Collaborative Upper Cache la Poudre Monitoring Program

SOURCE WATER MONITORING

The Upper Cache la Poudre (UCLP) Watershed Collaborative Monitoring Program was established in 2008 between the City of Fort Collins, the City of Greeley and Tri-Districts, to help meet present and future drinking water treatment goals.

Water quality monitoring of our raw, Cache la Poudre River drinking water supply is conducted from April through November. Monitoring sites are strategically located throughout the UCLP. Water quality data provide valuable information about the health of our source watershed and raw water supply.

The Summer 2016 Water Quality Update provides a seasonal summary of the UCLP Watershed by highlighting precipitation and streamflow conditions, as well as water quality during the summer season (July, August and September). Water quality begins to stabilize following peak snowmelt runoff and routine monitoring is reduced to monthly sampling. Routine water quality monitoring results are reported for six key monitoring sites located throughout the UCLP watershed, which capture water quality conditions above and below major tributaries and near water supply intake structures ***(Figure 1)***.

More information is available at *fcgov.com/source-water-monitoring*.

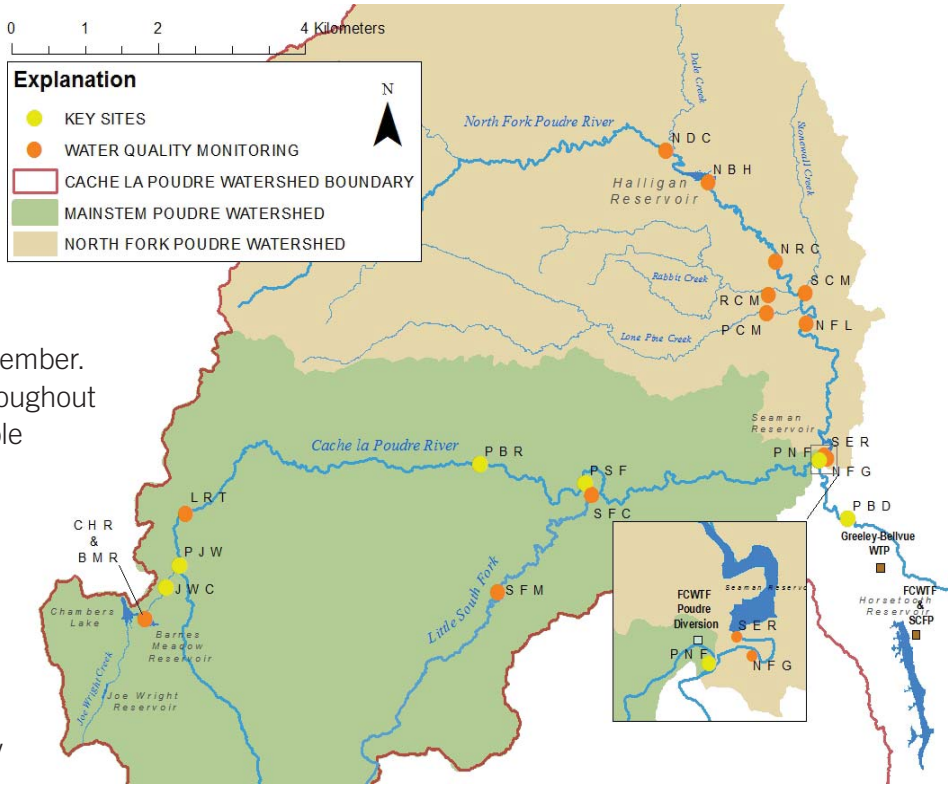


Figure 1 *- Upper Cache la Poudre Collaborative Monitoring Program sampling locations*

JWC - Joe Wright Creek above the confluence with the Poudre River
PJW - Poudre River above the confluence with Joe Wright Creek
PBR - Poudre River below the Town of Rustic
PSF - Poudre River below the confluence with the Little South Fork
PNF - Poudre River above the confluence with the North Fork at the City of Fort Collins' Intake
PBD - Poudre River below the confluence with the North Fork at the Bellvue Diversion

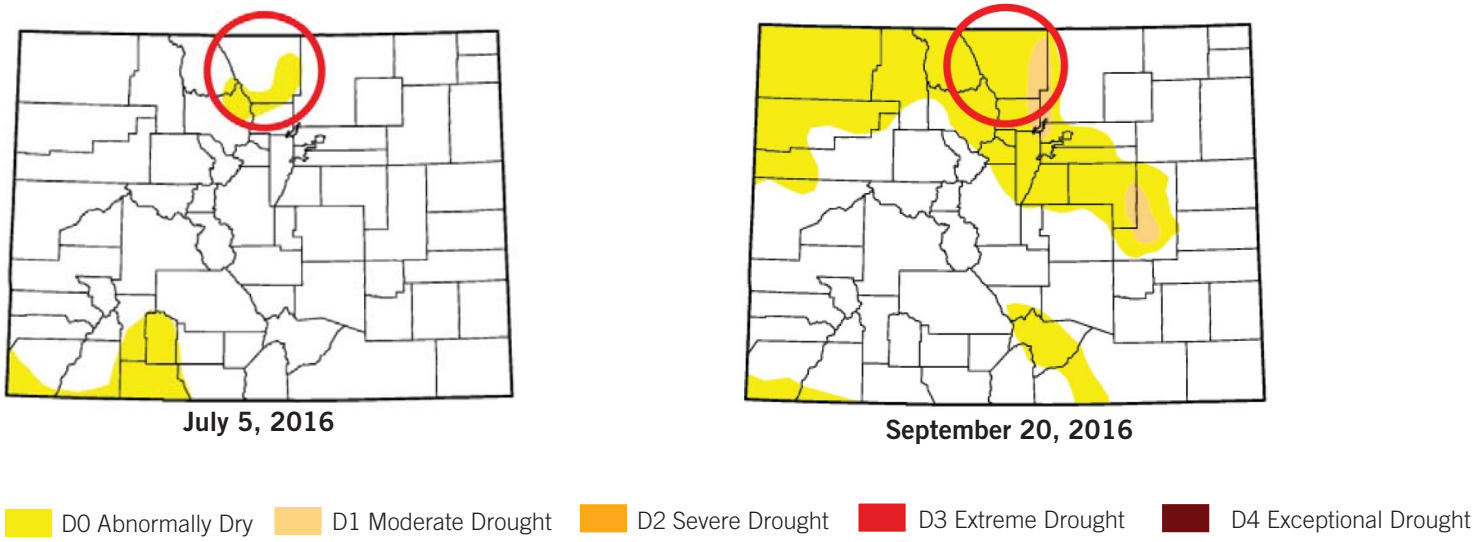
PRECIPITATION AND STREAMFLOW CONDITIONS

Total precipitation in the UCLP watershed in water year 2016 (October 1, 2015 – September 30, 2016) was near to below average for most of the year. A wet spring brought much needed precipitation to the watershed easing concern of drought conditions. Dry conditions beginning in early June persisted through September increasing the drought conditions to "abnormally dry" for much of the watershed ***(Figure 2)***. In water year 2016 a total of 39.8 inches of water was measured near the top of Cameron Pass compared to the average of 44.2 inches ***(Figure 3a)***.

The Colorado monsoon normally brings increased rainfall to the watershed during the summer months. In 2016, however, lower than normal precipitation was observed. The UCLP watershed received only 3.5 inches of water compared to an average of 7.4 inches – less than 50 percent of normal ***(Figure 3b)***.

Streamflow in the UCLP watershed quickly decreased following peak snowmelt runoff ***(Figure 3c)***. Changes in streamflow during the summer are typically driven by high intensity rainfall events, water releases from upstream reservoirs and water withdrawals. Summer streamflow was measured below the long-term average due to dry conditions through the summer months. By the end of the water year streamflow was measured at 45 percent of normal (45 cfs compared to an average of 100 cfs).

U.S. Drought Monitor - Colorado



The Drought Monitor focuses on broad-scale conditions. Local conditions may vary.

Figure 2 *- Drought conditions throughout Colorado measured by the U.S. Drought Monitor on July 5, 2016 (left) and September 20, 2016 (right). Note: Larimer County is outlined in red circle.*
Image from http://droughtmonitor.unl.edu.

PRECIPITATION AND STREAMFLOW CONDITIONS CONTINUED

Streamflow on June 6, 2016 (left) was measured at 2,310 cubic feet per second (cfs) near the canyon mouth compared to the same location on September 14 (right) when streamflow was recorded at 56 cfs.

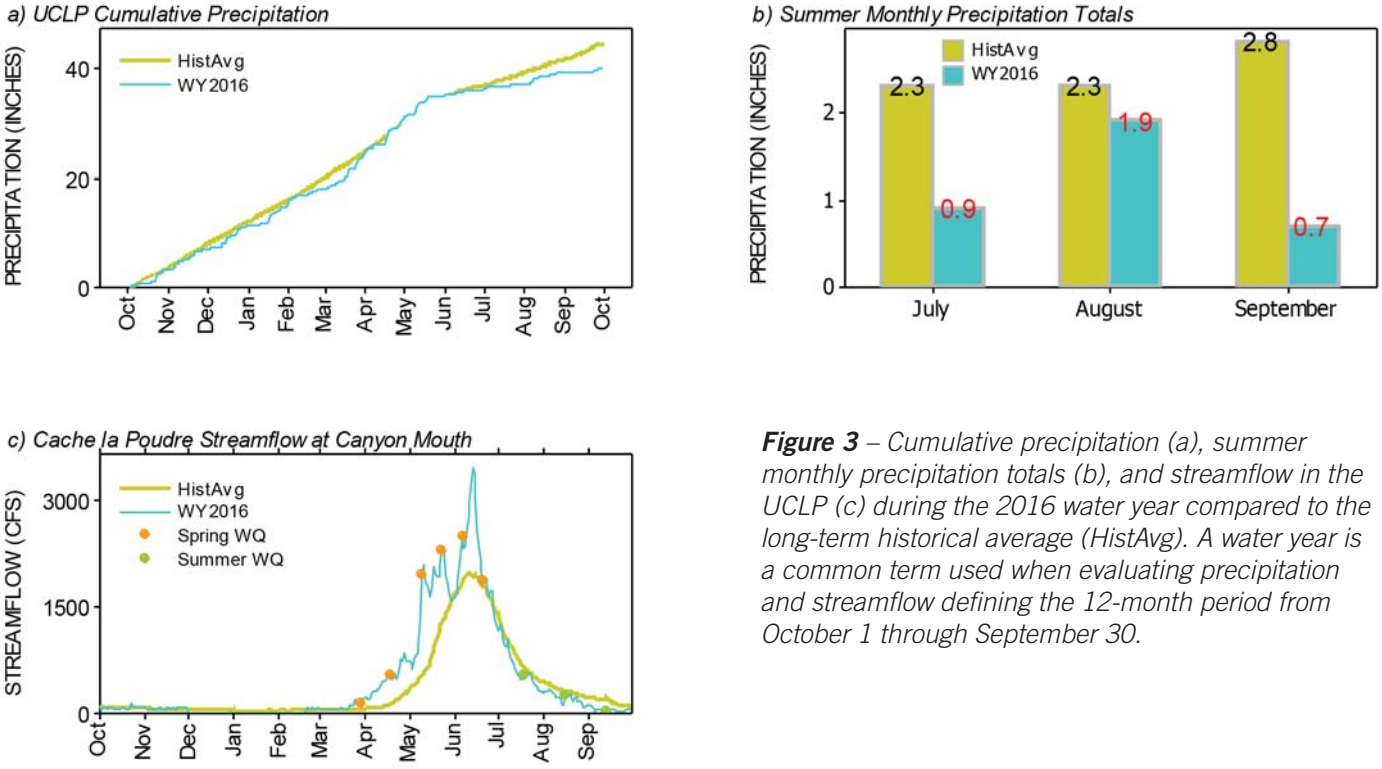


Figure 3 *– Cumulative precipitation (a), summer monthly precipitation totals (b), and streamflow in the UCLP (c) during the 2016 water year compared to the long-term historical average (HistAvg). A water year is a common term used when evaluating precipitation and streamflow defining the 12-month period from October 1 through September 30.*

WATER QUALITY INDICATORS

The Upper Cache la Poudre Collaborative Water Quality Monitoring Program tests for several key water quality indicators, including pH, conductivity, temperature and turbidity ***(Table 1)***. These key measurements provide a snapshot of water quality conditions, which are useful to identify trends or changes in water quality. Significant changes in water quality may provide an early warning of potential water pollution.

Table 1 - *Water quality indicators measured as part of the Upper Cache la Poudre Collaborative Water Quality Monitoring Program.*

Water Quality Indicator	Explanation
Temperature	Water temperature influences other water quality parameters and is a major driver of biological activity and algal growth in rivers, including certain phytoplankton species that produce the taste and odor compound, geosmin.
pH	pH is an important water quality parameter to monitor, as it influences the solubility and biological availability of chemical constituents, including nutrients and heavy metals. pH near 7 is considered neutral, with more acidic conditions occurring below 7 and more basic, or alkaline, conditions occurring above 7.
Conductivity	Conductivity is an index of dissolved ionic solids in water. Hardness is an index of the total calcium (Ca) and magnesium (Mg) in water.
Turbidity	Turbidity is monitored to track changes in water clarity. Clarity is influenced by the presence of algae and/or suspended solids introduced to surface waters through various land use activities, including runoff and erosion, urban stormwater runoff and drainage from agricultural lands. For water treatment, turbidity is an important indicator of the amount of suspended material that is available to harbor pollutants, such as heavy metals, bacteria, pathogens, nutrients and organic matter.

Summer water quality monitoring captures water quality conditions following peak streamflow throughout the receding or falling limb of the hydrograph and into early baseflow (low flow) conditions observed late summer into early autumn.

Water quality conditions vary with elevation, contributing watershed area and streamflow. During the summer months of 2016, all water quality indicators were within the range of values observed over the long-term monitoring record for the summer season. Most sites and parameters reported near the long-term median indicating normal water quality conditions. Temperature and pH were above the long-term median at all key sites. As expected, water clarity improved during the summer months as indicated by decreasing turbidity levels ***(Figure 3)***.

Anastasia Frantsova, with the City of Greeley, collects water quality samples in late summer (September 12) on the Little South Fork Cache la Poudre River.

WATER QUALITY INDICATORS CONTINUED

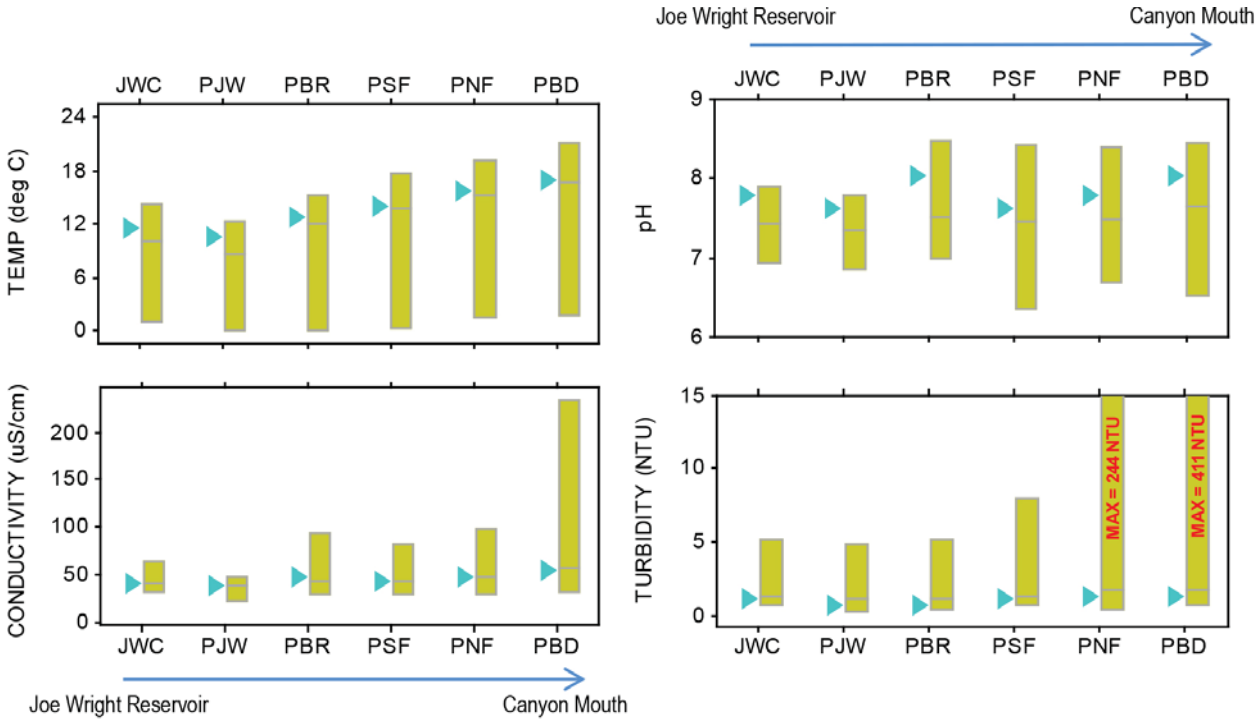
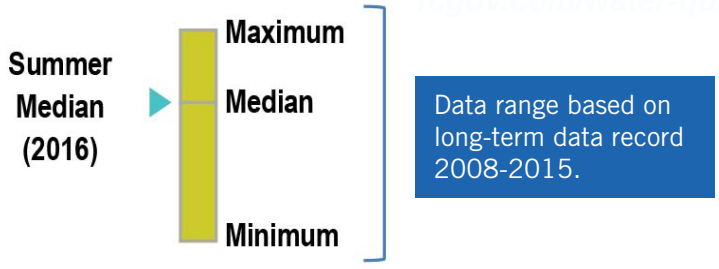


Figure 3 *– Water quality indicator data collected at key monitoring sites during Summer (July, August, September) 2015. Note: the large range of turbidity values observed at PNF and PBD are associated with water quality impacts from the High Park and Hewlett Gulch wildfires.*

Graphic Explanation



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MICROORGANISMS

Coliforms are types of bacteria found naturally in plant and soil material. They can also be found in the digestive tract of animals, including humans.

Disease causing bacteria or pathogens can be introduced to the raw drinking water supply from fecal contamination. Although the water treatment process effectively eliminates pathogens, source watershed monitoring can provide indication of changes in the activity and location of pathogen sources over time.

Through the Upper Cache la Poudre Collaborative Monitoring Program, the raw Poudre River water supply is routinely tested for the presence of bacterial contamination. This is done by measuring the total amount of coliforms, an indicator organism for the presence of pathogenic bacteria.

In addition, *Escherichia coli (E. coli)* is measured and used as an indicator of human or animal fecal waste pollution, since the source of origin is more specific than total coliforms.

E. coli and total coliforms were within the range of values seen in previous years and near or slightly lower than the long-term median (***Figure 5a*** and ***5b***, respectively). The large range of values observed over the long-term record at PNF and PBD is due to water quality impacts from the High Park and Hewlett Gulch wildfires. The dry conditions in the summer of 2016 limited the delivery of these microorganisms into the Poudre River from surrounding watershed during high intensity precipitation events.

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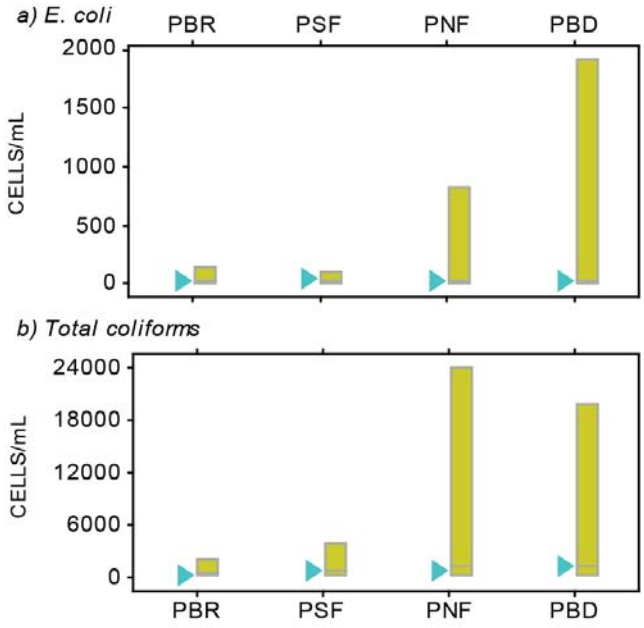


Figure 5 – *E. coli (a) and (b) T. coli counts on the Poudre River during the 2015 summer season.*

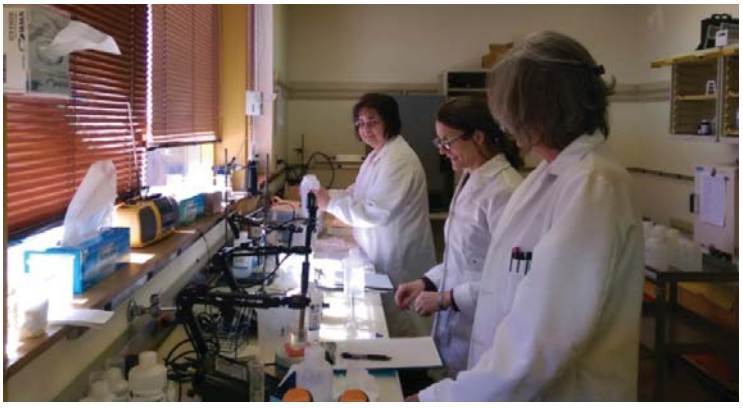
TASTE AND ODOR COMPOUNDS

Geosmin is a naturally occurring organic compound which introduces an earthy odor to water that can be detected by the most sensitive individuals at concentrations as low as 4 nanograms per liter (ng/L) or 4 parts per trillion (ppt). These compounds do not pose a public health risk, but it is of concern because its detectable presence can negatively affect customer confidence in the quality of drinking water. Geosmin is monitored at PBR and PNF during routine UCLP monitoring events.

Geosmin concentrations observed at PBR and PNF were below the taste and odor threshold of 4 ng/L. Concentrations were measured above detection in July at PBR and PNF and remained above detection at PNF in August. Concentrations were measured below detection (<1.0 ng/L) at both monitoring locations in September (***Table 2***).

Monitor Date	Geosmin (ng/L)	
	PBR	PNF
7/18/2015	1.18	1.08
8/15/2015	0.92	2.20
9/12/2015	0.89	0.76

Table 2 *– Poudre River geosmin concentrations (ppt) during the summer of 2016 at Poudre above the North Fork (PNF) and Poudre below Rustic (PBR) monitoring locations.*



Anita Flores, Ann Biegelsen and Sheri Lafferty (back to front), chemists at the Fort Collins Water Quality Lab, perform what they like to call "the Fab 4" – pH, alkalinity, specific conductance, and turbidity measurements.