

## CHERRY CREEK STREAM RECLAMATION AT PJCOS

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# Memorandum

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**To:** Chuck Reid, Manager, CCBWQA

**CC:** Rick Goncalves, Chairman, TAC

**From:** William P. Ruzzo, P.E.

**Date:** March 19, 2013

**Re:** Cherry Creek Stream Reclamation @ Parker Jordan Centennial Open Space – Project Report

Presented in this memorandum is a summary of the Cherry Creek Stream Reclamation at Parker Jordan Centennial Open Space (Project).

## BACKGROUND

In 2008, reclamation of Cherry Creek from the Bronco's Parkway trailhead to the pedestrian bridge (see Figure 1) was in preliminary design by J3 Engineering under contract with the Parker Jordan Metro District (PJMD). Project partners included SEMSWA, City of Centennial, and Arapahoe County Open Space. The Authority inspected the Project area and found the channel to be in a severe state of degradation (see Photo 1, next page). Observations included: extensive bed erosion (i.e.: "down cutting"); bank erosion resulting in steep slopes and material sloughing; lateral channel migration; damage from vehicle crossing the stream at several locations; and loss of wetlands and upland vegetation due to lowering of the water table by the bed erosion.

The Project was added to the Authority's capital improvement program (CIP) in 2008 and the Authority began monitoring the design in late 2009 through 2010. The Authority assessed the water quality benefits of the project and determined the Project meets Authority goals for stream reclamation. On March 8, 2010, the PJMD requested funding assistance from the Authority which led to a reimbursement agreement with the PJMD dated June 17, 2010 to provide \$56,000 for design purposes.

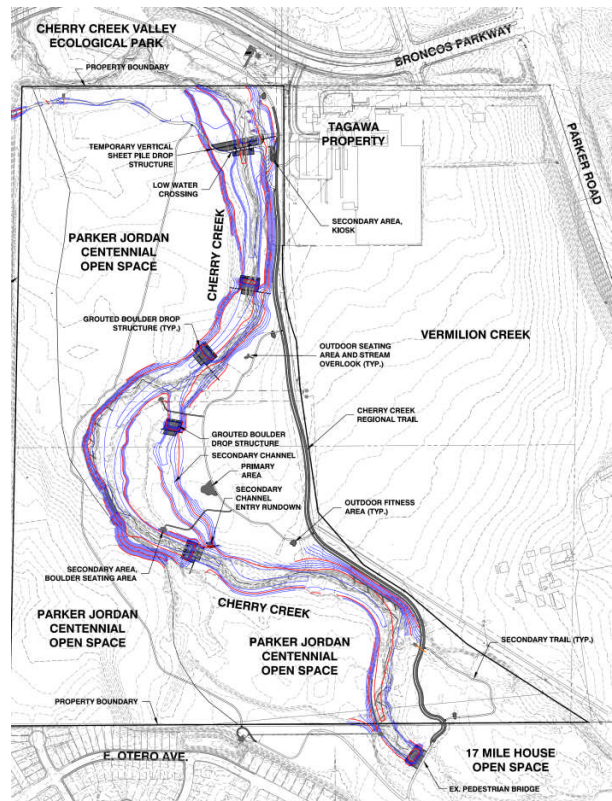


Figure 1 - Location Map

On February 8, 2011, the PJMD requested construction funding assistance from the Authority, which was formalized in a participation agreement with PJMD dated June 16, 2011 in the amount not to exceed \$586,871<sup>1</sup>. Construction began in September 2011 and was substantially complete by July 2012.

## DESIGN APPROACH

Because of the severity of the channel degradation, areas of extreme topographical constraints, and floodplain regulations limiting increases in flood elevations, the approach to the Project reach resulted in



**Photo 1 - Pre-Project**

a more formal approach to reclamation of Cherry Creek. For instance, essentially all of the existing channel bank and riparian vegetation had to be removed and replanted due to substantive changes in channel geometry necessary to accommodate topographic and floodplain limitations. The preferred design approach for reclamation is to retain and protect as much of the existing vegetation as possible, minimizing disturbances and improving the chances of re-vegetation success.

Drop structures necessary to flatten and control longitudinal grade are grouted boulder drop types with sheet pile cut-off walls to protect the structure from damages during larger flood events. The

preferred approach for reclamation conveys the mean flood event in a narrower channel that uses riffle-pool structures constructed entirely from rock and to allow rarer floods to spread out into a large floodplain, which lowers velocities, allowing more filtration and infiltration. Because each project is unique, more formal drop structures (i.e.: grouted boulder and sculpted concrete) are often used in reclamation projects where additional channel “anchoring” is deemed necessary by site constraints and greater risks of damages from the more rare flood events.

The Project was designed to raise the channel bed and reestablish the water table to prevent further down cutting, erosion, and subsequent sediment transport on Cherry Creek<sup>2</sup>. The goal of the channel improvement portion of the project was to restore



**Photo 2 - Post project drop structure**

and enhance the aquatic, wetland, and riparian functions and values of Cherry Creek, and to construct a wider and flatter floodplain by reshaping and raising the channel invert an average of 5 feet throughout the project area. This was accomplished by reshaping the main channel of Cherry Creek; constructing a secondary channel; laying back the upper channel banks; and installing five grouted-

<sup>1</sup> The Authority’s financial contribution to the Project was limited to components of the Project that provided water quality benefits. The total project cost that provided water quality benefits was found to be \$3,017,253.

<sup>2</sup> U.S. Army Corps of Engineers, September 14, 2011. *Department of the Army Permit No. NOW-2009-02909 Parker Jordan Open Space Cherry Creek Restoration Project.*

boulder drop structures, one vertical sheet pile drop structure with an integrated low-water pedestrian crossing, and seven types of bank protection. The proposed drop structures and bank protection measures include varying types of bioengineered and hard treatments.



Photo 3 - Post project with side channel

In addition to the improvements along the main channel, an overflow channel was constructed along the inside of a bend of Cherry Creek to reduce the stream pressure along the banks of the main channel during frequent flooding events (e.g., 2-year events) and reconnect the water table with portions of the floodplain. The overflow channel is about 1,200 feet long and constructed along the remnants of a historical channel on the east side of Cherry Creek. A sloping grouted-boulder drop structure was constructed at the downstream end of the overflow channel to transition the elevation to match the elevation of the main channel.

Seven different types of bioengineered bank protection were installed along the realigned/reshaped Cherry Creek channel throughout the project area. The protection types were designed to meet site-specific needs through the project reach. The protection types are unique for straight sections, inside and outside bends, bend-way weirs, and for the secondary channel.

## CONSTRUCTION ISSUE

During construction, localized dewatering (i.e.: groundwater pumping) was necessary in order to construct drop structures in dry conditions, which is a common practice in stream reclamation projects. The State Engineer's Office (SEO) rules for water well construction<sup>3</sup> includes construction dewatering wells and requires that a notice of intent (NOI) be filed with the SEO prior to dewatering activities, which the contractor had failed to do. The construction site was inspected by the SEO and it was determined that the dewatering practices resulted in consumptive use (i.e.: water loss through evaporation and transpiration or resulted in a time-lag before returning to the source). The contractor was required to file an NOI, modify the dewatering practices to prevent consumptive use, prepare and file a temporary substitute water supply plan (SWSP) and augment for the consumptive use.

The contractor also modified the construction BMPs to minimize water losses during conveyance and treatment activities to reduce sediment in the water, such as using pipes for transport, covered tanks for sediment removal from construction water, and eliminating land-application of construction water.

Whereas not all stream reclamation projects will result in consumptive use of ground or surface water, there is a greater likelihood that augmentation water will be needed for future stream reclamation projects. The Authority is currently investigating if the "Bowtie"<sup>4</sup> property water rights can be used to augment consumptive uses from construction activities, which also includes evaporative losses from practices that

<sup>3</sup> Office of the State Engineer January 1, 2005. *Rules and Regulations for Water Well Construction, Pump Installation, Cistern Installation, and Monitoring and Observation Hole/Well Construction.*

<sup>4</sup> The Bowtie property is located at the confluence of Cherry Creek and Piney Creek and is named after the shape of the property that was acquired by local governments as a stream corridor preservation activity. The Authority participated in the acquisition and received the water rights associated with a shallow and a deep, pre-senate bill 319 well.

reduce sediment discharges caused by construction activities. The investigation may also include using the water rights for temporary, supplemental watering of new vegetation.

### JUNE 6, 2012 FLOOD EVENT

Prior to the June 6, 2012 flood event, the majority of the construction effort had been completed but final inspection had yet to occur and final acceptance had not been granted. The improvements included low water crossing, drop structures, bendway weirs, bank stabilization measures, secondary channel construction and stabilization, erosion control protection, vegetation installation, and the majority of final stabilization of the disturbed construction area. Due to the size and magnitude of the Project, it was built in multiple phases. As a result, the project had a varying range of stabilization and vegetation establishment



Photo 4 Post project flood June 6, 2012

at the time of the flood. Phase 1 had the most advanced stage of re-vegetation in the low flow terrace due to its completion occurring at the beginning of March. Phase 3 vegetation was installed only 2-3 weeks prior to the event; therefore, seedling germination and establishment was minimal.

The impact of the flood event on the Project was analyzed<sup>5</sup>, concluding that:

*... stream reclamation project of Cherry Creek within PJCOS experienced an estimated 2-year storm event<sup>6</sup> on the evening of June 6<sup>th</sup> through the morning of June 7<sup>th</sup>. This storm occurred at a time when the project was vulnerable since vegetation was not fully established or in some cases minimal growth of vegetation occurred and portions of the project were not completed (i.e. erosion control blanket staked, vegetation installed). Although this storm even caused damages to the project, the integrity of the channel improvements functioned as intended in the design. Minor damages occurred to isolated areas of the structural components (drop structures, bendway weirs, grouted boulder edge walls). Minor to moderate damage occurred in vegetated areas and the general observation was that areas planted from February to mid-April functioned much better than portions more recently seeded and blanketed.*

Most stream reclamation projects are designed to minimize, not eliminate, flood damages during events up to and including the 1% chance (i.e.: 100-year event) and therefore some damages are expected. The projects are most vulnerable, however, during the period before adequate vegetation becomes established to protect the channel from erosion. The design includes measures, such as biologs, riprap, and blanket, to temporarily protect the more critical sections of the channel, such as the toe of slope and the main channel bank.

<sup>5</sup> J3 Engineering Consultants and The Restoration Group, Inc. June 20, 2012. *Documentation of the June 6<sup>th</sup> and 7<sup>th</sup> Flood Event on Cherry Creek through the Cherry Creek Low Water Crossing South of Arapahoe Road.*

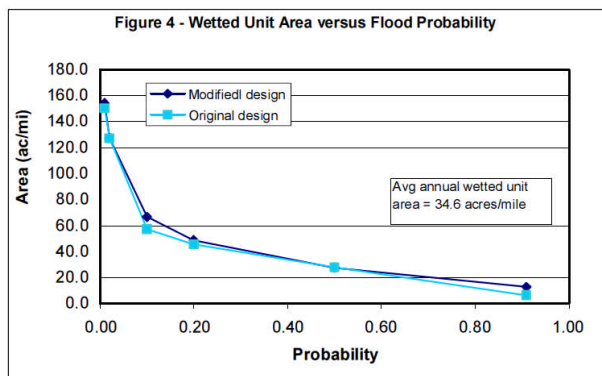
<sup>6</sup> The estimated flood peak discharge was 1,700-cfs at the Project.

The PJCOS project was tested by a flood event at its most critical time and yet received relatively minimal damages, which the Authority believes is evidence that the approach to stream reclamation is technically sound.

### WATER QUALITY BENEFITS

An assessment of the water quality benefits for the entire Project was made by the Authority<sup>7</sup>. The Project was found to lower stream velocities, channel shear, and stream power from values prior to reclamation, all of which minimize the transport of sediment and associated pollutants. It was also determined that the channel was in an extremely unstable state that resulted in erosion rates that were over 140-times rates that were considered “typical” for Cherry Creek.

Stream stabilization benefits and evaluation procedures have been documented in the Authority’s Stream Reclamation Interim Report<sup>8</sup>. Benefits include reductions in sediment and other pollutant loads and concentrations, including phosphorus and nitrogen. These benefits are supported by Authority data, literature research, and quantitative analysis.



<sup>7</sup> William P. Ruzzo, PE, LLC December 27, 2010. *Cherry Creek Stream Reclamation at PJCOS Modified Design*

<sup>8</sup> CCBWQA Technical Advisory Committee, June 16, 2011. *Stream Reclamation, Water Quality Benefit Evaluation – Interim Report.*