



Upper Columbia Basin Network Integrated Water Quality Annual Report 2012

Big Hole National Battlefield (BIHO)

Natural Resource Technical Report NPS/UCBN/NRTR—2013/808



ON THE COVER

North Fork Big Hole River, June 2012, Big Hole National Battlefield
NPS Photo

Upper Columbia Basin Network Integrated Water Quality Annual Report 2012

Big Hole National Battlefield (BIHO)

Natural Resource Technical Report NPS/UCBN/NRTR—2013/808

Eric Starkey

Aquatic Biologist
Upper Columbia Basin Network Inventory and Monitoring Program
105 E. 2nd St.
Suite #7
Moscow, ID 83843

October 2013

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Technical Report Series is used to disseminate results of scientific studies in the physical, biological, and social sciences for both the advancement of science and the achievement of the National Park Service mission. The series provides contributors with a forum for displaying comprehensive data that are often deleted from journals because of page limitations.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available from the Upper Columbia Basin Network (<http://www.nature.nps.gov/im/units/ucbn/>) and the Natural Resource Publications Management website (<http://www.nature.nps.gov/publications/nrpm/>). To receive this report in a format optimized for screen readers, please email irma@nps.gov.

Please cite this publication as:

Starkey, E. N. 2013. Upper Columbia Basin Network integrated water quality annual report 2012: Big Hole National Battlefield (BIHO). Natural Resource Technical Report NPS/UCBN/NRTR—2013/808. National Park Service, Fort Collins, Colorado.

Contents

	Page
Figures.....	vi
Tables.....	viii
Appendices.....	x
Executive Summary	xii
Acknowledgments.....	xv
Introduction and Background	1
Objectives	2
Study Area	5
North Fork Big Hole River- Big Hole National Battlefield (BIHO)	5
Methods.....	9
Water Chemistry	9
Quality Assurance/Quality Control (QA/QC):	9
Discharge	10
Macroinvertebrates	10
Results.....	11
North Fork Big Hole River	11
Water Chemistry:	11
Macroinvertebrates	28
Literature Cited	31

Figures

	Page
Figure 1. North Fork Big Hole River looking upstream towards water quality monitoring station #01.	6
Figure 2. Big Hole National Battlefield regional map	7
Figure 3. Water quality monitoring location in North Fork Big Hole River 2012.	8
Figure 4. BIHO- North Fork Big Hole River water quality monitoring station #001, August 2012.	11
Figure 5. BIHO- North Fork Big Hole River water quality monitoring station #001, October 2012.....	12
Figure 6. July 2012 cross section survey of North Fork Big Hole River, box plot of specific conductance and plot of 95% family-wise confidence level.	13
Figure 7. September 2012 cross section survey of North Fork Big Hole River, box plot of specific conductance and plot of 95% family-wise confidence level.	14
Figure 8. Daily maximum and mean temperature in North Fork Big Hole River, BIHO, 2012.....	18
Figure 9. Corrected daily mean specific conductance in North Fork Big Hole River, BIHO, 2012.....	19
Figure 10. Corrected daily minimum dissolved oxygen and daily maximum temperature in North Fork Big Hole River, BIHO, 2012.	23
Figure 11. Corrected daily maximum, minimum, and median pH in North Fork Big Hole River, BIHO, 2012.	25
Figure 12. Raw daily mean turbidity in North Fork Big Hole River, BIHO, 2012.	27

Tables

	Page
Table 1. Vital sign summary table for water chemistry in North Fork Big Hole River June-October, 2012	15
Table 2. Vital sign summary table for water chemistry in North Fork Big Hole River June-October, 2009.	16
Table 3. Data grade/rating for water temperature each deployment period June- October 2012 in North Fork Big Hole River, BIHO.	18
Table 4. Data grade/rating for specific conductance each deployment period June- October 2012 in North Fork Big Hole River, BIHO.	19
Table 5. Spawning times of fishes that may occur in the North Fork Big Hole River within BIHO.	21
Table 6. Data grade/rating for dissolved oxygen each deployment period June- October 2012 in North Fork Big Hole River, BIHO.	23
Table 7. Data grade/rating for pH each deployment period June-October 2012 in North Fork Big Hole River, BIHO.	25
Table 8. Data grade/rating for turbidity each deployment period June-October 2012 in North Fork Big Hole River, BIHO.	27
Table 9. Vital sign summary table for benthic macroinvertebrates in North Fork Big Hole River, 2012.	29

Appendices

	Page
Appendix A. 2012 Water Quality Monitoring Locations	35
Appendix B. BIHO Hydrologic Unit Code Boundaries	37
Appendix C. Sample Locations for Water Quality Monitoring at BIHO	39
Appendix D. Quality Control (QC) Indicators	41
Appendix E. Corrections History.....	43
Appendix F. Macroinvertebrate Metrics.....	47
Appendix G. Macroinvertebrate Taxa List	55

Executive Summary

The mission of the National Park Service is “to conserve unimpaired the natural and cultural resources and values of the national park system for the enjoyment of this and future generations” (NPS 1999). To uphold this goal, the Director of the NPS approved the Natural Resource Challenge to encourage national parks to focus on the preservation of the nation’s natural heritage through science, natural resource inventories, and expanded resource monitoring (NPS 1999). Through the Challenge, 270 parks in the national park system were organized into 32 inventory and monitoring networks. The Upper Columbia Basin Network (UCBN) is comprised of 8 national park sites located in Idaho, Montana, Oregon, and Washington.

The UCBN has identified 14 priority park vital signs, indicators of ecosystem health, which represent a broad suite of ecological phenomena operating across multiple temporal and spatial scales. The intent of the network is to monitor a balanced and integrated “package” of vital signs that meets the needs of current park management, but will also be able to accommodate unanticipated environmental conditions in the future. Water quality is a particularly high priority vital sign for six of the nine UCBN parks. The UCBN contains more than 34 rivers, streams, ponds, and reservoirs. Unlike many National Parks that are large and often encompass entire watersheds, most UCBN parks and water bodies are small and embedded in large watersheds with diverse land use.

This annual report details the status of key indicators of water quality obtained from monitoring in Big Hole National Battlefield (BIHO), June-October 2012. North Fork Big Hole River was previously sampled by the UCBN in 2009 (see Starkey 2010). Data from the 2012 field sampling effort was collected following methods detailed in the UCBN integrated water quality monitoring protocol (Starkey et al. 2008). The UCBN Integrated Water Quality Monitoring Protocol was formally peer-reviewed and approved for implementation in August 2009. This protocol can be found on the UCBN website at: <http://science.nature.nps.gov/im/units/ucbn/>. Benthic macroinvertebrates were collected by the United States Forest Service-PACFISH/INFISH Biological Opinion (PIBO) according to their peer reviewed protocol during the UCBN’s monitoring of stream channel characteristics and riparian condition in 2012. The UCBN’s peer reviewed stream channel characteristics and riparian condition protocols can also be found on the UCBN’s website listed above.

Water chemistry and macroinvertebrate results indicate that the North Fork Big Hole River is in fair to good condition, with the primary concerns being dissolved oxygen levels below established thresholds and elevated water temperatures. The status of water quality for North Fork Big Hole River relative to state regulatory thresholds is given in the summary table on the following page. UCBN water quality monitoring is conducted on a 3 year rotating panel. As a result, conditions in North Fork Big Hole River will be re-evaluated in 2015.

Note that several of the appendices in this report are primarily intended for UCBN internal reference. In addition, some appendices serve as hard copies of quality assurance/quality control procedures performed during data processing.

North Fork Big Hole River Water Chemistry Summary 2012

Measure	Current Condition (June-October, 2012)	State DEQ Thresholds a	% Exceedance c
Temperature (*MDMT, **MDAT)	* MDMT= 18.78 °C ** MDAT= 17.24 °C	"A 1 °F [0.56 °C] maximum increase above naturally occurring water temperature is allowed"	--
		<18 °C threshold to protect against stress or lethal conditions for arctic grayling ^b	1.2%
Specific conductance (mean)	57.8 µS/cm	N/A	N/A
Dissolved oxygen (mean daily min)	6.38 mg/l	Daily minimum > 8.0 mg/L; 7-d mean > 9.5 mg/L (Early life stage- applicable 16 July to 30 Sept.)	100% 100%
		1-day minimum >4.0 mg/L; 7-d mean minimum > 5.0 mg/L; 30 day mean >6.5 mg/L (Other life stages applicable to data collected 20 June to 15 July and 1 Oct. to 17 Oct.)	0% 0% 0%
pH (mean daily max)	7.30 pH Units	6.5-8.5; < 0.5 unit human induced change; Maintain >7.0 if naturally > 7.0	0%
pH (mean daily min)	7.15 pH Units		0%
Turbidity (mean daily max)	2.46NTU ^d	"No increase above natural turbidity is allowed"	--

*MDMT – Maximum Daily Maximum Temperature, **MDAT – Maximum Daily Average Temperature, ^a MT DEQ water quality standards for North Fork Big Hole River planning area, ^b BIHO preferred temperature threshold, ^c Proportion of samples above water quality standard ^d Excludes data rated as "unuseable"; see results section for explanation.

0-5% exceedance	
5-25% exceedance	
>25% exceedance	

Acknowledgments

Funding for this project was provided through the National Park Service Natural Resource Challenge and the Servicewide Inventory and Monitoring Program. The UCBN would also like to thank BIHO staff for their assistance in the field, accommodations during field work, and for the review of this report.

Introduction and Background

Water resources have been identified as a high priority vital sign for the Upper Columbia Basin Network (UCBN). These resources are used by many riparian, migratory, and terrestrial organisms in the Network, and have intrinsic value as places of natural beauty and recreation (Garrett et al. 2007). Reflecting this priority, the Water Resources Division (WRD) of the NPS provides a separate source of funding each fiscal year to the UCBN to accomplish water quality monitoring. In June 2012 the UCBN began its second year of integrated water quality monitoring in the North Fork Big Hole River at Big Hole National Battlefield (BIHO).

Water resources in the semi-arid West have been strongly affected by human activity, and many UCBN streams and rivers are listed by states as impaired for one or more parameters. Most UCBN water bodies and many aquatic resources such as migratory fish are strongly influenced by activities in the larger watersheds outside park boundaries. Understanding the current status of freshwater ecosystems will help guide management and restoration efforts, and provide insight into ecosystem change in a landscape with a shifting climate and dynamic human influences.

During the process of prioritizing vital signs to monitor in UCBN parks in 2005, water quality was identified as a high priority vital sign (Garrett et al. 2007). When asked what aspects of water quality were important to monitor, resource managers identified the sampling of macroinvertebrate assemblages within UCBN water bodies as the top water quality monitoring priority. Secondary priorities included baseline sampling of water chemistry parameters, characterization of channel morphology, and information on water quantity. Channel morphology and riparian vegetation are addressed in separate monitoring protocols which were also implemented at BIHO in 2012.

The objectives of the UCBN Integrated Water Quality Monitoring Protocol are documenting the aquatic macroinvertebrate assemblage composition and baseline water chemistry parameters. Aquatic macroinvertebrate assemblages have strong effects on freshwater ecosystem processes and represent an important trophic linkage between primary producers and fishes. Measures of macroinvertebrate assemblage composition and structure have been frequently used as water quality indicators because these assemblages integrate the effects of point and non-point source pollutants over spatial-temporal scales and can be used to answer many management questions. Also, macroinvertebrates are more cost-effective to sample than other biota or many water chemistry parameters.

Water chemistry and temperature have strong effects on aquatic biota. Consequently, direct and indirect human alteration of stream water quality is associated with altered biotic communities and ecosystem processes. Because of the direct relationship between water chemistry and biota, water chemistry is typically a central component of any water quality monitoring program. More recently, monitoring of stream water temperatures has increased in the Pacific Northwest, because of concerns over cold-water fish habitat (primarily salmonid fishes), the recognized

influence of land- and water-use on stream temperature regime, and the need for baseline temperature information to monitor the effects of climate change. National Park Service (NPS) Water Resource Division (WRD) has identified a suite of four “core water quality parameters”: temperature, specific conductance, pH, and dissolved oxygen, which are critical to understanding baseline conditions in aquatic habitats. The UCBN added turbidity as a parameter to measure because turbidity is listed as a source of impairment in several UCBN park streams.

Well articulated desired future condition statements have not yet been developed for water quality in UCBN parks. However, the mission statements for the NPS as a whole and for the individual parks clearly state the intent “to conserve unimpaired the natural and cultural resources and values of the national park system for the enjoyment of this and future generations” (NPS 1999). Water quality is a particularly important resource with nationally recognized merit. It is assumed that desired future conditions for all UCBN parks will include clean streams, rivers, and lakes free of human health concerns that provide visitors with recreational and scenic experiences. Monitoring macroinvertebrate assemblage composition and structure, and core water quality parameters will directly measure the water characteristics most important to park mission, visitor experience, and desired future conditions.

Objectives

The overarching programmatic goal of the UCBN integrated water quality monitoring program is to obtain information that will aid in informed management decisions pertaining to improved water quality within UCBN parks. Park managers have committed to improving the water quality of impaired waters by adopting the NPS Government Performance Results Act (GPRA) goal (Ia4) that streams and rivers managed by NPS will meet State and Federal water quality standards (NPS 2000).

Given this goal, it should be noted that in 2010 and 2012 the North Fork Big Hole River was listed as a category 4A water due to partial support of the aquatic life and primary contact recreation beneficial uses. In addition, in 2010 the North Fork Big Hole River was also listed as partially supporting the cold water fishery use. A category 4A water means that the stream has a pollution problem, but has total maximum daily loads (TMDL) being actively implemented to remedy issues. In 2006 and 2008 the North Fork Big Hole River was listed as a category 5 stream meaning that one or more uses were impaired and required a TMDL. Uses partially supported in 2006 and 2008 were; aquatic life, cold water fishery, and primary contact recreation. Probable causes of impairment are discussed in the study area section below.

Given the lack of available data on water quality in UCBN parks, the following fundamental questions drive much of the UCBN’s inquiry into water quality:

- Are the core water quality parameters of streams in the UCBN with established Total Maximum Daily Loads (TMDLs) selected for sampling improving over time?
- What is the status and long-term trend of core water quality parameters (temperature, pH, conductivity, dissolved oxygen, and turbidity) in UCBN streams selected for sampling?

- What is the status and long term trend in aquatic macroinvertebrate abundance and assemblage composition in selected UCBN streams?
- Do aquatic macroinvertebrate assemblages sampled within UCBN streams indicate polluted or otherwise impaired water quality?
- Do aquatic macroinvertebrate assemblages sampled within UCBN streams indicate “pristine” or “reference” conditions according to regional criteria established by the Environmental Protection Agency (EPA) and the states of Idaho, Oregon, Montana, and Washington?

In light of these questions and the broader goals outlined above, water quality monitoring in the UCBN addresses the following specific measurable monitoring objectives:

- Determine status and long term trend in key water quality parameters for selected streams within UCBN park units.
- Determine status and trend in aquatic macroinvertebrate abundance, assemblage composition, and functional feeding group composition in wadeable streams within the UCBN.

Study Area

North Fork Big Hole River- Big Hole National Battlefield (BIHO)

Big Hole National Battlefield is in the North Fork Big Hole River subwatershed, in Hydrologic Unit Code (HUC 12) 100200040509 (United States Geologic Survey [USGS]), Big Hole subbasin (HUC 8) 1002004, in Beaverhead County, Montana (Figures 1 and 2 Appendix B). The drainage area above the park is approximately 241 square km (150 square miles) (NPS 1997). According to Corrao and Erixson 2011, the Big Hole watershed is dominated by the following cover types: closed tree canopy (44%), herbaceous-grassland/shrub-steppe (23%), open tree canopy (17%), and shrubland (15%).

North Fork Big Hole River is classified as an A-1 surface water (Admin. Rules of MT 2012, 17.30.610 [through 3/31/2006]). As such, designated beneficial uses for North Fork Big Hole River include: agricultural, aquatic life, cold water fisheries, drinking water, industrial, and primary contact recreation (MT DEQ 2009, Admin. Rules of MT 2012, 17.30.622 [through 3/31/2006]). In 2006, the North Fork Big Hole River was identified as impaired and was placed on the 303(d) list (MT DEQ 2006). Probable causes of impairment included: “sediment-related listings (siltation, suspended solids, turbidity, bank erosion), metals (cadmium, copper, lead, mercury, and zinc), thermal modification, nutrients, riparian and fish habitat degradation, habitat alteration, habitat modification, channel incisement, and flow alteration (dewatering)” (MT DEQ 2009). Since that time, MT DEQ has developed total maximum daily loads (TMDLs) that address temperature, sediment, nutrients, and metal pollution (see MT DEQ 2009). In 2012, North Fork Big Hole River was listed as a category 4A water, meaning that it has a pollution problem, but has total maximum daily loads (TMDL) being actively implemented to reduce pollution (MT DEQ 2012). The causes of impairment are listed as alteration in stream-side or littoral vegetative covers, low flow alterations, and sedimentation/siltation.

Additional information about water quality in North Fork Big Hole River can be found in Natural Resource Condition Assessment: Big Hole and Bear Paw National Battlefields of the Nez Perce National Historical Park (Corrao and Erixson 2011) and Upper Big Hole River Watershed Assessment Report (BLM 2009).

The continuous water quality data logger (Hydrolab) was deployed within the park, approximately 100 meters upstream from the bridge over the North Fork Big Hole River and 40m west of the lower parking lot. This location was chosen due to logistical considerations and adequate water depth (Figures 1-3 and Appendix A). In addition, the Hydrolab deployment location was chosen to avoid placement of equipment near the culturally significant encampment area. The macroinvertebrate sample reaches coincide with the stream channel characteristics and riparian condition monitoring reaches (see Appendix C for GPS waypoints).



Figure 1. North Fork Big Hole River looking upstream towards water quality monitoring station #01.

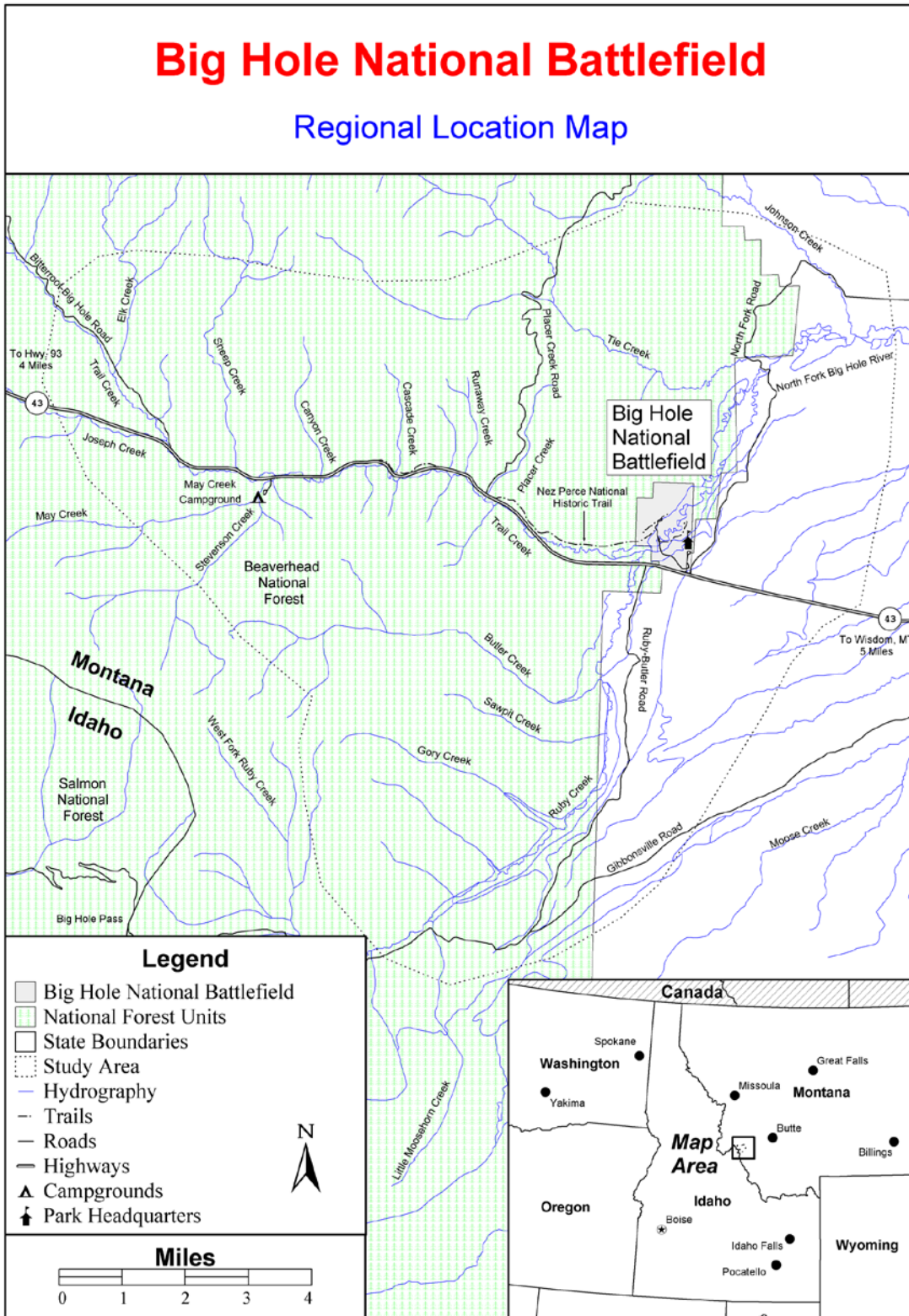


Figure 2. Big Hole National Battlefield regional map (NPS 1997).

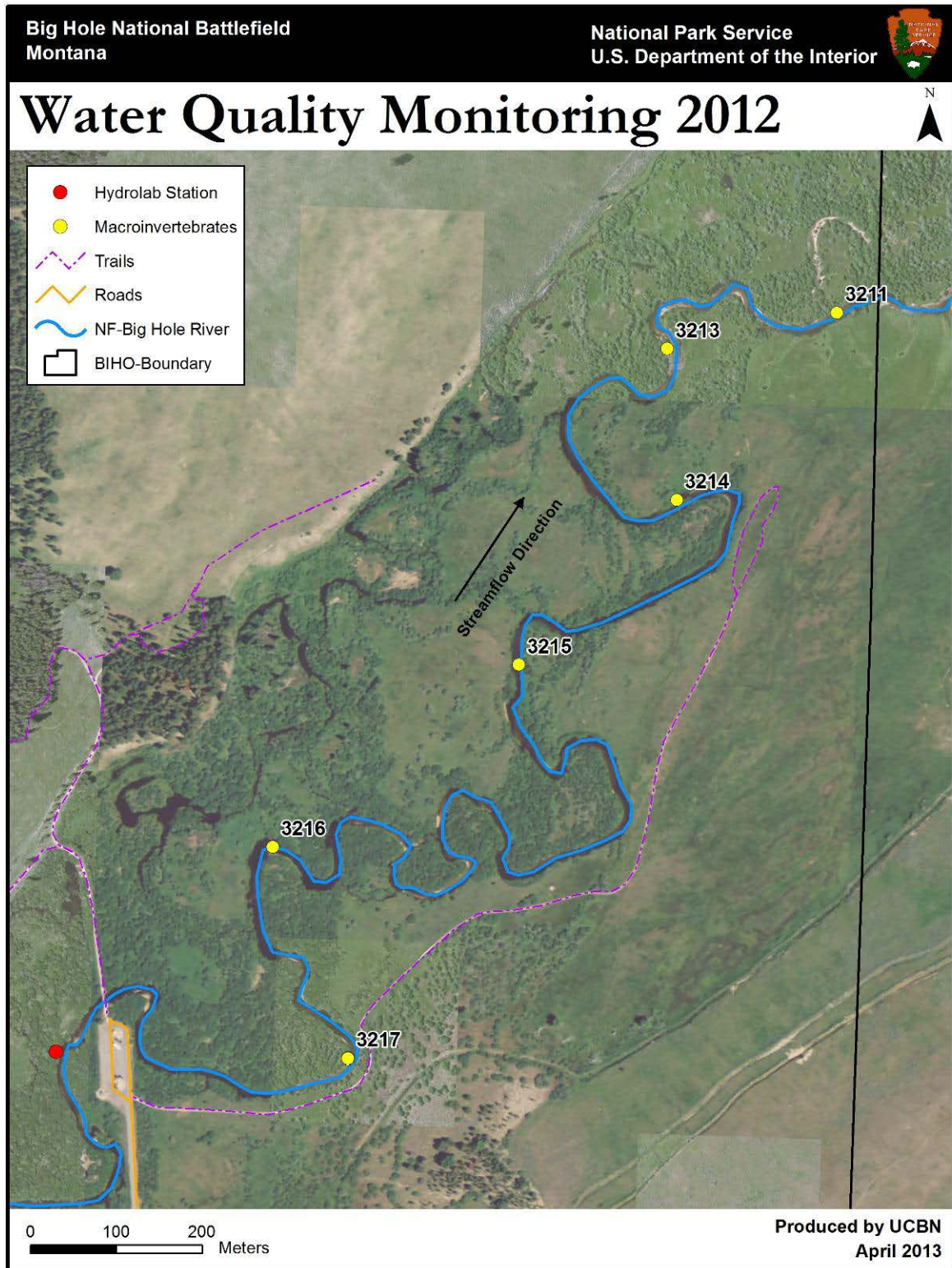


Figure 3. Water quality monitoring location in North Fork Big Hole River 2012. Macroinvertebrate sample locations correspond with UCBN stream channel characteristics and riparian condition monitoring sites 3211-3217.

Methods

Water Chemistry

A continuous water quality monitor (HACH, MS5 Hydrolab) was deployed from June 20th to October 16th in North Fork Big Hole River at an index site to estimate the status, variability, and long-term trends in core parameters. The core parameters measured were water temperature, dissolved oxygen, pH, specific conductance, and turbidity. These core parameters were measured hourly and the instrument serviced monthly throughout the deployment period. The monitor was deployed in the same location as in 2009. This location (station # 01) was relatively representative of conditions in the park, logistically feasible to access, and secure from vandalism and high flows. A cross-section survey was conducted to aid in the determination of Hydrolab site selection. For more information on the UCBN water chemistry sampling design see Starkey et al. (2008). Note that between July 25th and August 27th monitoring occurred using Hydrolab #054, monitoring prior to and following these dates occurred with Hydrolab #064. Hydrolab #054 was used for one month because #064 was sent to the Hach Company for repair of the dissolved oxygen sensor. This instrument was re-installed on August 27th.

Quality Assurance/Quality Control (QA/QC):

Quality assurance and quality control for continuous water quality monitor data collection are covered in detail in SOP #12 (Starkey et al. 2008). Basic procedures adhere to the guidelines established in Part B lite (Irwin 2008); the National Coastal Assessment Quality Assurance Project Plan 2001-2004 (U.S. EPA 2001); the Laboratory Methods Manual-Estuarines, Volume 1: Biological and Physical Analyses (U.S. EPA 1995); and Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers (Barbour et al. 1999).

General quality assurance and quality control methods for UCBN water quality multiprobe calibration and data downloads include the following:

- Representative multiprobe sample locations are determined by using a cross-section and stream segment survey. Each site is re-assessed for representativeness at the start and end each sample year.
- The UCBN follows pre-established maximum acceptable differences for field instrument calibration and QC checks. If the multiprobe readings are outside of the maximum acceptable differences, the multiprobe is removed for non-routine maintenance.
- When calibrating the multiprobe, values of known standard solutions are measured pre and post calibration, to help determine if the instrument's measurements have "drifted." In addition, repeated measures of these solutions are used to determine the repeatability of multiprobe measures.

- All multiprobe data is visually checked for outliers and QC issues immediately following the download of data. QC issues indicated by the data may include: wiper parking, defective sensors, power supply problems, and other anomalies affecting data quality.
- Quantitative and qualitative terms that describe how accurate data need to be in order to meet project objectives are discussed in detail in SOP #12 Starkey et al. 2008 and Appendix D in this report. NPS WRD lists the following data quality objectives as necessary for water chemistry data: target population, representativeness, completeness, data comparability, measurement sensitivity and detection limits, measurement precision as repeatability, and measurement systematic error/bias.

More detailed QA/QC for water quality multiprobes is contained in SOP #6 and 12, Starkey et al. 2008.

Discharge

No USGS gaging station exists on the North Fork Big Hole River or its tributaries. The closest gage is on the Big Hole River near Wisdom MT (USGS 06024540 Big Hole River bl Mudd Cr nr Wisdom MT) and is marginally useful for determining flow in north fork. As a result, no discharge data or results are presented in this report.

Macroinvertebrates

Macroinvertebrates were collected at 6 designated sample reaches by the United States Forest Service- PACFISH/INFISH Biological Opinion (PIBO) Effectiveness Monitoring Program during the assessment of stream channel characteristics. This assessment was completed as part of the UCBN stream channel characteristics monitoring protocol. Macroinvertebrates were collected from 8 fast water habitats (riffles, runs) in each sample reach. These 8 samples were combined for a single composite sample per reach. For more information on the PIBO macroinvertebrate sampling design, see Heitke et al. (2008).

Results

North Fork Big Hole River

Water Chemistry:

Cross Section Survey:

A cross section survey was conducted at the proposed multiprobe deployment location to evaluate if the site was reasonably representative of stream conditions throughout the park. As suggested by the water resource division the UCBN judges overall representativeness primarily on the basis of specific conductance (Starkey et al. 2008).

The 2012 deployment location provided adequate water depth throughout the field season, was easily accessible, and was away from heavily trafficked access points. In addition, this monitoring location was the same as in 2009. Despite being the same location as in 2009, several important changes occurred to the site just prior to and during the 2012 field season. In June 2012 a series of small beaver dams near the confluence of Trail and Ruby Creeks created a pond near the deployment location. Overflow from the pond re-entered the North Fork Big Hole River approximately 2 meters downstream of the deployment location. As the monitoring season progressed, the complex of beaver dams grew and discharge from the pond into the river increased (Figures 4 and 5). The water entering the stream flowed into the same pool as the deployment location and began to form an eddy back towards the monitoring station.



Figure 4. BIHO- North Fork Big Hole River water quality monitoring station #001, August 2012. The red arrow indicates the location and direction of inflow from the beaver pond.



Figure 5. BIHO- North Fork Big Hole River water quality monitoring station #001, October 2012. The red arrow indicates the location and direction of inflow from the beaver pond. Note increased discharge from beaver pond relative to August (Figure 4).

A one way analysis of variance (ANOVA) test was conducted to evaluate representativeness (R v2.12.0). Results of the ANOVA showed that there was a significant difference for specific conductance among the transects and the deployment location in July $F(4,43)=125.95$, $p < 0.05$ and in September $F(4,43)= 10.14$, $p < 0.05$.

To determine where the difference in representativeness occurred, a post hoc Tukey's test was conducted (R v2.12.0). Relative to specific conductance, results of the Tukey's test for the cross section conducted in July indicates that the deployment location was significantly different from transects 1, 2, 3, and 4 (Figure 6). Results of the Tukey's test for the cross section conducted in September also indicates that the deployment location was significantly different from transects 1, 2, 3, and 4 (Figure 7).

Both cross section surveys indicate the monitoring station may not have been as representative of conditions downstream as desired. Factors leading to this difference are likely related to the influence of water entering the stream from the beaver ponds. Data supports that water from the beaver pond and stream did not adequately mix until downstream of the deployment location (i.e. no difference amongst downstream transects).

In 2015, when water quality monitoring at BIHO is repeated, this location should be closely evaluated to determine if it remains the best option for long term deployment or if the station should be moved.

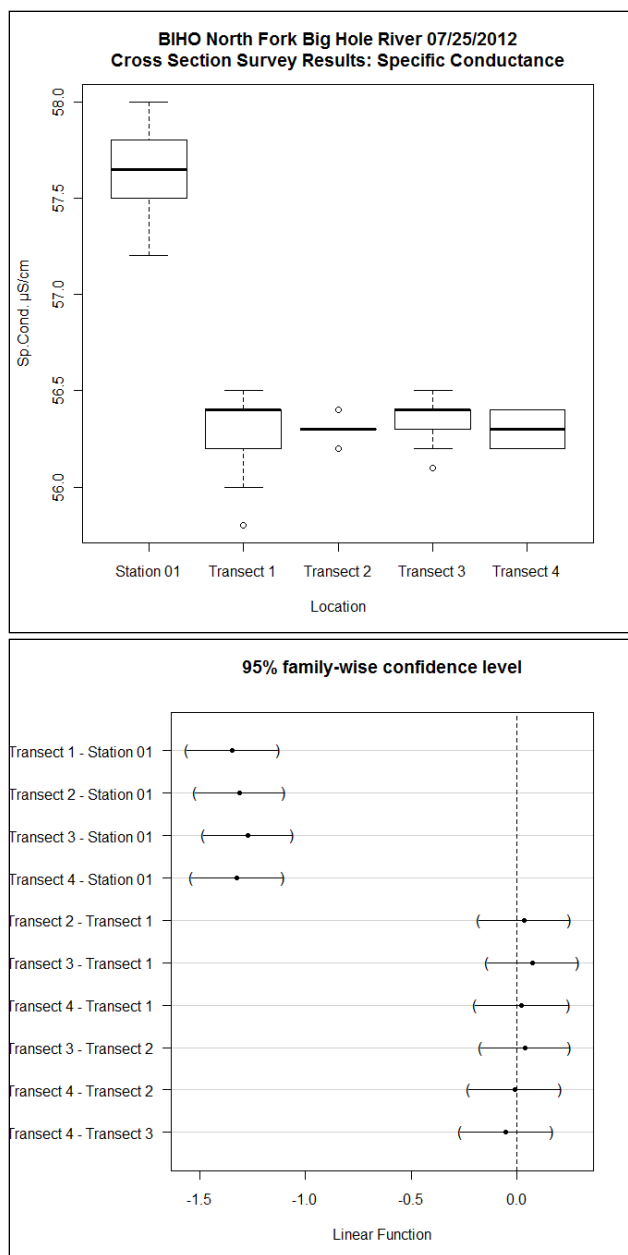


Figure 6. July 2012 cross section survey of North Fork Big Hole River, box plot of specific conductance and plot of 95% family-wise confidence level.
 Note that “Station 01” is the location of multiprobe deployment and transects progress downstream (1-4).

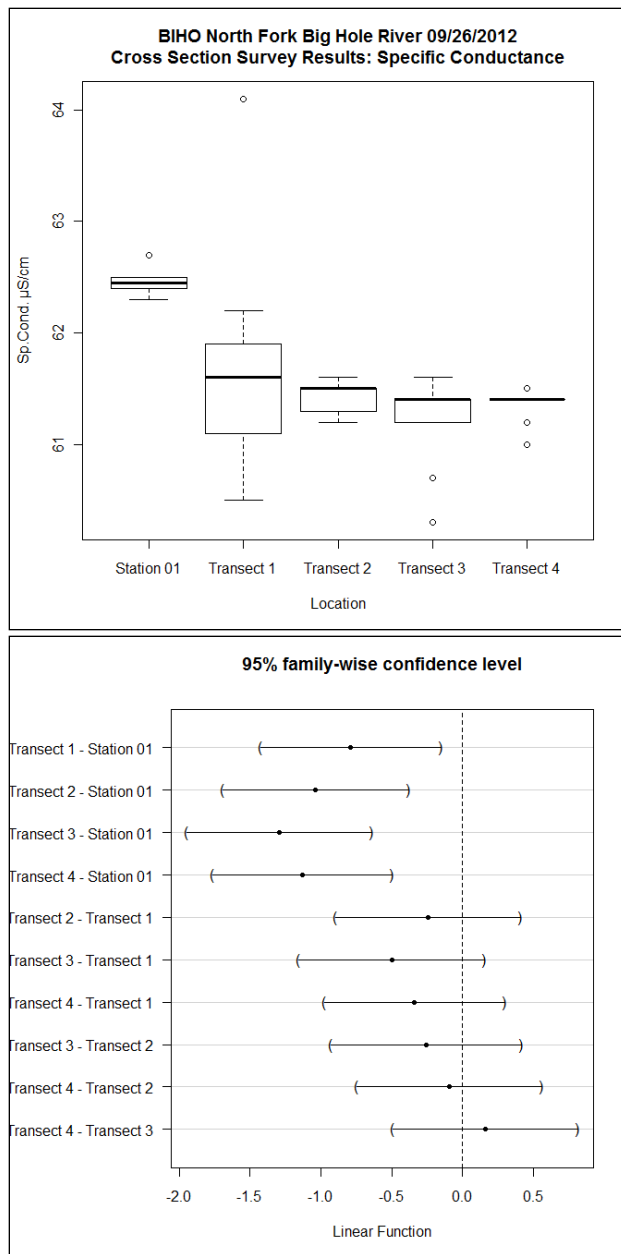


Figure 7. September 2012 cross section survey of North Fork Big Hole River, box plot of specific conductance and plot of 95% family-wise confidence level.
 Note that “Station 01” is the location of multiprobe deployment and transects progress downstream (1-4).

Status:

Condition of core water quality parameters along with the corresponding Montana DEQ regulatory threshold are given in Table 1. For comparison, the condition of core water quality parameters as observed in 2009 are given in Table 2. The primary concerns are low dissolved oxygen concentrations and elevated water temperatures and their effects on native cold water biota. Each parameter is discussed in further detail below.

Table 1. Vital sign summary table for water chemistry in North Fork Big Hole River June-October, 2012

North Fork Big Hole River Water Chemistry Summary 2012

Measure	Current Condition (June-October, 2012)	State DEQ Thresholds ^a	% Exceedance ^c
Temperature (*MDMT, **MDAT)	* MDMT= 18.78 °C ** MDAT= 17.24 °C	"A 1 °F [0.56 °C] maximum increase above naturally occurring water temperature is allowed"	--
		<18 °C threshold to protect against stress or lethal conditions for arctic grayling ^b	1.2%
Specific conductance (mean)	57.8 µS/cm	N/A	N/A
Dissolved oxygen (mean daily min)	6.38 mg/l	Daily minimum > 8.0 mg/L; 7-d mean > 9.5 mg/L (Early life stage- applicable 16 July to 30 Sept.)	100% 100%
		1-day minimum >4.0 mg/L; 7-d mean minimum > 5.0 mg/L; 30 day mean >6.5 mg/L (Other life stages applicable to data collected 20 June to 15 July and 1 Oct. to 17 Oct.)	0% 0% 0%
pH (mean daily max)	7.30 pH Units	6.5-8.5; < 0.5 unit human induced change; Maintain >7.0 if naturally > 7.0	0%
pH (mean daily min)	7.15 pH Units		0%
Turbidity (mean daily max)	2.46NTU ^d	"No increase above natural turbidity is allowed"	--

*MDMT – Maximum Daily Maximum Temperature, **MDAT – Maximum Daily Average Temperature, ^a MT DEQ water quality standards for North Fork Big Hole River planning area, ^b BIHO preferred temperature threshold, ^c Proportion of samples above water quality standard ^d Excludes data rated as "unuseable", see below for explanation.

0-5% exceedance	
5-25% exceedance	
>25% exceedance	

Table 2. Vital sign summary table for water chemistry in North Fork Big Hole River June-October, 2009.

North Fork Big Hole River Water Chemistry Summary 2009

Measure	Current Condition (June-October, 2012)	State DEQ Thresholds ^a	% Exceedance ^c
Temperature (*MDMT, **MDAT)	* MDMT= 19.06 °C ** MDAT= 17.10 °C	"A 1 °F [0.56 °C] maximum increase above naturally occurring water temperature is allowed"	--
		<18 °C threshold to protect against stress or lethal conditions for arctic grayling ^b	0.6%
Specific conductance (mean)	54.5 µS/cm	N/A	N/A
Dissolved oxygen (mean daily min)	7.34 mg/l ^d	Daily minimum > 8.0 mg/L; 7-d mean > 9.5 mg/L (Early life stage- applicable 16 July to 30 Sept.)	98.7% 100%
		1-day minimum >4.0 mg/L; 7-d mean minimum > 5.0 mg/L; 30 day mean >6.5 mg/L (Other life stages applicable to data collected 20 June to 15 July and 1 Oct. to 17 Oct.)	0% 0% 0%
pH (mean daily max)	7.37 pH Units	6.5-8.5; < 0.5 unit human induced change; Maintain >7.0 if naturally > 7.0	0%
pH (mean daily min)	7.14 pH Units		0%
Turbidity (mean daily max)	18.8 NTU ^e	"No increase above natural turbidity is allowed"	--

*MDMT – Maximum Daily Maximum Temperature, **MDAT – Maximum Daily Average Temperature , ^a MT DEQ water quality standards for North Fork Big Hole River planning area, ^b BIHO preferred temperature threshold, ^c Proportion of samples above water quality standard ^d Revised mean daily min from 2009 BIHO annual report (7.37mg/l) ^e Excludes data rated as "unuseable".

- *Temperature:*

The maximum daily maximum temperature (MDMT) was 18.78 °C and the maximum daily average temperature (MDAT) was 17.24 °C. The 18 °C threshold to protect against stress or lethal conditions for arctic grayling (see MT DEQ 2009) was exceeded in 1.2% of observations. In 2009, exceedance was 0.6% of observations. Figure 8 shows the daily maximum and mean daily temperatures in North Fork Big Hole River from June-October 2012. Table 3 lists the data rating/grade for each deployment period (monthly interval). These standard USGS ratings are based on the degree of sensor fouling and drift encountered during each deployment period (Wagner et al. 2006; Starkey et al. 2008). Data ratings less than "excellent" were due to a combination of sensor fouling and effect of environmental change during evaluation of fouling. Corrections that have been applied to the temperature data are listed in Appendix E.

While 18 °C is not a state regulatory threshold, the park has opted to use it as a benchmark to gauge resource condition and because “this temperature has the potential to physiologically impact [fluvial arctic] grayling (*Thymallus arcticus*) in a short time frame” and temperatures <18 °C “protect against extreme physiological stress or lethal conditions” (MT DEQ 2009).

“Arctic grayling is a freshwater fish in the same family (Salmonidae) as salmon, trout, and whitefish. A distinctive morphological characteristic of this fish is its large, sail-like dorsal fin. Arctic grayling is an obligate cool- or cold-water species. Individual fish can range widely, moving tens of miles on a seasonal or annual basis between spawning, rearing, and sheltering habitats”

(<http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=E03Q> Accessed 12/14/2012). While the most recent observations of grayling in the North Fork Big Hole River are near its confluence with the Big Hole River, BIHO would like to maintain favorable temperatures for this species (Rens and Magee 2007, Magee and McCullough 2008, Cayer et al. 2010, USFWS 75 FR 54708 54753). Arctic grayling populations in Montana are currently considered a candidate for listing as an endangered species (see USFWS 75 FR 54708 54753 and http://ecos.fws.gov/docs/candidate/assessments/2013/r6/E03Q_V01.pdf Accessed 12/14/2012). However, listing has been precluded due the need to complete other listing priorities.

Additional implications of elevated water temperatures may include decreased salmonid recruitment, decreased salmonid health, and potential shifts in fish and benthic macroinvertebrate communities (Vannote and Sweeney 1980; McCullough 1999). It is also important to note that elevated water temperatures have the capacity to reduce the total concentration of dissolved oxygen (i.e., there is an inverse relationship between water temperature and dissolved oxygen; Figure 10), thereby impacting aquatic biota.

Maintaining water temperatures suitable for naturally occurring species will depend on riparian, stream channel, and stream-flow conditions basin-wide. For this reason cooperation with other agencies, stakeholders, and adjacent landowners will be critical for improving water temperature.

For additional details about TMDLs specific to water temperature, see MT DEQ 2009.

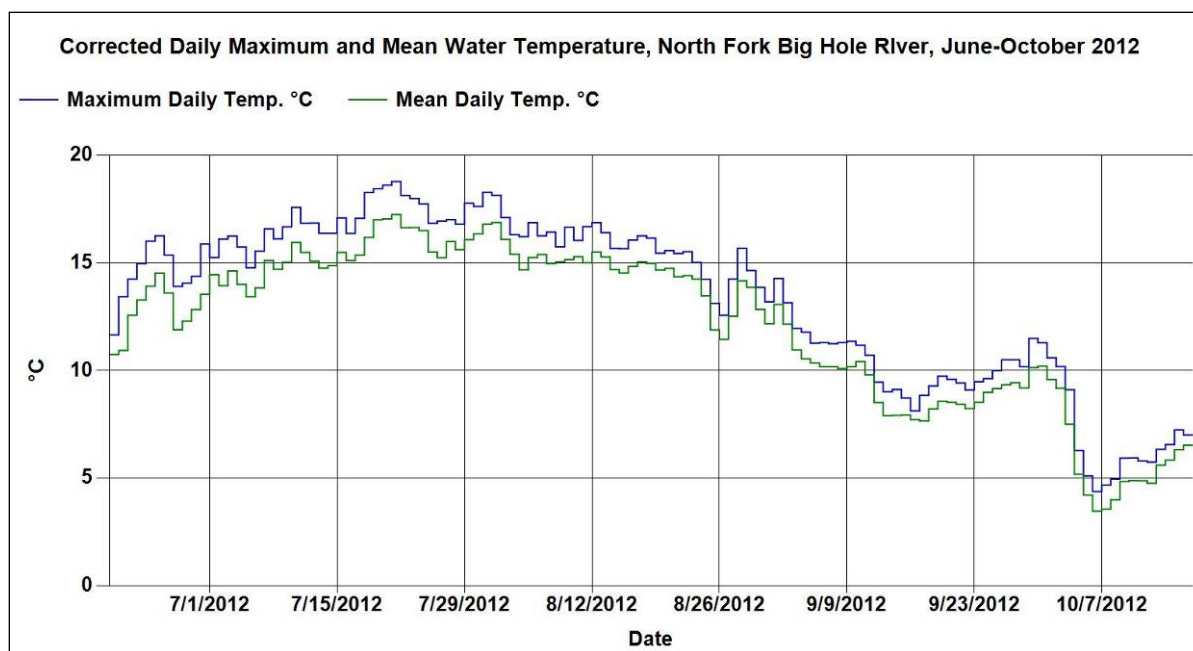


Figure 8. Daily maximum and mean temperature in North Fork Big Hole River, BIHO, 2012.

Table 3. Data grade/rating for water temperature each deployment period June-October 2012 in North Fork Big Hole River, BIHO.

Temperature Data Grade/Rating	From UTC-06:00	To UTC-06:00
GOOD	6/20/2012 13:00	7/25/2012 8:00
EXCELLENT	7/25/2012 19:00	8/27/2012 16:00
FAIR	8/27/2012 21:00	9/26/2012 8:00
EXCELLENT	9/26/2012 17:00	10/16/2012 15:00

- *Specific Conductance:*

Specific conductance ranged from 41.0 to 70.6 $\mu\text{S}/\text{cm}$, with an average specific conductance of 57.8 $\mu\text{S}/\text{cm}$. The steady increase in specific conductance shown in Figure 9 reflects decreased surface flow and subsequent drop in water level associated with evaporation throughout the summer. Table 4 shows the data rating/grade for each deployment period (monthly interval). These standard USGS ratings are based on the degree of sensor fouling and drift encountered during each deployment period (Wagner et al. 2006; Starkey et al. 2008). Corrections that have been applied to the specific conductance data are listed in Appendix E.

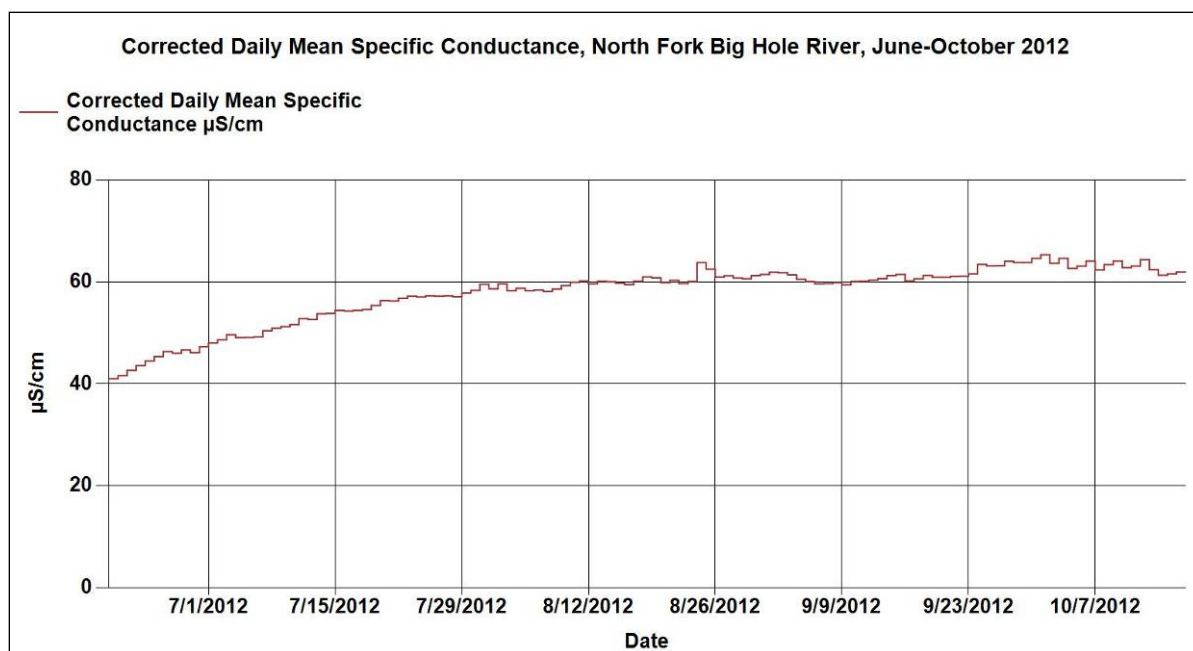


Figure 9. Corrected daily mean specific conductance in North Fork Big Hole River, BIHO, 2012.

Table 4. Data grade/rating for specific conductance each deployment period June-October 2012 in North Fork Big Hole River, BIHO.

Specific Conductance Data Grade/Rating	From UTC-06:00	To UTC-06:00
EXCELLENT	6/20/2012 13:00	7/25/2012 8:00
EXCELLENT	7/25/2012 19:00	8/27/2012 16:00
EXCELLENT	8/27/2012 21:00	9/26/2012 8:00
EXCELLENT	9/26/2012 17:00	10/16/2012 15:00

Dissolved Oxygen:

Prior to discussion about dissolved oxygen (DO) monitoring results, it is important to understand what and when DO standards are applicable to the North Fork Big Hole River. In the 2009 UCBN annual water quality monitoring report for BIHO (Starkey 2010), the UCBN used 8.0 mg/l as the benchmark standard for the entire monitoring season. Upon review of Montana water quality standards as stated in MT DEQ 2009 and 2010 the UCBN will now apply “early life stage” and “other life stage” DO standards as dictated by fish spawning times (Table 5). As such, the “early life stage” standard (daily minimum > 8.0 mg/L and 7-day mean > 9.5 mg/L) is applicable 16 July to 30 September. The “other life stage” standard (daily minimum >4.0 mg/L, 7-day mean minimum > 5.0 mg/L, 30-day mean >6.5 mg/L) is applicable to data collected 20 June to 15 July and 1 October to 17 October. The 2009 vital sign summary table has been updated accordingly and is provided in Table 2.

In 2012, mean daily minimum dissolved oxygen was 6.4 mg/L and dipped below the “early life stage” thresholds (daily minimum > 8.0 mg/L and 7-day mean > 9.5 mg/L) during 100% of observations between July 16th and September 30th. No “other life stage” exceedances occurred. In 2009, “Early life stage” exceedances were 98.7% (daily minimum > 8.0 mg/L) and 100% (7-day mean > 9.5 mg/L) and no “other life stages” exceedances occurred.

Low dissolved oxygen levels in North Fork Big Hole River may be having an impact on cold water fish development (early life stages) and recruitment. Maintaining dissolved oxygen levels suitable for cold water biota will depend on upland, riparian, stream channel, and stream-flow conditions basin-wide. For this reason cooperation with other agencies, stakeholders, and adjacent landowners will be critical for improving dissolved oxygen.

As expected, minimum dissolved oxygen levels generally corresponded to maximum water temperatures. Figure 10 shows the daily minimum dissolved oxygen and maximum temperatures in North Fork Big Hole River from June-October 2012. Table 6 shows the data rating/grade for each deployment period (monthly interval). These standard USGS ratings are based on the degree of sensor fouling and drift encountered during each deployment period (Wagner et al. 2006; Starkey et al. 2008). Data grades of “fair” and “poor” were primarily due to heavy fouling. Corrections applied to the dissolved oxygen data are listed in Appendix E.

Table. 5 Spawning times of fishes that may occur in the North Fork Big Hole River within BIHO.

This table helps identify periods when “early life stages” of fish may be present. The EPA definition of “early life stage” for salmonids is 30 days after emergence/swim-up; for all other species it is 34 days after spawning. This information is necessary when applying the dissolved oxygen standard to the North Fork Big Hole River.

Gray shading indicates timing of UCBN integrated water quality monitoring. This table has been adapted from the original, which can be found at www.deq.mt.gov/wqinfo/Standards/PDF/SpawningTimesFWP.pdf (Accessed 11/14/2012).

The code for the table is as follows: J1,J2, F1, F2 refer to the half month increments of January 1-15, January 16-31, February 1-14, February 15-29, and so on. In the table S=spawning period, I = incubation period for eggs of salmonids, E=time period in which salmonid sac-fry are in the gravels.

Species	J 1	J 2	F 1	F 2	M 1	M 2	A 1	A 2	M 1	M 2	J 1	J 2	J 1	J 2	A 1	A 2	S 1	S 2	O 1	O 2	N 1	N 2	D 1	D 2
Mountain whitefish	I	I	I	I	I	I												S	S	S	S	S	I	I
Rainbow trout					S	S	S	S	S	S	S	S	I	I	E									
Brook trout	I	I	I	I	E	E	E	E	E								S	S	S	S	I	I	I	I
Arctic grayling								S	S	S	S	S	I											
Longnose dace									S	S	S	S	S	S										
Longnose sucker						S	S	S	S	S	S	S	S											
White sucker							S	S	S	S	S	S												
Burbot			S	S	S	S																		
Mottled sculpin									S	S	S	S												

Applicable DO standard*	J 1	J 2	F 1	F 2	M 1	M 2	A 1	A 2	M 1	M 2	J 1	J 2	J 1	J 2	A 1	A 2	S 1	S 2	O 1	O 2	N 1	N 2	D 1	D 2
Early Life Stage							X	X	X				X	X	X	X	X	X						
Other Life Stage	X	X	X	X	X	X				X	X	X							X	X	X	X	X	X

* The applicable DO standard is based on the stated and assumed presence of “early life stage” fish (30 or 34 days after spawning).

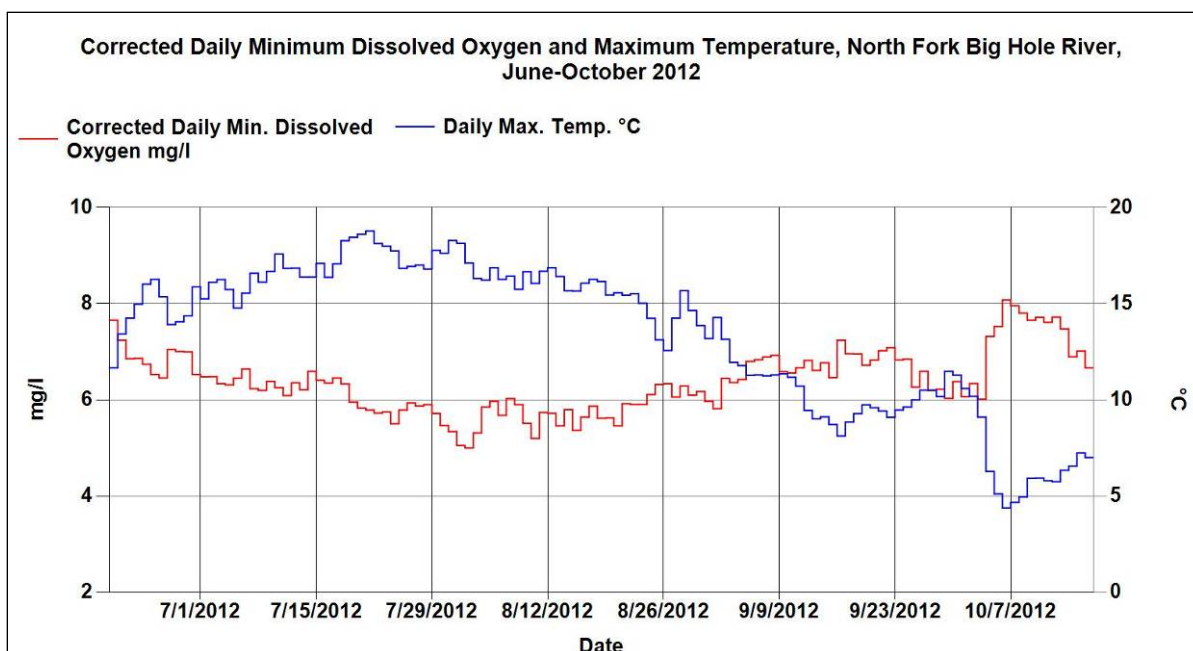


Figure 10. Corrected daily minimum dissolved oxygen and daily maximum temperature in North Fork Big Hole River, BIHO, 2012.

Table 6. Data grade/rating for dissolved oxygen each deployment period June-October 2012 in North Fork Big Hole River, BIHO.

Dissolved Oxygen Data Grade/Rating	From UTC-06:00	To UTC-06:00
GOOD	6/20/2012 13:00	7/25/2012 8:00
FAIR	7/25/2012 19:00	8/27/2012 16:00
POOR	8/27/2012 21:00	9/26/2012 8:00
GOOD	9/26/2012 17:00	10/16/2012 15:00

- *pH:*

The minimum and maximum pH (6.9 and 7.6 respectively) were never outside the acceptable regulatory thresholds of 6.5-8.5 pH units and the median (7.2 pH units) was well within this range. Figure 11 shows the daily maximum, minimum, and median pH in North Fork Big Hole River from June-October 2012. Table 7 shows the data rating/grade for each deployment period (monthly interval). These standard USGS ratings are based on the degree of sensor fouling and drift encountered during each deployment period (Wagner et al. 2006; Starkey et al. 2008). Data grades less than “excellent” were due to a combination of sensor fouling and drift. Corrections applied to the pH data are listed in Appendix E.

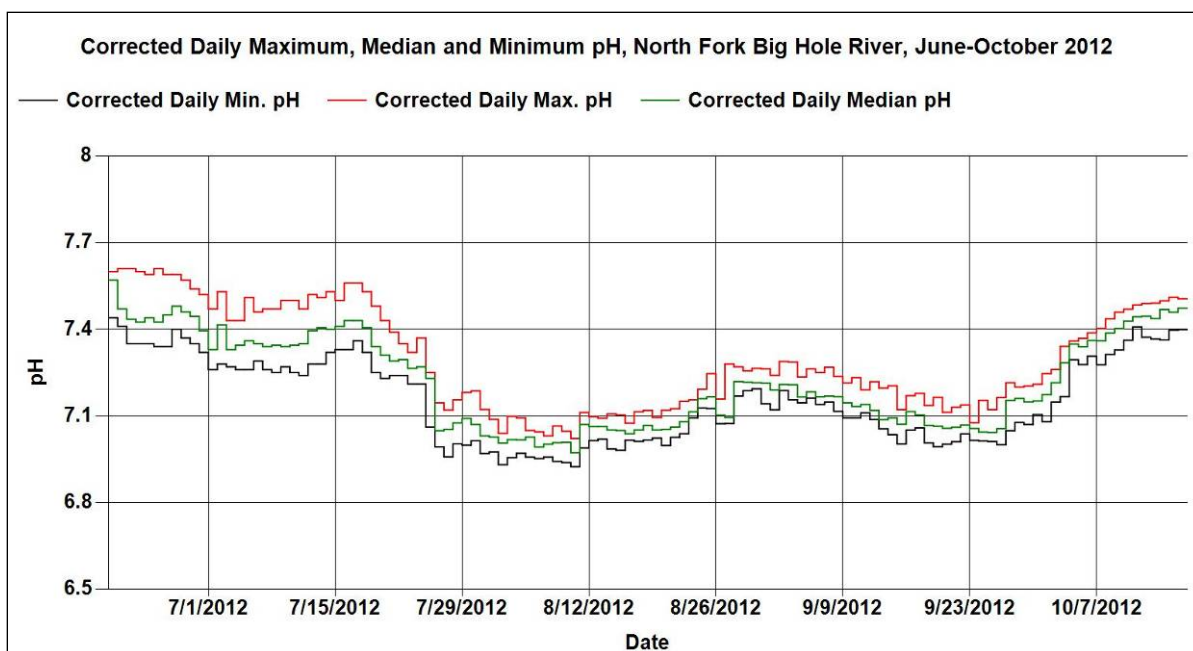


Figure 11. Corrected daily maximum, minimum, and median pH in North Fork Big Hole River, BIHO, 2012. Note that the maximum and minimum regulatory thresholds were never exceeded (6.5, 8.0 pH units).

Table 7. Data grade/rating for pH each deployment period June-October 2012 in North Fork Big Hole River, BIHO.

pH Data Grade/Rating	From UTC-06:00	To UTC-06:00
EXCELLENT	6/20/2012 13:00	7/25/2012 8:00
GOOD	7/25/2012 19:00	8/27/2012 16:00
GOOD	8/27/2012 21:00	9/26/2012 8:00
FAIR	9/26/2012 17:00	10/16/2012 15:00

- *Turbidity:*

Prior to discussion about turbidity in North Fork Big Hole River, it should be noted that conclusions based on this data are limited due to unusable data quality 6/20/2012 to 8/27/2012 (Table 8). Sensor fouling due to sediment and sensor drift were the primary factors influencing data quality. It is important to note that the method detection limit (MDL) for the turbidity sensor on Hydrolab 064 (used 6/20/2012-7/25/2012 and 8/27/2012-10/16/2012) was 0.2 NTU and the minimum level of quantitation (ML) was 0.58 NTU (Appendix D). The method detection limit (MDL) for the turbidity sensor on Hydrolab 054 (used 7/25/2012-8/27/2012) was 0.2 NTU and the minimum level of quantitation (ML) was 0.49 NTU (Appendix D). Meaning that Hydrolab 054 was slightly more sensitive to changes in turbidity than Hydrolab 064. Figure 12 shows the raw (uncorrected) daily mean turbidity in North Fork Big Hole River from June-October 2012. Raw values were graphed because the program used to manage the water quality data (AQUAIRUS) will only graph corrected data if it has a data grade better than “unusable” (i.e., Poor–Excellent). Corrections that were applied to turbidity data are listed in Appendix E.

Data indicates that turbidity ranged from <0.2 to 41 NTU, with the most pronounced spikes in turbidity occurring during deployments with “excellent” and “fair” data quality. However, due to less than desirable data quality and lack of historic data for this site the UCBN is unable to determine if conditions exceeded the state standard. Regulatory thresholds for turbidity state that “no increase above natural turbidity is allowed”. Although conclusions are limited based on the quality of data collected in 2012 it is likely that North Fork Big Hole River does experience pulses of turbidity in part due to historic/current land use within the Trail and Ruby Creek drainages. Turbidity levels are tied to sediment and erosion issues both of which have established TMDLs (MT DEQ 2006 and 2009).

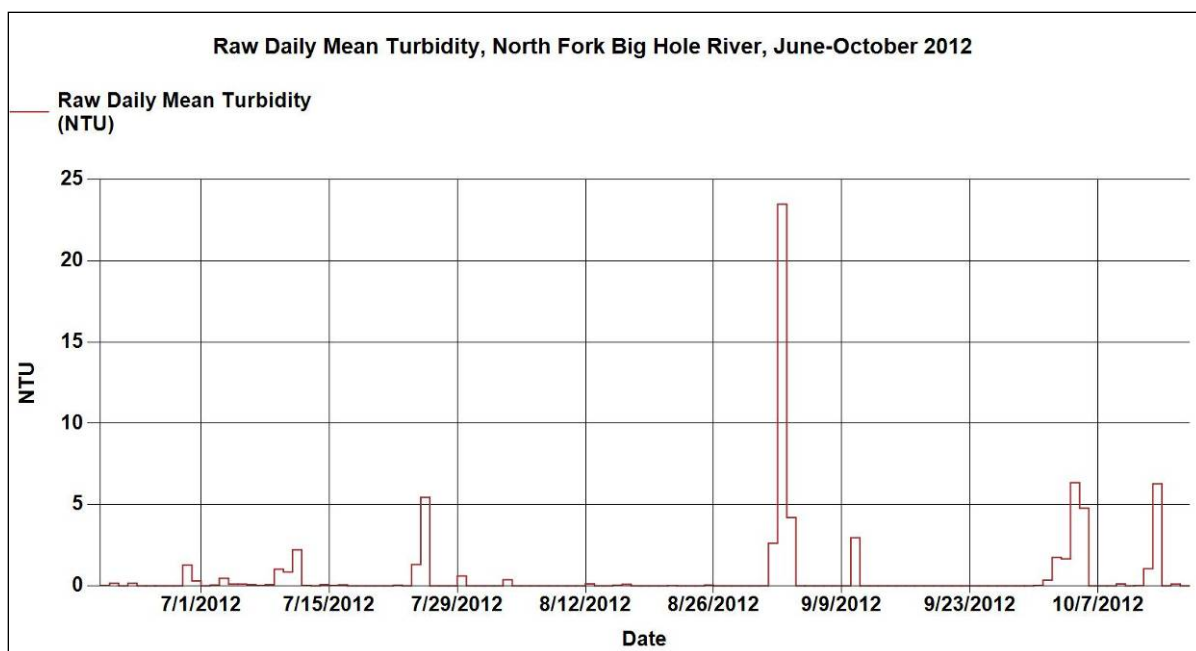


Figure 12. Raw daily mean turbidity in North Fork Big Hole River, BIHO, 2012.
Note that the un-usable data grades (blue) presented in table 8 were primarily due to severe fouling.

Table 8. Data grade/rating for turbidity each deployment period June-October 2012 in North Fork Big Hole River, BIHO.

Turbidity Data Grade/Rating	From UTC-06:00	To UTC-06:00
UNUSABLE	6/20/2012 13:00	7/25/2012 8:00
UNUSABLE	7/25/2012 19:00	8/27/2012 16:00
EXCELLENT	8/27/2012 21:00	9/26/2012 8:00
FAIR	9/26/2012 17:00	10/16/2012 15:00

Macroinvertebrates

Status:

The Hilsenhoff Biotic Index (HBI), which summarizes pollution tolerances of the macroinvertebrate taxa within the sample, ranged from 2.20 to 4.50 and the mean HBI was 3.07. Values indicate that on average water quality is excellent, with “organic pollution unlikely” (Hilsenhoff 1987, 1988). HBI values generally increase (HBI ranges from 0.0 to 10.0) as nutrient enrichment increases. While HBI is most sensitive to organic pollution, it may also respond to sediment loading, low dissolved oxygen and elevated water temperatures. Note that the 2009 HBI values were higher (3.59-5.39) than in 2012. Interpretation of the change that occurred between 2009 and 2012 should be done with some caution as macroinvertebrate sample collection methods differed (Starkey et al. 2008).

The mean US Forest Service (USFS) community tolerance quotient was 66 and ranged from 62 to 72. Community tolerance quotient values vary from 20 to just over 100, with lower values indicating better water quality. In a single sample reach, the maximum number of Ephemeroptera, Plecoptera, Trichoptera (EPT) taxa was 12; and there were a maximum of 7 long lived taxa. In 3 samples the dominate family was Chironomidae (non-biting midges). In the remaining 3 samples, the dominate family was Elmidae (riffle beetle).

The observed-to-expected ratio (OE) or River Invertebrate Prediction and Classification System (RIVPACS) score ranged from 0.35 to 0.41 and indicated “poor” biological condition. Note that a condition of poor indicates additional sampling should be conducted prior to designating the site “impaired.” Although observed-to-expected ratio results were lower than anticipated, Bollman and Bowman (2008) reported that for the Middle Rockies ecoregion as many as 40% of the evaluated streams were impaired and that sedimentation and temperature may be causative factors. See Table 9 and Appendix F for additional summary metrics.

These data suggest that the macroinvertebrate assemblage in the North Fork Big Hole River may be suboptimal. Suboptimal does not necessarily imply “impaired” but rather indicates cause for some concern and continued monitoring. Elevated water temperatures, sedimentation, or other factors may be contributing to these results.

Table 9. Vital sign summary table for benthic macroinvertebrates in North Fork Big Hole River, 2012.

North Fork Big Hole River Macroinvertebrate Summary August 2012						
PIBO Station	3211	3213	3214	3215	3216	3217
Sample ID	149036	149037	149038	149039	149040	149041
Richness*	24	18	25	21	22	21
Shannon's Diversity*	2.13	2.24	2.28	2.47	2.36	2.09
Simpson's Diversity*	0.78	0.86	0.85	0.90	0.87	0.82
Evenness*	0.67	0.77	0.71	0.81	0.77	0.69
# of EPT Taxa*	12	9	10	11	12	11
Dominant Family	Chironomidae	Elmidae	Chironomidae	Elmidae	Chironomidae	Elmidae
Dominant Taxa	Orthocladiinae	Elmidae	Orthocladiinae	Optioservus	Orthocladiinae	Optioservus
Hilsenhoff Biotic Index*	4.50	2.29	3.43	2.20	3.32	2.69
# of Intolerant Taxa*	7	6	7	8	8	7
# of Tolerant Taxa*	1	1	1	0	1	1
Tolerant Taxa Abundance	32	37	86	86	43	65
USFS Community Tolerance Quotient (d)*	70	62	72	66	64	62
# of shredder taxa*	2	3	3	5	2	4
# of scraper taxa*	2	4	3	2	3	2
# of collector-filterer taxa*	1	1	3	3	1	0
# of collector-gatherer taxa*	10	4	6	5	7	9
# of predator taxa*	5	3	6	3	4	4
# of clinger taxa*	8	10	11	11	10	10
Long-lived Taxa*	3	5	7	6	5	4

*Standardized to operational taxonomic units (OTU) and fixed count

Note that the entire macroinvertebrate taxa and metrics lists can be found in Appendix F and G.

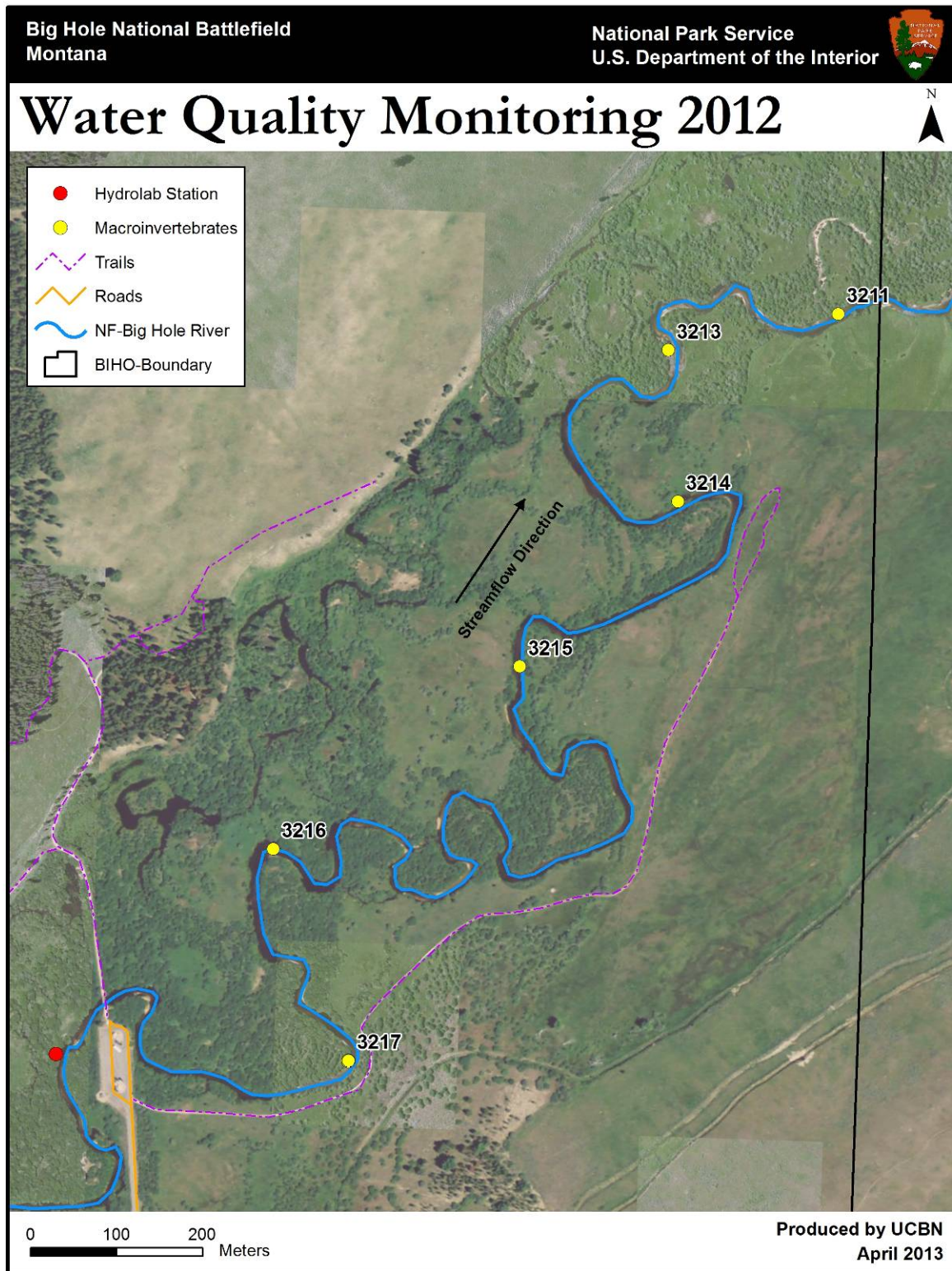
Literature Cited

- Administrative Rules of Montana. 2012. Environmental quality-water quality, Surface water quality standards and procedures. 17.30.601-17.30.670. Montana Department of Environmental Quality, Helena, MT. (www.deq.mt.gov/dir/legal/Chapters/CH30-06.pdf). Accessed 05 December 2012.
- Barbour, M. T., J. Gerritsen, B. D. Snyder, and J. B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency.
- Bollman, W. A. and J. A. Bowman. 2008. An assessment of the ecological conditions of the streams and rivers of Montana using the Environmental Monitoring and Assessment Program (EMAP) Method. Montana Department of Environmental Quality. Helena, MT.
- Bureau of Land Management (BLM). 2009. Upper Big Hole River watershed assessment report. Dillon, MT.
- Cayer, E., A. McCullough, J. Magee. 2010. Candidate conservation agreement with assurances for fluvial arctic grayling in the Upper Big Hole River- 2010 annual report. Montana Fish, Wildlife and Parks. Dillon, MT. (<http://fwp.mt.gov/fwpDoc.html?id=49817>). Accessed 17 May 2013.
- Corrao, M. V. and J.A. Erixson. 2011. Natural resource condition assessment: Big Hole National Battlefield. Natural Resource Report NPS/UCBN/NRR-2011/471. National Park Service, Fort Collins, CO.
- Garrett, L. K., T. J. Rodhouse, G. H. Dicus, C. C. Caudill, and M. R. Shardlow. 2007. Vitals Signs Monitoring Plan, Upper Columbia Basin Network. Natural Resource Report NPS/PWR/UCBN/NRR—2007/002. National Park Service, Fort Collins, CO.
- Heitke, J. D., E. J. Archer, D. D. Dugaw, B. A. Bouwes, E. A. Archer, R. C. Henderson, J. L. Kershner. 2008. Effectiveness monitoring for streams and riparian areas: sampling protocol for stream channel attributes. PACFISH/INFISH- Biological Opinion Effectiveness Monitoring Program (PIBO-EM). Logan, UT. (<http://www.fs.fed.us/biology/fishecology/emp>). Accessed 18 January 2010.
- Hilsenhoff, W. L. 1987. An improved biotic index of organic stream pollution. Great Lakes Entomologist **20**:31-39.
- Hilsenhoff, W. L. 1988. Rapid field assessment of organic pollution with a family-level biotic index. Journal of the North American Benthological Society. **7**:65-68.
- Irwin, R. J. 2008. Draft Part B lite QA/QC review checklist for aquatic vital sign monitoring protocols and SOPs, National Park Service, Water Resources Division. Fort Collins, CO. (http://www.nature.nps.gov/water/Vital_Signs_Guidance/Guidance_Documents/PartBLite.pdf). Accessed 18 February 2010.

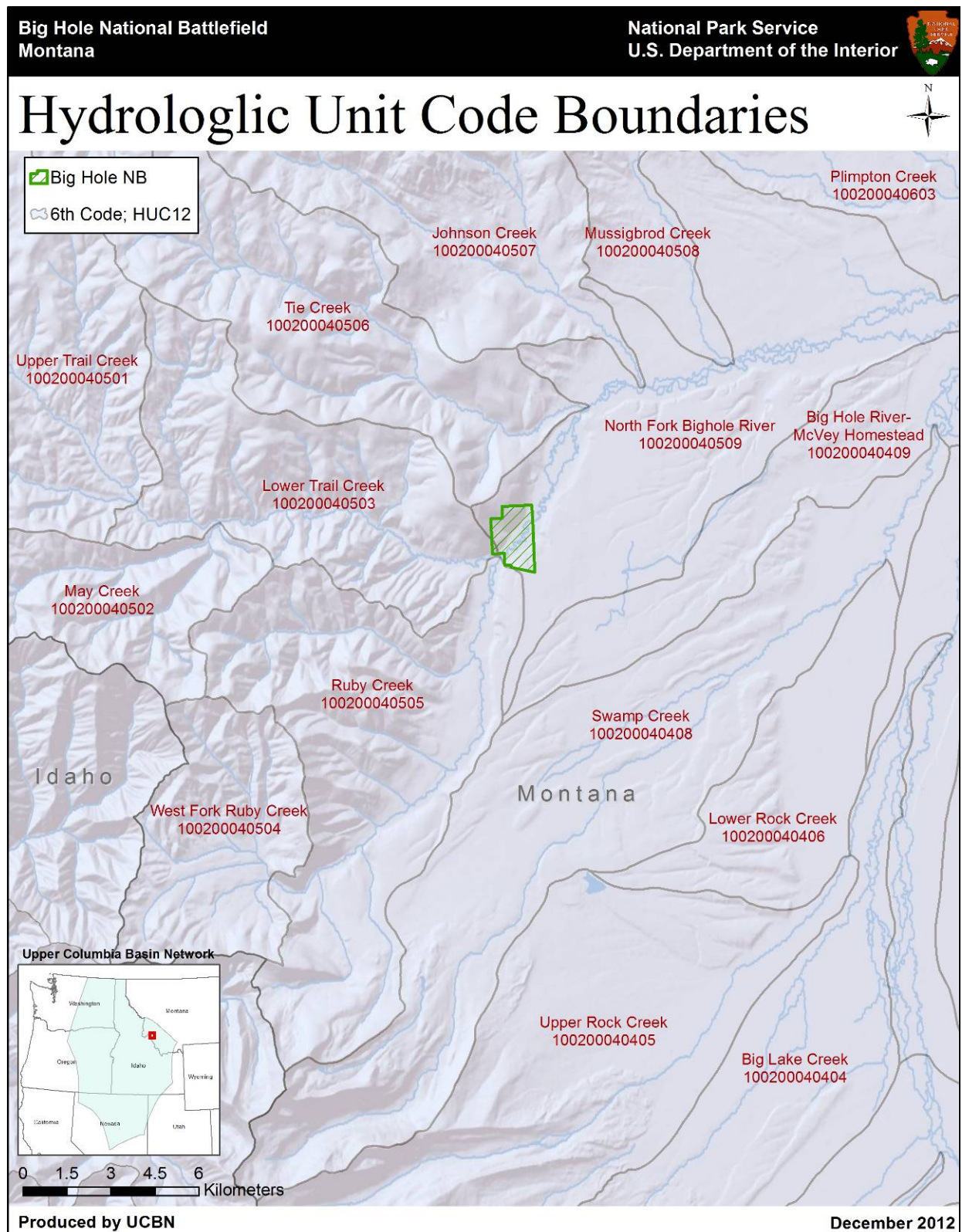
- Montana Department of Environmental Quality (DEQ). 2006. 2006 Integrated 303(d)/305(b) water quality report for Montana. Helena, MT.
- Montana Department of Environmental Quality (DEQ). 2009. Upper and North Fork Big Hole River planning area TMDLs and framework water quality restoration approach. MO3-TMDL-01A. Helena, MT.
- Montana Department of Environmental Quality (DEQ). 2010. Circular DEQ-7, Montana numerical water quality standards. Helena, MT.
- Montana Department of Environmental Quality (DEQ). 2012. Montana 2012 final water quality integrated report. Helena, MT.
- McCullough, D. A. 1999. A review and synthesis of effects of alterations to the water temperature regime on freshwater life stages of salmonids, with special reference to chinook salmon. EPA 910-R-99-010. U.S. Environmental Protection Agency, Washington, DC.
- National Park Service (NPS) 1997. Baseline water quality data inventory and analysis: Big Hole National Battlefield and Bear Paw Battlefield. NPS/NRWRD/NRTR-97/115. Fort Collins, CO.
- National Park Service (NPS). 1999. Natural resource challenge: the National Park Service's action plan for preserving natural resources. US Department of the Interior National Park Service, Washington D.C.
- National Park Service (NPS). 2000. Strategic plan FY 2001-2005. NPS D-1383. US Department of the Interior National Park Service, Washington D.C.
(http://planning.nps.gov/document/NPS_strategic_plan.pdf). Accessed 3 March 2011.
- Rens, E. and Magee J. 2007. Arctic grayling recovery program- Montana arctic grayling monitoring report 2006. Montana Fish, Wildlife and Parks. Dillon, MT.
(<http://fwp.mt.gov/fwpDoc.html?id=28962>). Accessed 17 May 2013.
- Starkey, E. N. 2010. Upper Columbia Basin Network integrated water quality annual report 2009: Big Hole National Battlefield (BIHO). Natural Resource Technical Report NPS/UCBN/NRTR—2010/291. National Park Service, Fort Collins, CO.
- Starkey, E. N., L. K. Garrett, T. J. Rodhouse, G. H. Dicus, and R. K. Steinhorst. 2008. Upper Columbia Basin Network integrated water quality monitoring protocol: Narrative version 1.0. Natural Resource Report NPS/UCBN/NRR—2008/026. National Park Service, Fort Collins, CO. (http://science.nature.nps.gov/im/units/ucbn/reports/index.cfm#IWQ_Mon). Accessed 4 January 2012.
- United States EPA. 2001. Environmental Monitoring and Assessment Program (EMAP): National Coastal Assessment Quality Assurance Project Plan 2001-2004. United States Environmental Protection Agency, Office of Research and Development, National Health and Environmental Effects Research Laboratory, Gulf Ecology Division, Gulf Breeze, FL.EPA/620/R-01/002.

- United States EPA. 1995. Environmental Monitoring and Assessment Program (EMAP): Laboratory Methods Manual-Estuaries, Volume 1: Biological and Physical Analyses. U.S. Environmental Protection Agency, Office of Research and Development , Narragansett, RI. EPA/620/R-95/008.
- United States Fish and Wildlife Service (USFWS). Endangered and Threatened Wildlife and Plants; Revised 12-Month Finding to List the Upper Missouri River Distinct Population Segment of Arctic Grayling as Endangered or Threatened; Proposed Rule. Federal Register 75 (8 September 2010): 54708–54753.
- Vannote, R. L., and B. W. Sweeney. 1980. Geographic analysis of thermal equilibria: a conceptual model for evaluating the effect of natural and modified thermal regimes on aquatic insect communities. *The American Naturalist* **115**: 667–695.
- Wagner, R. J., R. W. Boulger Jr., C. J. Oblinger, and B. A. Smith. 2006. Guidelines and Standard procedures for continuous water-quality monitors: station operation, record computation, and data reporting: U.S. Geological Survey Techniques and Methods 1–D3, 51.

Appendix A. 2012 Water Quality Monitoring Locations



Appendix B. BIHO Hydrologic Unit Code Boundaries



Appendix C. Sample Locations for Water Quality Monitoring at BIHO

Park	Stream	Monitoring Type	Station #/Site ID	Lat.	Long.	Y	X
BIHO	North Fork Big Hole River	Water Chemistry	001	45.65166414	-113.64428200	5058747.22112554	293967.64787458
BIHO	North Fork Big Hole River	Macroinvertebrate	3211	45.6515284028425	-113.642758646643	5058733	294086
BIHO	North Fork Big Hole River	Macroinvertebrate	3213	45.6510639458218	-113.645316504799	5058688	293885
BIHO	North Fork Big Hole River	Macroinvertebrate	3214	45.6493456648691	-113.644889042235	5058496	293912
BIHO	North Fork Big Hole River	Macroinvertebrate	3215	45.6477809496476	-113.647536085331	5058329	293700
BIHO	North Fork Big Hole River	Macroinvertebrate	3216	45.6457316184628	-113.65089160712	5058110	293431

Note that X and Y have been projected in NAD 83, UTM Zone 12. These locations were recorded by the field crew with a handheld GPS unit.

Appendix D. Quality Control (QC) Indicators

QC data quality indicators for 6/20/12 to 7/25/2012 and 8/27/12 to 10/16/12 at BIHO- North Fork Big Hole River, Hydrolab #064, Station ID: BIHO-NFBigHole #001.

STORET Name	Units	Detection Range Description from Manufacture	Method Detection Limit (MDL)	Minimum Level of Quantitation (ML)	Alternative Measurement Sensitivity Plus (AMS+) Beginning of Season	Alternative Measurement Sensitivity Plus (AMS+) End of Season	Precision+ (RPD) Beginning of Season	Precision+ (RPD) End of Season
Temperature, water	deg C	-5 to 50°C	N/A	N/A	0.95	0.04	0.11	0.10
Specific Conductance	µS/cm	0 to 100,000 µS/cm	N/A	N/A	5.00	0.50	0.47	0.32
Dissolved Oxygen	mg/L	0-20 mg/L	N/A	N/A	0.67	0.25	0.30	1.50
pH	pH units	0-14 Units	N/A	N/A	0.05	0.03	0.15	0.14
Turbidity	NTU	0-3000 NTU	0.20	0.58	1.10	0.70	4.08	--

QC data quality indicators for 7/25/12 to 8/27/2012 at BIHO- North Fork Big Hole River, Hydrolab #054, Station ID: BIHO-NFBigHole #001.

STORET Name	Units	Detection Range Description from Manufacture	Method Detection Limit (MDL)	Minimum Level of Quantitation (ML)	Alternative Measurement Sensitivity Plus (AMS+) Beginning of Season	Alternative Measurement Sensitivity Plus (AMS+) End of Season	Precision+ (RPD) Beginning of Season	Precision+ (RPD) End of Season
Temperature, water	deg C	-5 to 50°C	N/A	N/A	0.10	0.05	0.06	0.09
Specific Conductance	µS/cm	0 to 100,000 µS/cm	N/A	N/A	1.1	0.50	0.18	0.32
Dissolved Oxygen	mg/L	0-20 mg/L	N/A	N/A	0.38	0.19	1.31	0.13

STORET Name	Units	Detection Range Description from Manufacture	Method Detection Limit (MDL)	Minimum Level of Quantitation (ML)	Alternative Measurement Sensitivity Plus (AMS+) Beginning of Season	Alternative Measurement Sensitivity Plus (AMS+) End of Season	Precision+ (RPD) Beginning of Season	Precision+ (RPD) End of Season
pH	pH units	0-14 Units	N/A	N/A	0.06	0.58	0.27	0.16
Turbidity	NTU	0-3000 NTU	0.20	0.49	0.00	0.00	--	--

Appendix E. Corrections History

Correction history for North Fork Big Hole River, BIHO 2012 temperature data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
EStarkey	Drift Correction with Calibration Drift value of -0.340°C and Fouling Drift value of -0.370°C	8/27/2012 21:00	9/26/2012 8:00	10/3/2012 8:50	708

Correction history for North Fork Big Hole River, BIHO 2012 specific conductance data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
EStarkey	Drift Correction with Calibration Drift value of -1.350µS/cm and Fouling Drift value of 3.900µS/cm	9/26/2012 17:00	10/16/2012 15:00	10/19/2012 15:36	479

Correction history for North Fork Big Hole River, BIHO 2012 dissolved oxygen data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
EStarkey	Drift Correction with Calibration Drift value of 0.000mg/l and Fouling Drift value of 0.490mg/l. Note that no calibration drift correction was applied due to failure of DO sensor during drift check.	6/20/2012 13:00	7/25/2012 8:00	8/31/2012 10:25	836
EStarkey	Drift Correction with Calibration Drift value of 0.070mg/l and Fouling Drift value of 0.500mg/l	7/25/2012 19:00	8/27/2012 16:00	8/31/2012 10:27	790
EStarkey	Drift Correction with Calibration Drift value of -0.420mg/l and Fouling Drift value of 1.470mg/l	8/27/2012 21:00	9/26/2012 8:00	10/3/2012 9:29	708
EStarkey	Delete point(s)- due to outlier	9/7/2012 16:00	9/7/2012 16:00	10/3/2012 9:31	1
EStarkey	Drift Correction with Calibration Drift value of 0.320mg/l and Fouling Drift value of -0.770mg/l	9/26/2012 17:00	10/16/2012 15:00	10/22/2012 8:39	479

Correction history for North Fork Big Hole River, BIHO 2012 pH data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
EStarkey	Drift Correction with Calibration Drift value of -0.123pH Units and Fouling Drift value of 0.300pH Units	7/25/2012 19:00	8/27/2012 16:00	8/31/2012 10:35	790
EStarkey	Drift Correction with Calibration Drift value of -0.420pH Units and Fouling Drift value of 0.360pH Units	8/27/2012 21:00	9/26/2012 8:00	10/3/2012 9:40	708
EStarkey	Drift Correction with Calibration Drift value of -0.107pH Units and Fouling Drift value of 0.410pH Units	9/26/2012 17:00	10/16/2012 15:00	10/22/2012 8:47	479

Correction history for North Fork Big Hole River, BIHO 2012 turbidity data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
EStarkey	Delete point(s) due to outlier	6/21/2012 2:00	6/21/2012 2:00	8/31/2012 11:11	1
EStarkey	Delete point(s) due to outlier	6/20/2012 21:00	6/20/2012 21:00	8/31/2012 11:12	1
EStarkey	Delete point(s) due to outlier	6/21/2012 22:00	6/21/2012 22:00	8/31/2012 11:12	1
EStarkey	Delete point(s) due to outlier	6/23/2012 22:00	6/23/2012 22:00	8/31/2012 11:12	1
EStarkey	Delete point(s) due to outlier	6/29/2012 13:00	6/29/2012 13:00	8/31/2012 11:13	1
EStarkey	Delete point(s) due to outlier	6/30/2012 21:00	6/30/2012 21:00	8/31/2012 11:13	1
EStarkey	Delete point(s)- due to outlier	7/2/2012 21:00	7/2/2012 21:00	8/31/2012 11:14	1
EStarkey	Delete point(s) due to outlier	7/3/2012 2:00	7/3/2012 2:00	8/31/2012 11:14	1
EStarkey	Delete point(s) due to outlier	7/3/2012 5:00	7/3/2012 5:00	8/31/2012 11:14	1
EStarkey	Delete point(s) due to outlier	7/3/2012 23:00	7/3/2012 23:00	8/31/2012 11:15	1
EStarkey	Delete point(s) due to outlier	7/4/2012 4:00	7/4/2012 4:00	8/31/2012 11:15	1
EStarkey	Delete point(s) due to outlier	7/5/2012 23:00	7/5/2012 23:00	8/31/2012 11:15	1
EStarkey	Delete point(s) due to outlier	7/6/2012 2:00	7/6/2012 2:00	8/31/2012 11:15	1
EStarkey	Delete point(s) due to outlier	7/7/2012 19:00	7/7/2012 19:00	8/31/2012 11:16	1

Correction history for North Fork Big Hole River, BIHO 2012 turbidity data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
EStarkey	Delete point(s) due to outlier	7/11/2012 15:00	7/11/2012 15:00	8/31/2012 11:17	1
EStarkey	Delete point(s) due to outlier	7/11/2012 5:00	7/11/2012 5:00	8/31/2012 11:17	1
EStarkey	Delete point(s) due to outlier	7/14/2012 3:00	7/14/2012 3:00	8/31/2012 11:18	1
EStarkey	Revert to Raw data	7/14/2012 3:00	7/14/2012 3:00	8/31/2012 11:18	1
EStarkey	Delete point(s) due to outlier	7/16/2012 6:00	7/16/2012 6:00	8/31/2012 11:18	1
EStarkey	Delete point(s) due to outlier	7/22/2012 1:00	7/22/2012 1:00	8/31/2012 11:19	1
EStarkey	Delete point(s) due to outlier	7/23/2012 7:00	7/23/2012 7:00	8/31/2012 11:20	1
EStarkey	Delete point(s) due to outlier	8/3/2012 4:00	8/3/2012 4:00	8/31/2012 11:28	1
EStarkey	Delete point(s) due to outlier	8/15/2012 18:00	8/15/2012 18:00	8/31/2012 11:29	1
EStarkey	Delete point(s) due to outlier	8/16/2012 3:00	8/16/2012 3:00	8/31/2012 11:29	1
EStarkey	Delete point(s) due to outlier	8/21/2012 20:00	8/21/2012 20:00	8/31/2012 11:30	1
EStarkey	Delete point(s) due to outlier	8/25/2012 10:00	8/25/2012 10:00	8/31/2012 11:30	1
EStarkey	Delete point(s)- due to outlier	9/10/2012 17:00	9/10/2012 17:00	10/3/2012 9:47	1
EStarkey	Delete point(s)- due to outlier	10/9/2012 11:00	10/9/2012 11:00	10/22/2012 8:51	1
EStarkey	Delete point(s)- due to outlier	10/11/2012 14:00	10/11/2012 14:00	10/22/2012 8:52	1

Appendix F. Macroinvertebrate Metrics

NPS Upper Columbia Basin Benthos 2012 – BIHO *Standardized to OTU and fixed count

SampleID	149036	149037	149038	149039	149040	149041
Station (NAMC)	PIBO:3211	PIBO:3213	PIBO:3214	PIBO:3215	PIBO:3216	PIBO:3217
Reach ID	6464	6465	6466	6467	6468	6469
Waterbody	N.F. Big Hole 1	N.F. Big Hole 2	N.F. Big Hole 3	N.F. Big Hole 4	N.F. Big Hole 5	N.F. Big Hole 6
County	Beaverhead	Beaverhead	Beaverhead	Beaverhead	Beaverhead	Beaverhead
State	MT	MT	MT	MT	MT	MT
Latitude	45.65155278	45.65096111	45.6494694	45.64773611	45.64572222	45.64347778
Longitude	-113.642842	-113.644967	-113.645075	-113.647136	-113.650928	-113.649597
Collection Date	8/17/2012	8/17/2012	8/18/2012	8/19/2012	8/20/2012	8/20/2012
Habitat Sampled	Targeted Riffle	Targeted Riffle	Targeted Riffle	Targeted Riffle	Targeted Riffle	Targeted Riffle
Collection Method	Surber Net	Surber Net	Surber Net	Surber Net	Surber Net	Surber Net
Field Notes	524-01-I-I2-12	524-02-I-I2-12	524-03-I-I2-12	524-04-I-I2-12	524-05-I-I2-12	524-06-I-I2-12
Lab Notes	NULL	NULL	NULL	NULL	NULL	NULL
Area sampled (m^2)	0.74	0.74	0.74	0.74	0.74	0.74
Field Split	100	100	100	100	100	100
Lab Split	12.5	10.94	3.13	9.38	12.5	12.5
Split Count	748	840	814	794	764	728

SampleID	149036	149037	149038	149039	149040	149041
Fixed Count	300	300	300	300	300	300
Big Rare Count	12	8	29	8	10	51
Richness*	24	18	25	21	22	21
Abundance	8103	10387	35183	11450	8273	7939
Shannon's Diversity*	2.133456793	2.239318269	2.28305983	2.467622781	2.364802528	2.086695549
Simpson's Diversity*	0.781471572	0.86483835	0.84724638	0.897636566	0.871014493	0.819799331
Evenness*	0.671309206	0.774750951	0.70927242	0.810512267	0.765050161	0.685393388
# of EPT Taxa*	12	9	10	11	12	11
EPT Taxa Abundance	2465	4513	14181	6304	4201	3778
Dominant Family	Chironomidae	Elmidae	Chironomidae	Elmidae	Chironomidae	Elmidae
Station (NAMC)	PIBO:3211	PIBO:3213	PIBO:3214	PIBO:3215	PIBO:3216	PIBO:3217
Reach ID	6464	6465	6466	6467	6468	6469
Waterbody	N.F. Big Hole 1	N.F. Big Hole 2	N.F. Big Hole 3	N.F. Big Hole 4	N.F Big Hole 5	N.F. Big Hole 6
County	Beaverhead	Beaverhead	Beaverhead	Beaverhead	Beaverhead	Beaverhead
State	MT	MT	MT	MT	MT	MT
Latitude	45.65155278	45.65096111	45.6494694	45.64773611	45.64572222	45.64347778
Longitude	-113.642842	-113.644967	-113.645075	-113.647136	-113.650928	-113.649597
Collection Date	8/17/2012	8/17/2012	8/18/2012	8/19/2012	8/20/2012	8/20/2012
Habitat Sampled	Targeted Riffle	Targeted Riffle	Targeted Riffle	Targeted Riffle	Targeted Riffle	Targeted Riffle

SampleID	149036	149037	149038	149039	149040	149041
Collection Method	Surber Net	Surber Net	Surber Net	Surber Net	Surber Net	Surber Net
Abundance of Dominant Family	4051	3820	9671	2580	2130	2454
Dominant Taxa	Orthocladiinae	Elmidae	Orthocladiinae	Optioservus	Orthocladiinae	Optioservus
Abundance of Dominant Taxa	2697	2038	8592	1514	1600	1634
Hilsenhoff Biotic Index*	4.503333333	2.293333333	3.43	2.203333333	3.323333333	2.686666667
# of Intolerant Taxa*	7	6	7	8	8	7
Intolerant Taxa abundance	1686	2561	10119	5238	2892	3203
# of Tolerant Taxa*	1	1	1	0	1	1
Tolerant Taxa abundance	32	37	86	86	43	65
USFS Community Tolerance Quotient (d)*	70	62	72	66	64	62
# of shredder taxa*	2	3	3	5	2	4
Shredder Abundance	400	1079	3633	3391	693	1754
# of scraper taxa*	2	4	3	2	3	2
Scraper abundance	897	1423	6394	1687	1181	1746
Station (NAMC)	PIBO:3211	PIBO:3213	PIBO:3214	PIBO:3215	PIBO:3216	PIBO:3217

SampleID	149036	149037	149038	149039	149040	149041
Reach ID	6464	6465	6466	6467	6468	6469
Waterbody	N.F. Big Hole 1	N.F. Big Hole 2	N.F. Big Hole 3	N.F. Big Hole 4	N.F Big Hole 5	N.F. Big Hole 6
County	Beaverhead	Beaverhead	Beaverhead	Beaverhead	Beaverhead	Beaverhead
State	MT	MT	MT	MT	MT	MT
Latitude	45.65155278	45.65096111	45.6494694	45.64773611	45.64572222	45.64347778
Longitude	-113.642842	-113.644967	-113.645075	-113.647136	-113.650928	-113.649597
Collection Date	8/17/2012	8/17/2012	8/18/2012	8/19/2012	8/20/2012	8/20/2012
Habitat Sampled	Targeted Riffle	Targeted Riffle	Targeted Riffle	Targeted Riffle	Targeted Riffle	Targeted Riffle
Collection Method	Surber Net	Surber Net	Surber Net	Surber Net	Surber Net	Surber Net
# of collector-filterer taxa*	1	1	3	3	1	0
Collector-filterer abundance	22	284	1391	232	120	339
# of collector-gatherer taxa*	10	4	6	5	7	9
Collector-gatherer abundance	5120	4275	15934	2508	3961	1828
# of predator taxa*	5	3	6	3	4	4
Predator abundance	972	1016	3505	1989	988	1203
# of clinger taxa*	8	10	11	11	10	10
Long-lived Taxa*	3	5	7	6	5	4
# of Ephemeroptera taxa*	5	1	1	1	4	3

SampleID	149036	149037	149038	149039	149040	149041
Ephemeroptera abundance	1395	1235	6132	1758	2014	974
# of Plecoptera taxa*	1	2	3	4	2	3
Plecoptera abundance	378	1486	2470	1591	554	492
# of Trichoptera taxa*	6	6	6	6	6	5
Trichoptera abundance	692	1791	5579	2955	1634	2312
# of Coleoptera taxa*	2	3	4	3	4	2
Coleoptera abundance	1211	3844	7997	2595	1419	2466
Station (NAMC)	PIBO:3211	PIBO:3213	PIBO:3214	PIBO:3215	PIBO:3216	PIBO:3217
Reach ID	6464	6465	6466	6467	6468	6469
Waterbody	N.F. Big Hole 1	N.F. Big Hole 2	N.F. Big Hole 3	N.F. Big Hole 4	N.F. Big Hole 5	N.F. Big Hole 6
County	Beaverhead	Beaverhead	Beaverhead	Beaverhead	Beaverhead	Beaverhead
State	MT	MT	MT	MT	MT	MT
Latitude	45.65155278	45.65096111	45.6494694	45.64773611	45.64572222	45.64347778
Longitude	-113.642842	-113.644967	-113.645075	-113.647136	-113.650928	-113.649597
Collection Date	8/17/2012	8/17/2012	8/18/2012	8/19/2012	8/20/2012	8/20/2012
Habitat Sampled	Targeted Riffle	Targeted Riffle	Targeted Riffle	Targeted Riffle	Targeted Riffle	Targeted Riffle
Collection Method	Surber Net	Surber Net	Surber Net	Surber Net	Surber Net	Surber Net
# of Elmidae Taxa*	2	2	3	3	3	2
Elmidae abundance	400	1050	3368	1153	670	1157

SampleID	149036	149037	149038	149039	149040	149041
# of Megaloptera taxa*	0	0	0	0	0	0
Megaloptera abundance	0	0	0	0	0	0
# of Diptera taxa*	7	5	7	4	5	6
Diptera abundance	4232	1102	10327	1397	2305	1014
# of Chironomidae taxa*	3	1	3	2	2	2
Chironomidae abundance	4051	902	9671	1037	2130	811
# of Crustacea taxa*	0	0	0	0	0	0
Crustacea abundance	0	0	0	0	0	0
# of Oligochaete taxa*	0	0	0	0	0	0
Oligochaete abundance	0	0	130	0	0	0
# of Mollusca taxa*	1	0	2	2	0	1
Mollusca abundance	43	1	86	45	22	22
# of Insect taxa*	22	17	21	18	21	19
Insect abundance	7919	9459	32505	10296	7926	7258
Station (NAMC)	PIBO:3211	PIBO:3213	PIBO:3214	PIBO:3215	PIBO:3216	PIBO:3217
Reach ID	6464	6465	6466	6467	6468	6469
Waterbody	N.F. Big Hole 1	N.F. Big Hole 2	N.F. Big Hole 3	N.F. Big Hole 4	N.F. Big Hole 5	N.F. Big Hole 6
County	Beaverhead	Beaverhead	Beaverhead	Beaverhead	Beaverhead	Beaverhead
State	MT	MT	MT	MT	MT	MT

SampleID	149036	149037	149038	149039	149040	149041
Latitude	45.65155278	45.65096111	45.6494694	45.64773611	45.64572222	45.64347778
Longitude	-113.642842	-113.644967	-113.645075	-113.647136	-113.650928	-113.649597
Collection Date	8/17/2012	8/17/2012	8/18/2012	8/19/2012	8/20/2012	8/20/2012
Habitat Sampled	Targeted Riffle	Targeted Riffle	Targeted Riffle	Targeted Riffle	Targeted Riffle	Targeted Riffle
Collection Method	Surber Net	Surber Net	Surber Net	Surber Net	Surber Net	Surber Net
# of Non-insect taxa*	2	1	4	3	1	2
Non-insect abundance	184	928	2678	1154	347	681

Appendix G. Macroinvertebrate Taxa List

NPS Upper Columbia Basin Benthos 2012 – BIHO
Note that all samples were from targeted riffles and sampled using Surber nets.

Sample ID	Reach ID	Stream	Lab Split	Field Split	Area	Code	Taxon	Split Count	Big Rare Count
149036	6464	N.F. Big Hole 1	12.5	100	0.74	184	Orthocladiinae	249	4
149036	6464	N.F. Big Hole 1	12.5	100	0.74	236	Antocha monticola	2	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	180	Chironomidae	26	1
149036	6464	N.F. Big Hole 1	12.5	100	0.74	182	Chironominae	66	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	105	Dytiscidae	2	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	241	Hexatoma	2	6
149036	6464	N.F. Big Hole 1	12.5	100	0.74	247	Tipula	1	0
55 149036	6464	N.F. Big Hole 1	12.5	100	0.74	252	Centroptilum	13	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	287	Leptophlebiidae	15	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	419	Sweltsa	11	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	285	Rhithrogena	1	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	506	Hydroptilidae	12	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	519	Lepidostoma	22	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	515	Oxyethira	8	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	1199	Amiocentrus aspilus	1	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	5757	Chloroperlinae	23	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	2066	Ephemerella inermis/dorothea	6	0

Sample ID	Reach ID	Stream	Lab Split	Field Split	Area	Code	Taxon	Split Count	Big Rare Count
149036	6464	N.F. Big Hole 1	12.5	100	0.74	4017	Paraleptophlebia with tusks	2	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	2172	Torrenticola	2	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	234	Tipulidae	2	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	216	Pericoma	3	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	262	Ephemerellidae	66	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	276	Heptageniidae	7	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	314	Corixidae	1	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	121	Elmidae	18	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	67	Sperchon	1	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	65	Protzia	1	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	63	Lebertia	3	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	58	Trombidiformes	6	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	187	Tanypodinae	33	1
149036	6464	N.F. Big Hole 1	12.5	100	0.74	200	Empididae	4	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	144	Zaitzevia	1	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	144	Zaitzevia	8	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	135	Optioservus	72	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	1743	Cleptelmis addenda	1	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	2253	Neoplasta	2	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	970	Drunella grandis	18	0

Sample ID	Reach ID	Stream	Lab Split	Field Split	Area	Code	Taxon	Split Count	Big Rare Count
149036	6464	N.F. Big Hole 1	12.5	100	0.74	1076	Optioservus quadrimaculatus	10	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	525	Oecetis	3	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	531	Apatania	4	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	610	Physa	4	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	809	Brachycentrus americanus	2	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	834	Diphetor hageni	1	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	484	Micrasema	12	0
149036	6464	N.F. Big Hole 1	12.5	100	0.74	444	Perlidae	1	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	444	Perlidae	3	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	484	Micrasema	28	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	487	Glossosomatidae	2	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	610	Physa	0	1
149037	6465	N.F. Big Hole 2	10.94	100	0.74	531	Apatania	31	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	1076	Optioservus quadrimaculatus	52	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	2253	Neoplasta	2	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	135	Optioservus	77	2
149037	6465	N.F. Big Hole 2	10.94	100	0.74	144	Zaitzevia	4	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	144	Zaitzevia	11	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	216	Pericoma	3	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	200	Empididae	1	0

Sample ID	Reach ID	Stream	Lab Split	Field Split	Area	Code	Taxon	Split Count	Big Rare Count
149037	6465	N.F. Big Hole 2	10.94	100	0.74	58	Trombidiformes	21	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	63	Lebertia	6	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	66	Sperchonidae	47	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	121	Elmidae	165	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	403	Plecoptera	22	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	262	Ephemerellidae	99	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	234	Tipulidae	2	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	237	Dicranota	1	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	2172	Torrenticola	1	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	5757	Chloroperlinae	41	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	932	Brachycentrus occidentalis	17	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	943	Serratella tibialis	1	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	519	Lepidostoma	3	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	506	Hydroptilidae	2	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	495	Hydropsychidae	4	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	800	Pteronarcella badia	54	3
149037	6465	N.F. Big Hole 2	10.94	100	0.74	589	Neothremma	3	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	480	Trichoptera	55	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	241	Hexatoma	0	2
149037	6465	N.F. Big Hole 2	10.94	100	0.74	150	Brychius	2	0

Sample ID	Reach ID	Stream	Lab Split	Field Split	Area	Code	Taxon	Split Count	Big Rare Count
149037	6465	N.F. Big Hole 2	10.94	100	0.74	180	Chironomidae	13	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	236	Antocha monticola	5	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	221	Simuliidae	2	0
149037	6465	N.F. Big Hole 2	10.94	100	0.74	184	Orthoclaadiinae	60	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	182	Chironominae	17	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	184	Orthoclaadiinae	199	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	223	Simulium	4	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	236	Antocha monticola	5	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	180	Chironomidae	5	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	150	Brychius	4	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	241	Hexatoma	1	6
149038	6466	N.F. Big Hole 3	3.13	100	0.74	483	Brachycentrus	1	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	469	Skwala	1	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	285	Rhithrogena	4	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	287	Leptophlebiidae	3	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	799	Pteronarcys californica	0	2
149038	6466	N.F. Big Hole 3	3.13	100	0.74	800	Pteronarcella badia	11	3
149038	6466	N.F. Big Hole 3	3.13	100	0.74	495	Hydropsychidae	3	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	499	Hydropsyche	2	1
149038	6466	N.F. Big Hole 3	3.13	100	0.74	515	Oxyethira	3	0

Sample ID	Reach ID	Stream	Lab Split	Field Split	Area	Code	Taxon	Split Count	Big Rare Count
149038	6466	N.F. Big Hole 3	3.13	100	0.74	519	Lepidostoma	71	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	838	Hesperoperla pacifica	1	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	932	Brachycentrus occidentalis	6	6
149038	6466	N.F. Big Hole 3	3.13	100	0.74	1225	Cottidae	0	1
149038	6466	N.F. Big Hole 3	3.13	100	0.74	2172	Torrenticola	9	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	5757	Chloroperlinae	42	2
149038	6466	N.F. Big Hole 3	3.13	100	0.74	262	Ephemerellidae	101	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	263	Attenella	0	1
149038	6466	N.F. Big Hole 3	3.13	100	0.74	276	Heptageniidae	20	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	121	Elmidae	26	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	63	Lebertia	21	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	65	Protzia	3	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	67	Sperchon	4	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	58	Trombidiformes	20	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	19	Oligochaeta	3	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	187	Tanypodinae	3	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	216	Pericoma	2	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	135	Optioservus	100	3
149038	6466	N.F. Big Hole 3	3.13	100	0.74	144	Zaitzevia	24	1
149038	6466	N.F. Big Hole 3	3.13	100	0.74	144	Zaitzevia	8	0

Sample ID	Reach ID	Stream	Lab Split	Field Split	Area	Code	Taxon	Split Count	Big Rare Count
149038	6466	N.F. Big Hole 3	3.13	100	0.74	2253	Neoplasta	3	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	1743	Cleptelmis addenda	1	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	1076	Optioservus quadrimaculatus	22	3
149038	6466	N.F. Big Hole 3	3.13	100	0.74	970	Drunella grandis	12	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	531	Apatania	17	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	584	Rhyacophila	1	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	646	Pisidiidae	1	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	610	Physa	1	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	834	Diphetor hageni	2	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	487	Glossosomatidae	7	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	521	Ceraclea	1	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	484	Micrasema	2	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	481	Brachycentridae	15	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	455	Perlodidae	1	0
149038	6466	N.F. Big Hole 3	3.13	100	0.74	444	Perlidae	1	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	455	Perlodidae	2	1
149039	6467	N.F. Big Hole 4	9.38	100	0.74	473	Pteronarcys	1	0

Sample ID	Reach ID	Stream	Lab Split	Field Split	Area	Code	Taxon	Split Count	Big Rare Count
149039	6467	N.F. Big Hole 4	9.38	100	0.74	484	Micrasema	92	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	521	Ceraclea	3	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	487	Glossosomatidae	2	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	610	Physa	1	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	647	Pisidium	1	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	531	Apatania	3	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	970	Drunella grandis	46	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	1076	Optioservus quadrimaculatus	16	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	1743	Cleptelmis addenda	16	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	1743	Cleptelmis addenda	1	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	2150	Mideopsis	14	0

Sample ID	Reach ID	Stream	Lab Split	Field Split	Area	Code	Taxon	Split Count	Big Rare Count
149039	6467	N.F. Big Hole 4	9.38	100	0.74	144	Zaitzevia	20	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	144	Zaitzevia	1	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	135	Optioservus	105	1
149039	6467	N.F. Big Hole 4	9.38	100	0.74	200	Empididae	1	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	216	Pericoma	6	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	187	Tanypodinae	1	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	58	Trombidiformes	15	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	67	Sperchon	6	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	65	Protzia	2	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	63	Lebertia	34	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	121	Elmidae	20	0

Sample ID	Reach ID	Stream	Lab Split	Field Split	Area	Code	Taxon	Split Count	Big Rare Count
149039	6467	N.F. Big Hole 4	9.38	100	0.74	276	Heptageniidae	6	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	431	Malenka	2	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	439	Zapada	3	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	262	Ephemerellidae	61	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	4077	Diphedor/Fallceon	3	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	5757	Chloroperlinae	29	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	2172	Torrenticola	6	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	932	Brachycentrus occidentalis	6	1
149039	6467	N.F. Big Hole 4	9.38	100	0.74	927	Lymnaea	0	1
149039	6467	N.F. Big Hole 4	9.38	100	0.74	519	Lepidostoma	69	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	499	Hydropsyche	4	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	506	Hydroptilidae	2	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	800	Pteronarcella badia	70	4
149039	6467	N.F. Big Hole 4	9.38	100	0.74	628	Planorbidae	1	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	287	Leptophlebiidae	6	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	480	Trichoptera	24	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	419	Sweltsa	3	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	241	Hexatoma	1	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	150	Brychius	1	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	180	Chironomidae	6	0

Sample ID	Reach ID	Stream	Lab Split	Field Split	Area	Code	Taxon	Split Count	Big Rare Count
149039	6467	N.F. Big Hole 4	9.38	100	0.74	182	Chironominae	13	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	236	Antocha monticola	5	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	223	Simulium	4	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	184	Orthoclaadiinae	52	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	201	Chelifera	6	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	206	Wiedemannia	1	0
149039	6467	N.F. Big Hole 4	9.38	100	0.74	221	Simuliidae	1	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	201	Chelifera	4	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	184	Orthoclaadiinae	148	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	182	Chironominae	39	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	236	Antocha monticola	1	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	206	Wiedemannia	1	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	180	Chironomidae	8	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	150	Brychius	1	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	150	Brychius	1	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	241	Hexatoma	5	2
149040	6468	N.F Big Hole 5	12.5	100	0.74	252	Centroptilum	1	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	419	Sweltsa	11	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	480	Trichoptera	48	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	287	Leptophlebiidae	16	0

Sample ID	Reach ID	Stream	Lab Split	Field Split	Area	Code	Taxon	Split Count	Big Rare Count
149040	6468	N.F Big Hole 5	12.5	100	0.74	628	Planorbidae	1	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	800	Pteronarcella badia	0	1
149040	6468	N.F Big Hole 5	12.5	100	0.74	506	Hydroptilidae	1	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	519	Lepidostoma	50	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	515	Oxyethira	7	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	932	Brachycentrus occidentalis	1	1
149040	6468	N.F Big Hole 5	12.5	100	0.74	1225	Cottidae	0	1
149040	6468	N.F Big Hole 5	12.5	100	0.74	1199	Amiocentrus aspilus	5	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	5757	Chloroperlinae	33	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	4017	Paraleptophlebia with tusks	1	1
149040	6468	N.F Big Hole 5	12.5	100	0.74	2066	Ephemerella inermis/dorothea	65	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	2172	Torrenticola	1	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	262	Ephemerellidae	57	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	431	Malenka	1	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	418	Suwallia	1	1
149040	6468	N.F Big Hole 5	12.5	100	0.74	403	Plecoptera	1	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	276	Heptageniidae	12	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	121	Elmidae	18	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	63	Lebertia	14	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	58	Trombidiformes	9	0

Sample ID	Reach ID	Stream	Lab Split	Field Split	Area	Code	Taxon	Split Count	Big Rare Count
149040	6468	N.F Big Hole 5	12.5	100	0.74	187	Tanypodinae	2	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	200	Empididae	1	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	216	Pericoma	4	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	144	Zaitzevia	7	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	144	Zaitzevia	3	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	135	Optioservus	79	2
149040	6468	N.F Big Hole 5	12.5	100	0.74	2150	Mideopsis	6	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	1743	Cleptelmis addenda	1	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	1076	Optioservus quadrimaculatus	21	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	970	Drunella grandis	32	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	531	Apatania	16	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	647	Pisidium	1	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	834	Diphetor hageni	2	1
149040	6468	N.F Big Hole 5	12.5	100	0.74	481	Brachycentridae	9	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	484	Micrasema	14	0
149040	6468	N.F Big Hole 5	12.5	100	0.74	455	Perlodidae	4	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	455	Perlodidae	2	2
149041	6469	N.F. Big Hole 6	12.5	100	0.74	481	Brachycentridae	28	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	521	Ceraclea	1	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	834	Diphetor hageni	1	0

Sample ID	Reach ID	Stream	Lab Split	Field Split	Area	Code	Taxon	Split Count	Big Rare Count
149041	6469	N.F. Big Hole 6	12.5	100	0.74	588	Uenoidae	1	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	610	Physa	1	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	531	Apatania	7	2
149041	6469	N.F. Big Hole 6	12.5	100	0.74	584	Rhyacophila	1	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	970	Drunella grandis	35	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	1031	Timpanoga hecuba	0	1
149041	6469	N.F. Big Hole 6	12.5	100	0.74	1076	Optioservus quadrimaculatus	38	3
149041	6469	N.F. Big Hole 6	12.5	100	0.74	135	Optioservus	150	9
149041	6469	N.F. Big Hole 6	12.5	100	0.74	144	Zaitzevia	6	1
149041	6469	N.F. Big Hole 6	12.5	100	0.74	144	Zaitzevia	14	3
149041	6469	N.F. Big Hole 6	12.5	100	0.74	216	Pericoma	6	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	200	Empididae	1	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	58	Trombidiformes	30	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	63	Lebertia	20	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	65	Protzia	6	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	67	Sperchon	5	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	121	Elmidae	17	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	276	Heptageniidae	1	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	262	Ephemerellidae	51	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	237	Dicranota	1	0

Sample ID	Reach ID	Stream	Lab Split	Field Split	Area	Code	Taxon	Split Count	Big Rare Count
149041	6469	N.F. Big Hole 6	12.5	100	0.74	2066	Ephemerella inermis/dorothea	1	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	5757	Chloroperlinae	38	8
149041	6469	N.F. Big Hole 6	12.5	100	0.74	1199	Amiocentrus aspilus	12	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	927	Lymnaea	1	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	932	Brachycentrus occidentalis	3	3
149041	6469	N.F. Big Hole 6	12.5	100	0.74	838	Hesperoperla pacifica	0	2
149041	6469	N.F. Big Hole 6	12.5	100	0.74	519	Lepidostoma	139	2
149041	6469	N.F. Big Hole 6	12.5	100	0.74	506	Hydroptilidae	1	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	799	Pteronarcys californica	1	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	800	Pteronarcella badia	2	8
149041	6469	N.F. Big Hole 6	12.5	100	0.74	520	Leptoceridae	1	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	252	Centroptilum	1	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	241	Hexatoma	2	6
149041	6469	N.F. Big Hole 6	12.5	100	0.74	150	Brychius	1	1
149041	6469	N.F. Big Hole 6	12.5	100	0.74	180	Chironomidae	4	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	236	Antocha monticola	1	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	182	Chironominae	2	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	184	Orthocladiinae	69	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	201	Chelifera	1	0
149041	6469	N.F. Big Hole 6	12.5	100	0.74	206	Wiedemannia	6	0

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS341/122650, October 2013

National Park Service
U.S. Department of the Interior



Natural Resource Stewardship and Science

1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

www.nature.nps.gov

EXPERIENCE YOUR AMERICA™