



Upper Columbia Basin Network Integrated Water Quality Annual Report 2012

City of Rocks National Reserve (CIRO)

Castle Rocks State Park (CRSP)

Natural Resource Technical Report NPS/UCBN/NRTR—2013/807



ON THE COVER

Almo Creek, June 2012, Castle Rocks State park
NPS Photo

Upper Columbia Basin Network Integrated Water Quality Annual Report 2012

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Castle Rocks State Park (CRSP)

Natural Resource Technical Report NPS/UCBN/NRTR—2013/807

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October 2013

U.S. Department of the Interior

National Park Service

Natural Resource Stewardship and Science

Fort Collins, Colorado

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Please cite this publication as:

Starkey, E. N. 2013. Upper Columbia Basin Network integrated water quality annual report 2012: City of Rocks National Reserve (CIRO), Castle Rocks State Park (CRSP). Natural Resource Technical Report NPS/UCBN/NRTR—2013/807. National Park Service, Fort Collins, Colorado.

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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 1999a). 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 1999a). 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 City of Rocks National Reserve (CIRO) and Castle Rocks State Park (CRSP). North Fork, South Fork and Main Stem Circle Creeks flow through CIRO and Almo Creek flows through CRSP. Creeks in both CIRO and CRSP were 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 Circle and Almo Creeks are in fair to good condition. Water chemistry data indicate that conditions were within established thresholds. While some locations were not sufficiently sampled due to a dry stream channel, benthic macroinvertebrate results generally indicated good water quality but give cause for continued monitoring. The status of water quality for North Fork, South Fork and Main Stem Circle Creeks and Almo Creek relative to state regulatory thresholds is given in the summary tables on the following page. UCBN water quality monitoring is conducted on a 3 year rotating panel. As a result, conditions in these streams 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 Circle Creek Water Chemistry Summary for 24 hour period 17-18 June, 2012

Measure	Current Condition (17-18 June, 2012)	State DEQ Thresholds ^a	% Exceedance ^b
Temperature (*MDMT, **MDAT)	* MDMT= 14.30 °C ** MDAT= 12.36 °C	*MDMT<22 °C **MDAT<19 °C	0% 0%
Specific conductance (mean)	144.30 µS/cm	N/A	N/A
Dissolved oxygen (mean daily min)	8.33 mg/l	> 6.0 mg/l	0%
pH (mean daily max)	8.13 pH Units	9.0 pH Units, Max	0%
pH (mean daily min)	8.03 pH Units	6.5 pH Units, Min	0%
Turbidity (mean daily max)	-- ^c	< 50 NTU over background (instantaneous) < 25 for 10 consecutive days	Insufficient data

South Fork Circle Creek Water Chemistry Summary for 24 hour period 17-18 June 2012

Measure	Current Condition (17-18 June, 2012)	State DEQ Thresholds ^a	% Exceedance ^b
Temperature (*MDMT, **MDAT)	* MDMT= 16.66 °C ** MDAT= 13.93 °C	*MDMT<22 °C **MDAT<19 °C	0% 0%
Specific conductance (mean)	175.78 µS/cm	N/A	N/A
Dissolved oxygen (mean daily min)	7.89 mg/L	> 6.0 mg/L	0%
pH (mean daily max)	8.1 pH Units	9.0 pH Units, Max	0%
pH (mean daily min)	7.87 pH Units	6.5 pH Units, Min	0%
Turbidity (mean daily max)	11.55 NTU	< 50 NTU over background (instantaneous) < 25 for 10 consecutive days	Insufficient data

Circle Creek Water Chemistry Summary for 24 hour period 16-17 June 2012

Measure	Current Condition (16-17 June, 2012)	State DEQ Thresholds ^a	% Exceedance ^b
Temperature (*MDMT, **MDAT)	* MDMT= 20.34 °C ** MDAT= 16.14 °C	*MDMT<22 °C **MDAT<19 °C	0% 0%
Specific conductance (mean)	432.14 µS/cm	N/A	N/A
Dissolved oxygen (mean daily min)	7.52 mg/L	> 6.0 mg/L	0%
pH (mean daily max)	8.32 pH Units	9.0 pH Units, Max	0%
pH (mean daily min)	8.25 pH Units	6.5 pH Units, Min	0%
Turbidity (mean daily max)	<0.2 NTU	< 50 NTU over background (instantaneous) < 25 for 10 consecutive days	Insufficient data

Almo Creek Water Chemistry Summary for 24 hour period 16-17 June 2012

Measure	Current Condition (16-17 June, 2012)	State DEQ Thresholds ^a	% Exceedance _b
Temperature (*MDMT, **MDAT)	* MDMT= 18.94 °C ** MDAT= 14.64 °C	*MDMT<22 °C	0%
		**MDAT<19 °C	0%
Specific conductance (mean)	68.55 µS/cm	N/A	N/A
Dissolved oxygen (mean daily min)	7.88 mg/L	> 6.0 mg/L	0%
pH (mean daily max)	7.67 pH Units	9.0 pH Units, Max	0%
pH (mean daily min)	7.56 pH Units	6.5 pH Units, Min	0%
Turbidity (mean daily max)	-- ^c	< 50 NTU over background (instantaneous) < 25 for 10 consecutive days	Insufficient data

**MDMT – Maximum Daily Maximum Temperature, **MDAT – Maximum Daily Average Temperature, ^a Criteria for cold water life designation, ^b Proportion of samples above water quality standard (Note that the % exceedance indicated is based on 24 hours of data) ^c Poor data quality precludes reporting*

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 CIRO park staff for their review of this report and for accommodations during fieldwork.

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 North Fork Circle, South Fork Circle, and Main Circle Creeks at City of Rocks National Reserve (CIRO) and Almo Creek at Castle Rocks State Park (CRSP).

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 CIRO and CRSP 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 1999a). 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 (1a4) 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 Almo, North, South and Circle Creeks are considered “undesignated surface waters,” meaning that they have not been assigned a beneficial use. In Idaho undesignated streams are assumed to support cold water aquatic life and primary or secondary contact recreation (ID Admin Code 2012, 58.01.02.101.01a [through 4/5/00]). Circle Creek has been listed as an assessment unit that is intermittent (i.e. “has zero flow at some time during most years”) and as a result, Idaho Department of Environmental Quality (ID DEQ) was unable to determine attainment relative to presumed beneficial uses (ID DEQ 2011). The segment of Almo Creek within the park is part of the Edwards Creek assessment unit and has been listed as a category 2 stream, meaning that it is a water of concern but currently supports presumed beneficial uses (ID DEQ 2011). For information specific to this assessment unit see http://mapcase.deq.idaho.gov/wq2010/js/adb2010.aspx?WBIDSEGID=ID17040210SK012_02 and <http://mapcase.deq.idaho.gov/wq2010/> (accessed 06 September 2012).

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

City of Rocks National Reserve (CIRO)

North, South, and Main Circle Creeks

The North Fork, South Fork, and main stem of Circle Creeks are in the Raft River drainage in Hydrologic Unit Code (HUC 6) 170402100207 (United States Geologic Survey [USGS]), Circle Creek-Raft River subwatershed, in Cassia County, Idaho (Figure 1, Appendix A and B). The headwaters of the Circle Creek drainage are within CIRO. The North Fork of Circle Creek merges with the South and Middle forks on private property before re-entering the park as the main stem Circle Creek. It should be noted that, on some maps and in state reports North Fork and South Fork Circle Creeks are referred to as North Creek and South Creek.

As noted by Erixson and Corrao (2012) in the natural resource condition assessment, the vegetation of CIRO has been separated into five primary categories (percent of area covered); shrublands (33%), herbaceous-shrub steppe (26%), open and closed canopy evergreen (24%), grassland/herbaceous (14%), and other (including sparsely vegetated areas and agriculture) (3%). This is an accurate reflection of land cover types in the Circle Creek drainage above monitoring locations. One land use not explicitly accounted for in the above list is ranching. Ranching is present throughout the Circle Creek drainage and is extensive on both public and private lands. The North Fork of Circle Creek is within a different grazing allotment than the South Fork and main stem Circle Creeks.

Threats to water resources in CIRO have been listed as: cattle grazing, residential development, gas, oil and mining operations, and recreational use (Garrett et al. 2007). As mentioned above, North, South and Circle Creeks are considered “undesignated surface waters,” meaning that they have not been assigned a beneficial use. In Idaho undesignated streams are assumed to support cold water aquatic life and primary or secondary contact recreation (ID Admin Code 2012, 58.01.02.101.01a [through 4/5/00]). Circle Creek has been listed as an assessment unit that is intermittent (i.e. “has zero flow at some time during most years”) and as a result, Idaho Department of Environmental Quality (ID DEQ) was unable to determine attainment relative to presumed uses (ID DEQ 2011).

Additional information about the Circle Creek and Raft River watersheds can be found in Baseline Water Quality Data Inventory and Analysis- City of Rocks National Reserve (NPS 1999b). Natural Resource Condition Assessment: City of Rocks National Reserve (Erixson and Corrao 2012), Raft River Watershed Total Maximum Daily Load-Implementation Plan for Agriculture (Firth et.al. 2006).

Continuous water quality monitors (Hydrolabs) were deployed in North, South and Main Circle Creeks in locations that provided adequate water depth and surface flow in mid June. Monitoring locations are noted in Figures 2-7, and Appendix A. These locations were the same as in 2009. The macroinvertebrate sample reaches along North, South and Circle Creeks coincide with the stream channel characteristics and riparian condition monitoring reaches (see Appendix C for GPS waypoints).

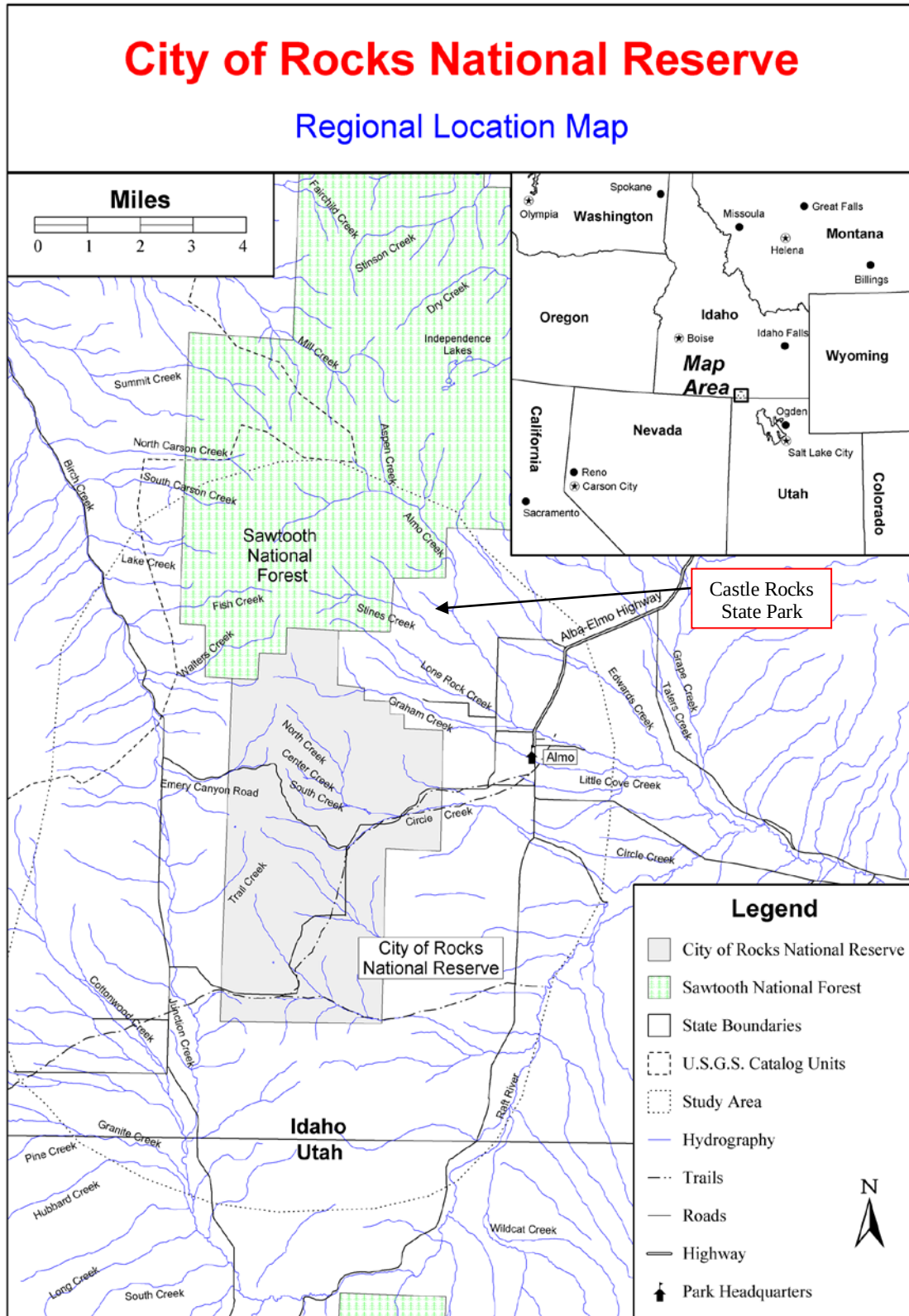


Figure 1. City of Rocks National Reserve regional map (NPS 1999). Note that monitoring occurred in both City of Rocks National Reserve and Castle Rocks State Park (CRSP) (CRSP location noted in red, boundary not shown).



Figure 2. North Circle Creek water quality monitoring station #01, approximately 15 m upstream from the intersection of Stripe Rock trail with North Fork Circle Creek trail.



Figure 3. South Circle Creek water quality monitoring station #01, approximately 15 m downstream of Box Top trail.



Figure 4. Main Circle Creek water quality monitoring station #01, approximately 150 m downstream of City of Rocks road.



Water Quality Monitoring 2012

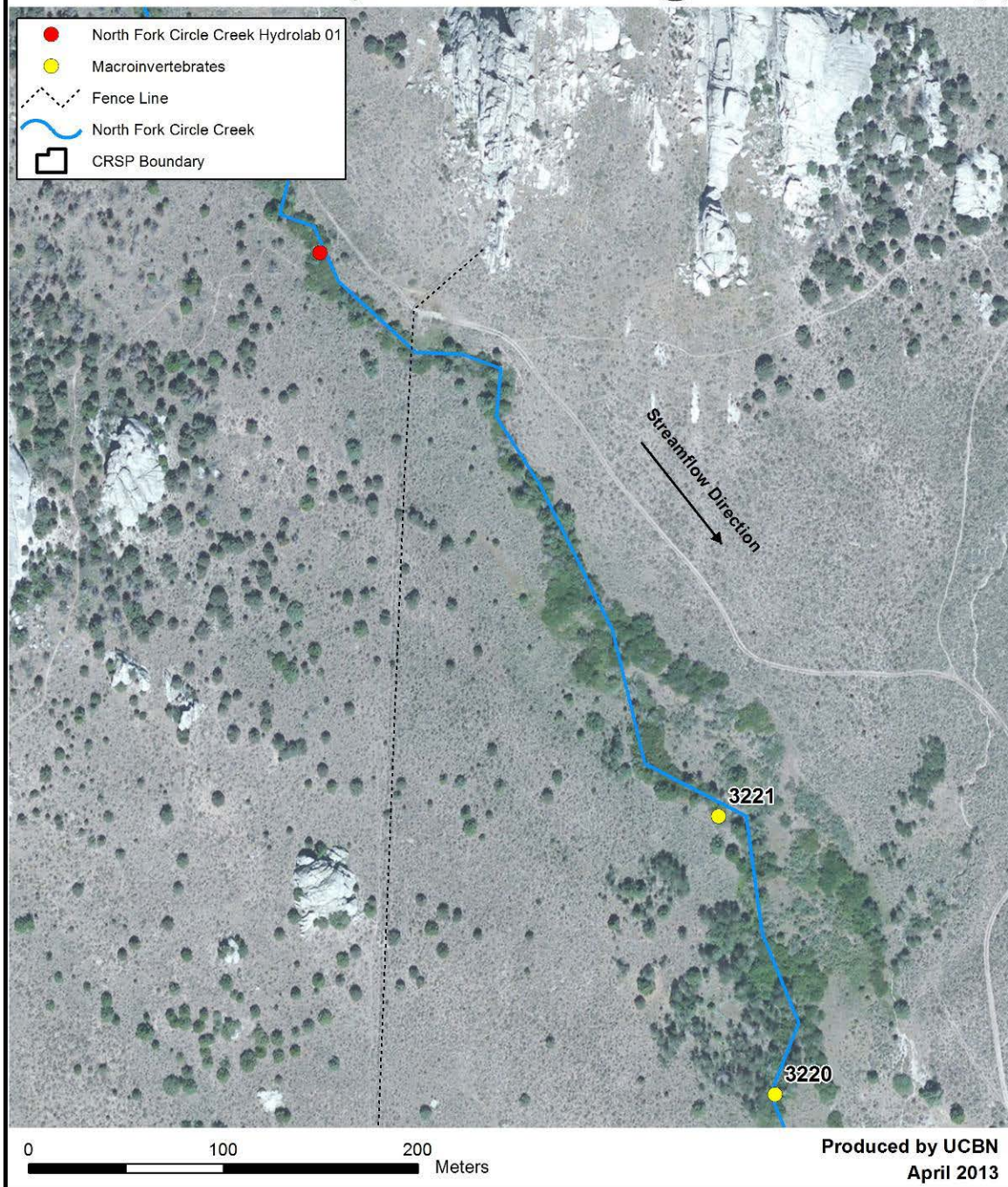


Figure 5. Water quality monitoring locations in CIRO- North Fork Circle Creek 2012.



Water Quality Monitoring 2012



Figure 6. Water quality monitoring locations in CIRO- South Fork Circle Creek 2012.



Water Quality Monitoring 2012

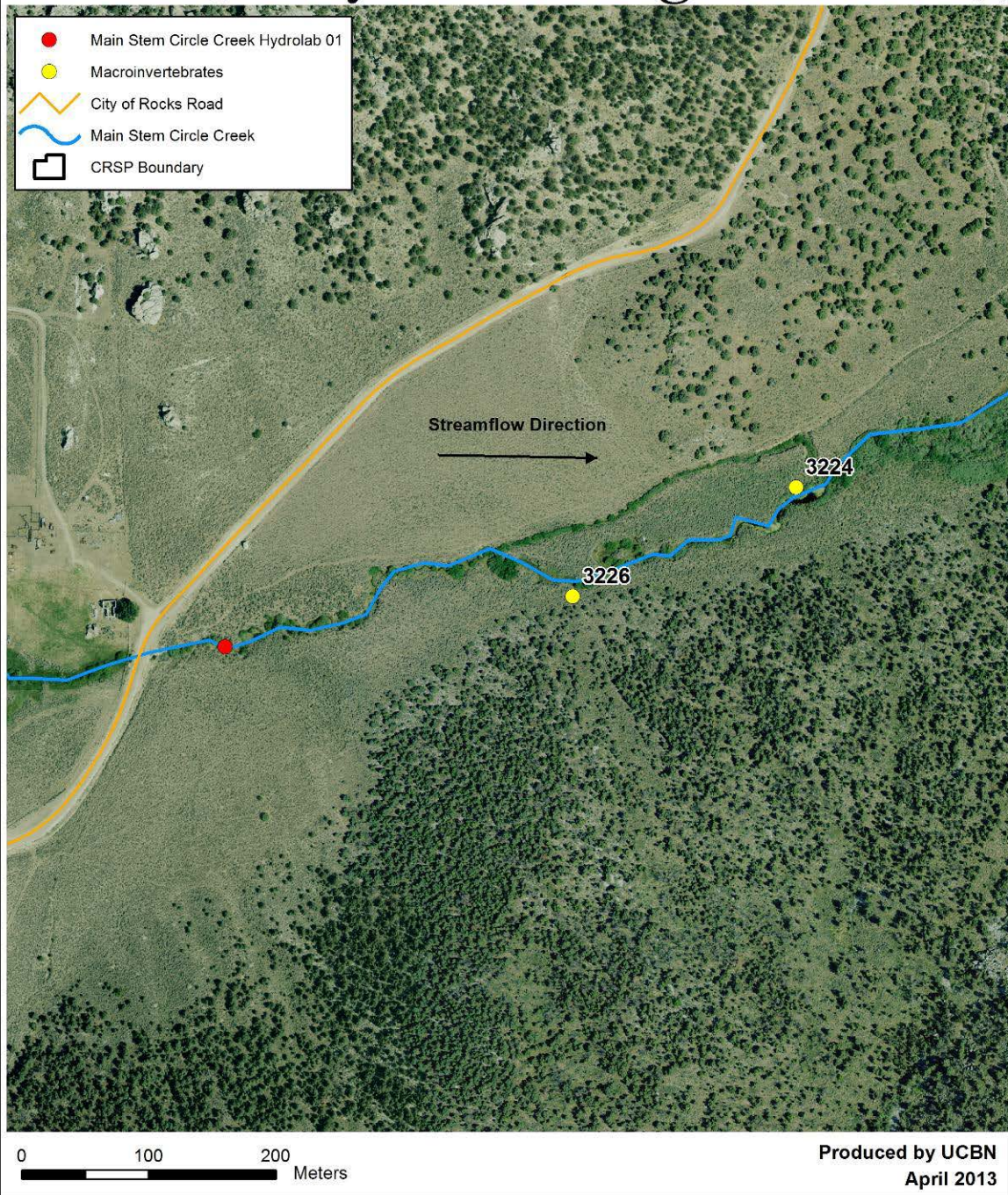


Figure 7. Water quality monitoring locations in CIRO- Main Circle Creek 2012.

Castle Rocks State Park (CRSP)

Almo Creek

Almo Creek is in the Raft River drainage in Hydrologic Unit Code (HUC 6) 170402100203 (United States Geologic Survey [USGS]), Almo Creek subwatershed, in Cassia County, Idaho (Figure 1, Appendix A and B). Almo Creek originates in and flows through the Sawtooth National Forest prior to entering Castle Rocks State Park. Water from Almo Creek is used extensively for downstream irrigation; consequently there are several diversions within the park. Adjustments to diversion headgates are made by CRSP managers according to a set schedule.

As noted by Erixson and Corrao (2012) in the natural resource condition assessment, the vegetation of CIRO has been separated into five primary categories (percent of area covered); shrublands (33%), herbaceous-shrub steppe (26%), open and closed canopy evergreen (24%), grassland/herbaceous (14%), and other (including sparsely vegetated areas and agriculture) (3%). This is an accurate reflection of land cover types in the Almo Creek drainage above the monitoring location. One land use not explicitly accounted for in the above list is ranching, which occurs extensively on CRSP public lands and downstream on private land. In 2008 two sections of Almo Creek were fenced off to exclude cattle and create wetland mitigation areas.

Threats to water resources in CRSP have been listed as: cattle grazing; residential development; gas, oil and mining operations; and recreational use (Garrett et al. 2007). As mentioned above, Almo Creek is considered “undesignated surface water,” meaning that it has not been assigned a beneficial use. In Idaho undesignated streams are assumed to support cold water aquatic life and primary or secondary contact recreation (ID Admin Code 2012, 58.01.02.101.01a [through 4/5/00]). The segment of Almo Creek within the park is part of the Edwards Creek assessment unit and has been listed as a category 2 stream, meaning that it is a water of concern but currently supports presumed beneficial uses (ID DEQ 2011).

Additional information about the Almo Creek and Raft River watersheds can be found in Baseline Water Quality Data Inventory and Analysis- City of Rocks National Reserve (NPS 1999b), Natural Resource Condition Assessment: City of Rocks National Reserve (Erixson and Corrao 2012), Raft River Watershed Total Maximum Daily Load-Implementation Plan for Agriculture (Firth et.al. 2006), Management Plan for Conservation of Yellowstone Cutthroat Trout in Idaho (ID DFG 2007).

The Hydrolab was deployed in Almo Creek in a location that provided adequate water depth and surface flow in mid June. The monitoring location is noted in Figures 8 and 9, and Appendix A. The location was the same as in 2009. The macroinvertebrate sample reaches along Almo Creek coincide with the stream channel characteristics and riparian condition monitoring reaches (see Appendix C for GPS waypoints).



Figure 8. Almo Creek looking East towards water quality monitoring station #01.

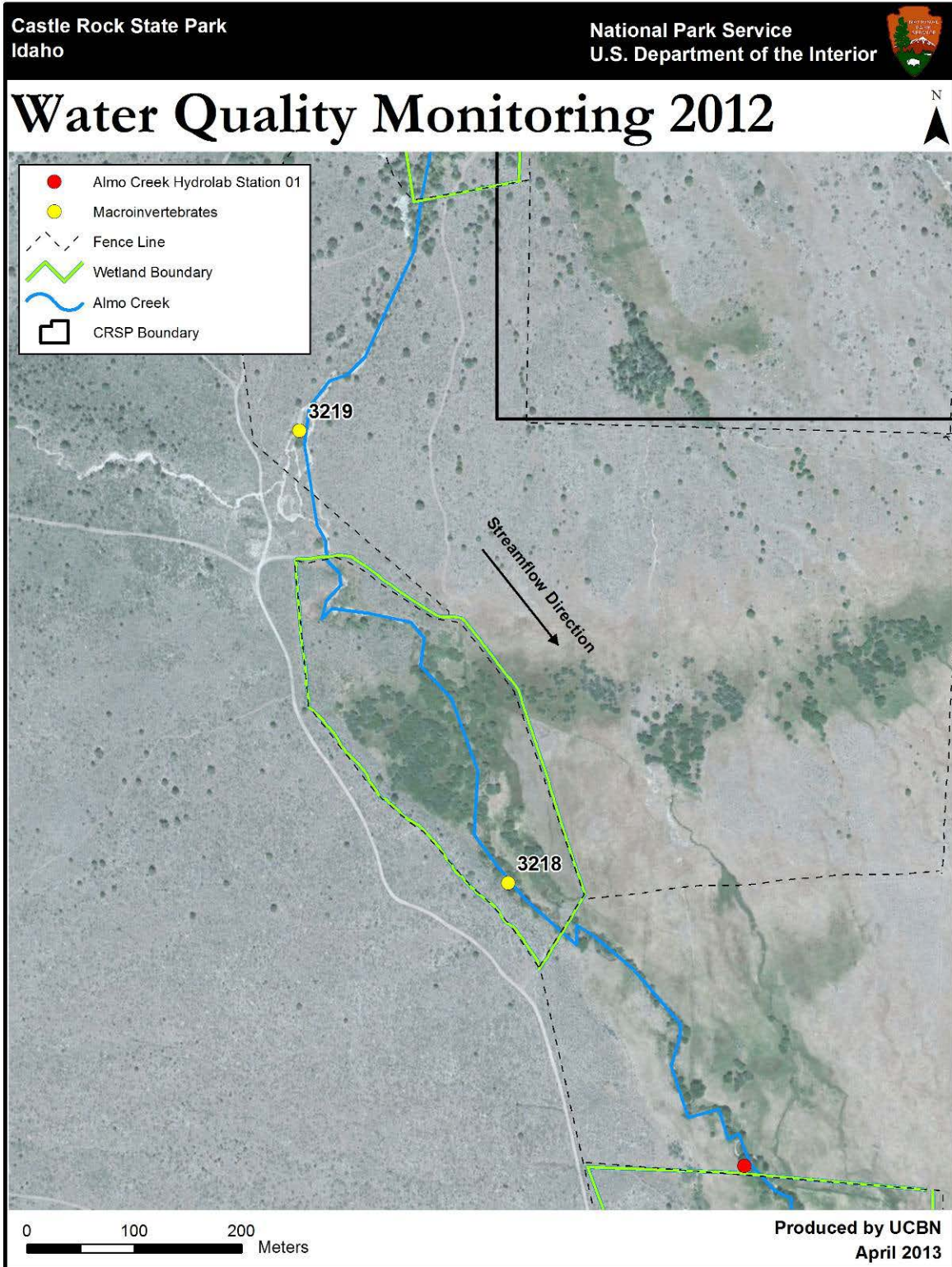


Figure 9. Water quality monitoring locations in CRSP- Almo Creek 2012.

Methods

Water Chemistry

Continuous water quality monitors (HACH, MS5 Hydrolabs) were deployed for 24 hours in each of the selected streams within CIRO/CRSP (North Fork Circle Creek, South Fork Circle Creek, Circle Creek, and Almo Creek). The deployment interval was 24 hours instead of six months due to the streams intermittent flow (see deployment periods in Table 1). Deployments occurred at index sites 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 every half hour and the instruments were retrieved and serviced at the end of each deployment period. Recalibration of the Hydrolab occurred after deployment in all four streams. As a result, the degree of sensor fouling was not assessed for each individual deployment; instead, sensor drift was determined for the entire time period. Note that no visible fouling occurred on any of the sensors during deployments. Data quality ratings were determined by the degree of sensor drift and other factors discussed in the results section. For more information on the UCBN water chemistry sampling design see Starkey et al. (2008).

Table 1. Deployment intervals of water quality monitors at CIRO and CRSP 2012.

UCBN Property Number	Hydrolab Serial Number	Stream	Deployment Start	Deployment End
064	0710C0045801	North Fork Circle Creek	06/17/2012 10:30:00 MDT	06/18/2012 10:00:00 MDT
054	070300045028	South Fork Circle Creek	06/17/2012 11:00:00 MDT	06/18/2012 09:00:00 MDT
054	070300045028	Circle Creek	06/16/2012 09:00:00 MDT	06/17/2012 09:00:00 MDT
064	0710C0045801	Almo Creek	06/16/2012 09:00:00 MDT	06/17/2012 08:30:00 MDT

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:

- 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

Currently no United States Geological Survey (USGS) real time gauging sites are present on the selected streams within or downstream of CIRO. The closest gage to the park is Raft River above Onemile Creek near Malta ID # 13078000. This data was used to determine general conditions within the Raft River drainage which includes Almo Creek, North Fork Circle Creek, South Fork Circle Creek, and the main stem of Circle Creek.

Macroinvertebrates

On North Fork Circle Creek and Almo Creek macroinvertebrates were collected at designated sample reaches (2 reaches in each stream) 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). Note that macroinvertebrates were to be collected on South Fork Circle Creek and Circle Creek; however, low or no flow conditions prevented assessment.

Results

City of Rocks National Reserve (CIRO): North Fork Circle Creek

Water Chemistry

Status:

Condition of core water quality parameters along with the corresponding Idaho DEQ regulatory threshold are given in Table 2. Data indicate that conditions were well within acceptable ranges relative to criteria for cold water aquatic life. Individual parameters are discussed below.

Table 2. Vital sign summary table for water chemistry in North Fork Circle Creek June, 2012

North Fork Circle Creek Water Chemistry Summary for 24 hour period 17-18 June, 2012

Measure	Current Condition (17-18 June, 2012)	State DEQ Thresholds ^a	% Exceedance ^b
Temperature (*MDMT, **MDAT)	* MDMT= 14.30 °C ** MDAT= 12.36 °C	*MDMT<22 °C **MDAT<19 °C	0% 0%
Specific conductance (mean)	144.30 µS/cm	N/A	N/A
Dissolved oxygen (mean daily min)	8.33 mg/l	> 6.0 mg/l	0%
pH (mean daily max)	8.13 pH Units	9.0 pH Units, Max	0%
pH (mean daily min)	8.03 pH Units	6.5 pH Units, Min	0%
Turbidity (mean daily max)	-- ^c	< 50 NTU over background (instantaneous) < 25 for 10 consecutive days	Insufficient data

*MDMT – Maximum Daily Maximum Temperature, **MDAT – Maximum Daily Average Temperature,^a Criteria for cold water aquatic life designation, ^b Proportion of samples above water quality standard (Note that the % exceedance indicated is based on 24 hours of data) ^c Poor data quality precludes reporting

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

- **Temperature:**

June 17-18th 2012, the maximum daily maximum temperature (MDMT) was 14.30 °C and the maximum daily average temperature (MDAT) was 12.36 °C (Figure 10). Neither the MDMT nor MDAT exceeded the cold water aquatic life criteria of 22.0 °C and 19.0 °C respectively. Data quality was rated as “good” due to the degree of sensor drift encountered during the deployment (Wagner et al. 2006; Starkey et al. 2008). Maximum and average temperatures were warmer than in 2009; however, weather conditions in 2009 were exceedingly wet and cool (see Starkey 2010).

Continuous temperature loggers were deployed at this location in 2011 and 2012. In 2011, the MDMT was 15.72 °C and the MDAT was 12.88 °C. In 2012, the MDMT was 18.77 °C and the MDAT was 14.56 °C. Despite 2012 data indicating warmer condition, our data suggest that cool water temperatures persist in midsummer months despite low flow conditions. No fouling or drift corrections were applied to 2011 or 2012 temperature data.

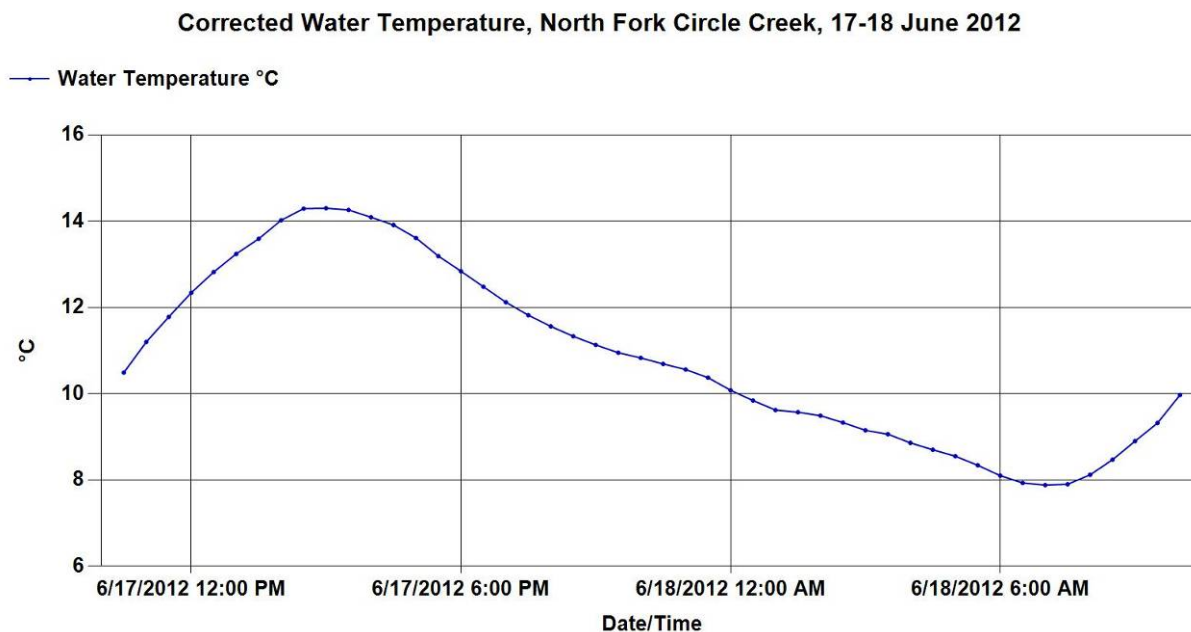


Figure 10. Corrected temperature in North Fork Circle Creek, CIRO, June 2012.

- *Specific Conductance:*

Specific conductance ranged from 143.0 to 146.0 $\mu\text{S}/\text{cm}$, with an average specific conductance of 144.3 $\mu\text{S}/\text{cm}$ (Figure 11). Note that there is no state threshold for specific conductance as it varies widely depending on the geology of the drainage basin and stream discharge. Data quality was rated as “excellent” due to the lack of sensor drift encountered during the deployment (Wagner et al. 2006; Starkey et al. 2008). Corrections that have been applied to the specific conductance data are listed in Appendix E.

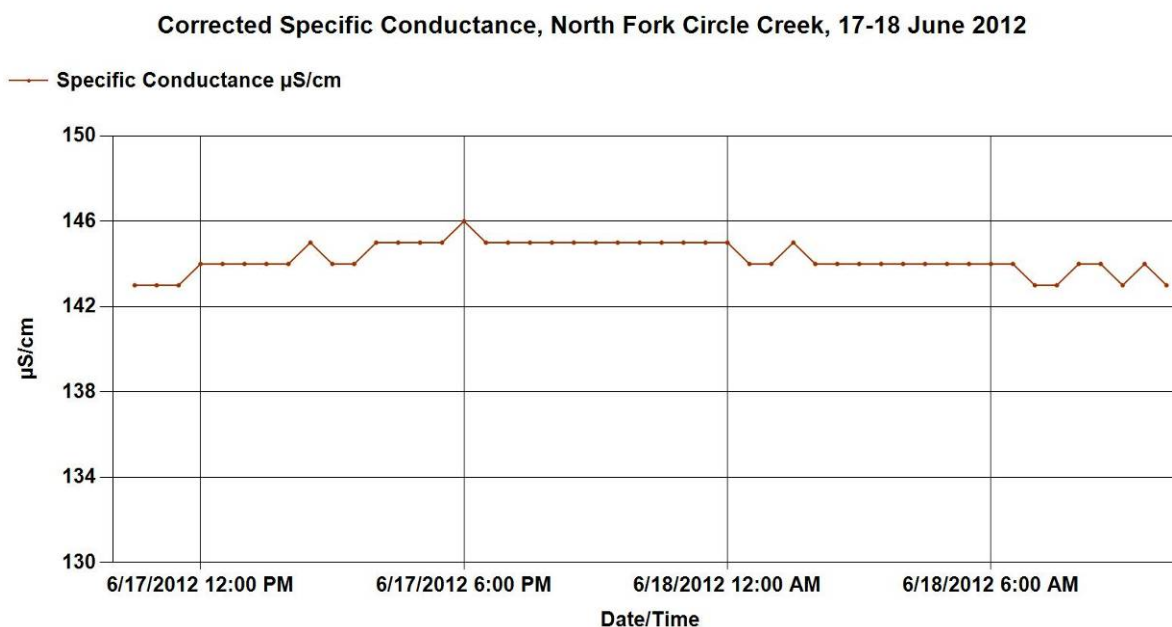


Figure 11. Corrected specific conductance in North Fork Circle Creek, CIRO, June 2012.

- Dissolved Oxygen:**
 Mean daily minimum dissolved oxygen was 8.33 mg/L and was never below the cold water aquatic life criteria of 6.0 mg/L. Minimum dissolved oxygen levels corresponded to maximum water temperatures. Figure 12 shows dissolved oxygen and temperature in North Fork Circle Creek from June 17th and 18th 2012. Data quality was rated as “excellent” due to the lack of sensor drift encountered during the deployment (Wagner et al. 2006; Starkey et al. 2008). Corrections that have been applied to the dissolved oxygen data are listed in Appendix E.

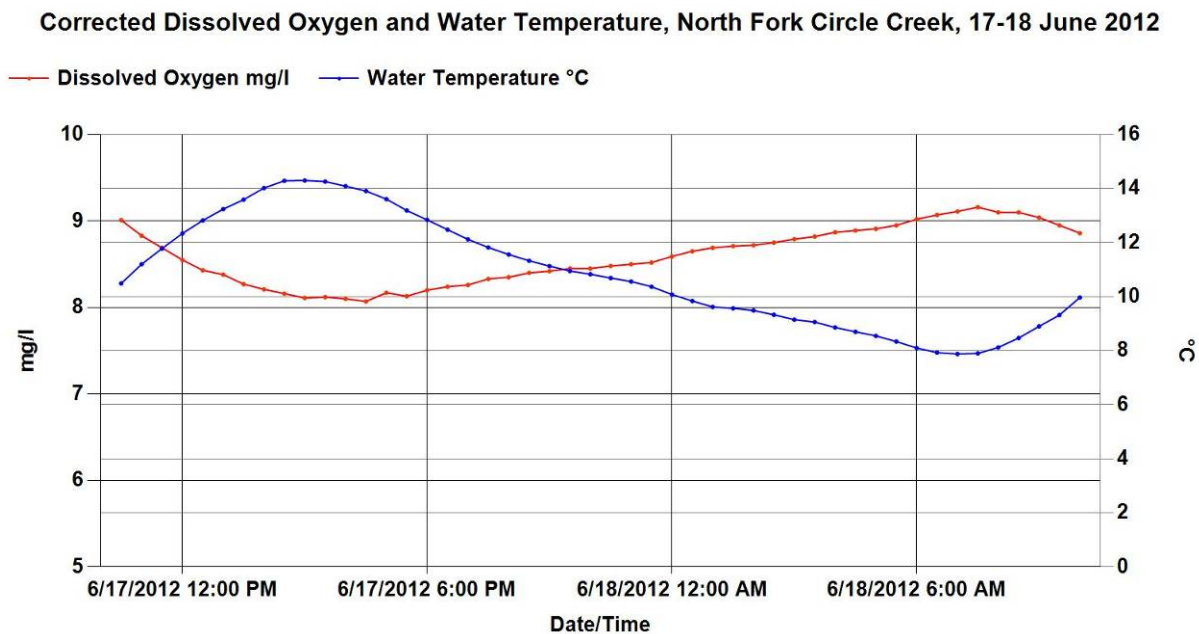


Figure 12. Corrected dissolved oxygen and temperature in North Fork Circle Creek, CIRO, June 2012.

- pH:**
 The minimum and maximum pH (8.03 and 8.13 respectively) were never outside the acceptable cold water aquatic life thresholds of 6.5-9.0 pH units and the median (8.07 pH units) was well within this range. Figure 13 shows pH levels in North Fork Circle Creek on June 17th and 18th 2012. Data quality was rated as “excellent” due to the lack of sensor drift encountered during the deployment (Wagner et al. 2006; Starkey et al. 2008). Corrections that have been applied to the pH data are listed in Appendix E.

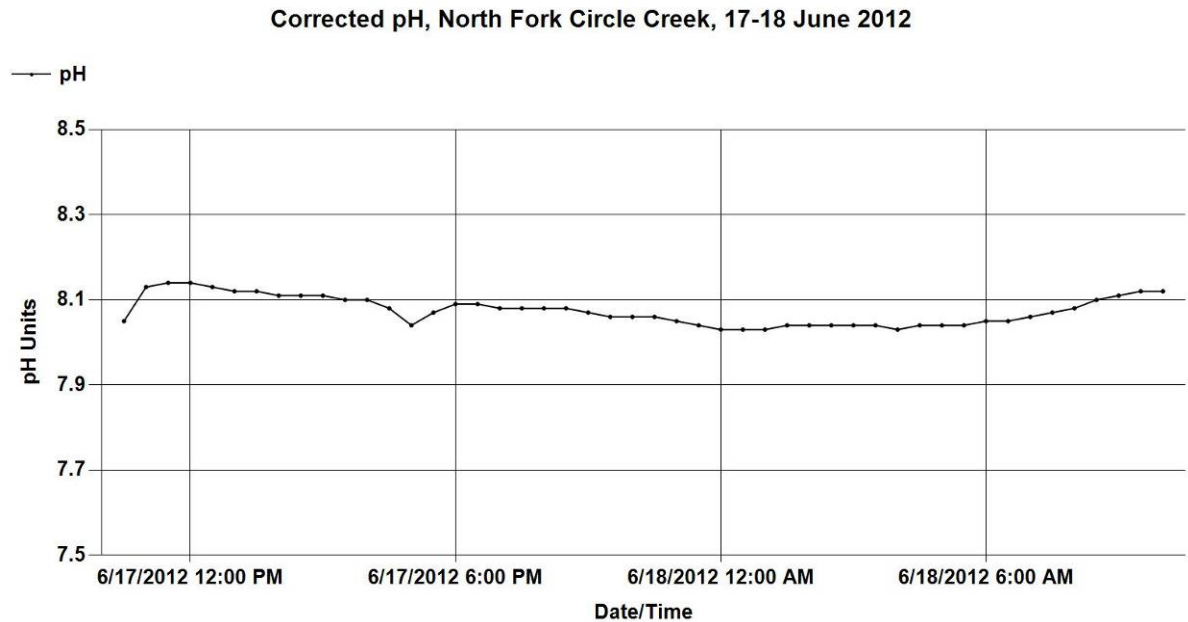


Figure 13. Corrected pH in North Fork Circle Creek, CIRO, June 2012.

Note that the maximum and minimum regulatory thresholds were never exceeded (6.5, 9.0 pH units).

- *Turbidity:*

Prior to discussion about turbidity in North Fork Circle Creek (Figure 14), it should be noted that conclusions based on this data are limited due to unusable data quality. Sensor drift was the primary factor influencing data quality. It is important to note that the method detection limit (MDL) for this sensor was 0.2 NTU and the minimum level of quantitation (ML) was 0.58 NTU (Appendix D). Figure 14 shows the raw (uncorrected) turbidity in North Fork Circle Creek June 17th and 18th 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.

Regulatory thresholds for turbidity state that it should be “< 50 NTU over background (instantaneous) and < 25 NTU for 10 consecutive days.” Although conclusions are limited based on the quality of data collected in 2012, it is likely that North Fork Circle Creek does meet these criteria during normal stream discharge conditions. As indicated in the 2009 report, this stream experiences periods of very high turbidity following heavy rainfall events (Starkey 2010).

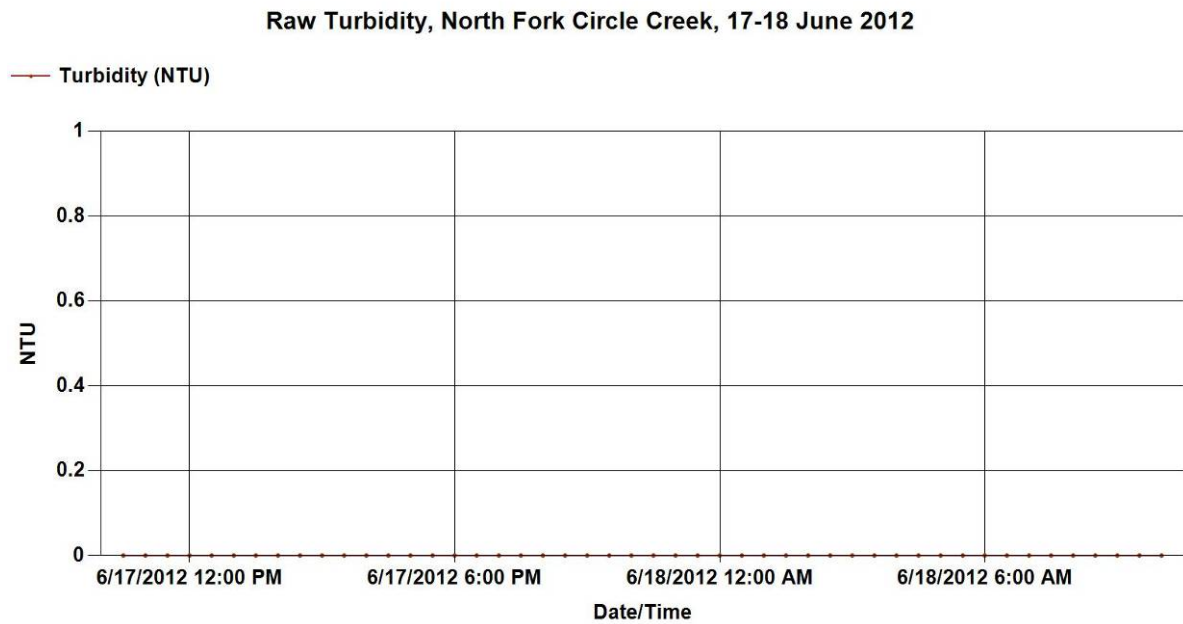


Figure 14. Raw turbidity in North Fork Circle Creek, CIRO, June 2012.

Macroinvertebrates

Status:

The Hilsenhoff Biotic Index (HBI), which summarizes pollution tolerances of the macroinvertebrate taxa within the sample, was 2.85 and 3.90. Values indicate that water quality is “very good” to “excellent” with “possible slight organic pollution” in one reach (#3221) and “organic pollution unlikely” in the other (#3220) (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 3.49 and 3.68 and indicated “excellent” water quality. While the HBI indicated similar results in 2009 and 2012 it should be noted that macroinvertebrate sample collection methods and locations differed slightly (Starkey et al. 2008).

The US Forest Service (USFS) community tolerance quotient was 60 and 73. Community tolerance quotient values vary from 20 to just over 100, with lower values indicating better water quality. As with the HBI, the tolerance quotient indicated that reach #3221 had lower water quality. In a single sample reach, the maximum number of Ephemeroptera, Plecoptera, Trichoptera (EPT) taxa was 13; and there were a maximum of 2 long lived taxa. In one reach (#3220), the dominate family was Baetidae (small minnow mayflies) and in the other (#3221) Chironomidae (non-biting midges).

The observed to expected ratio (OE) or River Invertebrate Prediction and Classification System (RIVPACS) scores were 0.76 and 0.70 and indicated that biological condition was “poor” (<0.78). 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, the intermittent nature of this stream, may in part, be influencing the results of the predictive model. It is important to note that, as above, reach #3221 rated as having poorer condition than site #3220. See Table 3 and Appendix F for additional summary metrics. Observed to expected ratios were not calculated in 2009 due to different data collection methods.

These data suggest that the macroinvertebrate assemblage in North Fork Circle Creek may be suboptimal. Suboptimal does not necessarily imply “impaired” but rather indicates cause for some concern and continued monitoring. Low stream flow, fine sediments, bank stability, and other factors may be contributing to these results.

Table 3. Vital sign summary table for benthic macroinvertebrates in North Fork Circle Creek, 2012.

North Fork Circle Creek Macroinvertebrate Summary July 2012		
PIBO Station	3220	3221
Sample ID	149044	149045
Richness*	23	23
Shannon's Diversity*	2.39	2.35
Simpson's Diversity*	0.83	0.82
Evenness*	0.76	0.75
# of EPT Taxa*	13	12
Dominant Family	Baetidae	Chironomidae
Dominant Taxa	Diphetor hageni	Chironominae
Hilsenhoff Biotic Index*	2.85	3.90
# of Intolerant Taxa*	8	9
# of Tolerant Taxa*	0	1
Tolerant Taxa Abundance	0	1
USFS Community Tolerance Quotient (d)*	60	73
# of shredder taxa*	3	2
# of scraper taxa*	2	1
# of collector-filterer taxa*	2	2
# of collector-gatherer taxa*	8	8
# of predator taxa*	5	6
# of clinger taxa*	8	5
Long-lived Taxa*	2	0

City of Rocks National Reserve (CIRO): South Fork Circle Creek

Water Chemistry

Status:

Condition of core water quality parameters along with the corresponding Idaho DEQ regulatory threshold are given in Table 4. Data indicate that conditions in South Fork Circle Creek were well within acceptable ranges relative to criteria for cold water aquatic life. Individual parameters are discussed below.

Table 4. Vital sign summary table for water chemistry in South Fork Circle Creek June, 2012

South Fork Circle Creek Water Chemistry Summary for 24 hour period 17-18 June 2012

Measure	Current Condition (17-18 June, 2012)	State DEQ Thresholds ^a	% Exceedance ^b
Temperature (*MDMT, **MDAT)	* MDMT= 16.66 °C ** MDAT= 13.93 °C	*MDMT<22 °C	0%
		**MDAT<19 °C	0%
Specific conductance (mean)	175.78 µS/cm	N/A	N/A
Dissolved oxygen (mean daily min)	7.89 mg/L	> 6.0 mg/L	0%
pH (mean daily max)	8.1 pH Units	9.0 pH Units, Max	0%
pH (mean daily min)	7.87 pH Units	6.5 pH Units, Min	0%
Turbidity (mean daily max)	11.55 NTU	< 50 NTU over background (instantaneous) < 25 for 10 consecutive days	Insufficient data

*MDMT – Maximum Daily Maximum Temperature, **MDAT – Maximum Daily Average Temperature, ^a Criteria for cold water aquatic life designation, ^b Proportion of samples above water quality standard (Note that the % exceedance indicated is based on 24 hours of data)

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

- **Temperature:**

June 17-18th 2012, the maximum daily maximum temperature (MDMT) was 16.66 °C and the maximum daily average temperature (MDAT) was 13.93 °C (Figure 15). Neither the MDMT nor MDAT exceeded the cold water aquatic life criteria of 22.0 °C and 19.0 °C respectively. Maximum and average temperatures were warmer than in 2009; however, weather conditions in 2009 were exceedingly wet and cool (see Starkey 2010). Despite being warmer than in 2009 our data suggests cool water temperatures persist in midsummer months despite relatively low flow conditions. Data quality was rated as “good” due to the degree of sensor drift encountered during the deployment (Wagner et al. 2006; Starkey et al. 2008).

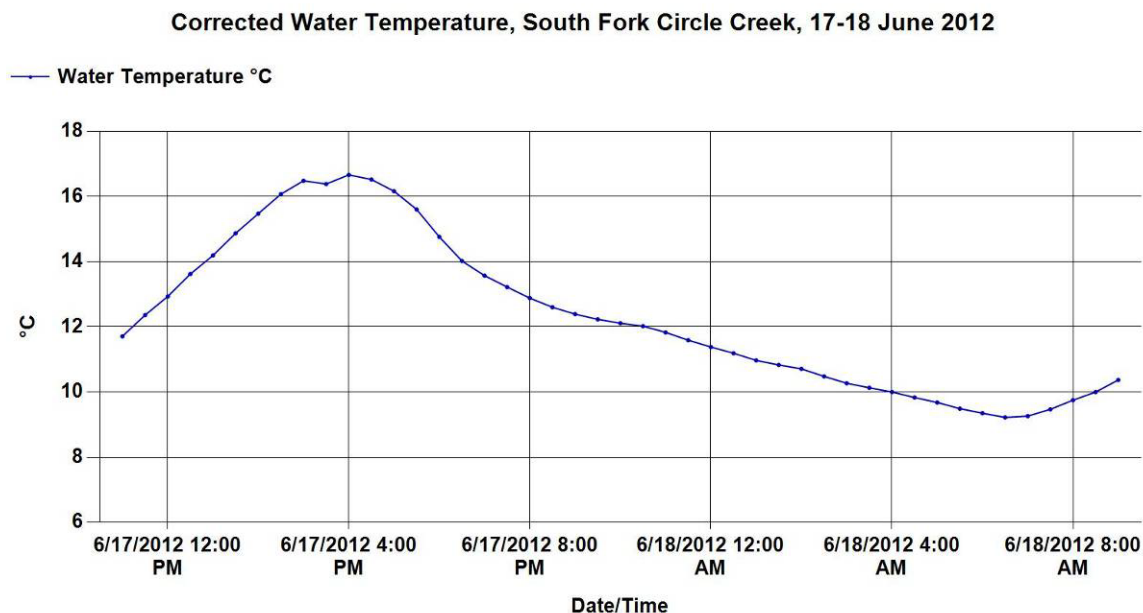


Figure 15. Corrected temperature in South Fork Circle Creek, CIRO, June 2012.

- *Specific Conductance:*

Specific conductance ranged from 175.0 to 177.0 $\mu\text{S}/\text{cm}$, with an average specific conductance of 175.8 $\mu\text{S}/\text{cm}$ (Figure 16). Note that there is no state threshold for specific conductance as it varies widely depending on the geology of the drainage basin and stream discharge. Data quality was rated as “good” due to sensor drift encountered during the deployment (Wagner et al. 2006; Starkey et al. 2008). Corrections that have been applied to the specific conductance data are listed in Appendix E.

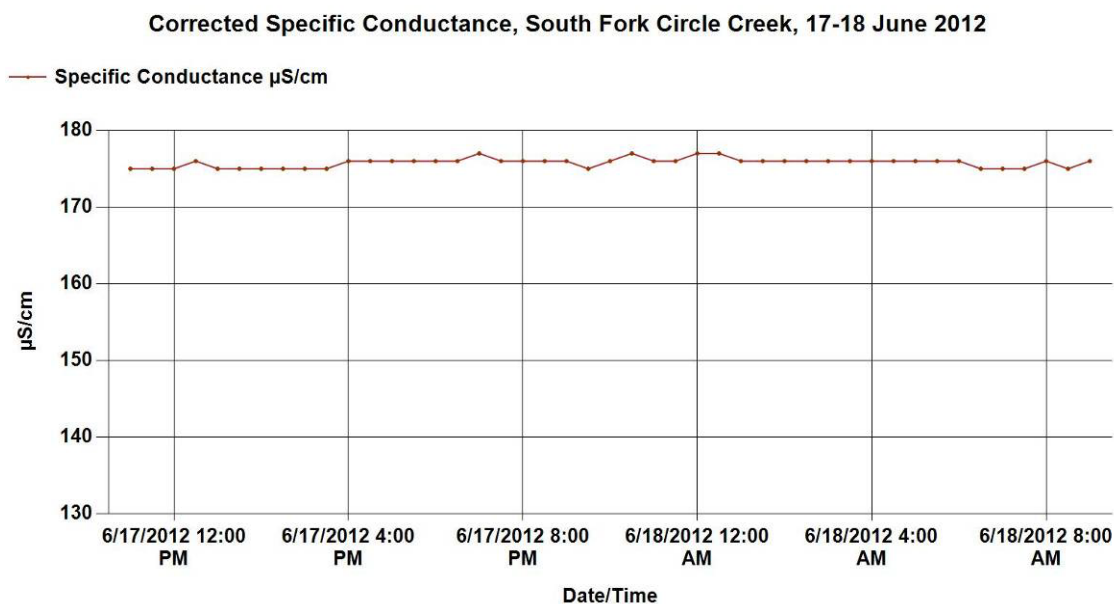


Figure 16. Corrected specific conductance in South Fork Circle Creek, CIRO, June 2012.

- Dissolved Oxygen:**
 Mean daily minimum dissolved oxygen was 7.89 mg/L and was never below the cold water aquatic life criteria of 6.0 mg/L. Minimum dissolved oxygen levels corresponded to maximum water temperatures. Figure 17 shows dissolved oxygen and temperature in South Fork Circle Creek from June 17th and 18th 2012. Data quality was rated as “excellent” due to the lack of sensor drift encountered during the deployment (Wagner et al. 2006; Starkey et al. 2008). Corrections that have been applied to the specific conductance data are listed in Appendix E.

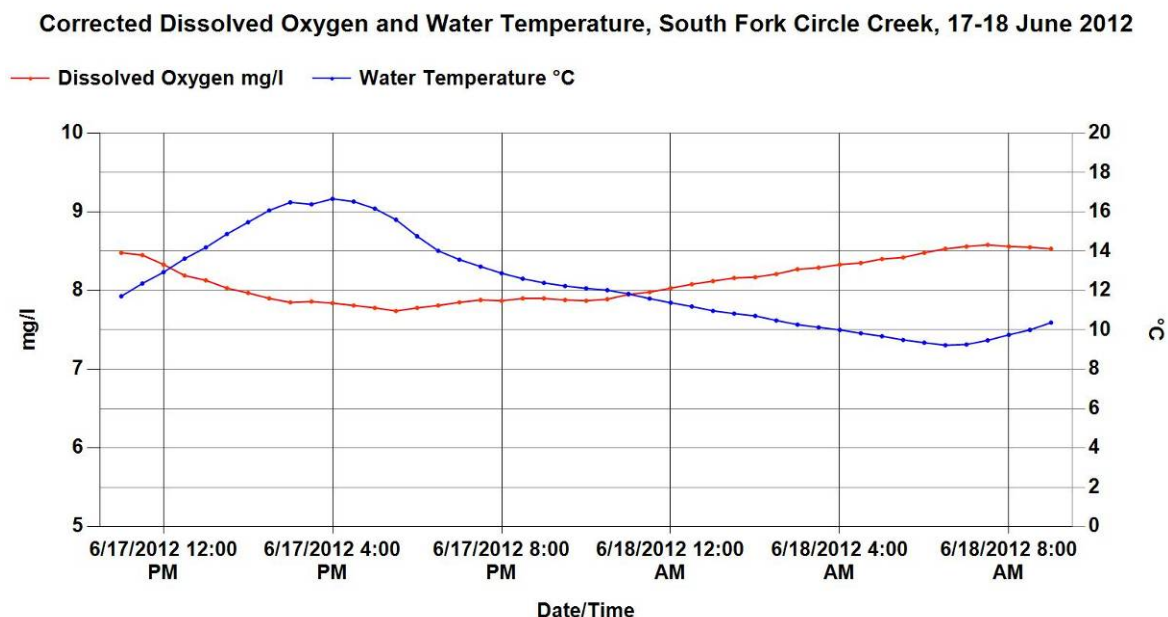


Figure 17. Corrected dissolved oxygen and temperature in South Fork Circle Creek, CIRO, June 2012.

- pH:**
 The minimum and maximum pH (7.87 and 8.22 respectively) were never outside the acceptable cold water aquatic life thresholds of 6.5-9.0 pH units and the median (7.94 pH units) was well within this range. Figure 18 shows pH levels in South Fork Circle Creek on June 17th and 18th 2012. Data quality was rated as “excellent” due to the lack of sensor drift encountered during the deployment (Wagner et al. 2006; Starkey et al. 2008). Corrections that have been applied to the specific conductance data are listed in Appendix E.

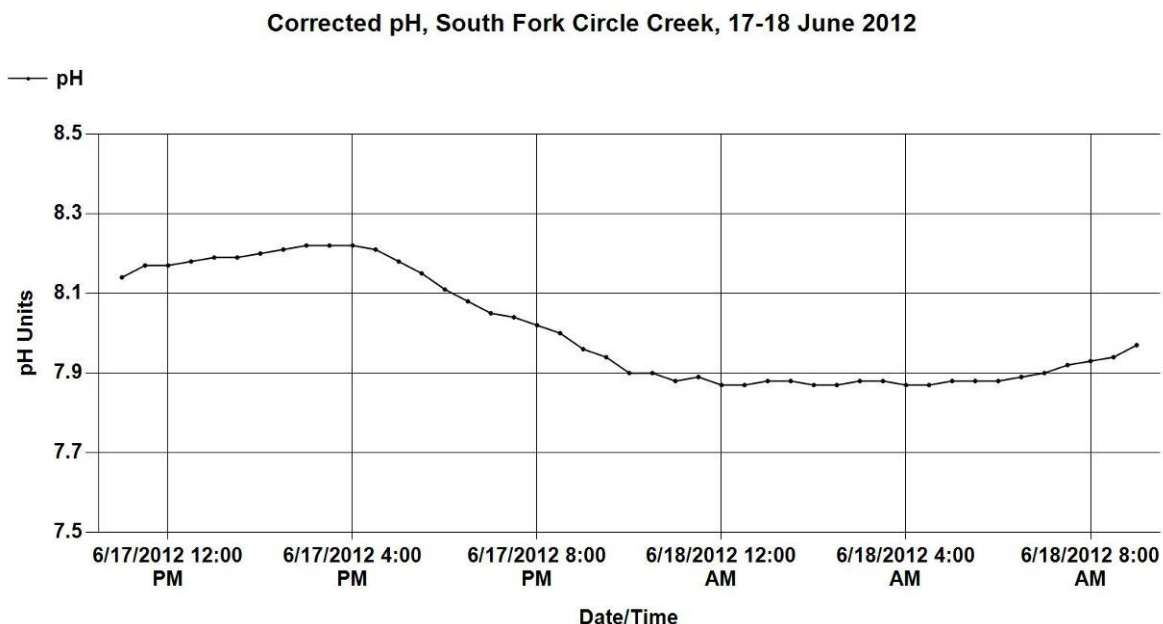


Figure 18. Corrected pH in South Fork Circle Creek, CIRO, June 2012.

Note that the maximum and minimum regulatory thresholds were never exceeded (6.5, 9.0 pH units).

- Turbidity:**
 June 17th -18th, the mean daily maximum turbidity was 11.55 NTU and was well under state thresholds for cold water aquatic life (Figure 19). The thresholds states that turbidity should be “< 50 NTU over background (instantaneous) and < 25 NTU for 10 consecutive days. As indicated in the 2009 report, this stream likely experiences periods of very high turbidity following heavy rainfall and quickly returns to low turbidity levels as stream flow stabilizes (Starkey 2010). It is important to note that the method detection limit (MDL) for this sensor was 0.2 NTU and the minimum level of quantitation (ML) was 0.49 NTU (Appendix D). Although some outliers were removed, data quality was rated as “excellent” due to the lack of sensor drift encountered during the deployment (Wagner et al. 2006; Starkey et al. 2008). Corrections that have been applied to the specific conductance data are listed in Appendix E.

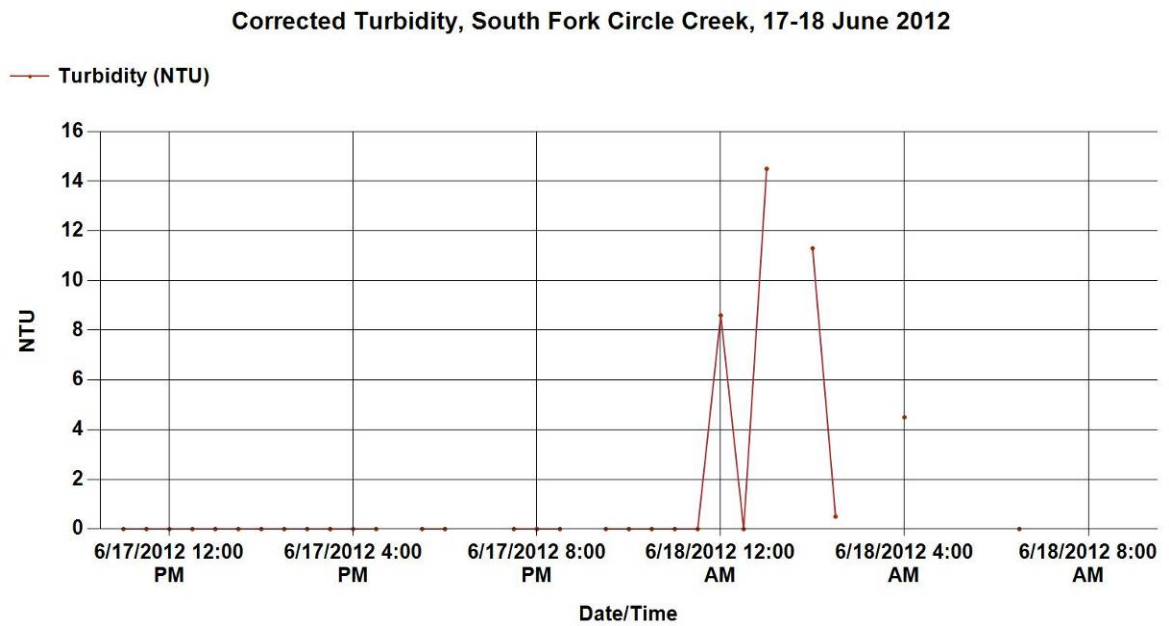


Figure 19. Corrected turbidity in South Fork Circle Creek, CIRO, June 2012.

Macroinvertebrates

Status:

In 2012, South Fork Circle Creek Sites 3222 and 3223 (Reach ID 6474 and 6475) were sampled for stream channel characteristics and riparian vegetation; however, during field work, surface flow stopped in half of the reach and no macroinvertebrate samples were taken. If surface flow exists, these two sites will be re-evaluated in 2013. See Starkey 2010 for results of sampling that occurred in 2009.

City of Rocks National Reserve (CIRO): Circle Creek

Water Chemistry

Status:

Condition of core water quality parameters along with the corresponding Idaho DEQ regulatory threshold are given in Table 5. Data indicate that conditions in Circle Creek were within acceptable ranges relative to criteria for cold water aquatic life. Individual parameters are discussed below.

Table 5. Vital sign summary table for water chemistry in Circle Creek June, 2012

Circle Creek Water Chemistry Summary for 24 hour period 16-17 June 2012			
Measure	Current Condition (16-17 June, 2012)	State DEQ Thresholds ^d	% Exceedance ^b
Temperature (*MDMT, **MDAT)	* MDMT= 20.34 °C ** MDAT= 16.14 °C	*MDMT<22 °C	0%
		**MDAT<19 °C	0%
Specific conductance (mean)	432.14 µS/cm	N/A	N/A
Dissolved oxygen (mean daily min)	7.52 mg/L	> 6.0 mg/L	0%
pH (mean daily max)	8.32 pH Units	9.0 pH Units, Max	0%
pH (mean daily min)	8.25 pH Units	6.5 pH Units, Min	
Turbidity (mean daily max)	<0.02 NTU	< 50 NTU over background (instantaneous) < 25 for 10 consecutive days	Insufficient data

*MDMT – Maximum Daily Maximum Temperature, **MDAT – Maximum Daily Average Temperature, ^a Criteria for cold water aquatic life designation, ^b Proportion of samples above water quality standard (Note that the % exceedance indicated is based on 24 hours of data)

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

- Temperature:**

June 16-17th 2012, the maximum daily maximum temperature (MDMT) was 20.34 °C and the maximum daily average temperature (MDAT) was 16.14 °C (Figure 20). Neither the MDMT nor MDAT exceeded the cold water aquatic life criteria of 22.0 °C and 19 °C respectively. However; the MDMT was substantially warmer than the North and South Fork Circle Creeks and may exceed thresholds in late summer (when water persists in the stream channel). Warmer water temperatures are likely due to a combination of natural and human induced causes. Natural causes include; increased distance from spring sources and lower gradient stream channel. Human induced causes may include: reduced riparian vegetation and alteration of the stream channel to form ponds or shallow pools (Figures 21 and 22). One example is the pool just downstream of City of Rocks road. This pool increases water retention time and heating via solar radiation.

Maximum and average temperatures were warmer than in 2009; however, weather conditions in 2009 were exceedingly wet and cool (see Starkey 2010). Data quality was rated as “good” due to the degree of sensor drift encountered during the deployment (Wagner et al. 2006; Starkey et al. 2008).

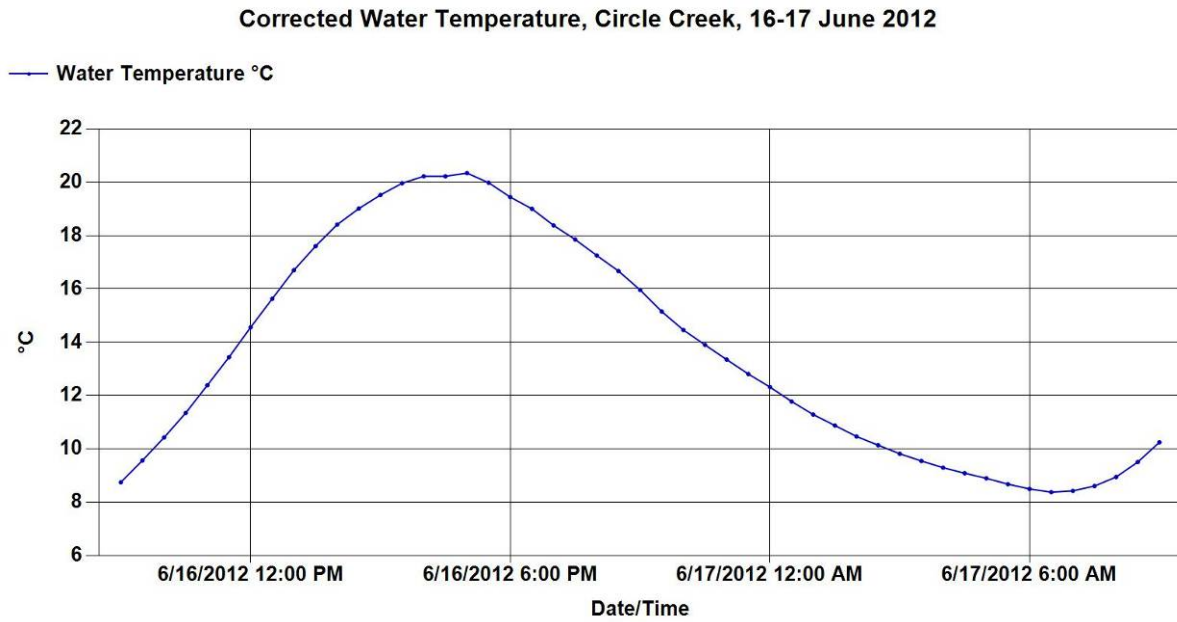


Figure 20. Corrected temperature in Circle Creek, CIRO, June 2012.



Figure 21. Looking downstream at pool constructed just downstream of City of Rocks road on Circle Creek.



Figure 22. Looking upstream at pool constructed just downstream of City of Rocks road on Circle Creek.

- *Specific Conductance:*

Specific conductance ranged from 410.0 to 454.0 $\mu\text{S}/\text{cm}$, with an average specific conductance of 432.1 $\mu\text{S}/\text{cm}$ (Figure 23). These values were substantially higher than those on North Fork and South Fork Circle Creek. Note that there is no state threshold for specific conductance as it varies widely depending on the geology of the drainage basin and stream discharge. Data quality was rated as “good” due to sensor drift encountered during the deployment (Wagner et al. 2006; Starkey et al. 2008). Corrections that have been applied to the specific conductance data are listed in Appendix E.

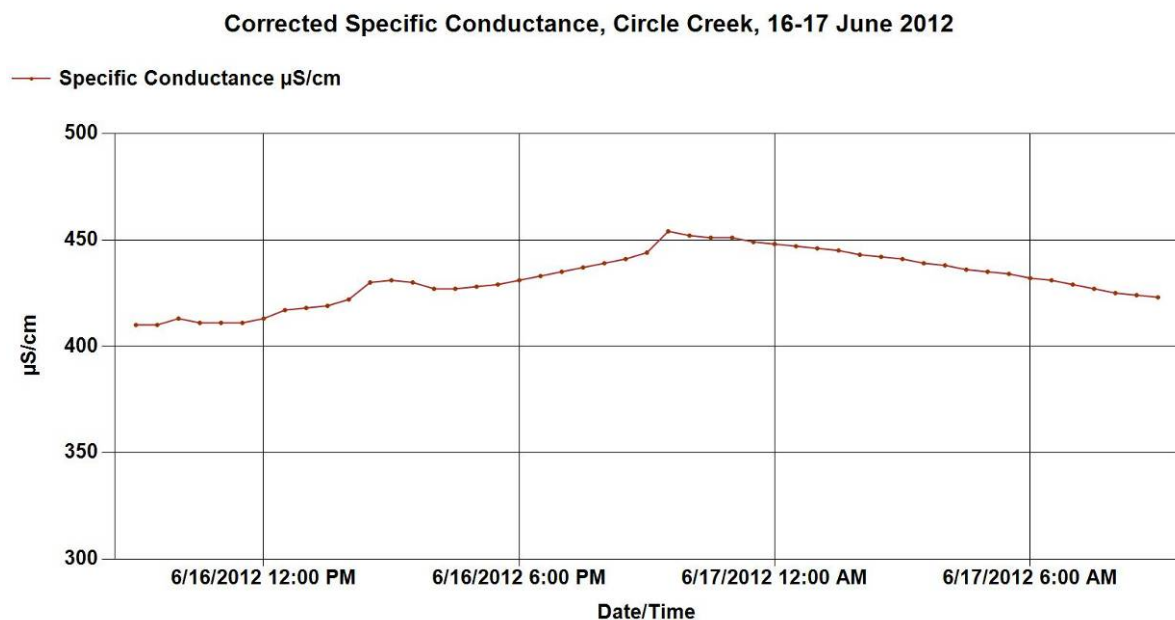


Figure 23. Corrected specific conductance in Circle Creek, CIRO, June 2012.

- Dissolved Oxygen:**
 Mean daily minimum dissolved oxygen was 7.52 mg/L and was never below the cold water aquatic life criteria of 6.0 mg/L. Minimum dissolved oxygen levels corresponded to maximum water temperatures. Figure 24 shows dissolved oxygen and temperature in Circle Creek from June 16th and 17th 2012. Data quality was rated as “excellent” due to the lack of sensor drift encountered during the deployment (Wagner et al. 2006; Starkey et al. 2008). Corrections that have been applied to the specific conductance data are listed in Appendix E.

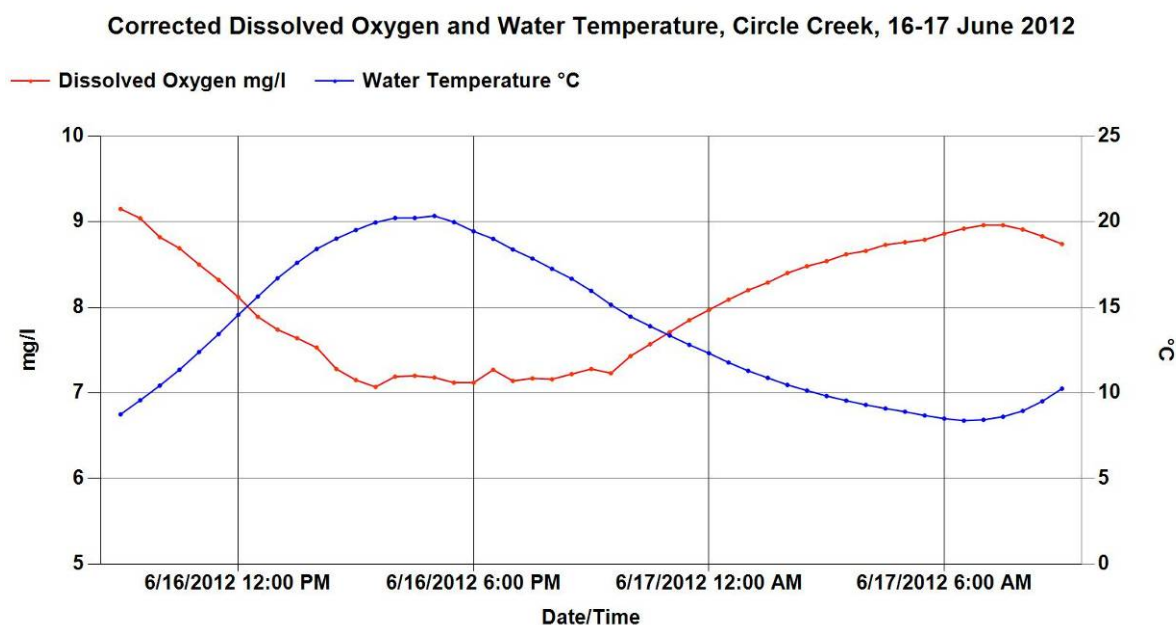


Figure 24. Corrected dissolved oxygen and temperature in Circle Creek, CIRO, June 2012.

- pH:**
 The minimum and maximum pH (8.24 and 8.37 respectively) were never outside the acceptable cold water aquatic life thresholds of 6.5-9.0 pH units and the median (8.27 pH units) was within this range. Although currently within acceptable ranges, future pH results should be monitored closely for exceedances of the upper pH threshold. Figure 25 shows pH levels in Circle Creek on June 16th and 17th 2012. Data quality was rated as “excellent” due to the lack of sensor drift encountered during the deployment (Wagner et al. 2006; Starkey et al. 2008). Corrections that have been applied to the specific conductance data are listed in Appendix E.

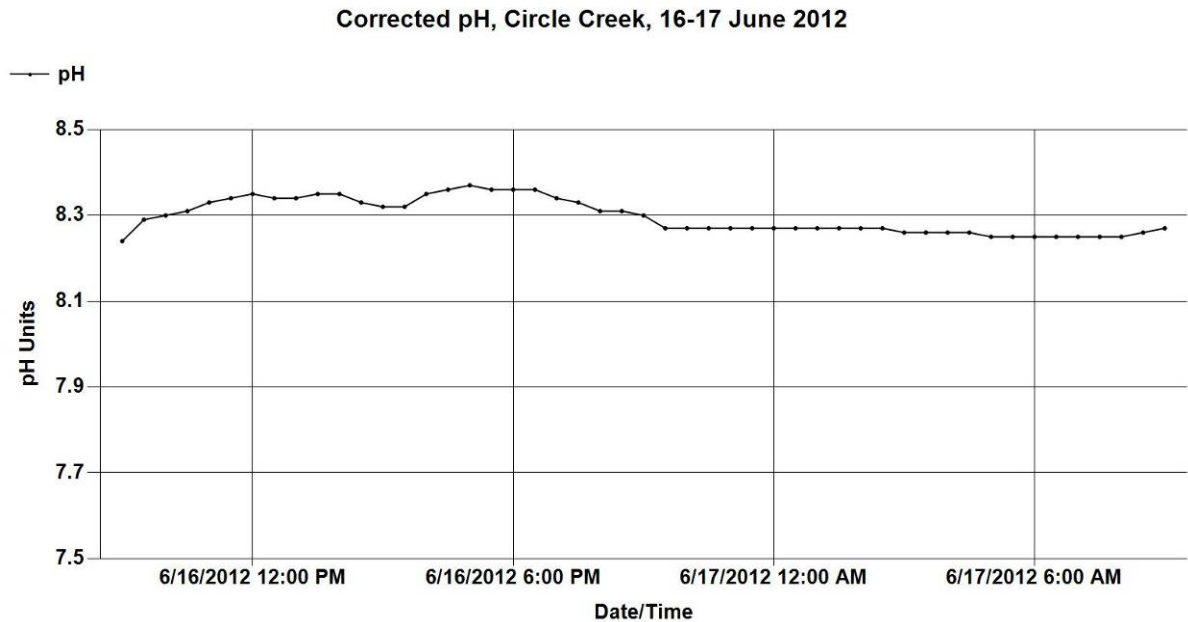


Figure 25. Corrected pH in Circle Creek, CIRO, June 2012.

Note that the maximum and minimum regulatory thresholds were never exceeded (6.5, 9.0 pH units).

- Turbidity:**
 June 16th -17th, the mean daily maximum turbidity was <0.2 NTU and was well under state thresholds for cold water aquatic life (Figure 26). The thresholds states that turbidity should be “< 50 NTU over background (instantaneous) and < 25 NTU for 10 consecutive days. As indicated in the 2009 report, Circle Creek likely experiences periods of very high turbidity following heavy rainfall and quickly returns to low turbidity levels as stream flow stabilizes (Starkey 2010). It is important to note that the method detection limit (MDL) for this sensor was 0.2 NTU and the minimum level of quantitation (ML) was 0.49 NTU (Appendix D). Although some outliers were removed, data quality was rated as “excellent” due to the lack of sensor drift encountered during the deployment (Wagner et al. 2006; Starkey et al. 2008). Corrections that have been applied to the specific conductance data are listed in Appendix E.

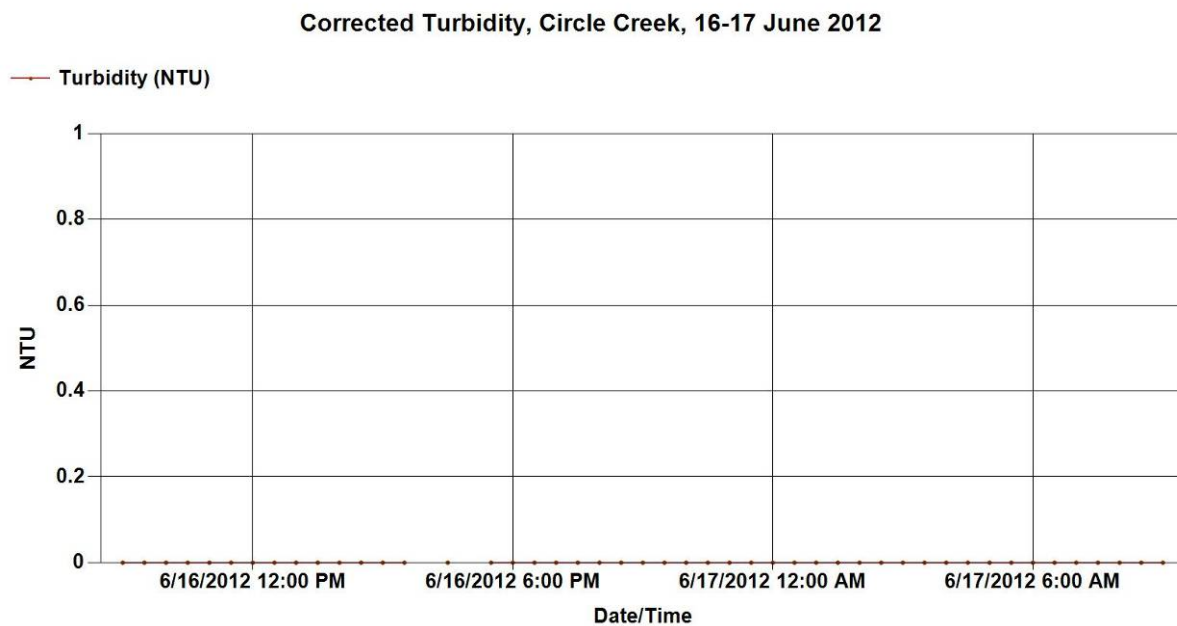


Figure 26. Corrected turbidity in Circle Creek, CIRO, June 2012.
Note that the method detection limit (MDL) is 0.2 NTU; as a result all values <0.2 NTU are recorded as 0.0 NTU.

Macroinvertebrates

Status:

In 2012, Circle Creek Sites 3224 and 3226 (Reach ID 6476 and 6478) were sampled for stream channel characteristics and riparian vegetation; however, macroinvertebrates were not collected due to insufficient streamflow and beaver dams. If surface flow exists, these two sites will be re-evaluated in 2013. See Starkey 2010 for results of sampling that occurred in 2009. Note that the presence of Beaver (*Castor canadensis*) and their dams may facilitate natural aggregation of the deeply incised stream channel.

Castle Rocks State Park (CRSP): Almo

Water Chemistry

Status:

Condition of core water quality parameters along with the corresponding Idaho DEQ regulatory threshold are given in Table 6. Data indicate that conditions were well within acceptable ranges relative to criteria for cold water aquatic life. Individual parameters are discussed below.

Table 6. Vital sign summary table for water chemistry in Almo Creek June, 2012

Almo Creek Water Chemistry Summary for 24 hour period 16-17 June 2012

Measure	Current Condition (16-17 June, 2012)	State DEQ Thresholds ^a	% Exceedance ^b
Temperature (*MDMT, **MDAT)	* MDMT= 18.94 °C	*MDMT<22 °C	0%
	** MDAT= 14.64 °C	**MDAT<19 °C	0%
Specific conductance (mean)	68.55 µS/cm	N/A	N/A
Dissolved oxygen (mean daily min)	7.88 mg/L	> 6.0 mg/L	0%
pH (mean daily max)	7.67 pH Units	9.0 pH Units, Max	0%
pH (mean daily min)	7.56 pH Units	6.5 pH Units, Min	0%
Turbidity (mean daily max)	-- ^c	< 50 NTU over background (instantaneous) < 25 for 10 consecutive days	Insufficient data

*MDMT – Maximum Daily Maximum Temperature, **MDAT – Maximum Daily Average Temperature, ^a Criteria for cold water aquatic life designation, ^b Proportion of samples above water quality standard (Note that the % exceedance indicated is based on 24 hours of data) ^c Poor data quality precludes reporting

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

- Temperature:**

June 16-17th 2012, the maximum daily maximum temperature (MDMT) was 18.94 °C and the maximum daily average temperature (MDAT) was 14.64 °C (Figure 27). Neither the MDMT nor MDAT exceeded the cold water aquatic life criteria of 22.0 °C and 19 °C respectively. Maximum and average temperatures were warmer than in 2009; however, weather conditions in 2009 were exceedingly wet and cool (see Starkey 2010). Data quality was rated as “good” due to the degree of sensor drift encountered during the deployment (Wagner et al. 2006; Starkey et al. 2008).

In 2011 and 2012 continuous temperature data was recorded in Almo Creek (June-August and June-October) but should not be directly compared to the 2009 and 2012 24-hour temperature data due to differences in deployment location. Differences in deployment location were necessary in order to insure sufficient water levels for long term deployment of the temperature logger. In 2011, the MDMT and MDAT were 20.82 °C and 16.84 °C. In 2012, the MDMT and MDAT were 19.98 °C and 16.34 °C. Our data suggest that cool water temperatures persist in midsummer months despite relatively low flow conditions.

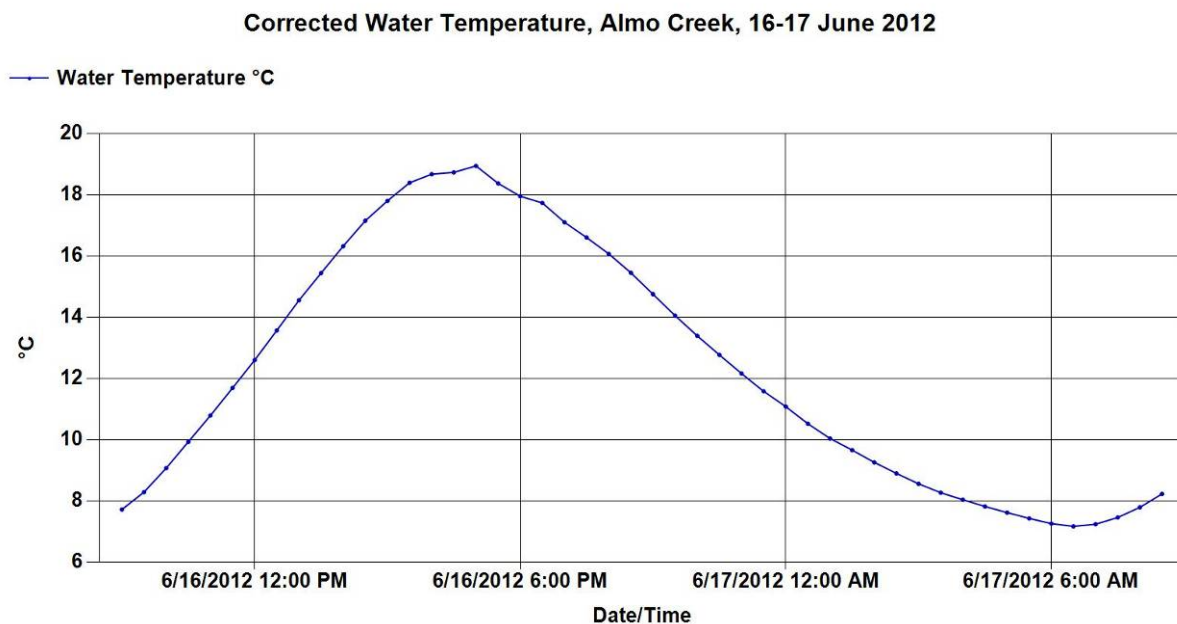


Figure 27. Corrected temperature in Almo Creek, CRSP, June 2012.

- *Specific Conductance:*

Specific conductance ranged from 67.0 to 71.0 $\mu\text{S}/\text{cm}$, with an average specific conductance of 68.6 $\mu\text{S}/\text{cm}$ (Figure 28). Note that there is no state threshold for specific conductance as it varies widely depending on the geology of the drainage basin and stream discharge. Data quality was rated as “excellent” due to the lack of sensor drift encountered during the deployment (Wagner et al. 2006; Starkey et al. 2008). Corrections that have been applied to the specific conductance data are listed in Appendix E.

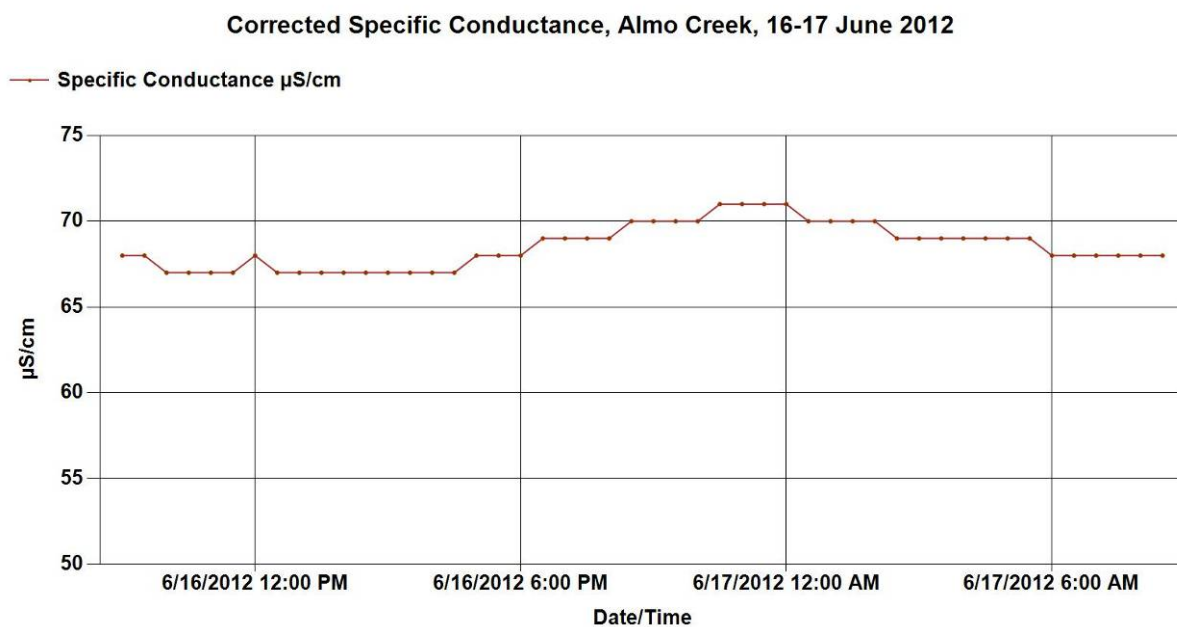


Figure 28. Corrected specific conductance in Almo Creek, CRSP, June 2012.

- Dissolved Oxygen:**
 Mean daily minimum dissolved oxygen was 7.88 mg/L and was never below the cold water aquatic life criteria of 6.0 mg/L. Minimum dissolved oxygen levels corresponded to maximum water temperatures. Figure 29 shows dissolved oxygen and temperature in Almo Creek from June 16th and 17th 2012. Data quality was rated as “excellent” due to the lack of sensor drift encountered during the deployment (Wagner et al. 2006; Starkey et al. 2008). Corrections that have been applied to the specific conductance data are listed in Appendix E.

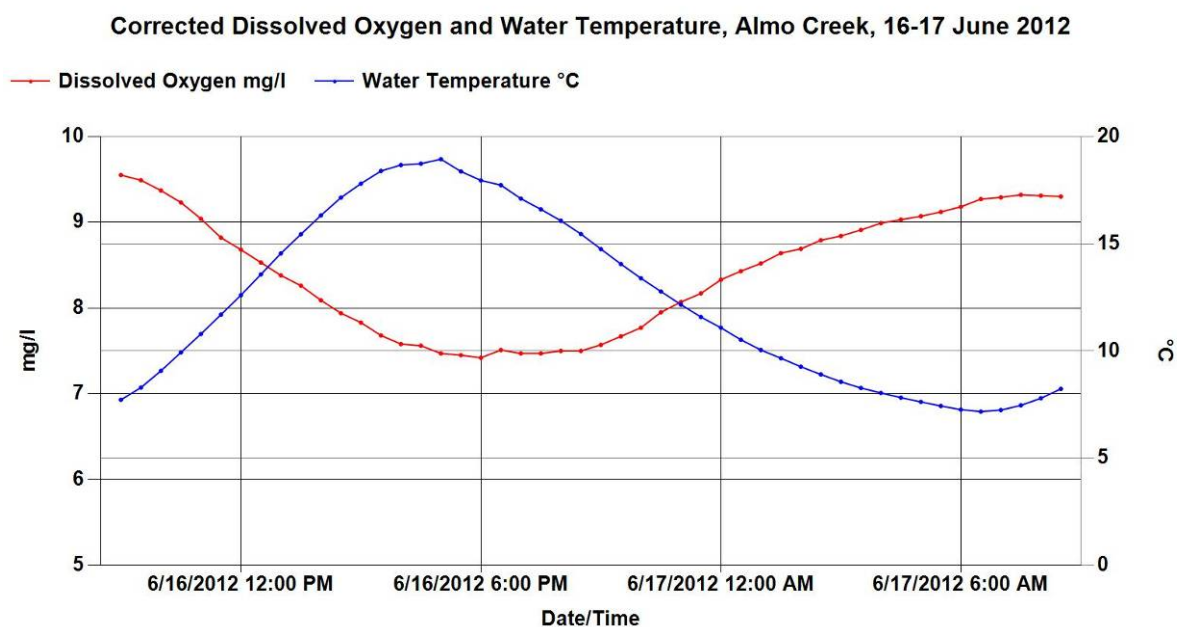


Figure 29. Corrected dissolved oxygen and temperature in Almo Creek, CRSP, June 2012.

- pH:**
 The minimum and maximum pH (7.52 and 7.69 respectively) were never outside the acceptable cold water aquatic life thresholds of 6.5-9.0 pH units and the median (7.62 pH units) was well within this range. Figure 30 shows pH levels in Almo Creek on June 16th and 17th 2012. Data quality was rated as “excellent” due to the lack of sensor drift encountered during the deployment (Wagner et al. 2006; Starkey et al. 2008). Corrections that have been applied to the specific conductance data are listed in Appendix E.

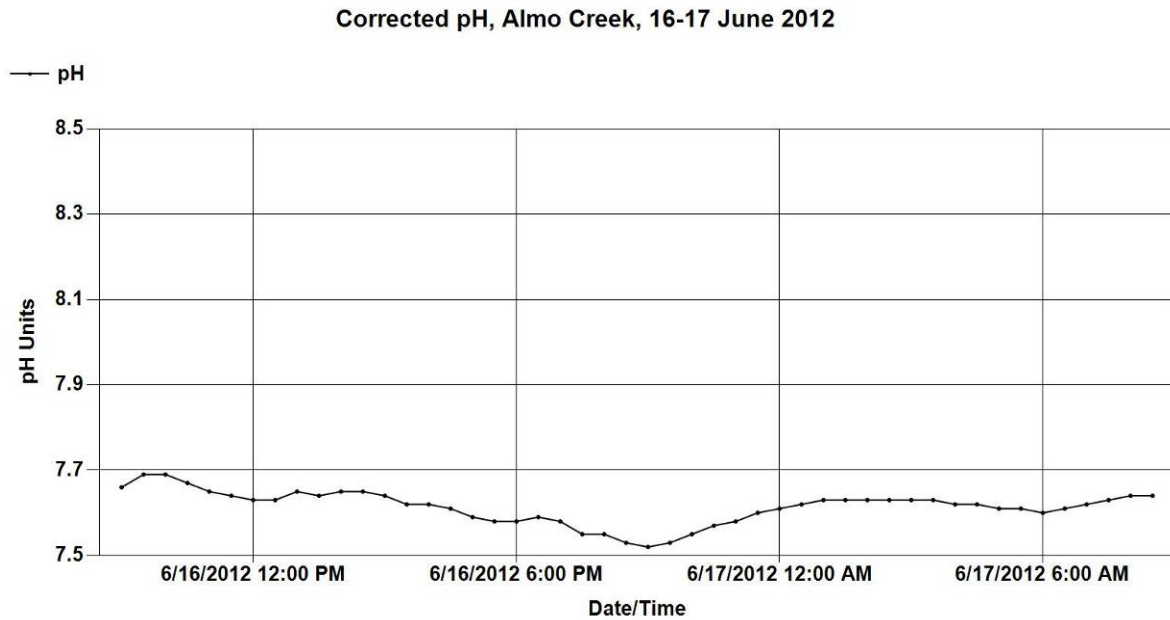


Figure 30. Corrected pH in Almo Creek, CRSP, June 2012.

Note that the maximum and minimum regulatory thresholds were never exceeded (6.5, 9.0 pH units).

- *Turbidity:*

Prior to discussion about turbidity in Almo Creek (Figure 31), it should be noted that conclusions based on this data are limited due to unusable data quality. Sensor drift was the primary factor influencing data quality. It is important to note that the method detection limit (MDL) for this sensor was 0.2 NTU and the minimum level of quantitation (ML) was 0.58 NTU (Appendix D). Figure 31 shows the raw (uncorrected) turbidity in Almo Creek June 16th and 17th 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.

Regulatory thresholds for turbidity state that it should be “< 50 NTU over background (instantaneous) and < 25 NTU for 10 consecutive days.” Although conclusions are limited based on the quality of data collected in 2012, it is likely that Almo Creek does meet these criteria during normal low flow conditions. As indicated in the 2009 report, this stream likely experiences periods of very high turbidity following heavy rainfall events (Starkey 2010).

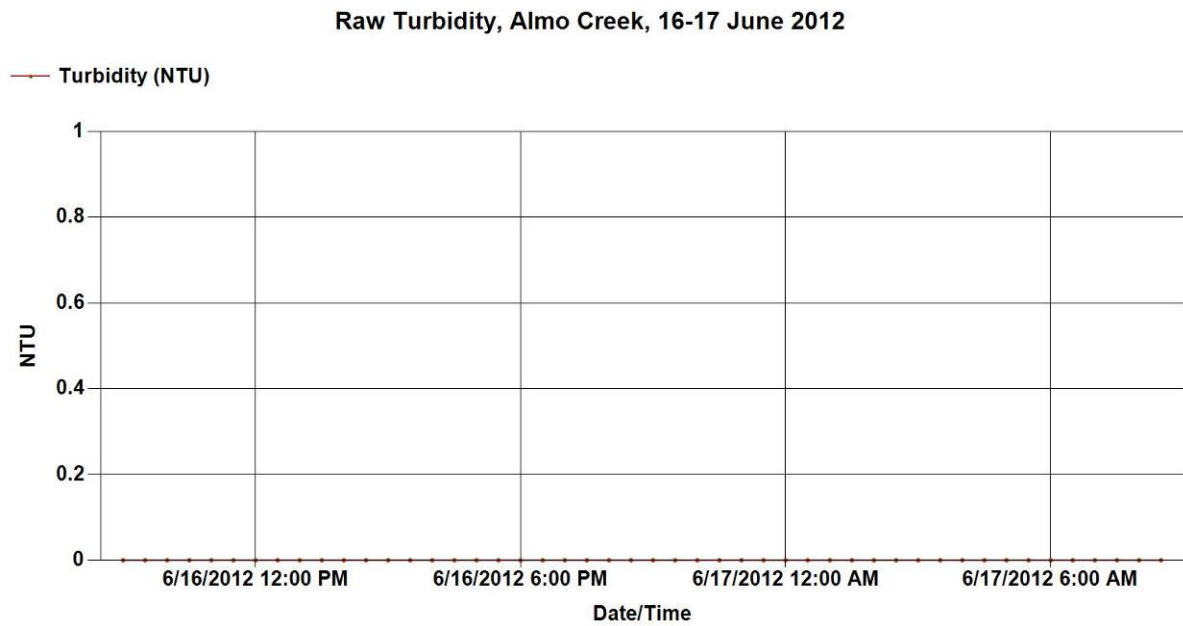


Figure 31. Raw turbidity in Almo Creek, CRSP, June 2012.

Macroinvertebrates

Status:

Due to varying stream flows during sampling, PIBO station 3219 has limited macroinvertebrate results. On day one of sampling there was no stream flow between transect 12 and the bottom of the reach. On the second day of sampling, following rain, the bottom of the reach went from flowing water to dry in less than 4 hours.

The Hilsenhoff Biotic Index (HBI), which summarizes pollution tolerances of the macroinvertebrate taxa within the sample, was 2.15 in reach #3218 and could not be determined for reach #3219. The HBI value indicates that water quality was “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 averaged 3.96 indicated “very good” water quality with “possible slight organic pollution.” It should be noted that macroinvertebrate sample collection methods and locations differed between 2009 and 2012 (Starkey et al. 2008).

The US Forest Service (USFS) community tolerance quotient was 76 and 108. Community tolerance quotient values vary from 20 to just over 100, with lower values indicating better water quality. Although a community tolerance quotient was calculated for reach #3219, it should be interpreted with caution due to limited sampling caused by low/no-flow conditions. In reach #3218, the number of Ephemeroptera, Plecoptera, Trichoptera (EPT) taxa was 10; and there were 8 long lived taxa. No EPT taxa were encountered in reach #3219 and there was a single long lived taxa. In reach #3218, the dominate family was Baetidae (small minnow mayflies) and in the other (#3221) Elmidae (riffle beetles).

The observed to expected ratio (OE) or River Invertebrate Prediction and Classification System (RIVPACS) score was 0.83 for reach #3218. This indicated that biological condition was “good” (>0.78). An O/E score was not calculated for reach #3219 due to the small sample size (i.e. lack of individuals in the sample). See Table 7 and Appendix F for additional summary metrics.

These data suggest that the macroinvertebrate assemblage within in Almo Creek is in good condition. Additional samples not subject to the influence of rapid changes in stream flow and dry channel will help confirm these results. Almo Creek will be re-sampled in 2015.

Table 7. Vital sign summary table for benthic macroinvertebrates in Almo Creek, 2012.

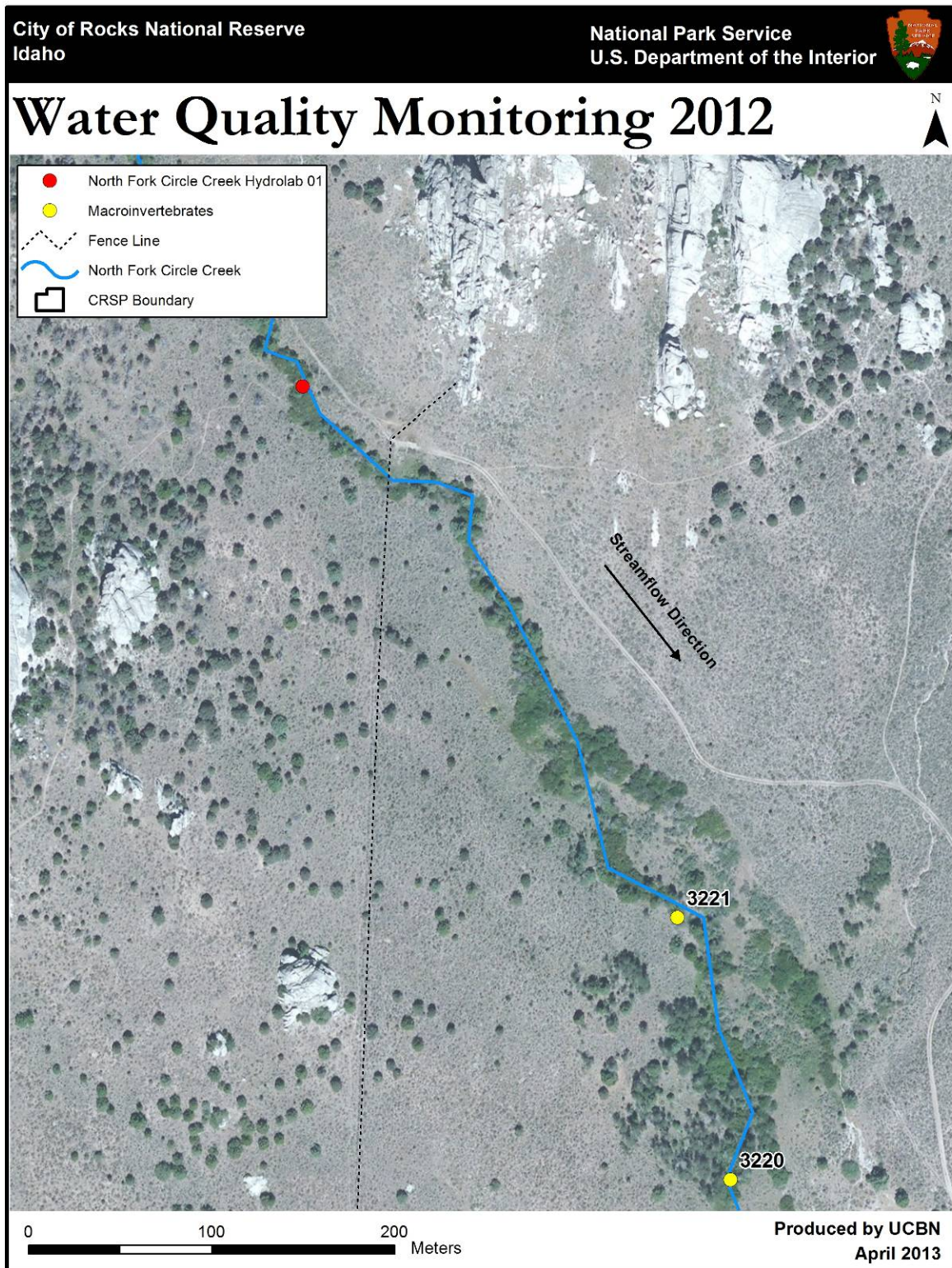
Almo Creek Macroinvertebrate Summary July 2012		
PIBO Station	3218	3219
Sample ID	149042	149043
Richness*	33	2
Shannon's Diversity*	2.47	0.69
Simpson's Diversity*	0.87	1.00
Evenness*	0.71	1.00
# of EPT Taxa*	10	0
Dominant Family	Baetidae	Elmidae
Dominant Taxa	Chloroperlinae	Trichoptera
Hilsenhoff Biotic Index*	2.15	0.00
# of Intolerant Taxa*	6	0
# of Tolerant Taxa*	2	0
Tolerant Taxa Abundance	5	0
USFS Community Tolerance Quotient (d)*	76	108
# of shredder taxa*	2	0
# of scraper taxa*	3	0
# of collector-filterer taxa*	0	0
# of collector-gatherer taxa*	8	0
# of predator taxa*	12	0
# of clinger taxa*	7	1
Long-lived Taxa*	8	1

Literature Cited

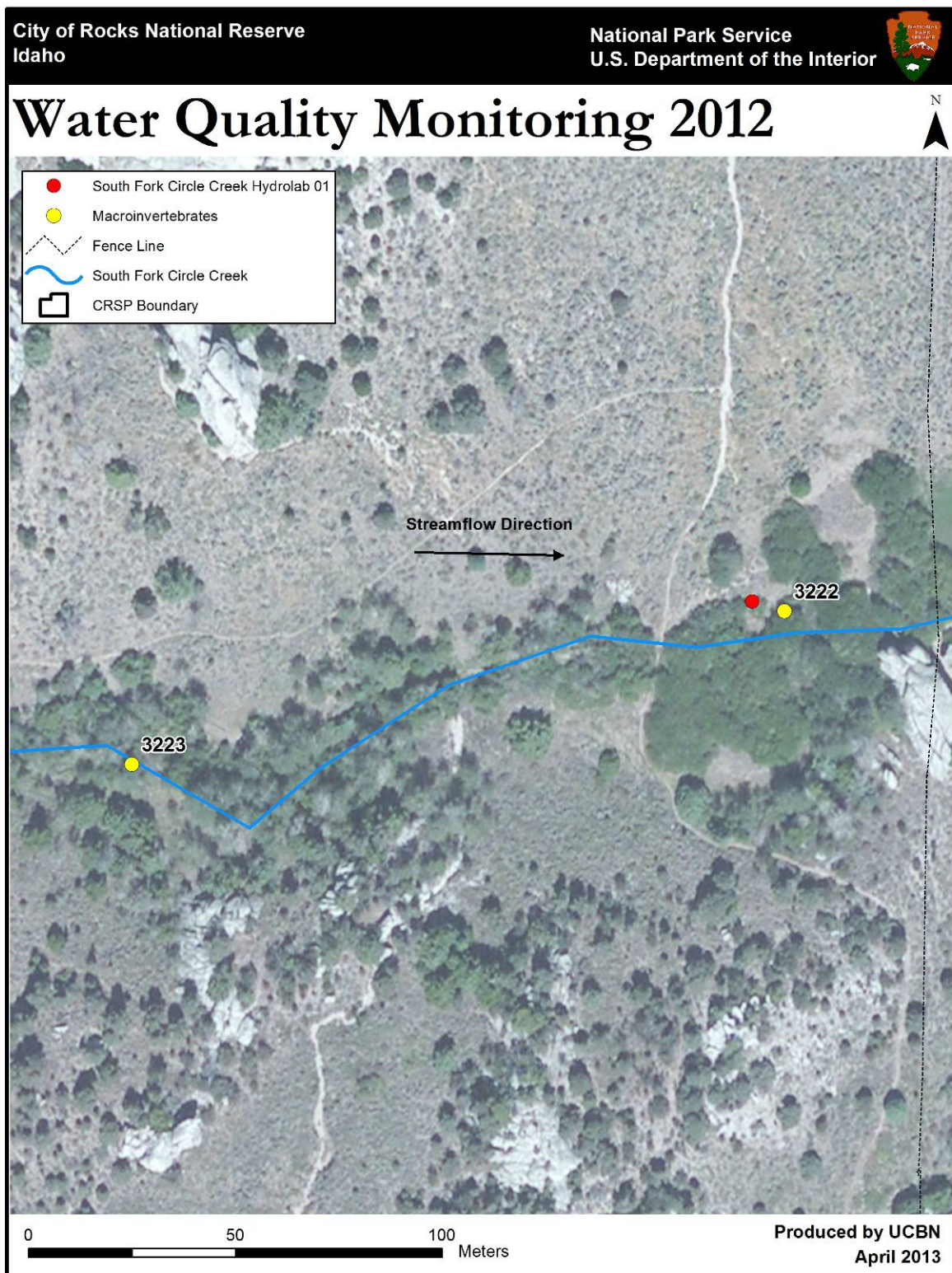
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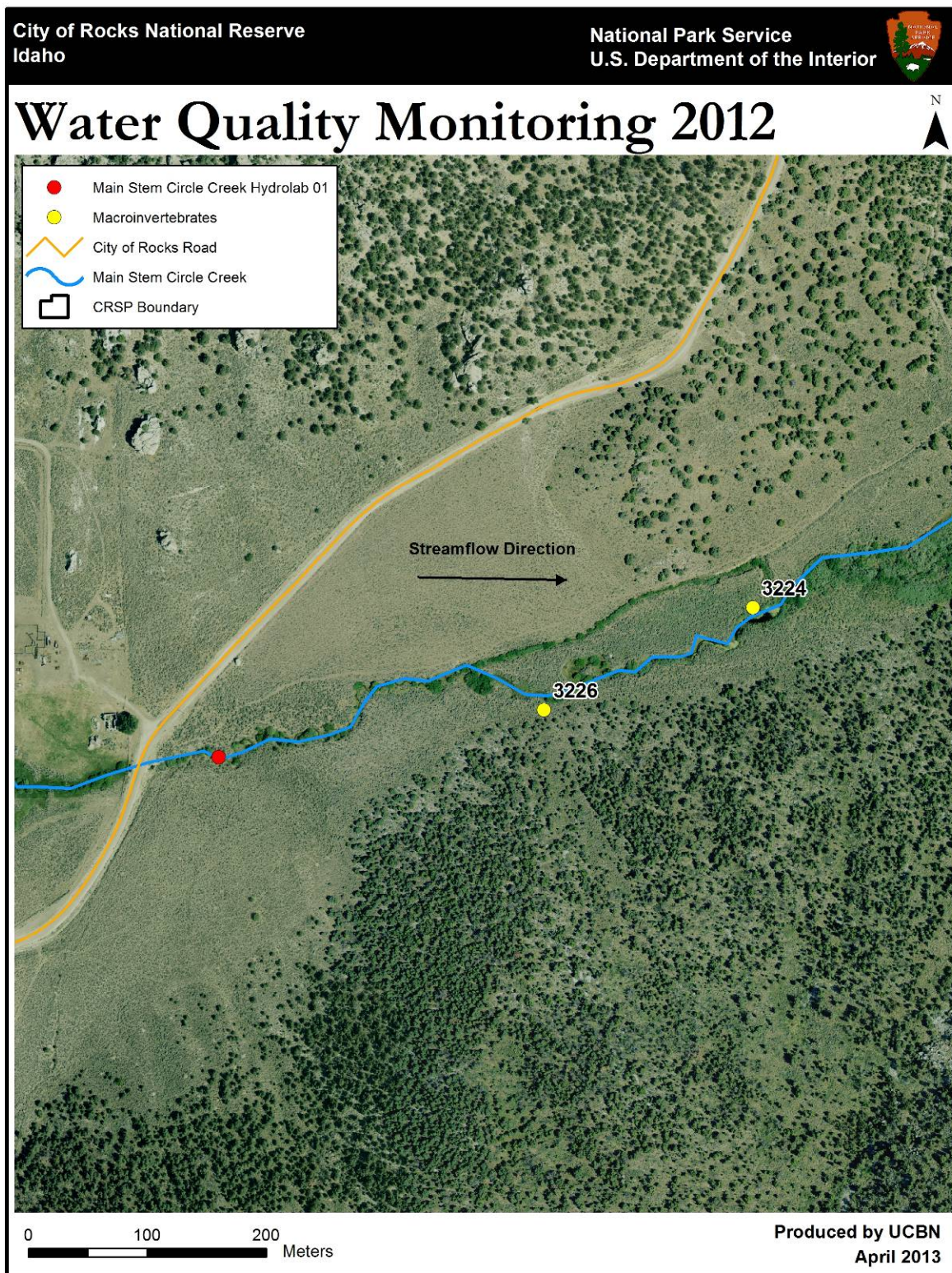
Appendix A. 2012 Water Quality Monitoring Locations



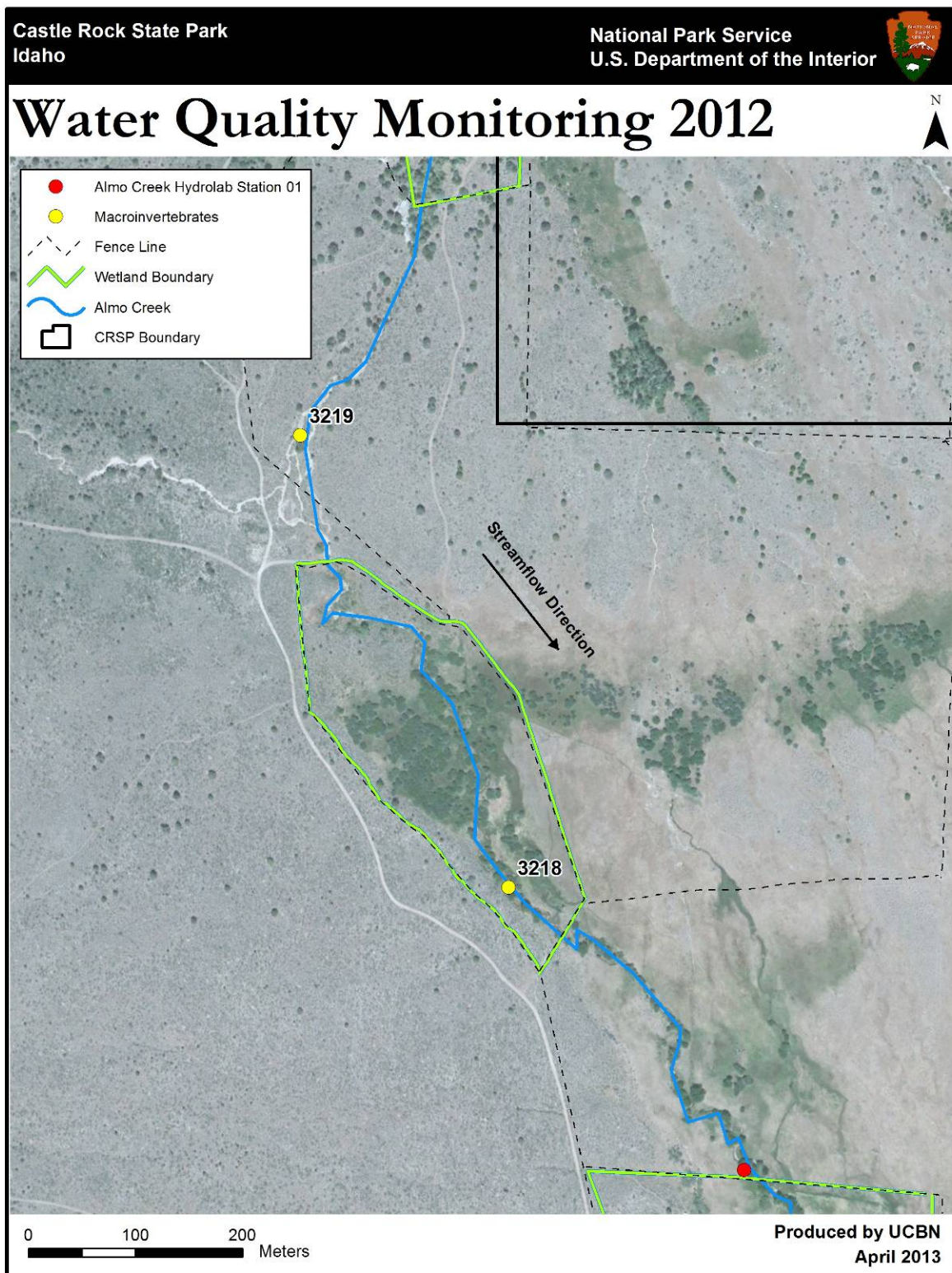
Appendix A. 2012 Water Quality Monitoring Locations (continued)



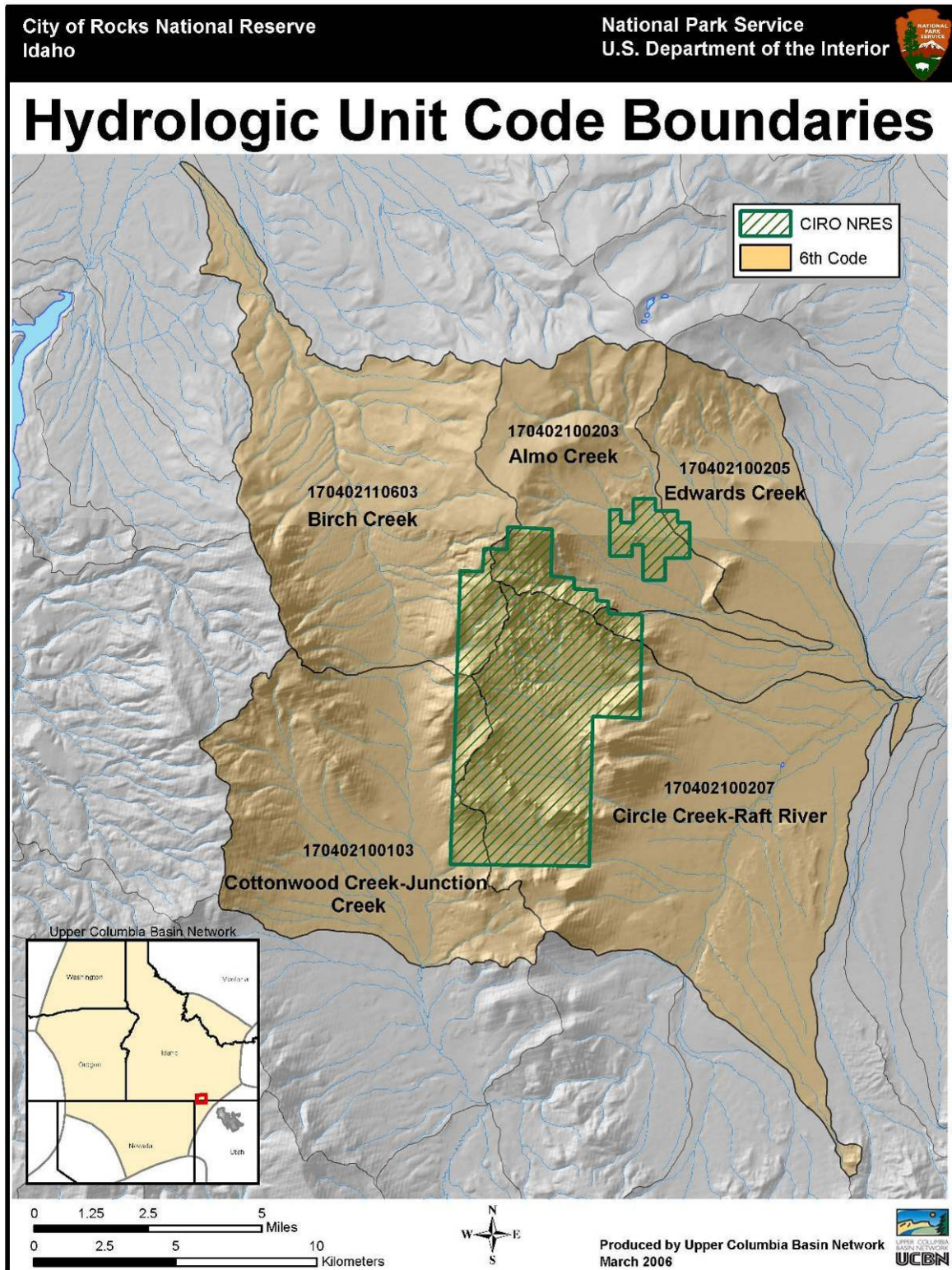
Appendix A. 2012 Water Quality Monitoring Locations (continued)



Appendix A. 2012 Water Quality Monitoring Locations (continued)



Appendix B. CIRO/CRSP Hydrologic Unit Code Boundaries



Appendix C. Sample Locations for Water Quality Monitoring at CIRO/CRSP

Park	Stream	Monitoring Type	Station #/ Site ID	Lat.	Long.	Y	X
CIRO	North Fork Circle Creek	Water Chemistry	001	42.090693	-113.707035	4663392.25359	276119.93333
CIRO	South Fork Circle Creek	Water Chemistry	001	42.077681	-113.707022	4661946.25176	276076.14854
CIRO	Circle Creek	Water Chemistry	001	42.076254	-113.680830	4661720.21418	278238.00566
CRSP	Almo Creek	Water Chemistry	001	42.126794	-113.659879	4667279.22126	280145.31404
CIRO	North Fork Circle Creek	Macroinvertebrates	3220	42.0868722	-113.703967	4662960	276360
CIRO	North Fork Circle Creek	Macroinvertebrates	3221	42.0881861	-113.7044	4663107	276329
CIRO	South Fork Circle Creek	Macroinvertebrates	3222	42.0774917	-113.706889	4661926	276085
CIRO	South Fork Circle Creek	Macroinvertebrates	3223	42.0772472	-113.708811	4661904	275926
CIRO	Circle Creek	Macroinvertebrates	3224	42.0773806	-113.675389	4661832	278691
CIRO	Circle Creek	Macroinvertebrates	3226	42.0768028	-113.677481	4661773	278516
CRSP	Almo Creek	Macroinvertebrates	3218	42.1292361	-113.662408	4667556	279944
CRSP	Almo Creek	Macroinvertebrates	3219	42.1328139	-113.664922	4667960	279749

Note that X and Y have been projected in WGS84, 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 2012 season at CIRO- South Fork Circle Creek and Circle Creek, Hydrolab #054, Station ID: CIRO-South Fork Circle Creek #001 and CIRO-Circle Creek #001. Note that this instrument was also used at BIHO- North Fork Big Hole River #001 from 07/25/2012-08/27/2012.

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	1.10	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
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	--	--

Q QC data quality indicators for 2012 season at CIRO- North Fork Circle Creek and CRSP-Almo Creek, Hydrolab #064, Station ID: CIRO-North Fork Circle Creek #001 and CRSP-Almo Creek #001. Note that this instrument was also used at BIHO- North Fork Big Hole River #001 from 06/20/2012-07/25/2012 and 08/27/2012 to 10/16/2012.

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	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	--

Appendix E. Corrections History

Correction history for North Fork Circle Creek, CIRO 2012 temperature data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
N/A	No Corrections Applied	N/A	N/A	N/A	0

Correction history for North Fork Circle Creek, CIRO 2012 specific conductance data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
N/A	No Corrections Applied	N/A	N/A	N/A	0

Correction history for North Fork Circle Creek, CIRO 2012 dissolved oxygen data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
N/A	No Corrections Applied	N/A	N/A	N/A	0

Correction history for North Fork Circle Creek, CIRO 2012 pH data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
N/A	No Corrections Applied	N/A	N/A	N/A	0

Correction history for North Fork Circle Creek, CIRO 2012 turbidity data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
N/A	No Corrections Applied	N/A	N/A	N/A	0

Correction history for South Fork Circle Creek, CIRO 2012 temperature data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
N/A	No Corrections Applied	N/A	N/A	N/A	0

Correction history for South Fork Circle Creek, CIRO 2012 specific conductance data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
N/A	No Corrections Applied	N/A	N/A	N/A	0

Correction history for South Fork Circle Creek, CIRO 2012 dissolved oxygen data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
N/A	No Corrections Applied	N/A	N/A	N/A	0

Appendix E. Corrections History (continued)

Correction history South Fork Circle Creek, CIRO 2012 pH data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
N/A	No Corrections Applied	N/A	N/A	N/A	0

Correction history for South Fork Circle Creek, CIRO 2012 turbidity data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
EStarkey	Delete Region- due to outlier. Suspect sensor blockage due to macroinvertebrates or debris.	6/18/2012 3:00	6/18/2012 3:30	6/26/2012 14:40	2
EStarkey	Delete Region- due to outlier. Suspect sensor blockage due to macroinvertebrates or debris.	6/18/2012 5:00	6/18/2012 6:00	6/26/2012 14:40	3
EStarkey	Delete Region- due to outlier. Suspect sensor blockage due to macroinvertebrates or debris.	6/18/2012 7:00	6/18/2012 8:00	6/26/2012 14:40	3
EStarkey	Delete Region- due to outlier. Suspect sensor blockage due to macroinvertebrates or debris.	6/18/2012 8:24	6/18/2012 9:05	6/26/2012 14:43	2
EStarkey	Delete Region- due to outlier. Suspect sensor blockage due to macroinvertebrates or debris.	6/17/2012 20:53	6/17/2012 21:09	6/26/2012 14:45	1
EStarkey	Delete Region- due to outlier. Suspect sensor blockage due to macroinvertebrates or debris.	6/18/2012 1:26	6/18/2012 1:37	6/26/2012 14:45	1
EStarkey	Delete Region- due to outlier	6/17/2012 19:00	6/17/2012 19:00	6/28/2012 15:48	1
EStarkey	Delete point(s)- due to outlier	6/18/2012 4:30	6/18/2012 4:30	6/28/2012 15:52	1
EStarkey	Delete Region- due to outlier	6/17/2012 17:00	6/17/2012 17:00	9/17/2012 11:28	1
EStarkey	Delete Region- due to outlier	6/17/2012 18:30	6/17/2012 18:30	9/17/2012 11:28	1

Correction history for Circle Creek, CIRO 2012 temperature data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
N/A	No Corrections Applied	N/A	N/A	N/A	0

Correction history for Circle Creek, CIRO 2012 specific conductance data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
N/A	No Corrections Applied	N/A	N/A	N/A	0

Appendix E. Corrections History (continued)

Correction history for Circle Creek, CIRO 2012 dissolved oxygen data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
N/A	No Corrections Applied	N/A	N/A	N/A	0

Correction history for Circle Creek, CIRO 2012 pH data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
N/A	No Corrections Applied	N/A	N/A	N/A	0

Correction history for Circle Creek, CIRO 2012 turbidity data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
EStarkey	Delete region due to outlier	6/16/2012 16:00	6/16/2012 16:00	6/27/2012 14:00	1
EStarkey	Delete region due to outlier	6/16/2012 17:00	6/16/2012 17:00	6/27/2012 14:00	1

Correction history for Almo Creek, CRSP 2012 temperature data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
N/A	No Corrections Applied	N/A	N/A	N/A	0

Correction history for Almo Creek, CRSP 2012 specific conductance data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
N/A	No Corrections Applied	N/A	N/A	N/A	0

Correction history for Almo Creek, CRSP 2012 dissolved oxygen data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
N/A	No Corrections Applied	N/A	N/A	N/A	0

Correction history for Almo Creek, CRSP 2012 pH data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
N/A	No Corrections Applied	N/A	N/A	N/A	0

Correction history for Almo Creek, CRSP 2012 turbidity data.

Creator	Comment	From Time	To Time	Applied Time	Points Modified
N/A	No Corrections Applied	N/A	N/A	N/A	0

Appendix F. Macroinvertebrate Metrics

NPS Upper Columbia Basin Benthos 2012 – CIRO/CRSP

*Standardized to OTU and fixed count (See results above for South Fork and Main Circle Creek)

SampleID	149042	149043	149044	149045
Station (NAMC)	PIBO:3218	PIBO:3219	PIBO:3220	PIBO:3221
Station (Customer)	6470	6471	6472	6473
Waterbody	Almo 1	Almo 2	N.F. Circle 1	N.F. Circle 2
County	Cassia	Cassia	Cassia	Cassia
State	ID	ID	ID	ID
Latitude	42.12923611	42.13281389	42.08687222	42.0881861
Longitude	-113.662408	-113.664922	-113.703967	-113.7044
Collection Date	7/6/2012	7/6/2012	7/4/2012	7/5/2012
Habitat Sampled	Targeted Riffle	Targeted Riffle	Targeted Riffle	Targeted Riffle
Collection Method	Surber net	Surber net	Surber net	Surber net
Field Notes	524-07-I-I1-12	524-08-I-I1-12	524-09-I-I1-12	524-10-I-I1-12
Lab Notes	NULL	NULL	NULL	NULL
Area sampled (m^2)	0.74	0.74	0.74	0.74
Field Split	100	100	100	100
Lab Split	75	100	100	100
Split Count	672	7	172	300
Fixed Count	300	2	169	296
Big Rare Count	9	0	0	0
Richness*	33	2	23	23
Abundance	1223	9	232	405
Shannon's Diversity*	2.469258544	0.693147181	2.39216054	2.3489099
Simpson's Diversity*	0.865083612	1	0.831924486	0.82377462
Evenness*	0.706207123	1	0.762929342	0.74913546
# of EPT Taxa*	10	0	13	12
EPT Taxa Abundance	735	3	182	157
Dominant Family	Baetidae	Elmidae	Baetidae	Chironomidae
Abundance of Dominant Family	254	3	103	186
Dominant Taxa	Chloroperlinae	Trichoptera	Diphetor hageni	Chironominae
Abundance of Dominant Taxa	202	3	86	154
Hilsenhoff Biotic Index*	2.146666667	0	2.846153846	3.90202703
# of Intolerant Taxa*	6	0	8	9
Intolerant Taxa abundance	184	0	53	95
# of Tolerant Taxa*	2	0	0	1
Tolerant Taxa abundance	5	0	0	1
USFS Community Tolerance Quotient (d)*	76	108	60	73
# of shredder taxa*	2	0	3	2
Shredder Abundance	43	0	18	42

Appendix F. Macroinvertebrate Metrics (continued)

NPS Upper Columbia Basin Benthos 2012 – CIRO/CRSP

*Standardized to OTU and fixed count

SampleID	149042	149043	149044	149045
Station (NAMC)	PIBO:3218	PIBO:3219	PIBO:3220	PIBO:3221
Station (Customer)	6470	6471	6472	6473
Waterbody	Almo 1	Almo 2	N.F. Circle 1	N.F. Circle 2
County	Cassia	Cassia	Cassia	Cassia
State	ID	ID	ID	ID
Latitude	42.12923611	42.13281389	42.08687222	42.0881861
Longitude	-113.662408	-113.664922	-113.703967	-113.7044
Collection Date	7/6/2012	7/6/2012	7/4/2012	7/5/2012
Habitat Sampled	Targeted Riffle	Targeted Riffle	Targeted Riffle	Targeted Riffle
Collection Method	Surber net	Surber net	Surber net	Surber net
# of scraper taxa*	3	0	2	1
Scraper abundance	132	0	27	19
# of collector-filterer taxa*	0	0	2	2
Collector-filterer abundance	5	0	14	15
# of collector-gatherer taxa*	8	0	8	8
Collector-gatherer abundance	528	3	123	284
# of predator taxa*	12	0	5	6
Predator abundance	282	3	30	36
# of clinger taxa*	7	1	8	5
Long-lived Taxa*	8	1	2	0
# of Ephemeroptera taxa*	6	0	6	6
Ephemeroptera abundance	485	0	136	101
# of Plecoptera taxa*	2	0	2	3
Plecoptera abundance	214	0	30	31
# of Trichoptera taxa*	2	0	5	3
Trichoptera abundance	36	3	16	24
# of Coleoptera taxa*	9	1	2	0
Coleoptera abundance	100	5	7	0
# of Elmidae Taxa*	2	0	1	0
Elmidae abundance	16	0	3	0
# of Megaloptera taxa*	1	0	0	0
Megaloptera abundance	2	0	0	0
# of Diptera taxa*	9	0	7	7
Diptera abundance	204	0	34	218
# of Chironomidae taxa*	3	0	2	3
Chironomidae abundance	157	0	7	186
# of Crustacea taxa*	0	0	0	0
Crustacea abundance	0	0	0	0

Appendix F. Macroinvertebrate Metrics (continued)

NPS Upper Columbia Basin Benthos 2012 – CIRO/CRSP

*Standardized to OTU and fixed count

SampleID	149042	149043	149044	149045
Station (NAMC)	PIBO:3218	PIBO:3219	PIBO:3220	PIBO:3221
Station (Customer)	6470	6471	6472	6473
Waterbody	Almo 1	Almo 2	N.F. Circle 1	N.F. Circle 2
County	Cassia	Cassia	Cassia	Cassia
State	ID	ID	ID	ID
Latitude	42.12923611	42.13281389	42.08687222	42.0881861
Longitude	-113.662408	-113.664922	-113.703967	-113.7044
Collection Date	7/6/2012	7/6/2012	7/4/2012	7/5/2012
Habitat Sampled	Targeted Riffle	Targeted Riffle	Targeted Riffle	Targeted Riffle
Collection Method	Surber net	Surber net	Surber net	Surber net
# of Oligochaete taxa*	0	0	0	0
Oligochaete abundance	5	0	0	0
# of Mollusca taxa*	0	0	0	1
Mollusca abundance	0	0	0	3
# of Insect taxa*	29	1	22	19
Insect abundance	1041	8	223	374
# of Non-insect taxa*	4	1	1	4
Non-insect abundance	182	1	9	31

Appendix G. Macroinvertebrate Taxa List

NPS Upper Columbia Basin Benthos 2012 – CIRO/CRSP
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
149042	6470	Almo 1	75	100	0.74	182	Chironominae	23	0
149042	6470	Almo 1	75	100	0.74	184	Orthoclaadiinae	41	3
149042	6470	Almo 1	75	100	0.74	223	Simulium	2	0
149042	6470	Almo 1	75	100	0.74	221	Simuliidae	1	0
149042	6470	Almo 1	75	100	0.74	160	Helophorus	3	0
149042	6470	Almo 1	75	100	0.74	161	Hydrobius	1	1
149042	6470	Almo 1	75	100	0.74	180	Chironomidae	4	0
149042	6470	Almo 1	75	100	0.74	75	Hyaella	2	0
149042	6470	Almo 1	75	100	0.74	105	Dytiscidae	3	0
149042	6470	Almo 1	75	100	0.74	108	Agabus	1	0
149042	6470	Almo 1	75	100	0.74	118	Oreodytes	2	1
149042	6470	Almo 1	75	100	0.74	241	Hexatoma	5	0
149042	6470	Almo 1	75	100	0.74	243	Limnophila	1	0
149042	6470	Almo 1	75	100	0.74	249	Baetidae	97	0
149042	6470	Almo 1	75	100	0.74	280	Epeorus	3	0
149042	6470	Almo 1	75	100	0.74	279	Cinygmula	4	1
149042	6470	Almo 1	75	100	0.74	287	Leptophlebiidae	51	0
149042	6470	Almo 1	75	100	0.74	359	Sialis	1	0
149042	6470	Almo 1	75	100	0.74	429	Nemouridae	4	0
149042	6470	Almo 1	75	100	0.74	652	Nemata	1	0
149042	6470	Almo 1	75	100	0.74	519	Lepidostoma	17	0
149042	6470	Almo 1	75	100	0.74	1180	Drunella coloradensis/flavilinea	1	0
149042	6470	Almo 1	75	100	0.74	1206	Rhyacophila brunnea/vemna group	3	0
149042	6470	Almo 1	75	100	0.74	2172	Torrenticola	18	0
149042	6470	Almo 1	75	100	0.74	2185	Sanfilippodytes	4	0
149042	6470	Almo 1	75	100	0.74	5757	Chloroperlinae	112	0

Appendix G. Macroinvertebrate Taxa List (continued)

NPS Upper Columbia Basin Benthos 2012 – CIRO/CRSP
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
149042	6470	Almo 1	75	100	0.74	2066	Ephemerella inermis/dorothea	0	1
149042	6470	Almo 1	75	100	0.74	237	Dicranota	2	0
149042	6470	Almo 1	75	100	0.74	262	Ephemerellidae	3	0
149042	6470	Almo 1	75	100	0.74	250	Baetis	43	0
149042	6470	Almo 1	75	100	0.74	276	Heptageniidae	45	0
149042	6470	Almo 1	75	100	0.74	303	Ameletus	18	2
149042	6470	Almo 1	75	100	0.74	418	Suwallia	2	0
149042	6470	Almo 1	75	100	0.74	431	Malenka	1	0
149042	6470	Almo 1	75	100	0.74	121	Elmidae	13	0
149042	6470	Almo 1	75	100	0.74	63	Lebertia	35	0
149042	6470	Almo 1	75	100	0.74	58	Trombidiformes	42	0
149042	6470	Almo 1	75	100	0.74	19	Oligochaeta	3	0
149042	6470	Almo 1	75	100	0.74	200	Empididae	4	0
149042	6470	Almo 1	75	100	0.74	216	Pericoma	1	0
149042	6470	Almo 1	75	100	0.74	210	Muscidae	3	0
149042	6470	Almo 1	75	100	0.74	179	Ceratopogonidae	2	0
149042	6470	Almo 1	75	100	0.74	187	Tanypodinae	17	0
149042	6470	Almo 1	75	100	0.74	144	Zaitzevia	8	0
149042	6470	Almo 1	75	100	0.74	144	Zaitzevia	2	0
149042	6470	Almo 1	75	100	0.74	135	Optioservus	3	0
149042	6470	Almo 1	75	100	0.74	153	Hydrophilidae	1	0
149042	6470	Almo 1	75	100	0.74	1076	Optioservus quadrimaculatus	1	0
149042	6470	Almo 1	75	100	0.74	1219	Hydraena	2	0
149042	6470	Almo 1	75	100	0.74	1538	Stictotarsus	10	0
149042	6470	Almo 1	75	100	0.74	834	Dipheter hageni	1	0
149042	6470	Almo 1	75	100	0.74	672	Ptychoptera	5	0

Appendix G. Macroinvertebrate Taxa List (continued)

NPS Upper Columbia Basin Benthos 2012 – CIRO/CRSP
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
149043	6471	Almo 2	100	100	0.74	1219	Hydraena	1	0
149043	6471	Almo 2	100	100	0.74	153	Hydrophilidae	1	0
149043	6471	Almo 2	100	100	0.74	66	Sperchonidae	1	0
149043	6471	Almo 2	100	100	0.74	121	Elmidae	2	0
149043	6471	Almo 2	100	100	0.74	480	Trichoptera	2	0
149044	6472	N.F. Circle 1	100	100	0.74	279	Cinygmula	4	0
149044	6472	N.F. Circle 1	100	100	0.74	271	Serratella	1	0
149044	6472	N.F. Circle 1	100	100	0.74	243	Limnophila	3	0
149044	6472	N.F. Circle 1	100	100	0.74	247	Tipula	1	0
149044	6472	N.F. Circle 1	100	100	0.74	180	Chironomidae	2	0
149044	6472	N.F. Circle 1	100	100	0.74	223	Simulium	8	0
149044	6472	N.F. Circle 1	100	100	0.74	184	Orthoclaadiinae	1	0
149044	6472	N.F. Circle 1	100	100	0.74	182	Chironominae	2	0
149044	6472	N.F. Circle 1	100	100	0.74	5757	Chloroperlinae	13	0
149044	6472	N.F. Circle 1	100	100	0.74	1206	Rhyacophila brunnea/vemna group	3	0
149044	6472	N.F. Circle 1	100	100	0.74	519	Lepidostoma	3	0
149044	6472	N.F. Circle 1	100	100	0.74	499	Hydropsyche	2	0
149044	6472	N.F. Circle 1	100	100	0.74	67	Sperchon	3	0
149044	6472	N.F. Circle 1	100	100	0.74	63	Lebertia	2	0
149044	6472	N.F. Circle 1	100	100	0.74	59	Hygrobatidae	2	0
149044	6472	N.F. Circle 1	100	100	0.74	135	Optioservus	2	0
149044	6472	N.F. Circle 1	100	100	0.74	218	Ptychopteridae	2	0
149044	6472	N.F. Circle 1	100	100	0.74	439	Zapada	5	0
149044	6472	N.F. Circle 1	100	100	0.74	303	Ameletus	14	0
149044	6472	N.F. Circle 1	100	100	0.74	292	Paraleptophlebia	5	0
149044	6472	N.F. Circle 1	100	100	0.74	250	Baetis	12	0

Appendix G. Macroinvertebrate Taxa List (continued)

NPS Upper Columbia Basin Benthos 2012 – CIRO/CRSP
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
149044	6472	N.F. Circle 1	100	100	0.74	262	Ephemerellidae	1	0
149044	6472	N.F. Circle 1	100	100	0.74	237	Dicranota	6	0
149044	6472	N.F. Circle 1	100	100	0.74	1219	Hydraena	3	0
149044	6472	N.F. Circle 1	100	100	0.74	909	Zapada cinctipes	4	0
149044	6472	N.F. Circle 1	100	100	0.74	1505	Rhyacophila vofixa group	3	0
149044	6472	N.F. Circle 1	100	100	0.74	834	Diphetor hageni	64	0
149044	6472	N.F. Circle 1	100	100	0.74	555	Psychoglypha	1	0
149045	6473	N.F. Circle 2	100	100	0.74	647	Pisidium	2	0
149045	6473	N.F. Circle 2	100	100	0.74	834	Diphetor hageni	32	0
149045	6473	N.F. Circle 2	100	100	0.74	655	Turbellaria	8	0
149045	6473	N.F. Circle 2	100	100	0.74	455	Perlodidae	1	0
149045	6473	N.F. Circle 2	100	100	0.74	1505	Rhyacophila vofixa group	2	0
149045	6473	N.F. Circle 2	100	100	0.74	2154	Oxus	1	0
149045	6473	N.F. Circle 2	100	100	0.74	909	Zapada cinctipes	5	0
149045	6473	N.F. Circle 2	100	100	0.74	250	Baetis	4	0
149045	6473	N.F. Circle 2	100	100	0.74	292	Paraleptophlebia	18	0
149045	6473	N.F. Circle 2	100	100	0.74	303	Ameletus	10	0
149045	6473	N.F. Circle 2	100	100	0.74	439	Zapada	10	0
149045	6473	N.F. Circle 2	100	100	0.74	431	Malenka	2	0
149045	6473	N.F. Circle 2	100	100	0.74	218	Ptychopteridae	10	0
149045	6473	N.F. Circle 2	100	100	0.74	234	Tipulidae	1	0
149045	6473	N.F. Circle 2	100	100	0.74	237	Dicranota	1	0
149045	6473	N.F. Circle 2	100	100	0.74	187	Tanypodinae	8	0
149045	6473	N.F. Circle 2	100	100	0.74	67	Sperchon	6	0
149045	6473	N.F. Circle 2	100	100	0.74	63	Lebertia	5	0
149045	6473	N.F. Circle 2	100	100	0.74	519	Lepidostoma	15	0

Appendix G. Macroinvertebrate Taxa List (continued)

NPS Upper Columbia Basin Benthos 2012 – CIRO/CRSP
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
149045	6473	N.F. Circle 2	100	100	0.74	1206	Rhyacophila brunnea/vemna group	1	0
149045	6473	N.F. Circle 2	100	100	0.74	5757	Chloroperlinae	5	0
149045	6473	N.F. Circle 2	100	100	0.74	2066	Ephemerella inermis/dorothea	6	0
149045	6473	N.F. Circle 2	100	100	0.74	182	Chironominae	114	0
149045	6473	N.F. Circle 2	100	100	0.74	184	Orthocladiinae	15	0
149045	6473	N.F. Circle 2	100	100	0.74	201	Chelifera	2	0
149045	6473	N.F. Circle 2	100	100	0.74	223	Simulium	9	0
149045	6473	N.F. Circle 2	100	100	0.74	180	Chironomidae	1	0
149045	6473	N.F. Circle 2	100	100	0.74	75	Hyaella	1	0
149045	6473	N.F. Circle 2	100	100	0.74	249	Baetidae	1	0
149045	6473	N.F. Circle 2	100	100	0.74	279	Cinygmula	4	0

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NPS 003/122649, October 2013

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