CLARK FORK – PEND OREILLE WATERSHED WATER QUALITY MONITORING PROGRAM

FINAL MONITORING REPORT 2009

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TRI-STATE WATER QUALITY COUNCIL

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EXECUTIVE SUMMARY

This annual monitoring report summarizes water quality results collected by the Tri-State Water Quality Council Monitoring Committee from monitoring stations located in the Clark Fork-Pend Oreille basin in calendar year 2009. This report describes the spatial trends of field parameters and laboratory analytical results for nutrients, heavy metals, and periphyton reported concentrations and represents the completion of the first year of a five year monitoring cycle. The five year monitoring cycle culminates in 2013 with a comprehensive five year trends analysis of water quality in the basin.

The Tri-State Water Quality Council established seven priority water quality objectives for the Clark Fork – Pend Oreille basin. Those objectives are:

1. Evaluate time trends in nutrient concentrations in the mainstem Clark Fork River and selected tributaries;
2. Evaluate time trends for periphyton (algae) standing crops in the Clark Fork River;
3. Monitor summer nutrient and periphyton target levels in the Clark Fork River;
4. Estimate nutrient loading rates to Lake Pend Oreille from the Clark Fork River;
5. Evaluate time trends for periphyton densities in near-shore areas of Lake Pend Oreille;
6. Evaluate time trends for Secchi depth transparency in Lake Pend Oreille; and
7. Evaluate time trends for nutrient concentrations in the Pend Oreille River.

In completion of these objectives, the 2009 monitoring program consisted of measuring field parameters and collecting samples at 24 monitoring locations divided among multiple organizations and agencies that form the Tri-State Water Quality Council Monitoring Committee. Monitoring takes place on the Clark Fork River, selected tributaries, Lake Pend Oreille, and the Pend Oreille River within the Clark Fork-Pend Oreille watershed of western Montana, northern Idaho, and northeastern Washington. Monitored nutrient parameters include total phosphorus, soluble reactive phosphorus, total persulfate nitrogen, and total soluble inorganic nitrogen (consisting of soluble ammonia and nitrate plus nitrite as nitrogen). Monitored metals include total recoverable and dissolved copper and zinc and dissolved cadmium. Concentrations of attached algae (periphyton) in the Clark Fork River were monitored for chlorophyll-a and ash free dry weight (AFDW) concentrations. During the summer months, locations on the Clark Fork River were monitored for nutrients and attached algae for compliance with State of Montana nutrient standards and Voluntary Nutrient Reduction Program (VNRP) nutrient targets. Water quality monitoring was conducted on Lake Pend Oreille in 2009 for field parameters, nutrient and periphyton concentrations, and Secchi depth. The Lake Pend Oreille Secchi depth and periphyton data was reviewed and is summarized in this report.

The Tri-State Water Quality Council's Monitoring Committee oversees water quality monitoring in the Clark Fork – Pend Oreille Basin through the collection efforts of the following six monitoring activities: 1) Clark Fork River monthly monitoring, 2) Clark Fork River peak flow monitoring, 3) Clark Fork River summer nutrient monitoring, 4) Clark Fork River periphyton monitoring, 5) Lake Pend Oreille monitoring, and 6) Pend Oreille River monthly monitoring.

Water quality results for each of the activities undergoes data quality control review by a designated organization. The results are further compiled, statistically evaluated, and summarized by HydroSolutions, the Tri-State Water Quality Council's environmental consultant. Nutrient results collected during summer nutrient monitoring are compared with State of Montana nutrient standards and VNRP target concentrations specific for that reach. Metals results collected during Clark Fork River monthly monitoring and Clark Fork River peak flow monitoring are compared to Montana and Idaho state heavy metals standards. The Tri-State Water Quality Council's Clark Fork – Pend Oreille Basin 2009 water quality monitoring results are summarized below.

Total Nitrogen

In monthly monitoring, the highest median total nitrogen (TN) concentration was at station 28, Clark Fork River below Thompson Falls, at 143 micrograms per liter (µg/L). Median total nitrogen concentrations generally decreased in the downstream direction, with the exception of an increase at station 30, Clark Fork River below Cabinet Gorge Dam, (124 µg/L), to station 55, Pend Oreille River at Metaline Falls (84 µg/L).

During peak flow monitoring at station 30, Clark Fork River below Cabinet Gorge Dam, the median TN concentration exceeded the median monthly concentration at that station. Higher concentrations during the peak flow period indicate that a larger percentage of the annual nutrient load to Lake Pend Oreille is delivered during a short period of time when flows and nutrient concentrations are higher.

During Clark Fork River summer nutrient monitoring, median TN concentrations exceeded the nutrient standard value of 300 µg/L at two stations. Station 2.5, Silver Bow Creek at Opportunity, had the highest median concentration at 1,924 µg/L. Station 9, Clark Fork River at Deer Lodge, with a median concentration of 304 µg/L, slightly exceeded the standard. Median summer TN concentrations generally decreased in the downstream direction with an exception of an increase at station 18, Clark Fork River below Missoula. Station 25, Clark Fork River above Flathead River, had the lowest median TN concentration at 142 µg/L.

Total Soluble Inorganic Nitrogen

In monthly monitoring, station 27.5, Thompson River near mouth, had the lowest median total soluble inorganic nitrogen (TSIN) concentration of the Clark Fork River monitoring stations at a calculated value of 32 µg/L. Monthly median TSIN concentrations decreased in the downstream direction from station 29, Clark Fork River at Noxon Bridge (50 µg/L) to stations 50 and 55, Pend Oreille River at Newport and Metaline Falls, to non-reportable concentrations (less than 20 µg/L).

During peak flow monitoring at station 30, Clark Fork River below Cabinet Gorge Dam, the median TSIN concentration exceeded the median monthly concentration at that station.

During Clark Fork River summer nutrient monitoring median TSIN concentrations exceeded the nutrient target concentration of 30 µg/L at three stations. Station 2.5, Silver Bow Creek at Opportunity, had the highest median concentration at 1,436 µg/L. Station 9, Clark Fork River at Deer Lodge (67 µg/L) exceeded the target TSIN concentration. Station 15.5, Clark Fork River above Missoula, had the lowest median TSIN concentration at 14 µg/L, while the median TSIN concentration at station 18, Clark Fork River below Missoula (51 µg/L), exceeded the target concentration.

Total Phosphorus

In monthly monitoring, median total phosphorus (TP) concentrations were generally consistent at all of the monthly monitoring stations. Median TP concentrations varied from a low of 7.7 µg/L at station 28, Clark Fork River below Thompson Falls, to a high of 12.6 µg/L at station 30, Clark Fork River below Cabinet Gorge Dam. In the Pend Oreille River median TP concentrations ranged from 8.7 µg/L at Newport to 9.5 µg/L at Metaline Falls.

During peak flow monitoring at station 30, Clark Fork River below Cabinet Gorge Dam, the median TP concentration exceeded the median monthly concentration at that station.

During Clark Fork River summer nutrient monitoring, median TP concentrations exceeded nutrient standard in each of the five monitoring stations in the upper Clark Fork River and attained the standard below the Clark Fork River-Blackfoot River confluence. Generally median summer TP concentrations decreased in the downstream direction with exceptions of increases in concentration at station 10, Clark Fork River above the Little Blackfoot River and station 18, Clark Fork River below Missoula.

Soluble Reactive Phosphorus

In monthly monitoring, the highest median soluble reactive phosphorus (SRP) concentration was at station 27.5, Thompson River near mouth, (7.62 µg/L). Median SRP concentrations decreased in downstream direction to 4.40 µg/L at station 30, Clark Fork River below Cabinet Gorge Dam, to non-reportable concentrations at stations 50 and 55, Pend Oreille River at Newport and Metaline Falls, respectively.

During peak flow monitoring at station 30, Clark Fork River below Cabinet Gorge Dam, the median SRP concentration exceeded the median monthly concentration at that station.

During Clark Fork River summer nutrient monitoring, median SRP concentrations exceeded the SRP target concentration of 6 µg/L at seven of nine stations. The highest median SRP concentration was at station 2.5, Silver Bow Creek at Opportunity, with a concentration of 182 µg/L. Median SRP concentrations generally decreased in the downstream direction. Other Clark Fork River stations that exceeded the SRP target concentration include 1) station 7, Clark Fork River below Warm Springs Creek, with a concentration of 22.89 µg/L; 2) station 9, Clark Fork River at Deer Lodge, with a concentration of 13.89 µg/L; 3) station 10, Clark Fork River above Little Blackfoot, with a concentration of 18.01 µg/L; 4) station 12 Clark Fork River at Bonita, with a concentration of 14.75 µg/L; 5) station 15.5 Clark Fork River above Missoula with a concentration of 6.69; and 6) station 18, Clark Fork River below Missoula, with median SRP concentration of 7.69 µg/L. Of those stations exceeding the target concentration, stations 15.5 and 18 were closest to attaining the SRP target. The lowest median SRP concentration during summer nutrient monitoring was at station 25, Clark Fork River above the Flathead River, with a concentration of 3.63 µg/L.

Total Recoverable Copper

During Clark Fork River monthly monitoring, median total recoverable copper concentrations were 2 µg/L at each of the three Clark Fork River monthly metals monitoring stations: station 28, Clark Fork River below Thompson Falls, station 29, Clark Fork River at Noxon Bridge, and at station 30, Clark Fork River below Cabinet Gorge Dam. One sample result, collected in December, at station 28, Clark Fork River below Thompson Falls, had a result below the laboratory reporting limit (1 µg/L). This station also had the highest reported concentration at 22 µg/L that exceeded Montana acute and chronic metals toxicity standards, which occurred in May. No other results exceeded acute or chronic toxicity standards.

During peak flow monitoring at station 30, Clark Fork River below Cabinet Gorge Dam, the median total recoverable copper concentration exceeded the median monthly concentration at that station. Higher concentrations during the peak flow period indicate that a larger percentage of the annual metals load to Lake Pend Oreille is delivered during a short period of time when flows and metals concentrations are higher.

Total Recoverable Zinc

During Clark Fork River monthly monitoring, median total recoverable zinc concentrations were at or below the laboratory reporting limit of 5 µg/L at each of the three Clark Fork River monthly metals monitoring stations.

During peak flow monitoring at station 30, Clark Fork River below Cabinet Gorge Dam, the median total recoverable zinc concentration exceeded the median monthly concentration at that station.

Dissolved Metals

During Clark Fork River monthly monitoring, dissolved cadmium, copper, and zinc samples were collected at station 30, Clark Fork River below Cabinet Gorge Dam. Median dissolved cadmium and zinc concentrations were less than the laboratory reporting limit. All of the dissolved cadmium sample results were less than the laboratory reporting limit. There were two dissolved zinc samples that exceeded the laboratory reporting limit with one of them being an anomalous result. The median dissolved copper concentration was 1.5 µg/L and there were five sample results exceeding the laboratory reporting limit of 1 µg/L with one anomalous result.

During peak flow monitoring at station 30, Clark Fork River below Cabinet Gorge Dam, the median dissolved zinc and cadmium concentrations were at or below the laboratory reporting limit. The median dissolved copper concentration was the same as the median monthly concentration at station 30, Clark Fork River below Cabinet Gorge Dam, at 2 µg/L.

Clark Fork River Periphyton

During Clark Fork River periphyton monitoring, chlorophyll-a concentrations were greater in September than in August at each monitored station. The greatest increases were recorded at station 9, Clark Fork River at Deer Lodge, where concentrations increased from 181 milligrams per square meter (mg/m^2) in August to 503 mg/m^2 in September, and at station 18, Clark Fork River below Missoula, where concentrations increased from 38 mg/m^2 to 361 mg/m^2.

Spatially, chlorophyll-a concentrations in the Clark Fork River in 2009 generally decreased in the downstream direction. The highest concentration for any one month and summer mean both occurred furthest upstream at station 9, Clark Fork River at Deer Lodge, at 503 mg/m^2 and 342 mg/m^2, respectively. The lowest concentration for any one month and summer mean occurred furthest downstream at station 25, Clark Fork River above Flathead at 23 mg/m^2 and 37 mg/m^2, respectively.

The maximum chlorophyll-a standard value of 150 mg/m^2 was exceeded at station 9, Clark Fork River at Deer Lodge, in August; and in September at station 9, the Clark Fork River at Deer Lodge; station 12, Clark Fork River at Bonita, and station 18, Clark Fork River below Missoula. The mean chlorophyll-a standard of 100 mg/m^2 was exceeded at five of the 7 monitoring stations in 2009. Stations 22 and 25, Clark Fork River at Huson and above Flathead River, respectively, were the two stations attaining the summer mean standard. (Note that mean or average values are used when discussing periphyton results since the mean is most representative and is used for comparing benthic algal chlorophyll-a standard concentrations established by the Administrative Rules of Montana).

Lake Pend Oreille Nutrients, Secchi Depth, and Periphyton

Lake Pend Oreille nutrient monitoring occurred as directed in the Tri-State Water Quality Council monitoring program Quality Assurance Project Plan (QAPP). Idaho Department of Environmental Quality (IDEQ) has not yet completed data quality review and validation, and has not proposed a schedule to complete the data validation. At the request of the IDEQ, most of the data collected is not included in this report. The IDEQ is preparing a separate trends report for Lake Pend Oreille water quality monitoring completed from years 2005 to 2010. The report will be available on the Tri-State Water Quality Council and IDEQ websites.

Lake Pend Oreille Secchi depth measurements were collected monthly from June to September. Measurements in June were at the lowest of each of the months measured at each of the monitoring stations. Secchi depth measurements increased each month and peaked in August. Stations with the greatest Secchi measurements were at Bayview open water at 14.1 meters, Pend Oreille North at 11.4 meters, Bayview near shore at 11 meters, and Midlake at 9 meters. The measurement at Garfield Bay in June had the lowest recorded reading at 1.2 meters. There were a number of measurements that were limited by the bottom depth of the Lake.

Periphyton samples were collected at eight near shore sites on Lake Pend Oreille in 2009, on September 16, 17 and 29, 2009. The highest chlorophyll-a and AFDW concentrations in 2009 were at Oden Bay with a chlorophyll-a concentration of 35.3 mg/m^2. The Lake Pend Oreille Talache site had non-detectable results for chlorophyll-a and AFDW.

Data Validation and Upload

Clark Fork-Pend Oreille water quality results discussed in this report have been reviewed for data quality. Data quality assurance for each monitoring activity in the watershed has been reviewed by the sponsoring or collecting organization. The data quality assurance review completed by HydroSolutions for Clark Fork River monthly monitoring, peak flow monitoring, and portions of Clark Fork River summer nutrient monitoring is detailed in this report. The data quality assurance review was completed using methods outlined in the latest Clark Fork River Watershed Monitoring Program QAPP and follows the Montana Department of Environmental Quality (MDEQ) Quality Assurance Quality Control (QAQC) Checklist (Tri-State Water Quality Council, 2010b). Data quality assurance included review of sample handling, field and analytical methodology, Data Quality Objectives, and data logic checks. (Note that summary result tables within this report including the appendices may not include associated data qualifiers. The reader should refer to the final Montana Equis Water Quality Exchange database to review the complete 2009 Tri-State Water Quality Council Monitoring Program dataset including data qualifiers for this report. A condensed summary of the final 2009 Tri-State Water Quality Council Monitoring Program dataset submitted to the Montana Equis Water Quality Exchange database in included at the end of this report).

Following data validation and acceptance by Montana DEQ and the Tri-State Water Quality Council Monitoring Committee, the 2009 Clark Fork—Pend Oreille water quality data was submitted to the National Water Quality Exchange (WQX) Warehouse on August 10, 2010, with WQX Transaction ID: _ac9d3717-f456-4024-a687-92e6f800af7d.

1.0 INTRODUCTION

This document was completed for the Tri-State Water Quality Council by HydroSolutions Inc (HydroSolutions) to provide a summary of water quality constituents in the Clark Fork-Pend Oreille watershed monitored by the Tri-State Water Quality Council for calendar year 2009. This annual report presents water quality results from samples collected at locations in the Clark Fork-Pend Oreille basin. This report describes results of field parameters measured and laboratory analytical results of nutrients, heavy metals, and periphyton concentrations. The results are compared with established nutrient standards and targets, algal standards, and heavy metal standards; and used to evaluate the overall water quality of the watershed in the year 2009. The document also describes the quality assurance quality control (QA/QC) procedures that were completed to review and present the water quality results.

This report represents the completion of the first year of a five year monitoring cycle. The five year monitoring cycle culminates in 2013 with a comprehensive five year trends analysis of water quality in the basin. The five-year trends analysis report is intended to provide in-depth assessment of long-term time trends in the data sets, and appraisal of nutrient loading to Lake Pend Oreille.

1.1 BACKGROUND

1.1.1 HISTORY

The Tri-State Water Quality Council is a partnership of citizens, businesses, industry, tribes, government, and environmental groups, working together to improve and protect water quality throughout the Clark Fork-Pend Oreille Watershed. In 1993, the states of Montana, Idaho, and Washington, in conjunction with the US Environmental Protection Agency Regions 8 and 10, released the Clark Fork-Pend Oreille Basin Management Plan, based on studies mandated by Congress under Section 525 of the Amendments to the 1987 Clean Water Act. The mandate was a direct result of the concerns of citizens regarding increased aquatic vegetation and attached algae in the Clark Fork River and Pend Oreille Lake. The main objectives of the study were to characterize water quality concerns, identify sources of, and recommend actions for maintaining and enhancing water quality throughout the basin. The findings and recommendations were reported back to Congress and formed the basis for the Basin Management Plan, adopted in 1993 and last updated in 2007.

The Clean Water Act is the primary federal law in the United States governing water pollution and established the objective of restoring and maintaining the chemical, physical, and biological integrity of the nation’s waters.

The formation of the Tri-State Water Quality Council was a direct result of the Basin Management Plan. One of the first tasks of the Tri-State Water Quality Council was to create a Monitoring Committee that would oversee and implement a long-term, basin-wide monitoring strategy. The monitoring program was started in 1998 and continues today. The Clark Fork-Pend Oreille Basin Management Plan focused efforts on controlling eutrophication and associated water use impairment problems that were identified as the most important interstate water quality problem. The goal of the Basin Management Plan is to restore and protect designated beneficial water uses. The Basin Management Plan further identified water quality objectives and emerging new water quality challenges.

The Tri-State Water Quality Council Monitoring Committee oversees the collection of basin-wide monitoring data intended to support sound, scientifically-based water management decisions. The monitoring program employs a statistically-based sampling design of historic watershed-specific nutrient and periphyton data. The current sampling protocol has been designed to be cost-effective and scientifically defensible.

The 2009-2013 monitoring program represents the third continuous five-year monitoring cycle managed by the Tri-State Water Quality Council. The previous five-year monitoring programs, conducted from 1998-2002 and 2003-2007, provided the basis for a statistical analysis of water quality time trends reflected in the Council's and the state agencies' data (Tri-State Water Quality Council 2009). Monitoring was also conducted in 2008, but results were not summarized in a final report. The 2008 data will be included in a trends analysis reports. Supporters of the Council's Monitoring Program include the City of Missoula, the City of Sandpoint, the Missoula Water Quality District, the University of Montana (UM), Montana Department of Environmental Quality (MDEQ), Idaho Department of Environmental Quality (IDEQ), Washington Department of Ecology (WDOE), Avista Corporation (Avista Corp.), U.S. Forest Service (USFS) Region 1, Plum Creek Timber Company, and Stimson Lumber.

1.1.2 MONITORING PROGRAM GOALS AND OBJECTIVES

The Tri-State Water Quality Council has established four primary water quality management goals and seven associated water quality monitoring program objectives for the Clark Fork-Pend Oreille Watershed, which conforms to specific watershed management goals identified in the Basin Management Plan (EPA 1993; 2007). The monitoring objectives for the Clark Fork River, Lake Pend Oreille, and the Pend Oreille River are achieved under separate project-specific sampling programs and associated quality assurance project plans (QAPPs). These sampling programs are managed inclusively by the Tri-State Water Quality Council. Each of the separate project-specific sampling programs and monitoring activities are discussed in the next section.

MANAGEMENT GOALS

The following management goals are identified by the Tri-State Water Quality Council:

- Control nuisance algae in the Clark Fork River by reducing nutrient concentrations
- Protect Lake Pend Oreille water quality by maintaining or reducing current rates of nutrient loading from the Clark Fork River
- Reduce near-shore eutrophication in Lake Pend Oreille by reducing nutrient loading from local sources
- Improve Pend Oreille River water quality through macrophyte management and tributary non-point source controls

MONITORING OBJECTIVES

The Tri-State Water Quality Council established seven priority water quality objectives for the Clark Fork – Pend Oreille basin. These objectives:

1) Evaluate time trends in nutrient concentrations in the mainstem Clark Fork River and selected tributaries;
2) Evaluate time trends for periphyton (algae) standing crops in the Clark Fork River;
3) Monitor summer nutrient and periphyton target levels in the Clark Fork River;
4) Estimate nutrient loading rates to Lake Pend Oreille from the Clark Fork River;
5) Evaluate time trends for periphyton densities in near-shore areas of Lake Pend Oreille;
6) Evaluate time trends for Secchi depth transparency in Lake Pend Oreille; and
7) Evaluate time trends for nutrient concentrations in the Pend Oreille River.

NUTRIENT STANDARDS AND TARGET CONCENTRATIONS

The Tri-State Water Quality Council worked to develop target nutrient concentrations for the Clark Fork River Basin through the Basin Management Plan and creation of the Voluntary Nutrient Reduction Program (VNRP). The State of Montana in 2002 subsequently adopted these targets as nutrient standards for total phosphorus as P, total nitrogen as N, and mean and maximum benthic algal chlorophyll-a concentrations in the Administrative Rules of Montana (ARM) 17.30.631. The standards are applicable in the mainstem Clark Fork River below Warm Springs Creek to the confluence with the Flathead River during the summertime months from June 21 to September 21. Nutrient target concentrations for soluble constituents (total soluble inorganic nitrogen and soluble reactive phosphorus) were established by the VNRP and are used as target concentrations by the Tri-State Water Quality Council. The Clark Fork River mainstem nutrient standards and target concentrations are summarized in Table 1-1:

Table 1-1. Clark Fork River Nutrient Standards and Nutrient Targets

River Reach	Nutrient Parameter	Concentration
Clark Fork River: Warm Springs Creek to Blackfoot River	Total Phosphorus as P (Standard)	20 µg/L
	Total Nitrogen as N (Standard)	300 µg/L
Clark Fork River: Blackfoot River to Flathead River	Total Phosphorus as P (Standard)	39 µg/L
	Total Nitrogen as N (Standard)	300 µg/L
Clark Fork River: Warm Springs Creek to Flathead River	Benthic algal chlorophyll-a (Summer Mean Standard)	100 mg/m^2
	Benthic algal chlorophyll-a (Summer Maximum Standard)	150 mg/m^2
	Total Soluble Inorganic Nitrogen (Target)	30 µg/L
	Soluble Reactive Phosphorus (Target)	6 µg/L

Notes:
Standards established by Administrative Rules of Montana (ARM) 17.30.631, applicable June 21 to September 21
Target concentrations established by the Clark Fork River Voluntary Nutrient Reduction Program (VNRP)
µg/L-microgram per liter; mg/m^2-milligram per square meter

1.2 MONITORING PROGRAM ACTIVITIES IN 2009

In accomplishing the Tri-State Water Quality Council's goals and objectives, the Council's Monitoring Committee manages basin-wide water quality monitoring and reporting through the cooperation of a network of agencies and organizations. The following list summarizes water quality monitoring activities throughout the basin completed in calendar year 2009:

1) Monthly collection of nutrient and heavy metals samples and field measurements at three lower Clark Fork River sites, and monthly collection of nutrient samples and field measurements in Thompson River near mouth completed April through December by HydroSolutions Inc;
2) Collection of nutrient and heavy metals samples at the Clark Fork River below Cabinet Gorge Dam during spring peak flow completed in six sampling events over about a one-month period, May to June, by Avista Corporation;
3) Collection of summer nutrient samples and field measurements at nine Clark Fork River and tributary stations completed during ten sampling events in June through September by the Missoula Waste Water Treatment Plant;
4) Collection of summer periphyton standing crop samples at seven Clark Fork River stations, completed twice: once in August and once in September by University of Montana Watershed Health Clinic research personnel;
5) Monthly collection of nutrient samples and field measurements, chlorophyll-a samples, and Secchi depth readings at three open water lake stations and six near shore lake stations on Lake Pend Oreille completed June through September; activities overseen by IDEQ;
6) Collection of periphyton standing crop samples at 9 near shore stations on Lake Pend Oreille completed in September, activities overseen by IDEQ and;
7) Monthly collection of nutrients and field constituents at two Pend Oreille River stations completed January through December by WDOE.

Maps of Clark Fork-Pend Oreille watershed and locations of all monitoring stations are provided in Appendix A. The 2009 monitoring program is summarized in Table A-1 in Appendix A. The summary chart provides an overview of each of the monitoring program activities: monitoring locations, specific nutrient and metal constituents and field parameters collected, sampling frequency and dates of collection, the identification of the sampler, and the analytical laboratory used.

The Council's water quality monitoring program activities are conducted under quality assurance project plans (QAPP). The QAPP provides a consistent and acceptable approach to data collection and management that will facilitate achievement of program objectives, provides the framework for conducting the activity, and provides the guidelines for reviewing analytical results to assure quality data. A sampling and analysis plan (SAP) is developed for each activity to provide the structure and protocol of the activity, defining what, where, when, and the protocols for accomplishing the monitoring event. A QAPP for Clark Fork Basin was revised in 2009 and is currently being finalized. A separate SAP is provided for Cabinet Gorge peak flow monitoring, while each of the SAPs for the other activities are incorporated into their respective

QAPP. The Council's Monitoring Committee, which oversees all of the monitoring program activities, reviews the QAPPs and SAPs to ensure consistency and unbiased quality data for the program. Table 1-2 summarizes monitoring activities, a contact responsible for that activity, and the QAPP and SAP that the 2009 monitoring activity was completed under.

Table 1-2. Tri-State Water Quality Council Monitoring Program Activities

Monitoring Activity	Contact	QAPP	SAP
CFR Monthly Monitoring	HydroSolutions Inc, Luke Osborne	TSWQC, 2005	TSWQC, 2005
CFR Peak Flow Monitoring	Avista Corp. Joe DosSantos	TSWQC, 2005	TSWQC, 2009a
CFR Summer Nutrient Monitoring	Missoula WWTP, Sherri Kenyon	TSWQC, 2005	TSWQC, 2005
CFR Periphyton Monitoring	University of Montana, Vicki Watson	TSWQC, 2005	TSWQC, 2005
Lake Pend Oreille Monitoring	Idaho DEQ, Robert Steed	TSWQC, 2006*	TSWQC, 2006
Pend Oreille River Monthly Monitoring	Washington Dept of Ecology, Jean Parodi	WDOE, 2003	WDOE, 2003

Notes:
CFR Clark Fork River
DEQ Department of Environmental Quality
TSWQC Tri-State Water Quality Council
WDOE Washington State Department of Ecology
QAPP Quality assurance project plan
*QAPP was amended in 2009 (TSWQC, 2009b)

1.3 MONITORING LOCATIONS

The 2009 monitoring program includes 24 monitoring locations on the Clark Fork River, selected tributaries, Lake Pend Oreille, and the Pend Oreille River within the Clark Fork-Pend Oreille watershed of western Montana, northern Idaho and northeastern Washington. Maps showing all monitoring stations are included in Appendix A. The locations selected for water quality monitoring provide distributed spatial coverage for evaluating the effects of point and non-point pollution sources and the influences of major population centers and tributary inflows. This design provides for a cost effective and scientifically-based assessment of nutrient and metals inputs and effects throughout the basin. A summary of monitoring locations, the sampling organization, and associated sampling frequencies are provided in Table 1-3.

Table 1-3. Monitoring Locations, Sampling Organization, and Sampling Frequency

Station	Name	Sampling Organization	Sampling Frequency
2.5	Silver Bow Creek at Opportunity	M-WWTP	S10
07	Clark Fork below Warm Springs Creek	M-WWTP	S10
09	Clark Fork at Deer Lodge	UM-WHC, M-WWTP	P10, S10
10	Clark Fork above Little Blackfoot River	UM-WHC, M-WWTP	P10, S10
12	Clark Fork at Bonita	UM-WHC, M-WWTP	P10, S10
15.5	Clark Fork above Missoula	UM-WHC, M-WWTP	P10, S10
18	Clark Fork below Missoula (Shuffields)	UM-WHC, M-WWTP	P10, S10
22	Clark Fork at Huson	UM-WHC, M-WWTP	P10, S10
25	Clark Fork above Flathead	UM-WHC, M-WWTP	P10, S10
27.5*	Thompson River near mouth	HydroSolutions Inc	N12
28**	Clark Fork below Thompson Falls	HydroSolutions Inc	NM12
29**	Clark Fork at Noxon Bridge	HydroSolutions Inc	NM12
30**	Clark Fork below Cabinet Gorge Dam	HydroSolutions Inc, Avista	NM18
50	Pend Oreille River at Newport, WA	WDOE	N12
55	Pend Oreille River at Metaline Falls, WA	WDOE	N12
	Lake Pend Oreille: Lakeview	IDEQ	P10, SD
	Lake Pend Oreille: Talache	IDEQ	P10, SD
	Lake Pend Oreille: Garfield Bay	IDEQ	P10, SD
	Lake Pend Oreille: Bayview near shore	IDEQ	P10, SD
	Lake Pend Oreille: Oden Bay	IDEQ	P10, SD
	Lake Pend Oreille: Sunnyside	IDEQ	P10, SD
	Lake Pend Oreille: Trestle	IDEQ	P10
	Lake Pend Oreille: Springy Point	IDEQ	P10
	Lake Pend Oreille: Kootenai	IDEQ	P10
	Lake Pend Oreille: Bayview open water	IDEQ	SD
	Lake Pend Oreille: Hope open water	IDEQ	SD
	Lake Pend Oreille: Granite open water	IDEQ	SD
	Lake Pend Oreille: Midlake	IDEQ	SD
	Lake Pend Oreille: PDO north	IDEQ	SD

Notes:

M-WWTP	Missoula Waste Water Treatment Plant
UM-WHC	University of Montana Watershed Health Clinic
Avista	Avista Corporation
WDOE	Washington Department of Ecology
IDEQ	Idaho Department of Environmental Quality
N12	Nutrient and field constituents, 12 monthly samples
NM12	Nutrient, metal and field constituents, 12 monthly samples
NM18	Nutrient, metal and field constituents, 12 monthly samples and 6 peak flow samples
P10	Periphyton collected in August and September at Clark Fork stations, September for Lake Pend Oreille stations
S10	Summer nutrient and field constituents, 10 samples during 3 months in summer
SD	Secchi Depth, nutrient and field constituents, 3 monthly samples collected June to September
Clark Fork	Clark Fork River
*	Site sponsored by Plum Creek;
**	Sites sponsored by Avista Corp.

1.4 MONITORING SCHEDULE

The schedule of monitoring program activities accomplished for 2009 are summarized below in Table 1-4 and are also provided in the monitoring program summary chart in Appendix A.

Table 1-4. Tri-State Water Quality Council 2009 Monitoring Schedule

Monitoring Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1. CFR Monthly Monitoring				■	■	■	■	■	■	■	■	■
2. CFR Peak Flow Monitoring					■	■						
3. CFR Summer Nutrients Monitoring						■	■	■	■			
4. CFR Periphyton Monitoring								■	■			
5. LPO Monitoring						■	■	■	■			
6. LPO Periphyton Monitoring									■			
7. POR Monitoring	■	■	■	■	■	■	■	■	■	■	■	■

Note:
CFR Clark Fork River
LPO Lake Pend Oreille
POR Pend Oreille River

1.5 MONITORING CONSTITUENTS

The 2009 monitoring program consists of the collection of the following nutrient and metal constituents, field parameters, and periphyton and Secchi depth measurements. The specific constituents sampled differed between monitoring activities and between monitoring stations within a single monitoring activity. The monitoring program summary chart in Appendix A defines the specific constituents monitored for in each activity.

NUTRIENT CONSTITUENTS

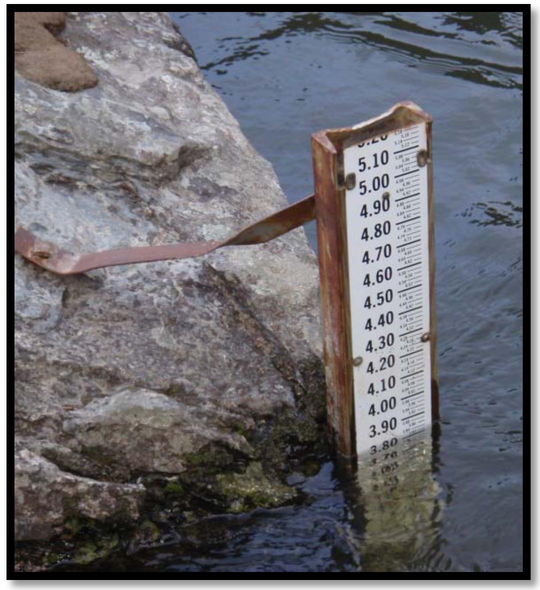
- Total phosphorus (TP)
- Soluble reactive phosphorus (SRP)
- Total persulfate nitrogen (TPN)
- Soluble nitrate + nitrite as nitrogen (NO_2+NO_3 as N)
- Soluble ammonia nitrogen (NH_3+NH_4 as N)

METAL CONSTITUENTS

- Total recoverable copper (Cu)
- Total recoverable zinc (Zn)
- Hardness
- Dissolved cadmium (diss Cd)
- Dissolved copper (diss Cu)
- Dissolved zinc (diss Zn)

FIELD PARAMETERS

- water temperature in degrees Celsius (˚C)
- dissolved oxygen in milligrams per liter (mg/L)
- pH (standard units)
- oxidation reduction (ORP) potential in millivolts (mV)
- specific conductance in microSiemens per centimeter (μS/cm)
- total dissolved solids in mg/L
- turbidity in Nephelometric Turbidity Units (NTU)



Instantaneous stream flow in cubic feet per second (cfs) and river stage (ft) were also recorded, where available, at established stream gage stations.

PERIPHYTON AND SECCHI DEPTH

Periphyton samples were analyzed for chlorophyll-a in milligrams per square meter (mg/m^2) and ash-free dry weight (AFDW) in grams per square meter (g/m^2). Secchi depth measurements were collected in meters (m).

1.6 SAMPLING AND ANALYTICAL METHODS

Specific methods of sample collection, preservation, and handling, followed by each of the Council's monitoring program activities can be found in their respective sampling and analysis plans or QAPPs. References for these plans can be found in Table 1-2. Field measurements for Clark Fork River monthly monitoring were collected with YSI-556 Multi-Probe System and HACH 2100P Turbidimeter. The instruments were calibrated each month prior to data collection or as recommended by the manufacturer.

All nutrient and metals analyses were performed by state-certified laboratories using standard analytical methods. Details regarding these methods are described in *Standard Methods for the Examination of Water and Wastewater, 20th Ed* (APHA, 1999) and various EPA documents. Further information regarding analytical methods may be found in the various laboratories' quality assurance plans which are part of respective monitoring activity QAPPs. The analytical methods, laboratory lower reporting limits, project required quantitation limits (established in the QAPP), and the laboratory used in the Clark Fork River monitoring activities are summarized in Table 1-5. For the Clark Fork River monthly monitoring, peak flow monitoring, and summer nutrient monitoring activities, the City of Missoula Waste Water Treatment Plant Laboratory (Missoula laboratory) and the Montana Department of Public Health and Human Services Laboratory (State Laboratory) performed the nutrients and metals analysis. For Clark Fork River periphyton monitoring, the University of Montana Watershed Health Clinic performed chlorophyll-a and AFDW analysis.

Table 1-5. Summary of Analytical Methods, Reporting Limits, and Laboratories

Analyte	Method	Laboratory Lower Reporting Limit	Project Required Quantitation Limit	Laboratory
Total Phosphorus (TP)	EPA 365.3	4 µg/L	10 µg/L	M-WWTP
Nitrate + Nitrite as Nitrogen (NO_2+NO_3 as N)	EPA 353.2	2 µg/L	30 µg/L	M-WWTP
Ammonia-Nitrogen (NH_3+NH_4 as N)	EPA 350.1	10 µg/L	30 µg/L	M-WWTP
Soluble Reactive Phosphorus (SRP)	EPA 365.3	2 µg/L	5 µg/L	M-WWTP
Total Persulfate Nitrogen (TPN)*	SM 4500-N B or C	10 µg/L	50 µg/L	*
Copper (Cu)	EPA 200.7	1 µg/L	1 µg/L	MT-DPHHS
Zinc (Zn)	EPA 200.7	5 µg/L	10 µg/L	MT-DPHHS
Dissolved Copper (diss Cu)	EPA 200.8	1 µg/L	1 µg/L	MT-DPHHS
Dissolved Zinc (diss Zn)	EPA 200._8	5 µg/L	10 µg/L	MT-DPHHS
Dissolved Cadmium (diss Cd)	EPA 200.8	1 µg/L	1 µg/L	MT-DPHHS
Chlorophyll-a	(UM-WHC, 2009)	4 mg/m^2	Not established	UM-WHC
Ash Free Dry Weight	(UM-WHC, 2009)	0.4 g/m^2	Not established	UM-WHC

Notes:
µg/L micrograms per liter
mg/m^2 and g/m^2 milligrams per square meter and grams per square meter
M-WWTP – Missoula Waste Water Treatment Plant Laboratory (Missoula Laboratory)
MT-DPHHS – Montana Department of Public Health and Human Services (State Laboratory)
UM-WHC – University of Montana Watershed Health Clinic
*TPN was analyzed at the State Laboratory for monthly and peak flow monitoring, and at the Missoula Laboratory for Clark Fork River summer nutrient monitoring

The project required quantitation limits shown in Table 1-5 are established in the QAPP (TSWQC, 2005) for each analyte. The laboratory lower reporting limits shown in Table 1-5 are established by the laboratories for each analyte as the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. Method detection limits are calculated by the laboratories and are a value less than the lower reporting limit. MDLs were not consistently provided by the laboratories and were only reported by the Missoula Laboratory. A result greater than the MDL but less than the lower reporting limit indicates the presence of the analyte was detected, but could not be accurately quantified, therefore it is an estimated value. The terms project required quantitation limit, laboratory lower reporting limit (laboratory reporting limit), and MDL are used throughout this report and in supporting appendices consistent with the QAPP as appropriate.

1.7 STATISTICAL METHODS

Box and whisker plots and summary statistics were prepared to evaluate 2009 water quality results in the Clark Fork – Pend Oreille watershed. In descriptive statistics, box and whisker plots visually compare water quality constituents from different monitoring stations. These plots are used to provide a spatial comparison of the data as the stations are lined up (left to right) upstream to downstream on the plot. The shapes of the box and whisker plots are based on the median, interquartile, and extreme values of the data, as shown in Figure 1-1. The box portion of the plot encloses the interquartile range which contains the middle 50 percent of the values. The median value is displayed as the thick centerline within the box. The top and bottom whiskers display the maximum and minimum observed values, excluding outliers or extreme values. Outliers, defined as values that are 1.5 to 3 times greater or less than the values in the interquartile range, are displayed with an asterisk (*). Extreme values are those values greater or less than 3 times the values in the interquartile range, and are displayed with a circle (o). The plots were made using Peltier Technical Services, Inc. Box and Whisker Chart Utility program that is an add-on in Microsoft Excel. Quartiles were computed using the "Minitab" method, since this method provided the best quartile distribution for the data sets. Minitab and other methods for computing quartile options are described in Langford (2006). For the purpose of box and whisker plot construction, water quality results that were non-detect are assumed to be one half the lower laboratory reporting limit. Box and whisker plots were prepared for each of the monthly and summer monitoring program activities.

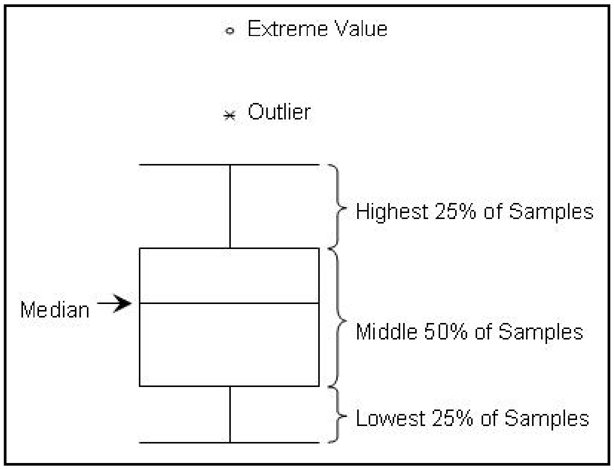


Figure 1-1. Box and Whisker Plot Construction Diagram.

Summary statistics including mean value, median value, minimum value, maximum value, standard deviation, and number of samples are summarized by monitoring station and are presented in various appendices described later. Summary statistics were computed using Microsoft Excel. For the purpose of preparing the summary statistics tables, water quality results that were non-detect are assumed to be one half of the lower laboratory reporting limit. Mean and standard deviation were not calculated for pH values since pH is on a logarithmic scale. Data qualifiers are not included in the summary statistics tables nor the data QA/QC review tables in the appendices. The reader should refer to the final 2009 Tri-State Water Quality Council Monitoring Program Clark Fork—Pend Oreille water quality dataset that was submitted to the National Water Quality Exchange (WQX) Warehouse to review the complete dataset and associated data qualifiers. A condensed version of the 2009 data submittal is included as Appendix J for the reader to review all data results and any applicable data qualifiers.

Note that within this report median values are primarily used to compare values of the same analyte since they are the most representative of multiple data collected over the different monitoring periods. In the case of periphyton monitoring and chlorophyll-a result reporting the mean or average value is the most representative and appropriate value to compare. Due to the collection method the mean chlorophyll-a value is the value that best characterizes the overall chlorophyll-a concentration at the monitoring station. Also as presented in Table 1-1, the State of Montana has adopted a standard for the summer mean chlorophyll-a concentration for portions of the Clark Fork River. For these reasons the mean chlorophyll-a concentration value is discussed in this report.

2.0 WATER QUALITY STATISTICS

This section provides a summary of Tri-State Water Quality Council Monitoring Program water quality data collected in the Clark Fork-Pend Oreille Watershed during 2009. Data was reviewed and statistically analyzed for each of the monitoring program activities except for nutrient monitoring activities on Lake Pend Oreille. IDEQ was unable to submit 2009 nutrient data as part of the program. Presented in this section are:

- Summary of Clark Fork River and Pend Oreille River monthly monitoring activities at six stations including statistics and spatial comparison of water quality data for field and nutrient constituents;
- Summary of Clark Fork River monthly and peak flow monitoring results at three stations of heavy metals constituents including review of water quality statistics, spatial comparison, and comparison of results to acute and chronic metals toxicity standards for Montana and Idaho;
- Summary of Clark Fork River summer nutrient monitoring activities at nine stations including statistics and spatial comparison of water quality results, and comparison of results to Montana water quality nutrient standards and VNRP target concentrations;
- Summary of Clark Fork River below Cabinet Gorge Dam peak flow monitoring results including review of water quality summary statistics and comparison of results to monthly water quality data;
- Summary of Clark Fork River periphyton monitoring results at seven stations including statistics, temporal, and spatial comparisons and review of algal standards attainment; and
- Summary of Lake Pend Oreille monitoring results including Secchi depth measurements at six near shore and three open water stations, and periphyton results at eight near shore stations.

2.1 FIELD CONSTITUENTS SPATIAL COMPARISON

Field constituents were recorded monthly at six monitoring stations in the Clark Fork-Pend Oreille watershed in Washington and Montana. Monthly water quality monitoring in the Clark Fork watershed began in April 2009. The monitoring stations include those identified in Table 1-3 with a sampling frequency of “N12, NM12, and NM18.” Measured constituents include stream temperature (°C), pH (standard units), specific conductance (µS/cm), dissolved oxygen (mg/L), and turbidity (NTU). Oxidation reduction potential (mV) and total dissolved solids (mg/L) were also recorded, but only at the four stations in the lower Clark Fork River. Boxplots presenting spatial patterns of 2009 field constituent data are provided in Appendix B, and summary statistics of water quality results are provided in Appendix C.

2.1.1 TEMPERATURE

Median stream temperature varied from 5.7 °C at station 27.5, Thompson River near mouth, to 12.4 °C at station 29, Clark Fork River at Noxon Bridge. The median temperature at station 30, Clark Fork River below Cabinet Gorge Dam, was nearly as warm with a median temperature of 12.2 °C. Station 55, Pend Oreille River at Metaline Falls had the highest individual temperature reading in the watershed at 24.1 °C, which occurred in August. Differences between stations may partially be due to diurnal differences and the time of day sampling occurred.

2.1.2 PH

Median pH values at the four monthly Clark Fork River monitoring stations varied from 8.05 at station 28, Clark Fork River below Thompson Falls, to 7.85 at station 29, Clark Fork River at Noxon Bridge. Median pH values were slightly higher in the Pend Oreille River varying from 8.36 at station 50, Pend Oreille River at Newport, to 8.33 at station 55, Pend Oreille River at Metaline Falls. Differences in pH at each station may be due to diurnal and seasonal variations, flow rate, temperature, and other factors.

2.1.3 SPECIFIC CONDUCTIVITY

Median specific conductance was lowest at station 27.5, Thompson River near mouth, at 143 µS/cm and highest at station 28, Clark Fork River below Thompson Falls, at 183 µS/cm. There was little variation in specific conductance between the two lower monthly Clark Fork River stations and the Pend Oreille River stations varying from 173 µS/cm at station 29, Clark Fork River at the Noxon Bridge, to 167 µS/cm at station 55, Pend Oreille River at Metaline Falls. Specific conductance in the Clark Fork and Pend Oreille Rivers generally decreased in the downstream direction.

2.1.4 DISSOLVED OXYGEN

Median dissolved oxygen concentrations were highest at station 27.5, Thompson River near mouth, and lowest at station 29, Clark Fork River at Noxon Bridge. The dissolved oxygen concentration at station 30, Clark Fork River below Cabinet Gorge Dam, was nearly the same as at Noxon Bridge. Generally dissolved oxygen concentrations decreased in the downstream direction. Differences in measured dissolved oxygen concentrations may also be affected by diurnal and seasonal variations, flow rate, temperature, and other factors.

2.1.5 TURBIDITY

The highest individual monthly turbidity measurements were recorded at station 28, Clark Fork River below Thompson Falls. Median turbidity values were low at all stations in the watershed. Median turbidity values varied from 0.93 NTU at station 29, Clark Fork River at Noxon Bridge, to 2.57 NTU at station 30, Clark Fork River below Cabinet Gorge Dam.

2.1.6 OXIDATION REDUCTION POTENTIAL

Oxidation reduction potential measurements at the four monthly stations in the Clark Fork River all varied from near zero (-18 mV to 18.1 mV) to greater than 350 mV. Median oxidation reduction potential values ranged from 173.7 mV at station 29, Clark Fork River at Noxon Bridge, to 139.8 mV at station 30, Clark Fork River below Cabinet Gorge Dam. Oxidation reduction potential was not measured in the Pend Oreille River.

2.1.7 TOTAL DISSOLVED SOLIDS

The concentration of total dissolved solids (TDS) was measured at the four monthly stations in the Clark Fork River. The lowest median concentration was at station 27.5, Thompson River near mouth, at 106 mg/L, while the other three Clark Fork River stations were nearly equal and varied from 131 mg/L at station 29, Clark Fork River at Noxon Bridge, to 124 mg/L at station 30, Clark Fork River below the Cabinet Gorge Dam. TDS is an indirect measurement, calculated from specific conductance field readings, using a conversion factor of 0.6 times the specific conductance.

2.2 NUTRIENT CONSTITUENTS SPATIAL COMPARISON

Nutrient samples were collected monthly at six monitoring stations in the Clark Fork-Pend Oreille watershed. Water quality monitoring in the Clark Fork watershed in 2009 began in April. The monitoring stations include those identified in Table 1-3 with a sampling frequency of “N12, NM12, and NM18.” Nutrient samples were collected at each monitoring station and analyzed for constituents outlined in section 1.5 and more specifically in the monitoring program summary chart in Appendix A. Box and whisker plots presenting spatial patterns of 2009 monthly monitoring nutrient concentrations are provided in Appendix B, and summary statistics of the water quality data are provided in Appendix C.

2.2.1 TOTAL NITROGEN

Total nitrogen (TN) or total persulfate nitrogen (TPN) was evaluated at six monthly monitoring stations. In 2009 station 27.5, Thompson River near mouth, had the lowest median total nitrogen concentration at 62 µg/L. The highest median total nitrogen concentration was at station 28, Clark Fork River below Thompson Falls, at 143 µg/L. Overall median total nitrogen concentrations decreased in the downstream direction from station 30, Clark Fork River below Cabinet Gorge Dam (124 µg/L), to station 55, Pend Oreille River at Metaline Falls (84 µg/L).

2.2.2 TOTAL SOLUBLE INORGANIC NITROGEN

Total soluble inorganic nitrogen (TSIN) is a calculated nutrient constituent and is equal to the sum of the concentration of nitrate plus nitrite (NO_2+NO_3 as N) and total ammonia nitrogen (NH_3+NH_4 as N), or:

$$\textbf{\textit{TSIN = NO}}_2\textbf{\textit{+NO}}_3\textbf{\textit{ as N + NH}}_3\textbf{\textit{+NH}}_4^+\textbf{\textit{ as N}}$$

Median 2009 TSIN concentrations increased from a calculated value of 32 µg/L at station 27.5, Thompson River near mouth, and peaked at station 29, Clark Fork River at Noxon Bridge, with a calculated value of 50 µg/L. Median concentrations decreased downstream from station 29, Clark Fork River at Noxon Bridge to the stations 50 and 55, Pend Oreille River at Newport and Metaline Falls, to non-reportable concentrations. Most of the nitrate plus nitrite and ammonia samples collected from the Pend Oreille River were non-detect (less than the laboratory reporting limit of 10 µg/L reported by WDOE) and were statistically and spatially evaluated using a value of one half of the laboratory reporting limit reported by WDOE.

2.2.3 TOTAL PHOSPHORUS

Median total phosphorus concentrations were generally consistent at all of the monthly Clark Fork—Pend Oreille monitoring stations. The greatest variability in individual total phosphorus concentrations occurred at station 28, Clark Fork River below Thompson Falls. Median concentrations varied from a low of 7.7 µg/L at station 28, Clark Fork River below Thompson Falls, to a high of 12.6 µg/L at station 30, Clark Fork River below Cabinet Gorge Dam. In the Pend Oreille River, median concentrations ranged from 8.7 µg/L at station 50, Pend Oreille River at Newport, to 9.5 µg/L at station 55, Pend Oreille River at Metaline Falls.

2.2.4 SOLUBLE REACTIVE PHOSPHORUS

Soluble reactive phosphorus (SRP) was monitored at two of the monthly Clark Fork River monitoring stations: station 27.5, Thompson River near mouth, station 30 Clark Fork River below Cabinet Gorge Dam; and at the two monthly Pend Oreille River monitoring stations. The highest median SRP concentration was at station 27.5, Thompson River near mouth, at 7.62 µg/L. Median SRP concentrations decreased downstream in the watershed to 4.40 µg/L at station 30, Clark Fork River below Cabinet Gorge Dam, to non-reportable concentrations in the Pend Oreille River at stations 50 and 55, Pend Oreille River at Newport and at Metaline Falls, respectively. Most of the SRP results from samples collected from the Pend Oreille River were at non-reportable concentrations (less than the laboratory reporting limit of 3.0 µg/L reported by WDOE) and were statistically and spatially evaluated using a value of one half of the laboratory reporting limit reported by WDOE.

2.3 HEAVY METALS SPATIAL COMPARISON

Heavy metals (total recoverable) samples were collected monthly at three monitoring stations in the lower Clark Fork River. Dissolved heavy metals samples were collected only at station 30, Clark Fork River below Cabinet Gorge Dam. Water quality monitoring in the Clark Fork River began in April 2009 at stations listed in Table 1-3 with a sampling frequency of "NM12 and NM18." Samples were analyzed for constituents outlined in Section 1.5 and more specifically in the monitoring program summary chart in Appendix A. Box and whisker plots presenting the spatial distribution of 2009 heavy metals concentrations are provided in Appendix B, and summary statistics of the water quality data are provided in Appendix C.

2.3.1 TOTAL RECOVERABLE COPPER

During Clark Fork River monthly monitoring, median total recoverable copper concentrations were 2 µg/L at each of the three Clark Fork River monthly metals monitoring stations: station 28, Clark Fork River below Thompson Falls, station 29, Clark Fork River at Noxon Bridge, and at station 30, Clark Fork River below Cabinet Gorge Dam. One sample result, collected in December, at station 28, Clark Fork River below Thompson Falls, had a result below the laboratory reporting limit (1 µg/L). This station also had the highest reported concentration at 22 µg/L, that exceeded Montana acute and chronic metals toxicity standards, which occurred in May. No other results exceeded acute or chronic toxicity standards.

2.3.2 TOTAL RECOVERABLE ZINC

Median 2009 total recoverable zinc concentrations were at or below the laboratory reporting limit of 5 µg/L at each of the three monthly metals monitoring stations. Station 28, Clark Fork River below Thompson Falls, had the greatest variation in results with four results exceeding the laboratory reporting limit. Station 29, Clark Fork River at Noxon Bridge, had one sample result that exceeded the laboratory reporting limit. Station 30, Clark Fork River below Cabinet Gorge Dam, had two sample results exceeding the laboratory reporting limit. No results exceeded acute and chronic metals toxicity standards.

2.3.3 DISSOLVED METALS

Dissolved cadmium, copper, and zinc samples were collected at station 30, Clark Fork River below Cabinet Gorge Dam, in 2009. Median dissolved cadmium and zinc concentrations were less than the laboratory reporting limit. All of the dissolved cadmium sample results were less than the laboratory reporting limit. There were two dissolved zinc samples that exceeded the laboratory reporting limit with one anomalous result. The median dissolved copper concentration was 1.5 µg/L, and there were five sample results exceeding the laboratory reporting limit of 1 µg/L with one anomalous result.

The anomalous results for dissolved copper and zinc exceeded the total recoverable concentrations by one order of magnitude and have been rejected in the database. These data points have not been included in boxplot and statistical summaries. Both anomalous results occurred during December sampling and are further discussed in the data quality assurance section.

2.3.4 HEAVY METALS STANDARDS COMPARISON

Acute and chronic aquatic life toxicity standards for heavy metals: cadmium, copper and zinc, were compared with sample results collected in 2009. Total recoverable copper and zinc concentrations at stations 28 and 29, Clark Fork River below Thompson Falls and Clark Fork River at Noxon Bridge, in 2009 were compared to acute and chronic aquatic life toxicity standards in the Montana Numeric Water Quality Standards, DEQ Circular-7 (Montana DEQ, 2008). Dissolved cadmium, copper and zinc concentrations at station 30, Clark Fork River below Cabinet Gorge Dam, were compared to the Idaho Numeric Criteria for Toxic Substances For Waters Designated for Aquatic Life, Recreation, or Domestic Water Supply Use was used (Idaho Administrative Procedures Act, 2010). The standards are different for Montana and Idaho since the state of Montana uses total recoverable metals concentrations in their numeric water quality criteria for most heavy metals and the state of Idaho uses the dissolved metals concentrations. Both the Montana and Idaho standards use surface water hardness at the time of sampling to calculate the acute and chronic aquatic life toxicity standards for these parameters.

Of the 81 total recoverable and dissolved metals sample results in 2009, there was one sample that exceeded both acute and chronic toxicity standards including those samples collected below Cabinet Gorge Dam during peak flow monitoring. A sample for total recoverable copper (22 µg/L) was collected at station 28, Clark Fork River below Thompson Falls, on May 21, 2009, and exceed the acute standard of 9.26 µg/L and the chronic standard of 6.41 µg/L. There was also an elevated concentration of total recoverable zinc for that sample, but below acute and chronic toxicity standards. The sample was collected during regular monthly monitoring, but occurred at the onset of spring runoff. All other 2009 total recoverable copper and zinc sample results were below the calculated acute and chronic standards for metals toxicity in Montana. All 2009 dissolved copper and zinc sample results were below the calculated acute and chronic standards for metals toxicity in Idaho. All 2009 dissolved cadmium sample results were reported as non-detect (a value less than the laboratory reporting limit) and below the calculated acute standards for metals toxicity. Five of the fifteen dissolved cadmium results that were reported as non-detect were analyzed at a reporting limit above the calculated chronic aquatic life toxicity standards for cadmium. Since no results exceeded chronic toxicity standards it is not expected that any of these results did either. A comparison of total recoverable and dissolved metals concentrations and their calculated standards is provided in Appendix C.

2.4 SUMMER NUTRIENT MONITORING

Intensive summer nutrient monitoring was conducted in the upper and middle portions of the Clark Fork River to evaluate attainment of Clark Fork Basin nutrient standards and targets provided in Table 1-1. Monitoring stations from Silver Bow Creek at Opportunity to the Clark Fork River at Bonita represent the upper Clark Fork River basin, and the stations from the Clark Fork above Missoula to the Clark Fork River above the Flathead River represent the middle Clark Fork River basin. Monitoring was conducted ten times during the compliance period (June 21 and September 21) at nine stations from Silver Bow Creek at Opportunity downstream to the Clark Fork River above the confluence with the Flathead River. The monitoring stations include those identified in Table 1-3 with a sampling frequency of "S10." Nutrient samples were collected at each monitoring station and analyzed for constituents outlined in section 1.5 and more specifically in the monitoring program summary chart in Appendix A. Summer nutrient monitoring activities including field data and water quality sample collection, analysis, and data quality assurance review were conducted by Missoula Waste Water Treatment Plant personnel. Hydrographs of the Clark Fork River at Deer Lodge and the Clark Fork River above Missoula depicting stream flows during the summer sampling dates are provided in Figures H-1 and H-2 in Appendix H. As shown in these figures, the first three sampling events were conducted during the falling limb of the hydrograph, with the majority of samples being collected during base flow conditions.

2.4.1 SUMMER NUTRIENT SPATIAL COMPARISON

Box and whisker plots presenting spatial patterns of 2009 summer nutrient concentrations are provided in Appendix D. Where appropriate, box and whisker plots are shown on two scales to better display the data. Applicable nutrient standards and target concentrations are displayed as horizontal lines on the plots. Summary statistics for all of the 2009 summer nutrient monitoring are provided in Appendix E. Summary of Clark Fork River summer nutrient monitoring water quality results including summary statistics and nutrient standards and target concentrations attainment at individual stations is discussed below.

TOTAL NITROGEN

Median summer total nitrogen (TN) concentrations in 2009 exceeded the nutrient standard value of 300 µg/L at two stations. Station 2.5, Silver Bow Creek at Opportunity had the highest median concentration at 1,924 µg/L. All nine TN results at this station exceeded the TN standard. Station 9, Clark Fork River at Deer Lodge, with a median concentration of 304 µg/L, just exceeded the standard. Four of eight sample results exceeded the TN standard at this station. Median summer total nitrogen concentrations generally decreased in the downstream direction with the exception of an increase in median concentration at station 18, Clark Fork River below Missoula. Station 25, Clark Fork River above Flathead, had the lowest median TN concentration at 142 µg/L.

TOTAL SOLUBLE INORGANIC NITROGEN

Calculated median summer total soluble inorganic nitrogen (TSIN) concentrations in 2009 exceeded the target nutrient concentration of 30 µg/L at three stations. Station 2.5, Silver Bow Creek at Opportunity, had the highest median concentration at 1,436 µg/L and exceeded the target TSIN concentrations ten of ten samples. Station 9, Clark Fork River at Deer Lodge, with a median concentration of 67 µg/L also exceeded the target TSIN concentrations ten of ten samples. Station 18, Clark Fork River below Missoula, with a median concentration of 51 µg/L exceeded the target TSIN concentration seven of ten samples. The Clark Fork River above Missoula had the lowest median TSIN concentration at 14 µg/L.

TOTAL PHOSPHORUS

During Clark Fork River summer nutrient monitoring, median TP concentrations exceeded nutrient standard in each of the five monitoring stations in the upper Clark Fork River and attained the standard below the Clark Fork River-Blackfoot River confluence. Generally median summer TP concentrations decreased in the downstream direction with exceptions of increases in concentration at station 10, Clark Fork River above the Little Blackfoot River and station 18, Clark Fork River below Missoula.

Median summer total phosphorus concentrations in the upper Clark Fork River exceeded the 20 µg/L nutrient standard at each of the five stations from Silver Bow Creek at Opportunity to the Clark Fork River at Bonita. Of the stations in the upper Clark Fork River, station 2.5, Silver Bow Creek at Opportunity, had the highest median total phosphorus concentration at 255.9 µg/L exceeding the TP standard ten of ten samples. Station 7, Clark Fork River below Warm Springs Creek, had a median TP concentration of 40.1 µg/L, exceeding the standard ten of ten samples. Station 9, Clark Fork River at Deer Lodge, had the lowest median concentration at 35.2 µg/L, exceeding the standard seven of ten samples. The other stations in the upper Clark Fork River had slightly higher consistent median TP and exceeded the standard eight of ten samples at station 10, Clark Fork River above Little Blackfoot River, and nine of ten samples at station 12, Clark Fork River at Bonita.

In the Clark Fork River below the Blackfoot River confluence, median summer TP concentrations varied from 9.9 µg/L to 19.9 µg/L. Of the stations below the Blackfoot River, there was one sample result that exceeded the total phosphorus nutrient standard of 39 µg/L. This exceedance occurred at station 18, Clark Fork River below Missoula, on September 3, 2009, with a concentration of 59.7 µg/L. Station 25, Clark Fork River above the Flathead River, had the lowest median concentration during 2009 summer nutrient monitoring.

SOLUBLE REACTIVE PHOSPHORUS

During Clark Fork River summer nutrient monitoring, median SRP concentrations exceeded the SRP target concentration of 6 µg/L at seven of nine stations. The highest median SRP concentration was at station 2.5, Silver Bow Creek at Opportunity, with a concentration of 182 µg/L. Median SRP concentrations generally decreased in the downstream direction. Other Clark Fork River stations that exceeded the SRP target concentration include 1) station 7, Clark Fork

River below Warm Springs Creek, with a concentration of 22.89 µg/L; 2) station 9, Clark Fork River at Deer Lodge, with a concentration of 13.89 µg/L; 3) station 10, Clark Fork River above Little Blackfoot, with a concentration of 18.01 µg/L; 4) station 12, Clark Fork River at Bonita, with a concentration of 14.75 µg/L; 5) station 15.5, Clark Fork River above Missoula with a concentration of 6.69; and 6) station 18, Clark Fork River below Missoula, with median SRP concentration of 7.69 µg/L. Each of the stations 2.5, 7, 9, 10, and 12 exceeded the SRP target concentration ten of ten samples. Of those stations exceeding the target concentration, stations 15.5 and 18 had the median concentrations closest to attaining the SRP target. Station 15.5, Clark Fork River above Missoula, exceeded the SRP target concentration five of ten samples. Station 18, Clark Fork River below Missoula, exceeded the SRP target concentration seven of ten samples. The lowest median SRP concentration during summer nutrient monitoring was at station 25, Clark Fork River above the Flathead River, with a concentration of 3.63 µg/L, where the target concentration was exceeded in only one of ten samples.

2.4.2 SUMMER NUTRIENT STANDARD AND TARGET ATTAINMENT

Individual sample results of the 2009 summer nutrient monitoring were reviewed to evaluate the attainment of nutrient standards and target concentrations in the Clark Fork Basin presented in Table 1-1. The number and percentage of samples exceeding Clark Fork Basin nutrient standards and target concentrations at each of the summer monitoring stations are summarized in Table 2-1. Although station 2.5, Silver Bow Creek at Opportunity, is upstream of the regulated Clark Fork Basin nutrient standards in ARM 17.30.631, it is discussed above and results of nutrient attainment are summarized below since it is a direct source to the upper Clark Fork River.

Generally, 2009 summer nutrient monitoring results for TN, TSIN, TP, and SRP exceeded state of Montana nutrient standards and VNRP target concentrations more in the upper Clark Fork River (upstream of the Clark Fork River – Blackfoot River confluence) than in the Clark Fork River above Missoula downstream to above the Flathead River. Nutrient concentrations generally decreased in the downstream direction.

Table 2-1. Summer Monitoring 2009 Nutrient Standards and Target Concentrations Attainment Summary

Station	Total Nitrogen (Nutrient Standard)		Total Soluble Inorganic Nitrogen (Nutrient Target)		Total Phosphorus (Nutrient Standard)		Soluble Reactive Phosphorus (Nutrient Target)	
	# above	% above	# above	% above	# above	% above	# above	% above
Silver Bow Ck at Opportunity	9	100%	10	100%	10	100%	10	100%
Clark Fork below Warm Springs Ck	0	0%	5	50%	10	100%	10	100%
Clark Fork at Deer Lodge	4	50%	10	100%	7	70%	10	100%
Clark Fork above Little Blackfoot River	3	33%	3	30%	8	80%	10	100%
Clark Fork at Bonita	2	22%	1	10%	9	90%	10	100%
Clark Fork above Missoula	0	0%	0	0%	0	0%	5	50%
Clark Fork below Missoula	0	0%	7	70%	1	10%	7	70%
Clark Fork at Huson	2	22%	4	40%	0	0%	4	40%
Clark Fork above Flathead	0	0%	1	10%	0	0%	1	10%

Notes:
Ck Creek
Clark Fork Clark Fork River

2.5 CABINET GORGE DAM PEAK FLOW MONITORING

Additional water quality monitoring was conducted at station 30, Clark Fork River below Cabinet Gorge Dam, during annual peak flow conditions. Six samples were collected by Avista Corporation personnel between May 25 and June 12, 2009, and analyzed for constituents provided on the monitoring program summary chart in Appendix A, at Station 30, Clark Fork River below Cabinet Gorge Dam. A hydrograph of the Clark Fork River below Cabinet Gorge Dam depicting stream flows during the peak flow sampling dates are provided in Figure H-3 in Appendix H. As shown in the figure, half of the samples were collected during the rising limb and at the peak of the hydrograph and the other half on the falling limb just after peak flow. Sample collection is intended to be focused on the rising limb and peak of the hydrograph.

Median nutrient and metals concentrations collected during peak flow monitoring and comparison of those values with median monthly monitoring concentrations are summarized in Table 2-2. Median nutrient and metals concentrations at station 30, Clark Fork River below Cabinet Gorge Dam, during the peak flow monitoring tended to exceed those collected during the monthly monitoring except for hardness and dissolved metals concentrations. Dissolved cadmium concentrations for all sample results during peak flow and monthly monitoring were below the laboratory reporting limit, but are shown differently in Table 2-2 due to variations in the laboratory reporting limit. Median concentrations of dissolved copper and zinc were equal during peak flow and monthly monitoring. Summary statistics for all of the 2009 Cabinet Gorge Dam peak flow monitoring results are provided in Appendix C.

Table 2-2. Summary of 2009 Median Nutrient and Metal Concentrations in the Clark Fork River below Cabinet Gorge Dam

Constituent	Monthly Monitoring Median Concentration [2]	Peak Flow Monitoring Median Concentration [2]
Ammonia-nitrogen (µg/L)	7	24
Inorganic nitrogen (nitrate and nitrite) (µg/L)	34.6	42.3
Soluble Reactive Phosphorus (SRP) (µg/L)	4.40	12.28
Phosphate-phosphorus (µg/L)	12.6	20.3
TSIN (µg/L)	43	73
Total Nitrogen (µg/L)	124	177
Total Hardness as $CaCO_3$ (mg/L)	91.3	56.3
Cadmium Dissolved (µg/L) [1]	<0.5	<0.04
Copper Dissolved (µg/L)	2	2
Copper Total Recoverable (µg/L)	2	3.5
Zinc Dissolved (µg/L)	<5	<5
Zinc Total Recoverable (µg/L)	<5	5.5

[1] All dissolved cadmium results were below laboratory reporting limits; differences in median concentrations are due to variations in the reporting limit.
[2] For the purpose of preparing summary statistics, non-detectable water quality results are assumed to be one half of the laboratory reporting limit, and here reported as "<" the laboratory reporting limit.
µg/L-micrograms per liter; mg/L-milligrams per liter

2.6 CLARK FORK RIVER PERIPHYTON STATISTICS

Periphyton samples were collected at seven Clark Fork River stations during 2009 from the Clark Fork River at Deer Lodge to the Clark Fork River above the Flathead River. Collection of periphyton standing crop occurred twice at each station, once in August and once in September. The monitoring stations include those identified in Table 1-3 with a sampling frequency of "P10." Periphyton sampling activities included sample collection, analysis, and data quality review and were conducted by University of Montana Watershed Health Clinic personnel under the direction of Dr. Vicki Watson. Roughly twenty samples were collected at prescribed stratified locations at each station, and were analyzed for:

- Chlorophyll-a in milligrams per square meter (mg/m^2)
- Ash-free Dry Weight (AFDW) in grams per square meter (g/m^2)

The samples measure the chlorophyll-a and AFDW concentrations from individual specific locations collected within the Clark Fork River. The samples were averaged to characterize algal concentrations of the river at that station at the time of sampling. Average values computed for each sampling event (August and September mean) were further averaged to arrive at the "summer mean" chlorophyll-a and AFDW concentrations for each station.

2.6.1 PERIPHYTON TEMPORAL COMPARISON

Results of Clark Fork River 2009 periphyton sampling are summarized in Appendix G. As shown in Figure G-1, chlorophyll-a concentrations were greater in September than in August at each station. The greatest increases were recorded at station 9, the Clark Fork River at Deer Lodge, where concentrations increased from 181 mg/m^2 in August to 503 mg/m^2 in September and at station 18, the Clark Fork River below Missoula, where concentrations increased from 38 mg/m^2 to 361 mg/m^2. Figure G-2 compares 2009 summer mean chlorophyll-a concentrations to summer mean concentrations between stations.

Clark Fork River 2009 AFDW concentrations were higher at most stations in September than in August. The largest increases in AFDW concentrations occurred at station 9, Clark Fork River at Deer Lodge, ranging from 50 g/m^2 to 92 g/m^2, at station 18, Clark Fork River below Missoula, ranging from 10 g/m^2 to 41 g/m^2, and at station 25, Clark Fork River above Flathead, ranging from 7 g/m^2 to 19 g/m^2. At two stations, a decrease in AFDW concentration was noticed. The concentrations at station 12, Clark Fork River at Bonita, decreased from 111 g/m^2 to 56 g/m^2 and decreased at station 10, Clark Fork River above Little Blackfoot, from 96 g/m^2 to 88 g/m^2. AFDW concentrations are summarized in Table G-2 and Figure G-3.

2.6.2 PERIPHYTON SPATIAL COMPARISON

Spatially chlorophyll-a concentrations in the Clark Fork River in 2009 generally decreased in the downstream direction as shown in Figure G-1. The highest concentration for any one month and summer mean both occurred furthest upstream at station 9, the Clark Fork River at Deer Lodge, at 503 mg/m^2 and 342 mg/m^2, respectively. Summer mean concentrations at station 12, Clark Fork River at Bonita, station 18, Clark Fork River below Missoula, were higher than the station immediately upstream. The lowest concentration for any one month and summer mean occurred furthest downstream at station 25, the Clark Fork River above Flathead, at 23 mg/m^2 and 37 mg/m^2, respectively.

Summer mean AFDW concentration in the Clark Fork River in 2009 was greatest at station 10, Clark Fork River above Little Blackfoot River, at 92 g/m^2 and decreased downstream to station 22, Clark Fork River at Huson, and station 25, Clark Fork River above Flathead River, at 12 and 13 g/m^2, respectively. The highest concentration in any one month occurred at station 12, Clark Fork River at Bonita, at 111 g/m^2 as shown in Figure G-3.

2.6.3 BENTHIC ALGAL CHLOROPHYLL-A STANDARDS ATTAINMENT

The August and September chlorophyll-a concentrations at each station are compared to the Clark Fork River summer maximum benthic algal chlorophyll-a standard of 150 mg/m^2. The summer mean chlorophyll-a concentration at each station is compared to the Clark Fork River summer mean benthic algal chlorophyll-a standard of 100 mg/m^2. Clark Fork River standards for benthic algal chlorophyll-a are provided in Table 1-1. Clark Fork River 2009 chlorophyll-a results and attainment summary are provided in Table 2-3 in Figure G-2 in Appendix G.

Table 2-3. Clark Fork River 2009 Chlorophyll-a Standards Attainment Summary

Station	August (mg/m^2)	September (mg/m^2)	Summer Mean (mg/m^2)
Clark Fork at Deer Lodge	181	503	342
Clark Fork above Little Blackfoot	102	126	114
Clark Fork at Bonita	145	226	185
Clark Fork above Missoula	117	148	133
Clark Fork below Missoula	38	361	199
Clark Fork at Huson	39	51	45
Clark Fork above Flathead	23	52	37
Standard (mg/m^2)	*150*	*150*	*100*
# Sites Above Standard	*1*	*3*	*5*
Percent Exceeding Standard	*14%*	*43%*	*71%*

Notes:
Chlorophyll-a Maximum Standard Value for any one site at one given time is 150 mg/m^2
Chlorophyll-a Mean Standard Value for any one site over the summer season is 100 mg/m^2
Concentrations exceeding respective standard values are highlighted
mg/m^2-milligrams per square meter, Clark Fork-Clark Fork River
Standards established by Administrative Rules of Montana (ARM) 17.30.631 for benthic algal chlorophyll-a, Clark Fork River Warm Springs Creek to Flathead River, from June 21 to September 21

As shown in Table 2-3, the summer maximum chlorophyll-a standard of 150 mg/m^2 was exceeded at station 9, Clark Fork River at Deer Lodge, in August (181 mg/m^2) and three stations in September, station 9, Clark Fork River at Deer Lodge; station 12, Clark Fork River at Bonita; and at station 18, Clark Fork River below Missoula. The summer mean chlorophyll-a standard of 100 mg/m^2 was exceeded at five of the 7 monitoring stations in 2009. Station 22, Clark Fork River at Huson and station 25, Clark Fork River above Flathead River, were the two stations attaining the summer mean standard.

2.7 LAKE PEND OREILLE NUTRIENTS, SECCHI DEPTH, AND PERIPHYTON

Nutrient monitoring in Lake Pend Oreille occurred as described in Section 1.2, monitoring program activities. The IDEQ has not completed data quality review and validation, and no schedule to complete the data validation is proposed. At the direction of the IDEQ most of the data collected in 2009 is not included in this report. The IDEQ reported results from Secchi depth measurements at three open water and six near shore sites, and from periphyton standing crop collection at eight near shore sites on Lake Pend Oreille. The IDEQ is preparing a separate trends report for Lake Pend Oreille water quality monitoring completed from years 2005 to 2010. The report will be available on the Tri-State Water Quality and IDEQ websites.

SECCHI DEPTH

Lake Pend Oreille Secchi depth measurements in 2009 are summarized in Table F-1 and Figure F-1 in Appendix F. Secchi depth measurements were collected monthly from June to September at six near shore and three open water stations. Measurements in June were at the lowest of each of the months measured at each of the monitoring stations. Secchi depth measurements increased each month and peaked in August. Stations with the greatest Secchi measurements were at Bayview open water at 14.1 meters, Pend Oreille North at 11.4 meters, Bayview near shore at 11 meters, and Midlake at 9 meters. The measurement at Garfield Bay in June had the lowest recorded measurement at 1.2 meters. There were a number of measurements that were limited by the bottom depth of the Lake including: one occurrence in June at Sunnyside, five occurrences in August at Garfield Bay, Lakeview, Oden Bay, Sunnyside, and Talache, and three occurrences in September at Lakeview, Sunnyside, and Talache. Secchi depth measurements were not taken at nearby deeper locations.

PERIPHYTON MONITORING

Periphyton samples were collected at eight near shore stations on Lake Pend Oreille in 2009. Chlorophyll-a and AFDW results from Lake Pend Oreille periphyton monitoring are summarized below in Table 2-3. Samples were collected at the sites on September 16, 17 and 29, 2009. Seven to eleven replicate samples were collected at each station and were analyzed by the University of Montana Watershed Health Clinic. The highest chlorophyll-a and AFDW concentrations in 2009 were at Oden Bay with a chlorophyll-a concentration of 35.3 mg/m^2. The Lake Pend Oreille Talache site had non-detectable results for chlorophyll-a and AFDW.

Table 2-4. Lake Pend Oreille 2009 Periphyton Monitoring, Chlorophyll-a and Ash Free Dry Weight Results Summary

Monitoring Station	Chlorophyll-a (mg/m^2)	AFDW (g/m^2)
Lake Pend Oreille: Bayview	6.0	3.6
Lake Pend Oreille: Garfield Bay	9.5	5.7
Lake Pend Oreille: Talache	0.1	0.2
Lake Pend Oreille: Lakeview	1.9	0.9
Lake Pend Oreille: Oden Bay	35.3	27.8
Lake Pend Oreille: Springy Point	9.8	6.5
Lake Pend Oreille: Sunnyside	5.3	2.1
Lake Pend Oreille: Trestle	8.4	9.4

mg/m^2 milligrams per square meter
g/m^2 grams per square meter
AFDW ash free dry weight

3.0 DATA QUALITY ASSURANCE REVIEW

A data quality assurance (QA) review has been completed on all data included in this report. HydroSolutions completed a QA review on all Clark Fork River monthly monitoring data, peak flow monitoring below Cabinet Gorge Dam data, and portions of the Clark Fork River summer nutrient monitoring data. QA reviews have been completed by monitoring program sponsoring organizations identified in Table 1-2.

The QA review in the following sections applies to monthly monitoring conducted in the Clark Fork River, peak flow monitoring in the Clark Fork River below Cabinet Gorge Dam, and portions of the Clark Fork River summer nutrient monitoring (including data quality objectives field precision, field sensitivity, and completeness; and data logic check).

The QA review was completed using guidance outlined in the latest Clark Fork River Watershed Monitoring Program Quality Assurance Project Plan (QAPP) and follows the MDEQ Quality Assurance Quality Control (QAQC) Checklist (Tri-State Water Quality Council, 2010b). The QA review also includes:

- Review of chain-of-custody forms and laboratory data sheets to verify that appropriate analyses were run and that the samples were analyzed within specified holding times;
- A comprehensive review of the sample delivery group to evaluate the overall quality of the data including potential transcription errors, detection or reporting limit discrepancies, data omissions, and suspect or anomalous values;
- Review of field data noting and explaining anomalous or suspect values; and
- Sample logic checks noting instances where dissolved sample fractions exceeded total concentrations.

3.1 SAMPLE HANDLING

3.1.1 CONDITION OF SAMPLES UPON RECEIPT

Sample handling followed guidance outlined in the QAPP. After the sample was collected, it was immediately placed on ice in a cooler for delivery to the laboratories. All samples were collected in containers provided by the respective laboratories and were delivered intact. The laboratories did not report any sample handling discrepancies for sample preservation. The laboratories did note that a sample collected during Clark Fork River peak flow monitoring below Cabinet Gorge Dam appeared to have been “switched” (field duplicate labeled as a field blank).

3.1.2 ALL FIELD DOCUMENTATION COMPLETE

Site visit forms and chain of custody forms were completed for each of the monthly sampling events completed by HydroSolutions. These forms were reviewed following completion of each event by the HydroSolutions project manager. Field notes were also recorded in a log book for each of the monthly sampling events. Site visit forms, chain of custody forms, and field notes are maintained in paper and digital format by HydroSolutions in their Helena office.

3.1.3 HOLDING TIMES MET

Analytical holding times were reviewed for Clark Fork River monthly, peak flow, and summer nutrients monitoring. Analytical holding times for all samples were met for monthly and peak flow monitoring. During Clark Fork River summer nutrient monitoring, total persulfate nitrogen samples were collected but not analyzed until after the holding times expired. These results have been qualified with an “H” flag in the Montana Equis Water Quality Exchange (MT-eWQX) database.

3.1.4 FIELD QUALITY CONTROL SAMPLE COLLECTION FREQUENCY

For the Clark Fork River monthly monitoring, one field duplicate sample and one field blank were collected during each month to meet the frequency specified in the QAPP. For the peak flow monitoring below Cabinet Gorge Dam, one field duplicate sample and one field blank sample were to be collected during the six sampling events. However, field duplicate samples for hardness and total recoverable copper and zinc; and field blank samples for hardness; dissolved copper, zinc, and cadmium; and total persulfate nitrogen were omitted by Avista Corporation sampling personnel.

For the summer nutrient monitoring, one field duplicate and one field blank sample were collected at each of nine stations during the ten events. Field blank samples for total nitrogen and total phosphorus were not collected, but trip blank samples for these analytes were collected. During summer nutrient monitoring a trip blank was prepared for each day sampling occurred (typically two days per event), including total nitrogen and total phosphorus. A summary of the number and frequency of field duplicate and field blank samples collected during the monthly, peak flow, and summer nutrient monitoring is provided in Appendix I, Tables I-1 and I-2 respectively.

3.1.5 SAMPLE IDENTIFICATION

Sample identification matched those specified in Table 1-3 and in the QAPP. In order to conform to the MT-eWQX system, the sampling date and activity code were added to each of the sample identification names (example: CFR-30-121709-S). The “S” is an activity code that indicates the sample is a routine sample. Other activity codes include: QC-FD and QC-FB, indicating field duplicate and field blank quality control samples respectively.

During the 2009 peak flow monitoring completed by Avista Corporation personnel, the field blank and field duplicate sample appears to have been mislabeled for total phosphorus. Also during peak flow monitoring, not all sample labels were completely legible by the laboratories. The impact of sample mislabeling on the 2009 peak flow data was mitigated through timely communication and chain of custody review by HydroSolutions Inc, the State and Missoula Laboratories, and Avista Corporation personnel, resulting only in the loss of reliable field quality control samples.

3.2 METHODOLOGY

3.2.1 LABORATORY AND FIELD METHODS

Laboratory and field methods were completed as described in the QAPP.

3.2.2 LABORATORY REPORTING LIMIT

The laboratory reporting limits for all analytes met the project-required reporting limit. A summary of analytes, the laboratory reporting limit, and their project required reporting limit is provided in Table 1-5.

3.2.3 LABORATORY QUALITY CONTROL FREQUENCY

Laboratory quality control samples including laboratory duplicate, blank, matrix spike, and laboratory control samples were analyzed at a frequency following criteria specified in the analytical method or as described in the Laboratory's Quality Assurance Plan (LQAP).

The State Laboratory completed one quality control sample each for every analyte each month. In total, 72 quality control samples were completed. Including the field duplicate and field blank samples, the State Laboratory completed 388 total analytical results (excluding calculations for total hardness) for an overall quality control sample frequency of 19 percent. Quality control sample analysis frequency completed in 2009 for the State Laboratory is summarized in Appendix I, Table I-3a.

Missoula Waste Water Treatment Plant Laboratory quality control samples were reviewed as part of this report for the monthly and peak flow monitoring activities. Laboratory quality control samples for the summer nutrient monitoring were reviewed separately by the Missoula Laboratory prior to submittal of final results. The Missoula Laboratory completed instrument and procedure duplicates, laboratory control standards (low and mid range), external control standards, and matrix spikes. The Missoula Laboratory analyzed laboratory duplicate samples at a frequency of 35 percent, low range control standards at 18 percent, mid range control standards at 85 percent, external control standards at 140 percent, and matrix spike samples at 16 percent. Quality control sample analysis frequency completed in 2009 for the Missoula Laboratory is summarized in Appendix I, Table I-3b.

3.3 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) for the monitoring program are described in the QAPP (TSWQC, 2010b). DQOs for measurement data also referred to as data quality indicators, include precision, accuracy, measurement range (sensitivity), representativeness, completeness, and comparability. DQOs for the Clark Fork-Pend Oreille monitoring program are addressed below.

3.3.1 PRECISION

Precision refers to the degree of variability in repeat measurements of the same property. Precision for laboratory analyses of samples are evaluated through laboratory reporting of relative percent differences (RPDs) in duplicate sample analyses. Precision for constituents measured in the field are evaluated by conducting repeat measurements. RPD is calculated as follows:

$$RPD = (O-D) / ((O+D)/2) \times 100$$

Where:
O = original, and
D = duplicate

LABORATORY PRECISION

Laboratory precision is measured by assessing results of laboratory duplicate samples. As described in the QAPP, the criteria used to assess analytical method precision are:

Water Chemistry 20 % RPD for duplicate results > 5 times the reporting limit

The State Laboratory completed one laboratory duplicate sample for each analyte each month. There were a total of 72 laboratory duplicate samples analyzed. None of the duplicate samples exceeded laboratory precision criteria.

Missoula Waste Water Treatment Plant Laboratory analyzed 81 instrument duplicate and 17 procedure-duplicate samples for monthly and peak flow monitoring. The procedure-duplicate samples were completed as part of the total phosphorus analysis. There was one instrument duplicate that exceeded 20 percent RPD, but did not exceed laboratory precision criteria.

A summary of the frequency of laboratory duplicates analyzed is provided in Appendix I, Table I-4.

FIELD (OVERALL) PRECISION

Overall precision is measured by assessing results of co-located field duplicate samples. As described in the QAPP, the criteria used to assess overall precision are:

Water Chemistry 25 % RPD for duplicate results > 5 times the reporting limit

Data are associated by the day or event that they are collected. Of the 161 original-duplicate pairs reviewed, there were a total of 11 field duplicate samples that exceeded the above data quality objectives. The data associated with these duplicates have been qualified as “J” (estimated value). Field duplicates exceeding precision criteria are summarized in Appendix I, Table I-5a and I-5b.

Dissolved copper and zinc results at station 30 collected on December 17, 2009 were an order of magnitude higher than typical results at the station. These results have been rejected and are qualified with an “R”. Field blank and field duplicate results do not indicate abnormalities. The following comment for the results has been entered into the MT-eWQX database: “reason for anomalous value unknown”.

3.3.2 LABORATORY ACCURACY

Accuracy is the combination of high precision and low bias. It is measured by assessing how close an analytical measurement is to its "true" value. The tool for assessing accuracy of measurements is the recovery of known concentrations through matrix spikes of field samples and in standard concentration solutions of Laboratory Control Samples (LCS) to establish method accuracy. Accuracy is determined by percent recovery as follows:

%Recovery for matrix spikes = ((SSR – SR)/SA) x 100

Where:
SSR = spiked sample result,
SR = sample result, and
SA = spike amount added

%Recovery for control standards = (FC/TC) x 100

Where:
FC = found concentration, and
TC = true concentration

There are two levels of assessing accuracy in the quality control process:

1) the method or laboratory controls represented by laboratory control samples; and

2) the sample represented by matrix spikes and matrix spike duplicate samples.

The QAPP established an accuracy goal of plus or minus 10 percent for water chemistry analyses.

Of the 72 matrix spike samples analyzed, one total recoverable copper matrix spike recovery that was analyzed in June missed the goal with an 88 percent recovery. Of the 72 laboratory control samples reported from the State Laboratory, no result exceeded the accuracy goal.

Missoula Laboratory analyzed a total of 255 laboratory control samples including low and mid range control standards and external control standards for monthly and peak flow monitoring. Of the 255 control samples analyzed, 26 samples exceeded the QAPP’s +-10 percent recovery goal. Of those samples only 2 exceeded the laboratory's acceptable recovery range for the method, but were within 15 percent recovery. Another 3 of those samples were below laboratory's calculated method detection limit. The remaining samples were within the laboratory's acceptable recovery range. The Missoula Laboratory analyzed 37 matrix spike samples for monthly and peak flow monitoring. There were six matrix spike samples that exceeded the QAPP's ±10 percent recovery goal, but all matrix spike recoveries were within laboratory quality control standards.

No results have been qualified due to accuracy. A summary of matrix spike and quality control sample results is presented in Appendix I, Table I-4.

3.3.3 MEASUREMENT RANGE OR SENSITIVITY

Measurement Range or Sensitivity refers to the limit of a measurement to reliably detect a characteristic of a sample. For analytical methods, sensitivity is expressed as the method detection limit (MDL). Laboratories determine their MDLs annually and routinely check each method's ability to achieve this level of sensitivity using negative controls through method blanks, continuing calibration blanks, and laboratory reagent blanks. For field data, sensitivity is assessed through the preparation and analysis of field blanks.

LABORATORY SENSITIVITY

Sensitivity quality controls for all laboratory methods follow the frequency and criteria specified in the analytical method or as described in the LQAP. In reviewing the State Laboratory's 2009 quality control report, there were no laboratory blank samples that exceeded the laboratory's LQAP standard and all sample results were not detected. A summary of laboratory accuracy results is presented in Appendix I, Table I-4.

The Missoula Laboratory does not analyze blank samples as part of their QA check standard. However blank samples are analyzed in developing their methods standards curve. There were no anomalies reported by the Missoula Laboratory in terms of laboratory sensitivity. No results have been qualified due to laboratory sensitivity.

FIELD SENSITIVITY

The sensitivity of field meters used in the monitoring of field constituents during monthly and summer nutrient monitoring are specified in the respective manuals for the YSI 556 water quality probe and Hach 2100P turbidimeter, provided in the QAPP (2010). Project measurement limits for chemical analyses are provided in Table 1-5. The criteria used to assess field method sensitivity for water samples is:

Field method controls (Field Blank) < Project Required Quantitation Limit

For field blanks that exceed this criteria, all associated project data less than ten times the detected value are qualified as "B", indicating analytical detection of the field blank. Of the 165 field blank samples analyzed, there were ten field blank results that exceeded the above data quality objectives and associated data has been flagged. Data are associated by the day or event that they are collected. Field blanks exceeding field sensitivity criteria are summarized in Appendix I, Table I-6a and I-6b.

During the Clark Fork River summer nutrient monitoring, trip blanks were collected for each day that samples were collected. Results of the 76 trip blank samples were reviewed and none exceeded sensitivity criteria.

3.3.4 SAMPLE REPRESENTATIVENESS

Representativeness is the extent to which the measurements actually represent the true environmental conditions in time and space. The study design directs measurements of field parameters and chemical analyses to be collected at benchmarked locations by wading from the bank. The sampling locations were chosen to best represent the reach of interest and to minimize any potential site-specific bias. Given the high volume and flow of water and large cross sectional area of the river, heterogeneous distribution of water and sediment do exist. This is especially true of Clark Fork River peak flow monitoring below Cabinet Gorge Dam when suspended sediment concentrations are elevated and not evenly distributed throughout the water column, primarily affecting sediment associated parameters such as phosphorus and metals.

For 2009 monitoring, sample representativeness was first achieved through the study design, and secondly through the sampler’s consistency in executing the study design. During 2009 monitoring, samplers followed guidance outlined in the QAPP and collected all samples from designated locations.

3.3.5 SAMPLE COMPLETENESS

Completeness is the comparison between the amounts of data that has been planned to be collected versus how much usable data were actually collected, expressed as a percentage. Data may be determined to be unusable (Rejected) in the validation process or lost due to sampler or laboratory error. Loss of more than 10 percent of the data points in a calendar year would have a significant effect on the annual trendline; therefore, the QAPP established project completeness at 90 percent. Sample completeness for each activity of the 2009 monitoring program is summarized in Appendix I, Tables I-7 to I-12.

Clark Fork River monthly monitoring began in April instead of January as in typical monitoring years, resulting in no data collection from January through March 2009. Sample completeness for 2009 was evaluated using data collected from April through December and is presented in Appendix I, Table I-7a and 7b. During data validation, there were three pH values that were rejected and the pH completeness for stations 27.5, 28, and 29 is 89 percent. One dissolved copper and one dissolved zinc value from station 30 was rejected; the completeness for those constituents is 89 percent. All other constituents exceeded the established sample completeness goal.

The established sample completeness goal of 90 percent was exceeded for all constituents for Pend Oreille River monthly monitoring, although the Pend Oreille River at Metaline Falls was sampled eleven times instead of the scheduled twelve. Project completeness is summarized in Appendix I, Table I-8.

Secchi depth and periphyton monitoring results were provided from IDEQ for 2009 Lake Pend Oreille monitoring. The completeness goals for Lake Pend Oreille monitoring are summarized in Appendix I, Table I-9. Completeness for Secchi depth was met. Periphyton standing crop was collect at eight of nine stations during periphyton monitoring on Lake Pend Oreille and is assessed at a completeness of 89 percent just shy of the goal. The completeness goals for other constituents were not evaluated.

During peak flow monitoring at Cabinet Gorge, project completeness was 100 percent for all parameters except for total phosphorus in which there are five of six sample results, or 83 percent completeness. Project completeness is summarized in Appendix I, Table I-10.

During Clark Fork River summer nutrient monitoring completeness was met for all constituents except total persulfate nitrogen (TPN), summarized in Appendix I, Table I-11. The completeness target of 90 percent for TPN was met at all individual sample sites except for the Clark Fork River at Deer Lodge, which received completeness of 80 percent. Overall TPN completeness for summer monitoring was 89 percent.

The established sample completeness goal of 90 percent was exceeded for chlorophyll-a and AFDW for Clark Fork River periphyton sampling and is summarized in Appendix I, Table I-12.

3.3.6 SAMPLE COMPARABILITY

Sample comparability was achieved for this project through consistent sampling locations, procedures, and analyses as outlined in the QAPP (TSWQC, 2010).

3.4 LOGIC CHECKS

Logic checks were performed to further validate the 2009 monitoring data. If logic checks were violated, then associated data values are flagged and in some cases rejected. The following logic checks were reviewed:

- Total phosphorus greater than soluble reactive phosphorus
- Total nitrogen greater than nitrate/nitrite plus ammonia or TSIN

- Total recoverable greater than dissolved for metals constituents

PHOSPHORUS: TOTAL AND SOLUBLE REACTIVE

Associated total phosphorus (TP) and soluble reactive phosphorus (SRP) concentrations were reviewed for all 2009 monitoring data. There were three sample pairs in which the soluble concentration exceeded the total concentration. Two of the sample pairs were within the range of analytical error (± 10%) as discussed with the Missoula Waste Water Treatment Plant Laboratory. The SRP sample collected during Clark Fork River monthly monitoring at station 27.5, Thompson River near mouth, on June 16, 2009 is outside the range of analytical error. Instrument duplicate and matrix spike samples were completed and passed laboratory quality control standards. All of these results have been flagged for discussion with MDEQ and the Tri-State Water Quality Monitoring Committee for final decision regarding data validity. TP-SRP logic check is summarized in Table I-13 in Appendix I.

NITROGEN: TOTAL AND SOLUBLE INORGANIC

Associated total nitrogen (TN) and total soluble inorganic nitrogen (TSIN) concentrations were reviewed for all 2009 monitoring data. There are three sample pairs in which the soluble concentration exceeded the total concentration. These occurred during Clark Fork River monthly monitoring as station 27.5, Thompson River near mouth, on August 19, September 9, and November 19, 2009. These total nitrogen samples were analyzed at the State Laboratory and ammonia and nitrate plus nitrite samples were analyzed at the Missoula Waste Water Treatment Plant. All of these results have been flagged in the MT-eWQX database for discussion with MDEQ and the Tri-State Water Quality Monitoring Committee for final decision regarding data validity. TN-TSIN logic check is summarized in Table I-14 in Appendix I. Total nitrogen results from the Clark Fork River Summer nutrient monitoring were analyzed by the Missoula Laboratory. All of these results passed the TN-TSIN logic check.

METALS: TOTAL RECOVERABLE AND DISSOLVED COPPER AND ZINC

Associated total recoverable and dissolved copper and zinc concentrations were reviewed for all 2009 monitoring data. Analytical results for two total recoverable and dissolved sample pairs for copper and two for zinc reported dissolved concentrations exceeding the total recoverable concentration. These occurred at station 30, Clark Fork River below Cabinet Gorge Dam, on three separate dates: June 6 (peak flow sample), September 9, and December 17, 2009. The December dissolved copper and zinc concentrations are anomalous as discussed earlier and are rejected. All of these results have been flagged for discussion with MDEQ and the Tri State Water Quality Monitoring Committee for final decision regarding data validity. Total recoverable and dissolved copper and zinc data quality logic checks are summarized in Tables I-15 and I-16 in Appendix I.

3.5 DATA QUALITY REVIEW SUMMARY

The QA review presented above applies to Clark Fork River monthly monitoring, Clark Fork River peak flow monitoring below Cabinet Gorge Dam, and portions of the Clark Fork River summer nutrient monitoring (including data quality objectives field precision, field sensitivity, and completeness; and data logic check) in 2009. A summary of that data quality review is provided below.

SAMPLE HANDLING

1) Several sample bottles were mislabeled or labels were not legible during Clark Fork River peak flow monitoring below Cabinet Gorge.
2) Field documentation was not completed during the Clark Fork River peak flow monitoring below Cabinet Gorge Dam.
3) Total persulfate nitrogen results for Clark Fork River summer nutrient monitoring exceeded holding times.
4) Not all field quality control samples (field duplicate and field blanks) were collected during Clark Fork River peak flow and summer nutrient monitoring.

METHODOLOGY

5) All field and analytical methods were carried out as prescribed in the QAPP (TSWQC, 2010).
6) Analytical reporting limits were met for all analytes.
7) The number and frequency of laboratory quality control samples met standards specified for the analytical method or for the laboratory's LQAP.

DATA QUALITY OBJECTIVES

8) Laboratory precision criteria for analytes were achieved at both the State and Missoula laboratories. A complete list of laboratory duplicate sample analysis results for the State Laboratory and Missoula Laboratory can be found in Appendix I, Tables I-17 and I-18, respectively.
9) Field precision was assessed by reviewing field duplicate samples. Of the 161 original-duplicate pairs reviewed, there were a total of eleven 2009 field duplicate samples that exceeded field precision criteria. The data associated with these duplicates have been qualified with a "J" estimated flag. A complete list of field duplicate results and the associated RPDs can be found in Appendix I, Table I-19.
10) Laboratory accuracy was assessed by reviewing laboratory quality control reports for results of control samples and matrix spike samples. For the State Laboratory, no laboratory control samples were outside of established limits, and one total recoverable copper matrix spike was slightly outside of accuracy limits. For the Missoula Laboratory, 26 of 255 laboratory control standard samples exceeded the QAPP's ±10 percent recovery goal. Of those samples only 2 of those samples exceeded the laboratory's acceptable recovery range, but were within 15 percent recovery for the method. Another 3 of those samples were below the laboratory's calculated method detection limit. The remaining samples were within the laboratory's acceptable recovery range. There were six of 37 matrix spike samples that exceeded the QAPP's ±10 percent recovery goal, but all matrix spike recoveries were within laboratory quality control standards. No results were qualified due to accuracy. A complete list of laboratory QA sample analysis results

for accuracy (matrix spike and laboratory control samples) can be found in Appendix I, Tables I-17 and I-18, respectively.

11) Laboratory sensitivity was assessed by reviewing results of laboratory quality control reports. All laboratory blanks from the State Laboratory were reported less than the laboratory reporting limit. A complete list of State Laboratory QA sample analysis results for sensitivity (laboratory blank samples) can be found in Appendix I, Tables I-17. The Missoula Laboratory did not report results of sample blanks, but completed analysis for development of method curves and did not report discrepancies for laboratory sensitivity.
12) Field sensitivity was assessed by reviewing field blank samples. Of the 165 field blank samples analyzed, there were ten field blank results that exceeded field sensitivity criteria and associated data has been flagged. A complete list of field and trip blank results can be found in Appendix I, Table I-20.
13) The program completeness goal of 90 percent was met for most all program activities. Clark Fork River monthly monitoring began in April instead of January and resulted in no data collection from January through March. Monitoring of Lake Pend Oreille occurred in 2009, but only Secchi depth and periphyton monitoring data were able to be submitted by the IDEQ. Program completeness for this activity was not achieved. Target completeness was not entirely met during Clark Fork River summer monitoring for TPN, and during Clark Fork River peak flow monitoring for total phosphorus.
14) Sample representativeness and sample comparability were achieved through consistent sampling locations, procedures, and analyses as outlined in the QAPP.

LOGIC CHECKS

15) Logic checks for total and dissolved (or soluble) fractions were performed on phosphorus, nitrogen, copper, and zinc to further validate the 2009 monitoring data. Data failing logic tests were qualified appropriately. All sample result pairs in which the soluble or dissolved fraction exceeded the total are summarized in Tables I-13 to I-16 in Appendix I. In all there were 10 sample pairs including three each for TP-SRP and TN-TSIN, and two each for copper and zinc. All associated results were flagged in the MT-eWQX database.

4.0 DATA VALIDATION RESPONSE ACTIONS AND RECOMMENDATIONS

DATA REVIEW PROCESS

Data collected during the 2009 monitoring program were reviewed to check for calculation and transformation errors, measurements within calibration range, and data entry errors. Data were reviewed according to the MDEQ Quality Control Checklist to ensure project DQOs are met and data are validated, flagged, or rejected accordingly. Results from the data review process are detailed in the data quality assurance review section above.

DATA VERIFICATION

Data verification was completed through routine monthly checks ensuring that the QAPP and analytical quality control procedures were followed. Sampling documentation, representativeness, compliance with sample holding times, instrument calibration and tuning, field and lab blank sample analyses, method QC sample results, field duplicates and the presence of any elevated laboratory reporting limits were reviewed. This review occurred monthly with data from the State Laboratory. Water quality data from the Missoula Laboratory were transmitted together in one package for the entire year and received in April 2010 by HydroSolutions. Total Nitrogen data were received in June 2010. The delay was due to changes in the data reporting requirements directed by the MDEQ and the new data management system, the MT-eWQX system. Due to the delay in receiving water quality results, routine data validation was not accomplished for this data; data validation was completed only after receipt of all 2009 data.

DATA VALIDATION

Data validation was completed for the 2009 Tri-State Water Quality Council Monitoring Program data. Data review, verification, and validation was completed by monitoring program activity contacts listed in Table 1-2 for the respective data sets, except for Clark Fork River peak flow monitoring which is reviewed by HydroSolutions. The final Monitoring Program 2009 data validation was conducted by the MDEQ Quality Assurance Officer. All 2009 data incorporated in the MT-eWQX and Tri-State Water Quality Council's data base has been validated.

RESPONSE ACTIONS AND RECOMMENDATIONS

Based on review and validation of 2009 Tri-State Water Quality Council Monitoring Program monitoring data, the following response actions and recommendations are made:

- Ensure proper sample handling and identification of samples for all monitoring activities.. This will be achieved by:
    - Reviewing and updating the peak flow sampling and analysis plan
    - Synthesizing all methods and protocols into an easy to follow checklist
    - Completing upfront training with Avista Corporation sampling personnel to clarify expectations
    - Reviewing procedures in collecting quality control samples in the field
    - Reviewing thoroughly all samples and chain of custody forms to be sure the correct samples were collected and they were properly identified
- Provide Clark Fork River peak flow monitoring site visit forms for Avista Corporation sampling personnel to complete in the field during each of the six sampling events and for the quality control samples to document sample collection
- Conduct field training with Avista sampling personnel to ensure they thoroughly understand peak flow sampling protocols and methods
- Communicate more clearly with Missoula Waste Water Treatment Plant Laboratory during Clark Fork River summer nutrient monitoring to ensure all samples have been collected and analyzed within holding times and meet program requirements.

- Request timely receipt of all monthly analytical data including the data summary, quality assurance report, and electronic data deliverable (EDD) from the State and Missoula laboratories to meet contractual reporting schedules. Receiving these in a timely fashion is necessary to perform routine data verification, for regular monitoring program assessments, and to provide feedback and corrective actions if necessary.
- Request the University of Montana Watershed Health Clinic Lab provide MT-eWQX compatible EDD when reporting data results.
- Ensure that dissolved cadmium samples are analyzed with a laboratory reporting limit of 0.08 µg/L rather than at the project required quantitation limit of 1 µg/L, so that non-detect results can be compared with the chronic toxicity standard. Consider revising the project required quantitation limit to 0.08 µg/L in the QAPP.

DATA UPLOAD

Following the data review and validation process, data from Clark Fork River monthly monitoring, Clark Fork River peak flow monitoring below Cabinet Gorge Dam, Clark Fork River summer nutrient monitoring, and Clark Fork River periphyton monitoring are compiled into a single database for inclusion into the MT-eWQX. Following data validation and acceptance by MDEQ and the Tri-State Water Quality Council Monitoring Committee, the 2009 Clark Fork—Pend Oreille water quality data was submitted to the National Water Quality Exchange (WQX) Warehouse on August 10, 2010, with WQX Transaction ID: _ac9d3717-f456-4024-a687-92e6f800af7d.

Lake Pend Oreille monitoring data are maintained by the IDEQ and Pend Oreille River monitoring data are maintained by the WDOE.

5.0 REFERENCES

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APPENDIX A

WATER QUALITY MONITORING PROGRAM SUMMARY AND STATION LOCATION FIGURES

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2009 MONTHLY MONITORING WATER QUALITY DATA SPATIAL BOXPLOTS

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2009 MONTHLY AND PEAK FLOW WATER QUALITY DATA SUMMARY STATISTICS TABLES AND HEAVY METALS STANDARDS COMPARISON

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2009 SUMMER MONITORING WATER QUALITY DATA SPATIAL BOXPLOTS

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2009 SUMMER MONITORING WATER QUALITY DATA SUMMARY STATISTICS TABLES

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2009 LAKE PEND OREILLE SECCHI DEPTH DATA SUMMARY

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2009 CLARK FORK RIVER PERIPHYTON DATA SUMMARY

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2009 CLARK FORK RIVER HYDROGRAPHS

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2009 LABORATORY AND FIELD DATA QUALITY REVIEW

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2009 MONTANA EQUIS WATER QUALITY EXCHANGE SUBMITTAL CONDENSED

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