QUALITY ASSURANCE PROJECT PLAN FOR
VOLUNTEER WATER QUALITY MONITORING PROGRAM–
WATER CHEMISTRY, MACROINVERTEBRATES, AND BACTERIA

REVISION: 1
DATE: FEBRUARY 2015
ORGANIZATION: BAD RIVER WATERSHED ASSOCIATION

PROJECT AND QAPP MANAGER: KEVIN BREWSTER
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GROUP A. PROJECT MANAGEMENT

A1. DISTRIBUTION LIST

1. Naomi Tillison, Water Resources Specialist, Bad River Natural Resources Department
2. Wisconsin Department of Natural Resources Bureau of Watershed Management
3. Nancy Larson, Wisconsin Department of Natural Resources Lake Superior Basin Team Leader
4. Dr. Kurt Schmude, University of Wisconsin Superior Project Manager
5. Tracey Ledder, Bad River Watershed Association Technical Advisor
6. Kevin Brewster, Bad River Watershed Association Restoration Manager
7. Joan Elias, Bad River Watershed Association Program Committee Chair
8. Mariana Brewster, Bad River Watershed Association Volunteer Coordinator
9. Tony Janisch, Bad River Watershed Association Executive Director

A2. PROJECT TASK/ORGANIZATION

Below is a list of individuals and organizations that will participate in this project along with their specific roles and responsibilities.

Project Manager- Kevin Brewster, Restoration Manager

a) Write the Quality Assurance Project Plan (QAPP)
b) Implement the QAPP
c) Collect and manage field data
d) Contact person for analytical laboratories
e) Data entry, validation
f) Data analysis and interpretation
g) Assist with project outreach and communication
h) Assist with volunteer training and management
i) Project reporting

Assistant Project Manager- Mariana Brewster, Volunteer Coordinator

a) Project outreach and communication
b) Volunteer recruitment, training, and management
c) Assist with QAPP implementation
d) Assist with collection and management of field data
e) Assist with QC of macroinvertebrate identification
f) Assist with data analysis and interpretation
g) Assist with project reporting

Tracey Ledder, Technical Advisor

a) Assist with QAPP implementation
b) Assist with volunteer training
c) Assist with QA/QC of samples and methodology

Tom Doolittle, Technical Advisor

a) Macroinvertebrate identification

Tony Janisch, Executive Director

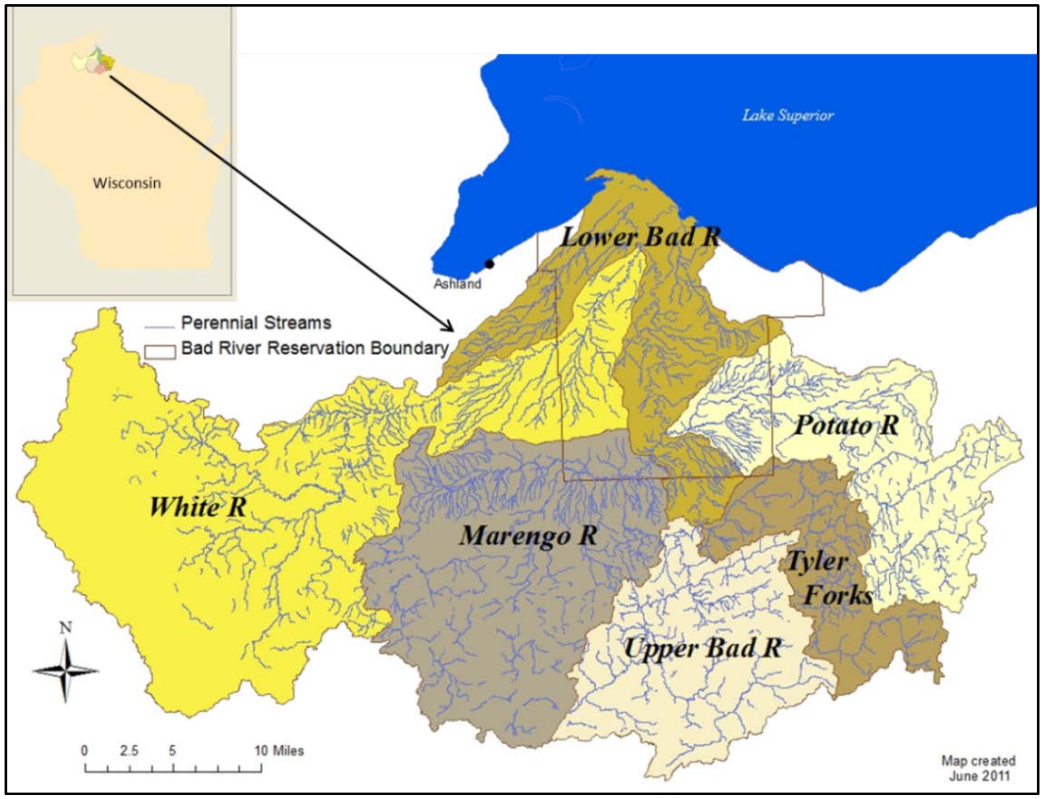
a) General administration and oversight
b) Budget tracking
c) Assist with field work and reporting as needed

Seasonal Staff
Assist with collection of field data and assist with data management. In addition to the project officers shown, the Volunteer Water Quality Monitoring Program also has an Advisory Panel consisting of representatives from the Lake Superior National Estuarine Research Reserve, Wisconsin Department of Natural Resources (WDNR), Bad River Natural Resources Department, Northland College, National Park Service, and Ashland, Bayfield, and Iron County Land and Water Conservation Departments.

A3. PROBLEM DEFINITION/BACKGROUND

The Bad River Watershed (hereafter Watershed) drains over 1,000 square miles along Wisconsin's north shore (Figure 1). The Chequamegon-Nicolet National Forest is found at the headwaters. The streams and rivers of the watershed are important spawning grounds for sturgeon, lake-run trout, salmon and walleye as well as many other fish. The unique wetland known as the Kakagon Slough/Bad River Slough is located at the mouth of the watershed on Lake Superior. This freshwater estuary is the largest and possibly most pristine remaining on Lake Superior. The lower one-third of the watershed is land of the Bad River Band of Lake Superior Chippewa Indians Reservation. The Kakagon Slough provides abundant habitat for wild rice which is highly important to the Band's culture, as well as being the only remaining extensive coastal wild rice wetland in the Great Lakes Basin and providing exceptional habitat for a variety of wildlife.

Figure 1. Map of the Bad River Watershed, its location in Wisconsin, the Hydrologic Unit Code (HUC) level 5 subwatersheds within it, and the reservation boundary of the Bad River Band of Lake Superior Chippewa Indians.



The Watershed is made up of six level five Hydrologic Unit Code (HUC) subwatersheds – the Upper Bad River draining 135 square miles, the Lower Bad River draining 124 square miles, Tyler Forks draining 79 square miles, the Marengo River draining 218 square miles, the Potato River which drains 140 square miles, and the White River subwatershed which drains 366 square miles.

Though the water resources of the Watershed are currently in good condition, several impacts to water quality indicate they may no longer be termed "pristine". Prior to the formation of the Bad River Watershed Association (BRWA) in 2002, comparably little data on water quality existed outside of the boundaries of the Bad River Indian Reservation because the State of Wisconsin directed limited resources to monitor this watershed due to tight budgets. Water quality is negatively impacted by point sources from municipal wastewater and non-point sources from road crossings, failing household septic systems, and agricultural and logging practices. Groundwater is the only source of drinking water for the majority of households. Highly erodible soils on stream banks are easily affected by poorly planned and implemented land use practices. The biological system has been disturbed by exotic species such as purple loosestrife and sea lamprey. Other negative impacts to the watershed as a whole include destructive recreation uses, land parcelization, and development for recreational uses and home building. Although a recent proposed project to develop an open-pit iron ore mine in the headwaters of the watershed has been withdrawn, the potential for this destructive land conversion remains. If developed, it would affect the Upper Bad, Tyler Forks, and Potato River watersheds.

BRWA was formed in 2002 as a way to involve citizens in taking care of their home watershed by collecting baseline water chemistry (using LaMotte Surface Water Monitoring kits) and biological monitoring data using macroinvertebrates. BRWA developed a Volunteer Water Quality Monitoring Program (WQ Program) with two main objectives: 1) establish at least a four-year baseline of water quality from several sites in the Watershed using basic water chemistry and biological (macroinvertebrate) assessment data, 2) to get local citizens involved with their watershed, and management issues that affect it, by monitoring water quality. In 2006, BRWA added *Escherichia coli* (*E. coli*) bacteria monitoring to its WQ Program.

From the beginning, BRWA's WQ Program was operated largely by volunteers and limited paid staff. BRWA hired its first paid Executive Director in 2007 and as of 2015, employs one full-time and two three-quarter time staff to carry out the main functions of the organization and operate its programs.

BRWA has invested considerable time and resources in recent years to evaluate its WQ Program and learn from its volunteers and natural resource professional partners on how to best move the program forward with the original monitoring objectives having been met.

The following Quality Assurance Project Plan (QAPP) details methods and procedures and lays out a strategy to implement BRWA's WQ Program into the future. It assumes full volunteer participation and staffing to support it. Actual implementation of the program will occur based on volunteer interests and the ability of BRWA to provide staffing and funding support to implement it.

The strategy gives BRWA a path to move its program forward and a structure to follow so the program has purpose and direction. It also provides a pathway for BRWA to put its data to use and to work with its volunteers and partners to identify and solve water quality problems so the integrity of the Bad River Watershed can be "maintained for future generations." This document provides a framework for implementation of monitoring objectives set out in BRWA's Strategic Plan. Long-term strategic

monitoring goals are establishment of baseline water quality values across the watershed, and the continuation of monitoring of representative sites to detect water quality changes over time.

A4. PROJECT TASK/DESCRIPTION

WQ Program Questions

1. Are streams in the Bad River Watershed healthy (i.e., meeting water quality standards for their designated uses)?
2. Are there problem areas?
3. What are the problems?
4. How can volunteer-collected data support decision-making that improves watershed resources?
5. Are there streams deserving of special protections that don't have them?
6. Are streams changing in response to climate change?

WQ Program Goal

The goal of BRWA's Water Quality Program is to involve citizens in gathering information necessary to support informed decision-making that will maintain and improve the integrity of our watershed for future generations.

Objectives

1. Get local citizens involved with their watershed by monitoring water quality.
2. Collect baseline data on streams and rivers of the Bad River Watershed.
3. Evaluate data to identify high quality and negatively impacted areas.
4. Share all data with the Bad River Natural Resources Department and Wisconsin Department of Natural Resources for use in making management decisions about the streams and rivers sampled as part of this project.
5. Share data with other interested partners including local town and county governments.
6. Work with partners to implement solutions in problem areas and protect high quality areas.

Focus Areas

1. Baseline – *Checking the pulse of our streams.* Use data for general water quality assessments and reporting, such as state or tribal 305(b) reporting. Could also be used to find potential problem areas or areas deserving of protection or restoration. Main focus will be collecting four years of water chemistry and macroinvertebrate data at designated sites. Also collect at least one year of continuous temperature and *E. coli* data.
2. Watershed Action – *Working with partners to take care of watershed resources.* This includes identifying potential high-quality streams for prioritizing culvert maintenance and replacement, special designations, restoration opportunities, and identifying potential problem areas and working with partners and landowners to implement solutions. Continuous temperature and macroinvertebrate monitoring will be used to help identify high quality areas and *E. coli* monitoring and stream assessments will be used to identify potential problem areas.

Core Sampling Parameters to meet objectives (methods)

1. Water chemistry/quality – Dissolved oxygen, chloride, pH, temperature, turbidity (LaMotte Surface Water Quality monitoring kits); turbidity comparison (Transparency tubes)
2. Physical – Continuous temperature monitoring (Onset HOBO thermistors such as TidbiT v2), Get to Know Your Watershed stream assessments, stream walk events and other volunteer and staff field activity.

3. Biological – macroinvertebrates (multiple microhabitats) and bacteria (*E. coli,* Easy gel-incubated)

The parameters and methods selected are reasonable and accessible for volunteers to implement and provide information that is useful in determining the general health of streams and rivers, identify healthy areas, and identify potentially impacted areas. The volunteer-collected data are not intended to provide impact assessments, permitting decisions, or enforcement cases, which often require more rigorous sampling methods and professional expertise to implement, but may be used to support further inquiry.

The project schedule for implementation is provided in Table 1. This is an ongoing project, so the schedule reflects typical tasks and how they are conducted annually. Periodic updates may occur to add additional project objectives and monitoring parameters as needed to implement baseline data collection within the Bad River Watershed.

Table 1. Project schedule for BRWA's volunteer water quality monitoring program.

Parameter	Data Collection	Validation & Reporting
Water Chemistry	Monthly- first Saturday of the month & at least one rain event annually	Late fall/early winter
Macroinvertebrates	Spring (April - May) Fall (September-October)	Late fall/early winter
Bacteria	Monthly- first Saturday of the month (April 1 – September 15) and rain events	Late fall/early winter

A5. QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

Water Chemistry

The BRWA uses LaMotte Surface Water Monitoring kits for conducting the majority of the water chemistry tests done by volunteers. Parameters tested include chloride, dissolved oxygen, pH, and turbidity (Table 2). Additionally, temperature is measured with an armored hand-held thermometer and transparency is measured with a transparency tube. Standard Operating Procedures (SOPs) appear in Section B4, below.

In addition to initial field training, all volunteers participate in an annual quality control session, usually in January or February. At the quality control session volunteers are given known solutions to analyze, and their procedures are checked. The checks also provide an opportunity to ensure that volunteers' reagents are up-to-date, equipment is complete, and kits are clean.

Accuracy/Precision/Bias: BRWA's Technical Advisor or other qualified expert (including laboratory supply vendors) prepare and/or provide standard solutions of chloride and turbidity, and a solution of known pH that all volunteers test using their kits. This provides for an accuracy check for individual volunteers and as a check on accuracy, precision, and whether volunteer testing exhibits any bias as a group. Because of the difficulty in creating a standard solution for dissolved oxygen, this parameter is tested by filling a bucket full of tap water and having all volunteers collect a sample from the bucket at the same time. The dissolved oxygen test is a measure of precision for the group of volunteers.

Table 2. Water chemistry tests, detection limits, range, data quality objectives, and benchmarks (for comparing results) utilized by the Bad River Watershed Association.

Parameter	LaMotte Test Range	Data Quality Objective	Surface Water Benchmark*
pH	3.0 - 10.5	Group agreement within 0.5 pH units	6.5 - 8.5
Dissolved Oxygen	0 - 10 mg/L at 0.2 intervals	Group agreement within than +/- 0.5 mg/L	>5mg/L all streams, 6 mg/L designated trout streams
Chloride	0 - 200 mg/L at intervals of 4	Group agreement within than +/- 4 mg/L	Establish baseline
Turbidity	5 - 100 JTU at intervals of 5	Group agreement within 5 JTUs	Establish baseline
Transparency	0 - 120 cm at intervals of 0.2 cm	Group agreement within 2.0 cm	Establish baseline

**Benchmarks from USGS (1992).*

Results from the QC sessions are summarized into an annual "Quality Control Lab Results" report submitted by BRWA's Technical Advisor. The reports summarize the average agreement volunteers achieved compared to the standards. These results give BRWA an idea of the accuracy and precision of volunteer data as a whole program. Data quality objectives for each of the parameters are in Table 2. Follow-up procedures for agreement values outside of those in Table include: 1) check that standard solutions were prepared properly, 2) check that volunteer procedures are correct, 3) check that volunteer reagents are up-to-date, and 4) check that volunteer equipment is clean and in good condition. Following these checks, BRWA staff and Technical Advisor may determine that another QC session is needed, or to include re-training on the testing procedures.

Individual volunteer results are reviewed by the Technical Advisor and/or BRWA staff to determine if follow-up training with the volunteer is needed.

Completeness: Volunteers are asked to sample water chemistry year round (as long as they feel it is safe) on the first Saturday of each month and to sample at least one rain event over the course of the year. That provides a target of 12 to 13 water chemistry sample events per year. Volunteers are not always able to sample every month for various reasons including weather, vacations, and other personal reasons. If a volunteer misses more than three monthly sample events in a year, BRWA Project Managers will work with the volunteer to determine the reason for the absences and the best course of action to resolve the absences. When necessary, volunteers can substitute for each other to ensure that monthly samples are collected.

Representativeness: Water chemistry samples are taken mid-depth at mid-stream in flowing water at each site for consistency and to ensure samples are representative of the stream at that location. Volunteers are trained to approach from downstream and allow any disturbed sediment to settle before a sample bottle is rinsed and filled. Sites are generally chosen at road/stream crossings for safe and convenient access on public property. All efforts are made to select sites at road crossings that are representative of the information desired about the watershed (headwaters, below confluences, upstream/downstream of possible sites of impact).

Comparability: Volunteers all use the same water chemistry sampling methods and are trained by BRWA Project Managers. Volunteers are asked to sample water chemistry year round (as long as they feel it is safe) on the first Saturday of each month. Sampling using the same methods and timing in the field allows for comparable data within sites and across sites and across time.

Macroinvertebrates

Standard Operating Procedures (SOPs) appear in section B4 below.

Precision/Accuracy: The primary goal of this project is to estimate stream health by calculating indices based on the biodiversity and richness of macroinvertebrate taxa. To guarantee precision and accuracy, the Project Managers will accompany volunteers during group training sessions to observe their collection techniques and note any divergence from protocols. The Project Managers will also perform an independent collection (duplicate sample) at 10% of the sites sampled in each season (spring and fall).

Resulting indices of samples collected by volunteers will be compared to expert results and should fall within the same category of stream health (i.e., "excellent", "very good", "good,", "fair", or "poor"). Borderline cases will be reviewed by the Project Manager and Technical Advisor to determine possible causes of the differences and whether the volunteer data are acceptable for inclusion in the database.

Volunteers who meet quality standards will be allowed to conduct future field collection without expert oversight, though they will be "recertified" after about every five sampling events. Volunteers who do not meet quality standards will be retrained in the relevant methods and a Project Manager will re-evaluate their collection during the subsequent sampling event.
All identifications made by volunteers and staff will be reviewed by the macroinvertebrate expert Technical Advisor.

Bias: Potential sources of bias that could influence results are primarily due to differences in techniques among volunteers, such as overlooking small and slow-moving organisms when picking the sample in the field, how vigorously the volunteer kicks the substrate when sampling and determining the number of samples per habitat type. Ideally, sites will be sampled by different volunteers at least once every two years to examine the effects of bias in individual collection styles. Sites not resulting in the same stream health category will be evaluated as above by the Project Manager and Technical Advisor.

Completeness: Following a QA/QC review of all collected and analyzed data, data completeness will be assessed by dividing the number of measurements judged valid by the number of total measurements performed. The data quality objective for completeness for each parameter for each sampling event is 90%. If the program does not meet this standard, the Project Managers will work to determine the main causes of data invalidation and develop a course of action to improve the completeness of future sampling events.

Representativeness: Samples will be collected from multiple microhabitats within a stream reach, upstream of the road crossing far enough to be out of the area in the stream influenced by the crossing itself. Available microhabitats are sampled according to the overall percentage of their presence. Habitat types include riffles, runs, pools, aquatic vegetation, instream snags or logjams, and riparian vegetation overhanging into the stream. In the absence of riffles upstream of the road crossing, a riffle downstream of the road crossing can be sampled.

Comparability: To ensure comparability, all volunteers participating in the program will follow the same sampling methods and use the same units of reporting. The methods are based on EPA Rapid Assessment multi-habitat protocols (Barbour et al. 1999). Periodic reviews of sampling events by the Project Managers will ensure adherence to these standard methods. **Items to be aware of that may affect comparability:** 1) Comparability between sites using indices will be affected if habitats are different, 2) Comparability with WDNR may be affected by volunteers selectively (if inadvertently) picking macroinvertebrates in the field. WDNR biologists submit samples directly to the laboratory for picking. Comparison studies between volunteer family level and professional species level collection and identification have shown the two methods to be in general agreement in terms of conclusions made.

Bacteria

SOPs appear in section B4 below.

Precision/ Accuracy: To assure method consistency, every 10th sample will undergo replicate analysis. To assure proper technique and aseptic sample handling, a method blank (deionized or sterilized water) will be analyzed every 20 sample events.

Replicates will be compared by calculating the relative percent difference (RPD) as follows:

$$\% \text{ difference} = [(x - y) / ((x + y)/2)] * 100\%$$

where x = result of first analysis
y = result of second analysis

When 10 replicate percent difference values are obtained, a mean value will be calculated and used as a control value. A Shewhart Control limit (mean plus and minus three standard deviations, i.e., 99.72% confidence level) will be calculated. Replicate values falling outside the control limit will be flagged and sample handling, aseptic technique, and laboratory procedures will be reviewed, followed by analysis of a follow-up replicate. Prior data will be flagged until a follow-up replicate falls within the control limit.

Method blanks: If growth is observed on a method blank (sterile deionized water sample) plate, sample handling and aseptic technique will be reviewed, followed by analysis of a follow-up blank sample. Prior data will be flagged until a follow-up blank produces no plate growth (US-EPA 2012). Control limits will be recalculated every ten laboratory replicate analyses, or at least annually.

Bias: Potential sources of bias that could influence results include volunteer sampling techniques and laboratory practices. Volunteers will be trained in a standard sampling site approach and sample capture method (minimizing sediment disturbance, and mid-channel and water column sample capture), and proper sample handling and processing (sample transport/storage, aseptic technique, good record keeping), to reduce sample bias.

Completeness: Sampling will be conducted monthly on the first Saturday of the month (April 1 – September 15) at assigned sites and during rain events. This ensures consistent site monitoring during

the significant seasonal growth period of bacteria, and allows for determination/differentiation of bacterial sources by comparison of dry weather and rainfall event bacterial densities.

Representativeness: Samples are taken mid-depth at mid-stream in flowing water at each site for consistency, and to ensure samples are representative of the stream at a given location.

Comparability: To ensure comparability, all volunteers participating in the program will follow the same sampling and incubation methods and use the same units and means of reporting.

Continuous Temperature Monitoring

Calibration, deployment, and data retrieval procedures are outlined in the BRWA Staff QAPP (Hudson 2012).

Precision/ Accuracy: The thermistors are checked prior to deployment using a NIST-traceable thermometer. Accuracy, based on manufacturer documentation, must be +/- 0.2^{o} C. Thermistors are field checked monthly to assure they remain in optimal flow conditions and that they are functioning properly.

Bias: Bias may be introduced by differences in how the thermistors are deployed among volunteers. Training will demonstrate optimal placement techniques to ensure maximum exposure to stream flow, minimal sediment and debris accumulation, and lowest possible risk of exposure to air at low flows.

Completeness: Thermistors are deployed in late May and retrieved at the end of October each year. This deployment period encompasses the most thermally dynamic period of the year, and captures peak stream temperature, which is the most important parameter affecting fisheries ecology and climate change baseline metrics.

Representativeness: Thermistors will be placed in streams so that they are exposed to as much of stream base flow as possible. They will be placed at a depth that prevents the exposure of the thermistor to air at low flows, and located in a zone of the stream that reduces possibility of sediment or debris covering the instrument.

Comparability: To ensure comparability, all volunteers participating in the program will follow the same thermistor placement and monthly check reporting protocols.

A6. SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

The Project Managers will ensure that all program personnel and volunteers are properly trained. BRWA has developed standard operating procedures (SOPs) for volunteer water chemistry, macroinvertebrate, and bacteria monitoring that are consistent with protocols used by the WDNR, Bad River Natural Resources Department (BRNRD), and the Wisconsin Citizens-Based Monitoring Program. BRWA staff consults with WDNR, BRNRD, and other natural resource professionals on a regular basis to ensure protocols are consistent with agency professionals and makes adjustments as necessary.

Water Chemistry

Water chemistry volunteers will be trained by a Project Manager. Groups may be trained together in the basics of sampling and analyses utilizing the Lamotte kits. Preferably each new volunteer will be given specific training streamside at the volunteer's assigned site, on their first sampling date. Training will

consist of collecting a water sample, using equipment properly, quality assurance practices, filling out data sheets, and field safety.

Macroinvertebrates
Volunteer training will consist of an annual training session led by a Project Manager/s. The session will include a presentation covering program goals and objectives, biological and physical data collection methods, filling out field data sheets, safety issues, and quality assurance practices and a field component where Project Managers will train volunteers on proper sampling techniques, conducting the habitat assessment, and picking and preserving samples. All new volunteers will be required to attend group training before monitoring. Current volunteers will be required to attend a refresher training every two years. A database will be maintained by BRWA that lists all volunteers that have received training as well as the date of training.

Bacteria
Volunteer training will consist of an annual training session led by a Project Manager/s. Training will occur prior to the bacteria sampling field season (begins April 1) and will consist of collecting a water sample, using equipment properly, quality assurance practices, filling out data sheets, and field safety. Training will also consist of plating, incubating, and counting samples. To improve training of volunteers, example pictures of plates with different colony counts and development will be utilized.

A7. DOCUMENTS AND RECORDS
The final QAPP will be retained by BRWA at its main office in hard copy and electronic portable document format (PDF). Copies of the QAPP will be made available to personnel at the WDNR, Bad River Natural Resources Department, and UW-Superior as listed in section A1.

All hard copy field data sheets, instrument calibration data sheets, and chain of custody forms will be archived at the main BRWA office and will be scanned into PDF format for electronic storage. All data will be entered into an electronic database (Microsoft Excel or Access), with the exception of data provided by the UW-Superior, which will be entered into the DNR Surface Water Integrated Monitoring System (SWIMS) database and sent to BRWA as an Excel spreadsheet. Macroinvertebrate samples will be archived by UW-Superior according to their protocols for sample storage. The Project Director will verify all data entered by BRWA staff against the hard copy of the final data sheets. Copies of the digital database will be stored in two locations not on the same computer.

GROUP B: DATA GENERATION AND ACQUISITION

B1. SAMPLING PROCESS DESIGN (Experimental Design)

Sampling sites will be located throughout the Bad River Watershed, typically near road crossings on rivers and wadeable streams for access to the stream through the public right-of-way. The following outlines sampling plans for the two main focus areas of BRWA's WQ Program, baseline and watershed action.

Sampling Plan for Baseline Focus Area

Schedule

- Water Chemistry
  - Continue once per month, first Saturday of the month plus one rain event annually for water chemistry.
- Macroinvertebrates
  - Continue spring and fall macroinvertebrate sampling with identifications to family-level.
  - Set up two-week sample window to minimize variability prior to June 1 for spring sample and after September 15 for fall sample.
  - Archive fall samples and work with Dr. Kurt Schmude when funds are available to identify to lowest possible taxonomic level and ensure data are entered into DNR SWIMS database.
- *E. coli*
  - Complete one season of *E. coli* monitoring at baseline sites.
  - *E. coli* monitoring season to run from April 1 to September 15.
  - At minimum get a sample once/month on first Saturday of the month and 3 rain events for a total of 10 samples throughout a season.
  - If possible, increase focus on sampling rain events. Give volunteers a goal of getting 5 rain or spring runoff events between April 1 and September 15.
  - Sampling *E. coli* for the Baseline Program is lower priority than the Watershed Action Program if resources or available volunteers are limited.
- Continuous temperature monitoring
  - Complete one year of continuous temperature monitoring at baseline sites during 4-year baseline period.
  - Deployment period from before June 1 to after October 1.

Site Selection

1. Establish headwater, mid-length, and near-mouth sites on the main tributaries (White, Marengo, Potato, Tyler Forks, Bad) and collect four years of baseline water chemistry and macroinvertebrate data, along with at least one year of *E. coli* and continuous temperature monitoring at these sites.
   a. Establish "index" sites at "near mouth" locations on the 5 main tributaries. These sites will be sampled for chemistry and macroinvertebrates indefinitely. Conduct *E. coli* and continuous temperature monitoring every 5 years.
   b. Headwater and mid-length sites on 5 main tributaries get sampled for 1 year every 5-10 years once baseline established. Try to sample all parameters (water chemistry, macroinvertebrates, continuous temperature, and *E. coli*).
2. Establish secondary sites near the mouth of main feeders to the main tributaries. Collect baseline data the same as the headwater and mid-length main tributary sites (see 1.b.). (Main feeders would be streams such as Long Lake Branch, 18-Mile, 20-Mile, Schramm, Brunsweiler, Trout Brook, Billy Creek (west), Silver Creek, Alder Creek, Vaughn Creek, Lawrence Creek, etc.).
   a. After baseline is established, sample these sites for 1 year every 5-10 years.
3. Develop baseline on ORW/ERW waters, same as #2.

Sampling Plan for Watershed Action Focus Area

- *E. coli*
    - Identify potential problem sites or areas of concern, rather than collecting baseline information. If high *E. coli* counts are found, work with partners and landowners to find solutions.
    - Sampling *E. coli* for the Watershed Action Program is higher priority than for the Baseline Program if resources or available volunteers are limited.
    - Start with one complete season of *E. coli* monitoring at watershed action sites. A season is defined as April 1 to September 15.
    - At minimum get a sample once/month on first Saturday of the month and 3 rain events for a total of 10 samples throughout a season.
    - If possible, increase focus on sampling rain events. Give volunteers a goal of getting 5 rain or spring runoff events between April 1 and September 15.
    - Evaluate data at end of season for next step.
- Get to Know Your Watershed Stream Assessments
    - This is a tool to be used to help identify potential sources of stream impairments or good candidate sites for culvert replacements or other stream restoration or protection projects.
    - Use the assessments as a follow-up based on the needs and results from other monitoring or specific concerns raised with the idea of getting more specific information about potential stream problems and solutions.
    - Utilize the Unified Stream Assessment protocols from the Center for Watershed Protection, BRWA's Get to Know Your Watershed streambank erosion assessment, or other related tool that fits the needs of the desired assessment.
- Continuous temperature monitoring
    - Use continuous temperature monitoring as a screening tool to identify potential high quality perennial water where there is little to no information available.
    - Identify best locations for culvert replacements and stream restoration projects.
    - Identify streams for collecting data to support possible Outstanding or Exceptional Resource Water designation or other protection options, such as conservation easements.
    - Deployment period extends from before June 1 to after October 1.
- Special designation support data
    - Following continuous temperature monitoring, determine streams that could be potential candidates for Outstanding or Exceptional Resource Water (O/ERW) designations.
    - Per Wisconsin's Coordinated Assessment and Listing Methodology (WisCALM) document (Wisconsin Department of Natural Resources 2013), macroinvertebrate and fisheries indexes of biotic integrity (IBI) values are used as supporting information for potential listing of a waterbody as O/ERW as part of a General Condition Assessment (see page 48 of WisCALM 2013).
    - Collect macroinvertebrate sample from these streams and work with Dr. Kurt Schmude to collect genus/species data to support macroinvertebrate IBI number used for WisCALM.
    - Work with WDNR fisheries staff to conduct fisheries assessment for IBI calculation from these streams.
- Water Chemistry
    - Use to understand site conditions and to identify and prioritize future restoration sites.

B2. SAMPLING METHODS

Water Chemistry

Water chemistry sampling will occur once a month (typically the first Saturday of the month, with some leeway). In this way we have some weather comparisons between sites. At least one rain event a year will be sampled for each subwatershed, depending on localized weather. This is especially important as one of the main concerns is erosion and sedimentation, which happens mostly during high water events. Bridges are used for year-round access to midstream sampling.

Volunteers will use LaMotte Surface Water Monitoring kits. The tests conducted and methods used are as follows:

- Dissolved oxygen - An azide modification of the Winkler titration method. Oxygen is reacted producing a color change, and then back-titrated. Oxygen is released and the color disappears. The concentration of DO is proportional to the quantity of titrant used to release the oxygen.
- Chloride - The method produces a neutral or slightly alkaline solution, potassium chromate (chloride reagent #1) can indicate the end point of the silver nitrate (Chloride reagent #2) titration of chloride. Silver chloride is precipitated quantitatively before red silver chromate is formed.
- pH - The sample is reacted with an indicator that creates a color change. The color of the reacted sample is compared to standard pH colors using an octet comparator.
- Turbidity - The method involves comparing the clarity of a clean sample and a river sample and adding a standard turbidity (<1% kaolin) by drops to match the sample's turbidity.

Volunteers will also measure transparency and water and air temperature.

- Transparency - This quantifies the degree of transparency of a water sample by way of observation of a moveable Secchi disk in a sample tube. The sample tube is filled with a representative water sample and the disk is raised from the bottom of the tube until midpoint between disappearance and reappearance of the disk is reached.
- Temperature – Air and water temperature are measured with a hand-held armored glass thermometer, generally to the nearest 0.5°C.

All sampling equipment (dipper, bottles) should be rinsed three times in the stream to be sampled before the sample is actually taken. Volunteers should use care to not stir bottom sediments while sampling or rinsing. If sediments are stirred and raised into stream flow, the sample should be taken upstream. The sample will be taken from flowing water in the stream at about half depth of the water column. The sample bottle will be mixed each time the sample is poured to another analytical vial.

Scoops, caps, droppers or bottle tops should not be mixed between reagents. After analysis, analytical vials and test tubes will be rinsed thoroughly with distilled water, and dried inside and out before storing. Scoops may be wiped clean with a paper towel. If any chemical residue or sediment from the sample remains after thorough rinsing, they may be washed with a light soapy mixture of distilled water and Ivory dish soap. All equipment should be dry before storage.

SOPs appear in section B4 below.

Macroinvertebrates

Volunteers monitor stream water quality by collecting biological and physical data two times per year, during spring and fall (Table 5). Biological data will consist of a representative sample of the benthic community. Physical data to be collected include a habitat assessment and flow.

Our biological evaluation of stream water quality is based at the community level, such that we attempt to include a complete sample of the different macroinvertebrate groups present rather than a random sub-sample. We do not assume that a single collection represents all the diversity in the community, but rather we consider our results an accurate assessment of stream condition only after repeated collections spanning at least four years. During field data collection efforts, volunteers collect specimens from the benthic community from all habitats present at the site. Macroinvertebrates collected from the benthic community are identified to the family-level and tallied to provide data for the calculation of biotic and diversity indices. These indices are used to rate the health of the stream ecosystem and provide a basis for trend analyses. Our results will be compared with other data sets available through WDNR and other agencies/organizations for the site in question and compared with locations in the same river system included in this program.

Table 5. Annual events scheduled for BRWA's volunteer macroinvertebrate monitoring program.

Event	Date	Participants
Fall Training	October (1st week)	New Volunteers & Current Volunteers on voluntary basis
Fall Field Day	October (2nd and 3rd week)	All Volunteers
Fall Indoor ID	November (1st week)	All Volunteers & Identification Experts
Spring Training	May (1st week)	New Volunteers & Current Volunteers on a voluntary basis
Spring Field Day	May (2nd and 3rd week)	All Volunteers
Spring Indoor ID	June (1st week)	All Volunteers & Identification Experts

For each sampling event, monitoring by volunteers will be completed within the same two week period each year. If a site is temporarily inaccessible, due to factors such as significant high water events, the monitoring time may be delayed for three additional weeks. If the issue concerning inaccessibility is continued beyond the extended dates, then no monitoring data will be collected during that time and there will be a gap in the data. Summer sampling is generally not recommended because the majority of organisms have probably emerged as part of their life cycles and newly hatched larvae are too small for easy identification. If volunteers are unable to monitor their site during the specified time, they should contact the Project Managers as soon as possible and no later than the end of the first week in the sampling window in order for the Project Managers to arrange for another volunteer to complete the monitoring. If no volunteer is available, the Project Managers will be responsible to see that the site is monitored unless sufficient redundancy has been included in the monitoring schedule that additional data are not needed.

Field macroinvertebrate data collection: Upon arriving at the site, the volunteer will inspect the sampling gear to ensure that it is clean. If there is debris or aquatic life on any of the equipment, water

withdrawn from the stream with a clean container will be used to clean the equipment at a distance of not less than 100 feet from any water body. The volunteer will collect 10 samples from microhabitats apportioned according to the habitats' abundance at the site. The volunteer will collect samples with a D-frame kick net by holding the net frame firmly against the stream bottom and disturbing the substrate upstream (approximately a full arm's length) from the net with their feet, by jabbing the net into submerged vegetation, and by scraping coarse woody debris with a hand or object to dislodge organisms into the net.

The net should be inspected often to make sure the invertebrates that are being dislodged are washing into the net. If two people are collecting the sample, one person can hold the net while the other manually removes vegetation from the snag or logjam and rinses it into the net, or shakes the snags to loosen the vegetation caught so it drifts into the net. Coarse debris should be removed from the net, while making sure to rinse the macroinvertebrates that are clinging to the vegetation back into the net.

D-frame nets will be used to sample all habitat types, the contents of the net will be emptied into shallow white trays, and volunteers will pick aquatic organisms from the tray and store them in containers filled with 70% isopropyl alcohol for later identification. Continue sampling different habitat types as they are present at the site. Inspect the sample jar contents to ensure that more than 125 macroinvertebrates have been collected. Volunteers are encouraged to collect a minimum of 125 specimens, with an emphasis placed upon picking every aquatic organisms observed, without bias based on size or other factor. If it is determined that insufficient numbers of macroinvertebrates are captured after initial sampling efforts, sampling should be extended for a second period of equal duration and noted on the field sheet. If insufficient numbers exist after completion of the second sampling effort, stop collecting and preserve the sample. Low numbers of organisms may be indicative of water quality or habitat types and should be noted on the field sheet.

A site sketch depicting the locations and types of habitats sampled will be completed by the volunteer during field data collection activities. The volunteer will indicate on the data sheet which habitats were sampled, stream conditions, and any changes in methodology or unusual observations. Potential sources of variability such as weather, stream flow, turbidity, and erosion will be noted during each sampling event and discussed in study results. The field data sheet will include sections to record unusual procedures or accidents, such as losing part of the collection by spilling. Before leaving the site, the volunteer will thoroughly rinse the net to ensure that no organisms are transported to the next site, and will inspect the site to make sure that no equipment or refuse is left behind. The net should be left to dry in the sun prior to being taken to another river or stream, or rinsed well with a hose if that is not possible.

Habitat Assessment: A separate Field Data Sheet is included for a habitat assessment of the site during macroinvertebrate sampling. Volunteers will fill out the sheet on-site according to the following (after the macroinvertebrates have been collected):

a) Composition of River Bed: estimate the percentage make-up of the stream bed.
b) Percent Embedded: estimate the percentage of the larger rocks and particles that are surrounded by fine silt and sand.
c) Flow: fill in the percentage of the stream channel presently filled with water.
d) Overhead Canopy: stand as near to the center of the stream as possible and hold your hands straight out to the side. Now move your hands upward until your outstretched fingertips are

pointing to the edges of the canopy. The percent of the 180 degrees that your hands moved from the straight out to straight up is the percentage canopy cover.

e) Water Odor: circle the best approximation.
f) Algal Growth: Use the index to rate the amount of algae growth on a scale of 0 to 2. Look at rocks and vegetation as well as slow water areas.
g) Bank vegetation: estimate the percentage and type of bank vegetation that is present at your sampling site.
h) Depth: select a spot typical of the riffle area, measure depths at 1 step intervals from bank to bank. If the water becomes too deep, please do not try to measure all the way across.
i) Current velocity: measure the time it takes a neutrally buoyant float to travel 10 feet, twice in each of the two fast sections and two slow sections of the riffle (stopwatch, tape and orange method).

Equipment: Field sampling gear includes D-frame nets (500-micron mesh), sorting pans, containers and lids, forceps, eye-droppers, kitchen sieve, isopropyl alcohol, tape measure, clipboard, and waders. All equipment will be stored in the BRWA office and made available for pick-up by volunteers prior to sampling events. Equipment will be returned to the BRWA on indoor identification days. Equipment will be maintained by BRWA staff.

Bacteria

A stream sampling point is approached from downstream to minimize disturbance of sediment at the sample point. A site and sample event-labeled, sterile sample bottle is opened and rinsed twice with stream water, then capped and submerged in a zone estimated to be representative of stream base flow, at mid-water column level. The sample bottle is opened, filled with a sample and capped underwater. A field data sheet is filled out with information on location, time, stream conditions, dry or rain sample event, and the sampler's name.

Continuous Temperature Monitoring

Thermistor deployment methods

A. Thermistors will be placed upstream of the culvert, at least 30 feet away from the road crossing. Each thermistor will be placed in a well-mixed area of a stream where it will ideally remain submerged and free of sedimentation during the period of deployment. The latter is an important consideration when monitoring in low-gradient streams, or alluvial high and moderate gradient streams with aggrading or shifting substrates (e.g., sand). A riffle or run is preferred to a pool. Seek shade so as to minimize any radiant heat from the sun.

   BRWA's deployment design for volunteer temperature monitoring is a piece of 2-inch diameter PVC pipe attached to a brick. The PVC is secured to the brick with a hose clamp secured around the brick and PVC. The thermistor is attached inside of the PVC with a removable wire and wire clip. In highly unstable or "flashy" streams, extra care should be taken to secure the thermistor in place. Run a piece of wire through the loop on the thermistor and attach it to a sturdy object (such as a tree) above bankful height on the streambank. Other deployment options are described in the WDNR protocol (WDNR 2004).

B. Water depth where the thermistor is deployed and time and date of thermistor deployment are recorded on datasheet. Time and mileage to/from the site are recorded as volunteer contribution on the datasheet.

B3. SAMPLING HANDLING AND CUSTODY

B3.1. Field Handling Procedures

Water Chemistry
Samples are analyzed in the field. Reacted sample material is poured into a disposal jug and disposed of in a municipal treatment system.

Macroinvertebrates
At the sample site, a label written in pencil will be placed inside every container used at the site. The label should state at least the following information: sample ID number, replicate number, waterbody name, collector's name, and a split-sample designation if needed. If a single sample's contents has to be placed in 2 separate containers due to large sample quantity, label the container accordingly (e.g,. container 1 of 2, sample 19990510-16-05). Place a label inside the sample jar, using bond paper written in pencil.

The field data sheet includes a section to record the number of containers used at the site. The volunteer is responsible for putting labels in containers, securely closing the containers, and returning all containers and equipment to the BRWA office. Upon delivery to the BRWA office, all containers are checked for labels, secured together with a rubber band and site label, and placed together in one box. In addition, data sheets are checked for completeness and to verify that the correct number of containers from the sample site is indicated on the data sheet. Samples will be stored in the BRWA office until the indoor identification session (one to two weeks later). The field data sheets are used on the identification day, after which they remain on file indefinitely.

Bacteria
Sample bottles are labeled with a Sharpie or similar indelible marker. The label should state at least the following information: sample ID number, waterbody name, collector's name, and a lab replicate sample designation if needed. Further site information should be recorded on a bacterial sample collection event field sheet. Once gathered, samples must be kept in a cool, dark place, and on ice in a cooler or refrigerated if held longer than one hour prior to preparation. Storage up to 24 hours must be at 4-6^{o} C.

Continuous Temperature Monitoring
Thermistors are checked monthly during deployment.

B3.2 Laboratory Handling Procedures

Water Chemistry
There are no laboratory handling procedures associated with water chemistry sampling.

Macroinvertebrates
During the indoor identification session, the sample identifier checks the data sheet and jars to ensure that all the jars, and only the jars, from that collection are present prior to emptying them into a white pan for sorting. The pans have a 2 x 6 grid on the bottom numbered 1-12. A random subsample of at least 125 organisms is selected in the following manner. The volunteer rolls a die and all organisms in the grid square corresponding to the number on the die are picked and placed into a new container of 70% isopropyl alcohol. Rolling of the die and picking of organisms, square by

square, is repeated until at least 125 organisms have been picked. If any specimens are separated from the pan during identification, a site label accompanies them. After identification, isopropyl alcohol used in the field will be discarded and specimens will be stored in fresh 70% alcohol. Samples will be stored in glass containers and contents will be reviewed periodically to guarantee proper storage until the macroinvertebrate Technical Advisor has completed identifications. Labels made of heavy-gauge paper will be inserted into containers to provide relevant information such as sample ID (corresponding to database), sample site location, and date collected.

Bacteria

Samples are either prepared for incubation by field collectors immediately after returning from the field, or are dropped off at the BRWA office for refrigerated storage. Samples must be kept on ice or refrigerated at 4-6^{o} C if not immediately prepared for incubation upon arrival at the laboratory. Samples must be incubated within 24 hours of collection.

Continuous Temperature Monitoring

There are no laboratory handling procedures associated with continuous temperature monitoring.

B4. ANALYTICAL METHODS

B4.1 Field Analytical Procedures

Water Chemistry

Lamotte Water Quality Monitoring Kits Instructions for

Dissolved Oxygen Model EDO Code 7414
Chloride Model PSC-DR Code 4503-DR-01
Precision Wide Range pH Code 5858
Thermometer
Turbidity

Standard Operating Procedure
Dissolved Oxygen

Procedure:

A. Summary of Method
   The method is an azide modification of the Winkler titration method. Oxygen is reacted producing a color change, and then back-titrated. Oxygen is released and the color disappears. The concentration of DO is proportional to the quantity of titrant used to release the oxygen.

B. Definitions
   mL = milliliter
   ppm = parts per million

C. Health and Safety
   Manganous sulfate solution, Alkaline Potassium Iodide Azide, Sulfamic Acid Powder and Sodium Thiosulfate (0.025N) are considered hazardous substances. Avoid contact between chemical reagents and skin, eyes, nose, and mouth. Wash hands after finishing analysis. Dispose of used chemicals in a closeable plastic container that is properly labeled.

D. Cautions
Water sample must be headspace free. Remove air bubbles from titrator when filling. Hold dropper bottles vertically upside-down when dispensing reagent. Discard used reagent in titrator at end of test. Keep track of titrant level in titrator during analysis or the DO results will be incorrect.

E. Interferences
None noted.

F. Personnel Qualifications
All personnel should be trained in the use of this method and sampling in general.

G. Apparatus and Materials
Manganous sulfate solution (4167-G), Alkaline Potassium Iodide Azide (7166-G), Sulfamic Acid Powder (6286-H), Sodium Thiosulfate (4169-H), starch indicator solution, 1.0 gram plastic spoon (0697), direct reading titrator (0377), glass test tube with cap (0608), water sampling bottle (0688-DO)

H. Instrument or Method Calibration
Calibration is not required. To achieve USEPA certified method status the sodium thiosulfate solution must be standardized daily.

I. Sample Collection
Follow sampling instructions applicable to each specific site. Rinse the Water Sampling Bottle (0688-DO) with sample water. Cap and submerge in the river. Open cap and fill bottle under water. Tap the sides of the bottle to dislodge any air bubbles. Replace the cap under water. Retrieve the bottle and make sure no air bubbles are trapped inside.

J. Handling and Preservation
Samples may be stored for a few hours after adding manganous sulfate solution, alkali-iodide solution, and sulfuric acid according to the method. Protect sample from exposure to air while adding reagents. Protect preserved samples from sunlight and titrate as soon as possible.

K. Sample Preparation and Analysis
1. Fill Water Sampling Bottle according to instructions above (J).
2. Add 8 drops of Manganous sulfate solution (4167).
3. Add 8 drops of Alkaline Potassium Iodide Azide (7166).
4. Cap and mix.
5. Allow precipitate to settle. Mix and settle again.
6. Use the 1.0 gram spoon to add one level measure of Sulfamic Acid Powder (6286).
7. Cap and mix until reagent and precipitate dissolve.
8. Fill titration tube (0608) to the 20 mL line.
9. Fill titrator with Sodium Thiosulfate, 0.025N (4169).
10. Titrate until sample color is a pale yellow.
11. Add 8 drops of Starch Indicator (4170WT).
12. Continue titration until blue color just disappears and solution is colorless.
13. Read result in ppm Dissolved Oxygen from volume of titrant used.

L. Troubleshooting
If problems occur during sampling or analysis, report them on the data sheet. Contact the technical advisor for problem correction.

M. Data
Fill out site data sheet with site observations and analytical results. Calculations are only required if the sample was diluted.

N. Hardware and Software
Send a copy of the day's sampling data sheet to the Bad River Watershed Association Technical Advisor/Volunteer Coordinator

O. Data and Records Management
It will be the Technical Advisor/Volunteer Coordinator's responsibility to enter data into a computer database and generate annual reports. Paper records (data sheets) will be kept by the volunteer and centrally by the Technical Advisor/Volunteer Coordinator.

Quality Assurance and Quality Control

Training in the use and maintenance of the monitoring kit and site sampling will be mandatory. Checks of the volunteer's ability to analyze a standard solution will be made initially and annually. Volunteers will also be trained on how to get a sample from their assigned sampling site.

Follow instructions for each test carefully (reaction times are very important). Wash out test tubes after each test. Tighten reagent caps immediately after use and DO NOT interchange caps. Avoid prolonged exposure of equipment and reagents to direct sunlight. Protect equipment and reagents from extremely high temperatures or freezing temperatures.

Standard Operating Procedure
Chloride

Procedure:

A. Summary of Method
In a neutral or slightly alkaline solution, potassium chromate (chloride reagent #1) can indicate the end point of the silver nitrate (Chloride reagent #2) titration of chloride. Silver chloride is precipitated quantitatively before red silver chromate is formed.

B. Definitions
ppm = parts per million

C. Health and Safety
Chloride Reagent #1 (4504-E), Chloride Reagent #2 (4505DR-G), Phenolphthalein Indicator, 1% (2246-E) and Sulfuric Acid, 0.5N (6090-E) are considered to be hazardous substances. Avoid contact between chemical reagents and skin, eyes, nose, and mouth. Wash hands after finishing analysis. Dispose of used chemicals in a closeable plastic container that is properly labeled.

D. Cautions
Remove air bubbles when filling titrator tube. Pay attention to calculation of concentration from titrant volume as this method is not direct reading.

E. Interferences
Bromide, iodide, and cyanide register as equivalent chloride concentrations. Sulfide, thiosulfate, and sulfite ions interfere but can be removed. Orthophosphate in excess of 25 mg/L interferes by precipitation as silver phosphate. Iron in excess of 10 mg/L interferes by masking the endpoint.

F. Personnel Qualifications
Personnel should be trained in sampling and analysis for this method.

G. Apparatus and Materials
Chloride Reagent #1 (4504-E), Chloride reagent #2 (4505DR-G), Phenolphthalein Indicator, 1% (2246-E) Sulfuric Acid, 0.5N (6090-E), glass test tube with cap (0778), Direct Reading Titrator, 0-200 (0382)

H. Instrument or Method Calibration
No calibration is required.

I. Sample Collection
Sample according to individual site instructions. Make sure the sampling container is cleaned prior to sampling and rinsed in stream to be sampled (three times) before sample collection. While collecting sample be careful not to stir up bottom sediments, which will increase the turbidity/sediment load in the sample and possibly change results. Sample with an upstream motion.

J. Handling and Preservation
No special preservation is required if the sample is to be stored.

K. Sample Preparation and Analysis
1. Fill test tube (0778) to 15 mL line with sample water.
2. Add one drop Phenolphthalein Indicator, 1% (2246). If solution remains colorless go to #3. If solution turns pink add Sulfuric acid, 0.5N (6090), one drop at a time until the pink disappears.
3. Add 3 drops Chloride Reagent #1 (4504), cap and swirl to mix. Solution will turn yellow.
4. Fill Direct Reading titrator (0382) with Chloride Reagent #2 (4505DR). Insert titrator in center hole of test tube cap.
5. While gently swirling tube, slowly press plunger to add Chloride Reagent #2 one drop at a time until yellow color changes to orange-brown.
6. Read test result where plunger tip meets titrator scale. Record as ppm Chloride. (Remember that each minor division gets multiplied by 4 for ppm).

EXAMPLE – Plunger tip is 3 minor divisions below line 100. Test result is 100 + (3 minor divisions * 4) = 112 ppm.

L. Troubleshooting
If problems occur during sampling or analysis, report them on the data sheet. Contact the technical advisor for problem correction.

M. Data
Fill out site data sheet with site observations and analytical results. Calculations are only required if the sample was diluted.

N. Hardware and Software
Send a copy of the day's sampling data sheet to the Bad River Watershed Association Technical Advisor/Volunteer Coordinator

O. Data and Records Management
It will be the Technical Advisor/Volunteer Coordinator's responsibility to enter data into a computer database and generate annual reports. Paper records (data sheets) will be kept by the volunteer and centrally by the Technical Advisor/Volunteer Coordinator.

Quality Assurance and Quality Control

Training in the use and maintenance of the monitoring kit and site sampling will be mandatory. Checks of the volunteer's ability to analyze a standard solution will be made initially and annually. Volunteers will also be trained on how to get a sample from their assigned sampling site.

Follow instructions for each test carefully (reaction times are very important). Wash out test tubes after each test. Tighten reagent caps immediately after use and DO NOT interchange caps. Avoid prolonged exposure of equipment and reagents to direct sunlight. Protect equipment and reagents from extremely high temperatures or freezing temperatures.

Standard Operating Procedure
Turbidity

Procedure:

A. Summary of Method
Turbidity is the expression of the optical property that causes light to be scattered and absorbed in a sample. The method compares turbidity of a measured amount of a sample with identical amount of turbidity-free water containing a measured amount of standardized turbidity reagent.

B. Definitions
JTU = Jackson Turbidity Units

C. Health and Safety

D. Cautions
Be careful to view sample and standard in a comfortable light source. Disregard sample color, the analysis looks only at the cloudy nature/haziness of a sample.

E. Interferences
The color of the sample versus the color of the standard may interfere with the analyst's view of the sample. Disregard color and look at the clarity or haziness of the black circle at the bottom of the turbidity tubes.

F. Personnel Qualifications
All personnel should be trained in this method.

G. Apparatus and Materials
Standard Turbidity Reagent (7520-H), Turbidity columns (0835), test tube brush, 0.5 mL pipette (0369), plastic stirring rod (1114).

H. Instrument or Method Calibration
No instrument calibration is necessary.

I. Sample Collection
Collect sample according to specific site instructions. Be sure to mix sample well before pouring to turbidity tube, but allow bubbles to dissipate before reading.

J. Handling and Preservation
Determine turbidity on the day the sample is taken. Vigorously shake all samples before examination. Do not store for long periods as irreversible changes in turbidity can occur.

K. Sample Preparation and Analysis
1. Fill one Turbidity column (0835) to the 50 mL line with the sample water. If the black dot on the bottom of the tube is not visible when looking down through the column of liquid, pour out the 50 mL, rinse the tube and re-fill to the 25 mL mark with re-agitated sample.
2. Fill the second Turbidity column (0835) with an amount of turbidity free water that is equal to the amount of sample being measured. Distilled water is preferred. This is the "clear water" tube.
3. Place the two tubes side by side and note the difference in clarity. If the black dot is equally clear in both tubes, the turbidity is zero. If the black dot in the sample tube is less clear, proceed to Step 4.
4. Shake the Standard Turbidity Reagent (7250) vigorously. Add 0.5 mL to the "clear water" tube. Use the stirring rod (1114) to stir contents of both tubes to equally distribute turbid particles. Check for amount of turbidity by looking down through the solution at the black dot. If the turbidity of the sample water is greater than that of the "clear water", continue to add Standard Turbidity Reagent in 0.5 mL increments to the "clear water" tube, mixing after each addition until the turbidity equals that of the sample. Record total amount of Turbidity Reagent added.
5. Each 0.5 mL addition to the 50 mL size sample is equal to 5 Jackson Turbidity Units (JTUs). If the 25 mL sample size is used, each 0.5 mL addition of the Standard Turbidity Reagent is equal to 10 Jackson Turbidity Units (JTUs).
6. Rinse both columns carefully after each determination.

L. Troubleshooting
If problems occur during sampling or analysis, report them on the data sheet. Contact the technical advisor for problem correction.

M. Data
Fill out site data sheet with site observations and analytical results. Calculate the sample results according to #5 above.

N. Hardware and Software
Send a copy of the day's sampling data sheet to the Bad River Watershed Association Technical Advisor/Volunteer Coordinator.

O. Data and Records Management
It will be the Technical Advisor/Volunteer Coordinator's responsibility to enter data into a computer database and generate annual reports. Paper records (data sheets) will be kept by the volunteer and centrally by the Technical Advisor/Volunteer Coordinator.

Quality Assurance and Quality Control

Training in the use and maintenance of the monitoring kit and site sampling will be mandatory. Checks of the volunteer's ability to analyze a standard solution will be made initially and annually. Volunteers will also be trained on how to get a sample from their assigned sampling site.

Follow instructions for each test carefully (reaction times are very important). Wash out test tubes after each test. Tighten reagent caps immediately after use and DO NOT interchange caps. Avoid prolonged exposure of equipment and reagents to direct sunlight. Protect equipment and reagents from extremely high temperatures or freezing temperatures.

Standard Operating Procedure
Transparency

Procedure:

A. Summary of Method
Transparency is typically measured with the use of a plastic tube with length markings on the side and a black and white Secchi disk that is either fixed to the bottom of the tube or attached to a string so it can be moved up or down in the water column. The Secchi tube method used by BRWA is based on the method described in the Minnesota Pollution Control Agency's Citizen Stream Monitoring Program Instruction Manual (MPCA 2011).

The Secchi tube is designed to function like the traditional Secchi disk used in lake monitoring. To measure transparency, the tube is filled with water collected from a stream or river. Looking down into the tube, a weighted Secchi disk is lowered into the tube by a line, allowing the user to raise and lower the disk within the same water sample numerous times. To obtain a Secchi tube measurement, the depth of the water at the midpoint between disappearance and reappearance of the disk is recorded in centimeters, which are marked on the side of the tube. If the symbol is visible when the tube is full, the transparency reading is ">120 cm." A greater transparency reading reflects higher water clarity (MPCA 2011).

B. Definitions
Transparency = a measure of water clarity.

Turbidity = the amount of suspended particles in the water.

Secchi Tube = A clear plastic tube marked in centimeters or inches along its side. A black and white disc is lowered into the tube on a string that is used to assess the clarity of stream water.

Suspended Material = Small particles floating in the water.

True Color = A measure of dissolved substances in water.

Sediment = Soil or other bits of eroded material that run off land and settle in water.

C. Health and Safety
Protect feet with waders, boots or sneakers while working in streams. Wash hands after working and before eating.

If you feel that working in the stream will put you at personal risk – DO NOT SAMPLE.

D. Cautions
Avoid prolonged exposure of equipment to direct sunlight.

E. Interferences
Direct sunlight can affect Secchi tube measurements. Measurements should be taken in a shaded area or with the sampler's back to the direct sunlight.

Disturbing the stream bottom prior to taking a water sample to measure transparency will give incorrect readings. Care must be taken to collect transparency water samples upstream of any stream bottom areas disturbed by the sampler.

Water samples for transparency should be taken below the stream surface and in the main flow of the stream.

F. Personnel Qualifications
Volunteers do not need qualifications or experience related to transparency sampling prior to expressing interest in BRWA's program. BRWA staff, its Technical Advisor, or other qualified person familiar with BRWA's transparency protocol will train volunteers in the correct method to measure stream transparency.

G. Apparatus and Materials
- Waders or hip boots
- Secchi tube (make sure Secchi disk and string are with the tube)
- Bucket or similar container to collect water sample and pour into Secchi tube
- Data sheet
- Pencil or pen

H. Instrument or Method Calibration
No instrument calibration is required.

I. Sample Collection

1) Timing:
Secchi tube depth should be taken during each monthly visit and annual rain event visit to the assigned monitoring site.

2) Site selection
   a) Sites are selected by BRWA staff based on protocols outlined in BRWA's Volunteer Water Quality Monitoring Program Quality Assurance Project Plan (BRWA 2012).
   b) Obtain landowner permission if the sample site will be on private property.

3) Collecting the sample
   a) Pull string out to remove the Secchi disk from the tube.
   b) Walk into the water downstream from the sampling location. Be careful not to stir up the bottom sediment upstream of your sampling location.
   c) Face upstream (into the current) in the middle of the stream.
   d) Secchi tubes may be filled directly by holding the tube in the water with the open end facing upstream, or alternatively the water sample may be collected in a bucket. In either case, it is desirable to sample in the main stream current, as far from the streambank as possible. Collect water below the surface but be sure to avoid collecting bottom sediments.
   e) Return to shore with the sample.
   f) If a bucket is used, the water should be gently stirred or swished (without introducing air bubbles) until it is homogeneous, then poured into the tube.
   g) Whether you used a bucket or filled the tube directly from the stream, the water level should drain to the zero mark on the centimeter tape measure (you may have to continuously break the surface tension in the drain hole).
   h) When taking the reading, find a shaded area or turn your back to the sun, so the tube is shaded.
   i) Lower the Secchi disk into the open end of the tube until it disappears; then raise the Secchi disk until it reappears.
   j) Pinch the string against side of tube when the Secchi disk is at the midpoint. Use the adjustable stopper to hold the string in place if needed to read the tape measure.
   k) Hold the tube up so you can sight across the point at which the disk and tape measure intersect.
   l) Record depth at the top of the Secchi disk to the nearest centimeter.
   m) If the symbol is visible when disk is at bottom, record as ">120 cm."

J. Handling and Preservation
No entry.

K. Sample Preparation and Analysis:
No entry.

L. Troubleshooting
When sampling in cold weather, keep chunks of ice out of the Secchi tube when taking measurements. Make sure the water level in the Secchi tube is at the "0" centimeter mark

before taking measurements. The drain hole may need to be cleared of ice or other debris to allow the water level to drain to "0."

M. Data
Transparency data will be entered onto a datasheet by volunteers in the field. Some volunteers submit data to BRWA staff by entering it into an online spreadsheet. All hardcopy datasheets are submitted to BRWA staff and entered into an electronic spreadsheet (e.g. Microsoft Excel). A second person should check 100% of the data entries as part of data validation.

N. Hardware and Software
Send a copy of the day's sampling data sheet to the Bad River Watershed Association Technical Advisor/Volunteer Coordinator.Data and Records Management
Field data sheets will be kept in folders stored in a filing cabinet in the BRWA office.

O. Transparency data will be entered onto a datasheet by volunteers in the field. Some volunteers submit data to BRWA staff by entering it into an online spreadsheet. Regardless of whether data were entered online, all hardcopy datasheets are submitted to BRWA staff. Data entered online are reviewed against the hard copy datasheets and data not entered online are entered into an electronic spreadsheet (e.g., Microsoft Excel) immediately after datasheets are returned by volunteers. Once field data have been entered, the BRWA staff who entered the data will place their initials on the field data sheet to indicate the data have been entered. All data entered will be reviewed and verified by a second person (100% check of hand-entered data). The second person will also enter his or her initials on the datasheet.

Data are considered validated following verification of entry and a report describing results from an annual quality control check described in section Q.

Following each field season (usually late fall or winter), field data sheets are scanned into electronic PDF or similar format for electronic storage. Hard copies are stored in a file cabinet in the BRWA office. All BRWA files are backed up on an external hard drive on a weekly basis. The external hard drive is stored at the home of a BRWA staff person.

Following data review, verification, and validation, data are ready for analysis and sharing with intended users (e.g., Wisconsin Department of Natural Resources, Bad River Natural Resources Department) and other partners.

<u>Quality Assurance and Quality Control</u>
All volunteers will undergo training prior to conducting transparency monitoring. BRWA staff, its Technical Advisor, or other qualified person familiar with BRWA's transparency protocol will train volunteers in the correct method to measure stream transparency.

Quality control checks will be held annually to ensure water chemistry volunteers are collecting good data. These checks will be done in a laboratory with volunteers using their Secchi tubes to test the same solution. Results will be averaged and percent agreement calculated to give an indication of agreement between results measured by multiple volunteers on the same sample. The check will allow BRWA to identify volunteers having trouble with collecting Secchi tube data and allow agreement between volunteer data to be tracked over time to identify if any additional quality control or training may be needed to ensure measurements are being collected properly.

BRWA staff will conduct periodic side-by-side tests of Secchi tube measurements with volunteers to answer any questions and ensure methods are being implemented properly.

During the first year of implementing this protocol, volunteers will collect turbidity data using the previous method used by BRWA along with transparency using Secchi tubes. This exercise will establish a relationship between the two readings and allow BRWA to better "link" the two methods in our long-term understanding for each stream.

Standard Operating Procedure
Temperature

Procedure:

A. Summary of Method
   Direct readings are taken from a thermometer.

B. Definitions
   Readings are expressed in degrees centigrade (^{o}C).

C. Health and Safety
   No special precautions.

D. Cautions
   Keep thermometer shaded for both air and water readings.

E. Interferences
   None known.

F. Personnel Qualifications
   All personnel should be trained in sampling and the use of this analytical method.

G. Apparatus and Materials
   Thermometer.

H. Instrument or Method Calibration
   No calibration required.

I. Sample Collection
   No sample is collected.

J. Handling and Preservation
   No handling or preservation necessary.

K. Sample Preparation and Analysis
   Hang the thermometer into the flowing water of the stream for two minutes. Retrieve and read.

L. Troubleshooting
If problems occur during sampling or analysis, report them on the data sheet. Contact the technical advisor for problem correction.

M. Data
Fill out site data sheet with site observations and analytical results.

N. Hardware and Software
Send a copy of the day's sampling data sheet to the Bad River Watershed Association Technical Advisor/Volunteer Coordinator.

O. Data and Records Management
It will be the Technical Advisor/Volunteer Coordinator's responsibility to enter data into a computer database and generate annual reports. Paper records (data sheets) will be kept by the volunteer and centrally by the Technical Advisor/Volunteer Coordinator.

Quality Assurance and Quality Control

Training in the use and maintenance of the monitoring kit and site sampling will be mandatory. Checks of the volunteer's ability to analyze a standard solution will be made initially and annually. Volunteers will also be trained on how to get a sample from their assigned sampling site.

Follow instructions for each test carefully (reaction times are very important). Wash out test tubes after each test. Tighten reagent caps immediately after use and DO NOT interchange caps. Avoid prolonged exposure of equipment and reagents to direct sunlight. Protect equipment and reagents from extremely high temperatures or freezing temperatures.

Standard Operating Procedure

pH

Procedure:

A. Summary of Method
A sample is reacted with an indicator that creates a color change. The color of the reacted sample is compared to standard pH colors using an octet comparator.

B. Health and Safety
The Wide Range Indicator (2218) is considered a hazardous solution. Avoid contact with skin and eyes. Wash with soap and water if dropped on skin.

C. Cautions
The comparator should be properly positioned for optimal color comparison.

D. Personnel Qualifications
All personnel should be trained in sampling and the use of this method.

E. Apparatus and Materials

Test tube, 5.0 mL (0230), Wide Range Indicator (2218), Octet Comparator.

F. Instrument or Method Calibration
No calibration necessary.

G. Sample Collection
Collect sample according to specific site instructions. Be sure to mix sample well before pouring to test tube.

H. Handling and Preservation
Sample should be analyzed as soon as possible.

I. Sample Preparation and Analysis
1. Fill test tube to 5.0 mL line with sample water.
2. While holding the dropper bottle pipette vertically, add 10 drops of indicator solution.
3. Cap and mix.
4. Insert the tube into the Octet Comparator. Match sample color to the standard. Record pH. The comparator should be positioned between the operator and the light source, so that the light enters through the special light-diffusing screen in back of the comparator. Avoid viewing the comparator against direct sunlight or an irregularly lighted background.

J. Troubleshooting
If problems occur during sampling or analysis, report them on the data sheet. Contact the technical advisor for problem correction.

K. Data
Fill out site data sheet with site observations and analytical results. Calculations are only required if the sample was diluted.

L. Hardware and Software
Send a copy of the day's sampling data sheet to the Bad River Watershed Association Technical Advisor/Volunteer Coordinator.

M. Data and Records Management
It will be the Technical Advisor/Volunteer Coordinator's responsibility to enter data into a computer database and generate annual reports. Paper records (data sheets) will be kept by the volunteer and centrally by the Technical Advisor/Volunteer Coordinator.

<u>Quality Assurance and Quality Control</u>
Training in the use and maintenance of the monitoring kit and site sampling will be mandatory. Checks of the volunteer's ability to analyze a standard solution will be made initially and annually. Volunteers will also be trained on how to get a sample from their assigned sampling site.

Follow instructions for each test carefully (reaction times are very important). Wash out test tubes after each test. Tighten reagent caps immediately after use and DO NOT interchange caps. Avoid prolonged exposure of equipment and reagents to direct sunlight. Protect equipment and reagents from extremely high temperatures or freezing temperatures.

Macroinvertebrates
There are no field analytical methods involved with the macroinvertebrate monitoring.

Bacteria
There are no field analytical methods involved with the bacteria monitoring.

Continuous Temperature Monitoring
There are no field analytical methods involved with continuous temperature monitoring.

B4.2 Laboratory Analytical Procedures

Water Chemistry
There are no laboratory analytical procedures associated with the water chemistry sampling.

Macroinvertebrates
Macroinvertebrate sampling methodology follows Barbour, et al. (1999), *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish*, 2nd Ed. Aquatic macroinvertebrates collected in the field during the spring and fall are identified to the family-level in the lab at an indoor identification session. Although reference literature for taxonomic identification is dependent upon the preference of the expert, copies of *Aquatic Insects of Wisconsin* (Hilsenhoff 1995), *Aquatic Entomology: The Fisherman's and Ecologist's Illustrated Guide to Insects and Their Relatives* (McCafferty 1983), *Guide to Aquatic Invertebrates of the Upper Midwest* (Bouchard 2004), and *A Guide to Common Freshwater Invertebrates of North America* (Voshell 2002) will be available during indoor identification sessions. Stereo microscopes with up to 65x magnification will also be available during indoor identification sessions to aid the identifiers. The Technical Advisor will complete and check all identifications made by volunteers.

Several biotic and diversity indices will be used to rate the water quality of each stream, make comparisons between streams, and perform trend analyses within the same stream over time.

Calculate metrics with macroinvertebrate data such as Hilsenhoff Family Biotic Index, Hilsenhoff Biotic Index, Taxa Richness, and Ephemeroptera, Plecoptera, Tricoptera (EPT) Taxa Richness (Hilsenhoff 1995).

Diversity indices to be used include: Total Taxa, Taxa Richness, EPT Index, Hilsenhoff Biotic Index (HBI) and Hilsenhoff Family Biotic Index (HFBI). The Total Taxa index is the total number of families found at a sample site during one sample event. The EPT index is the total number of families belonging to the Ephemeroptera, Plecoptera, and Trichoptera orders found at a sample site during one sample event. A system developed by William L. Hilsenhoff to rate the sensitivity of aquatic macroinvertebrates will be used to total the number of sensitive orders (Biotic Index) and families (Family Biotic Index). All biotic diversity index scores will be calculated in Microsoft Excel or Access.

Statistical analysis of data will be performed to examine variation between sample sites and trends within sites over time. Before conducting statistical analysis, BRWA staff will consult with professional statisticians for guidance in choosing the correct statistical procedure and performing statistical analyses.

Bacteria

"Coliscan Easygel" SOP (Micrology Laboratories N.D.).

1. Disinfect working surfaces with a bleach-based cleaning solution or 50% or higher alcohol and allow to air dry.
2. Wash hands before beginning analyses (also wearing Nitrile gloves is recommended).
3. Remove sample bottles from cooler/refrigeration.
4. Label petri dishes with the appropriate sample information. A permanent marker or wax pencil will work.
5. Sterilely transfer 1.0 to 5.0 mL of sample from the sample containers into the bottles of Coliscan Easygel. Swirl the bottles to distribute the inoculum and then pour the medium/inoculum mixtures into the correctly labeled petri dishes. Place the lids back on to the petri dishes. Gently swirl the poured dish until the entire dish is covered with liquid (but be careful not to splash over the side or on the lid).
6. The dishes may be placed right-side-up directly into a level incubator or warm level spot in the room while still liquid. Solidification will occur in approximately 40 minutes.
7. Incubate at 35° C (95° F) for 24 hours or at room temperature for 48 hours. (See comments on incubation.)
8. Inspect the dishes:
    a. Count all the purple colonies on the Coliscan dish (disregard any light blue, blue-green or white colonies), and report the results in terms of *E. coli* per ml of water. NOTE: To report in terms of *E. coli* per 100 ml of water, first find the number to multiply by. To do this: first, divide 100 by the number of ml that you used for your sample. Then, multiply the count in your plate by the result obtained from #1. For example, a 3 ml sample, 100 / 3 = 33.3. So, 4 *E. coli* colonies multiplied by 33.3 will equal 133.2 *E. coli* per 100 ml of water.
    b. Count all the pink and purple colonies on the Coliscan dish (disregard any light blue, blue-green or white colonies) and report the results in terms of coliforms per ml of water.
9. Do one of the following prior to disposal in normal trash:
    a. Place dishes and Coliscan bottles in a pressure cooker and cook at 15 lbs. for 15 minutes. This is the best method.
    b. Place dishes and Coliscan bottles in an ovenproof bag, seal it, and heat in an oven at 300° F for 45 minutes.
    c. Places dishes and Coliscan bottles in a large pan, cover with water and boil for 45 minutes.
    d. Place 5 ml (about 1 teaspoon) of straight bleach onto the surface of the medium of each plate. Allow to sit at least 5 minutes. Place in a watertight bag and discard in trash.

Continuous Temperature Monitoring

There are no laboratory analytical procedures associated with continuous temperature monitoring.

B5. QUALITY CONTROL

Quality control objectives, criteria, and corrective actions are discussed in section A7. The Project Manager is responsible for ensuring that quality control measures associated with this project are implemented and will evaluate (in consultation with other staff and natural resource professionals) and make decisions about interpretation of QC results, improvements that could be made to project quality control, and improvements and changes that should be made to the project to help achieve its objectives. It is the responsibility of all staff associated with and trained in collecting data for this project

to implement and ensure quality control objectives are met. Further discussion of quality control for each parameter is as follows:

Water Chemistry

Quality control checks will be held annually to ensure the volunteers are getting good data. These checks will be done in a laboratory with volunteers using their kits to test standards of known concentration. Project method checking will be done by periodically by sampling alongside the Bad River Natural Resources Department (BRNRD) samplers during their monthly run.

Macroinvertebrates

Equipment Quality Control

1. D-frame nets must be inspected for damage and replaced if necessary.
2. Containers for sample collection, sorting tray, and forceps must be checked for damage and cleanliness and replaced/substituted if necessary.
3. All equipment must be cleaned, dried and stored securely after sampling event.

Field Procedures Quality Control

1. Replicate benthic macroinvertebrate sampling must be performed through side-by-side field data collection when a new volunteer starts monitoring and then every 3-5 years thereafter. A Project Manager will accompany the volunteers and collect benthic macroinvertebrate data to compare biotic and diversity indices with those of the volunteer and thus, verify quality control in collection techniques and thoroughness.
2. The Project Managers will accompany new individuals or teams during their first macroinvertebrate sampling event and collect duplicate samples.
3. Project Managers will also visit each sample collection site and observe volunteers on a rotational basis for the spring and fall sampling periods until each site has been visited once, when the rotation will start over again.

    a) Techniques under review shall include [1] collecting style (must be thorough and vigorous), [2] habitat diversity (must include all habitats and be thorough in each one), [3] picking style (must pick thoroughly through all materials collected and pick all sizes and types) [4] variety and quantity of organisms (must ensure that diversity and abundance at site is represented in sample), and [5] the transfer of collected macroinvertebrates from the net to the sample jars (specimens must be properly handled and jars correctly labeled).

Indoor Identification Quality Control

1. All containers with macroinvertebrate specimens must be checked by a Project Manager upon receipt from volunteer to assure that they contain labels and are secured together with a rubber band and site label, and placed together in one box.
2. Field data sheets used by volunteers must be checked for completeness and to verify that the correct number of containers from the sample site is indicated on the form.
3. Prior to identification, data sheets and jars must be checked to ensure that all jars, and only jars from that collection, are present prior to emptying them into a white pan for sorting.
4. During the identification session, if any specimens are separated from the pan during identification, a site label must accompany them.

5. Following identification, all specimens from the sample site in question must be stored in 70% alcohol in an air-tight container and a label included in the container that includes all relevant information (i.e., sample event date, sample site location, taxonomic family name).
6. All sample identifications must be checked and verified by the Technical Advisor.

Data Analysis Quality Control

1. Field records must be reviewed for errors upon receipt by the Project Manager to minimize errors before entry into a database and subsequent analysis.
2. Calculations for diversity and other variables will be automated to reduce human error and must be verified, preferably by another Project Expert, with manual calculations.
3. Data entered into computer must be reviewed by comparing hard copy print outs of database with field data sheets.
4. Data analysis methods must be reviewed on a five year basis by qualified professionals.

A quality control check list has been developed for use by Project Managers.

Bacteria

Incubator temperature is checked against a NIST-traceable thermometer annually. Operating temperature must be 36^{o}, +/- 2.0^{o} C.

Laboratory replicate samples are analyzed every 10 sample events. Acceptable results are determined by control value analysis.

Method blanks are run every 20 sample events, using sterile deionized water as a sample. No bacterial or fungal growth should be observed on the plates after incubation.

Continuous Temperature Monitoring

The thermistor units are checked prior to deployment using a NIST-traceable thermometer. Accuracy, based on manufacturer documentation, should be +/- 0.2^{o} C. Units falling outside of the manufacturer's accuracy range will be taken out of service and returned to the factory for repair/replacement.

B6. INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

Water Chemistry

Chemistry kits will be checked regularly for expired reagents. Kits will be stored indoors between samplings. Thermometers will be inspected physically for damage and compared to other thermometers to verify that they are functioning correctly, prior to distribution to the volunteer. If equipment has been damaged or is malfunctioning, replacement thermometers will be provided by BRWA staff. All equipment not in use will be stored in the BRWA office.

Macroinvertebrates

D-frame nets will be inspected before each sampling event to ensure that they are intact. If holes are found in the netting, nets will be replaced prior to use. Containers for collecting samples will also be inspected before each event and replaced if necessary.

Bacteria

Incubator temperature is checked against a NIST-traceable thermometer annually. Operating temperature must be 36^{o} C, +/- 2.0^{o} C.

Continuous Temperature Monitoring
The thermistor units are calibrated prior to deployment using a NIST-traceable thermometer. Accuracy, based on manufacturer documentation, must be +/- 0.2^{o} C. Anchor cables and hardware should be inspected for wear and corrosion prior to deployment.

B7. INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

Water Chemistry
There are no instrument or equipment calibrations conducted with the water chemistry monitoring.

Macroinvertebrates
There are no instrument or equipment calibrations conducted with the macroinvertebrate monitoring.

Bacteria
Incubator temperature is checked against a NIST-traceable thermometer annually. Operating temperature must be 36^{o} C, +/- 2.0^{o} C.

Continuous Temperature Monitoring
The thermistor units are checked prior to deployment using a NIST-traceable thermometer. Accuracy, based on manufacturer documentation, must be +/- 0.2^{o} C.

B8. INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES
All supplies and consumables required for water chemistry, macroinvertebrate, and bacteria monitoring will be received at the BRWA office and inspected to ensure they are the supplies that were ordered and that no damage has occurred during shipping. Any damaged supplies and consumables should be returned immediately to the manufacturer for replacement.

A list of monitoring supplies and consumables, including dates of purchase and projected replacement, has been developed in a Microsoft Excel workbook. Supplies will be maintained by project managers and stored at the BRWA office.

B9. NON-DIRECT MEASUREMENTS
Results from this project will be compared to available metrics used by WDNR and the BRNRD to evaluate and interpret these kinds of data. Possible metrics that will be calculated include: 1) macroinvertebrates—total taxa, taxa richness, Hilsenhoff Family Biotic Index (HFBI), Hilsenhoff Biotic Index (HBI), and Ephemeroptera, Plecoptera, Tricoptera (EPT) taxa richness.

B10. DATA MANAGEMENT
Field data sheets for water chemistry and bacteria monitoring will be kept in one binder and macroinvertebrate field data sheets in a separate binder. Field data will be collected by volunteers and recorded on a data sheet. Volunteers will be instructed to enter their data online into a Google Docs spreadsheet, and then they must submit a hard copy of the data sheet to BRWA either via mail or a PDF via email. Staff will enter data into an electronic database (e.g., Microsoft Excel) when data are received from the volunteer. Once field data have been entered, the initials of the staff person who entered the data are placed in the appropriate column on the field data sheet to indicate the data have been entered.

Following each field season (usually late fall or winter), field data sheets will be scanned into electronic PDF or similar format for electronic storage. Hard copies will be stored in a file cabinet in the BRWA office. All hand-entered data (100%) into BRWA's database will be checked against the field sheets by a BRWA staff person. All BRWA files are backed up on an external hard drive on a weekly basis. The external hard drive is stored at the home of a BRWA staff person.

Following data review, validation (described in section D2), and completion of an annual quality control report (described in section C2), data are ready for analysis and sharing with intended users (i.e., WDNR, BRNRD) and other partners.

GROUP C: ASSESSMENT AND OVERSIGHT

C1. ASSESSMENTS AND RESPONSE ACTIONS

The responsibility for maintenance of quality for a project lies with every BRWA staff member, volunteer and contractor associated with this project. All project personnel shall aid in identifying perceived problems that may affect quality and report such problems to their supervisor in the case of staff or to the BRWA Project Manager or Assistant Project Manager in the case of volunteers and contractors.

All laboratory or field problems will be reported to the BRWA Project Manager and will be discussed with other BRWA staff or other technical support staff utilized by BRWA as needed to determine the appropriate response action.

Deviations from the QAPP will immediately be reported to the Project Manager for review and approval. Deviations from the QAPP will be documented on a deviation form by the Project Manager.

C2. REPORTS TO MANAGEMENT

An annual quality control report will be generated by the BRWA Project Manager, with assistance from the Assistant Project Manager and Technical Advisor. The report will summarize quality control checks, any response actions taken based on quality control checks, and deviations from the QAPP. This report will typically be completed in late winter or early spring (February/March) when all water chemistry quality control checks, macroinvertebrate and bacteria data checks, temperature data, and QC validation are completed.

Once data have been validated for use by assessing and documenting their quality via this QAPP, they are ready to be shared as needed. It is the intent, at minimum, that the water chemistry and macroinvertebrate monitoring data be shared with WDNR for use in their statewide water quality database and reporting and decision-making related to that database. Reporting to agencies such as WDNR will occur per the requirements for the agency. For instance, WDNR's protocol for water chemistry monitoring describes specific data formatting and submission requirements. The BRWA Project Manager will contact appropriate agency staff to ensure data submission requirements are met as needed.

GROUP D: DATA VALIDATION AND USABILITY

D1. DATA REVIEW, VERIFICATION, AND VALIDATION

BRWA staff will enter all field data into BRWA's Microsoft Excel or Access database immediately following each field trip. A BRWA staff person will verify 100% of all database entries with the hard copy datasheets. The database will be stored in two locations, not on the same computer.

Water chemistry monitoring data will be verified and validated by evaluating quality control results compared to the data quality objectives described in Table 1 for accuracy and usability based on the pre- and post-deployment checks and associated response actions described in section A7.

Macroinvertebrate monitoring results will be confirmed by identification from a Technical Advisor trained in macroinvertebrate identification. Experts will conduct identification with the aid of dissecting microscopes (with a maximum enlargement of 65x), consultation with dichotomous keys (Hilsenhoff 1995; Bouchard 2004) and the use of a reference collection when available.

Experts who will assist in macroinvertebrate identification quality control include:

Tracey Ledder, BRWA Technical Advisor and Monitoring Coordinator, Lake Superior National Estuarine Research Reserve.

Dr. Kurt Schmude, University of Wisconsin-Superior.

Tom Doolittle, USDA-Forest Service, Washburn field office.

Bacterial sampling data will be verified and validated by laboratory replicate and method blank results. Results are invalid if laboratory replicate values fall outside of an internally-derived control range, and are considered valid when follow-up laboratory replicate analyses fall within the control range. Results are invalid if a method blank is positive for microbial growth, and are considered valid when a follow-up method blank is negative for microbial growth.

Continuous temperature monitoring data will be verified and validated by pre-deployment thermistor temperature accuracy checks against the manufacturer's accuracy specifications and NIST-certified thermometer. Volunteer record sheets will be assessed to ensure proper deployment and follow-up site checks were carried out.

D2. RECONCILIATION WITH USER REQUIREMENTS

Data Uses for Citizen-Generated Monitoring Data

To realize the efficiencies of enhancing Department programs with citizen-generated data, it is important that these data be evaluated and utilized in the same decision-making capacities as Department-collected data. Citizen monitors will be trained in collecting certain water quality parameters and will meet prescribed quality assurance procedures. All citizen-collected data will be entered into the WDNR's SWIMS database. Representative and acceptable data from all sources (citizen- Levels 2 and 3- and Department generated) will be considered when prioritizing management actions. Level 1 citizen data may be used as an initial screening tool, but may not be utilized exclusively when prioritizing management actions.

Once protocols, stringent quality assurance and quality control measures, and training have been established for this citizen-based water monitoring program (Levels 2 and 3), citizen-collected data have the potential to contribute to the following Clean Water Act Objectives:

- Establish, review and revise water quality standards.
- Identify impaired waters.
- Evaluate management (protection/restoration) effectiveness.

Citizen-generated data can also be used to:

- Provide broader spatial and temporal coverage in river, stream, wetland, lake, groundwater, and beach water quality.
- Monitor water quality conditions to support TMDL/303(d) listing, 305(b) Reports, and general information on the water quality of Wisconsin water bodies.
- Assess water quality conditions in relation to nonpoint source management projects.
- Support decision making by individuals and agencies other than the Department.

County Land and Water Resource Plans

Data quality objectives will be reviewed on an annual basis to ensure that objectives are met. Any data quality problems will be reported to the BRWA Project Manager for assessment and corrective actions. In addition, data quality issues will be recorded as a separate item in the database and provided to all data users. Specific response to and reconciliation of problems that occur in data quality are outlined in section C1.

ACKNOWLEDGEMENTS

Joan Elias, Tracy Ledder, Matt Hudson, Michele Wheeler, Naomi Tillison, Sharon Anthony, and Dawn White provided valuable input during the development of this document, and continue to do so. Mariana Brewster and Kevin Brewster revised and updated this document. BRWA committee members, staff, and consulting experts listed in this document have generously contributed valuable expertise and ideas that are well reflected in the scope and usefulness of this document.

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