CREATIVE STRATEGIES FOR IMPLEMENTING PROJECTS TO MANAGE NON-POINT SOURCE POLLUTION: A CASE STUDY FROM THE MCDANIEL FARM PARK STREAM RESTORATION PROJECT

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Abstract. The Sweetwater Creek watershed is located in central Gwinnett County within the Ocmulgee River basin. The study area encompasses 26 square miles. A total of 153 projects were identified in the watershed. Project prioritization included a review of data from the Sweetwater Creek Watershed Improvement Plan (WIP) to develop a short list of BMP and stream projects for implementation. The McDaniel Farm Park stream restoration project was the first watershed implementation project in Gwinnett County.

The McDaniel Farm Park project involves the restoration of a deeply incised stream channel and of stream buffers along two tributaries, as well as along Sweetwater Creek.

The project includes the use of natural channel design and soil bioengineering to stabilize the eroding banks and restore the meander in the floodplain. The final design plans were based on fluvial geomorphic techniques and measurements.

INTRODUCTION

In June 2000, the Gwinnett County Department of Water Resources (DWR) completed a Watershed Protection Plan (WPP) as part of Georgia Environmental Protection Division (EPD) requirements for new or expanded wastewater National Pollutant Discharge Elimination System (NPDES) permits. The WPP outlined steps to improve and protect the water quality of rivers and streams located within the County in order to maintain streams at, or return them to, their specified designated use. The WPP identified the primary stressors associated with stream degradation and provided the following strategies to address them:

- Mitigate the changes in runoff volume and timing caused by developed areas.
- Protect stream riparian areas and buffers to improve aquatic habitat and reduce stream temperatures.
- Reduce the amount of pollutants released to streams via stormwater runoff.

Gwinnett County has begun addressing the affected areas by developing Watershed Improvement Plans (WIPs) using a phased watershed approach:

- Phase I - Prioritization of the recommended projects in the WIP
- Phase II – Project implementation

WIPs have been developed for Crooked Creek, Jackson and Beaver Ruin Creeks, Sweetwater Creek, Upper Yellow River watersheds, the Chattahoochee River tributaries, and the Lower Yellow River watershed. The focus of the WIP is to identify projects for a Capital Improvement Plan (CIP) that addresses affected areas by reducing the total suspended solids (TSS) load and by improving aquatic habitat.

The implementation phase involves the design and construction of projects recommended in the WIP. This paper examines the challenges associated with project implementation and presents a creative way of using stream restoration to help meet the goals of the WIP and provide funding for future design and construction of the projects.

MCDANIEL FARM PARK STREAM RESTORATION DESIGN

As a result of the Phase I study, the McDaniel Farm Park stream restoration project was the first project chosen for implementation for a number of reasons. The main strengths of this project is that it (1) was identified in the WIP as providing reduction in TSS, (2) is located on County-owned land within an existing park and thus could be completed without costly and time-consuming acquisition measures, and (3) provides opportunities for public awareness and education.

The McDaniel Farm Park project is located in the 26–square-mile Sweetwater Creek watershed, which is centrally located in Gwinnett County and is in the Ocmulgee River basin. The project involves the restoration of a deeply incised stream channel (South Tributary) and improvement of stream buffers along the South Tributary, (referred to as Site 1 area); and improvements to the ripar-

ian zone of Sweetwater Creek and another tributary (North Tributary). The North Tributary and Sweetwater Creek are referred to as Site 2. Figure 1 shows the location of the two sites.

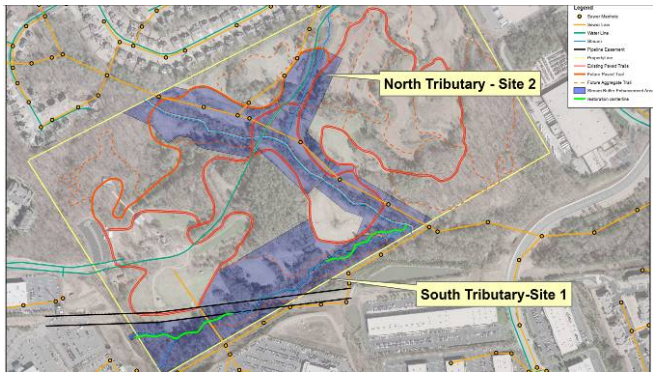

Figure 1. Project Location and Stream Layout

Site 1 – South Tributary of Sweetwater Creek

The tributary in Site 1 originates in the headwaters of Sweetwater Creek and flows in a northeasterly direction to its confluence with Sweetwater Creek (Figure 1). Much of the watershed in the headwaters is developed impervious (e.g., large parking lots and buildings). The maintained right-of-way (ROW) for a gas pipeline parallels the tributary on the left (facing downstream) for the first 1,000 feet, and then parallels the channel on the right for several hundred feet.

The hydrology in the upstream portion of the tributary is controlled by three stormwater detention basins (i.e., BMPs). Two BMPs discharge into the channel headwaters: one directly into the channel through a culvert and the other across the pipeline ROW. The section of tributary at the BMP discharge pipe has been filled with large boulders, presumably to minimize bed and bank erosion at the end of the pipe. However, the channel in this area is actively eroding, and the damage is severe. The tributary is deeply incised and narrow (4 to 5 feet deep and 2 to 3 feet wide) for 460 feet.

For the next 1,000 to 1,200 feet, the tributary is relatively stable, although there are several places where stream bank erosion is occurring, limiting the overall biotic potential of this site. The third stormwater BMP discharge enters the tributary about 1,300 feet downstream. A 140-foot long open channel, lined with concrete and riprap, connects the outfall structure to the tributary. Riprap was also placed in the tributary to minimize erosion. The last 800 feet of the channel is narrow and deeply incised with bank heights ranging from 4 to 10 feet deep and widths of 5 to 8 feet. The stream banks are eroded and some mass wasting of bank material was observed. Headcuts have formed in this reach and down-cutting is progressing upstream from its confluence with Sweetwater Creek. Figure 2 shows an example of the incised creek.

Figure 2. Typical Example of Severely Eroded Bank Conditions

Site 2 - North Tributary of Sweetwater Creek and Sweetwater Creek

Site 2 encompasses land improvements surrounding two stream channels: Sweetwater Creek and an unnamed tributary crossing the park (Figure 2). The main-stem of Sweetwater Creek bisects the McDaniel Farm Park site flowing from northeast to southwest. The topography along Sweetwater Creek is generally flat floodplain of varying widths ranging from about 50 to 300 feet. Most of the level floodplain was cleared at some point and is now planted in pasture and Bermuda grass. A narrow band (10 to 20 feet wide) of trees and shrubs borders most of the channel, the dominant shrub species consist of invasive Chinese privet (*Ligustrum sinense*), which will be managed as part of the restoration.

The North Tributary, which originates in a recently developed residential area, flows in a southerly direction for about 1,000 feet across the site. Like Sweetwater Creek, the topography along the North Tributary is generally flat on both sides of the channel forming a 100- to 150-foot wide floodplain. The vegetation along the channel is an early succession growth phase dominated by shrubs, vines, and young trees. However, most of the vegetation consists of exotic species such as Chinese privet, Japanese honeysuckle (*Lonicera japonica*), and silktree (*Albizia julibrissin*). The removal of the native woody vegetation leaves the stream bank vulnerable to erosion.

GEOMORPHIC AND HABITAT CONDITIONS

The conditions at the proposed restoration site were documented during a field visit on May 5, 2005 using the following methods:

- Habitat Assessment (EPD, 2004)
- Bank Erosion Hazard Index (BEHI) (Rosgen, 2001)
- Near Bank Stress (NBS) (Rosgen, 2001)
- Channel Evolution Model (CEM) (Schumm et al., 1984)

The results of the habitat assessment and Rosgen channel classification are summarized in Table 1. The habitat scores and channel classifications listed in the table correspond to the reach lengths as designated by the station numbers. The habitat conditions in the first 400 feet (score of 84 units) and last 800 feet (score of 67 units) of the channel were substantially degraded. More than 60 percent of the potential habitat has been lost, primarily due to altered hydrology and increased bed and bank erosion. In the upstream and downstream reaches, the bottom profile is generally flat and remnant pools are filled in with sand. Bottom sediments are unstable, consisting of unconsolidated gravel, sand, and silt. Between Stations 4+00 and 14+00, the geomorphic conditions of the tributary are relatively stable and habitat potential is improved. Habitat scores in this section range from 130 to 145; however, portions of the riparian zone between Stations 4+00 and 14+00 are disturbed, reducing the overall habitat score.

Table 1 Habitat Scores and Condition Category in McDaniel Farm Park South Tributary

Station [b]	Habitat Score [a]	Condition Category	Rosgen Classification
00+00 to 4+10	84	Marginal	"G" Channel with remnant "B" and "E" channel characteristics.
4+10 to 6+00	130	sub optimal	"E" channel characteristics.
6+00 to 14+00	145	sub optimal	"B" channel characteristics.
14+00 to 22+00	67	Marginal	"G" Channel with remnant "B" and "E" channel characteristics.

a Habitat scores represent the condition of the channel in the reach between station numbers.
b Station numbers represent the linear distance from the property line at the upstream end of the site.

The BEHI, NBS, and CEM were evaluated at the locations listed in Table 2. Data for these parameters were collected in unstable reaches and at points where active erosion was occurring. The BEHI and NBS condition category ratings ranged from "high" to "extreme," indicating a high potential for erosion and bank failure (Table 2). Station 4+10 represents a short segment of channel, which is actively degrading (poor BEHI and NBS ratings) in a relatively stable reach, as indicated by the CEM values of 1 or 5.

Table 2 BEHI, and NBS, Scores and Condition Category at Stations in McDaniel Farm Park South Tributary

Station	BEHI Score	BEHI Condition Category	NBS Score	NBS Condition Category
0+42	46.95	Extreme	3.33	Extreme
4+10	46.85	Extreme	1.28	High
20+40	50.85	Extreme	2.08	High
21+00	31.15	High	2.96	Very High

STREAM RESTORATION

The restoration of the Sweetwater Creek tributary involved the use of natural channel design and soil bioengineering to stabilize the eroding banks. The restoration plan addressed site constraints, including topography and nearby developed areas such as the walkways, ROWs, roads, and the Gwinnett Place Mall.

The natural channel design included Rosgen Priority 1 and 2 restoration techniques in the incised channels. The design utilized channel geometry measurements of the existing channel and a reference reach, along with an evaluation of Piedmont regional curves to ensure the channel form is compatible with the site-specific hydrology. The existing channels will be realigned and reconfigured to introduce a meander pattern, slope, and cross-section with a bankfull bench to dissipate flow energy of storm events.

Figure 2 shows a conceptual layout for 460 feet of the upstream headwater section. In the headwaters, the conceptual plan included restoration of the degraded and eroding "G" channel, forming a stable "B" system. This involves reshaping the steep vertical walls of the "G" channel to a flatter slope that is moderately entrenched but stable. In this reach, the stream channel will be stabilized using six cross vanes and four J-hooks. The channel cross section will be reshaped, conforming to a "B" channel reference condition, thus alleviating the incised and eroding condition of the existing channel. The reshaped banks will be reinforced using soil bioengineering techniques and planted with native species. In addition, the natural meander will be restored and will connect the channel with an enhanced riparian zone area downstream.

Other degraded portions of the channel immediately downstream will be restored using various stabilization techniques, including soil bioengineering, planting native vegetation, installing rock vanes, and stabilizing a severe head-cut with a step-pool structure.

The plan to restore the deeply incised "G" channel in the last 800 feet of the tributary includes restoring the hydrology and meander through the floodplain In the first 300 feet, stream banks will be stabilized using 9 J-hooks. The channel cross section will be reshaped, conforming to a "C" channel reference condition. The reshaped banks will be reinforced using soil bioengineering techniques and planted with native species. In the last 500 feet, stream banks will be stabilized using 8 cross vanes. The channel cross section will be reshaped, conforming to an "E" channel reference condition and will include meander. In this reach, the invert of the channel will be elevated across the floodplain, restoring the natural hydrology of the area. The reshaped channel banks will be reinforced using soil bioengineering techniques and planted with native species. The final elevation of the channel, with shallow depth and a relatively smooth bed, will connect to Sweetwater Creek through a step-pool system.

RIPARIAN ZONE AND UPLAND BUFFER IMPROVEMENTS

The project includes 28 acres of vegetation enhancements in upland buffers and in the riparian zones along the creeks to improve diversity. Approximately 13 acres will be restored (extensively replanted) and 15 acres will be improved (supplemental planting).

An extensive planting program is planned for the mitigation areas, as shown in Figure 3. The mitigation areas are divided into 8 zones depending on the hydrology, slope, and on-site conditions. Native species that are endemic to the local area will be used. Approximately 1,300 pounds of native grass seed, 3,200 live stakes, 1,260 shrub and tree seedlings, 4,866 containerized shrubs, and 1,128 balled and burlapped trees will be used to replant the site.

Selected open pasture area will be restored by planting with native trees, shrubs, and grasses. Areas currently covered with trees and shrubs will be improved through supplemental planting with native tree and shrub species to increase the diversity and habitat value of the area. Additionally, management of invasive species will be initiated in the riparian and floodplain habitats. Re-planting with native species will coincide with removal of exotic species.

Elements of the proposed riparian zone improvements along the South Tributary, North Tributary, and Sweetwater Creek include the following:

- Thinning existing overstocked riparian sapling stands adjacent to the North Tributary
- Managing exotic species
- Planting with native plant species on floodplains and riparian areas

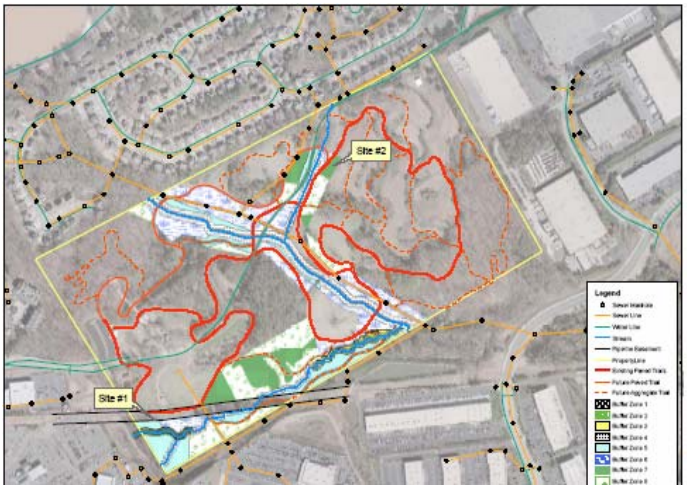

Figure 3
Vegetation Plan

SUMMARY

The restoration plan proposed for the McDaniel Farm Park tributary is summarized as follows:

- Approximately 1,260 feet of Rosgen Priority 1 and 2 stream restoration
- Spot repairs in about 165 feet of channel
- Sites 1 and 2 riparian zone enhancement (e.g., exotic species control, replanting with native species) along 4,714 feet of channel
- Erosion control at BMPs

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