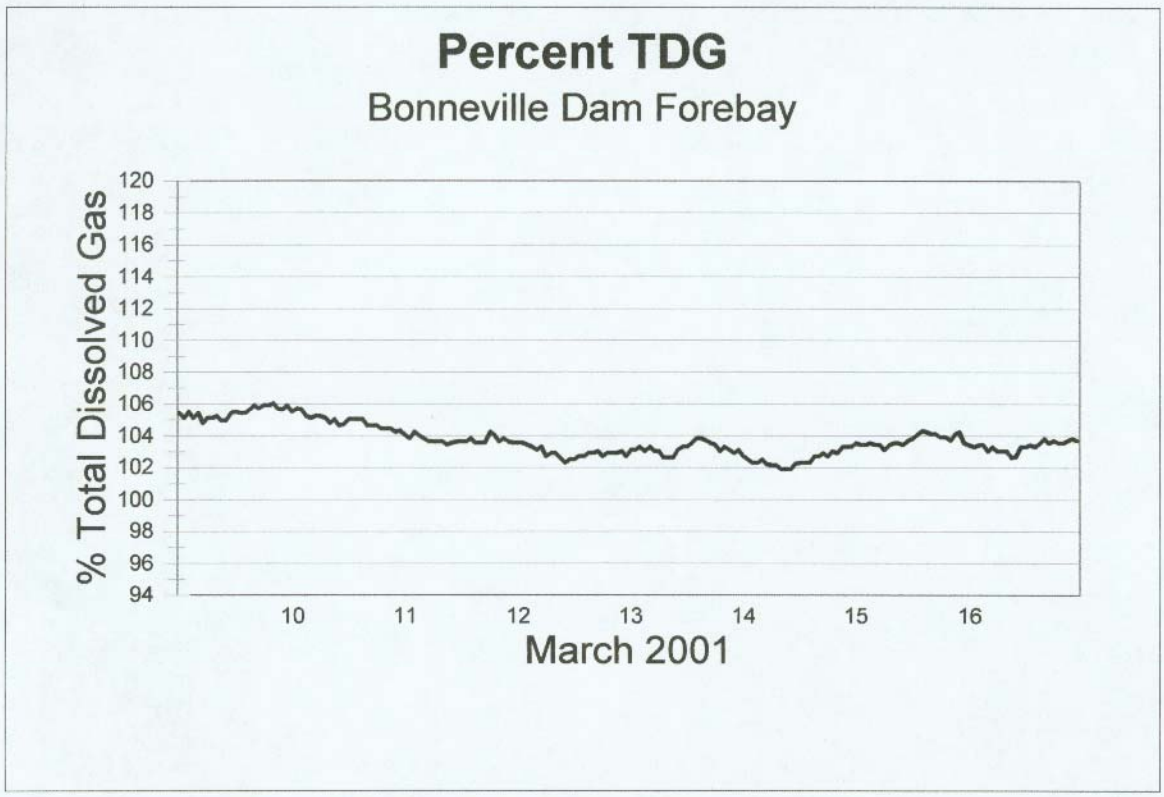

Figure 4. Percent TDG in Bonneville Dam forebay - March 10-16, 2001.

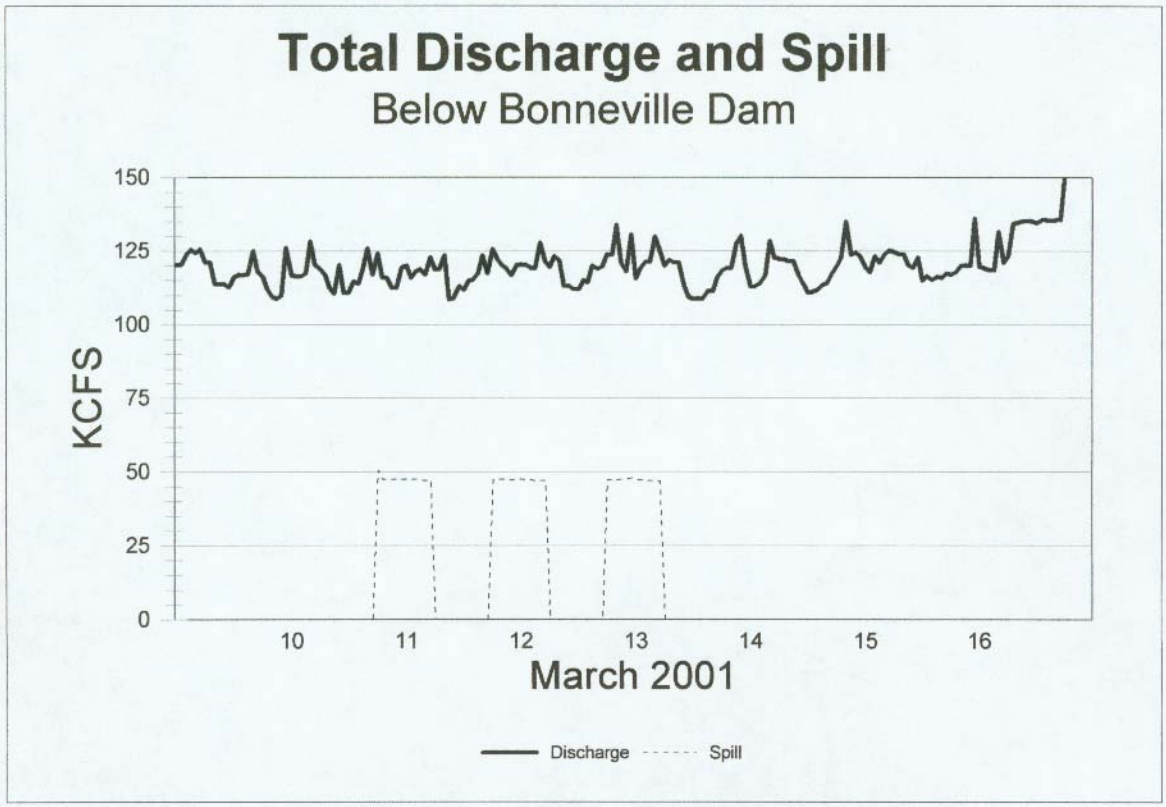

Figure 5. Total discharge and spill from Bonneville Dam - March 10-16, 2001.

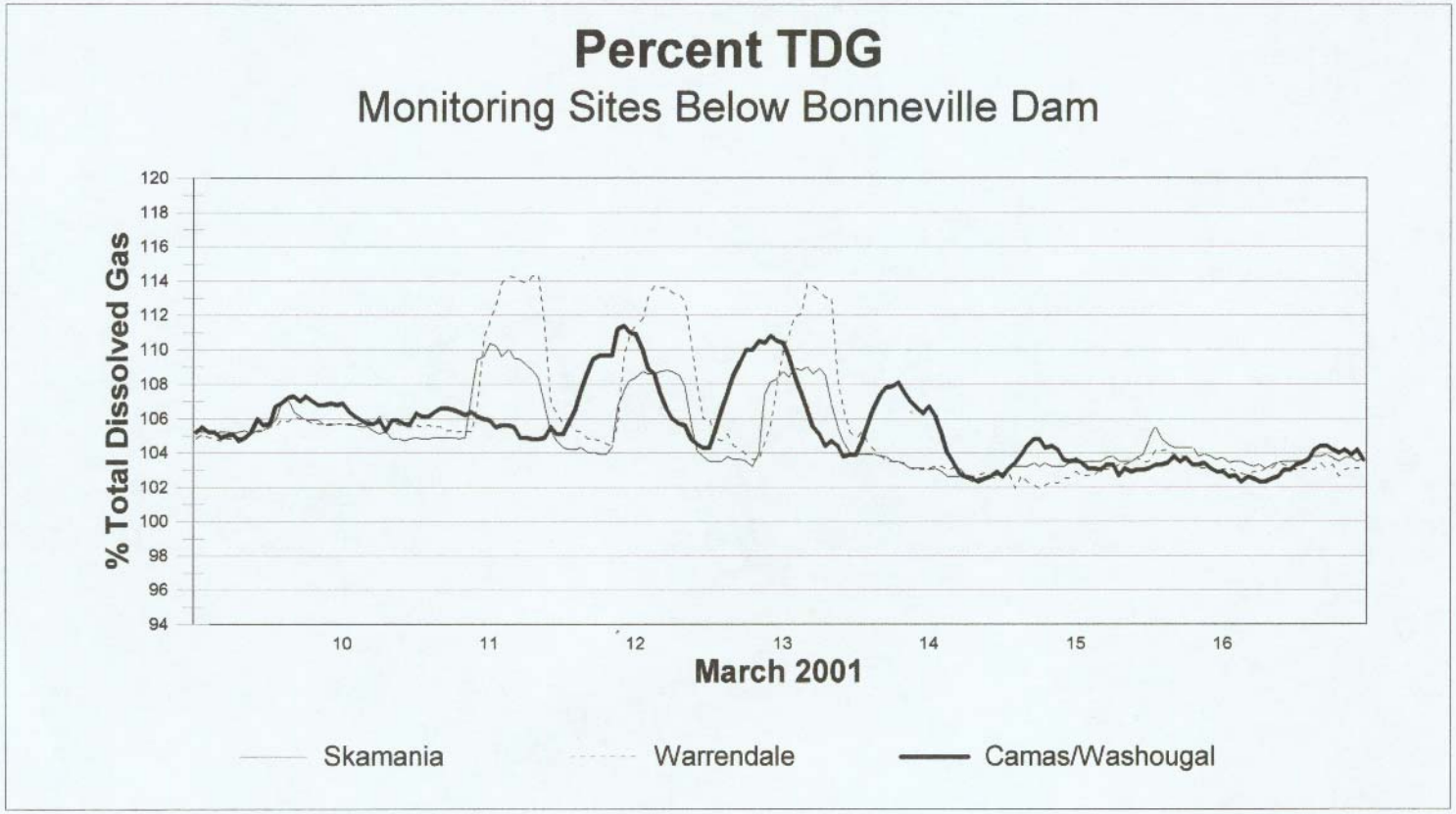

Figure 6. Percent TDG at Skamania, Warrendale, and Camas Washougal monitoring sites, March 10-16, 2001.