Quality Control Report

Bad River Watershed Association's (BRWA) 2014 "Staff Baseline Water Quality Monitoring Near the Potential Penokee Iron Ore Mine - Continuous Temperature"

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National Park Service, Retired

Independent Review Conducted By:

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Technical Advisor, Bad River Watershed Association
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Summary

This Quality Control Report satisfies quality assurance reporting outlined in section C2 of BRWA's Quality Assurance Project Plan (QAPP) entitled "Staff Baseline Water Quality Monitoring Near the Potential Penokee Iron Ore Mine –Continuous Temperature, Macroinvertebrate, and Conductivity." The report includes results of quality assurance tests pre- and post-field season, and notes any changes in methodology or quality control that occurred during the course of project implementation (see "Deviations").

During 2014 BRWA monitored temperature at 16 sites as part of the continuous temperature monitoring program (Table 1). Five sites were monitored by returning volunteers, six sites by BRWA staff, and five sites by private contractors. Monitoring efforts consisted of deploying Hobo V2 temperature tidbits (thermistors) and maintaining them during monthly site visits. If unexpected rain events occurred, extra site visits may have been required. Retrieving designated thermistors at the season's end, as well as keeping adequate field notes were also part of monitoring responsibilities. All monitoring personnel collected data according to BRWA's QAPP and Standard Operating Procedures. The private contractor hired for the continuous temperature monitoring, conducted all quality control testing of the thermistors and field equipment, as described in the staff QAPP, and managed all temperature data.

Macroinvertebrate samples were collected by staff and trained volunteers at eight sites in fall of 2014 (Table 1). All participants received training and reviewed the protocol prior to sampling. Samples were again sent to Dr. Kurt Schmude for identification.

Total phosphorous and specific conductance (conductivity) data were also collected monthly by private contractors at 20 sites, including eight of the temperature monitoring sites (Table 1). Quality control (QC) measures pertaining to specific conductance monitoring are included in this report. For QC measures regarding total phosphorus monitoring see "Final Report to the Bad River Watershed Association on Monitoring of Total Phosphorus and Associated Parameters, 2014" (Elias 2015). Dates of conductivity monitoring were as follows:

7/1/2014
7/23/2014
8/19/2014
9/20/2014
10/22/2014

BRWA purchased a new Hanna Instruments HI Model 98129 pH/SC/TDS handheld multiprobe for monitoring conductivity. An older multiprobe of the same model was also used. Both instruments have automatic temperature compensation to 25°C. Both instruments were calibrated at the beginning of every field day and calibration was checked at the end of every field day. A calibration log book was kept for the season and is maintained in the BRWA office.

Some changes in locations of BRWA's temperature monitoring sites occurred in 2014. Through collaboration with our partners in the region, we identified new sites for which no data existed and data were desirable. Collaboration is also an attempt to prevent duplicate efforts. BRWA monitored temperature at seven sites not previously monitored. Nine sites were repeated, in order to learn more about the natural range of variation. Some sites were discontinued because three years of temperature data have been collected (BRWA's initial goal) or due to lack of personnel and funding.

All eight macroinvertebrate monitoring sites had been sampled previously. Seven of the 20 conductivity monitoring sites had been monitored for conductivity in 2011; the remaining 13 sites were new in 2014.

Table 1. Bad River Watershed Association monitoring locations in 2014 for continuous temperature (Temp), macroinvertebrates (Macro), and specific conductance (Conductivity); thermistor deployment and retrieval dates; and macroinvertebrate sampling dates.

BRWA ID	River	Site Name	Coordinates	WI DNR SWIMS ID	Temp	Temp Deploy Date	Temp Retrieve Date	Macro Date	Conductivity
15	Alder Creek	at HWY 122	46.38536; -90.408689	10043169	X	6/12/2014	10/19/2014		
2021	Apple Creek	off O'Brien Lake Rd	46.34777; -90.40246	10041625	X	6/4/2014	10/13/2014		X
2017	Bad River	at Caroline Lk Outflow	46.26786; -90.56161	10037307					X
785	Bad River	at Gilman Park	46.32292; -90.66322	10033485	X	6/6/2014	10/22/2014		X
787	Bad River	in Mellen, E. Taylor Ave	46.32766; -90.65585						X
463	Potato	HWY 169	46.46219; -90.50814	263032					X
464	Potato	at Perry's	46.45677; -90.52010						X
465	Barr	at Perry's	46.45576; -90.51486						X
2010	Devils	at HWY 77	46.32113; -90.65213	10037097	X	6/6/2014	*thermistor missing		X
2018	Devils	at Oppergard Rd	46.31754; -90.59289	10037308				10/25/2014	
32	Bull Gus	at FR 703	46.30306; -90.50600	10037096					X
809	Montreal	County Line Rd	46.35599; -90.54869	10022080					X
829	City Crk	Lake Dr.	46.30878; -90.64485	10043264					X
17	Erickson	at Casey Sag Rd	46.37250; -90.46510	10034370				10/31/2014	X
23	Javorsky	at HWY 77	46.34484; -90.51842	10034371				10/24/2014	X
884	Gehrman	at Popko Rd	46.37408; -90.59107	10039136	X	6/15/2014	10/19/2014		
885	Gehrman	at HWY 169	46.37811; - 90.60586						X

Table 1 continued.

140	Unnamed trib to Brunsweiler	at HWY C	46.40682; -90.79402	10039133	X	6/11/2014	10/22/2014		
110	Unnamed trib to Trout Brook	at Broeniman rd & Springbrook	46.34951; -90.76705	10039132	X	6/11/2014	10/22/2014		
115	Unnamed trib to Trout Brook	at N. York rd	46.36769; -90.77735		X	6/11/2014	10/22/2014		
116	Fred's Creek	at N. York rd	46.34951; -90.76705		X	6/11/2014	10/22/2014		
921	Trout Brook	at Quarry Rd	46.3274; -90.76319	10022074	X	6/14/2014	10/12/2014		
921.2	Trout Brook	at Quarry Rd - rockdam	not far from site 921		X	6/14/2014	10/12/2014		
26	Tyler	at HWY 77	46.34749; -90.49460	10012906				10/20/2014	
2020	Tyler	at Moore Pk Rd	46.33780; -90.48957	10034351				10/24/2014	
889	Tyler	at Stricker Rd	46.39472; -90.59000	10034446				10/30/2014	
469	Vaughn	at HWY 169	46.487392; 90.507986	263033	X	6/5/2014	*thermistor missing		X
1029	Vaughn	at Lower Rd	46.49136; -90.46649	10033483					X
468	Trib to Vaughn	Edwards Rd	46.478332; 90.500104		X	6/5/2014	10/19/2014		
2013	Opergard	off Revai Rd	46.34160; -90.58571	10034376					X
869	Ballou	at Red House Rd	46.305897; -90575935	10034374	X	6/3/2014	10/22/2014		X
2014	Rouse Crk	at Casey Sag Rd	46.360833; 90.465767	10042327	X	6/3/2014	10/22/2014		X
2022	Unnamed trib to Rouse Crk	at Casey Sag Rd	46.36097; -90.46577	10034372				10/31/2014	
2019	Unnamed Tyler Forks Trib	at FR703	46.29086; -90.5015	10037309	X	6/3/2014	10/22/2014	10/25/2014	X

Deviations

Continuous Temperature
BRWA's QAPP recommends that all temperature thermistors be placed and deployed no later than June 1 and remain in the stream actively collecting data for at least four months. This year, all of the 16 temperature thermistors were deployed past the QAPP deadline of 6/1. All but two sites complied with the four month deployment requirement.

Further explanation is addressed for both of these deviations in the "Significant Quality Assurance Problems and Recommended Solutions" section below.

Macroinvertebrates
No deviations for macroinvertebrate monitoring occurred.

Conductivity
BRWA's QAPP requires calibrating conductivity probes with a 1413µS/cm standard, checking with an 84µS/cm standard, and checking with deionized water. Both probes were calibrated using a 1413µS/cm standard, however for post-calibration checks a 74µS/cm standard was used (instead of 84µS/cm). We consider the 74µS/cm standard to be adequate for this purpose. At the end of each field day one multiprobe was checked with 74µS/cm standard and the other was checked with 1413µS/cm standard. Checks with deionized water were not conducted consistently; however checks in air were conducted.

BRWA's QAPP also requires side-by-side comparisons of two probes and duplicate measurements in the field. Side-by-side comparisons of the probes were only conducted during calibration, not in the field. The probes were not used interchangeably; the same instrument was used at the same site throughout the season. Duplicate measurements in the field were not taken.

Precision via Alternate Measurement Sensitivity was not measured in 2014.

Significant Quality Assurance Problems and Recommended Solutions

Continuous Temperature
Analysis was conducted to locate "suspect" data that may have occurred during the 2014 monitoring season. Two of the field personnel reported thermistors that were washed away and not recovered at the end of the season. Consequently, all temperature data were lost after efforts to find the missing thermistors were unsuccessful.

At several sites partial sedimentation occurred around the thermistor PVC housing, although seemingly not significant enough to alter water temperatures.

Two monitoring set ups were found washed up or repositioned near the water's edge, indicating periodic exposure to air due to sudden high flows followed by rapidly receding flows during recent rain events.

The following describes monitoring sites with anomalous data and gives a recommended decision on data usage.

1. Unnamed tributary to Trout Brook at Broeniman Rd and Springbrook Rd , SWIMS ID# 10039132 – On 9/3/14, field personnel found the thermistor was moved out of position and semi-exposed, but still had water moving through the PVC housing due to recent high flow activity. Field notes indicated that the thermistor was again moved out of flow on September 23rd. The thermistor temperatures on the dates prior to and after the date that the thermistor was found exposed did not seem noticeably high or low, which makes it difficult to identify anomalous data to exclude as "air temperatures" rather than water

temperatures. These occurrences are well after the maximum daily mean temperature (MDM), calculated to have occurred on June 21. If any anomalous temperatures occurred in September, they would not have affected the MDM. The thermograph at this site was comparable to data from other nearby monitoring sites, which shows the peak temperatures at this site corresponded with peak temperatures in other monitoring sites. **Therefore, in the data provided for the SWIMS database, none of the temperature data were excluded and should be considered accurate and usable for calculating the maximum daily mean temperature.**

2. Tributary to Vaughn (Edwards Crk), new monitoring site lacking both BRWA and SWIMS ID numbers - Field notes indicated that the thermistor at this site may have washed up on shore on two separate site visits. The thermistor was found exposed on 8/28/14 and again on the 9/4/14 site visit. Field personnel noted that the thermistor likely washed up following a rain event that occurred on 8/24/14, noting 3.5" – 4" of rainfall on that date. The calculated maximum daily mean temperature (MDM) for this site was on 8/25/14, but according to the contractor, the logged temperatures prior to those site visits should be considered unreliable due to the exposure to air temperatures. An alternate MDM on 9/1/14 was calculated. However that date again was too close to the second occurrence of thermistor exposure, and should not be considered reliable for MDM. A second alternate MDM could be considered on 6/29/14, which coincided with two other monitoring sites. Since other monitoring sites had MDM's occurring around 6/29/14 as well as on 8/25/14, it is impossible to guess which peak temperature is or would have been correct since exposure data had to be eliminated. **We recommend not using the data for this site for the SWIMS database for a MDM reference.**

3. The following two of the 16 temperature thermistors were washed away during high flow events late in the monitoring season. Great efforts were made to find and retrieve the thermistors but to no avail.
    - Devils Creek at HWY 77, BRWA site #2010/ SWIMS ID # 10037097
    - Vaughn Creek at HWY 169, BRWA site #469/ SWIMS ID # 263033

    The thermistor at the Vaughn Creek site was last checked on 9/22/14 and discovered missing upon the attempted retrieval date of 10/22/14. Consequently, no data were retrieved and submitted for the SWIMS database.

    The Devils Creek site was last checked on 8/18/14, and discovered missing upon the attempted retrieval date of 10/22/14. The temperature data from Devil's Creek were downloaded upon a site visit on 7/23/14. The thermistor therefore collected reliable data from its deployment date of 6/6/14 until 7/23/14. Although only collecting data for less than 2 months, the MDM may have been captured, but it is impossible to be certain. The MDM for most monitoring sites this year fell on 7/21/14 and 7/22/14 (11 out of 13 sites with reliable data). The MDM for this site in 2013 was 19.633 and occurred on 8/27/13. However, with the uncertainty that the downloaded data collected on 7/23/14 contained the MDM for this site, none of the data were included in the submitted files to be used in the SWIMS database.

Macroinvertebrates

No significant quality assurance problems occurred.

Conductivity

Despite the above deviations from the QAPP, we believe the conductivity data collected in 2014 to be useable and should be included in the SWIMS database. The deviations were relatively minor.

Suggestions for Future Improvement

Continuous Temperature

Recommendations for the next season of temperature monitoring would be to stress the requirements outlined in BRWA's QAPP, specifically the deployment deadline(weather permitting) of no later than June 1, and the required minimum deployment for collecting baseline data, being no less than four months. At the beginning of the monitoring season whenever the deployment date occurs, a retrieval date for all thermistors should be calculated. This should be the date that field personnel know in advance as the earliest date to retrieve thermistors.

Discussions have occurred to purchase stainless steel cable for all temperature monitoring setups to prevent rust and fraying of cables which may result in breakage and possible loss of thermistors. This is highly recommended especially following a year where two thermistors were lost as a result of broken cables. Pre-season inspection of all setups should continue and be more stringent.

As stated in previous QC reports, thermistors should be checked more frequently following rain events to avoid prolonged periods of time when thermistors may be buried with sediment and debris or not recording stream temperatures due to being displaced and repositioned during high flows. It is also recommended that field personnel check the thermistor housing, including cables, for damage that can occur during these high flows. It is also recommended that handheld field thermometers be replaced with the purchase of new handheld thermometers, all from the same manufacturer. This may help eliminate temperature bias as described below **by using thermometers of the same type and by eliminating older units whose accuracy may be compromised.**

Conductivity

A low strength conductivity standard (<100µS/cm) should be used for post calibration and end of field day checks, although it is not necessary to use 84 µS/cm. Checks with deionized or distilled water should also be conducted as part of calibration checking as well as during the field day to be sure probes are functioning properly. When more than one probe is used during the field season, the probes should be compared to one another with a series of measurements and relative percent differences should be calculated. Precision of the probes should be measured via AMS. Duplicate measurements should be taken at the rate of ~10%.

Data Quality Indicators from QAPP

Continuous Temperature

<u>Thermistors – Precision via Alternative Measurement Sensitivity (AMS)</u>

Each thermistor was used to take 10 measurements of a water bath at room temperature and in an ice bath near 0°C, both prior to and after the field season. The standard deviation of these ten measurements was used to calculate AMS, with the optimum AMS target being ≤ ±0.2°C, as stated in BRWA's QAPP (Table 2). The data quality objective for AMS was met for all 14 thermistors retrieved at the end of field season 2014.

<u>Thermistors – Bias</u>

Field placement of all thermistors was according to QAPP protocol. At least three times during the season, temperature measurements recorded by the thermistors were compared with a field hand-held thermometer. Seven of the 14 monitoring sites did not meet the data quality objective for Bias as outlined in the QAPP. The mean difference between field thermometer and thermistor temperature readings was not within the certified accuracy of the field thermometer (± one scale division, or 0.5°C). However, none of the field check data measured with the field thermometers indicated that any thermistor was exposed to air. The data quality objective for Bias was met for the remaining 7 monitoring sites.

Table 2. Alternative Measurement Sensitivity calculated for thermistors for the field season 2014 during pre- (5/18/14 and 6/2/14) and post- (1/14/15) deployment accuracy checks.

			Pre-test 5/18/2014	Pre-test 6/2/2014	Pre-test 5/18/2014	Post-test 1/14/2015	Post-test 1/14/2015
Site Name	Thermistor Number	Volunteer (V), Staff (S), or Contractor (C)	AMS ice bath	AMS ice bath re-test	AMS room temp.	AMS ice bath	AMS room temp.
Gehrman Creek	9885848	S/V	0.270	0.029	0.025	0.029	0.025
Trout Brook	9885850	V	0.364	0.038	0.038	0.044	0.000
Unnamed Trib to Trout Brook	9885855	S	0.273	0.000	0.038	0.048	0.025
Bad River	9885856	S	0.326	0.000	0.033	0.044	0.036
Unnamed Trib to Brunsweiler	9885860	S	0.297	0.044	0.041	0.037	0.000
Rouse Creek	9885864	C	0.310	0.046	0.025	0.047	0.033
Unnamed Tyler Fks Trib	9922449	C	0.270	0.044	0.033	0.038	0.025
Ballou Creek	9922453	C	0.298	0.028	0.038	0.038	0.041
Alder Creek	10133369	V	0.345	0.029	0.000	0.038	0.032
Apple Creek	10133370	V	0.321	0.044	0.039	0.044	0.041
*Devils Creek	10133371	S	0.326	0.038	0.000	NA	NA
Unnamed Trib to Trout Brook	10133372	S	0.339	0.042	0.000	0.000	0.033
Trout Brook (site #2-Rockdam)	10133373	V	0.331	0.037	0.041	0.000	0.000
Fred's Creek	10133374	S	0.315	0.044	0.039	0.047	0.000
*Vaughn	10133376	C	0.262	0.038	0.040	NA	NA
Trib to Vaughn-Edwards	10133378	C	0.251	0.047	0.032	0.029	0.000

* Thermistors 10133371and 10133376 were washed away and not recovered at the end of the field season. Thermistors could not be re-tested in the post calibration tests.

NOTE: All thermistors during the pre-season ice bath tests failed to meet the optimum target AMS of $\leq \pm 0.2$°C as stated in BRWA's QAPP. Retests were performed and all thermistors passed and met BRWA's QC requirements for AMS.

Reasons for the differences in tidbit temperature recordings to the handheld field thermometer recordings are speculative. Perhaps the temperature differences resulted from not allowing field thermometers to stabilize for 2 minutes prior to reading, as suggested in the QAPP and SOP. The field thermometers are also older and vary in manufacturers. Certified accuracy of field thermometers may vary depending on the manufacturer, however original documentation for each field thermometer no longer exists. And on a few occasions, the differences were so great that it could have indicated reading errors by field personnel. Despite data quality objectives not being met for bias at the sites mentioned above, the placement of the thermistors and remaining field checks indicate that the data are still usable and reliable. Additionally, the post-season accuracy tests (see below) indicate all thermistors functioned properly throughout the season. Field placement of thermistors maintained by volunteers was the responsibility of the volunteers. All were trained on BRWA's protocol prior to receiving and deploying their thermistors.

Thermistors – Accuracy

A NIST-traceable thermometer (Control Company CC-244) was used for the pre- and post-deployment accuracy checks. The pre-season accuracy checks were performed with NIST thermometer Serial # 130514523, with a certification expiration date of 9/5/15. All thermistors recorded accuracy within the certified range of the TidbiT

v2 thermistors (+/-0.2 °C) in both the room temperature and ice baths (Table 3). The data quality objective for Accuracy was met.

Table 3. Pre- (5/18/14) and Post - (1/14/15) deployment accuracy (+/-0.2°C) check for all thermistors maintained by BRWA contractors, staff and volunteers during the 2014 field season. Accuracy check was conducted according to BRWA's QAPP(Control Company CC-244 NIST traceable thermometer was used as the reference thermometer for all checks).

Site Name	Thermistor Number	Volunteer (V), Staff (S), or Contractor (C)	Accuracy ice bath Pre-test	Accuracy room temp Pre-test	Accuracy ice bath Post-test	Accuracy room temp Post-test
Gehrman Creek	9885848	S/V	0.03	0.05	0.05	0.00
Trout Brook	9885850	V	0.04	0.12	0.13	0.05
Unnamed Trib to Trout Brook	9885855	S	0.03	0.07	0.07	0.00
Bad River	9885856	S	0.07	0.11	0.06	0.03
Unnamed Trib to Brunsweiler	9885860	S	0.11	0.14	0.16	0.07
Rouse Creek	9885864	C	0.09	0.15	0.12	0.07
Unnamed Tyler Fks Trib	9922449	C	0.02	0.05	0.06	-0.02
Ballou Creek	9922453	C	0.00	0.05	0.03	-0.04
Alder Creek	10133369	V	0.08	0.10	0.08	0.03
Apple Creek	10133370	V	0.00	0.09	0.04	0.01
*Devils Creek	10133371	S	0.07	0.10	NA	NA
Unnamed Trib to Trout Brook	10133372	S	-0.04	0.06	0.02	-0.02
Trout Brook (site #2-Rockdam)	10133373	V	0.11	0.14	0.16	0.07
Fred's Creek	10133374	S	0.05	0.09	0.06	0.02
*Vaughn	10133376	C	0.12	0.12	NA	NA
Trib to Vaughn-Edwards	10133378	C	0.06	0.10	0.05	0.02

* Thermistors 10133371and 10133376 were washed away and not recovered at the end of the field season. Thermistors could not be re-tested in the post calibration tests.

Thermistors – Representativeness

Similar to the start of the 2013 field season, the 2014 field season began later than anticipated, this year due to uncertainty in site selection as well as an extended winter season attributing to late snow melt causing high flows and making access to temperature monitoring sites difficult or dangerous. All of the 16 temperature thermistors were deployed past the QAPP deadline of June 1. However, all but two sites complied with the QAPP requirement for minimum deployment for collecting baseline data, which is a minimum collection period of four months, a deployment start no later than June 1 and retrieval no earlier than August 31. The two sites not meeting the 4 month minimum for baseline data collection were:

- Trout Brook at Quarry Rd, BRWA site # 921/SWIMS # 10022074
- Trout Brook site #2 (Rockdam) at Quarry Rd, a new site lacking ID #s.

The two sites above fell short of the 4 month minimum by 2 days, not a significant deviation. Eight of the 16 sites were deployed within the first week of June, the earliest on 6/3/14. The other eight sites were deployed during the second week of June, the latest on 6/15/14.

Based on data recorded from other sites in 2014, the maximum daily mean (MDM) temperatures likely occurred in the middle of July 2014, and at a few sites, later in August. Only two calculated MDM's occurred in late June,

(Rouse Crk at Casey Sag Rd, BRWA site #2014 – MDM on 6/29/14 and Unnamed Tyler Forks Trib at FR 703, BRWA site #2019/SWIMS ID# 10037309 –MDM on 6/28/14.) (Table 4).

Table 4. Sites monitored for continuous temperature by Bad River Watershed Association with 2014 maximum daily mean (MDM) temperatures for 2014 and for repeated sites from 2013.

Site Name	Location	Thermistor Number	2014 MDMT	2014 Date of MDMT	2013 MDMT (for sites repeated in 2014)	2013 Date of MDMT
Alder Creek	at HWY 122	10133369	24	7/21/2014		
Apple Creek	at O'Brien Lake Rd	10133370	22	7/22/2014	24	7/19/2013
Bad River	at Gilman Park	9885856	23	7/21/2014	26	7/18/2013
Gehrman Creek	at Popko Rd	9885848	18	8/25/2014		
Unnamed Trib to Brunsweiler	at HWY C	9885860	21	7/22/2014		
Unnamed Trib to Trout Brook	at Broeniman Rd & Springbrook	9885855	21	7/21/2014		
Unnamed Trib to Trout Brook	at North York Rd	9885855	*18	8/25/2014		
Fred's Creek	at North York Rd	10133374	23	7/21/2014		
Trout Brook	at Quarry Rd	9885850	24	7/21/2014	26	7/18/2013
Trout Brook	at Quarry Rd-Rockdam	10133373	24	7/21/2014		
Trib to Vaughn	at Edwards	10133378	NA	NA		
Ballou Creek	at Red House Rd	9922453	21	7/21/2014	23	7/18/2013
Rouse Creek	at Casey Sag Rd	9885864	21	6/29/2014	21	8/27/2013
Unnamed Tyler Forks Trib	at FR 703	9922449	19	6/28/2014	21	6/25/2013

* the temps for this date may better represent the MDM since there was a full day (24 hours) of sample time vs the calculated MDM of 18.2781 on 6/11/2014 which was the date on which the thermistor was deployed and was not a full day of sampling (deployment time of 1:45 pm)
NOTE: Devils Crk at HWY 77 was also a repeated site monitored in 2013 and 2014, however the thermistor was washed away and not retrieved at the end of the 2014 season.

Despite the late deployment dates, the 2014 data record from 13 monitoring sites (13 out of 16 sites total) likely captured the maximum daily mean temperatures and is useable for that purpose, with the above mentioned exclusions of the tributary to Vaughn (Edwards Creek) site and the two sites (Devils Creek at Hwy 77 and Vaughn Creek at Hwy 169) both which were washed away and not retrieved. It was evident that the thermistor at the tributary to Vaughn creek site may have washed up on shore upon two separate site visits indicating exposure to air for an unknown length of time, near a likely date in which daily maximum high temperatures may have occurred. Data from this site are too unreliable to be certain if the MDM was collected.

To summarize, 12 of the 16 original sites had at least four months of data collected, meeting the QAPP objective. Two of the four sites not deployed for four months only missed the minimum deployment period by two days, and thermistors from the two other sites were lost. After comparison of thermistor data, there is sufficient evidence that the maximum daily mean temperatures were captured for 13 of the 16 monitoring sites.

Maximum daily mean temperatures likely occurred in mid- July for most monitoring sites (9 out of 13), allowing data from 13 of the 16 sites to be usable for that purpose.

Thermistors – Comparability
TidbiT v2 thermistors were used at all sites. These models are frequently used by WDNR.

Thermistors – Completeness
Completeness equals the total number of thermistors deployed that are retrieved and produce usable MDMT data divided by the total number of thermistors deployed times 100 [((8 /8)* 100) = 100%]. The data quality objective for completeness as described in BRWA's QAAP should be >90%. The data quality objective was [((13/16)* 100) = 81.25%], and was subsequently not met.

Macroinvertebrates
Precision, Accuracy, and Bias
The multi-habitat method of collecting macroinvertebrates does not support quantitative precision, accuracy, or bias calculations. Instead, qualitative methods were used to assess these parameters.

To ensure accuracy and minimize bias, BRWA again worked with Dr. Kurt Schmude, Aquatic Entomologist with the University of Wisconsin-Superior Lake Superior Research Institute (LSRI) Taxonomy Laboratory. Dr. Schmude and his lab conducted all sample processing and analysis according to their established protocols (Appendix D of BRWA's QAPP). Field personnel were trained by a previous Project Manager (Valerie Damstra) in 2013 and reviewed the protocol prior to sampling in 2014. BRWA Project Managers received training in proportional, multi-habitat sampling techniques from Dr. Schmude prior to sampling conducted in fall 2011. Volunteers were either BRWA staff members or federal employees with biological field expertise with one exception who was trained by and assisted one of the federal employees.

Precision of the method was not assessed in 2014.

Representativeness
The multi-habitat sampling method, as outlined in the QAPP, is considered to allow a representative sample of the stream community as a whole. The method was followed for all samples.

Comparability
All samples were collected and analyzed using methods described in BRWA's QAPP for this project. Dr. Kurt Schmude also analyzes macroinvertebrate samples for WDNR projects.

Completeness
BRWA identified 10 sites for sampling in 2014. Complete samples were collected at eight sites and analyzed according to data quality objectives established in the QAPP. Data quality objective of 100% Completeness was not met.

Conductivity
Conductivity was measured and reported by BRWA as specific conductance. Use of the word "conductivity" refers to measurements of specific conductance in this report.

Accuracy
Calibration (Table 5) – Both HI98129 instruments were calibrated successfully prior to each field day. The data quality objective was met.

Calibration Checks (Table 5) – Calibration checks were conducted at the beginning (pre-sampling) and end (post-sampling) of each field day except one. On 9/20/2014 the instruments were not checked against a low

Table 5. Specific conductance calibration and calibration check results for BRWA 2014 monitoring season. 'RPD' = Relative percent Difference.

Probe #	Date	Cal. Sol'n (µS/cm)	Calib or Check?	Pre/Post Check	Spec. Cond. (µS/cm)	RPD	Calib Success?	Check Success?
1	7/1		Calib	Pre			Y	
1	7/1	74	Check	Pre	76	2.80		Y
1	7/1	1413	Check	Post	1334	5.75		Y
1	7/1	DIW	Check	Post	0			Y
2	7/1		Calib				Y	
2	7/1	74	Check	Pre	77	4.11		Y
2	7/1	74	Check	Post	76	2.80		Y
2	7/1	Air=0	Check	Pre	0			Y
1	7/23		Calib				Y	
1	7/23	74	Check	Pre	77	4.11		Y
1	7/23	1413	Check	Post	1347	4.78		Y
1	7/23	Air=0	Check	Pre				Y
2	7/23		Calib				Y	
2	7/23	74	Check	Pre	77	4.11		Y
2	7/23	74	Check	Post	76	2.80		Y
2	7/23	Air=0	Check	Pre	1			Y
1	8/16		Calib				Y	
1	8/16	74	Check	Pre	82	10.39		N
1	8/16	1413	Check	Post	1388	1.79		Y
1	8/16	Air=0	Check	Pre		0.00		Y
1	8/16	Air=0	Check	Post		0.00		Y
2	8/16		Calib				Y	
2	8/16	74	Check	Pre	77	4.11		Y
2	8/16	74	Check	Post	75	1.48		Y
2	8/16	Air=0	Check	Pre	0			Y
1	9/20		Calib				Y	
1	9/20	1413	Check	Post	1392	1.50		Y
1	9/20	Air=0	Check	Pre	0			Y
2	9/20		Calib				Y	
2	9/20	1413	Check	Post	1374	2.80		Y
2	9/20	Air=0	Check	Pre	0			Y
1	10/22		Calib				Y	
1	10/22	74	Check	Pre	80	7.93		Y
1	10/22	1413	Check	Post	1389	1.71		Y
1	10/22	Air=0	Check	Pre	0			Y
2	10/22		Calib				Y	
2	10/22	74	Check	Pre	78	5.40		Y
2	10/22	74	Check	Post	76	2.80		Y
2	10/22	Air=0	Check	Pre	0			Y

conductivity standard prior to the field day. End of day calibration checks were conducted on 9/20/2014 as usual. All calibration checks were within the QAPP guideline for relative percent difference (within 10% of certified value) except one probe on 8/16. The RPD for this check was 10.39%. Checks with deionized water were not conducted consistently; checks in air were conducted at the beginning of each field day. The data quality objective was not met due to lack of checking against deionized water. However, all calibration checks against certified standards and in air were successful, meeting that portion of the data quality objective.

Bias

Blank samples (deionized water) were not conducted, so the data quality objective was not met. Measurements in air were 0 (zero) µS/cm except for one measurement of 1µS/cm.

The same instrument was used at each site throughout the season, that is, the instruments were not swapped between sites. However, comparability was not assessed with side-by-side measurements in the field.

Representativeness

Five conductivity (specific conductance) measurements were taken at each site during the 2014 field season between July and November. These data are not adequate to represent the full range of variability at these sites, but they are useful for comparing conductivity among sites.

Precision

Duplicate conductivity measurements were not conducted in 2014. The data quality objective was not met.

Alternative Measurement Sensitivity (AMS) evaluations were not conducted in 2014. The data quality objective was not met.

Completeness

Conductivity was not measured during the first sampling day (6/3/2014) when samples were collected for total phosphorus because the instruments were not available. Measurements were taken at all 20 sites on 5 of 6 sampling events, for completeness of 83%.