

COTTONWOOD CREEK STREAM RECLAMATION AT EASTER AVENUE

Memorandum

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To: Chuck Reid, Manager, CCBWQA
CC: Rick Goncalves, Chairman, TAC
From: William P. Ruzzo, P.E.
Date: December 27, 2013
Re: Cottonwood Creek at Easter Avenue – Project Summary Report

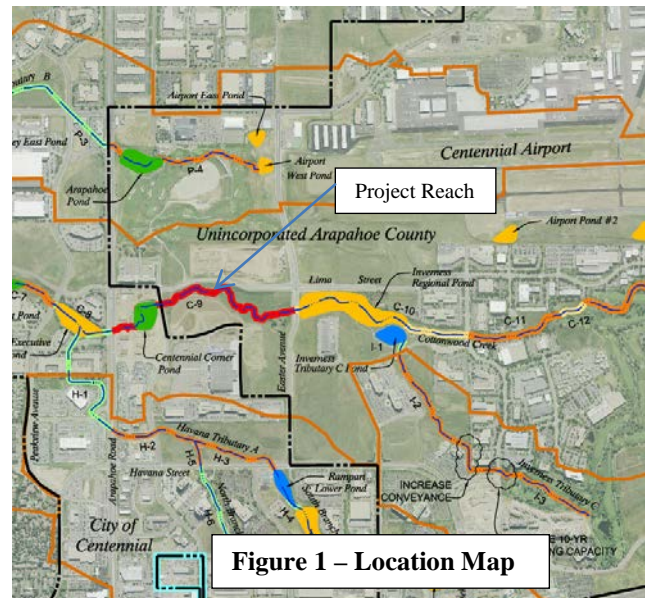
Presented in this memorandum is a summary of the Cottonwood Creek Stream Reclamation between Easter Avenue and Briarwood Avenue (Cottonwood @ Easter Avenue, Project, see Figure 1 Location Map).

BACKGROUND AND PURPOSE

The Cottonwood @ East Avenue project is part of a watershed master plan¹ prepared under the guidance of the Urban Drainage & Flood Control District for SEMSWA and Douglas County. The Project is approximately 0.42-miles long following the creek thalweg and the drainage area is 5.47-square miles at Briarwood Avenue. SEMSWA began design for the reclamation of the Project reach in 2006 at which time detailed topographic information was obtained. Construction of the project was delayed until 2010 during which time additional erosion in the reach has occurred.

The Cottonwood\Easter Project was reviewed by the TAC in May 2007 at the request of the U.S. Army Corp of Engineers because of a 404 permit application by SEMSWA. Because SEMSWA's design approach to stream stabilization was consistent with the Authority's water quality goals and objectives, the Cottonwood Project was included in the Authority's 2008 Master PRF list by the TAC.

The Master PRF List shows the 2600 foot long project to contribute 50-lbs/year of phosphorus to Cherry Creek Reservoir based on typical erosion rates of silty clayey channels. Capital costs were



¹ Muller Engineering Company August 2010. *Cottonwood Creek (Downstream of Lincoln Avenue) Outfall Systems Plan Conceptual Design Report.*

estimated to be \$1,350,000 with an annualized cost of \$105,000 including maintenance. Assuming 90% efficiency, the Cottonwood @ Easter Avenue Project would immobilize 45-lbs per year of phosphorus at an annual cost of \$2,332 per pound. There are over 30 projects on the Master CIP list with annual cost per pound estimates ranging from as little as \$300 to over \$3,000, a tenfold variation. The average value is approximately \$1,200 and the median value is approximately \$400.

PROJECT PARTNERS AND FUNDING

The Authority partnered with SEMSWA through a Memorandum of Understanding (MOU) in 2010 to provide \$338,000 for the construction of the Cottonwood @ Easter Avenue project. The MOU was one of the first intergovernmental agreements between the Authority and local governments for the construction of pollutant reduction facilities (PRFs) such as stream reclamation.

WATER QUALITY BENEFITS

The Authority supports the reclamation of streams in the watershed because reclamation provides water quality benefits by reducing erosion and immobilizing pollutants in the channel by filtering them through riparian vegetation. These benefits have been demonstrated by PRF monitoring, literature reviews, and the TAC's investigations¹. Because of rapid urbanization in Cottonwood Creek watershed, channel degradation



had resulted in significant erosion far beyond assumed average or typical conditions for other streams (see Figure 2), rendering the 2006 topographic survey out of date.

To determine how much the erosion would impact earth quantities that might require design changes, SEMSWA commissioned an additional topographic survey in 2010 and prepared comparative cross sections. The Authority then analyzed the changes in the stream channel geometry using the two topographic surveys for the project. The Authority evaluated the 31 cross sections to estimate the amount of erosion that had occurred during the four year period. Each section was reviewed to determine the change in cross section area related to stream

flow erosion. The eroded area was estimated using the following criteria:

1. Change in cross section area was limited to the main channel area, a lateral distance around 80-feet.
2. Where it appeared that bank material sloughed into the channel bed but had not been eroded, the sloughed area of the bank was not included in the erode area calculation since the material is still in the channel bottom.
3. Some cross sections showed that the 2010 topography was higher than 2006 topography, which may be interpreted as deposition or perhaps channel shifting. No erosion was assumed for these sections.

Table 1 below summarizes the calculations performed to estimate the amount of erosion that had occurred over the period from start of design to start of construction.

Table 1 – Channel Erosion Estimate

Total Erosion	2623 cubic yards
Project Length	0.42-miles (thalweg)
Erosion Duration	4-years
Erosion Rate	1574 cy/mi/yr
Sediment Density	90 pcf
Erosion Rate	1912 Tons/mi/yr

When compared to other channel erosion rates, the Cottonwood @ Easter Avenue results show that the erosion rate for the four year period was extremely high when, as shown in Table 2. Ward Branch and Stroubles Creek are results from areas outside of Colorado that were found in the literature.

The four-year rate for the Cottonwood @ Easter Avenue project is about 10 times what was estimated for Cottonwood Creek within Cherry Creek State Park – which occurred over a period of 50 or more years - and about 19-times the rate the Authority currently uses to approximate sediment loads from an unstable stream system (i.e.: 100 tons/mi/yr). It is likely, however, that Briarwood to Easter Avenue reach would not continue at this rate for an extended period of time.

Table 2 – Comparison of Stream Erosion Rates (tons/mile/year)

Cottonwood Creek		Ward Branch	Stroubles Creek
Cherry Creek State Park	Easter to Briarwood		
182	1912	610	164

The Authority also obtained sediment samples and had them tested for total phosphorus content. Total phosphorus concentrations ranged from 431 to 910 mg/kg with an average of 573-mg/kg. This translates to average total phosphorus in the samples of 1.0-lbs P per ton of sediment, which is consistent with the Authority’s estimated value for calculating water quality benefits.

Conclusions

The analysis and comparison suggests that when bank sloughing (or wasting) occurs, the sediment loads increase dramatically over normal stream bank and bed erosion rates. The significant increase in sediment loads – and associated pollutants - further demonstrates the importance of stabilizing and reclaiming stream systems well before the condition worsens such as the Easter to Briarwood reach.

Reclamation of the reach of Cottonwood Creek between Easter Avenue and Briarwood will reduce channel bed/bank erosion and pollutant loads to Cherry Creek Reservoir.

