

Appendix B

2015 - 2018

TDG Monitoring Plan

This page is purposely left blank for duplex printing.

**U.S. ARMY
CORPS OF ENGINEERS**

TDG MONITORING PLAN

2015 - 2018

October 2014

U.S. Army Corps of Engineers TDG Monitoring Plan for 2015-2018

TABLE OF CONTENTS

1.0 INTRODUCTION.....	1
2.0 GENERAL OVERVIEW	1
3.0 CORPS RESPONSIBILITIES	1
4.0 FMS GAUGE MANAGEMENT	2
4.1 FMS Gauge Operation	2
4.2 PUDs and Reclamation TDG Monitoring.....	3
4.3 Repair of Malfunctioning Gauges.....	3
5.0 DATA MANAGEMENT	4
5.1 Data Collected.....	4
5.2 Data Quality Criteria.....	5
5.3 Data Transmission and Distribution	5
6.0 ANNUAL DATA QA/QC EVALUATION REPORT	5
7.0 COOPERATION WITH PARTICIPATING AGENCIES.....	5

LIST OF TABLES

Table 1	2015-2018 TDG Monitoring Network	7
Table 2	List of Contact Persons in 2015-2018	9

LIST OF FIGURES

Figure 1	2015-2018 TDG Monitoring Network	10
----------	--	----

U.S. ARMY CORPS OF ENGINEERS TDG MONITORING PLAN FOR 2015-2018

1.0 INTRODUCTION

This Total Dissolved Gas (TDG) Monitoring Plan (Plan) was prepared by the U.S. Army Corps of Engineers (Corps) as an update to the Plan of Action for Dissolved Gas Monitoring in 2010-2014.¹ This TDG Monitoring Plan summarizes what, how, when, and where to take the measurements, the roles and responsibilities of the Corps and others in TDG monitoring, and identifies channels of communication with other cooperating agencies and interested parties. This includes the Corps, the Chelan, Douglas, and Grant County Public Utility Districts (PUDs), and the U.S. Bureau of Reclamation (Reclamation).

2.0 GENERAL OVERVIEW

The Plan describes the following: Corps' responsibilities; fixed monitoring stations (FMS) gauge management; data management; annual data quality control/quality assurance (QA/QC) evaluation reports; and, cooperation with participating agencies.

3.0 CORPS RESPONSIBILITIES

This TDG monitoring plan describes the following Corps' responsibilities associated with TDG monitoring:

Portland, Seattle, and Walla Walla Districts will perform the activities required to ensure that the TDG monitoring sites are operating accurately, including but not limited to the following tasks:

- Assist in preparation of the TDG Monitoring Plan
- Prepare an annual QA/QC evaluation report which is included as an appendix in the Corps' Annual TDG and Temperature Report
- Procure data collection/transmission instruments
- Prepare and awarding equipment and service contracts
- Perform initial instrument installation and testing
- Install and remove permanent FMS installations
- Evaluate existing FMS to ensure that measured TDG levels are representative of true river conditions
- Collect and transmit TDG data to the Corps' Water Management System (CWMS)
- Review data for early detection of instrument malfunction
- Conduct periodic calibration, service and maintenance calls
- Provide emergency service calls

¹ The National Oceanic and Atmospheric Administration (NOAA) Fisheries Federal Columbia River Power System (FCRPS) Biological Opinion asks for the Corps to implement the TDG monitoring plan (Reasonable and Prudent Alternative Action 32)

- Perform special TDG measurements, as necessary
- Maintain records of instrument calibration and/or adjustments
- Retrieve, servicing, and storing instruments at the end of the season
- Provide raw and revised data to the Division office
- Perform additional monitoring / studies at selected locations on an “as needed/as funded” basis
- Perform data corrections of the data for regionally agreed upon TDG gauges in CWMS.

The Corps’ Reservoir Control Center (RCC) Water Quality Unit will be responsible for the following activities:

- Set up and facilitate an annual post-season TDG monitoring review meeting where the Corps Districts, Reclamation, the PUDs, and related contractors give presentations on how their FMS met the data quality criteria. This post-season TDG monitoring review meeting is held to update the region on TDG monitoring stations performance during the year and identify needed changes and/or improvements.
- Ensure that TDG data is disseminated to outside users which involves maintaining TDG web reports, ensuring that TDG data is coming into the Corps’ CWMS database so that the web reports remain populated, contacting the Districts, the PUDs, and Reclamation when data communication to the database fails, and developing web reports to meet the region’s TDG data needs.
- Perform data correction for regionally agreed upon FMS gauges in CWMS.

4.0 FMS GAUGE MANAGEMENT

This section describes the Corps’ FMS gauge operation, PUDs and Reclamation TDG operations, repair of malfunctioning gauges, and FMS gauge removal and storage.

4.1 FMS Gauge Operation

Gauges to be installed and their assigned locations are listed in Table 1 and shown in Figure 1. All seasonal instruments are scheduled to be in place and connected to their data collection platforms (DCPs) no later than April 1. Some gauges will record year round while others will be seasonal (Table 1). Most, but not all, forebay gauges are operated seasonally from April 1 through August 31 and most, but not all, tailwater gauges operate year-around. The Warrendale gauge will be kept active at least until late May to facilitate monitoring of TDG impacts on chum redds below Bonneville Dam. The seasonal gauges may be installed several weeks before April 1 and remain in operation several weeks after August 31. The Corps Districts will coordinate activation of these FMS with the Corps’ RCC Water Quality Unit.

Corps’ stations that remain in service during the fall-winter season continue their operation with minimum interruption into the spring, following the necessary instrument service, maintenance check-up, and site equipment upgrades (e.g., deployment conduits). These stations include the tailwater monitors at each lower Columbia and lower Snake River project.

An assessment of monitoring site integrity will be conducted; any damages that may have occurred over the fall-winter will be repaired before proceeding on to calibration and testing.

Fall-winter monitoring of TDG will be consistent with what was recommended in the TDG Total Maximum Daily Load (TMDL) for the lower Columbia and the lower Snake rivers.

The FMS instrument must be deployed to the compensation depth; otherwise, the TDG measurements may be overestimated.

4.2 PUDs and Reclamation TDG Monitoring

It is the Corps' understanding that the following entities will continue to operate their FMS monitoring stations in 2015-2018:

- U.S. Bureau of Reclamation: Reclamation will continue to operate FMS monitoring stations below Hungry Horse Dam, at the International Boundary and in the forebay and tailwater of Grand Coulee Dam. Hourly data transmission to the Corps' CWMS database will continue via the GOES satellite.
- Douglas County Public Utility District: Douglas County Public Utility District: Douglas PUD will continue to operate FMS's in the forebay and tailwater of Wells Dam; hourly and year round data from both of these stations will continue to be sent to the Corps' CWMS database. Prior to 2013, TDG data was reported during the juvenile bypass season from April to August seasonally. In 2013 Douglas PUD added a third reporting station at river mile 537.5 (7.5 miles below Chief Joseph Dam) in order to improve bulk flow measurements of incoming TDG. Data for this TDG station is available at <http://douglaspud.org/wells-project/total-dissolved-gas-and-temperature-monitoring>.
- Chelan County Public Utility District: Chelan PUD will continue to operate FMS monitoring stations in the forebay and tailwater of Rocky Reach Dam and Rock Island Dam. Hourly data from these four stations will continue to be posted in the Corps CWMS database.
- Grant County Public Utility District: Grant PUD will continue to operate FMS monitoring stations in the forebay and tailwater of Wanapum and Priest Rapids dams. Hourly data from these four stations will continue to be posted in the Corps' CWMS database.

The PUDs and the Reclamation TDG monitoring programs points of contact are listed on Table 2.

4.3 Repair of Malfunctioning Gauges

4.3.1 USACE FMS Gauges

The Corps will endeavor to have an adequate inventory of spare instruments that will be maintained to ensure that at least one backup monitor is available for deployment as necessary. Instruments needing repairs that are beyond the staff's capability will be shipped to the manufacturer. In-house water quality and information management staff will do repairs of communication network systems. Service and repair of the data collection platforms will be performed by the manufacturer or by a contractor.

In the event that a FMS monitor is expected to be out of service for an extended period of time, the Corps' will use the System Total Dissolved Gas SYSTDG model to provide estimated TDG

levels for the location of the malfunctioning gauge and use that estimation for spill management purposes.

To help reduce response time in determining whether an emergency field visit is needed, the following decision-making procedure was developed through regional discussions:

- High priority will be placed on fixing a faulty instrument when TDG data is used for real-time spill decisions during spill season (April 3 through August 31).

During spill season, if a FMS gauge malfunctions, a repair team will visit the site to perform repairs within 2 days (3 days if weekend and 4 days if a holiday weekend) of the malfunction or District notification during the week of April through August unless the instrument location or high flow conditions create a safety concern. Typically, the repairs will be performed on the next day during the week and on Monday or Tuesday (if Monday is a holiday) if observed over the weekend. A gauge malfunction that occurs during the weekend or holiday may require a longer response time depending upon when the malfunction is detected and the availability of capable technician/equipment. High priority will be placed on fixing a faulty instrument when TDG levels are, or expected to be, in excess of the current state standards.

- No emergency trips are made for the parameter of temperature.
- During September through March, if a non-seasonal FMS gauge malfunctions, a repair team will visit the site within three calendar days (4 days if a holiday weekend) of the time of malfunction or District notification.
- No emergency trips will be made for the Camas-Washougal gauge, since it will no longer be used for real-time TDG management.

4.3.2 Reclamation and PUDs

The PUDs and the Reclamation use the same criteria listed above for determining the frequency of site visits for malfunctioning gauges. At Wells Dam, owned by Douglas County PUD, the tailrace sensor is not serviced when flows are above 275 kcfs due to safety concerns of service personnel. In this case, sensors are serviced as soon as safe conditions return.

5.0 DATA MANAGEMENT

TDG data from the Corps' FMS will be collected and transmitted systematically and without interruption to CWMS. The CWMS database is a data management system incorporating the acquisition, transformation, verification, storage, display, analysis, and dissemination of information using a relational database (ORACLE) to store the data. Other agencies transmit their data into the CWMS database via the Geostationary Operational Environmental Satellite (GOES) system or send the data to the Corps' File Transfer Protocol (FTP) server (café) where it is posted and entered into the CWMS databases.

5.1 Data Collected

Actual data collection and transmission will begin no later than April 1 for the entire monitoring network and will continue through August 31. The exact start date will be coordinated with the

Corps' RCC project biologists and cooperating agencies, based on run-off, spill, and fish migration conditions. The following data will be collected:

- Water temperature
- Barometric pressure
- TDG pressure
- (calculated) depth

Temperature, barometric pressure, and TDG pressure will be collected on a first priority basis since they are used in BiOp spill management. Thermistor strings that monitor temperature at several depths throughout the year and report data hourly have been placed at Dworshak, Lower Granite, Little Goose, Lower Monumental, Ice Harbor, and McNary Reservoir forebays.

5.2 Data Quality Criteria

In 2002, the Corps, in cooperation with the regional Water Quality Team established the following data quality criteria (DQC) for FMS:

1. Two dedicated TDG probes (one installed and one spare being calibrated in the lab).
2. For Corps' TDG gauge probes, rotation and calibration will occur at least once every three weeks during the spill season and monthly during the non-spill season. The frequency of probe rotation and calibration will vary with the different PUDs and other agencies as shown in Table 1.
3. Field check the TDG probes once they are deployed.
4. The data from the FMS is sent to the Corps' CWMS database.
5. There is a goal of 95 percent data completeness. This goal incorporates the requirement to repair a malfunctioning gauge as soon as possible in order to achieve the 95% of all the data, which is understood to be within 2 calendar days during April through August (3 days if weekend and 4 days if a holiday weekend).
6. If a FMS malfunctions, then a site visit is made to fix the gauge.
7. The FMS will be assessed at the end of the monitoring season against these criteria and the Districts will generate a performance QA/QC report that will be included in the annual TDG and Water Temperature Report.
8. Adjustments will be made to the individual FMS that do not perform to the objectives described.

A more detailed description of the probes, lab and field calibration procedures, field checks and other details of the DQC are provided in the District's QA/QC reports which are posted at: http://www.nwd-wc.usace.army.mil/tmt/wqnew/tdg_and_temp/2013/

The PUDs and the Reclamation use the same data quality criteria for FMS with the additional allowance for operator safety during extreme flow conditions. At Wells Dam, probes are recalibrated once a month rather than once every three weeks. In May 2013, a redundant sensor was deployed in the Wells Dam tailrace, which serves as a backup in the event that the primary probe fails.

Chelan PUD calibrates probes once a month during the fish spill season and every other month during the non-fish spill season.

Grant PUD is obligated by its Washington Department of Ecology (WDOE) approved Quality Assurance Project Plan (QAPP; Hendrick 2009²) to calibrate and deploy instrument probes every two weeks during the spill season (April through August) and every three weeks during the non-spill season (September through March).

5.3 Data Transmission and Distribution

Data will be collected and transmitted hourly. FMS data for the Corps' Portland and Walla Walla Districts will also be sent to the U.S. Geological Survey (USGS) internal Automated Data Processing System (ADAPS) databases simultaneously. Data transmission from Chief Joseph, Libby and Albeni Falls Dams will be transmitted via radio to the CWMS database by the Corps' Seattle District.

Daily reports summarizing TDG and related information will be posted on the Technical Management Team's (TMT) home page found at <http://www.nwd-wc.usace.army.mil/tmt/>. Information provided on the TMT homepage includes, but is not limited to, the following data reports:

- High 12-hour average TDG readings
- Water temperature, barometric pressure, TDG pressure
- Calculated percent TDG
- Project hourly spill (in kcfs and percent of total outflow)
- Project total hourly outflow (total river flow)
- Instrument probe depth

6.0 ANNUAL DATA QA/QC EVALUATION REPORT

An annual QA/QC report will be prepared after the end of each spill season to summarize the yearly highlights of the TDG monitoring program. The Corps' QA/QC reports will include a summary of the data quality received from each FMS. Information on the performance of the instruments (including accuracy, precision and bias associated with each parameter) and the nature and extent of instrument failures will be documented. These summaries should include statistics on data confidence limits. The Corps' QA/QC reports will be included as appendices in the Corps' Annual TDG and Temperature Report which is submitted to Oregon Department of Environmental Quality and WDOE as part of the Oregon TDG criteria modification and Washington TDG criteria adjustment conditions.

7.0 COOPERATION WITH PARTICIPATING AGENCIES

The Reclamation, Douglas County PUD, Chelan County PUD, and Grant County PUD currently monitor for TDG at their mainstem projects and have maintained a cooperative effort with the Corps in collecting and reporting TDG and related water quality parameters. This cooperation is

² Hendrick, R. 2009. Quality Assurance Project Plan for Monitoring Selected Water Quality Parameters within the Priest Rapids Hydroelectric Project. Prepared for Public Utility District No. 2 of Grant County, Washington. January, 2009. <http://www.gcpud.org/resources/resLandWater/waterQuality.htm>

expected to continue through the foreseeable future. After the TDG monitoring plan has been coordinated with the region, responsible parties will coordinate the details of implementation of the plan by the end of February each year to ensure a mutual understanding of the most current objectives of the TDG monitoring program.

Table 1: 2015-2018 TDG Monitoring Network

STATION NAME	STATION CODE	OWNER ^{a, b}	DATES OF OPERATION ^c	CALIBRATION FREQUENCY	
				FALL-WINTER	SPRING-SUMMER
Albeni Falls Forebay	ALFI	USACE-NWS	April 1 – August 31	N/A	2 Weeks
Albeni Falls Tailwater	ALQI	USACE-NWS	April 1 – August 31	N/A	2 Weeks
Anatone	ANQW	USACE-NWW	April 1 – August 31	N/A	3 Weeks
Bonneville Forebay	BON	USACE-NWP	April 1 – August 31	N/A	3 Weeks
International Boundary	CIBW	Reclamation	Year Round	Monthly	2 Weeks
Camas-Washougal	CWMW	USACE-NWP	April 1 – August 31	N/A	3 Weeks
Cascades Island	CCIW	USACE-NWP	April 1 – August 31	N/A	3 Weeks
Chief Joseph Forebay	CHJ	USACE-NWS	April 1 – August 31	N/A	2 Weeks
Chief Joseph Tailwater	CHQW	USACE-NWS	April 1 – August 31	N/A	2 Weeks
Dworshak Tailwater	DWQI	USACE-NWW	Year Round	Monthly	3 Weeks
Grand Coulee Forebay	FDRW	Reclamation	Year Round	Monthly	2 Weeks
Grand Coulee Tailwater	GCGW	Reclamation	Year Round	Monthly	2 Weeks
Hungry Horse Tailwater	HGHM	Reclamation	April 1 – August 31	N/A	2 Weeks
Ice Harbor Forebay	IHRA	USACE-NWW	April 1 – August 31	N/A	3 Weeks
Ice Harbor Tailwater	IDSW	USACE-NWW	Year Round	Monthly	3 Weeks
John Day Forebay	JDY	USACE-NWP	April 1 – August 31	N/A	3 Weeks
John Day Tailwater	JHAW	USACE-NWP	Year Round	Monthly	3 Weeks
Lewiston	LEWI	USACE-NWW	April 1 – August 31	N/A	3 Weeks
Libby Tailwater	LBQM	USACE-NWS	April 1 – August 31	N/A	2 Weeks
Little Goose Forebay	LGSA	USACE-NWW	April 1 – August 31	N/A	3 Weeks
Little Goose Tailwater	LGSW	USACE-NWW	Year Round	Monthly	3 Weeks
Lower Granite Forebay	LWG	USACE-NWW	April 1 – August 31	N/A	3 Weeks
Lower Granite Tailwater	LGNW	USACE-NWW	Year Round	Monthly	3 Weeks
Lower Monumental Forebay	LMNA	USACE-NWW	April 1 – August 31	N/A	3 Weeks

STATION NAME	STATION CODE	OWNER ^{a, b}	DATES OF OPERATION ^c	CALIBRATION FREQUENCY	
				FALL-WINTER	SPRING-SUMMER
Lower Monumental Tailwater	LMNW	USACE-NWW	Year Round	Monthly	3 Weeks
McNary Forebay	MCNA	USACE-NWW	April 1 – August 31	N/A	3 Weeks
McNary Tailwater	MCPW	USACE-NWW	Year Round	Monthly	3 Weeks
Pasco	PAQW	USACE-NWW	April 1 – August 31	N/A	3 Weeks
Peck	PEKI	USACE-NWW	April 1 – August 31	N/A	3 Weeks
Priest Rapids Forebay	PRD	Grant County PUD	Year Round	3 Weeks	2 Weeks
Priest Rapids Tailwater	PRXW	Grant County PUD	Year Round	3 Weeks	2 Weeks
Rock Island Forebay	RIS	Chelan County PUD	Year Round	2 Months	Monthly
Rock Island Tailwater	RIGW	Chelan County PUD	Year Round	2 Months	Monthly
Rocky Reach Forebay	RRH	Chelan County PUD	Year Round	2 Months	Monthly
Rocky Reach Tailwater	RRDW	Chelan County PUD	Year Round	2 Months	Monthly
The Dalles Forebay	TDA	USACE-NWP	April 1 – August 31	N/A	3 Weeks
The Dalles Tailwater	TDDO	USACE-NWP	Year Round	Monthly	3 Weeks
Wanapum Forebay	WAN	Grant County PUD	Year Round	3 Weeks	2 Weeks
Wanapum Tailwater	WANW	Grant County PUD	Year Round	3 Weeks	2 Weeks
Warrendale	WRNO	USACE-NWP	Year Round	Monthly	3 Weeks
Wells Forebay	WEL	Douglas County PUD	Year Round	Monthly	Monthly
Wells Tailwater	WELW	Douglas County PUD	Year Round	Monthly	Monthly
Wells Forebay– in Lake Pateros (Washburn Island) RM 537.5	WSBW	Douglas County PUD	Year Round	Monthly	Monthly

a. USACE = U.S. Army Corps of Engineers (NWP = Portland District, NWS = Seattle District, NWW = Walla Walla District)

b. Reclamation = U.S. Bureau of Reclamation

c. The seasonal gauges may go in several weeks before April 1 and remain in operation several weeks after August 31.

Table 2. List of Contact Persons in 2015-2018

Project	Name	Position	Phone #	E-Mail
Internat'l Bndry., Hungry Horse, Grand Coulee	Norbert Cannon	Chemist	(208) 334-1540	ncannon@pn.usbr.gov
	Clyde Lay	Water Quality Regional Coordinator	(208) 685-6926	clay@pn.usbr.gov
	Karl Tarbet	Hydromet Program Manager	(208) 378-5272	ktarbet@pn.usbr.gov
Chief Joseph, Albeni Falls, Libby	Kent Easthouse	Coordinator	(206) 764-6926	kent.b.easthouse@usace.army.mil
	Ross Emry	Meteorological Technician	(206) 390-5574	ross.d.emry@usace.army.mil
	John Lemons	Columbia Basin Environmental Contractor -	(509) 690-7027	johnlemons@centurylink.net
Wells (Douglas County PUD)	Chas Kyger	Coordinator - Backup	(509) 881-2388	chask@dcpud.org
	Andrew Gingerich	Coordinator - Main	(509) 881-2323	andrewg@dcpud.org
Rocky Reach and Rock Island (Chelan County PUD)	Marcie Steinmetz	Coordinator	(509) 661-4186	marcie.steinmetz@chelanpud.org
	Mike Blalock	Data Manager	(509) 669-1732	mikeblalock@chelanpud.org
Priest Rapids and Wanapum (Grant County PUD)	Carson Keeler	Biologist III	(509) 764-5088 ext 2687 (509) 797- 5176 cell	ckeeler@gcpud.org
	Tom Dresser	Manager of Fish, Wildlife, and Water Quality Program	(509) 754-5088 Ext. 2312	tdresse@gcpud.org
Dworshak, Low. Granite, Little Goose, Low. Monumental, Ice Harbor, McNary, Pasco, Anatone	Steve Juul	Coordinator	(509) 527-7281	steve.t.juul@usace.army.mil
	Russ Heaton	Oversight	(509) 527-7282	russ.d.heaton@usace.army.mil
	Kevin Wright	USGS Contractor - Oversight	(509) 527-2571	kswright@usgs.gov
John Day, The Dalles, Bonneville, Warrendale, Skamania, Camas	Tina Lundell	Coordinator	(503) 808-4878	tina.m.lundell@usace.army.mil
	Chauncey Anderson	USGS Contractor - Oversight	(503) 251-3206	chauncey@usgs.gov
	Heather Bragg	USGS Contractor - Oversight	(503) 251-3224	hmbragg@usgs.gov
USACE Northwest Division Program Coordination	Scott English	Coordinator	(503) 808-3938	scott.e.english@usace.army.mil
	Laura Hamilton	Oversight/ Data Manager	(503) 808-3939	laura.j.hamilton@usace.army.mil

Figure 1: 2015-2018 TDG Monitoring Network

