**Group Name**

**Descriptive Project Title**

**Sampling and Analysis Plan**

Date

Prepared by:

Person, Title

Affiliation

Address

Approved by:

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Project Manager (Montana DEQ)

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Terri Mavencamp (Montana DEQ QA Officer)

Insert Photo

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# 1.0 INTRODUCTION

## 1.1 Project Area Overview

The purpose of this section is to describe generally where your monitoring will take place, and to provide context for your project area by describing especially relevant aspects of geography, ecology and landscape activities:

* Describe the waterbody and/or sites that you will be monitoring. Include relevant information about the surrounding watershed and landscape characteristics (e.g., geographic location, where the stream originates and what it flows into, primary land uses in the vicinity of the waterbody or site). [EPA’s Surf Your Watershed](http://cfpub.epa.gov/surf/state.cfm?statepostal=MT) and <http://nris.mt.gov/interactive.asp> are great resources.
* Include a project area map.
* Identify water quality impairment causes (if any) that are currently associated with this waterbody by visiting Montana DEQ’s Clean Water Act Information Center at <http://deq.mt.gov/Water/WQPB/cwaic> and searching for the waterbody.
* Describe location and characteristics of any known pollution sources at the site or in the area; include maps or figures if relevant to the monitoring project.
* Summarize any known data collection efforts or other water quality investigations that have been conducted in your project area.
* Summarize regulatory information relevant to your project (e.g., water quality standards, threatened or endangered species, and permits).

## 1.2 Project Goals and Objectives

The purpose of this section is to articulate **WHY** you are monitoring. Clearly stated goals and objectives allow you to more easily communicate with volunteers and supporters, and allows you to identify the specific monitoring activities necessary to achieve your goals:

* State the overall goal driving your monitoring. Include relevant background information which describes the purpose of and need for data collection (e.g., to collect baseline data to enable future comparisons; to evaluate whether or not a stream can be listed or delisted from Montana’s 303(d) list; to identify and quantify the sources of a specific pollutant to identify potential restoration projects).
* Articulate your research questions – what question(s) are you hoping to be able to answer about your waterbody or watershed by collecting data (e.g., how do nutrient concentrations collected before riparian fencing compare to concentrations after? Have metals concentrations decreased below water quality standards to warrant delisting from the 303(d) list? How many cubic yards of sediment are eroding into the stream from a particular reach of streambank?).
* State the specific objectives of your monitoring project; be very specific about which parameters or conditions will be monitored.
* State how the data will be analyzed to answer the specific questions that you asked.

**NOTE**: If one of your goals is to collect data to “list or delist” a stream on the 303(d) list, it is important that you consult with DEQ staff or reference DEQ guidance throughout the process to ensure that your process is consistent with the requirements of our assessment methods (e.g., minimum sample size, core parameters, sampling design considerations). Refer to the Supplemental Guidance document associated with this SAP template for more information.

**Table 1 – Project Goals, Research Questions and Objectives [Examples included]**

|  |  |  |  |
| --- | --- | --- | --- |
| **Goal** | **Question** | **Objective** | **Data analysis/Product** |
| To evaluate whether abandoned mine reclamation was successful in reducing metals concentrations in the stream. | Have metals concentrations decreased below water quality standards to warrant delisting from the 303(d) list? | Collect metals data at five sites during high and low flow conditions. | Compare metals concentrations to numeric water quality standards (Montana Circular DEQ-7). |
| Collect sediment metals data at five sites. | Compare sediment metals concentrations to NOAA's Screening Quick Reference Tables for Inorganics in Sediment |
| Collect TSS data during each water sampling event. | Evaluate if metals concentrations are higher when suspended sediment concentrations are higher. |
| Collect flow data during each water sampling event. | Identify whether metals concentrations differ between high and low flow conditions. |
| To collect baseline information about nutrient concentrations to allow for annual comparison in the future. | What are current nutrient concentrations in the stream? | Collect nutrient samples at five sites during summertime growing season (July 1 - September 30) | Compare nutrient concentrations to numeric nutrient standards (Montana Circular DEQ-12A). |
| Take photos of stream substrate during each sampling event. | Visually estimate algae biomass at each site using guide in Montana DEQ's Chlorophyll-a SOP. |
| Collect flow data during each water sampling event. | Use flow data in subsequent years to evaluate how nutrient loads differ from year to year. |

## 1.3 Project Budget

The purpose of this section is to specify the project budget for various sampling and other activities. This budget should include, at a minimum, the total laboratory analytical costs associated with the sampling outlined in this SAP:

* Provide an overview of the project budget (i.e., what costs are associated with the project including, but not limited to, the laboratory analytical costs).
* Include a table in **Appendix A** showing the project budget which includes, at a minimum, the itemized laboratory analytical budget associated with the sampling activities contained in this SAP.

# 2.0 Sampling Process

## 2.1 Study Design

The purpose of this section is to specify critical information about your sampling design: WHERE the sampling will occur, WHO will conduct the sampling, WHAT will be collected per site, and WHEN the different types of data will be collected:

* Describe the reach of the river, lake or stream that you will be monitoring.
* Approximate the number of volunteers that will be collecting data.
* Include any additional explanation for why the parameters you selected are appropriate to answer your study question.

### Sampling Locations

* Describe where samples will be collected and why those locations were chosen (e.g., are there any important inflows, diversions, bridges or structures that may influence the study? Are there particular road or landowner access considerations?)
* Include a table that shows, for each site: Site Name, Site Description, Latitude, Longitude, Parameters and Rational for Site Selection.

**NOTE**: Sampling locations should represent the reaches or conditions of the waterbody that you are investigating. Take into account aspects that may impact the parameters that you are sampling (e.g., springs or tributary inflows, irrigation diversions, suspected areas of increased pollution).

Refer to the Supplemental Guidance document associated with this SAP template for more information.

**Table 2 - Sampling Locations\***

| **Site Name** | **Site Description** | **Latitude** | **Longitude** | **Parameters to Collect** | **Rationale for Site Selection** |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

\*These are proposed sampling locations; locations may change due to unforeseen access or other sampling issues.

### Sampling Map

* Include a map which displays your sampling locations and any pertinent land or water features in your study area.

Several options exist for free, web based mapping tools, including:

* DEQ’s web mapping application (<http://svc.mt.gov/deq/wmadst/>)
* Montana’s Natural Resource Information System (State Library) Digital Atlas (<http://mslapps.mt.gov/Geographic_Information/Applications/DigitalAtlas/Default>)
* Google Maps (<https://www.google.com/maps/>). DEQ does not endorse Google Maps but is aware that many volunteer monitoring programs have found it useful.

**Figure 1 - Map of Sampling Locations**

**Insert Sampling Map**

### Sampling Timing

Describe when samples will be collected. Refer to the Supplemental Guidance document associated with this SAP template for more information.

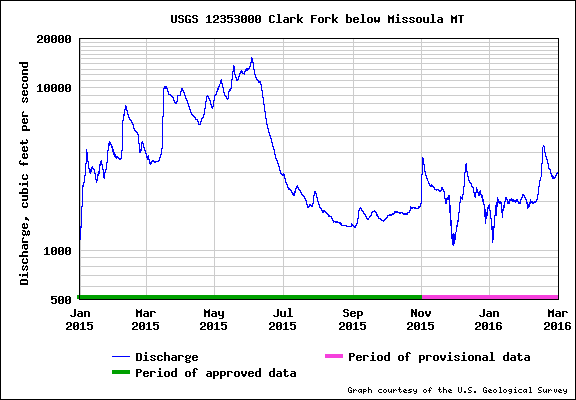
* State the overall timeframe of sampling.
* State the frequency of sampling per parameter (e.g., once per month, weekly, daily).
* Describe any particular seasonal or flow conditions that the sampling timeframe is trying to capture (e.g., baseflow or high flow; summertime growing season for nutrients).
* Include a Sample Collection Timeframe table with as many specific dates as possible.

**Table 3 - Sample Collection Timeframe**

|  |  |  |
| --- | --- | --- |
| **Data** | **Parameters** | **Reason for Date Selection** |
| Week of June 6, 2016 | Metals, TSS, flow | High flow expected |
| Week of July 11, 2016 | Nutrients, TSS, flow | During summer growing season |
| Week of August 22, 2016 | Nutrients, Metals, TSS, flow | Baseflow; summer growing season |
| Week of October 17, 2016 | Metals, TSS, flow | No irrigation inflows |

**NOTE**: Take into account the normal hydrograph for your river and/or watershed. A hydrograph figure is not required in your SAP but is helpful in explaining rationale behind sample timing selection. Hydrographs, such as those shown in the example below, can be created from USGS gage data (http://waterdata.usgs.gov/MT/nwis/current/?type=flow).

**Example hydrograph for Clark Fork River below Missoula, MT**



## 2.2 Sampling Methods

The purpose of this section is to specify **HOW** you are going to perform your monitoring, including sample collection methods, laboratory methods and sample handling procedures:

* Describe the method you will use to collect data for each of your selected parameters.

***NOTE****: Consider including a brief description of each method in this section and including more detailed, step-by-step instructions in an appendix; otherwise, cite your organization’s Standard Operating Procedures document.*

Include, at a minimum, the following information for these various types of monitoring methods:

* **In situ measurements using field meters**: type of meter, which parameters will be measured, when the measurements will be taken relative to other samples (order of operations), and which field form will be used to record measurements.
* **Water sample collection**: type and size of bottle to be used per parameter, method of collection to be used (e.g., grab, filtered grab, Van Dorn), rinsing or other decontamination method, filtration method (if applicable), acid preservation type and method (if applicable), sample storage method (on ice, frozen, room temperature), chain of custody field form requirements.
* **Flow (discharge) method**: which meter (if applicable) or alternate method will be used, where flow will be measured, and which field form will be used to record the measurements.
* **Site photographs**: how many (minimum) photos will be taken per site, what crews should take pictures of, and how will photos be tracked or recorded.

Refer to the Supplemental Guidance document associated with this SAP template for more information.

## 2.3 Field Forms

The purpose of this section is to list the field forms that volunteers will complete during sampling activities in the field:

* Provide a list of the field forms that will be used during monitoring activities covered under this SAP.
* Consider including a copy of the field forms as an appendix to this document.

## 2.4 Laboratory Methods and Sample Handling Procedures

Modify the following table such that the parameters you will be collecting appear in the table with all accompanying columns, and delete the rows for parameters that you won’t be collecting. To maintain formatting, delete rows by highlighting the row(s), right clicking on the highlighted rows, and select “Delete Cells 🡪 Delete Entire Row.”

***NOTE****: Parameters in* ***green font*** *are infrequently assessed by DEQ and we request that you contact DEQ to provide justification before analyzing these parameters.*

Refer to the Supplemental Guidance document associated with this SAP template for more information.

**Table 4 – Monitoring Parameter Suite, Sample Handling, Analysis & Preservation**

| **Parameter** | **Preferred Method** | **Alternate Method** | **Required Reporting Limit ug/L** | **Holding Time Days** | **Bottle** | **Preservative** |
| --- | --- | --- | --- | --- | --- | --- |
| **Water Sample - Common Ions, Physical Parameters, Miscellaneous** | | | | | | |
| Total Suspended Solids (TSS) | A2540 D |  | 4000 | 7 | 1000 ml HDPE/ 500 ml HDPE | ≤6oC |
| Total Dissolved Solids (TDS) | A2540 C |  | 4000 | 7 |
| Volatile Suspended Solids (VSS) | A2540 E |  | 4000 | 7 |
| Alkalinity (Bicarb., Carb.) | A2320 B | EPA 310.2 | 1000 | 14 |
| Sulfate | EPA 300.0 | A4110 B | 50 | 28 |
| Chloride | EPA 300.0 | A4110 B | 50 | 28 |
| Bromide | EPA 300.0 | A4110 B | 50 | 28 |
| Fluoride | EPA 300.0 | A4110 B/A4500-F-B | 50 | 28 |
| *E. Coli* | A9223 B | EPA 160.4 | 1 MPN/100 ml | 6 hrs | 100 ml HDPE | ≤10oC |
| Biochemical Oxygen Demand (BOD) | A5210 B |  | 2000 | 2 | 1000 ml HDPE | ≤6oC |
| Carbonaceous Biochemical Oxygen Demand (CBOD) | A5210 B | EPA 405.1 |  | 2 | 1000 ml HDPE | ≤6oC |
| Dissolved Organic Carbon (DOC) | A5310 B |  | 500 | 28 | 125ml Glass | Filt. 0.45 um, H2SO4, ≤6oC |
| Total Organic Carbon (TOC) | A5310 C |  | 500 | 28 | 125ml Glass | H2SO4, ≤6oC |
| Sulfide | A4500-S2 D |  | 1000 | 7 | 250 ml HDPE | Zinc Acetate + NaOH to pH >9, ≤6oC |
| **Water Sample - Nutrients** | | | | | | |
| Total Persulfate Nitrogen (TPN) | A4500-N C | A4500-N B | 40 | 28 | 250ml HDPE | ≤6oC (28d HT), Freeze (45d HT) |
| Dissolved Orthophosphate as P | EPA 365.1 | A4500-P F | 1 | 2 | 250ml HDPE | Filt. 0.45 um, ≤6oC |
| Total Phosphorus as P | EPA 365.1 | A4500-P F | 3 | 28 | 250 ml HDPE | H2SO4 , ≤6oC or Freeze |
| Nitrate-Nitrite as N | EPA 353.2 | A4500-NO3 F | 10 |
| Total Ammonia as N | EPA 350.1 | A4500-NH3 B,C,D,E,or G | 50 |
| **Water Sample – Other** | | | | | | |
| Methane | SW8015 Mod |  | 0.2 | 14 | 2-40 mL VOA vials | 4 Drops H2SO4 |
| Polychlorinated Biphenyls (PCB) | EPA 608 |  | 0.08 | 7 | 1000 ml Glass | ≤6oC |
| **Water Sample - Dissolved Metals (0.45 um filtered)** | | | | | | |
| Aluminum | EPA 200.7 | EPA 200.8 | 9 | 180 | 250 ml HDPE | Filt 0.45 um, HNO3 |
| **Water Sample - Total Recoverable Metals** | | | | | | |
| *Total Recoverable Metals Digestion* | EPA 200.2 | APHA3030F (b) | N/A | 180 | 500 ml HDPE/ 250 ml HDPE | HNO3 |
| Arsenic | EPA 200.8 |  | 1 |
| Cadmium | EPA 200.8 |  | 0.03 |
| Calcium | EPA 200.7 |  | 1000 |
| Chromium | EPA 200.8 | EPA 200.7 | 1 |
| Copper | EPA 200.8 | EPA 200.7 | 1 |
| Iron | EPA 200.7 |  | 20 |
| Lead | EPA 200.8 |  | 0.3 |
| Magnesium | EPA 200.7 |  | 1000 |
| Potassium | EPA 200.7 |  | 1000 |
| Selenium | EPA 200.8 |  | 1 |
| Silver | EPA 200.8 | EPA 200.7/200.9 | 0.2 |
| Sodium | EPA 200.7 |  | 1000 |
| Zinc | EPA 200.7 | EPA 200.8 | 8 |
| Antimony | EPA 200.8 |  | 0.5 |
| Barium | EPA 200.7 | EPA 200.8 | 3 |
| Beryllium | EPA 200.7 | EPA 200.8 | 0.8 |
| Boron | EPA 200.7 | EPA 200.8 | 10 |
| Manganese | EPA 200.7 | EPA 200.8 | 5 |
| Nickel | EPA 200.7 | EPA 200.8 | 2 |
| Strontium | EPA 200.7 | EPA 200.8 | 20 |
| Thallium | EPA 200.8 |  | 0.2 |
| Uranium, Natural | EPA 200.8 |  | 0.2 |
| **Water Sample - Total** | | | | | | |
| Mercury | EPA 245.1 |  | 0.05 | 28 | HDPE, Glass | HNO3 |
| Mercury, Ultra low level | EPA 245.7 |  | 0.005 | 28 | 100mL Glass | 0.5 ml 12N HCl |
| **Water Sample - Calculated Results** | | | | | | |
| Total Hardness as CaCO3 | A2340 B (Calc) |  | 1000 |  |  |  |
| Sodium Absorption Ratio (SAR) | Calc |  |  |  |  |  |
| **Parameter** | **Preferred Method** | **Alternate Method** | **Req. Report Limit mg/kg (dry weight)** | **Holding Time Days** | **Bottle** | **Preservative** |
| **Sediment Sample - Total Recoverable Metals** | | | | | | |
| *Total Recoverable Metals Digestion* | EPA 200.2 |  | N/A | 180 | 2000 ml HDPE Widemouth | None |
| Arsenic | EPA 200.8 | EPA 200.9 | 1 |
| Cadmium | EPA 200.8 | EPA 200.9 | 0.2 |
| Chromium | EPA 200.8 | EPA 200.7 | 9 |
| Copper | EPA 200.8 | EPA 200.7 | 15 |
| Iron | EPA 200.7 | EPA 200.7 | 10 |
| Lead | EPA 200.8 | EPA 200.9 | 5 |
| Zinc | EPA 200.7 | EPA 200.7 | 20 |
| **Sediment Sample - Total Metals** | | | | | | |
| Mercury | EPA 7471B |  | 0.05 | 28 | 2000 ml HDPE Widemouth | None |

# 3.0 Quality Assurance/Quality Control

The purpose of this section is to summarize all quality assurance and quality control requirements associated with your project. This will help you to ensure that the data you are collecting will be of sufficiently high quality to suit the needs of your project, and to communicate the quality of your data for other potential users of your data.

## 3.1 Quality Assurance and Quality Control Overview

To inform water quality studies, data needs to accurately represent conditions in the watershed. Most projects require some degree of proper sample handling, processing, and data quality assessment, particularly when scientific or resource management questions are being investigated.

Quality Assurance (QA) is the overall management of a sampling program. It ensures the monitoring process, from the methods used to how data will be managed and analyzed, is adequate for the project to meet its objectives with a stated level of confidence. QA activities include developing a sampling and analysis plan, making sure that volunteers or staff is properly trained, and following standard operating procedures.

Quality control (QC) includes technical actions taken to detect and control errors. QC consists of developing measures and protocols to ensure sample collection and analyses are consistent and correct. If there is a problem, good QC will help to identify the problem. It also helps determine whether volunteer work is being performed correctly. QC activities may include collecting replicate samples for chemical analyses and the use of field blanks.

Data quality objectives (DQOs) are qualitative and quantitative statements that clarify the purpose of the study, define the most appropriate type of information to collect, determine the most appropriate conditions from which to collect that information, and specify tolerable levels of potential decision errors. Essentially, DQOs prompt monitoring project managers to determine what level of data quality is necessary to achieve the objectives of the project.

Data quality indicators (DQIs) are attributes of samples that allow for assessment of data quality. Because there are large sources of variability in streams and rivers, DQIs are used to evaluate the sources of variability and error and thereby increasing confidence in our data.

A list of Data Quality Assurance and Quality Control terms and definitions is included in **Appendix B**.

## 3.2 Data Quality Indicators

This section describes for each data quality indicator (representativeness, comparability, completeness, sensitivity, precision and accuracy) how the sampling and analysis plan and study design aims to achieve data quality. Data quality indicator criteria are specified, where appropriate.

### Representativeness

Representativeness refers to the extent to which measurements represent an environmental condition in time and space. This project follows a judgmental sampling design in which spatial and temporal considerations were used to help ensure representativeness.

Spatial representation

* Describe how your sampling design helps achieve spatial representativeness (e.g., sampling sites were chosen to capture variability in land use, flow or other watershed characteristics that may be influencing water quality; monitoring site locations were limited as a result of site access and landowner permission; monitoring sites were selected along the entire length of the stream from headwaters to mouth).

Temporal representation

* Describe how your sampling design helps achieve temporal representativeness (e.g., samples collected from the same site on different days will be collected at approximately the same time of day; sampling on the same waterbody on the same day will be conducted from downstream to upstream to ensure that the same water is not being sampled twice and so field crews are not disturbing the sampling location; sufficient time will be allowed to pass between sampling events at the same site (e.g., 28 days for nutrients; 7 days for metals); sampling biological parameters for long-term trend monitoring will be conducted as close as possible to the same date each year to minimize seasonal variation).

### Comparability

Comparability is the degree to which different methods, data sets, and/or decisions agree or are similar. Comparability allows data users to determine the applicability of data to certain projects or decisions. For example, Montana DEQ may incorporate water chemistry data collected by volunteers if the methods, analytes and reporting limits are comparable to those that DEQ uses.

* Describe how your sampling design helps achieve comparability (e.g., following standard operating procedures, collecting the same data as was collected during previous years’ volunteer monitoring efforts, collecting the same analytes used by DEQ to assess water quality, using similar laboratory detection limits).

### Completeness

Completeness is a measure, expressed as a percentage, of the amount of data *planned for collection* compared to the amount *actually collected*. Prior to leaving a sampling site the Stream Team volunteers will be required to fill out a data sheet, which will be reviewed and signed by the field leader on site; this will reduce the occurrence of empty data fields. The overall project goal is 90% completeness. Because of the limited funding for laboratory analysis, collection of additional samples in the event of breakage of sample bottles en route to the laboratory is not planned.

* State your overall project completeness goal (i.e., how many sampling events or samples do you plan to do and what percentage of this total is your goal to actually complete? Generally 70 – 90%).
* Describe how your sampling design helps achieve completeness (e.g., all field forms will be reviewed for completeness prior to departure from the site; any sampling events that must be cancelled for any reason will be rescheduled; lab reports will be reviewed upon receipt to ensure that results for each sample submitted are received).

### Sensitivity

Sensitivity refers to the limit of a measurement to reliably detect a characteristic of a sample. 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. For analytical methods, sensitivity is expressed as the method detection limit (MDL).

Laboratory Sensitivity: Laboratories determine their method detection limits (MDLs) annually, and routinely check each method’s ability to achieve this level of sensitivity using negative controls (e.g., method blanks, continuing calibration Blanks, and laboratory reagent blanks). Sensitivity quality controls for all laboratory methods will follow the frequency and criteria specified in the analytical method or as described in the analytical laboratory’s Laboratory Quality Assurance Plan (LQAP).

**Corrective Action:** If the analytical method controls fail the specified limit, check with the laboratory to see how they addressed the non-conformance and qualify data as necessary.

### Precision, Bias and Accuracy for Water Samples

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. Bias can occur either at sample collection or during measurement. 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. Precision measures the level of agreement or variability among a set of repeated measurements, obtained under similar conditions.

Evaluation of precision and accuracy for the water sampling portion of this project will consist of collecting and evaluating the results of field duplicates and field blank samples.

Precision: Field Duplicates

Field duplicates will be collected during this project and used to determine field and laboratory precision. Field duplicates consist of two sets of sample containers filled with the same water from the same sampling site. Specify the number of duplicate samples you will take, either as a total number or a percentage; must be at least 10% of the total number of samples. All duplicate samples will be collected at the same location. Field duplicate samples will be collected, handled and stored in the same way as the routine samples for laboratory shipment. Duplicates are used to determine field and laboratory precision.

Field duplicates will be used to evaluate data precision by calculating their relative percent difference (RPD):

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

where:

D1 is first replicate result

D2 is second replicate result

Precision for field QC samples will be assessed by ensuring that relative percent difference (RPD) between duplicates is less than 25%. If the RPD of field duplicates is greater than 25%, all data results from the duplicate pair’s parent sample that are less than 5 times the concentration in the duplicate sample will be flagged with a “J”.

Precision: Laboratory Duplicates

Energy Laboratories uses EPA approved and validated methods. Energy Laboratory’s standard operating procedures all require a method validation process including precision and accuracy performance evaluations and method detection limit studies. Internal laboratory spikes and duplicates are all part of Energy Laboratories quality assurance program; laboratory QA/QC results generated from this program are provided with the analytical results. The criteria used is 20% RPD for duplicate results greater than five times the MDL.

Accuracy: Field Blanks

Field blanks consist of laboratory-grade deionized (DI) water, transported to the field, and poured into a prepared sample container. Blanks are prepared in the field at the same time as the routine samples, and will be preserved, handled and analyzed in the same way as the routine samples. Specify the number of blanks that will be collected during your project (e.g., one per visit? One per monitoring team?). Field blank samples are used to determine the integrity of the volunteer monitors’ handling of samples, the condition of the sample containers supplied by the laboratory, and the accuracy of the laboratory methods.

Accuracy for field QC samples will be assessed by ensuring that blank samples return values less than the lower reporting limit (shown in **Section 3**). If a blank sample returns a result greater than the threshold, all data for that parameter from that batch of samples will be qualified with a “B” flag. The exception is that data with a value greater than 10 times the detected value in the blank does not need to be qualified.

Accuracy: Laboratory

Accuracy of individual measurements will be assessed by reviewing the analytical method controls (i.e. Laboratory Control Sample, Continuing Calibration Verification, Laboratory Fortified Blank, Standard Reference Material) and the analytical batch controls (i.e. Matrix Spike and Matrix Spike Duplicate). The criteria used for this assessment will be the limits that Energy laboratory has developed through control charting of each method’s performance or based on individual method requirements.

Other

All samples will be checked to verify that they were processed within their specified holding times. Sample results whose holding time was exceeded prior to being processed will be qualified with an “H” flag.

Because of the limited funding for laboratory analysis, collection of additional samples in the event of data results that do not meet data quality objectives is not planned. If problems are linked to field crew sampling error, the data is either rejected or qualified, depending on the degree of the problem, and supplemental training will be provided prior to the next sampling event, as possible.

## 3.3 Training

All volunteers will be trained in all field methods, including field meters, sample collection and handling, prior to the initial sampling event. Specify when your volunteer training event is scheduled for. Volunteers will demonstrate understanding of and proficiency in field methods to volunteer monitoring program manager(s) prior to sampling. Volunteers will be required to bring a copy of this SAP as well as any supplemental documentation of detailed field methods and/or standard operating procedures.

## 3.4 Data Management, Record Keeping & Reporting

The Project Manager is responsible for data management and record keeping, including the following activities that occur during or after the sampling is completed:

* Draft a brief synopsis of any SAP methodology derivations that occurred.
* Store and backup all data generated during this project, including field forms, laboratory reports obtained from the laboratories, electronic copied of field photographs, and written field notes.
* Review field forms for completeness and accuracy, especially Site Visit and Chain of Custody forms.
* Enter all laboratory data into MT e-WQX database.
* Maintain records of hours worked by volunteers for purposes of budget tracking.

Copies of laboratory analytical reports and Electronic Data Deliverable (EDD) spreadsheets will be provided by the DEQ contract analytical lab to both the Project Manager and to DEQ. All data will be entered by the Project Manager, or other specified party, into MT e-WQX database. Prior to entering data into the MT e-WQX database, the Project Manager will review the laboratory data in the following manner:

1. Ensure lab results are within required reporting limits (including the laboratory QA/QC samples); if results are outside the reporting limits, the Project Manager will check with the laboratory to see how they addressed the non-conformance and qualify data as necessary.
2. Complete the QC Checklist included in **Appendix C**.
3. Assign appropriate data qualifiers provided in **Appendix D** to data, as needed, in both hardcopy and electronic form.

## 3.5 Project Team Responsibilities

The purpose of this section is to specify the project team members involved with this monitoring project, to clarify the roles and responsibilities of each member:

* Specify who is responsible for, at a minimum, the following tasks: (1) ensuring field forms are complete and accurate, (2) filling out the chain of custody form for the lab, (3) delivering or shipping the samples to the lab, (4) communicating with the lab and with DEQ, (5) performing data quality assessment and identifying data qualifiers, and (6) responsible for overall data management tasks discussed in Section 3.4.
* Include a table of the project team, including person’s name, role, contact information, and responsibilities. Consider including a column in this table showing the training each member has received relevant to their role.

**Table 5 – Project Team Roles and Responsibilities**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Person** | **Role** | **Contact Information** | **Responsibilities** | **Training (optional)** |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

## 3.6 Data Routing

The purpose of this section is to specify how different types of data being collected will be routed through the data management system being used:

* Specify how water chemistry data analyzed by the laboratory will be routed, stored and managed (e.g., data will be uploaded into the Montana Department of Environmental Quality (DEQ) Montana EqUIS database (<http://deq.mt.gov/wqinfo/datamgmt/MTEWQX.mcpx>) for eventual upload into EPA’s STORET database (<http://www.epa.gov/storet/>).
* Specify how other data (e.g., in situ measurements, flow measurements, site photos and field forms) will be routed, stored and managed.
* Include a Data Routing Process table to clarify how each type of data collected will be managed, and who holds the responsibility for each.

**Table 6 – Data Routing Process**

|  |  |  |  |
| --- | --- | --- | --- |
| **Task** | **Information/Data** | **Primary Responsibility** | **Secondary Responsibility** |
| Reviewing for completeness | field forms | volunteer | project manager |
| Scanning | field forms | office assistant | project manager |
| upload and backup | digital site photos | project manager | n/a |
| lab coordination | sample chain of custody forms, electronic data deliverables | project manager | n/a |
| data entry into EQuIS | lab results, field measurements, site information | project manager | n/a |

# 4.0 ASSESSMENT RESULTS

The purpose of this section is to map out the intended plan for using the data that you are collecting under this SAP. This will help ensure that you are collecting the correct kind of data, the appropriate amount of data, and that you data quality objectives are appropriate for the intended use of your data.

This section also outlines how you intend to make the data and/or data analyses available to others so it can be useful for informing research, educating the public, informing future monitoring plans, etc.

## 4.1 Data Analysis

* For each parameter covered under this SAP, describe how you plan to analyze the data and use it to achieve your goals and objectives stated in Section 1 (e.g., if collecting nutrient concentration data, will you compare them against numeric which water quality standards and, if so, which are the correct standards to apply? Or, if not comparing to standards and instead comparing concentrations from the same site over time, or comparing data from multiple sites against one another, how will you make your comparisons and draw conclusions).
* Note whether sufficient data will be collected following completion of this SAP or if additional data collection is anticipated.

## 4.2 Data Communication

* Specify your intended mechanisms for data sharing and reporting (e.g., written report for volunteers and the public, public presentations, local media outlets, communication with DEQ or other agency personnel who might be able to use the data).

# References

List any citations you reference throughout this document.

# Appendix A - Project Budget

**Projected Budget for Laboratory Analysis and Other Project Activities**

|  |  |  |  |
| --- | --- | --- | --- |
| **Description (Analyte or Activity)** | **Cost per Unit** | **Quantity** | **Total Cost** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

# Appendix B – QA/QC Terms and Definitions

**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. Madison Stream Team Sampling and Analysis Plan Page 23

**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 an additional sample 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.

**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.

**Sampling and 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.

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

# Appendix C – Quality Control Checklist

**Laboratory QC**

\_\_\_ Condition of samples upon receipt

\_\_\_ Cooler/sample temperature within required range

\_\_\_ Proper collection containers

\_\_\_ All containers intact

\_\_\_ Sufficient sample volume for analysis

\_\_\_ 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 noted as such in lab results.

\_\_\_ Analyses carried out as described in the SAP (e.g., analytical methods, photo documentation, field protocols)

\_\_\_ Reporting detection limits 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 all within the required control limits defined within the SAP

\_\_\_ Project DQOs and DQIs were met (as described in SAP)

\_\_\_ Summary of results of OC analysis, issues encountered, and how issues were resolved addressed (corrective action)

\_\_\_ Completed QC checklist before upload into DEQ’s EQuIS (or other) database.

# Appendix D – Data Qualifiers (Flags)

|  |  |
| --- | --- |
| **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. |
| D | 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. |