Quality Assurance Project Plan

Greater Gallatin Watershed Council
Volunteer Monitoring Program:
Gallatin Stream Team

JULY 2008
REV03-2011
(Revised March 18, 2011)

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1.0 DISTRIBUTION LIST

This quality assurance project plan (QAPP) is reviewed annually by the GGWC QA Officer and updates are incorporated, if needed. The revised document is provided to the individuals on the distribution list prior to the start of the field season.

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Doug Fletcher	Hyalite Creek Stream Leader	GGWC Board	Removed from web version	Removed from web version
Rose Vallor	Hyalite Creek Field Leader	GGWC Volunteer	Removed from web version	Removed from web version
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2.0 PROGRAM ORGANIZATION

The GGWC Volunteer Stream Monitoring Program (referred to as the Gallatin Stream Team), is a cooperative effort between GGWC and GLWQD. GGWC provides volunteer recruitment and support. GLWQD provides technical support, training and data management oversight. Additional program support is provided by MSUEWQ, DEQ and MT Watercourse. In addition to the program officers shown in the organizational chart (**Figure 2-1**), Stream Leaders (GGWC Board members) provide guidance and oversight to the Stream Team volunteer Field Leaders. Field Leaders coordinate and provide oversight during sampling events. The Gallatin Stream Team is able to consult with the Montana Watershed Coordination Council Water Quality Monitoring Work Group (WQMWG). WQMWG consists of local, state and federal agencies and the Montana University System with technical expertise in water quality monitoring project development, quality assurance directives, and data collection and analysis. Mindy McCarthy, DEQ QA Officer, Tammy Crone, GLWQD and GGWC QA officer, and Adam Sigler, MSU Extension Water Quality, all participate on the WQMWG.

Data management is coordinated between GLWQD, MSUEWQ and the designated Stream Team database volunteer. Primary data users are GGWC, DEQ and GLWQD. Energy Laboratories, Inc. (Billings, Montana) conducts the laboratory analysis. Rhithron Associates of Missoula conducts macroinvertebrate analysis.

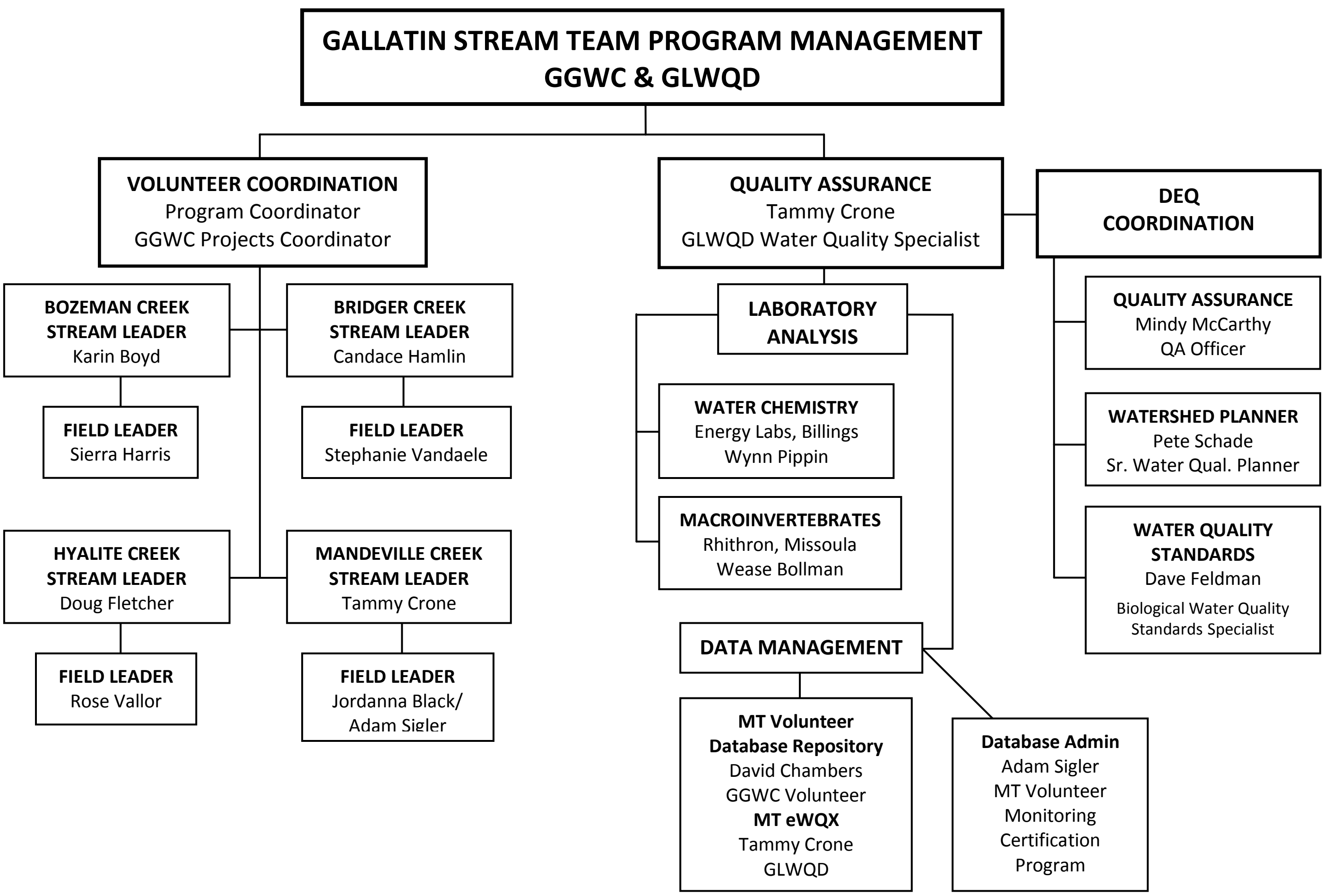


Figure 2-1. Gallatin Stream Team Program Organizational Chart

3.0 PROGRAM BACKGROUND

The Gallatin Stream Team began as a one-year pilot program in 2008. GGWC plans to continue this program long-term. The program has become a flagship success for GGWC and has been successful in providing scientifically-credible data to DEQ in 2008 for the Lower Gallatin TMDL Planning Area (LGTPA). The goal for the Gallatin Stream Team is to provide a framework for volunteer monitors to collect water quality data on local streams for long-term trend analysis, and to supplement the GLWQD Surface Water Monitoring Network. Specifically, program goals are:

- Provide credible data to decision-makers acting to protect and restore the Gallatin watershed:
    - Describe current watershed conditions
    - Identify trends in watershed conditions
    - Track problem areas
    - Screen for potential problems
    - Help to determine watershed restoration priorities
    - Monitor the effectiveness of restoration projects
- Provide information collected to fellow volunteers, resource planners, agencies, organizations and the general public on a regular basis
- Facilitate public involvement in watershed monitoring and stewardship
- Retain volunteers and engage existing volunteers to train new program participants
- Accommodate volunteer needs and training

Data collected will continue to meet DEQ scientific credibility requirements so it can be used by the county and the state to assist in making water quality and land use decisions as well as help identify specific problems that require further attention or study. GGWC will use the data to educate residents on the connections between land use and water quality. The program is currently focused on four streams within the Gallatin Watershed: Bozeman (Sourdough) Creek, Bridger Creek, Hyalite Creek and Mandeville Creek **(Figure 3-1** and **Attachment B)**.

3.1 Bozeman (Sourdough) Creek

The Bozeman (Sourdough) Creek headwaters begin in the Gallatin National Forest and flows through an urbanizing watershed before reaching its confluence with the East Gallatin River. The stream serves as a main drinking water supply for the City of Bozeman, with the city water treatment plant intake located in a rural area just outside the Gallatin National Forest boundary. The city is investigating the feasibility of building a dam above the intake to meet future water supply needs. Fuels reduction is also planned in the watershed above the intake to reduce fire danger as part of the city's source water protection plan. The lower segment of Bozeman Creek below Kagy Boulevard is not fully meeting beneficial uses and water quality standards. It is on the DEQ 303(d) list of impaired waterbodies due to excess nutrients sedimentation and *E. coli* bacteria. As commercial and residential development continues in this community, impervious surfaces will increase, adding to potential stormwater runoff issues. Therefore, documenting current and future conditions will be important for the City of Bozeman, local residents and governmental agencies to eventually develop and implement best management practices (BMPs) that could minimize potential negative water quality impacts to Bozeman (Sourdough) Creek.

A local volunteer effort to develop a Bozeman Creek Enhancement Plan was initiated in 2010. The process is being led by a steering committee with assistance for the National Park Service Trails Program. This 20-year plan is focused on improving water quality, stream corridor conditions, and recreational and educational opportunities from Kagy Boulevard to the confluence with the East Gallatin River. The plan will include potential restoration projects and serve as a blueprint for project development.

3.2 Bridger Creek

Bridger Creek originates on the eastern side of the Bridger Mountains and flows through Bridger Canyon, which is a rural watershed, before reaching its confluence with East Gallatin River just north of the City of Bozeman. Land ownership consists of public (Gallatin National Forest) and private entities. The water quality in Bridger Creek is influenced by rural subdivision development, a local ski area, golf course, and increasing urban development. Bridger Creek is on the DEQ 2006 303(d) List of impaired waterbodies for nutrients. Bridger Creek is a tributary to the East Gallatin River which is impaired due to excess nutrients and sedimentation and also on the 303(d) list. It is anticipated that future development will continue in this watershed, most notably development in and around the Bridger Bowl Ski Area and near the Bridger Creek Golf Course. The old City of Bozeman Landfill is also located in this watershed.

3.3 Hyalite Creek

Hyalite Creek originates in the Gallatin Range South of Bozeman and flows through a mostly rural and suburban landscape before reaching its confluence with the East Gallatin River northeast of the City of Belgrade. The stream is impounded in the upper reach and is currently the only dammed stream in the watershed. Numerous irrigation ditches provide return flow to the stream in the valley; most of which include return flow from the West Gallatin River. The Hyalite Creek watershed is comprised of public and private landownership that includes U.S. Forest Service, small rural and agricultural acreages, and residential subdivisions. The City of Bozeman uses Hyalite Creek for a portion of its municipal water supply. The Hyalite Recreational Area is heavily used by the public for hiking, camping, biking, fishing, and ice climbing. Boating also occurs on the reservoir. Hyalite Creek is on the DEQ 2006 303(d) List of impaired waterbodies for excess nutrients from the headwaters to the City of Bozeman water supply diversion ditch. From the diversion ditch to the confluence with the East Gallatin River, the stream is not listed for pollutant-related use impairments. However, this is because the stream has not been assessed by DEQ.

3.4 Mandeville Creek

Mandeville Creek originates as a spring creek south of Bozeman near 19th Avenue. It flows in a northerly direction through suburban and urban areas, including Montana State University campus, and land north of Interstate 90 that is slated for industrial and commercial development, before reaching its confluence with the East Gallatin River north of Bozeman. Historically the stream supported its own fishery and was an important spawning tributary for the East Gallatin River (Craig Mandeville, personal communication). This stream is severely impacted by urban land use and issues of concern include: stormwater runoff, siltation and flow alteration, riparian habitat degradation, and nutrients. The stream is not on the 303(d) list of impaired waterbodies and has not been assessed by DEQ. However, Mandeville Creek is a tributary to the East Gallatin River, which is impaired and on the Montana 303(d) list.

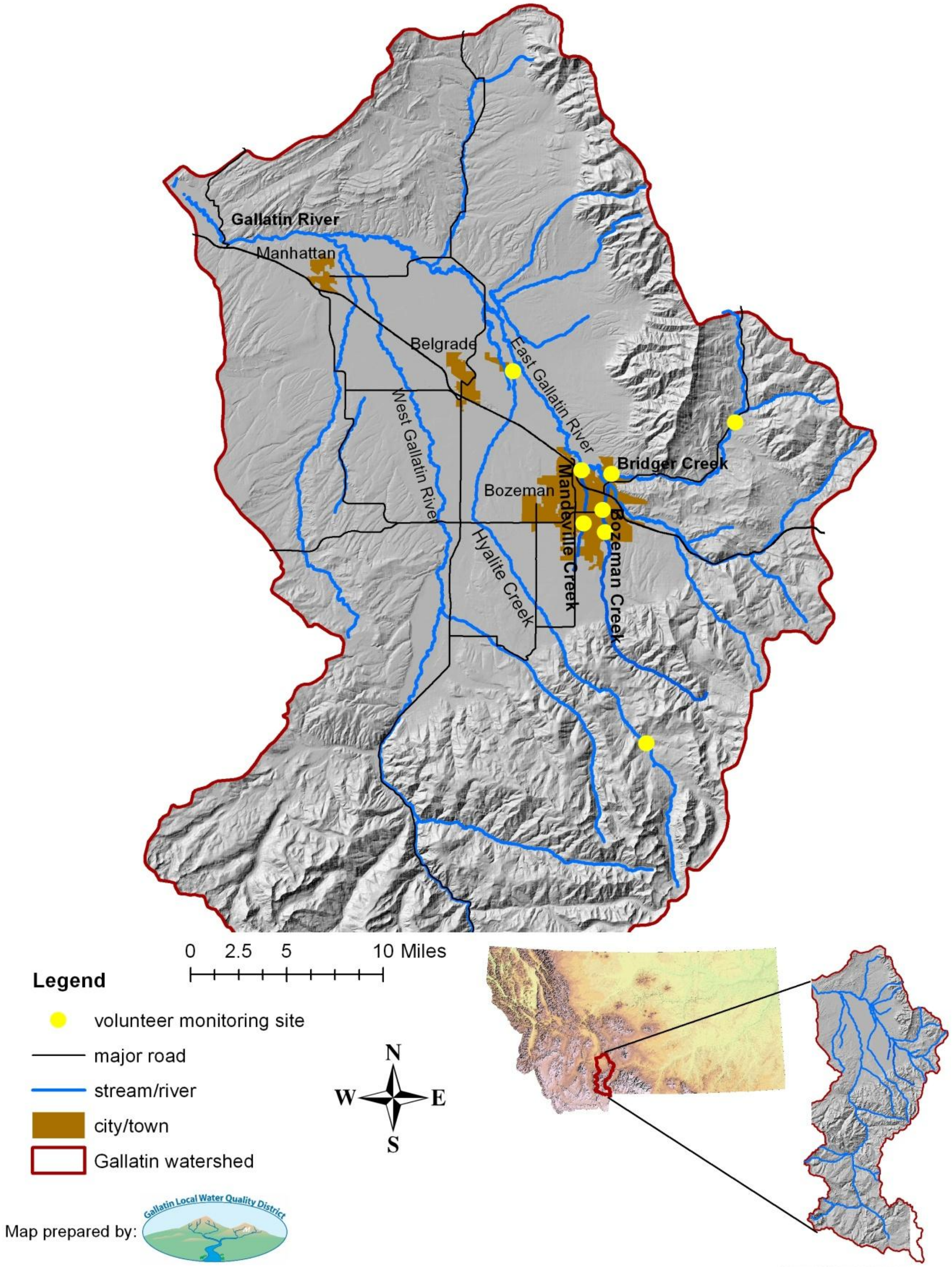


Figure 3-1. Monitoring Program Streams in the Gallatin Watershed

4.0 PROGRAM DESCRIPTION

GGWC conducts volunteer recruitment throughout the year. A volunteer field training is held in June. Training is conducted in coordination with GLWQD, MSUEWQ and DEQ. Support is provided by MT Watercourse. Stream Leaders consist of GGWC Board members to provide for consistent program oversight with the GGWC Watershed Coordinator and GLWQD Water Quality Specialist.

Sampling activities occur annually at two monitoring sites per stream, July through September. Additional data collection of field parameters and stream discharge may occur October through December, as time and staffing allow. Specific water sampling activities are outlined in **Table 4-1**. To create baseline data for long-term trend monitoring, each sampling activity is a critical component of the overall monitoring program.

Laboratory analysis of water samples is conducted by Energy Laboratories in Billings, MT. Macroinvertebrate samples are collected once during the field season and, as funding for analysis becomes available, the preserved samples are sent to Rhithron Associates in Missoula, MT for taxonomic identification and enumeration. Analysis is conducted by Dave Feldman of DEQ.

To better understand in-stream characteristics, TruTrack™ data loggers will be used to collect diurnal information on water temperature, air temperature and water level. The data loggers and staff gages will be installed, and flows measured to establish stream discharge rating curves by GLWQD staff with assistance from GGWC volunteers as staffing and time allow. Data loggers will be maintained and data downloaded by GLWQD and MSUEWQ staff.

Following sampling events, data is entered into the MT Watercourse Volunteer Water Quality Database Repository and the MT Water Quality Exchange (MT-eWQX) database. DEQ submits MT-eWQX data to the U.S. Environmental Protection Agency (EPA) STORET Data Warehouse. GGWC coordinates an annual mini-symposium for volunteers to share data and information with each other, local and state agencies, elected officials, neighbors and other interested watershed stakeholders.

Table 4-1. Program Activities

Major Program Activities	Jan	Feb	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Volunteer recruitment & training	X	X	X	X						X
TruTrack™ data loggers installed*			X	X	X	X	X	X		
Measure pH, DO, Temp, SC (TDS) & flow					X	X	X	X	X	
Seasonal macroinvertebrate sampling & habitat assessments					X					
Wolman Pebble Count						X				
Water chemistry grab samples & periphyton photo documentation					X	X	X			
Lab analysis of water grab samples					X	X	X			
Lab analysis of macroinvertebrates**									X	
Data processing & reporting	X	X				X	X	X	X	X
Mini-Symposium		X								
*Data loggers will be used as staffing for the program allows and may not occur each field season. **Analysis of samples will occur during this program time frame when funding becomes available.										

5.0 DATA QUALITY OBJECTIVES FOR FIELD MEASUREMENT DATA

5.1 Precision, Accuracy Measurement Range

Table 5-1 illustrates the precision, accuracy and measurement range for the field parameters. YSI 556 meters are used to record these parameters.

Table 5-1. Field Data Measurement Objectives

Parameter	Precision	Accuracy	Measurement Range	Resolution
pH	±20%	±0.2 units	0 to 14 units	0.01 units
temperature	±20%	±0.15ºC	-5 to 45ºC	0.1ºC
dissolved oxygen*	±20%	±0.2 mg/L	0 to 50 mg/L	0.01 mg/L
specific conductivity	±20%	±0.5% of reading (±0.001 mS/cm)	0 to 200 mS/cm	0.001 to 0.01 mS/cm
total dissolved solids	±20%	calculated from SC (mS/cm)**	0 to 100 g/L	4 digits

*YSI meter with internal barometer. Accuracy ±3 mmHg with ±15ºC, resolution 0.1 mmHg, measurement range 500 to 800 mmHg.
**TDS constant default of 0.65. Reported in g/L.

5.2 Representativeness

For program assessment, representativeness is limited by funding for sampling analysis. Four streams will be monitored with two sampling sites per stream. The monitoring sites selected will each be representative of that particular stream, keeping in mind access to private property and landowner availability and participation. All four streams are inter-montane, cold-water, wadeable streams with a predominance of riffle habitats. The monitoring sites will be indicative of that habitat type and sampling techniques for these stream types will be used in the program as outlined by DEQ Water Quality Planning Bureau Field Procedures Manual for Water Quality Assessment Monitoring (WQPBWQM-020). For macroinvertebrate sampling, volunteers will use the Environmental Monitoring and Assessment Method (EMAP) a spatial sampling method developed by EPA. This method was adopted by DEQ in 2008 to replace the traveling kick method outlined in WQPBWQM-020, which has not yet been updated.

5.3 Comparability

The Gallatin Stream Team Program will ensure comparability by following the monitoring protocols established by DEQ for assessment and analysis (WQPBWQM-020). Data will be analyzed following DEQ preferred EPA analytical methods and meet DEQ required reporting limits.

5.4 Completeness

There are no legal or compliance uses anticipated for the Gallatin Stream Team Program data. In addition, there is no fraction of the planned data that must be collected in order to fulfill statistical criteria. It is expected that samples will be collected from at least 90% of the sites unless unanticipated weather conditions prevent sampling.

6.0 TRAINING REQUIREMENTS/CERTIFICATION

Gallatin Stream Team volunteers will be required to participate in a one-day field training and refresher course held in June. The training is conducted by GLWQD and MSUEWQ with assistance from DEQ (QA Officer and Biological Water Quality Standards Specialist). Training assistance will also be provided by Montana Watercourse.

The morning session will focus on QA training, emphasizing what QA/QC is, why it is important, and the importance of sampling continuity. It will also consist of instruction on YSI 556 meter calibration, maintenance and use procedures. The afternoon session will be devoted to proper technique for taking meter readings, familiarization with water sampling supplies (bottles, preservatives, completing the chain of custody form), technique for collecting water grab samples, site visit photo documentation, how to GPS the sampling site, conducting streamflow measurements, reading a staff gage, cross sections and pebble counts, completing a site visit form, and macroinvertebrate sampling and preservation. The training will be based on DEQ WQPBWQM, EPA EMAP, and components of the Montana Volunteer Water Monitoring Guidebook developed by the Montana Watercourse and approved by DEQ.

Montana Watercourse and MSU-Extension Water Quality have developed a Volunteer Water Monitoring Certification Program for Montana. The GGWC Gallatin Stream Team Program promotes participation in this certification program to its volunteers.

A field audit will be conducted by the GGWC QA Officer and a combination of certified volunteers and MSU Extension Water Quality personnel (based on availability) for each Stream Team on the first day of monitoring to evaluate volunteer performance. The audit will ensure volunteers are calibrating meters and conducting all field activities according to established protocols. Additional field audits will be conducted, as needed.

7.0 DOCUMENTATION AND RECORDS

Field data sheets must be completed, in full, on-site. The Field Leader is responsible for reviewing the data sheets for completeness and signing off on the Site Visit Form before leaving the sampling site. The Field Leader is responsible for returning completed field sheets and preserved macroinvertebrate samples to the GGWC QA Officer/GLWQD Water Quality Specialist the same month sampling occurs. Copies of field data sheets are in the Standard Operating Procedures (**Attachment E**).

Signed landowner property access permission forms are maintained by GGWC with copies provided in each Stream Team folder so that it can be referred to on-site, if needed.

Table 7-1 lists who should receive data in what format. After QA review by the GGWC QA Officer, The GGWC Database Coordinator will enter field and laboratory analytical data into the MT Volunteer Water Quality Database Repository and MT-eWQX. GLWQD will submit the monitoring data to DEQ via upload into MT e-WQX.

Original field data sheets, laboratory reports and all computer back-up disks will be maintained by GGWC. Copies will be maintained and stored at GLWQD. Macroinvertebrate samples will be stored with GLWQD until analysis funding is available.

Table 7-1. Repository for Data Records

Data Report	Original (hard copy) to:	Copy or PDF to:	EDD to:
Field Data Sheets (via stream Field Leader)	1. GGWC QA Officer/GLWQD 2. GGWC Watershed Coordinator	• GGWC Database Coordinator • GGWC Stream Leaders GLWQD Water Quality Specialist	
Laboratory Report (via Energy Laboratories)	1. GGWC QA Officer/GLWQD 2. GGWC Watershed Coordinator	• GGWC Database Coordinator • GLWQD Water Quality Specialist • DEQ QA Officer • DEQ Watershed Planner	• GGWC QA Officer • GLWQD Water Quality Specialist • DEQ QA Officer • DEQ Watershed Planner
Macroinvertebrate Report (via Rhithron Associates)	1. GGWC Watershed Coordinator	• GLWQD Water Quality Specialist • DEQ Biological Water Quality Standards Specialist	

8.0 SAMPLING PROCESS DESIGN

The sampling schedule is outlined in **Table 8-1**. Volunteers will make every effort to sample on the same day each month, 3-4 weeks apart. The sampling date will be pre-set by GLWQD. An alternate date will be selected in case sampling cannot occur on the primary date. The sampling schedule will be provided to the volunteers at the June training. July sampling will be coordinated with the GGWC QA Officer so field audits can be conducted. If possible, sampling events will be coordinated to occur at least 5 days after a heavy rain event to capture ambient conditions. If this is not possible due to scheduling difficulties, weather conditions will be noted on the field data sheets. If a volunteer cannot participate in the scheduled sampling, they are requested to contact their Stream Leader/Field Leader as soon as possible, so alternative monitors can be found. Volunteers are strongly encouraged to work in teams of 3 at a minimum; 4-5 team members are recommended per sampling event.

Table 8-1. Sampling Design & Schedule

Parameter	July	Aug	Sept	Oct	Nov	Dec
pH, dissolved oxygen, specific conductivity, total dissolved solids, water temperature (Using YSI 556 meter with internal barometer)	X	X	X	X*	X*	X*
Streamflow (float method), record staff gage reading	X	X	X	X*	X*	X*
Geo-location (using GPS meter or Google Earth)	X					
Macroinvertebrates	X					
Wolman Pebble Count		X				
Photo documentation (for chlorophyll-*a* interpretation)	X	X	X			
Water chemistry grab samples: (**Bozeman Cr & Mandeville Cr) • Total phosphorus; Nitrogen, Nitrate + Nitrite; Total Ammonia as N; Total Persulfate Nitrogen; Total Suspended Solids, Hardness as $CaCO_3$; **Total Recoverable Metals (Calcium, Copper, Iron, Lead, Magnesium, Mercury, Zinc)	X	X	X			
**These parameters will be measured as volunteer capacity is increased and available.*						

Permission to access sampling sites is obtained from all private property owners, in writing, in advance. As a courtesy, owners are notified at least 48 hours in advance of plans to conduct monitoring activities on the site. Sampling sites for each stream are indicated in **Table 8-2** and on site maps in **Attachment B**.

Table 8-2. Sampling Station Locations & "F" Site Locations

Stream	Station ID*	Station Description	Station		"F" Site	
			Lat**	Long**	Lat	Long
Bozeman Creek	BOZMC01	City Hall above Lamme St	45.6810	-111.0330	45.6810	-111.0324
	BOZMC02	Below outfall @ East Lincoln St. (Manion)	45.6640	-111.0302	45.6641	-111.0304
Bridger Creek	BRIDC01	Bridger Cr Golf Course @ McIllhattan Rd	45.7087	-111.0235	45.7087	-111.0235
	BRIDC02	10600 Bridger Canyon Road (McGlynn)	45.7486	-110.8916	45.7486	-110.8916
Hyalite Creek	HYLTC01	1925 E. Baseline Rd. (Pierce)	45.7876	-111.1291	45.7875	-111.1292
	HYLTC02	DNRC gage below reservoir	45.5013	-110.9861	45.5013	-110.9856
Mandeville Creek	MANVC01	Above Red Wing Drive	45.7112	-111.0555	45.7111	-111.0562
	MANVC02	MSU campus @ College Street	45.6700	-111.0530	45.6713	-111.0530

*All Station IDs will begin with the Project ID: GGWC-_ _ _ _ _# #.
**NAD 83, decimal degrees (recorded to 4th decimal place)

9.0 SAMPLING METHODS REQUIREMENTS

Volunteers will conduct sampling activities following the Gallatin Stream Team Program Standard Operating Procedures (SOP) for stream monitoring (**Attachment C**). This SOPis based upon DEQ Field Procedures Manual (WQPBWQM-020), the Montana Watercourse Volunteer Monitoring Handbook and EPA EMAP. A portion of this information is summarized in **Table 9-1**.

Table 9-1. Sampling Method Requirements

Parameter	Sampling Equipment	Volume	Bottle	Preservative	Hold Time
pH	YSI 556 meter	instream	none	none	n/a
temperature	YSI 556 meter	instream	none	none	n/a
dissolved oxygen	YSI 556 meter	instream	none	none	n/a
specific conductivity	YSI 556 meter	instream	none	none	n/a
Total dissolved solids (TDS)	YSI 556 meter	n/a	n/a	n/a	n/a
streamflow & cross section	wood block, tape meas., twine, stakes, stopwatch	instream	n/a	n/a	n/a
latitude/longitude	GPS meter	n/a	n/a	n/a	n/a
macroinvertebrates	kick net 500 µ-mesh	2 – 500 ml	wide-mouth	95% ethanol	6 mo
Wolman pebble count	Gravelometer	≥100 particles	n/a	n/a	n/a
photo-documentation	digital camera	n/a	n/a	n/a	n/a
Total suspended solids (TSS)	grab sample	500 ml	Plastic	Cool, 6°C	7 days
Hardness as $CaCO_3$*	Calculation	n/a	n/a	n/a	n/a
Total Persulfate Nitrogen	grab sample	50 ml	Plastic	Cool, 4°C	30 days
Nitrate-Nitrite as N, low level	grab sample	50 ml	Plastic	H_2SO_4, 4°C	28 days
Total Ammonia as N, low level	grab sample	50 ml	Plastic	H_2SO_4, 4°C	28 days
Total Phosphorus as P, low level	grab sample	50 ml	Plastic	H_2SO_4, 4°C	28 days
Total recoverable metals* (calcium, iron, magnesium, zinc; low-level: copper, lead, mercury)	grab sample	250 ml	Plastic	HNO_3, 4°C	180 days

*Total recoverable metals and Hardness pertain to Bozeman Creek and Mandeville Creek only.

9.1 Sample Handling and Custody Requirements

Field samples will be collected and preserved according to specifications outlined in **Table 9-1**. Sample containers will be equipped with labels and filled out using waterproof markers. Standard Chain of Custody (COC) procedures will be followed. COC documentation will accompany samples to the laboratory. Samples will be placed in a cooler, on ice, to await shipment to Energy Laboratories in Billings by FedEx or UPS next weekday service. Macroinvertebrate samples will be labeled in the field according to the SOP and shipped via FedEx or UPS ground transport to Rhithron Associates in Missoula, Montana when funding is available to cover analysis costs.

10.0 ANALYTICAL METHODS REQUIREMENT

Analysis methods listed in **Table 10-1** represent standard accepted procedures. Analytical reporting limits for field parameters (pH, dissolved oxygen, specific conductivity, TDS, temperature, flow, latitude/longitude) are listed in Table 2, Section 5.1 of this QAPP. Analytical method details for the water grab samples are not included in this QAPP document but are described in *Standard Methods for the Examination of Water and Wastewater, 20th Ed* (APHA, 1999). EPA Method 200.2, 200.7 and nutrient analyses (EPA 350.1, 353.2, and 365.1) are outlined in EPA 600/R-79-020, while EPA Method 200.7_8 and 245.1 are outlined in EPA 600/R-94-111. Analytical method details for macroinvertebrates are described in DEQ WQPBWQM-009rev2.

Table 10-1. Analytical Methods and Detection Limits

Analyte	Method	Analytical Reporting Limit (µg/L) Energy Lab
Common Ions and Physical Parameters		
Total suspended solids (TSS)	A2540 D	4,000
Nutrients		
Total Persulfate Nitrogen	A4500 N-C	50
Nitrate-Nitrite as N, low level	EPA 353.2	10
Total Ammonia as N, low level	EPA 350.1	50
Total Phosphorus as P, low level	EPA 365.1	5
Total Recoverable Metals *(Bozeman & Mandeville Creeks only)		
Total Recoverable Metals Digestion	EPA 200.2	n/a
Calcium	EPA 200.7	1000
Copper, Low Level	EPA 200.8	1
Iron	EPA 200.8	30
Lead, Low Level	EPA 200.8	0.5
Magnesium	EPA 200.8	1000
Mercury, Low Level	EPA 245.1	0.05
Zinc	EPA 200.7	10
Hardness as $CaCO_3$	A 2340 B (calculated)	n/a
Biological		
Macroinvertebrates	DEQ WQPBWQM-009rev2	n/a

11.0 QUALITY CONTROL REQUIREMENTS

Data quality objectives (DQOs) are the quantitative and qualitative criteria established for a sampling design in order to meet the project's objectives. Data quality indicators (DQIs) are quantitative criteria established for the data acquired within this design to assure it is of sufficient quality for its intended use.

11.1 Representativeness

Representativeness refers to the extent to which measurements represent an environmental condition in time and space. This is a judgmental sampling design using the following rationale:

Spatial representation: Sampling sites are chosen to represent the potential of landscape characteristics and land use/land cover influences existing in the watershed to influence water quality. Limitations do exist as a result of site access and landowner permission. Sampling sites are identified based on site access and opportunities to capture the variability in land use and watershed characteristics.

Temporal representation: Two time periods are used to spatially represent the potential for stream flows, which increase during runoff to influence the nutrient and metals concentration in waterbodies. These are spring runoff and summer base flows.

When sampling macroinvertebrates for long-term trend monitoring at a particular site, sampling will be conducted as close as possible to the same date each year to minimize seasonal variation.

11.2 Comparability

Comparability is the applicability of the project's data to the project's decision rule. The decision rule used for the GGWC Stream Team Program is based on the "sufficient and credible data" guidelines used by DEQ where data collected by other organizations allows DEQ to make valid and reliable determinations of beneficial use support for waterbodies.

11.3 Completeness

Completeness is a measure of the amount of data prescribed for assessment activities and the usable data actually collected, expressed as a percentage. Prior to leaving a sampling site the Stream Team members will be required to fill out a data sheet, which will be reviewed and signed by their Field Leader on site. These checks will reduce the occurrence of empty data fields. The overall project goal is 90% completeness. Sites lost due to inaccessibility will reduce the total number of sites in the equation above but not the completeness goal.

11.4 Sensitivity

Sensitivity refers to the limit of a measurement to reliably detect a characteristic of a sample. For analytical methods, sensitivity is expressed as the method detection limit (MDL). Laboratories must determine their MDL's 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 Laboratory's Quality Assurance Plan (LQAP). The criteria used to assess field method sensitivity for water and sediment samples shall be:

- Field method controls (Field Blank) < Reporting Limit

<u>Corrective Action</u>: If analytical method controls fail the specified limit, check with the laboratory to see how they addressed the non-conformance and qualify data as necessary. If Field Blanks fail, qualify all associated project data < 10x the detected value.

11.5 Precision

Precision refers to the degree of agreement among repeated measurements of the same characteristic. This project will rely on analytical and field duplicates to assess precision based on 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

11.5.1 Lab precision (laboratory duplicates)

Precision quality control for all laboratory methods will follow the frequency specified in the analytical method or as described in the LQAP. The criteria used to assess analytical method precision shall be:

- Water samples: 20% RPD for duplicate results > 5 times the MDL

11.5.2 Overall precision (field duplicates)

Frequency of field co-located duplicates will be 10% of samples collected in the field. The criteria used to assess overall precision shall be:

- Water samples: 25 % RPD for duplicate results > 5 times the MDL

<u>Corrective Action</u>: If laboratory duplicates fail this limit, check with the laboratory to see how they addressed or qualified the data and add additional qualifiers and notes as needed. If the field duplicates fail this limit, qualify all associated results < 5 x the concentration in the duplicate pair's parent sample with a "J".

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 or data results that do not meet QA/QC is not planned. If sampler problems are found, the data is either thrown-out or qualified, depending on the degree of the problem. Arrangements for monitor retraining will be made before the next sampling event is scheduled, if possible, by the GGWC QA Officer.

Energy Laboratories utilizes EPA approved and validated methods. A method validation process including precision and accuracy performance evaluations and method detection limit studies are required of all Energy Laboratories standard operating procedures. Method performance evaluations include quality control samples, analyzed with a batch to ensure sample data integrity. 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.

Lab data will be reviewed by the GGWC QA Officer to ensure results are within reporting limits (including laboratory QA/QC samples) prior to data entry into the MT Volunteer Water Quality Database Repository and MT e-WQX by the GGWC Database Coordinator. Copies of lab reports and EDDs will be forwarded to DEQ QA Officer after review by GGWC QA Officer.

11.6 Bias and Accuracy

Bias is directional error from the true value. In this context, it is an extension of the representativeness concept applied to an individual sample. Bias can occur either at sample collection or during measurement.

Accuracy is the combination of high precision and low bias. 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.

Corrective Action: For any QC value outside of the recovery range, check with the laboratory to see how they addressed the non-conformance and qualify data as necessary.

11.7 Field Measurements

QA/QC procedures from the grab sample field-sampling portion of this program will consist of duplicates and blank samples (one each per sampling event per stream in July and September). The field blanks consist of laboratory-grade deionized (DI) water, transported to the field, and poured off into a prepared sample container. The blank will be prepared at the same time as the grab sample. The blank sample is 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.

Duplicates consist of two sets of sample containers filled with the same water from the same sampling site. All duplicate samples will be collected at the same location. Duplicates are used to determine field and laboratory precision. Duplicate samples will not be identified as such and will enter the laboratory blindly for analyses. Both duplicates and blank samples are stored and handled with the normal sample load for laboratory shipment. For Bozeman and Mandeville Creeks, field duplicates will also be collected for Total Recoverable Metals. Because the designated sampling unit for the macroinvertebrates is a multi-transect sampling, information about the variability among measurements is inherent to the collection design. Therefore, duplicate samples are not planned for collection.

12.0 INSTRUMENT/EQUIPMENT MAINTENANCE AND CALIBRATION

A YSI 556 meter will be maintained by the Field Leader for each stream following the maintenance procedures outlined in the Instruction Manual. Maintenance service, as needed, will be provided by Geotech, Inc. in Denver, Colorado, or Fondriest Environmental in Beaver Creek, Ohio. Both entities are YSI Factory Authorized Repair Centers. A maintenance and calibration log book will be kept with each meter and maintained by the Field Leader for each stream. The meters will be calibrated, prior to each sampling event, according to the manufacturer's instructions using approved calibration standards. Calibration results are recorded in the log book. Calibration procedures and standards as well as a sample of the maintenance and calibration log forms are contained in the GGWC Gallatin Stream Team SOP in **Attachment C**. Field leaders will notify the GGWC QA Officer of any instrument malfunctions so that arrangements can be promptly made for remedies prior to the next scheduled sampling event. The GLWQD will house the YSI meters during the off season and make arrangements for scheduled maintenance and calibration checks.

Prior to and after sampling events the kick nets will be inspected for tears or punctures by stream team members. Any damage will be reported to the Stream Leader who will then inform the GGWC Watershed Coordinator so that replacements can be ordered. Kick nets and all other field equipment will be cleaned after each use and maintained by the Field Leader for each stream during the sampling season.

12.1 Inspection and Acceptance Requirements for Supplies

Extra buffers and calibration standards are ordered from Cole Parmer and inspected by Field Leaders upon arrival. The supplier will be notified if broken or expired containers are received and replacements provided. Containers will be marked with date received and inspected routinely by Field Leaders to ensure they are not expired prior to their use for meter calibration.

13.0 Data Acquisition, Management, Verification & Reporting

13.1 Data Acquisition Requirements

For the Gallatin Stream Team Program macroinvertebrate assessment analysis, pollution tolerance values assigned to organisms and metric calculation formulas are taken from the literature and documentation provided by Rhithron Associates and DEQ WQPB. USGS 7.5 minute topographic maps, Google Earth maps, etc. are used to identify site locations, land-use activities, and landscape features during an initial watershed survey.

13.2 Data Management

Field data sheets are inspected and signed by the sampling team Field Leader before leaving the site. If the Field Leader is not on-site during the sampling event, then the sampling team leader for that day will be responsible for inspecting the field data sheets and turning them in to the Field Leader within one week of the sampling event. The data sheets are then to be provided to the GGWC QA Officer before the end of the month so the forms can be reviewed for accuracy. Copies will be forwarded to the GGWC Database Coordinator for entry into the Volunteer Database Repository.

Energy Laboratories will send laboratory reports to GLWQD to the attention of the Water Quality Specialist, who will review the results. Hardcopy reports from the laboratory will be accompanied by an EDD in the MT-eWQX database format that reports values less than the quantitation limit ("J" value report). Laboratory reports will also be provided as PDFs. All data will be entered into the Volunteer Water Quality Database Repository by the GGWC Database Coordinator and MT e-WQX by the GLWQD Water Quality Specialist. In addition, laboratory report PDFs and EDDs will also be forwarded to the DEQ QA Officer and GGWC.

Rhithron Associates will send macroinvertebrate analytical results in PDF to GGWC and GLWQD, who will forward the data to the DEQ Biological Water Quality Standards Specialist (Dave Feldman) for review and further analysis.

13.3 Data Assessment and Response Actions

Review of Gallatin Stream Team field activities is the responsibility of each Stream and Field Leader, in conjunction with the GGWC QA Officer. A field audit will be conducted for each Stream Team on their first sampling event of the season by the GGWC QA Officer/GLWQD Water Quailty Specialist and a combination of certified volunteer monitors and MSUEWQ personnel. Volunteers in need of performance improvement will be retrained on-site during the audit. All field and program activities may be reviewed by the DEQ QA Officer as requested. Any identified procedural problems will be corrected based on recommendations from the QA Officers.

13.4 Reports

A mini-symposium is conducted each winter (February/March) to report on the data collected for the previous field season. This is an opportunity for volunteers to share data with each other as well as state and local agencies, decision-makers and the general public. A summary of program results will be distributed to all Gallatin Stream Team Program volunteers and the community via the GGWC newsletter, Gallatin Stream Report Cards, and the GGWC website.

13.5 Data Review, Validation, Verification Requirements and Methods

All field and laboratory data is reviewed by the GGWC QA Officer to determine if the data meet QAPP objectives. As needed, the DEQ QA Officer will request to review data for the program. Decisions to reject or qualify data are made by the DEQ QA Officer.

During a sampling event, any field sample readings out of the expected range are reported to the Field Leader with a second sample reading taken by the Field Leader to verify the condition. If the reading is still out of the expected range it is noted and reported on the field data sheet.

Once data has been entered into the MT Volunteer Water Quality Database Repository, the Database Coordinator will print out the data and proofread it against the original data sheets. Errors in data entry will be corrected. Outliers and inconsistencies will be flagged for further review by GGWC QA Officer, (with assistance, if needed, by the DEQ QA Officer), or discarded.

As soon as possible after each sampling event, calculations for precision, completeness and accuracy will be made. If data quality indicators do not meet the program's specifications, data may be discarded. Resampling may only occur if funding is available. If the cause of failure is due to equipment problems, calibration/maintenance techniques will be reviewed, reassessed and improved. If the problem is sampling error, team members will be retrained. Any limitations on data use will be detailed in any project reports and other documentation as needed.

Revisions to this QAPP will be submitted to DEQ QA Officer for approval.

Attachment A

Analytical Budget

2011 ANALYTICAL BUDGET

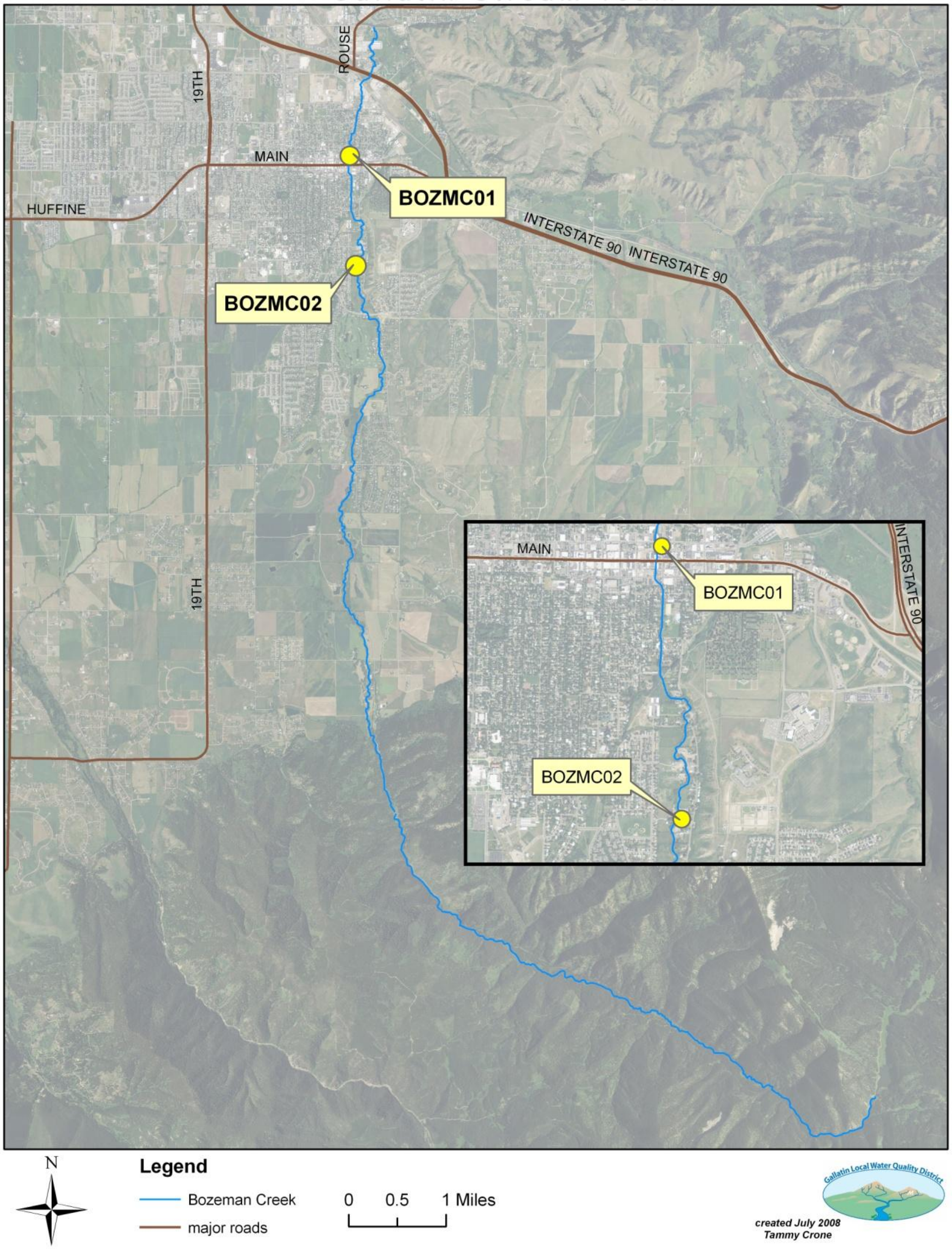
PARAMETER	COST PER SAMPLE Bozeman Creek	Bridger Creek	Hyalite Creek	Mandeville Creek
Common Ions and Physical Parameters				
Total Suspended Solids (TSS)	$ 10	$ 10	$ 10	$ 10
Nutrients				
Total Persulfate Nitrogen (TPN)	$ 25	$ 25	$ 25	$ 25
Nitrate-Nitrite as N, Low Level	$ 15	$ 15	$ 15	$ 15
Total Ammonia as N, Low Level	$ 15	$ 15	$ 15	$ 15
Total Phosphorus as P, Low Level	$ 15	$ 15	$ 15	$ 15
Total Recoverable Metals				
Digestion Prep - Total Recoverable Metals	$ 15	$ -	$ -	$ 15
Copper, Low Level	$ 20	$ -	$ -	$ 20
Iron	$ 20	$ -	$ -	$ 20
Lead, Low Level	$ 20	$ -	$ -	$ 20
Zinc	$ 15	$ -	$ -	$ 15
Mercury, Low Level	$ 10	$ -	$ -	$ 10
Calculated (for metals)				
Hardness as $CaCO_3$	$ -	$ -	$ -	$ -
Water Chemistry Sample Cost:	$ 180	$ 80	$ 80	$ 180
25% Lab Discount Quote B1670:	$ 45	$ 20	$ 20	$ 45
Final Water Chemistry Sample Cost/Site:	**$ 135**	**$ 60**	**$ 60**	**$ 135**
# Water Samples to Collect:	6	6	6	6
QC Water Samples to Collect:	4	4	4	4
Total # Water Samples w/ QC	**10**	**10**	**10**	**10**
Total Water Sampling Cost/Stream:	**$ 1,350**	**$ 600**	**$ 600**	**$ 1,350**
WATER CHEMISTRY TOTAL:	**$ 3,900**			
Biological				
Macroinvertebrate Taxonomic ID	$ 255	$ 255	$ 255	$ 255
Interpretive Report	$ 75	$ 75	$ 75	$ 75
Total Macro Sample Cost/Site:	**$ 330**	**$ 330**	**$ 330**	**$ 330**
# Macro Samples to Collect:	**2**	**2**	**2**	**2**
Total Macro Cost/Stream:	**$ 660**	**$ 660**	**$ 660**	**$ 660**
BIOLOGICAL (Macroinvertebrates) TOTAL:	**$ 2,640**			
2011 MONITORING GRAND TOTAL:	**$ 6,540**			

Water chemistry analysis to be performed by Energy Laboratories, Billings, MT per Quote #B1670.
Macroinvertebrate analysis to be performed by Rhithron Associates, Missoula, MT.

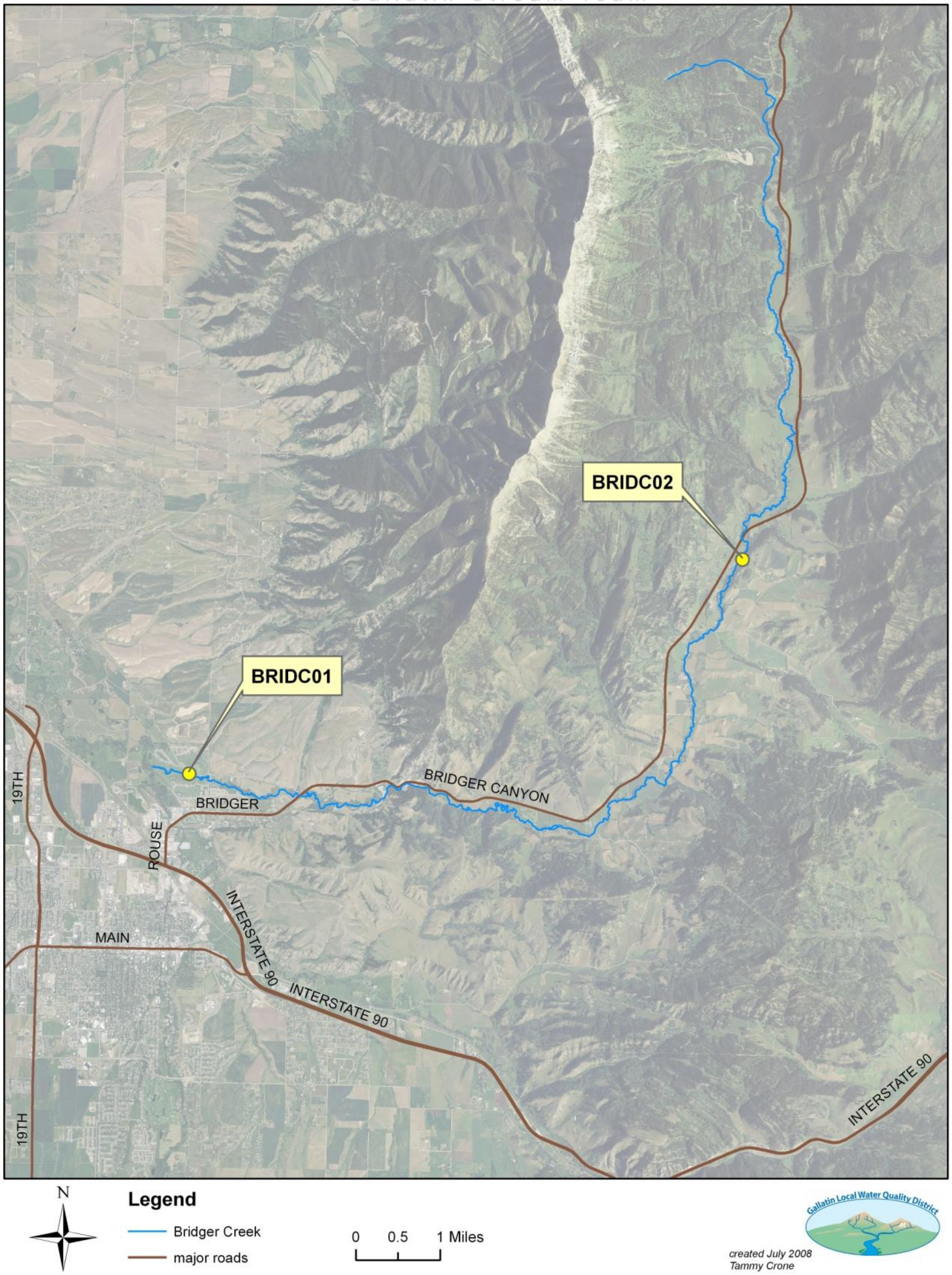
Attachment B

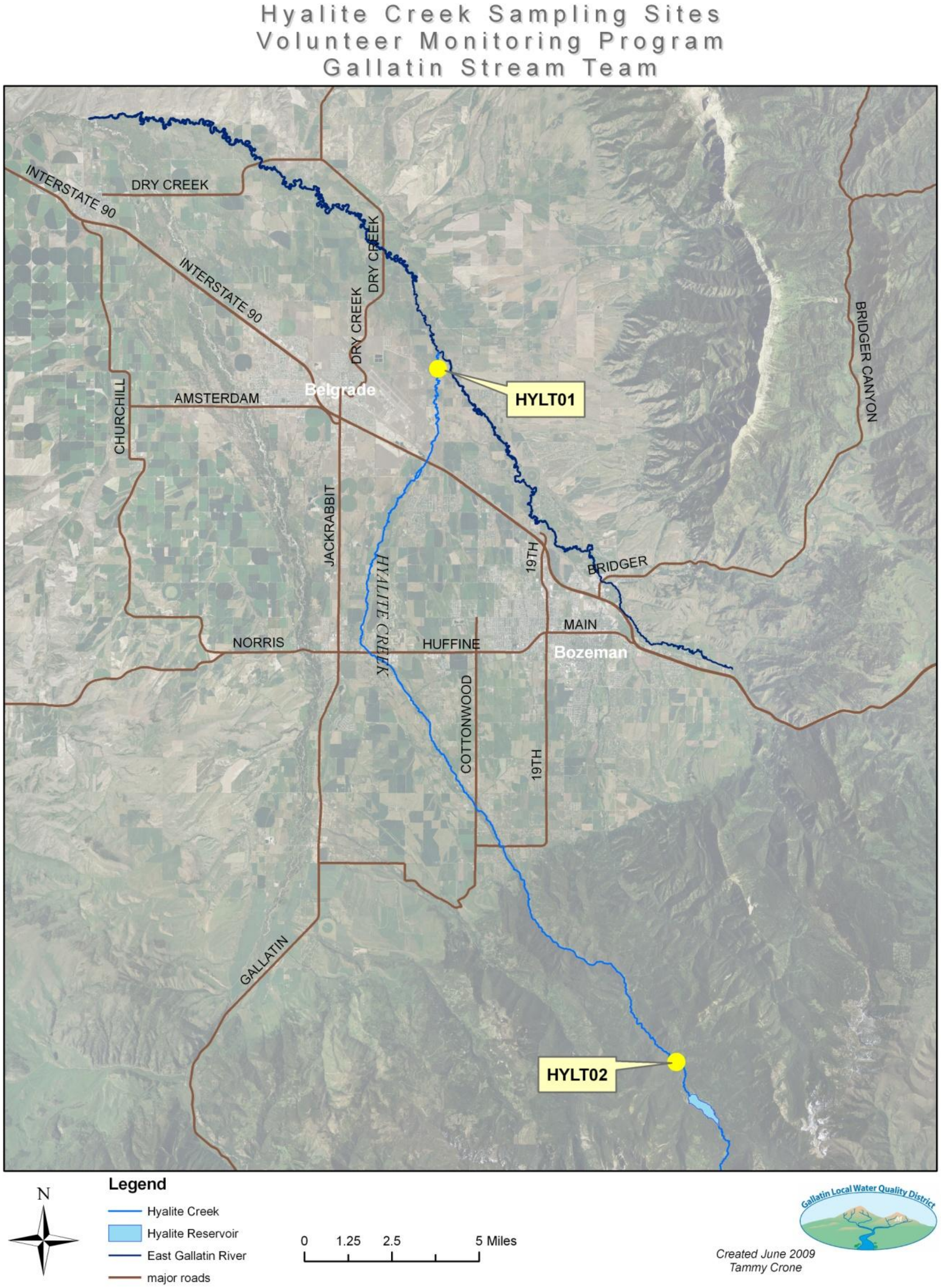
Stream Sampling Site Maps
and
Bozeman Creek Sampling Site Justification

Bozeman Creek Sampling Sites
Volunteer Monitoring Program
Gallatin Stream Team

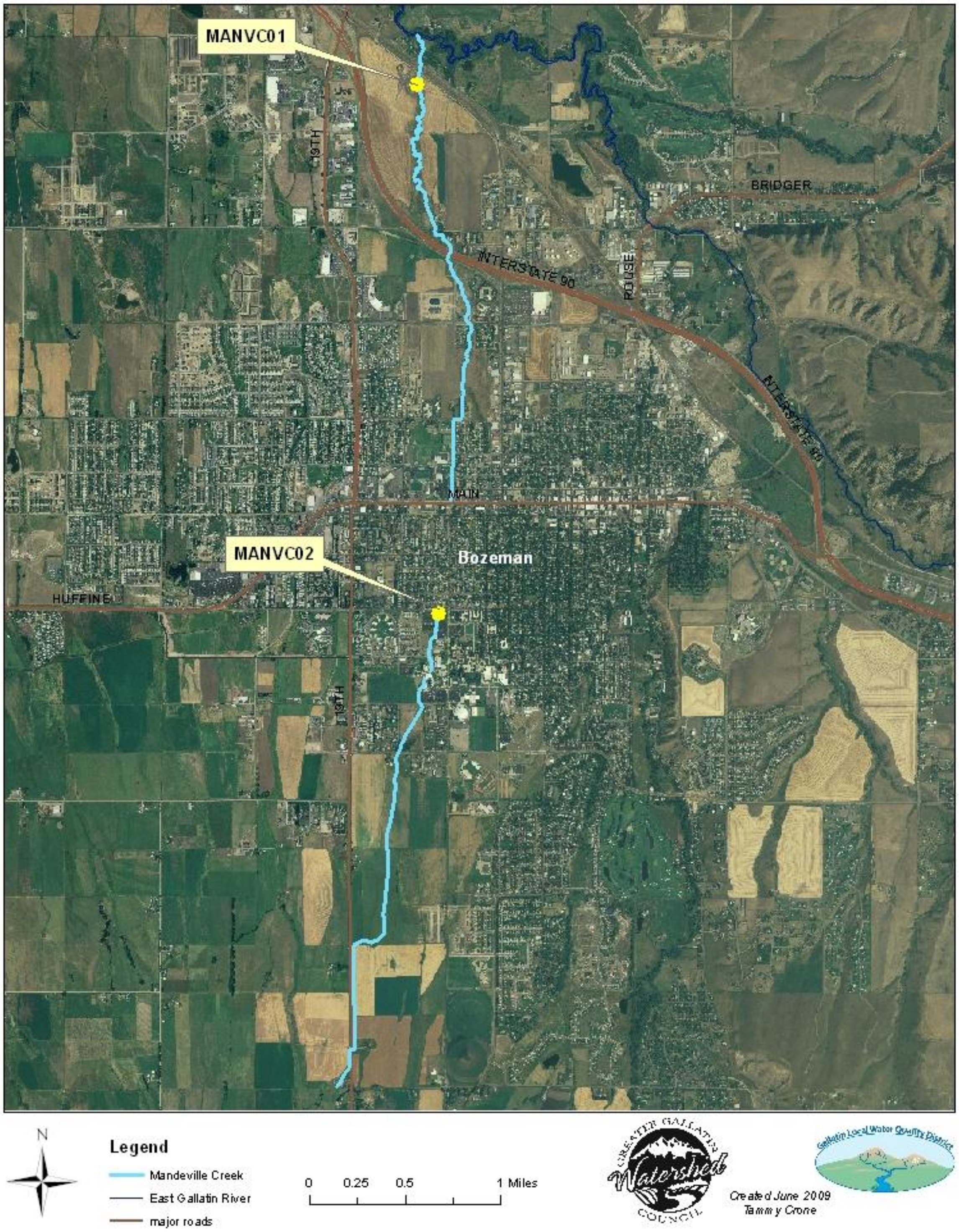


Bridger Creek Sampling Sites
Volunteer Monitoring Program
Gallatin Stream Team




Hyalite Creek Sampling Sites
Volunteer Monitoring Program
Gallatin Stream Team
DRY CREEK
INTERSTATE 90
INTERSTATE 90
DRY CREEK
DRY CREEK
HYLT01
Belgrade
AMSTERDAM
CHURCHILL
BRIDGER CANYON
JACKRABBIT
HYALITE CREEK
19TH
BRIDGER
MAIN
NORRIS
HUFFINE
Bozeman
COTTONWOOD
19TH
GALLATIN
HYLT02
N
Legend
Hyalite Creek
Hyalite Reservoir
East Gallatin River
major roads
0
1.25
2.5
5 Miles
Gallatin Local Water Quality District
Created June 2009
Tammy Crone

Mandeville Creek Sampling Sites
GGWC Volunteer Monitoring Program
Gallatin Stream Team



1 Bozeman Creek – Sample Site Selection Justification

1.1 Site Selection

The sites selected, BOZMC01 (old library site) and BOZMC02 (Manion property) were chosen initially because of strong interest on the part of the monitoring volunteers – enthusiasm which we were eager to capture. One site is just on the southern edge of urbanization (BOZMC02), the other is central to urbanization, on the north side of Bozeman's Main Street (BOZMC01). Technically, there is not enough diversity between the two sites, yet they are indeed important sites for long-term collection of baseline data in an urbanizing area. Next year, and with additional funding, the team will select a headwaters/suburban sampling site a distance away from urbanization, probably five miles south of the Manion site, near the Sourdough Trailhead. We realize that current site selection is not ideal for capturing overall impacts to the stream.

1.2 What does the Stream Team hope to accomplish by sampling from these two urban sites?

Bozeman is rapidly growing and will continue to grow in the future. Long-term collection of data at BOZMC02 will show how urbanization in the upper portion of the watershed influences water quality in the upper reach over the long-term. At BOZMC01, urbanization is denser; also Bozeman Creek is piped for a large portion of its length through downtown Bozeman and this site is just downstream of where it finally daylights again. There, we see potential issues with stormwater runoff. Again, although both sampling sites are relatively close together, they each exhibit different "urban microclimates" and factors that we wish to study.

1.3 What is the data collection effort meant to capture at these two sites?

After long-term sampling we hope to identify trends, both negative and positive on the impacts of urbanization to the water quality of Bozeman Creek.

Submitted by:

Sue Higgins, Bozeman Creek Stream Team Member
July 31, 2008

Attachment C

Quality Control Checklist and Data Qualifiers

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 QAPP)

___Field blanks collected at the proper frequency (specified in QAPP)

___All sample IDs match those provided in the QAPP. Field duplicates are clearly marked on samples and noted as such in lab results.

___Analyses carried out as described within the QAPP (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 10% frequency

___Laboratory blanks/duplicates/matrix spikes/lab control samples were all within the required control limits defined within the QAPP

___Project DQOs and DQIs were met (as described in QAPP)

___Summary of results of QC analysis, issues encountered, and how issues were addressed (corrective action)

___Completed QC checklist before STORET upload

Table 1. 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.

Table 2. Quality control terminology and descriptions.

FIELD QC		
Term	**Description**	**Purpose/Usage**
Trip Blanks	Used only for VOC (Volatile Organic Chemicals). Alias VOA (volatile organic analysis)	To determine if cross contamination occurs between samples.
Field Blank	Reagent water exposed to field sampling conditions	Monitors contamination resulting from field activities and or ambient levels of analytes present at time of sampling.
Field Duplicate	Two independent samples taken under the same conditions. For solids; two samples which are co-located (taken side by side.) Water samples would be two independent samples taken at the same location at the same time.	To determine the homogeneity of the samples collected.
Field Replicate	A single sample is obtained, homogenized, then slit into multiple samples	Monitors laboratory precision independent of laboratory operations.

LABORATORY BATCH QC		
Acronym	**Description**	**Definition**
LRB/Method Blank	Laboratory Reagent Blank	An aliquot of reagent water or other blank matrices that are treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, and internal standards that are used with other samples. The LRB is used to determine if method analytes or other interferences are present.
LFB/LCS	Laboratory Fortified Blank; Laboratory Control Sample	Reagent water spiked with a known amount of analyte. Ideally treated exactly like a MS/LFM. Control used to determine bias in sample spikes.
MS/LFM	Matrix Spike/Laboratory Fortified Matrix .	An aliquot of an environmental sample to which known quantities of the method analytes are added in the laboratory. The LFM is analyzed exactly like a sample, and its purpose is to determine whether the sample matrix contributes bias to the analytical results. The background concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the LFM corrected for background concentrations
MSD/LFMD	Matrix Spike Duplicate/Laboratory Fortified Matrix Duplicate	Determine method precision in sample concentrations are < 5X the RL.
DUP	Duplicate	Determine method precision in sample concentrations are > 5X the RL.
QCS	Quality Control Sample	A solution of method analytes of known concentrations which is used to fortify an aliquot of reagent water or sample matrix. The QCS is obtained from a source external to the laboratory and different from the source of calibration standards. It is used to check either laboratory or instrument performance
SRM	Standard Reference Material	Primarily used as a QCS to verify instrument calibration.

LABORATORY ANALYSIS QC		
Acronym	**Description**	**Definition**
ICB	Initial Calibration Blank	Monitors instrument drift at low end of cal curve.
CCB	Continuing Calibration Blank	Monitors instrument drift at low end of cal curve.
ICV	Initial Calibration Blank	Monitors instrument drift at a defined concentration near the mid range of cal curve.
CCV	Continuing Calibration Blank	Monitors instrument drift at a defined concentration near the mid range of cal curve.
IPC	Instrument Performance Check	Monitors instrument drift at a defined concentration near the mid range of cal curve.
MS/LFM	Matrix Spike/Laboratory Fortified Matrix .	An aliquot of an environmental sample to which known quantities of the method analytes are added in the laboratory. The LFM is analyzed exactly like a sample, and its purpose is to determine whether the sample matrix contributes bias to the analytical results. The background concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the LFM corrected for background concentrations
MSD/LFMD	Matrix Spike Duplicate/Laboratory Fortified Matrix Duplicate	Determine method precision in sample concentrations are < 5X the RL.
DUP	Duplicate	Determine method precision in sample concentrations are > 5X the RL.
QCS	Quality Control Sample	A solution of method analytes of known concentrations which is used to fortify an aliquot of reagent water or sample matrix. The QCS is obtained from a source external to the laboratory and different from the source of calibration standards. It is used to check either laboratory or instrument performance
SRM	Standard Reference Material	Primarily used as a QCS to verify instrument calibration.
IDL	Instrument detection limit	Signal just above baseline. 3-5x the STD DEV of 7 replicates of a blank. Not used for quantification.
MDL	Method detection limit	Statistical determination of the lowest concentration of an analyte with 95% certainty the analyte is present.
PQL	Practical Quantitation Limit	3-5x the MDL. Lowest level that quantification is determined
RL	Reporting Limit	Value a Laboratory reports results. Usually the PQL.

Attachment D

Montana DEQ Water Quality Protection Bureau
Water Quality Monitoring Field Procedures Manual 2005
(WQPBWQM-020 Rev 2)
Online at:
http://www.deq.mt.gov/wqinfo/QAProgram/default.mcpx

Montana DEQ Water Quality Protection Bureau
Water Quality Manual for Sample Collection, Sorting, and Taxonomic Identification of Benthic Macroinvertebrates 2006
(WQPBWQM-009 Rev 2)
Online at:
http://www.deq.mt.gov/wqinfo/QAProgram/default.mcpx

Attachment E

GGWC
Standard Operating Procedures
For Stream Monitoring