Quality Assurance Project Plan

Spokane River Total Dissolved Gas Total Maximum Daily Load Evaluation

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Total Dissolved Gas
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March 2003

303(d) listings addressed in this study:
Middle and Lower Spokane River Total Dissolved Gas

Waterbody Number: WA-54-1010, WA-54-1020, WA-57-1010

Ecology EIM Number: SPOKTDG1

Approvals

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Background/Problem Statement

Ecology is determining the Total Maximum Daily Load (TMDL) of total dissolved gas (TDG) in the mainstem Spokane River from the Idaho border to its confluence with the Columbia River. The state of Washington has received information that shows that TDG levels exceed state water quality standards in multiple reaches of the Spokane River. The impaired reaches within the state of Washington are likely to be placed on Ecology's 2002 303(d) list. In addition, a TDG TMDL is being developed for Lake Roosevelt, and pollutant allocations are likely to be assigned to the Spokane River.

Because TDG levels have been observed above the water quality standards criterion of 110% of saturation at multiple locations in the river, and because the available information does not show TDG being reduced below the criterion between the monitoring points, the entire Spokane River below Post Falls Dam in Idaho must be considered impaired for TDG (Figure 1). Portions of the Spokane River are waters of the Spokane Tribe of Indians and of the state of Idaho. The state of Washington will issue this TMDL for waters of the state and submitting it to the U.S. Environmental Protection Agency (EPA) for its approval. Idaho will be responsible for its portion of the river. EPA will issue the TMDL for Tribal waters and will coordinate among Washington, Idaho, and the Spokane Tribe.

Elevated TDG levels are usually caused by spill events at the hydroelectric projects on the river. Water pouring over the spillway of a dam and plunging into tailrace waters entrains air bubbles. When these are carried to depth in the dam's stilling basin, the higher hydrostatic pressure forces air from the bubbles into solution. The result is water supersaturated with dissolved nitrogen, oxygen, and the other constituents of air. As the bubbles rise in the aerated zone of the tailrace, some of the gas leaves solution. However, as the bubbles dissipate and the water enters the downstream reach, the remaining TDG will remain unless wind- or channel-induced turbulence causes more degassing.

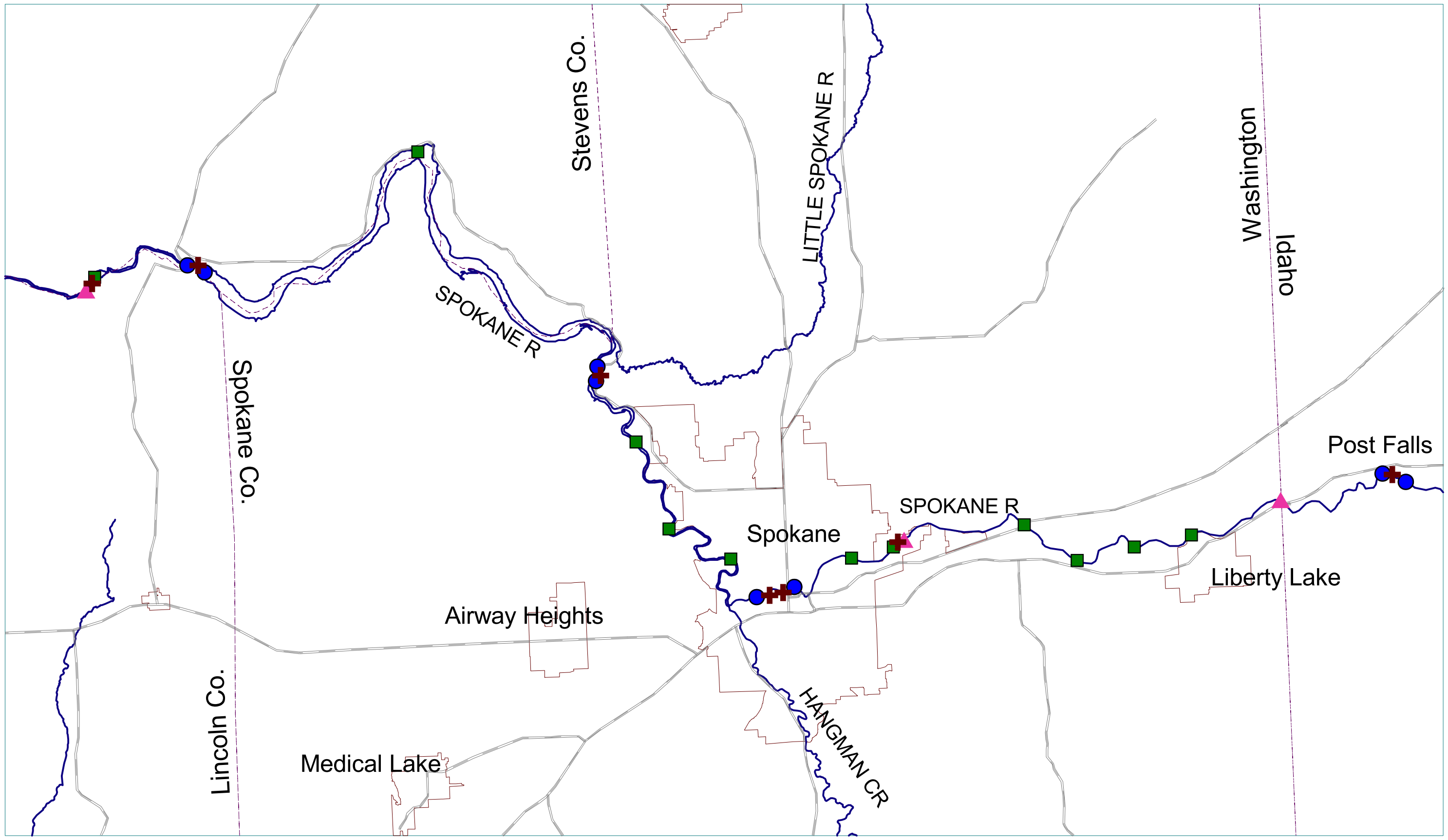
Water that passes the dam through the powerhouse usually has the same TDG as upstream. However, at some dams under certain conditions, TDG can be elevated if air is present in the turbines. It is not clear if this occurs at hydropower turbines on the Spokane River. Analysis of the TDG data from the river shows a strong relationship to spills; therefore, spills are clearly the principal cause of high TDG.

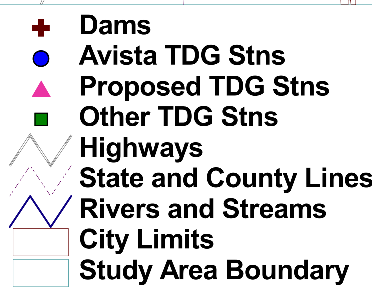
TDG may also be affected by natural phenomena:

- High biological primary productivity can raise TDG by raising dissolved oxygen. This may be occurring in Lake Coeur D'Alene and Long Lake (Lake Spokane).

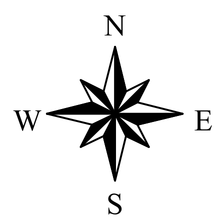
- For a constant TDG loading level, the percent saturation of TDG can rise if atmospheric barometric pressure drops or if the water temperature increases. These effects are generally stronger when travel time is slower.

- Natural waterfalls and cascades can either increase or decrease gas levels. In general, plunging waterfalls generate gas while cascades passing over rock surfaces can cause degassing. Several of the hydroelectric projects are built on existing waterfalls, which may be affecting TDG in the system: Post Falls, Upper and Lower Spokane Falls, and Little Falls.





Spokane River TDG TMDL Study Area



Fish in water with high TDG levels may not display signs of difficulty if higher water pressures at depth offset high TDG pressure passing through the gills into the blood stream. However, if the fish inhabit supersaturated water for extended periods, or rise in the water column to a lower water pressure at shallower depths, TDG may come out of solution within the fish, forming bubbles in their body tissues. This gives rise to gas bubble trauma (GBT).

Spills can occur at any time when flow exceeds powerhouse capacity ("involuntary" spills). There are three main reasons for involuntary spills:

- The powerhouse can't pass flood flows.
- The powerhouse is off-line due to lack of power demand.
- The powerhouse is off-line for maintenance or repair.

There are 7 hydroelectric projects in the TMDL area (Figure 1):

- Post Falls Dam (Avista, in Idaho).
- Upriver Dam (City of Spokane, in Washington).
- Upper Falls Project (Avista, in Washington).
- Monroe Street Project (Avista, in Washington).
- Nine Mile Dam (Avista, in Washington).
- Long Lake Dam (Avista, in Washington.
- Little Falls Dam (Avista, half Washington/half Spokane Reservation).

With the exception of Long Lake and Post Falls Dams, dams on the Spokane River are run-of-the-river dams with very little active storage capacity. Spills that generate high TDG levels occur most often during the spring months (March through June) when spring snowmelt raises flows above the capacity of hydroelectric plants. Avista Corporation, which operates the farthest upstream dam at Post Falls, reports that during spring runoff the dam is fully opened and conditions resemble the natural waterfall on which the dam was constructed.

All dams except Little Falls and Upriver are covered by a single Federal Energy Regulatory Commission license. Avista has applied for renewal of this license and is currently in the midst of the relicensing process, which includes a Section 401 certification from Ecology.

The proposed TMDL will need to address the cumulative effects of hydroelectric projects and natural phenomena. To determine loading capacity, pollutant allocations, and evaluate implementation for the TMDL, a combination of monitoring and modeling will be necessary.

Three years of TDG monitoring has been conducted by Avista at Post Falls, Long Lake, and Little Falls Dams (Avista, 2000; 2001; 2002), and more is planned for Spring 2003. Ecology is planning to complement Avista's monitoring with additional monitoring to fill potential data gaps.

A detailed CE-QUAL-W2 model has been developed for the Spokane River to develop a TMDL for dissolved oxygen (Berger et al., 2002). Gas exchange equations have been included in the model, but have not been assessed for the purposes of a TDG TMDL.

The only other TDG TMDL that Ecology has issued to date is the Lower Columbia TDG TMDL (Pickett and Harding, 2002). Some spreadsheet-based modeling approaches used in this TMDL may be applicable to the Spokane River.

Project Description

The overall goal of the project is to set TMDLs by evaluating the effects of dam spills on TDG in the river. Due to extensive monitoring of TDG by Avista, the TMDLs will be developed almost entirely from existing and on-going data and analysis. Avista is planning monitoring during the spring runoff season at several of its Spokane River projects: above and below Long Lake Dam, above and below Nine Mile Dam, below Lower Falls, above Upper Falls, and above and below Post Falls Dam (shown with circles in Figure 1). Detailed monitoring studies of TDG downstream of the dams' spillways may also be conducted at Long Lake dam.

However, with respect to the development of the TMDL, a few data gaps exist. One dam on the Spokane River, Upriver Dam, is owned and operated by the city of Spokane, which has no plans to conduct independent monitoring of TDG this season. This leaves a gap between Post Falls and the Upper Falls project, a distance of over 26 miles. The main objective of this monitoring is to fill this gap with TDG data collected from a fixed platform at one or two locations. A secondary objective of this monitoring is to provide TDG data for comparison to Avista measurements.

Modeling of the system may include spreadsheet-based analysis of barometric pressure, wind, and water temperature data, similar to the Lower Columbia River TDG TMDL. Also, the existing CE-QUAL-W2 model will be evaluated for its applicability to this TMDL. Since a full-scale data collection for the model is not planned, sufficient input data may not be available. Also, modification of the model to address TDG may be sufficiently resource-intensive to preclude us of the model, especially when a simpler approach may suffice. Available data and resources will be evaluated against the CE-QUAL-W2 model development needs; and, if these needs are feasible and reasonable, this model will be used for TMDL development.

Responsibilities

- *Paul Pickett*. Project Manager and Principal Investigator. Responsible for overall project management, preparation of Quality Assurance Project Plan (QA Project Plan), supervision and completion of field sampling, analysis of project data, modeling, and overall preparation of technical content of draft and final reports.

- *Jim Ross*. Environmental Assesment Program, Eastern Region. Responsible for the calibration, deployment, maintenance, and retrieval of monitoring equipment, as well as for technical assistance with regard to on-site issues.

- *Will Kendra, Karol Erickson, and Rob Plotnikoff.* Supervisors of the Watershed Ecology Section, Water Quality Studies Unit, and Freshwater Monitoring Unit, respectively, of the Environmental Assessment Program. Responsible for review and approval of the QA Project Plan and draft final report.

- *Cliff Kirchmer and Stew Lombard*. Responsible for technical assistance on Quality Assurance, including review and approval of the QA Project Plan.

- *Jim Bellatty, Nancy Weller, Jean Parodi, and Ken Merrill.* Section manager, Watershed Unit Supervisor, Hydropower Water Quality Specialist (and lead client contact), and Spokane Watershed TMDL Coordinator, respectively, for the Eastern Region Section of Ecology's Water Quality Program. Responsible for review and approval of the draft QA Project Plan and draft final report.

Schedule

TDG monitoring will be targeting the spring and early summer season, since this is the period of maximum flows from spring runoff. Three years of data from Avista were analyzed to determine the target season for high TDG levels. TDG was plotted against flow, and the minimum flow producing TDG over the criterion was determined. During April and May, flows are high enough to trigger TDG levels over 110% at least 80% of the time, while flows in March and June can produce TDG over 110% at least 50% of the time. Therefore, the monitoring period will be March through June. Projections by Avista are anticipating maximum flows in April and May. However, climatic conditions this year suggest an early runoff is likely, so it will be important to begin monitoring in March. Monitoring will end either at the end of June or when an analysis of basin hydrology indicates that the spring season runoff is complete.

Monitoring data will also be reported in a technical memorandum to the project client and EA Program files, developed in accordance with program report review guidelines. Digital archiving of data in the EIM database will be in accordance with EA Program guidelines. Monitoring data, modeling results, and the results of other analyses will be presented in the TMDL submittal reports. The schedule for the data and TMDL submittal reports is shown in Table 1.

Table 1. Project Milestones

Report	Milestone	Due Date
Data Technical Memorandum		
	Internal Draft to Supervisor	September 2003
	Internal Draft to Client	October 2003
	External Draft to Stakeholders	November 2003
	Report Published	January 2004
	EIM Data Entry	January 2004
TMDL Submittal Report		
	Internal Draft to Supervisor	February 2004
	Internal Draft to Client	March 2004
	External Draft to Stakeholders	April 2004
	Final Draft to Formal Public Comment	June 2004
	Report Submitted to EPA	October 2004

Data Quality Objectives and Decision Criteria

TDG meters, like other field monitoring equipment, are subject to bias due to systematic errors introduced by calibration, equipment hardware or software functioning, or field methods. Bias will be minimized by following standard protocols for calibration and maintenance, and by following field protocols for stabilization of meter readings. Bias is difficult to assess for TDG field measurements, because a more accurate verification method, such as a laboratory standard, is not available. No Data Quality Objectives (DQOs) are being set for bias.

The precision of the results from continuous monitoring instruments cannot be estimated from replicate measurements. In this study, the potential variability of TDG results may be indicated by agreement among the simultaneous results from two or more instruments, either during calibration or in the field. Most TDG measurements are expected to fall into the range of 100% to 140% saturation. State criteria are currently set at 110% saturation. Measurement Quality Objectives (MQOs) are equivelant to DQOs for this study, equal to 1% saturation. This is similar to MQOs reported by the U.S. Geological Survey (USGS) for the fixed monitoring system in the lower Columbia (Tanner and Bragg, 2001). MQOs will be met if TDG meter readings are within 1 percent saturation or 5 mm Hg of the expected value based on comparison to calibration values (pressurized chamber) or duplicate measurements (paired readings of Ecology meters). MQOs will also be evaluated for any paired readings of the Avista and Ecology meters. If MQOs are not met for Avista-Ecology pairs, the differences will be evaluated but the data will not be qualified or discarded unless other information indicates problems with the data.

TDG percent saturation measurements are dependent upon barometric pressure (BP) readings, so MQOs are also necessary for the on-site BP measurement method used. The target for this study will be an MQO of 1 mm Hg for the field barometer readings or BP estimation method. The BP MQO will be evaluated by paired readings with a field barometer, Hydrolab pressure sensor with the TDG membrane removed, or estimates calculated from nearby airport readings.

Water quality data will also be collected for temperature, dissolved oxygen, pH, and conductivity. Since these are parameters of secondary importance to the study, DQOs have not been established, but MQOs will be set to determine if data are acceptable for reporting. The MQO for water quality data will be met, and data will be reported, if post-calibration shows that the temperature is within 0.5 ^{o}C, pH is within 0.5 standard units, DO is within 0.5 mg/L, and conductivity is with 5% or 5 microSiemens/centimeter (µS/cm). MQOs will be assessed using standards or paired readings.

Table 2. Study MQOs

Parameter	Measurement Quality Objective
Total Dissolved Gas Saturation	1% or 5 mm Hg
Temperature	0.5 ^{o}C
pH	0.5 standard units
Dissolved Oxygen	0.5 mg/L
Conductivity	5% or 5 µS/cm
Barometric Pressure (Field)	1 mm Hg

DQOs are not being specified for existing data or for modeling results. However, the following acceptance criteria will be applied:

- *Data Reasonableness.* Quality of existing data will be evaluated where available. Sources within well-established programs will be acceptable based on the credibility of the source (such as National Weather Service or U.S. Geological Survey data). Data will be reviewed for whether the amount of variability is appropriate, based on statistical measures, expected values, and comparison between data sets. Data with too much or too little variability will not be used.

- *Data Completeness*. Data sets will be used that are reasonably complete during the period of interest. Incomplete data sets will be used if they are considered representative of conditions during the period of interest.

- *Data Representativeness*. Data will be used that are representative of the location or time period under consideration. For example, attention will be paid to the variations in meteorological condtions throughout the TMDL study area and to seasonal differences between high and low flow conditions.

- *Model Calibration and Verification.* The primary measure of calibration and verification success will be by comparing observed versus modeled TDG percent saturation. Bias will be measured by the average residual of paired values (observed-modeled), and precision by the root mean square error of paired values. The goal of this study will be a bias of less than 0.1% saturation and precision of less than 1% saturation. A greater precision and bias will be acceptable if the model successfully predicts the average days per year that the river exceeds the water quality criterion, and visual inspection of the time series shows good matching of the patterns of TDG.

Study Design and Field Procedures

Ecology currently has two Hydrolab® Datasonde® 4 meters with TDG sensors. These meters can be deployed for extended periods while measuring and storing data internally. Similar meters are measuring TDG throughout the Columbia and Snake River Basins with good success. Generally they are deployed for two-week to one-month periods between download and recalibration.

For monitoring in the Spokane River, one or two deployment sites will be identified that are optimal for monitoring both logistically and for representativeness. The following sites have been identified as possible priority locations (shown with triangles in Figure 1):

- Immediately upstream of Upriver Dam.
- Sullivan Road, Harvard Road, or State Line.
- Downstream of Little Falls Dam.

Avista's plans for monitoring have not been finalized, but the city of Spokane's role in monitoring appears to be limited. Therefore, one station will be upstream of Upriver Dam, while the exact location of the second will be determined when Avista's plans are firmed up.

At each site, a location will be determined that ideally would meet the following criteria:

- A PVC tube can be mounted that would allow the meter to be lowered in the tube to a depth of at least 5 meters during baseflow.
- The tube is protected from floating river debris.
- The tube is easily accessed without a boat; for example, from a dam, boat, or dock.
- The site can be secured from vandalism.

Field staff will mount, monitor, and maintain the tube. The meters will be deployed in the tubes and at two week intervals the meters will be returned to the lab, the data downloaded, and the meters recalibrated and redeployed. After calibration, prior to each deployment, and after retrieval prior to post-calibration, the meters will be taken to an Avista monitoring site for side-by-side readings.

One or two synoptic surveys may be conducted of the Spokane River from the state line to below Little Falls Dam. Each survey would begin at the upstream end and proceed down the river over the course of one day. Monitoring locations would be from bridges and in the forebay and tailrace of hydropower projects where access is available. (Potential survey sites are shown with squares in Figure 1.) Survey dates would be during peak spring freshet flows when spills are most likely. These surveys are optional and will be conducted if logistics and timing can be worked out.

Barometric pressure data is equally critical to determining TDG percent saturation. BP can either be determined by direct measurement with a datalogging barometer or be calculated from neighboring meteorlogical data sites. The latter method is preferred due to cost. Felts Field is directly adjacent to Upriver Dam, and additional sites (Spokane Airport and Couer D'Alene) offer reasonable interpolations. To ensure data quality, the calculation method was checked with field spot measurements with a hand-held barometer. Felts Field readings correlated to field readings with r^2 values of 0.988 and greater. Calculating local BP using a correlation from Felts Field BP readings should be adequate to meet BP MQOs. Calculated values will be checked with readings from an aneroid barometer and the Hydrolab pressure sensor without the TDG membrane.

Data acquisition from a variety of existing sources will be necessary for the TMDL analysis. Data for TDG levels from Avista monitoring sites and spill release volumes at the dams will be obtained after the surveys from appropriate staff. Meterologic and flow data are generally available from the source agencies on the Internet.

Data will be analyzed to evaluate a number of relevant parameters in the TMDL study area during the TMDL season:

- Critical low barometric pressures.
- Wind and its effect on gas exchange.
- Water temperature increases and their effect on TDG levels.
- TDG generation by each project.

Data for these analyses will be available from either Ecology surveys, National Weather Service sources, or Avista.

TMDL development will follow standard TMDL protocols and will follow an approach similar to the Lower Columbia River TDG TMDL.

Laboratory Procedures

No laboratory work is planned.

Quality Control Procedures

Field Quality Control

Meters will be calibrated for TDG before every deployment and post-calibrated after each deployment in Ecology's Eastern Regional Office laboratory. A lab sheet has been developed for TDG calibration and post-calibration of the meters (Appendix A). TDG calibration and post-calibration procedures will follow Standard Method SM 2810B (APHA *et al*, 1995), manufacturer's instructions, and USGS protocols for TDG (Tanner and Johnston, 2001).

Water quality parameters other than TDG will be calibrated before each deployment if pre- or post-calibration show MQOs are not being met. Pre- and post-calibration for temperature, pH, and conductivity will consist either of paired meter readings in a water bath or comparison to a standard. Pre- and post-calibration for DO will consist either of paired meter readings in an air-saturated water bath or air calibration. Calibration for pH, conductivity, and DO (temperature is factory calibrated) will follow manufacturer's instructions and Ecology standard protocols (WDOE, 1992).

Meters will be checked for proper performance at the deployment site at the beginning and end of each deployment. After calibration and prior to each deployment, meters will be placed side by side near one of the Avista meters and readings reviewed to ensure they are meeting MQOs. A significant descrepancy between readings will result in a review of meter performance. A field data sheet has been developed to check performance in the field (Appendix B).

Data Review, Quality Assessment, and Validation

Data Review and Validation

Data will be downloaded from the meters to a spreadsheet and reviewed for outliers and values exceeding MQOs. Outliers and data that exceed the MQOs will be evaluated for the cause of the problem. Slight exceedances will be tolerated, with the data qualified and the poorer precision taken into account in data analysis. Exceedances that can be traced to membrane or other equipment failure will result in rejection of the data.

Data completeness will be adequate if monitoring is completed with data meeting the MQOs at least 85% of the time (equivalent to about 1 day per week of lost data). A lower rate of data completeness will be acceptable; all data meeting MQOs will be used.

The results of modeling and other analyses will be evaluated for compliance with acceptance criteria. Any shortcomings in the analyses will be taken into account in the development of a margin of safety for the TMDL. Every effort will be made to complete the TMDL with data collected by this study and existing data. However, if the quality of data or analytical results is sufficiently poor and the margin of safety unreasonably high, completion of the TMDL may be postponed while addional data is collected and analyses conducted.

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Appendices

Appendix A

Hydrolab TDG Calibration Procedures (To be Done Prior to Survey)

Hyrolab #_______________ Lab barometer ID ____________
TDG sensor #____________ Date barometer last calib. ____________
Survey location ________ Today's date ____________
Survey Date __________ Checked by ____________

1. Calibrate Tdg With Digital Pressure Gauge (Membrane Off).

Lab BP _________ mm Hydrolab ambient pressure _________ mm Time ___________
Baro+100mm: expected/measured _________ /_________
Baro+200mm: expected/ measured _________ /_________
Baro+300mm: expected/ measured _________ /_________

If any readings are >2 mm off, do a 2-point calibration at BP and BP+200 mm and note below.
Calibration BP: calibrated/measured _________ /_________
BP+200mm: calibrated/ measured _________ /_________

2. Install Dry Membrane And Test Hydrolab With Pressure Gage And Chamber.

Lab BP + 200mm = ______ mm
Before applying 200 mm pressure Hydrolab Pressure _________ mm Time ________
After applying pressure Hydrolab Pressure _________ mm Time ________

3. Install Sensor Guard And Test Hydrolab With Club Soda.

Before soda test Hydrolab Pressure _________ mm Time ________
High pressure, soda test Hydrolab Pressure _________ mm Time ________
Low pressure, after soda test Hydrolab Pressure _________ mm Time ________

4. Check Membrane For Internal Moisture After The Outside Has Had Time To Dry

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Hydrolab TDG Post-Calibration Procedures (To be Done at Conclusion of a Survey)

Today's date ____________ Checked by ____________

1. Test Low Calibration With Membrane Attached.

Lab BP __________ mm Hydrolab Pressure _________ mm Time ________

2. Test Hydrolab With Digital Pressure Gage And Pressure Chamber.

Lab BP + 200mm = ______ mm
Before applying 200 mm pressure Hydrolab Pressure _________ mm Time ________
After applying pressure Hydrolab Pressure _________ mm Time ________

3. Test Hydrolab With Club Soda.

Before soda test Hydrolab Pressure _________ mm Time ________
High pressure, soda test Hydrolab Pressure _________ mm Time ________
Low pressure, after soda test Hydrolab Pressure _________ mm Time ________

(If the unit does not perform well on #1-3 above, re-evaluate the corresponding site record.)

Remove TDG membrane, clean the membrane, air dry, store with dessicator.
Allow TDG sensor to air dry for at least 24 hours.

Appendix B

Hydrolab TDG Field Inspection/Calibration Sheet

Deployment Procedures
Project: ____________ Date: ____________ Personnel: _____________________________________
Weather: _________________________________ Air temperature: _______ °C
Observed river conditions (flow, spill, etc.): ____
Barometer ID _____________ Date last cal.___________

1. Take readings with both meters at Avista site. Site description:_______________________________
Start time:_________ Bar Press:_____________
DS 15: Depth:___m; TDG:___mmHg; DO:___mg/L; pH:____; Cond:___uS/cm; Temp:____; Time:____
DS 16: Depth:___m; TDG:___mmHg; DO:___mg/L; pH:____; Cond:___uS/cm; Temp:____; Time:____

2. After a minimum of 15 minutes, if both Hydrolab readings have not changed 1 mm./2 min, or if meters are changing but difference is constant:
____________ mm (DS#____) - _____________ mm (DS#____) = ____________ mm Time: _________
IF Difference is > 10 mm, do A and B
A. Test both Datasondes with club soda:
DS#____ ; TDG:____________ mm Time: _________
DS#____; TDG:____________ mm Time: _________
B. Test both Datasondes with pressure gage and chamber:
DS#____: ambient____________ mm; plus 200mm___________ mm Time: _________
DS#____: ambient____________ mm; plus 200mm___________ mm Time: _________
IF DATASONDE FAILS EITHER TEST, REPLACE MEMBRANE AND RETEST, OR DO NOT USE.

3. Depart Avista site. End time:___________ Bar Press:____________

4. Take reading at 1st deployment site. Location: _____________; Start time:______; Bar Press:__________
DS#:____; Depth:___m; TDG:___mmHg; DO:___mg/L; pH:____; Cond:___uS/cm; Temp:____; Time:____
Calculate minimum sensor compensation depth (MSCD) (Meter PT_____ - Field BP____) / 75 = _____m
Deployment time:___________ Bar Press:____________

5. Take reading at 2nd deployment site. Location: _____________; Start time:______; Bar Press:__________
DS#:____; Depth:___m; TDG:___mmHg; DO:___mg/L; pH:____; Cond:___uS/cm; Temp:____; Time:____
Calculate minimum sensor compensation depth (MSCD) (Meter PT_____ - Field BP____) / 75 = _____m
Deployment time:___________ Bar Press:____________

Retrieval Procedures
Project: ____________ Date: ____________ Personnel: _____________________________________
Weather: _________________________________ Air temperature: _______ °C
Observed river conditions: ____
Barometer ID _____________ Date last cal.___________

6. Take reading at 1st deployment site. Location: _____________; Start time:______; Bar Press:__________
DS#:____; Depth:___m; TDG:___mmHg; DO:___mg/L; pH:____; Cond:___uS/cm; Temp:____; Time:____
Calculate minimum sensor compensation depth (MSCD) (Meter PT_____ - Field BP____) / 75 = _____m
Retrieval time:___________ Bar Press:____________

7. Take reading at 2nd deployment site. Location: _____________; Start time:______; Bar Press:__________
DS#:____; Depth:___m; TDG:___mmHg; DO:___mg/L; pH:____; Cond:___uS/cm; Temp:____; Time:____
Calculate minimum sensor compensation depth (MSCD) (Meter PT_____ - Field BP____) / 75 = _____m
Retrieval time:___________ Bar Press:____________

8. Take readings with both meters at Avista site. Site description:_______________________________
Start time:_________ Bar Press:_____________
DS 15: Depth:___m; TDG:___mmHg; DO:___mg/L; pH:____; Cond:___uS/cm; Temp:____; Time:____
DS 16: Depth:___m; TDG:___mmHg; DO:___mg/L; pH:____; Cond:___uS/cm; Temp:____; Time:____