


Quality Assurance Project Plan Addendum 2

Spokane River Toxics Reduction Strategy Study

Prepared for:
Spokane River Regional Toxics Task Force

DRAFT

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APPROVALS

Quality Assurance Project Plan – Addendum 2

February 20, 2016

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Abstract

This Addendum to the Quality Assurance Project Plan (QAPP) corresponds to a continuation in 2016 of the work described in the original QAPP for 2014 and the 2015 QAPP Addendum 1. The objective of the 2016 Monthly Water Quality Monitoring is to determine the seasonal variability in PCB concentrations in the Spokane River, providing information at higher flow conditions than were monitored in prior Spokane River Regional Toxics Task Force synoptic sampling. The field monitoring program will consist of up to six monthly sampling events beginning in March 2016.

The 2014 QAPP, 2015 QAPP Addendum 1 and Sampling and Analysis Plan (SAP) (approved by Ecology and SRRTTF) are still applicable. The revisions contained in this Addendum consist of:

- Sampling on a monthly schedule at a reduced number of stations.

Introduction

The Spokane River Regional Toxics Task Force (SRRTTF) is developing a comprehensive plan to reduce toxic pollutants in the Spokane River, specifically polychlorinated biphenyls (PCBs). The comprehensive plan will be designed to identify specific management actions that can be undertaken to control pollutant loads such that water quality objectives can ultimately be attained. Comprehensive plans of this type require data capable of describing individual sources and site-specific processes that drive resulting concentrations. LimnoTech (2014a) described the overall data collection strategy for a first year of monitoring, based on the work conducted to identify key gaps in the existing data set and issues addressed at a December 2013 monitoring workshop.

A Synoptic Survey was conducted in 2014 to identify potentially significant dry weather sources of PCBs to the Spokane River between Lake Coeur d'Alene and Nine Mile Dam. The results of this study showed the strong likelihood of a groundwater PCB source between Barker Road and the Trent Avenue Bridge, and the potential of an additional groundwater PCB source between the Trent Avenue Bridge and the Spokane USGS gage (LimnoTech, 2015). The SRRTTF Technical Track Work Group recommended, and the Task Force as a whole approved (SRRTTF, 2015a, 2015b), conducting a 2015 Synoptic Survey to confirm the findings of the 2014 Synoptic Survey over a narrower spatial scope. This work was conducted in August 2015 in accordance with the 2015 QAPP Addendum 1.

This QAPP Addendum 2 has been prepared to provide the revised sampling plan and to document the procedural and analytical requirements for the 2016 Monthly Water Quality Monitoring to take place beginning in March 2016. The Quality Assurance/Quality Control procedures outlined in the 2014 QAPP (LimnoTech, 2014b) will be followed for this sampling work.

Project Organization

Each of the organizations included in the project team has established an organizational structure for providing technical direction and administrative control to accomplish quality-related activities for the development of the project.

Key project personnel and their corresponding responsibilities are listed in Table 1 below and shown in Figure 1.

Table 1. Project Team Responsibilities

Name/Affiliation	Project Title/Responsibility
SRRTTF	**Oversight and direction** Secure funding for project activities Review and utilize project results Facilitate communications and provide public access to information Develop recommendations for controlling and reducing sources Develop comprehensive plan
Bud Leber – SRRTTF-ACE	**SRRTTF ACE President** Manage contracts: review and approve project specifications Ensure project is completed in timely manner Receive deliverables and reports Manage data on behalf of SRRTTF Communicate with SRRTTF Communicate quality assurance issues with SRRTTF Ensure access to project information on the SRRTTF website Facilitate upload of data to EIM
David Dilks - LimnoTech	**Project Manager** General oversight Review/approval of all work products prior to delivery to SRRTTF-ACE Ensures that work is done in accordance with QAPP and SAP Reviews project with Laboratory Operations Directors prior to sampling Provides oversight of field activities (variances, documentation, QA/QC) Arranges for system audits
Jim Bellatty, Adriane Borgias – Department of Ecology	**Advisor** Reviews/approves QAPP
Robert Steed – Idaho DEQ	**Advisor** Reviews/approves QAPP
Cathy Whiting - LimnoTech	**Field Manager: Synoptic Survey and Quarterly sampling events** Direct all field activities, ensure samples handled in accordance with SAP Data screening, evaluation, validation, and usability determination Manage field variances, nonconformance, and corrective actions Manage reports, documentation, Project QA/QC file, and electronic data Communicates project specifics with Project Manager
Carrie Turner/Bob Betz - LimnoTech	**Project Quality Assurance Officer** Performs systematic evaluation of data quality Receives notices, initiates investigation, and documents nonconformance with DQOs Manage the Project QA/QC file
LimnoTech	**Independent Auditor** Perform a critical, written evaluation of the work product Conducts audits at the direction of the Project Manager
Shea Hewage – AXYS Analytical Services	**Laboratory Operations Director** Sample analysis Serves as main point of contact for laboratory Manages laboratory Quality Assurance systems Final review and validation of data and field systems Initiates corrective actions for nonconformance Communicates with Project Manager and SRRTTF-ACE
Richard Grace – AXYS	**Laboratory Project Director** Oversight of all laboratory commercial and technical project specifications
Sean Campbell – AXYS Analytical Services	**Laboratory Project Manager** Serves as main point of contact for laboratory Assists Laboratory Operations Director with management of laboratory QA systems Communicates with Project Manager

Name/Affiliation	Project Title/Responsibility
Dale Hoover-AXYS Analytical Services	**Laboratory QA/QC Managers** Manages Laboratory QA/QC activities Reviews and verifies field records, laboratory records and laboratory data Addresses nonconformance and carries out corrective actions at the laboratory.
John Kern – SVL Analytical, Inc.	**Technical Director** Sample analysis Serves as main point of contact for laboratory Manages laboratory Quality Assurance systems Final review and validation of data and field systems Initiates corrective actions for nonconformance Communicates with Project Managers and SRRTTF-ACE
Michael Desmarais– SVL Analytical, Inc.	**Laboratory QA/QC Manager** Manages Laboratory QA/QC activities Reviews and verifies field records, laboratory records and laboratory data Addresses non-conformances and carries out corrective actions at the laboratory.
Christine Meyer – SVL Analytical, Inc.	**Laboratory Project Manager** Serves as main point of contact for laboratory Assists Laboratory Operations Director with management of laboratory QA systems
Shawn Hinz – Gravity Environmental	**Conducts Sample Collection** Collects samples in accordance with QAPP and SAP Prepares and follows the Invasive Species Plan Prepares and administers Health and Safety Plan for employees Maintains equipment logs, field records and data sheets Transfers field data to Field Manager Manages field equipment, conducts calibrations Addresses nonconformance findings and responds to corrective actions

The lines of reporting for the organizations in the project are shown in the organization chart (Figure 1). Each team member has responsibility for performance of assigned quality control duties in the course of accomplishing identified activities. The quality control duties include:

- Completing the assigned task on or before schedule and in a quality manner in accordance with established procedures; and
- Ascertaining that the work performed is technically correct and meets all aspects of the QAPP.

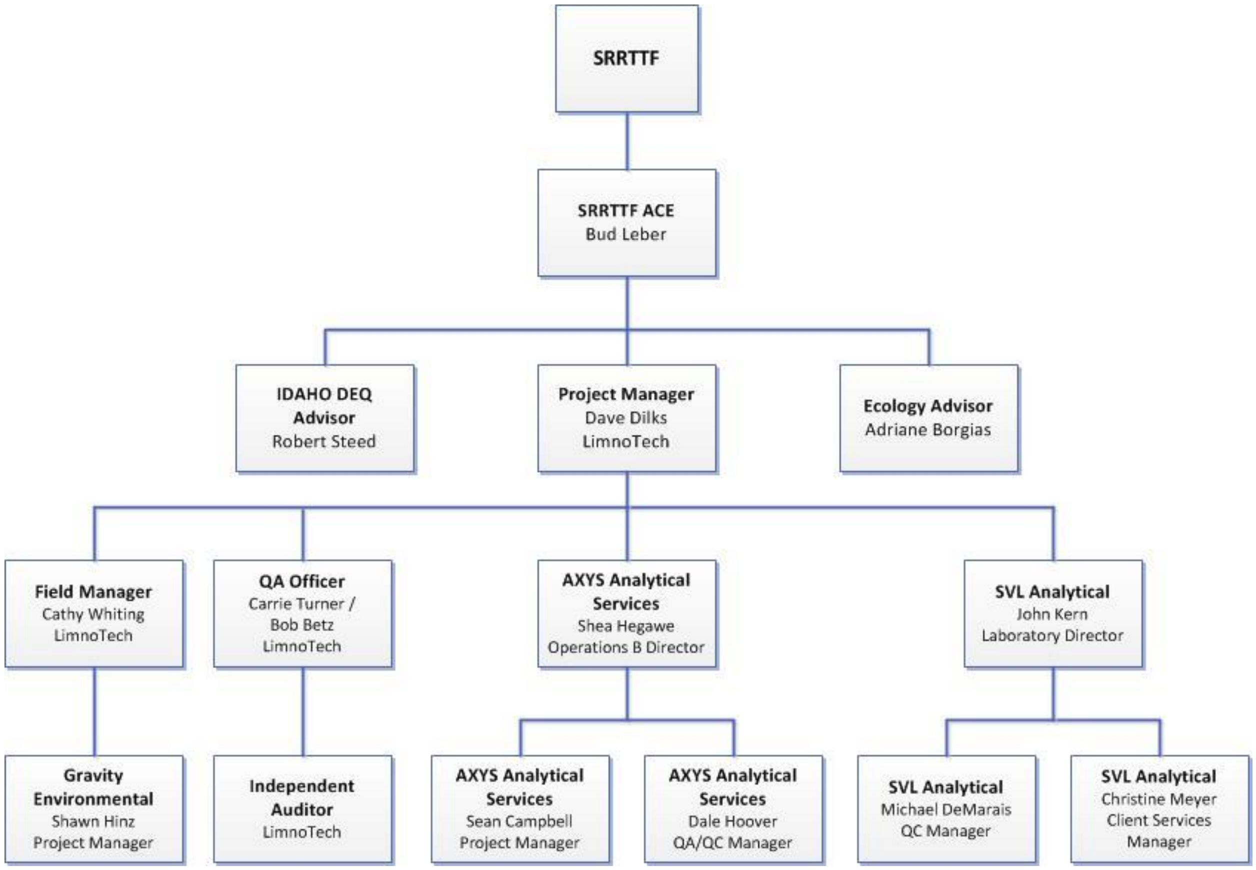

Figure 1. Project Team Organization

Budget

The total budget for this project is $206,500. This includes PCB analysis by AXYS Analytical Services, conventional parameter analyses by SVL Analytical, field sampling by Gravity Environmental, and coordination and data analysis by LimnoTech.

Background

The Spokane River watershed has existing PCB monitoring data, which provide an estimate of the amount of PCBs entering the Spokane River from contributing source area categories (e.g. stormwater, WWTPs). Based on the Spokane River PCB Source Assessment 2004-2007 (Serdar et al, 2011), only 43% of the PCB source loading to the river between Stateline (RM 96.1) and Long Lake Dam (RM 33.9) could be identified. This is due in part to the uncertainty of the analyses and the high variability in the data. The existing data indicate that sources of PCBs are very diffuse throughout the watershed, such that more data will be needed to support development of a management plan with targeted control actions (LimnoTech, 2013). Two studies were conducted in 2014, the Confidence Interval Testing and the Synoptic Survey, and an additional Dry Weather Survey was conducted in 2015.

Confidence Interval Testing

Confidence Interval Testing was performed in May 2014 to provide information for the Summer 2014 sampling program. The Confidence Interval Testing was performed by Ecology as an initial task to confirm the appropriate sample volumes and frequencies. This initial sampling effort was designed to generate information both on the temporal variability of PCB concentrations, as well as estimates of measurement uncertainty for the low PCB concentrations occurring in the Spokane River.

Five sampling events were conducted in May 2014 on the Spokane River at the State Park Parcel at River Mile 87, located between Mirabeau and Sullivan Parks (referred to as the Mirabeau Park site) and three sampling events at the Lake Coeur d'Alene outlet. Samples were collected for both discrete and composite analyses at Mirabeau Park, while discrete samples were collected at the Lake Coeur d' Alene outlet.

The results showed that PCB concentrations were very low at both stations, with lab blank-corrected concentrations ranging from 7.7 to 54 pg/l at the Lake Coeur d'Alene Outlet and 6.2 to 80 pg/l at Mirabeau Park. Concentrations observed in trip blanks and laboratory blanks were at similar levels to those observed in field samples, making it difficult to distinguish an environmental signal from the noise in laboratory measurement. Based on these results, it was determined that the PCB concentrations were predicted to be significantly higher during the August 2014 Synoptic Survey than they were during the May sampling, due to much lower river flows and consequently lower dilution of weather-independent external PCB sources. Therefore, the data would be sufficient to support a semi-quantitative mass balance assessment and be able to identify stream reaches where incremental loads lead to a significant increase in river concentrations.

2014 Synoptic Survey

The 2014 Synoptic Survey consisted of dry weather sampling in August 2014, at multiple locations in the Spokane River upstream of Lake Spokane. These stations consisted of river locations with gaging stations, NPDES permitted sources and the Latah (Hangman) Creek mouth. Multiple river sampling events were conducted (with some compositing to reduce analytical costs) over a two week sampling period to reduce the uncertainty in loading estimates caused by day to day variability in concentrations.

The results showed that total PCB concentrations are mostly below 50 pg/l from the Lake Coeur d'Alene outlet to the Barker Road Bridge. Concentrations are generally between 100 and 200 pg/l from the Trent Avenue Bridge downstream to Nine Mile Dam. Approximately one quarter of all samples exceed the Washington water quality standard of 170 pg/l, while all of the samples exceed the downstream Spokane Tribe of Indians' water quality standard of 1.3 pg/l.

2015 Synoptic Survey

The objective of 2015 Synoptic Survey was to collect the necessary data to repeat the semi-quantitative mass balance assessment conducted using the 2014 Synoptic Survey data, focusing on the section of river between Barker Road and the Spokane USGS Gage. The survey was conducted in August 2015 and the in-stream sampling locations were placed in a narrower spatial area to further identify potential groundwater contributions.

The results confirmed the presence of a significant source between Barker Road and Trent Avenue. The entry location was narrowed down to downstream of Mirabeau Park. The results near the City of Spokane are inconclusive pending analysis of laboratory data that have been delayed in delivery.

2016 Monthly Water Quality Monitoring

The objective of the monthly water quality sampling is to determine the seasonal variability in PCB concentrations in the Spokane River, to the extent that measured concentrations exceed laboratory blanks. The field monitoring program will consist of up to six monthly sampling events as described below. Samples will be collected according to the requirements of the Sampling and Analysis Plan as well as QAPP Addendum 2. Sampling will be conducted at the locations listed in Table 2 and shown on Figure 2.

Sampling will be conducted monthly from March through May 2016. During the first three months of monitoring, LimnoTech will review current information on snow pack, river flows, and weather forecasts, and make a determination as to whether sampling in June of 2016 will be worthwhile in terms of capturing the effects of snowmelt. If June 2016 sampling is conducted, two monthly monitoring events will be conducted in the fall of 2016. If June 2016 sampling is not conducted, three additional monthly monitoring events will be conducted in the fall of 2016.

In addition, LimnoTech will conduct a mid-project assessment after Spring 2016 laboratory results become available, to determine if the data collected during that time are providing valuable information. The results of this assessment will be provided to the Task Force prior to conducting fall sampling, with the option to either: 1) Continue fall sampling as planned, 2) Make modifications to the sampling plan, or 3) Terminate all remaining sampling.

Parameters

The study parameters include PCB congeners, total suspended solids (TSS), total dissolved solids (TDS), total organic carbon (TOC) and dissolved organic carbon (DOC). TSS, TOC and DOC will be used to provide information on the distribution of PCBs among various forms (i.e. purely dissolved, adsorbed to solids, sorbed to DOC), which will be needed if a fate and transport model is developed. TDS can be used as a tracer to provide information on groundwater contribution to the river. The parameters included in the 2016 Monthly Water Quality Monitoring are listed in Table 3.

Schedule

Key milestones associated with the project are described below along with their targeted completion dates:

Revise and approve QAPP	February 29, 2015
Conduct sampling events	Event 1 - March 2016 Event 2 - April 2016 Event 3 - May 2016 Event 4 – To Be Determined Events 5 & 6 – Fall 2016
Data Validation	January 30, 2017
Report	February 15, 2017

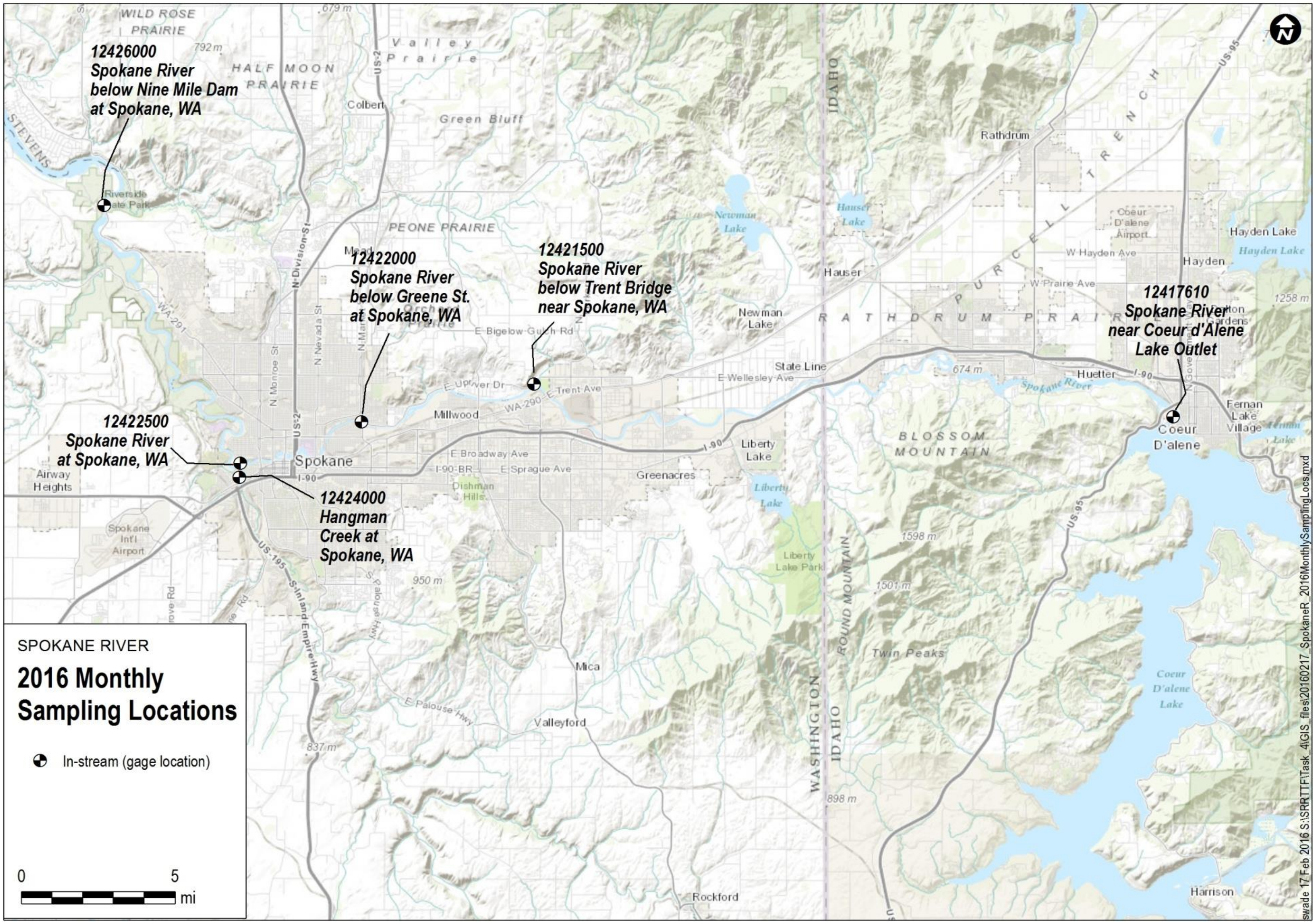

Figure 2. Spokane River Monitoring Locations Map

Table 2. Spokane River Monitoring Locations

Site	Location	Type of Sample
SR-1	Spokane River Below Nine Mile Dame	In-stream
SR-3	Spokane River at Spokane	In-stream
HC-1	Hangman Creek	In-stream
SR-4	Spokane River at Greene Street Bridge	In-stream
SR-7	Spokane River at Below Trent Bridge	In-stream
SR-15	Lake Coeur d'Alene Outlet	In-stream

Table 3. Spokane River Monitoring Parameters

Parameter	Type of Parameter
Polychlorinated Biphenyl (PCB) – 209 Congeners	Laboratory analytical
Dissolved Organic Carbon (DOC)	Laboratory analytical
Total Organic Carbon (TOC)	Laboratory analytical
Total Suspended Solids (TSS)	Laboratory analytical
Total Dissolved Solids (TDS)	Laboratory analytical
Temperature	In-situ measurement
Conductivity	In-situ measurement
pH	In-situ measurement
Dissolved Oxygen (DO)	In-situ measurement
Turbidity	In-situ measurement

Quality Objectives and Criteria

The data quality objectives are intended to clarify the study's technical and quality objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of the data needed to support decisions. The data quality objectives for this study have been developed in order to ensure that the data collected are of acceptable quality and support the objectives of the project. The data quality objectives are described in Section 1.4 of the 2014 QAPP (LimnoTech, 2014b).

The 2016 data will be evaluated relative to the data quality objectives outlined in the 2014 QAPP (LimnoTech, 2014b). Data quality will be interpreted using the Data Quality Indicators (DQIs) which are the quantitative statistics and qualitative descriptors used to interpret the degree of acceptability of the data to the user. The DQIs include bias and precision, representativeness, completeness, comparability, and the required detection limits (sensitivity) for the analytical methods.

The Data Quality Indicators and the measurement performance criteria for each are provided in Tables 4 and 5. The number of samples collected per location is included in Table 6. The specifications for field instruments are included in Table 7.

It should be noted that there is no standard blank correction method, and numerous approaches are utilized, both nationally and within the Spokane River Basin. The selection of the most appropriate blank correction methodology must consider factors such as: study objectives, sample matrix, sampling methodology, expected range of results, and tolerance for biased results.

Table 4. PCB Data Quality Indicators

		BIAS	BIAS	BIAS		PRECISION	SENSITIVITY	COMPLETENESS
	Analytical Method	Daily Calibration Verification	Lab Control Sample Recovery *	Sample and Method Blank Surrogate Recovery	Method Blank	Duplicate Sample	Detection Limit (Level at which non-detects are reported)	Completeness Criteria
		% recovery limits	% recovery limits	% recovery limits	Concentration (pg/L)	RPD (valid for congeners > 10x EDL)	Concentration (pg/L)	%
PCB Congeners	EPA 1668C /AXYS Method MLA-010 Rev 11	50-145%	50-150%	25-150%*	Maximum = 127 pg/L (total) Laboratory will B-qualify congeners results < 3x the concentration in an associated blank	50%	1-20	95%

*Per AXYS Method MLA-010 Revision 11 for OPR, internal standards and labeled compounds.

Table 5. Data Quality Indicators – DOC, TOC, TSS, TDS

DQI		BIAS	BIAS	BIAS	PRECISION	PRECISION	SENSITIVITY	COMPLETENESS
Parameter	Analytical Method	Lab Control Sample	Matrix Spikes	Lab Blanks	Replicate Samples	Matrix Spike Replicate	Detection Limit	Completeness Criteria
		% recovery limits	% recovery limits		RPD	RPD		%
DOC	EPA 415.3	80-120%	80-120%	< ½ EQL	30%	20%	1 mg/L	95
TOC	EPA 415.1	80-120%	80-120%	< ½ EQL	30%	20%	1 mg/L	95
TSS	EPA 160.2	80-120%	--	< ½ EQL	30%	--	1 mg/L	95
TDS	EPA 160.1	80-120%	--	< ½ EQL	30%	--	1 mg/L	95

Table 6. 2016 Monthly Sampling – PCB Sample Count

Sampling Location	Number of Samples	Duplicates
Spokane River at 9 Mile Dam	6	1
Spokane River at Spokane	6	1
Hangman Creek	6	1
Spokane River at Green Street Bridge	6	1
Spokane River Below Trent Bridge	6	1
Lake Coeur d'Alene Outlet	6	1

Table 7. Specification Limits of Field Measurement Instruments

Parameter	Instrument	Range	Accuracy	Resolution
Temperature	Hydrolab	-5 to 50°C	±0.10°C	0.01°C
	YSI	-5 to 45°C	±0.15°C	0.01°C
pH	Hydrolab	0 to 14 units	±0.2 units	0.01 units
	YSI	0 to 14 units	±0.2 units	0.01 units
Dissolved Oxygen	Hydrolab	0 to 20 mg/L	±0.2 mg/L	0.01 mg/L
	YSI	0 to 20 mg/L	±0.2 mg/L	0.01 mg/L
Conductivity	Hydrolab	0 to 100 mS/cm	±0.5% of range	1.0 uS/cm
	YSI	0 to 100 mS/cm	±1% of range	1.0 uS/cm
Turbidity	YSI	0-1000 NTU	±5% of range	0.1 units

Sampling Procedures

Monitoring is scheduled to begin in March 2016. One round of samples will be collected at each of the six sampling locations during each event. One archive sample will be collected for each PCB sample collected.

All sampling procedures described in the 2014 SAP (LimnoTech, 2014c) will be followed.

Sample Handling and Custody

Sample handling will be the responsibility of Gravity Environmental and will be performed using methods as specified in the 2014 SAP (LimnoTech, 2014c), so that representative samples are collected, stored, and submitted to the laboratory for analysis. Sample containers, volumes, preservatives and holding times are summarized in Table 8. Proper sample handling and custody procedures will be employed as discussed in the 2014 QAPP (LimnoTech, 2014b).

Table 8. Guidelines for sample container preparation and preservation

Parameter	Container	Volume	Preservative	Holding Time
PCB	Amber glass	2.36 L	4^o C	1 year
TSS	Polypropylene	1 L	4^o C	7 days
TDS	Polypropylene	500 ml	4^o C	7 days
TOC	Amber glass	40 ml	4^o C, H_2SO_4	28 days
DOC	Amber glass	40 ml	4^o C	28 days

Analytical Methods

The following section details the aspects of the analytical requirements, ensuring that appropriate analytical methods are employed. Tables 4 and 5 summarize the analytical methods to be used by the laboratory. Table 8 displays the required container type, sample volume, preservation, and hold time for the study parameters according to the previously referenced methods. AXYS Analytical Services and SVL Analytical, Inc. will provide sample containers from a commercial supplier. All sample containers will be new and pre-cleaned by the supplier. In addition, the contract laboratories will provide sample labels for each bottle. The detection limits, expected concentrations, and analytical methods are included in Table 9 (Ecology, 2014).

Table 9. Parameters, Detection Limits, Expected Concentrations and Analytical Methods

Parameter	Matrix	Detection Limit	Expected Concentrations	Analytical Method	Laboratory
PCB (pg/L)	Water	1-20	10-10,000 total	EPA 1668C	AXYS Analytical Services
TSS (mg/L)	Water	1	1-80	SM-2540D	SVL Analytical, Inc.
TDS (mg/L)	Water	1	1-80	SM-2540C	SVL Analytical, Inc.
TOC (mg/L)	Water	1	1-2	SM-5310B	SVL Analytical, Inc.
DOC (mg/L)	Water	1	1-2	SM-5310B	SVL Analytical, Inc.

Quality Control

Analytical quality control will be performed in accordance with the specified analytical methods and as presented in the 2014 QAPP (LimnoTech, 2014b).

Field Sampling Quality Control

Field sampling QC consists of collecting field QC samples to help evaluate conditions resulting from field activities. Field QC is intended to support a number of data quality goals:

- Combined contamination from field sampling through sample receipt at the laboratory (to assess potential contamination from ambient conditions, sample containers, sample transport, and laboratory analysis) – assessed using trip blanks/transfer blanks.
- Combined sampling and analysis technique variability, as well as sample heterogeneity – assessed using field replicates.

Trip Blanks – Trip blanks will be used to evaluate whether contaminants have been introduced into the samples due to exposure to ambient conditions or from the sample containers themselves. A trip blank is a controlled water sample, with minimal concentrations of contaminants of concern, which is produced by the laboratory. The trip blank accompanies the sampling equipment into the field and is stored with the analytical samples. Trip blanks will be collected at a frequency of 10% or one blank per sampling round.

Trip blanks, as described above, will be preserved, packaged, and sealed in the same manner described for the surface water samples. A separate sample number and station number will be assigned to each blank. The samples will be submitted as “blind” samples to the laboratory for analysis. If target analytes are found in the blanks above the criteria, sampling and handling procedures will be reevaluated and corrective actions taken. These may consist of, but are not limited to, obtaining sampling containers from new sources, training of personnel, discussions with the laboratory, invalidation of results, greater attention to detail during the next sampling event, or other procedures considered appropriate.

Field Replicate Samples – Field replicate samples will be collected to evaluate the precision of sample collection through analysis. Field replicates will be collected at designated sample locations by filling two distinct sample containers for each analysis. Field replicate samples will be preserved, packaged, and sealed in the same manner described for the surface water samples. A separate sample number and station number will be assigned to each replicate. The samples will be submitted as “blind” samples to the laboratory for analysis.

Field replicates will be collected for each analytical parameter at a frequency of 10% or one field replicate per sampling round, whichever is less. The replicate samples will be collected at random locations for each sampling event. If the acceptance criteria are exceeded, field sampling and handling procedures will be evaluated, and problems corrected through greater attention to detail, additional training, revised sampling techniques, or whatever appears to be appropriate to correct the problem.

Field Measurements Quality Control

Quality control requirements for field measurements are provided in Table 5.

Field instrumentation will be calibrated according to the manufacturer’s requirements and will be calibrated daily. If a field instrument cannot be calibrated it should not be used.

Laboratory Analysis Quality Control

Laboratory QC is the responsibility of the laboratory personnel and QA/QC departments of AXYS Analytical Services and SVL Analytical, Inc. The laboratory’s QA Manual details the QA/QC procedures it follows. The following elements are part of standard laboratory quality control practices:

- Analysis of method blanks
- Analysis of laboratory control samples
- Instrument calibration (including initial calibration, calibration blanks, and calibration verification)
- Analysis of matrix spikes (TOC/DOC)
- Analysis of duplicates

The data quality objectives for AXYS Analytical Services and SVL Analytical, Inc. (including frequency, QC acceptance limits, and corrective actions if the acceptance limits are exceeded) are detailed in 2014 QAPP (LimnoTech, 2014b). Any excursions from these objectives must be documented by the laboratory and reported to the Project Manager/Project QAO.

Corrective Action

Corrective actions will be implemented as required to rectify problems identified during the course of normal field and laboratory operations. Possible problems requiring corrective action include:

- Equipment malfunctions;
- Analytical methodology errors; or
- Non-compliance with quality control systems.

Equipment and analytical problems that require corrective action may occur during sampling and sample handling, sample preparation, and laboratory analysis.

For non-compliance problems, steps for corrective action will be developed and implemented at the time the problem is identified. The individual who identifies the problem is responsible for immediately notifying the Project Manager and the Project QAO.

Any non-conformance with the established quality control procedures outlined in the 2014 QAPP (LimnoTech, 2014b) will be identified and corrected. The Project Manager will ensure that a Corrective Action Memorandum is issued for each non-conformance condition. All non-conformance memoranda will be discussed in the final report submitted to the SRRTTF-ACE.

Field Measurements and Sample Collection

Project staff will be responsible for reporting any suspected QA non-conformance or deficiencies to the Field Manager. The Field Manager will be responsible for assessing the suspected problems in consultation with the Project Manager to review the sampling protocols and provide additional training if necessary. If it is determined that the situation warrants a corrective action, then a Corrective Action Memorandum will be issued by the Field Manager.

The Field Manager will be responsible for ensuring that the corrective action for non-conformance takes place by:

- Evaluating all reported incidences of non-conformance;
- Controlling additional work on nonconforming items;
- Determining what corrective action is needed;
- Maintaining a log of non-conformance issues;
- Reviewing responses to corrective action memoranda;
- Ensuring that copies of corrective action memoranda and responses are included in the project files.

No additional work will be performed until appropriate corrective action has been implemented and documented in response to the corrective action memoranda.

Laboratory Analyses

Corrective actions are required whenever laboratory conditions, instrument malfunction or personnel situations have led or could potentially lead to errors in the analytical data. The corrective action taken will be dependent on the analysis and the event.

Laboratory personnel are alerted that corrective actions may be necessary if:

- QC data are outside the acceptable range for precision and accuracy;
- Blanks contain target analyses above acceptable levels;
- Undesirable trends are detected in spike recoveries or RPD between duplicates;

- Excessive interference is noted; or
- Deficiencies are detected by the Independent Auditor during laboratory system audits as described.

Corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors, checks the instrument calibration, spike and calibration mixes, and instrument sensitivity, etc.

Corrective action taken within each laboratory is the responsibility of the Laboratory Operations/Technical Director. When a problem occurs, the Laboratory Technical Director informs the Project Manager about the problem and the steps taken to resolve it. Once the problem is resolved, full documentation of the corrective action procedure will be submitted to the Project Manager.

All non-conformance memoranda initiated by the contract laboratory will be discussed in the case narrative or included in the laboratory reports. The Project Manager will follow-up on all corrective actions that are taken to ensure that the memoranda are accurate.

Data Management

Data management will be conducted as described in the 2014 QAPP (LimnoTech, 2014b).

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