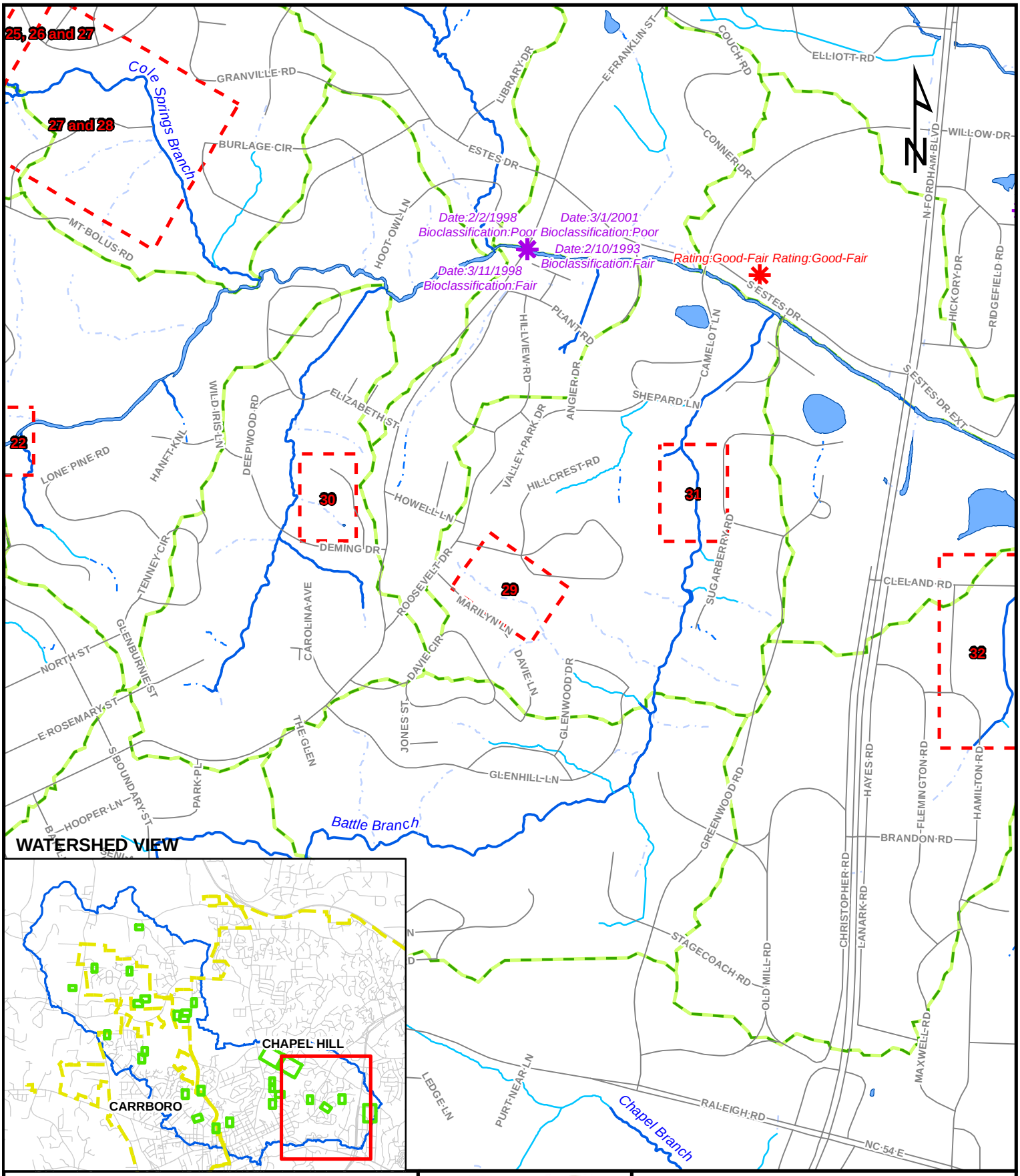
SITE 29

Stabilization of Headcuts on Steep Hillside Using Bioretention Cells

Index Sheet No.: 30
Raw Data Name: IJ 64

Estimated Construction Cost: $128,600



Legend

- Ambient Monitoring
- Benthic Monitoring
- Fish Sampling
- Municipal Boundary
- Orange County Roads
- Subwatersheds
- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Stream, unknown flow

EarthTech
A tyco International Ltd. Company

SITE 29
VICINITY MAP

Geomorphic Analysis and Identification of Potential Sites for Stormwater BMPs
Orange County, North Carolina

0 500 1,000 2,000 Feet

1 inch equals 1,000 feet

Project Description

	Drainage Area (acres)	Impervious Area (acres)	% Impervious
Site 29	14.0	2.5	17.6%

Location

Site 29 is located east of the intersections of Roosevelt Drive, Hillcrest Rd and Maryilyn Ln, just to the east of downtown Chapel Hill. Access to the site can be gained by parking on Weaver Rd, which is southwest of the site, and walking northwest along an unpaved utility service road that parallels the stream.

Problem Description

Site 29 consists of a stream located on a steep hillside, on which the erosive velocities of peak stormflow have created at least three headcuts. The slope of the hillside, at approximately 10 %, along with the runoff produced by the 18% impervious surface of the contributing drainage area, has created high velocity flows that are eroding portions of the hillside. Given enough time, the headcuts will continue to erode uphill, releasing massive amounts of sediment and causing the stream to become a steep gulley. In addition to sediment, the relatively high imperviousness of the urbanized drainage area is contributing pollutants to the watershed, which should be treated before flowing into nearby Battle Branch, which is a major tributary to Bolin Creek.

Using the BANCS model, it is estimated that approximately 566 tons of sediment are being exported from the site each year. Concomitant nutrient export associated with the sediment has also been calculated and is listed in **Table 29.1**.

Table 29.1

Pre-Treatment	
Estimated Total Sediment Export	566.6 tons/year
Erosion per length of Channel	1.3 tons/yr/ft
Pounds of Nitrogen	1133.1 lbs/year
Pounds of Phosphorus	566.6 lbs/year
Post-Treatment	
Estimated Total Sediment Export	4.5 tons/year
Erosion per length of Channel	0.032 tons/yr/ft
Pounds of Nitrogen	9.1 lbs/year
Pounds of Phosphorus	4.5 lbs/year

Proposed Solution

Site 29 poses a difficult situation for traditional stormwater BMP treatment because of the lack of available space due to the steep slope and narrow valley of the stream. A solution for treatment at this site is to construct a "bio-grade step", which is a series of small bio-retention cells, each cell lower in elevation than the previous cell, filled with a filter media, such as a mixture of sand, fines and organic mater (see Appendix A-Details). Ideally, this media will have a filtration rate of 1.0 to 2.0 inches per hour, to optimize pollution removal (Schueler, et. al., 2007). Each cell is connected to the other through this same media, thus allowing stormwater to filter through each cell without the expense of an underdrain. Overflow of each cell would be provided by a "lip" constructed at the downstream end of each cell.

This treatment option will provide a linear, grade-control solution to reduce erosive velocities of the stream, thereby reducing sediment export, while also treating stormwater runoff for pollutants. The depth of each cell can vary depending on choice of planting materials. Trees, with a deeper rooting structure, will require deeper soils, while herbaceous plants and shrubs can have soils as shallow as 1.5 feet (Schuler et. al, 2007).

Below the proposed area of the bio-grade step, the slope of the hill flattens, and the stream flows diffusely through a sewer easement lined with rip-rap. This location affords a good opportunity for construction of a stormwater wetland, as a final means of pollutant removal and attenuation of peak flows before the stream concentrates once again into an incised channel downstream of the site.

Potential pollution removal rates using this treatment method have been estimated and are shown in **Table 29.2**.

Table 29.2

SITE 29	Pollutant Load (lbs)		
	TN	TP	TSS
EXISTING CONDITION	141.53	14.29	1923.76
BIORETENTION TREATMENT REMOVAL %	35.00%	45.00%	85.00%
STORM WATER WETLAND TREATMENT REMOVAL %	37.00%	35.00%	85.00%
NET REDUCTION	34.04	2.75	245.28
FUTURE CONDITION	107.49	11.54	1678.48

Constraints

Based on available GIS data, Site 29 appears to be located in a right of way owned by the Orange Water and Sewer Authority (OWASA), therefore land acquisition and access should not be a constraint to this project.

Alternatives

There are no alternatives proposed for this site.

Cost-Estimate Breakdown

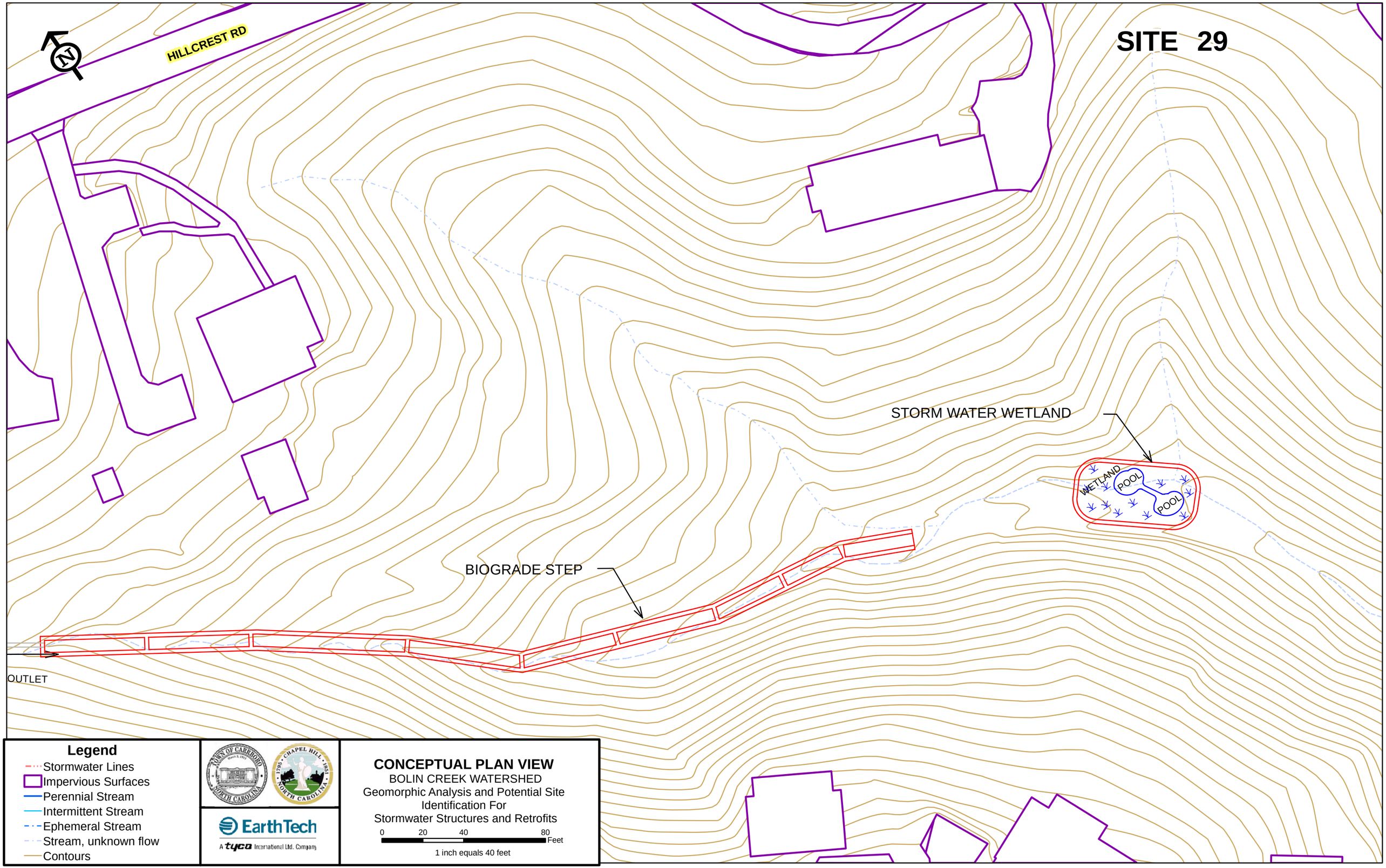
Table 29.3 shows a conceptual itemized cost estimate for Site 29. These costs represent construction and maintenance costs only. The cost for stormwater wetlands is derived from an equation developed by Brown and Schueler (1997). The cost for the bio-grade step is derived from a cost per cubic foot treated for bioretention areas as reported by Schueler, et. al. (2007).

Table 29.3
SITE 29 Construction Cost

Pay Item Description	Estimated Quantity	Unit	Unit Bid Price	Bid Amount
Biograde Step	7869.0	CF	12.62	$99,307
Stormwater Wetland	5642.0	CF	Equation Derived	$12,547
			Total	$111,854

Mobilization (5%)	1.00	LS	$5,593
Contingencies (10%)	1.00	LS	$11,185
	Total +	Mobilization and Contingencies	**$128,632**
Maintenance Costs			
Maintenance (5% of base construction cost of BMP)	1.0	Year	**$6,432**

This page intentionally left blank.



Legend

- Stormwater Lines
- Impervious Surfaces
- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Stream, unknown flow
- Contours

EarthTech
A tyco International Ltd. Company

CONCEPTUAL PLAN VIEW
BOLIN CREEK WATERSHED
Geomorphic Analysis and Potential Site Identification For
Stormwater Structures and Retrofits

0 20 40 80 Feet

1 inch equals 40 feet

Legend

- Stormwater Lines
- Perennial Stream
- Intermittent Stream
- Ephemeral Stream
- Stream, unknown flow

EarthTech
A tyco International Ltd. Company

AERIAL PHOTO VIEW

BOLIN CREEK WATERSHED
Geomorphic Analysis and Potential Site Identification For
Stormwater Structures and Retrofits

0 20 40 80 Feet

1 inch equals 40 feet