

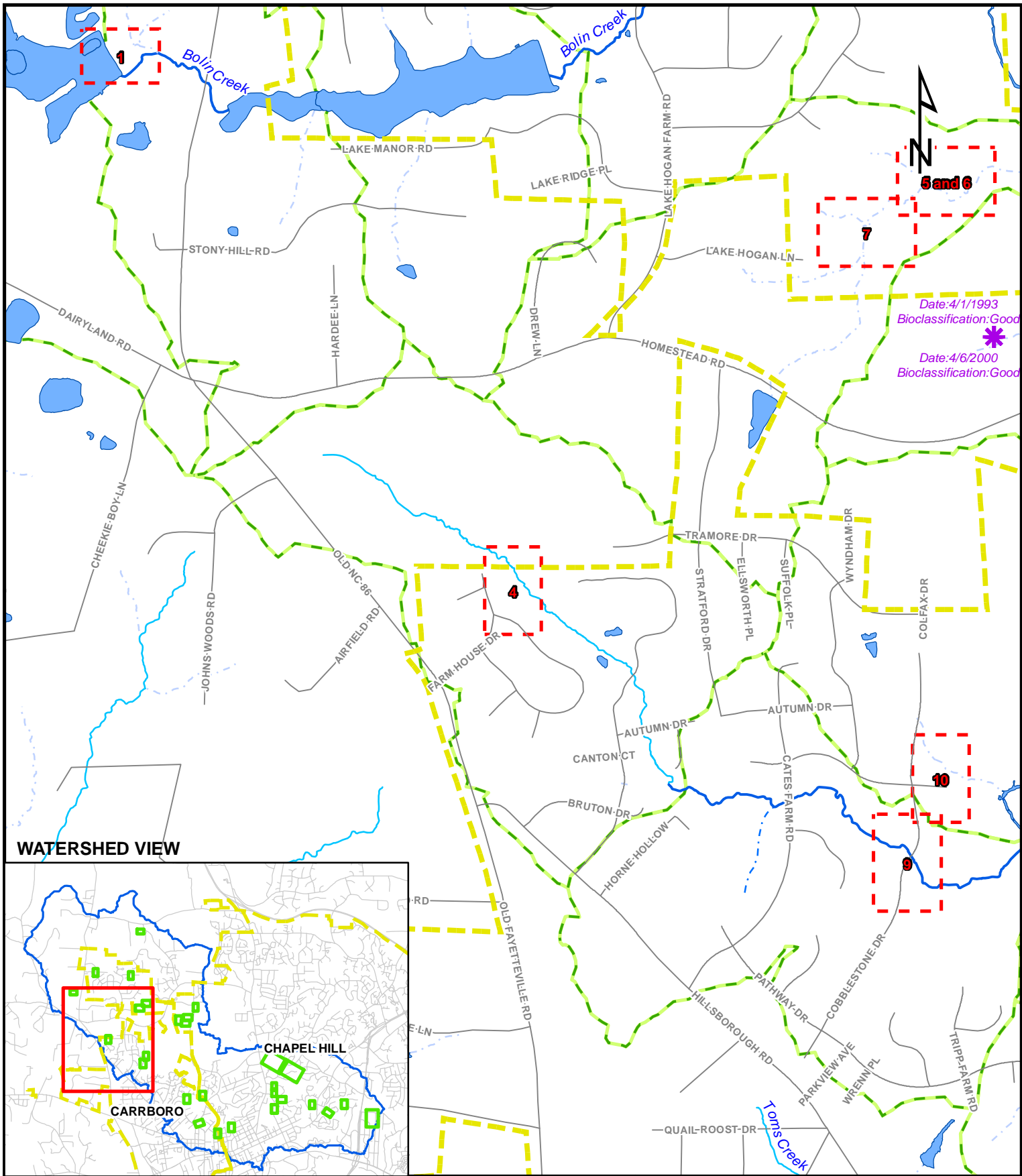
**SITE 4**

**Retrofit of Stormwater Outfall at Subdivision**

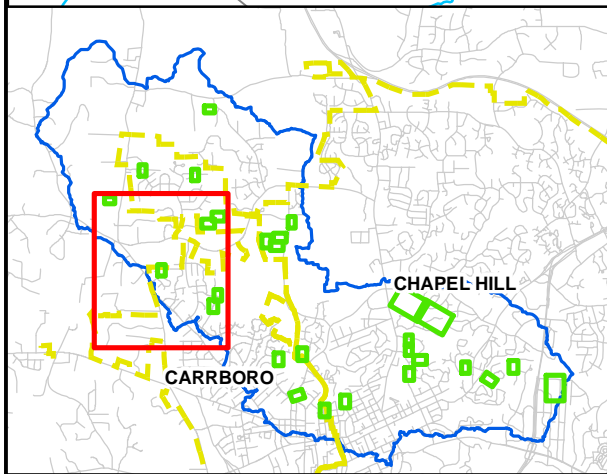
Index Sheet No.: 9  
Raw Data Name: TA 3



Estimated Construction Cost: \$73,500



**WATERSHED VIEW**



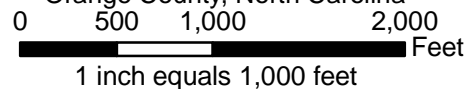
**Legend**

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



**SITE 4  
VICINITY MAP**

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



### **Project Description**

	Drainage Area (acres)	Impervious Area (acres)	% Impervious
Site 4	11.8	2.6	22.2%

### **Location**

Site 4 is located approximately 200 feet to the northeast of the intersection of Sunset Creek Circle and Farmhouse Dr., in a subdivision located southeast of the intersection of Old NC 86 and Homestead Rd.

### **Problem Description**

Site 4 consists of an existing stormwater outfall structure located downhill from a subdivision, and uphill of a ditch leading into a stream. The structure is a square concrete box with two walls, which appears to collect stormwater and turn the flow 90 degrees into a ditch. Uphill of the structure is a stormwater pipe outlet and a steeply sloped, base ditch filled with rip-rap and lined with plastic sheeting leading into the structure. The drainage pipe appears to discharge the stormwater collected in the curb and gutter system of the subdivision. The ditch into which the structure turns flow is approximately 170 feet long, and leads into an incised stream channel. Bank erosion is evident where the ditch meets the stream, indicating that the velocity of the flow discharging into the stream is not sufficiently dissipated (see Appendix B-Photos).

There is no evidence that there is any water quality treatment being provided by the stormwater system at Site 4.

### **Proposed Solution**

The existing conditions of Site 4 provide a challenge for implementing a “traditional” BMP. The ditch into which the concrete structure turns flow is narrow and deep, due to an earthen berm that was constructed parallel to the contour of the very steep hillside. Fitting a typical bio-retention area with sufficient volume to treat pollutants into this confined space would be impractical. Instead, a possible solution is to construct a “bio-grade step” within the narrow area of the existing ditch, and keep the existing structure, as it does effectively turn the flow from its path straight off the side of the slope. The “bio-grade step” consists of a series of small bio-retention cells filled with a filter media, such as a mixture of sand, fines and organic mater (see Appendix A-Details). Ideally, this media will have an infiltration rate of 1.0 to 2.0 inches per hour, to optimize pollution removal (Schueler, et. al., 2007). Each cell is connected to the next cell down-slope by a pervious drain layer of sand or other media, thus allowing stormwater to filter through each cell without the expense of an under-drain. Each cell is designed to overflow to the next after reaching the desired backwater elevation.

*Bolin Creek Watershed  
Geomorphic Analysis and Potential Site Identification for Stormwater BMPs and Retrofits*

The surface areas of the “bio-grade step” should be planted with a mixture of woody and herbaceous native plants. The vegetation will provide filtration and stability.

Potential pollution removal rates using this method have been estimated and are shown in **Table 4.1**.

**Table 4.1**

SITE 4	Pollutant Load (lbs)		
	TN	TP	TSS
EXISTING CONDITION	4.20	0.37	73.80
BIORETENTION TREATMENT REMOVAL %	35.00%	45.00%	85.00%
NET REDUCTION	1.47	0.17	62.73
FUTURE CONDITION	2.73	0.21	11.07

**Constraints**

Construction access to the site could be limited by the narrow ditch and the very steep hillside. The removal of some trees to work around this ditch may be required. In addition, periodic maintenance of the bio-grade step will be required

**Alternatives**

No alternatives are proposed for this site.

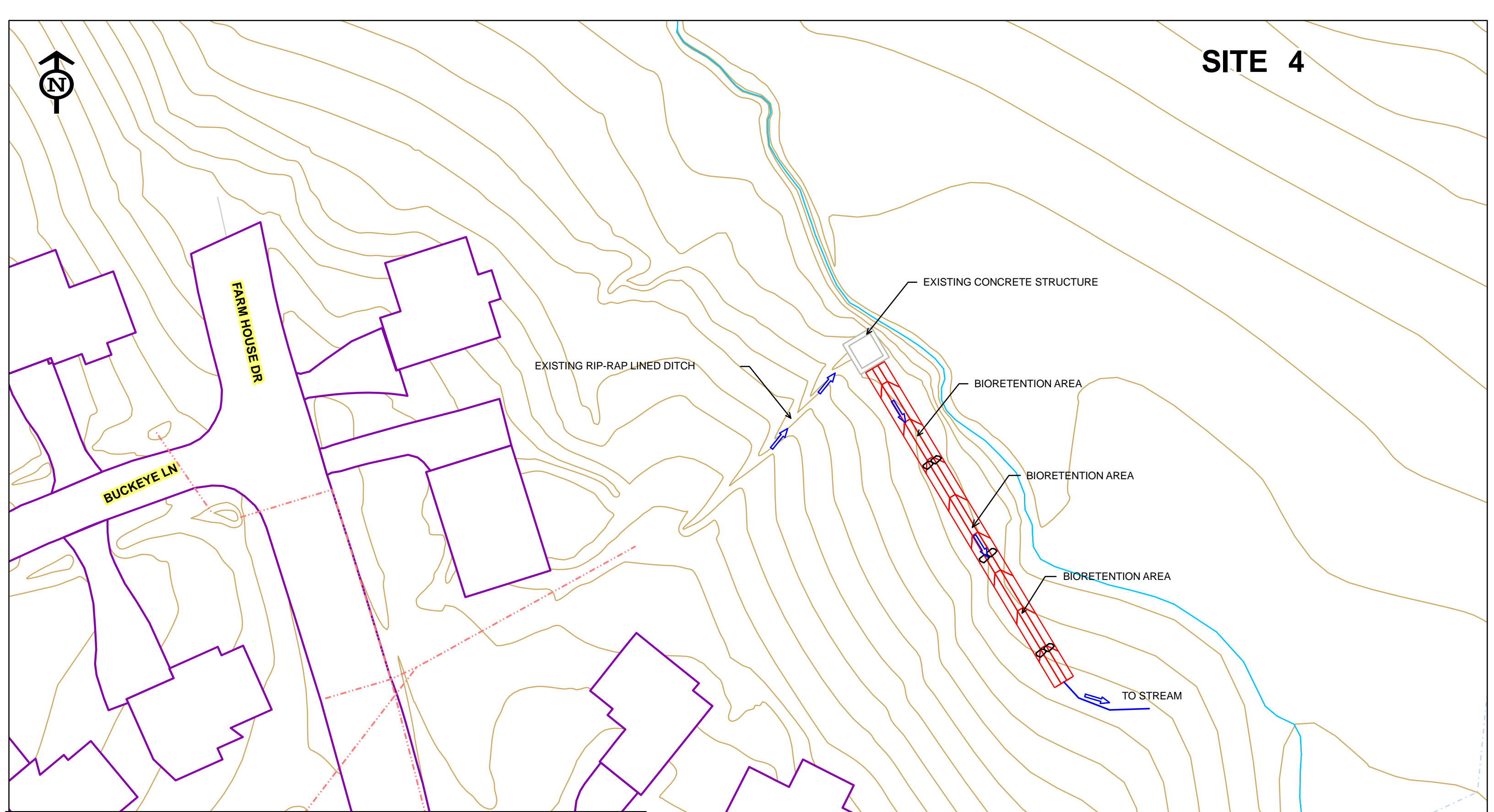
**Cost-Estimate Breakdown**

**Table 4.2** shows a conceptual itemized cost estimate. These costs represent construction and maintenance costs only. The cost for the bio-grade step is derived from a cost per cubic foot treated for bioretention areas reported by Schueler, et. al. (2007). The contingency fee for this site has been increased due to the difficulty of access.

**Table 4.2**

**Site 4 Construction Cost**

Pay Item Description	Estimated Quantity	Unit	Unit Bid Price	Bid Amount
Bio-grade Step	4854.0	CF	12.62	\$61,257
			<b>Total</b>	<b>\$61,257</b>
Mobilization (5%)	1.0	LS		\$3,063
Contingencies (15%)	1.0	LS		\$9,189
			<b>Total + Mobilization and Contingencies</b>	<b>\$73,509</b>
<b>Maintenance Costs</b>				
Maintenance (5% of base construction cost)	1.0	Year		\$3,675



EXISTING RIP-RAP LINED DITCH

EXISTING CONCRETE STRUCTURE

BIORETENTION AREA

BIORETENTION AREA








BIORETENTION AREA

TO STREAM

**FARM HOUSE DR**

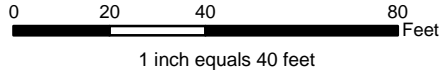
**BUCKEYE LN**

**Legend**

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



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





**SITE 4**

**FARM HOUSE DR**

**BUCKEYE LN**

EXISTING RIP-RAP LINED DITCH

EXISTING CONCRETE STRUCTURE

BIORETENTION AREA

BIORETENTION AREA

BIORETENTION AREA

TO STREAM

**Legend**

- Stormwater Lines
- Perennial Stream
- Intermittent Stream
- - - Ephemeral Stream
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**AERIAL PHOTO VIEW**

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

