

# **Appendix J**

## **Gas Bubble Trauma Monitoring And Data Reporting For 2015**

**Fish Passage Center  
Portland, Oregon**

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# FISH PASSAGE CENTER

847 NE 19<sup>th</sup> Avenue, #250, Portland, OR 97232

Phone: (503) 833-3900 Fax: (503) 232-1259

[www.fpc.org/](http://www.fpc.org/)

e-mail us at [fpcstaff@fpc.org](mailto:fpcstaff@fpc.org)

November 20, 2015

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 2015* to both you and Mr. Paul Wagner of National Marine Fisheries Service. This report summarizes data collected during the 2015 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

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# Gas Bubble Trauma Monitoring and Data Reporting for 2015

## 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 2015 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 2015, 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 bypass or other sampling apparatus (at RIS and BON). At Rock Island Dam, fish are held up to 24 hours in a shallow tank prior to examination. While not desirable there are no 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.

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 |

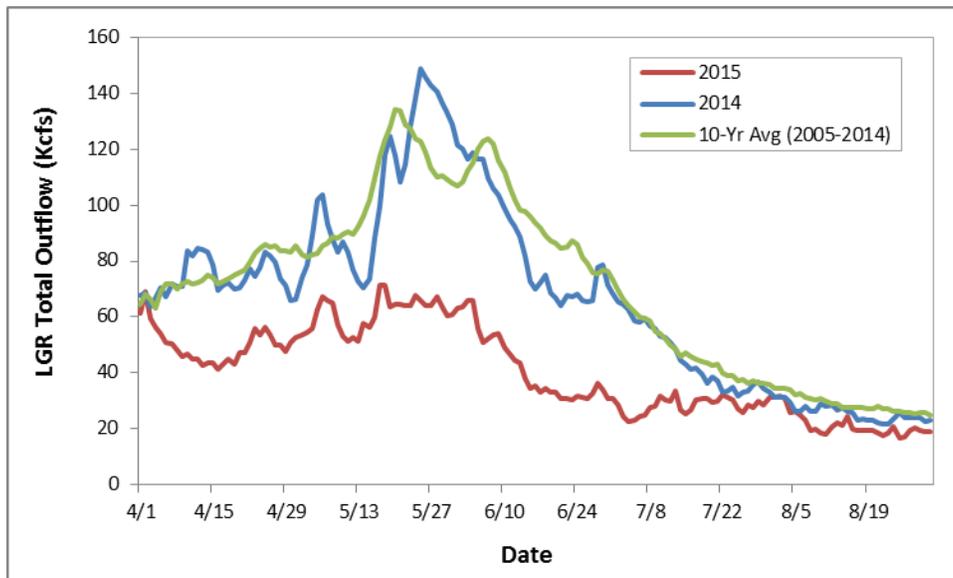
In an effort to standardize handling and reporting practices among sites and to provide accounting for Endangered Species Act permitting purposes, the FPC modified the handling protocol for the GBT program. Although some modifications were made to the handling protocol in 2015, the examination procedures did not change. For more detailed information on the modifications and the examination procedure, the GBT Monitoring Protocol is available on the FPC website ([ftp://ftp.fpc.org/gbt/GBTManual\\_Datasheet/GBTMonitoringProtocol\\_2015.pdf](ftp://ftp.fpc.org/gbt/GBTManual_Datasheet/GBTMonitoringProtocol_2015.pdf)).

## 2015 Water Conditions

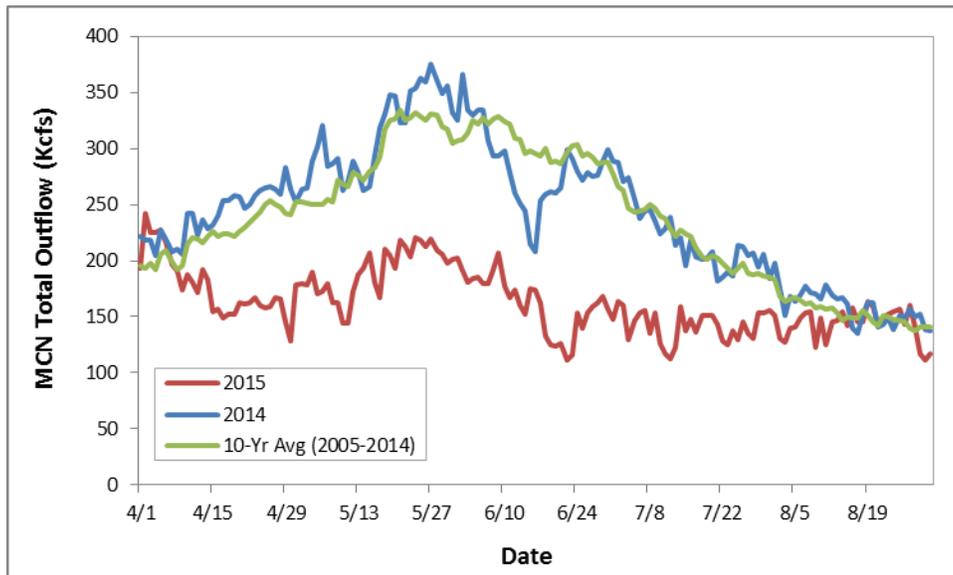
The runoff volume (January–July) for the 2015 water year was considerably below average in both the Middle Columbia and Lower Snake rivers. Runoff (January–July) was 83% of average (1981–2010) at The Dalles Dam and 69% of average at Lower Granite Dam. To put the low runoff volumes into perspective, the 2015 January–July runoff volumes at The Dalles and Lower Granite were ranked 68<sup>th</sup> and 74<sup>th</sup>, respectively, over the last 87 years (1929–2015).

In the Snake River, this resulted in below average flows throughout the spring and summer seasons, with peak flows of only about 71 Kcfs in mid-May (Figure J-1). In the Middle Columbia, the 2015 runoff resulted in below average flows in both the spring and summer periods (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. Because of the extremely low flows in 2015, spill volumes were low and TDG levels rarely exceeded TDG waiver levels during the spill season, except at the Ice Harbor Dam forebay TDG monitor. At Ice Harbor Dam, the forebay gage often reads higher than the gage at the Lower Monumental Dam tailwater (the next upstream project where spill is occurring), and higher than the downstream tailwater gage at the project. Since the TDG 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 was decreased in-season.

**Figure J-1.**  
**Average daily flows at Lower Granite Dam**  
**2015, 2014, and the 10-year average**



**Figure J-2**  
**Average daily flows at McNary Dam**  
**2015, 2014 and the 10-year average**



## Results

In all, 10,577 juvenile salmonids were examined for GBT between April and August of 2015 (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 2015 as part of the Smolt Monitoring Program.**

| Species              | BON   | MCN   | LMN   | LGS   | LGR | RIS   | Total  |
|----------------------|-------|-------|-------|-------|-----|-------|--------|
| Chinook Subyearlings | 961   | 651   | 612   | 700   | 0   | 1,162 | 4,086  |
| Chinook Yearlings    | 888   | 1,153 | 282   | 464   | 347 | 846   | 3,980  |
| Steelhead            | 464   | 456   | 370   | 315   | 264 | 642   | 2,511  |
| Total                | 2,313 | 2,260 | 1,264 | 1,479 | 611 | 2,650 | 10,577 |

Fin signs were found in 20 or 0.19% of the total fish sampled at all sites (Table J-3), with half of those detections occurring at Rock Island Dam. Of the 20 fish that had signs of fin GBT in 2015, 19 were rank 1, where less than 5% of a fin area was covered with bubbles. One fish was observed with rank 2, where 6% to 25% of a fin area was covered with bubbles. This single rank 2 fin GBT fish was encountered at Little Goose Dam. No fish that were examined for GBT in 2015 exhibited fin GBT of rank 3 or 4. A more detailed breakdown of GBT exams and signs for 2015 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 2015 as part of the Smolt Monitoring Program.**

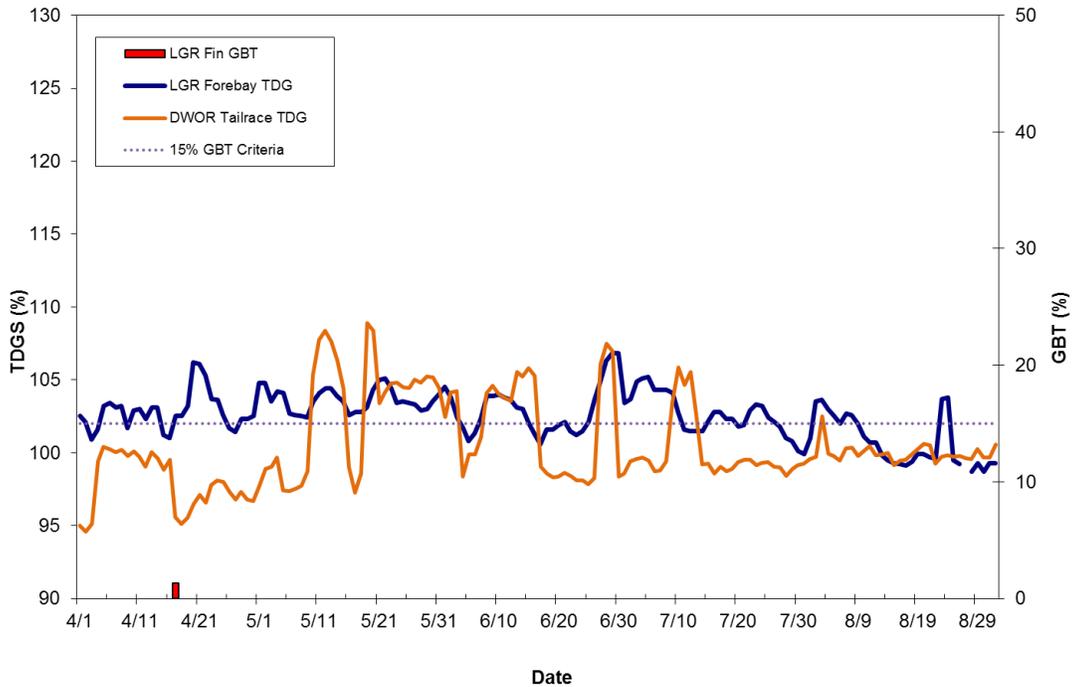
| Species              | Fin GBT by Site |     |     |     |     |     | Grand Total |
|----------------------|-----------------|-----|-----|-----|-----|-----|-------------|
|                      | BON             | MCN | LMN | LGS | LGR | RIS |             |
| Chinook Subyearlings | 0               | 0   | 0   | 0   | 0   | 4   | 4           |
| Chinook Yearlings    | 1               | 4   | 0   | 2   | 1   | 4   | 12          |
| Steelhead            | 1               | 0   | 0   | 1   | 0   | 2   | 4           |
| Total                | 2               | 4   | 0   | 3   | 1   | 10  | 20          |

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 2015.

**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 10<sup>th</sup> to May 22<sup>nd</sup>. The predomination of summer migrating subyearling Chinook in the sample is used to trigger the end of sampling. Due to concern regarding the low flows and elevated temperatures in 2015, hatchery releases of subyearling Chinook occurred earlier than usual, resulting in an earlier than usual May 22 end of sampling date at this project. At no time in 2015 did the TDG at the LGR forebay exceed the EPA 110% standard. Signs of fin GBT were observed at LGR on one sampling occasion (April 17<sup>th</sup>), where 1.3% of the fish examined had rank 1 signs of GBT (Table J-3).

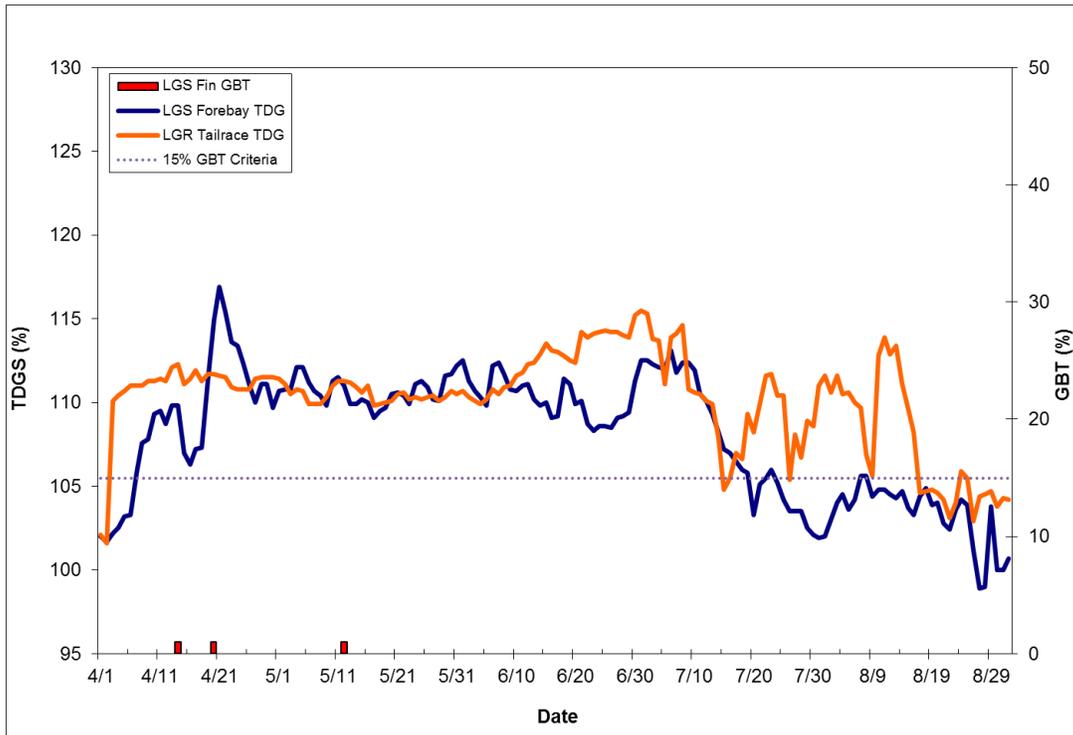
**Figure J-3**  
**Percent GBT observed in the sample at Lower Granite Dam**



**Little Goose Dam (LGS)**

GBT sampling at LGS occurred from April 14<sup>th</sup> to July 21<sup>st</sup>. Sampling was terminated after the July 21<sup>st</sup> sample at LGS due to: the decreasing numbers of fish in the sample that precluded adequate sample sizes, excessive temperatures, and TDG levels in the LGS forebay that were below the EPA standard of 110%. Both the prevalence and severity of GBT signs at LGS were low in 2015. Signs of fin GBT were detected on three occasions in 2015, April 14<sup>th</sup>, April 20<sup>th</sup>, and May 12<sup>th</sup> (Figure J-4, Table J-6). On all three occasions, only 1% of the GBT sample exhibited signs of fin GBT and only one occasion had fish with signs of rank 2 (6% to 25% of a fin area was covered with bubbles). Total dissolved gas levels in the LGR tailwater never exceeded the 120% criteria in 2015 (Figure J-4). Total dissolved gas levels in the LGS forebay exceeded 115% for two days in mid-April (April 21<sup>st</sup> and 22<sup>nd</sup>) (Figure J-4).

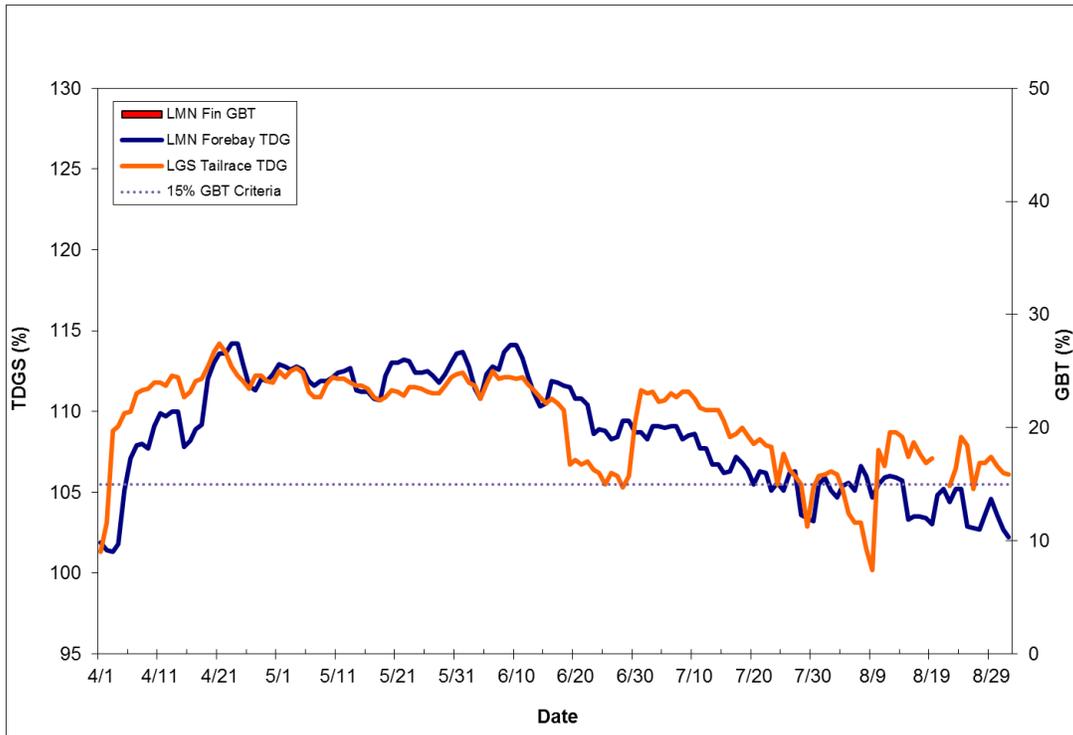
**Figure J-4**  
**Percent GBT observed in the sample at Little Goose Dam**



**Lower Monumental Dam (LMN)**

GBT sampling at LMN occurred from April 17<sup>th</sup> to July 22<sup>nd</sup>. Sampling was terminated after the July 22<sup>nd</sup> sample at LGS due to: the decreasing numbers of fish in the sample that precluded adequate sample sizes, excessive temperatures, and TDG levels in the LGS forebay that were below the EPA standard of 110%. There were zero occasions of fin GBT at Lower Monumental Dam in 2015 (Table J-7). Total dissolved gas in the LGS tailwater never exceeded 120% in 2015 (Figure J-5). In addition, TDG in the Lower Monumental forebay never exceeded 115% in 2015 (Figure J-5).

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

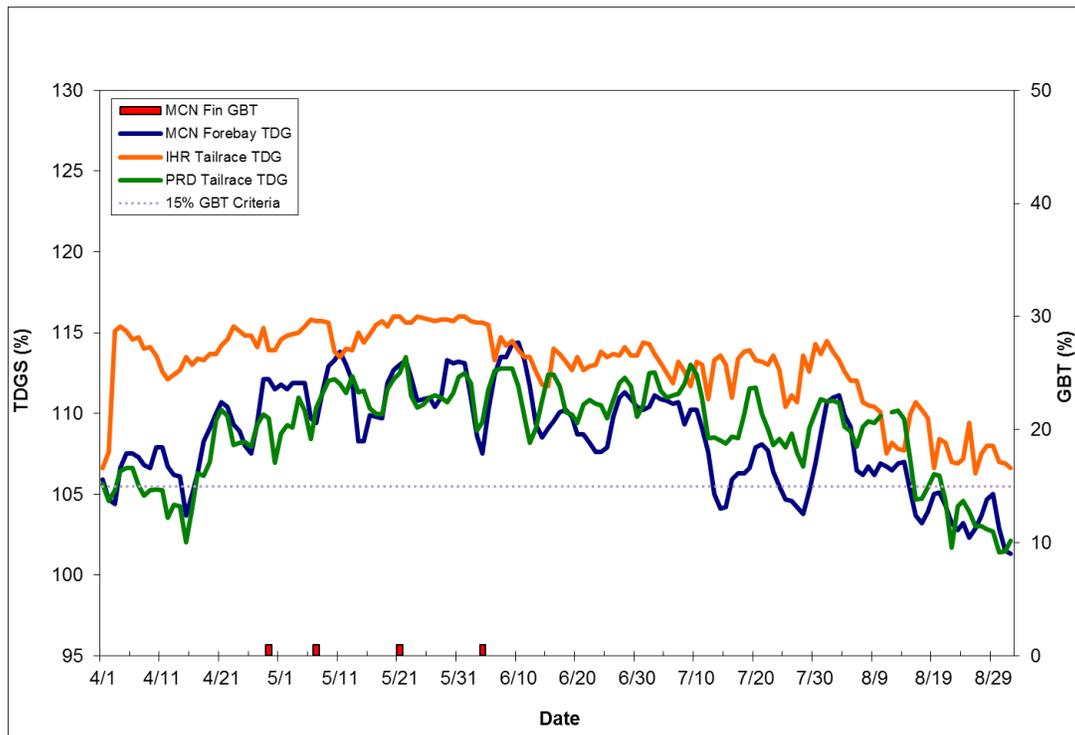


**McNary Dam (MCN)**

GBT sampling at MCN occurred from April 15<sup>th</sup> to July 16<sup>th</sup>. On June 18<sup>th</sup>, the U.S. Army Corps of Engineers (COE) Biologist at MCN requested a reduction in GBT sampling from twice per week to once per week due to an increase in the number of mortalities of recovering GBT-examined fish. At the time higher than normal temperatures were observed in the river. This request 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 July 16<sup>th</sup> when sampling for GBT was terminated for 2015 due to continued excessive temperatures and high mortalities in the recovery raceways. Given that TDG levels were below the EPA 110% TDG standard and mortalities for recovering fish were elevated, it was agreed that GBT sampling should be terminated.

The TDG levels in the tailwater at Priest Rapids (PRD) and Ice Harbor dams never exceeded the 120% waiver level in 2015 (Figure J-6). Total dissolved gas at the MCN forebay never exceeded the 115% waiver level in 2015. There were four instances when GBT was detected in a sample at McNary Dam in 2015 (Figure J-6, Table J-8). All four of these incidents had a prevalence of 1.0% (Figure J-6, Table J-8) and all of the fish that showed signs of fin GBT at MCN in 2015 had rank 1 signs.

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



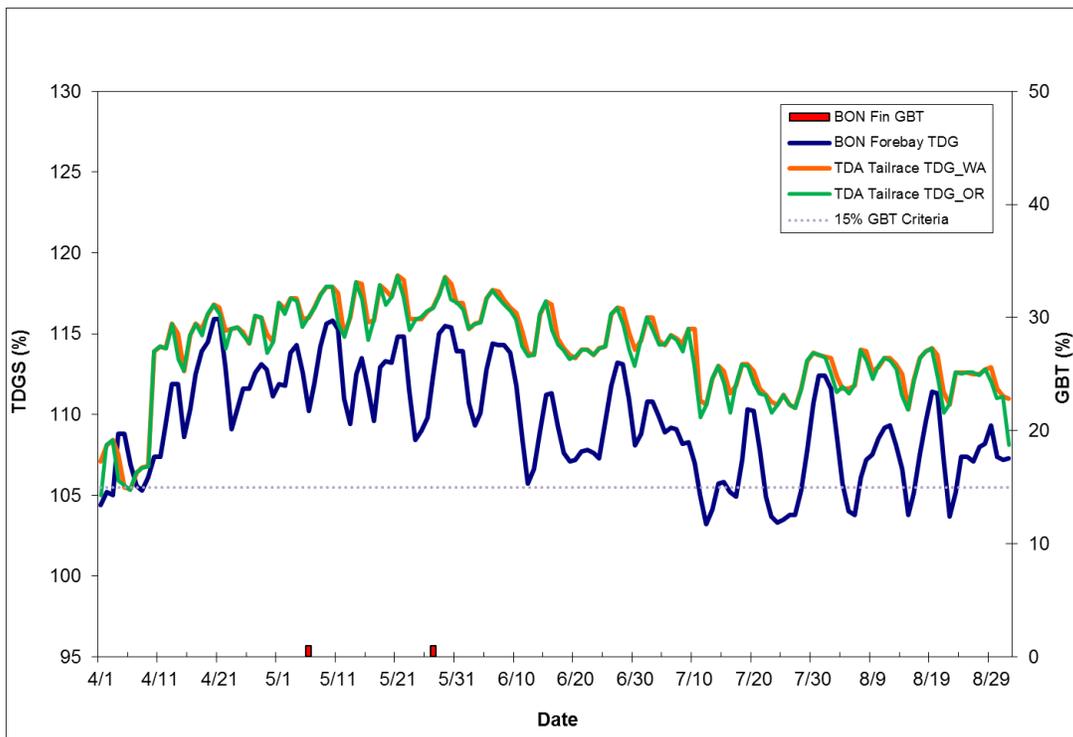
***Bonneville Dam (BON)***

GBT sampling at BON occurred from April 22<sup>th</sup> to July 20<sup>th</sup>. After the July 20<sup>th</sup> GBT sample the Fish Passage Center reduced sampling at BON from twice per week to once per week. Similar to MCN, the decision to reduce the sampling frequency was due to the combination of increased mortalities of recovering GBT examined fish, elevated temperatures at the facility, and TDG levels in the forebay that were generally below the EPA 110% standard. At the same time, collection of the 100 fish target was becoming difficult. On July 20<sup>th</sup>, FPC staff informed personnel at BON to proceed with GBT sampling once per week but to examine fish for GBT only if the target of 100 fish was obtainable. Due to continued low passage numbers, this target sample size was never obtainable; thus, the July 20<sup>th</sup> GBT sample was the last for the 2015 season.

At Bonneville Dam, there were two occasions in 2015 when signs of fin GBT in fish were recorded (May 6<sup>th</sup> and May 27<sup>th</sup>) (Figure J-7, Table J-9). On both of these occasions the GBT prevalence was 1.0%. Both of the fish that exhibited signs of GBT at BON in 2015 had signs that were rank 1.

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 2015. Total dissolved gas in the BON forebay calculated using the Washington DOE methodology, exceeded the Washington DOE 115% waiver level for a total of seven days in 2015. The longest continuous period where the BON forebay exceeded 115% was only three days, from May 9<sup>th</sup> to May 11<sup>th</sup>.

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



**Rock Island Dam (RIS)**

GBT sampling at RIS occurred from April 17<sup>th</sup> to July 16<sup>th</sup>. GBT sampling at RIS was terminated after the July 16<sup>th</sup> sample because of the inability to collect the sample necessary to conduct GBT exams. There were seven total days when signs of fin GBT were detected at RIS in 2015 (Figure J-8, Table J-10). The maximum GBT rate at RIS in 2015 was 3%, which occurred on June 4<sup>th</sup>. Total dissolved gas levels in the tailwaters of Grand Coulee (GCL), Chief Joseph (CHJ), Wells (WEL), and Rocky Reach (RRH) dams never exceeded 120% in 2015. In addition, all four forebay monitors above RIS (including the RIS forebay monitor) had TDG levels that never exceeded the 115% waiver level in 2015. Of the 10 total fish that showed signs of fin GBT at RIS in 2015, all were rank 1.

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

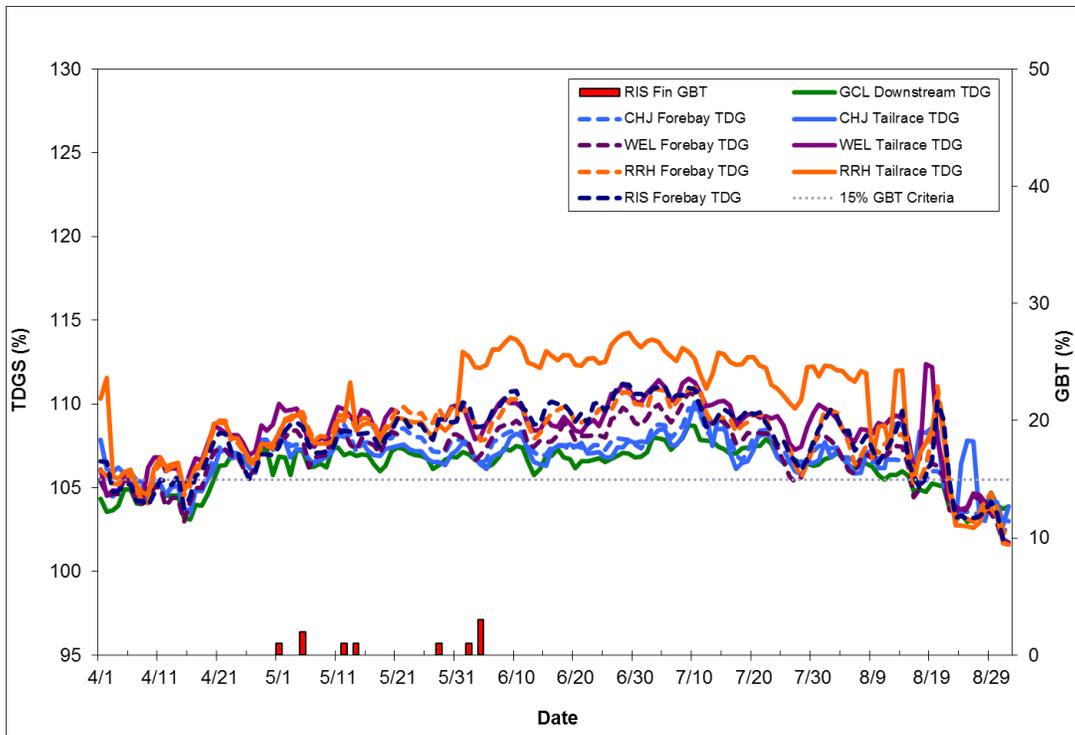


Table J-4 compares the 2015 estimates of the overall percentage of fish with signs of GBT to past years' estimates. This is not meant as a measurement of overall GBT, but is used to easily display the annual relative magnitude of GBT in 2015 compared to past years. As can be seen in the table, the overall annual incidence of GBT in 2015 was in the lower range among the past 19 years, similar to that observed in other low flow 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 2015.**

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

### **Historical Summary (1995–2015)**

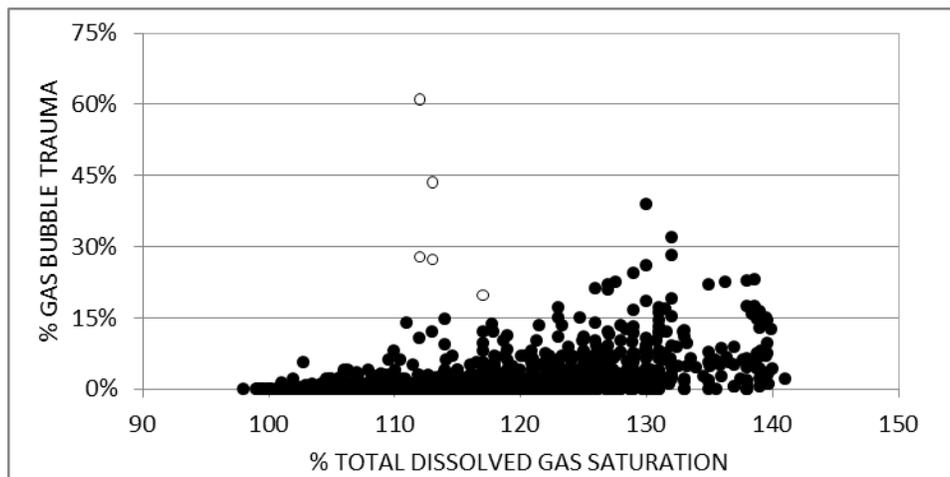
The Gas Bubble Trauma monitoring program has been implemented annually since 1995. There are over twenty years of data available, and as a result of involuntary spill events, data for GBT are available over a wide range of total dissolved gas concentrations. In fact, over this historic record, observations 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 2,567 daily exams have occurred over the time period, with a total of 295,798 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 have been collected (2,567 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. 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 that year. 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 2,567 daily exams as a function of TDG.

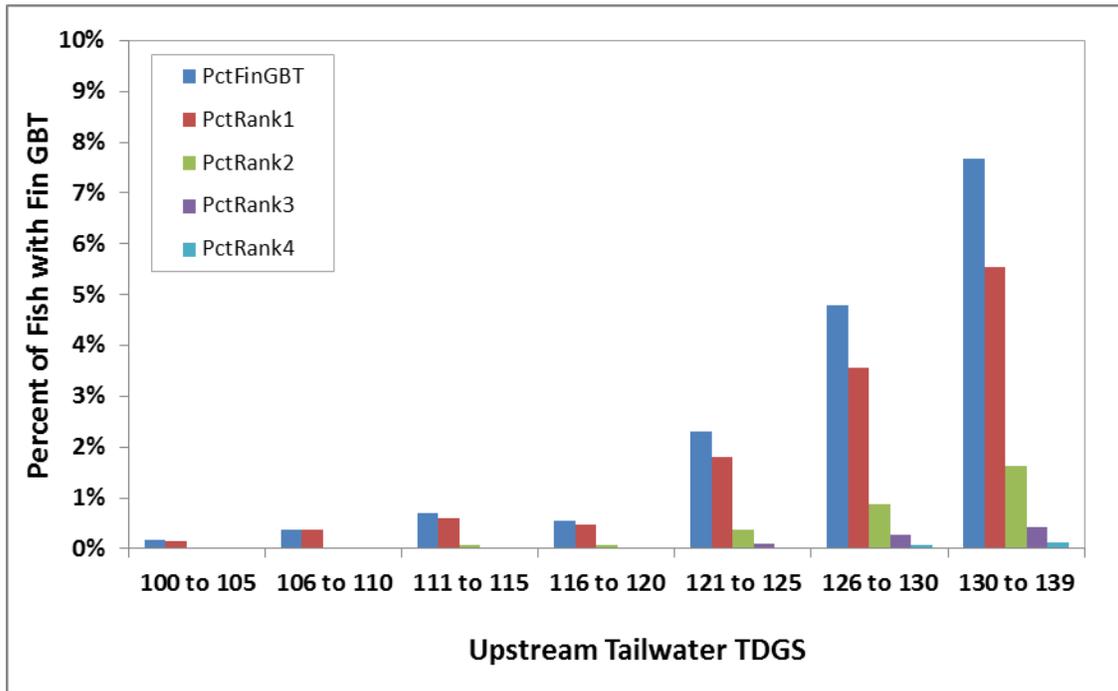
**Figure J-9**

**Percent GBT observed as a function of TDG observed. TDG measured at the tailwater of the upstream project at the Snake River projects and at John Day Dam tailwater for the Columbia River 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 1995–2015 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. And, secondly, 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 2015 migration season. Under the conditions observed in 2015 the TDG was generally below the 115% forebay standard (with the exception of Ice Harbor Dam forebay as previously discussed and a few days at Bonneville Dam) and 120% tailwater TDG level. The low incidence of signs of GBT observed this year reflects the TDG observations.

The action criteria that serve as “early warning” indicators for potential lethal GBT conditions were not exceeded in 2015. The highest level of GBT (3.0%) was observed at Rock Island Dam. The highest level observed in the FCRPS was 1.3% on one day at Little Goose 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 2015.

| <b>Exam Date</b> | <b>Number Examined</b> | <b>Number with Fin GBT</b> | <b>Percent with Fin GBT</b> |
|------------------|------------------------|----------------------------|-----------------------------|
| 4/10/2015        | 35                     | 0                          | 0.0%                        |
| 4/17/2015        | 75                     | 1                          | 1.3%                        |
| 4/24/2015        | 100                    | 0                          | 0.0%                        |
| 5/1/2015         | 99                     | 0                          | 0.0%                        |
| 5/8/2015         | 100                    | 0                          | 0.0%                        |
| 5/15/2015        | 100                    | 0                          | 0.0%                        |
| 5/22/2015        | 102                    | 0                          | 0.0%                        |

**Table J-6**

Detailed breakdown of GBT exams and signs of fin GBT at Little Goose Dam in 2015.

| <b>Exam Date</b> | <b>Number Examined</b> | <b>Number with Fin GBT</b> | <b>Percent with Fin GBT</b> |
|------------------|------------------------|----------------------------|-----------------------------|
| 4/14/2015        | 100                    | 1                          | 1.0%                        |
| 4/20/2015        | 99                     | 1                          | 1.0%                        |
| 4/28/2015        | 100                    | 0                          | 0.0%                        |
| 5/5/2015         | 100                    | 0                          | 0.0%                        |
| 5/12/2015        | 100                    | 1                          | 1.0%                        |
| 5/19/2015        | 100                    | 0                          | 0.0%                        |
| 5/26/2015        | 100                    | 0                          | 0.0%                        |
| 6/2/2015         | 100                    | 0                          | 0.0%                        |
| 6/9/2015         | 100                    | 0                          | 0.0%                        |
| 6/16/2015        | 100                    | 0                          | 0.0%                        |
| 6/23/2015        | 100                    | 0                          | 0.0%                        |
| 6/30/2015        | 100                    | 0                          | 0.0%                        |
| 7/7/2015         | 100                    | 0                          | 0.0%                        |
| 7/14/2015        | 100                    | 0                          | 0.0%                        |
| 7/21/2015        | 80                     | 0                          | 0.0%                        |

**Table J-7**

Detailed breakdown of GBT exams and signs of fin GBT at Lower Monumental Dam in 2015.

| <b>Exam Date</b> | <b>Number Examined</b> | <b>Number with Fin GBT</b> | <b>Percent with Fin GBT</b> |
|------------------|------------------------|----------------------------|-----------------------------|
| 4/17/2015        | 15                     | 0                          | 0.0%                        |
| 4/23/2015        | 100                    | 0                          | 0.0%                        |
| 5/1/2015         | 100                    | 0                          | 0.0%                        |
| 5/6/2015         | 100                    | 0                          | 0.0%                        |
| 5/13/2015        | 100                    | 0                          | 0.0%                        |
| 5/20/2015        | 100                    | 0                          | 0.0%                        |
| 5/27/2015        | 100                    | 0                          | 0.0%                        |
| 6/3/2015         | 99                     | 0                          | 0.0%                        |
| 6/10/2015        | 75                     | 0                          | 0.0%                        |
| 6/17/2015        | 100                    | 0                          | 0.0%                        |
| 6/24/2015        | 100                    | 0                          | 0.0%                        |
| 7/1/2015         | 100                    | 0                          | 0.0%                        |
| 7/8/2015         | 79                     | 0                          | 0.0%                        |
| 7/15/2015        | 91                     | 0                          | 0.0%                        |
| 7/22/2015        | 5                      | 0                          | 0.0%                        |

**Table J-8**

Detailed breakdown of GBT exams and signs of fin GBT at McNary Dam in 2015.

| <b>Exam Date</b> | <b>Number Examined</b> | <b>Number with Fin GBT</b> | <b>Percent with Fin GBT</b> |
|------------------|------------------------|----------------------------|-----------------------------|
| 4/15/2015        | 75                     | 0                          | 0.0%                        |
| 4/17/2015        | 100                    | 0                          | 0.0%                        |
| 4/21/2015        | 100                    | 0                          | 0.0%                        |
| 4/23/2015        | 100                    | 0                          | 0.0%                        |
| 4/29/2015        | 100                    | 1                          | 1.0%                        |
| 5/1/2015         | 100                    | 0                          | 0.0%                        |
| 5/5/2015         | 100                    | 0                          | 0.0%                        |
| 5/7/2015         | 100                    | 1                          | 1.0%                        |
| 5/13/2015        | 100                    | 0                          | 0.0%                        |
| 5/15/2015        | 100                    | 0                          | 0.0%                        |
| 5/19/2015        | 100                    | 0                          | 0.0%                        |
| 5/21/2015        | 100                    | 1                          | 1.0%                        |
| 5/27/2015        | 100                    | 0                          | 0.0%                        |
| 5/29/2015        | 100                    | 0                          | 0.0%                        |
| 6/2/2015         | 100                    | 0                          | 0.0%                        |
| 6/4/2015         | 100                    | 1                          | 1.0%                        |
| 6/10/2015        | 100                    | 0                          | 0.0%                        |
| 6/12/2015        | 100                    | 0                          | 0.0%                        |
| 6/16/2015        | 100                    | 0                          | 0.0%                        |
| 6/18/2015        | 100                    | 0                          | 0.0%                        |
| 6/24/2015        | 100                    | 0                          | 0.0%                        |
| 7/2/2015         | 85                     | 0                          | 0.0%                        |
| 7/16/2015        | 100                    | 0                          | 0.0%                        |

**Table J-9**

Detailed breakdown of GBT exams and signs of fin GBT at Bonneville Dam in 2015.

| <b>Exam Date</b> | <b>Number Examined</b> | <b>Number with Fin GBT</b> | <b>Percent with Fin GBT</b> |
|------------------|------------------------|----------------------------|-----------------------------|
| 4/22/2015        | 59                     | 0                          | 0.0%                        |
| 4/26/2015        | 100                    | 0                          | 0.0%                        |
| 4/29/2015        | 100                    | 0                          | 0.0%                        |
| 5/3/2015         | 100                    | 0                          | 0.0%                        |
| 5/6/2015         | 100                    | 1                          | 1.0%                        |
| 5/10/2015        | 100                    | 0                          | 0.0%                        |
| 5/13/2015        | 100                    | 0                          | 0.0%                        |
| 5/17/2015        | 100                    | 0                          | 0.0%                        |
| 5/20/2015        | 100                    | 0                          | 0.0%                        |
| 5/24/2015        | 100                    | 0                          | 0.0%                        |
| 5/27/2015        | 100                    | 1                          | 1.0%                        |
| 5/31/2015        | 100                    | 0                          | 0.0%                        |
| 6/3/2015         | 100                    | 0                          | 0.0%                        |
| 6/10/2015        | 93                     | 0                          | 0.0%                        |
| 6/14/2015        | 100                    | 0                          | 0.0%                        |
| 6/17/2015        | 100                    | 0                          | 0.0%                        |
| 6/21/2015        | 100                    | 0                          | 0.0%                        |
| 6/24/2015        | 54                     | 0                          | 0.0%                        |
| 6/28/2015        | 84                     | 0                          | 0.0%                        |
| 7/2/2015         | 100                    | 0                          | 0.0%                        |
| 7/6/2015         | 100                    | 0                          | 0.0%                        |
| 7/8/2015         | 100                    | 0                          | 0.0%                        |
| 7/12/2015        | 100                    | 0                          | 0.0%                        |
| 7/16/2015        | 100                    | 0                          | 0.0%                        |
| 7/20/2015        | 23                     | 0                          | 0.0%                        |

**Table J-10**

Detailed breakdown of GBT exams and signs of fin GBT at Rock Island Dam in 2015.

| <b>Exam Date</b> | <b>Number Examined</b> | <b>Number with Fin GBT</b> | <b>Percent with Fin GBT</b> |
|------------------|------------------------|----------------------------|-----------------------------|
| 4/17/2015        | 100                    | 0                          | 0.0%                        |
| 4/21/2015        | 100                    | 0                          | 0.0%                        |
| 4/23/2015        | 100                    | 0                          | 0.0%                        |
| 4/29/2015        | 100                    | 0                          | 0.0%                        |
| 5/1/2015         | 100                    | 1                          | 1.0%                        |
| 5/5/2015         | 100                    | 2                          | 2.0%                        |
| 5/7/2015         | 100                    | 0                          | 0.0%                        |
| 5/12/2015        | 100                    | 1                          | 1.0%                        |
| 5/14/2015        | 100                    | 1                          | 1.0%                        |
| 5/19/2015        | 100                    | 0                          | 0.0%                        |
| 5/21/2015        | 100                    | 0                          | 0.0%                        |
| 5/26/2015        | 100                    | 0                          | 0.0%                        |
| 5/28/2015        | 100                    | 1                          | 1.0%                        |
| 6/2/2015         | 100                    | 1                          | 1.0%                        |
| 6/4/2015         | 100                    | 3                          | 3.0%                        |
| 6/9/2015         | 100                    | 0                          | 0.0%                        |
| 6/11/2015        | 100                    | 0                          | 0.0%                        |
| 6/16/2015        | 100                    | 0                          | 0.0%                        |
| 6/18/2015        | 100                    | 0                          | 0.0%                        |
| 6/23/2015        | 100                    | 0                          | 0.0%                        |
| 6/25/2015        | 100                    | 0                          | 0.0%                        |
| 6/30/2015        | 75                     | 0                          | 0.0%                        |
| 7/2/2015         | 75                     | 0                          | 0.0%                        |
| 7/7/2015         | 100                    | 0                          | 0.0%                        |
| 7/9/2015         | 100                    | 0                          | 0.0%                        |
| 7/14/2015        | 100                    | 0                          | 0.0%                        |
| 7/16/2015        | 100                    | 0                          | 0.0%                        |