Madison Stream Team WATER QUALITY MONITORING PROJECT

SAMPLING AND ANALYSIS PLAN

Prepared for the Montana Department of Environmental Quality

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List of Figures and Tables

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Introduction

This document constitutes the Sampling and Analysis Plan (SAP) for the completion of water quality sampling for five creeks (Moore, O'Dell, South Meadow and North Meadow Creeks and the West Fork of the Madison) in the Upper Madison TMDL planning area in Madison County Montana (Figure 1). This effort was initiated by the Madison Watershed Partnership and watershed coordinator (Sunni Heikes-Knapton) to increase education and outreach opportunities specific to water quality in the Madison Watershed. Additionally, the supporting organizations recognize the value of collecting baseline water quality and quantity data on impaired waterways, specifically if the data is recognized as credible and useful for the pre-TMDL planning process.

Project Objectives

The goals of the project are:

- To increase community engagement in water resources and data collection to enhance understanding of local water resources.
- To increase volunteer capacity to participate in the upcoming TMDL process.
- To collect baseline data that will be useful to the TMDL process.

Through the collection of water quality data, the project will provide the following products or opportunities:

- Annual report containing data from current year with comparisons to data collected in previous years. Baseline conditions will be established by noting any extremes or incidences of exceedences of state standards. Annual report will be made publically available at the Madison Conservation District website.
- Report will contain discussion on water quality changes between stations and changes between years. This will provide opportunities to outreach to landowners that may be influencing water quality conditions at specific sites.
- Summary of preliminary findings of the Madison Stream Team project will be presented to the general public and other pertinent audiences following the field season.

Sampling Design

The list of streams on the 303d list in the Upper Madison TMDL planning area was evaluated and streams in proximity to the volunteer base were selected for monitoring. Five of the sixteen streams on the 303d list were selected for the monitoring program. Three sample sites were selected on each stream with consideration of accessibility and distribution from headwaters to mouth. The sampling schedule is focused between June and September and is largely influenced by the availability of volunteers, many of whom reside in the watershed only during the summer months.

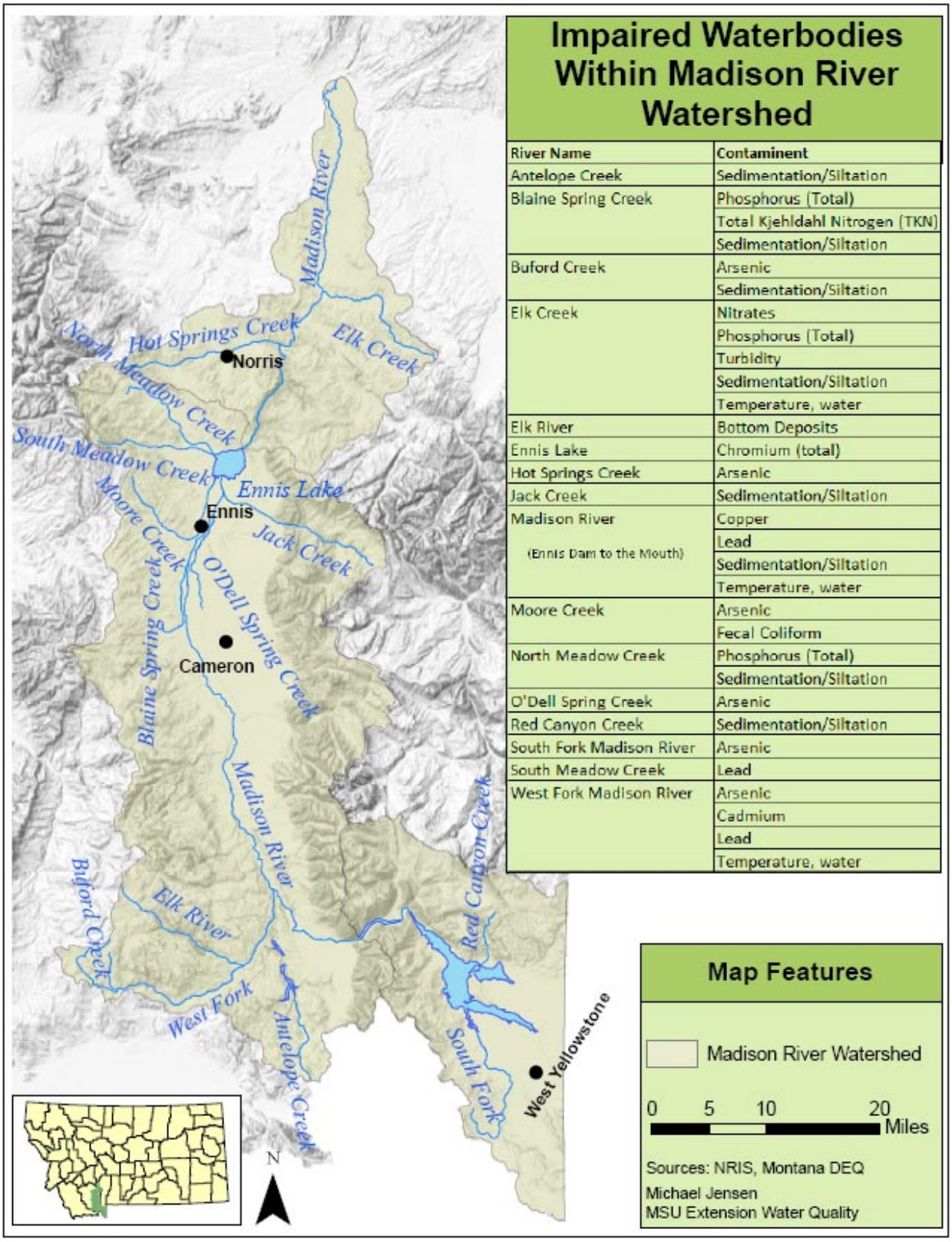


Figure 1: Upper Madison Watershed, stream segments on the MT DEQ 303d list.

Data collection activities to be conducted at each site on each sample date are outlined in tabular format in the SOPs at the end of this document. On each visit to each site for each stream, collection of field parameters (temperature, pH, specific conductance, and dissolved oxygen), discharge, turbidity and nuisance algae photo documentation will occur. Pebble counts will occur at each site on each stream once per year during low flow (August or September). *E. coli* and coliform concentrations using Easygel will be assessed on Moore Creek and the West Fork of the Madison for all visits to all sites.

Lab analysis in the fall (September or October) of 2011 is identical for each stream and is structured to be a screening for a suite of metals (Arsenic, Cadmium Copper, Iron, Lead, Zinc) along with total suspended solids and hardness (calculated from calcium and magnesium) to help interpret the metals data. Samples for lab analysis in 2011 will only be collected at the lower (downstream) site on each stream. A set of quality control samples will be collected on the West Fork of the Madison for the fall 2011 sampling event and on none of the other streams (due to lab budget constraints).

Lab analysis in 2012 will target parameters for which the selected streams are 303d listed. Metals samples will be collected in 2012 at all three sample sites on each stream during the June/July event and the September event (not the July/August event). Calcium and magnesium will be analyzed for calculation of total hardness on all occasions that metals samples are collected. TSS will be collected during the June/July event, but not during the September event (streams should be clear in the fall and that can be confirmed with turbidity measurements). Nutrient samples collected on North Meadow Creek will be collected during the July/August event and the September event (not the June/July event) to coincide with the growing season. A set of quality control samples will be collected for each stream at one of the three sites on each sample day (total regular samples per stream = 2 visits X 3 sites = 6; QC sample sets per stream = 2 visits X 1 site = 2; 25% of samples are QC). A detailed outline of what data will be collected at what sites is presented in tabular form in the SOPs at the end of this document. The 2012 sampling plan may be revised based on results from the screening samples collected in September of 2011. Table 1 outlines the parameters which are slated to be analyzed for each stream in 2012 (based on 303d listing).

The chemistry sampling plan was put together with input from Patrick Lizon and Pete Schade (MDEQ) with a goal of collecting the required 8 samples per reach to assess metals impairment but ultimately with more weight given to the need to have one set of QC samples for each stream for each sampling day.

Table 1 Lab parameters to be analyzed by stream during 2012.

2012 Lab Parameters by Stream	
Stream	**Parameters**
Moore Creek	Arsenic, TSS, Calcium, Magnesium, Hardness
North Meadow Creek	Total N, Nitrate, Total P
O'Dell Creek	Arsenic, TSS, Calcium, Magnesium, Hardness
South Meadow Creek	Lead, TSS, Calcium, Magnesium, Hardness
West Fork Madison River	Arsenic, Cadmium, Lead, TSS, Calcium, Magnesium, Hardness

Table 2 Sample site IDs, names, coordinates and descriptions.

Site ID	Site Name	Latitude	Longitude	Site Description
MST-MC-BRK	Moore upper	45.338583	-111.737733	Southeast boundary of Bricker (BRK) property.
MST-MC-GOG	Moore middle	45.3787	-111.721883	Southern boundary of Valley Garden property at fence line of Goggins (GOG) property
MST-MC-CNF	Moore lower	45.406833	-111.709983	Upstream of confluence (CNF) with Fletcher Channel of Madison River
MST-MC-IRS	Moore UT	45.379317	-111.7254	Unnamed Tributary (UT) to Moore Creek flows consisting of spring and irrigation return flows, irrigator spring(IRS)
MST-NM-FSCG	North Meadow upper2	45.52977	-111.85362	At USFS primitive campground (FSCG) near FS Road 6360.
MST-NM-HAM	North Meadow middle	45.470783	-111.7723	Approx. 200’ upstream of bridge on Hamilton (HAM) Ranch
MST-NM-MLL	North Meadow lower	45.4461	-111.713883	Near confluence with Ennis Lake, south of Meadow Lake Lodge (MLL) main house
MST-OD-RST	O'Dell upper	45.260567	-111.7324	Directly above steel bridge on Granger Ranch. Restoration Area (RST)
MST-OD-GNGR	O'Dell middle	45.331783	-111.726917	1 mile in from highway 287 on ranch access road, on Granger Ranch (GNGR)
MST-OD-VGR	O'Dell lower	45.3639	-111.706967	Near southern boundary of FWP land on Valley Garden Ranch (VGR) Fishing Access Site.
MST-SM-FS	South Meadow upper	45.455117	-111.855	Near USFS (FS) campground, 100‘upstream of bridge.
MST-SM-EDC	South Meadow middle	45.450967	-111.747217	200’ upstream of bridge on Endecott (EDC) Ranch.
MST-SM-LKRD	South Meadow lower	45.443517	-111.718617	Near confluence with North Meadow Creek, 10’ downstream of culvert outlet on county road, Lake Road (LKRD).
MST-WF-FSRD	West Fork of Madison River upper	44.803067	-111.616800	Approx. 7.5 miles from highway 287, forest service road (FSRD)
MST-WF-CMP	West Fork of Madison River middle	44.848617	-111.582833	Adjacent to Smith Lake outflow campground (CMP).
MST-WF-CNF	West Fork of Madison River lower	44.8884	-111.581717	Approx. 200’ upstream of confluence (CNF) adjacent to USFS access road.

Table 3 Sample site selection rational

Site ID	Site Name	Rational for site selection
MST-MC-BRK	Moore upper	Stream relatively unaffected by urban influence, ease of access. Interested landowner.
MST-MC-GOG	Moore middle	Near upstream boundary of restoration project on Moore Creek. Interested landowner.
MST-MC-CNF	Moore lower	Near downstream boundary of restoration project on Moore Creek. Interested landowner.
MST-MC-IRS	Moore UT	Tributary to Moore Creek with irrigation return flow. Flows potentially affected by urban influence. Interested landowner.
MST-NM-FS	North Meadow upper	Historic sampling location from 1999 sampling report. Adjacent to historic tailings. This site was moved upstream in August 2011 to a safer location for sampling (MS-NM-FSCG).
MST-NM-FSCG	North Meadow upper2	Ease of access from USFS road, ideal cross section. This site replaced
MST-NM-HAM	North Meadow middle	Upstream from Historic sampling location from 1999 sampling report. Interested landowner.
MST-NM-MLL	North Meadow lower	Upstream from Historic sampling location from 1999 sampling report. Ease of access.
MST-OD-RST	O'Dell upper	Within boundary of restoration area on O'Dell Creek.
MST-OD-GNGR	O'Dell middle	Downstream of restoration area on O'Dell Creek. Location of ongoing temperature monitoring affiliated with the O'Dell Creek project.
MST-OD-VGR	O'Dell lower	Near confluence with Madison River, ease of access on public land.
MST-SM-FS	South Meadow upper	Historic sampling location from 1999 sampling report. Ease of access on public land.
MST-SM-EDC	South Meadow middle	Within reach of South Meadow Creek Water Efficiency project, interested landowner.
MST-SM-LKRD	South Meadow lower	Historic sampling location from 1999 sampling report. Ease of access from public right of way.
MST-WF-FSRD	West Fork of Madison River upper	Ease of access from adjacent USFS road, ideal cross section.
MST-WF-CMP	West Fork of Madison River middle	Near accessible campground site, public land, ideal cross section.
MST-WF-CNF	West Fork of Madison River lower	Near confluence with Madison River, ease of access on public land.

Instantaneous discharge (flow) will be measured for each site on each visit (if it is safe) so that loads of pollutants can be calculated. TruTrack stage recorders will be deployed at a few sites as funding and resources are available so rating curves can be constructed to facilitate continuous discharge estimation. Measurement of field parameters is a basic operating procedure when other water quality data is collected and will provide context for interpreting basic stream conditions and other data. Samples collected for nutrients and metals will be handled according to SOPs and shipped to the DEQ contracted laboratory (Energy Laboratories) for analysis. Metal concentration data will be evaluated relative to MT DEQ standards in the context of specific conductance, TSS, and hardness data. Nutrient concentration data will be compared to MT DEQ draft nutrient

standards. Nutrient impairment will also be assessed by photographing rocks collected during the growing season for a qualitative assessment of algae/chlorophyll presence.

Turbidity measurement using secchi tubes is very effective for education because it provides immediate results in comprehendible units. Secchi tube measurements are quantitative but have limited resolution and are more prone to observer variability than are measurements with a turbidity meter. Turbidity measurements with a Hach meter will be collected if a meter becomes available. Turbidity measurements will also assist in the interpretation of metals data by semi quantitatively assessing the amount of solids in the water column during fall sampling when TSS data is not in the budget. A simplified pebble count to assess the percent of sediment less than 2 mm will be conducted at each site during the August sample event.

MST data will be summarized in graphs to facilitate easy comparison to applicable standards presented in Circular DEQ-7 and ARM 17.30.623 and MT DEQ draft nutrient criteria (MTDEQ 2008). The Upper Madison Watershed is classified as a B1 stream within the Middle Rockies level III Ecoregion. Water quality data along with pebble count and chlorophyll photographs will facilitate discussion of future data collection priorities.

Project Team Responsibilities

The project manager will be the Madison Watershed Coordinator, Sunni Heikes-Knapton. Responsibilities of the project manager include pre-season meeting, volunteer coordination, storage/maintenance of equipment, data management, data analysis, report composition, coordinating educational events. The Madison Conservation District has been awarded a Big Sky Watershed Corp member to be filled in October 2011. The Watershed Corps member will be tasked with providing assistance in project management, volunteer recruitment, data analysis, report composition and field work. The project administration will be completed by the Madison Conservation District, which will include the accounting and financial management of the project. The project team responsibilities are provided in Table 4.

Table 4 Project team members and responsibilities

Name/Title	Project Responsibilities	Contact information
Sunni Heikes-Knapton; Madison Watershed Coordinator	Project Manager: Data Collection, analysis, report composition, coordination of educational events, equipment maintenance	PO Box 606 Ennis, MT 59729 406.682.3181 mwc@3rivers.net
Adam Sigler; MSUEWQ Water Quality Specialist	Conduct Level 3 volunteer training, assist with SAP preparation and data management training for volunteers.	Sigler Lab, MSU, PO Box 173120, Bozeman, MT, 59717-3120 406.994.7381 asigler@montana.edu
TBD; Big Sky Watershed Corps Member	Provide assistance in project management, volunteer recruitment, data analysis, report composition and field work.	Same as Madison Watershed Coordinator
Janet Endecott; Madison Conservation District Supervisor	Financial Management, invoice payment	PO Box 606 Ennis, MT 59729 Phone removed from web version Email removed from web version
Melissa Newman; High School Science Teacher	Education organizer	PO Box 517 Ennis, MT 59729 Phone removed from web version Email removed from web version

Sampling Methods

Sampling will be conducted according to the standard operating procedures (SOPs) outlined at the end of this document. A Site Visit Form (see end of document) will be completed for each site visit and will include all field data collected and an inventory of samples collected for analysis at the DEQ contracted laboratory. Site locations will be corroborated using this document and/or a GPS and the method will be specified on the field visit form. The GPS coordinate system datum will be NAD 1983 State Plane Montana, in decimal degrees to at least the fourth decimal. Photographs will be taken using a digital camera.

Field methods

Field parameter data will be collected with an YSI 556 if a certified level 3 monitor is participating in monitoring. For field visits without a level 3 monitor present, Oakton handheld meters will be used to collect field parameters. All meters will be calibrated according to manufacturer instructions on the same day before sampling occurs and calibration logs will be kept for each meter.

Table 5 Field instruments and performance characteristics

Parameter	Meter	Measurement Range	Resolution	Accuracy
Level 2 Monitors				
temperature	Oakton ECTestr11	0.0 to 50.0° C	0.1 °C	Not Specified
pH	Oakton eco Testr pH2	0.0 to 14.00 units	0.1 units	±0.01
SC	Oakton ECTestr11	2 to 20 mS/cm	.01 mS/cm	±1% f.s.
DO	YSI 550 A	0.0-20.0 mg/l	0.01 mg/l	±0.3 mg/L or 2% of reading, whichever is greater
Level 3 Monitors				
temperature	YSI 556	-5 to 45° C	0.01° C	±0.15° C
pH	YSI 556	1.0 to 14.00 units	0.01 units	±0.2 units
SC	YSI 556	0 to 200 mS/cm	0.001 mS/cm to 0.1 mS/cm	±0.5% of reading or ±0.001 mS/cm
DO	YSI 556	0 to 50 mg/L	0.01 mg/L	±2% of the reading or 0.2 mg/L

Turbidity measurements will be completed using secchi tubes by collecting a water sample from the middle of the water column in the middle of the channel. With the tube filled to the zero line and the sampler's back to the sun, the secchi disk is lowered on a string until the secchi pattern is no longer discernible by sampler. The depth of the secchi disk below the water line in the tube is the turbidity measurement with units of centimeters. Three readings will be completed and averaged. Detailed procedures are outlined in the SOPs at the end of this document.

Pebble counts will be conducted in riffles with a simplified procedure which assesses the percent of fines less than 2 mm. Pebble counts will be conducted according to the SOPs in the appendix of this document. In the same riffles where pebble counts are conducted, 10 rocks will be randomly selected to be photographed for qualitative assessment of nuisance algae growth. These rocks will be placed on the bank and photographed along with a title card indicating the site and date within the photo frame.

Flow (Discharge) Measurement

Stream discharge data will be collected at all water quality monitoring sites using the float method. This method has been found to be more reliable than low end velocity meters while still providing quantitative data with low capital costs and relative simplicity for volunteers to grasp. As resources are available, TruTrack capacitance rods will be installed and programmed to record hourly water height (mm), water temperature (C), and air temperature (C). Upon each subsequent site visit, data will be downloaded to laptop computer equipped with Omnilog Software and saved as a Microsoft Excel file with site name, date, and time of download. Measured flow and recorded height will be used to create a stage/discharge relationship for each year data is collected. At Patrick Lizon's suggestion, stage data for periods with air temperatures less than freezing will be evaluated and data may be qualified based on DEQ observations that stage data accuracy decreases within this temperatures range.

Water Sample Collection and Handling for Laboratory Analysis

Grab samples will be collected for delivery to the DEQ contracted lab for chemistry analysis using acid washed, polyethylene bottles provided by the testing laboratory. Table 6 details the analytical methods and handling procedures for each parameter. Table 1 lists parameters to be analyzed by stream, and a detailed parameter list for each stream is included in the SOPs at the end of this document.

Bottles shall be rinsed three times with stream water prior to sampling. Samples will be collected in a well-mixed portion of each stream. During sampling, the sample bottle opening should face upstream and should be drawn through the water column once, carefully avoiding disturbance of bottom sediments. Samples will be preserved in the field and stored on ice until shipment to the lab.

Table 6 Lab parameter analytical methods, reporting limits, hold times, and preservatives.

Parameter	Preferred Method	Alternate Method	Req. Report Limit ug/L	Holding Time Days	Bottle	Preservative
Arsenic	EPA 200.8	-	3	180	500 ml HDPE	HNO_3, ≤6°C
Cadmium	EPA 200.8	-	0.08			
Copper	EPA 200.8	EPA 200.7	1			
Iron	EPA 200.7	EPA 200.8	50			
Lead	EPA 200.8	-	0.5			
Zinc	EPA 200.7	EPA 200.8	10			
Calcium	EPA 200.7	EPA 200.8	1000			
Magnesium	EPA 200.7	-	1000			
Total suspended solids	EPA 160.2	A2540 D	4000	7	500ml HDPE	≤6°C
Total Persulfate Nitrogen (TPN)	A 4500-N C	A4500-N B	50	30		
Nitrate-Nitrite as N	EPA 353.2	A4500-NO3 F	10	28	500ml HDPE	H_2SO_4, ≤6°C
Total Phosphorus as P	EPA 365.1	A4500-P F	5			
Total Hardness as $CaCO_3$	A2340 B (Calc)	-	-	-	-	-

Quality control (QC) samples consisting of blanks and duplicates will be collected at one site on one sample visit for each stream. The location and visit for QC sampling is indicated in the parameter tables in the

SOPs. A field blank is prepared by transporting laboratory-grade deionized (DI) water to the field (provided by the laboratory) and pouring it into sample containers provided by the lab. The blank will be prepared at the same time that the samples are collected from the stream. A duplicate sample is a second stream sample collected at the same time in the same way that the regular stream sample is collected. Duplicate and blank samples will be collected at the same location for each event. The site that QC samples are collected at will rotate between years. Duplicate and blank samples are labeled according to the labeling protocol below which does not identify which sample is which to the lab. Blank and duplicate samples are handled and delivered to the lab in the same manner that regular samples are handled.

Sample labels should be filled out with Company (Madison Conservation District or MCD), the date, the time and the sample ID. The sample ID is very important and includes the year, the month, the day, the site ID and a letter indicating they type of sample (regular, blank or duplicate).

Sample ID = Year-Month-Day-SiteID-Sample-Type Letter

A = Regular Sample
B = Duplicate Sample
C = Blank Sample

Sample ID Examples:

A regular sample collected at the Moore Creek Upper site on August 15th, 2011 would be labeled:

20110815-MCBRK-A

A duplicate at the same place and time as above:

20110815-MCBRK-B

A blank at the same place and time as above:

20110815-MCBRK-C

A regular sample collected at the lower West Fork of the Madison site on July 3rd, 2011 would be labeled:

20110703-WFCNR-A

Note: For simplicity and brevity for sample bottle labels, these IDs do not include the MST portion of the site IDs which will be added before uploading the data to databases.

Immediately following grab-sample collection, samples will be put on ice. The MT DEQ contract analytical lab chain of custody forms will be used to document and track all samples collected during the project. Chain of custody forms will be completed for each set of samples submitted to the laboratory.

Quality Assurance and Quality Control Requirements

In order for water quality data to be useful, it needs to be an accurate representation of conditions in the water body at the time the samples were collected. This requires proper sample handling and processing and then assessment of data to ensure quality. Data quality objectives (DQOs) state the required quality of data for the intended use and data quality indicators (DQIs) are the specific criteria that data are assessed by to determine quality. Definitions and a list of DQIs are included in the glossary. These indicators are assessed by collecting quality control (QC) samples and then performing quality assurance (QA) checks on those samples.

QC samples are blank, duplicate and spike samples collected or created in the lab and/or the field for evaluation of quality indicators. Once the lab results are returned for the QC samples, QA is the process of assessing the data through use of indicators to determine data quality.

Data Quality Objectives

Efforts have been made to produce a **spatially representative** dataset by selecting three sites for each stream spread over the length of the streams. See Table 3 for a description of the rational for site selection. Efforts will be made to collect samples during June to produce high flow data, but the monitoring schedule is constrained by the availability of the volunteers. The bulk of monitoring will occur during base flow from July through September.

Provisions are in place to ensure **sensitivity** of data collected to differences in stream water quality and **comparability** of data collected to other datasets. These provisions include the collection of grab samples and field QC for submission to a certified laboratory and assessment of QC data relative to data quality indicators. Data that does not meet quality criteria will be qualified appropriately in the annual report and during the MT EQUIS submission process.

In order to ensure the highest degree of data **completeness** possible, the team leaders will fill out datasheets and review them before leaving a site. Sunni Heikes-Knapton will review datasheets for completeness and will follow-up with volunteers if fields are not completed. A minimum of 60% completeness (2 out of 3 scheduled events) is the goal for the project for 2011-12 accounting for possible weather, access, and volunteer availability challenges.

Data Quality Indicators

Quality assurance and quality control (QAQC) can be broken down into a field and a laboratory component. The field component consists of collection of blank and duplicate samples and comparison of data to criteria. The laboratory component consists of assessment of data for blanks as well as a variety of duplicate and spiked samples analyzed by the lab. Blank samples should ideally yield results indicating "no detection" of the analyte in question. Duplicate samples should ideally produce identical results and analysis of spiked samples should recover exactly the amount of analyte added. Methods are not perfect however, so the criteria outlined in the following two sections are used to assess if data is of acceptable quality.

Quality Assurance for Field Quality Control Samples

Field quality control samples are typically collected for 10% of all samples collected; this means 1 in 10 samples. In 2011, one set of field QC samples will be collected from the West Fork of the Madison Lower site which will serve as QC for all 5 sets of samples collected for all 5 streams in 2011. In 2012, one set of field QC samples will be collected for each stream for each of the two sampling days which will result in 2 QC set for each 6 sets of samples collected. This QC sample collection plan will result in greater than a 10% QC for the project as a whole. Each set of field QC samples will include a blank and a duplicate for each analyte being sampled for. Accuracy for field QC samples will be assessed by ensuring that blank samples return values less than the data quality indicator criteria specified in Table 7. If a blank sample returns a result greater than the threshold, all data for that parameter from that batch of samples may need to be qualified. The exception is that data with a value greater than 10 times the detected value in the blank does not need to be qualified. Precision for field QC samples will be assessed by ensuring that relative percent difference (RPD) between duplicates is less than 25%. RPD is calculated using the equation below. In addition to these accuracy/precision checks, it will be necessary to check that all samples were processed within their specified hold times.

RPD as % = ((D1 – D2)/((D1 + D2)/2)) x 100

Where: D1 is first replicate result, D2 is second replicate result

Table 7 Data quality indicator criteria for field QC samples

Parameter	Field Blank Threshold	Field Duplicate RPD
Arsenic	3 µg/L	< 25% RPD
Cadmium	0.08 µg/L	< 25% RPD
Copper	1 µg/L	< 25% RPD
Iron	50 µg/L	< 25% RPD
Lead	0.5 µg/L	< 25% RPD
Zinc	10 µg/L	< 25% RPD
Calcium	1000 µg/L	< 25% RPD
Magnesium	1000 µg/L	< 25% RPD
Total Suspended Solids	4000 µg/L	< 25% RPD
Total Hardness as $CaCO_3$	See Ca & Mg	< 25% RPD
Total Persulfate Nitrogen	0.1 mg/L	< 25% RPD
Nitrate-Nitrite as N	0.01 mg/L	< 25% RPD
Total Phosphorus as P	0.005 mg/L	< 25% RPD

Quality Assurance for Lab Quality Control Samples

Certified laboratories run QC samples for at least 10% of their sample volume. Integrity of laboratory data will be determined by comparing results for laboratory QC samples to the data quality indicator criteria in Table 8. Reports with lab QC results and data quality indicator calculations should be provided by the lab with each set of sample results. Each of the quality indicator criteria in Table 8 must be checked for each analyte for each batch of samples submitted to the lab. This process is easier if a matrix is used to systematically check the numbers. An example of a completed matrix is provided on page 30.

Table 8 Data quality indicator criteria for lab QC samples

Parameter	**Method**	**Method Blanks**	**Lab Duplicates (RPD)**	**Lab Control LCS/LFB** (percent recovery)	**Matrix Spike/ Matrix Spike Dup** (percent recovery)
Arsenic	EPA 200.8	3 µg/L	< 10% RPD	85%-115%	70%-130%
Cadmium	EPA 200.8	0.08 µg/L	< 10% RPD	85%-115%	70%-130%
Copper	EPA 200.8	1 µg/L	< 10% RPD	85%-115%	70%-130%
Iron	EPA 200.7	50 µg/L	< 10% RPD	85%-115%	70%-130%
Lead	EPA 200.8	0.5 µg/L	< 10% RPD	85%-115%	70%-130%
Zinc	EPA 200.7	10 µg/L	< 10% RPD	85%-115%	70%-130%
Calcium	EPA 200.7	1000 µg/L	< 10% RPD	85%-115%	70%-130%
Magnesium	EPA 200.7	1000 µg/L	< 10% RPD	85%-115%	70%-130%
Total Hardness as	A2340 B (Calculated)	See Ca &	< 10% RPD	See Ca & Mg	See Ca & Mg

Parameter	Method	Method Blanks	Lab Duplicates (RPD)	Lab Control LCS/LFB (percent recovery)	Matrix Spike/ Matrix Spike Dup (percent recovery)
$CaCO_3$		Mg			
Total Suspended Solids	EPA 160.2	4000 µg/L	< 10% RPD	70%-130%	-
Total Persulfate Nitrogen	A4500-N C or A4500-N B	<0.1 mg/L	< 10% RPD	90%-110%	90%-110%
Nitrate-Nitrite as N	A353.2 or A4500-NO3 F	<0.01 mg/L	< 10% RPD	90%-110%	90%-110%
Total Phosphorus as P	EPA 365.1 or 4500-P F	<0.005 mg/L	< 10% RPD	90%-110%	90%-110%

Qualifying Data that fails data quality criteria

If any of the data quality objectives for field or laboratory QC samples fail the criteria above, all data for that analyte for that sample batch must be qualified accordingly. Note that a blank which exceeds the threshold does not automatically mean all data for that sample batch must be qualified. Sample results with values greater than 10 times the detected value in the blank do not need to be qualified. A narrative in the annual sampling report should outline what data was qualified and for what reason. The data will also need to be qualified during the process of uploading to MT EQUIS using the appropriate qualifier codes. A list of data qualifier codes is provided on page 29.

Training

A seven hour level 2 training was conducted for MST volunteers on June 29th and 30th 2011 by Adam Sigler, Katie Kleehammer and Sunni Heikes-Knapton in Ennis, Montana. The classroom portion on day one covered watershed and water quality basics and results from 2010 sampling. During the field portion of the training, 8 volunteers learned how to calibrate and use Oakton handheld EC and pH meters, measure discharge using the float method, conduct pebble counts to screen for fine sediment, randomly collect rocks to photograph for nuisance algae assessment, collect water quality samples for submission to a lab, fill out field visit sheets, measure turbidity using secchi tubes, and screen for *E. coli* using Coliscan Easygel.

An 8 hour level 3 training was conducted by the same instructors on August 18th 2011 at the Ennis high school and on Moore Creek in Ennis. This training covered the same methods as the level 2 training with the addition of use of an YSI 556 meter. Five volunteers participated in the training and were evaluated for proficiency in conducting methods according to SOPs. Based on the field proficiency evaluations and a written take home test, all 5 volunteers passed this portion of the certification requirements. Final determination about certification will be made in the fall of 2011 based on whether volunteers make it out to sample the required 2 times and attend the data management training.

Data Analysis, Record Keeping & Reporting Requirements

Copies of laboratory analytical reports and electronic data deliverable spreadsheets will be provided by the DEQ contract analytical lab to both the Madison Watershed Coordinator and to DEQ. The MST coordinator will review the laboratory data to ensure lab results are within reporting limits (including the laboratory QA/QC samples) prior to data entry into the MT Volunteer Water Quality Database Repository

housed at the MT Watercourse and later into MT EQUIS. A review of field and analytical data will be conducted following receipt of the laboratory data package that includes all items on the QC Checklist on page 24. Data qualifiers provided on page 29 will be assigned to data in both hardcopy and electronic form that does not meet these target quality control criteria.

Data generated during this project will be stored on field forms and in laboratory reports obtained from the laboratories. Site Visit and Chain of Custody forms will be properly completed for all samples. Written field notes, field forms, and digital photos will be processed by field staff following QA/QC procedures to screen for data entry errors. Data from all sampling events will be entered into EQUIS.

References

DEQ 2005a. Water Quality Planning Bureau Field Procedures Manual for Water Quality Assessment Monitoring. Montana Dept. of Environmental Quality, WQPBWQM-020, revision 2. April 21, 2005. Available at

http://deq.mt.gov/wqinfo/qaprogram/PDF/SOP%20WQPBWQM-020.pdf

DEQ, 2005b. Quality Assurance Project Plan (QAPP) Sampling and Water Quality Assessment of Streams and Rivers in Montana, 2005. Available at http://www.deq.state.mt.us/wqinfo/QAProgram/WQPBQAP-02.pdf.

DEQ, 2006. Circular DEQ-7, Montana Numeric Water Quality Standards, 2006. Available at http://www.cedarcreekengineering.com/customers/carolina/Avon/Reports/Montana/GW%20-%20CompiledDEQ-7.pdf

MT DEQ. 2008. Scientific and Technical Basis of the Numeric Nutrient Criteria for Montana's Wadeable Streams and Rivers. Michael Suplee, Ph.D. - Montana Department of Environmental Quality; Vicki Watson, Ph.D. – University of Montana; Arun Varghese and Josh Cleland – ICF International. Available on the web at: http://deq.mt.gov/wqinfo/standards/PDF/WhitePaper_FNL3_Nov12-08.pdf [verified June 5, 2010].Appendix A: Site Visit Form and QC Checklist

MT DEQ. 2011. MT DEQ. Clean Water Act Information Center, Jack Creek Water Quality Assessment. http://cwaic.mt.gov/wqrep/2010/assmtrec/MT41F004_050.pdf
URL confirmed: 5/10/2011

MT DEQ. 2011. MT DEQ. Montana Department of Environmental Quality Metals Assessment Method, Final. Prepared by Jonathan Drygas, Water Quality Planning Bureau, Monitoring and Assessment Section. WQPBMASTR-03 www.deq.mt.gov/wqinfo/qaprogram/PDF/SOPs/FINAL_**MetalsMethod**.pdf
URL confirmed: 8/17/2011

MST Analytical Budget 2011-2012

	Cost per Sample												
	Total N	Nitrate	Total P	Digestion	Arsenic	Cadmium	Copper	Iron	Lead	Zinc	TSS	Calcium	Magnesium
	$15.00	$10.00	$10.00	$10.00	$7.00	$7.00	7	7	$7.00	7	8	7	7

2011 Sample Season (only September)

	Number of Samples																	
	# Sites	Visits w Chemistry	QC Samples per Visit	Visits w QC	QC Total	Total N	Nitrate	Total P	Digestion	Arsenic	Cadmium	Copper	Iron	Lead	Zinc	TSS	Calcium	Magnesium	
South Meadow	1	1	2	0	0	-	-	-	1	1	1	1	1	1	1	1	1	1	
O-Dell Creek	1	1	2	0	0	-	-	-	1	1	1	1	1	1	1	1	1	1	
West Fork Madison	1	1	2	1	2	-	-	-	3	3	3	3	3	3	3	3	3	3	
North Meadow Creek	1	1	2	0	0	-	-	-	1	1	1	1	1	1	1	1	1	1	
Moore Creek	1	1	2	0	0	-	-	-	1	1	1	1	1	1	1	1	1	1	
																			2011 Total
Total Cost	5	5	10	1	2	$0.00	$0.00	$0.00	$70.00	$49.00	$49.00	$49.00	$49.00	$49.00	$49.00	$56.00	$49.00	$49.00	**$518.00**

2012 Sample Season (June/July, July/August, September)

	Number of Samples																	
	# Sites	Visits w Chemistry	QC Samples per Visit	Visits w QC	QC Total	Total N	Nitrate	Total P	Digestion	Arsenic	Cadmium	Copper	Iron	Lead	Zinc	TSS	Calcium	Magnesium	
South Meadow	3	2	2	2	4	-	-	-	10	-	-	-	-	10	-	5	10	10	
O-Dell Creek	3	2	2	2	4	-	-	-	10	10	-	-	-	-	-	5	10	10	
West Fork Madison	3	2	2	2	4	-	-	-	10	10	10	-	-	10	-	5	10	10	
North Meadow Creek	3	2	2	2	4	10	10	10	-	-	-	-	-	-	-	-	-	-	
Moore Creek	3	2	2	2	4	-	-	-	10	10	-	-	-	-	-	5	10	10	
																			2012 Total
Total Cost	15	10	10	10	20	$150.00	$100.00	$100.00	$400.00	$210.00	$70.00	0	0	$140.00	0	$160.00	$280.00	$280.00	**$1,890.00**

2011 will serve as a screening event for metals where each stream will be sampled for a suite of metals at the downstream most site.
In 2011, QC samples will only be collected at the West Fork of the Madison site.
2012 sampling focuses on the parameters which each stream is listed for with samples collected at all three sites during the first and last sampling events.
In 2012, TSS samples will only be collected during the first sample event.
QC samples in 2012 will be collected at one site per sample day on each stream.
Two samples in the "QC Samples per Visit " column means one set of duplicates and one set of blanks.

Proposal Total
$2,408.00

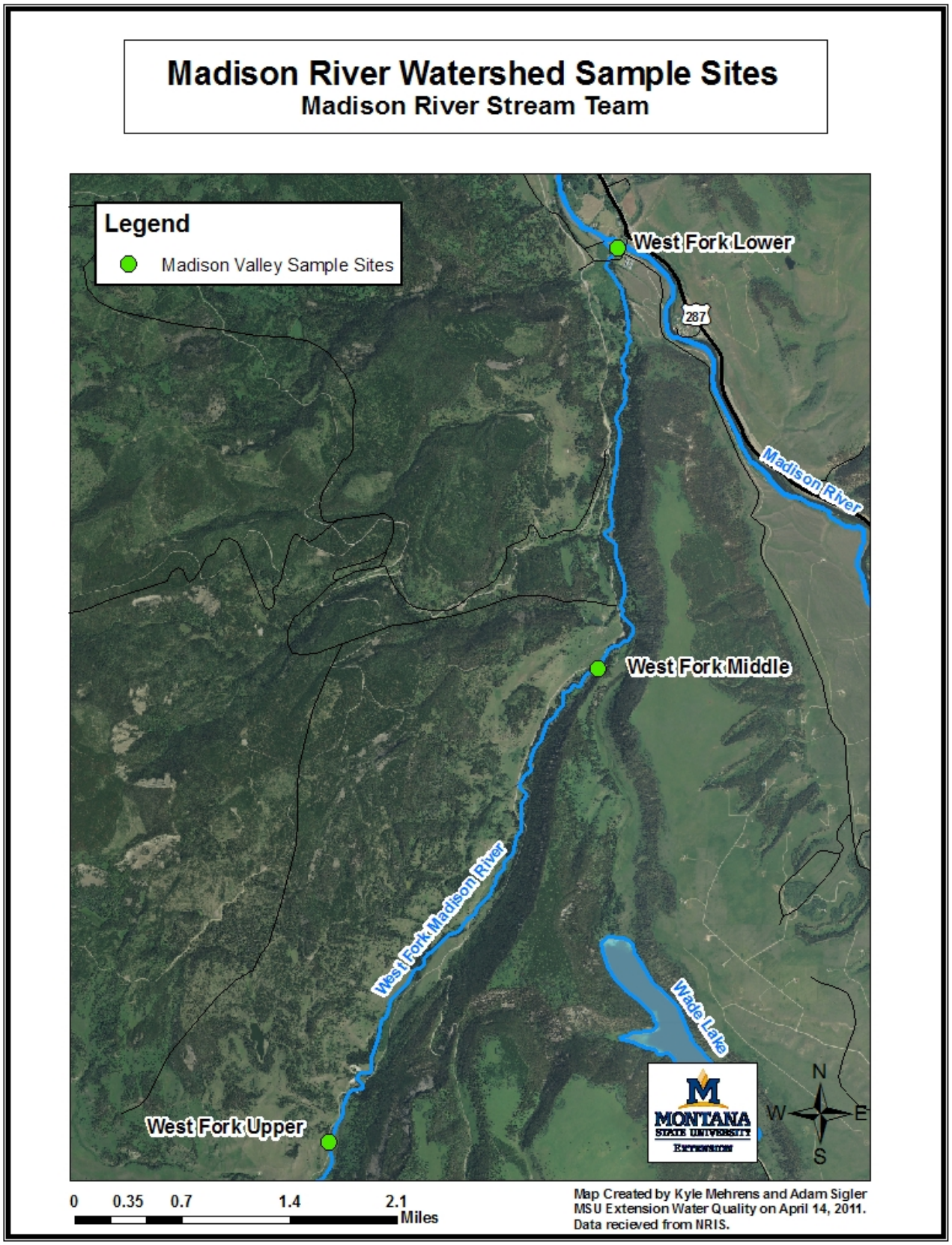


Figure 2. West Fork Madison River Sites.

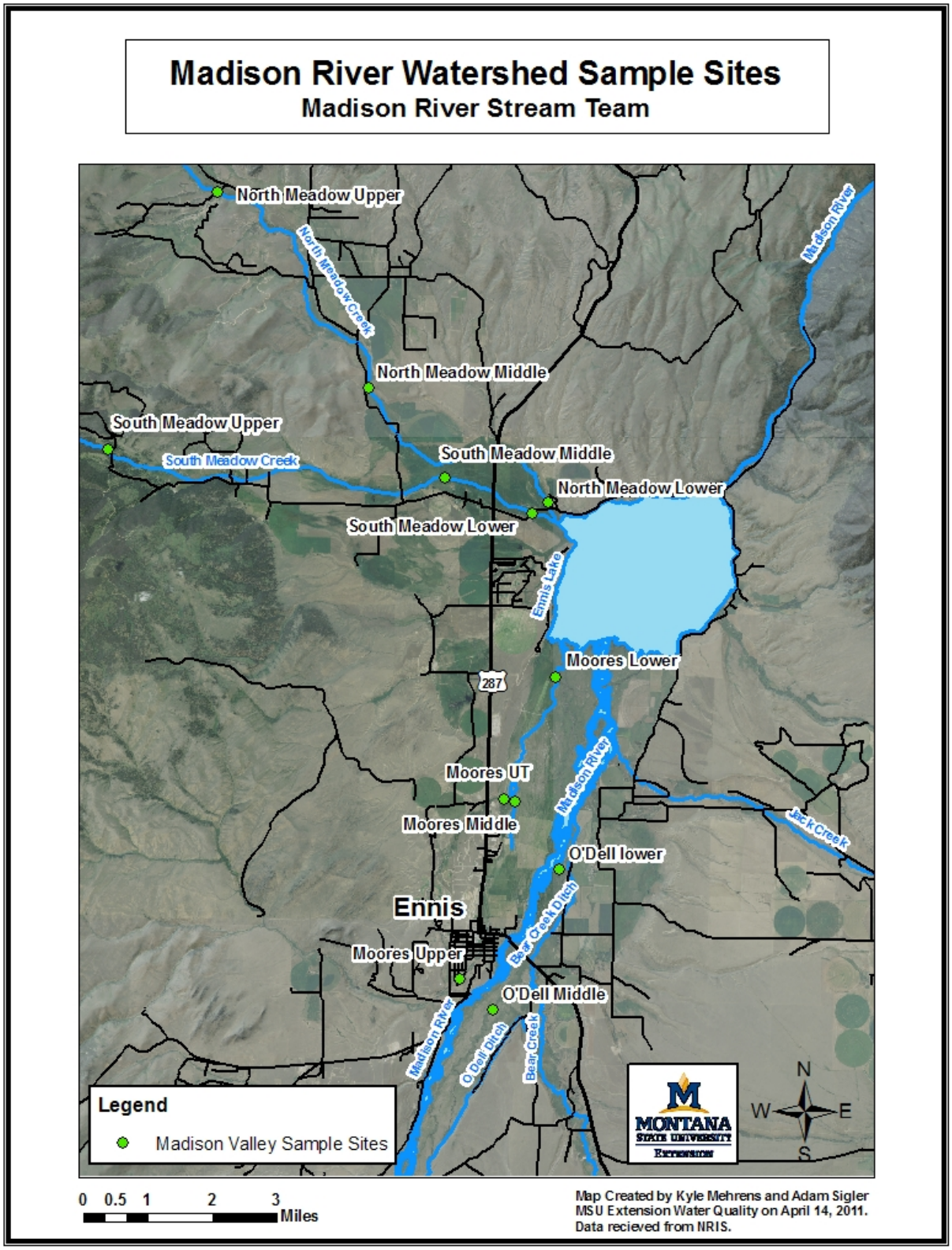


Figure 3. Sample sites near Ennis.

Quality Control Checklist

___Condition of samples upon receipt
___Cooler/sample temperature
___Proper collection containers
___All containers intact
___Sample pH of acidified samples <2
___All field documentation complete. If incomplete areas cannot be completed, document the issue.
___Holding times met
___Field duplicates collected at the proper frequency (specified in SAP)
___Field blanks collected at the proper frequency (specified in SAP)
___All sample IDs match those provided in the SAP. Field duplicates are clearly marked on samples and noted as such in lab results.
___Analyses carried out as described within the SAP (e.g. analytical methods, photo documentation, field protocols)
___Reporting detection limit met the project-required detection limit
___All blanks were less than the project-required detection limit
___If any blanks exceeded the project-required detection limit, associated data is flagged
___Laboratory blanks/duplicates/matrix spikes/lab control samples were analyzed at a minimum 10% frequency
___Laboratory blanks/duplicates/matrix spikes/lab control samples were all within the required control limits defined within the SAP
___Project DQOs and DQIs were met (as described in SAP)
___Summary of results of QC analysis, issues encountered, and how issues were addressed (corrective action)
___Completed QC checklist before MT-EQUIS upload

QA/QC Terms

Accuracy. A data quality indicator, accuracy is the extent of agreement between an observed value (sampling result) and the accepted, or true, value of the parameter being measured. High accuracy can be defined as a combination of high precision and low bias.

Analyte. Within a medium, such as water, an analyte is a property or substance to be measured. Examples of analytes would include pH, dissolved oxygen, bacteria, and heavy metals.

Bias. Often used as a data quality indicator, bias is the degree of systematic error present in the assessment or analysis process. When bias is present, the sampling result value will differ from the accepted, or true, value of the parameter being assessed.

Blind sample. A type of sample used for quality control purposes, a blind sample is a sample submitted to an analyst without their knowledge of its identity or composition. Blind samples are used to test the analyst's or laboratory's expertise in performing the sample analysis.

Comparability. A data quality indicator, comparability is the degree to which different methods, data sets, and/or decisions agree or are similar.

Completeness. A data quality indicator that is generally expressed as a percentage, completeness is the amount of valid data obtained compared to the amount of data planned.

Data users. The group(s) that will be applying the data results for some purpose. Data users can include the monitors themselves as well as government agencies, schools, universities, businesses, watershed organizations, and community groups.

Data quality indicators (DQIs). DQIs are attributes of samples that allow for assessment of data quality. These include precision, accuracy, bias, sensitivity, comparability, representativeness and completeness.

Data quality objectives (DQOs). Data quality objectives are quantitative and qualitative statements describing the degree of the data's acceptability or utility to the data user(s). They include data quality indicators (DQIs) such as accuracy, precision, representativeness, comparability, and completeness. DQOs specify the quality of the data needed in order to meet the monitoring project's goals. The planning process for ensuring environmental data are of the type, quality, and quantity needed for decision making is called the ***DQO process*****.**

Detection limit. Applied to both methods and equipment, detection limits are the lowest concentration of a target analyte that a given method or piece of equipment can reliably ascertain and report as greater than zero.

Duplicate sample. Used for quality control purposes, duplicate samples are two samples taken at the same time from, and representative of, the same site that are carried through all assessment and analytical procedures in an identical manner. Duplicate samples are used to measure natural variability as well as the precision of a method, monitor, and/or analyst. More than two duplicate samples are referred to as *replicate samples*.

Environmental sample. An environmental sample is a specimen of any material collected from an environmental source, such as water or macroinvertebrates collected from a stream, lake, or estuary.

Equipment or rinsate blank. Used for quality control purposes, equipment or rinsate blanks are types of field blanks used to check specifically for carryover contamination from reuse of the same sampling equipment (see *field blank*).

Field blank. Used for quality control purposes, a field blank is a "clean" sample (e.g., distilled water) that is otherwise treated the same as other samples taken from the field. Field blanks are submitted to the analyst along with all other samples and are used to detect any contaminants that may be introduced during sample collection, storage, analysis, and transport.

Instrument detection limit. The instrument detection limit is the lowest concentration of a given substance or analyte that can be reliably detected by analytical equipment or instruments (see *detection limit*).

Matrix. A matrix is a specific type of medium, such as surface water or sediment, in which the analyte of interest may be contained.

Measurement Range. The measurement range is the extent of reliable readings of an instrument or measuring device, as specified by the manufacturer.

Method detection limit (MDL). The MDL is the lowest concentration of a given substance or analyte that can be reliably detected by an analytical procedure (see *detection limit*).

Precision. A data quality indicator, precision measures the level of agreement or variability among a set of repeated measurements, obtained under similar conditions. Relative percent difference (RPD) is an example of a way to calculate precision by looking at the difference between results for two duplicate samples.

Protocols. Protocols are detailed, written, standardized procedures for field and/or laboratory operations.

Quality assurance (QA). QA is the process of ensuring quality in data collection including: developing a plan, using established procedures, documenting field activities, implementing planned activities, assessing and improving the data collection process and assessing data quality by evaluating field and lab quality control (QC) samples.

Quality assurance project plan (QAPP). A QAPP is a formal written document describing the detailed *quality control* procedures that will be used to achieve a specific project's data quality requirements. This is an overarching document that might cover a number of smaller projects a group is working on. A QAPP may have a number of sample analysis plans (SAPs) that operate underneath it.

Quality control (QC). QC samples are the blank, duplicate and spike samples that are collected in the field and/or created in the lab for analysis to ensure the integrity of samples and the quality of the data produced by the lab.

Relative percent difference (RPD). RPD is an alternative to *standard deviation*, expressed as a percentage and used to determine precision when only two measurement values are available. Calculated with the following formula:
RPD as % = ((D1 – D2)/((D1 + D2)/2)) x 100

Where:
D1 is first replicate result
D2 is second replicate result

Replicate samples. See duplicate samples.

Representativeness. A data quality indicator, representativeness is the degree to which data accurately and precisely portray the actual or true environmental condition measured.

Sample analysis plan (SAP). A SAP is a document outlining objectives, data collection schedule, methods and data quality assurance measures for a project.

Sensitivity. Related to *detection limits*, sensitivity refers to the capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest. The more sensitive a method is, the better able it is to detect lower concentrations of a variable.

Spiked samples. Used for quality control purposes, a spiked sample is a sample to which a known concentration of the target analyte has been added. When analyzed, the

difference between an environmental sample and the analyte's concentration in a spiked sample should be equivalent to the amount added to the spiked sample.

Split sample. Used for quality control purposes, a split sample is one that has been equally divided into two or more subsamples. Splits are submitted to different analysts or laboratories and are used to measure the precision of the analytical methods.

Standard reference materials (SRM). An SRM is a certified material or substance with an established, known and accepted value for the analyte or property of interest. Employed in the determination of bias, SRMs are used as a gauge to correctly calibrate instruments or assess measurement methods. SRMs are produced by the U. S. National Institute of Standards and Technology (NIST) and characterized for absolute content independent of any analytical method.

Standard operating procedures (SOPs). An SOP is a written document detailing the prescribed and established methods used for performing project operations, analyses, or actions.

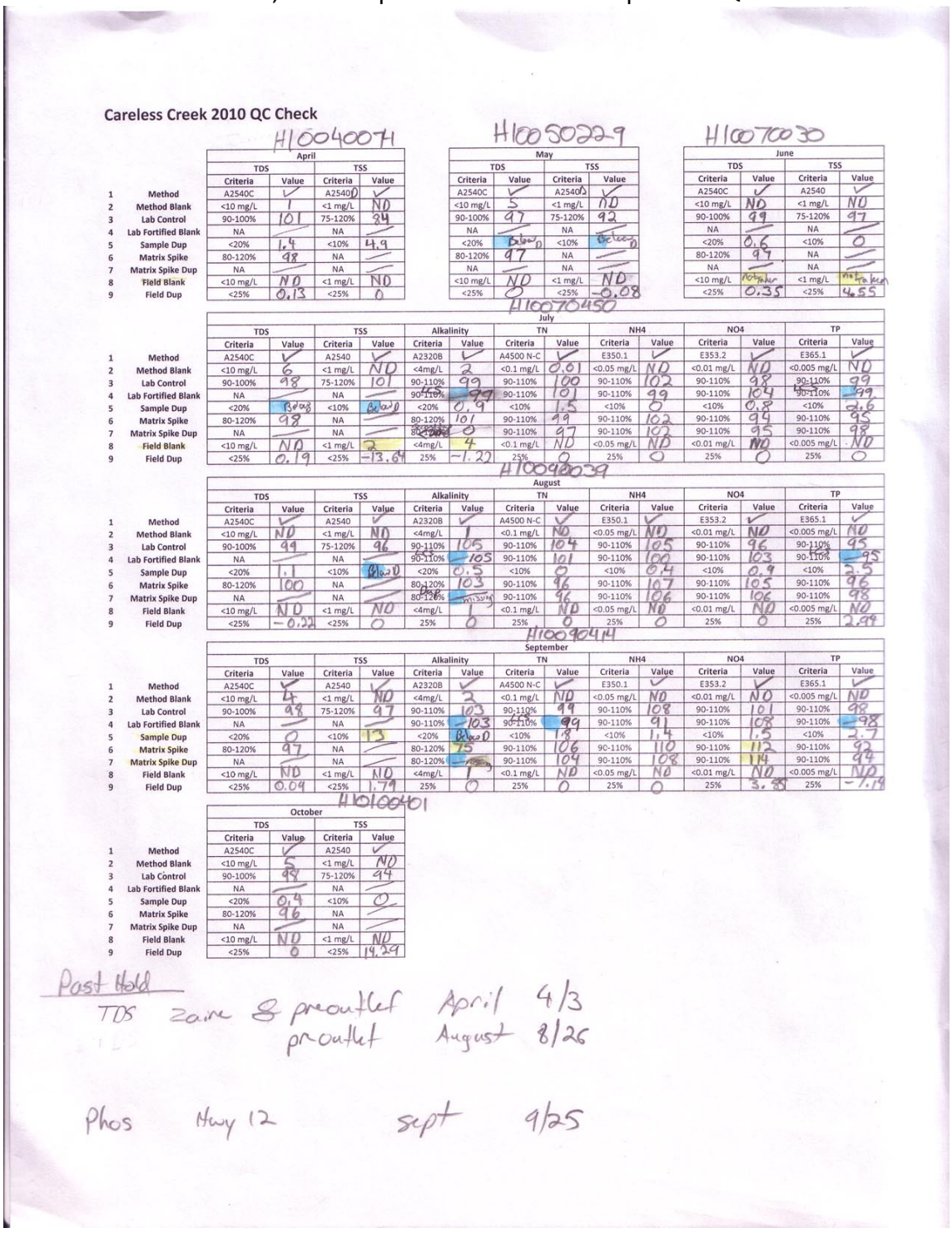
True value. In the determination of accuracy, observed measurement values are often compared to true, or standard, values. A true value is one that has been sufficiently well established to be used for the calibration of instruments, evaluation of assessment methods or the assignment of values to materials.

Data qualifiers and descriptions

Result Qualifier	Result Qualifier Description
B	Detection in field and/or trip blank
D	Reporting limit (RL) increased due to sample matrix interference (sample dilution)
H	EPA Holding Time Exceeded
J	Estimated: The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample.
R	Rejected: The sample results are unusable due to the quality of the data generated because certain criteria were not met. The analyte may or may not be present in the sample.
U	Not Detected: The analyte was analyzed for, but was not detected at a level greater than or equal to the level of the adjusted Contract Required Quantitation Limit (CRQL) for sample and method.
UJ	Not Detected/Estimated: The analyte was not detected at a level greater than or equal to the adjusted CRQL or the reported adjusted CRQL is approximate and may be inaccurate or imprecise.

Example QAQC matrix

Below is an example of a matrix for use in addressing whether all data quality criteria are met for each analyte for each batch of samples. This table can be created using the thresholds from tables 16 and 17 in this SAP. QC numbers from the lab and calculated from the field are filled in, and compared to thresholds to perform QC checks.



Careless Creek 2010 QC Check

H1004007 1

April

		TDS		TSS	
		Criteria	Value	Criteria	Value
1	Method	A2540C	✓	A2540D	✓
2	Method Blank	<10 mg/L	1	<1 mg/L	ND
3	Lab Control	90-100%	101	75-120%	94
4	Lab Fortified Blank	NA	—	NA	—
5	Sample Dup	<20%	1.4	<10%	4.9
6	Matrix Spike	80-120%	98	NA	—
7	Matrix Spike Dup	NA	—	NA	—
8	Field Blank	<10 mg/L	ND	<1 mg/L	ND
9	Field Dup	<25%	0.13	<25%	0

H1005022 9

May

		TDS		TSS	
		Criteria	Value	Criteria	Value
1	Method	A2540C	✓	A2540D	✓
2	Method Blank	<10 mg/L	5	<1 mg/L	ND
3	Lab Control	90-100%	97	75-120%	92
4	Lab Fortified Blank	NA	—	NA	—
5	Sample Dup	<20%	Below D	<10%	Below D
6	Matrix Spike	80-120%	97	NA	—
7	Matrix Spike Dup	NA	—	NA	—
8	Field Blank	<10 mg/L	ND	<1 mg/L	ND
9	Field Dup	<25%	0	<25%	−0.08

H1007003 0

June

		TDS		TSS	
		Criteria	Value	Criteria	Value
1	Method	A2540C	✓	A2540	✓
2	Method Blank	<10 mg/L	ND	<1 mg/L	ND
3	Lab Control	90-100%	99	75-120%	97
4	Lab Fortified Blank	NA	—	NA	—
5	Sample Dup	<20%	0.6	<10%	0
6	Matrix Spike	80-120%	99	NA	—
7	Matrix Spike Dup	NA	—	NA	—
8	Field Blank	<10 mg/L	Not Taken	<1 mg/L	Not Taken
9	Field Dup	<25%	0.35	<25%	4.55

H1007045 0

July

		TDS		TSS		Alkalinity		TN		NH4		NO4		TP	
		Criteria	Value	Criteria	Value	Criteria	Value	Criteria	Value	Criteria	Value	Criteria	Value	Criteria	Value
1	Method	A2540C	✓	A2540	✓	A2320B	✓	A4500 N-C	✓	E350.1	✓	E353.2	✓	E365.1	✓
2	Method Blank	<10 mg/L	6	<1 mg/L	ND	<4mg/L	2	<0.1 mg/L	0.01	<0.05 mg/L	ND	<0.01 mg/L	ND	<0.005 mg/L	ND
3	Lab Control	90-100%	98	75-120%	101	90-110%	99	90-110%	100	90-110%	102	90-110%	98	90-110%	99
4	Lab Fortified Blank	NA	—	NA	—	90-110%	99	90-110%	101	90-110%	99	90-110%	104	90-110%	99
5	Sample Dup	<20%	Blank	<10%	Blank	<20%	0.9	<10%	1.5	<10%	0	<10%	0.8	<10%	2.6
6	Matrix Spike	80-120%	98	NA	—	80-120%	101	90-110%	99	90-110%	102	90-110%	94	90-110%	95
7	Matrix Spike Dup	NA	—	NA	—	80-120%	0	90-110%	97	90-110%	102	90-110%	95	90-110%	98
8	Field Blank	<10 mg/L	ND	<1 mg/L	2	<4mg/L	4	<0.1 mg/L	ND	<0.05 mg/L	ND	<0.01 mg/L	ND	<0.005 mg/L	ND
9	Field Dup	<25%	0.19	<25%	−13.64	25%	−1.22	25%	0	25%	0	25%	0	25%	0

H1004803 9

August

		TDS		TSS		Alkalinity		TN		NH4		NO4		TP	
		Criteria	Value	Criteria	Value	Criteria	Value	Criteria	Value	Criteria	Value	Criteria	Value	Criteria	Value
1	Method	A2540C	✓	A2540	✓	A2320B	✓	A4500 N-C	✓	E350.1	✓	E353.2	✓	E365.1	✓
2	Method Blank	<10 mg/L	ND	<1 mg/L	ND	<4mg/L	1	<0.1 mg/L	ND	<0.05 mg/L	ND	<0.01 mg/L	ND	<0.005 mg/L	ND
3	Lab Control	90-100%	99	75-120%	96	90-110%	105	90-110%	104	90-110%	105	90-110%	96	90-110%	95
4	Lab Fortified Blank	NA	—	NA	—	90-110%	105	90-110%	101	90-110%	100	90-110%	103	90-110%	95
5	Sample Dup	<20%	1.1	<10%	Blank	<20%	0.5	<10%	0	<10%	0.4	<10%	0.9	<10%	2.5
6	Matrix Spike	80-120%	100	NA	—	80-120%	103	90-110%	96	90-110%	107	90-110%	105	90-110%	96
7	Matrix Spike Dup	NA	—	NA	—	80-120%	Missing	90-110%	98	90-110%	106	90-110%	106	90-110%	98
8	Field Blank	<10 mg/L	ND	<1 mg/L	ND	<4mg/L	1	<0.1 mg/L	ND	<0.05 mg/L	ND	<0.01 mg/L	ND	<0.005 mg/L	ND
9	Field Dup	<25%	−0.22	<25%	0	25%	0	25%	0	25%	0	25%	0	25%	2.94

H1009041 4

September

		TDS		TSS		Alkalinity		TN		NH4		NO4		TP	
		Criteria	Value	Criteria	Value	Criteria	Value	Criteria	Value	Criteria	Value	Criteria	Value	Criteria	Value
1	Method	A2540C	✓	A2540	✓	A2320B	✓	A4500 N-C	✓	E350.1	✓	E353.2	✓	E365.1	✓
2	Method Blank	<10 mg/L	4	<1 mg/L	ND	<4mg/L	2	<0.1 mg/L	ND	<0.05 mg/L	ND	<0.01 mg/L	ND	<0.005 mg/L	ND
3	Lab Control	90-100%	98	75-120%	97	90-110%	103	90-110%	99	90-110%	108	90-110%	101	90-110%	98
4	Lab Fortified Blank	NA	—	NA	—	90-110%	103	90-110%	99	90-110%	91	90-110%	108	90-110%	98
5	Sample Dup	<20%	0	<10%	13	<20%	Below D	<10%	1.8	<10%	1.4	<10%	1.5	<10%	2.7
6	Matrix Spike	80-120%	97	NA	—	80-120%	75	90-110%	106	90-110%	110	90-110%	112	90-110%	92
7	Matrix Spike Dup	NA	—	NA	—	80-120%	Missing	90-110%	104	90-110%	108	90-110%	114	90-110%	94
8	Field Blank	<10 mg/L	ND	<1 mg/L	ND	<4mg/L	1	<0.1 mg/L	ND	<0.05 mg/L	ND	<0.01 mg/L	ND	<0.005 mg/L	ND
9	Field Dup	<25%	0.04	<25%	1.79	25%	0	25%	0	25%	0	25%	3.38	25%	−7.14

H1010040 1

October

		TDS		TSS	
		Criteria	Value	Criteria	Value
1	Method	A2540C	✓	A2540	✓
2	Method Blank	<10 mg/L	5	<1 mg/L	ND
3	Lab Control	90-100%	99	75-120%	94
4	Lab Fortified Blank	NA	—	NA	—
5	Sample Dup	<20%	0.4	<10%	0
6	Matrix Spike	80-120%	96	NA	—
7	Matrix Spike Dup	NA	—	NA	—
8	Field Blank	<10 mg/L	ND	<1 mg/L	ND
9	Field Dup	<25%	0	<25%	14.29

Past Hold

TDS Zaire & proutlet April 4/3

proutlet August 8/26

Phos Hwy 12 sept 9/25