SUCK CREEK STREAM RESTORATION
(Project No. 0117950008)

MONITORING YEAR 3 of 5 (2006)

Submitted

January 2007

Submitted to:

North Carolina Department of Environment and Natural Resources
Ecosystem Enhancement Program
Raleigh, North Carolina

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I. Executive Summary

The objective of the Suck Creek stream restoration project, implemented in 2003, was to restore an unstable, degraded stream corridor and adjacent riparian zones to a stable condition that supports high quality in-stream and riparian habitat. The design integrated design goals with site constraints, such as the need to maintain access to surrounding cattle pastures, and the requirements of local agencies, such as ensuring public safety. Design elements included: (1) constructing 3,260 feet of channel with a stable dimension, pattern and profile; (2) installing in-stream structures such as log vanes, J-hook vanes, cross vanes, root wads, and boulder clusters; (3) planting the stream banks and adjacent 7.8 acres of riparian buffer with native plant species; (4) installing fencing to exclude cattle from the restored area; and (5) creating stable road crossings to allow access to adjacent pasture lands. Construction was completed in April 2003, the as-built survey was completed June 2003, and the riparian buffer was planted in February 2004. Year 1 Monitoring was conducted in October 2004. Year 2 monitoring was conducted in September 2005. The Year 3 monitoring provided in this report was conducted in August 2006.

The stream restoration component of the project involved implementing a Priority I Restoration method to create a more stable C4 stream type. Based on the findings of the 2006 monitoring effort summarized in this report, the restored reaches are predominantly stable. Localized areas of bank erosion and bed aggradation in the form of mid-channel bars were observed within the restored channel. Cross vane structures are functioning properly or have reduced function but structure repairs are not recommended at this time. The majority of cross vane structures are functioning properly; maintenance is recommended for only two of the vanes. All of the log vane structures are functioning adequately. The mean particle size of mobile sediment in the upper reach has decreased (from D_{50} = 7.3 mm. to D_{50} = 0.7 mm). The mean particle size of mobile sediment in the lower reach has not significantly changed An extensive mid-channel bar has continued to form just downstream of the boulder field in the upper reach.

Vegetation representing local riparian communities was planted to provide additional stability to the stream banks and establish a riparian buffer. The planted riparian vegetation onsite is well established on the stream banks and in the riparian corridor. Total cover by herbaceous plants is 99 percent. Predominant species are tall wormwood (*Artemisia caudata*) and whorled coreopsis (*Coreopsis verticillata*). Woody stem growth is most dense on the stream bank and becomes sparse in outlying riparian areas. Volunteer black willow and river birch root sucker stems account for the majority of woody stems. The woody stem density for the riparian buffer exceeds the success criteria of 260 stems/acre.

There is no wetland component to this mitigation site.

II. Project Background

1. Project Objectives

The goal of the project was to transform the pre-existing altered stream corridor to a more stable and biologically active form through the following objectives:

- Restore 3,260-linear feet of Suck Creek through geomorphic modification through dimension, pattern and profile adjustments, and cattle exclusion;
- Establish a riparian zone (7.8 acres) surrounding restored sections of Suck Creek;
- Improve the habitat within the channel and riparian zone;
- Provide cattle exclusion fencing and controlled crossings to protect restoration effort; and
- Provide perpetual protection of the riparian area and stream with a conservation easement.

2. Project Structure, Restoration Type, and Approach

The pre-restoration channel was incised with unstable banks. Using reference data from regional curves and appropriate reference reaches, the channel geometry was modified to produce a more stable C4 stream type, as defined by Rosgen (Rosgen 1994). In accordance with the Priority 1 Restoration method, the stream bed was elevated to reconnect it to its abandoned terrace, increasing available flood prone area to near pre-existing conditions. The result of the restoration effort is an increase in the width to depth ratio and reduced bank height ratios, thus improving channel stability. The sinuosity of the reach was also increased which resulted in a decreased mean slope. The decreased mean slope reduces the stream velocities of bankfull events that should also increase stream stability. In-stream structures including rock cross vanes, root wads and log vanes were incorporated into the channel. A vegetative buffer was planted along the stream corridor to further stabilize the stream banks, improve habitat conditions, and reduce ambient water temperature. Stream channel construction was completed in April of 2003 and the vegetated buffers were planted in February 2004. Stream and buffer restoration areas are surrounded by fencing and are protected by a conservation easement.

Suck Creek was restored through the North Carolina Ecosystem Enhancement Program (EEP) – formerly Wetlands Restoration Program (NCWRP). This is the Year 3 monitoring report for Suck Creek.

Table I provides information on the project structure and objectives.

Table I: Project Mitigation Objectives Table
Suck Creek Stream Restoration: Project No. 0117950008

Project Segment or Reach ID	Existing Feet/Acres	Type	Approach	Footage or Acreage	Mitigation Ratio	Mitigation Units	Stationing	Comment
Upper Reach	NA	R	P1	875 Lf	1.0	875	0+00 – 08+75	Restore dimension, pattern, and profile
Lower Reach	NA	R	P1	2,088 Lf	1.0	2,088	08+75 – 29+63	Restore dimension, pattern, and profile
Riparian Buffer Area	NA	R	SS	7.8 Ac.	1.0	7.8	NA	Restore riparian and wetland community

Mitigation Unit Summations

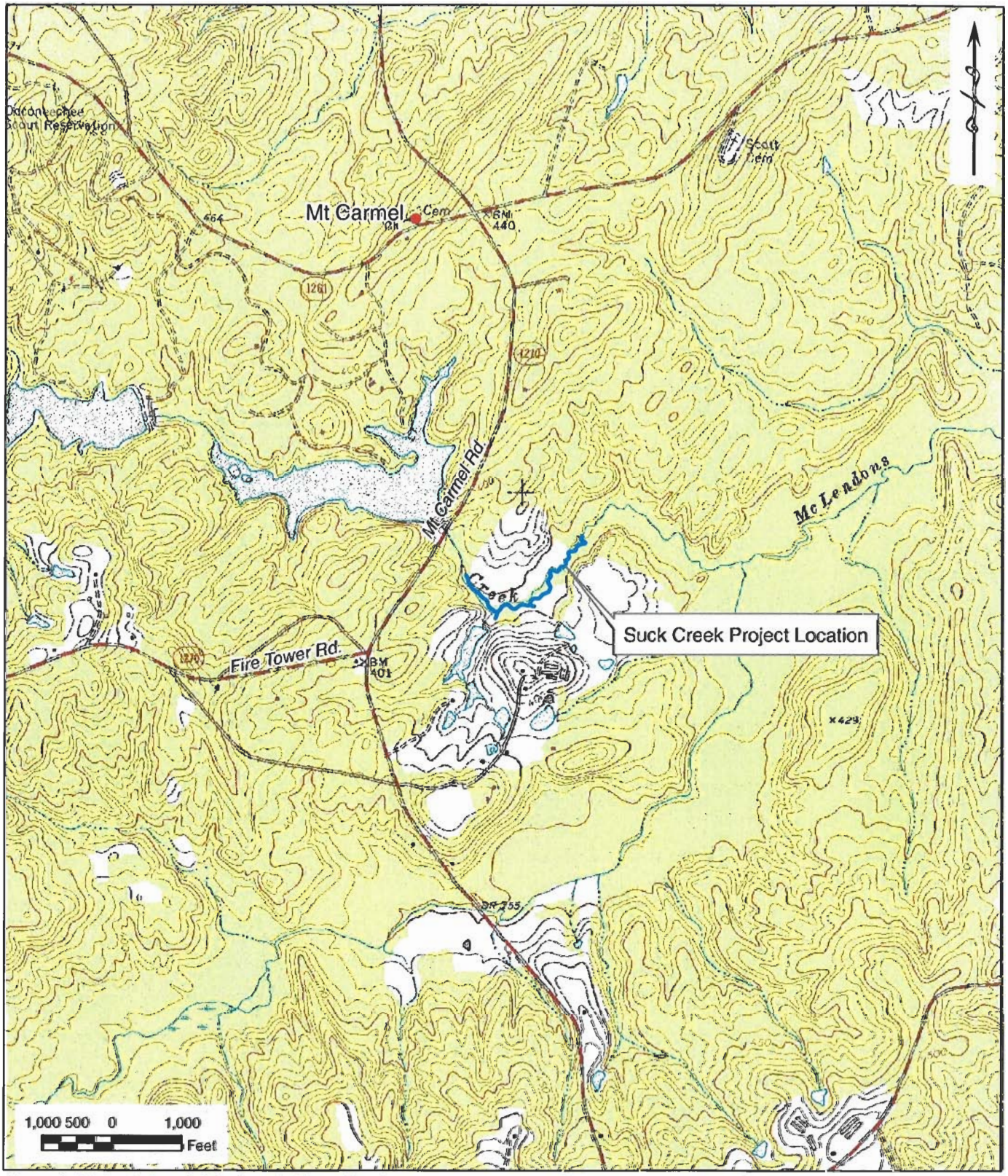
Stream (lf)	Riparian Wetland (Ac)	Nonriparian Wetland (Ac)	Total Wetland (Ac)	Buffer (Ac)	Comment
2,963	--	--	--	7.8	

R= Restoration
EI = Enhancement I
EII = Enhancement II
S = Stabilization
P1 = Priority I
P2 = Priority II
P3 = Priority III
SS = Stream Bank stabilization

3. Location and Setting

The Suck Creek Stream Restoration Project site lies within the Richardson Farm in Moore County, North Carolina. The stream drains a portion of the Deep River Subbasin (USGS Hydrologic Unit 03030003) and North Carolina Department of Water Quality (NCDWQ) Subbasin 03-06-10 of the Cape Fear River Basin. The project watershed consists of mainly of agricultural lands.

The Suck Creek site is located south of SR1261 and east of SR1210. Access to the site is provided via an access road on Richardson Farm. At the downstream terminus, the stream drains a 4.8 mile watershed that includes several impoundments. A vicinity map with directions to the site is provided in Figure 1.



The project is located west of Carthage in Moore County. From Raleigh, follow US-1 south to US-15/501 toward Carthage. When approaching Carthage, take NC-24/ Monroe Street into downtown. Follow through the downtown traffic circle to Dowd Road / SR 1240. Take Dowd Road west away from Carthage for approximately 1.5 miles. Take a right onto Beulah Hill Church Road / Mt. Carmel Road (SR 1210). After approximately 1.5 miles, turn right onto Richardson Farm Road (SR 1290) – a gravel road. Follow Richardson Farm Road to the primary residence and then turn left onto a gravel road. Follow the gravel road past the cattle nursery and chicken barns. The upper section of the project stream is located at the bottom of the hill. Please note that this is a private residence and permission is requested prior to entering the site.

Source: NCDOT USGS Topographic Quadrangle No. 105

Ecosystem Enhancement Program

FIGURE 1
PROJECT VICINITY MAP

Suck Creek Stream Restoration
Project No. 011795008
Monitoring Year 2 of 5
Moore County, North Carolina

THE LOUIS BERGER GROUP, INC
30A Vreeland Road
Florham Park, NJ 07932

January 2007

4. Project History and Background

Project activity and reporting history are provided in Table II. The project contact information is provided in Table III. The project background history is provided in Table IV.

Table II. Project Activity and Reporting History
Suck Creek Stream Restoration: Project No. 0117950008

Activity or Report	Data Collection Complete	Actual Completion or Delivery
Restoration Plan	N/A	N/A
Final Design - 90%	N/A	2002
Construction	N/A	Apr-03
Temporary S&E mix applied to entire project area	N/A	N/A
Permanent seed mix applied to reach/segments 1 & 2	N/A	Apr-03
Containerized and B&B plantings for reach/segments 1 & 2	N/A	Feb-04
Mitigation Plan / As-built (Year 0 Monitoring - Baseline)	Mar-04	Jul-04
Year 1 Monitoring	Oct-04	Dec-04
Year 2 Monitoring	Sep-05	Dec-05

N/A: Historical project documents necessary to provide this data were unavailable.

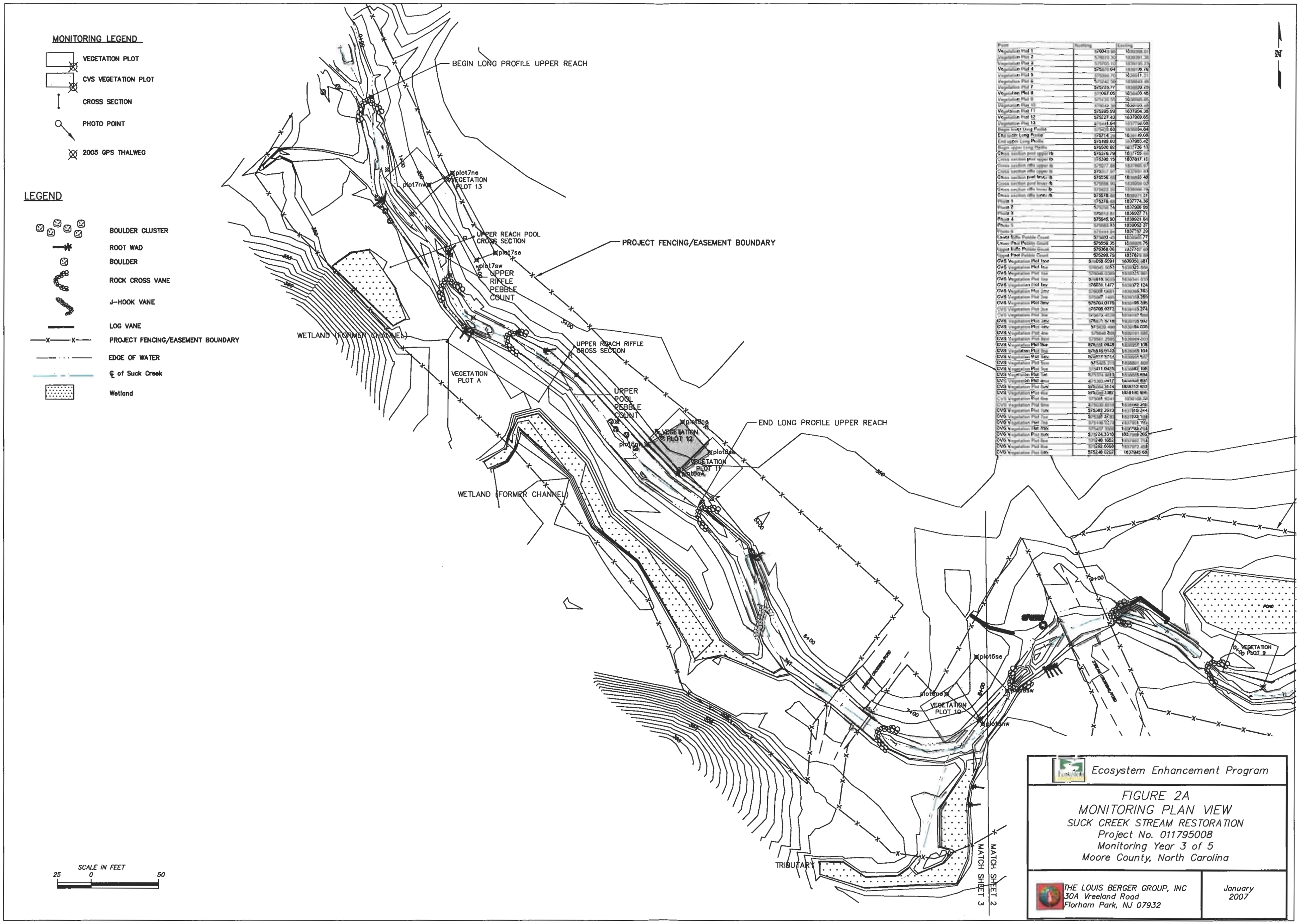
Table III. Project Contact Table
Suck Creek Stream Restoration: Project No. 0117950008

Designer: Kimley-Horn and Associates, Inc.	P.O. Box 33068, Raleigh, NC, 27636 Mr. Will Wileham, Phone: (919) 677-2000
Construction Contractor: Shamrock Environmental Corporation	PO Box 14987, Greensboro NC 27415 Mr. Bill Wright
Planting Contractor: Shamrock Environmental Corporation	PO Box 14987, Greensboro NC 27415 Mr. Bill Wright
Seeding Contractor: Shamrock Environmental Corporation	PO Box 14987, Greensboro NC 27415 Mr. Bill Wright
Seedmix Sources: Ernst Crownvetch Farms	9006 Mercer Pike, Meadville, PA 16335 (814) 336-2404
Nursery Stock Suppliers: Hillis Nursery Company	92 Gardner Rd., McMinnville, TN 37110 (931) 668-9125
Monitoring Performers:	
Year 1 Monitoring (stream and vegetation): Kimley-Horn and Associates, Inc.	P.O. Box 33068, Raleigh, NC, 27636 Mr. Will Wileham, Phone: (919) 677-2000
Year 2 Monitoring (stream and vegetation): The Louis Berger Group, Inc.	1513 Walnut Street, Suite 250, Cary, NC, 27511 Mr. Ed Samanns, Phone: (973) 765-1800

Table IV. Project Background Table **Suck Creek Stream Restoration: Project No. 0117950008**	
Project County	Moore
Drainage Area of Upper Reach	4.7 sq. miles
Drainage Area of Lower Reach	4.8 sq. miles
Drainage Area Impervious Cover Estimate (%)	<2 percent
Stream Order	2
Physiographic Region	Piedmont
Ecoregion	Sand Hills
Rosgen Classification of As-built	C4
Cowardin Classification	Riverine Upper Perennial Stream Bed Sand Substrate (R3SB2) Lotic System
Dominant Soil Types	Chewacla silt loam, Tetotum silt loam
Reference Site ID	Upstream of project site and Richland Creek
USGS HUC for Project and Reference	3030003
NCDWQ Sub-Basin for Project and Reference	03-06-10
NCDWQ Classification for Project and Reference	C
NCDWQ Classification of Reach 1	C
NCDWQ Classification of Reach 2	C
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	--
% of project easement fenced	100%

5. Monitoring Plan View

The monitoring plan view is included as Figure 2.



Point	Northing	Easting
Vegetation Plot 1	[illegible]	[illegible]
Vegetation Plot 2	[illegible]	[illegible]
Vegetation Plot 3	[illegible]	[illegible]
Vegetation Plot 4	[illegible]	[illegible]
Vegetation Plot 5	[illegible]	[illegible]
Vegetation Plot 6	[illegible]	[illegible]
Vegetation Plot 7	575223.77	[illegible]
Vegetation Plot 8	[illegible]	[illegible]
Vegetation Plot 9	[illegible]	[illegible]
Vegetation Plot 10	[illegible]	[illegible]
Vegetation Plot 11	575205.99	1837994.38
Vegetation Plot 12	575227.43	1837969.85
Vegetation Plot 13	[illegible]	[illegible]
Begin lower Long Profile	[illegible]	[illegible]
End lower Long Profile	[illegible]	[illegible]
End upper Long Profile	575199.03	[illegible]
Begin upper Long Profile	575500.02	[illegible]
Cross section pool upper rb	575376.79	[illegible]
Cross section pool upper lb	[illegible]	1837817.16
Cross section riffle upper rb	[illegible]	[illegible]
Cross section riffle upper lb	[illegible]	[illegible]
Cross section pool lower rb	[illegible]	[illegible]
Cross section pool lower lb	[illegible]	[illegible]
Cross section riffle lower rb	[illegible]	[illegible]
Cross section riffle lower lb	[illegible]	[illegible]
Photo 1	[illegible]	1837774.36
Photo 2	[illegible]	1837906.95
Photo 3	[illegible]	1836927.71
Photo 4	575645.80	1838921.04
Photo 5	[illegible]	1839062.27
Photo 6	[illegible]	1837767.29
Lower Riffle Pebble Count	[illegible]	[illegible]
Lower Pool Pebble Count	575556.35	[illegible]
Upper Riffle Pebble Count	575388.06	[illegible]
Upper Pool Pebble Count	575299.79	[illegible]
CVS Vegetation Plot 1sw	[illegible]	[illegible]
CVS Vegetation Plot 1se	[illegible]	[illegible]
CVS Vegetation Plot [illegible]	[illegible]	[illegible]
CVS Vegetation Plot [illegible]	[illegible]	[illegible]
CVS Vegetation Plot 1nw	576031.1477	[illegible]
CVS Vegetation Plot [illegible]	[illegible]	[illegible]
CVS Vegetation Plot [illegible]	[illegible]	[illegible]
CVS Vegetation Plot 3sw	575704.0179	[illegible]
CVS Vegetation Plot [illegible]	575705.9372	[illegible]
CVS Vegetation Plot [illegible]	[illegible]	[illegible]
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CVS Vegetation Plot [illegible]	[illegible]	[illegible]
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CVS Vegetation Plot [illegible]	[illegible]	[illegible]
CVS Vegetation Plot 9se	[illegible]	[illegible]
CVS Vegetation Plot [illegible]	575518.9143	[illegible]
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CVS Vegetation Plot [illegible]	[illegible]	[illegible]
CVS Vegetation Plot 7nw	[illegible]	[illegible]
CVS Vegetation Plot [illegible]	[illegible]	[illegible]
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Ecosystem Enhancement Program

FIGURE 2A
MONITORING PLAN VIEW
SUCK CREEK STREAM RESTORATION
Project No. 011795008
Monitoring Year 3 of 5
Moore County, North Carolina

THE LOUIS BERGER GROUP, INC
30A Vreeland Road
Florham Park, NJ 07932

January 2007

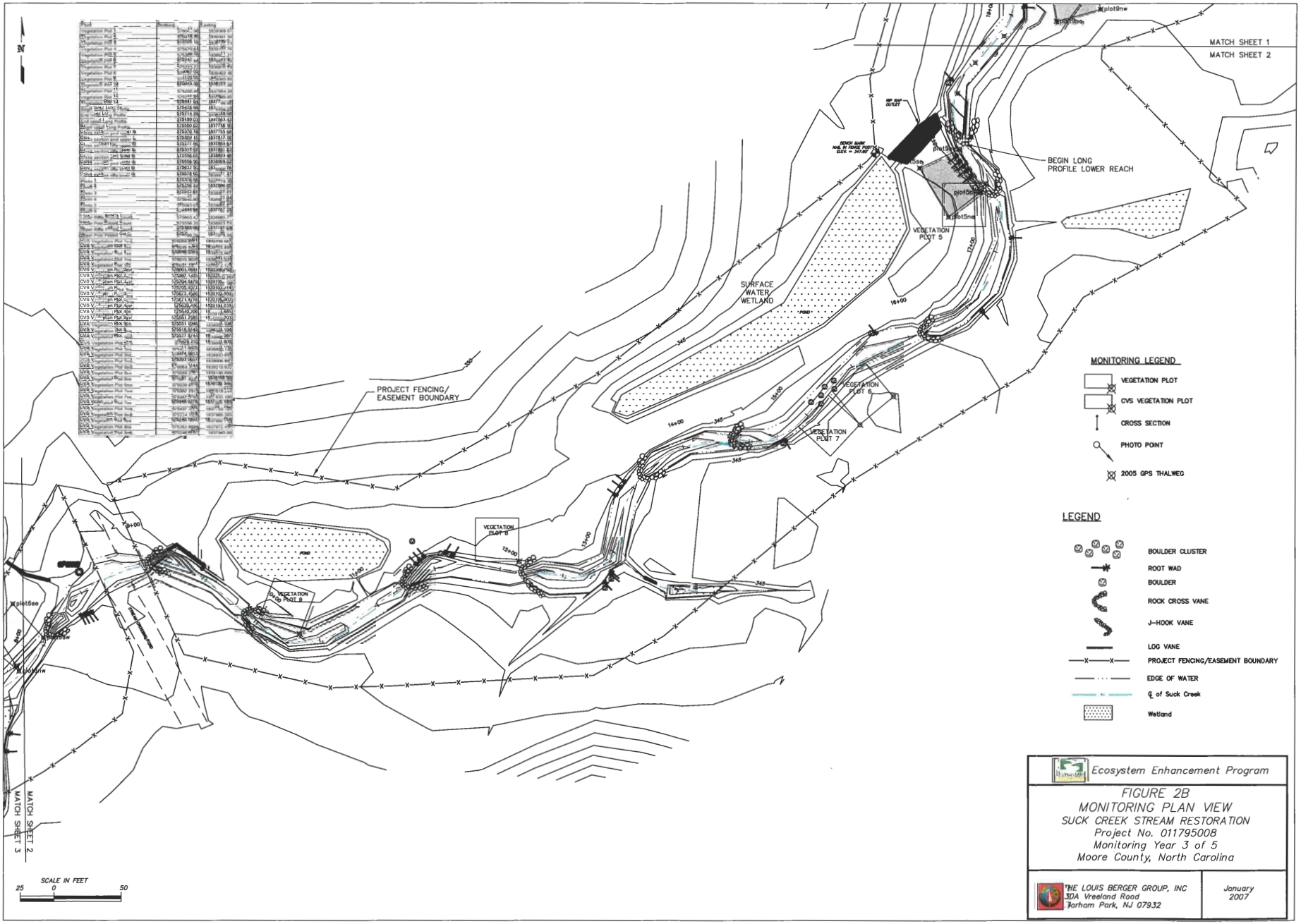

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FIGURE 2B
MONITORING PLAN VIEW
SUCK CREEK STREAM RESTORATION
Project No. 011795008
Monitoring Year 3 of 5
Moore County, North Carolina

THE LOUIS BERGER GROUP, INC
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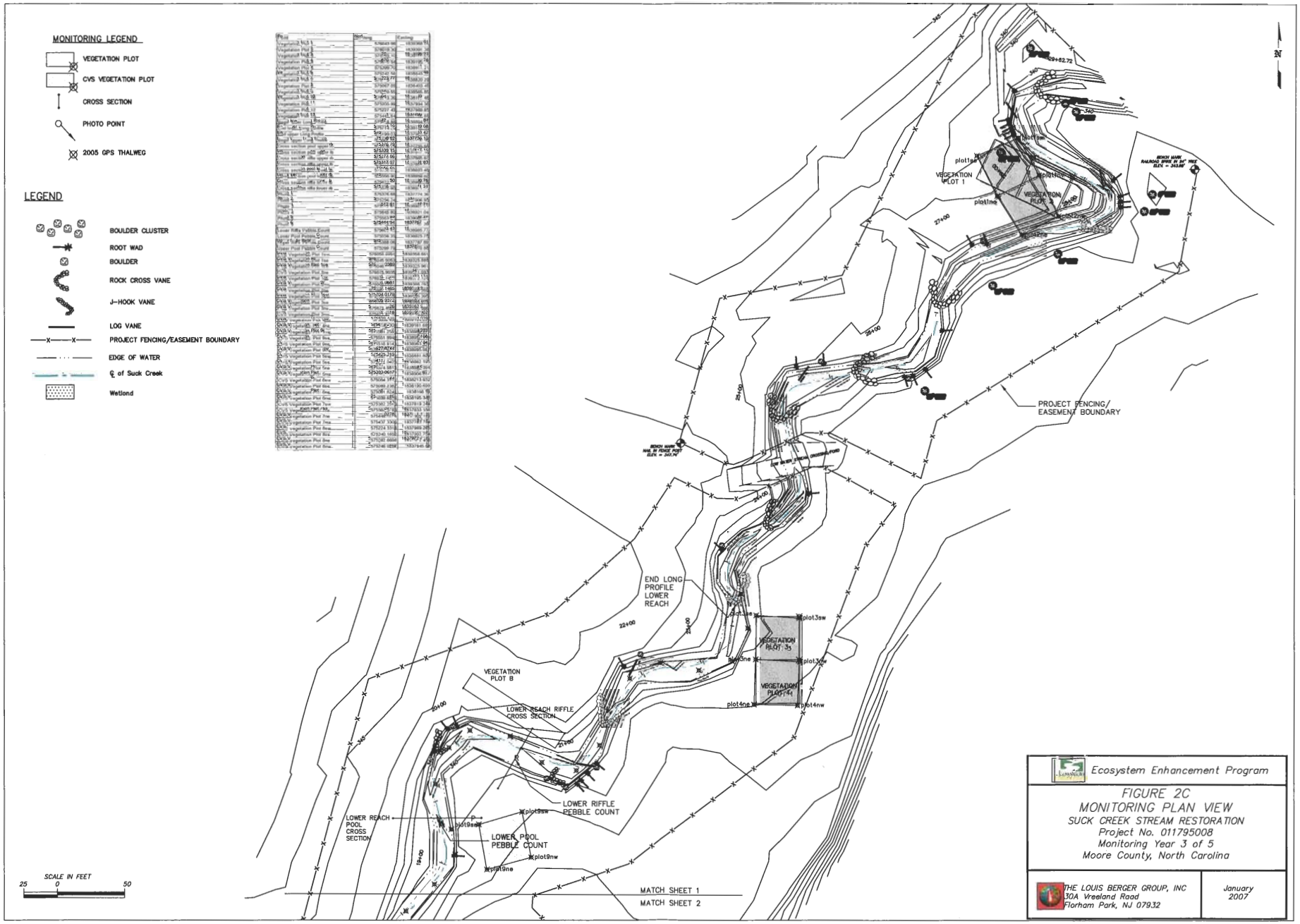
January 2007


MONITORING LEGEND
VEGETATION PLOT
CVS VEGETATION PLOT
CROSS SECTION
PHOTO POINT
2005 GPS THALWEG
LEGEND
BOULDER CLUSTER
ROOT WAD
BOULDER
ROCK CROSS VANE
J-HOOK VANE
LOG VANE
PROJECT FENCING/EASEMENT BOUNDARY
EDGE OF WATER
℄ of Suck Creek
Wetland
PROJECT FENCING/ EASEMENT BOUNDARY
END LONG PROFILE LOWER REACH
VEGETATION PLOT 1
VEGETATION PLOT 2
VEGETATION PLOT 3
VEGETATION PLOT 4
VEGETATION PLOT B
LOWER REACH RIFFLE CROSS SECTION
LOWER RIFFLE PEBBLE COUNT
LOWER REACH POOL CROSS SECTION
LOWER POOL PEBBLE COUNT
MATCH SHEET 1
MATCH SHEET 2
SCALE IN FEET
25 0 50
N
Ecosystem Enhancement Program
FIGURE 2C
MONITORING PLAN VIEW
SUCK CREEK STREAM RESTORATION
Project No. 011795008
Monitoring Year 3 of 5
Moore County, North Carolina
THE LOUIS BERGER GROUP, INC
30A Vreeland Road
Florham Park, NJ 07932
January 2007

III. Project Condition and Monitoring Results

A. Vegetation Assessment

1. Vegetative Problem Areas

Vegetative Problem Areas are defined as either lacking vegetation or containing exotic vegetation. No problem areas were identified during Monitoring Year 3. Problem areas reported in previous years had become colonized with herbaceous vegetation.

2. Vegetative Problem Area Plan View

The location of each vegetative problem area is shown in Appendix A.

3. Stem Counts

Vegetation monitoring in Year 3 was conducted using two sampling methodologies: EEP Stem Counting Protocol and the CVS-EEP Protocol for Recording Vegetation (Levels 1 & 2). The EEP Stem Counting Protocol was used to collect data for comparison with Year 2 vegetation monitoring results since this methodology was used in Year 2. EEP Stem Count plot numbers and locations for this years monitoring were the same as the previous year. CVS-EEP vegetation plots (3,4) were located atop of the EEP Stem Count plots (3,4). Other CVS-EEP plots (1,2,5,6,7,8) where set across portions of the EEP Stem Count plots (1,2,5,10,11,12,13), and one CVS-EEP plot (9) was set outside of any previous vegetation monitoring plots. The data summary of woody stem density onsite described below was collected using EEP Stem Counting Protocol. The data summary generated using the CVS-EEP protocol is provided in Appendix A.

Based on the data collected using the EEP Stem Counting Protocol, all of the 13 plots had stem densities above the success criteria of 260 planted trees per acre. The average tree density for the entire site exceeded the success criteria at 1,042 trees per acre. Recruitment of volunteer species has significantly increased stem densities site-wide; with root suckering of river birch along the stream bank accounting for the majority of volunteer stems.

Within each plot, woody stem densities were higher along the stream banks because of regeneration from live stakes and root suckering of river birch. Stem density rapidly decreased with distance away from the stream banks. The most common woody plants recorded away from the stream banks included: sycamore (*Platanus occidentalis*), green ash (*Fraxinus pennsylvanica*) and sweet gum (*Liquidambar styraciflua*). These woody stem species are often taller than the herbaceous growth within this area. All of last year's red stem dogwood (*Cornus stolonifera*) were identified this year, correctly, as silky dogwood (*Cornus amomum*).

Thick herbaceous growth covers nearly all of the stream banks and riparian zone. The herbaceous growth is dominated by tall wormwood (*Artemisia caudata*) and whorled coreopsis (*Coreopsis verticillata*).

A summary of stem count data collected using the EEP Stem Counting Protocol is provided in Table V. The results of the vegetation monitoring conducted using the CVS-EEP Protocol is provided in Appendix A.

Table V. Stem Counts for Each Species Arranged by Plot and Location – Based on Data collected Using the EEP Stem Counting Protocol
Suck Creek Stream Restoration: Project No. 0117950008

Species	Plots													Year 3 Totals	Year 2 Totals	% Survival
	1	2	3	4	5	6	7	8	9	10	11	12	13			
Shrubs																
Alnus serrulata[1]							1		3	2		1		7	7	100
Baccharis halimifolia								1			1			2	0	
Celtis laevigata[1]										1				1	0	
Cornus amomum						3	6		1	2			3	15	0	
Cornus stolonifera						1								1	23	4
Ligustrum vulgaris	1													1	0	
Oxydendrum arboreum[1]														0	3	0
Trees																
Acer rubrum[1]		2	2											4	1	100
Betula nigra	7	1	2			7	6		8	19	36	84	25	195	150	100
Diospyros virginiana													1	1	0	
Fraxinus pennsylvanica			1		6							1		8	4	100
Liquidambar styraciflua[1]	2	1	1						4	2		5	2	17	24	71
Liriodendron tulipifolia														0	0	
Nyssa sylvatica	1	1									1	1		4	0	
Pinus taeda	1		3	4			2		1	2				13	2	100
Platanus occidentalis	2	1					1		2	5			18	29	36	80
Prunus serotina							1							1	0	
Quercus phellos														0	2	0
Salix nigra	2		5		1	3	6	8	8	2			1	36	50	72
Total Stems	*17*	*8*	*17*	*8*	*12*	*20*	*30*	*17*	*36*	*45*	*49*	*104*	*63*	*335*	*302*	
Stem Density	*688*	*323*	*688*	*323*	*485*	*809*	*1,214*	*688*	*1,457*	*1,821*	*1,983*	*4,210*	*2,550*			

[1]Volunteer or sapling vegetation found within sampling plots.

B. Stream Assessment

1. Procedural Items

During the Year 2 (2005) field sampling effort at the lower pool cross section, the right bank stake could not be found. The field crew used a sub-meter accurate GPS unit to locate to the approximate coordinates of the previous year's location. When the stake location could not be located, a new end point was created. Conduit was driven into the ground to mark the location, GPS coordinates were established at the location of the installed conduit, the elevation of the top of conduit was established using a laser level and rod (tied into the permanent benchmark located on-site) and the cross section was surveyed. This same cross section location was used during Year 3 monitoring.

2. Hydrologic Criteria

A stream gauge was installed the first week in August 2006. Since a full year of hydrologic data was not collected, this criteria was not evaluated for the full Year 3 monitoring period. During the period of available data (August – October 2006) no bankfull events were recorded. A graphic of the data collected is provided in Appendix B.

3. Stream Problem Areas Plan View

The position of each structural problem area is shown in Appendix B.

4. Stream Problem Areas Table

There were no new problem areas identified during Year 3 monitoring. All Year 2 problem areas were unchanged, had not degraded further, or herbaceous vegetation had established on the problem area. The root wad failure at Station 19+10 has stabilized and vegetated and is not considered a problem area. This area will be looked at in future monitoring to track its stability. A summary of the problem structures observed during Year 3 monitoring with notes about each structures status is provided in Appendix B.

Maintenance is recommended on the cross vanes at Stations 21+60 and 26+60 since scour between and around individual rocks in the arm is extensive and the arm of the structure is not creating a bar behind the structure of any kind. Sediment has deposited atop the vane arms and has become vegetated. Piping between vane rocks still continues.

The mid-channel bar downstream of the boulder field (Stations 4+00 to 4+60) has become vegetated with rice cutgrass (*Leersia oryzoides*). This feature likely occurs because of unfocused velocity, down stream of the boulder field, and too slight a water surface slope. Low water levels due to the late summer drought may have also created shallow water conditions conducive for the germination and establishment of rice-cut grass. No maintenance actions are recommended at this time.

The root wad failure at Station 19+10 that caused bank erosion last year has stabilized. The banks and fabric matting have formed a vegetated slumping bank.

5. Number Issue Photos Section

A photograph of each structural problem area is provided in Appendix B.

6. Fixed Station Photos

Photographs taken at each established photograph station are provided in Appendix B.

7. Stability Assessment

A semi-qualitative summary of results from the visual inspection is proved in Table VIa for the Upper Reach and Table VIb for the Lower Reach.

Table VIa. Categorical Stream Feature Visual Stability Assessment – Upper Reach
Suck Creek Stream Restoration: Project No. 0117950008
Segment/Reach: Upper Reach

Feature	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
A. Riffles	N/A	N/A	88	88		
B. Pools	N/A	N/A	88	88		
C. Thalweg	N/A	N/A	100	100		
D. Meanders	N/A	N/A	100	100		
E. Bed General	N/A	N/A	99	99		
F. Bank Condition	N/A	N/A	96	96		
G. Vanes / J Hooks etc.	N/A	N/A	100	100		
H. Wads and Boulders	N/A	N/A	100	100		

N/A: Historical project documents necessary to provide this data were unavailable at the time of this report submission.

Table VIb. Categorical Stream Feature Visual Stability Assessment – Lower Reach
Suck Creek Stream Restoration: Project No. 0117950008
Segment/Reach: Lower Reach

Feature	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
A. Riffles	N/A	N/A	93.5	93.5		
B. Pools	N/A	N/A	100	100		
C. Thalweg	N/A	N/A	100	100		
D. Meanders	N/A	N/A	99	99		
E. Bed General	N/A	N/A	100	100		
F. Bank Condition	N/A	N/A	100	100		
G. Vanes / J Hooks etc.	N/A	N/A	85	85		
H. Wads and Boulders	N/A	N/A	96	96		

N/A: Historical project documents necessary to provide this data were unavailable at the time of this report submission.

8. Quantitative Measures Summary Tables

Graphic interpretations of cross sections, profiles and sediment distributions are shown in Appendix B. A summary of geomorphic measurements is shown in Table VII and Table VIII.

Table VII. Baseline Morphology and Hydraulic Summary
Suck Creek Stream Restoration: Project No. 0117950008
Segment/Reach: Entire Reach

Parameter	USGS Gage Data			Regional Curve Interval			Pre-Existing Condition			Project Reference Stream			Design			As-built		
Dimension	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
BF Width (ft)													15	20	N/A	N/A	N/A	21.2
Floodprone Width (ft)																		
BF Cross Sectional Area (ft^2)													18	36	N/A	N/A	N/A	18.1
BF Mean Depth (ft)													1.2	1.8	N/A	N/A	N/A	1.3
BF Max Depth (ft)													1.8	2.9	N/A	N/A	N/A	2.2
Width/Depth Ratio													12.5	11.1	N/A	N/A	N/A	16.3
Entrenchment Ratio													N/A	N/A	N/A	N/A	N/A	N/A
Bank Height Ratio													N/A	N/A	N/A	N/A	N/A	N/A
Wetted Perimeter (ft)													N/A	N/A	N/A	N/A	N/A	N/A
Hydraulic Radius (ft)													N/A	N/A	N/A	N/A	N/A	N/A
Pattern																		
Channel Beltwidth (ft)													21	99	N/A	20	104	N/A
Radius of Curvature (ft)													32	69	N/A	35	55	N/A
Meander Wavelength (ft)													130	265	N/A	120	265	N/A
Meander Width ratio																		
Profile																		
Riffle length (ft)													N/A	N/A	N/A	10	42	N/A
Riffle slope (ft/ft)													.45	1.0	N/A	0.5	1.0	N/A
Pool length (ft)													N/A	N/A	N/A	20	128	N/A
Pool spacing (ft)													60	140	N/A	54	171	N/A
Substrate																		
d50 (mm)													N/A	N/A	N/A	0.8	20	N/A
d84 (mm)													N/A	N/A	N/A	10	34	N/A
Additional Reach Parameters																		
Valley Length (ft)																		
Channel Length (ft)																		
Sinuosity																		
Water Surface Slope (ft/ft)																		
BF slope (ft)																		
Rosgen Classification																		
*Habitat Index																		
*Macrobenthos																		

* Inclusion will be project specific and determined primarily by As-built monitoring plan/success criteria
N/A: Historical project documents necessary to provide this data were unavailable.

Table VIII. Morphology and Hydraulic Monitoring Summary
Suck Creek Stream Restoration: Project No. 0117950008
Segment/Reach:

Parameter	Cross Section 1 Upper Pool						Cross Section 2 Upper Riffle						Cross Section 3 Lower Pool						Cross Section 4 Lower 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)	27.3	26.2	24.7				21.2	19.2	17.0				31	9.9	10.5				20.7	16.6	16.6			
Floodprone Width (ft)	N/A	N/A	N/A				N/A	N/A	N/A				N/A	N/A	N/A				N/A	N/A	N/A			
BF Cross Sectional Area (ft^2)	34.3	32.5	28.8				18.1	15.2	15.7				33	13.4	11.4				27.4	20.9	20.5			
BF Mean Depth (ft)	1.8	1.2	1.2				0.9	0.8	0.9				1.1	1.4	1.1				1.3	1.3	1.2			
BF Max Depth (ft)	2.8	2.7	2.7				1.6	1.6	1.6				2.8	1.6	1.4				2.2	2	1.9			
Width/Depth Ratio	7.4	21.1	21.1				25	24.2	18.5				29.2	7.3	9.7				15.6	13.2	13.4			
Entrenchment Ratio	2.1	N/A	N/A				2.8	N/A	N/A				2.5	N/A	N/A				3.2	N/A	N/A			
Bank Height Ratio	N/A	1.24	1.2				N/A	2.04	2.05				N/A	2.71	3.1				N/A	1.6	2.02			
Wetted Perimeter (ft)	N/A	27.3	25.8				N/A	19.7	17.6				N/A	11.7	12				N/A	13.2	17.7			
Hydraulic Radius (ft)	N/A	1.2	1.1				N/A	0.8	0.9				N/A	1.1	0.9				N/A	1.2	1.2			
Substrate																								
d50 (mm)	17.9	14.8					13.2	7.3	0.7				0.8	0.8					20	0.7	0.5			
d84 (mm)	32	32					30.8	34	23				10	9					33.4	5	133			

Parameter	MY-01 (2004)			MY-02 (2005)			MY-03 (2006)			MY-04 (XXXX)			MY-05 (XXXX)			MY+ (XXXX)		
Upper Reach																		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel beltwidth (ft)	21	99	N/A	13	27	20	13	27	20									
Radius of curvature (ft)	32	69	N/A	30	33	31.5	30	33	31.5									
Meander wavelength (ft)	130	265	N/A	141	160	150	141	160	150									
Meander width ratio	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A									
Profile																		
Riffle length (ft)	10	42	N/A	32	75	53.5	11	26	18.5									
Riffle slope (ft/ft)	0.5%	1.0%	N/A	0.09	0.1	0.01	0.38	0.41	0.40									
Pool length (ft)	20	128	N/A	18	45	31.5	56	86	71									
Pool spacing (ft)	54	171	N/A	68	88	78	64	99	81.5									
Lower Reach																		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel beltwidth (ft)	21	99	N/A	13	27	20	13	27	20									
Radius of curvature (ft)	32	69	N/A	30	33	31.5	30	33	31.5									
Meander wavelength (ft)	130	265	N/A	141	160	150	141	160	150									
Meander width ratio	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A									
Profile																		
Riffle length (ft)	10	42	N/A	26	56	41	21	27	24									
Riffle slope (ft/ft)	0.5%	1.0%	N/A	0.03	0.08	0.055	0.021	0.07	0.046									
Pool length (ft)	20	128	N/A	20	34	27	35	77	56									
Pool spacing (ft)	54	171	N/A	83	123	103	84	119	101.5									

Table VIII. Morphology and Hydraulic Monitoring Summary – Continued						
Suck Creek Stream Restoration: Project No. 0117950008						
Segment/Reach:						
	MY-01 (2004)	MY-02 (2005)	MY-03 (2006)	MY-04 (XXXX)	MY-05 (XXXX)	MY+ (XXXX)
Additional Reach Parameters		Lower/Upper	Lower/Upper			
Valley length (ft)	N/A	411/386	411/386			
Channel length (ft)	N/A	515/408	515/408			
Sinuosity	N/A	1.25/1.05	1.25/1.05			
Water surface slope (ft/ft)	N/A	0.0022/0.0017	0.0020/0.0021			
Bankfull slope (ft)	N/A	0.0023/0.0029	0.0054/0.0035			
Rosgen Classification	C5	C5	C5			
*Habitat Index	N/A	N/A	N/A			
*Macrobenthos	N/A	N/A	N/A			

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

N/A: Historical project documents necessary to provide this data were unavailable at the time of this report submission.

IV. Methodology Section

No unavoidable deviations from established protocols occurred during Year 3 monitoring.

Appendix A
(Click here)

APPENDIX A

1. VEGETATION DATA TABLES

1. Vegetation Data Tables

Table 1. Vegetation Metadata	
Report Prepared By	Michael Lee
Date Prepared	11/17/2006 11:49
database name	CVS_EEP_DataEntry_v202.mdb
database location	C:\work\CVS-EEP
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	This worksheet, which is a summary of the project and the project data.
Plots	List of plots surveyed.
Vigor	Frequency distribution of vigor classes.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Stem Count by Plot and Spp	Count of living stems of each species for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	Suck Creek
project Name	Suck Creek
Description	Stream Restoration
length (ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	9

Table 2. Vegetation Vigor by Species							
	Species	**4**	**3**	**2**	**1**	**0**	**Missing**
	Alnus serrulata	4					
	Betula nigra	63	3				
	Celtis occidentalis	2					
	Cornus amomum		1				
	Diospyros virginiana	1					
	Fraxinus nigra		1				
	Fraxinus pennsylvanica	8	1				
	Liquidambar styraciflua	1					
	Pinus taeda	7					
	Quercus phellos	2					
	Salix nigra	12	8	2			
	Platanus occidentalis	9	1				
	Acer rubrum	1	3				
TOT:	**13**	**110**	**18**	**2**			

Table 3. Vegetation Damage by Species									
	Species	**All Damage Categories**	**(no damage)**	**Deer**	**Drought**	**Insects**	**Site Too Dry**	**Unknown**	**(other damage)**
	Acer rubrum	4	1	1					2
	Alnus serrulata	4	2	2					
	Betula nigra	66	50	14		1		1	
	Celtis occidentalis	2	2						
	Cornus amomum	1		1					
	Diospyros virginiana	1	1						
	Fraxinus nigra	1		1					
	Fraxinus pennsylvanica	9	5	4					
	Liquidambar styraciflua	1	1						
	Pinus taeda	7	7						
	Platanus occidentalis	10	9						1
	Quercus phellos	2	2						
	Salix nigra	22	14		1	1	3	2	1
TOT:	**13**	**130**	**94**	**23**	**1**	**2**	**3**	**3**	**4**

Table 4. Vegetation Damage by Plot

	plot	All Damage Categories	(no damage)	Deer	Drought	Insects	Site Too Dry	Unknown	(other damage)
	79-1-1T-1/1	6	5					1	
	79-1-2	15	9	3			1		2
	79-1-3	13	9				2	2	
	79-1-4	9	6	1					2
	79-1-5	7	5	2					
	79-1-6	33	21	9	1	2			
	79-1-7	18	14	4					
	79-1-8	28	25	3					
	79-1-9	1		1					
TOT:	**9**	**130**	**94**	**23**	**1**	**2**	**3**	**3**	**4**

Table 5. Stem Count by Plot and Species

	Species	Total Stems	# plots	avg# stems	plot 79-1-1T-1/1	plot 79-1-2	plot 79-1-3	plot 79-1-4	plot 79-1-5	plot 79-1-6	plot 79-1-7	plot 79-1-8	plot 79-1-9
	Acer rubrum	4	2	2				3		1			
	Alnus serrulata	4	3	1.33				1		2		1	
	Betula nigra	66	6	11	1	9	1			16	13	26	
	Celtis occidentalis	2	2	1						1	1		
	Cornus amomum	1	1	1						1			
	Diospyros virginiana	1	1	1					1				
	Fraxinus nigra	1	1	1		1							
	Fraxinus pennsylvanica	9	5	1.8			1		4		2	1	1
	Liquidambar styraciflua	1	1	1				1					
	Pinus taeda	7	4	1.75	1		3	2		1			
	Platanus occidentalis	10	4	2.5	2	2		1		5			
	Quercus phellos	2	2	1			1	1					
	Salix nigra	22	6	3.67	2	3	7		2	6	2		
TOT:	**13**	**130**	**13**	**30.05**	**6**	**15**	**13**	**9**	**7**	**33**	**18**	**28**	**1**

APPENDIX A

2. VEGETATION PROBLEM AREA PHOTOS

2. Vegetation Problem Area Photos

No vegetation problem areas were observed during the Year 3 monitoring.

APPENDIX A

3. VEGETATION MONITORING PLOT PHOTOS

3. Vegetation Monitoring Plot Photos

A representative photo of each vegetation plot, taken on the day of sampling, is shown.

CVS Vegetation Plot 1

CVS Vegetation Plot 2

CVS Vegetation Plot 3

CVS Vegetation Plot 4

CVS Vegetation Plot 5

CVS Vegetation Plot 6

CVS Vegetation Plot 7

CVS Vegetation Plot 8

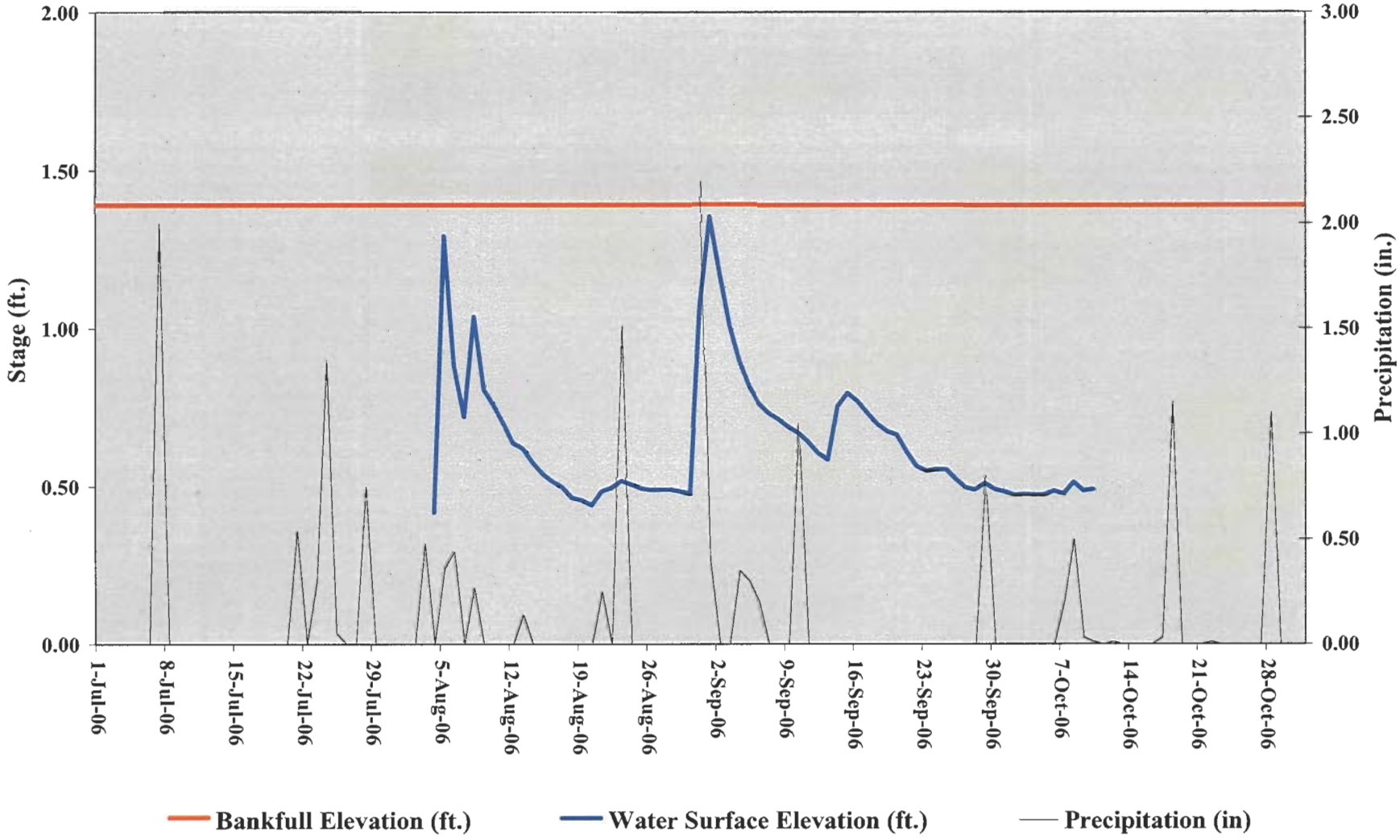
CVS Vegetation Plot 9

Appendix B
(Click here)

APPENDIX B

1. STREAM GAUGE DATA

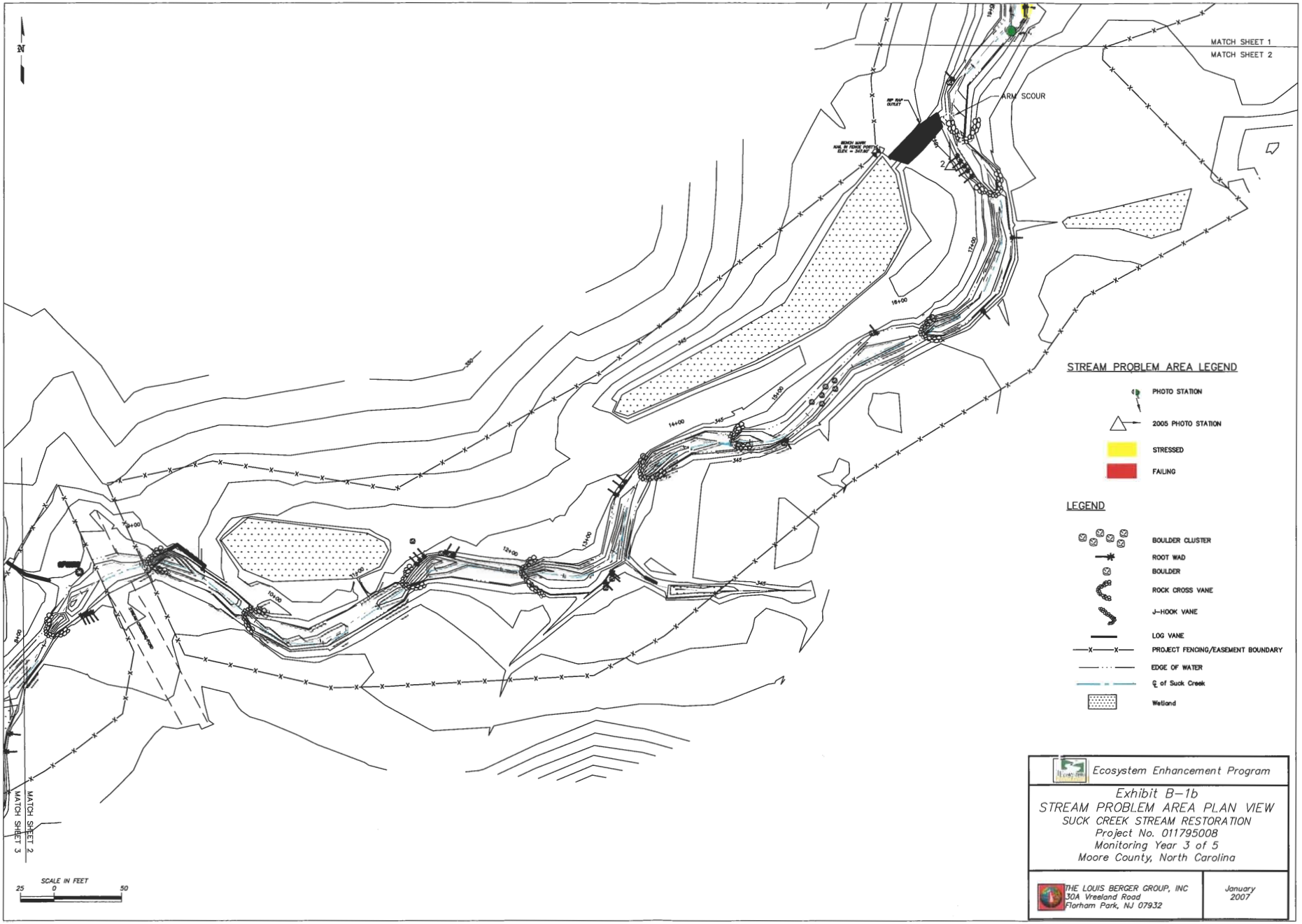
Suck Creek Mitigation Site
Stream Gauge SCSG-1 (Serial No. N4497E95)



APPENDIX B

2. PROBLEM AREAS PLAN VIEW


STREAM PROBLEM AREA LEGEND
PHOTO STATION
2005 PHOTO STATION
STRESSED
FAILING
LEGEND
BOULDER CLUSTER
ROOT WAD
BOULDER
ROCK CROSS VANE
J-HOOK VANE
LOG VANE
PROJECT FENCING/EASEMENT BOUNDARY
EDGE OF WATER
℄ of Suck Creek
Wetland
PROJECT FENCING/EASEMENT BOUNDARY
MID-CHANNEL BAR
MATCH SHEET 2
MATCH SHEET 3
N
SCALE IN FEET
25 0 50
Ecosystem Enhancement Program
Exhibit B-1a
STREAM PROBLEM AREA PLAN VIEW
SUCK CREEK STREAM RESTORATION
Project No. 011795008
Monitoring Year 3 of 5
Moore County, North Carolina
THE LOUIS BERGER GROUP, INC
30A Vreeland Road
Florham Park, NJ 07932
January
2007

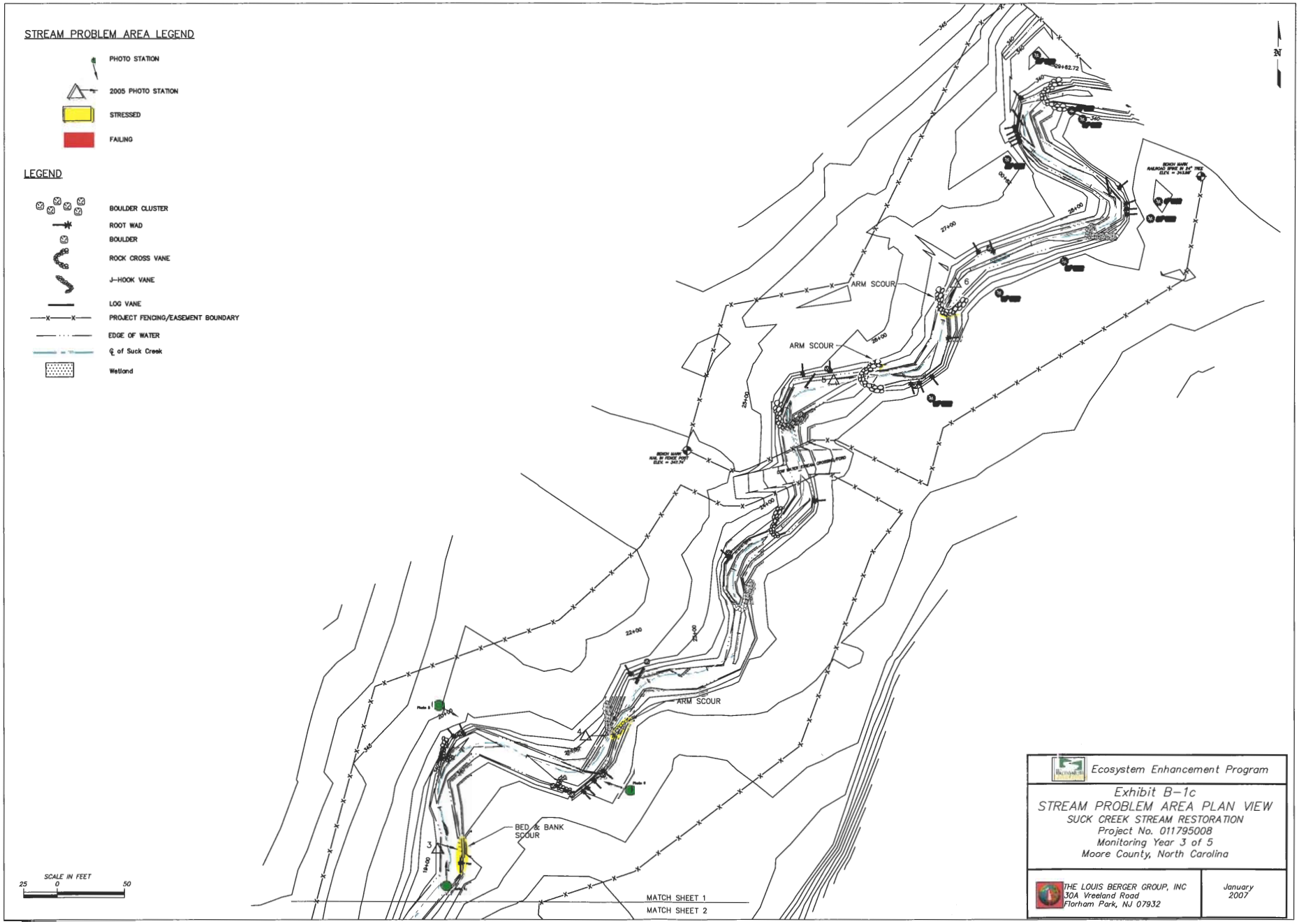


Ecosystem Enhancement Program

Exhibit B–1b
STREAM PROBLEM AREA PLAN VIEW
SUCK CREEK STREAM RESTORATION
Project No. 011795008
Monitoring Year 3 of 5
Moore County, North Carolina

THE LOUIS BERGER GROUP, INC
30A Vreeland Road
Florham Park, NJ 07932

January 2007


STREAM PROBLEM AREA LEGEND
PHOTO STATION
2005 PHOTO STATION
STRESSED
FAILING
LEGEND
BOULDER CLUSTER
ROOT WAD
BOULDER
ROCK CROSS VANE
J-HOOK VANE
LOG VANE
PROJECT FENCING/EASEMENT BOUNDARY
EDGE OF WATER
℄ of Suck Creek
Wetland
ARM SCOUR
ARM SCOUR
ARM SCOUR
BED & BANK SCOUR
MATCH SHEET 1
MATCH SHEET 2
SCALE IN FEET
25 0 50
N
Ecosystem Enhancement Program
Exhibit B-1c
STREAM PROBLEM AREA PLAN VIEW
SUCK CREEK STREAM RESTORATION
Project No. 011795008
Monitoring Year 3 of 5
Moore County, North Carolina
THE LOUIS BERGER GROUP, INC
30A Vreeland Road
Florham Park, NJ 07932
January
2007

APPENDIX B

3. TABLE B.2. STREAM PROBLEM AREAS

Table B.1. Stream Problem Areas
Suck Creek Stream Restoration: Project No. 0117950008

Feature Issue	Station Numbers	Suspected Cause	Photo Number / ID
Mid channel bar	4+00 to 4+60	Slope too slight to move sediment. More sediment has deposited and vegetation has established.	Station 4+00
Cross Vane, arm scour	18+00	Large voids between rocks in vane. No change from prior year.	Station 18+00
Root wad failure	19+10	Improper installation. Vegetation has established.	Station 19+10
Cross Vane, arm scour	21+60	Large voids between rocks in vane. No change from prior year.	Station 21+60
Cross Vane, arm scour	25+70	Large voids between rocks in vane. No change from prior year.	Station 25+70
Cross Vane, arm scour	26+60	Large voids between rocks in vane. No change from prior year.	

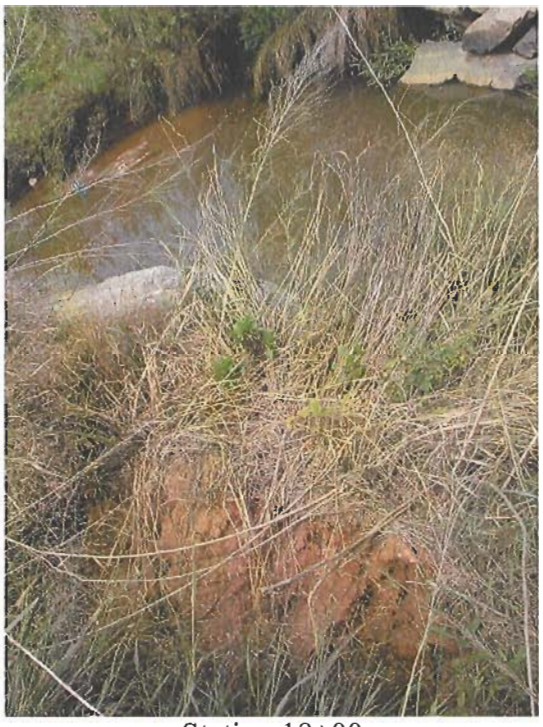
APPENDIX B

4. STREAM PROBLEM AREA PHOTOS

4. Representative Stream Problem Area Photos

A photo of each structural problem area is shown with corresponding stationing.

Station 4+00



Station 18+00

Station 19+10

Station 21+60

Station 25+70

APPENDIX B

5. STREAM PHOTO-STATION PHOTOS

5. Stream Photo-Station Photos

Photo Station 1

Photo Station 2

Photo Station 3

Photo Station 4

Photo Station 5

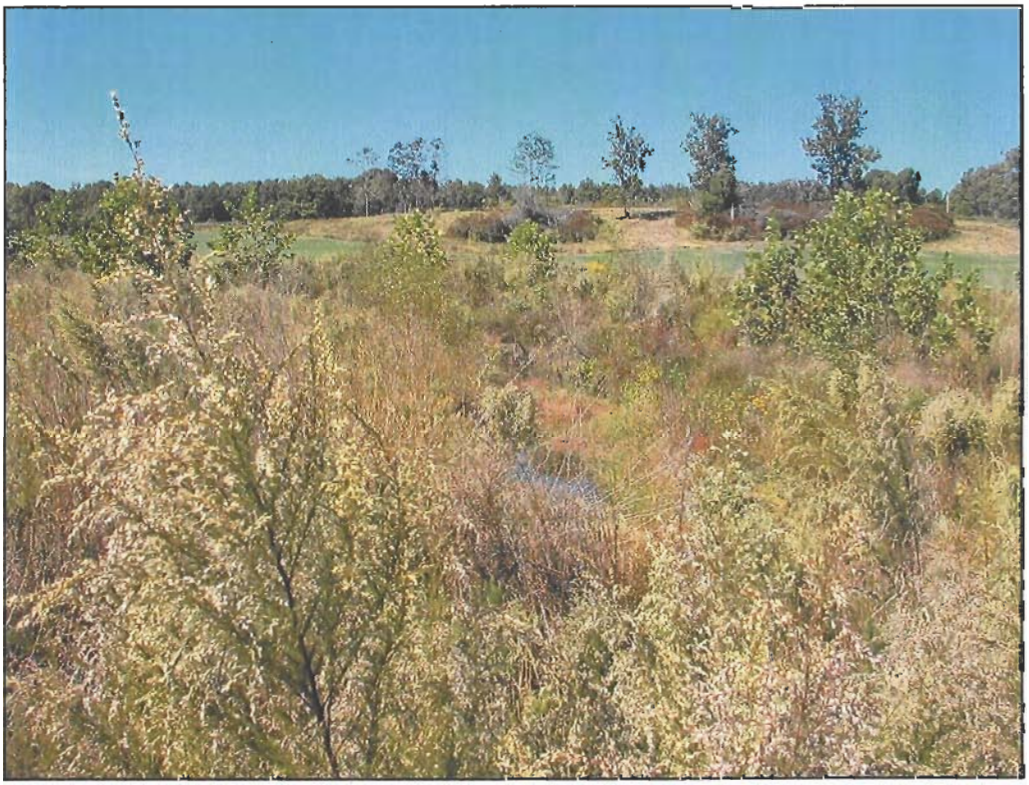


Photo Station 6

APPENDIX B

6. TABLE B.2. QUALITATIVE VISUAL STABILITY ASSESSMENT

6. Table B.2. Qualitative Visual Stability Assessment

Table B.2.a. Visual Morphological Stability Assessment Suck Creek Stream Restoration - Upper Reach: 2,088 feet						
Feature Category	Metric (per As-Built and reference baseline)	(# 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?	7	8		88	
	2. Armor Stable?		0			
	3. Facet grade appears stable?	7	8		88	
	4. Minimal evidence of embedding / fining?	7	8		88	
	5. Length appropriate?	7	8		88	88
B. Pools	1. Present?	7	8		88	
	2. Sufficient depth?	7	8		88	
	3. Length appropriate?	7	8		88	88
C. Thalweg	1. Upstream of meander bend centering?	8	8		100	
	2. Downstream of meander bend centering?	8	8		100	100
D. Meanders	1. Outer bend in state of limited / controlled erosion	7	7		100	
	2. Of those eroding, # w/concomitant point bar formation?					
	3. Apparent Rc within spec?	7	7		100	
	4. Sufficient Floodplain Access and Relief?	7	7		100	100
E. Bed General	1. General channel bed aggradation areas?			60/850	93	
	2. Channel bed degradation?			0/850	100	96
F. Vanes	1. Free of back or arm scour?	7	7		100	
	2. Height appropriate?	7	7		100	
	3. Angle and geometry appear appropriate?	7	7		100	
	4. Free of piping or other structural failures?	7	7		100	100
G. Wads / Boulders	1. Free of Scour?	7	7		100	
	2. Footing Stable?	7	7		100	100

Table B.2.b. Visual Morphological Stability Assessment Suck Creek Stream Restoration - Lower Reach: 875 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?	23	23		100	
	2. Armor Stable?		0			
	3. Facet grade appears stable?	20	23		87	
	4. Minimal evidence of embedding / fining?	20	23		87	
	5. Length appropriate?	23	23		100	93.5
B. Pools	1. Present?	24	24		100	
	2. Sufficient depth?	24	24		100	
	3. Length appropriate?	24	24		100	100
C. Thalweg	1. Upstream of meander bend centering?	21	21		100	
	2. Downstream of meander bend centering?	21	21		100	100
D. Meanders	1. Outer bend in state of limited / controlled erosion	20	21		95	
	2. Of those eroding, # w/concomitant point bar formation?	21	21		100	
	3. Apparent Rc within spec?	21	21		100	
	4. Sufficient Floodplain Access and Relief?	21	21		100	99
E. Bed General	1. General channel bed aggradation areas?		0/2000		100	
	2. Channel bed degradation?		0/2000		100	100
F. Vanes	1. Free of back or arm scour?	15	19		79	
	2. Height appropriate?	17	19		90	
	3. Angle and geometry appear appropriate?	19	19		100	
	4. Free of piping or other structural failures?	14	19		73	85
G. Wads / Boulders	1. Free of Scour?	25	26		96	
	2. Footing Stable?	25	26		96	96

APPENDIX B

7. CROSS SECTION PLOTS AND RAW DATA TABLES

Survey Data

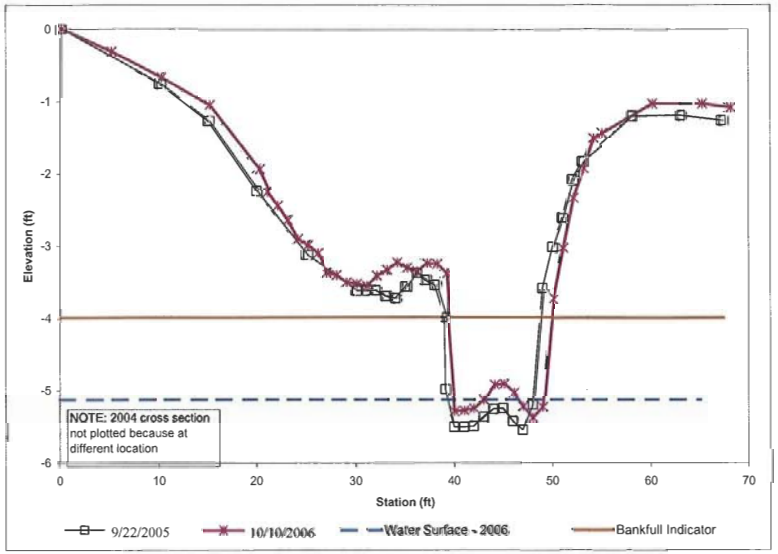
Station	Foreshot	Station	Foreshot	Notes	Station	Foreshot	Notes
2004		*9/22/2005*			*10/10/2006*		
0	5.63	0	4.67	LB	0	11.21	Gr LPin
5	5.89	10	5.42		5	11.52	
15	6.76	15	5.94		10	11.87	
18	7.35	20	6.91		15	12.26	
21	7.84	25	7.79		20	13.14	
23	8.37	30	8.28		21	13.46	
25	8.81	31	8.28		22	13.65	
26	9.07	32	8.28		23	13.85	
30	9.09	33	8.36		24	14.11	
35	8.95	34	8.39		25	14.19	
39	9.15	35	8.23		26	14.3	
41	9.35	36	8.04		27	14.58	
42.8	9.93	37	8.14		28	14.61	
45	10.49	38	8.21		29	14.71	
47	10.81	39	8.65	BKF	30	14.73	
49	11.17	39.1	9.65	LEW	31	14.76	
50	11.37	40	10.17	SB	32	14.62	
52	11.57	41	10.17	SB	33	14.54	
53	11.58	42	10.16	SB	34	14.44	
54	11.58	43	10.03	SB	35	14.51	
54.3	11.43	44	9.92	SB	36	14.56	
54.6	10.30	45	9.91	SB	37	14.45	
55	10	46	10.09	SB	38	14.46	
55.5	9.04	47	10.21	CL	39	14.59	
57	8.2	48	9.86	SB	40	16.49	
61	7.74	49	8.25	SB	41	16.48	
68	7.17	50	7.68		42	16.45	WS
75	6.44	51	7.27		43	16.33	
90	5.68	52	6.75		44	16.12	
105.6	5.48	53	6.50		45	16.11	
		58	5.87		46	16.23	
		63	5.86		47	16.42	
		67.2	5.93	RB	48	16.58	
					49	16.43	
					50	14.93	
					51	14.22	
					52	13.53	
					53	13.13	
					54	12.71	
					55	12.64	
					60	12.24	
					65	12.24	
					67.9	12.29	Gr Rt Pin

Summary Data

	2004	*2005*	*2006*	
Bankfull Cross Sectional Area (ft^2)	33.0	13.4	11.4	
Bankfull Width (ft)	31.0	9.9	10.5	
Bankfull Mean Depth (ft)	1.1	1.4	1.1	
Bankfull Max Depth (ft)	2.8	1.6	1.4	
Width/Depth Ration	29.2	7.3	9.7	
Entrenchment Ratio	2.5	N/A	N/A	
Classification	-	-	-	

Cross Section - Lower Pool

Cross Section Plot - Looking Downstream



Cross Section Photo - Looking Downstream

Title	Lower Section - Pool Cross Section				
Project		Suek Creek Stream Restoration Project Moore County, NC		**Project #**	011795008
				Figure	
Survey Date	October 10, 2006	**Survey Weather**	Sunny, 90° F	**Field Team**	Tisha Johnson; Mike O'Rourke	**Location**	Lower Reach

Survey Data

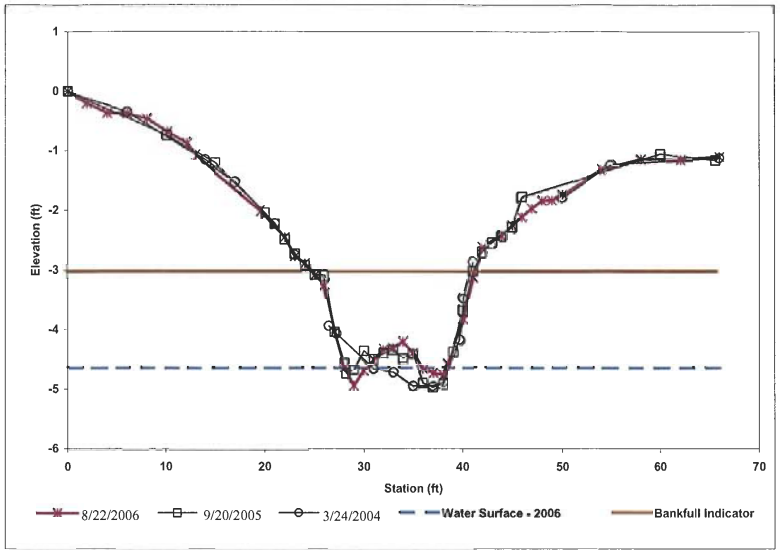
Station	Foreshot	Station	Foreshot	Notes	Station	Foreshot	Notes
3/24/2004		*9/20/2005*			*8/22/2006*		
0	5.98	0	11.51	LB	0	13.65	On LPin
6	6.32	10	12.23		2	13.84	
14	7.13	15	12.71		4	14	
17	7.50	20	13.55		6	14.01	
21	8.20	21	13.74		8	14.1	
23	8.73	22	14.00		10	14.31	
26.4	9.92	23	14.24		12	14.5	
27.2	10.05	24	14.43		13	14.71	
31	10.64	25	14.59	SB	19.5	15.65	
33	10.70	26	14.60	SB	22	16.1	
35	10.93	27	15.55	SB	23	16.42	
37	10.93	28	16.07	LEW	24	16.54	BKF
38	10.85	28.2	16.25	SB	25	16.74	
39.7	10.15	29	16.18	SB	26	16.9	
40	9.44	30	15.87	SB	27	17.69	
41	8.84	31	16.01	SB	28	18.28	WS
50	7.76	32	15.90	SB	29	18.58	
55	7.21	33	15.84	SB	30	18.34	
66	7.10	34	15.98	SB	31	18.16	
		35	15.91	CL	32	17.97	
		36	16.41	SB	33	17.94	
		37	16.48	SB	34	17.84	
		38	16.42	SB	35	18.03	
		39	15.87	SB	36	18.31	
		40	15.18	SB	37	18.38	
		41	14.52	BKF	38	18.41	
		42	14.20		38.5	18.22	
		43	14.05		40	17.47	
		44	13.93		41	16.76	
		45	13.79		42	16.26	
		46	13.28		44	16.06	
		60	12.56		45	15.9	
		65.6	12.67	RB	46	15.74	
					47	15.6	
					48	15.47	
					49	15.46	
					50	15.38	
					54	14.96	
					58	14.79	
					62	14.79	
					66	14.75	Gr RPin

Summary Data

	2004	*2005*	*2006*	
Bankfull Cross Sectional Area (ft^2)	27.4	20.9	20.5	
Bankfull Width (ft)	20.7	16.6	16.6	
Bankfull Mean Depth (ft)	1.3	1.3	1.2	
Bankfull Max Depth (ft)	2.2	2.0	1.9	
Width/Depth Ration	15.6	13.2	13.4	
Entrenchment Ratio	3.2	N/A	N/A	
Classification	-	-	-	

Cross Section - Lower Riffle

Cross Section Plot - Looking Downstream



Cross Section Photo - Looking Downstream

Title	Lower Section - Riffle Cross Section				
Ecosystem Enhancement	**Project**		Suck Creek Stream Restoration Project Moore County, NC	**Project #**	011795008
				Figure	
	Survey Date August 22, 2006	**Survey Weather** Sunny, 90° F	**Field Team** Richard Bolton; Tisha Johnson; Mike O'Rourke	**Location** Lower Reach	

Survey Data

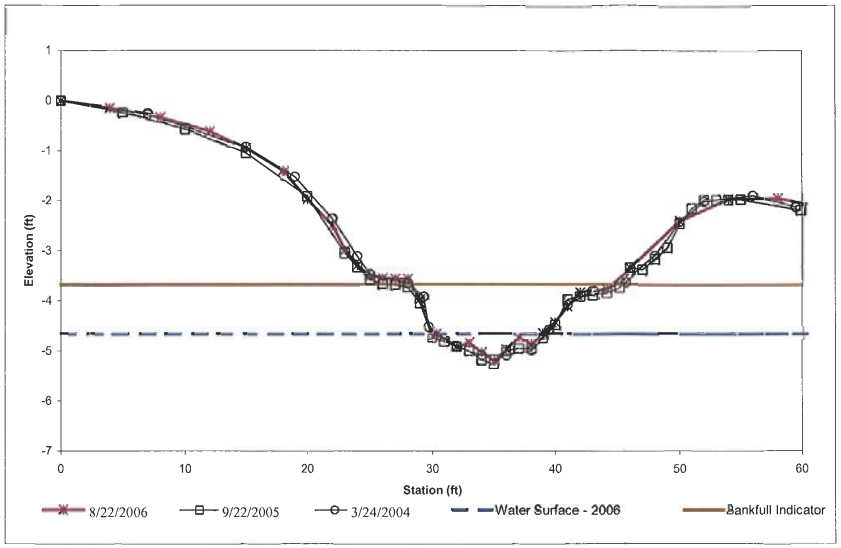
Station	Foreshot	Station	Foreshot	Notes	Station	Foreshot	Notes
3/24/2004		*9/22/2005*			*8/22/2006*		
0	5.82	0	5.69	LB	0	5.68	Gr LPin
7	6.18	5	5.92		4	5.81	
15	6.85	10	6.25		8	6	
19	7.45	15	6.74		12	6.28	
22	8.28	20	7.61		15	6.63	
24	9.03	23	8.73		18	7.08	
25	9.39	24	9.02		20	7.65	
28	9.56	25	9.26		22	8.17	
29.3	9.84	26	9.35	BKF	23	8.66	
29.7	10.44	27	9.37	SB	24	8.97	
32	10.84	28	9.41	SB	25	9.18	
34	11.00	29	9.74	SB	26	9.22	
36	11.00	30	10.42	LEW	27	9.23	
38	10.90	31	10.50	SB	28	9.23	
39.5	10.50	32	10.60	SB	29	9.65	
41	10.00	33	10.69	SB	30	10.37	
43	9.72	34	10.86	CL	30.3	10.33	WSE
45.5	9.55	35	10.95	SB	32	10.6	
48	9.01	36	10.69	SB	33	10.51	
50	8.35	37	10.64	SB	34	10.7	
52	7.94	38	10.64	SB	35	10.87	
56	7.82	39	10.43	SB	36	10.65	
59.5	7.78	40	10.17	SB	37	10.4	
		41	9.66	SB	38	10.54	
		42	9.60	SB	39	10.32	
		43	9.58	SB	40	10.1	
		44	9.52	SB	41	9.79	
		45	9.42	SB	42	9.51	
		46	9.03		44	9.44	
		47	9.07		46	9.02	BKF
		48	8.86		50	8.08	
		49	8.63		54	7.65	
		50	8.15		58	7.63	
		51	7.85		61	7.78	Gr RPin
		52	7.68				
		53	7.68				
		54	7.68				
		55	7.67				
		59.9	7.88	RB			

Summary Data

	2004	*2005*	*2006*	
Bankfull Cross Sectional Area (ft^2)	18.1	15.2	15.7	
Bankfull Width (ft)	21.2	19.2	17	
Bankfull Mean Depth (ft)	0.9	0.8	0.9	
Bankfull Max Depth (ft)	1.6	1.6	1.6	
Width/Depth Ration	25.0	24.2	18.5	
Entrenchment Ratio	2.8	N/A	N/A	
Classification	-	-	-	

Cross Section - Upper Riffle

Cross Section Plot - Looking Downstream



Cross Section Photo - Looking Downstream

Title	Upper Section - Riffle Cross Section			
Project	Suck Creek Stream Restoration Project Moore County, NC		**Project #**	011795008
			Figure	
Survey Date	**Survey Weather**	**Field Team**	**Location**	
August 22, 2006	Sunny, 90° F	Richard Bolton; Tisha Johnson; Mike O'Rourke	Upper Reach	

Survey Data

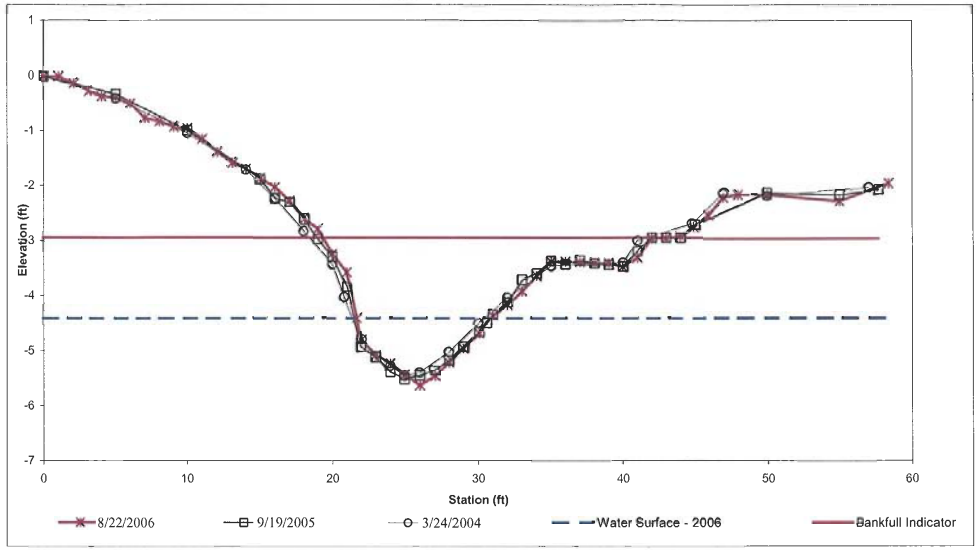
Station	Foreshot	Station	Foreshot	Notes	Station	Foreshot	Notes
3/24/2004		*9/19/2005*			*8/22/2006*		
0	6.02	0	5.92	LB	0	5.71	Gr LPin
5	6.42	5	6.24		1	5.71	
10	7.07	10	6.92		2	5.83	
14	7.74	15	7.80		3	5.97	
16	8.25	16	8.14		4	6.07	
18	8.85	17	8.22		5	6.09	
20	9.45	18	8.52		6	6.2	
20.8	10.05	19	8.89		7	6.47	
22	10.82	20	9.21		8	6.53	
24	11.30	21	9.76		9	6.63	
25	11.48	22	10.85	LEW	10	6.67	
26	11.42	23	11.03	SB	11	6.86	
28	11.05	24	11.31	SB	12	7.09	
30	10.52	25	11.43	CL	13	7.28	
32	10.05	26	11.37	SB	14	7.41	
35	9.48	27	11.28	SB	15	7.57	
40	9.42	28	11.09	SB	16	7.73	
41	9.02	29	10.85	SB	17	7.98	
44.8	8.71	30	10.58	SB	18	8.3	
47	8.15	30.6	10.42	REW	19	8.49	
50	8.19	31	10.26	SB	20	8.94	
57	8.05	32	10.04	SB	21	9.28	
		33	9.63	SB	21.7	10.11	LEW
		34	9.52	SB	22	10.51	
		35	9.29	SB	23	10.79	
		36	9.35	SB	24	10.94	
		37	9.27	SB	25	11.15	
		38	9.32	SB	26	11.33	
		39	9.35	SB	27	11.17	
		40	9.39	SB	28	10.92	
		41	9.11	SB	29	10.67	
		42	8.86	BKF	30	10.39	
		43	8.86		31	10.06	REW
		44	8.86		32	9.88	
		45	8.63		33	9.62	
		50	8.04		34	9.35	
		55	8.08		35	9.09	
		57.7	7.99	RB	36	9.09	
					37	9.09	
					38	9.11	
					39	9.11	
					40	9.19	
					41	9.01	
					42	8.67	
					43	8.66	
					44	8.63	BKF
					45	8.47	
					46	8.23	
					47	7.91	
					48	7.86	
					50	7.86	
					55	7.98	
					58.4	7.66	Gr RPin

Summary Data

	2004	*2005*	*2006*
Bankfull Cross Sectional Area (ft^2)	34.3	32.5	28.8
Bankfull Width (ft)	27.3	26.2	24.7
Bankfull Mean Depth (ft)	1.8	1.2	1.2
Bankfull Max Depth (ft)	2.8	2.7	2.7
Width/Depth Ration	7.4	21.1	21.1
Entrenchment Ratio	2.1	N/A	N/A
Classification	-	N/A	N/A

Cross Section - Upper Pool

Cross Section Plot - Looking Downstream



Cross Section Photo - Looking Downstream

Title	Upper Section - Pool Cross Section			
Project	Suck Creek Stream Restoration Project Moore County, NC		**Project #**	011795008
			Figure	
Survey Date	**Survey Weather**	**Field Team**	**Location**	
August 22, 2006	Sunny, 90° F	Richard Bolton; Tisha Johnson; Mike O'Rourke	Upper Reach	

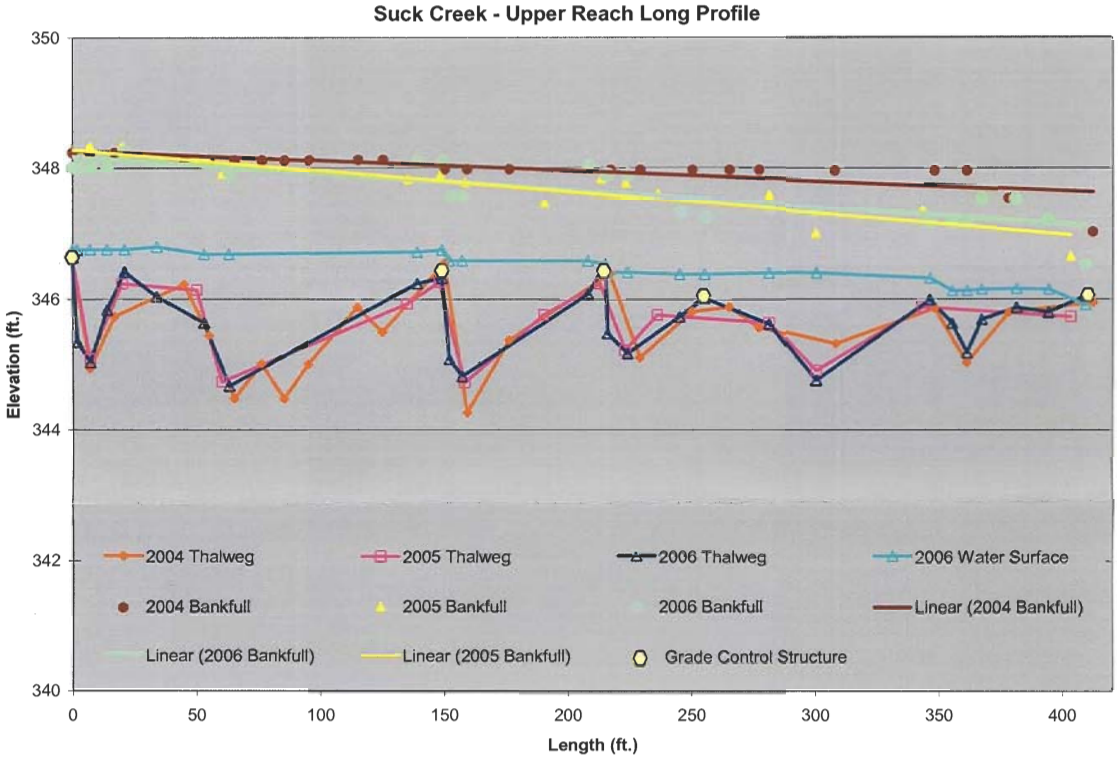
APPENDIX B

8. LONGITUDINAL PLOTS AND RAW DATA TABLES

8. Longitudinal Profiles

Longitudinal Profile – Upper Reach

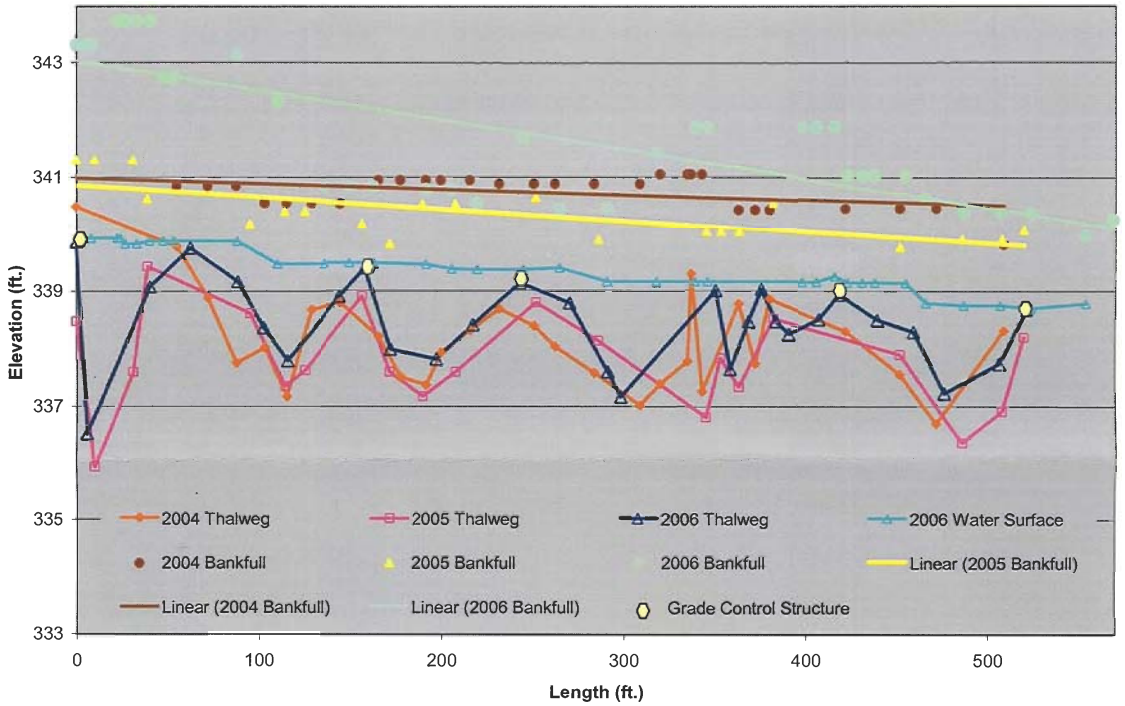
Feature/Facet Slope, Length and Spacing Upper Longitudinal Profile							
Feature	Station	Feature Length	Thalweg Elevation	Water Elevation	Bankfull Elevation	Water Surface Slope	Depth at Bankfull
	ft.	ft.	ft.	ft.	ft.	ft./ft.	ft.
Cross Vane - Top	0		346.64	346.75	348.00		1.36
Pool	2	14	345.35	346.75	348.00	0.00	2.65
Pool	7.2		345.04	346.75	348.00		2.96
Glide	14	7	345.84	346.75	348.00	0.00	2.16
Riffle	21	13	346.42	346.75	348.24	0.04	1.82
Run	34	19	346.04	346.79	348.13	-0.11	2.09
Pool	53	86	345.64	346.68	348.13	0.04	2.49
Pool	63		344.68	346.68	347.91		3.23
Glide	139	10	346.25	346.72	348.11	0.03	1.86
Riffle	149	3	346.33	346.75	348.11	-0.16	1.78
Pool	152	56	345.10	346.59	347.57	0.00	2.47
Pool	157		344.84	346.59	347.57		2.73
Glide	208	7	346.09	346.59	348.04	-0.05	1.95
Riffle	215	1	346.54	346.54	347.90	-0.12	1.36
Pool	216	29	345.50	346.42	347.90	-0.03	2.4
Pool	224		345.20	346.42	347.90		2.7
Glide	245	10	345.75	346.39	347.33	0.00	1.58
Riffle	255	26	346.03	346.39	347.23	0.02	1.2
Pool	281	65	345.64	346.41	347.37	-0.09	1.73
Pool	300		344.76	346.40	347.37		2.61
Riffle	346	9	345.99	346.32	347.19	-0.19	1.2
Pool	355	12	345.63	346.13	347.19	0.02	1.56
Pool	361		345.18	346.13	347.19		2.01
Glide	367	14	345.69	346.15	347.57	0.01	1.88
Riffle	381	13	345.87	346.16	347.54	-0.01	1.67
Run	394	15	345.80	346.15	347.24	-0.24	1.44
Pool	409		346.05	345.91	346.55		0.5



Longitudinal Profile – Lower Reach

Feature/Facet Slope, Length and Spacing Lower Longitudinal Profile							
Feature	Station	Feature Length	Thalweg Elevation	Water Elevation	Bankfull Elevation	Water Surface Slope	Depth at Bankfull
	ft.	ft.	ft.	ft.	ft.	ft./ft.	ft.
Cross Vane - Top	0		339.88	339.89	342.74		2.86
Pool	6	40	336.52	339.89	342.74	0.00	6.22
Glide	40	22	339.09	339.89	343.14	0.00	4.05
Riffle	62	26	339.77	339.89	342.31	-0.40	2.54
Run	88	14	339.18	339.49	340.84	0.00	1.66
Pool	102	42	338.38	339.49	340.84	0.00	2.46
Pool	115		337.81	339.49	340.84		3.03
Glide	144	14	338.90	339.49	340.79	-0.03	1.89
Run	158	14	339.40	339.46	340.79	-0.08	1.39
Pool	172	45	337.99	339.38	340.56	-0.01	2.57
Pool	197		337.82	339.37	341.70		3.88
Glide	217	26	338.41	339.37	340.47	0.03	2.06
Riffle	243	27	339.14	339.40	340.47	-0.24	1.33
Run	270	21	338.79	339.16	341.43	0.00	2.64
Pool	291	77	337.60	339.16	341.87	0.00	4.27
Pool	298		337.17	339.16	341.87		4.7
Pool	350		339.01	339.16	341.87		2.86
Pool	358		337.65	339.16	341.89		4.24
Glide	368	7	338.47	339.16	341.89	0.10	3.42
Riffle	375	8	339.03	339.26	341.04	-0.11	2.01
Pool	383	24	338.47	339.15	341.04	0.00	2.57
Pool	390		338.25	339.15	341.04		2.79
Glide	407	11	338.51	339.15	341.04	-0.01	2.53
Riffle	418	21	338.94	339.14	340.61	-0.35	1.67
Run	439	20	338.50	338.79	340.37	-0.04	1.87
Pool	459	47	338.29	338.75	340.37	-0.05	2.08
Pool	476		337.23	338.75	340.37		3.14
Glide	506	15	337.74	338.70	339.98	0.08	2.24
Riffle	521		338.68	338.78	340.25		1.57

Suck Creek - Lower Reach Long Profile



APPENDIX B

9. PEBBLE COUNT PLOTS AND RAW DATA TABLES

9. Sediment Distribution

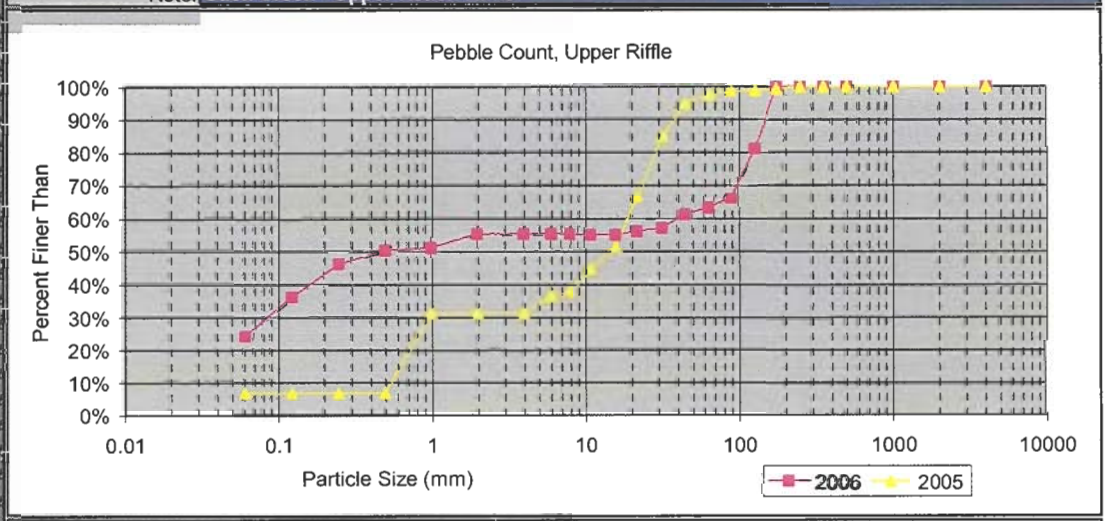
Upper Riffle Cross Section

Pebble Count

Material	Size Range (mm)		2005	2006
silt/clay	0	0.062	10	35
very fine sand	0.062	0.13		
fine sand	0.13	0.25		
medium sand	0.25	0.5		
coarse sand	0.5	1	37	34
very coarse sand	1	2		
very fine gravel	2	4		
fine gravel	4	6	8	
fine gravel	6	8	2	5
medium gravel	8	11	10	3
medium gravel	11	16	10	4
coarse gravel	16	22	23	5
coarse gravel	22	32	27	7
very coarse gravel	32	45	15	9
very coarse gravel	45	64	4	
small cobble	64	90	2	
medium cobble	90	128		1
large cobble	128	180	1	
very large cobble	180	256	1	
small boulder	256	362		
small boulder	362	512		
medium boulder	512	1024		
large boulder	1024	2048		
very large boulder	2048	4096		
bedrock				
Total Particle Count:			150	103

Pebble Count

Note: Suck Creek - Upper Reach Riffle



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
#N/A	0.51	0.7	23	38	34%	33%	32%	1%	0%	

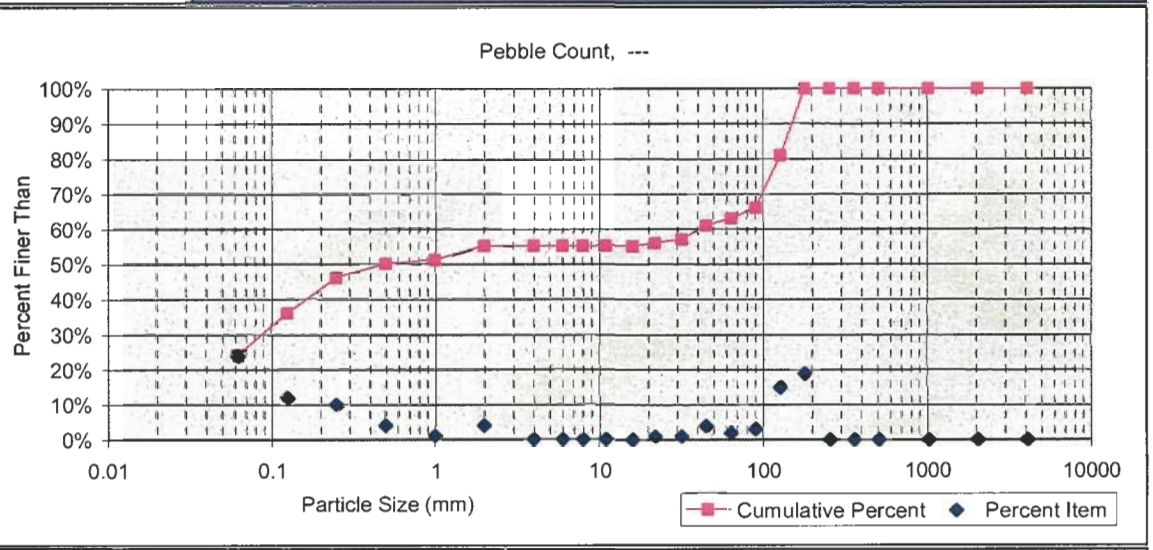
Lower Riffle
Cross Section

Pebble Count

Material	Size Range (mm)		Count
silt/clay	0	0.062	24
very fine sand	0.062	0.13	12
fine sand	0.13	0.25	10
medium sand	0.25	0.5	4
coarse sand	0.5	1	1
very coarse sand	1	2	4
very fine gravel	2	4	
fine gravel	4	6	
fine gravel	6	8	
medium gravel	8	11	
medium gravel	11	16	
coarse gravel	16	22	1
coarse gravel	22	32	1
very coarse gravel	32	45	4
very coarse gravel	45	64	2
small cobble	64	90	3
medium cobble	90	128	15
large cobble	128	180	19
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	
bedrock			
	Total Particle Count:		100

Pebble Count,

Note: Suck Creek Lower Reach Riffle



Size percent less than (mm)				
D16	D35	D50	D84	D95
#N/A	0.12	0.5	135	165

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
24%	31%	8%	37%	0%	0%