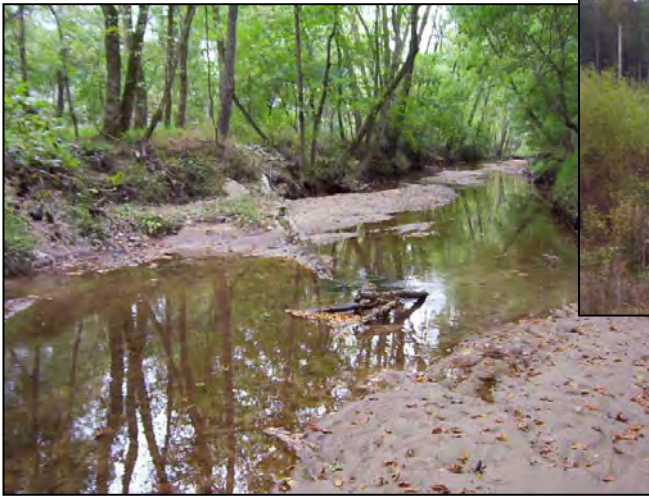


**SANDY CREEK STREAM ENHANCEMENT
AND WETLAND RESTORATION SITE
2007 Annual Monitoring Report (Year 4)**

**Durham County
EEP Project No. 322
Design Firm: Becky L. Ward Consulting**



February 2008

**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**



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1.0 EXECUTIVE SUMMARY

The Sandy Creek Stream Enhancement and Wetland Restoration Site (Site) was selected to mitigate impacts to Section 404 jurisdictional areas associated with the extension of Martin Luther King, Jr. Parkway (Parkway) between Cook Road and Hope Valley Road in Durham County. The impacts of the Parkway on jurisdictional wetlands and non-wetland jurisdictional waters totaled 1.73 acres near Third Fork Creek. The Site provides 3.6 acres of restoration and creation as mitigation for the impacts. The Ecosystem Enhancement Program (EEP) will be using the remaining 1.87 acres as mitigation for other impacts within the Cape Fear River Basin. In addition to the wetland restoration, Sandy Creek has been enhanced with the installation of log vanes. The log vanes are intended to create pool features that will enhance habitat and water quality along 2,700 linear feet of stream. Stream stationing begins at the downstream end of the project and increases upstream.

Site construction and planting was completed in June 2003. The Site was partially replanted in January 2004. The 2007 monitoring report represents the fourth year of vegetation and hydrological monitoring. The Site must demonstrate both hydrologic and vegetation success for a minimum of five years or until the Site is deemed successful. The following paragraphs summarize the results of the on-site monitoring that has occurred during the fourth year.

Vegetation Monitoring

Vegetation success criteria for the wetland restoration areas include a minimum survival of 288 stems per acre of planted species at the end of the current monitoring year. In addition, six planted species must survive throughout the Site. Four of the five vegetation plots achieved the density criterion for success at the Site. However, since only three planted species were recorded in the aggregated vegetation plots, the Site as a whole fails the diversity criterion.

Low survival of many of the planted species can be attributed to flooding at Plot 4 (located in an on-site pond) and invasive exotics at Plot 5. The surviving stems are most likely volunteer individuals of the planted species recruited from the surrounding woods. Initial plantings were previously reported to be largely destroyed by geese, and this event is assumed to be responsible for low species diversity at the site at Year 4. Poor soil composition (Urban land soils occupy approximately 5.5 acres of the Site) is another factor in poor survival.

Stream Enhancement Monitoring

The log vanes in Sandy Creek were observed and evaluated for stability and effectiveness. The vanes appear stable with no visible signs of piping. Vegetation has established on the depositional areas behind the vane arms at many locations. The banks adjacent to all the vanes were stable and vegetated, while showing no evidence of erosion. However, the enhancement of bed form from the installation of these vanes is not currently evident. Sandy Creek is currently classified as a sandbed system within a suburban watershed. Under conditions free from excessive sediment input, Sandy Creek would be classified as a gravel cobble system. Based on cursory observations, the high sediment load in the stream has not allowed pools to form downstream of the structures. No discernable bed features were observed throughout the reach. The permanent cross-section survey and pebble counts show limited change over the past year. Bankfull area was observed to increase since last year, and may be attributed to sediment transport during peak flow conditions.

Wetland Hydrology Monitoring

The 2007 hydrologic monitoring results indicate limited hydrologic success within the Site. Only one gauge (Gauge A) exhibited saturation within 12 inches of the ground surface for at least 12.5 percent (consecutive days) of the growing season (March 30 – November 11 or 227 days). Gauges B and C

exhibited saturation within 12 inches of the ground surface for 5-12.5 percent of the growing season. Drought conditions throughout the monitoring period contributed to the limited hydrologic saturation.

2.0 PROJECT BACKGROUND

2.1 MITIGATION OBJECTIVES AND STRUCTURE

The Site is located adjacent to Sandy Creek Park (future Sandy Creek Environmental Education Center) in Durham, North Carolina near the intersection of Highway 15-501 Bypass / 15-501 Business (Figure 1). Site directions: from Raleigh, follow I-40 west to Highway 15-501. Take Highway 15-501 north approximately 2 miles. Pass under 15-501 Bypass and turn left onto Tower Boulevard. Take Tower Boulevard until it dead ends at Pickett Road. Turn left. Sandy Creek Road will be on the left directly after crossing over 15-501 Bypass. Take Sandy Creek Road to the end and enter into the Sandy Creek Park. The entrance to the wetland restoration area is accessed by following the greenway trail (Sandy Creek Trail) to a dilapidated bridge crossing over Sandy Creek. The stream enhancement reach begins approximately 1525 feet upstream of the bridge and ends approximately 1175 feet downstream of the bridge at the stream culverts located under Highway 15-501.

The objectives of this project are to restore habitat and water quality in Sandy Creek and restore the abandoned sludge drying bed locations to riparian wetlands. The restored wetland ecosystem will provide quality habitat and food for wildlife, as well as buffer and water storage benefits within the Sandy Creek watershed.

2.2 LOCATION AND SETTING

The Site occupies areas once used by the defunct New Hope Creek Wastewater Treatment Facility owned by the City of Durham (City). As part of a park and greenway development plan the City Parks and Recreation Department removed existing structures including piping, control buildings, and fencing of the existing sludge drying beds located west of Sandy Creek within the proposed wetland restoration area. Prior to construction of the wetland project, the City had completed phase one of the Sandy Creek Trail, a greenway trail located along the east side of Sandy Creek. Demolition of the treatment plant east of Sandy Creek continued concurrently with the wetland and stream restoration project.

Wetland Restoration Activities

The area proposed for wetland restoration was excavated as an extension of existing ponds and vegetated wetlands located adjacent to the Site (Figure 2). The wetland was designed so that a broad berm set at the elevation of the seasonal high water table of the pond (262.0 feet) separates the restored wetland into two sections. The southern section ties into the grade of the existing wetland and slopes gradually up to the berm. From the berm, the ground gradually slopes down to the north into a depression that stores run-off from adjacent slopes and floodwaters from Sandy Creek. In the middle of the depression, an elevated island was constructed to allow for various vegetation assemblages. Following the completion of earthwork the Site was planted with native tree and shrub species.

Stream Enhancement Activities

Thirteen log vane structures were placed along 2700 linear feet of Sandy Creek in order to create pool features within the sandbed system. The log vanes consisted of two hardwood trees, stacked together to form each structure. The logs were secured together with rebar and tied with cables at both ends. Vegetation was planted on the banks to stabilize the disturbance created during installation. Additional modifications to the channel included regrading and stabilizing a small section of bank directly above the culverts located under Highway 15-501 and the removal of fallen trees and debris to improve flow conditions.



1 mi. 0 1 mi. 4 mi.
 1:144,000
 Source: 1997 North Carolina Atlas and Gazetteer, p.39.



SITE LOCATION
Sandy Creek Stream Enhancement
and Wetland Restoration Site
 Durham County, North Carolina

Dwn. by:	MAF	FIGURE 1
Ckd by:	MCG	
Date:	DEC 2007	
Project:	06-282.03	

Exhibit Table I. Project Mitigation Objectives and Structure Sandy Creek Stream Enhancement and Wetland Restoration Site / EEP Project No. 322					
Project Segment or Reach ID	Mitigation Type*	Approach**	Linear Footage or Acreage	Stationing***	Comments
Reach I	EII	SSS	2700 linear feet	00+00 to 27+00	Primarily achieved with placement of log vanes
Wetland Restoration	R	-	3.6 acres	NA	

* EII = Enhancement II, R = Restoration

** SSS = Stream Bank Stabilization

*** Stationing begins at the downstream end of the project and increases upstream

2.3 PROJECT HISTORY AND BACKGROUND

Exhibit Table II. Project Activity and Reporting History Sandy Creek Stream Enhancement and Wetland Restoration Site / EEP Project No. 322			
Activity Report	Scheduled Completion	Data Collection Complete	Actual Completion or Delivery
Restoration Plan	NA*	NA*	NA*
Final Design (90%)	NA*	NA*	NA*
Construction	NA*	NA*	Jun 2003
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 / As-builts (Year 0 Monitoring – baseline)	NA*	Jun 2003	Oct 2003
Year 1 Monitoring	NA*	May 2004	NA*
Site Replanting (portions of Zone 3)	NA*	NA*	Mid 2004
Year 1 Monitoring re-sampling	NA*	Sep 2004	Dec 2004
Year 2 Monitoring (Vegetation)	Dec 2005	Oct 2005	Dec 2005
Year 2 Monitoring (Groundwater Gauges)	Dec 2005	Oct 2005	Dec 2005
Year 3 Monitoring (Vegetation)	Dec 2006	Nov 2006	Dec 2006
Year 3 Monitoring (Groundwater Gauges)	Dec 2006	Nov 2006	Dec 2006
Year 4 Monitoring (Vegetation)	Dec 2007	Nov 2007	Dec 2007
Year 4 Monitoring (Groundwater Gauges)	Dec 2007	Nov 2007	Dec 2007

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.

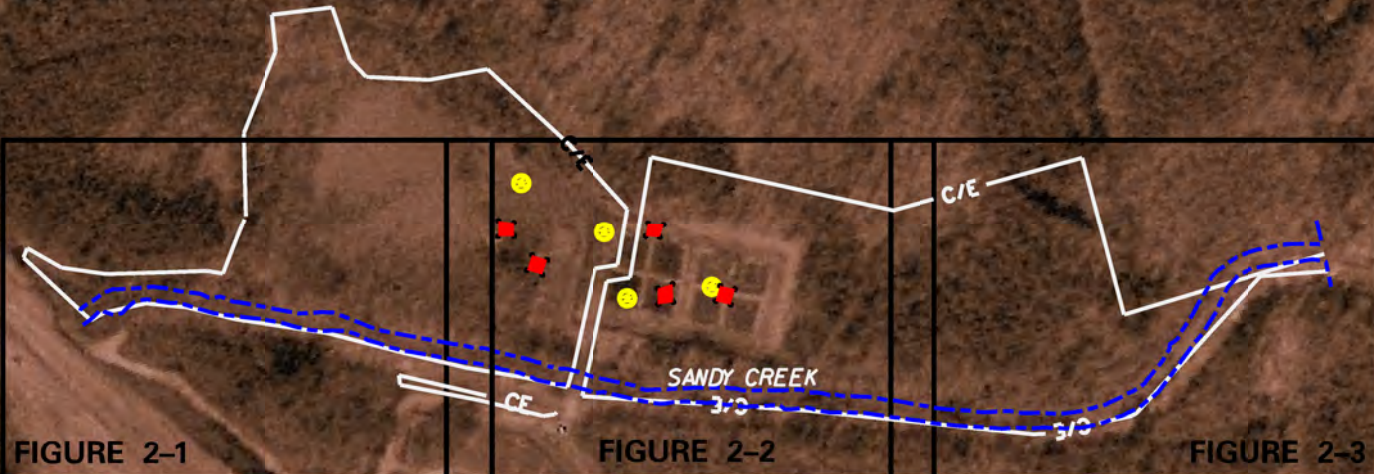
*NA – Historical project documents necessary to provide this data were unavailable at the time of this report submission.

Exhibit Table III. Project Contacts Sandy Creek Stream Enhancement and Wetland Restoration Site / EEP Project No. 322	
Designer Becky L. Ward Consulting	Ms. Becky Ward 1512 Eglantyne Court Raleigh, NC 27613 (919) 870-0526
Construction Contractor Shamrock Environmental, Inc	Mr. Greg Kiser 6106 Corporate Park Drive Browns Summit, NC 27214 (336) 375-1989
Planting Contractor	NA*
Seeding Contactor	NA*
Seed Mix Sources	NA*
Nursery Stock Suppliers	NA*
Monitoring Performers	EcoScience Corporation 1101 Haynes Street, Suite 101 Raleigh, NC 27604 (919) 828-3433
Stream Monitoring POC	Jens Geratz
Vegetation Monitoring POC	Elizabeth Scherrer
Wetland Monitoring POC	Jens Geratz

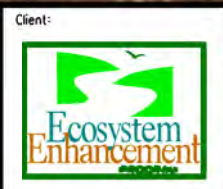
*NA – Historical project documents necessary to provide this data were unavailable at the time of this report submission.

Exhibit Table IV. Project Background Sandy Creek Stream Enhancement and Wetland Restoration Site / EEP Project No. 322	
Project County	Durham
Drainage Area	7.3 square miles to culvert at Bypass 15-501
Impervious cover estimate (%)	10 percent
Stream Order	3 rd order
Physiographic Region	Piedmont
Ecoregion (Griffith and Omernik)	Triassic Basin
Rosgen Classification of As-built	NA (Enhancement only)
Cowardin Classification	Stream (R3UB2)
	Wetlands (PFO1)
Dominant soil types	Stream - Chewacla and Wehadkee soils (Ch)
	Wetlands - Urban Land (Ur)
SCO #ID	010542301
USGS HUC for Project and Reference	03030002060110 / NA
NCDWQ Sub-basin for Project and Reference	03-06-05 / NA
NCDWQ classification for Project and Reference	C, NSW / 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	NA
Percent of project easement fenced	None

- C/E - CONSERVATION EASEMENT
- VEGETATION MONITORING PLOT
- MONITORING GAUGE LOCATION
- - - EXISTING STREAM



SOURCE: USGS 3.75 MINUTE DIGITAL ORTHO QUARTER QUADRANT COLOR INFRARED 1998



Client: EcoScience Corporation

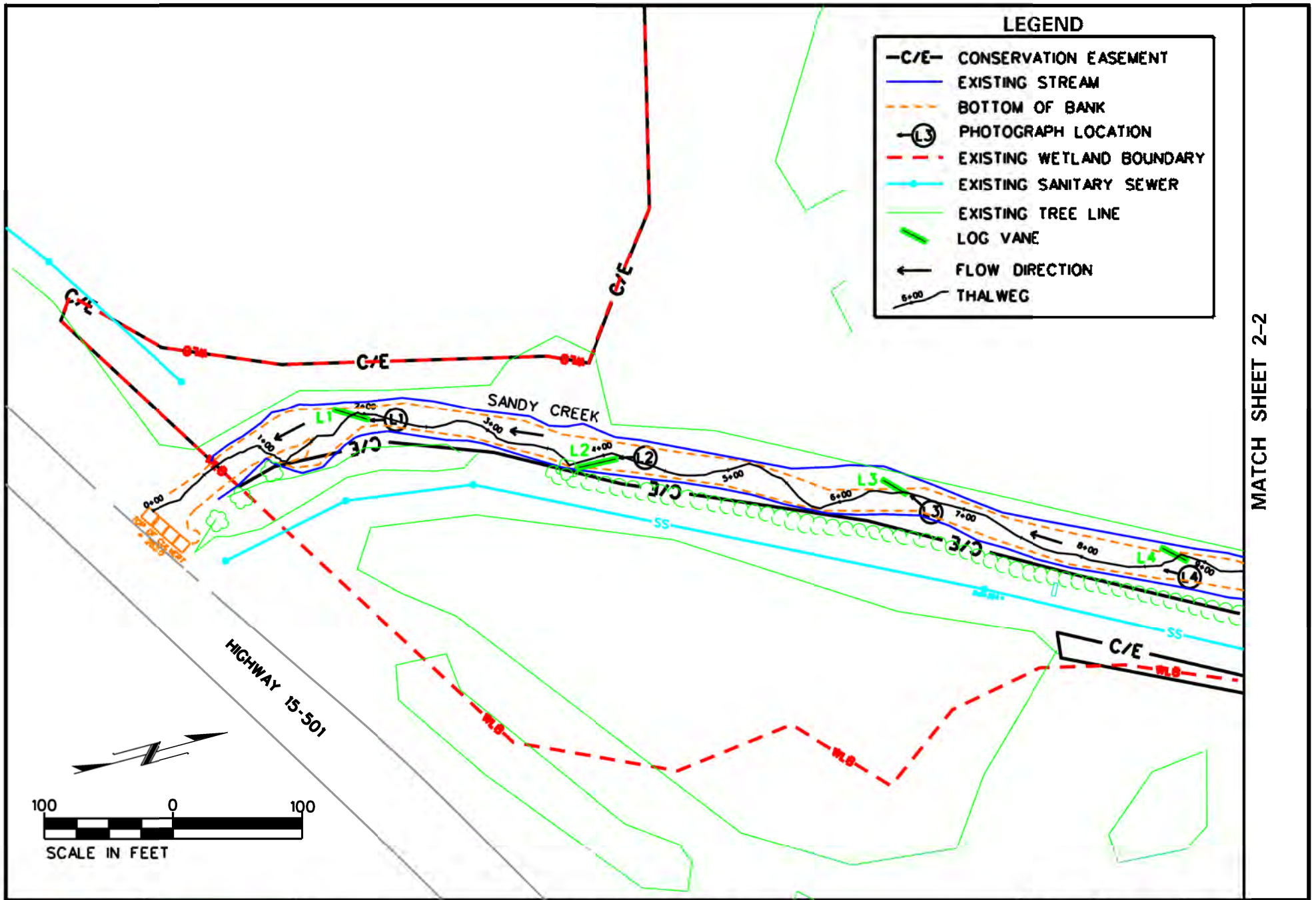
Title: MONITORING PLAN VIEW SHEET INDEX

Project: Sandy Creek Stream Enhancement and Wetland Restoration Site
EEP Project No. 322
DURHAM COUNTY, NORTH CAROLINA

Dwn By: GWN
Ckd By: JWG
ESC Project No.: 06.282.03

Date: FEB 2008
Scale: 1" = 400'

FIGURE
2



LEGEND	
-C/E-	CONSERVATION EASEMENT
—	EXISTING STREAM
- - -	BOTTOM OF BANK
Ⓛ	PHOTOGRAPH LOCATION
- - -	EXISTING WETLAND BOUNDARY
—	EXISTING SANITARY SEWER
—	EXISTING TREE LINE
—	LOG VANE
←	FLOW DIRECTION
—	THALWEG

MATCH SHEET 2-2



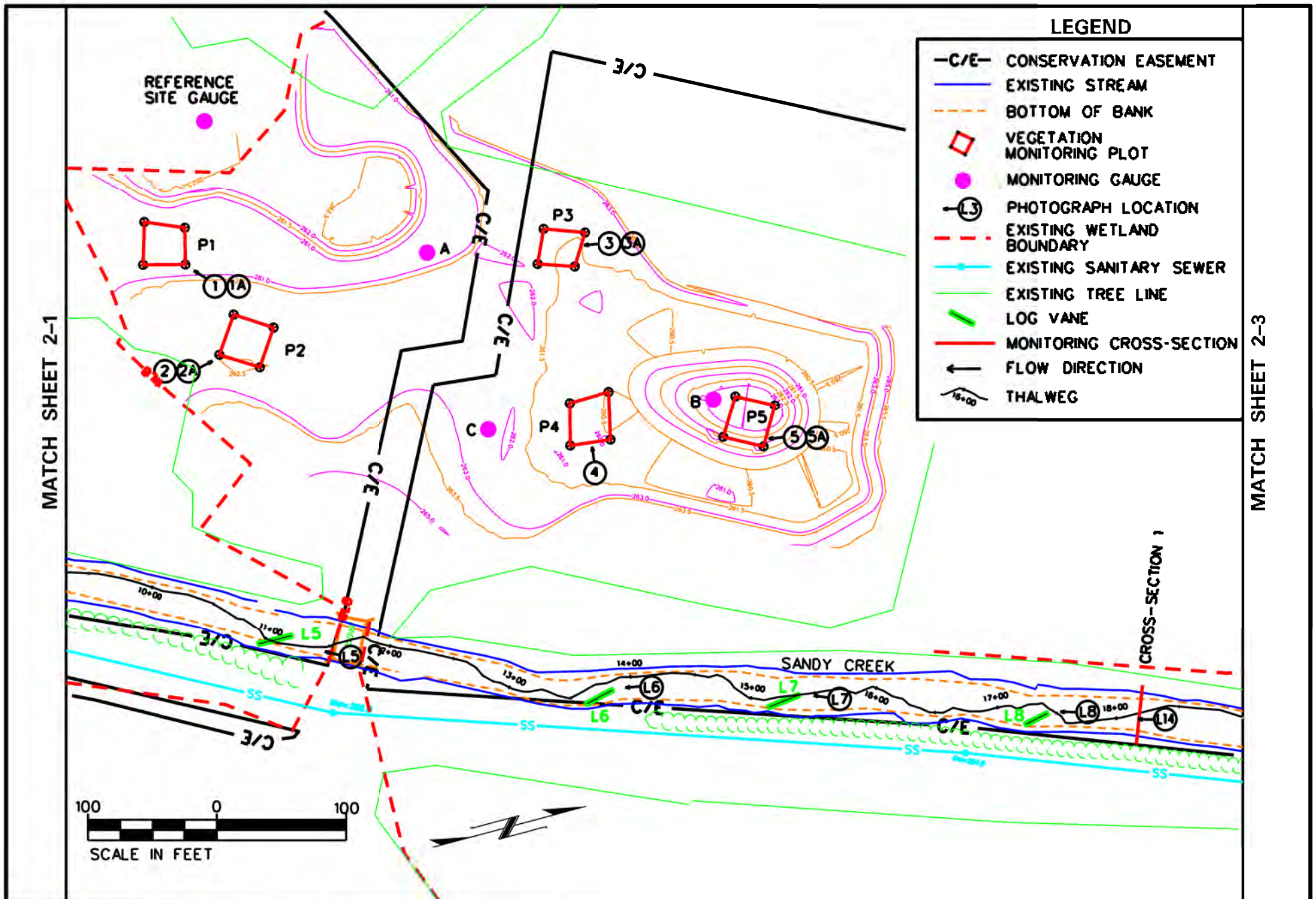
MONITORING PLAN VIEW

Project: **Sandy Creek Stream Enhancement and Wetland Restoration Site**
EEP Project No. 322
DURHAM COUNTY, NORTH CAROLINA

Own By:	GWN	Date:	FEB 2008
Ctrl By:	JWG	Scale:	1" = 100'
ESC Project No.:		06.282.03	

FIGURE

2-1

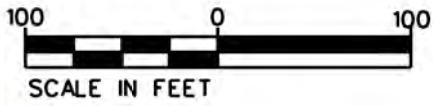


LEGEND

- C/E- CONSERVATION EASEMENT
- EXISTING STREAM
- BOTTOM OF BANK
- VEGETATION MONITORING PLOT
- MONITORING GAUGE
- PHOTOGRAPH LOCATION
- EXISTING WETLAND BOUNDARY
- EXISTING SANITARY SEWER
- EXISTING TREE LINE
- LOG VANE
- MONITORING CROSS-SECTION
- FLOW DIRECTION
- THALWEG

MATCH SHEET 2-1

MATCH SHEET 2-3



MONITORING PLAN VIEW

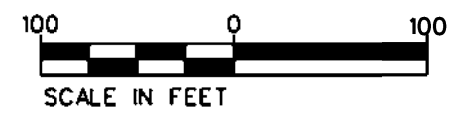
Project: **Sandy Creek Stream Enhancement and Wetland Restoration Site**
EEP Project No. 322
DURHAM COUNTY, NORTH CAROLINA

Drawn By: **GWN** Date: **FEB 2008**
 Ckd By: **JWG** Scale: **1" = 100'**
 ESC Project No: **06-282.03**

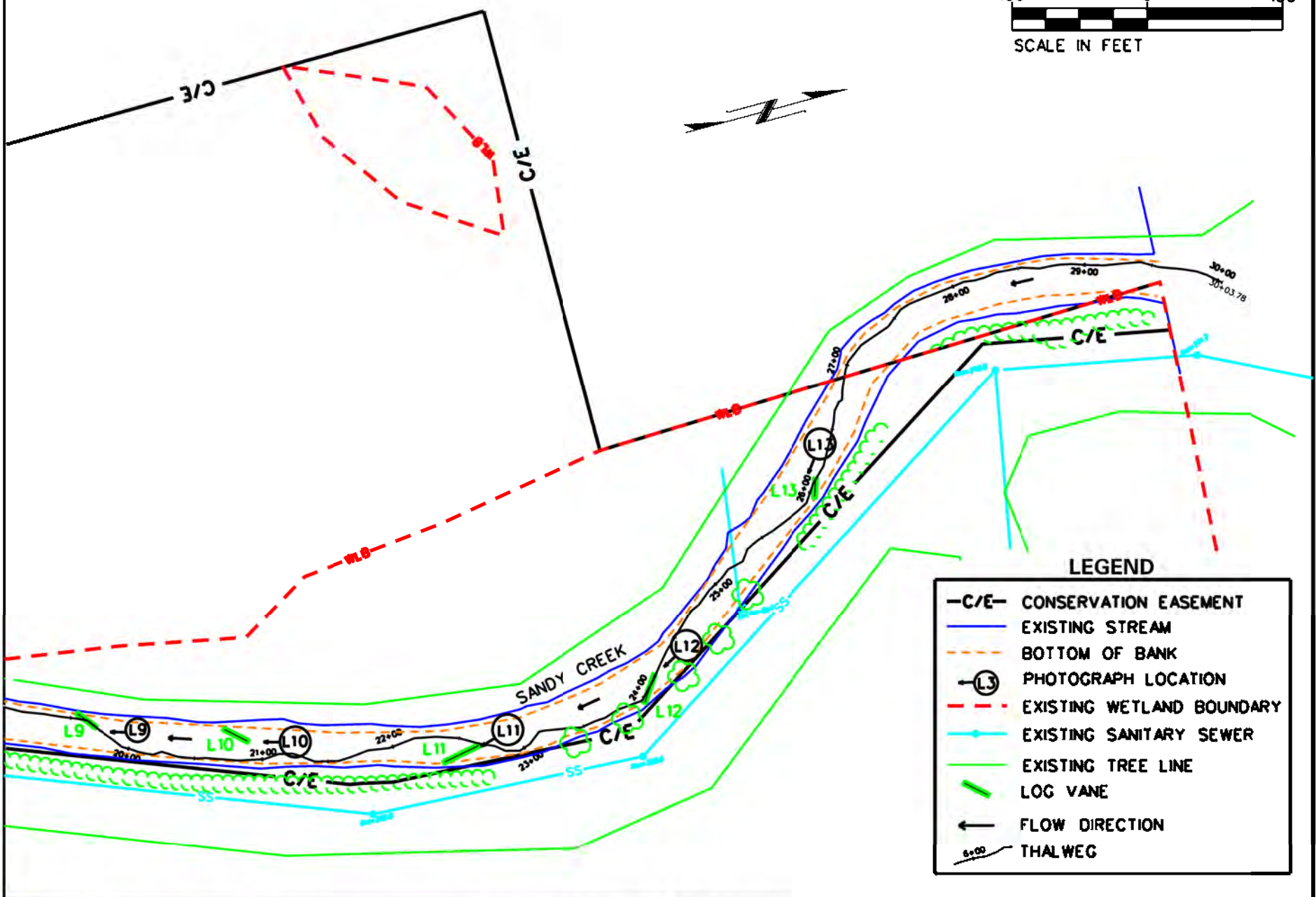
FIGURE

2-2





MATCH SHEET 2-2



LEGEND	
-C/E-	CONSERVATION EASEMENT
—	EXISTING STREAM
- - -	BOTTOM OF BANK
Ⓛ	PHOTOGRAPH LOCATION
- - -	EXISTING WETLAND BOUNDARY
—	EXISTING SANITARY SEWER
—	EXISTING TREE LINE
→	LOG VANE
→	FLOW DIRECTION
—	THALWEG



MONITORING PLAN VIEW
 Project: **Sandy Creek Stream Enhancement and Wetland Restoration Site**
EEP Project No. 322
DURHAM COUNTY, NORTH CAROLINA

Drawn By:	GWN	Date:	FEB 2008
Ord By:	JWG	Scale:	1" = 100'
ESC Project No:		06-282.03	

FIGURE
2-3

3.0 PROJECT CONDITION AND AND RESULTS

3.1 VEGETATION ASSESSMENT

Vegetation success criteria for the wetland restoration areas include a minimum survival of 288 stems per acre of planted species at the end of Year 4. In addition, six planted species must survive throughout the Site. Stem counts were conducted for all woody species, including volunteer species following EEP Stem Counting protocols. The taxonomic standard for vegetation follows *Flora of the Carolinas, Virginia, Georgia, and surrounding areas* (Weakley, 2007). A total of 267 stems of planted species were counted in the four plots. Stem density per acre for Plots 1-5 are 9300, 2200, 1500, 0, and 350 respectively. The average density for planted species in all plots is 2670 stems per acre. Four of the five vegetation plots achieved the density criterion for success at the Site. However, since only three planted species were recorded in the aggregated vegetation plots, the Site fails the diversity criterion. Despite successful average density for planted species in four of the five plots, the Site as a whole fails overall vegetation success criteria for wetland restoration due to the failed diversity criterion. Vegetation Survey Data Tables, as well as plot photos, are provided in Appendix A.

3.1.1 Vegetation Problem Areas

Low survival of many of the planted species can be attributed to permanent flooding of Plot 4 (located in an on-site pond) and invasive exotics at Plot 5. Initial plantings were previously reported to be largely destroyed by geese, and this event is assumed to be responsible for low species diversity at the site in Year 4. High occurrences of *Fraxinus pennsylvanica* and *Salix nigra* are likely due to volunteer individuals of planted species. Poor soil composition (Urban land soils occupy approximately 5.5 acres of the Site) is another factor in poor survival. A Vegetation Problem Areas Table, Vegetation Problem Area Plan View, and photos are provided in Appendix A.

3.2 STREAM ASSESSMENT

3.2.1 Bankfull Events

Exhibit Table V. Hydrological (Bankfull) Verifications Sandy Creek Stream Enhancement and Wetland Restoration Site / EEP Project No. 322			
Date of Data Collection	Date of Occurrence	Method	Photo Number
01/12/07	12/26/06	Photographed evidence on-site	N/A
11/12/07	10/27/07	Photographed evidence on-site	BE1 (Appendix B)

3.2.2 Bank Stability Assessment

A detailed BEHI and NBS assessment are required in year 5. This report represents the fourth year of monitoring, therefore no bank stability assessment was performed.

3.2.3 Stream Problem Areas

An analysis of stream features was performed in order to evaluate the current condition of Sandy Creek. Identified problem areas exist in the form of an overall aggradation of sediment throughout the restored reach of Sandy Creek, presumably from an upstream source. The Stream Problem Areas Table and photos are located in Appendix B.

**Exhibit Table VII. Categorical Stream Feature Visual Stability Assessment
Sandy Creek Stream Restoration Site / EEP Project No. 322
Segment/Reach: 2,700 feet**

Feature	Initial*	MY-01*	MY-02	MY-03	MY-04**	MY-05
A. Riffles	NA	NA	0%	0%	0%	
B. Pools	NA	NA	0%	0%	0%	
C. Thalweg	NA	NA	0%	0%	0%	
D. Meanders	NA	NA	100%	100%	100%	
E. Bed General	NA	NA	0%	0%	0%	
F. Bank Condition	NA	NA	NA*	NA*	100%	
G. Log Vanes	NA	NA	100%	100%	100%	

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

**The riffles, pools, thalweg, and bed features of Sandy Creek are continuously changing due to the sandy composition of the streambed. None of these features are considered visually stable. See Table B2 in Appendix B for assessment details.

**Exhibit Table IX. Morphology and Hydraulic Monitoring Summary
Sandy Creek Stream Enhancement and Wetland Restoration Site / EEP Project No. 322**

Parameter	Cross-Section 1				
	MY-01	MY-02	MY-03	MY-04	MY-05
Dimension					
BF Width (ft)	NA*	28.8	29.5	31.1	
Floodprone Width (ft)	NA*	>500	>500	>500	
BF Cross Sectional Area (ft)	NA*	75.1	92.7	105.1	
BF Mean Depth (ft)	NA*	2.6	3.1	3.4	
Width/Depth Ratio (ft)	NA*	11	9.4	9.2	
Entrenchment Ratio (ft)	NA*	>2.2	>2.2	>2.2	
Wetted Perimeter (ft)	NA*	32.7	34.0	35.2	
Bank Height Ratio	NA*	1.23	1.42	1.27	
Hydraulic Radius (ft)	NA*	2.3	2.7	3.0	
Substrate					
d50 (mm)	0.61	0.58	0.58	0.55	
d84 (mm)	1.5	0.98	0.98	0.89	

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

3.3 WETLAND ASSESSMENT

Exhibit Table X. Wetland Criteria Attainment Sandy Creek Stream Enhancement and Wetland Restoration Site / EEP Project No. 322							
Tract	Well ID	Well Hydrology Threshold Met?	Tract Mean	Vegetation Plot ID	Vegetation Density Met (260 stems/acre)	Diversity Met? (6 species)	Tract Mean
1	A	✓ (28%)	14% of growing season	P1	✓ (9300)	2	Failed because of lack of diversity
1	B	(5%)		P2	✓ (2200)	2	
1	C	(9%)		P3	✓ (1500)	2	
REF	Ref Site	(4%)		P4	(0)	0	
			P5	✓ (350)	1		

4.0 REFERENCES

Weakley, A.S. 2007. Flora of the Carolinas, Virginia, Georgia, and surrounding areas. Working draft of January 2007. University of North Carolina Herbarium, North Carolina Botanical Garden, University of North Carolina. 1015pp.

APPENDIX A

VEGETATION RAW DATA

**Sandy Creek Stream Enhancement and Wetland Restoration Site
Vegetation Survey Data Tables**

Stem Counts for Each Species Arranged by Plot											
Species	Plots					Year 4 Total	Year 4 % Survival	Year 3 Total	Year 2 Total	Year 1 Total	Year 0 Total
	1	2	3	4	5						
<i>Acer rubrum</i>			4			4	13	4	4	12	30
<i>Alnus serrulata</i>											1
<i>Betula nigra</i>										5	2
<i>Carya ovata</i>											4
<i>Cephalanthus occidentalis</i>											2
<i>Fraxinus pennsylvanica</i>	91	37	18			146	913	128	148	104	16
<i>Liriodendron tulipifera</i>										2	9
<i>Nyssa sylvatica</i>											5
<i>Quercus lyrata</i>										3	5
<i>Quercus phellos</i>									3	3	14
<i>Salix nigra</i>	95	7	8		7	117	2340	88	108	73	5
<i>Sambucus canadensis</i>										1	11
<i>Viburnum nudum</i>										3	8

Stem Counts for Volunteer Species Arranged by Plot											
Species	Plots					Year 4 Totals	Year 3 Totals	Year 2 Totals	Year 1 Totals	Year 0 Totals	
	1	2	3	4	5						
<i>Acer negundo</i>	1					1	2	1		2	
<i>Baccharis halimifolia</i>	2					2					
<i>Celtis leavigata</i>								1		2	
<i>Cornus amomum</i>				2		2	2	2			
<i>Gleditsia triacanthos</i>					1	1			1		
<i>Liquidambar styraciflua</i>			25		1	26		6	1		
<i>Pinus taeda</i>			11			11					
<i>Platanus occidentalis</i>		1				1		1	2		
<i>Populus deltoides</i>											
<i>Ulmus americana</i>			2			2					

**Sandy Creek Stream Enhancement and Wetland Restoration Site
Monitoring Year 4**

Exhibit Table 6. Vegetative Problem Areas			
Sandy Creek Stream Enhancement and Wetland Restoration Site / EEP Project No. 322			
Feature / Issue	Station # / Range	Probable Cause	Photo #
Bare Floodplain	Vegetation Plot 4	Flooding from pond creation	VPA1
Poor Survival	Vegetation Plot 5	Invasive exotics	VPA 2

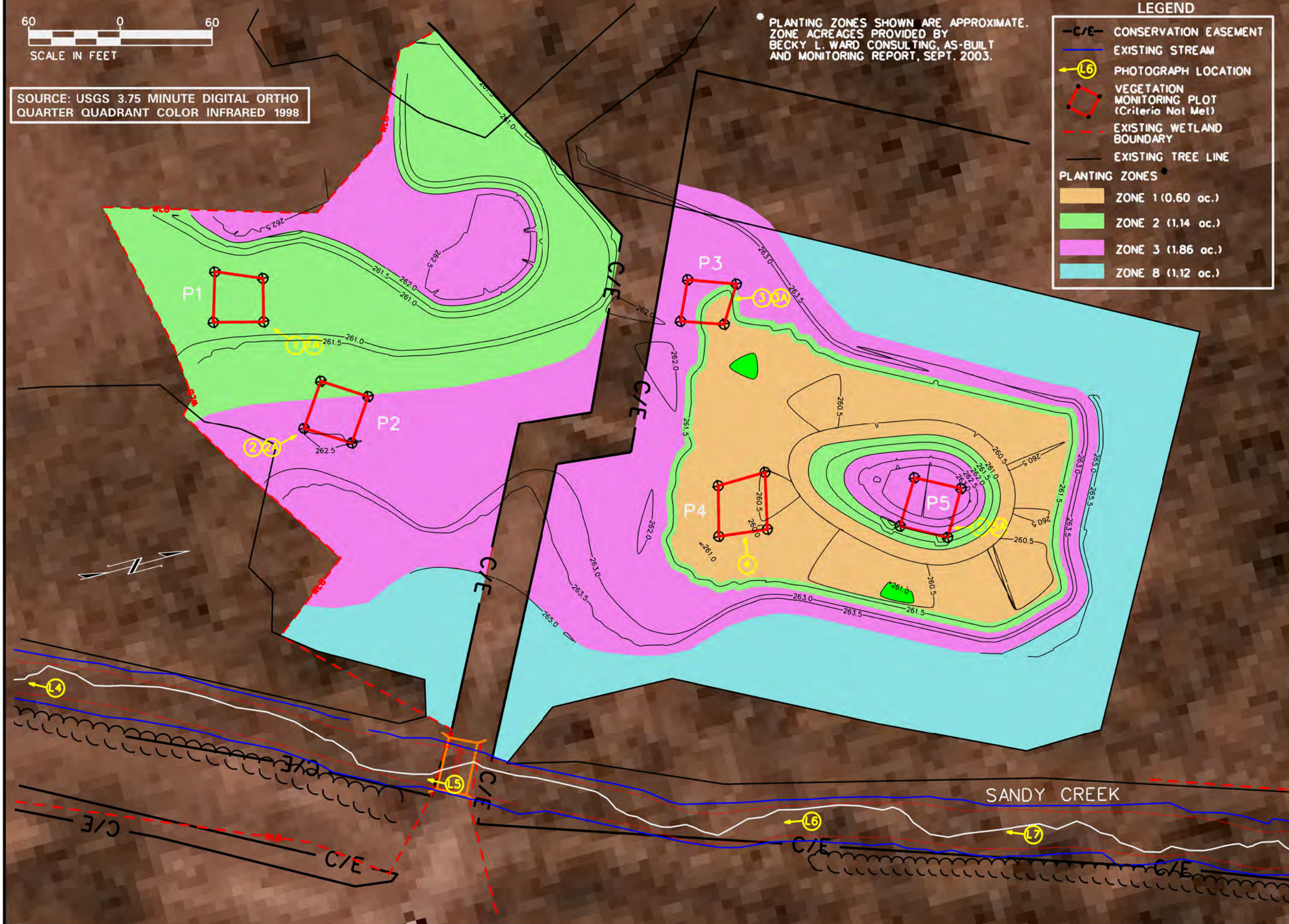


SOURCE: USGS 3.75 MINUTE DIGITAL ORTHO QUARTER QUADRANT COLOR INFRARED 1998

* PLANTING ZONES SHOWN ARE APPROXIMATE. ZONE ACREAGES PROVIDED BY BECKY L. WARD CONSULTING, AS-BUILT AND MONITORING REPORT, SEPT. 2003.

LEGEND

- C/E- CONSERVATION EASEMENT
 - EXISTING STREAM
 - PHOTOGRAPH LOCATION
 - VEGETATION MONITORING PLOT (Criterio Not Met)
 - EXISTING WETLAND BOUNDARY
 - EXISTING TREE LINE
- PLANTING ZONES
- ZONE 1 (0.60 ac.)
 - ZONE 2 (1.14 ac.)
 - ZONE 3 (1.86 ac.)
 - ZONE 8 (1.12 ac.)



REVISIONS	



Client: 

Project: **SANDY CREEK STREAM ENHANCEMENT AND WETLAND RESTORATION SITE**

EEP Project No. 322
DURHAM COUNTY, NORTH CAROLINA

Title: **VEGETATION PROBLEM AREAS**

Dwn By: TAL	Date: NOV 2007
Ckd By: MCG	Scale: 1"=60'
ESC Project No.: 06-282.03	

FIGURE
A

**Sandy Creek Stream Enhancement and Wetland Restoration Site
Vegetation Problem Areas Photos**



VPA Photo 1. Low species survival and flooding at Plot 4.



VPA Photo 2. Invasive exotics within Plot 5.

**Sandy Creek Stream Enhancement and Wetland Restoration Site
Vegetation Monitoring Plot Photos**

Vegetation Plot 1 (August 1, 2007)



Photo 1



Photo 1A

**Sandy Creek Stream Enhancement and Wetland Restoration Site
Vegetation Monitoring Plot Photos**

Vegetation Plot 2 (August 1, 2007)



Photo 2



Photo 2A

**Sandy Creek Stream Enhancement and Wetland Restoration Site
Vegetation Monitoring Plot Photos**

Vegetation Plot 3 (August 1, 2007)



Photo 3



Photo 3A

**Sandy Creek Stream Enhancement and Wetland Restoration Site
Vegetation Monitoring Plot Photos**

Vegetation Plot 4 (August 1, 2007)



Photo 4

**Sandy Creek Stream Enhancement and Wetland Restoration Site
Vegetation Monitoring Plot Photos**

Vegetation Plot 5 (August 1, 2007)



Photo 5

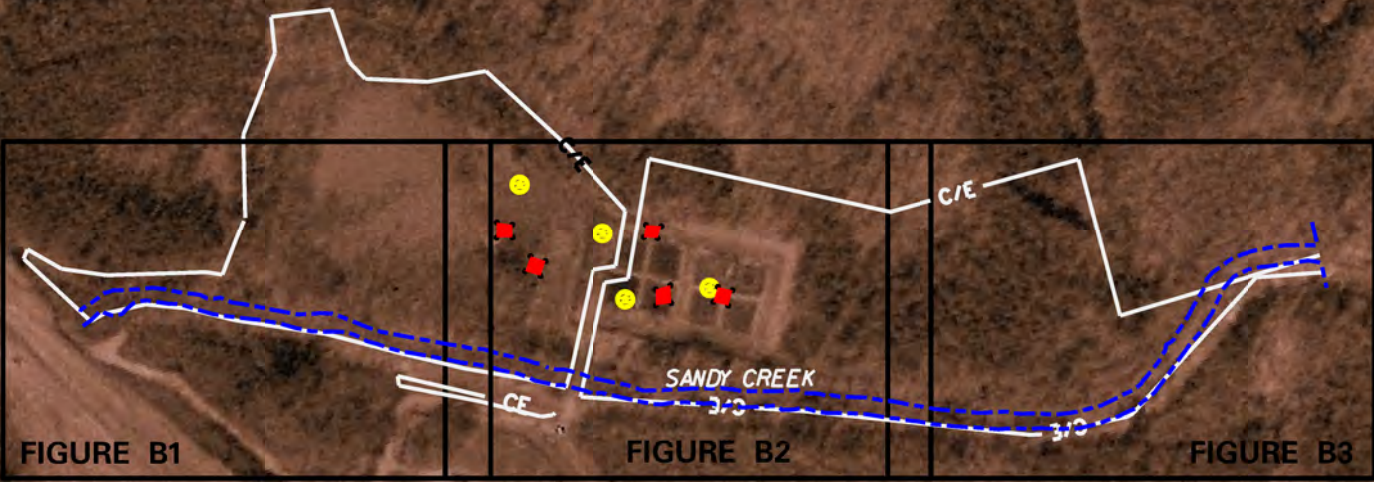


Photo 5A

APPENDIX B

GEOMORPHOLOGICAL RAW DATA

- C/E- CONSERVATION EASEMENT
- VEGETATION MONITORING PLOT
- MONITORING GAUGE LOCATION
- EXISTING STREAM



SOURCE: USGS 3.75 MINUTE DIGITAL ORTHO QUARTER QUADRANT COLOR INFRARED 1998

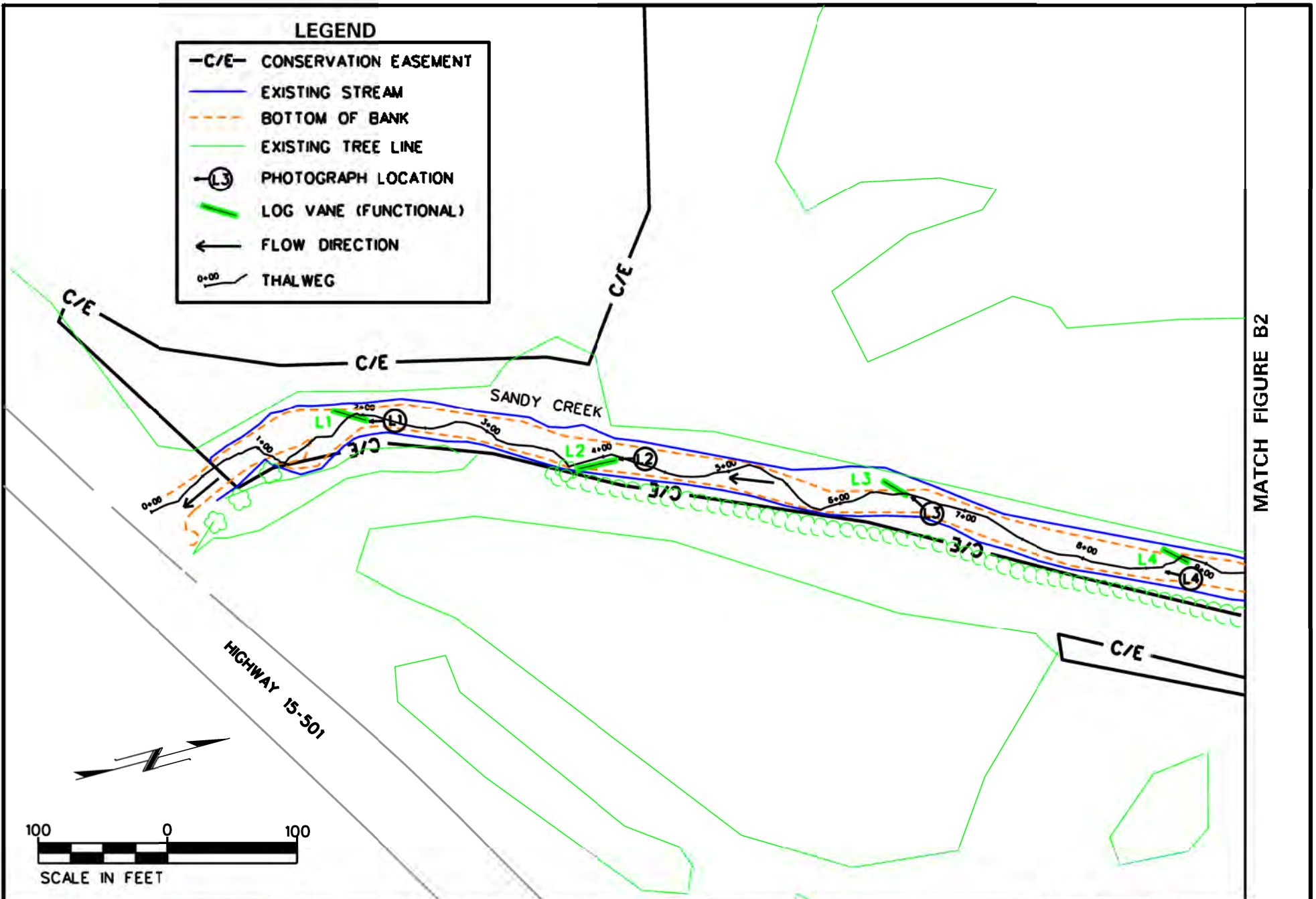


Title: **STREAM CURRENT CONDITION PLAN VIEW SHEET INDEX**



Project: **Sandy Creek Stream Enhancement and Wetland Restoration Site
EEP Project No. 322
DURHAM COUNTY, NORTH CAROLINA**

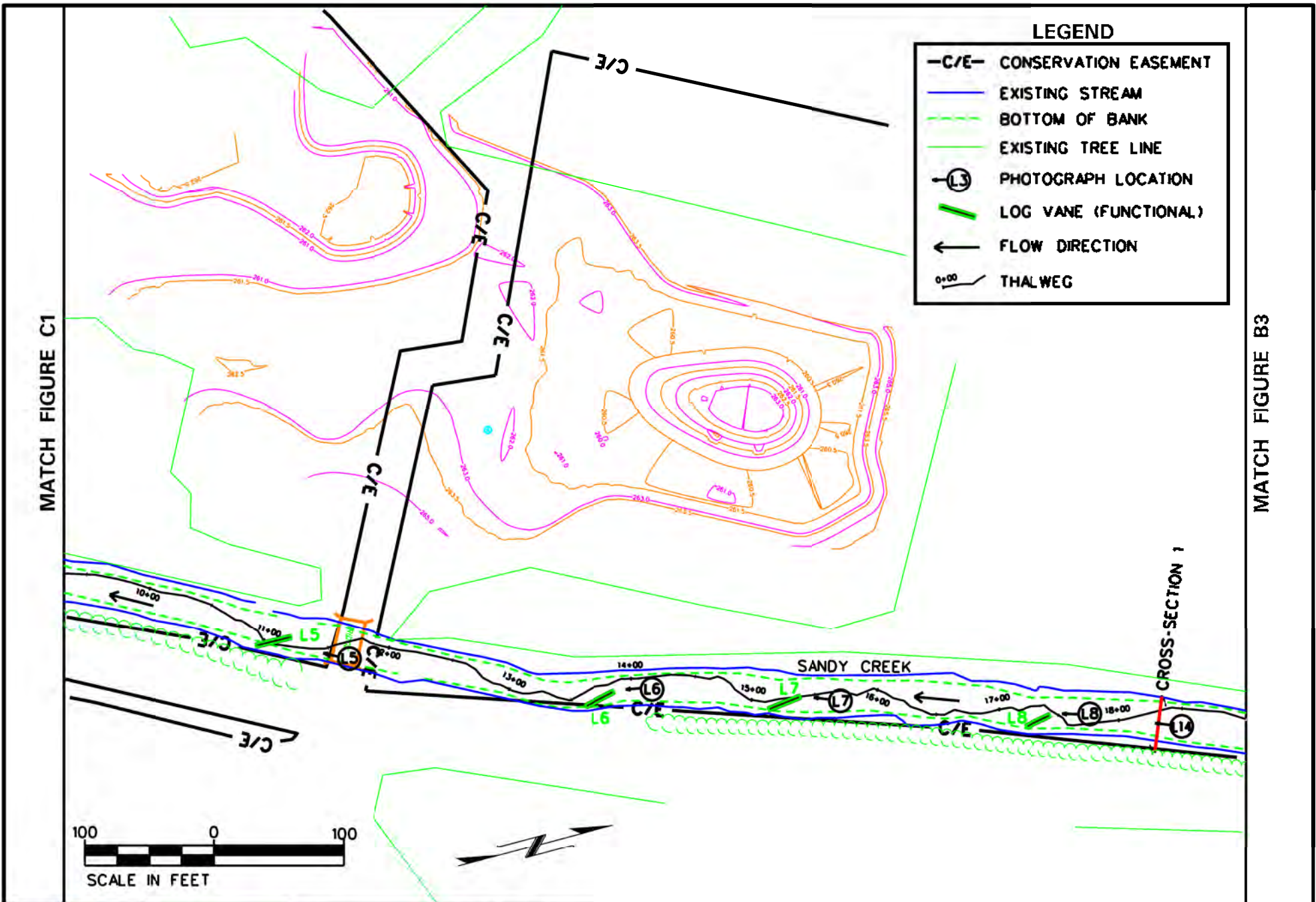
Drawn By:	TAL	Date:	FEB 2008
Checked By:	MCG	Scale:	1" = 400'
ESC Project No.:		06-282.03	



FIGURE
B

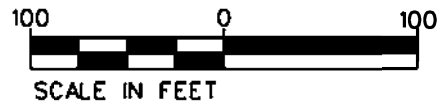


MATCH FIGURE B2

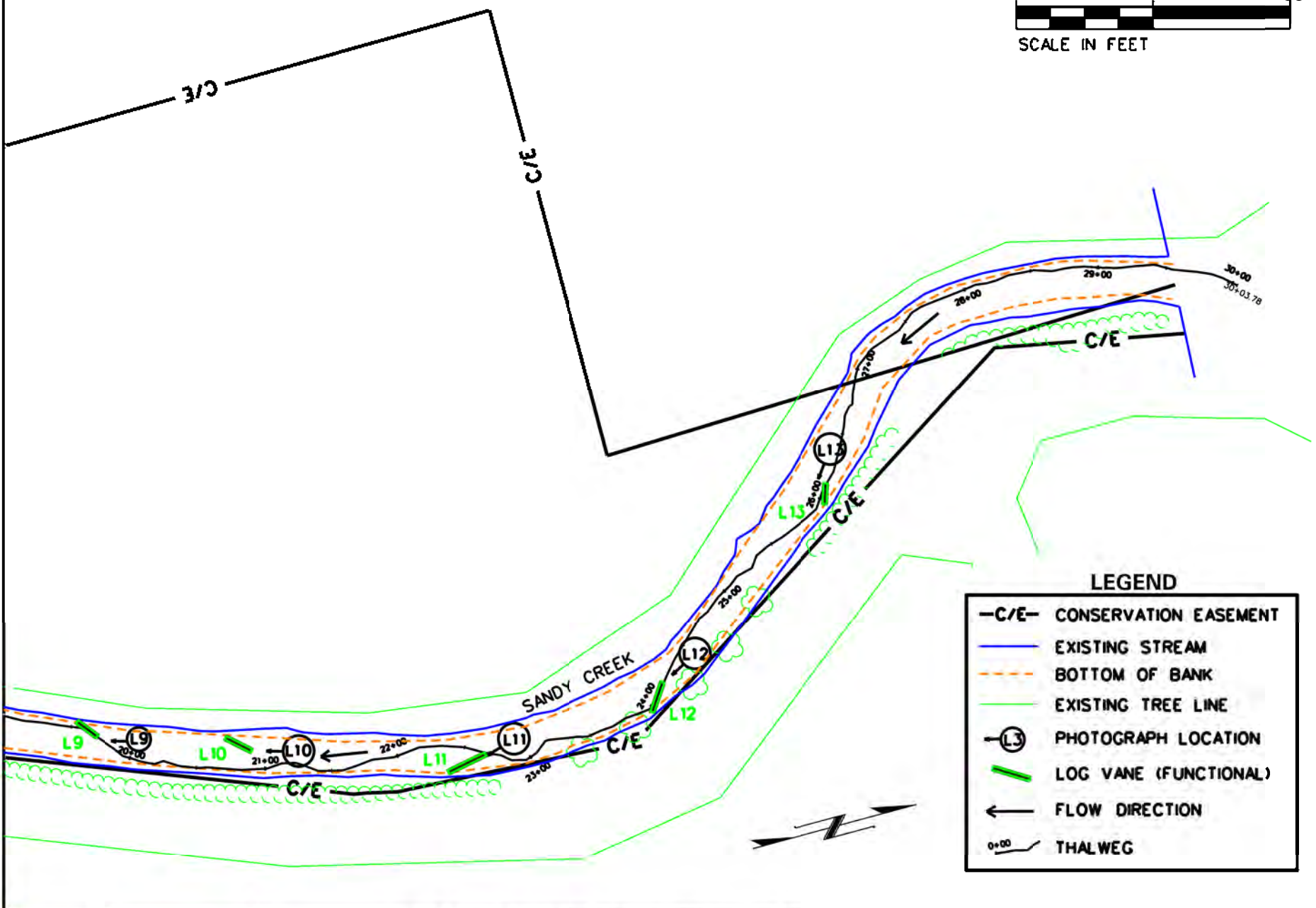
		Title: STREAM CURRENT CONDITION PLAN VIEW		Dwn By: TAL	Date: FEB 2008	FIGURE B1
		Project: Sandy Creek Stream Enhancement and Wetland Restoration Site EEP Project No. 322 DURHAM COUNTY, NORTH CAROLINA		Cld By: MCG	Scale: 1" = 100'	
				ESC Project No.: 06-282.03		



 <p>EcoScience Corporation Raleigh, North Carolina</p>	 <p>Ecosystem Enhancement</p>	Title: STREAM CURRENT CONDITION PLAN VIEW		Drawn By: TAL	Date: FEB 2008	FIGURE B2
		Project: Sandy Creek Stream Enhancement and Wetland Restoration Site EEP Project No. 322 DURHAM COUNTY, NORTH CAROLINA		Checked By: MCG	Scale: 1" = 100'	
				ESC Project No.: 06-282.03		



MATCH FIGURE B2



LEGEND	
—C/E—	CONSERVATION EASEMENT
—	EXISTING STREAM
- - -	BOTTOM OF BANK
- - -	EXISTING TREE LINE
⊙ L3	PHOTOGRAPH LOCATION
→	LOG VANE (FUNCTIONAL)
←	FLOW DIRECTION
0+00	THALWEG



Title: STREAM CURRENT CONDITION PLAN VIEW

Project: Sandy Creek Stream Enhancement and Wetland Restoration Site
EEP Project No. 322
DURHAM COUNTY, NORTH CAROLINA

Own By:	TAL	Date:	FEB 2008
Chd By:	MCG	Scale:	1" = 100'
ESC Project No.:		06-282.03	

FIGURE

B3

**Sandy Creek Stream Enhancement and Wetland Restoration Site
Monitoring Year 4**

Table B1. Stream Problem Areas			
Sandy Creek Stream Enhancement and Wetland Restoration Site / EEP Project No. 322			
Feature Issue	Station Numbers	Suspected Cause	Photo Number
Aggradation/Bar Formation	00+00 to 27+00	Excessive sediment load from upstream sources	SPA1, 2

**Sandy Creek Stream Enhancement and Wetland Restoration Site
Stream Problem Area Photos**



SPA Photo 1. Excessive sediment load from upstream sources.



SPA Photo 2. Excessive sediment load from upstream sources.

Table B2. Visual Morphological Stability Assessment
Sandy Creek Stream and Wetland Restoration Site / EEP Project No. 322
2,700 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?	0	N/A	N/A	0	
	2. Armor stable (e.g. no displacement)?	N/A	N/A	N/A	N/A	
	3. Facet grade appears stable?	0	N/A	N/A	0	
	4. Minimal evidence of embedding/fining?	0	N/A	N/A	0	
	5. Length appropriate?	0	N/A	N/A	0	0%
B. Pools	1. Present? (e.g not subject to severe aggrad. or migrat.?)	0	N/A	N/A	0	
	2. Sufficiently deep (Max Pool D:Mean Bkf >1.6?)	0	N/A	N/A	0	
	3. Length appropriate?	0	N/A	N/A	0	0%
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	0	N/A	N/A	0	
	2. Downstream of meander (glide/inflection) centering?	0	N/A	N/A	0	0%
D. Meanders	1. Outer bend in state of limited/controlled erosion?	N/A	N/A	N/A		
	2. Of those eroding, # w/concomitant point bar formation?	N/A	N/A	N/A		
	3. Apparent Rc within spec?	N/A	N/A	N/A		
	4. Sufficient floodplain access and relief?	2700 ft	N/A	N/A	100	100%
E. Bed General	1. General channel bed aggradation areas (bar formation)	N/A	N/A	2700 ft	0	
	2. Channel bed degradation – areas of increasing down-cutting or head cutting?	N/A	N/A	2700 ft	0	0%
F. Bank	1. Actively eroding, wasting, or slumping bank	N/A	N/A	0	100%	100%
G. Vanes	1. Free of back or arm scour?	13	13	N/A	100	
	2. Height appropriate?	13	13	N/A	100	
	3. Angle and geometry appear appropriate?	13	13	N/A	100	
	4. Free of piping or other structural failures?	13	13	N/A	100	100%

**Sandy Creek Stream Enhancement and Wetland Restoration Site
Stream Photo-stations**



Photo L1: Log Vane 1 at Station 2 + 04 (August 21, 2007)



Photo L2: Log Vane 2 at Station 4 + 12 (August 21, 2007)

**Sandy Creek Stream Enhancement and Wetland Restoration Site
Stream Photo-stations**



Photo L3: Log Vane 3 at Station 6 + 55 (August 21, 2007)



Photo L4: Log Vane 4 at Station 8 + 88 (August 21, 2007)

**Sandy Creek Stream Enhancement and Wetland Restoration Site
Stream Photo-stations**



Photo L5: Log Vane 5 at Station 10 + 99 (August 21, 2007)



Photo L6: Log Vane 6 at Station 13 + 83 (August 21, 2007)

**Sandy Creek Stream Enhancement and Wetland Restoration Site
Stream Photo-stations**



Photo L7: Log Vane 7 at Station 15 + 39 (August 21, 2007)



Photo L8: Log Vane 8 at Station 17 + 45 (August 21, 2007)

**Sandy Creek Stream Enhancement and Wetland Restoration Site
Stream Photo-stations**



Photo L9: Log Vane 9 at Station 19 + 72 (August 21, 2007)



Photo L10: Log Vane 10 at Station 20 + 91 (August 21, 2007)

**Sandy Creek Stream Enhancement and Wetland Restoration Site
Stream Photo-stations**



Photo L11: Log Vane 11 at Station 22 + 66 (August 21, 2007)



Photo L12: Log Vane 12 at Station 24 + 20 (August 21, 2007)

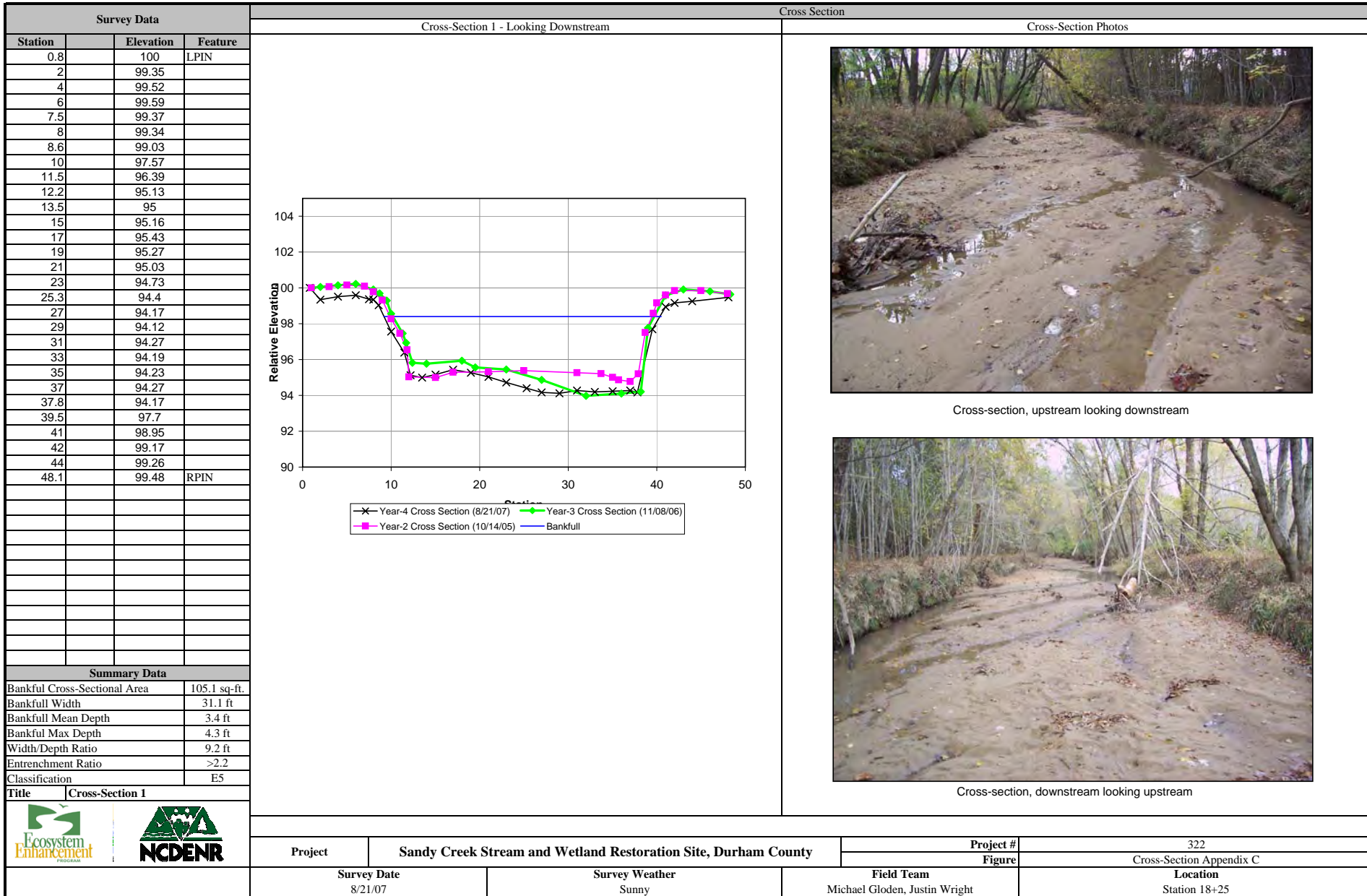
**Sandy Creek Stream Enhancement and Wetland Restoration Site
Stream Photo-stations**



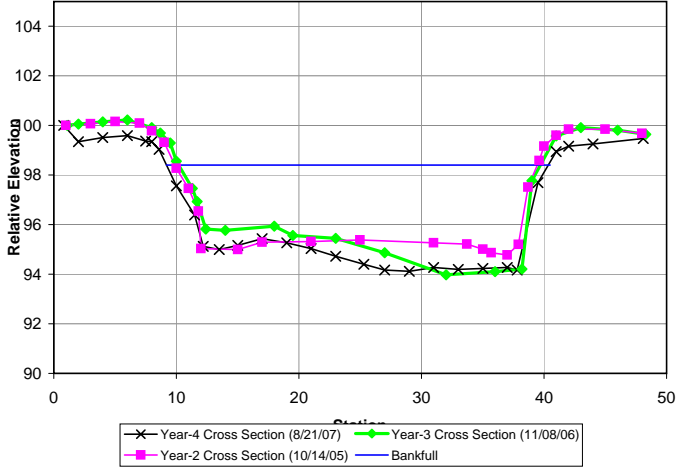
Photo L13: Log Vane 13 at Station 26 + 12 (August 21, 2007)



Photo L14: Permanent Cross-Section (18 + 25) Viewed Looking Downstream



Cross-Section 1 - Looking Downstream



Cross Section

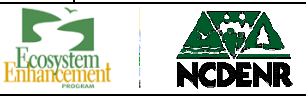
Cross-Section Photos



Cross-section, upstream looking downstream

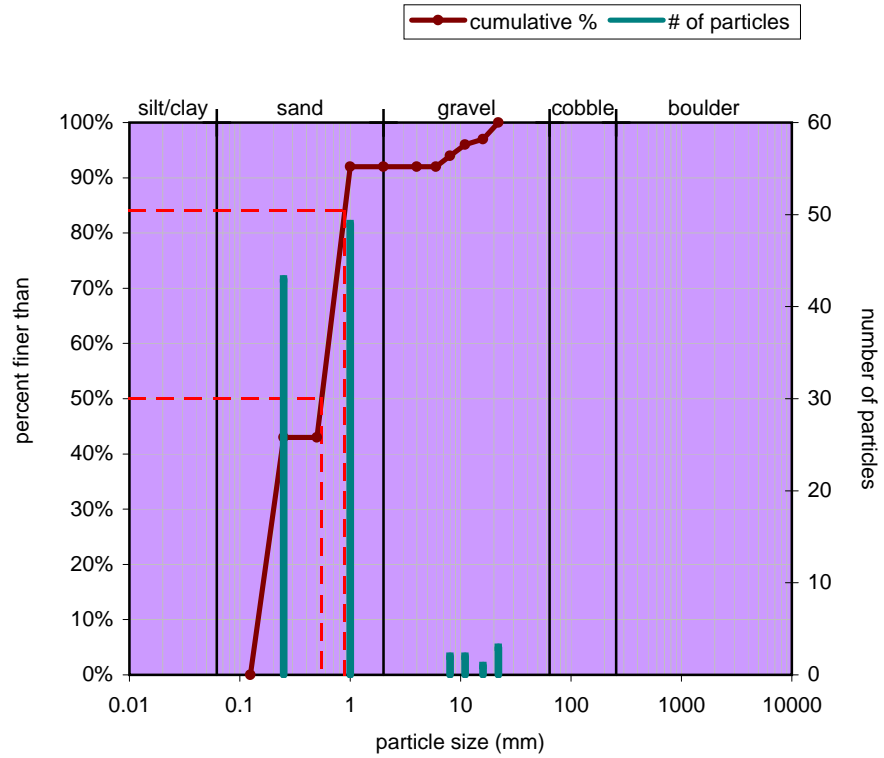


Cross-section, downstream looking upstream



silt/clay		0 - 0.062		
very fine sand	0.062 -	0.125		
fine sand	0.125 -	0.25	43	
medium sand	0.25 -	0.5		
coarse sand	0.5 -	1	49	
very coarse sand	1 -	2		
very fine gravel	2 -	4		
fine gravel	4 -	6		
fine gravel	6 -	8	2	
medium gravel	8 -	11	2	
medium gravel	11 -	16	1	
coarse gravel	16 -	22	3	
coarse gravel	22 -	32		
very coarse gravel	32 -	45		
very coarse gravel	45 -	64		
small cobble	64 -	90		
medium cobble	90 -	128		
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:		100		
bedrock -----				
clay hardpan -----				
detritus/wood -----				
artificial -----				
total count:		100		
Note:				

Bed Surface Pebble Count, ---



Size (mm)		Size Distribution		Type	
D16	0.16	mean	0.4	silt/clay	0%
D35	0.22	dispersion	2.5	sand	92%
D50	0.55	skewness	-0.19	gravel	8%
D65	0.68			cobble	0%
D84	0.89			boulder	0%
D95	9.4				

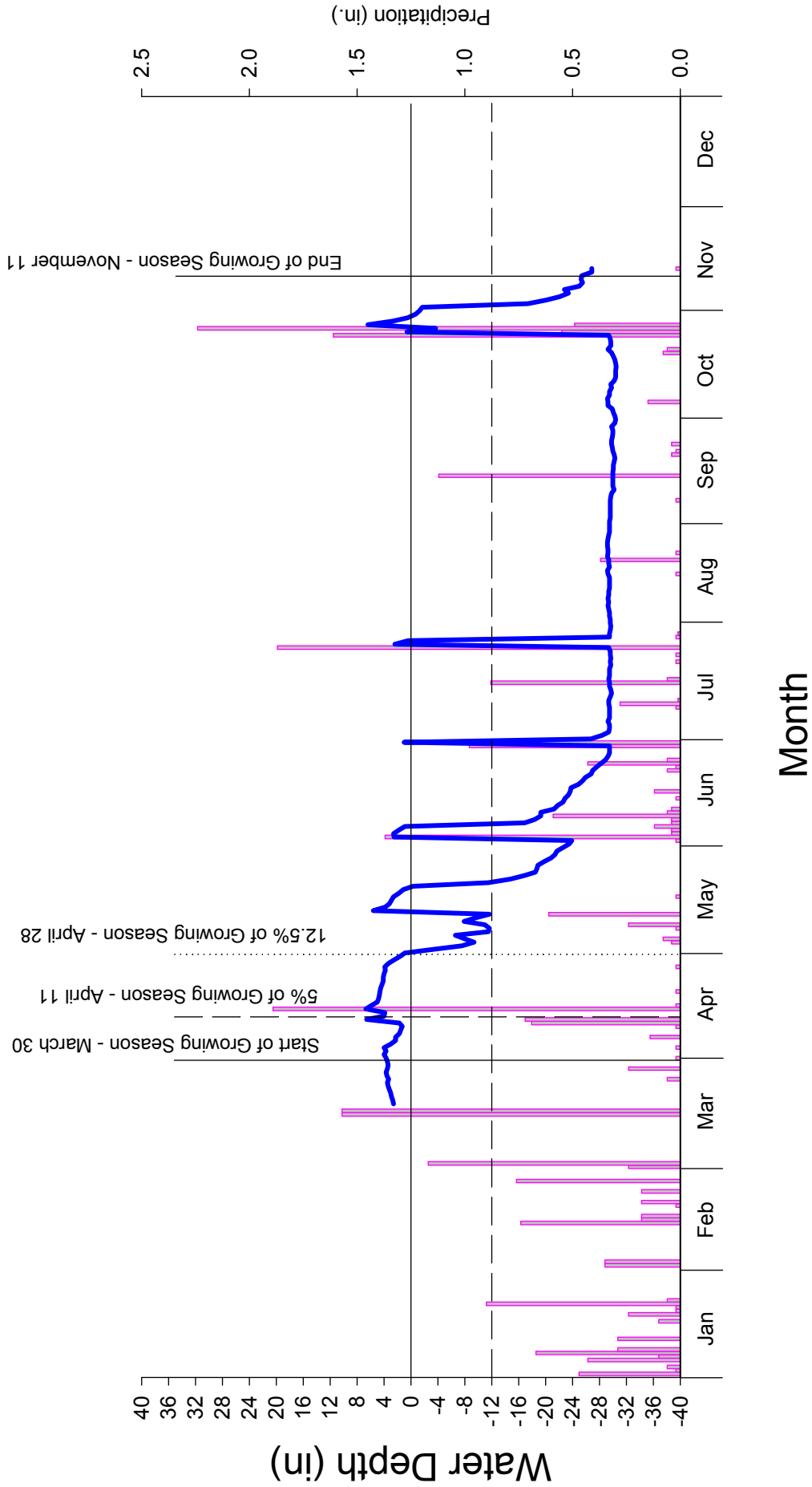
APPENDIX C

WETLAND RAW DATA

Sandy Creek

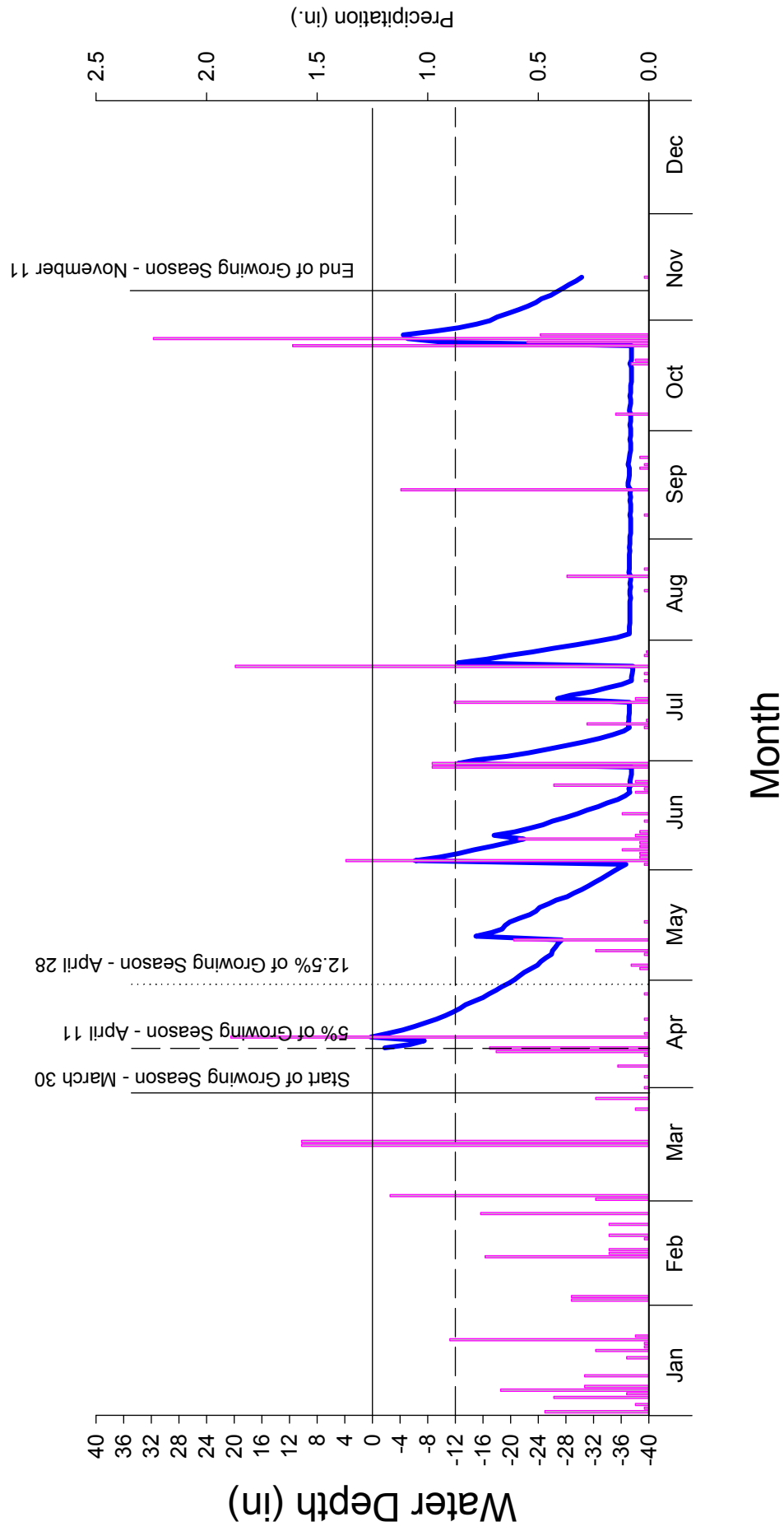
2007

Monitoring Gauge A - AB3546A



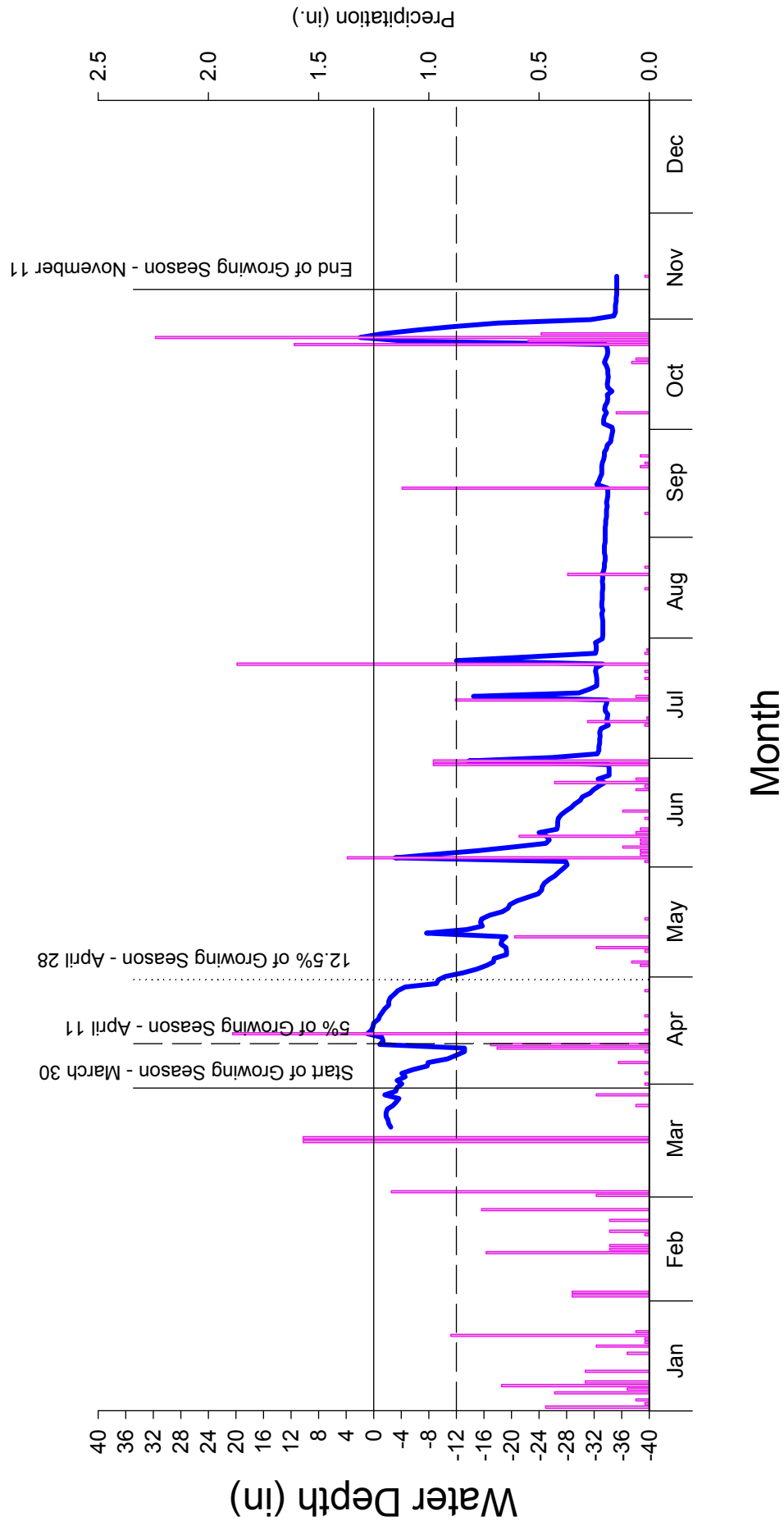
*Gauge installed March 19

Sandy Creek 2007 Monitoring Gauge B-9DE54F2



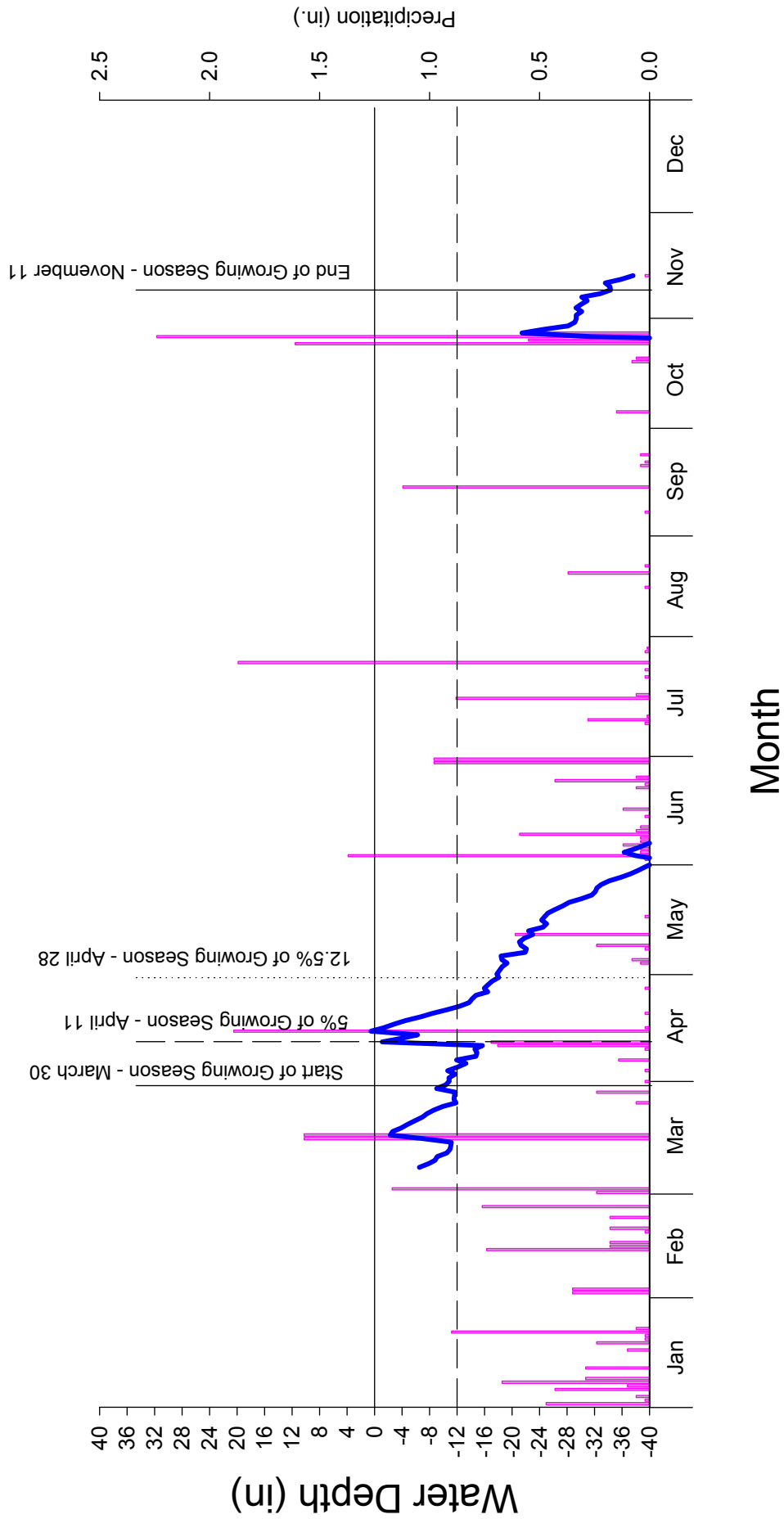
* Gauge installed March 19
 ** Water table equalized on April 12, where data begins

Sandy Creek 2007 Monitoring Gauge C - 9DE70CB



* Gauge installed March 19

Sandy Creek 2007 Monitoring Gauge Reference Site - N3CF7AEC



* Breaks indicate > 40" below the ground surface

SOURCE: USGS 3.75 MINUTE DIGITAL ORTHO
QUARTER QUADRANT COLOR INFRARED 1998

LEGEND

- C/E- CONSERVATION EASEMENT
 - EXISTING STREAM
 - - - TOE OF CHANNEL
 - - - EXISTING WETLAND
-
- ⊙ GAUGE LOCATION
 - % of growing season *
 - ⊙ > 12.5%
 - ⊙ < 5-12%
 - ⊙ < 5%

REFERENCE
SITE GAUGE



REVISIONS	



Project:
**SANDY CREEK
STREAM
ENHANCEMENT
AND WETLAND
RESTORATION
SITE**

EEP Project
No. 322
DURHAM COUNTY,
NORTH CAROLINA

Title:
**WETLAND
PROBLEM
AREAS**

Dwn By:	TAL	Date:	NOV 2007
Ckd By:	MCG	Scale:	1"=60'
ESC Project No.:		06-282.03	

FIGURE
C

