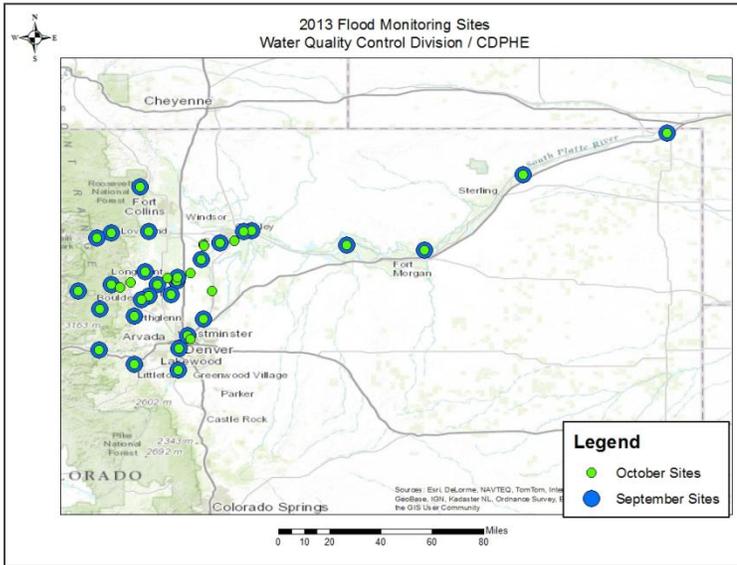




September 2013 Flood Water Quality Sampling Summary



In collaboration with the Environmental Protection Agency (EPA), the Water Quality Control Division (division) conducted two sampling events after the flood of September 2013. This documents details findings and answers questions from monitoring conducted in the flood-impacted areas of northeast Colorado.

Large volumes of precipitation over a long duration occurred on the eastern slope beginning September 11, 2013. Precipitation totals ranged from four inches to over 15 inches. For most locations, the average annual rainfall amount is around 16 inches. Historically, average September precipitation east of the Continental Divide is less than two inches.¹ The flooding affected personal property and public infrastructure including roads, bridges, water treatment facilities, wastewater treatment facilities, distribution systems and collection systems. In limited cases, drinking water systems were compromised resulting in Boil Water Advisories. A number of wastewater systems were affected

resulting in sewage discharge to streams and rivers. Industrial facilities and agricultural operations were also impacted. Flood waters were expected to contain high quantities of sediment, bacteria and other pollutants.

1. What was the purpose and timeline of the post-flood sampling effort? Who collected and analyzed samples? How many sites were sampled? How was quality of the data assured? Where is data stored? What were the stream flow levels during the sampling?

A Sampling and Analysis Plan (SAP) was developed for the South Platte River and major tributaries to characterize water quality during and after floodwaters receded. The purpose was to examine potential health risks for citizens and relief workers while also assessing the ecological impacts of the flood on streams and rivers in Colorado. Additionally, the division and EPA wanted to evaluate areas for water quality restoration efforts. Sampling sites were selected at locations across the entire flooded area from Denver to Julesburg. The above map highlights sampling locations. The first sampling event took place on September 26 and the second on October 28 and 29. Further sampling is planned for spring 2014.

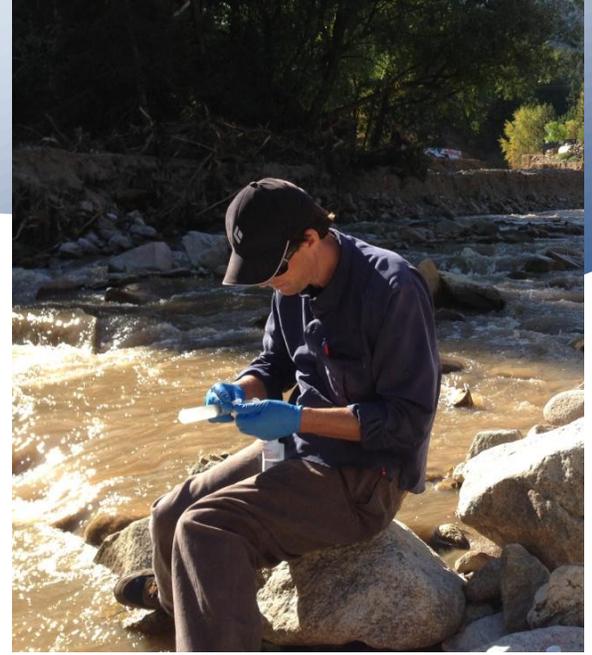
Number of Sampling Locations for the South Platte River and Tributaries

| River Basin | September | October |
|---------------------------|-----------|---------|
| Upper South Platte River | 2 | 3 |
| Middle South Platte River | 1 | 3 |
| Lower South Platte River | 4 | 4 |
| Bear Creek | 1 | 1 |
| Big Thompson Creek | 4 | 6 |
| Boulder Creek | 7 | 6 |
| Cache La Poudre River | 2 | 2 |
| Cherry Creek | 1 | 1 |
| Clear Creek | 2 | 2 |
| St. Vrain Creek | 5 | 11 |

Sampling locations were downstream of oil and gas production locations, historic mining areas and infrastructure impacted by the floods such as wastewater facilities.

¹ <http://coflood2013.colostate.edu/preciptotals.html>

Ten staff members from the division and EPA collected samples. For the first event, samples from 29 sites were analyzed by the Colorado Department of Public Health and Environment Laboratory Services Division. For the second event, the EPA Laboratory in Golden, Colorado, analyzed samples from 39 sites. Ten additional sites were added to the second sampling event based on requests from EPA due to improved access to sites previously inaccessible. Data was collected based on procedures outlined in the SAP and the division's quality assurance project plan. Once quality assurance and quality control procedures are finalized, data will be stored in the division's water quality database. This information is available via EPA's Storage and Retrieval Data Warehouse: <http://www.epa.gov/storet/>.



Adam Taubman, from the division draws samples from the Upper Thompson River in Jamestown.

The division and the EPA did not conduct sampling during peak stream flows due to safety considerations for sampling personnel. During peak stages of the flood, average daily flows were 75 to 200 times higher than historic average daily flow conditions throughout the watershed. During the September sampling event, average daily flows were 10 to 30 times higher than historic average daily flow conditions. High stream flows damaged flow measurement gages, which limited the availability of accurate flow data in many impacted streams and rivers. Flows during the October sampling event remained elevated in comparison to historic levels but were less than those in September.

2. What were the main chemical pollutants found and did the data suggest potential impacts to the South Platte?

The Laboratory Services Division and the EPA tested for the following pollutants:

- **Metals** provided information regarding pollutants from historic mining areas
- **Volatile Organic Compounds (VOCs)** provided indication of pollutants, such as BTEX, from oil and gas activities
- **Semi-Volatile Organic Compounds (SVOCs)** provided indication of pollutants from oil and gas activities, agricultural areas, and urban runoff)
- **Nutrients and Bacteria** provided information about pollutants from flooded wastewater systems and agricultural areas

Based on the division's assessment of data, water quality observed in streams on the Front Range appear to have returned to pre-flood conditions.

Two sampling sites exceeded standards for metals after the flood. However, both locations had previously high levels of these same metals. Clear Creek below Idaho Springs exceeded both copper and zinc water quality standards. This was not surprising, since a Total Maximum Daily Load (TMDL) for cadmium, lead and zinc was completed for Clear Creek in 2008. The TMDL implementation and remediation for Clear Creek is ongoing. Zinc levels in James Creek (upstream of Lefthand Creek) also exceeded standards for the September sampling event and were considered slightly higher than historic levels in this watershed. However, portions of this watershed are documented to have zinc levels above the relevant water quality metals standards. The site was re-sampled in October and zinc levels for James Creek were within allowable standards limits. All other metals tested were within expected ranges and in compliance with water quality standards.

All volatile organic compounds (VOCs and SVOCs) related to oil and gas production were below applicable standards established for the protection of human health or water supply. The majority of these compounds were below levels detectable by laboratory equipment. Based on preliminary analysis by the EPA, pesticide and emerging contaminant levels were within the expected range. Pesticides and emerging contaminants with applicable surface water quality standards were in compliance.

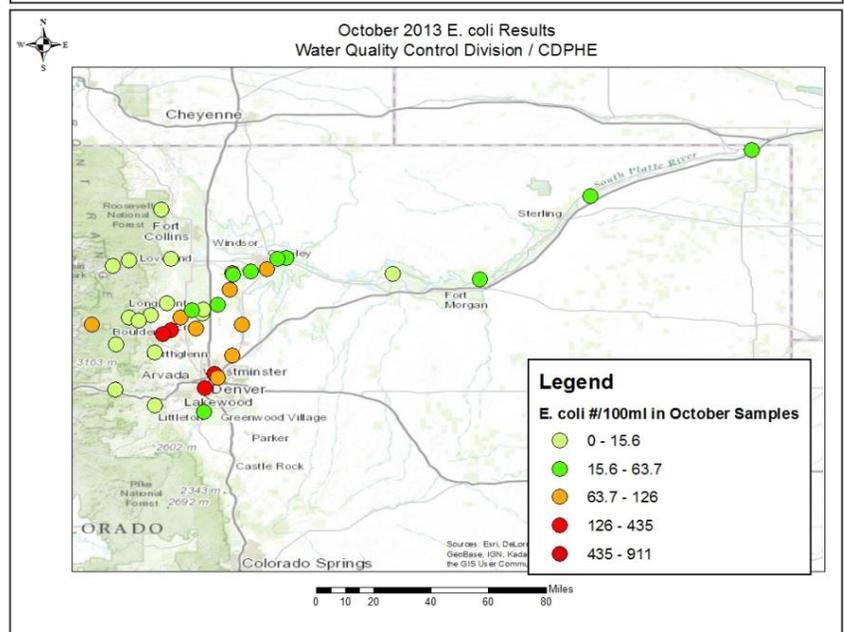
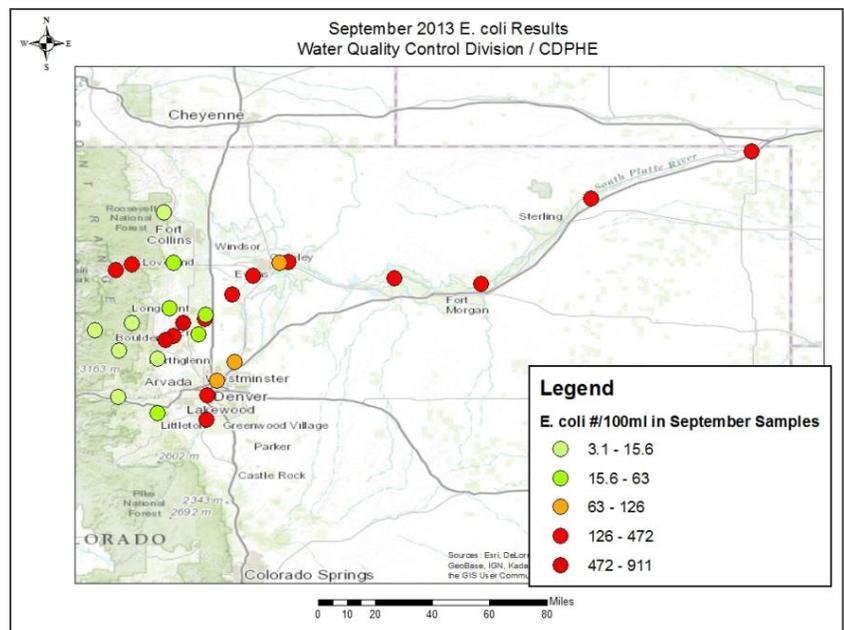
E. coli, a common indicator of fecal contamination, was above recreational standards in 16 of the 29 locations sampled for the first event. For the second sampling event, only four sites exceeded *E. coli* standards. Three of these sites exhibited elevated *E. coli* levels prior to flood conditions. For nutrients, nitrate concentrations did not exceed standards related to drinking water supplies. Concentrations of other nutrients such as ammonia, total nitrogen, and total phosphorus will be evaluated in context of the long-term trend sampling conducted by the division as part of reporting required by EPA in 2016.

3. Was there a bacterial contamination concern to human health through primary contact or ingestion from exposure to floodwater or lake water? Was there indication that the quality of flood waters impacted water supply, recreation, agricultural or aquatic life uses? Were spatial or temporal patterns observed?

E. coli is an indicator of fecal contamination, which is a concern for human health. Drinking water supply diversions are located on surface waters primarily in and upstream of the Denver metropolitan area. Based on the division’s review of sampling results, none of the surface water samples exceeded drinking water or agricultural standards.

The state water quality standard for primary contact recreation (i.e. swimming) is 126 colonies/100 ml. Data indicated high levels of *E. coli* in some areas of the South Platte River basin for both the September and October sampling events. For the September sampling event, the highest concentrations of *E. coli* were sampled in the Boulder Creek and Big Thompson River watersheds. Concentrations of *E. coli* were also elevated on the South Platte River mainstem. For the October sampling event, only four sites exceeded *E. coli* standards, although three of these sites exhibited elevated *E. coli* levels prior to flood conditions (Boulder Creek, Clear Creek and Cherry Creek). In addition to human health concerns, high concentrations of bacteria may also be of concern for cattle grazing in flooded areas. The Water Quality Control Division coordinated with Colorado State University on this issue and no acute concerns were identified.

Concentrations of the majority of pollutants analyzed were below the state’s acute standard (lethal) for protection of aquatic life (including fish and aquatic insects) in 37 out of 39 locations. Due to the extreme nature of this event, staff anticipated that acute standards would be exceeded as was discussed with metals in question two above. It is too early to tell if there will be long-term impacts to aquatic life from increased transport of sediment, reconfiguration of channels, habitat loss, and long-term or chronic exposure to elevated water quality concentrations of



metals and nutrients (ammonia). Continued monitoring will assess if there are flood-related stream and channel damage affecting water quality and aquatic habitat. The continued monitoring is part of the division's routine sampling and assessment mandatory to fulfill EPA requirements on the quality of Colorado's streams, lakes, and reservoirs.

5. Will there be follow-up sampling to examine long-term impacts to water quality?

Yes, the EPA and the division will conduct a joint sampling event in April of 2014. The EPA will also lead a sampling event in February of 2014 to examine contaminants in the sediments of flood-impacted areas. The division is coordinating with the Colorado Department Agriculture to evaluate how alluvial wells may have been impacted from the flood waters. A limited amount of sampling is planned for this effort during the summer of 2014 at state owned groundwater monitoring wells in Weld County.



Flood damage near Estes Park, Colorado from the Upper Thompson River.

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