

SHOP CREEK

POLLUTION REDUCTION FACILITY

A Watershed Solution to Urban Runoff Quality
Cherry Creek Basin Water Quality Authority

The Problem

The Cherry Creek Reservoir Clean Lakes Study (DRCOG 1984) identified that Reservoir water quality and its uses were moderately impaired and that phosphorus was the limiting nutrient. To protect the water quality of Cherry Creek, the Water quality Control Commission (WQCC) originally set an in-lake phosphorus standard of 35- $\mu\text{g/l}$ (1985) and subsequently changed the standard to 15- $\mu\text{g/l}$ chlorophyll *a* (2000). A maximum phosphorus concentration of 40- $\mu\text{g/l}$ was set as the goal. The Cherry Creek Control Regulation (December 2004), requires the implementation of best management practices (BMP) for all new development and pollutant reduction facilities throughout the watershed (PRF). PRF are typically larger scale BMP with expressed purpose of reduction phosphorus loads to Cherry Creek Reservoir and are primarily constructed with Authority funds.

Shop Creek - One Solution

In the 1980's, an urbanizing watershed of 550-acres within the City of Aurora was causing severe erosion to a small drainage channel (Shop Creek) within Cherry Creek State Park. Soils were also being carried into the Park from upstream development and ending up in the Reservoir, along with other associated pollutants, particularly phosphorus.

The City of Aurora worked with the Urban Drainage & Flood Control District, the Cherry Creek Basin Water Quality Authority and Cherry Creek State Parks to develop a demonstration project for treatment of phosphorus. To maximize phosphorus removal from storm runoff, detention, retention and wetlands were combined in series to provide a "treatment train" (see photo at left). The



Aerial View of Shop Creek (Muller Engineering)

detention area located upstream of Parker Road (not shown) removes coarse sediment. The retention area (photo below) furthers sedimentation and particulate phosphorus removal. The series of seven wetlands even greater phosphorus removal, including dissolved phosphorus.

From the Park prospective, the solution complements park values, aesthetics, recreational access, wildlife habitat, low maintenance.

Technical Data

- Watershed area 550 acres
- Imperviousness of 40%, of which 75% is hydraulically connected.
- Permanent pool of 4.8 acre feet, which is 0.10 inches of runoff from entire watershed or 0.26 inches from impervious areas.

- Surcharge above permanent pool of 9.1-acre feet, providing detention for 0.2 inches of runoff from entire watershed.
- Outlet empties 90% of surcharge volume in 30-hours.
- Total of 3.5-acres of wetlands.
- One year storm event velocity of 1-fps.
- Six drop-structures constructed from soil cement.

Performance

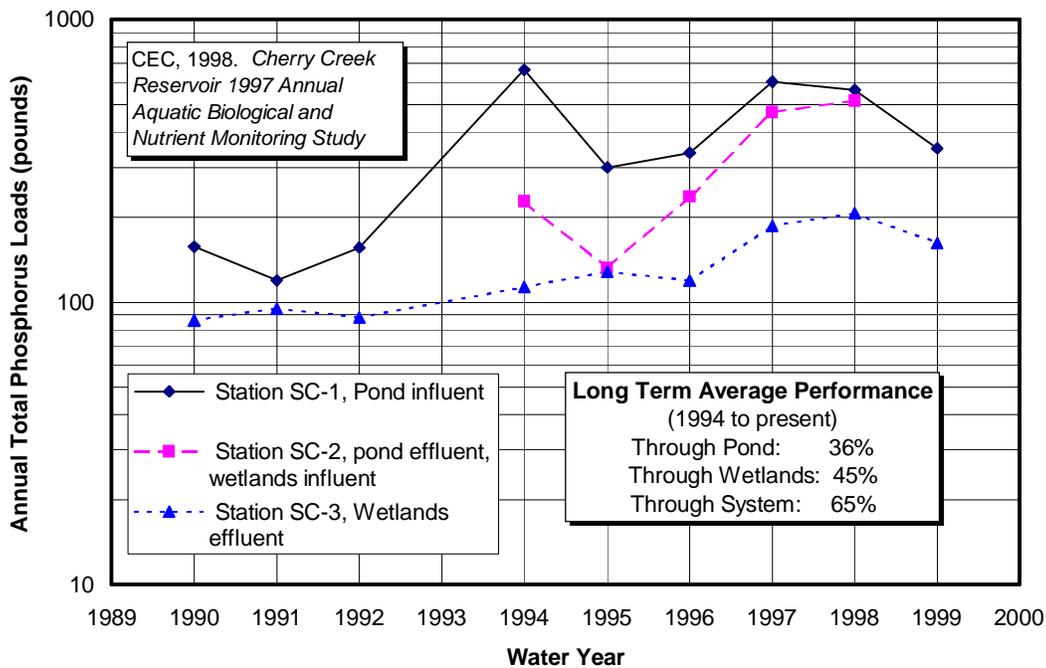
Regular sampling occurs upstream, downstream of retention pond and downstream of wetlands. In addition to phosphorus (total and dissolved), samples analyzed for nitrates, nitrites, nitrogen, copper, iron, manganese, zinc, alkalinity, chemical oxygen demand, and total suspended solids. Long term performance for phosphorus is shown in the chart below. Sampling upstream and within the wetlands was discontinued in 2000.



Other Pollutant Reduction Facilities (PRF)

The Authority has constructed and is operating, maintaining and monitoring eight major PRFs in the Cherry Creek Reservoir watershed. A ninth facility, Cottonwood Creek Restoration, began construction in 2004.

Shop Creek Detention/wetlands System



- Cottonwood Creek/Perimeter Rd. This PRF is similar to Shop Creek, except that the initial retention basin for Cottonwood Creek is much larger to accommodate the larger runoff volume from the 7,500-acre drainage area. Also, Cottonwood Creek is followed by a single wetland.
- Quincy Drainage. This PRF captures runoff from the 530-acre drainage basin and quickly infiltrates the runoff through the sandy alluvium. Native grasses typical of a semi-arid climate populate the pond. Typically, no surface flows are discharged from this PRF during baseflow conditions and discharges during precipitation events have been limited.

directly discharge into the lake. The projects include East Side Shade Shelter (1996) and the Tower Loop (1999) projects (see photo at left).

The Recreation Component

Multiple uses for PRF are vital to their success and provisions for recreation are key to many projects. The before (photo left) and after (next page) photos illustrate the Tower Loop area, a PRF constructed in 1999. Tower Loop is a very popular fishing area and controlling public access was a key factor in the design. Recreation was enhanced by providing “fishing pods”

A mission of the Authority is public education regarding impacts of urban runoff on water quality of Cherry Creek. By providing or enhancing recreation opportunities for PRF, the Authority also enhances its opportunities to educate the public about urban runoff pollution.

Most of the PRF’s constructed by the Authority to date have included signage prepared by professional park planners. For instance, along Shop Creek several kiosks have been installed explaining the need and benefits of the project.

The Authority was also recently awarded a Section 319, information and education Grant from EPA. The Authority will work with Cherry Creek State Park Staff to increase the general awareness regarding the importance of BMPs in Cherry Creek Reservoir to gain public support and participation in protecting water quality.

Tower Loop Erosion before Construction (Ruzzo)



Shoreline Protection Projects. The Authority has an ongoing program of projects to protect the shoreline of the Reservoir, thereby limiting sediment and attached phosphorus that

Cherry Creek Basin

The Cherry Creek Reservoir watershed covers 386 square miles of the Front Range corridor, extending upstream to the

Palmer Divide. The basin drains northward from elevation reaching approximately 7,700 feet near Colorado Springs, to 5,600 feet at the Reservoir. Topography within the watershed is quite variable – consisting of pinyon pine covered hillsides, short grass prairie, and canyons, such as those found in Castlewood Canyon State Park.



Aerial View of the Reservoir (USACE)

The Reservoir was impounded in 1950, creating the 860-acre lake and a 3,500 acre State Park.

Precipitation averages from 13” at the Reservoir to 18” at the divide with long-term maximums ranging from 22” to 33”. Annual storm runoff has varied over the last 15-years from a low of 5,000 acre feet to a high of 27,700 acre feet in 1999. Phosphorus loads have also varied widely with watershed hydrology, ranging from a low of 4,500 pounds to a high of 18,800 pounds.

Cherry Creek Basin Water Quality Authority

The CCBWQA is a quasi-municipal corporation and political subdivision of the State that has primary responsibility for water quality in the Cherry Creek Basin. The Authority is specifically empowered to develop and implement plans for water quality controls for the Reservoir and watershed. The watershed management strategy of the Authority includes:

- **Regulations.** Stormwater Quality Regulations (Regulations) have been adopted by the Authority (2000). The purpose is to implement, monitor, and enforce technical measures (BMP) to reduce sediments and nutrients reaching Cherry Creek and Cherry Creek Reservoir. The Regulations establish minimum requirements for BMP that address construction erosion (temporary measures) and water quality enhancement for completed developments (permanent measures).
- **Planning.** The Authority has adopted (1999) a Storm Drainage Quality Plan to further protect the water quality

of Cherry Creek. The Plan identifies projects, called pollutant reduction facilities (PRF) that include enhanced BMP (i.e.: detention, retention, wetlands, filtration), in-stream and in-lake controls, and shoreline and stream bank protection. PRFs provide levels of protection beyond permanent BMPs by also targeting other pollutants such as sediment, nitrogen, and metals. PRF measures also provide a net environmental benefit by improving riparian health and wildlife habitat. The Authority funds PRF by collecting fees and taxes.

- **Operations and Maintenance Plan.** The Authority is developing a long-term program to insure that technical measures continue to serve their purpose. The goal of the plan is to insure physical integrity and proper hydraulic function for PRF. The plan will identify specific requirements for PRF that address maintenance access, safety and convenience, aesthetic and recreation requirements.



Tower Loop with Enhanced Recreation Features (Ruzzo)