

**UNNAMED TRIBUTARY TO BEAR SWAMP CREEK  
STREAM RESTORATION SITE  
2005 Annual Monitoring Report (Year 3)**

**Franklin County  
EEP Project No. 27  
Design Firm: Arcadis G&M of North Carolina, Inc.**



**February, 2006**

**Prepared for: NCDENR/ ECOSYSTEM ENHANCEMENT PROGRAM  
1619 Mail Service Center  
Raleigh, NC 27699-1619**

**Prepared by: ECOSCIENCE CORPORATION  
1101 Haynes Street, Suite 101  
Raleigh, NC 27604**



## Table of Contents

1.0 EXECUTIVE SUMMARY .....	1
2.0 PROJECT BACKGROUND.....	3
2.1 Location and Setting .....	3
2.2 Mitigation Structure and Objectives .....	3
2.3 Project History and Background.....	4
3.0 PROJECT MONITORING AND RESULTS .....	7
3.1 VEGETATION ASSESSMENT.....	7
3.1.1 Soil Data.....	7
3.1.2 Vegetation Problem Areas.....	7
3.1.3 Stem Counts .....	7
3.2 STREAM ASSESSMENT.....	9
3.1.1 Bank Stability Assessment .....	9
3.1.2 Stream Problem Areas.....	9

## LIST OF FIGURES

Table 1	Site Location .....	Appendix A
Table 2	Monitoring Plan View.....	Appendix A

## LIST OF TABLES

Table 1	Project Mitigation Structure and Objectives .....	Page 4
Table 2	Project Activity and Reporting History.....	Page 4
Table 3	Project Contacts.....	Page 5
Table 4	Project Background.....	Page 6
Table 5	Preliminary Soil Data .....	Page 7
Table 6	Vegetation Problem Areas.....	Page 7
Table 7	Stem Counts for Each Species Arranged in Plot.....	Page 7
Table 8	BEHI Estimates .....	Page 9
Table 9	Stream Problem Areas.....	Page 9
Table 10	Categorical Stream Feature Visual Stability Assessment.....	Page 10
Table 11	Baseline Morphology and Hydraulic Summary .....	Page 11
Table 12	Morphology and Hydraulic Monitoring Summary.....	Page 12

APPENDIX A: FIGURES

APPENDIX B: VEGETATION DATA

Vegetation Problem Area (Plan View)

Vegetation Problem Area Photos

Vegetation Survey Data Tables

Vegetation Plot Photos

APPENDIX C: STREAM GEOMORPHOLGY DATA

Stream Problem Area (Plan View)

Representative Stream Problem Area Photos

Permanent Station Photos

Exhibit C1 Visual Morphological Stability Assessment

Cross-Section Plots and Raw Data Tables

Exhibit Cross-Sections

Longitudinal Plots and Raw Data Tables

Exhibit Longitudinal Profile

Exhibit Raw Data Tables for Slope

Pebble Count Plots and Raw Data Tables

---

## **1.0 EXECUTIVE SUMMARY**

The Unnamed Tributary to Bear Swamp Creek Stream Mitigation Site (hereafter referred to as the “Site”) was constructed for the North Carolina Ecosystem Enhancement Program (EEP) to provide compensatory stream mitigation in the Tar/Pamlico River Basin. This stream restoration project is located on an unnamed tributary to Bear Swamp Creek at the Murphy Hay Farm just north of the Town of Louisburg. This project involves the permanent exclusion of cattle from the stream, stabilization of eroding stream banks, installation of cross-vane structures for habitat, and the planting of a forested riparian buffer.

The following report summarizes the monitoring activities that have occurred in the past year (the third year of project monitoring) at the Site. Site construction began and was completed in July 2002. As-built surveys for the Site were performed in August 2002. First year monitoring was conducted in September 2003, and second year monitoring was performed in 2004. The Site must demonstrate vegetative criteria success and a stable restored stream channel for a minimum of five years or until the Site is deemed successful. The following paragraphs summarize the results of the current year monitoring.

### **Vegetation Monitoring**

Vegetation success criteria for the forested riparian restoration areas is based on a minimum survival of 320 stems per acre of planted species at the end of Year 5. Volunteer woody vegetation will also be included in the survivability calculations. Based on the third year surveys, the average count of the surviving planted species is 620 stems per acre. If volunteer species are included, the total number of stems increases to 8,120 stems per acre.

The Site is meeting the established success criteria for vegetation based on the survival of the planted species. When volunteer species are included in the calculation, the densities are very high. This is typical of the early forest successional development process when open fields and pastures go fallow. Early successional species in abundance on the site include loblolly pine (*Pinus taeda*), red maple (*Acer rubrum*), and sweet gum (*Liquidambar styraciflua*). The heavy loblolly pine colonization, in particular, is becoming a nuisance as they compete with the more desirable species for light and nutrients. Measures may need to be undertaken in the near future to cull their numbers.

### **Stream Enhancement Monitoring**

Success criteria for the restored stream reach has been established to confirm no significant changes have occurred to the dimension, pattern, profile, and bed material over the 5-year monitoring period. Location surveys of the constructed features were conducted to verify the performance of the stream. A total station survey was used to describe the stream longitudinal profile and five permanent stream cross-section (3 riffles and 2 pools). A modified Wolman pebble count and assessment of the constructed features was also undertaken.

Overall, the stream channel bed form is stable. Water surface and bed slopes have changed little from the as-built conditions. However, many of the grade control structures (rock vanes) in the stream have failed which has led to low to moderate bed degradation immediately behind these structures. Of the twenty-four rock vanes that were installed, ten are not performing their intended function. Six vanes have water piping through or behind the structure. The remaining four have filled-in with sediment and have become obsolete.

---

Based on the cross-sections and visual observations, the channel dimensions have not changed significantly. However, observed features and surveyed cross-section indicate that the channel has narrowed slightly and is developing a bankfull bench at many locations. The stream was designed as a B5c (step-pool) stream (Rosgen 1996), which provides a sand bed channel with moderate entrenchment and a moderate width-depth ratio. The current classification measurements are split, with the current channel exhibiting the moderate entrenchment characteristic of a B-channel, yet exhibiting a very low width-depth ratio of an E-channel. During the current survey, bankfull indicators were also found at a significantly lower elevation than those described by the designer. Caution is advised in interpreting and comparing past years data. This years morphological data is based on the newly identified bankfull elevation. Pebble counts show no significant change to the channel substrate.

---

## **2.0 PROJECT BACKGROUND**

### **2.1 LOCATION AND SETTING**

The Site is located north of Louisburg in Franklin County, NC, immediately south of Dyking Road (SR 1235) at the Murphy Hay Farm (Figure 1, Appendix A). From Raleigh follow Highway 401 north to Louisburg. Approximately one mile past the the Highway 561 split in Louisburg take a left onto Dyking Road. The Murphy Hay Farm will be approximately one mile on your left. The entrance to the stream restoration area is accessed by several gates through the electric fence. The stream restoration reach begins approximately 460 feet upstream of the road crossing and ends approximately 775 feet downstream.

### **2.2 RESTORATION STRUCTURE AND OBJECTIVES**

Approximately 1,400 linear feet of an Unnamed Tributary to Bear Swamp Creek were identified on the 32-acre Murphy Hay Farm. The stream had severely degraded and eroded significantly due to past vegetation removal and the unrestricted access of cattle. The torrential rain events associated with Hurricanes Fran and Floyd provided the final impetus for restoration work. The stream originates at a pond approximately 500 feet east of Dyking Road and 1,000 feet east of the project. Land use in the watershed consists of agriculture, pature, forest, and single-family residential.

The design of the new stream included both Priority II and III stream restoration. The degraded F5 and G5c stream types were restored to a B5c (Rosgen 1996). Approxiamtely 664 linear feet of new channel was constructed; and 771 linear feet of stream was stabilized in-place. Approximalely 800 tons of rock were used to construct 24 rock vanes throughout the reach (Figure 2, Appendix A). The vanes were designed to improve hyraulic flow and reduce shear stress. The vanes also provided bed stabilization and improved stream habitat by creating pools. The steep, eroded banks were graded back and expanded to increase the entrenchment ratio. Root wads were also installed to provide bank protecting and additional habitat diversity. Approximately 2.4 acres of riparian vegetation was also established along the restored channel in Zone 1 (inner 30 feet) of the Tar/Pamlico Riparian Buffer. This riparian buffer zone has been fenced to exclude cattle. Site construction began and was completed in July 2002. Project monitoring began the next year in September 2003.

The objective of this project is to restore habitat and water quality to the restored reach and the Tar-Pamlico River Basin as a whole. By stablizing the streambed and banks, the restoration will improve water quality by reducing the amount of sediment contributed to the watershed. Exclusion of cattle and establishment of a permanent riparian buffer should further help reduce sediment and nutrient input. The newly established riparian buffer will provide shade, thereby reducing water temperatures, and increase habitat and food for wildlife.

<b>Project Segment or Reach ID</b>	<b>Restoration Type</b>	<b>Approach</b>	<b>Linear Footage or Acreage</b>	<b>Stationing</b>	<b>Comments</b>
Reach 1	R	P2/P3	780 linear feet*	Exact locations unknown	--
	S	SSS	680 linear feet*	Exact locations unknown	--
Riparian Vegetation Re-establishment	R	--	2.4 acres	N/A	--

\*Linear footage values provided in the project's Mitigation Plan—reaches are not distinguished on figures or in text narrative

R = Restoration

P1 = Priority I

EI = Enhancement I

P2 = Priority II

EII = Enhancement II

P3 = Priority III

S = Stabilization

SSS = Stream Bank Stabilization

## 2.3 PROJECT HISTORY AND BACKGROUND

<b>Activity Report</b>	<b>Scheduled Completion</b>	<b>Data Collection Complete</b>	<b>Actual Completion or Delivery</b>
Restoration Plan	NA*	NA*	NA*
Final Design (90%)	NA*	NA*	NA*
Construction	NA*	NA*	July 2002
Temporary S&E mix applied to entire project area	NA*	NA*	NA*
Permanent seed mix applied to reach/segments	NA*	NA*	NA*
Bare Root Seedling Installation	NA*	NA*	NA*
Mitigation Plan	NA*	NA*	April 2003
Minor repairs made filling small washed out areas			May 2003
Final Report	NA*	NA	July 2003
Year 1 Vegetation Monitoring	NA*	Fall 2003	Jan 2004
Year 1 Stream Monitoring	NA*	Sept 2003	
Year 2 Vegetation Monitoring	NA*	NA*	NA*
Year 2 Stream Monitoring	NA*	NA*	
Year 3 Vegetation Monitoring	Dec 2005	Oct 2005	Dec 2005
Year 3 Stream Monitoring	Dec 2005	Nov 2005	

Bolded Items represent those events or deliverables that are variable. Non-bolded items represent events that are standard over the course of a typical project.

\*NA – Historical project documents necessary to provide this data were unavailable at the time of this report submission.

<b>Table 3. Project Contacts</b> <b>UT to Bear Swamp Creek Stream Restoration Site / EEP Project No. 27</b>	
<b>Designer</b> Arcadis G&M of North Carolina, Inc. (ARCADIS)	Mr. Robert Lepsic 801 Corporate Center Drive, Suite 300 Raleigh, NC 27607 (919) 854-1282
<b>Construction Contractor</b> SEI Environmental, Inc.	130 Penmarc Drive, Suite 108 Raleigh, NC 27603-2434
<b>Planting Contractor</b> North State Environmental, Inc.	2889 Lowery Street Winston Salem, NC 27101 (336) 725-2010
<b>Seeding Contactor</b> NA*	NA*
Seed Mix Sources	NA*
Nursery Stock Suppliers	NA*
<b>Monitoring Performers</b>	EcoScience Corporation 1101 Haynes Street, Suite 101 Raleigh, NC 27604 (919) 828-3433
Stream Monitoring POC	Jens Geratz
Vegetation Monitoring POC	Elizabeth Scherrer

\*NA – Historical project documents necessary to provide this data were unavailable at the time of this report submission.



<b>Table 4. Project Background</b> <b>UT to Bear Swamp Creek Stream Restoration Site / EEP Project No. 27</b>	
Project County	Franklin
Drainage Area	0.26 square miles
Impervious cover estimate (%)	<1 percent
Stream Order	1st order
Physiographic Region	Piedmont
Ecoregion (Griffith and Omernik)	Northern Outer Piedmont
Rosgen Classification of As-built	B5c
Cowardin Classification	Stream (R3UB2)
Dominant soil types	Wake-Saw-Wedowee Complex (WaB)
	Wedowee (WeB, WeC)
	Wake-Wateree-Wedowee Complex (WbD)
Reference Site ID	000543201A
USGS HUC for Project and Reference	03020101040010
NCDWQ Sub-basin for Project and Reference	03-03-01
NCDWQ classification for Project and Reference	NA*
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor	N/A
Percent of project easement fenced	30-foot buffer fenced around entire reach

\*NA – Historical project documents necessary to provide this data were unavailable at the time of this report submission.

### 3.0 PROJECT MONITORING AND RESULTS

#### 3.1 VEGETATION ASSESSMENT

##### 3.1.1 Soil Data

Series	Max Depth (in.)	% Clay on Surface	K	T	OM %
Wake-Saw-Wedowee Complex (WaB)	32	3-20	0.15-0.28	1-4	0.5-3
Wedowee (WeB, WeC)	32	5-20	0.24-0.28	4	0.5-3
Wake-Wateree-Wedowee Complex (WbD)	54	2-20	0.15-0.28	1-4	0.5-3

##### 3.1.2 Vegetation Problem Areas

Feature / Issue	Station # / Range	Probable Cause	Photo #
Invasive Populations	Throughout, but especially at Vegetation Plot 1	<i>Pinus taeda</i> : seeding from adjacent stands	1 and 2
	Near Vegetation Plots 1 and 4	<i>Acer rubrum</i> : outside seed source	--
	Mainly at upstream end of site	<i>Lonicera japonica</i> : outside seed source	--
Bare Ground	0+50 to 1+00 and 1+50 to 2+00	Steep dry cut slope	3

A vegetation problem area plan view and photos are provided in Appendix B.

##### 3.1.3 Stem Counts

The existing five 20-foot by 45-foot plots were located and the corners marked with steel fence posts painted orange. Stem counts were conducted for all woody species, including volunteer species. An inventory of planted species is given in Table 7. A tally of volunteer woody species is listed in Table 7a.

Species	Plots					Year 1 Totals*	Year 2 Totals	Survival %
	1	2	3	4	5			
<b>Shrubs</b>								
<i>Alnus serrulata</i>						0	0	--
<i>Cornus amomum</i>	3	6		3		13	12	92
<i>Ilex verticillata</i>						0	0	--
<i>Salix nigra</i>	4	21		3		19	29	153
<i>Sambucus canadensis</i>						0	0	--
<b>Trees</b>								
<i>Betula nigra</i>	4	1		1		0	6	--

Species	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Year 1 Totals	Year 2 Totals
<i>Carpinus caroliniana</i>						1	0
<i>Fraxinus pennsylvanica</i>		6	1		1	8	100
<i>Juglans nigra</i>	1	2				3	100
<i>Morus rubra</i>						1	0
<i>Ostrya virginiana</i>						5	0
<i>Quercus michauxii</i>	1			2	2	3	167
<i>Quercus pagoda</i>						1	0

\* Initial Totals for planted species within vegetation plots are not available.

Species	Plots					Year 1 Totals	Year 2 Totals
	1	2	3	4	5		
<i>Acer negundo</i>	2	1				0	3
<i>Acer rubrum</i>	43			27	3	51	73
<i>Baccharis halimifolia</i>		2				0	2
<i>Celtis laevigata</i>			2			0	2
<i>Diospyros virginiana</i>			1			0	1
<i>Liquidambar styraciflua</i>	13				13	20	26
<i>Liriodendron tulipifera</i>	2			1		7	2
<i>Pinus taeda</i>	200	161	36	72	78	250	547
<i>Platanus occidentalis</i>					1	0	1
<i>Prunus serotina</i>		2		1	2	0	5
<i>Rhus copallina</i>						1	0
<i>Rhus glabra</i>	43					2	43
<i>Ulmus alata</i>	37		1	2	1	0	41
<i>Viburnum nudum</i>			3			0	3

An inventory of herbaceous species on the site was also taken. Dominant herbaceous species over the Site as a whole are listed below:

<i>Aster dumosus</i> (frost aster)	<i>Phytolacca americana</i> (pokeweed)
<i>Bidens frondosa</i> (beggar ticks)	<i>Polygonum</i> sp. (smartweed)
<i>Duchesnea indica</i> (Indian strawberry)	<i>Rumex crispus</i> (curly dock)
<i>Eupatorium capillifolium</i> (dog fennel)	<i>Solanum carolinianum</i> (horse nettle)
<i>Eupatorium fistulosum</i> (Joe Pye weed)	<i>Solidago</i> sp. (goldenrod)
<i>Helianthus angustifolius</i> (swamp sunflower)	<i>Toxicodendron radicans</i> (poison ivy)
<i>Lonicera japonica</i> (Japanese honeysuckle)	<i>Vernonia</i> sp. (ironweed)

## 3.2 STREAM ASSESSMENT

### 3.1.1 Bank Stability Assessment

<b>Table 8. BEHI Estimate</b>															
<b>UT to Bear Swamp Creek Stream Restoration Site / EEP Project No. 27</b>															
<b>Time Point</b>	<b>Segment/ Reach</b>	<b>Linear Footage</b>	<b>Extreme</b>		<b>Very High</b>		<b>High</b>		<b>Moderate</b>		<b>Low</b>		<b>Very Low</b>		<b>Sediment Export Tons/year</b>
			<b>ft</b>	<b>%</b>	<b>ft</b>	<b>%</b>	<b>ft</b>	<b>%</b>	<b>ft</b>	<b>%</b>	<b>ft</b>	<b>%</b>	<b>Ft</b>	<b>%</b>	
3 <sup>rd</sup> year monitoring	Reach 1 Above Road	460	--	--	--	--	--	--	100	22	--	--	360	78	1.3
3 <sup>rd</sup> year monitoring	Reach 2 Below Road	975	--	--	--	--	--	--	--	--	50	5	925	95	0.4
3 <sup>rd</sup> year monitoring	Project Total	1435	--	--	--	--	--	--	100	7	50	3	1225	90	6.0

### 3.1.2 Stream Problem Areas

<b>Table 9. Stream Problem Areas</b>			
<b>UT to Bear Swamp Creek Stream Restoration Site / EEP Project No. 27</b>			
<b>Feature Issue</b>	<b>Station Numbers</b>	<b>Suspected Cause</b>	<b>Photo Number</b>
Vane 2, filled in		low slope, excess sediment	1
Vane 3, structure failure		Piping, inadequate use of filter fabric, steep vane arms	2
Vane 6, structure failure		Piping, inadequate use of filter fabric, steep vane arms	3
Vane 8, structure failure		Piping, inadequate use of filter fabric, steep vane arms	4
Vane 10, structure failure		Piping, inadequate use of filter fabric, steep vane arms	5
Vane 11, structure failure		Piping, inadequate use of filter fabric, steep vane arms	6
Vane 14, filled in		low slope, excess sediment	7
Vane 17, filled in		low slope, excess sediment	8
Vane 19, structure failure		Piping, inadequate use of filter fabric, steep vane arms	9
Vane 24, filled in		low slope, excess sediment	Not available
Incoming 4-inch pipe		No energy dissipater	10
Slight Bank Erosion		Floodplain restriction	11

A stream problem area plan view and photos of problem areas are provided in Appendix C

**Table 10. Categorical Stream Feature Visual Stability Assessment  
 UT to Bear Swamp Creek Stream Restoration Site / EEP Project No. 27  
 Segment/Reach: 1,439 feet**

<b>Feature</b>	<b>Initial</b>	<b>MY-01</b>	<b>MY-02</b>	<b>MY-03</b>	<b>MY-04</b>	<b>MY-05</b>
A. Riffles	100%	NA*	NA*	80%		
B. Pools	100%	NA*	NA*	91%		
C. Thalweg	100%	NA*	NA*	88%		
D. Meanders	100%	NA*	NA*	77%		
E. Bed General	100%	NA*	NA*	95%		
F. Rock Vanes	100%	NA*	NA*	82%		
G. Root Wads	100%	NA*	NA*	86%		

\*NA – Historical project documents necessary to provide this data were unavailable at the time of this report submission.

**Table 11. Baseline Morphology and Hydraulic Summary  
UT to Bear Swamp Creek Stream Restoration Site / EEP Project No. 27  
1,439 linear feet**

Parameter	USGS Gage Data			Regional Curve Interval			Pre-Existing Condition			Project Reference Stream			Design			As-built		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
<b>Dimension</b>																		
BF Width (ft)	NA*	NA*	NA*	N/A	N/A	6.7	NA*	NA*	NA*	11.0	11.8	11.4	10.0	10.0	10.0	8.1	10.7	9.6
Floodprone Width (ft)	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	25.5	80.0	40.6	14.0	22.0	18.0	11.4	19.0	13.5
BF Cross Sectional Area (ft <sup>2</sup> )	NA*	NA*	NA*	N/A	N/A	8.5	NA*	NA*	NA*	10.3	14.0	12.1	8.6	8.6	8.6	8.1	10.7	9.3
BF Mean Depth (ft)	NA*	NA*	NA*	N/A	N/A	1.0	NA*	NA*	NA*	0.9	1.2	1.1	0.8	0.8	0.8	0.9	1.0	1.0
BF Max Depth (ft)	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	1.9	2.4	2.1	1.4	1.8	1.6	1.5	1.7	1.6
Width/Depth Ratio	NA*	NA*	NA*	N/A	N/A	6.7	NA*	NA*	NA*	11.0	11.8	10.7	12	12	12	8.2	11.4	10.0
Entrenchment Ratio	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	2.2	2.4	2.3	1.4	2.2	1.8	1.7	1.8	1.8
Wetted Perimeter(ft)	NA*	NA*	NA*	N/A	N/A	8.7	NA*	NA*	NA*	13.2	14.0	13.6	11.6	11.6	11.6	10.1	12.7	11.6
Hydraulic radius (ft)	NA*	NA*	NA*	N/A	N/A	1.0	NA*	NA*	NA*	0.8	1.0	0.9	0.7	0.7	0.7	0.8	0.8	0.8
<b>Pattern</b>																		
Channel Beltwidth (ft)	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	6.0	8.0	7.0	20.0	80.0	37.0	5.5	82.5	31.3
Radius of Curvature (ft)	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	63.0	390.0	240.0	55.0	342.0	199.0	11.0	221.0	77.8
Meander Wavelength (ft)	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	21.0	88.0	46.0	18.0	77.0	40.0	42.4	236.9	121.3
Meander Width ratio	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	0.5	0.7	0.6	2.0	8.0	3.7	0.6	8.6	3.3
<b>Profile</b>																		
Riffle length (ft)	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*	NA*
Riffle slope (ft/ft)	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	0.001	0.14	0.04	0.0015	0.132	0.067	0.0026	0.0238	0.0108
Pool length (ft)	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	7.0	13.0	9.3	6.0	11.0	8.0	3.9	30.6	11.1
Pool spacing (ft)	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	22.0	69.0	42.0	19.0	61.0	37.0	31.7	115.5	53.5
<b>Substrate</b>																		
d50 (mm)	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	3	3	3	0.2	0.2	0.2	0.4	0.4	0.4
d84 (mm)	NA*	NA*	NA*	N/A	N/A	N/A	NA*	NA*	NA*	49.7	49.7	49.7	2.9	2.9	2.9	16	16	16
<b>Additional Reach Parameters</b>																		
Valley Length (ft)		NA*			N/A			NA*			NA*			1,300			1,300	
Channel Length (ft)		NA*			N/A			NA*			NA*			1,435			1,435	
Sinuosity		NA*			N/A			NA*			1.1			1.1			1.1	
Water Surface Slope (ft/ft)		NA*			N/A			NA*			0.016			0.0157			0.0154	
BF slope (ft/ft)		NA*			N/A			NA*			0.016			0.0157			0.0154	
Rosgen Classification		NA*			N/A			NA*			B5c			B5c			B5c	
**Habitat Index		NA*			N/A			NA*			NA*			NA*			NA*	
**Macrobenthos		NA*			N/A			NA*			NA*			NA*			NA*	

\*Historical project documents necessary to provide this data were unavailable at the time of the report submission

\*\*Inclusion will be project specific and determined primarily by As-built monitoring plan/success criteria

**Table 12. Morphology and Hydraulic Monitoring Summary  
UT to Bear Swamp Creek Stream Restoration Site / EEP Project No. 27  
1,439 linear feet**

Parameter	Cross Section 1 Riffle						Cross Section 2 Riffle						Cross Section 3 Pool						Cross Section 4 Pool					
	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
<b>Dimension</b>																								
BF Width (ft)	NA*	NA*	5.0				NA*	NA*	3.4				NA*	NA*	5.0				NA*	NA*	4.1			
Floodprone Width (ft)	NA*	NA*	9.5				NA*	NA*	7.3				NA*	NA*	9.8				NA*	NA*	32.4			
BF Cross Sectional Area (ft <sup>2</sup> )	NA*	NA*	2.6				NA*	NA*	1.9				NA*	NA*	1.9				NA*	NA*	9.3			
BF Mean Depth (ft)	NA*	NA*	0.5				NA*	NA*	0.6				NA*	NA*	0.4				NA*	NA*	2.2			
BF Max Depth (ft)	NA*	NA*	0.7				NA*	NA*	0.8				NA*	NA*	0.6				NA*	NA*	3.2			
Width/Depth Ratio	NA*	NA*	9.6				NA*	NA*	6.1				NA*	NA*	13.3				NA*	NA*	1.9			
Entrenchment Ratio	NA*	NA*	1.9				NA*	NA*	2.1				NA*	NA*	2.0				NA*	NA*	7.8			
Wetted Perimeter (ft)	NA*	NA*	6.0				NA*	NA*	4.6				NA*	NA*	5.8				NA*	NA*	12.9			
Hydraulic radius (ft)	NA*	NA*	0.8				NA*	NA*	0.4				NA*	NA*	0.3				NA*	NA*	0.7			
<b>Substrate</b>																								
d50 (mm)	0.4	NA*	0.33				NA*	NA*	0.73				1.9	NA*	0.65				6.9	NA*	0.87			
d84 (mm)	3.0	NA*	0.65				NA*	NA*	4.5				2937	NA*	1.5				3129	NA*	1.6			

Parameter	MY-01 (2003)			MY-02 (2004)			MY-03 (2005)			MY-04 (2006)			MY-05 (2007)			MY+ (2008)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
<b>Pattern</b>																		
Channel Beltwidth (ft)	13.3	62.7	33.2	NA*	NA*	NA*	13.3	62.7	33.2									
Radius of Curvature (ft)	40.0	500.0	158.5	NA*	NA*	NA*	40.0	500.0	158.5									
Meander Wavelength (ft)	19.2	112.4	57.0	NA*	NA*	NA*	19.2	112.4	57.0									
Meander Width ratio	1.3	6.3	3.4	NA*	NA*	NA*	2.8	23.9	12.1									
<b>Profile</b>																		
Riffle length (ft)	NA*	NA*	NA*	NA*	NA*	NA*	3.8	62.7	28.0									
Riffle slope (ft/ft)	0.0024	0.0487	0.0197	NA*	NA*	NA*	0.001	0.061	0.014									
Pool length (ft)	3.7	23.9	12.6	NA*	NA*	NA*	1.8	22.7	5.2									
Pool spacing (ft)	17.7	69.3	41.6	NA*	NA*	NA*	14.0	183.0	64.6									
<b>Additional Reach Parameters</b>																		
Valley Length (ft)		1,300			NA*			1,300										
Channel Length (ft)		1,435			NA*			1,439										
Sinuosity		1.1			NA*			1.1										
Water Surface Slope (ft/ft)		0.0161			NA*			0.0153										
BF slope (ft/ft)		0.0161			NA*			0.0165										
Rosgen Classification		B5c			NA*			E5/Bc5										
Habitat Index*		NA*			NA*			N/A										
Macrobenthos*		NA*			NA*			N/A										

\*Historical project documents necessary to provide this data were unavailable at the time of report submission

**Table 12. cont. Morphology and Hydraulic Monitoring Summary  
 UT to Bear Swamp Creek Stream Restoration Site / EEP Project No. 27  
 1,439 linear feet**

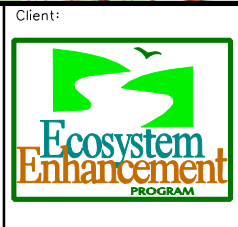
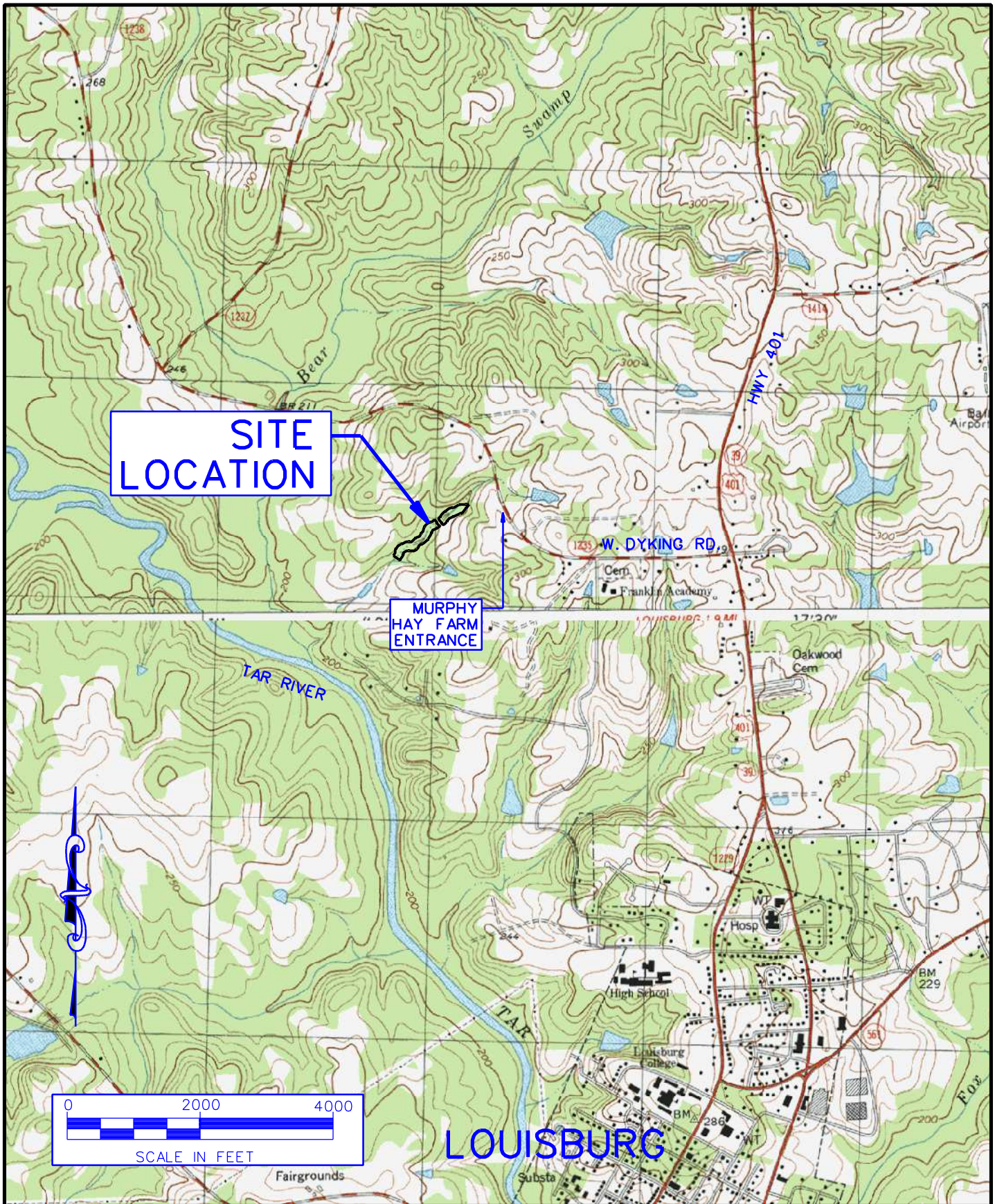
Parameter	Cross Section 5																							
	Riffle																							
Dimension	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
BF Width (ft)	NA*	NA*	5.7																					
Floodprone Width (ft)	NA*	NA*	10.1																					
BF Cross Sectional Area (ft <sup>2</sup> )	NA*	NA*	6.1																					
BF Mean Depth (ft)	NA*	NA*	1.1																					
BF Max Depth (ft)	NA*	NA*	1.3																					
Width/Depth Ratio	NA*	NA*	5.3																					
Entrenchment Ratio	NA*	NA*	1.8																					
Wetted Perimeter(ft)	NA*	NA*	7.9																					
Hydraulic radius (ft)	NA*	NA*	0.8																					
<b>Substrate</b>																								
d50 (mm)	0.4	NA*	1.5																					
d84 (mm)	3.0	NA*	14.0																					

\*Historical project documents necessary to provide this data were unavailable at the time of report submission



## **APPENDIX A**

### **FIGURES**



Client: **Project:**

**Unnamed Tributary to Bear Swamp Creek Stream Restoration Site**

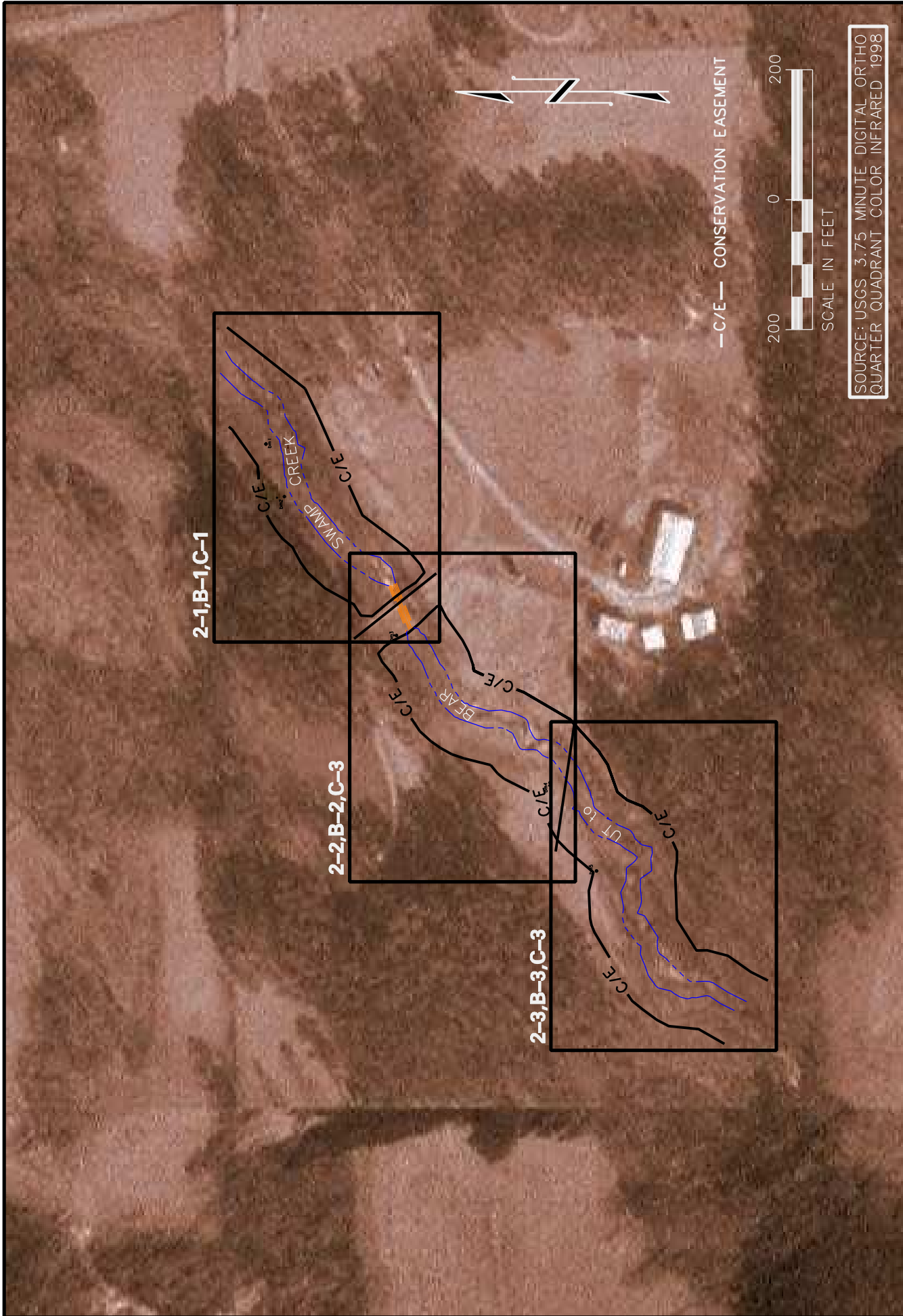
**EEP Project No. 27**

FRANKLIN COUNTY, NORTH CAROLINA

Own By: JDG  
Ckd By: JWG  
Date: DEC 2005  
Scale: 1" = 2000'  
ESC Project No.: 05-243.04

FIGURE

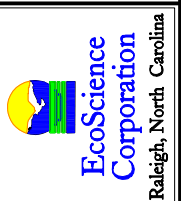
**1**

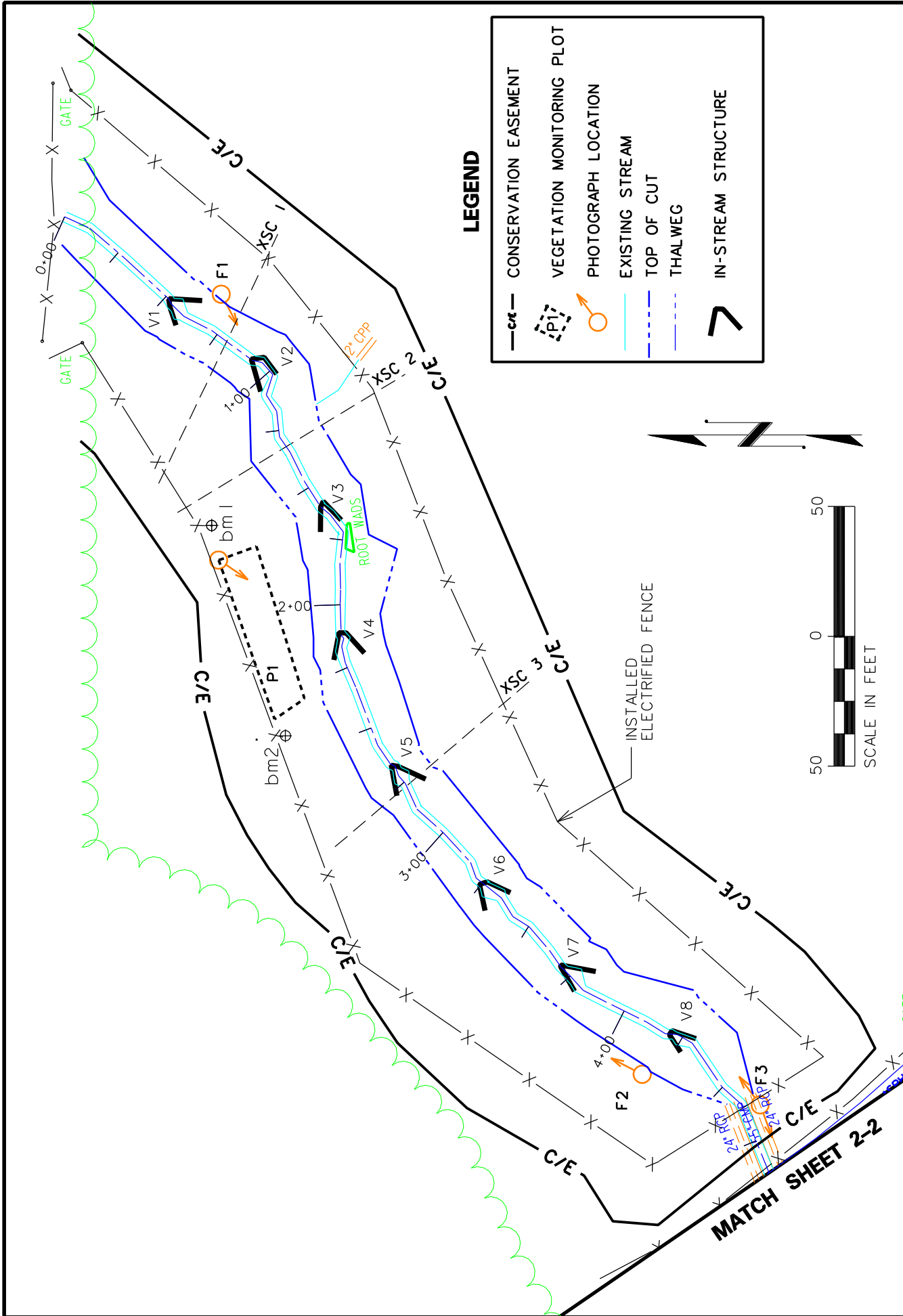


SOURCE: USGS 3,75 MINUTE DIGITAL ORTHO QUARTER QUADRANT COLOR INFRARED 1998

Client:	Ecosystem Enhancement PROGRAM		
Project:	EEP Project No. 27		
Project:	Unnamed Tributary to Bear Swamp Creek Stream Restoration Site		
Dwn By:	JDG	Date:	DEC 2005
Cr'd By:	JWG	Scale:	1" = 200'
ESC Project No.:	05-243.04		
FIGURE	<b>2</b>		

**MONITORING PLAN VIEW/SHEET INDEX**  
**Unnamed Tributary to Bear Swamp Creek Stream Restoration Site**  
**EEP Project No. 27**  
 FRANKLIN COUNTY, NORTH CAROLINA





**LEGEND**

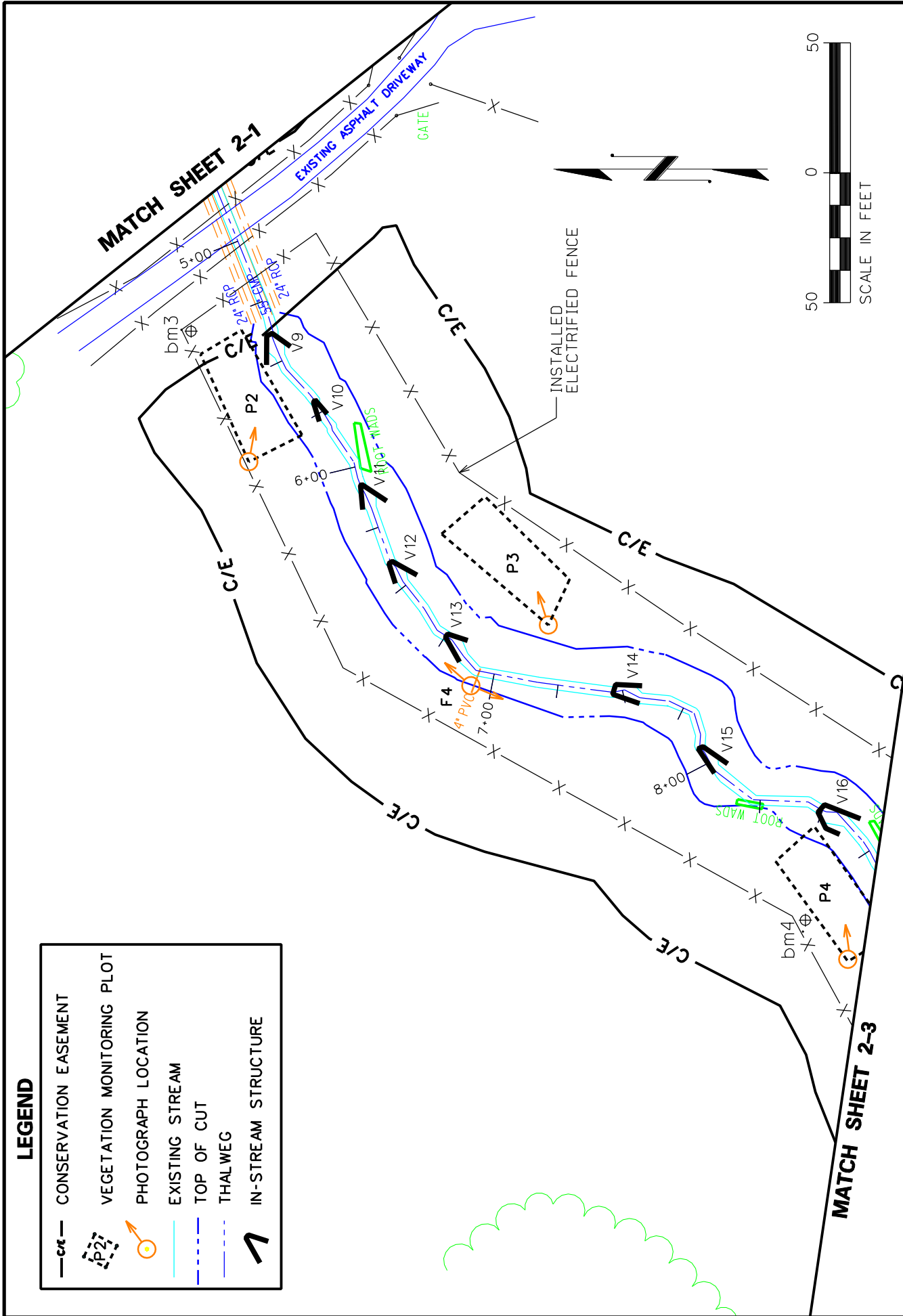
- CONSERVATION EASEMENT
- VEGETATION MONITORING PLOT
- PHOTOGRAPH LOCATION
- EXISTING STREAM
- TOP OF CUT
- THALWEG
- IN-STREAM STRUCTURE

 <b>EcoScience Corporation</b> Raleigh, North Carolina	 <b>Ecosystem Enhancement PROGRAM</b>	<b>Monitoring Plan View</b> <b>Unnamed Tributary to Bear Swamp Creek Stream Restoration Site</b>		Date: DEC 2005 Dwn By: JDG	Figure <h1 style="margin: 0;">2-1</h1>
		<b>EEP Project No. 27</b> FRANKLIN COUNTY, NORTH CAROLINA		Ctd By: JWG Scale: 1" = 50' EEP Project No.: 27	

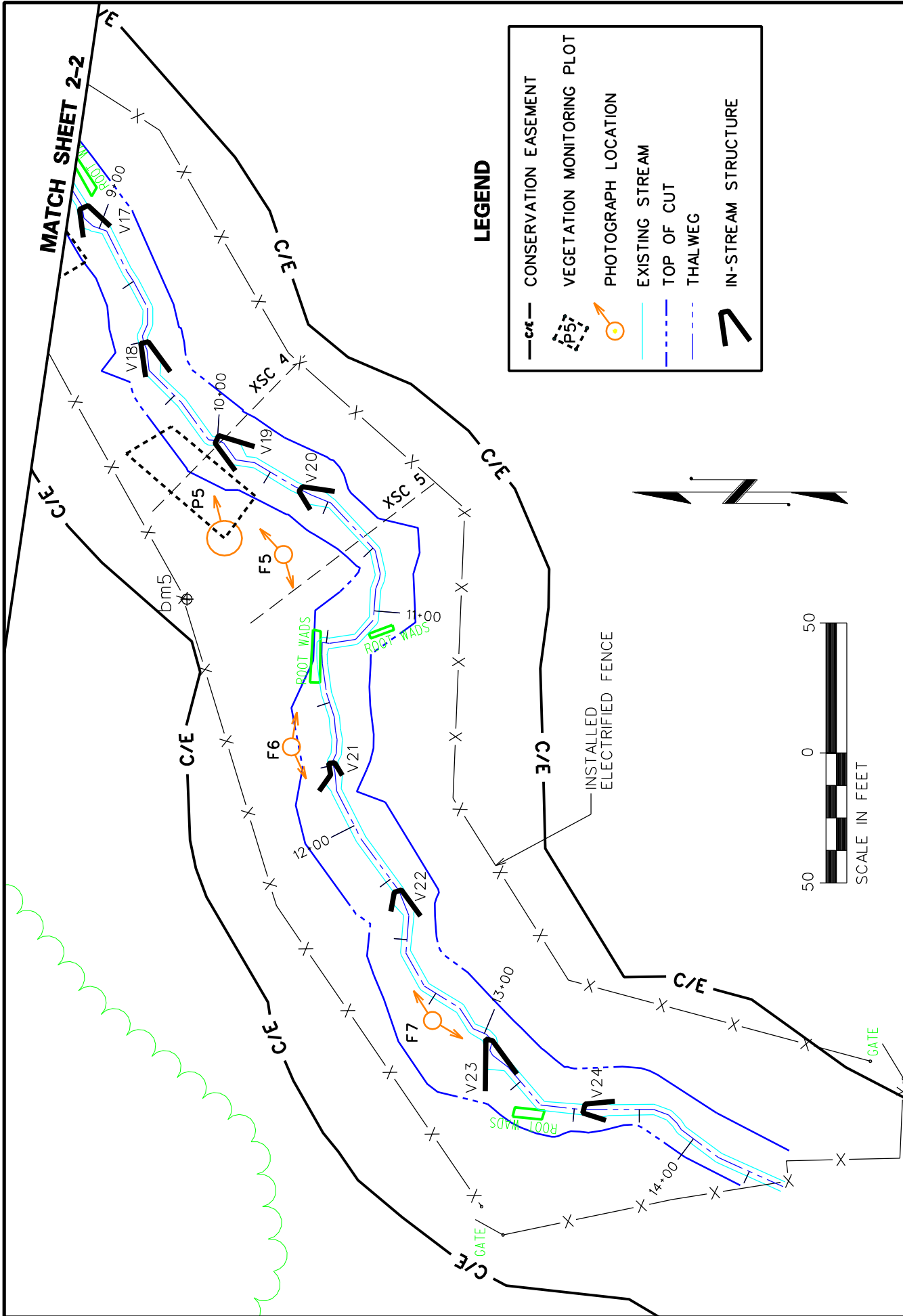
**MATCH SHEET 2-2**

**LEGEND**

	CONSERVATION EASEMENT
	VEGETATION MONITORING PLOT
	PHOTOGRAPH LOCATION
	EXISTING STREAM
	TOP OF CUT
	THALWEG
	IN-STREAM STRUCTURE



<p>EcoScience Corporation Raleigh, North Carolina</p>	<p>Ecosystem Enhancement PROGRAM</p>	<p><b>MONITORING PLAN VIEW</b></p> <p><b>Unnamed Tributary to Bear Swamp Creek Stream Restoration Site</b></p>		<p>Date: DEC 2005</p>	<p><b>FIGURE</b></p> <p><b>2-2</b></p>
		<p>Client:</p>	<p>Project:</p>	<p>Dwn By: JDG</p> <p>Ckd By: JWG</p> <p>Scale: 1" = 50'</p> <p>ESC Project No.: 05-243.04</p>	



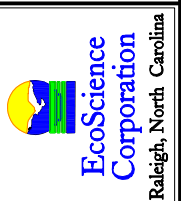
**LEGEND**

- CONSERVATION EASEMENT
- VEGETATION MONITORING PLOT
- PHOTOGRAPH LOCATION
- EXISTING STREAM
- TOP OF CUT
- THALWEG
- IN-STREAM STRUCTURE

FIGURE  
**2-3**

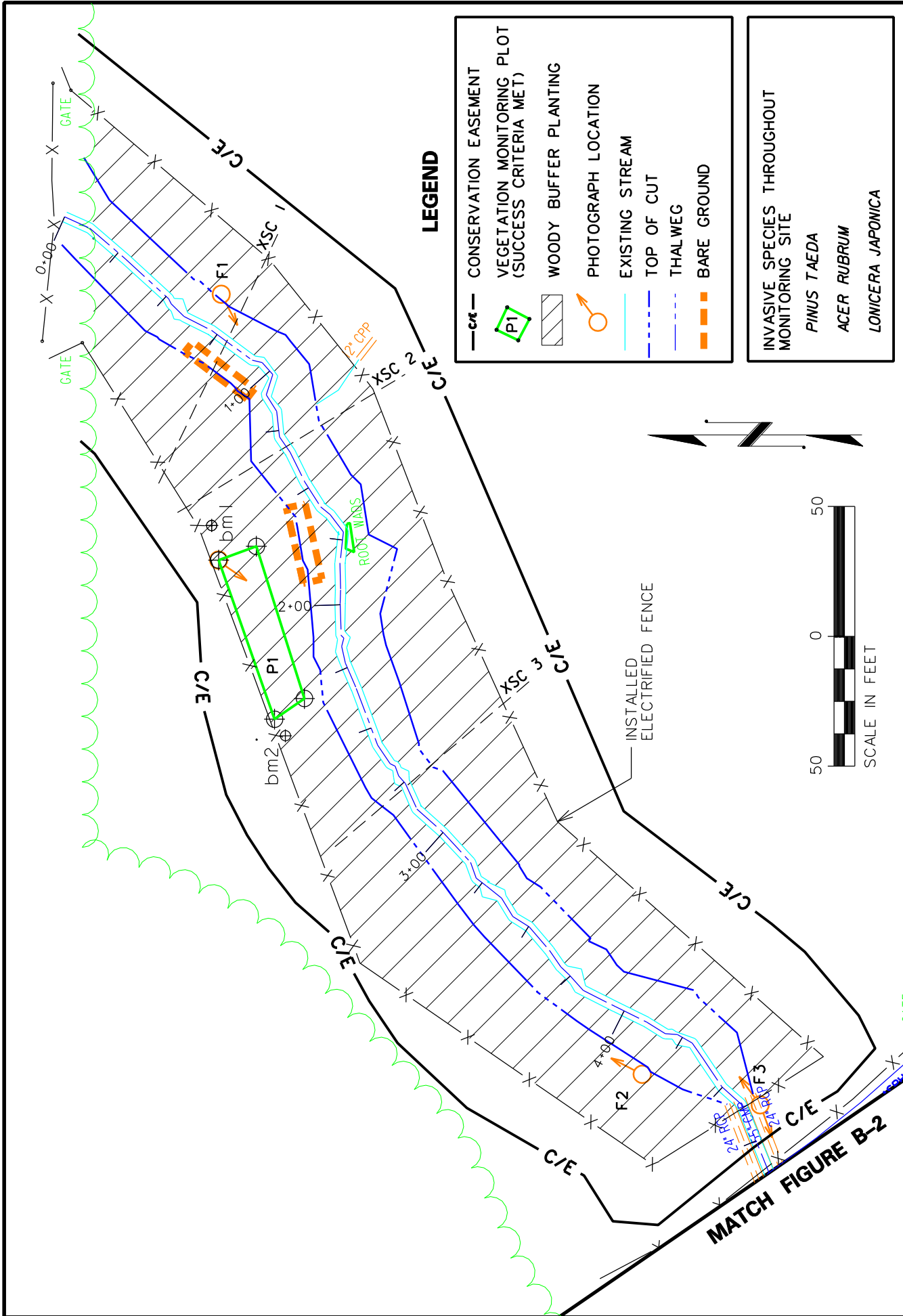
Date: DEC 2005  
Dwn By: JDG  
Scale: 1" = 50'  
Ckd By: JWG  
ESC Project No.: 05-243.04

**MONITORING PLAN VIEW**  
**Unnamed Tributary to Bear Swamp Creek Stream Restoration Site**  
**EEP Project No. 27**  
FRANKLIN COUNTY, NORTH CAROLINA



**APPENDIX B**

**VEGETATION DATA**



**LEGEND**

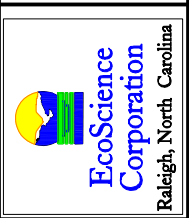
- CONSERVATION EASEMENT
- VEGETATION MONITORING PLOT (SUCCESS CRITERIA MET)
- WOODY BUFFER PLANTING
- PHOTOGRAPH LOCATION
- EXISTING STREAM
- TOP OF CUT
- THALWEG
- BARE GROUND

- INVASIVE SPECIES THROUGHOUT MONITORING SITE**
- Pinus taeda*
  - Acer rubrum*
  - Lonicera japonica*

FIGURE  
**B-1**

Date: DEC 2005  
Dwn By: JDG  
Scale: 1" = 50'  
Ckd By: JWG  
ESC Project No.: 05-243.04

**VEGETATION PROBLEM AREAS**  
**Unnamed Tributary to Bear Swamp Creek Stream Restoration Site**  
**EEP Project No. 27**  
FRANKLIN COUNTY, NORTH CAROLINA



**MATCH FIGURE B-2**

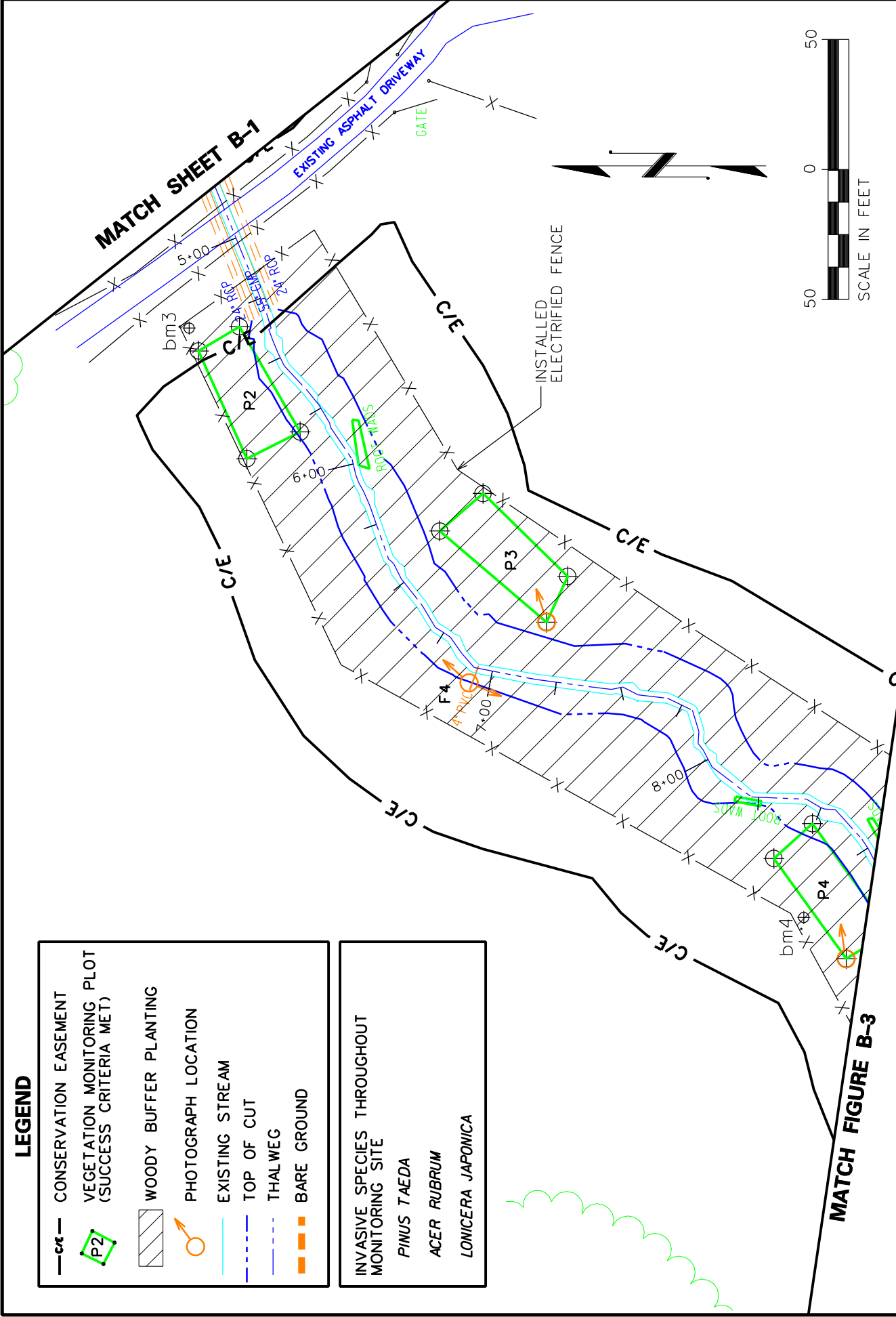


**LEGEND**

	CONSERVATION EASEMENT
	VEGETATION MONITORING PLOT (SUCCESS CRITERIA MET)
	WOODY BUFFER PLANTING
	PHOTOGRAPH LOCATION
	EXISTING STREAM
	TOP OF CUT
	THALWEG
	BARE GROUND

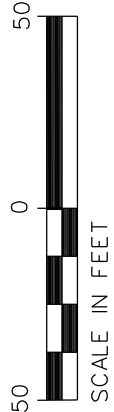
  

INVASIVE SPECIES THROUGHOUT MONITORING SITE	
	PINUS TAEDA
	ACER RUBRUM
	LONICERA JAPONICA



**MATCH FIGURE B-3**

**MATCH SHEET B-1**



**VEGETATION PROBLEM AREAS**  
**Unnamed Tributary to Bear Swamp Creek Stream Restoration Site**

Drawn By:	JDG	Date:	DEC 2005
Check By:	JWG	Scale:	1" = 50'
ESC Project No.:		05-243.04	

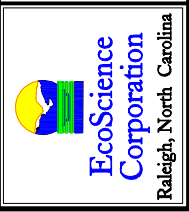
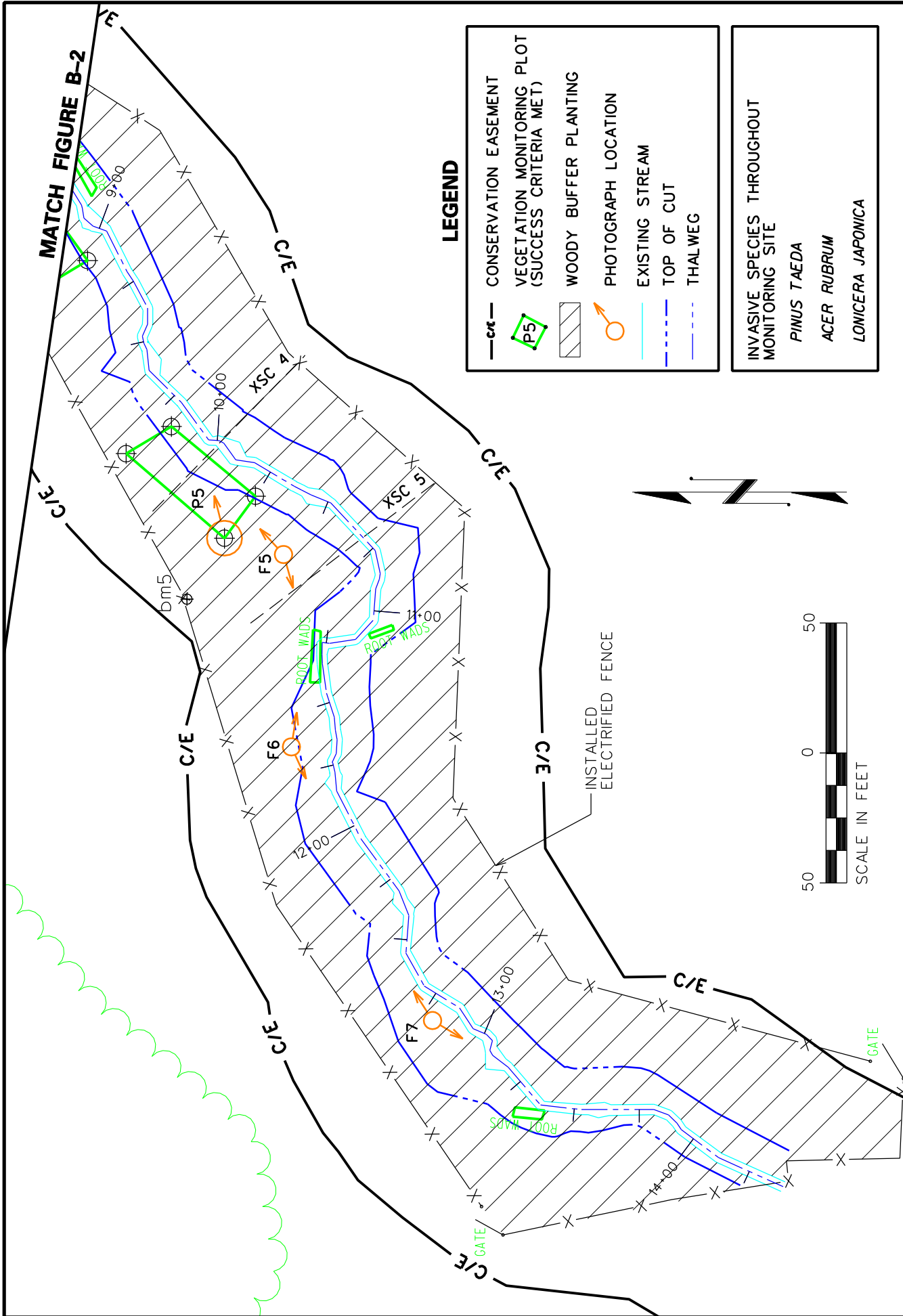


FIGURE  
**B-2**

**EEP Project No. 27**  
 FRANKLIN COUNTY, NORTH CAROLINA



**Client:** EcoScience Corporation  
Raleigh, North Carolina

**Project:** Unnamed Tributary to Bear Swamp Creek Stream Restoration Site

**EEP Project No. 27**  
FRANKLIN COUNTY, NORTH CAROLINA

**Date:** DEC 2005

**Scale:** 1" = 50'

**FIGURE**  
**B-3**

**ESC Project No.:** 05-243.04

**UT to Bear Swamp Creek Stream Restoration Site  
Representative Vegetation Problem Area**

Photo 1. Heavy loblolly pine colonization near Station 1+00.



Photo 2. Heavy loblolly pine colonization near Station 10+00.



Photo 3. Heavy loblolly pine colonization near Station 1+00.



**Unnamed Tributary to Bear Swamp Stream Restoration Site**

Year 2 Monitoring

Data collected 10/05/05

0.02-acre plots

Stem Counts for Each Species Arranged by Plot								
Species	Plots					Year 1 Totals*	Year 2 Totals	Survival %
	1	2	3	4	5			
<b>Shrubs</b>								
<i>Alnus serrulata</i>						0	0	--
<i>Cornus amomum</i>	3	6		3		13	12	92
<i>Ilex verticillata</i>						0	0	--
<i>Salix nigra</i>	4	21		3		19	29	153
<i>Sambucus canadensis</i>						0	0	--
<b>Trees</b>								
<i>Betula nigra</i>	4	1		1		0	6	--
<i>Carpinus caroliniana</i>						1	0	0
<i>Fraxinus pennsylvanica</i>		6	1		1	8	8	100
<i>Juglans nigra</i>	1	2				3	3	100
<i>Morus rubra</i>						1	0	0
<i>Ostrya virginiana</i>						5	0	0
<i>Quercus michauxii</i>	1			2	2	3	5	167
<i>Quercus pagoda</i>						1	0	0
Total	13	36	1	9	3			
Density	650	1800	50	450	150			
Average Density	620							

Stem Counts for Volunteer Species Arranged by Plot							
Species	Plots					Year 1 Totals	Year 2 Totals
	1	2	3	4	5		
<i>Acer negundo</i>	2	1				0	3
<i>Acer rubrum</i>	43			27	3	51	73
<i>Baccharis halimifolia</i>		2				0	2
<i>Celtis laevigata</i>			2			0	2
<i>Diospyros virginiana</i>			1			0	1
<i>Liquidambar styraciflua</i>	13				13	20	26
<i>Liriodendron tulipifera</i>	2			1		7	2
<i>Pinus taeda</i>	200	161	36	72	78	250	547
<i>Platanus occidentalis</i>					1	0	1
<i>Prunus serotina</i>		2		1	2	0	5
<i>Rhus copallina</i>						1	0
<i>Rhus glabra</i>	43					2	43
<i>Ulmus alata</i>	37		1	2	1	0	41
<i>Viburnum nudum</i>			3			0	3
Total	340	166	43	103	98		
Density	17000	8300	2150	5150	4900		
Average Density	7500						
Planted + Volunteer Totals	353	202	44	112	101		
Density	17650	10100	2200	5600	5050		
Average Density	8120						

**Vegetation Plot 1 – UT to Bear Swamp Creek Restoration Site (Year 3)**



Photo was taken October 5, 2005 from the northeast corner looking southwest.

**Vegetation Plot 2 – UT to Bear Swamp Creek Restoration Site (Year 3)**



Photo was taken October 5, 2005 from the northeast corner looking southwest.

**Vegetation Plot 3 – UT to Bear Swamp Creek Restoration Site (Year 3)**



Photo was taken October 5, 2005 from the southeast corner looking northwest.

**Vegetation Plot 4 – UT to Bear Swamp Creek Restoration Site (Year 3)**



Photo was taken October 5, 2005 from the southeast corner looking northwest.

**Vegetation Plot 5 – UT to Bear Swamp Creek Restoration Site (Year 3)**

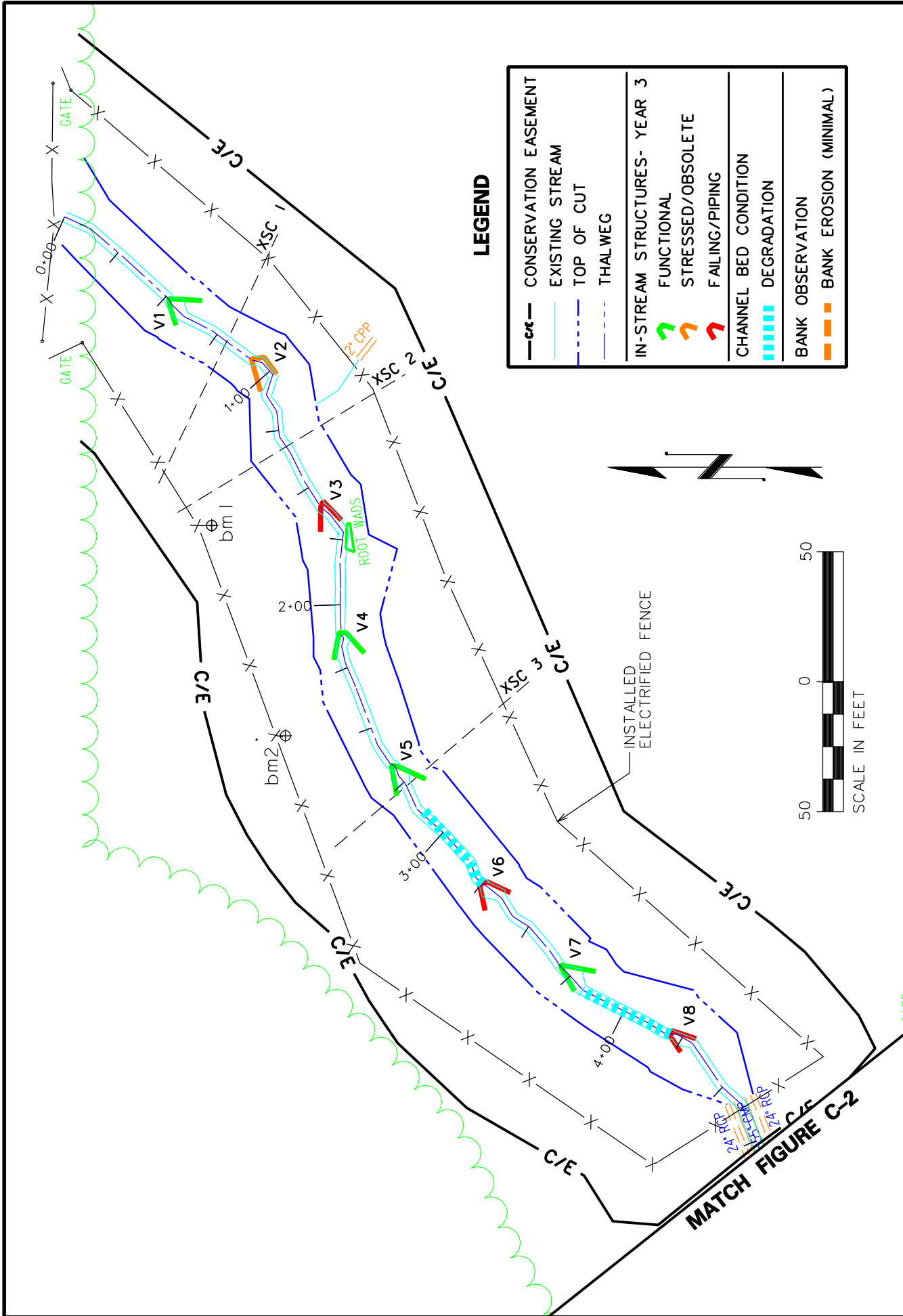


Photo was taken October 5, 2005 from the northwest corner looking southeast.



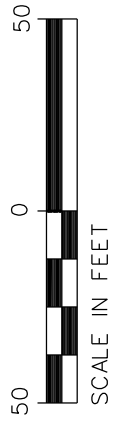
## **APPENDIX C**

### **STREAM GEOMORPHOLOGY DATA**



**LEGEND**

— C/E	CONSERVATION EASEMENT
—	EXISTING STREAM
—	TOP OF CUT
—	THALWEG
—	IN-STREAM STRUCTURES- YEAR 3
→	FUNCTIONAL
→	STRESSED/OBSOLETE
→	FAILING/PIPING
—	CHANNEL BED CONDITION
—	DEGRADATION
—	BANK OBSERVATION
—	BANK EROSION (MINIMAL)

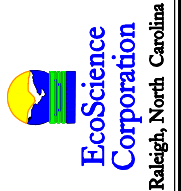


**MATCH FIGURE C-2**

**STREAM PROBLEM AREAS**  
**Unnamed Tributary to Bear Swamp Creek Stream Restoration Site**

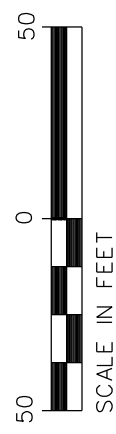
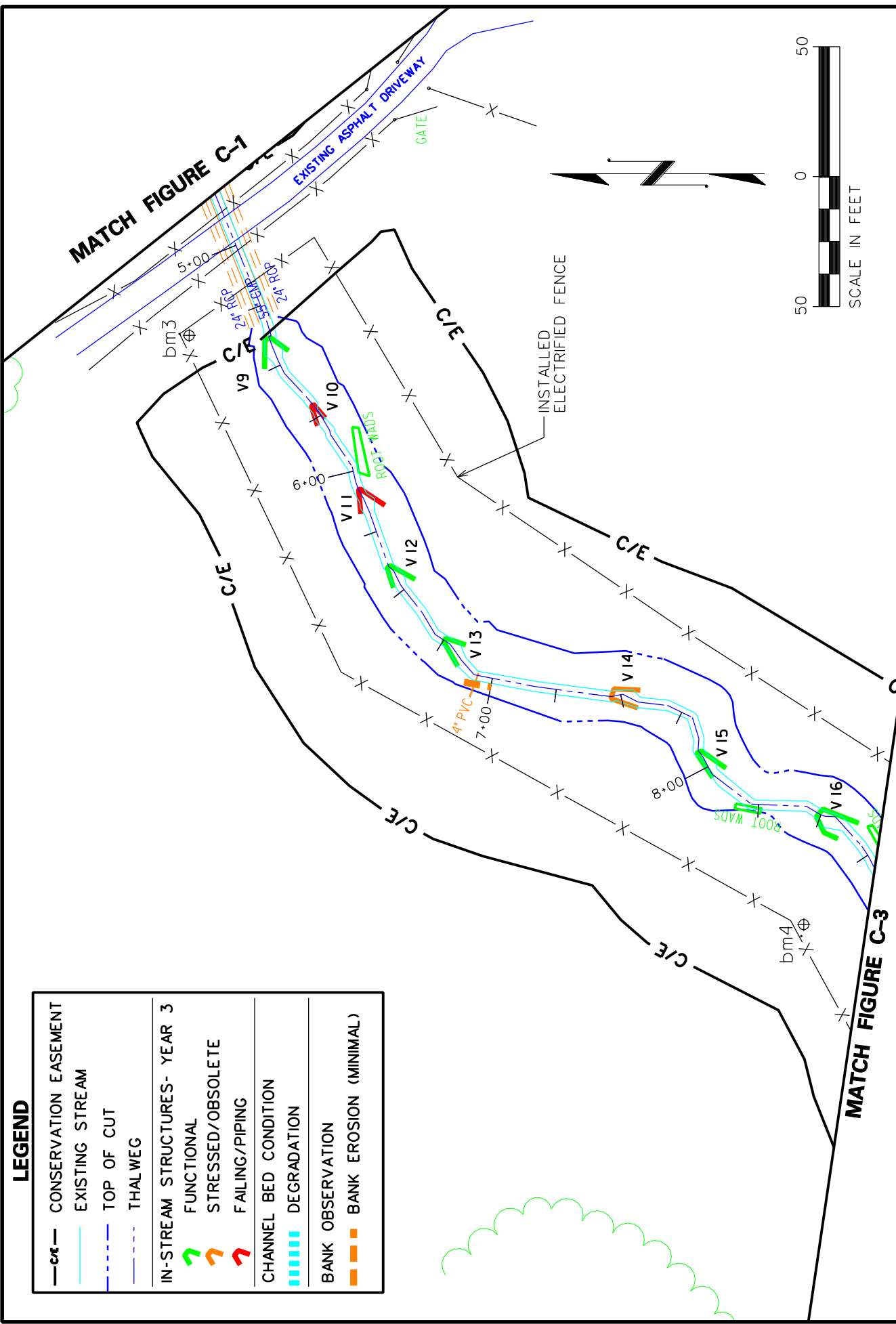
Drawn By:	JDG	Date:	DEC 2005
Checked By:	JWG	Scale:	1" = 50'
ESC Project No.:		05-243.04	

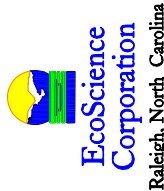

**EEP Project No. 27**  
 FRANKLIN COUNTY, NORTH CAROLINA



**LEGEND**

— C/E —	CONSERVATION EASEMENT
—	EXISTING STREAM
—	TOP OF CUT
—	THALWEG
IN-STREAM STRUCTURES- YEAR 3	
↗	FUNCTIONAL
↘	STRESSED/OBSOLETE
↖	FAILING/PIPING
CHANNEL BED CONDITION	
	DEGRADATION
BANK OBSERVATION	
—	BANK EROSION (MINIMAL)

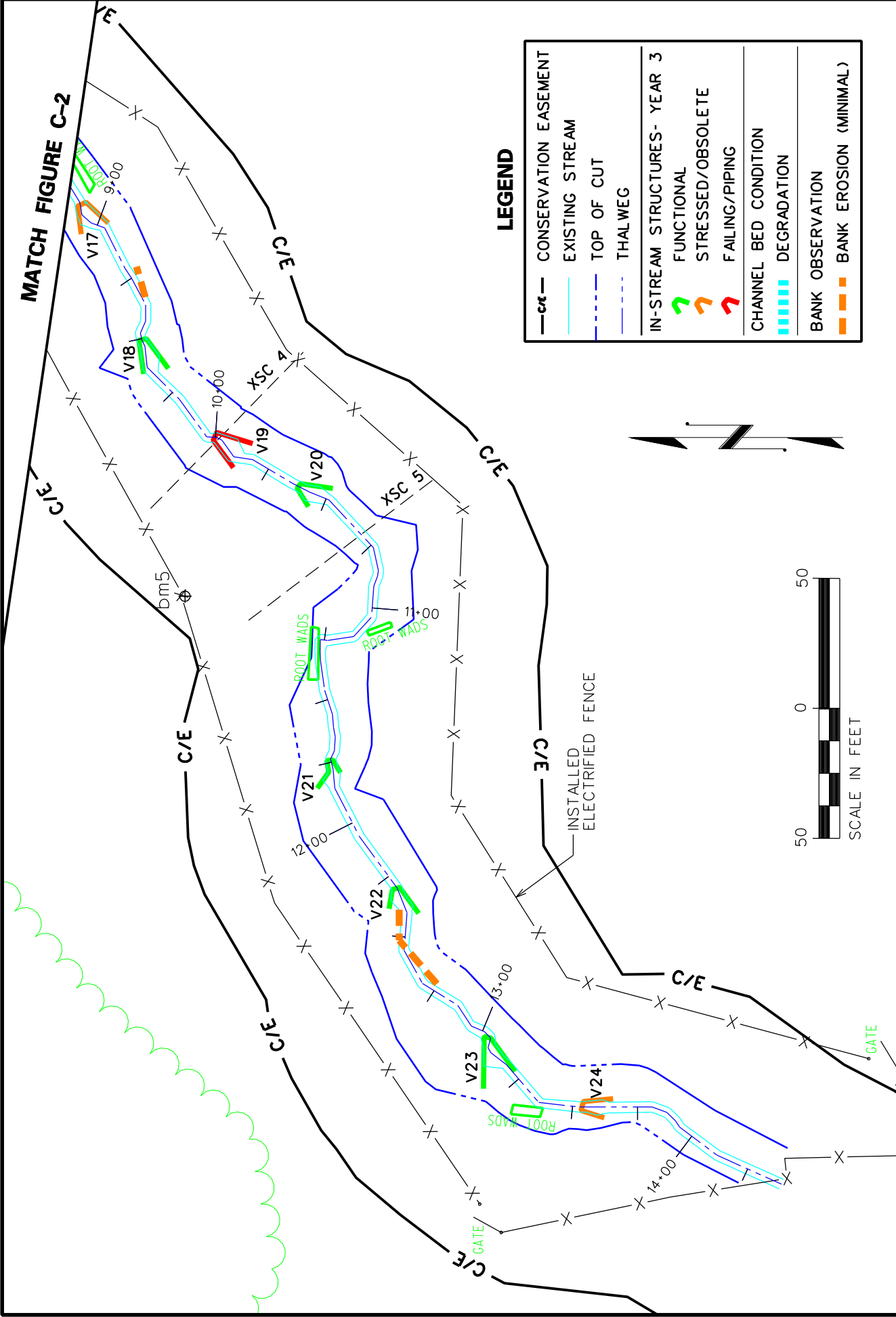


 <p><b>EcoScience Corporation</b> Raleigh, North Carolina</p>	 <p><b>Ecosystem Enhancement Program</b></p>	<p><b>STREAM PROBLEM AREAS</b></p> <p><b>Unnamed Tributary to Bear Swamp Creek Stream Restoration Site</b></p>		<p>FIGURE</p> <p><b>C-2</b></p>
		<p>Client:</p>	<p>Project:</p>	<p>Dwn By: JDG</p> <p>Ckd By: JWG</p> <p>ESC Project No.: 05-243.04</p>

**EEP Project No. 27**

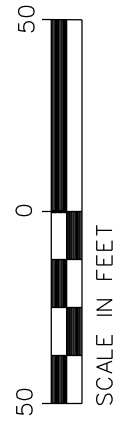
FRANKLIN COUNTY, NORTH CAROLINA

MATCH FIGURE C-2



**LEGEND**

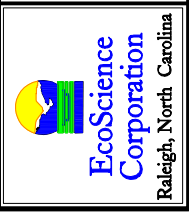
	CONSERVATION EASEMENT
	EXISTING STREAM
	TOP OF CUT
	THALWEG
	IN-STREAM STRUCTURES- YEAR 3 FUNCTIONAL
	STRESSED/OBSOLETE
	FAILING/PIPING
	CHANNEL BED CONDITION DEGRADATION
	BANK OBSERVATION
	BANK EROSION (MINIMAL)



**Stream Problem Areas**  
**Unnamed Tributary to Bear Swamp Creek Stream Restoration Site**

EEP Project No. 27  
 FRANKLIN COUNTY, NORTH CAROLINA

Drawn By:	JDG	Date:	DEC 2005
Checked By:	JWG	Scale:	1" = 50'
ESC Project No.:		05-243.04	



**C-3**

FIGURE

**UT to Bear Swamp Creek Stream Restoration Site (Year 3)  
Stream Problem Areas**

Photo 1. Rock Vane 2 has filled in with sediment but stream remains stable.



Photo 2. Piping of flow behind Rock Vane 3.



**UT to Bear Swamp Creek Stream Restoration Site (Year 3)  
Stream Problem Areas**

Photo 3. Piping of flow behind Rock Vane 3, causing moderate degradation of channel behind vane.



Photo 4. Piping of flow behind Rock Vane 3, causing moderate degradation of channel behind vane.



**UT to Bear Swamp Creek Stream Restoration Site (Year 3)  
Stream Problem Areas**

Photo 5. Piping of flow behind Rock Vane 10.



Photo 6. Piping of flow behind Rock Vane 11.



**UT to Bear Swamp Creek Stream Restoration Site (Year 3)**  
**UT to Bear Swamp Creek Stream Restoration Site (Year 3)**  
**Stream Problem Areas**

Photo 7. Rock Vane 14 has filled in with sediment but stream remains stable.



Photo 8. Rock Vane 17 has filled in with sediment but stream remains stable.





**UT to Bear Swamp Creek Stream Restoration Site (Year 3)  
Stream Problem Areas**

Photo 9. Piping of flow behind Rock Vane 11.



Photo 10. Erosion directly adjacent to stream from incoming 4-inch pipe.



**UT to Bear Swamp Creek Stream Restoration Site (Year 3)  
Stream Problem Areas**

Photo 11. Minor erosion along outside bend where channel is pinched.



**Photo Point 1 – UT to Bear Swamp Creek Stream Restoration Site (Year 3)**



Photo was taken November 29, 2005 looking downstream

**Photo Point 2 – UT to Bear Swamp Creek Stream Restoration Site (Year 3)**



Photo was taken November 29, 2005 looking upstream.

**Photo Point 3 – UT to Bear Swamp Creek Stream Restoration Site (Year 3)**



Photo was taken November 29, 2005 looking upstream.



Photo was taken October 5, 2005 looking downstream.

**Photo Point 4 – UT to Bear Swamp Creek Stream Restoration Site (Year 3)**



Photo was taken November 29, 2005 looking upstream.



Photo was taken October 5, 2005 looking downstream.

**Photo Point 5 – UT to Bear Swamp Creek Stream Restoration Site (Year 3)**



Photo was taken November 29, 2005 looking upstream.



Photo was taken October 5, 2005 looking downstream.

**Photo Point 6 – UT to Bear Swamp Creek Stream Restoration Site (Year 3)**



Photo was taken October 5, 2005 looking upstream.



Photo was taken November 29, 2005 looking downstream

**Photo Point 7 – UT to Bear Swamp Creek Stream Restoration Site (Year 3)**



Photos taken on October 5, 2005 and November 29 looking upstream.



Photos taken on October 5, 2005 and November 29 looking downstream.

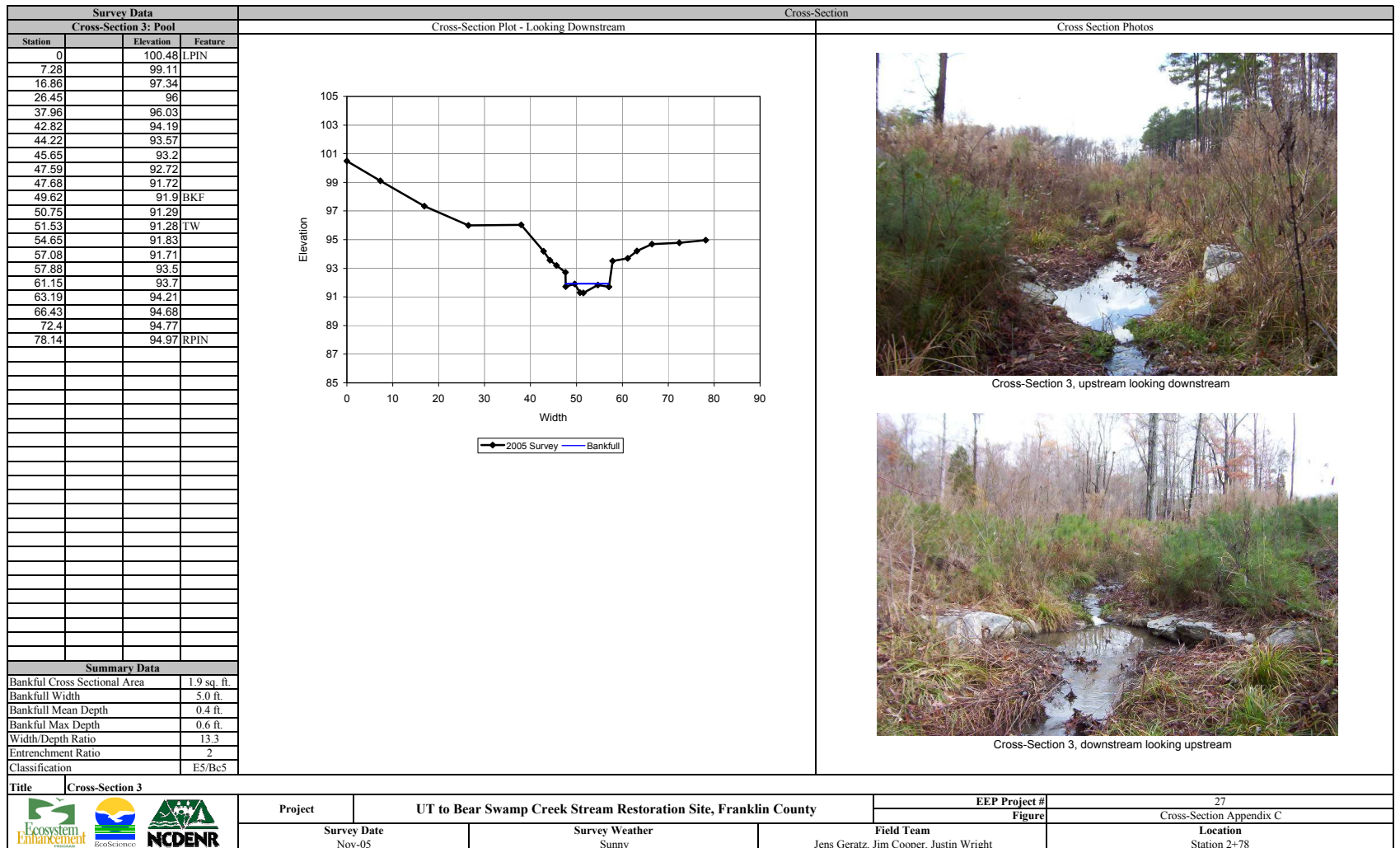


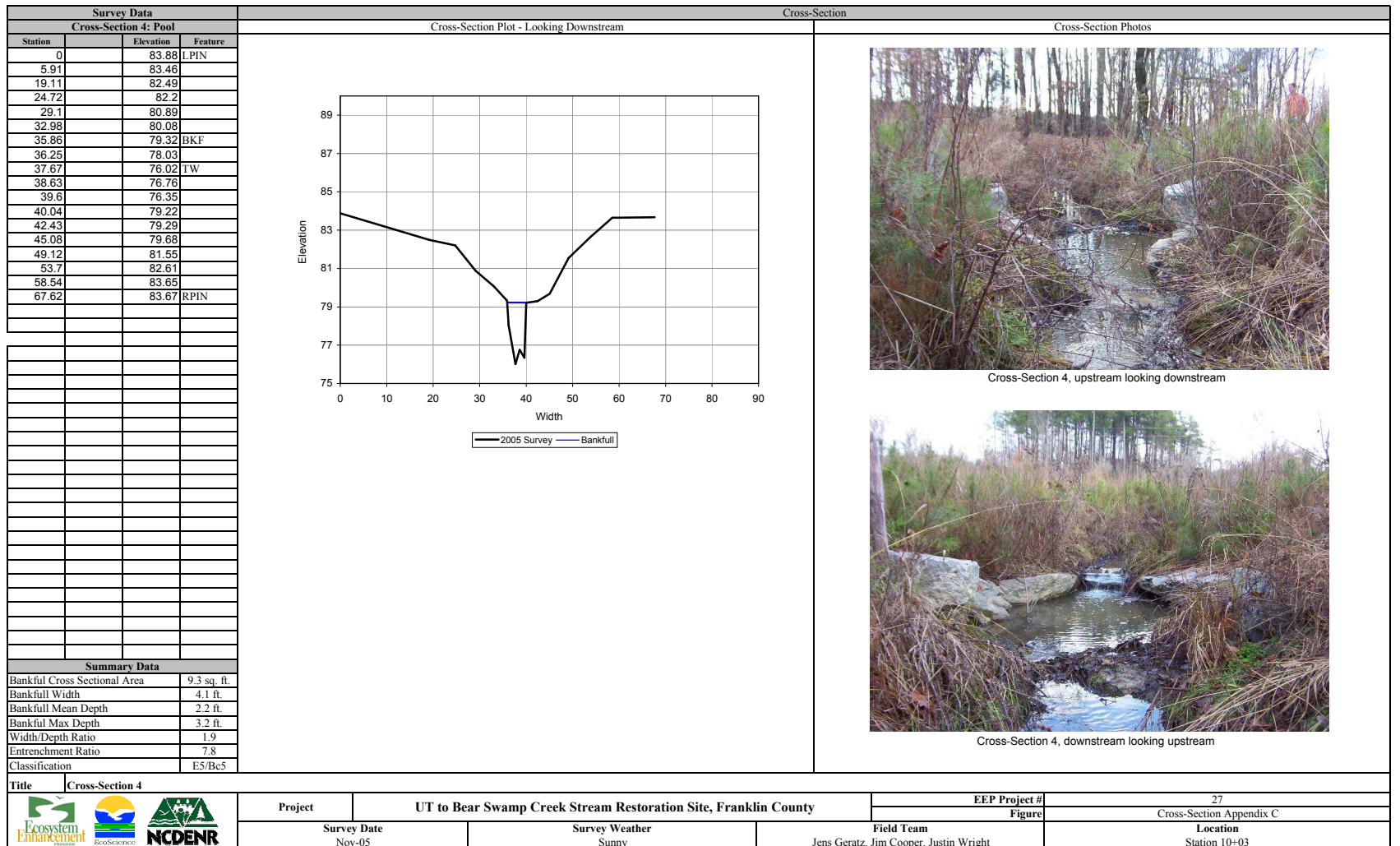
**Table C1. Visual Morphological Stability Assessment**  
**UT to Bear Swamp Creek Stream Restoration Site / EEP Project No. 27**  
**1,439 linear feet**

Feature Category	Metric (per As-built and reference baselines)	(# Stable) Number Performing as Intended	Total number per As-built	Total Number / feet in unstable state	% Perform in Stable Condition	Feature Perform. Mean or Total
A. Riffles	1. Present?	12	14	N/A	86	
	2. Armor stable (e.g. no displacement)?	12	14	N/A	86	
	3. Facet grade appears stable?	10	14	N/A	71	
	4. Minimal evidence of embedding/fining?	10	14	N/A	71	
	5. Length appropriate?	12	14	N/A	86	<b>80%</b>
B. Pools	1. Present? (e.g not subject to severe aggrad. or migrat.?)	14	14	N/A	100	
	2. Sufficiently deep (Max Pool D:Mean Bkf >1.6?)	12	14	N/A	86	
	3. Length appropriate?	12	14	N/A	86	<b>91%</b>
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	7	7	N/A	100	
	2. Downstream of meander (glide/inflection) centering?	6	8	N/A	75	<b>88%</b>
D. Meanders	1. Outer bend in state of limited/controlled erosion?	12	14	N/A	86	
	2. Of those eroding, # w/concomitant point bar formation?	1	2	N/A	50	
	3. Apparent Rc within spec?	14	14	N/A	100	
	4. Sufficient floodplain access and relief? <sup>b</sup>	10	14	N/A	71	<b>77%</b>
E. Bed General	1. General channel bed aggradation areas (bar formation)	N/A	N/A	3/75	96	
	2. Channel bed degradation – areas of increasing down-cutting or head cutting?	N/A	N/A	2/150	93	<b>95%</b>
F. Vanes	1. Free of back or arm scour?	7	8	N/A	88	
	2. Height appropriate?	6	8	N/A	75	
	3. Angle and geometry appear appropriate?	7	8	N/A	88	
	4. Free of piping or other structural failures?	6	8	N/A	75	<b>82%</b>
G. Wads/Boulders	1. Free of scour?	19	25	N/A	76	
	2. Footing stable?	24	25	N/A	96	<b>86%</b>







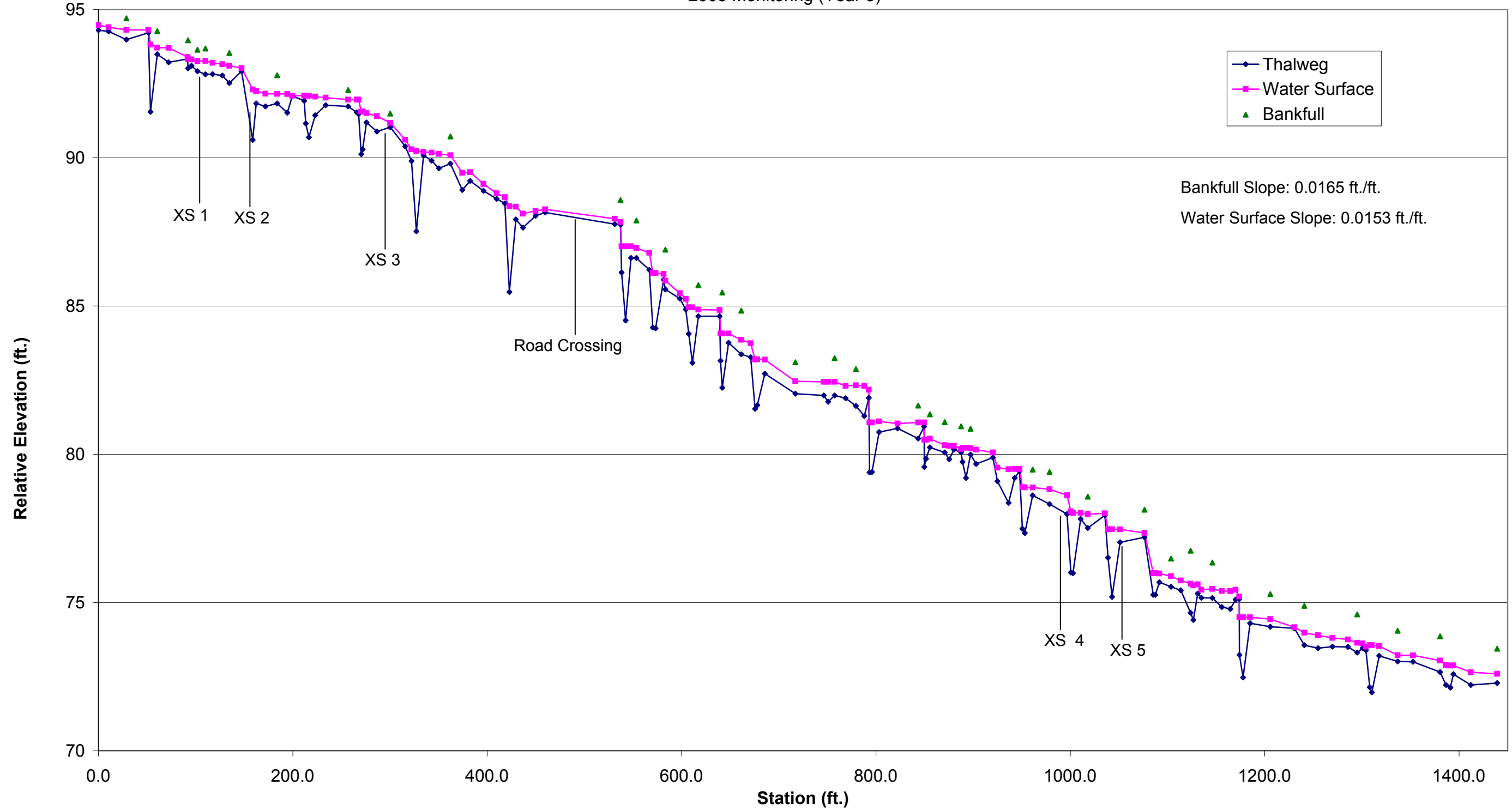


Survey Data			Cross-Section Plot - Looking Downstream	Cross-Section Photos
Cross-Section 5: Riffle				
Station	Elevation	Feature		
0	83.58	LPIN		
7.04	83.21			
11.71	82.5			
16.94	81.38			
19.12	80.24			
20.37	78.77			
21.36	78.38	BKF		
21.49	77.48			
21.67	77.12	TW		
24.02	77.17			
25.97	77.21			
27.22	78.55			
28.99	79.15			
32.23	81.25			
35.13	82.34			
39.52	82.65			
52.86	82.37			
69.61	82.32	RPIN		
Summary Data			<p style="text-align: center;"> </p>	
Bankful Cross Sectional Area	6.1 sq. ft.			
Bankfull Width	5.7 ft.			
Bankfull Mean Depth	1.1 ft.			
Bankfull Max Depth	1.3 ft.			
Width/Depth Ratio	5.3			
Entrenchment Ratio	1.8			
Classification	E5/Bc5			
Title	Cross-Section 5			<b>EEP Project #</b> 27 <b>Figure</b> Cross-Section Appendix C
Project	UT to Bear Swamp Creek Stream Restoration Site, Franklin County			
Survey Date	Nov-05	Survey Weather	Sunny	<b>Field Team</b> Jens Geratz, Jim Cooper, Justin Wright
			<b>Location</b> Station 10+68	

# UT to Bear Swamp Creek

Longitudinal Profile

2005 Monitoring (Year 3)



**Project Name:** UT to Bear Swamp Creek  
**Task:** Longitudinal Profile  
**Date:** November 2005  
**Crew:** JC, JG, JW

Station	TW Elevation	WS Elevation	BKF Elevation	Feature	Station	TW Elevation	WS Elevation	BKF Elevation	Feature
0.0	94.3	94.48			382.4	89.22	89.51		TR
10.5	94.26	94.40		TR	396.3	88.88	89.11		
28.6	93.98	94.31	94.7	BR/TP	409.8	88.61	88.80		
51.3	94.21	94.31		BP	418.2	88.46	88.67		BR
53.5	91.55	93.81			422.9	85.47	88.36		TP
60.4	93.49	93.71	94.27		429.4	87.92	88.35		BP
72.3	93.22	93.71			436.8	87.64	88.11		
91.8	93.33	93.40			449.8	88.04	88.21		
92.1	93.01	93.31	93.96		459.7	88.15	88.26		
95.7	93.1	93.31		TR	531.3	87.76	87.94		
101.8	92.92	93.26	93.64		537.2	87.74	87.83	88.57	
110.1	92.81	93.27	93.68		538.2	86.13	87.01		TP
117.5	92.82	93.20			542.5	84.51	87.01		BP
127.5	92.77	93.15			548.0	86.62	87.01		TR
134.7	92.52	93.10	93.53	BR	553.5	86.62	86.95	87.88	
147.3	92.92	93.02			566.9	86.22	86.80		BR
158.8	90.6	92.30			570.5	84.27	86.11		TP
162.3	91.83	92.24			573.3	84.25	86.11		BP
171.9	91.73	92.16			581.6	85.89	86.08		TR
183.9	91.83	92.15	92.78		583.3	85.56	85.85	86.9	
194.2	91.52	92.15			598.2	85.25	85.43		
199.5	92.08	92.09		TR	604.4	84.88	85.24		BR
211.8	91.92	92.09		BR	607.5	84.06	84.95		TP
213.2	91.15	92.09			611.2	83.08	84.95		BP
216.5	90.69	92.09			617.2	84.65	84.88	85.7	TR
223.1	91.43	92.06		BP	639.2	84.65	84.86		BR
233.7	91.77	92.03			640.0	83.15	84.07		TP
257.0	91.73	91.96	92.28	TR	641.9	82.24	84.07	85.45	BP
265.7	91.53	91.96			648.3	83.76	84.07		TR
267.8	91.47	91.96			661.4	83.37	83.86	84.84	
270.3	90.12	91.56			671.2	83.27	83.74		BR
271.8	90.28	91.56		BR	675.7	81.53	83.20		TP
275.7	91.19	91.51			678.0	81.65	83.20		BP
286.5	90.88	91.40			685.7	82.72	83.19		TR
300.3	91.03	91.18	91.49		717.1	82.04	82.46	83.1	
315.6	90.38	90.60			746.4	81.98	82.44		BR
322.1	89.89	90.28			750.9	81.77	82.44		
327.1	87.52	90.23		TP	757.4	81.98	82.44	83.24	TR
334.5	90.08	90.20		BP	768.8	81.89	82.31		BR
342.8	89.9	90.17			779.5	81.63	82.32	82.87	TP
350.3	89.64	90.13			788.1	81.29	82.30		BP
362.2	89.8	90.08	90.72		792.7	81.9	82.18		
374.4	88.91	89.49			793.4	79.39	81.07		TP



**Project Name:** UT to Bear Swamp Creek  
**Task:** Longitudinal Profile (continued)  
**Date:** November 2005  
**Crew:** JC, JG, JW

Station	TW Elevation	WS Elevation	BKF Elevation	Feature	Station	TW Elevation	WS Elevation	BKF Elevation	Feature
795.9	79.4	81.07		BP	1134.9	75.16	75.43		
803.3	80.75	81.11		TR	1146.2	75.15	75.46	76.35	
822.3	80.87	81.03		BR	1156.0	74.85	75.39		TP
843.4	80.53	81.07	81.64		1164.7	74.78	75.38		BP
849.7	80.93	81.07			1170.1	75.1	75.43		TR
849.8	79.57	80.49		TP	1173.8	75.12	75.20		BR
851.6	79.85	80.49		BP	1174.1	73.23	74.50		TP
855.6	80.23	80.52	81.35	TR	1177.8	72.47	74.50		BP
870.8	80.06	80.30	81.08	BR	1185.1	74.3	74.50		TR
875.4	79.83	80.28			1205.9	74.18	74.44	75.28	
880.4	80.16	80.28		TR	1230.6	74.13	74.16		BR
887.7	80.06	80.17	80.94	BR	1240.8	73.56	73.98	74.89	TR
889.1	79.74	80.22		TP	1255.1	73.46	73.89		
892.8	79.2	80.22		BP	1269.7	73.51	73.80		
897.4	79.99	80.20	80.86		1285.7	73.5	73.75		
903.1	79.67	80.15			1295.3	73.31	73.64	74.6	
920.4	79.89	80.06			1300.8	73.46	73.62		BR
925.0	79.09	79.55			1304.2	73.39	73.51		
936.6	78.36	79.49			1308.1	72.14	73.56		TP
942.8	79.2	79.50			1310.2	71.97	73.56		BP
947.8	79.43	79.50			1317.8	73.2	73.53		TR
950.6	77.49	78.89		TP	1336.9	73.01	73.22	74.05	
953.2	77.34	78.88		BP	1352.8	73	73.22		
961.3	78.61	78.88	79.48	TR	1380.5	72.65	73.04	73.86	BR
978.8	78.32	78.82	79.4		1386.6	72.22	72.88		TP
996.6	77.98	78.62		BR	1391.2	72.13	72.87		BP
1000.6	76.01	78.07		TP	1394.1	72.58	72.88		TR
1002.7	75.99	78.02		BP	1412.1	72.22	72.65		
1010.6	77.82	78.02		TR	1439.3	72.28	72.59	73.44	BR
1018.0	77.51	77.98	78.57	BR	end profile				
1035.7	77.94	78.01							
1038.8	76.51	77.47		TP					
1043.0	75.19	77.47		BP					
1051.2	77.03	77.46		TR					
1076.3	77.2	77.35	78.13	BR					
1085.3	75.26	75.99		TP					
1087.5	75.26	75.99		BP					
1091.6	75.68	75.98		TR					
1103.7	75.53	75.89	76.48						
1113.7	75.41	75.74							
1123.8	74.65	75.64	76.75	BR					
1126.6	74.41	75.58		TP					
1131.1	75.3	75.61		BP					

**Project Name:** UT to Bear Swamp Creek  
**Task:** Riffle Calculations  
**Date:** November 2005  
**Crew:** JC, JG, JW

Feature/Facet slope, length, and spacing					Feature/Facet slope, length, and spacing				
Riffle Station	Length	WS Elevation	Change	Slope	Riffle Station	Length	WS Elevation	Change	Slope
10.5		94.40			961.3		78.61		
28.6	18.1	94.31	0.09	0.005	996.6	35.3	78.32	0.29	0.008
95.7		93.31			1010.6		77.82		
134.7	39.0	93.10	0.21	0.005	1018.0	7.4	77.51	0.31	0.042
199.5		92.08			1051.2		77.46		
211.8	12.3	91.92	0.16	0.013	1076.3	25.1	77.35	0.12	0.005
300.3		91.18			1091.6		75.98		
322.1	21.8	90.28	0.90	0.004	1123.8	32.2	75.64	0.34	0.011
382.4		89.51			1170.1		75.43		
418.2	35.8	88.67	0.84	0.023	1173.8	3.8	75.20	0.23	0.061
548.0		87.01			1185.1		74.50		
566.9	18.9	86.80	0.21	0.011	1230.6	45.5	74.16	0.34	0.007
581.6		86.08			1240.8		73.98		
604.4	22.8	85.24	0.84	0.037	1300.8	60.0	73.62	0.36	0.006
617.2		84.88			1317.8		73.53		
639.2	22.0	84.86	0.02	0.001	1380.5	62.7	73.04	0.49	0.008
648.3		84.07			1394.1		72.88		
671.2	22.9	83.74	0.33	0.014	1439.3	45.2	72.59	0.29	0.006
685.7		83.19			Average riffle slope: 0.014 ft./ft.				
746.4	60.7	82.44	0.75	0.012	Riffle length: 28.0 ft. (average)				
757.4		82.44			3.8 ft. - 62.7 ft. (range)				
768.8	11.4	82.31	0.13	0.011					
803.3		81.11							
822.3	19.0	81.03	0.07	0.004					
855.6		80.52							
870.8	15.2	80.30	0.22	0.014					
880.4		80.28							
887.7	7.3	80.17	0.12	0.016					

**Project Name:** UT to Bear Swamp Creek  
**Task:** Pool Calculations  
**Date:** November 2005  
**Crew:** JC, JG, JW

Feature/Facet slope, length, and spacing					Feature/Facet slope, length, and spacing				
Pool Station	Length	WS Elevation	Change	Slope	Pool Station	Length	WS Elevation	Change	Slope
28.6		94.31			1000.6		78.07		
51.3	22.7	94.31	0.00	0	1002.7	2.2	78.02	0.05	0.023
211.8		92.09			1038.8		77.47		
223.1	11.3	92.06	0.03	0.003	1043.0	4.2	77.47	0.00	0.000
327.1		90.23			1085.3		75.99		
334.5	7.4	90.20	0.03	0.0041	1087.5	2.2	75.99	0.00	0.000
422.9		88.36			1126.6		75.58		
429.4	6.5	88.35	0.01	0.0015	1131.1	4.5	75.61	0.04	0.009
538.2		87.01			1156.0		75.39		
542.5	4.3	87.01	0	0	1164.7	8.7	75.38	0.01	0.001
570.5		86.11			1174.1		74.50		
573.3	2.8	86.11	0	0	1177.8	3.7	74.50	0.00	0.000
607.5		84.95			1308.1		73.56		
611.2	3.7	84.95	0	0	1310.2	2.1	73.56	0.00	0.000
640.0		84.07			1386.6		72.88		
641.9	1.9	84.07	0	0	1391.2	4.6	72.87	0.01	0.002
675.7		83.20			Average pool slope: 0.0022 ft./ft.				
678.0	2.3	83.20	0	0	Pool-to-pool spacing: 64.6 ft. (average)				
779.5		82.32			14 ft. - 183 ft. (range)				
788.1	8.6	82.30	0.02	0.002	Pool length: 5.2 ft. (average)				
793.4		81.07			1.8 ft. - 22.7 ft. (range)				
795.9	2.5	81.07	0.00	0.000					
849.8		80.49							
851.6	1.8	80.49	0.00	0.000					
889.1		80.22							
892.8	3.7	80.22	0.00	0.000					
950.6		78.89							
953.2	2.6	78.88	0.01	0.004					

Bed Surface		
Material	Size Range (mm)	Count
silt/clay	0 - 0.062	14
very fine sand	0.062 - 0.125	30
fine sand	0.125 - 0.25	13
medium sand	0.25 - 0.5	
coarse sand	0.5 - 1	
very coarse sand	1 - 2	
very fine gravel	2 - 4	3
fine gravel	4 - 6	9
fine gravel	6 - 8	2
medium gravel	8 - 11	6
medium gravel	11 - 16	2
coarse gravel	16 - 22	8
coarse gravel	22 - 32	4
very coarse gravel	32 - 45	1
very coarse gravel	45 - 64	2
small cobble	64 - 90	2
medium cobble	90 - 128	1
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		97
bedrock -----		3
clay hardpan -----		
detritus/wood -----		
artificial -----		
total count:		100
Note: Reach-wide classification count		

