



FISH PASSAGE CENTER

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November 16, 2016

Mr. Scott English
U.S. Army Corps of Engineers
Northwestern Division
PO Box 2870
Portland, OR 97208-2870

Dear Mr. English:

As per our agreement, we are providing a copy of our *Gas Bubble Trauma Monitoring and Data Reporting for 2016* to both you and Mr. Paul Wagner of National Marine Fisheries Service. This report summarizes data collected during the 2016 juvenile salmonid migration.

Please feel free to contact us if you require any additional information.

Sincerely,

Michele DeHart
Fish Passage Center Manager

CC: Paul Wagner, NOAA Fisheries
Laura Hamilton, USACE
Julie Ammann, USACE

Appendix J

Gas Bubble Trauma Monitoring And Data Reporting For 2016

**Fish Passage Center
Portland, Oregon**

Gas Bubble Trauma Monitoring and Data Reporting for 2016

Overview

The objective of the juvenile salmonid gas bubble trauma (GBT) monitoring program is to provide a measure of the exposure to harmful levels of total dissolved gas (TDG) experienced by migrating juvenile salmonids. The monitoring assesses both the incidence and severity of exposure, and provides an “early warning” of potentially harmful levels of TDG. The data are reported to the fisheries management entities and the water quality agencies of Washington and Oregon, and are available to other interested parties through Fish Passage Center weekly reports and daily postings to the FPC Web site during the season (<http://www.fpc.org/smolt/gasbubbletrauma.html>). The fisheries management entities review the data in-season to determine if modifications to spill are necessary based on the GBT monitoring.

The monitoring of juvenile salmonids in 2016 for GBT was conducted at Upper Columbia, Middle Columbia and Snake river sites. Fish were collected and examined for signs of GBT at Rock Island Dam (RIS) on the Upper Columbia River, and at Bonneville Dam (BON) and McNary Dam (MCN) on the Middle Columbia River. The Snake River monitoring sites were Lower Granite (LGR), Little Goose (LGS), and Lower Monumental (LMN) dams. The goal of the GBT monitoring program was to sample 100 salmonids each day of sampling at each site. The proportion of each species sampled (limited to Chinook and steelhead) was dependent upon their prevalence at the time of sampling. A daily sample size of 100 fish is necessary to assure that the sample observation accurately represents the population incidence of signs of gas bubble trauma.

Yearling Chinook and steelhead were sampled through the spring at all the sampling sites. Once subyearling Chinook predominated in the smolt collections, the program shifted from sampling yearling Chinook and steelhead to sampling subyearling Chinook through the end of August, unless an adequate sample could not be collected. In 2016, sampling at some sites was terminated prior to the end of August as a result of high temperatures in the Snake and Middle Columbia rivers. (More detail on these instances is provided below.)

Since fish held at shallow depths for long periods of time may exhibit bubbles even at low TDG levels and would not be representative of the migrating population (Weitkamp, 2000), the GBT monitoring program is designed to minimize the holding time prior to examining fish. Fish to be examined were netted off the bypass separator bars (at LGR, LGS, LMN, and MCN) or removed from the sample tank or other sampling apparatus (at RIS and BON). At BON and RIS, fish for the GBT sample can be held for prolonged periods, particularly at RIS where fish may be held for up to 24-hours. Over the years, SMP personnel at BON have minimized the amount of time that GBT sample fish are held in the sample tank prior to examination. However, at RIS there are few good alternatives to this sampling procedure, and data from Rock Island Dam should be evaluated within the context of the sampling procedure. Since the values are likely biased high, the results are evaluated independently of the other monitoring locations. In an attempt to address the concern over holding times, the FPC and RIS staff implemented a pilot sampling protocol in 2016. Details of this protocol are provided below, in the summary of results for RIS.

Once collected, fish are anesthetized and examined using a modified examination tray. The tray is equipped with a siphon tube that delivers anesthetic water over the fish's

gills allowing fish to be continually anesthetized during the GBT examination. Sampling occurred two days per week at the Columbia River sites and one day a week at each of the Snake River sites throughout the spring and summer spill programs. Examinations of fish were conducted using variable magnification (6x to 40x) dissecting scopes. The eyes and unpaired fins were examined for the presence of bubbles. The bubbles present were quantified using a ranking system based on the percent area of the fins or eyes covered with bubbles (USGS 1997) (Table J-1). Additional information was recorded for each fish during the examination, including species, age, fork length, fin clips, and tags present.

Table J-1
Ranking criteria used in monitoring for signs of gas bubble trauma.

Rank	Sign
0	no bubbles present
1	up to 5% of a fin area or eye covered with bubbles
2	6% to 25% of a fin area or eye covered with bubbles
3	26% to 50% of a fin area or eye covered with bubbles
4	> than 50% of a fin area or eye covered with bubbles

In an effort to standardize handling and reporting practices among sites and to provide accounting for Endangered Species Act permitting purposes, the FPC modified the handling protocol for the GBT program in 2015. Monitoring in 2016 followed the same protocol that was issued in 2015. For more detailed information on the examination procedure, the 2016 GBT Monitoring Protocol is available on the FPC website (ftp://ftp.fpc.org/gbt/GBTManual_Datasheet/GBTMonitoringProtocol_2016.pdf).

2016 Water Conditions

The runoff volume (January–July) for the 2015 water year was near average in both the Middle Columbia and Lower Snake rivers. Runoff (January–July) was 96% of average (1981–2010) at The Dalles Dam and 88% of average at Lower Granite Dam. To put the runoff volumes into perspective, the 2016 January–July runoff volumes at The Dalles and Lower Granite were ranked 54th and 52nd, respectively, over the last 88 years (1929–2016).

Runoff in the Snake River was early, with two peak flow periods; one in late April at about 130 Kcfs and one in early May at about 120 Kcfs (Figure J-1). Late spring and summer flows in the Snake River were below ten year average and more similar to the extreme low flow year of 2015. Runoff in the Middle Columbia was similar, with above average flows throughout most of April and the first half of May and below average flows from mid-May through the end of August (Figure J-2). Flows in the Snake and Middle Columbia rivers were sufficiently low throughout the entire spring and summer seasons that uncontrolled spill events were rare. Total dissolved gas (TDG) levels were mostly below waiver levels during the spill season, with exception to the Ice Harbor forebay, the Bonneville forebay, and the Bonneville tailwater at Cascade Island. At Ice Harbor Dam, the forebay gage occasionally read higher than the gage at the Lower Monumental Dam tailwater (the next upstream project where spill is occurring), and often higher than the downstream tailwater gage at the project. Since the TDG in the forebay is higher than at the tailrace of the dam above, it is unlikely that these occurrences are solely determined by

spill and are more likely due to localized primary productivity and elevated temperatures near the monitor. However, in response to these exceedences the amount of spill at Lower Monumental Dam has often been decreased in-season.

Figure J-1.
Average daily flows at Lower Granite Dam
2016, 2015, and the 10-year average

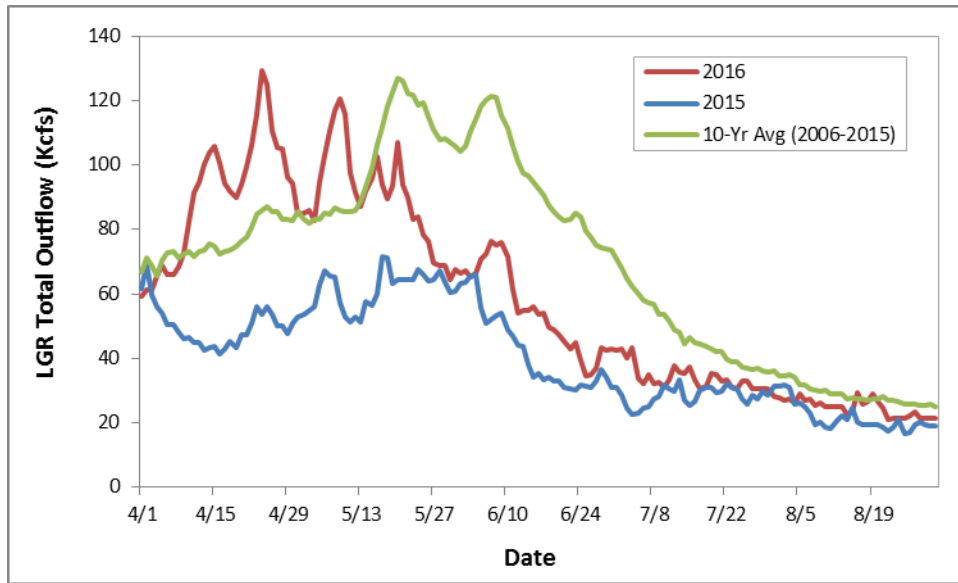
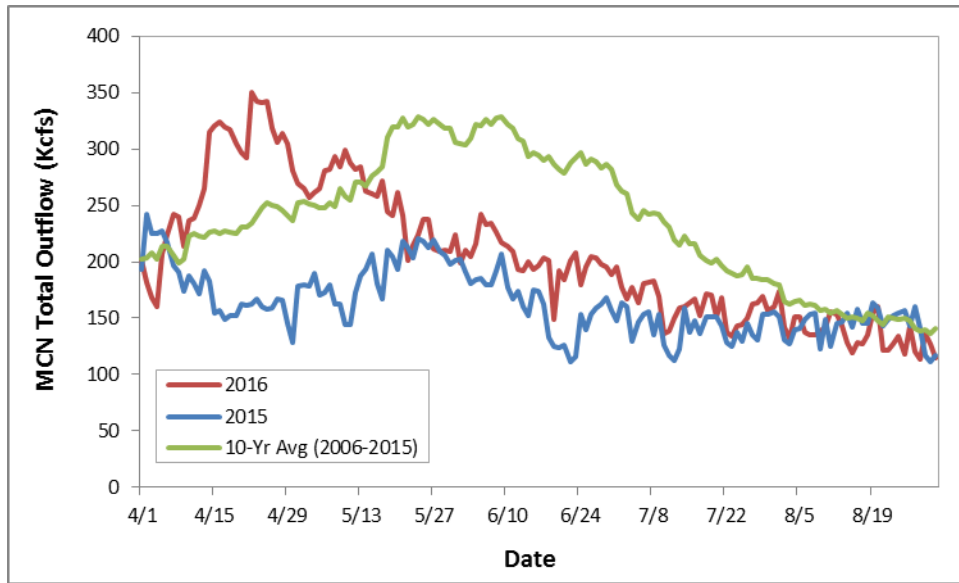


Figure J-2
Average daily flows at McNary Dam
2016, 2015 and the 10-year average



Results

In all, 11,557 juvenile salmonids were examined for GBT between April and August of 2016 (Table J-2). The fish were collected and examined as part of the Smolt Monitoring Program.

Table J-2
Number of juvenile salmonids examined for signs of GBT at dams on the Lower Snake River and on the Columbia River from April to August 2016 as part of the Smolt Monitoring Program.

Species	BON	MCN	LMN	LGS	LGR	RIS	Total
Chinook Subyearlings	1,483	1,585	452	592	0	1,088	5,200
Chinook Yearlings	1,051	876	373	407	279	797	3,783
Steelhead	149	389	543	398	580	515	2,574
Total	2,683	2,850	1,368	1,397	859	2,400	11,557

Fin signs were found in 21 or 0.18% of the total fish sampled at all sites (Table J-3), with 15 of those detections occurring at Rock Island Dam. Of the 21 fish that had signs of fin GBT in 2016, 18 were rank 1, where less than 5% of a fin area was covered with bubbles. The remaining three were observed with rank 2, where 6% to 25% of a fin area was covered with bubbles. Two of these rank 2 fin GBT fish were encountered at Bonneville Dam while the third was encountered at Rock Island Dam. No fish that were examined for GBT in 2016 exhibited fin GBT of rank 3 or 4. A more detailed breakdown of GBT exams and signs for 2016 can be found at the end of this appendix (Tables J-5 through J-10).

Table J-3

Number of juvenile salmonids found with fin GBT at dams on the Lower Snake River and on the Columbia River from April to August 2016 as part of the Smolt Monitoring Program.

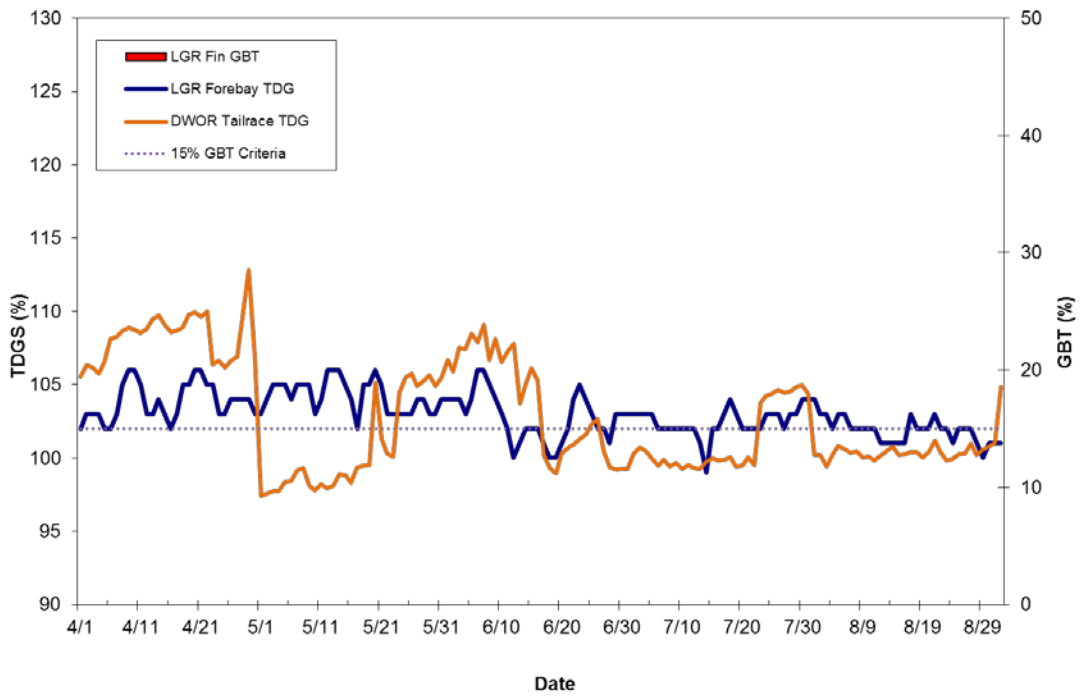
Species	Fin GBT by Site						Grand Total
	BON	MCN	LMN	LGS	LGR	RIS	
Chinook Subyearlings	1	0	0	0	0	1	2
Chinook Yearlings	5	0	0	0	0	12	17
Steelhead	0	0	0	0	0	2	2
Total	6	0	0	0	0	15	21

The action criteria for GBT is established as 15% of fish showing any signs of fin GBT, or 5% of the fish sampled showing signs of fin GBT greater than or equal to rank 3. Neither of these two action criteria was approached in 2016.

Lower Granite Dam (LGR)

With very rare exception, the TDG in any year measured at the Lower Granite Dam forebay is consistently below the 110% Environmental Protection Agency (EPA) TDG standard. Accordingly, sampling at this site is used to provide a background level of GBT for migrating juvenile salmonids that are first entering the hydrosystem. Planned GBT sampling is conducted for spring Chinook and steelhead during the spring period since, if TDG were to exceed the 110% standard, it would occur due to uncontrolled spill at upstream storage projects during the spring period. GBT sampling at LGR occurred from April 8th to June 10th. The predomination of summer migrating subyearling Chinook in the sample is used to trigger the end of sampling. At no time in 2016 did the TDG at the LGR forebay exceed the EPA 110% standard. No signs of fin GBT were observed at LGR in 2016 (Figure J-3, Table J-5).

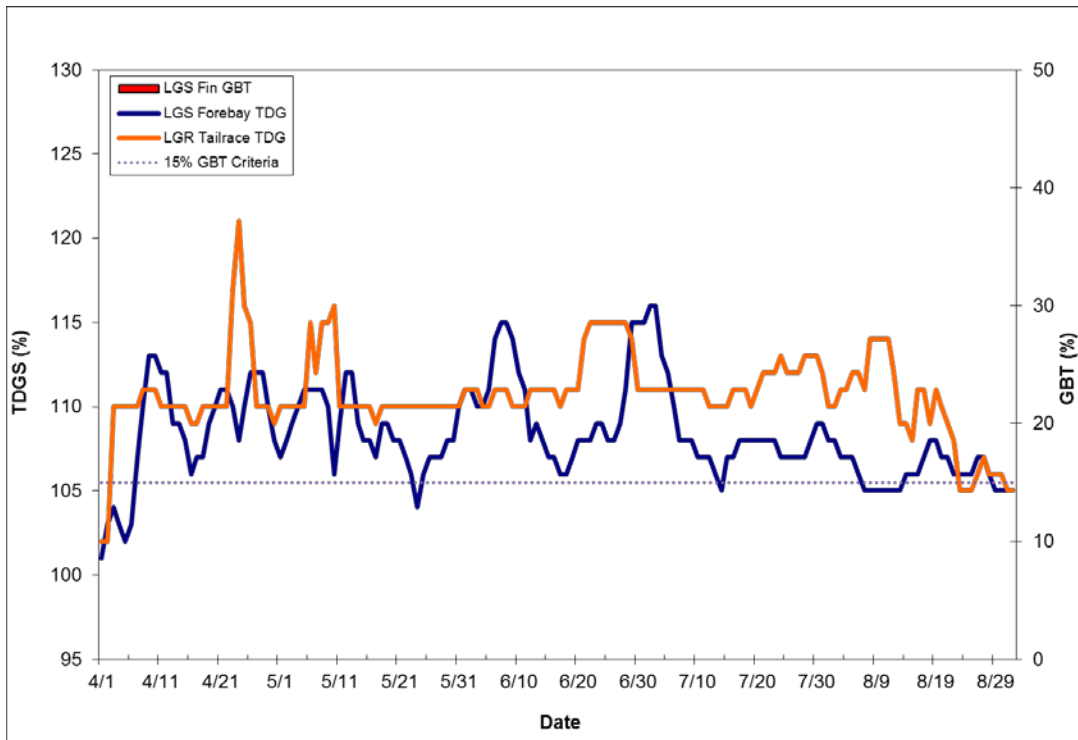
Figure J-3
Percent GBT observed in the sample at Lower Granite Dam



Little Goose Dam (LGS)

GBT sampling at LGS occurred from April 14th to July 19th. Sampling at LGS was terminated after the sample on July 19th due to: decreasing numbers of fish in the previous two samples that precluded adequate sample sizes and TDG levels in the LGS forebay that were below the EPA standard of 110%. No signs of GBT were observed at LGS in 2016 (Figure J-4, Table J-6). On April 24th, total dissolved gas levels in the LGR tailwater exceeded the 120% criteria (Figure J-4). This was the only day in 2016 where total dissolved gas exceeded 120% in the LGR tailwater. Total dissolved gas levels in the LGS forebay exceeded 115% for two days in 2016, both in early July (July 2nd and 3rd) (Figure J-4).

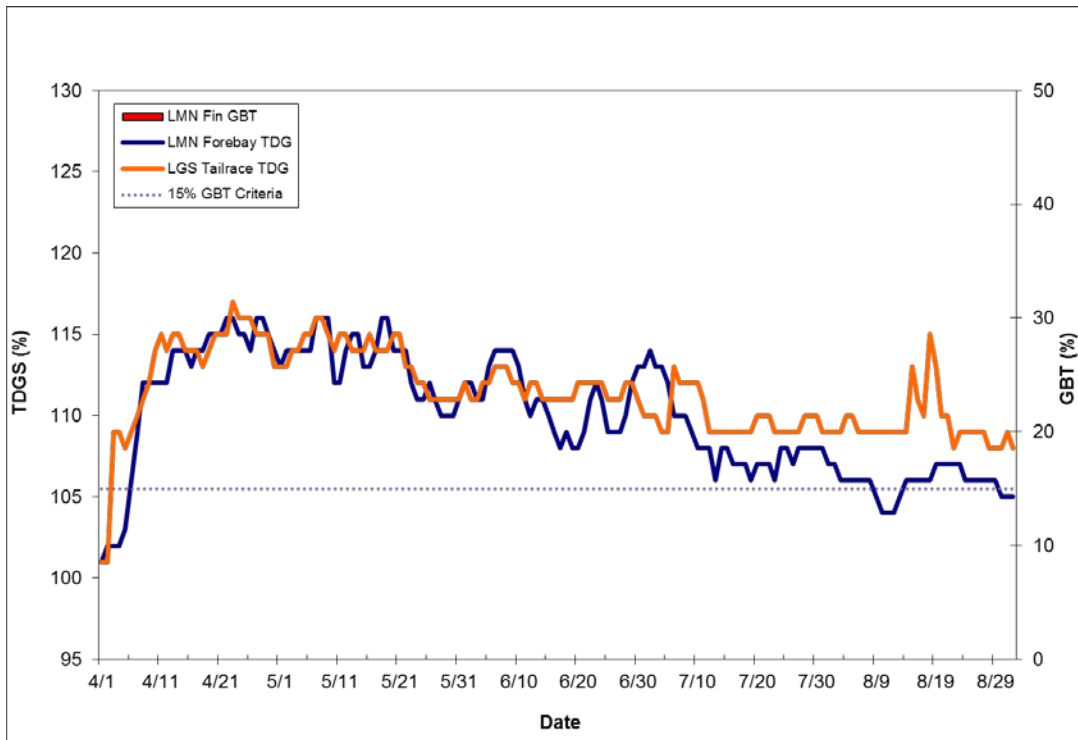
Figure J-4
Percent GBT observed in the sample at Little Goose Dam



Lower Monumental Dam (LMN)

GBT sampling at LMN occurred from April 8th to July 13th. Sampling was terminated after the sample on July 13th due to: decreasing numbers of fish in previous samples that precluded adequate sample sizes and TDG levels in the LMN forebay that were below the EPA standard of 110%. There were zero occasions of fin GBT at Lower Monumental Dam in 2016 (Table J-7). Total dissolved gas in the LGS tailwater never exceeded 120% in 2016 (Figure J-5). Total dissolved gas in the Lower Monumental forebay exceeded 115% on nine occasions, all of which occurred in late April through mid-May (Figure J-5).

Figure J-5
Percent GBT observed in the sample at Lower Monumental Dam.

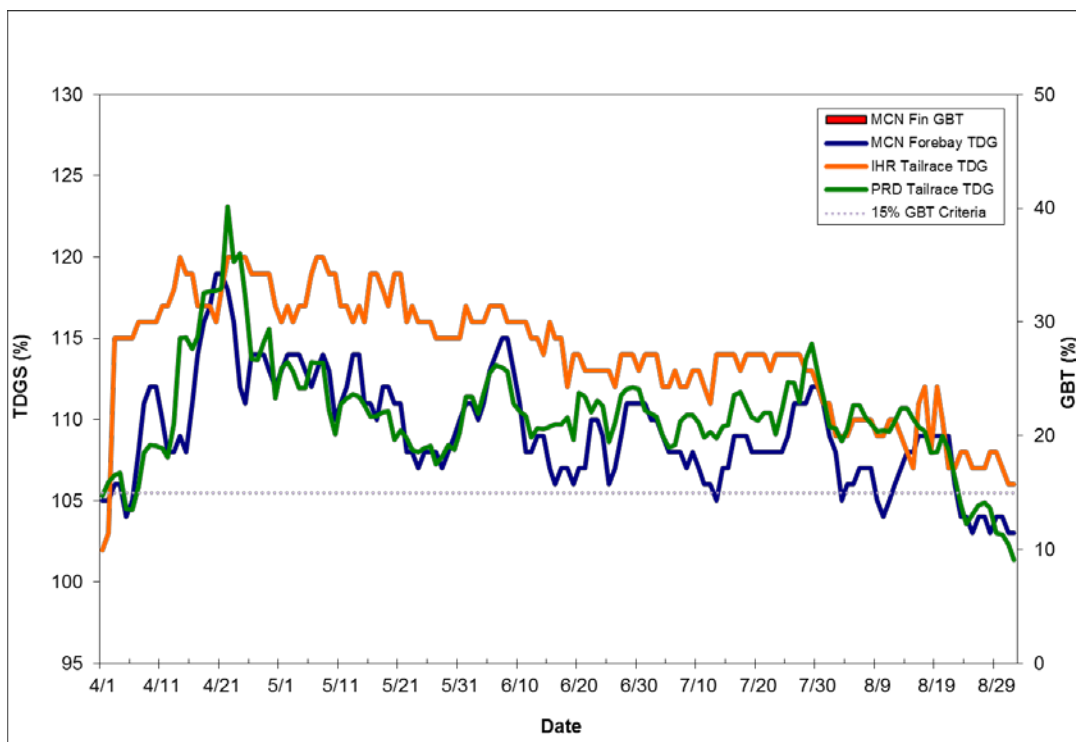


McNary Dam (MCN)

GBT sampling at MCN occurred from April 15th to August 9th. Similar to what occurred in 2015, GBT sampling at MCN was reduced from twice per week to once per week due to elevated temperatures and increased mortality rates of recovering GBT-examined fish. This reduction in sampling began on July 26th. At the time, TDG levels in the MCN forebay had been below the EPA 110% standard for most of July. This modification in the GBT sampling schedule was consistent with the COE’s protocols to provide precautionary measures to avoid or minimize any direct or delayed mortality resulting from additional thermal stress when handling juvenile salmonid fishes at water temperatures above 20°C. MCN continued once-per-week sampling until August 9th when sampling for GBT was terminated for 2016 due to an inability to meet sample size requirements for two successive samples.

The TDG levels in the tailwater at Priest Rapids Dam (PRD) exceeded the 120% waiver level on two separate occasions (April 22nd and April 24th) (Figure J-6). Total dissolved gas levels in the tailwater at Ice Harbor Dam never exceeded the 120% waiver level in 2016. Total dissolved gas at the MCN forebay exceeded the 115% waiver level for six consecutive days in April (April 18-23). No signs of GBT were observed at McNary in 2016 (Figure J-6, Table J-8).

Figure J-6
Percent GBT observed in the sample at McNary Dam.



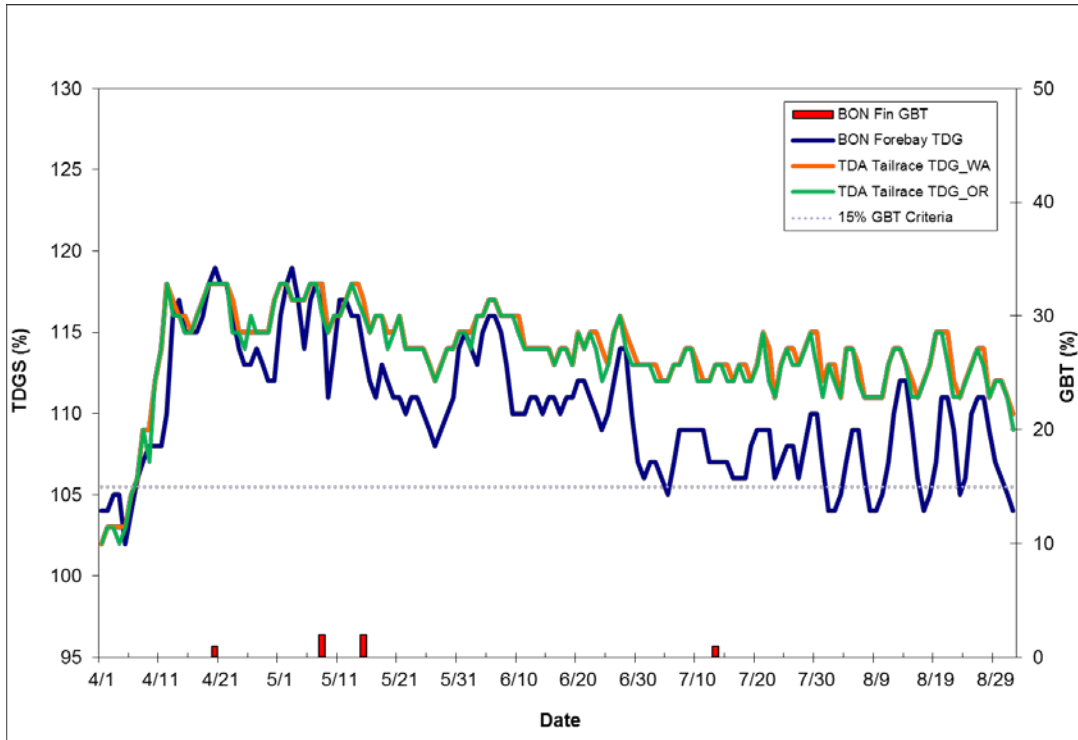
Bonneville Dam (BON)

GBT sampling at BON occurred from April 17th to August 8th. Sampling was terminated after the sample on August 8th due to: decreasing numbers of fish in previous samples that precluded adequate sample sizes and TDG levels in the BON forebay that were generally below the EPA standard of 110%. At Bonneville Dam, six total fish were observed with signs of fin GBT in 2016, on four separate days (Figure J-7, Table J-9). Two of the days had a GBT prevalence of 1.0% while the other two had a prevalence of 2.0%. Of the fish that had signs of fin GBT in 2016, four of had signs that were rank 1 and two had signs that were rank 2. Of the fish with rank 2 signs, one was observed on May 7th and the other was observed on May 14th.

Total dissolved gas in The Dalles Dam tailwater was managed under both the Oregon and Washington methodologies of estimating a 12-hour average TDG. Under the Oregon methodology, the 12-hour average is based on the 12 highest hourly TDG measurements in a single calendar day, regardless of whether they are consecutive or not. Under the Washington methodology, the 12-hour average is based on rolling 12-hour averages with the highest of the rolling averages reported as the 12-hour average for a given day. The COE managed to the gas level based on the higher of the two methodologies. The 12-hour averages under both of these methodologies are provided in Figure J-7 below. Total dissolved gas in The Dalles tailwater never exceeded the 120% waiver level in 2016. Total dissolved gas in the BON forebay, as calculated using the Washington DOE methodology, exceeded the Washington DOE 115% waiver level for a total of 21 days in 2015. The longest continuous period where the BON forebay exceeded 115% was six days, from

April 18th to April 23rd. There were other periods in early May when TDG in the BON forebay exceeded the 115% waiver but never for more than four days at a time before dropping below 115% for a day or two.

Figure J-7
Percent GBT observed in the sample at Bonneville Dam.



Rock Island Dam (RIS)

In 2016, FPC staff and SMP personnel at RIS implemented a pilot sampling protocol to reduce the amount of time GBT sample fish were held in the trap prior to examination. Under the pilot protocol, SMP personnel at RIS attempted to collect fish for the GBT sample directly from the dewatering screens, as they entered the trap. This direct sampling occurred from the time the staff arrived at the project until approximately 9:00 am (approximately two hours). These “freshly sampled” fish were then prioritized for GBT exams. If the total number of “freshly sampled” fish fell short of the target sample size (100 fish), SMP personnel would then examine fish from the daily collection, until the target sample size was met. Each fish from the GBT sample was flagged with a code to indicate whether it was “freshly sampled” or from the daily collection (i.e., held for up to 24-hours). The FPC will conduct analyses to compare GBT rates of “freshly sampled” fish versus those from the daily collection. These analyses will inform whether the pilot sampling protocol will continue in 2017 and future years.

GBT sampling at RIS occurred from April 12th to July 19th. GBT sampling at RIS was terminated after the sample on July 19th because of the inability to collect the adequate sample for GBT exams. There were eight total days in 2016 when signs of fin GBT were detected at RIS (Figure J-8, Table J-10). The maximum GBT rate at RIS in 2016 was 4%, which occurred on two occasions (April 29th and May 17th). Of the 15 total fish that showed signs of fin GBT at RIS in 2016, 14 were rank 1 and one was rank 2. The rank 2 fish was observed in the April 19 GBT sample.

Total dissolved gas levels in the tailwaters of Grand Coulee (GCL), Chief Joseph (CHJ), and Wells (WEL) dams never exceeded 120% in 2016. However, TDG in the tailwater of Rocky Reach Dam (RRH) exceeded the 120% waiver for 11 total days. Of these 11 days, 10 came in a continuous period (April 16-April 25) while the 11th occasion was a single day (July 16th). Total dissolved gas levels in the Chief Joseph (CHJ) and Wells (WEL) forebays never exceeded the 115% waiver limits (Figure J-8). However, total dissolved gas in the Rocky Reach (RRH) forebay exceeded 115% for a total of three days in 2016 (April 18th, April 19th, and April 23rd) while TDG in the Rock Island (RIS) forebay exceeded 115% for a total of four consecutive days (April 17-20).

Figure J-8
Percent GBT observed in the sample at Rock Island Dam.

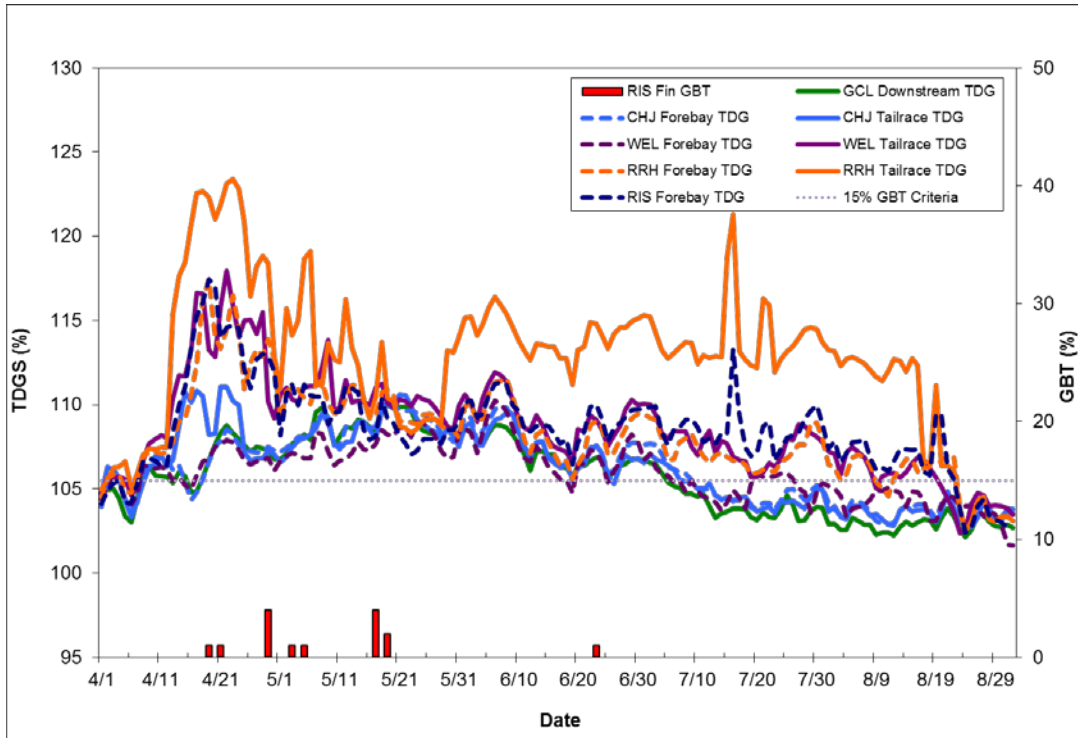


Table J-4 compares the 2016 estimates of the overall percentage of fish with signs of GBT to past years' estimates. This is not meant as a measurement of overall GBT, but is used to easily display the annual relative magnitude of GBT in 2016 compared to past years. As can be seen in the table, the overall annual incidence of GBT in 2016 was in the lower range among the previous 20 years. (The overall percentage was estimated both with and without Rock Island Dam included, due to the potential of this site causing the estimate to be biased high in some years).

Table J-4
Percent of sampled fish with signs of fin GBT estimated for
the total fish observed in each year 1996 to 2016.

Year	Total % Signs	% Signs excluding RIS
1996	3.3	4.2
1997	3.2	4.3
1998	1.0	1.6
1999	0.3	1.4
2000	0.2	0.2
2001	0.001	0.1
2002	0.7	0.7
2003	1.5	0.5
2004	0.18	0.18
2005	0.46	0.11
2006	1.6	1.4
2007	2.4	2.9
2008	0.5	0.7
2009	0.29	0.23
2010	0.36	0.43
2011	2.5	0.95
2012	0.68	0.44
2013	0.31	0.28
2014	0.25	0.17
2015	0.19	0.13
2016	0.18	0.07

Historical Summary (1995–2016)

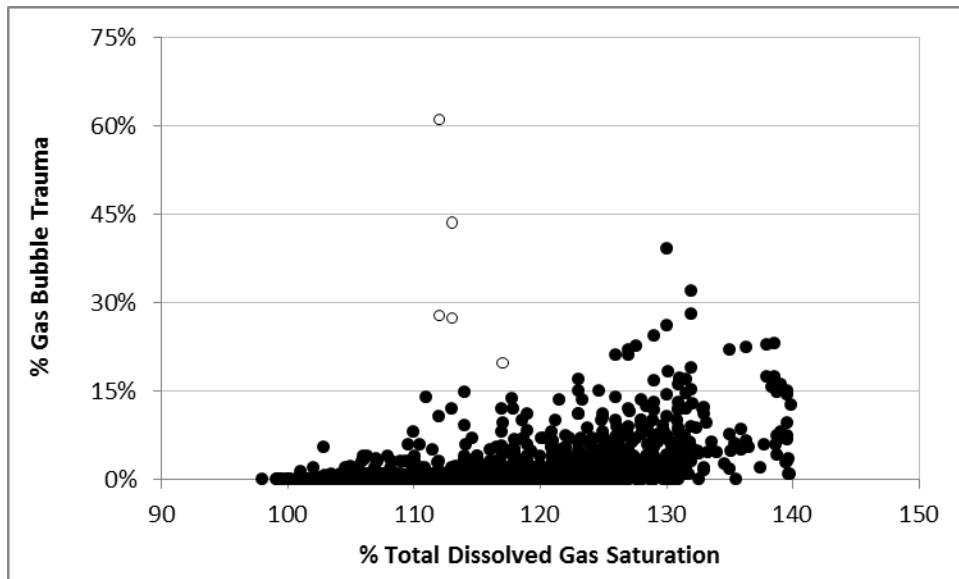
The Gas Bubble Trauma monitoring program has been implemented annually since 1995. There are over twenty years of data available, and as a result of involuntary spill events, data for GBT are available over a wide range of total dissolved gas concentrations. In fact, over this historic record, observations have occurred at tailwater TDG levels as high as 140%. This has allowed the assessment of the impacts of TDG on the salmonid population over a wide range of tailwater TDG conditions.

Excluding Rock Island Dam samples, a total of 2,656 daily exams have occurred over the time period, with a total of 304,622 fish examined. (The daily sample size criteria based on the monitoring protocol is 100 fish. In this analysis some flexibility was considered and all daily samples with greater than 75 fish were included). The GBT monitoring program has consistently shown over the years that signs of GBT are minimal when TDG is managed to the present dissolved gas standards associated with the implementation of the Federal Columbia River Power System (FCRPS) Biological Opinion Spill program.

In all the years when TDG and GBT data have been collected (2,656 samples), there have been only 34 instances when the 15% GBT criterion was exceeded. Of those 34 instances, five (open circles in Figure J-9) can be attributed to late migrating steelhead smolts in 2002 and 2007. At the time these steelhead smolts were collected at Little Goose Dam approximately 98% of the juvenile steelhead migrating that year had already passed this project. These late migrating fish were observed in the forebay of the dam on the surface, had prolonged migration times, and were likely residualizing (see <http://www.fpc.org/documents/memos/136-07.pdf>). These fish may be considered anomalous, and were likely present due to the very low flow conditions that occurred those years. The other 29 times the biological criteria were exceeded occurred when TDG was greater than 120%. Of these 29 exceedences, 26 (90%) were observed at TDG concentrations greater than 125%. The following graph (Figure J-9) shows the summary of the 2,656 daily exams as a function of TDG.

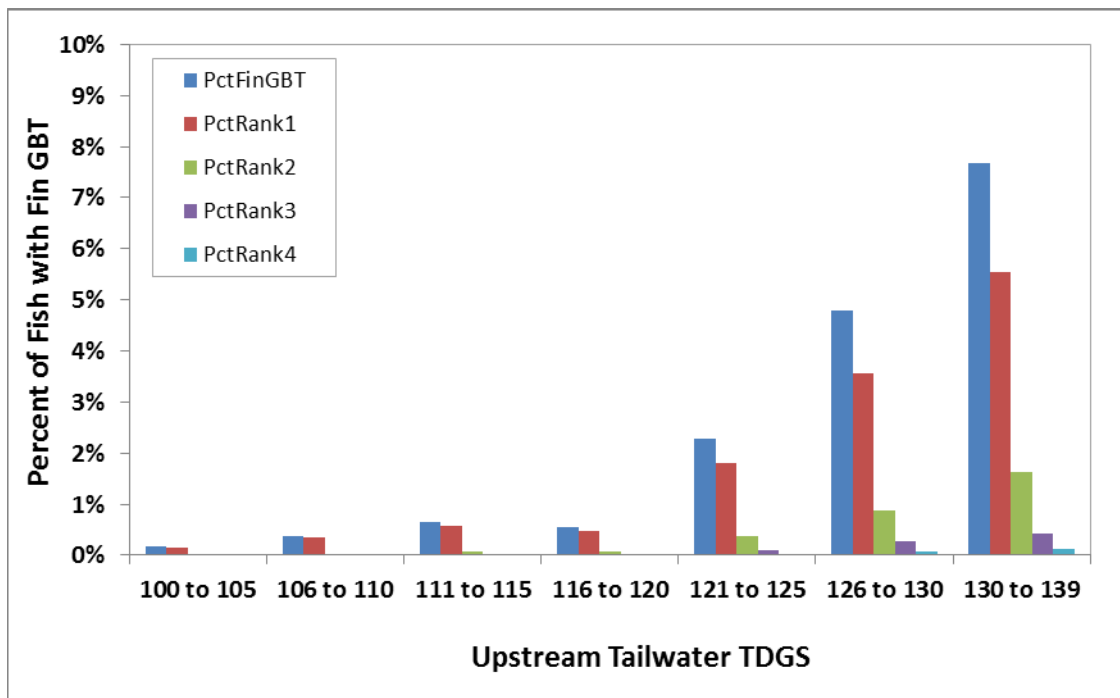
Figure J-9

Percent GBT observed as a function of TDG observed. TDG measured at the tailwater of the upstream project at the Snake River projects and McNary and at John Day Dam tailwater for the Bonneville samples. Open circles indicate observations for late migrating steelhead observed in 2002 and 2007.



Over the historic record there have been several instances when GBT data were collected during periods of uncontrolled spill that led to higher levels of TDG. This allows fish collected over the years to be sorted into groups that migrated under similar TDG levels (Figure J-10). The following graph summarizes the gas bubble trauma data collected over the years of the implementation of the GBT Monitoring Program as a function of the TDG levels.

Figure J-10
Percent of all fish collected from 1995–2016 showing signs of GBT at given TDG levels.



From Figure J-10 two things are apparent. The incidence of fish observed with signs of GBT and the severity of those signs increases with increasing levels of TDG supersaturation. This is consistent with the research on which the monitoring program was developed. Second, signs of GBT are almost non-existent below 120% TDG, begin increasing slightly between 121% and 125% TDG, and then increase in both incidence and severity above 125% TDG.

Discussion

The Biological Opinion Spill Program is managed using the data collected for TDG levels. The GBT biological monitoring is meant to complement the physical monitoring

program. GBT sampling was successfully accomplished for the 2016 migration season. Under the conditions observed in 2016, TDG levels were mostly below the 115% forebay standard. The two exceptions were the Ice Harbor and Bonneville dam forebays. The Ice Harbor Dam forebay exceeded the 115% standard approximately 28% of the time (between April 1 and August 31) and the Bonneville Dam forebay exceeded the 115% standard approximately 14% of the time. In addition, there were only fewer instances when the 120% tailwater standard was exceeded in 2016. Most notable was the Bonneville Dam tailwater, where TDG levels exceeded the 120% TDG standard approximately 7% of the time (between April 1 and August 31). The low incidence of signs of GBT observed in 2016 year reflects the TDG observations.

The action criteria that serve as “early warning” indicators for potential lethal GBT conditions were not exceeded in 2016. The highest level of GBT (4.0%) was observed at Rock Island Dam. The highest level observed in the FCRPS was 2.0% on two separate occasions at Bonneville Dam.

Data collected over the past 20 plus years strongly suggest that the Biological Monitoring serves as an effective management tool providing “early warning” of potentially harmful levels of TDG. What we have learned from the historic data is that the “early warning” signs are not triggered at TDG levels less than 120% at the tailwater monitors. Most observations indicating potential harm occurred above TDG levels of 125%, as measured at the tailwater TDG monitors.

References

- U.S. Geological Survey (USGS). 1997. Protocol for determining gas bubble trauma in juvenile salmonids. Columbia River Research Laboratory. Cook, Washington
- Weitkamp, D.E. 2000. Total Dissolved Gas Supersaturation in the Natural River Environment. Report by Parametrix to Chelan County Public Utility District, No.1. Wenatchee, WA. 21 p.

Table J-5

Detailed breakdown of GBT exams and signs of fin GBT at Lower Granite Dam in 2016.

Exam Date	Number Examined	Number with Fin GBT	Percent with Fin GBT
4/8/2016	101	0	0.0%
4/15/2016	100	0	0.0%
4/22/2016	101	0	0.0%
4/29/2016	100	0	0.0%
5/13/2016	101	0	0.0%
5/20/2016	101	0	0.0%
5/27/2016	100	0	0.0%
6/3/2016	54	0	0.0%
6/10/2016	101	0	0.0%

Table J-6

Detailed breakdown of GBT exams and signs of fin GBT at Little Goose Dam in 2016.

Exam Date	Number Examined	Number with Fin GBT	Percent with Fin GBT
4/14/2016	99	0	0.0%
4/19/2016	100	0	0.0%
4/26/2016	100	0	0.0%
5/3/2016	100	0	0.0%
5/10/2016	100	0	0.0%
5/17/2016	100	0	0.0%
5/24/2016	100	0	0.0%
5/31/2016	100	0	0.0%
6/7/2016	100	0	0.0%
6/14/2016	100	0	0.0%
6/21/2016	100	0	0.0%
6/28/2016	100	0	0.0%
7/5/2016	100	0	0.0%
7/12/2016	83	0	0.0%
7/19/2016	15	0	0.0%

Table J-7

Detailed breakdown of GBT exams and signs of fin GBT at Lower Monumental Dam in 2016.

Exam Date	Number Examined	Number with Fin GBT	Percent with Fin GBT
4/8/2016	78	0	0.0%
4/16/2016	100	0	0.0%
4/22/2016	100	0	0.0%
4/28/2016	100	0	0.0%
5/6/2016	100	0	0.0%
5/11/2016	100	0	0.0%
5/18/2016	100	0	0.0%
5/25/2016	100	0	0.0%
6/1/2016	100	0	0.0%
6/8/2016	100	0	0.0%
6/15/2016	100	0	0.0%
6/22/2016	75	0	0.0%
6/29/2016	55	0	0.0%
7/6/2016	100	0	0.0%
7/13/2016	60	0	0.0%

Table J-8

Detailed breakdown of GBT exams and signs of fin GBT at McNary Dam in 2016.

Exam Date	Number Examined	Number with Fin GBT	Percent with Fin GBT
4/15/2016	100	0	0.0%
4/19/2016	100	0	0.0%
4/25/2016	100	0	0.0%
4/29/2016	100	0	0.0%
5/3/2016	100	0	0.0%
5/7/2016	101	0	0.0%
5/9/2016	100	0	0.0%
5/13/2016	100	0	0.0%
5/17/2016	100	0	0.0%
5/21/2016	100	0	0.0%
5/23/2016	102	0	0.0%
5/27/2016	100	0	0.0%
5/31/2016	100	0	0.0%
6/6/2016	100	0	0.0%
6/10/2016	100	0	0.0%
6/14/2016	103	0	0.0%
6/18/2016	102	0	0.0%
6/20/2016	100	0	0.0%
6/24/2016	100	0	0.0%
6/28/2016	100	0	0.0%
7/2/2016	100	0	0.0%
7/4/2016	100	0	0.0%
7/8/2016	100	0	0.0%
7/12/2016	100	0	0.0%
7/16/2016	100	0	0.0%
7/18/2016	100	0	0.0%
7/22/2016	100	0	0.0%
7/26/2016	100	0	0.0%
8/1/2016	27	0	0.0%
8/9/2016	15	0	0.0%

Table J-9

Detailed breakdown of GBT exams and signs of fin GBT at Bonneville Dam in 2016.

Exam Date	Number Examined	Number with Fin GBT	Percent with Fin GBT
4/17/2016	100	0	0.0%
4/20/2016	100	1	1.0%
4/24/2016	100	0	0.0%
4/27/2016	100	0	0.0%
5/1/2016	100	0	0.0%
5/4/2016	100	0	0.0%
5/8/2016	100	2	2.0%
5/15/2016	100	2	2.0%
5/18/2016	100	0	0.0%
5/22/2016	100	0	0.0%
5/25/2016	100	0	0.0%
6/8/2016	100	0	0.0%
6/12/2016	100	0	0.0%
6/15/2016	45	0	0.0%
6/19/2016	100	0	0.0%
6/22/2016	100	0	0.0%
6/26/2016	100	0	0.0%
6/29/2016	100	0	0.0%
7/3/2016	100	0	0.0%
7/6/2016	100	0	0.0%
7/10/2016	100	0	0.0%
7/13/2016	100	1	1.0%
7/17/2016	100	0	0.0%
7/20/2016	100	0	0.0%
7/24/2016	100	0	0.0%
7/27/2016	100	0	0.0%
7/31/2016	22	0	0.0%
8/2/2016	100	0	0.0%
8/8/2016	16	0	0.0%

Table J-10

Detailed breakdown of GBT exams and signs of fin GBT at Rock Island Dam in 2016.

Exam Date	Number Examined	Number with Fin GBT	Percent with Fin GBT
4/12/2016	100	0	0.0%
4/19/2016	100	1	1.0%
4/21/2016	100	1	1.0%
4/26/2016	100	0	0.0%
4/29/2016	100	4	4.0%
5/3/2016	100	1	1.0%
5/5/2016	100	1	1.0%
5/10/2016	100	0	0.0%
5/12/2016	100	0	0.0%
5/17/2016	100	4	4.0%
5/19/2016	100	2	2.0%
5/24/2016	100	0	0.0%
5/26/2016	100	0	0.0%
6/7/2016	100	0	0.0%
6/9/2016	100	0	0.0%
6/14/2016	100	0	0.0%
6/16/2016	100	0	0.0%
6/21/2016	100	0	0.0%
6/23/2016	100	1	1.0%
6/28/2016	100	0	0.0%
6/30/2016	100	0	0.0%
7/5/2016	100	0	0.0%
7/7/2016	100	0	0.0%
7/19/2016	100	0	0.0%