

Clear Creek County
Jefferson County
City of Lakewood
Town of Morrison
Aspen Park Metropolitan District
Brook Forest Inn
Conifer Sanitation Association
Conifer Metropolitan District
Denver Water Department
Evergreen Metropolitan District
Forrest Hills Metropolitan District
Genesee Water & Sanitation District
Geneva Glen
Jefferson County School District
Kittredge Sanitation & Water District
West Jefferson County Metro District
Evergreen Trout Unlimited
U.S. Army Corps of Engineers

Evergreen Middle School Buchanan Ponds Study

The BCWA worked with Megan and Laura, science teachers from Evergreen Middle School, on a special water quality study at the nearby Buchanan Ponds. There were 220 students involved in the project (*BCWA WQSD05 Buchanan Ponds and BCWA Fact Sheet 55*). The program was divided into 4 phases: 1) an introductory presentation to the classes on water quality health in the Bear Creek Watershed, 2) an adventurous field trip to the monitoring sites where student made observations, took flow measurements and used a water quality multi-probe to measure water chemistry and collected water for laboratory analyses, 3) a presentation to the classes to review the various field and laboratory findings, and 4) six junior water-

shed managers helped develop the Fact Sheet 55 and this article.

Field probe measurements were done at three sites for temperature, pH, dissolved oxygen, specific conductance or conductivity, and stream flow. Students collected water samples to measure total nitrogen and total phosphorus concentrations. We calculated nutrient loads and predicted how the two ponds influenced nutrients and water pH. Students make observations on conditions of sites including what things people were doing to change water quality; they found invasive plants and animals, they observed pollutants (like oil, grease, road salts, trash and sediments) and even identified a few fixes or good practices. The lack of weeds around the ponds suggest chemicals had been used to kill the weeds. Since all of the drainage systems were designed to quickly dump the storm-water into the ponds or stream, one student cor-

rectly noted that *the ponds were used to get rid of all the bad pollutants*.

The field chemistry data showed that runoff from roads, parking lots, driveways and sidewalks can pollute Buchanan Ponds. The higher than normal conductivity of the water suggested that road salts were reaching the drainage way. The study also showed how the pond ecosystems can change the water chemistry. Nutrients cause the algae and a tiny plant called *Duck Weed* in the ponds to grow and grow, which then changes the pond pH. The more algal growth, the more basic or alkaline the water becomes. If the water pH gets too high and over 9.0 then it can harm the fish. The sun can heat up the water really fast in the ponds and if the water gets too hot for the fish, temperature becomes a pollutant.

Some students found the science to be *hard*, others called it *challenging*, and best stated by one student – *water is important and we must protect it*.

Six junior watershed managers tell us why it was important for them to look at Buchanan Ponds water quality:

“Because they flow into other ponds and rivers, which if the ponds were polluted then all the other places that the water flows would also be polluted.” Johnathon S.

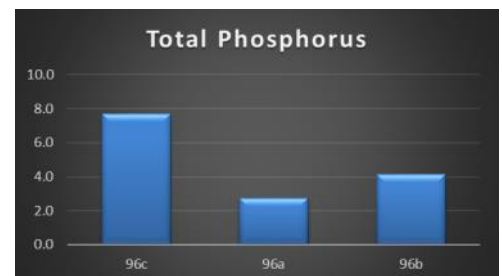
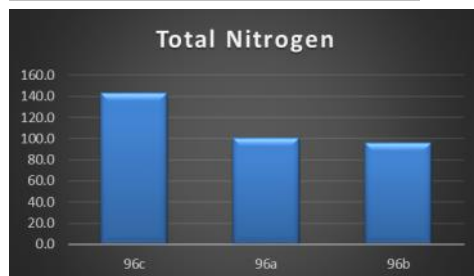
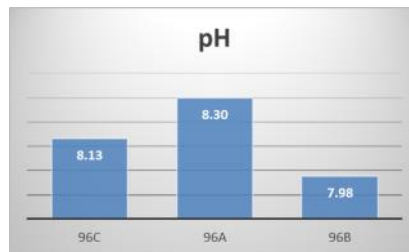
“Because it helps give you a better understanding of what goes into the water and how good or bad it is; and what you need to do to fix it in order to maintain healthy water quality.” Olivia F.

“Because we need to know what’s going into our water; further down the road we can see if it’s getting more polluted and see how we can stop it.” Logan G.

“There are lots of pollutants causing problems. There is nutrient loading. If there are too much nutrients, then the algae start to grow more, which raises pH levels and causes plants and animals to die.” Kiryn W.

“Because Buchanan Ponds are part of our watershed. We drink water from our watershed. It is important to look at water quality because we have fish who live in the ponds and I want to protect them.” Nicholas R.

“Because we could see the things that help and don’t help our environment. We saw that we could help research the water conditions and other things to help improve the environment by starting with Buchanan Ponds.” Lilla F.





King Murphy Augmentation Pond is located on Witter Gulch in Clear Creek County and serves as a sediment catchment basin for the drainage system. Sediment deposition from 2013 flooding filled the basin. The county completed a restoration effort to repair and upgrade this catch basin and augmentation pond.

BCWA Models Climate Change in the Bear Creek Watershed

Increasing stream water temperatures within the watershed can harm fish and other aquatic life.

- Higher water temperatures decreases the solubility of dissolved oxygen—low oxygen.
- Higher temperatures increase the metabolism, respiration and oxygen demand of fish and other aquatic life—increasing stress.
- Solubility of many toxic substances increases and intensifies as the temperature rises—increasing toxicity.
- There is a maximum temperature that each species of fish or other aquatic organism can tolerate— predicted future conditions could exceed these limits.
- If the temperature of a stream reach is raised by 2-10° C., it is probable that cold water fish will be replaced by warm water fish.
- Trout have optimum temperatures for rates of growth and reproduction—higher temperatures reduce those rates.

From December 2015 to June 2016, BCWA and Evergreen Metro engaged in a series of webinars and an in-person meeting to conduct a *climate change risk assessment* using the U.S. Environmental Protection Agency’s (EPA) Climate Resilience Evaluation and Awareness Tool (CREAT). CREAT provides data for historical and projected climate conditions that users can incorporate into scenarios to help them understand how threats are driven by climate change.

BCWA built scenarios by selecting different future conditions defined by changes in annual average and monthly temperature and precipitation, as well as intense precipitation events and hot days that may exacerbate the climate-related threats of concern. While all Global Circulation Models (GCMs) project warming, the projected changes in precipitation vary. Some models project wetter conditions for a given location and others project drier conditions. The models also vary in the changes in the magnitude of intense precipitation events; some project stormier conditions than others. CREAT averages the projected data from climate models to provide data for warmer and wetter, hotter and drier and moderate future conditions.

BCWA and Evergreen Metro are using the assessment to build on existing modeling and monitoring efforts to better understand how climate change threats could affect utility operations and water-

shed health. BCWA included a number of climate change threats in our assessment that would present water quality and quantity issues through 2050 within the upper Bear Creek Watershed. Predicted increasing temperatures from climate change could present regulatory and treatment challenges for members, in addition to affecting the health of sensitive fish species in the watershed.

A minimal very likely near-term temperature increase of 1 to 2°F will present issues for the cold-water fisheries. Additional concerns include water supply reductions from drought, as well as water quality degradation from wildfires and subsequent flooding. Previous flooding events have resulted in significant sedimentation in Evergreen Lake that diminished the reservoir’s capacity. BCWA considered how climate change may increase the severity or frequency of these threats, and assessed the risks of water quality or quantity conditions that would challenge their ability to maintain a reliable supply, to treat the incoming raw water and to protect the health of the watershed ecosystem. BCWA considered both moderate and hotter and drier conditions with a stormy future. These two scenarios were used to ensure that BCWA members were conducting robust planning that considered different potential future climate conditions. The *Minimum Proactive Plan* includes short-term measures to increase modeling, monitoring, water-

shed management, staff training and public outreach activities, as well as implementing new green infrastructure in the service area.

These measures would improve temperature and water quality data collection as well as modeling capabilities so that BCWA and Evergreen Metro can better understand the potential impacts to their infrastructure and operations due to climate change.

CLIMATE VARIABLE	BASELINE SCENARIO	MODERATE CONDITIONS SCENARIO	HOTTER AND DRIER CONDITIONS SCENARIO
Average Annual Temperature	46.26°F	5.18°F increase	6.12°F increase
Average July Temperature	67.4°F	5.75°F increase	5.88°F increase
Average December Temperature	29.82°F	4.39°F increase	5.96°F increase
Hot Days over 90°F	2.3 days	>10 days	>20 days
Total Annual Precipitation	19.27 inches	3.68% increase	0.88% increase
July Precipitation	2.04 inches	4.69% decrease	0.93% increase
December Precipitation	0.82 inches	18.04% increase	5.48% increase
100-Year Storm Event	2.8 inches 6 hours	28.59% increase	28.59% increase