Cottonwood Creek, Butcher Creek, and Threemile Creek Water Quality Monitoring Report 2011-2012

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Prepared for: U.S. Environmental Protection Agency
Date: August, 2014

Technical Results Summary
KPC-CWTMBC-12

Acknowledgements

This report was greatly improved from comments made by Ciarra Greene. Casey McCormack and Marcus Oatman conducted the fieldwork for this project.

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Acronyms and Abbreviations

BLM Bureau of Land Management

BMPs Best Management Practices

BOR Bureau of Reclamation

C Celsius

cfs Cubic feet per second

cm centimeter(s)

CWA Clean Water Act

CWAL Cold Water Aquatic Life

DEQ Idaho Department of Environmental Quality

DO Dissolved Oxygen

EPA Environmental Protection Agency

GIS Geographical Information Systems

HUC Hydrologic Unit Code

IASCD Idaho Association of Soil Conservation Districts

IDAPA Idaho Administrative Procedure Act

mg/L milligrams per liter

NH_3 Ammonium

NO_2+NO_3 Nitrate-Nitrite

NRCS Natural Resources Conservation Service

OP Ortho Phosphorus

QA/QC Quality assurance/quality control

SCC Soil Conservation Commission

TDS Total Dissolved Solids

TMDL Total Maximum Daily Load

TP Total Phosphorus

TSS Total Suspended Solids

USFS United States Forest Service

WAG Watershed Advisory Group

Introduction

The Nez Perce Tribe (Tribe) is a federally recognized Indian Tribe with an aboriginal territory of more than 13 million acres extending from northeastern Oregon and southeastern Washington, through north-central Idaho, to southwestern Montana. The Tribe's 1855 treaty with the United States acknowledged and guaranteed a variety of retained off-reservation fishing, hunting, and gathering rights. The current Nez Perce Tribal Reservation is approximately 770,483 acres in size, and many tribal members continue to practice a subsistence-based lifestyle to this day. Clean water is valued for its cultural, spiritual, and economic uses, and the Tribe has a vested interest in protecting the quality of water both on Reservation and throughout the Clearwater, Snake, and Columbia River Basins.

The Tribe's Water Resources Division (WRD) applied for and received Treatment in the Same Manner as a State (TAS) to implement the Clean Water Act §106 Water Quality Monitoring Program in 1990. In 1999, the WRD began collecting water quality data for Reservation water bodies. Table 1 is an Atlas of Tribal Water Resources found within the boundaries of the Reservation of 1863.

Table 1. Atlas of Tribal Water Resources

Topic	Value
Reservation Area (acres)	770,483
Reservation Population	12,256
Number of watersheds within or intersecting the Reservation boundary	19
Total Miles of Rivers and Streams - *Miles of perennial streams* - *Miles of intermittent streams (does not include unnamed streams)* *the remaining stream miles are unknown for perennial vs. intermittent	1,590 *602** *85**
Number of Lakes/Reservoirs/Ponds	8
Acres of Lakes/Reservoirs/Ponds	2,883

In 2012, the WRD §106 staff collected water quality data from eight different creeks in the Cottonwood Creek, Butcher Creek, and Threemile Creek watersheds. Monitoring sites were established at or near the mouth of each major tributary, and multiple monitoring sites were established on the main stems of each creek. The total sum of stream miles located upstream of the monitoring stations is approximately 95 miles, or six percent of the 1,590 total stream miles located within the Reservation.

This report reviews monitoring results for the following parameters at all monitoring locations:

-Total Phosphorus (TP)
-Orthophosphorus (OP)
-Bacteria (Escherichia coli)
-Nitrogen Components—NO_3+NO_2; NH_3
-Total Suspended Sediment (TSS)
-Instantaneous Water Temperature
-Continuous Water Temperature
-Turbidity
-Dissolved Oxygen (DO)
-Percent (%) Saturation
-Specific Conductance
-Total Dissolved Solids

The Bureau of Reclamation (BOR) Pacific Northwest Regional Laboratory, in Boise Idaho, conducted all inorganic parameter testing and bacteria analysis. WRD field staff performed all other measurements.

Water Quality Monitoring Program Objectives

Table 2. Monitoring Objectives

Program Area	Objective
Overall Water Quality Program	1. Assess whether water quality criteria/benchmarks are being met and beneficial uses are being supported for waterbodies across the Reservation (Overall Water Quality). 2. Establish a baseline of water quality condition for all waters and periodically reassess previously monitored waterbodies to look for changes (Status and Trends).
Nonpoint Source Pollution Program	1. Identify water quality limited waterbodies. 2. Determine sources of pollutants

Program Area	Objective
	within watersheds and prioritize restoration projects accordingly. 3. Determine the effectiveness of best management practices (BMPs) in supporting beneficial uses and improving water quality. 4. Evaluate cumulative watershed effects from installation of BMPs.

Watershed Descriptions

Cottonwood Creek

The Cottonwood Creek watershed, 5th field hydrologic unit code (HUC) #1706030513, drains approximately 124,439 acres in Idaho County, Idaho. Cottonwood Creek is a fourth order tributary to the South Fork Clearwater River (SF CWR). It originates in the steep, forested lands of Cottonwood Butte and flows eastward across the rolling cropland of the Camas Prairie and into the deep canyons found in the eastern portion of the watershed, where it then enters the SF CWR near Stites, Idaho. A waterfall is located approximately 9 miles upstream from the mouth of Cottonwood Creek that potentially restricts fish passage upstream.

Cottonwood Creek flows from an elevation of 5,730 feet to an elevation of 1,332 feet. Land uses consist of cropland (74%), pastureland (7%), rangeland (13%), forestland (6%), and urban areas (<1%). The City of Cottonwood and a small portion of the City of Grangeville are found within the watershed.

There are five major tributaries to Cottonwood Creek: Stockney Creek, Shebang Creek, Red Rock Creek, Long Haul Creek, and South Fork Cottonwood Creek. Cottonwood Creek and its five tributaries were all listed on the State of Idaho's 1998 §303-(d) list as water quality limited from their headwaters to their mouths. Red Rock Creek also has a waterfall located 3.6 miles from the mouth that has been identified as a potential fish barrier.

Threemile Creek and Butcher Creek

The Butcher Creek and Three Mile Creek watersheds collectively drain approximately 36,169 acres in Idaho County, Idaho. Both streams are second order tributaries of the SF CWR.

Threemile Creek's forested headwaters originate four miles south of Grangeville, at approximately 5,000 feet. The stream flows approximately 16 miles to its confluence with the SF CWR at river mile 7.6. The watershed is approximately 24,966 acres in size and 99% privately owned (< 0.5% owned by the Bureau of Land Management) (USDOI Bureau of Land Management, 1999).

Butcher Creek's forested headwaters originate one mile south of Mt. Idaho, at approximately 5,000 feet. The stream flows 11.9 miles to its confluence with the SF CWR at river mile 11.7 and drains an area of approximately 11,203 acres. The watershed is 98% privately owned and 2% state-owned. The lower 1.8 miles of Butcher Creek flows within the Nez Perce Tribal Reservation boundary.

Climate

Climate in this region is characterized by cool, moist winters and warm dry summers. Air temperatures in the watershed typically decrease as elevation increases.

Average annual precipitation ranges from 20-25 inches across most of the watershed with over 30 inches falling in the Cottonwood Butte area. Monthly precipitation averages are greatest from March to June and the least during July, ranging from 2-3 inches per month in the spring to 1-2 inches per month during the rest of the year.

Parts of the Cottonwood Creek watershed are intermittently covered with snowpack from November - March. Average annual snowfall ranges from 22 inches per year in Kooskia to 60 inches per year across the Camas Prairie (Idaho Department of Environmental Quality, 2000).

Rain accompanied by warm Chinook winds is a common occurrence in the winter and early spring and often results in high intensity runoff events.

Fisheries

More than 30 species of fish inhabit the Clearwater River Subbasin, including 19 native species, two of which have been reintroduced. Steelhead/rainbow trout are the salmonid species found to inhabit these three watersheds. Table 2 shows general spawning and incubation periods for Steelhead/rainbow trout found in the tributaries to the lower Clearwater River.

Table 3. Spawning and incubation periods in lower Clearwater River Tributaries.

Spawning and Incubation Periods in Cottonwood, Threemile, and Butcher Creek Watersheds.												
Salmonid Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Steelhead/Rainbow Trout		✓	✓	✓	✓	✓						

Past Watershed Assessments

The Environmental Protection Agency (EPA) approved the Cottonwood Creek Total Maximum Daily Load (TMDL) report in June of 2000 and the South Fork Clearwater River Subbasin Assessment and TMDL report in October of 2003, which addresses the Threemile Creek and Butcher Creek watersheds. Shortly thereafter, the Watershed Advisory Groups (WAGs) and supporting agencies created TMDL implementation plans for these watersheds. These plans provide the framework necessary to implement best management practices (BMPs) aimed at improving water quality through practices such as riparian restoration, bank stabilization, animal waste systems, grassed waterways, conservation cropping and tillage practices, and livestock exclusion.

Limited water quality monitoring was conducted by Idaho Department of Environmental Quality staff in these three watersheds prior to the TMDL effort. Additional water quality monitoring was conducted by Idaho Association of Soil Conservation District (IASCD) staff in the Cottonwood Creek watershed in 2001 and 2005 (Clark, 2006) and in the Threemile/Butcher Creek watersheds in 2005 (Clark, 2006). Monitoring sites that were established during those past monitoring efforts were revisited, when possible, for the sake of consistency, and in order to perform a trend analysis with the data.

Methods and Materials

Water Quality Limited Segments

The Clean Water Act (CWA) requires restoration and maintenance of the chemical, physical, and biological integrity of the nation's water (Public Law 92-500, Federal Water Pollution Control Act Amendments of 1972). Section §303(d) of the CWA establishes requirements for states and tribes to identify and prioritize waterbodies that are water quality limited (i.e., do not meet water quality standards). A number of streams in this study were placed on the State of Idaho's initial §303(d) list.

Sampling Protocols

The WRD staff has a Quality Assurance Project Plan (QAPP) which has been reviewed and approved by the US Environmental Protection Agency (EPA). WRD staff follows methods and protocols found in the U.S. Geological Survey (USGS) *National Field Manual for the Collection of Water Quality Data* (TWRI Book 9, 1999-2004) when collecting water quality data in Reservation waters (U.S. Geological Survey, variously dated).

Approximately four liters of stream water were collected at each site, using a DH-81 depth-integrating suspended-sediment sampler. The samples were collected and transferred into a 2.5-gallon polyethylene churn splitter. The polyethylene churn splitter was rinsed with ambient water at each location prior to sample collection. The resultant composite sample was thoroughly homogenized before filling the appropriate sample containers. Water quality samples (TSS, NO_3+NO_2, NH_3, OP and TP) were then shipped to Boise, ID overnight to be analyzed at the Bureau of Reclamation (BOR) Pacific Northwest Regional Laboratory.

Bacteriological samples (*E. coli*) were collected directly from the thalweg into sterile sample containers. These samples were also shipped to Boise, ID overnight to be analyzed at the BOR Pacific Northwest Regional Laboratory. Most probable number (MPN) multiple tube fermentation was used to determine *E. coli* levels in the water sample.

A list of parameters, sample sizes, preservation methods, holding times, and analytical methods is displayed in Table 4. All sample containers were labeled with waterproof markers with the following information: station location, sample identification, date of collection, and time of collection. Samples were placed on ice and shipped to the laboratory the same day as collection. Chain-of-custody forms accompanied each sample shipment.

Table 4. Water Quality Parameters.

Parameters	Sample Size	Preservation	Holding Time	Method
Total Suspended Solids (TSS)	1 qt cubitainer	Store at 4°C	7 days	2540 D
Nitrogen Components: Nitrate+Nitrite (NO_3+NO_2) Ammonia (NH_3)	1 qt cubitainer	Cool 4°C, H_2SO_4 pH < 2	28 Days	EPA 353.2 EPA 350.1 EPA 351.2
Total Phosphorus (TP)	100 mL	Cool 4°C, H_2SO_4 pH < 2	28 Days	EPA 365.4
Ortho-phosphate (OP)	100 mL	Store at 4°C	48 Hours	EPA 365.1-PF
Escherichia coli (*E. coli)*	100 mL	Cool 4°C	30 Hours	MPN

Field Measurements

At each location, field parameters for dissolved oxygen, specific conductance, pH, temperature and turbidity were measured. Calibration of all field equipment was in accordance with the manufacturer's specifications. Field measurement parameters, equipment, and calibration techniques are shown in Table 5.

Table 5. Field Measurements.

Parameters	Instrument	Calibration
Dissolved Oxygen	YSI Model 556 MPS	Ambient air calibration
Temperature	YSI Model 556 MPS	Centigrade thermometer
Specific Conductance	YSI Model 556 MPS	Specific Conductance (25^{o}C standard)
pH	YSI Model 556 MPS	Standard buffer (7,10) bracketing for linearity
Turbidity	Hach Model 2100P	Formazin Primary Standard

All field measurements were recorded in a field notebook along with pertinent observations about the site, including weather conditions, flow rates, personnel on site, and any problems observed that might affect water quality.

Flow Measurements

Flow measurements were taken at each site using a Marsh McBirney Flow Mate Model 2000 flow meter. The six-tenths depth method (0.6 of the total depth from the surface of the water surface) was used. A transect line was established at each monitoring station, across the width of the stream at an angle perpendicular to the flow, for the calculation of cross-sectional area. Discharge was computed by summing the products of the partial areas (partial sections) of the flow cross-sections and the average velocities for each of those sections. Stream discharge was reported as cubic feet per second (cfs).

Quality Assurance and Quality Control (QA/QC)

The BOR Pacific Northwest Regional Laboratory utilizes methods approved and validated by the EPA. A method validation process, including precision and accuracy performance evaluations and method detection limit studies, is an element of the BOR Pacific Northwest Regional Laboratory Standard Methods. Method performance evaluations include quality control samples analyzed with a batch to ensure sample data integrity. Internal laboratory spikes and duplicates are part of the BOR Pacific Northwest Regional Laboratory's quality assurance program. Laboratory QA/QC results generated from this project can be provided upon request.

QA/QC procedures from the field-sampling portion of this project included a duplicate sample and a blank sample (one set per sampling event). The field blanks consisted of laboratory-grade deionized water, transported to the field and poured off into the appropriate sample containers. The blank sample was used to determine the integrity of the field team's handling of samples, the condition of the sample containers and deionized water supplied by the laboratory, and the accuracy of the laboratory methods. Duplicate samples were obtained by filling two sets of sample containers with homogenized composite water from the same sampling site. The duplicate and blank samples were not identified as such to laboratory personnel to ensure laboratory precision.

Data Handling

All of the field data and analytical data generated from each survey were reviewed in the WRD office by both field staff and the Water Quality Program Coordinator. These duplicate internal reviews ensure that all necessary observations, measurements, and analytical results were properly recorded. The analytical results were evaluated for completeness and accuracy. Any suspected errors were investigated and resolved, if possible. The data were then stored electronically and made available to interested entities upon request.

Monitoring Site Descriptions

Water quality monitoring was previously conducted by Idaho Association of Soil Conservation District (IASCD) staff in the Cottonwood Creek watershed (2001 and 2004) and in the Threemile/Butcher Creek watersheds (2005). Monitoring sites that were established during those monitoring efforts were revisited, when possible, for the sake of consistency, and in order to perform a trend analysis with the data.

#07502 A: Located near the mouth of SF Cottonwood Creek at the road crossing of State Route 7 (46° 0'8.89"N, 116° 9'52.17"W).

#04501 A: Located near the mouth of Long Haul Creek at the Day Road crossing (46° 0'14.97"N, 116° 8'23.15"W).

#07801 A: Located near the mouth of Stockney Creek at the Center Road crossing (46° 3'4.12"N, 116°12'43.96"W).

#07101 A: Located near the mouth of Shebang Creek at the Kube Road crossing (46° 1'59.67"N, 116°13'10.61"W).

#06405 A: Located on Red Rock Creek, above the canyon (46° 5'22.53"N, 116° 9'57.57"W).

#01428 A: Located on Cottonwood Creek near the headwaters (46° 3'39.35"N, 116°23'25.62"W).

#01423 A: Located on Cottonwood Creek downstream of the City of Cottonwood wastewater treatment ponds (46° 2'28.69"N, 116°17'48.15"W).

#01412 A: Located on Cottonwood Creek at the Tribal Reservation boundary (46° 2'8.30"N, 116° 8'24.24"W).

#01401 A: Located near the mouth of Cottonwood Creek (46° 4'49.76"N, 115°58'45.38"W).

#00701 A: Located near mouth of Butcher Creek (46° 0'22.56"N, 115°57'52.09"W).

#00709 A: Located near midway point in Butcher Creek watershed, at Case Road crossing (45°55'52.88"N, 116° 4'6.50"W).

#00711 A: Located near headwaters of Butcher Creek (45°54'23.96"N, 116° 4'54.82"W).

#08401 A: Located near mouth of Threemile Creek (46° 3'4.11"N, 115°58'59.18"W).

#08408 A: Located near midway point in Threemile Creek watershed, at Fairview Road crossing (45°59'58.58"N, 116° 4'41.29"W).

#08417 A: Located near headwaters of Threemile Creek (45°52'53.70"N, 116° 6'45.71"W).

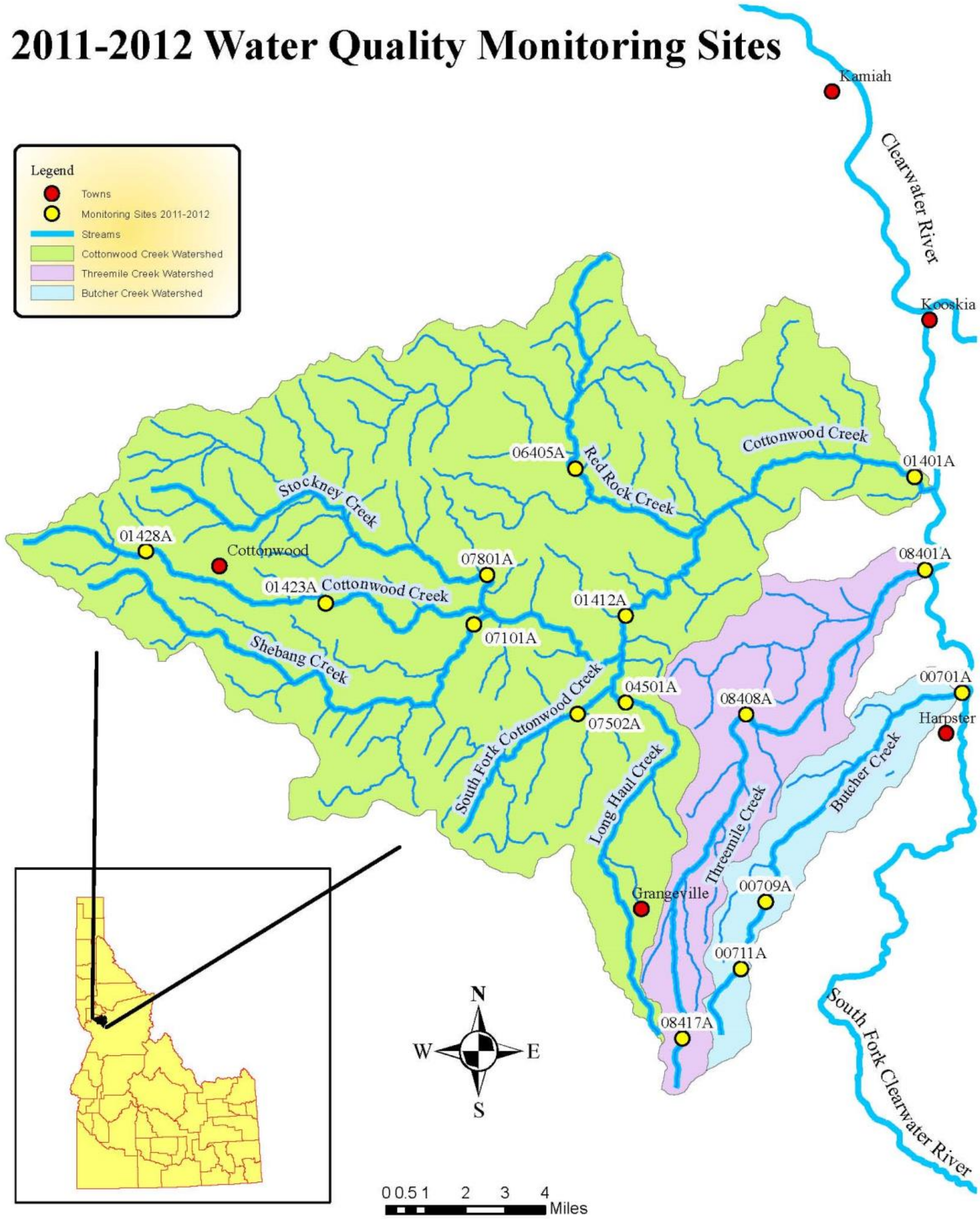


Figure 1. 2011-2012 Water Quality Monitoring Sites.

Pollutants of Concern and Associated Water Quality Criteria

Dissolved Oxygen

Dissolved Oxygen (DO) is found in microscopic bubbles of oxygen that are mixed in the water and occur between water molecules. DO is a very important indicator of a waterbody's ability to support aquatic life. Fish "breathe" by absorbing dissolved oxygen through their gills. Oxygen enters the water by absorption directly from the atmosphere or via photosynthesis by aquatic plants and algae. Oxygen is removed from the water by respiration and decomposition of organic matter. The State of Idaho standard for DO states that dissolved oxygen must exceed 6.0 mg/L for cold water biota at all times.

Water Temperature

Water temperature is a very important indicator of overall water quality. Many of the physical, biological, and chemical characteristics of a waterbody are directly affected by temperature. For example, temperature influences the following:

- amount of oxygen that can be dissolved in water.
- photosynthetic rate of algae and larger aquatic plants.
- metabolic rates of aquatic organisms.
- sensitivity of organisms to toxic wastes, parasites, and diseases.

Cool water can hold more oxygen than warm water, because gases are more easily dissolved in cool water. The reduction of oxygen solubility at high water temperatures can compound the stress on fish caused by marginal dissolved oxygen concentrations.

The cold water aquatic life (CWAL) criteria for Idaho streams states that water temperatures must be twenty-two degrees Celsius or less with a maximum daily average of no greater than nineteen degrees Celsius. All of the waterbodies monitored during this project are also listed for Salmonid Spawning (SS), which means that water temperatures must be 13 ^{o}C or less with a maximum daily average no greater than 9 ^{o}C during salmonid spawning and incubation periods.

Specific Conductance

Specific Conductance (SC) is a measure of the ability of water to conduct an electrical current. Conductivity increases with increasing concentrations and mobility of dissolved ions. These ions, which come from the breakdown of compounds, conduct electricity because they are negatively or positively charged when dissolved in water. Therefore, SC is an indirect measure of the presence of dissolved solids such as chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, and iron, and can be used as an indicator of water pollution.

No surface water standards or criteria exist that set limits on SC.

pH

pH represents the effective concentration (activity) of hydrogen ions (H^+) in water. The activity of hydrogen ions can be expressed most conveniently in logarithmic units. pH is defined as the negative logarithm of the activity of H^+ ions:

$pH = -\log [H^+]$,
where $[H^+]$ is the concentration of H^+ ions in moles per liter.

The State of Idaho surface water quality criteria for Aquatic Life Use designations states that Hydrogen Ion Concentration (pH) values must fall within the range of 6.5 and 9.0 (IDAPA 58.01.02.250.01.a).

Total Suspended Solids and Turbidity

Total Suspended Solids (TSS) includes both sediment and organic material suspended in water. Suspended sediment can cause problems for fish by clogging gills. In addition, excessive sediment provides a medium for the accumulation and transport of other constituents such as phosphorus and bacteria. Literature suggests that levels below 25 mg/L are ideal for the protection of fisheries and produce no harmful effects on fish or fisheries (DFO, 2000).

The State of Idaho water quality standard for Turbidity states that measurements shall not exceed background turbidity by more than 50 NTU instantaneously or more than 25 NTU for more than ten consecutive days. The 25^{th} percentile of all turbidity data collected by EPA over the last decade was 1.45 NTU. So, for the sake of this analysis, any reading over 51.45 NTU will be considered an exceedance over background turbidity levels.

Nitrate+Nitrite (NO_3+NO_2) and Ammonia (NH_3)

Nitrate (NO_3), Nitrite (NO_2), and Ammonia (NH_3) are considered inorganic forms of nitrogen. Excessive concentrations of nitrate and/or nitrite can be harmful to humans and wildlife. The EPA Ecoregion guidance criterion for NO_3 + NO_2 is 0.072 mg/L. The target for the analysis of the data in this report is 0.3 mg/L, which is thought to be more representative of conditions on the ground, and was the target criterion used in the TMDLs for these watersheds.

High concentrations of nitrate and/or nitrite can produce "brown blood disease" in fish. Nitrite enters the bloodstream through the gills and turns the blood a chocolate-brown color. As in humans, nitrite reacts with hemoglobin to form methemoglobin. Brown blood cannot carry sufficient amounts of oxygen, and affected fish can suffocate despite adequate oxygen concentration in the water. This accounts for the gasping behavior often observed in fish with brown blood disease, even when oxygen levels are relatively high (Mississippi State University, 1998).

Ammonia is the least stable form of nitrogen in water. Ammonia concentrations can affect hatching and growth rates of fish; changes in tissues of gills, liver, and kidneys may occur during structural development.

Phosphorus

In freshwater lakes and rivers, phosphorus is often found to be the growth-limiting nutrient, because it occurs in the least amount relative to the needs of plants. If excessive amounts of phosphorus and nitrogen are added to the water, algae and aquatic plants can be produced in large quantities. When these algae die, bacteria decompose them and use up oxygen. As a result, dissolved oxygen concentrations can drop too low for fish to breathe, leading to fish kills. The loss of oxygen in the bottom waters can free phosphorus previously trapped in the sediments, further increasing the available phosphorus.

Phosphorus sources exist in both inorganic and organic forms. Some important sources of Total Phosphorus (TP) include commercial fertilizers and manure, land application of biosolids, wastewater treatment plant (WWTP) effluent, erosion from livestock grazing, non-agricultural fertilization, and septic systems. Over time, excess phosphorus input causes a phosphorus surplus, which accumulates in soil and is mobilized when erosion occurs.

The EPA Ecoregion guidance criterion for phosphorus is 0.03 mg/L. The target for the analysis of the data in this report is 0.1 mg/L, which is thought to be more representative of conditions on the ground, and was the target criterion used in the TMDLs for these watersheds.

Bacteria (*E. coli*)

The coliform bacteria group consists of several genera of bacteria belonging to the family *Enterobacteriaceae*. These mostly harmless bacteria live in soil, water, and the digestive system of animals. *Escherichia coli* (*E. coli)* is a type of fecal coliform bacteria commonly found in the intestines of animals and humans. The presence of *E. coli* in water is a strong indication of recent sewage or animal waste contamination.

The State of Idaho *E. coli* standard for primary contact is not to exceed 406 organisms/100 mL at any time and not to exceed 576 organisms/100 mL at any time for secondary contact (IDAPA 58.01.02.251.02.a); however, a single exceedance over the criterion does not constitute a violation of water quality standards (IDAPA 58.01.02.080.03). Five samples must be taken within a 30-day period to assess against the geometric mean criterion of 126 cfu/100 ml to determine a violation.

An assessment of the geometric mean criterion was not conducted during this study due to time considerations and limited resources. However, the instantaneous measurements that were collected will allow for identification of streams where followup monitoring should occur. All streams on the Nez Perce Reservation will be evaluated using the primary contact recreation criterion of 406 organisms/100mL.

Applicable Criterion/Standards and Analysis Techniques

The data were analyzed, and descriptive statistics such as maximum, minimum, median, and mean values for each parameter measured were determined. The number of exceedances was calculated based on the number of sampling events whose respective values exceeded water quality targets or criteria.

The Nez Perce Tribe does not have approved water quality standards, so target criteria for this water quality assessment are based upon a combination of TMDL targets, EPA guidelines, literature review, and State of Idaho water quality standards. Descriptive statistics are presented per subwatershed, as are statistical comparisons between the data sets, when possible.

All of the waterbodies in this assessment had the designated beneficial uses of:

-Salmonid Spawning (SS)
-Cold Water Aquatic Life (CWAL)
-Primary Contact Recreation (PCR) **The Tribe has designated all water bodies as Primary Contact Recreation (Resolution #NP03-136).*
-Agricultural and industrial water supply
-Wildlife habitat
-Aesthetics

Table 6 shows the first three beneficial uses on the list above, along with associated numeric criteria used to evaluate the support status of these water bodies. Table 7 shows all of the numeric criteria used to evaluate the data sets in this water quality report.

Table 6. Beneficial use designations and associated criteria.

Parameter	Salmonid Spawning	Cold Water Aquatic Life	Primary Contact Recreation
Bacteria, pH, DO	pH between 6.5 and 9.5 Water column: DO exceeds 6.0 mg/L in water column or 90% saturation, whichever is greater Inter-gravel DO: DO	pH between 6.5 and 9.5 DO exceeds 6.0 mg/L	Less than 126 *E. coli* /100 mL as a geomean of five samples over 30 days; no samples greater than 406 *E. coli*/100 ml

Parameter	Salmonid Spawning	Cold Water Aquatic Life	Primary Contact Recreation
	exceeds 5 mg/L for a one day minimum and exceeds 6.0 mg/L for a seven day average		
Temperature	13 ˚C or less daily maximum during spawning and incubation period; 9 ˚C or less daily average.	22 ˚C or less daily maximum; 19 ˚C or less daily average	
Turbidity		Turbidity shall not exceed background by more than 50 NTU instantaneously or more than 25 NTU for more than 10 consecutive days	
Ammonia		Ammonia not to exceed calculated concentrations based on pH and temperature	

DO: dissolved oxygen, E. coli: Escherichia coli, NTU: nephelometric turbidity units

Table 7. Pollutant targets used to measure exceedances.

Pollutant of Concern	Pollutant Targets
Temperature	13 ^{o}C instantaneous; 9 ^{o}C daily average during Salmonid spawning period (February - June). 22 ^{o}C instantaneous; 19 ^{o}C daily average the rest of the year.
Total Phosphorus	0.1 mg/L
Total Suspended Solids	25 mg/L
NO_2+NO_3	0.3 mg/L
Dissolved Oxygen	6.0 mg/L
pH	6.5 - 9.0
Bacteria	406 E.coli organisms/100 mL for primary contact recreation
Ammonia	CMC = $\frac{0.275}{1+10^{7.204-pH}} + \frac{39.0}{1+10^{pH-7.204}}$

CMC = Acute Criterion Maximum Concentration (one hour average is not to exceed value)

Most data collected during this monitoring project did not fit a normal distribution, and contained numerous instances of censored data and outliers. Censored data can cause problems when using parametric methods of statistical analysis because these methods often require that all data have numerical values. Nonparametric methods often deal with the ranking of the data, not the data themselves. For example, with data "below the detection limit," any value that is less than the smallest value of all the data being analyzed can be assigned. This assignment does not affect the ranking of the data even though the exact value of the "below the detection limit" is unknown. Nonparametric procedures are also less affected by outliers (Spooner, 1994).

Data sets were first tested for normality using the Shapiro-Wilk test. If the data sets to be compared were from two years and were normally distributed, a t-test was performed; if the data were not normally distributed, a Mann-Whitney Rank Sum test was employed. If the data sets to be compared were from three years or more and were normally distributed a One Way Analysis of Variance (ANOVA) was performed; if the data were not normally distributed, a Kruskal-Wallis One Way Analysis of Variance on Ranks test was employed. The Kruskal-Wallis is the non-parametric analogue of a one-way ANOVA which ranks all the observations from smallest to largest within the data sets. The ranks for each group are summed and the rank sums compared. If there is no difference between the two groups, the mean ranks should be approximately the same. If they differ by a large amount, one may conclude that there is a statistically significant difference between the groups that is not attributable to random sample variation.

All data were analyzed using this method, although only select parameters have been included in this report.

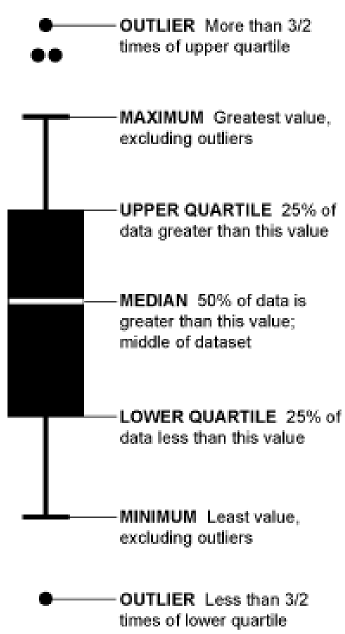


Figure 2. Box and Whisker Plot.

Box and whisker plots were often used to graphically illustrate the differences between the data sets. Box plots graph data as a box representing statistical values. The boundary of the box closest to zero indicates the 25th percentile, a line within the box marks the median, and the boundary of the box farthest from zero indicates the 75th percentile. Whiskers above and below the box indicate the 90th and 10th percentiles. Outlying points are also shown in most of the graphs.

Figure 2 explains how a box and whisker plot represents the data.

Pollutant Load Estimation

Existing pollutant loads were calculated by using the following equation:

> Existing load (lbs/day) = concentration (mg/L) * flow (cfs)* 5.39
> Where: 5.39 = conversion factor (coverts equation results to pounds per day)

A total load allocation was calculated for each subwatershed, using the nutrient targets set in the TMDL reports for these watersheds. In addition, an explicit margin of safety of 10% was deducted from the load allocation to account for uncertainties about the relationships among physical, chemical, and hydrological factors. Existing pollutant load estimations were then compared to the load allocation to evaluate if load reductions called for in the TMDLs are being met.

Results and Discussion

Subwatershed Current and Comparative Analysis

South Fork Cottonwood Creek (#07502A)

Figure 3. South Fork Cottonwood Creek monitoring site (#07502A), 2011-2012.

The South Fork of Cottonwood Creek drains 12,557 acres of land, of which 10,989 acres are cropland, 1,091 acres are pastureland, 452 acres are rangeland, 16 acres are forested, and 9 acres are urban/industrial land. All 12,557 acres of land are held in private ownership.

Vegetative communities along the South Fork Cottonwood Creek are dominated by Reed Canarygrass (*Phalaris arundinacea*), with a variety of other herbaceous and woody trees and shrubs as sub-dominates.

Table 8 presents descriptive statistics for the South Fork Cottonwood Creek site in 2011-2012, and Table 9 compares select parameters from the 2001, 2005, and 2012 data sets.

Table 8. Descriptive statistics for South Fork Cottonwood Creek monitoring site, 2011-2012.

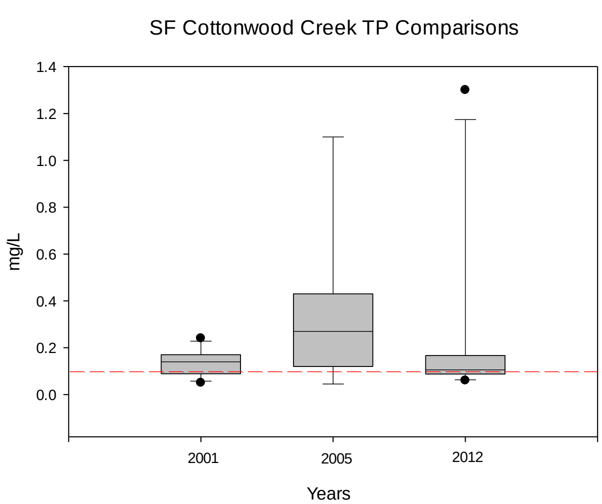
07502A: SF Cottonwood Creek	Temp (oC)	D.O. (mg/L)	pH (H+)	Turbidity (NTU)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	23.91	15.72	8.97	1000.00	2419.60	22.60	0.15	1.30	640.00	45.85
Minimum	0.08	7.27	6.90	1.09	1.00	0.01	0.02	0.06	1.00	0.09
Mean	9.98	12.02	7.85	122.47	415.75	2.76	0.07	0.27	66.00	5.22
Median	11.30	13.68	7.80	4.89	88.40	1.10	0.06	0.11	3.00	0.42
# exceedance	3.0	0.0	0.0	2.0	4.00	8.0	3.0	7.0	2.0	
% exceedance	23.1%	0.0%	0.0%	16.7%	36.4%	66.7%	25.0%	58.3%	16.7%	
# sampling events	13	13	13	12	11	12	12	12	12	11

Temp = temperature; D.O. = dissolved oxygen; OP = ortho phosphorus; TP=total phosphorus; TSS = total suspended solids; NO_3+NO_2 = Nitrate + Nitrite

Table 9. Comparison of 2001, 2005, and 2012 data for South Fork Cottonwood Creek.

Parameters	Median			Minimum			Maximum		
	2001	2005	2012	2001	2005	2012	2001	2005	2012
pH	7.90	8.50	7.80	7.09	7.63	6.90	8.92	9.04	8.97
TP (mg/L)	0.16	0.27	0.11	0.05	0.05	0.06	0.36	1.10	1.30
E. coli (cfu/ 100mL)	55.00	14.60	88.40	10.00	0.05	1.00	2400.0	1119.9	2419.6
TSS (mg/L)	8.00	9.80	3.00	2.00	2.00	1.00	60.00	220.0	640.0
Turbidity	11.90	15.30	4.89	1.85	4.37	1.09	113.0	459.0	1000.0
NO_3+NO_2	1.20	1.30	1.28	0.05	0.05	0.11	19.00	11.00	22.60

TP=total phosphorus; TSS = total suspended solids; NO_3+NO_2 = Nitrate + Nitrite

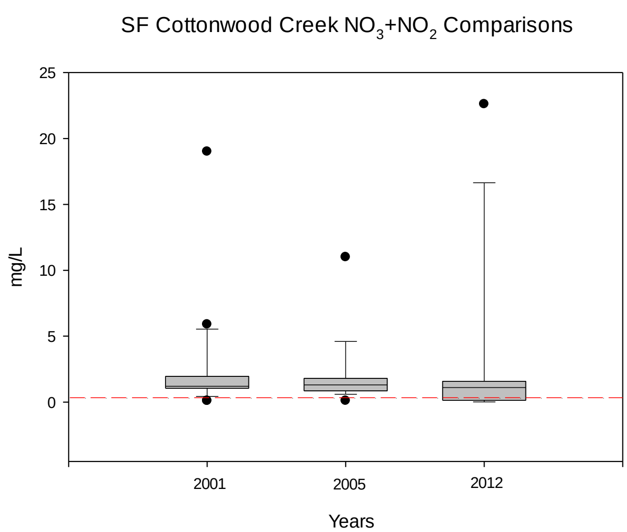


Median TP levels were highest in 2005, at 0.27 mg/L. Observed median levels were lowest in 2012, at 0.11 mg/L. The highest TP level in 2012 occurred on March 26, during a high flow event, when levels reached 1.3 mg/L. TP exceeded the 0.1 mg/L target set in the TMDL 58% of the time in 2011-2012 (n=12). Table 10 shows total phosphorus loading data and required reductions.

Figure 4. Comparison of SF Cottonwood Creek total phosphorus data. The dashed red line indicates the applicable 0.1 mg/L target.

Table 10. Total phosphorus existing load, load capacity, load allocation, and required reduction for SF Cottonwood Creek near mouth. Flows highlighted in yellow represent the 50th percentile flow derived from USGS Streamstats regression equations.

Sample Date	Flow (cfs)	TP (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
10/26/2011	0.26	0.089	0.124725	0.140	0.126126	none
11/15/2011	0.29	0.092	0.143805	0.156	0.140679	2.17%
12/13/2011	0.26	0.087	0.121922	0.140	0.126126	none
1/23/2012	0.64	0.175	0.60368	0.345	0.310464	48.57%
2/15/2012	0.42	0.101	0.228644	0.226	0.203742	10.89%
3/26/2012	45.85	1.3	321.271	24.713	22.24184	93.08%
4/17/2012	0.78	0.14	0.588588	0.420	0.378378	35.71%
5/8/2012	0.47	0.112	0.28373	0.253	0.227997	19.64%
6/13/2012	8.16	0.88	38.70451	4.398	3.958416	89.77%
7/17/2012	0.17	0.11	0.100793	0.092	0.082467	18.18%
8/14/2012	0.09	0.071	0.034442	0.049	0.043659	none
9/25/2012	0.28	0.06	0.090552	0.151	0.135828	none

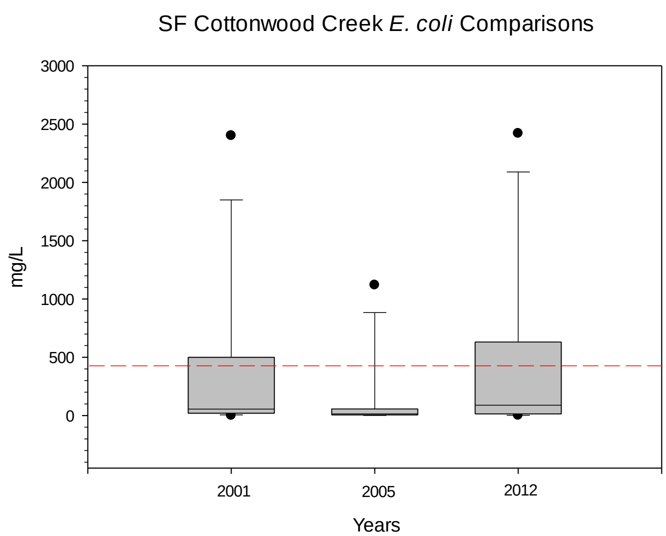


NO_3 +NO_2 levels were highest in the winter and spring months, with the highest reading being seen on March 26th, 2012 at 22.6 mg/L. The target of 0.3 mg/L was exceeded 67% of the time (n=12). For reference, the primary drinking water standard is 10 mg/L. Figure 5 shows a comparison of nitrate+nitrite data between the three data sets. Table 11 shows nitrate+nitrite loading data and required reductions.

Figure 5. Comparison of SF Cottonwood Creek NO_3+NO_2 data. The dashed red line indicates the applicable 0.3 mg/L target for NO_3+NO_2.

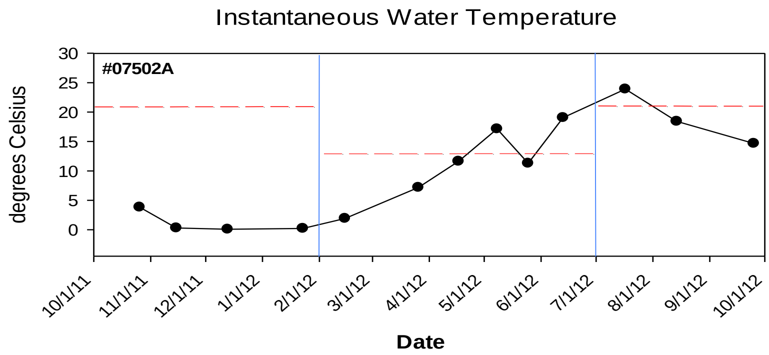
Table 11. NO_3+NO_2 existing load, load capacity, load allocation, and required reduction for SF Cottonwood Creek near mouth. Flows highlighted in yellow represent the 50th percentile flow derived from USGS Streamstats regression equations.

Sample Date	Flow (cfs)	NO3/NO2 (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
10/26/2011	0.26	1.3	1.82182	0.420	0.378378	79.23%
11/15/2011	0.29	1.4	2.18834	0.469	0.422037	80.71%
12/13/2011	0.26	2.74	3.839836	0.420	0.378378	90.15%
1/23/2012	0.64	1.64	5.657344	1.035	0.931392	83.54%
2/15/2012	0.42	1.25	2.82975	0.679	0.611226	78.40%
3/26/2012	45.85	22.6	5585.172	74.139	66.72551	98.81%
4/17/2012	0.78	0.95	3.99399	1.261	1.135134	71.58%
5/8/2012	0.47	0.22	0.557326	0.760	0.683991	none
6/13/2012	8.16	0.9	39.58416	13.195	11.87525	70.00%
7/17/2012	0.17	0.11	0.100793	0.275	0.247401	none
8/14/2012	0.09	0.01	0.004851	0.146	0.130977	none
9/25/2012	0.28	0.01	0.015092	0.453	0.407484	none



The instantaneous *E. coli* target of 406 organisms/ 100 mL was exceeded four times during the 2012 study, from June to September. Cattle were often observed on land adjacent to the creek, and are the likely source of bacterial contamination.

Figure 6. Comparison of SF Cottonwood Creek *E. coli* data. The dashed red line indicates the applicable 406 org/100 mL primary contact recreation criteria.



The instantaneous temperature target was exceeded three times (23.1%) during the 2011-2012 sampling period. These exceedences were observed from May to August.

Figure 7. Instantaneous temperature readings for SF Cottonwood Cr. (#07502A), 2011-2012. The blue lines delineate the period of the year deemed critical to salmonid spawning and incubation. The dashed red lines represent the associated target criteria.

South Fork Cottonwood Creek, additional observations:

- In the 2001 and 2012 study, there was flow in the stream year-round. However, in the 2005 study, flow stopped in late July and didn't resume until early October. Large pools of standing water were found along the length of the stream during 2005 and aquatic invertebrates and fish were observed residing in these pools until flow resumed in October.
- TSS concentrations exceeded the 25 mg/L target twice in 2012, with levels measured at 640 mg/L and 114 mg/L. Median TSS levels were nearly 70% lower in 2012 than in 2005. A Pearson's Product-moment correlation coefficient of 0.99 shows that there is a clear relationship between streamflow and movement of sediment within the SF Cottonwood Creek.
- A Pearson's Product-moment correlation coefficient of 0.91 shows a clear relationship between TP and TSS in 2012. This is consistent with the data set collected in 2005.

Long Haul Creek (#4501A)

Figure 8. Long Haul Creek (#4501A) monitoring site, 2011-2012.

Long Haul Creek drains 8,872 acres of land, of which 6,940 acres are cropland, 905 acres are pastureland, 100 acres are rangeland, 250 acres are forested and 677 acres are considered urban/industrial. All 8,872 acres are privately owned. Heavy grazing has limited woody vegetation in significant parts of the drainage. One stream survey found that only 55% of the stream banks within the Long Haul Creek were considered to be in stable condition (Idaho County Soil and Water Conservation District, 2000).

Table 12. Descriptive statistics for Long Haul Creek monitoring site (#4501A), 2011-2012.

04501A: Long Haul Creek	Temp (oC)	D.O. (mg/L)	pH (H+)	Turbidity (NTU)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	23.65	15.31	9.22	396.00	2419.60	5.82	0.21	0.68	188.00	11.47
Minimum	0.01	8.57	7.08	1.29	59.40	0.01	0.04	0.07	1.00	0.19
Mean	9.69	11.93	8.13	57.34	670.28	1.06	0.12	0.23	25.09	2.12
Median	10.04	11.58	8.13	6.95	325.50	0.28	0.14	0.21	5.00	0.99
# exceedance	4.0	0.0	0.0	2.0	3.00	5.0	6.0	8.0	2.0	
% exceedance	33.3%	0.0%	0.0%	18.2%	30.0%	45.5%	54.5%	72.7%	18.2%	
# sampling events	12	12	12	11	10	11	11	11	11	9

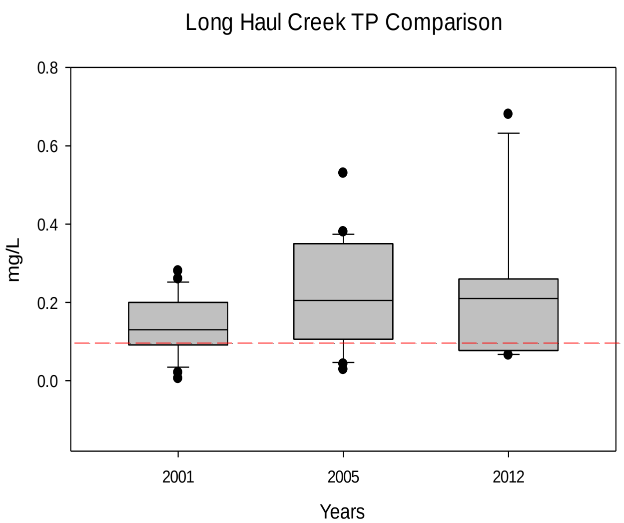
Temp = temperature; D.O. = dissolved oxygen; OP = ortho phosphorus; TP=total phosphorus; TSS = total suspended solids; NO_3+NO_2 = Nitrate + Nitrite

Table 13. Comparison of 2001, 2005, and 2012 data for Long Haul Creek.

Parameters	Median			Minimum			Maximum		
	2001	2005	2012	2001	2005	2012	2001	2005	2012
pH	8.21	8.47	8.13	7.32	8.10	7.08	9.30	9.80	9.22
TP (mg/L)	0.130	0.205	0.21	0.050	0.028	0.07	0.280	0.530	0.68
E. coli (cfu/ 100mL)	95.0	177.9	325.50	10.0	1.0	59.40	3000.0	1299.7	2419.6
TSS (mg/L)	4.00	6.45	5.00	2.00	2.00	1.00	66.0	46.0	188.00

Parameters	Median			Minimum			Maximum		
	2001	2005	2012	2001	2005	2012	2001	2005	2012
Turbidity (NTU)	6.6	15.1	6.95	1.51	2.04	1.29	171.0	224.0	396.00
NO_3+NO_2	0.05	0.075	0.28	0.05	0.05	0.01	5.90	4.90	5.82

TP=total phosphorus; TSS = total suspended solids; NO_3+NO_2 = Nitrate + Nitrite

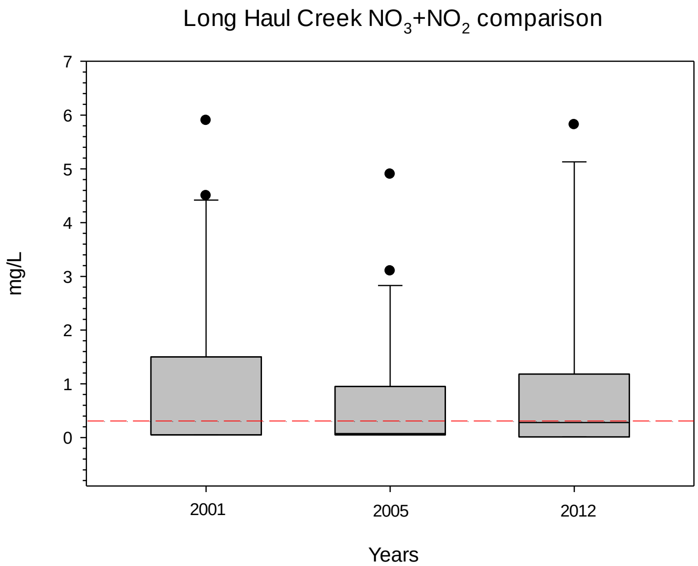


Median total phosphorus levels were fairly consistent in Long Haul Creek between monitoring years. The highest TP level in 2012 occurred on March 26, during a high flow event, when levels reached 0.68 mg/L. TP exceeded the 0.1 mg/L target set in the TMDL 73% of the time in 2012 (n=11). Figure 9 shows a comparison of TP levels in different years and Table 14 shows total phosphorus loading data and required reductions.

Figure 9. Comparison of Long Haul Creek TP data. The dashed red line indicates the applicable 0.1 mg/L target criteria.

Table 14. Total phosphorus existing load, load capacity, load allocation, and required reduction for Long Haul Creek, near mouth. Flows highlighted in yellow represent flows derived from USGS Streamstats regression equations.

Sample Date	Flow (cfs)	TP (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
10/25/2011	0.99	0.26	1.387386	0.534	0.480249	65.38%
11/15/2011	0.21	0.077	0.087156	0.113	0.101871	none
12/19/2011	0.4	0.065	0.14014	0.216	0.19404	none
1/23/2012	1.55	0.232	1.938244	0.835	0.751905	61.21%
2/15/2012	0.86	0.074	0.34302	0.464	0.417186	none
3/26/2012	30.5	0.68	111.7886	16.440	14.79555	86.76%
4/17/2012	2.24	0.14	1.690304	1.207	1.086624	35.71%
5/8/2012	1.21	0.125	0.815238	0.652	0.586971	28.00%
6/13/2012	11.47	0.44	27.20225	6.182	5.564097	79.55%
7/17/2012	0.19	0.21	0.215061	0.102	0.092169	57.14%
9/25/2012	0.33	0.23	0.409101	0.178	0.160083	60.87%

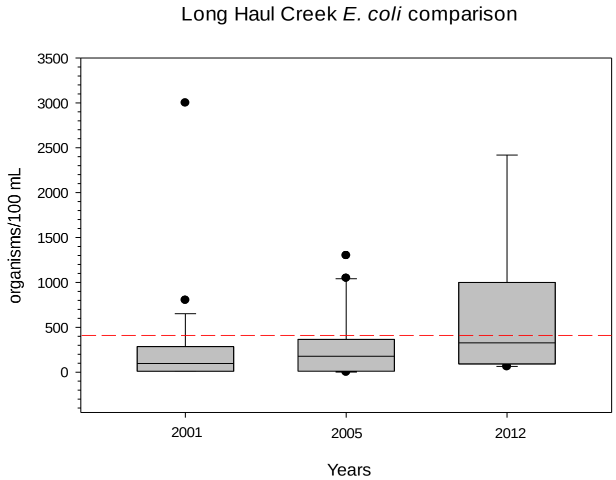


NO_3+NO_2 levels exceeded the 0.3 mg/L target criterion 45.5% of the time in 2011-2012 (n=11), with the highest measurement occurring on March 26th. Figure 10 illustrates the range of NO_3+NO_2 for each monitoring year. Table 15 shows Nitrate+Nitrite loading data and required reductions.

Figure 10. Comparison of Long Haul Creek NO3+NO2 data. The dashed red line indicates the applicable 0.3 mg/L target.

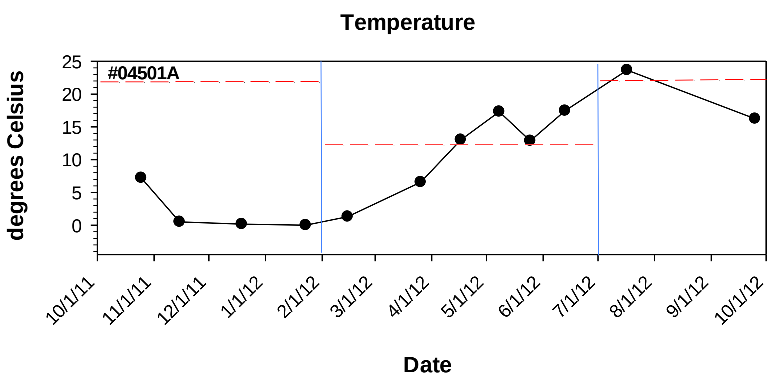
Table 15. NO_3+NO_2 existing load, load capacity, load allocation, and required reduction for Long Haul Creek near mouth. Flows highlighted in yellow represent flows derived from USGS Streamstats regression equations.

Sample Date	Flow (cfs)	NO3/NO2 (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
10/25/2011	0.99	0.16	0.853776	1.601	1.440747	none
11/15/2011	0.21	0.19	0.215061	0.340	0.305613	none
12/19/2011	0.4	2.37	5.10972	0.647	0.58212	88.61%
1/23/2012	1.55	1.18	9.85831	2.506	2.255715	77.12%
2/15/2012	0.86	0.45	2.08593	1.391	1.251558	40.00%
3/26/2012	30.5	5.82	956.7789	49.319	44.38665	95.36%
4/17/2012	2.24	0.28	3.380608	3.622	3.259872	3.57%
5/8/2012	1.21	0.01	0.065219	1.957	1.760913	none
6/13/2012	11.47	1.14	70.47856	18.547	16.692291	76.32%
7/17/2012	0.19	0.01	0.010241	0.307	0.276507	none
9/25/2012	0.33	0.01	0.017787	0.534	0.480249	none



Median *E. coli* levels have increased over time, although the difference among the data sets was not statistically significant, and could be due to random sampling variability. The primary contact recreation criterion of 406 organisms/ 100mL was exceeded three times in 2012. Figure 11 illustrates the increase in *E. coli* levels.

Figure 11. Comparison of Long Haul Creek *E. coli* data. The dashed red line indicates the applicable 576 organisms/100mL target criteria for PCR.



The instantaneous temperature target was exceeded five times (n=12) during the 2011-2012 sampling period. These exceedences were observed from May to August.

Figure 12. Instantaneous water temperature readings for Long Haul Cr. (#04501A), 2011-2012. The blue lines delineate the period of the year deemed critical to salmonid spawning and incubation. The dashed red lines represent the associated target criteria.

Long Haul Creek, additional observations:

- TSS concentrations exceeded the 25 mg/L target twice in 2012, with the highest measured level at 188 mg/L, during spring runoff in March. Median TSS levels were quite consistent throughout the three monitoring years.
- A correlation coefficient of 0.89 shows a clear relationship between TP and TSS in 2012. This is consistent with the data sets collected in previous years.
- TP levels exceeded the 0.1 mg/L target 73% of the time (n=11). Overall, median TP levels showed a slight upward trend in subsequent monitoring years.

Stockney Creek (#07801A)

Figure 13. Stockney Creek (#07801A) monitoring site, 2011-2012

Stockney Creek drains 19,917 acres of land, of which 16,364 acres are cropland, 897 acres are pastureland, 2,094 acres are rangeland, 558 acres of land are forested and four acres are urban/industrial. 19,516 acres of this watershed are privately owned and 401 acres are owned by the Nez Perce Tribe.

There have been numerous impacts to the stream channel and vegetation throughout most of the length of Stockney Creek. The upper reaches were channelized and vegetative communities have changed, most likely from willow (*Salix spp*) dominated communities to vegetation dominated by reed canarygrass (*Phalaris arundincea*) (Idaho County Soil and Water Conservation District, 2000).

Table 16. Descriptive statistics for Stockney Creek monitoring site, 2011-2012.

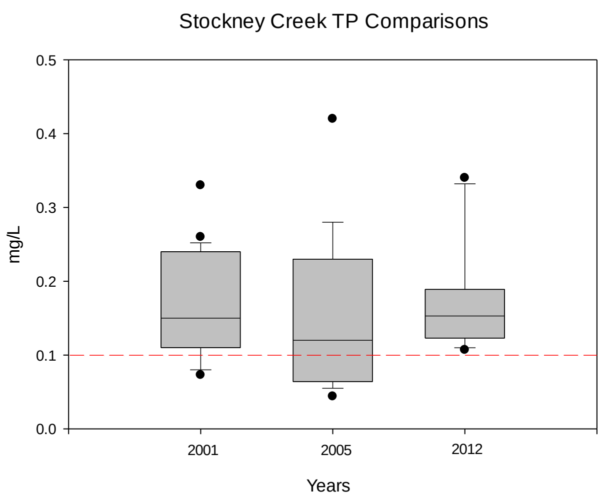
07801A Stockney Creek	Temp (oC)	D.O. (mg/L)	pH (H+)	Turbidity (NTU)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	18.77	13.59	8.25	24.20	1046.20	4.45	0.25	0.34	50.00	6.73
Minimum	-0.10	7.22	7.25	0.95	5.10	0.25	0.07	0.11	1.00	0.05
Mean	6.97	10.94	7.80	7.89	273.25	1.90	0.12	0.18	11.36	2.47
Median	6.98	11.41	7.84	4.19	35.90	1.79	0.11	0.15	10.00	1.10
# exceedance	1.0	0.0	0.0	0.0	3.00	10.0	6.0	11.0	1.0	
% exceedance	8.3%	0.0%	0.0%	0.0%	27.3%	90.9%	54.5%	100.0%	9.1%	
# sampling events	12	12	12	11	11	11	11	11	11	11

Temp = temperature; D.O. = dissolved oxygen; OP = ortho phosphorus; TP=total phosphorus; TSS = total suspended solids; NO_3+NO_2 = Nitrate + Nitrite

Table 17. Comparison of 2001, 2005, and 2012 data for Stockney Creek.

Parameters	Median			Minimum			Maximum		
	2001	**2005**	**2012**	**2001**	**2005**	**2012**	**2001**	**2005**	**2012**
pH	8.01	8.32	7.84	6.95	7.97	7.25	8.45	8.90	8.25
TP (mg/L)	0.150	0.120	0.150	0.073	0.044	0.11	0.330	0.420	0.34
E. coli (cfu/100mL)	70.00	41.30	35.9	10.00	2.00	5.10	2400.00	613.10	1046.20
TSS (mg/L)	8.00	5.60	10.0	2.00	2.00	1.00	32.00	47.00	50.00
Turbidity (NTU)	10.30	8.68	4.19	3.80	3.16	0.95	124.00	105.00	24.20
NO_3+NO_2	0.90	0.78	1.79	0.05	0.05	0.25	9.90	4.50	4.45

TP=total phosphorus; TSS = total suspended solids; NO_3+NO_2 = Nitrate + Nitrite



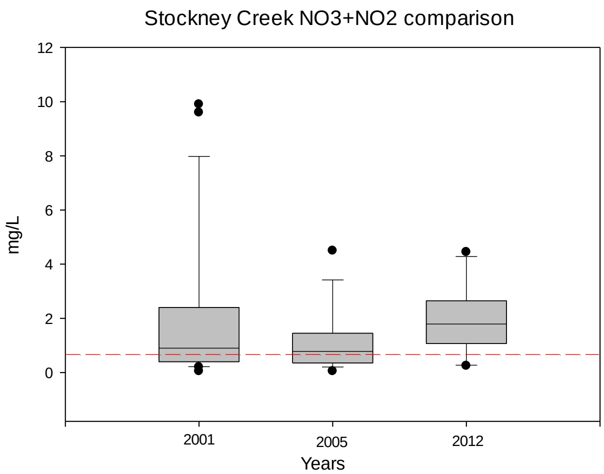
Median and mean TP levels were relatively consistent over all monitoring years. Variability of TP values was greatest in 2005, while levels were much more consistent in 2012, with 100% of the samples exceeding the 0.1 target criterion. Figure 14 illustrates the TP comparison between years. Table 18 shows total phosphorus loading data and required reductions.

Figure 14. Comparison of Stockney Creek total phosphorus data. The dashed red line indicates the applicable 0.1 mg/L target.

Table 18. Total phosphorus existing load, load capacity, load allocation, and required reduction for Stockney Creek near mouth.

Sample Date	**Flow (cfs)**	**TP (mg/L)**	**Existing Load (lbs/day)**	**Load Capacity (lbs/day)**	**Load Allocation (lbs/day)**	**Required Reduction (%)**
10/24/2011	0.63	0.16	0.543312	0.340	0.305613	43.75%
11/14/2011	1.01	0.11	0.582497	0.544	0.489951	15.89%
12/13/2011	0.81	0.12	0.537006	0.437	0.392931	26.83%
1/11/2012	1.1	0.12	0.717409	0.593	0.53361	25.62%
2/14/2012	2.62	0.15	2.160635	1.412	1.270962	41.18%
3/20/2012	4.8	0.15	3.932544	2.587	2.32848	40.79%
4/17/2012	6.73	0.13	4.715711	3.627	3.264723	30.77%

5/7/2012	3.64	0.19	3.708104	1.962	1.765764	52.38%
6/12/2012	5.23	0.3	8.45691	2.819	2.537073	70.00%
7/16/2012	0.5	0.34	0.9163	0.270	0.24255	73.53%
9/18/2012	0.05	0.16	0.04312	0.027	0.024255	43.75%

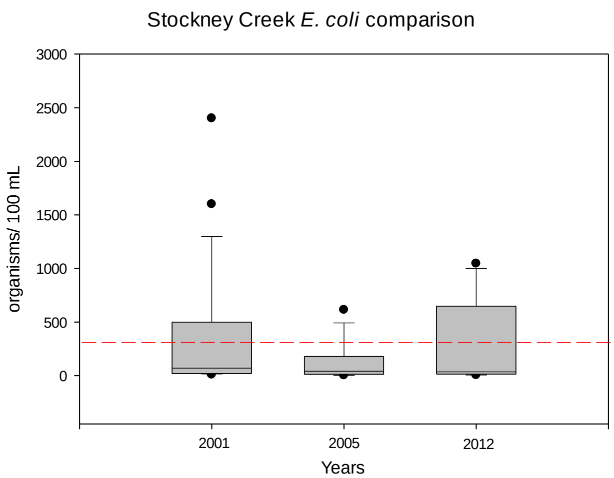


Median NO_3+NO_2 levels increased by 130 percent from 2005 to 2012, and exceeded the 0.3 mg/L target criterion 91% of the time (n=11). The seasonal peaks that were observed in the 2001 study were less pronounced in both 2005 and 2012 (Figure 15). Table 19 shows NO_3+NO_2 loading data and required reductions.

Figure 15. Comparison of Stockney Creek NO3+NO2 data. The dashed red line indicates the applicable 0.3 mg/L target for NO3+NO2.

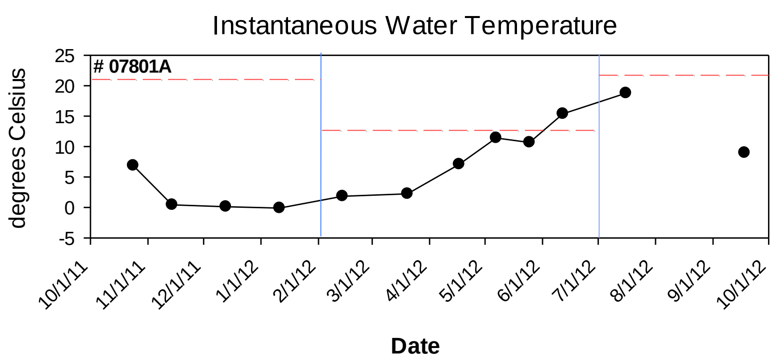
Table 19. Total NO3+NO2 existing load, load capacity, load allocation, and required reduction for Stockney Creek near mouth.

Sample Date	Flow (cfs)	NO3/NO2 (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
10/24/2011	0.63	0.4	1.188495	1.019	0.916839	22.86%
11/14/2011	1.01	1.1	5.824973	1.633	1.469853	74.77%
12/13/2011	0.81	1.9	8.469846	1.310	1.178793	86.08%
1/11/2012	1.1	1.6	9.36782	1.779	1.60083	82.91%
2/14/2012	2.62	1.8	25.27802	4.237	3.812886	84.92%
3/20/2012	4.8	4.5	115.1304	7.762	6.98544	93.93%
4/17/2012	6.73	3.6	131.3144	10.882	9.794169	92.54%
5/7/2012	3.64	2.1	40.80877	5.886	5.297292	87.02%
6/12/2012	5.23	1.14	32.13626	8.457	7.611219	76.32%
7/16/2012	0.5	0.25	0.67375	0.809	0.72765	none
9/18/2012	0.05	2.65	0.714175	0.081	0.072765	89.81%



Median *E. coli* levels decreased in each subsequent monitoring year (Figure 16), with three exceedances of the primary contact recreation criteria of 406 org/100mL being observed in 2012 (n=11), up from one exceedance in the 2005 study (n=17).

Figure 16. Comparison of Stockney Creek *E. coli* data. The dashed red line indicates the applicable 406 org/100 mL target.



Only one exceedance of the instantaneous temperature criteria was observed during this monitoring project, on June 12, 2012.

Figure 17. Instantaneous water temperature readings for Stockney Cr. (#07801A), 2011-2012. The blue lines delineate the period of the year deemed critical to salmonid spawning and incubation. The dashed red lines represent the associated target criteria.

Stockney Creek, additional observations:

- TSS levels were quite low during the 2012 study and measured levels only exceeded the 25 mg/L target criteria one time, on June 12, 2012.

Shebang Creek (#07101A)

Figure 18. Shebang Creek (#07101A) monitoring site, 2011-2012

Shebang Creek drains 18,332 acres of land, of which 15,790 acres are cropland, 1,408 acres are pastureland, 754 acres are rangeland, 318 acres of land are forested and 62 acres are urban/industrial. All 18,332 acres are privately owned.

The upper surveyed reaches of Shebang Creek are in relatively good condition and have a high potential for restoration of quality aquatic habitat. These reaches also had the best vegetative communities, with over 50% of the reach dominated by *Carex spp.* communities (Idaho County Soil and Water Conservation District, 2000). The lower reaches of Shebang Creek have been much more impacted by livestock and channelization of the stream.

Table 20. Descriptive statistics for Shebang Creek monitoring site, 2011-2012.

07101A: Shebang Creek	Temp (oC)	D.O. (mg/L)	pH (H+)	Turbidity (NTU)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	19.53	14.86	8.19	9.80	2419.60	7.74	0.11	0.17	7.00	5.22
Minimum	0.10	5.51	6.64	0.58	1.00	0.04	0.01	0.04	1.00	0.02
Mean	8.15	11.25	7.65	4.25	340.97	1.49	0.04	0.09	3.55	1.86
Median	8.80	11.42	7.75	2.18	96.00	0.65	0.03	0.09	3.00	0.99
# exceedance	2.0	1.0	0.0	0.0	1.00	8.0	1.0	3.0	0.0	
% exceedance	16.7%	8.3%	0.0%	0.0%	9.1%	72.7%	9.1%	27.3%	0.0%	0.0%
# sampling events	12	12	12	11	11	11	11	11	11	10

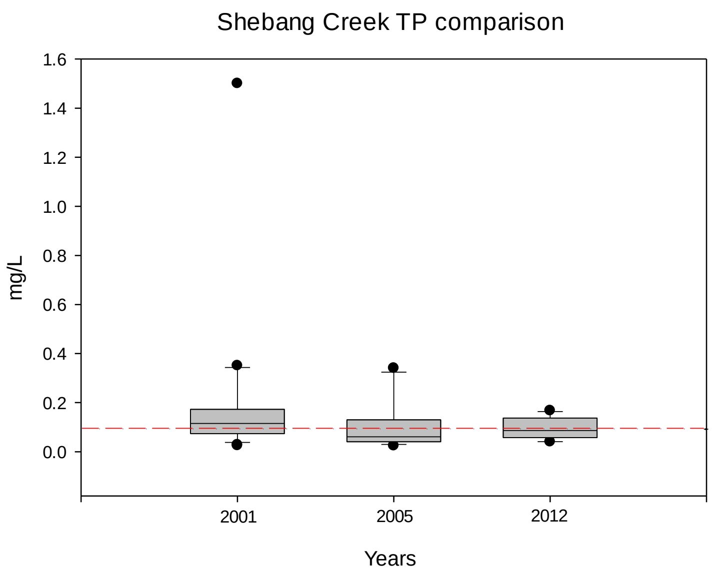
Temp = temperature; D.O. = dissolved oxygen; OP = ortho phosphorus; TP=total phosphorus; TSS = total suspended solids; NO_3+NO_2 = Nitrate + Nitrite

Table 21. Comparison of 2001, 2005, and 2012 data for Shebang Creek.

Parameters	Median			Minimum			Maximum		
	2001	2005	2012	2001	2005	2012	2001	2005	2012
DO (mg/L)	10.25	11.97	11.42	2.05	7.40	5.51	14.29	16.30	14.86
TP (mg/L)	0.12	0.06	0.09	0.03	0.02	0.04	1.50	0.34	0.17

Parameters	Median			Minimum			Maximum		
E. coli (cfu/ 100mL)	170.0	42.1	96.0	10.0	5.2	1.0	5000.0	1413.6	2419.6
TSS (mg/L)	8.5	2.0	3.0	2.0	2.0	1.0	700.0	87.0	7.0
Turbidity (NTU)	8.28	5.40	2.18	2.24	2.05	0.58	103.0	331.0	9.80
NO_3+NO_2	0.385	0.630	0.65	0.05	0.05	0.01	8.50	6.70	7.74

TP=total phosphorus; TSS = total suspended solids; NO_3+NO_2 = Nitrate + Nitrite



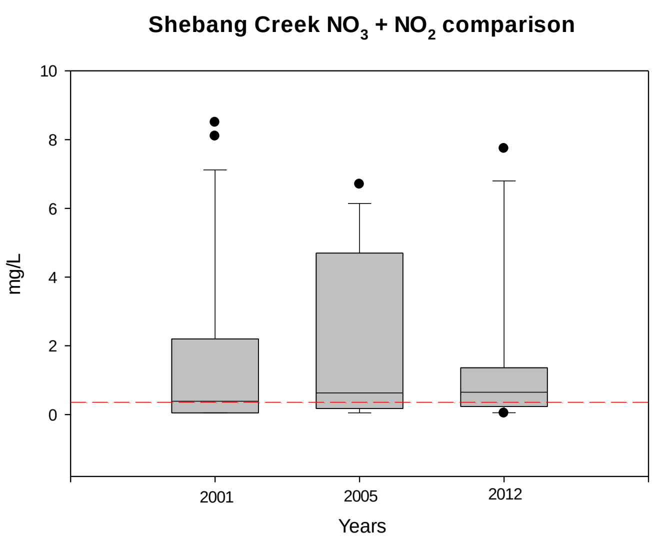
Median and mean TP levels were relatively low at this site over all monitoring years, with the 0.1 mg/L target being exceeded three times in the 2012 study (n=11). Variability of TP values was greatest in 2001, while levels were most consistent in 2012. Figure 19 illustrates the TP comparison between years. Table 22 shows total phosphorus loading data and required reductions.

Figure 19. Comparison of Shebang Creek total phosphorus data. The dashed red line indicates the applicable 0.1 mg/L target.

Table 22. Total phosphorus existing load, load capacity, load allocation, and required reduction for Shebang Creek near mouth. Flows highlighted in yellow represent the 50th percentile flow derived from USGS StreamStats regression equations.

Sample Date	Flow (cfs)	TP (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
10/24/2011	0.11	0.086	0.050989	0.059	0.053361	none
11/14/2011	0.22	0.045	0.053361	0.119	0.106722	none
12/13/2011	0.73	0.04	0.157388	0.393	0.354123	none
1/11/2012	0.15	0.057	0.046085	0.081	0.072765	none
2/14/2012	1.76	0.059	0.559698	0.949	0.853776	none
3/20/2012	4.77	0.092	2.365348	2.571	2.313927	2.17%
4/17/2012	3.83	0.167	3.447498	2.064	1.857933	46.11%
5/7/2012	2.38	0.137	1.757463	1.283	1.154538	34.31%
6/12/2012	5.22	0.15	4.22037	2.814	2.532222	40.00%

Sample Date	Flow (cfs)	TP (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
7/16/2012	0.13	0.099	0.069369	0.070	0.063063	9.09%
9/18/2012	0.02	0.085	0.009163	0.011	0.009702	none

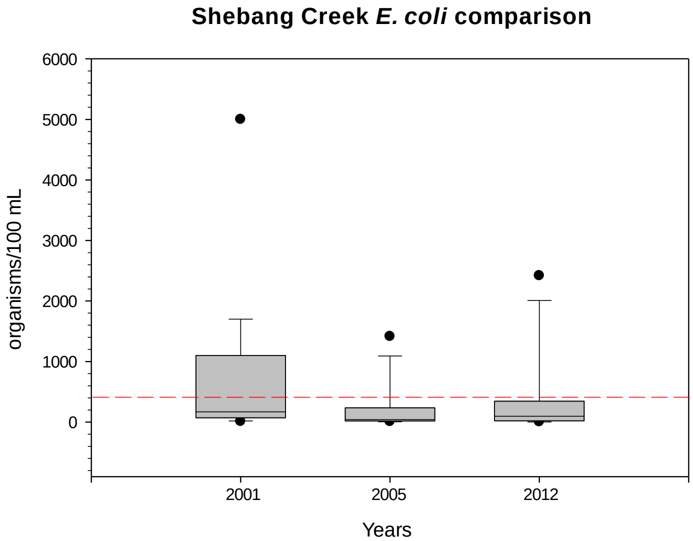


Median NO_3+NO_2 levels were virtually identical in the 2005 and 2012 data sets. The 0.3 mg/L target criterion was exceeded 73% of the time in the 2012 study (n=11). Figure 20 illustrates the ranges of NO_3+NO_2 between years. Table 23 shows NO_3+NO_2 loading data and required reductions.

Figure 20. Comparison of Shebang Creek NO3+NO2 data. The dashed red line indicates the applicable 0.3 mg/L target for NO3+NO2.

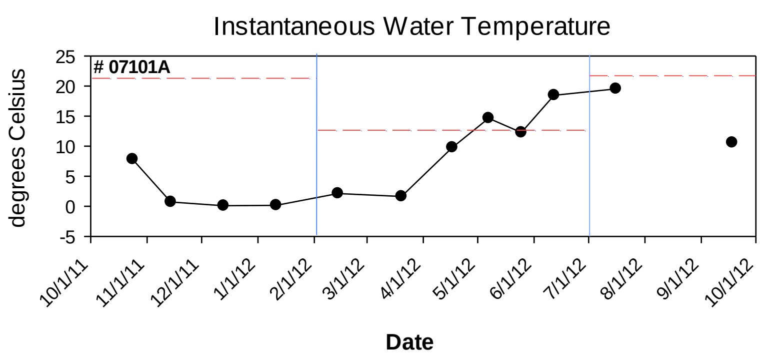
Table 23. Total NO3+NO2 existing load, load capacity, load allocation, and required reduction for Shebang Creek near mouth. Flows highlighted in yellow represent the 50th percentile flow derived from USGS StreamStats regression equations.

Sample Date	Flow (cfs)	NO3/NO2 (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
10/24/2011	0.11	0.2	0.136367	0.178	0.160083	none
11/14/2011	0.22	0.5	0.640332	0.356	0.320166	50.00%
12/13/2011	0.73	1.4	5.351192	1.180	1.062369	80.15%
1/11/2012	0.15	0.8	0.606375	0.243	0.218295	64.00%
2/14/2012	1.76	1.3	12.33232	2.846	2.561328	79.23%
3/20/2012	4.77	7.7	198.9977	7.713	6.941781	96.51%
4/17/2012	3.83	3.0	62.55041	6.193	5.573799	91.09%
5/7/2012	2.38	0.6	7.568638	3.848	3.463614	54.24%
6/12/2012	5.22	0.04	1.125432	8.441	7.596666	none
7/16/2012	0.13	0.11	0.077077	0.210	0.189189	none
9/18/2012	0.02	0.65	0.07007	0.032	0.029106	58.46%



Median *E. coli* levels were highest during the 2001 monitoring effort, (Figure 21), and seven exceedances of the primary contact recreation criterion of 406 org/100mL were observed that year (n=23). In 2012, one exceedance of the criterion occurred, on October 24, 2011 (n=11).

Figure 21. Comparison of Shebang Creek *E. coli* data. The dashed red line indicates the applicable 406 org/100 mL target.



Two exceedances of the instantaneous water quality criterion occurred in 2012, both during the salmonid spawning period in May and June.

Figure 22. Instantaneous water temperature readings for Shebang Cr. (#07101A), 2011-2012. The blue lines delineate the period of the year deemed critical to salmonid spawning and incubation. The dashed red lines represent the associated target criteria.

Shebang Creek, additional observations:

- Nitrogen levels were elevated in all three monitoring studies and appears to be the primary pollutant of concern in the Shebang Creek subwatershed.
- TSS levels were quite low during the 2012 study and never exceeded the 25 mg/L target criterion.
- TP levels exceeded the 0.1 mg/L TMDL target 27% of the time (n=11), which was the lowest exceedance percentage of any tributary to Cottonwood Creek.
- DO levels dropped below the 6.0 mg/L criterion, in September 2012, when streamflow was extremely low (0.02 cfs).

Red Rock Creek (#06405A)

Figure 23. Red Rock Creek (#06405A) monitoring site, 2011-2012

Red Rock Creek is the last major tributary to come into Cottonwood Creek, before its confluence with the South Fork of the Clearwater River. The creek drains 26,482 acres, of which 20,899 acres are cropland, 944 acres are pastureland, 3,777 acres are rangeland, 833 acres are forested and 29 acres are urban/industrial. 24,586 acres of this watershed are in private ownership and 1,896 acres are owned by the Nez Perce Tribe.

The upper reaches of the creek show a variety of impacts, including stream channelization, livestock grazing, degradation of streambank vegetation, and erosion. The lower portion of the stream is more stable than the upstream portion, since it is protected by a bedrock, boulder and cobble substrate. Although fewer livestock are present in the lower section of the creek, they may still be having an impact on stream-side vegetation.

This was the second year of water quality monitoring on this stream.

Table 24. Descriptive statistics for Red Rock Creek monitoring site, 2011-2012.

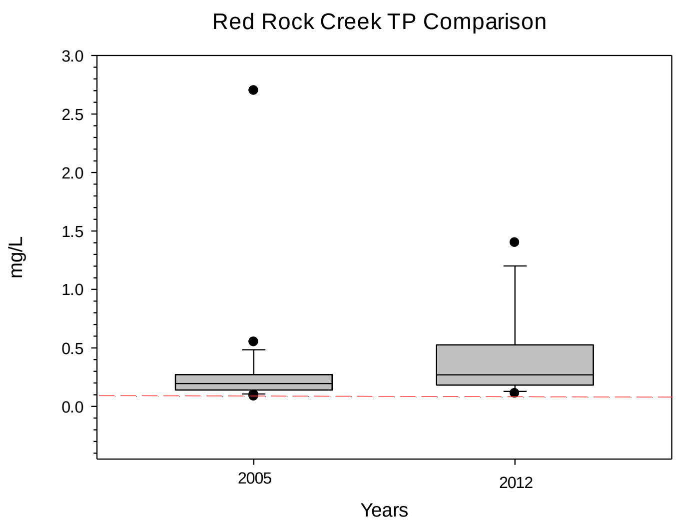
06405A: Red Rock Creek	Temp (oC)	D.O. (mg/L)	pH (H+)	Turbidity (NTU)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	17.90	14.72	8.67	676.00	1046.20	12.20	0.54	1.40	400.00	56.64
Minimum	0.18	9.40	6.36	1.54	1.00	0.35	0.05	0.11	1.00	0.46
Mean	8.40	12.24	7.99	75.64	359.65	3.05	0.24	0.40	45.58	7.91
Median	9.53	11.90	8.30	5.56	85.50	2.63	0.21	0.27	6.50	2.47
# exceedance	1.0	0.0	2.0	2.0	5.00	12.0	12.0	12.0	2.0	
% exceedance	7.1%	0.0%	14.3%	16.7%	45.5%	100.0%	100.0%	100.0%	16.7%	0.0%
# sampling events	14	14	14	12	11	12	12	12	12	12

Temp = temperature; D.O. = dissolved oxygen; OP = ortho phosphorus; TP=total phosphorus; TSS = total suspended solids; NO_3+NO_2 = Nitrate + Nitrite

Table 25. Comparison of 2005 and 2012 data for Red Rock Creek.

Parameters	**Median**		**Minimum**		**Maximum**	
	2005	**2012**	**2005**	**2012**	**2005**	**2012**
DO (mg/L)	10.64	11.90	8.12	9.40	15.87	14.72
TP (mg/L)	0.195	0.270	0.087	0.110	2.70	1.40
E. coli (cfu/ 100mL)	410.6	85.5	24.0	1.0	2419.2	1046.2
TSS (mg/L)	9.9	6.5	2.0	1.0	1200.0	400.0
Turbidity (NTU)	9.315	5.560	4.660	1.540	1000.0	676.0
NO_3+NO_2	1.20	2.63	0.05	0.35	12.0	12.0

TP=total phosphorus; TSS = total suspended solids; NO_3+NO_2 = Nitrate + Nitrite



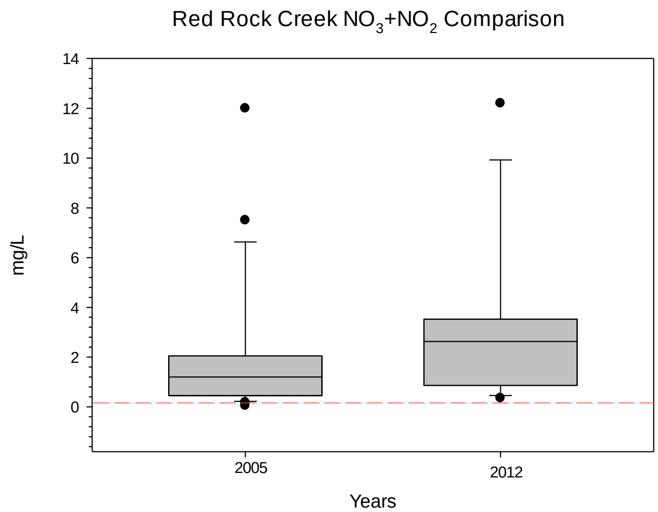
Median and mean TP levels were elevated at this site during both monitoring years, with the 0.1 mg/L target being exceeded 100% of the time in the 2012 study (n=12), and 91% of the time in 2005 (n=22). TP levels in Red Rock Creek are closely linked to stream flow, with a correlation coefficient of 0.94 between the two parameters. Figure 24 shows the differences between data sets. Table 26 shows TP loading data and required reductions.

Figure 24. Comparison of Red Rock Creek total phosphorus data. The dashed red line indicates the applicable 0.1 mg/L target.

Table 26. Total phosphorus existing load, load capacity, load allocation, and required reduction for Red Rock Creek near mouth.

Sample Date	**Flow (cfs)**	**TP (mg/L)**	**Existing Load (lbs/day)**	**Load Capacity (lbs/day)**	**Load Allocation (lbs/day)**	**Required Reduction (%)**
10/25/2011	1.9	0.24	2.45784	1.024	0.92169	62.50%
11/15/2011	1.55	0.19	1.587355	0.835	0.751905	52.63%
12/19/2011	1.82	0.18	1.765764	0.98098	0.882882	50.00%
1/23/2012	3.47	0.59	11.03495	1.870	1.683297	84.75%
2/15/2012	3.04	0.33	5.407248	1.639	1.474704	72.73%
3/26/2012	56.64	1.40	427.4054	30.529	27.476064	93.57%

Sample Date	Flow (cfs)	TP (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
4/17/2012	5.31	0.30	8.58627	2.862	2.575881	70.00%
5/8/2012	3.53	0.30	5.70801	1.903	1.712403	70.00%
6/13/2012	14.93	0.74	59.5498	8.047	7.242543	87.84%
7/17/2012	1.28	0.24	1.655808	0.690	0.620928	62.50%
8/14/2012	0.46	0.17	0.421498	0.24794	0.223146	47.06%
9/18/2012	0.95	0.11	0.563255	0.512	0.460845	18.18%



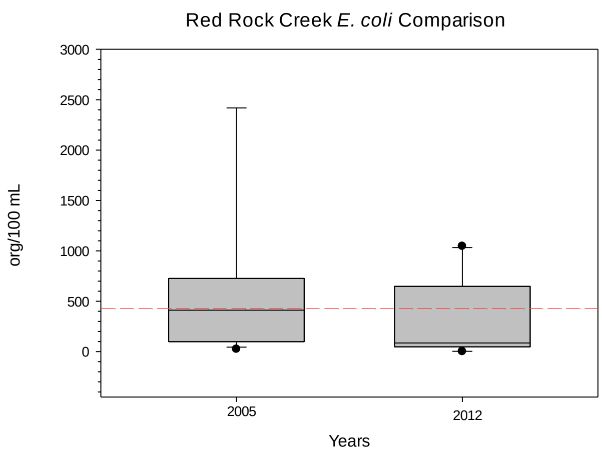
NO_3+NO_2 levels are extremely high in Red Rock Creek, with the median level in 2012 being measured at 2.63 mg/L, substantially higher than the 0.3 mg/L target criterion. The 0.3 mg/L target criterion was exceeded 100% of the time in the 2012 study (n=12). Figure 25 illustrates the ranges of NO_3+NO_2 between years. Table 27 shows NO_3+NO_2 loading data and required reductions.

Figure 25. Comparison of Red Rock Creek NO3+NO2 data. The dashed red line indicates the applicable 0.3 mg/L target for NO3+NO2.

Table 27. Total NO3+NO2 existing load, load capacity, load allocation, and required reduction for Red Rock Creek near mouth.

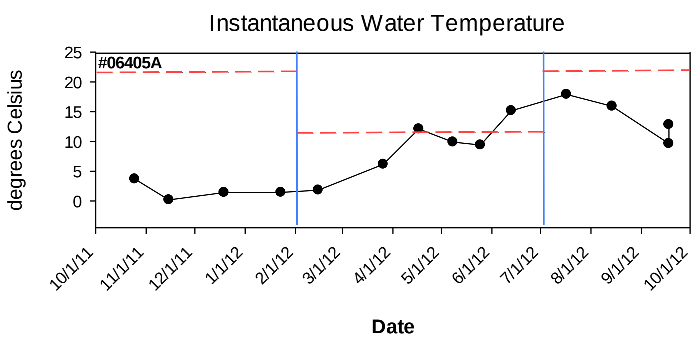
Sample Date	Flow (cfs)	NO3/NO2 (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
10/25/2011	1.9	1.6	16.18078	3.072	2.76507	82.91%
11/15/2011	1.55	2.6	21.63816	2.506	2.255715	89.58%
12/19/2011	1.82	3.1	30.21418	2.94294	2.648646	91.23%
1/23/2012	3.47	3.4	63.03012	5.611	5.049891	91.99%
2/15/2012	3.04	3.6	58.49659	4.916	4.424112	92.44%
3/26/2012	56.64	12.2	3724.533	91.587	82.428192	97.79%
4/17/2012	5.31	4.6	132.2286	8.586	7.727643	94.16%
5/8/2012	3.53	2.7	50.61102	5.708	5.137209	89.85%
6/13/2012	14.93	1.08	86.91052	24.142	21.727629	75.00%

Sample Date	Flow (cfs)	NO3/NO2 (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
7/17/2012	1.28	0.79	5.450368	2.070	1.862784	65.82%
8/14/2012	0.46	0.35	0.86779	0.74382	0.669438	22.86%
9/18/2012	0.95	0.7	3.58435	1.536	1.382535	61.43%



Median *E. coli* levels decreased from 2005 to 2012 (Figure 26). Five exceedances of the primary contact recreation criterion of 406 org/100mL were observed in 2012 (n=12). These exceedances occurred consecutively from March to August of 2012.

Figure 26. Comparison of Red Rock Creek *E. coli* data. The dashed red line indicates the applicable 406 org/100 mL target.



Two exceedances of the instantaneous water quality criterion occurred in 2012, both during the salmonid spawning period in May and June.

Figure 27. Instantaneous water temperature readings for Red Rock Creek (#07101A), 2011-2012. The blue lines delineate the period of the year deemed critical to salmonid spawning and incubation. The dashed red lines represent the associated target criteria.

Red Rock Creek, additional observations:

- Both nitrogen and phosphorus levels were extremely high during both monitoring studies, with 100% of all samples exceeding target criteria in 2012.
- TSS levels were quite low during the 2012 study, with the exception of one high flow event in late March, 2012, when TSS levels rose to 400 mg/L and

coincided with the highest measured concentrations of both nitrogen and phosphorus components.

- Cattle were observed in and directly adjacent to the stream on a regular basis and are likely contributing to the high *E. coli* readings.

Cottonwood Creek

Four monitoring sites were located on the mainstem of Cottonwood Creek (Figure 1). #01428A was located as close to the headwaters as access would allow. #01423A was located below the City of Cottonwood's waste water treatment plant (WWTP). #01412A was located at "Columbia Crossing", which delineates the Nez Perce Tribal boundary. #01401A was located at the mouth of Cottonwood Creek. Below is an analysis of the data collected for each site.

Cottonwood Creek Headwaters (#01428A)

Figure 28. Cottonwood Creek headwaters (#01428A) monitoring site, 2011-2012

This monitoring station was located on the mainstem of Cottonwood Creek, several miles east of the City of Cottonwood. The land above this particular site is primarily forested, with small areas of pastureland interspersed. One homestead was located directly above the monitoring station and cattle on that property had access to the creek during certain periods of the year.

Table 28. Descriptive statistics for Cottonwood Creek headwaters (#01428A), 2011-2012.

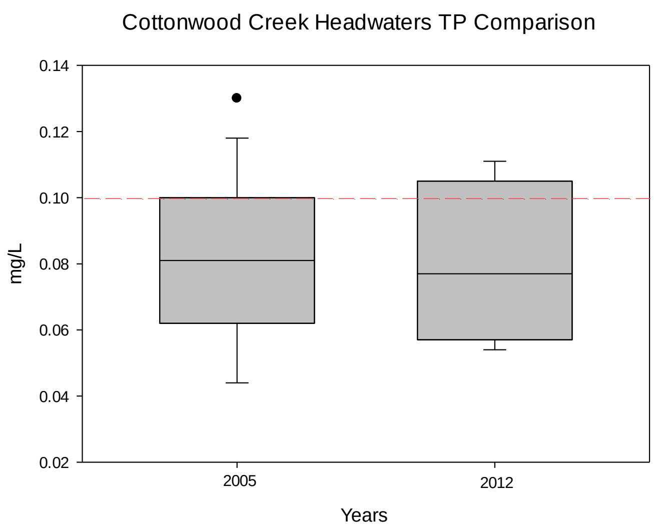
01428A: Cottonwood Creek headwaters	Temp (oC)	D.O. (mg/L)	pH (H+)	Turbidity (NTU)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	20.23	13.71	8.05	22.40	2419.60	1.35	0.05	0.111	28.00	7.17
Minimum	-1.20	7.70	4.46	3.66	52.10	0.01	0.02	0.054	1.00	0.05
Mean	6.84	11.20	6.97	10.05	457.90	0.31	0.04	0.080778	12.11	2.17
Median	5.59	11.13	7.55	8.41	162.60	0.09	0.03	0.077	8.00	0.77
# exceedance	2.0	0.0	3.0	0.0	2.0	2.0	0.0	2	1.0	
% exceedance	20.0%	0.0%	30.0%	0.0%	25.0%	22.2%	0.0%	22.2%	11.1%	
# sampling events	10	10	10	9	8	9	9	9	9	9

Temp = temperature; D.O. = dissolved oxygen; OP = ortho phosphorus; TP=total phosphorus; TSS = total suspended solids; NO_3+NO_2 = Nitrate + Nitrite

Table 29. Comparison of 2005 and 2012 data for Cottonwood Creek headwaters.

Parameters	Median		Minimum		Maximum	
	2005	**2012**	**2005**	**2012**	**2005**	**2012**
DO (mg/L)	12.50	11.10	8.54	7.70	14.08	13.71
TP (mg/L)	0.08	0.08	0.04	0.05	0.13	0.11
E. coli (cfu/ 100mL)	218.7	162.6	44.3	52.1	2419.2	2419.6
TSS (mg/L)	13.0	8.0	2.0	1.0	31.0	28.0
Turbidity (NTU)	17.2	8.4	7.1	3.7	55.0	22.4
NO_3+NO_2	0.15	0.09	0.05	0.01	4.10	1.35

TP=total phosphorus; TSS = total suspended solids; NO_3+NO_2 = Nitrate + Nitrite

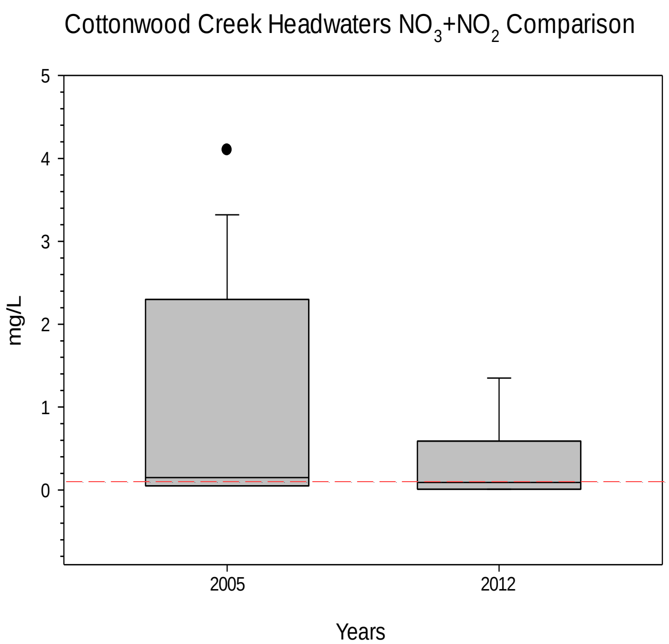


Median and mean TP levels were relatively low at this site during both monitoring years, with the 0.1 mg/L target being exceeded twice in the 2012 study (n=9), and three times in 2005 (n=15). Figure 29 shows the differences between data sets. Table 30 shows TP loading data and required reductions.

Figure 29. Comparison of Cottonwood Creek headwaters total phosphorus data. The dashed red line indicates the applicable 0.1 mg/L target.

Table 30. Total phosphorus existing load, load capacity, load allocation, and required reduction for Cottonwood Creek headwaters.

Sample Date	Flow (cfs)	TP (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
10/24/2011	0.05	0.111	0.029915	0.027	0.024255	18.92%
11/14/2011	0.1	0.059	0.031801	0.054	0.04851	none
1/11/2012	0.11	0.055	0.03261	0.059	0.053361	none
2/14/2012	0.77	0.077	0.319573	0.415	0.373527	none
3/20/2012	3.08	0.061	1.012673	1.660	1.494108	none
4/16/2012	7.17	0.1	3.86463	3.865	3.478167	10.00%
5/7/2012	3.69	0.054	1.074011	1.989	1.790019	none
6/12/2012	4.46	0.11	2.644334	2.404	2.163546	18.18%
7/16/2012	0.1	0.1	0.0539	0.054	0.04851	10.00%

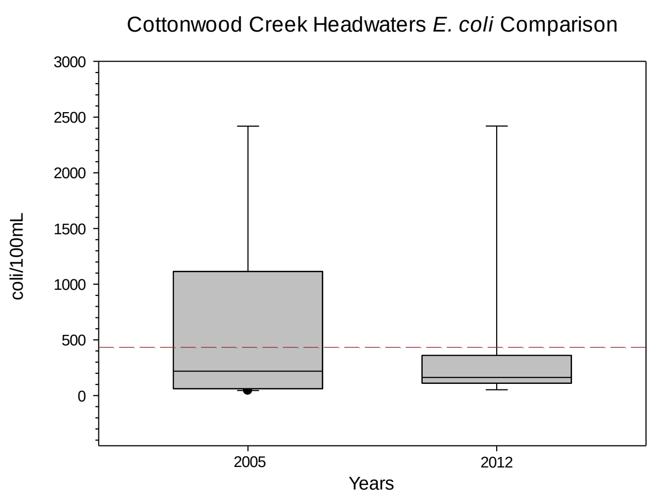


NO_3+NO_2 levels were relatively low at the headwaters of Cottonwood Creek in 2011-2012, with a median level of 0.09 mg/L. The 0.3 mg/L target criterion was exceeded twice during the 2012 study (n=12). Nitrogen levels in 2005-2006 spiked dramatically in January of 2006 and remained elevated until March, with a median level of 2.6 mg/L over the three month period. Figure 30 illustrates the ranges of NO_3+NO_2 between years. Table 31 shows NO_3+NO_2 loading data and required reductions.

Figure 30. Comparison of Cottonwood Creek headwaters NO_3+NO_2 data. The dashed red line indicates the applicable 0.3 mg/L target for NO_3+NO_2.

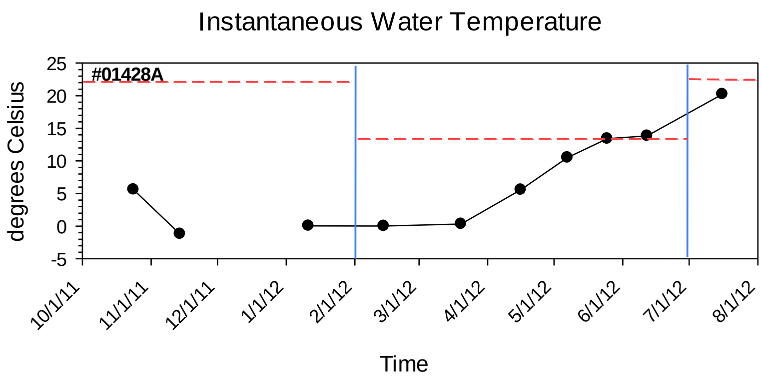
Table 31. Total NO_3+NO_2existing load, load capacity, load allocation, and required reduction for Cottonwood Creek near headwaters.

Sample Date	Flow (cfs)	NO3/NO2 (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
10/24/2011	0.05	0.01	0.002695	0.081	0.072765	none
11/14/2011	0.1	0.01	0.00539	0.162	0.14553	none
1/11/2012	0.11	0.14	0.083006	0.178	0.160083	none
2/14/2012	0.77	0.88	3.652264	1.245	1.120581	69.32%
3/20/2012	3.08	1.35	22.41162	4.980	4.482324	80.00%
4/16/2012	7.17	0.3	11.59389	11.594	10.434501	10.00%
5/7/2012	3.69	0.09	1.790019	5.967	5.370057	none
6/12/2012	4.46	0.04	0.961576	7.212	6.490638	none
7/16/2012	0.1	0.01	0.00539	0.162	0.14553	none



Median *E. coli* levels decreased slightly from 2005 to 2012 (Figure 31). Two exceedances of the primary contact recreation criterion of 406 org/100mL were observed in 2012 (n=9).

Figure 31. Comparison of Cottonwood Creek headwaters *E. coli* data. The dashed red line indicates the applicable 406 org/100 mL target.



Two exceedances of the instantaneous water quality criterion occurred in 2012, both during the salmonid spawning period in May and June.

Figure 32. Instantaneous water temperature readings for Cottonwood Creek headwaters (#01428A), 2011-2012. The blue lines delineate the period of the year deemed critical to salmonid spawning and incubation. The dashed red lines represent the associated target criteria.

Cottonwood Creek Headwaters, additional observations:

- Nutrient levels were relatively low at this site during this monitoring project, with only approximately 20% of the samples exceeding numeric target criteria in 2012.
- TSS levels were low during the 2012 study, with the highest measurement occurring on June 12, 2012 (28 mg/L).
- Three pH readings below the desired range of 6.5-9.5 occurred in subsequent months from October 2011 to January 2012. The cause of these low numbers is unknown at this time.
- Streamflow was very low at this site during the summer months, and flow completely stopped in July 2012 and did not return during the remainder of this monitoring effort (through October).

Cottonwood Creek, Below Waste Water Treatment Plant (#01423A)

Figure 33. Cottonwood Creek (#01423A) below WWTP, 2011-2012

This monitoring station was located on the main stem of Cottonwood Creek, just below the section of stream that the City of Cottonwood's WWTP discharges into. As described in the previous section, this site is also located in the upper Cottonwood Creek subwatershed. The land use is primarily cropland upstream of this site, although the stream also flows through the City of Cottonwood.

Table 32. Descriptive statistics for Cottonwood Creek monitoring site, below WWTP, 2011-2012.

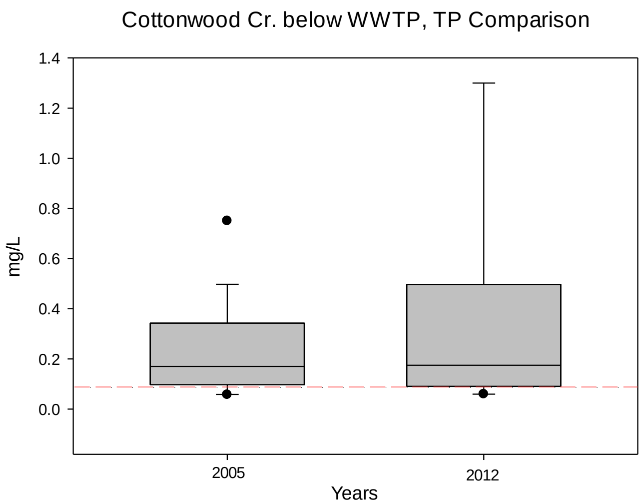
Cottonwood Creek WWTP	Temp (oC)	D.O. (mg/L)	pH (H+)	Turbidity (NTU)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	17.42	14.42	8.48	23.00	2419.60	2.96	0.97	1.30	18.00	8.71
Minimum	0.03	7.74	6.24	0.85	1.00	0.57	0.02	0.06	1.00	0.10
Mean	6.17	11.86	7.57	8.44	342.13	1.52	0.17	0.37	8.10	3.07
Median	6.08	11.81	7.62	4.97	59.05	1.52	0.09	0.17	8.50	0.90
# exceedance	1.0	0.0	1.0	0.0	2.00	10.0	5.0	7.0	0.0	
% exceedance	9.1%	0.0%	9.1%	0.0%	20.0%	100.0%	50.0%	70.0%	0.0%	
# sampling events	11.0	11.0	11.0	10.0	10	10	10	10	10.0	9.00

Temp = temperature; D.O. = dissolved oxygen; OP = ortho phosphorus; TP=total phosphorus; TSS = total suspended solids; NO_3+NO_2 = Nitrate + Nitrite

Table 33. Comparison of 2005 and 2012 data for Cottonwood Creek below WWTP, 2011-2012.

Parameters	**Median**		**Minimum**		**Maximum**	
	2005	**2012**	**2005**	**2012**	**2005**	**2012**
DO (mg/L)	12.25	11.81	8.74	7.74	16.50	14.42
TP (mg/L)	0.17	0.17	0.06	0.06	0.75	1.30
E. coli (cfu/ 100mL)	63.80	59.05	1.00	1.00	648.80	2419.60
TSS (mg/L)	4.55	8.50	2.00	1.00	47.00	18.00
Turbidity (NTU)	8.75	4.97	4.63	0.85	64.60	23.00
NO_3+NO_2	1.00	1.52	0.30	0.57	4.00	2.96

TP=total phosphorus; TSS = total suspended solids; NO_3+NO_2 = Nitrate + Nitrite

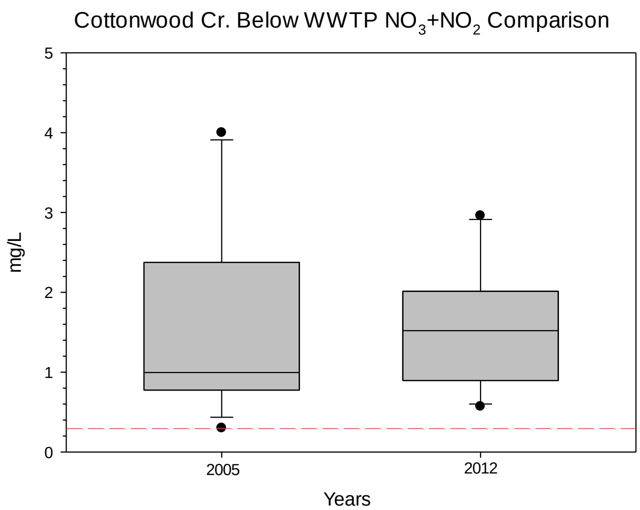


Total phosphorus levels were elevated at this site, with approximately 70% of the samples exceeding the 0.1 mg/L target in each monitoring year. The highest TP levels in 2012 were measured during January and February, when both samples were at 1.3 mg/L, nearly 1,200 % higher than the 0.1 mg/L target criteria. Figure 34 shows the differences between data sets. Table 34 shows TP loading data and required reductions.

Figure 34. Comparison of Cottonwood Creek, below WWTP, total phosphorus data. The dashed red line indicates the applicable 0.1 mg/L target.

Table 34. Total phosphorus existing load, load capacity, load allocation, and required reduction for Cottonwood Creek, below WWTP. Flows highlighted in yellow represent the 50th percentile flow derived from USGS Streamstats regression equations.

Sample Date	Flow (cfs)	TP (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
10/24/2011	0.38	0.159	0.325664	0.205	0.184338	43.40%
11/14/2011	0.12	0.059	0.038161	0.065	0.058212	none
12/13/2011	0.69	0.062	0.230584	0.372	0.334719	none
1/11/2012	0.5	1.3	3.5035	0.270	0.24255	93.08%
2/14/2012	0.9	1.3	6.3063	0.485	0.43659	93.08%
3/20/2012	6.53	0.23	8.095241	3.520	3.167703	60.87%
4/16/2012	8.71	0.19	8.919911	4.695	4.225221	52.63%
5/7/2012	4.52	0.1	2.43628	2.436	2.192652	10.00%
6/12/2012	5.89	0.143	4.539835	3.175	2.857239	37.06%
7/16/2012	0.1	0.19	0.10241	0.054	0.04851	52.63%

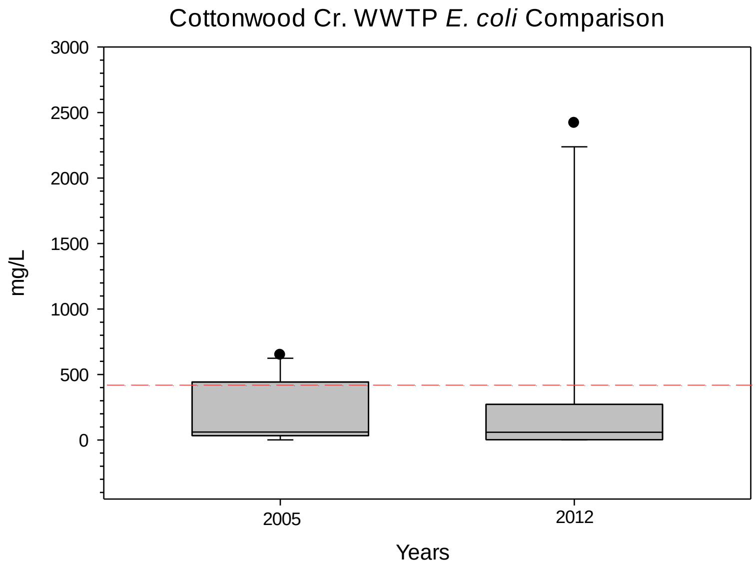


NO_3+NO_2 levels exceeded the 0.3 mg/L target criterion 100% of the time during both monitoring years. There was less seasonal variation in nitrogen levels at this site than at other sites in this study, potentially indicating that effluent or seepage from the WWTP could be contributing to the high loads observed. Figure 35 illustrates the ranges of NO_3+NO_2 between years. Table 35 shows NO_3+NO_2 loading data and required reductions.

Figure 35. Comparison of Cottonwood Creek, below WWTP, NO_3+NO_2 data. The dashed red line indicates the applicable 0.3 mg/L target for NO_3+NO_2.

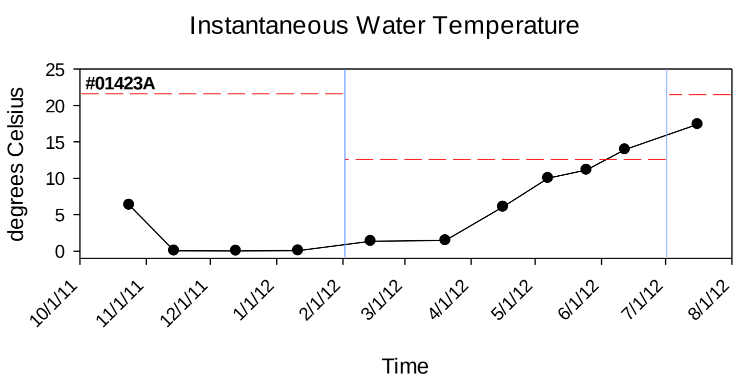
Table 35. Total NO_3+NO_2existing load, load capacity, load allocation, and required reduction for Cottonwood Creek, below WWTP. Flows highlighted in yellow represent the 50th percentile flow derived from USGS StreamStats regression equations.

Sample Date	Flow (cfs)	NO3/NO2 (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
10/24/2011	0.38	1.51	3.092782	0.614	0.553014	82.12%
11/14/2011	0.12	1.56	1.009008	0.194	0.174636	82.69%
12/13/2011	0.69	2.96	11.00854	1.116	1.004157	90.88%
1/11/2012	0.5	0.93	2.50635	0.809	0.72765	70.97%
2/14/2012	0.9	1.53	7.42203	1.455	1.30977	82.35%
3/20/2012	6.53	2.5	87.99175	10.559	9.503109	89.20%
4/16/2012	8.71	0.9	42.25221	14.084	12.675663	70.00%
5/7/2012	4.52	0.88	21.43926	7.309	6.577956	69.32%
6/12/2012	5.89	0.57	18.09585	9.524	8.571717	52.63%
7/16/2012	0.1	1.85	0.99715	0.162	0.14553	85.41%



Median *E. coli* levels decreased slightly from 2005 to 2012 (Figure 36). Two exceedances of the primary contact recreation criterion of 406 org/100mL were observed in October and November of 2011 (n=10).

Figure 36. Comparison of Cottonwood Creek headwaters *E. coli* data. The dashed red line indicates the applicable 406 org/100 mL target.



One exceedance of the instantaneous water quality criterion occurred in June of 2012, during the salmonid spawning period.

Figure 37. Instantaneous water temperature readings for Cottonwood Creek below WWTP (#01423A), 2011-2012. The blue lines delineate the period of the year deemed critical to salmonid spawning and incubation. The dashed red lines represent the associated target criteria.

Cottonwood Creek below WWTP, additional observations:

- Nutrient levels were extremely elevated at this site, with 70% of the total phosphorus samples and 100% of the nitrate-nitrite samples exceeding the numeric target criteria. These levels are consistent with the levels measured during the 2005 water quality study.
- One exceedance of the 1.24 mg/L ammonia criterion set in the TMDL occurred on January 11, 2012, with a recorded level of 7.37 mg/L.
- TSS levels were low during the 2012 study, with the highest measurement occurring on June 12, 2012 (18 mg/L).

- One pH reading below the numeric criteria occurred on March 20, 2012.
- Specific conductivity levels average 557 µS during the winter months, which is a 292% increase over levels observed at the headwaters site. Although this increase may be due to geologic changes, this increase in conductivity levels could also be an indicator of discharge or seepage from the Cottonwood WWTP.

Cottonwood Creek, Nez Perce Reservation boundary (#1412A)

Figure 38. Cottonwood Creek (#1412A) @ Reservation boundary, 2011-2012

This monitoring station was located on the main stem of Cottonwood Creek, at "Columbia Crossing", which delineates the Nez Perce Tribal Reservation boundary. This monitoring station is located in the "Middle Cottonwood Subwatershed", as defined in the TMDL. This subwatershed drains 12,061 acres, of which 8,929 acres are cropland, 689 acres are pastureland, 1,597 acres are rangeland, and 846 acres are forestland. 11,298 acres are privately owned, and 763 acres are owned by the Nez Perce Tribe.

Table 36. Descriptive statistics for Cottonwood Creek monitoring site at Reservation boundary, 2011-2012.

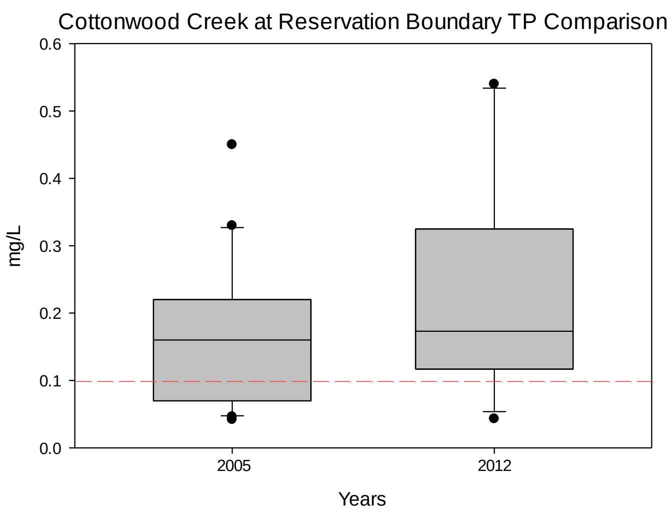
01412A: Cottonwood Cr. @ Reservation boundary	Temp (oC)	D.O. (mg/L)	pH (H+)	Turbidity (NTU)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	19.53	17.14	8.79	142.00	1986.30	8.42	0.24	0.54	37.00	101.69
Minimum	0.47	9.45	7.61	1.43	4.10	0.34	0.02	0.04	1.00	0.85
Mean	9.19	12.71	8.25	23.89	333.64	1.61	0.12	0.23	7.25	19.26
Median	10.67	11.26	8.40	4.99	108.60	0.74	0.09	0.17	4.50	6.11
# exceedance	2.0	0.0	0.0	2.0	2.00	12.0	5.0	10.0	1.0	
% exceedance	14.4%	0.0%	0.0%	16.7%	18.2%	100.0%	41.7%	83.3%	8.3%	
# sampling events	13	13	13	12	11	12	12	12	12	12

Temp = temperature; D.O. = dissolved oxygen; OP = ortho phosphorus; TP=total phosphorus; TSS = total suspended solids; NO_3+NO_2 = Nitrate + Nitrite

Table 37. Comparison of 2005 and 2012 data for Cottonwood Creek at Reservation boundary.

Parameters	Median		Minimum		Maximum	
	2005	**2012**	**2005**	**2012**	**2005**	**2012**
DO (mg/L)	11.41	11.26	8.20	9.45	14.26	19.53
TP (mg/L)	0.16	0.17	0.04	0.04	0.45	0.54
E. coli (cfu/ 100mL)	62.70	108.60	1.00	4.10	2108.43	1986.30
TSS (mg/L)	4.25	4.50	2.00	1.00	80.00	37.00
Turbidity (NTU)	8.45	4.99	3.13	1.43	212.00	142.00
NO_3+NO_2	1.00	1.52	0.30	0.57	4.00	2.96

TP=total phosphorus; TSS = total suspended solids; NO_3+NO_2 = Nitrate + Nitrite



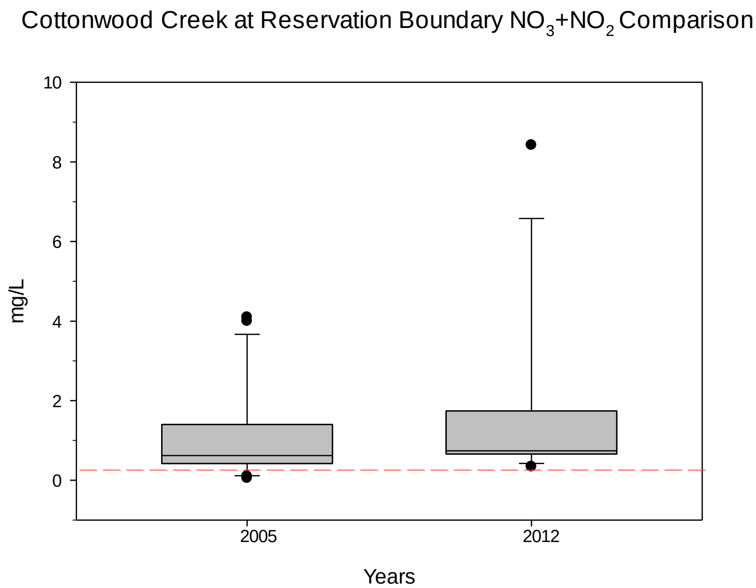
Total phosphorus levels were elevated at this site, with 80% of the samples exceeding the 0.1 mg/L target in 2012. Although the median TP levels were the same in 2005 and 2012, the range of values was larger in 2012, with the maximum concentration being measured at 0.54 mg/L. Figure 39 shows a comparison of the data sets and Table 38 shows TP loading data and required reductions.

Figure 39. Comparison of Cottonwood Creek, at Reservation boundary, total phosphorus data. The dashed red line indicates the applicable 0.1 mg/L target.

Table 38. Total phosphorus existing load, load capacity, load allocation, and required reduction for Cottonwood Creek, below WWTP.

Sample Date	Flow (cfs)	TP (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
10/25/2011	4.05	0.146	3.187107	2.183	1.964655	38.36%
11/15/2011	3.63	0.043	0.841325	1.957	1.760913	none
12/19/2011	3.15	0.079	1.341302	1.698	1.528065	none
1/23/2012	15.04	0.31	25.13034	8.107	7.295904	70.97%
2/15/2012	8.16	0.54	23.7505	4.398	3.958416	83.33%
3/27/2012	101.69	0.33	180.876	54.811	49.329819	72.73%
4/24/2012	18.08	0.144	14.03297	9.745	8.770608	37.50%

Sample Date	Flow (cfs)	TP (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
5/8/2012	14.86	0.109	8.730399	8.010	7.208586	17.43%
6/13/2012	57.14	0.52	160.152	30.798	27.718614	82.69%
7/17/2012	2.17	0.23	2.690149	1.170	1.052667	60.87%
8/14/2012	0.85	0.2	0.9163	0.458	0.412335	55.00%
9/18/2012	2.3	0.14	1.73558	1.240	1.11573	35.71%



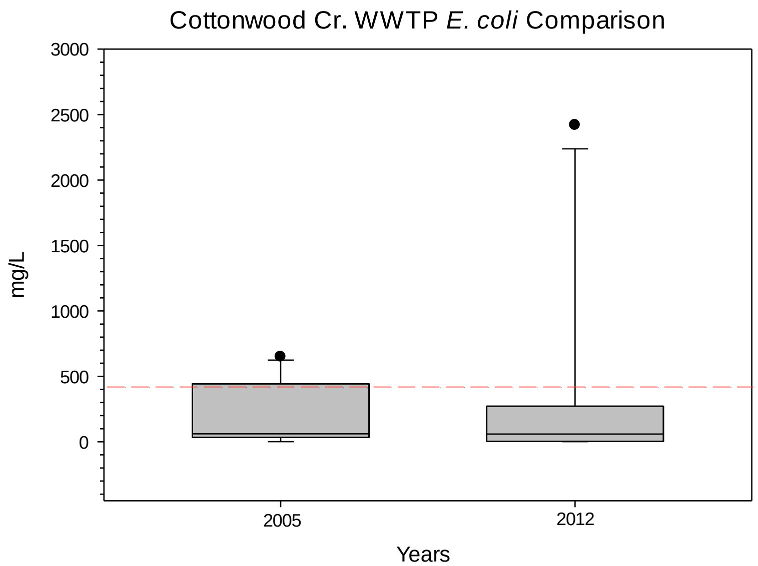
NO_3+NO_2 levels exceeded the 0.3 mg/L target criterion in 100% of the samples collected (n=12). The highest level observed occurred in late March, 2012 and was 8.42 mg/L, or over 2,700% higher than the target criterion. Figure 40 illustrates the ranges of NO_3+NO_2 between years. Table 39 shows NO_3+NO_2 loading data and required reductions.

Figure 40. Comparison of Cottonwood Creek, at Reservation boundary, NO_3+NO_2 data. The dashed red line indicates the applicable 0.3 mg/L target.

Table 39. Total NO_3+NO_2existing load, load capacity, load allocation, and required reduction for Cottonwood Creek, below WWTP.

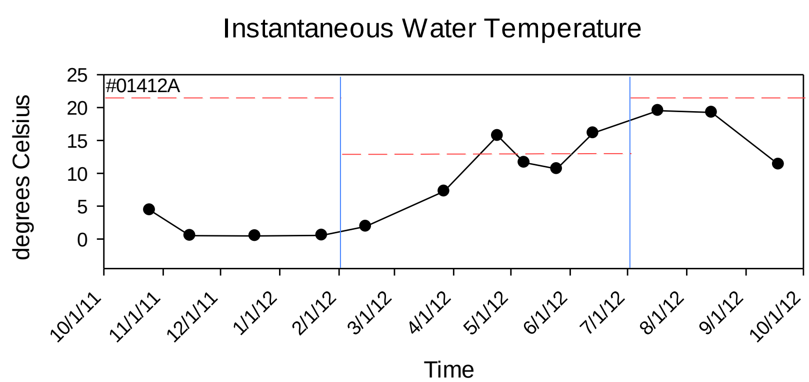
Sample Date	Flow (cfs)	NO3/NO2 (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
10/25/2011	4.05	0.34	7.42203	6.549	5.893965	20.59%
11/15/2011	3.63	0.72	14.0873	5.870	5.282739	62.50%
12/19/2011	3.15	1.83	31.07066	5.094	4.584195	85.25%
1/23/2012	15.04	2.28	184.8296	24.320	21.887712	88.16%
2/15/2012	8.16	1.47	64.65413	13.195	11.875248	81.63%
3/27/2012	101.69	8.42	4615.079	164.433	147.989457	96.79%
4/24/2012	18.08	0.65	63.34328	29.235	26.311824	58.46%

Sample Date	Flow (cfs)	NO3/NO2 (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
5/8/2012	14.86	0.68	54.46487	24.029	21.625758	60.29%
6/13/2012	57.14	0.83	255.6272	92.395	83.155842	67.47%
7/17/2012	2.17	0.61	7.134743	3.509	3.158001	55.74%
8/14/2012	0.85	0.76	3.48194	1.374	1.237005	64.47%
9/18/2012	2.3	0.72	8.92584	3.719	3.34719	62.50%



Median *E. coli* levels decreased slightly from 2005 to 2012 (Figure 41). Two exceedances of the primary contact recreation criterion of 406 org/100mL were observed in October and November of 2011 (n=10).

Figure 41. Comparison of Cottonwood Creek headwaters *E. coli* data. The dashed red line indicates the applicable 406 org/100 mL target.



Two exceedances of the instantaneous water quality criterion occurred, once in April 2012 and once in June of 2012, both during the salmonid spawning period.

Figure 42. Instantaneous water temperature readings for Cottonwood Creek at Reservation boundary (#01412A), 2011-2012. The blue lines delineate the period of the year deemed critical to salmonid spawning and incubation. The dashed red lines represent the associated target criteria.

Cottonwood Creek at Reservation boundary, additional observations:

- Nutrient levels were extremely elevated at this site, with 83% of the total phosphorus samples and 100% of the nitrate/nitrite samples exceeding the numeric target criteria. These levels are consistent with the levels measure during the 2005 water quality study.
- TSS levels were low during the 2012 study, with the highest measurement occurring on June 13, 2012 (37 mg/L).

Cottonwood Creek Mouth (#01401A)

Figure 43. Cottonwood Creek (#01401A) @ mouth, 2011-2012

This monitoring station was located on the main stem of Cottonwood Creek, near its confluence with the South Fork Clearwater River. This monitoring station is located in the "Lower Cottonwood Subwatershed", as defined in the TMDL. This subwatershed drains 16,120 acres, of which 6,188 acres are cropland, 993 acres are pastureland, 6,755 acres are rangeland, and 2,184 acres are forestland. 14,121 acres are privately owned, 399 acres are owned by the BLM, and 1,600 acres are owned by the Nez Perce Tribe.

Lower Cottonwood Creek differs significantly, both hydrologically and geologically, from the upper portion of the creek. As the creek leaves the Camas Prairie, it flows into and through a relatively narrow stretch of canyon, where stream gradients can be as high as 5%. Cobble and boulder substrate dominates this canyon reach, as opposed to the sand and silt typically found in the prairie reaches. As the creek approaches its confluence with the South Fork of the Clearwater River, the gradient drops to less than one percent. The substrate in this lower stream reach is dominated by cobble and gravel, likely being transported from the upper reaches, and aggradation of the stream bed appears to be occurring. Vegetation in this reach is comprised primarily of weed species and graminoids, with scattered Cottonwood (*Populus trichocarpa*) stands found in the adjacent floodplain.

Table 40. Descriptive statistics for Cottonwood Creek monitoring site at mouth, 2011-2012.

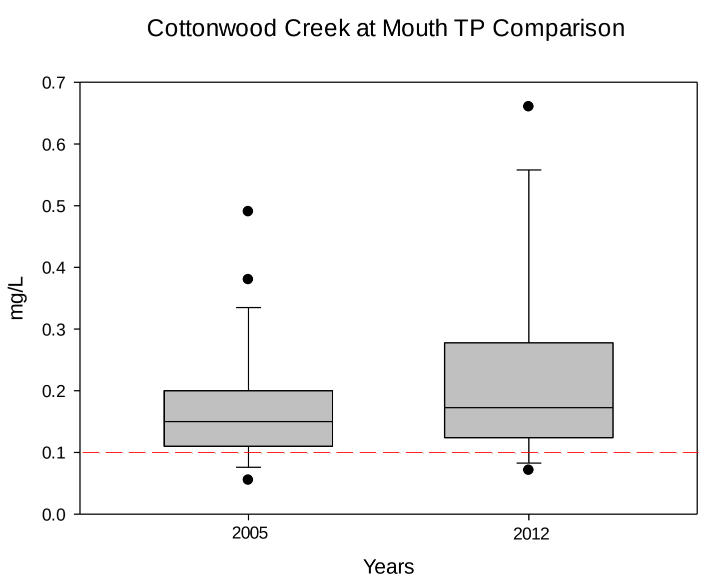
01401A: Cottonwood Cr. Mouth	Temp (oC)	D.O. (mg/L)	pH (H+)	Turbidity (NTU)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	23.73	17.60	8.88	89.90	307.60	6.61	0.24	0.66	272.00	129.02
Minimum	0.08	7.98	6.59	0.55	2.00	0.01	0.01	0.07	1.00	2.72
Mean	12.29	12.01	8.05	13.17	66.88	0.98	0.12	0.22	26.67	22.15
Median	14.54	11.58	8.36	2.16	39.60	0.14	0.12	0.17	2.50	10.30
# exceedance	6.0	0.0	0.0	1.0	0.00	4.0	7.0	11.0	1.0	
% exceedance	46.2%	0.0%	0.0%	8.3%	0.0%	33.3%	58.3%	91.7%	8.3%	
# sampling events	13	13	13	12	12	12	12	12	12	12

Temp = temperature; D.O. = dissolved oxygen; OP = ortho phosphorus; TP=total phosphorus; TSS = total suspended solids; NO_3+NO_2 = Nitrate + Nitrite

Table 41. Comparison of 2005 and 2012 data for Cottonwood Creek at mouth.

Parameters	Median		Minimum		Maximum	
	2005	**2012**	**2005**	**2012**	**2005**	**2012**
DO (mg/L)	11.05	11.58	8.65	7.98	13.77	17.60
TP (mg/L)	0.15	0.17	0.06	0.07	0.49	0.66
E. coli (cfu/ 100mL)	59.70	39.60	12.00	2.00	2419.20	307.60
TSS (mg/L)	2.00	2.50	2.00	1.00	83.00	272.00
Turbidity (NTU)	5.67	2.16	1.86	0.55	198.00	89.90
NO_3+NO_2	0.21	0.14	0.05	0.01	6.20	6.61

TP=total phosphorus; TSS = total suspended solids; NO_3+NO_2 = Nitrate + Nitrite

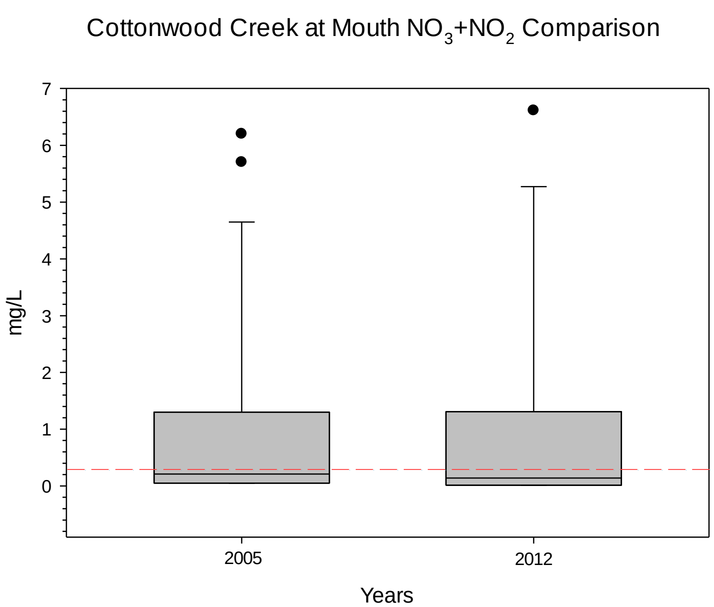


Total phosphorus levels were elevated at this site, with 95% of the samples exceeding the 0.1 mg/L target in 2012. The maximum value measured in 2012 was 0.66 mg/L. Median concentrations were very similar to levels measured in 2005. Figure 44 compares the data from both years. Table 42 shows loading data and required TP reductions.

Figure 44. Comparison of Cottonwood Creek, at mouth, total phosphorus data. The dashed red line indicates the applicable 0.1 mg/L target.

Table 42. Total phosphorus existing load, load capacity, load allocation, and required reduction for Cottonwood Creek, at mouth.

Sample Date	Flow (cfs)	TP (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
10/31/2011	6.62	0.11	3.924998	3.568	3.211362	18.18%
11/21/2011	8.25	0.071	3.157193	4.447	4.002075	none
12/21/2011	8.28	0.159	7.096043	4.463	4.016628	43.40%
1/30/2012	18.02	0.176	17.09449	9.713	8.741502	48.86%
2/22/2012	24.15	0.66	85.91121	13.017	11.715165	86.36%
3/28/2012	129.02	0.28	194.717	69.542	62.587602	67.86%
4/24/2012	25.72	0.13	18.022	13.863	12.476772	30.77%
5/15/2012	12.31	0.122	8.09481	6.635	5.971581	26.23%
6/20/2012	22.43	0.169	20.43171	12.090	10.880793	46.75%
7/23/2012	3.46	0.27	5.035338	1.865	1.678446	66.67%
8/20/2012	2.72	0.32	4.691456	1.466	1.319472	71.88%
9/24/2012	4.82	0.22	5.715556	2.598	2.338182	59.09%

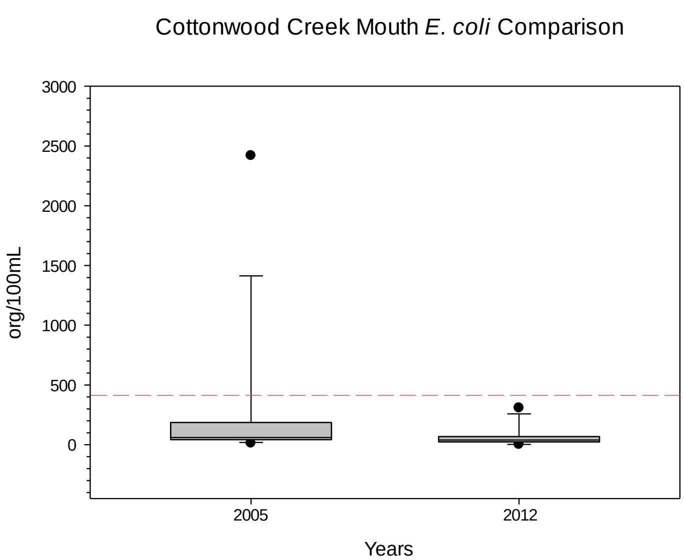


NO_3+NO_2 levels exceeded the 0.3 mg/L target criterion 33% of the time (n=12). The highest level observed occurred in late March, 2012 at 6.61 mg/L. Median levels decreased 33% from 2005 to 2012, although there was no statistically significant difference. Figure 45 illustrates the ranges of NO_3+NO_2 between years. Table 43 shows loading data and required NO_3+NO_2 reductions.

Figure 45. Comparison of Cottonwood Creek, at Reservation boundary, NO_3+NO_2 data. The dashed red line indicates the applicable 0.3 mg/L target.

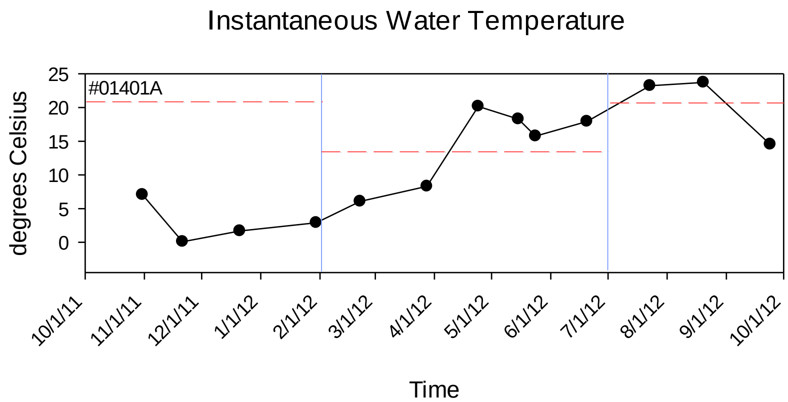
Table 43. Total NO_3+NO_2existing load, load capacity, load allocation, and required reduction for Cottonwood Creek, at mouth.

Sample Date	Flow (cfs)	NO3/NO2 (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
10/31/2011	6.62	0.01	0.356818	10.705	9.634086	none
11/21/2011	8.25	0.29	12.89558	13.340	12.006225	6.90%
12/21/2011	8.28	1.42	63.37346	13.389	12.049884	80.99%
1/30/2012	18.02	2.15	208.8248	29.138	26.224506	87.44%
2/22/2012	24.15	0.97	126.2634	39.051	35.145495	72.16%
3/28/2012	129.02	6.61	4596.712	208.625	187.762806	95.92%
4/24/2012	25.72	0.15	20.79462	41.589	37.430316	none
5/15/2012	12.31	0.01	0.663509	19.905	17.914743	none
6/20/2012	22.43	0.13	15.7167	36.269	32.642379	none
7/23/2012	3.46	0.02	0.372988	5.595	5.035338	none
8/20/2012	2.72	0.02	0.293216	4.398	3.958416	none
9/24/2012	4.82	0.01	0.259798	7.794	7.014546	none



There were no exceedances of the primary contact recreation criterion of 406 org/100mL during the 2012 monitoring project (n=12). Median *E. coli* levels decreased by 34% from 2005 to 2012 (Figure 46), although it wasn't a statistically significant decrease.

Figure 46. Comparison of Cottonwood Creek mouth *E. coli* data. The dashed red line indicates the applicable 406 org/100 mL target.



Six exceedances of the instantaneous water quality criterion occurred, the most of any site in the Cottonwood Creek catchment (n=13).

Figure 47. Instantaneous water temperature readings for Cottonwood Creek at mouth (#01401A), 2011-2012. The blue lines delineate the period of the year deemed critical to salmonid spawning and incubation. The dashed red lines represent the associated target criteria.

Cottonwood Creek at mouth, additional observations:

- Phosphorus levels were extremely high at this site, with 95% of the samples exceeding the numeric target criteria. These levels are consistent with the levels measure during the 2005 water quality study.
- Nitrogen levels were relatively low at this site, when compared to other monitoring stations in the watershed. This is likely due to dilution from groundwater that contributes to total streamflow in the lower reach.
- TSS levels were low during the 2012 study, with the exception of one event, when TSS was measured at 272 mg/L (2/22/12). It is unknown what caused this spike, as streamflow was relatively low at the time. Turbidity levels also exceeded the target criterion on this day.

Threemile Creek (#08417A, #08408A, #08401A)

Figure 48. Threemile Creek, 2011-2012

Three monitoring stations were established on Threemile Creek (Figure 1), one near the headwaters (#08417A), one north of Grangeville at the transition point where the stream leaves the prairie and enters into a canyon (#08408A), and one near the mouth of the creek (#08401A). Tables 44-46 show descriptive statistics for each monitoring site in 2011-2012.

Table 44. Descriptive statistics for Threemile Creek monitoring site near headwaters, 2011-2012.

08417A: Threemile Creek headwaters	Temp (oC)	D.O. (mg/L)	pH (H+)	Turbidity (NTU)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	12.61	13.95	7.61	4.78	161.60	0.06	0.06	0.09	6.00	3.47
Minimum	-2.11	10.23	3.93	0.29	1.00	0.02	0.04	0.05	1.00	0.17
Mean	4.40	12.24	6.74	1.62	28.13	0.04	0.05	0.07	3.08	1.15
Median	4.03	12.05	7.40	1.43	6.30	0.04	0.05	0.06	2.50	0.39
# exceedance	0.0	0.0	4.0	0.0	0.00	0.0	0.0	0.0	0.0	
% exceedance	0.0%	0.0%	30.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
# sampling events	13	13	13	12	12	12	12	12	12	12

Temp = temperature; D.O. = dissolved oxygen; OP = ortho phosphorus; TP=total phosphorus; TSS = total suspended solids; NO_3+NO_2 = Nitrate + Nitrite

Table 45. Descriptive statistics for Threemile Creek monitoring site just above canyon (middle), 2011-2012.

08408A: Threemile Creek @ beginning of canyon	Temp (oC)	D.O. (mg/L)	pH (H+)	Turbidity (NTU)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	19.08	15.60	8.87	431.00	2419.60	9.06	1.70	1.80	368.00	10.82
Minimum	-2.14	9.39	6.90	1.36	17.50	0.77	0.18	0.30	1.00	0.56
Mean	8.55	12.31	8.13	42.91	408.27	4.85	0.71	0.84	35.00	3.04
Median	9.80	11.68	8.32	8.15	148.60	4.47	0.62	0.83	5.50	1.29
# exceedance	2.0	0.0	0.0	1.0	3.00	12.0	12.0	12.0	1.0	
% exceedance	15.4%	0.0%	0.0%	8.3%	25.0%	0.0%	100.0%	100.0%	8.3%	0.0%
# sampling events	13	13	13	12	12	12	12	12	12	11

Temp = temperature; D.O. = dissolved oxygen; OP = ortho phosphorus; TP=total phosphorus; TSS = total suspended solids; NO_3+NO_2 = Nitrate + Nitrite

Table 46. Descriptive statistics for Threemile Creek monitoring site near mouth, 2011-2012.

08401A Threemile Mouth	Temp (oC)	D.O. (mg/L)	pH (H+)	Turbidity (NTU)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	21.48	13.72	9.00	48.30	461.10	7.12	0.29	0.32	22.00	71.53
Minimum	4.28	8.60	6.74	0.67	1.00	0.15	0.23	0.26	1.00	0.62
Mean	12.15	11.64	7.88	8.83	85.00	2.11	0.25	0.29	4.08	10.61
Median	14.71	11.75	8.03	3.08	27.40	1.16	0.26	0.29	2.50	3.26
# exceedance	4.0	0.0	0.0	0.0	1.00	10.0	12.0	12.0	0.0	
% exceedance	30.8%	0.0%	0.0%	0.0%	8.3%	0.0%	100.0%	100.0%	0.0%	0.0%
# sampling events	13	13	13	12	12	12	12	12	12	12

Temp = temperature; D.O. = dissolved oxygen; OP = ortho phosphorus; TP=total phosphorus; TSS = total suspended solids; NO_3+NO_2 = Nitrate + Nitrite

Total phosphorus levels varied throughout the creek. No exceedances of the 0.1 mg/L target criterion were observed at the headwater site, while every sample exceeded the criterion at the remaining two locations. Monitoring station #08408A, hereafter referred to as the “middle” monitoring site, had the highest TP levels of the three sites. TP levels at the mouth were considerably lower than at the middle site, likely because sediment, to which phosphorus tends to adhere, dropped out of suspension between the two sites. A 55% reduction in median TSS levels from the middle site to the lower site adds credence to this hypothesis. Figure 49 shows TP levels in Threemile Creek, 2011-2012. Total phosphorus loading data and required reductions for Threemile Creek were calculated at the mouth (#08401A). Table 47 shows the required TP load reductions.

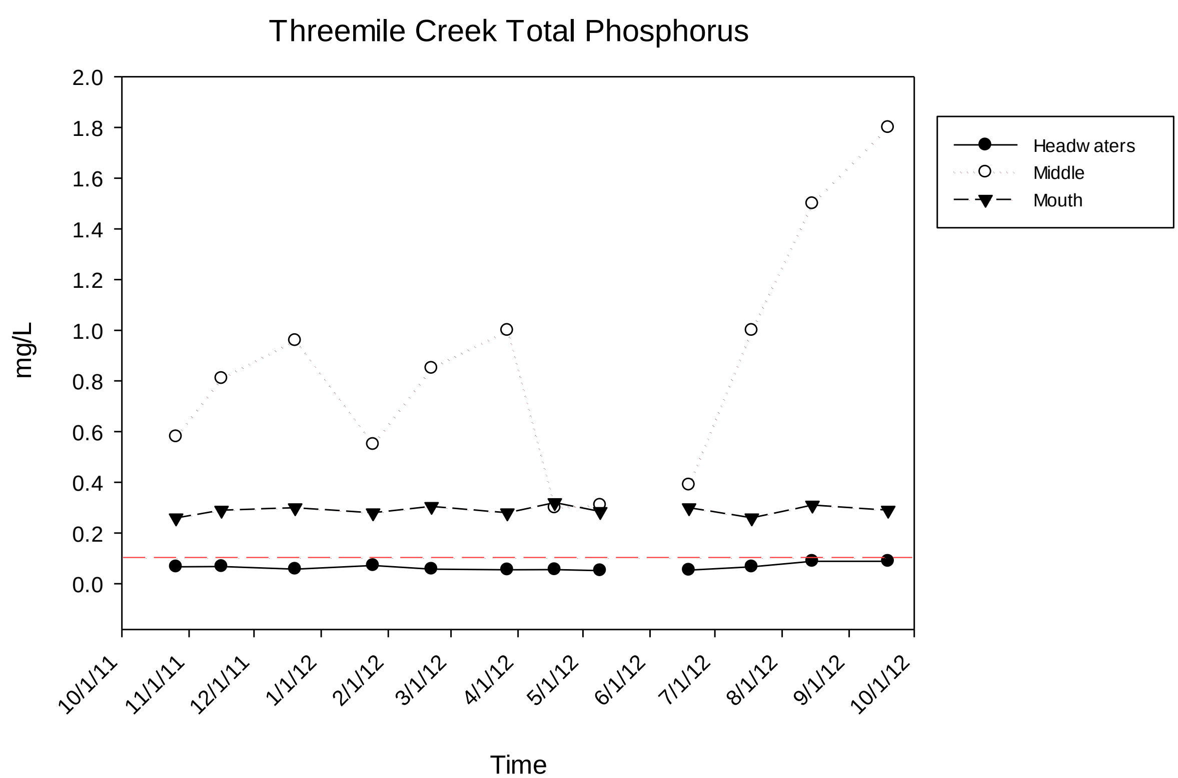


Figure 49. TP levels at Threemile Creek monitoring sites, 2011-2012.

Table 47. Total phosphorus existing load, load capacity, load allocation, and required reduction for Threemile Creek, at mouth.

Sample Date	Flow (cfs)	TP (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
10/31/2011	1.99	0.26	2.788786	1.073	0.965349	65.38%
11/21/2011	2.5	0.29	3.90775	1.348	1.21275	68.97%
12/21/2011	1.89	0.3	3.05613	1.019	0.916839	70.00%
1/30/2012	4.01	0.28	6.051892	2.161	1.945251	67.86%
2/22/2012	14.75	0.305	24.24826	7.950	7.155225	70.49%
3/28/2012	71.53	0.28	107.9531	38.555	34.699203	67.86%
4/24/2012	13.71	0.32	23.64701	7.390	6.650721	71.88%
5/15/2012	6.21	0.285	9.539492	3.347	3.012471	68.42%
6/20/2012	7.73	0.3	12.49941	4.166	3.749823	70.00%
7/23/2012	1.56	0.26	2.186184	0.841	0.756756	65.38%
8/20/2012	0.62	0.31	1.035958	0.334	0.300762	70.97%
9/24/2012	0.81	0.29	1.266111	0.437	0.392931	68.97%

NO_3+NO_2 levels also varied between monitoring sites. No exceedances of the 0.3 mg/L target criterion were observed at the headwater site, 100% of the samples exceeded the criterion at the middle site, and 83% of the samples exceeded the criterion at the mouth (n=12 for all sites). Dilution is a likely cause for the slight reduction in nitrogen levels observed at the mouth.

Levels were quite high at the middle site, with a high of 9.06 mg/L on August 15, 2012, which is near the drinking water criterion of 10.0 mg/L, and 2,900% higher than the 0.3 mg/L target criterion. Figure 50 shows NO_3+NO_2 levels in Threemile Creek. NO_3+NO_2 loading data and required reductions for Threemile Creek were calculated at the mouth (#08401A). Table 48 shows the required NO_3+NO_2 load reductions.

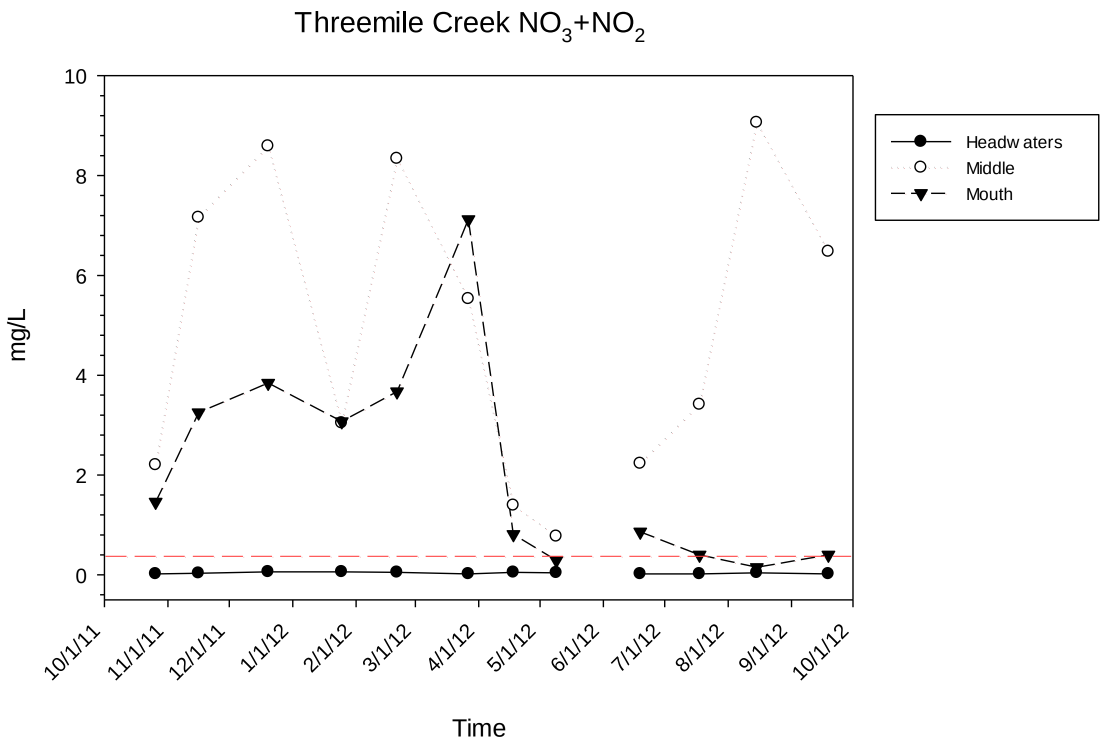


Figure 50. NO3+NO2 levels at Threemile Creek monitoring sites, 2011-2012.

Table 48. Total NO_3+NO_2existing load, load capacity, load allocation, and required reduction for Threemile Creek, at mouth.

Sample Date	Flow (cfs)	NO3/NO2 (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
10/31/2011	1.99	1.46	15.66011	3.218	2.896047	81.51%
11/21/2011	2.5	3.25	43.79375	4.043	3.63825	91.69%
12/21/2011	1.89	3.84	39.11846	3.056	2.750517	92.97%
1/30/2012	4.01	3.07	66.35467	6.484	5.835753	91.21%
2/22/2012	14.75	3.67	291.7742	23.851	21.465675	92.64%
3/28/2012	71.53	7.12	2745.093	115.664	104.097609	96.21%
4/24/2012	13.71	0.81	59.85649	22.169	19.952163	66.67%
5/15/2012	6.21	0.29	9.706851	10.042	9.037413	6.90%
6/20/2012	7.73	0.86	35.83164	12.499	11.249469	68.60%
7/23/2012	1.56	0.4	3.36336	2.523	2.270268	32.50%
8/20/2012	0.62	0.15	0.50127	1.003	0.902286	none
9/24/2012	0.81	0.4	1.74636	1.310	1.178793	32.50%

No exceedances of the primary contact recreation criterion for *E. coli* occurred at the headwater sight; three exceedances occurred at the middle site; and one exceedance occurred at the mouth (n=12 for all sites). Figure 51 shows a comparison of *E.coli* from all monitoring locations.

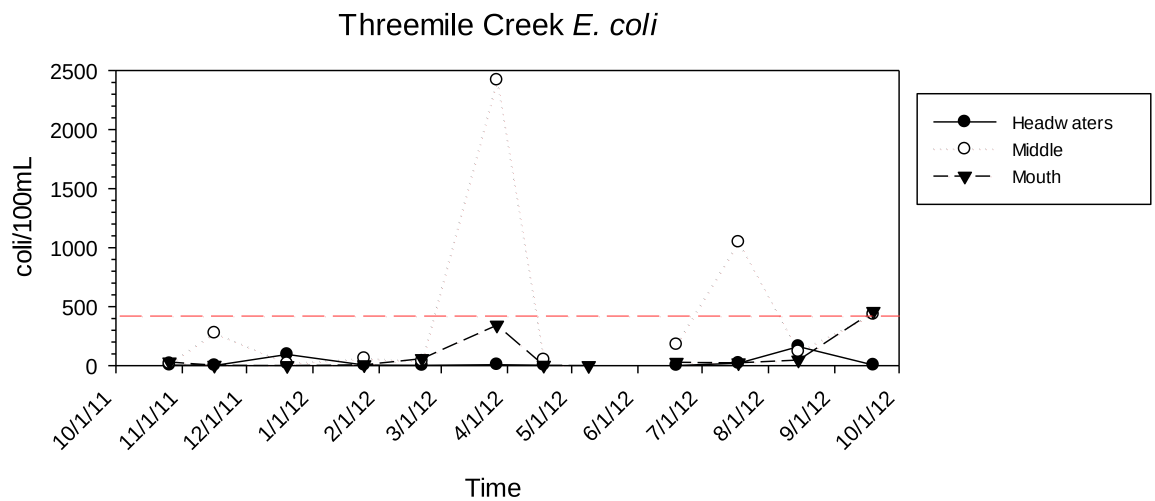


Figure 51. Comparison of Threemile Creek headwaters *E. coli* data. The dashed red line indicates the applicable 406 org/100 mL target.

No exceedances of the instantaneous water temperature criteria were observed at the headwaters site, two exceedances were observed at the middle site, and four exceedances were observed at the lower site. All exceedances occurred during the salmonid spawning and incubation period. Figure 52 shows the instantaneous temperature readings for the Threemile Creek monitoring sites, 2011-2012.

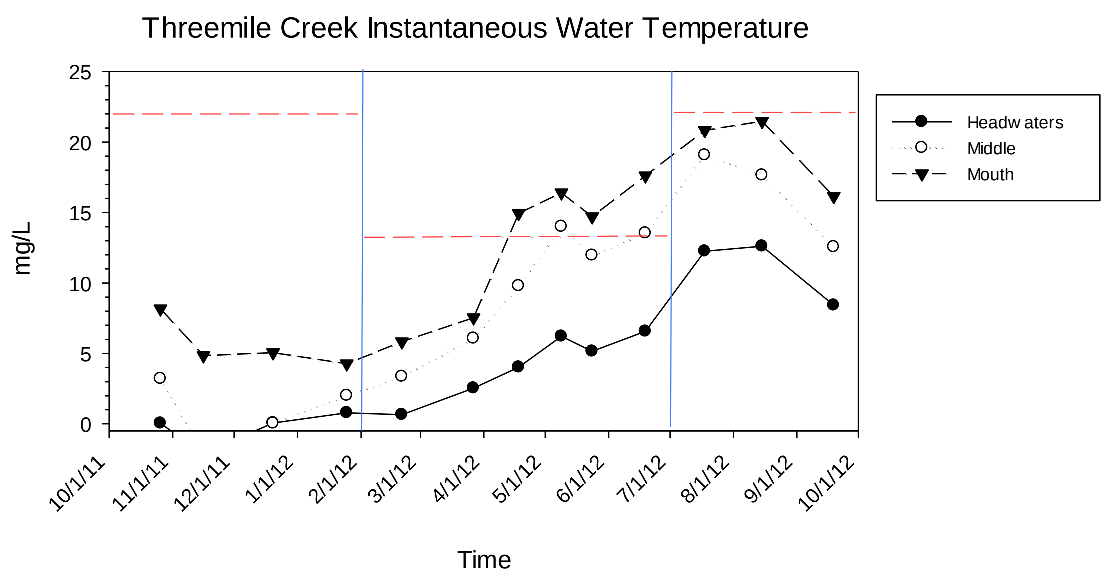


Figure 52. Instantaneous water temperature readings for Threemile Creek at mouth (#08401A), 2011-2012. The blue lines delineate the period of the year deemed critical to salmonid spawning and incubation. The dashed red lines represent the associated target criteria.

Threemile Creek, additional observations:

- Water quality was most impaired at the middle site, and pollutant loads generally decreased between that site and the mouth.
- Water quality was best at the headwater site, although four pH measurements below the recommended criterion level of 6.5 were observed. It is unknown at this time what caused these low readings. Geologic influences and input from decaying pine needles in the forested headwaters are potential causes.
- TSS levels were low during this study, with the exception of one event at the middle site, when a level of 368.0 mg/L was recorded on March 26, 2012. It was the only exceedance of the 25.0 mg/L target criteria observed at any of the three sites.
- DO levels were above the 6.0 mg/L criterion throughout the year at all sites.

Butcher Creek (#00711A, #00709A, #00701A)

Figure 53. Butcher Creek mouth, 2011-2012

Three monitoring stations were established on Butcher Creek (Figure 1), one in the headwaters near Mt. Idaho (#00711A), one north of Grangeville at the Case Road Crossing (#00709A), and one near the mouth of Butcher Creek (#00701A). The site located at the mouth was inaccessible at certain times of the year and, as a result, was only monitored from April through September of 2012. Tables 49-51 show descriptive statistics for each monitoring site in 2011-2012.

Table 49. Descriptive statistics for Butcher Creek monitoring site near headwaters, 2011-2012.

00711A Butcher Creek headwaters	Temp (oC)	D.O. (mg/L)	pH (H+)	Turbidity (NTU)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	22.56	14.10	8.03	20.20	1299.70	0.34	0.08	0.15	14.00	9.16
Minimum	-2.12	7.51	5.58	3.87	2.00	0.01	0.04	0.08	2.00	0.08
Mean	8.54	11.23	7.22	12.95	266.12	0.09	0.05	0.12	7.67	1.65
Median	8.19	11.04	7.48	14.55	31.00	0.04	0.05	0.12	7.50	0.46
# exceedance	3.0	0.0	2.0	0.0	3.00	1.0	0.0	9.0	0.0	
% exceedance	23.1%	0.0%	15.4%	0.0%	25.0%	8.3%	0.0%	75.0%	0.0%	0.0%
# sampling events	13	13	13	12	12	12	12	12	12	12

Temp = temperature; D.O. = dissolved oxygen; OP = ortho phosphorus; TP=total phosphorus; TSS = total suspended solids; NO_3+NO_2 = Nitrate + Nitrite

Table 50. Descriptive statistics for Butcher Creek monitoring site at Case Road crossing (middle), 2011-2012.

00709A Butcher Creek @ Case Road	Temp (oC)	D.O. (mg/L)	pH (H+)	Turbidity (NTU)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	22.13	14.82	8.25	31.70	1986.30	0.32	0.09	0.23	49.00	12.64
Minimum	-1.84	8.76	6.12	5.87	1.00	0.01	0.02	0.08	2.00	0.21
Mean	7.82	11.96	7.48	15.17	362.14	0.09	0.06	0.12	11.36	2.87
Median	7.83	11.32	7.70	13.80	86.30	0.03	0.05	0.12	6.00	1.32
# exceedance	2.0	0.0	1.0	0.0	2.00	2.0	0.0	6.0	1.0	
% exceedance	16.7%	0.0%	8.3%	0.0%	20.0%	18.2%	0.0%	54.5%	9.1%	0.0%
# sampling events	12	12	12	11	10	11	11	11	11	9

Temp = temperature; D.O. = dissolved oxygen; OP = ortho phosphorus; TP=total phosphorus; TSS = total suspended solids; NO_3+NO_2 = Nitrate + Nitrite

Table 51. Descriptive statistics for Butcher Creek monitoring site near mouth, 2011-2012.

00701A Butcher Creek @ mouth	Temp (oC)	D.O. (mg/L)	pH (H+)	Turbidity (NTU)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	19.42	11.92	8.72	16.50	40.80	0.17	0.12	0.16	4.00	6.20
Minimum	13.13	9.11	7.99	1.60	3.10	0.07	0.07	0.11	2.00	0.76
Mean	16.16	10.20	8.31	6.74	17.23	0.12	0.09	0.13	3.17	2.54
Median	15.27	10.27	8.29	5.50	15.80	0.12	0.09	0.13	3.50	1.83
# exceedance	3.0	0.0	0.0	0.0	0.00	0.0	2.0	6.0	0.0	
% exceedance	50.0%	0.0%	0.0%	0.0%	0.0%	0.0%	33.3%	100.0%	0.0%	0.0%
# sampling events	6	6	6	6	6	6	6	6	6	6

Temp = temperature; D.O. = dissolved oxygen; OP = ortho phosphorus; TP=total phosphorus; TSS = total suspended solids; NO_3+NO_2 = Nitrate + Nitrite

Total phosphorus levels were elevated at every monitoring site. At the headwater site 75% of the samples exceeded the 0.1 mg/L target criterion. 55% of the samples at the middle site exceeded the target criterion, and 100% of the samples collected at the mouth exceeded the target criterion (Figure 54).

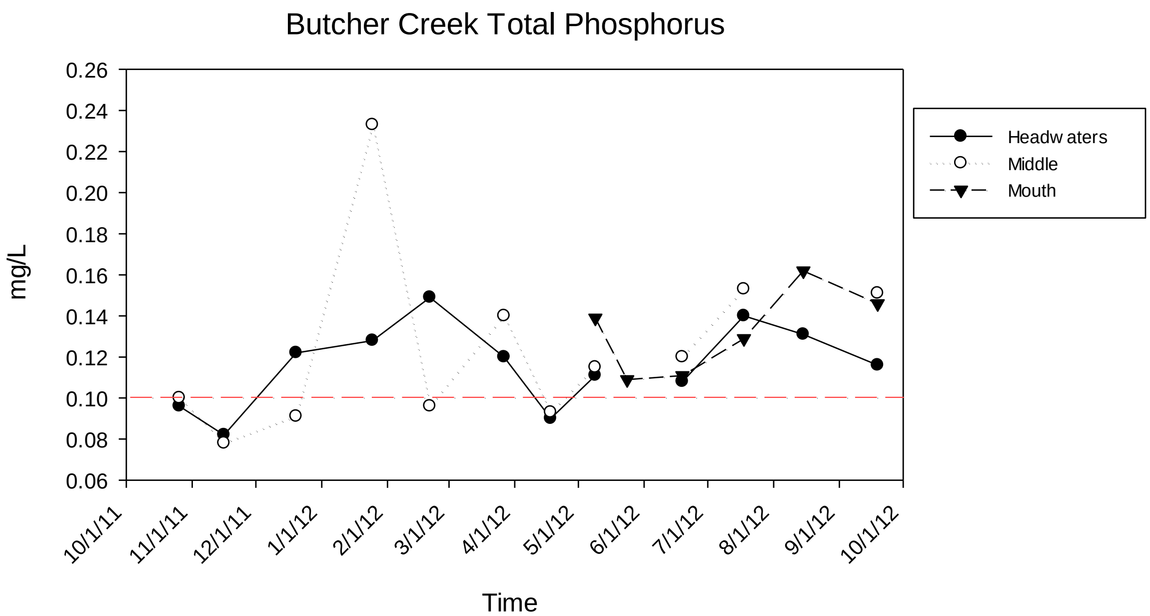


Figure 54. TP levels at Butcher Creek monitoring sites, 2011-2012.

Total phosphorus loading data and required reductions for Butcher Creek were calculated for the monitoring station located near the midpoint of the watershed, at Case Road (#00701A), due to the limited dataset collected from the site located near the mouth (#00701A). Table 52 shows the required TP load reductions.

Table 52. Total phosphorus existing load, load capacity, load allocation, and required reduction for Butcher Creek, at Case Road. Flows highlighted in yellow represent the 50th percentile flow derived from USGS StreamStats regression equations.

10/26/2011	0.29	0.1	0.15631	0.156	0.140679	10.00%
11/16/2011	0.4	0.078	0.168168	0.216	0.19404	-15.38%
12/20/2011	0.53	0.091	0.25996	0.286	0.257103	1.10%
1/25/2012	1.32	0.233	1.657748	0.711	0.640332	61.37%
2/21/2012	0.61	0.096	0.315638	0.329	0.295911	6.25%
3/27/2012	12.64	0.14	9.538144	6.813	6.131664	35.71%
4/18/2012	4.74	0.093	2.37602	2.555	2.299374	3.23%
5/9/2012	3.49	0.115	2.163277	1.881	1.692999	21.74%
6/19/2012	2.11	0.12	1.364748	1.137	1.023561	25.00%
7/18/2012	0.43	0.153	0.354608	0.232	0.208593	41.18%
9/19/2012	0.21	0.151	0.170917	0.113	0.101871	40.40%

NO_3+NO_2 levels were quite low in Butcher Creek. One exceedance of the 0.3 mg/L target criterion was documented at the headwaters site (00711A), two exceedances occurred at the middle (Case Road) site, and no exceedances were observed at the mouth, although the lack of access to the lower site during spring runoff likely resulted in the highest values being absent from the data set. Figure 55 shows NO_3+NO_2 levels in Butcher Creek during the 2011-2012 sampling year.

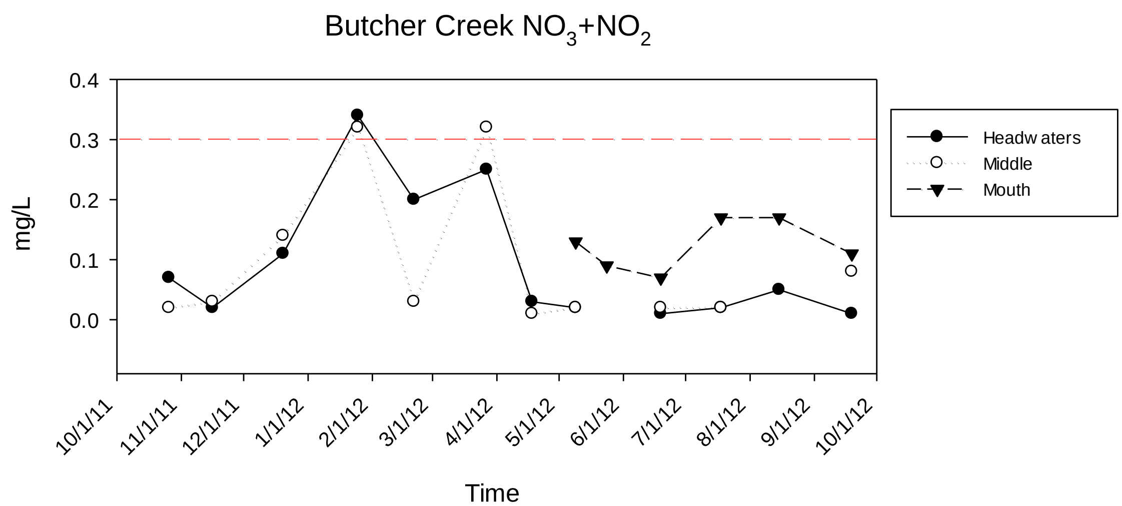


Figure 55. NO3+NO2 levels at Butcher Creek monitoring sites, 2011-2012.

NO_3+NO_2 loading data and required reductions for Butcher Creek were also calculated at the middle, Case Road site (#00709A), due to the limited data set at the mouth. Table 53 shows the required NO_3+NO_2 load reductions.

Table 53. Total NO_3+NO_2existing load, load capacity, load allocation, and required reduction for Butcher Creek, at Case Road crossing. Flows highlighted in yellow represent the 50th percentile flow derived from USGS StreamStats regression equations.

Sample Date	Flow (cfs)	NO3/NO2 (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	Load Allocation (lbs/day)	Required Reduction (%)
10/26/2011	0.29	0.02	0.031262	0.469	0.422037	none
11/16/2011	0.4	0.03	0.06468	0.647	0.58212	none
12/20/2011	0.53	0.14	0.399938	0.857	0.771309	none
1/25/2012	1.32	0.32	2.276736	2.134	1.920996	15.63%
2/21/2012	0.61	0.03	0.098637	0.986	0.887733	none
3/27/2012	12.64	0.32	21.80147	20.439	18.394992	15.63%
4/18/2012	4.74	0.01	0.255486	7.665	6.898122	none
5/9/2012	3.49	0.02	0.376222	5.643	5.078997	none
6/19/2012	2.11	0.02	0.227458	3.412	3.070683	none
7/18/2012	0.43	0.02	0.046354	0.695	0.625779	none
9/19/2012	0.21	0.08	0.090552	0.340	0.305613	none

Three exceedances of the primary contact recreation criterion for *E. coli* occurred at the headwater sight (n=12); two exceedances occurred at the middle site (n=10); and no exceedances occurred at the mouth (n=6). The elevated readings coincided with the presence of livestock witnessed at the upper two sites. No livestock was observed at the lower site near the mouth. Figure 56 shows the *E.coli* measurements at all monitoring locations.

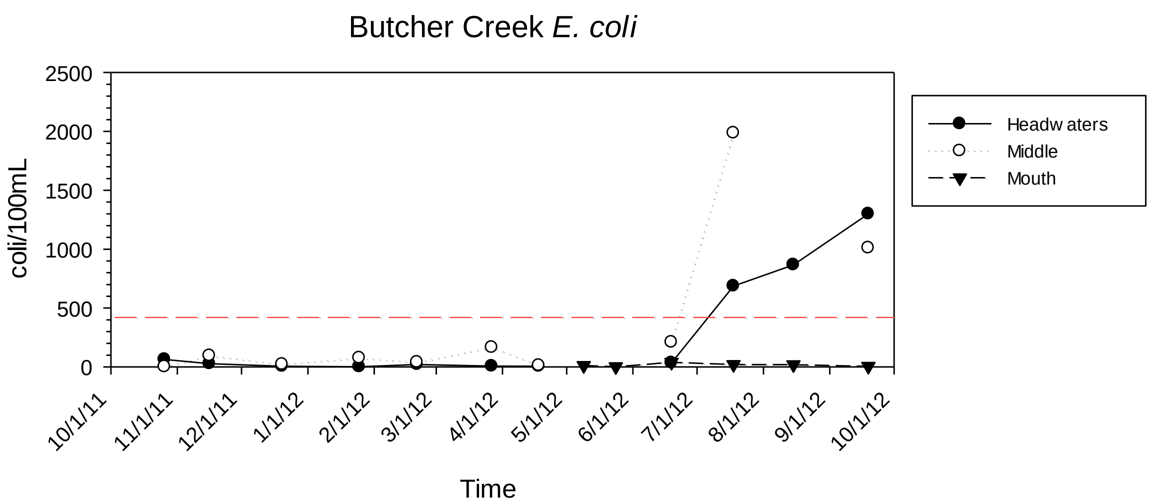


Figure 56. Comparison of Butcher Creek *E. coli* data. The dashed red line indicates the applicable 406 org/100 mL target.

Three exceedances of the instantaneous water temperature criteria were observed at the headwaters site (n=13), two exceedances were observed at the middle, Case Road site (n=12), and three exceedances were observed at the lower site near the mouth (n=6). All exceedances occurred during the salmonid spawning and incubation period. Figure 57 shows the instantaneous temperature readings for the Threemile Creek monitoring sites, 2011-2012.

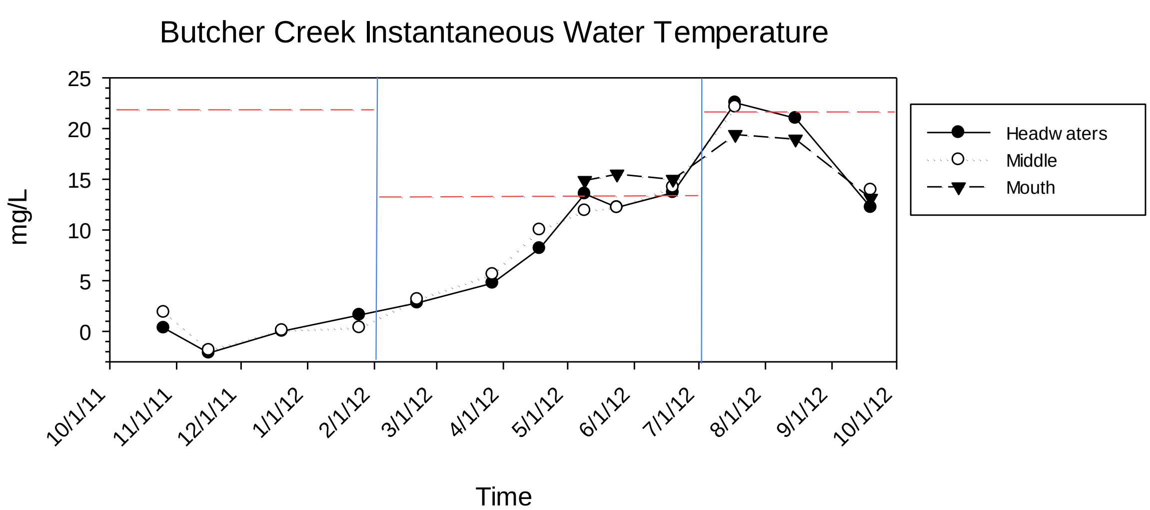


Figure 57. Instantaneous water temperature readings for Butcher Creek, 2011-2012. The blue lines delineate the period of the year deemed critical to salmonid spawning and incubation. The dashed red lines represent the associated target criteria.

Butcher Creek, additional observations:

- One exceedance of the 25 mg/L TSS target criterion occurred at the Case Road site (#00709A). Otherwise, sediment levels were quite low at all monitoring locations.
- Three pH measurements below the recommended criterion level of 6.5 were observed, two at the headwaters site and one at the middle, Case Road site. It is unknown at this time what caused these low readings. Geologic influences and input from decaying pine needles in the forested headwaters are potential causes.
- DO levels were above the 6.0 mg/L criterion throughout the year at all sites.
- Nutrient levels were lower in this sub-watershed than at any other sub-watershed monitored during this project. The relative lack of agricultural lands is a likely reason for lower nutrient inputs.

Conclusions

The monitoring program for the mainstems and selected tributaries of Cottonwood Creek, Threemile Creek, and Butcher Creek was successfully carried out as planned. Protocols were followed, QA/QC standards were met, and specific information per parameter for each sub-watershed was collected.

Three sets of water quality data were compared for the mainstem and most tributaries of Cottonwood Creek. While some differences were noted, there was not a statistically significant difference between data sets for any of the monitoring locations evaluated, meaning that the water quality impairments in the Cottonwood Creek watershed are persistent and widespread.

Nutrient enrichment is a primary concern for all three of the assessed watersheds, with both nitrogen and phosphorus levels exceeding target criteria most of the time at most monitoring sites.

Elevated phosphorus levels are the norm in all three watersheds. Only three sites exceeded the target criteria of 0.1mg/L less than 50% of the time (the headwaters of Cottonwood Creek and Threemile Creek, and Shebang Creek); recorded levels at the other sites were far higher, with many of them exceeding the target criteria 100% of the time. The average ratio of orthophosphorus to total phosphorus was above 0.5 for most sites, indicating that a sizeable portion of the total phosphorus load is in soluble form and can be readily taken up by aquatic vegetation. This high level of phosphorus is potentially contributing to excessive growth of algae and other aquatic plants that can cause destruction of habitat and depletion of dissolved oxygen, which usually results in the disappearance of intolerant aquatic insect species and fish.

NO_3+NO_2 levels are also very high in most of these watersheds. The data suggest that much of the nitrogen could be coming from agricultural fields. In these watersheds, nitrogen fertilizers are often applied in the early Fall for winter wheat and later in the fall for bluegrass. All monitoring locations showed a significant spike in nitrogen in the winter months, likely caused by winter rains washing residual nitrogen off of fields and into nearby waterways. Only a handful of sites appeared not to have a significant problem with nitrogen enrichment; those were the headwaters of Cottonwood Creek (#01428A), Long Haul Creek (#04501A), and Butcher Creek (#00711A, 00709A, 00701A).

There was one exceedance of the ammonia target set in the Cottonwood Creek TMDL. This occurred at the site located below the City of Cottonwood's WWTP (#01423A). Ammonia levels were measured at 7.37 mg/L on January 11, 2012, nearly 500% higher than the 1.24 mg/L criterion set in the TMDL (Idaho Department of Environmental Quality, 2000). Multiple exceedances of the ammonia criteria were observed at this site in the 2005 IASCD water quality monitoring study.

Instantaneous water temperature criteria were also exceeded at every monitoring location except the headwaters of Threemile Creek, making high water temperature a principal concern. Aquatic organisms from microbes to fish are dependent on certain temperature ranges for their optimal health. Aquatic insects are sensitive to temperature and will move in a stream to find their optimal temperature. Temperature is also critical for fish spawning and embryo development. If stream temperatures are outside of optimal levels for prolonged periods of time, organisms become stressed and may die or be unable to reproduce.

Escherichia coli (*E. coli)* are a type of fecal coliform bacteria commonly found in the intestines of animals and humans. The presence of *E. coli* in water is a strong indication of recent sewage or animal waste contamination. Bacteria levels in 2012 had decreased noticeably at several sites from levels observed in previous studies, but exceedances still occurred at most sites. Cattle were present at those sites with the highest number of *E. coli* violations.

Total suspended solids (TSS) include both sediment and organic material suspended in water. TSS can cause problems for fish by clogging gills and for aquatic plants by limiting growth because of reduced light penetration. In addition, TSS provides a medium for the accumulation and transport of other constituents such as phosphorus and bacteria. Sediment, in itself, doesn't appear to be a significant problem in these watersheds, although erosion and runoff are the main factors affecting the transport of phosphorus to surface waters, and continued emphasis on controlling sediment loading will help to reduce overall phosphorus levels.

Designated Use Support Status

Designated use support status determinations have been developed based on the water quality data collected during this study. Table 54 lists the waterbodies and their designated use status.

Table 54. Designated use support status for assessed waterbodies. The stream names in bold under "waterbody name" are the larger waterbodies, while the streams below those are tributaries to that primary stream.

Waterbody Name	Total Stream Miles	Designated Uses	Use Support Decision	Parameter/Indicator
Cottonwood Creek (Idaho County)	31.2	Primary Contact Recreation	Not Supporting	*E. coli*
		Cold Water Aquatic Life	Not Supporting	pH, temperature, turbidity
		Salmonid Spawning	Not Supporting	temperature
SF Cottonwood Creek	6.9	Primary Contact Recreation	Not Supporting	*E.coli*
		Cold Water Aquatic Life	Not Supporting	Temperature, turbidity
		Salmonid Spawning	Not Supporting	Temperature
Long Haul Creek	12.41	Primary Contact Recreation	Not Supporting	*E.coli*
		Cold Water Aquatic Life	Not Supporting	Temperature, turbidity
		Salmonid Spawning	Not Supporting	Temperature
Stockney Creek	26.48	Primary Contact Recreation	Not Supporting	*E.coli*
		Cold Water Aquatic Life	Not Supporting	Temperature

Waterbody Name	Total Stream Miles	Designated Uses	Use Support Decision	Parameter/Indicator
		Salmonid Spawning	Not Supporting	Temperature
Shebang Creek	14.5	Primary Contact Recreation	Not Supporting	*E.coli*
		Cold Water Aquatic Life	Not Supporting	Temperature
		Salmonid Spawning	Not Supporting	Temperature
Red Rock Creek	11.1	Primary Contact Recreation	Not Supporting	*E.coli*
		Cold Water Aquatic Life	Not Supporting	Temperature
		Salmonid Spawning	Not Supporting	Temperature
Threemile Creek	18.2	Primary Contact Recreation	Not Supporting	*E.coli*
		Cold Water Aquatic Life	Not Supporting	Temperature, turbidity
		Salmonid Spawning	Not Supporting	Temperature
Butcher Creek	12.3	Primary Contact Recreation	Not Supporting	*E.coli*
		Cold Water Aquatic Life	Not Supporting	Temperature
		Salmonid Spawning	Not Supporting	Temperature

Recommendations

Cottonwood Creek

Significant erosion is currently evident along a number of streams, and treatment should be applied to streams that are already undergoing the most severe erosion. Nutrients are a major problem in this watershed and controlling erosion would help to decrease TP levels. While every stream in this watershed is water quality limited and would benefit from strategic BMP installations, Red Rock Creek appears to be the tributary that is contributing the highest nutrient, bacteria and sediment load to the mainstem of Cottonwood Creek. Fencing cattle away from the creek, as well as installing stream stabilization structures and revegetating the riparian area will help to reduce sediment transport in this problem area.

Excessive stream temperatures are also a widespread problem within this watershed and will be a difficult issue to overcome. Perhaps the most effective strategy would be to work toward the establishment of natural full potential canopy shade. Reducing sediment loads within critical reaches will assist in reducing stream temperatures as well, since suspended particles tend to absorb more heat. Identification and removal of agricultural drain tiles could be another strategy to increase streambank storage of water and help to restore a more natural hydrology to the system.

Cattle are ubiquitous in this watershed and are a significant factor limiting water quality. Fencing cattle away from creeks and developing off-stream watering facilities is apt to be the most cost-effective method to reduce bacteria, nutrient and sediment levels throughout the watershed.

Continued implementation of targeted stream improvements to reduce sediment loads, lower temperatures, lower nutrients and lower bacteria levels will be important. Stakeholders in the watershed should fund, devise, and construct high quality stream improvements designed to promote water quality enhancement.

Threemile/Butcher Creeks

The portion of Threemile Creek above the City of Grangeville is lightly grazed, and cattle have access to the creek. Cattle exclusion and riparian plantings in this reach would help to reduce levels of sediment, nutrients, bacteria, and temperature.

Below the City of Grangeville, land use consists mostly of dryland agriculture, although limited grazing also occurs. Nutrient input from this area is substantial and establishment of a healthy riparian buffer should be a priority. The City of Grangeville's infrastructure, including its WWTP, is also a potential source of pollutants to Threemile

Creek, and every effort should be made to implement stormwater BMPs and to closely monitor effluent discharges to reduce overall pollutant loads.

Livestock exclusion and the development of offsite watering facilities, in conjunction with riparian planting and restoration, is the best strategy for improving water quality in the Butcher Creek watershed. Inspection and maintenance of septic systems in the upper watershed may also help reduce nutrient and bacteria loading to Butcher Creek.

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Glossary

§303(d)	Refers to section 303 subsection "d" of the Clean Water Act. 303(d) requires states to develop a list of waterbodies that do not meet water quality standards. This section also requires total maximum daily loads (TMDLs) be prepared for listed waters. Both the list and the TMDLs are subject to U.S. Environmental Protection Agency approval.
Bedload	Material (generally sand-sized or larger sediment) that is carried along the streambed by rolling or bouncing.
Beneficial/designated Use	Any of the various uses of water, including, but not limited to, aquatic biota, recreation, water supply, wildlife habitat, and aesthetics, which are recognized in water quality standards.
Best Management Practices (BMPs)	Structural, nonstructural, and managerial techniques that are effective and practical means to control nonpoint source pollutants.
Catchment	Land area that contributes runoff (drains) to a given point in a stream or river. Synonymous with watershed and drainage or river basin.
Conductivity	The ability of an aqueous solution to carry electric current, expressed in micro (µ) mhos/cm at 25 °C. Conductivity is affected by dissolved solids and is used as an indirect measure of total dissolved solids in a water sample.
Criteria	In the context of water quality, numeric or descriptive factors taken into account in setting standards for various pollutants. These factors are used to determine limits on allowable concentration levels, and to limit the number of violations per year. EPA develops criteria guidance; states establish criteria.
Cubic Feet per Second	A unit of measure for the rate of flow or discharge of water. One cubic foot per second is the rate of flow of a stream with a cross-section of one square foot flowing at a mean velocity of one foot per second. At a steady rate, one cubic foot per second is equal to 448.8 gallons per minute and 10,984 acre-feet per day.
Discharge	The amount of water flowing in the stream channel at the time of measurement. Usually expressed as cubic feet per second (cfs).
Dissolved Oxygen	The oxygen dissolved in water. Adequate DO is vital to fish and other aquatic life.
E. coli	Short for *Escherichia Coli*, *E. coli* are a group of bacteria

	that are a subspecies of coliform bacteria. Most *E. coli* are essential to the healthy life of all warm-blooded animals, including humans. Their presence is often indicative of fecal contamination.
Mean	Describes the central tendency of a set of numbers. The arithmetic mean (calculated by adding all items in a list, then dividing by the number of items) is the statistic most familiar to most people.
Median	The middle number in a sequence of numbers. If there are an even number of numbers, the median is the average of the two middle numbers. For example, 4 is the median of 1, 2, 4, 14, 16; and 6 is the median of 1, 2, 5, 7, 9, 11.
Nonpoint Source	A dispersed source of pollutants, generated from a geographical area when pollutants are dissolved or suspended in runoff and then delivered into waters of the state. Nonpoint sources are without a discernable point or origin. They include, but are not limited to, irrigated and non-irrigated lands used for grazing, crop production, and silviculture; rural roads; construction and mining sites; log storage or rafting; and recreation sites.
Nutrient	Any substance required by living things to grow. An element or its chemical forms essential to life, such as carbon, oxygen, nitrogen, and phosphorus. Commonly refers to those elements in short supply, such as nitrogen and phosphorus, which usually limit growth.
pH	The negative $\log_{10}$ of the concentration of hydrogen ions, a measure which in water ranges from very acid (pH=1) to very alkaline (pH=14). A pH of 7 is neutral. Surface waters usually measure between pH 6 and 9.
Point Source	A source of pollutants characterized by having a discrete conveyance, such as a pipe, ditch, or other identifiable "point" of discharge into a receiving water. Common point sources of pollution are industrial and municipal wastewater.
Pollutant	Generally, any substance introduced into the environment that adversely affects the usefulness of a resource or the health of humans, animals, or ecosystems.
Surface Runoff	Precipitation, snow melt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions; a major transporter of nonpoint source pollutants in rivers, streams, and lakes. Surface

runoff is also called overland flow.

Suspended Sediments Fine material (usually sand size or smaller) that remains suspended by turbulence in the water column until deposited in areas of weaker current. These sediments cause turbidity and, when deposited, reduce living space within streambed gravels and can cover fish eggs or alevins.

Thalweg The center of a stream's current, where most of the water flows.

Total Suspended Solids (TSS) A measure of the suspended organic and inorganic solids in water.

Tributary A stream feeding into a larger stream or lake.

Turbidity A measure of the extent to which light passing through water is scattered by fine suspended materials. The effect of turbidity depends on the size of the particles (the finer the particles, the greater the effect per unit weight) and the color of the particles.

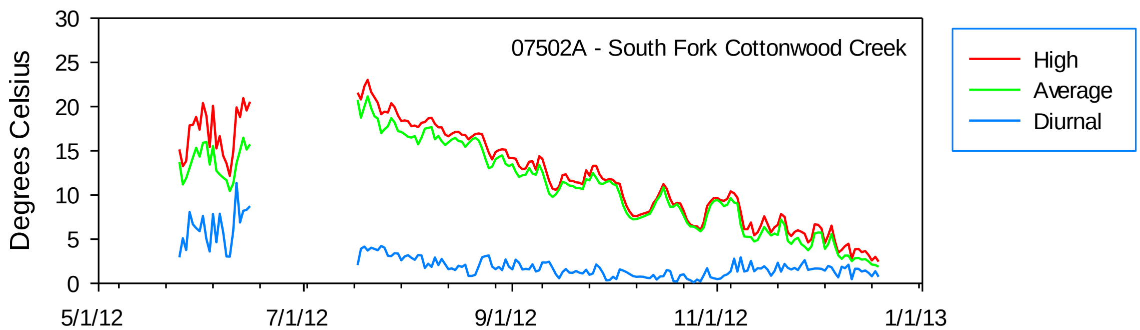
Water Quality Limited A label that describes waterbodies for which one or more water quality criterion is not met or beneficial uses are not fully supported.

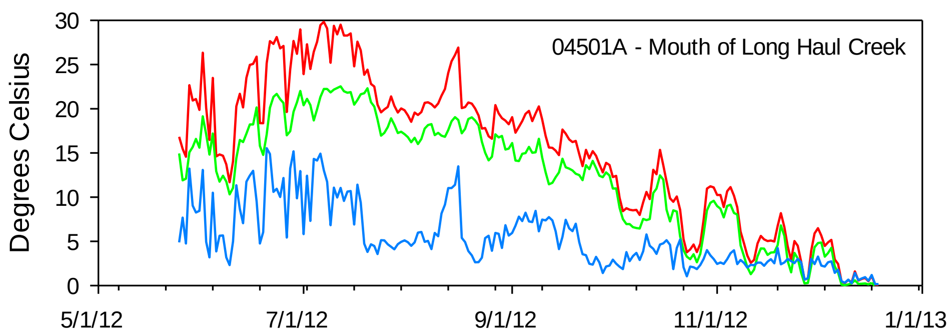
Water Quality Standards State or Tribe adopted and EPA-approved ambient standards for waterbodies. The standards prescribe the use of the waterbody and establish the water quality criteria that must be met to protect designated uses.

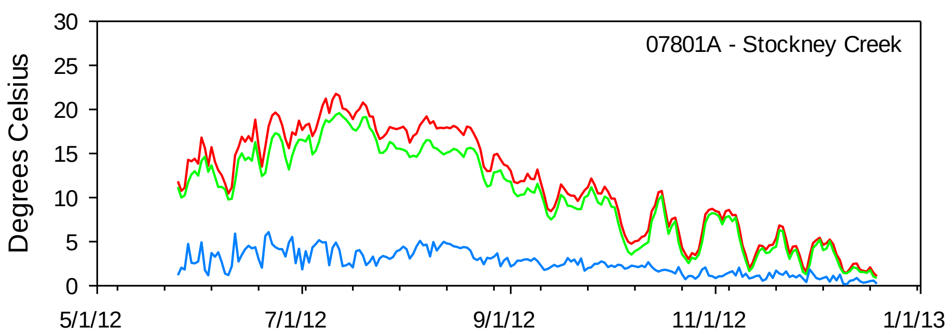
Watershed 1) All the land which contributes runoff to a common point in a drainage network, or to a lake outlet. Watersheds are infinitely nested, and any large watershed is composed of smaller "subwatersheds." 2) The whole geographic region which contributes water to a point of interest in a waterbody.

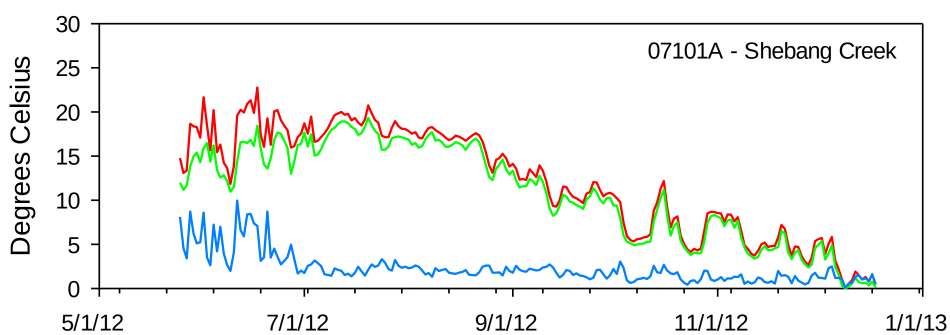
Appendix A: Continuous water temperature data

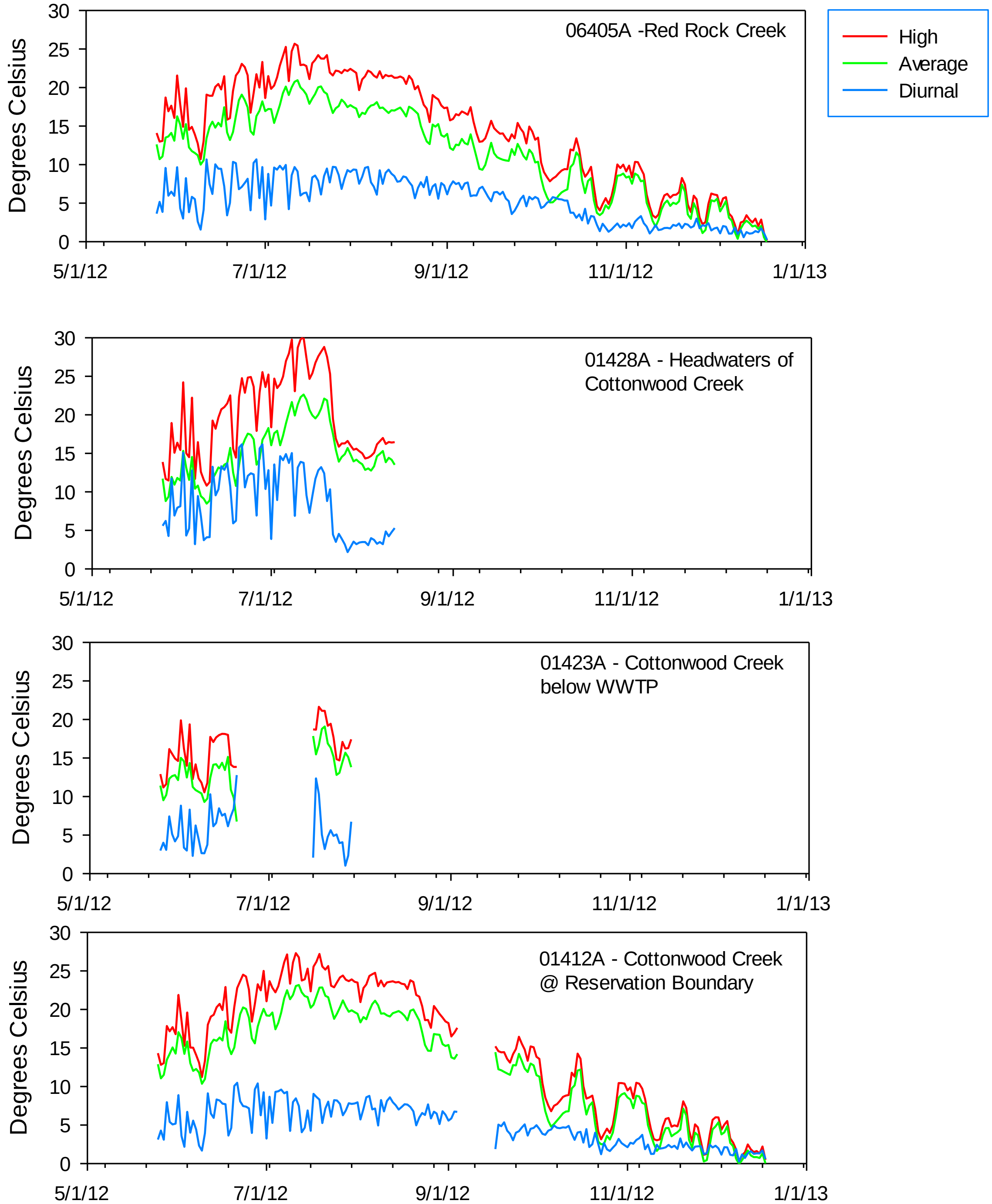
Onset HOBO Water Temperature Pro v2 Data Loggers were placed at each monitoring site, after calibration in the office. The graphs show maximum and average temperatures, as well as diurnal variation.



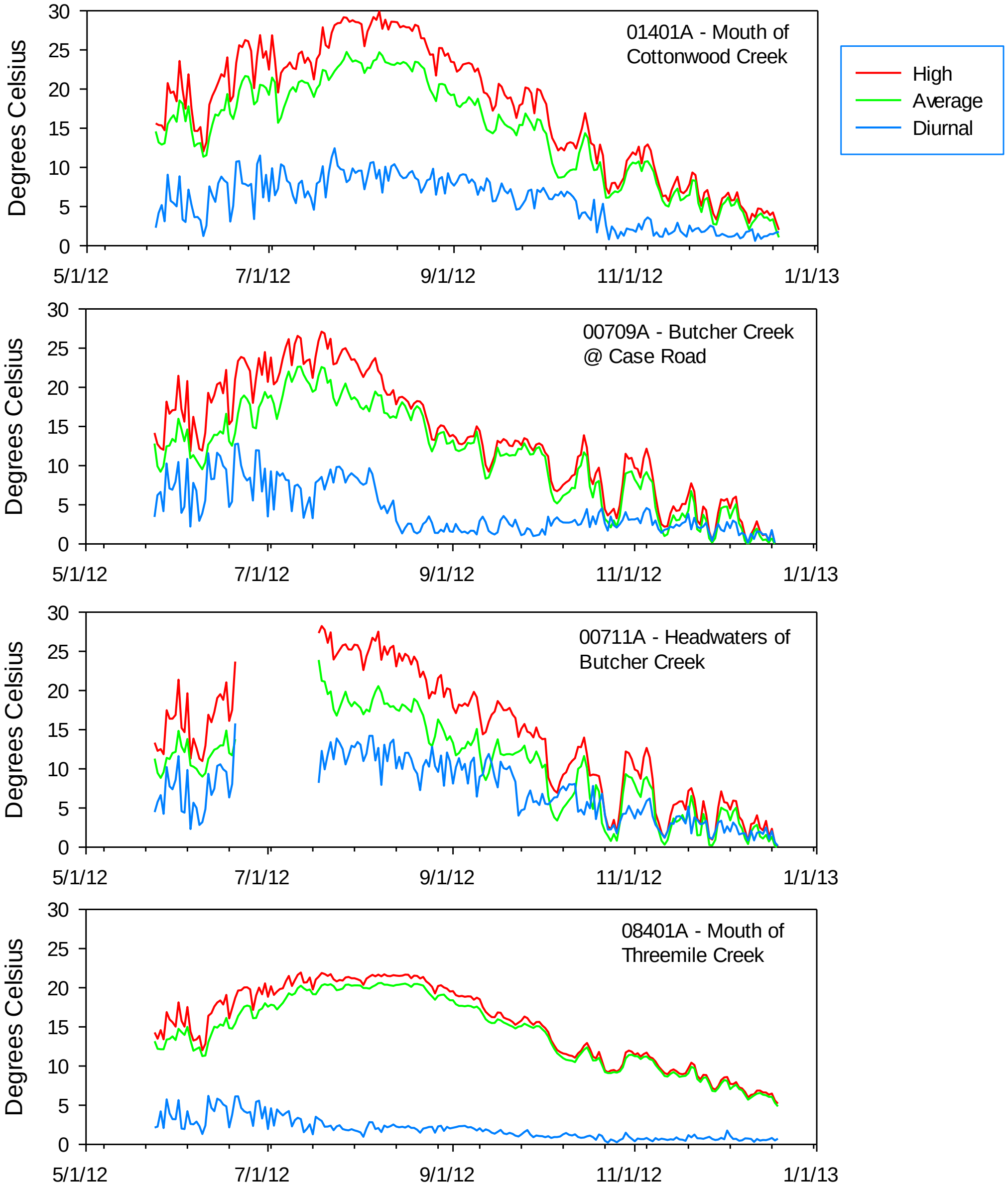


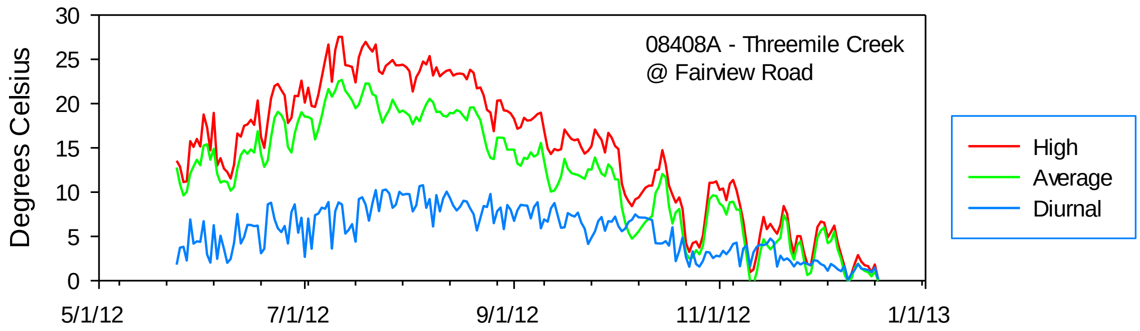


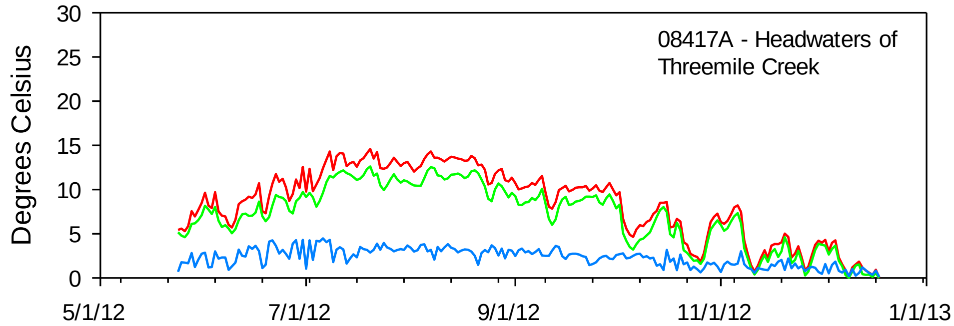




High
Average
Diurnal
06405A -Red Rock Creek
01428A - Headwaters of Cottonwood Creek
01423A - Cottonwood Creek below WWTP
01412A - Cottonwood Creek @ Reservation Boundary
Degrees Celsius
0
5
10
15
20
25
30
5/1/12
7/1/12
9/1/12
11/1/12
1/1/13


01401A - Mouth of Cottonwood Creek
00709A - Butcher Creek @ Case Road
00711A - Headwaters of Butcher Creek
08401A - Mouth of Threemile Creek
High
Average
Diurnal
Degrees Celsius
0
5
10
15
20
25
30
5/1/12
7/1/12
9/1/12
11/1/12
1/1/13


08408A - Threemile Creek
@ Fairview Road
High
Average
Diurnal
Degrees Celsius
30
25
20
15
10
5
0
5/1/12
7/1/12
9/1/12
11/1/12
1/1/13


08417A - Headwaters of
Threemile Creek
Degrees Celsius
30
25
20
15
10
5
0
5/1/12
7/1/12
9/1/12
11/1/12
1/1/13

Appendix B: Raw Data

01428A: Cottonwood Creek headwaters

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
10/24/2011	10:35	5.6	155	80.5	10.12	6.19	4.85	172.3	0.01	0.04	0.111	0.01	6	0.05
11/14/2011	10:25	-1.2	132	88.6	13.38	4.46	3.66	146.7	0.01	0.028	0.059	0.02	1	0.1
12/13/2011	10:30													N/A
1/11/2012	10:15	0.04	139	84.4	12.20	4.94	4.34	410.6	0.14	0.024	0.055	0.02	4	0.11
2/14/2012	10:00	0.03	134	93.9	13.71	7.3	6.33	152.9	0.88	0.03	0.077	0.01	8	0.77
3/20/2012	10:30	0.33	115	91.1	13.19	8.05	10.09	98.5	1.35	0.029	0.061	0.01	10	3.08
4/16/2012	10:50	5.58	79	92.7	11.65	7.97	16.5	52.1	0.3	0.042	0.1	0.03	23	7.17
5/7/2012	10:30	10.5	89	95.1	10.61	7.44	13.9	N/A	0.09	0.032	0.054	0.03	24	3.69
5/25/2012	11:30	13.4	110	92.6	9.66	7.83	N/A							N/A
6/12/2012	10:30	13.85	104	94.2	9.74	7.89	22.4	210.5	0.04	0.04	0.11	0.02	28	4.46
7/16/2012	10:45	20.23	133	85.7	7.70	7.65	8.41	2419.6	0.01	0.053	0.1	0.02	5	0.1
8/13/2012	10:22													N/A
9/17/2012	11:00													N/A

01423A: Cottonwood Creek WWTP

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
10/24/2011	11:35	6.33	502	88.2	10.87	7.88	4.93	2419.6	1.51	0.068	0.159	0.01	6	0.38
11/14/2011	11:15	0.05	583	99	14.42	6.69	2.05	613.1	1.56	0.022	0.059	0.02	1	0.12
12/13/2011	10:50	0.03	503	94.8	13.83	7.57	0.85	101.7	2.96	0.038	0.062	0.09	1	N/A
1/11/2012	11:10	0.06	625	87.8	12.79	7.32	4.34	1	0.93	0.97	1.3	7.37	11	0.5
2/14/2012	10:50	1.36	274	93.2	13.11	7.62	3.14	50.4	1.53	0.15	1.3	1.07	2	0.9
3/20/2012	11:20	1.46	219	92.5	12.97	6.24	12.50	3	2.5	0.125	0.23	0.31	14	6.53
4/16/2012	11:55	6.08	150	92.4	11.47	7.57	15.50	5.2	0.9	0.119	0.19	0.32	13	8.71
5/7/2012	11:30	10.01	152	96.40	10.87	7.80	13.10	67.7	0.88	0.046	0.1	0.04	11	4.52
5/25/2012	11:10	11.15	224	107.60	11.81	8.48	N/A	N/A						N/A
6/12/2012	11:15	13.95	203	102.60	10.58	8.18	23.00	158.6	0.57	0.06	0.143	0.02	18	5.89
7/16/2012	12:20	17.42	574	80.90	7.74	7.95	5.00	1	1.85	0.128	0.19	0.03	4	0.1
8/13/2012	10:45													N/A
9/17/2012	11:25													N/A

01412A: Cottonwood Cr. @ Reservation boundary

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
10/25/2011	12:15	4.42	520	117.90	15.24	8.43	4.31	648.80	0.34	0.1	0.146	0.01	3	4.05
11/15/2011	11:20	0.51	483	119.70	17.14	7.80	2.15	21.80	0.72	0.015	0.043	0.01	1	3.63
12/19/2011	11:40	0.47	466	110.20	15.87	8.44	1.43	14.60	1.83	0.06	0.079	0.02	2	3.15
1/23/2012	12:10	0.55	350	98.60	14.17	7.76	15.5	65.70	2.28	0.24	0.31	0.24	11	15.04
2/15/2012	11:30	1.93	400	103.60	14.33	8.40	3.39	4.10	1.47	0.069	0.54	0.01	2	8.16
3/27/2012	13:25	7.27	295	92.60	11.15	7.84	88.9	137.40	8.42	0.171	0.33	0.06	1	101.69
4/24/2012	9:30	15.73	309	110.90	11.00	7.61	8.28	49.60	0.65	0.079	0.144	0.01	8	18.08
5/8/2012	10:30	11.63	329	122.30	13.28	8.79	7.58	N/A	0.68	0.065	0.109	0.02	5	14.86
5/25/2012	9:30	10.67	386	98.60	10.93	8.35	N/A	N/A						N/A
6/13/2012	11:30	16.12	304	96.10	9.45	8.17	142	1986.30	0.83	0.21	0.52	0.03	37	57.14
7/17/2012	11:10	19.53	426	106.20	10.65	8.53	3.92	307.60	0.61	0.19	0.23	0.03	6	2.17
8/14/2012	11:15	19.25	418	117.20	10.79	8.53	5.66	325.50	0.76	0.16	0.2	0.02	7	0.85
9/18/2012	11:10	11.36	557	103.10	11.26	8.62	3.51	108.60	0.72	0.077	0.14	< 0.01	4	2.3

01401A: Cottonwood Cr. Mouth

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
10/31/2011	11:40	7.06	458	113.3	13.70	7.61	0.76	22.8	0.01	0.094	0.11	0.01	1	6.62
11/21/2011	12:10	0.08	469	120.8	17.60	6.60	0.62	30.9	0.29	0.046	0.071	0.01	1	8.25
12/21/2011	11:10	1.68	450	114.3	15.94	8.36	0.55	2	1.42	0.104	0.159	0.01	1	8.28
1/30/2012	11:25	2.91	387	108.0	14.55	6.59	2.94	25.6	2.15	0.151	0.176	0.01	2	18.02
2/22/2012	11:20	6.07	408	103.9	12.89	8.47	89.9	6.2	0.97	0.041	0.66	0.02	272	24.15
3/28/2012	11:55	8.31	282	98.7	11.58	7.00	45.9	307.6	6.61	0.187	0.28	0.05	21	129.02
4/24/2012	12:15	20.16	310	106.4	9.88	8.88	4.18	143	0.15	0.082	0.13	0.01	3	25.72
5/15/2012	11:10	18.28	349	130.0	12.22	8.81	2.33	60.2	0.01	0.007	0.122	0.01	6	12.31
5/24/2012	15:00	15.75	343	97.3	9.65	8.19	N/A							N/A
6/20/2012	11:05	17.94	354	119.7	11.30	8.65	6.11	38	0.13	0.136	0.169	0.02	5	22.43
7/23/2012	11:00	23.23	383	97.7	8.29	8.39	1.99	41.2	0.02	0.24	0.27	0.01	4	3.46
8/20/2012	11:35	23.73	357	94.4	7.98	8.71	1.27	53.8	0.02	0.24	0.32	0.01	2	2.72
9/24/2012	11:20	14.54	403	98.0	10.49	8.34	1.52	71.2	0.01	0.167	0.22	0.01	2	4.82

00711A Butcher Creek headwaters

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
10/26/2011	10:55	0.34	110	88	12.74	5.58	7.69	63.1	0.07	0.036	0.096	0.01	3	0.18
11/16/2011	12:00	-2.12	117	89	13.83	5.78	7.01	27.5	0.02	0.038	0.082	0.03	2	0.14
12/20/2011	10:40	0.03	122	96.5	14.1	7.43	10.6	6.3	0.11	0.048	0.122	0.01	7	0.08
1/25/2012	11:20	1.62	98	95.7	13.37	6.66	17.6	2	0.34	0.067	0.128	0.02	5	0.65
2/21/2012	11:15	2.82	112	100.2	13.54	7.48	17.2	20.3	0.2	0.04	0.149	0.01	11	0.52
3/27/2012	11:40	4.76	72	90.6	11.63	6.71	20.2	7.4	0.25	0.068	0.12	0.01	8	9.16
4/18/2012	11:10	8.19	71	93.8	11.04	7.25	12.3	6.3	0.03	0.053	0.09	0.02	8	3.49
5/9/2012	10:55	13.58	76	91.7	9.54	7.53	17.6	N/A	0.02	0.055	0.111	0.02	14	2.91
5/24/2012	12:49	12.24	85	93.7	10.05	7.75	N/A							N/A
6/19/2012	12:05	13.69	93	101.1	10.48	7.78	16.8	34.5	0.01	0.052	0.108	0.02	12	1.88
7/18/2012	11:55	22.56	102	100.6	8.7	7.96	18.7	686.7	0.02	0.05	0.14	0.01	14	0.34
8/15/2012	12:05	21.02	137	84.3	7.51	8.03	5.82	866.4	0.05	0.082	0.131	0.02	6	0.4
8/16/2012	11:20							173.2						N/A
9/19/2012	11:25	12.24	121	88.1	9.44	7.98	3.87	1299.7	0.01	0.055	0.116	< 0.01	2	0.1

00709A Butcher Creek @ Case Road

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
10/26/2011	11:40	1.9	140	97.4	13.50	6.51	8.84	1	0.02	0.044	0.1	0.01	3	0.29
11/16/2011	12:45	-1.84	153	94.6	14.58	6.12	5.87	95.9	0.03	0.036	0.078	0.02	2	N/A
12/20/2011	11:30	0.1	132	101.6	14.82	7.65	8.73	21.8	0.14	0.039	0.091	0.02	5	N/A
1/25/2012	12:05	0.38	105	98.2	14.21	7.09	31.7	76.7	0.32	0.056	0.233	0.02	49	1.32
2/21/2012	12:00	3.17	115	104.8	14.05	7.97	13.2	39.9	0.03	0.024	0.096	0.01	6	0.61
3/27/2012	12:20	5.63	78	93.0	11.68	6.93	26.2	166.4	0.32	0.072	0.14	0.01	11	12.64
4/18/2012	12:00	10.03	77	97.1	10.96	7.49	13.8	12.4	0.01	0.051	0.093	0.04	5	4.74
5/9/2012	10:15	11.91	83	96.2	10.39	7.74	17.7	N/A	0.02	0.054	0.115	0.02	14	3.49
5/24/2012	13:23	12.21	97	96.0	10.29	8.01	N/A							N/A
6/19/2012	12:45	14.23	101	105.5	10.82	8.08	19	209.8	0.02	0.06	0.12	0.01	14	2.11
7/18/2012	11:15	22.13	124	100.6	8.76	8.25	15.4	1986.3	0.02	0.086	0.153	0.02	12	0.43
8/13/2012	12:18													N/A
9/19/2012	12:00	13.96	164	92.2	9.51	7.95	6.44	1011.2	0.08	0.089	0.151	0.01	4	0.21

00701A Butcher Creek @ mouth

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
4/25/2012	13:00	14.9	123	118.0	11.92	8.07	16.5	12.1	0.13	0.086	0.139	0.02	4	6.2
5/16/2012	10:40	15.53	145	104.3	10.39	8.72	8.98	3.1	0.09	0.074	0.109	0.03	4	2.67
6/27/2012	10:45	15.01	167	102.4	10.31	8.58	7.78	40.8	0.07	0.084	0.111	0.01	4	3.73
7/24/2012	11:45	19.42	199	100.3	9.22	8.51	3.21	21.6	0.17	0.108	0.129	0.01	3	0.98
8/21/2012	11:30	18.97	212	98.2	9.11	8	2.39	19.5	0.17	0.118	0.162	0.01	2	0.76
9/25/2012	10:40	13.13	221	97.4	10.23	7.99	1.6	6.3	0.11	0.099	0.146	0.01	2	0.87

06405A: Red Rock Creek

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
10/25/2011	10:35	3.7	686	110.9	14.50	8.13	2.37	66.3	1.58	0.19	0.24	0.02	2	1.9
11/15/2011	10:20	0.18	674	100.5	14.58	6.36	1.87	55.7	2.59	0.165	0.19	0.01	1	1.55
12/19/2011	10:50	1.42	633	105.0	14.72	8.35	2.14	47.1	3.08	0.164	0.18	0.03	2	1.82
1/23/2012	11:20	1.45	453	99.0	13.88	7.29	7.27	85.5	3.37	0.54	0.59	0.05	5	3.47
2/15/2012	10:30	1.82	667	104.2	14.45	8.38	4.79	12	3.57	0.19	0.33	0.01	3	3.04
3/26/2012	11:15	6.16	484	91.6	11.35	6.45	676	980.4	12.2	0.43	1.4	0.06	400	56.64
4/17/2012	13:30	12.1	573	105.7	11.35	8.52	24.2	488.4	4.62	0.22	0.3	0.02	25	5.31
5/8/2012	9:50	9.9	581	110.2	12.44	8.38	21.8	N/A	2.66	0.22	0.3	0.02	21	3.53
5/25/2012	8:55	9.41	625	97.0	11.07	8.25	N/A	N/A						N/A
6/13/2012	10:30	15.15	452	93.7	9.40	8.13	155	1046.2	1.08	0.41	0.74	0.04	67	14.93
7/17/2012	10:10	17.9	561	102.1	9.62	8.42	6.33	524.7	0.79	0.23	0.24	0.03	12	1.28
8/14/2012	10:15	15.91	389	103.8	10.25	8.31	4.33	648.8	0.35	0.1	0.17	0.02	8	0.46
9/18/2012	10:10	9.64	417	115.2	13.09	8.28	1.54	1	0.7	0.048	0.11	0.01	1	0.95
9/18/2012	13:20	12.81	408	101.0	10.67	8.67	N/A							N/A

08417A: Threemile Creek headwaters

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
10/26/2011	10:00	0.04	95	93.3	13.62	5.09	0.64	5.2	0.02	0.047	0.067	0.02	1	0.32
11/16/2011	11:00	-2.11	94	85.9	13.35	5.08	1.25	1	0.03	0.046	0.068	0.02	2	0.32
12/20/2011	10:05	0.06	95	93.0	13.57	7.51	0.42	96	0.06	0.053	0.058	0.01	2	0.22
1/25/2012	10:40	0.78	94	94.0	13.43	3.93	0.55	6.3	0.06	0.051	0.072	0.01	1	0.3
2/21/2012	10:40	0.65	99	97.2	13.95	7.46	0.29	3.1	0.05	0.045	0.058	0.01	2	0.17
3/27/2012	10:40	2.54	80	88.4	12.05	6.34	4.78	8.6	0.02	0.039	0.055	0.01	2	1.71
4/18/2012	10:20	4.03	67	91.0	11.92	7.47	3.15	4.1	0.05	0.039	0.056	0.03	6	3.47
5/9/2012	11:45	6.22	61	90.0	11.14	7.33	1.95	N/A	0.04	0.038	0.052	0.01	4	3.42
5/24/2012	11:47	5.16	60	93.4	11.87	7.29	N/A							N/A
6/19/2012	10:55	6.57	75	101.4	12.35	7.40	1.43	1	0.02	0.041	0.054	0.01	4	2.31
7/18/2012	12:25	12.25	88	98.0	10.48	7.57	1.42	20.30	0.02	0.05	0.067	0.01	4	0.75
8/15/2012	12:50	12.61	95	96.3	10.23	7.61	1.86	161.60	0.04	0.055	0.089	0.01	6	0.43
8/16/2012	11:35							24.1						N/A
9/19/2012	10:40	8.42	100	95.2	11.13	7.54	1.67	6.30	0.02	0.053	0.089	0.01	3	0.35

08408A: Threemile Creek @ Fairview Rd.

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
10/26/2011	12:50	3.22	283	100.30	13.32	7.53	3.88	17.5	2.2	0.487	0.58	0.01	1	1.09
11/16/2011	13:30	-2.14	358	98.80	15.35	7.49	1.76	275.2	7.16	0.81	0.81	0.02	1	0.93
12/19/2011	13:20	0.04	351	107.00	15.60	8.35	1.36	18.7	8.59	0.94	0.96	0.02	1	1.1
1/25/2012	13:15	2.01	269	101.90	14.08	7.79	14	61.3	3.04	0.46	0.55	0.02	8	3.08
2/21/2012	13:00	3.37	357	113.00	15.04	8.69	12.6	38.9	8.34	0.76	0.85	0.02	6	1.8
3/26/2012	12:25	6.07	148	94.60	11.68	6.90	431	2419.6	5.53	0.18	1	0.08	368	N/A
4/18/2012	12:45	9.8	158	100.00	11.34	8.29	16.9	50.4	1.39	0.2	0.3	0.03	10	10.82
5/9/2012	12:50	14.01	145	98.60	10.16	8.55	12.8	N/A	0.77	0.24	0.31	0.02	8	7.26
5/24/2012	13:55	11.96	196	100.30	10.80	8.32	N/A							N/A
6/19/2012	13:30	13.54	198	109.40	11.38	8.40	11.1	178.5	2.23	0.32	0.39	0.02	5	4.72
7/18/2012	10:15	19.08	248	101.50	9.39	8.17	5.2	1046.2	3.41	0.93	1	0.04	5	1.29
8/15/2012	11:05	17.65	401	106.60	10.15	8.35	2.08	118.7	9.06	1.5	1.5	0.03	6	0.56
8/16/2012	11:00							238.2						N/A
9/19/2012	13:00	12.57	444	110.20	11.70	8.87	2.27	436.0	6.48	1.7	1.8	0.01	1	0.82

08401A Threemile Mouth

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
10/31/2011	10:45	8.18	270	112.5	13.25	6.74	0.81	32.1	1.46	0.26	0.26	0.01	1	1.99
11/21/2011	13:30	4.86	279	104.9	13.45	7.30	0.82	4.1	3.25	0.258	0.29	0.01	1	2.5
12/21/2011	12:10	5.07	286	104.8	13.35	8.07	0.67	1	3.84	0.259	0.3	0.01	1	1.89
1/30/2012	12:35	4.28	252	105.5	13.72	7.65	3.35	8.6	3.07	0.27	0.28	0.01	2	4.01
2/22/2012	12:40	5.84	265	102.2	12.76	8.11	6.69	60.5	3.67	0.29	0.305	0.01	5	14.75
3/28/2012	13:10	7.55	203	98.1	11.75	7.22	48.3	344.8	7.12	0.23	0.28	0.05	22	71.53
4/24/2012	11:15	14.95	163	110.5	11.15	8.24	14.68	4.1	0.81	0.27	0.32	0.01	4	13.71
5/15/2012	12:30	16.41	167	131.4	12.83	9.00	9.76	1	0.29	0.24	0.285	0.02	3	6.21
5/24/2012	14:30	14.71	192	102.4	10.38	8.14	N/A							N/A
6/20/2012	12:15	17.62	199	101.7	9.70	8.03	14.9	29.8	0.86	0.26	0.3	0.02	4	7.73
7/23/2012	12:00	20.84	239	96.3	8.60	7.92	2.81	25	0.4	0.24	0.26	0.01	3	1.56
8/20/2012	12:40	21.48	273	98.5	8.69	7.70	1.5	47.9	0.15	0.24	0.31	0.01	2	0.62
9/24/2012	12:30	16.15	304	114.7	11.75	8.34	1.68	461.1	0.4	0.24	0.29	0.01	1	0.81

07801A Stockney Creek

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO 2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
10/24/2011	12:50	6.88	510	87.3	10.61	7.62	3.33	1046.2	0.4	0.13	0.16	0.01	3	0.63
11/14/2011	13:15	0.43	537	76.7	11.06	7.25	2.31	121.0	1.1	0.07	0.11	0.01	2	1.01
12/13/2011	12:45	0.12	539	86.0	12.50	7.68	0.95	5.1	1.9	0.07	0.12	0.02	1	0.81
1/11/2012	13:00	-0.1	500	87.4	12.76	7.67	1.75	14.6	1.6	0.09	0.12	0.03	3	1.1
2/14/2012	12:15	1.83	445	97.9	13.59	8.05	4.16	11.0	1.8	0.11	0.15	0.01	6	2.62
3/20/2012	13:15	2.24	445	93.4	12.81	7.86	12.40	16.0	4.5	0.11	0.15	0.02	14	4.8
4/17/2012	10:15	7.07	450	99.5	12.01	7.31	17.20	35.9	3.6	0.09	0.13	0.02	13	6.73
5/7/2012	13:25	11.41	464	107.8	11.76	8.25	8.91	260.3	2.1	0.12	0.19	0.03	10	3.64
5/25/2012	10:55	10.68	607	93.5	10.37	8.12	N/A	N/A						N/A
6/12/2012	13:10	15.37	530	90.2	9.01	8.13	24.20	816.4	1.14	0.184	0.3	0.04	50	5.23
7/16/2012	13:45	18.77	527	77.7	7.22	7.85	7.36	648.8	0.25	0.25	0.34	0.03	11	0.5
8/13/2012	11:22													N/A
9/18/2012	12:05	8.98	517	65.8	7.58	7.82	4.19	30.5	2.65	0.07	0.16	0.01	12	0.05

07101A: Shebang Creek

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
10/24/2011	13:40	7.81	364	97.2	11.56	7.73	3.18	2419.6	0.23	0.032	0.086	0.01	7	0.11
11/14/2011	12:15	0.73	357	84.8	12.13	7.11	1.77	110.6	0.54	0.012	0.045	0.01	3	0.22
12/13/2011	11:10	0.1	409	92	13.40	7.55	0.58	7.5	1.36	0.022	0.04	0.02	1	N/A
1/11/2012	12:00	0.17	378	90.2	13.11	7.31	0.96	1	0.75	0.022	0.057	0.01	2	0.15
2/14/2012	11:35	2.12	253	107.9	14.86	7.87	1.36	21.8	1.3	0.022	0.059	0.01	1	1.76
3/20/2012	12:10	1.63	268	95.9	13.38	6.64	9.15	222.4	7.74	0.055	0.092	0.01	6	4.77
4/17/2012	10:50	9.78	260	99.4	11.27	7.76	7.58	344.8	3.03	0.114	0.167	0.04	3	3.83
5/7/2012	12:45	14.64	260	109.4	11.11	8.14	9.16	93.3	0.59	0.057	0.137	0.03	6	2.38
5/25/2012	10:30	12.27	300	100.3	10.74	8.09	N/A	N/A						N/A
6/12/2012	12:20	18.46	317	103.4	9.68	8.19	9.8	365.4	0.04	0.08	0.15	0.02	6	5.22
7/16/2012	13:10	19.53	397	90	8.22	7.93	2.18	96	0.11	0.058	0.099	0.03	3	0.13
8/13/2012	11:03													N/A
9/18/2012	12:45	10.58	426	49.6	5.51	7.48	1.01	68.3	0.65	0.018	0.085	< 0.01	1	0.02

07502A: SF Cottonwood Creek

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
10/26/2011	14:00	3.84	469	109.60	14.40	7.36	4.25	139.6	1.3	0.049	0.089	0.02	2	0.26
11/15/2011	13:45	0.3	441	102.70	14.77	7.54	10.7	79.8	1.4	0.058	0.092	0.02	3	0.29
12/13/2011	11:45	0.08	459	93.90	13.68	7.55	2.36	16	2.74	0.061	0.087	0.02	1	
1/23/2012	13:55	0.23	402	99.60	14.47	7.80	5.52	14.6	1.64	0.13	0.175	0.02	2	0.64
2/15/2012	13:30	1.92	428	113.10	15.65	8.32	3.25	1	1.25	0.05	0.101	0.01	1	0.42
3/26/2012	13:45	7.19	303	88.70	10.72	6.90	1000	88.4	22.6	0.11	1.3	0.44	640	45.85
4/17/2012	11:25	11.64	361	127.80	13.81	8.40	14.7	4.1	0.95	0.078	0.14	0.02	8	0.78
5/8/2012	12:25	17.14	356	165.90	15.72	8.97	8.91	N/A	0.22	0.05	0.112	0.01	12	0.47
5/25/2012	10:10	11.3	401	102.50	11.20	8.06	N/A							
6/13/2012	13:45	19.06	181	81.80	7.57	7.53	413	2419.6	0.9	0.15	0.88	0.02	114	8.16
7/17/2012	13:25	23.91	455	93.50	7.87	8.00	2.93	629.4	0.11	0.07	0.11	0.03	4	0.17
8/14/2012	12:15	18.43	469	77.50	7.27	7.65	2.98	410.6	0.01	0.043	0.071	0.02	3	0.09
9/25/2012	13:15	14.67	470	90.40	9.17	7.96	1.09	770.1	0.01	0.016	0.06	0.01	2	0.28

04501A: Long Haul Creek

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
10/25/2011	13:35	7.21	551	99.50	12.00	8.14	6.3	2419.6	0.16	0.201	0.26	0.01	2	0.99
11/15/2011	13:05	0.5	503	104.40	15.04	7.61	1.44	325.5	0.19	0.052	0.077	0.01	2	0.21
12/19/2011	12:45	0.16	537	105.30	15.31	7.89	1.5	325.5	2.37	0.047	0.065	0.03	1	N/A
1/23/2012	13:10	0.01	287	96.90	14.15	7.42	27.8	59.4	1.18	0.142	0.232	0.01	17	1.55
2/15/2012	12:20	1.31	347	105.10	14.80	8.27	6.95	90.6	0.45	0.035	0.074	0.01	3	0.86
3/26/2012	13:00	6.57	172	93.40	11.43	7.08	396	328.2	5.82	0.18	0.68	0.05	188	N/A
4/17/2012	12:15	13.02	238	108.90	11.45	8.97	17.1	119.1	0.28	0.096	0.14	0.02	7	2.24
5/8/2012	11:30	17.31	229	122.00	11.71	9.22	12.2	N/A	0.01	0.069	0.125	0.01	9	1.21
5/25/2012	9:45	12.87	320	97.90	10.32	8.38	N/A	N/A						N/A
6/13/2012	12:30	17.46	249	92.90	8.88	7.87	158	2419.6	1.14	0.21	0.44	0.1	41	11.47
7/17/2012	12:10	23.65	677	111.90	9.46	8.57	2.19	524.7	0.01	0.16	0.21	0.02	5	0.19
8/13/2012	11:49													N/A
9/25/2012	12:05	16.23	895	87.70	8.57	8.12	1.29	90.6	0.01	0.165	0.23	0.01	1	0.33