

# COTTONWOOD CREEK RECLAMATION

## *Stream Stabilization Approach 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) set an in-lake, seasonal chlorophyll *a* standard of 15- $\mu\text{g/l}$  and set a phosphorus goal of 40- $\mu\text{g/l}$  (2000, 2001). The Cherry Creek Control Regulation (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 constructed by the Authority that reduce phosphorus loads to the Reservoir.

Urbanization of the Cottonwood Creek watershed (8.5 square miles) greatly increased during 1980's and continues today. Urbanization increases the rate, frequency, duration and magnitude of storm runoff, all of which increases erosion of the streambed and banks. This erosion is evident in the adjacent photo, which shows that the Creek had degraded up to 10-feet within Cherry Creek State Park. These soils, along with other associated pollutants, particularly phosphorus, are being carried into the Reservoir, degrading its quality. Soils were also being carried into the Park from upstream development and ending up in the Reservoir.

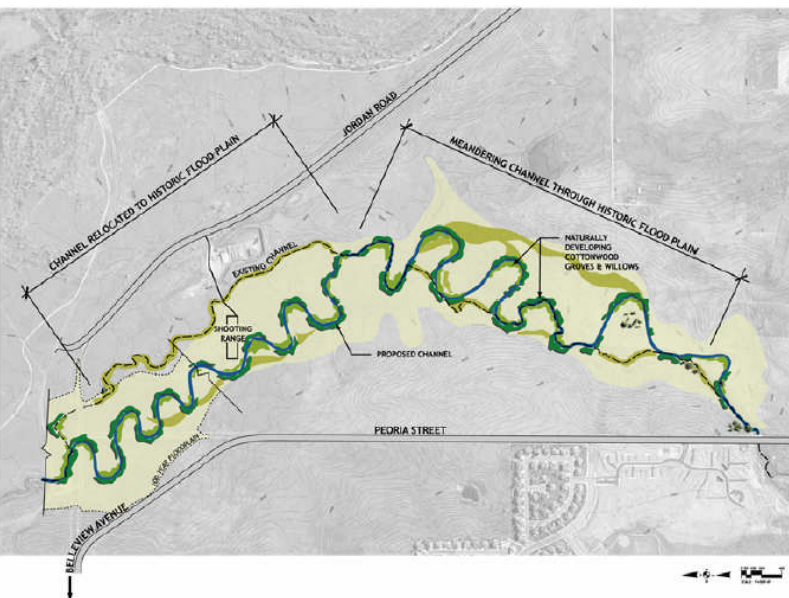


#### Flood History

Cottonwood Creek through Cherry Creek State Park has a history of flood events that have severely eroded the channel bed and banks and confined it to a narrow section beginning at Peoria Street (see photo above). Flooding has been reported in the past at the intersection of Peoria Street and Bellevue Avenue, and within the shooting range, most recently in August 2004. Previous farming activities have apparently relocated the lower portion of the channel up on a ridge through the shooting center, rather than in the valley, which has altered the flood plain.

#### Stream Stabilization – One Solution

The Cottonwood Creek Stream Reclamation project extends from Peoria Street to the Perimeter Road within Cherry Creek State Park. This reach constitutes phase III and IV of the four phase improvements for Lower Cottonwood Creek. Phase I was the perimeter road wetlands constructed in 1996 and Phase II was the Peoria Street extended detention basin, completed in 2003. Phase III stream reclamation-Peoria Street to the confluence with Lone Tree Creek-was completed in 2004. Phase IV-confluence to the Perimeter Road-is scheduled to begin construction in 2006.



The primary purpose of stream stabilization (Phase III and IV) is to reduce erosion of the streambed and stream banks. Phase III and IV will also enhance growth of wetland and riparian vegetation, will attract wildlife, and will provide passive recreation opportunities, all of which are important objectives in the design approach.

The proposed design concept will go beyond simply stabilizing the Creek in place. Improvements will re-create, as closely as possible, a natural, well-vegetated, functional stream system that establishes close ties between its baseflow channel and its broad, flat floodplain overbanks (see picture at left).

## Water Quality Benefits

Cottonwood Creek will be reclaimed as a meandering, shallow prairie stream that will overtop with fairly frequent storm events, allowing over-banks and secondary channels to dissipate flood flows, thereby reducing velocities and erosive forces. Hydrologic conditions will be conducive to the regeneration of cottonwoods, willows, and other natural riparian species along the channel. This additional vegetation will further help to slow down flood flows, reinforce channel banks, enhance water quality, and provide other environmental benefits. In an attempt to quantify the phosphorus reduction benefits, the Authority has estimated the reduction in phosphorus from stream stabilization and the additional floodplain area and wetlands.

### 1. Stream Bank Stabilization.

The improved stream will increase the length from 11,600 linear feet, with a sinuosity of 1.37 to 14,260 feet, with a sinuosity of 1.74. Authority estimates for stream stabilization (both banks for Cottonwood Creek only) is approximately 210 pounds of phosphorus per mile for 2.19 miles, per year or around 460 lbs.

### 2. Flood Plain Area.

Existing 2-year floodplain width is 5.3 acres, which will increase to over 80 acres. This will increase the riparian corridor area from 4.4- to 24.9 acres and provide for greater infiltration and filtration by vegetation. Estimates were made of long term phosphorus removal by inundating the floodplain for various flood frequencies, based on dynamic, particle-settling theory. These estimates resulted in a long-term average 1.0 lbs/P per acre/year of floodplain, or around 70 pounds per year.

### 3. Riparian Wetlands.

The existing channel has less than 0.5 acres of riparian wetlands, which are primarily associated with limited channel bottom. The project will widen the channel and increase the frequency of riparian flooding. These improvements are expected to increase riparian wetland areas by 20-acres and immobilize from 200-lbs annually (i.e.: about 10-lbs/ac/yr).

### 4. Annual Phosphorus Reduction

Total of all components is  $460 + 70 + 200 = 730$  pounds P.



Cottonwood Creek Reclamation Phase 1 was completed in early August 2004 with the first flood occurring on August 18, 2004. Based on water-marks at Peoria Street, the peak flow entering the newly constructed channel was estimated to be 1400 cfs, which compares to the projected 100-year event of 4,000cfs. The photo below shows the restored creek during the flood event. The success of the project is attributed to the "low-energy" design. This approach flattens the channel slope decreasing velocity (kinetic energy) and allows the flood to spread over larger areas, increasing flow area and decreasing velocity.

### Additional Information

Information about the Cherry Creek Basin Water Quality Authority can be obtained from our recently created website at [www.cherrycreekbasin.org](http://www.cherrycreekbasin.org)