Little Grassy Creek
Stream Restoration Monitoring Report
EEP Project # 224
Monitoring Year 04

Submitted to:

Ecosystem Enhancement PROGRAM

NCEEP, 1652 Mail Service Center, Raleigh, NC 27699-1652

Data Collection: 2011
Construction Completed: September 2007
Submitted: December 2011

Monitoring Firm

Landmark Center II, Suite 220
4601 Six Forks Road
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Project Contact: Adam Spiller
Email: adam.spiller@kci.com
KCI Project No: 12071067C_LG11

Design Firm

Michael Baker Engineering, Inc.
8000 Regency Parkway
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Phone: 919.463.5488
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1.0 EXECUTIVE SUMMARY / PROJECT ABSTRACT

Little Grassy Creek and an unnamed tributary to Little Grassy Creek (UT1) in Granville County, North Carolina were preserved and enhanced by the Ecosystem Enhancement Program (EEP). The project preserved 12,546 linear feet of Little Grassy Creek, 164 linear feet of UT1, 452 linear feet of UT2, 3,774 linear feet of UT3, and 2,250 linear feet of UT4, and enhanced 75 linear feet of Little Grassy Creek and 2,464 linear feet of UT1. The project goals and objectives are listed below.

Project Goals

- Improving water quality.
- Restoring aquatic and riparian habitat.

Project Objectives

- Stabilizing the banks on 469 LF of UT1 and 75 LF on Little Grassy Creek
- Controlling invasive species for 7 acres of stream buffer along UT1
- Enhancing stream buffer on approximately 8.3 acres along UT1 and Little Grassy Creek
- Preserving approximately 12,710 LF of stream along UT1 and Little Grassy Creek
- Establishing native streambank and floodplain vegetation in the permanent conservation easement

The conservation easement was planted where the riparian area had been cleared or thinned due to past agricultural activities. Planting also occurred where construction activities took place, with bare root trees and shrubs planted on the floodplain and live stakes planted along the regraded banks. Exotic invasive vegetation was also removed from the conservation easement. Seven vegetation monitoring plots were established during the baseline monitoring. The fourth year of monitoring calculated an average of 399 planted stems/acre and 694 total stems/acre across all monitoring plots. Specifically, the seven plots ranged between stem densities of 40 to 728 planted stems/acre. Plots 6 and 7 were found to have planted stem densities below the five-year success criterion of 260 stems/acre with only Plot 6 having a total stem density less than 260 stems/acre. It should be noted that Plots 6 and 7 are not adjacent to a project stream, they are located in an upland area of additional easement acreage. The plots have numerous volunteer woody stems, and it is expected that the total stem densities for all plots will increase over the course of monitoring. The fourth year of monitoring found the vegetation component of the project to be on track to meeting the success criteria.

The stream assessment completed during the fourth year of monitoring found the streams to be functioning as designed. The measured channel dimensions at the monitored cross-sections have not changed significantly since the previous monitoring year. Additionally, there are not any problems with the installed root wads and cross vane. In December of 2010, a beaver dam was found near the downstream limits of the project on Little Grassy Creek. The dam was creating backwater conditions through the enhancement portion of Little Grassy Creek. The dam was removed in early 2011 by the landowner. During the 2011 monitoring period there were no signs that the dam was being rebuilt. The last site walk was in November 2011.

Summary information/data related to the occurrence of items such as beaver or encroachment and statistics related to performance of various project and monitoring elements can be found in the tables and figures in the report appendices. Narrative background and supporting information formerly found in these reports can be found in the Baseline Monitoring Report (formerly Mitigation Plan) and in the Mitigation Plan (formerly the Restoration Plan) documents available on the EEP's website. All raw data supporting the tables and figures in the appendices are available from EEP upon request.

2.0 METHODOLOGY

In the spring of 2011 a survey grade GPS unit was used to map the locations of UT2, UT3, and UT4. These assets were previously unmapped or the data was inaccurate. These assets have been added to this report.

The cross-section data were collected with a laser level during the week of August 29, 2011.

The Level 2 CVS-EEP protocol (http://cvs.bio.unc.edu/methods.htm) was used to collect vegetation data from the Little Grassy Creek site during the week of August 29, 2011.

3.0 REFERENCES

Lee, M. T., R. K. Peet, S. D. Roberts, and T. R. Wentworth. 2006. CVS-EEP Protocol for Recording Vegetation, Version 4.0 (http://cvs.bio.unc.edu/methods.htm)

Weakley, A. S. 2006. Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas. (http://www.herbarium.unc.edu/FloraArchives/WeakleyFlora_2006-Jan.pdf)

Appendix A

Project Vicinity Map and Background Tables

DIRECTIONS TO LITTLE GRASSY CREEK SITE:
From Raleigh, take US 540 West. Take the exit for NC 50 and travel north. In Creedmoor follow signs for US 15 North. Follow 15 North, then take a left onto Gela Rd. About 0.75 miles down Gela Rd. the project begins on the northern side of the road.

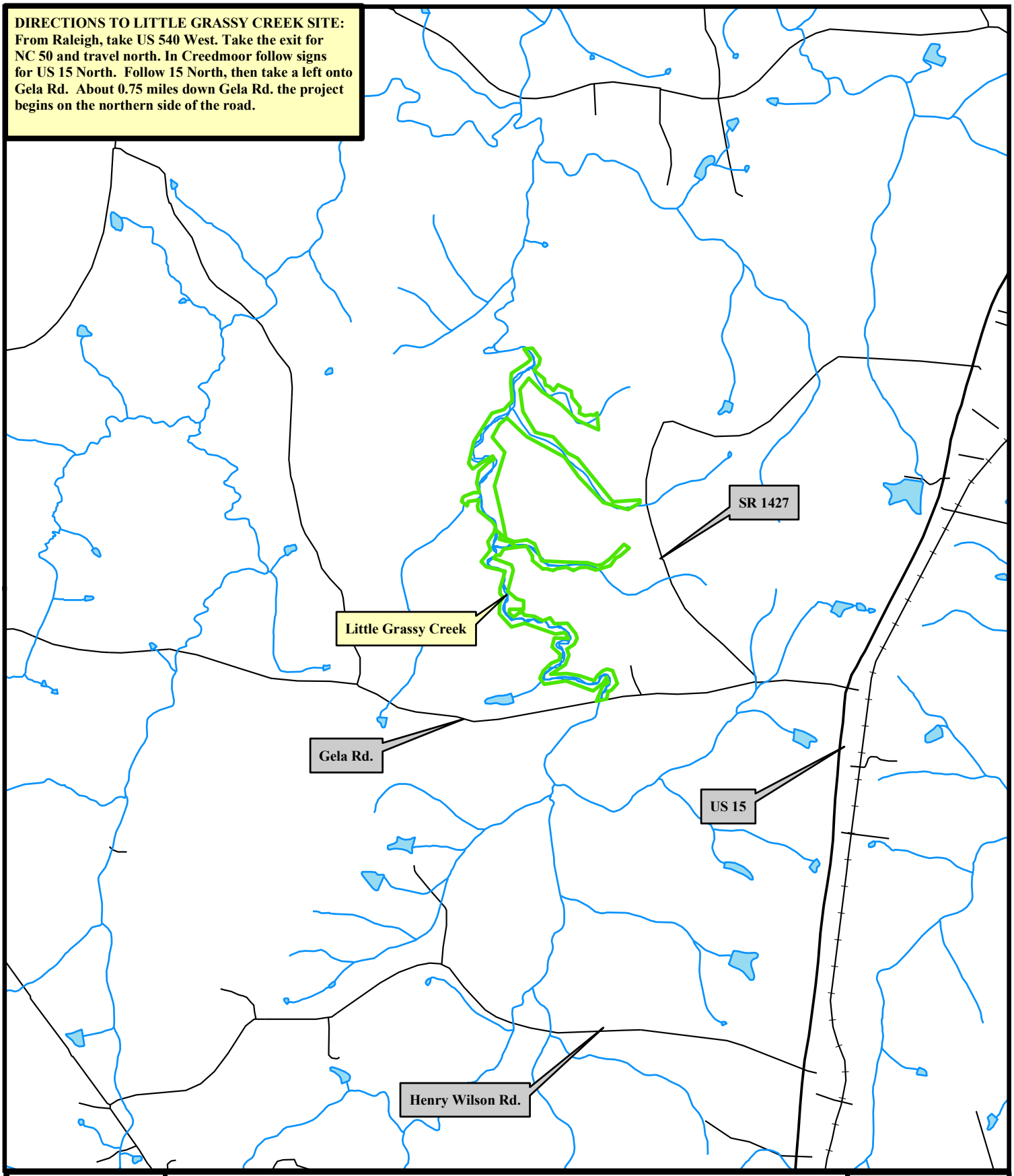


Figure 1. Site Vicinity Map
Little Grassy Creek, Granville County, EEP Project # 224

Ecosystem Enhancement Program

Project Easement

0.25 0.125 0 0.25 0.5 Miles

N W E S

KCI ASSOCIATES OF NC

Segment / Reach ID	Existing Linear Feet	Type	Approach	Linear Feet	Stationing	Comment
UT 1, Preservation Reach	-	P	-	164	See plan sheets	Planted native vegetation
UT 1, Enhancement Reach	2,643	EII	-	2,464	10+00 to 36+27	Sloped back banks, installed root wads, and planted riparian buffer
UT 2	452	P	-	452	140+00 - 144+52	Installed cattle exclusion fencing
UT 3	3,774	P	-	3,774	150+00 - 187+74	Installed cattle exclusion fencing
UT 4	2,250	P	-	2,250	190+00 - 212+50	Installed cattle exclusion fencing
Little Grassy Creek, Pres. Reach	12,624	P	-	12,546	10+00 - 136+21	Planted native vegetation
Little Grassy Creek, Enhanc. Reach	-	EII	-	75	See plan sheets	Installed a cross vane, sloped back and matted banks and, installed rock ford crossing

P = Preservation
EII = Enhancement II

Table 1b. Project Component Summations
Project Number and Name: 224 - Little Grassy Creek

Restoration Level	Stream (lf)	Riparian Wetland (Ac)		Non-Riparian (Ac)	Upland (Ac)	Buffer (Ac)	BMP
		Riverine	Non-Riverine				
Restoration							
Enhancement							
Enhancement I							
Enhancement II	2,539						
Creation							
Preservation	19,186						
HQ Preservation							
		0	0				
Totals (Feet/Acres)	**21,725**	**0**		**0**	**0**	**0**	**0**
MU Totals	**4,853**	**0**		**0**	**0**	**0**	0

Table 2. Project Activity and Reporting History Project Number and Name: 224 - Little Grassy Creek		
Elapsed Time Since Grading Complete: 4 yr 3 months **Elapsed Time Since Planting Complete: 3 yr 11 months** **Number of Reporting Years: 4**		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration Plan		Aug-06
Final Design - 90%		Sep-06
Construction		Sep-07
Permanent Seed Mix Applied		Oct-07
Live Stake Planting		Jan-08
Bare Root Planting		Jan-08
As-Built Survey	Oct-07	Oct-07
Year 1 Monitoring	Oct-08	Dec-08
Year 2 Monitoring	Nov-09	Dec-09
Year 3 Monitoring	Dec-10	Dec-10
Year 4 Monitoring	Oct-11	Dec-11

Table 3. Project Contacts Table Project Number and Name: 224 - Little Grassy Creek	
Design Firm	Michael Baker Engineering, Inc. 8000 Regency Parkway, Suite 200 Cary, NC 27518 Contact: Mr. Kevin Tweedy Phone: (919) 463-5488
Construction, Seeding, and Planting Contractor	River Works, Inc. 8000 Regency Parkway, Suite 200 Cary, NC 27518 Contact: Mr. Will Pedersen Phone: (919) 459-9001
Seed Mix Source	Mellow Marsh Farm Phone: (919) 742-1200
Nursery Stock Supplier	International Paper Phone: 1-888-888-7159
Monitoring Performer MY-01	Michael Baker Engineering, Inc. 8000 Regency Parkway, Suite 200 Cary, NC 27518 Contact: Mr. Dwayne Honeycutt Phone: (919) 463-5488
Monitoring Performer MY-02 through MY-04	KCI Associates of NC Landmark Center II, Suite 220 4601 Six Forks Rd. Raleigh, NC 27609 Contact: Mr. Adam Spiller Phone: (919) 278-2514 Fax: (919) 783-9266

Table 4. Project Attribute Table Project Number and Name: 224 - Little Grassy Creek					
Project County	Granville County				
Physiographic Region	Piedmont				
Ecoregion	Carolina Slate Belt				
Project River Basin	Roanoke				
USGS HUC for Project (14 digit)	03010102161020				
NCDWQ Sub-basin for Project	03-02-06				
Within extent of EEP Watershed Plan?	U				
WRC Class (Warm, Cool, Cold)	Warm				
% of project easement demarcated	U				
Beaver activity observed during design phase?	No				
Restoration Component Attribute Table					
	LGC	UT 1	UT 2	UT 3	UT 4
Drainage Area	8.1 sq.mi.	0.24 sq. mi.	0.41 sq. mi.	0.28 sq. mi.	0.17 sq. mi.
Stream Order	Fourth	First	First	First	First
Project length (feet)	12,621	2,628	452	3,774	2,250
Perennial or Intermittent	Perennial	Perennial	Perennial	Perennial	Perennial
Watershed Type (Rural, Urban, Developing, etc.)	Rural				
Watershed LULC Distribution					
Urban	U				
Ag-Row Crop	U				
Ag-Livestock	U				
Forested	U				
Water/Wetlands	U				
Watershed impervious cover (%)	-				
NCDWQ AU/Index Number	U				
NCDWQ Classification	C (LGC), C (UT 1)				
303d listed?	No				
Upstream of a 303d listed segment?	No				
Reasons for 303d Listing or Stressor	N/A				
Total acreage of easement	84.7 Acres				
Total vegetated acreage within the easement	84.7 Acre				
Total planted acreage as part of the restoration	5.2 Acres				
Rosgen Classification of pre-existing	-				-
Rosgen Classification of As-built	E4				C6/1 - E6
Valley Type	U				U
Valley Slope	U				U
Valley side slope range (e.g. 2-3%)	U				U
Valley toe slope range (e.g. 2-3%)	U				U
Trout waters designation	No				
Species of concern, endangered etc.? (Y/N)	No				
Dominant soil series and characteristics					
Series	Chewacla				
Depth Clay%	-				-
K	-				-
T	-				-

"N/A" is for items that do not apply.

"-" is for items that are unavailable.

"U" is for items that are unknown.

Appendix B

Visual Assessment Data

SHEET 3

UT4

UT3

PRIVATE DRIVEWAY

CONSERVATION EASEMENT

UT1

SHEET 4

GELA ROAD

SHEET 5

LITTLE GRASSY CREEK

LITTLE GRASSY CREEK

UT2

SHEET 2

NC GRID NAD '83

-350 0 350 700

GRAPHIC SCALE

IMAGE SOURCE: NC 2010 STATEWIDE ORTHOIMAGERY

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVED

Ecosystem Enhancement PROGRAM

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

LITTLE GRASSY CREEK

GRANVILLE COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 224 - MY04

DATE: NOV 2011

SCALE: 1" = 700'

CURRENT CONDITION PLAN VIEW

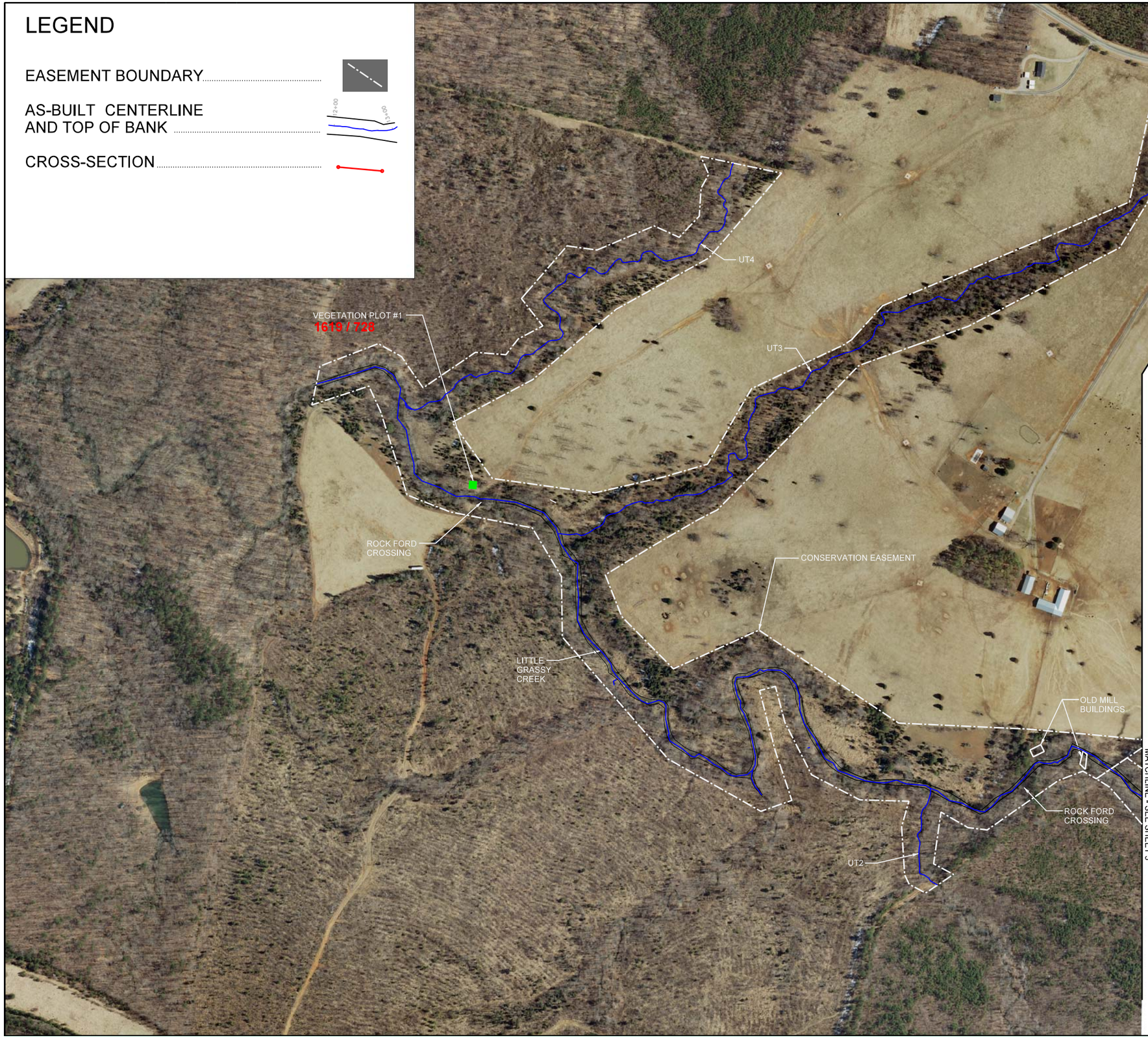
SHEET 1 OF 5

LEGEND

EASEMENT BOUNDARY

AS-BUILT CENTERLINE
AND TOP OF BANK

CROSS-SECTION



PROJECT CONDITION

BANK EROSION

UNDERCUT BANK

VEG PLOT ACHIEVING
DENSITY CRITERION

VEG PLOT BELOW
DENSITY CRITERION

LOW PLANTED
STEM DENSITY

VEG PLOT TOTAL/PLANTED
STEM DENSITY **890 / 423**

NC GRID
NAD '83

–200 0 200 400
GRAPHIC SCALE

IMAGE SOURCE: NC 2010 STATEWIDE ORTHOIMAGERY

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVED

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LITTLE GRASSY CREEK
GRANVILLE COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 224 - MY04

DATE: NOV 2011
SCALE: 1" = 400'

CURRENT CONDITION PLAN VIEW

LEGEND

EASEMENT BOUNDARY

AS-BUILT CENTERLINE AND TOP OF BANK

CROSS-SECTION

PROJECT CONDITION

BANK EROSION

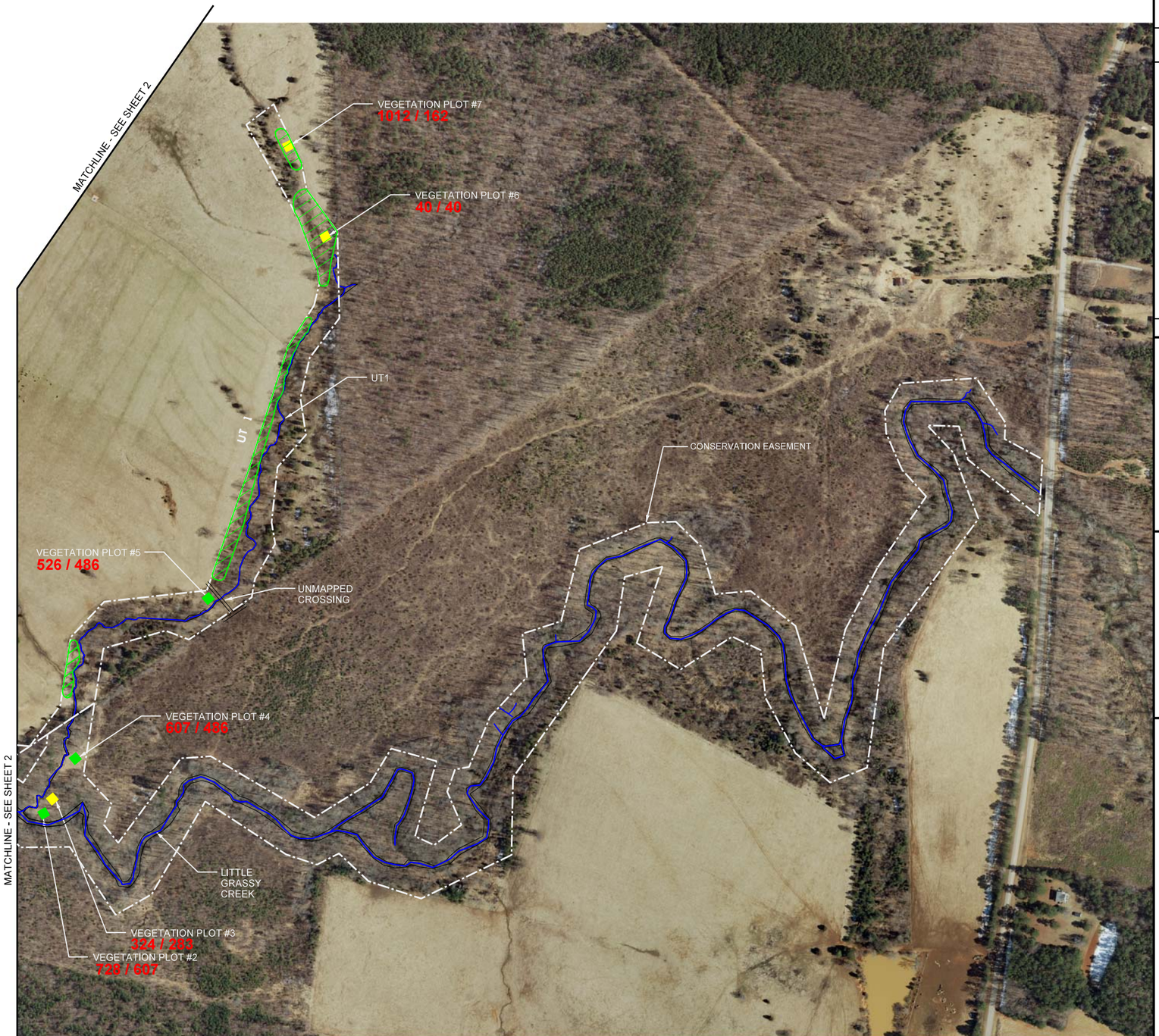
UNDERCUT BANK

VEG PLOT ACHIEVING DENSITY CRITERION

VEG PLOT BELOW DENSITY CRITERION

LOW PLANTED STEM DENSITY

VEG PLOT TOTAL/PLANTED STEM DENSITY 890 / 423



NC GRID NAD '83

–200 0 200 400

GRAPHIC SCALE

IMAGE SOURCE: NC 2010 STATEWIDE ORTHOIMAGERY

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GRANVILLE COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 224 - MY04

DATE: NOV 2011
SCALE: 1" = 400'

CURRENT CONDITION PLAN VIEW

LEGEND

EASEMENT BOUNDARY

AS-BUILT CENTERLINE AND TOP OF BANK

CROSS-SECTION

NC GRID NAD 83

–20 0 20 40

GRAPHIC SCALE

IMAGE SOURCE: NC 2010 STATEWIDE ORTHOIMAGERY

CONSERVATION EASEMENT

607 / 486

VEGETATION PLOT #4

VEGETATION PLOT #3

324 / 283

VEGETATION PLOT #2

728 / 607

UT1

CROSS-SECTION #1

CROSS-SECTION #2

AS-BUILT TOP OF BANK LINE

AS-BUILT THALWEG

CROSS-SECTION #3

PROJECT CONDITION

BANK EROSION

UNDERCUT BANK

VEG PLOT ACHIEVING DENSITY CRITERION

VEG PLOT BELOW DENSITY CRITERION

LOW PLANTED STEM DENSITY

VEG PLOT TOTAL/PLANTED STEM DENSITY 890 / 423

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVED

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RALEIGH, NORTH CAROLINA 27609

LITTLE GRASSY CREEK
GRANVILLE COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 224 - MY04

DATE: NOV 2011
SCALE: 1" = 40'

CURRENT CONDITION PLAN VIEW

SHEET 4 OF 5

LEGEND

EASEMENT BOUNDARY

AS-BUILT CENTERLINE AND TOP OF BANK

CROSS-SECTION

PROJECT CONDITION

BANK EROSION

UNDERCUT BANK

VEG PLOT ACHIEVING DENSITY CRITERION

VEG PLOT BELOW DENSITY CRITERION

LOW PLANTED STEM DENSITY

VEG PLOT TOTAL/PLANTED STEM DENSITY 890 / 423

NC GRID NAD 83

−20 0 20 40

GRAPHIC SCALE

IMAGE SOURCE: NC 2010 STATEWIDE ORTHOIMAGERY

REVISIONS				
SYM.	DESCRIPTION	DATE	APPROVED	

Ecosystem Enhancement Program

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RALEIGH, NORTH CAROLINA 27609

LITTLE GRASSY CREEK

GRANVILLE COUNTY, NORTH CAROLINA
EEP PROJECT NUMBER 224 - MY04

DATE: NOV 2011
SCALE: 1" = 40'

CURRENT CONDITION PLAN VIEW

Table 5. Visual Stream Morphology Stability Assessment
Project Number and Name: 224 - Little Grassy Creek
Assessed Length 350 **Reach - UT1**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended*	Total Number in As-built*	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. **Vertical Stability** (Riffle and Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%			
		2. Degradation - Evidence of downcutting			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	5	5			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	7	7			100%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstream riffle)	7	7			100%			
	4.**Thalweg Position****	1. Thalweg centering at upstream of meander bend (Run)					N/A			
		2. Thalweg centering at downstream of meander (Glide)					N/A			
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			1	20	97%	0	0	97%
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	0	0	100%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	1	20	97%	0	0	97%
3. Engineered Structures+	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	0	0			N/A			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	0	0			N/A			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	0	0			N/A			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	0	0			N/A			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	0	0			N/A			

* This monitoring year is the first year that riffles and pools were assessed and counted so the number that are stable and the baseline number are the same.

** This enhancement section has low flows with an undeveloped thalweg and no distinct meanders, so this metric was not assessed.

+ There are no traditionally engineered structures on this reach, only root wads.

Table 6. Vegetation Condition Assessment

Project Number and Name: 224 - Little Grassy Creek

Planted Acreage 5.2 **Easement Acreage 84.7**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material.	0.1 acres	Pattern and Color	0	0.00	0.0%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Pattern and Color	4	1.60	30.8%
			Total	4	1.60	30.8%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	Pattern and Color	0	0.00	0.0%
			Cumulative Total	4	1.60	30.8%
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	1000 SF	Pattern and Color	0	0.00	0.0%
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	none	Pattern and Color	0	0.00	0.0%

Stream Station Photos

Cross-Section 1 – Looking across the stream at the right bank. 8/27/09 - MY 02

Cross-Section 1 – Looking across the stream at the right bank. 9/1/11 - MY 04

Cross-Section 1 – Looking across the stream at the left bank. 8/27/09 - MY 02

Cross-Section 1 – Looking across the stream at the left bank. 9/1/11 - MY 04

Cross-Section 2 – Looking across the stream at the right bank. 8/27/09 - MY 02

Cross-Section 2 – Looking across the stream at the right bank. 9/1/11 - MY 04

Cross-Section 2 – Looking across the stream at the left bank. 8/27/09 - MY 02

Cross-Section 2 – Looking across the stream at the left bank. 9/1/11 - MY 04

Cross-Section 3 – Looking across the stream at the right bank. 8/27/09 - MY 02

Cross-Section 3 – Looking across the stream at the right bank. 9/1/11 - MY 04

Cross-Section 3 – Looking across the stream at the left bank. 8/27/09 - MY 02

Cross-Section 3 – Looking across the stream at the left bank. 9/1/11 - MY 04

Cross-Section 4 – Looking across the stream at the right bank. 8/27/09 - MY 02

Cross-Section 4 – Looking across the stream at the right bank. 8/30/11 - MY 04

Cross-Section 4 – Looking across the stream at the left bank. 8/27/09 - MY 02

Cross-Section 4 – Looking across the stream at the left bank. 8/30/11 - MY 04

Cross Vane Photo. 8/27/09 - MY 02

Cross Vane Photo. 8/30/11 - MY 04

Vegetation Monitoring Plot Photos

Vegetation Plot 1 Photo – 8/30/11 - MY 04

Vegetation Plot 2 Photo – 8/30/11 - MY 04

Vegetation Plot 3 Photo – 8/30/11 - MY 04

Vegetation Plot 4 Photo – 9/1/11 - MY 04

Vegetation Plot 5 Photo – 8/30/11 - MY 04

Vegetation Plot 6 Photo – 8/30/11 - MY 04

Vegetation Plot 7 Photo – 8/30/11 - MY 04

Appendix C

Vegetation Plot Data

Table 7. Vegetation Plot Mitigation Success Summary Table Project Number and Name: 224 - Little Grassy Creek		
Vegetation Plot ID	**Monitoring Year 04 Planted Stem Density (stems/acre)**	**Vegetation Survival Threshold Met?**
1	728	Yes
2	607	Yes
3	283	No
4	486	Yes
5	486	Yes
6	40	No
7	162	No

Table 8. CVS Vegetation Plot Metadata Project Number and Name: 224 - Little Grassy Creek	
Report Prepared By	April Helms
Date Prepared	12/13/2011 11:24
database name	KCI-2011-A.mdb
database location	M:\2007\12071067_2007 EEP OPEN END\Veg_database
computer name	12-CV76KF1
file size	59768832
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
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.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	224
project Name	Little Grassy Creek
Description	Stream restoration site in Granville County, NC
River Basin	Roanoke
length(ft)	15,249
stream-to-edge width (ft)	50
area (sq m)	8.1
Required Plots (calculated)	7* (*Number of plots determined by project designer).
Sampled Plots	7

Table 9. Stem Count Total and Planted Stems by Plot and Species
Project Number and Name: 224 – Little Grassy Creek

			Current Plot Data (MY4 2011)																					Annual Means											
			E224-A-VP1			E224-A-VP2			E224-A-VP3			E224-A-VP4			E224-A-VP5			E224-A-VP6			E224-A-VP7			MY4 (2011)			MY3 (2010)			MY2 (2009)			MY1 (2008)		
Scientific Name	Common Name	Species Type	P-LS	P-all	T	P-LS	P-all	T	P-LS	P-all	T	P-LS	P-all	T	P-LS	P-all	T	P-LS	P-all	T	P-LS	P-all	T	P-LS	P-all	T	P-LS	P-all	T	P-LS	P-all	T	P-LS	P-all	T
Acer rubrum	red maple	Tree	3	3	3																			3	3	3	3	3	3	3	3	3		4	4
Betula nigra	river birch	Tree	4	4	7	9	9	10						1										13	13	18	13	13	14	15	15	17		19	19
Carpinus caroliniana	American hornbeam	Shrub Tree	1	1	1																			1	1	1	1	1	1	2	2	9		2	2
Carya sp.	hickory	Tree						1																		1			1						
Cedrus sp.	cedar																												2						
Cercis canadensis	eastern redbud	Shrub Tree	3	3	3							2	2	2	1	1	1							6	6	6	8	8	8	8	8	9		9	9
Corylus americana	American hazelnut	Shrub	3	3	3										1	1	1							4	4	4	4	4	4	5	5	5		5	5
Diospyros virginiana	common persimmon	Tree				3	3	3	5	5	6			2	1	1	1							9	9	12	9	9	10	11	11	12		11	11
Fraxinus pennsylvanica	green ash	Tree				1	1	1	1	1	1	2	2	2							3	3	3	7	7	7	7	7	7	9	9	9		8	8
Juglans nigra	black walnut	Tree																														2			
Juniperus virginiana	eastern redcedar	Tree																					2			2									
Lindera benzoin	northern spicebush	Shrub Tree										1	1	1										1	1	1	1	1	1	1	1	4			
Liquidambar styraciflua	sweetgum	Tree			5			1									1						3			10			6			7		2	2
Liriodendron tulipifera	tuliptree	Tree			1	1	1	1				1	1	1										2	2	3	3	3	3	3	3	6		16	16
Platanus occidentalis	American sycamore	Tree	2	2	2							5	5	5	7	7	7	1	1	1				15	15	15	15	15	15	15	15	15			
Quercus falcata	southern red oak	Tree																														1		7	7
Quercus phellos	willow oak	Tree				1	1	1	1	1	1	1	1	1	2	2	2				1	1	1	6	6	6	6	6	6	7	7	7			
Rhus sp.	sumac				13																					13						16			
Rhus copallinum	flameleaf sumac	Shrub Tree																											12					2	2
Sambucus canadensis	Common Elderberry	Shrub Tree	2	2	2																			2	2	2	2	2	2	2	2	2			
Ulmus sp.	elm	Tree																					16			16									
Ulmus alata	winged elm	Tree																											9			5			
Unknown		unknown																														1		1	1
		Stem count	18	18	40	15	15	18	7	7	8	12	12	15	12	12	13	1	1	1	4	4	25	69	69	120	72	72	104	81	81	130	0	86	86
		size (ares)	1			1			1			1			1			1			1			7			7			7			7		
		size (ACRES)	0			0			0			0			0			0			0			0			0			0			0.17		
		Species count	7	7	10	5	5	7	3	3	3	6	6	8	5	5	6	1	1	1	2	2	5	12	12	17	12	12	17	12	12	18	0	12	12
		Stems per ACRE	728	728	1619	607	607	728	283	283	324	486	486	607	486	486	526	40	40	40	162	162	1012	399	399	694	416	416	601	468	468	752	0	497	497

Appendix D

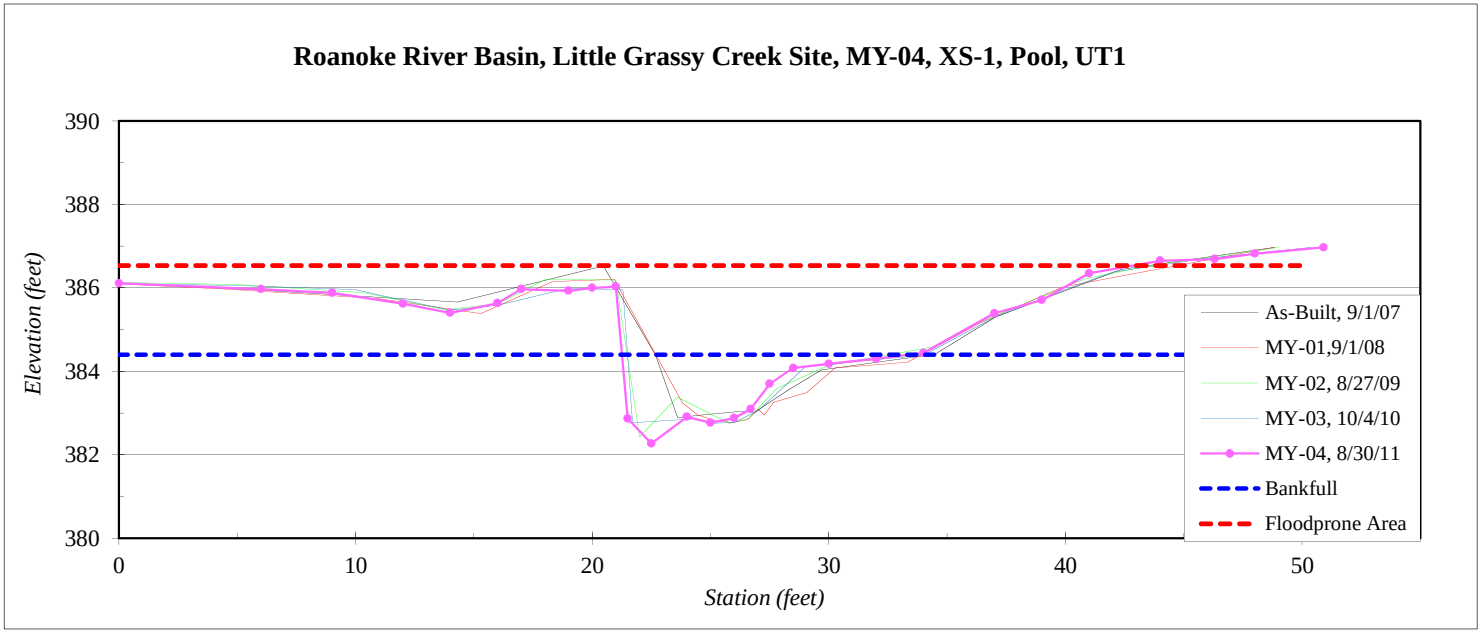
Stream Assessment Data

River Basin:	Roanoke
Site:	Little Grassy Creek Site, MY-04
XS ID	XS-1, Pool, UT1
Drainage Area (sq mi):	0.24
Date:	8/30/2011
Field Crew:	A. French, A. Helms

Station	Elevation
0.0	386.11
6.0	385.97
9.0	385.88
12.0	385.62
14.0	385.40
16.0	385.63
17.0	385.97
19.0	385.93
20.0	386.00
21.0	386.03
21.5	382.87
22.5	382.27
24.0	382.91
25.0	382.77
26.0	382.88
26.7	383.10
27.5	383.70
28.5	384.08
30.0	384.18
32.0	384.30
34.0	384.44
37.0	385.39
39.0	385.71
41.0	386.35
44.0	386.65
46.3	386.69
48.0	386.82
50.9	386.97

SUMMARY DATA	
Bankfull Elevation:	384.4
Bankfull Cross-Sectional Area:	11.0
Bankfull Width:	12.2
Flood Prone Area Elevation:	386.5
Flood Prone Width:	39
Max Depth at Bankfull:	2.1
Mean Depth at Bankfull:	0.9
W / D Ratio:	13.5
Entrenchment Ratio:	3.2
Bank Height Ratio:	1.4

Stream Type	C/E4

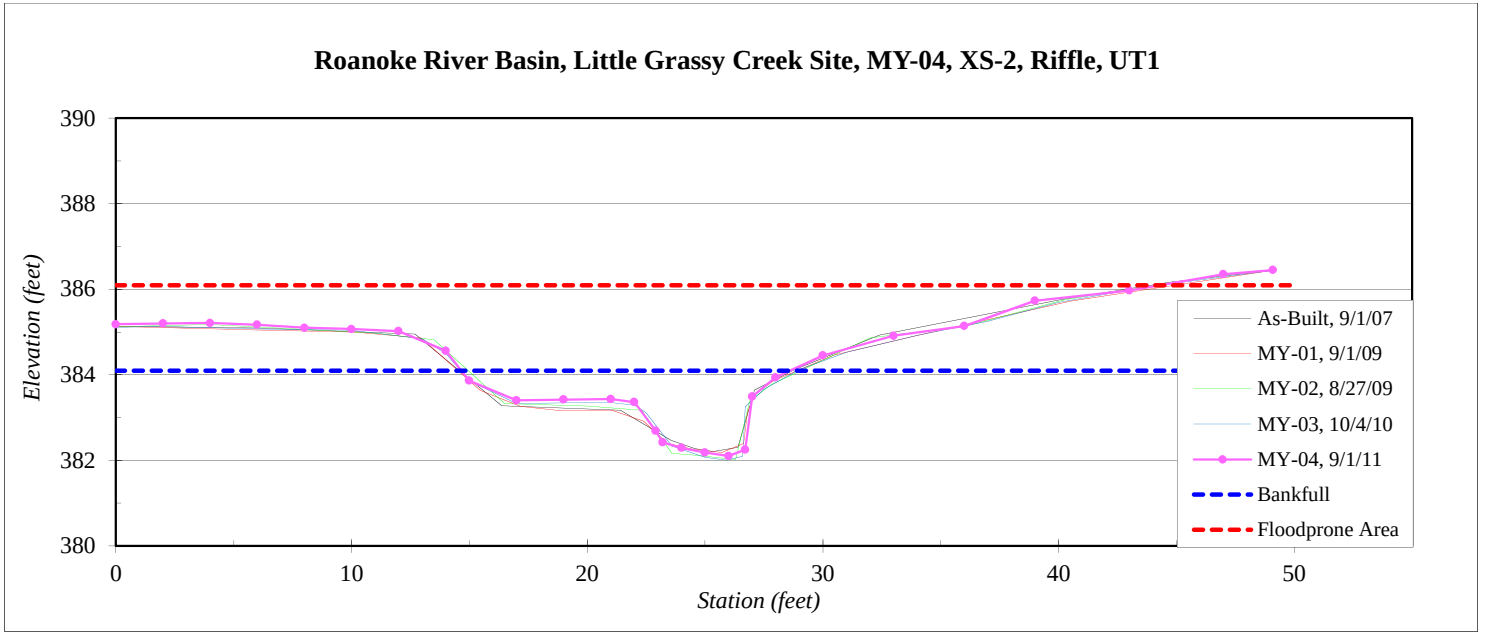


River Basin:	Roanoke
Site:	Little Grassy Creek Site, MY-04
XS ID	XS-2, Riffle, UT1
Drainage Area (sq mi):	0.24
Date:	9/1/2011
Field Crew:	A. French, A. Helms

Station	Elevation
0.0	385.18
2.0	385.20
4.0	385.21
6.0	385.17
8.0	385.10
10.0	385.07
12.0	385.02
14.0	384.56
15.0	383.86
17.0	383.40
19.0	383.42
21.0	383.43
22.0	383.36
22.9	382.69
23.2	382.42
24.0	382.29
25.0	382.18
26.0	382.10
26.7	382.25
27.0	383.49
28.0	383.94
30.0	384.45
33.0	384.91
36.0	385.14
39.0	385.73
43.0	385.97
47.0	386.35
49.1	386.45

SUMMARY DATA	
Bankfull Elevation:	384.1
Bankfull Cross-Sectional Area:	13.7
Bankfull Width:	14.3
Flood Prone Area Elevation:	386.1
Flood Prone Width:	>40
Max Depth at Bankfull:	2.0
Mean Depth at Bankfull:	1.0
W / D Ratio:	14.9
Entrenchment Ratio:	>3.0
Bank Height Ratio:	1.0

Stream Type	C/E4

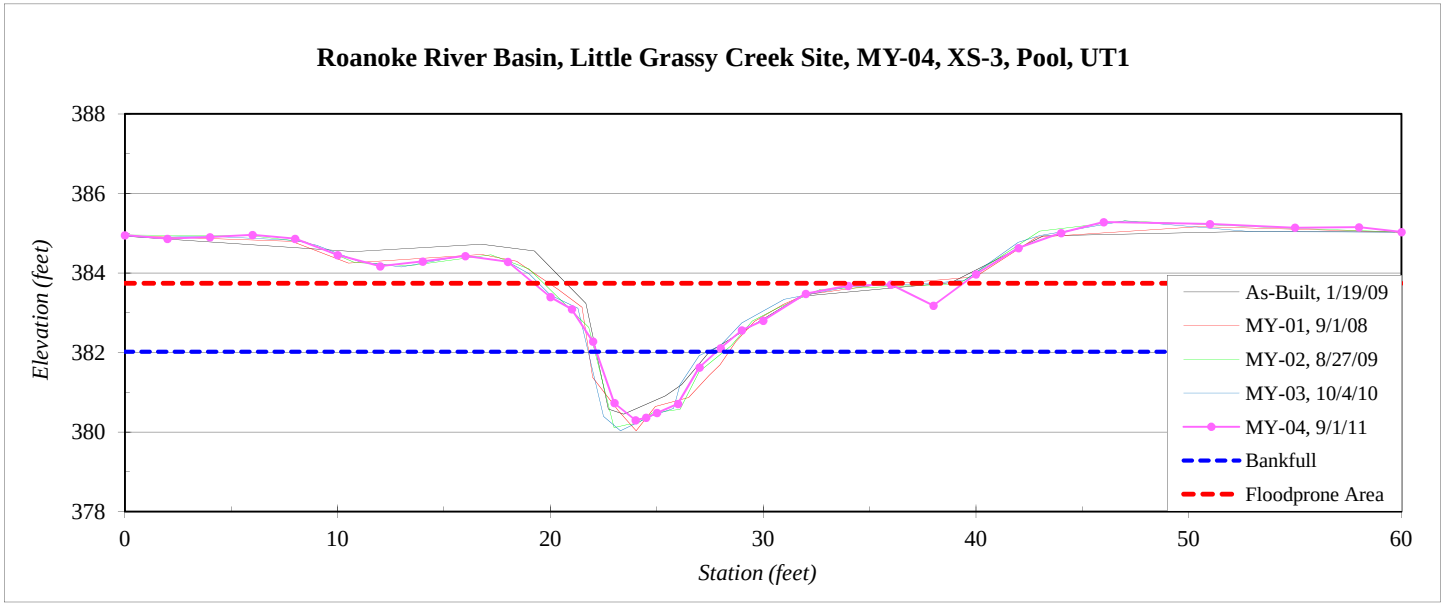


River Basin:	Roanoke
Site:	Little Grassy Creek Site, MY-04
XS ID	XS-3, Pool, UT1
Drainage Area (sq mi):	0.24
Date:	9/1/2011
Field Crew:	A. French, A. Helms

Station	Elevation
0.0	384.95
2.0	384.86
4.0	384.90
6.0	384.96
8.0	384.86
10.0	384.45
12.0	384.17
14.0	384.29
16.0	384.43
18.0	384.28
20.0	383.40
21.0	383.09
22.0	382.28
23.0	380.73
24.0	380.30
24.5	380.36
25.0	380.48
26.0	380.71
27.0	381.63
28.0	382.11
29.0	382.56
30.0	382.80
32.0	383.48
34.0	383.68
36.0	383.71
38.0	383.18
40.0	383.97
42.0	384.63
44.0	385.01
46.0	385.28
51.0	385.23
55.0	385.14
58.0	385.15
60.0	385.03

SUMMARY DATA	
Bankfull Elevation:	382.0
Bankfull Cross-Sectional Area:	6.0
Bankfull Width:	5.6
Flood Prone Area Elevation:	383.7
Flood Prone Width:	21
Max Depth at Bankfull:	1.7
Mean Depth at Bankfull:	1.1
W / D Ratio:	5.2
Entrenchment Ratio:	3.7
Bank Height Ratio:	1.8

Stream Type	C/E4



River Basin:	Roanoke
Site:	Little Grassy Creek Site, MY-04
XS ID	XS-4, Pool, LGC
Drainage Area (sq mi):	8.1
Date:	9/1/2011
Field Crew:	A. French, A. Helms

Station	Elevation
0.0	377.95
3.0	377.89
6.0	377.68
8.0	377.05
10.0	376.18
12.0	375.23
14.0	374.59
16.0	373.76
18.0	373.28
20.0	373.08
22.0	373.05
24.0	372.22
24.6	369.50
25.5	369.37
27.0	369.07
28.5	369.04
29.5	369.00
30.5	369.33
32.0	369.61
33.0	370.81
34.0	371.75
34.5	372.95
36.0	373.14
37.5	373.38
38.5	373.83
40.0	374.38
41.0	374.93
44.0	375.60
46.0	376.46
49.0	377.25
52.0	377.61
54.0	377.92
56.0	378.17

SUMMARY DATA	
Bankfull Elevation:	375.0
Bankfull Cross-Sectional Area:	80.9
Bankfull Width:	28.6
Flood Prone Area Elevation:	380.9
Flood Prone Width:	>60
Max Depth at Bankfull:	6.0
Mean Depth at Bankfull:	2.8
W / D Ratio:	10.1
Entrenchment Ratio:	>2.0
Bank Height Ratio:	1.3

Stream Type	C/E4

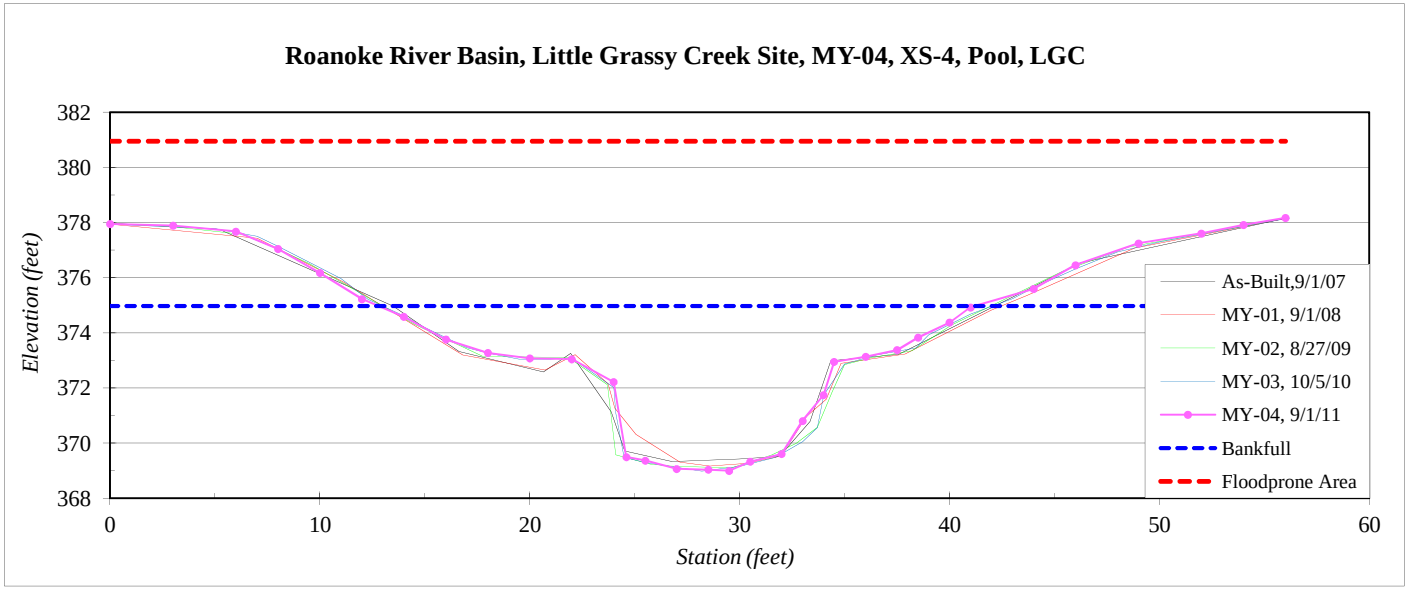


Table 10. Monitoring - Cross-Section Morphology Data Tables

Project Number and Name: 224– Little Grassy Creek

Segment Reach: UT1 (2,628 ft) and Little Grassy Creek (12,621 ft)

Parameter	Cross-Section 1 Pool - UT 1						Cross-Section 2 Riffle - UT 1						Cross-Section 3 Pool - UT 1					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
Record Elevation (datum) used	384.4	384.4	384.4	384.4	384.4		384.1	384.1	384.1	384.1	384.1		382.0	382.0	382.0	382.0	382.0	
Bankfull Width (ft)	11.8	11.2	11.1	12.5	12.2		14.2	14.5	14.1	14.3	14.3		5.3	6.6	6.1	5.5	5.6	
Floodprone Width (ft)	-	-	39	39	39		-	-	>40	>40	>40		-	-	21	21	21	
Bankfull Cross-Sectional Area (ft^2)	8.7	9.3	10.0	10.9	11.0		14.4	14.7	14.2	13.7	13.7		5.4	7.4	7.2	6.9	6.0	
Bankfull Mean Depth (ft)	0.7	0.8	0.9	0.9	0.9		1.0	1.0	1.0	1.0	1.0		1.0	1.1	1.2	1.3	1.1	
Bankfull Maximum Depth (ft)	1.5	1.6	2.0	1.7	2.1		1.9	1.9	2.1	2.1	2.0		1.6	2.0	1.9	2.0	1.7	
Width/Depth Ratio	16.1	13.6	12.3	14.3	13.5		14.1	14.3	14.0	14.9	14.9		5.2	5.8	5.2	4.4	5.2	
Entrenchment Ratio	1.6	1.7	3.5	3.1	3.2		3.0	3.1	>3.0	>3.0	>3.0		2.7	3.2	3.4	3.7	3.7	
Bank Height Ratio*	1.6	1.6	1.5	1.5	1.4		1.0	1.0	1.0	1.0	1.0		1.9	1.7	1.7	1.7	1.8	
Cross-Sectional Area Between End Pins (ft^2)	-	-	-	41.8	43.3		-	-	-	24.4	32.8		-	-	-	55.1	59.1	
d50 (mm)	-	-	-	-	-		-	-	-	-	-		-	-	-	-	-	

Parameter	Cross-Section 4 Pool - Little Grassy Creek					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5
Record Elevation (datum) used	375.0	375.0	375.0	375.0	375.0	
Bankfull Width (ft)	28.7	29.5	29.0	29.2	28.6	
Floodprone Width (ft)	-	-	>60	>60	>60	
Bankfull Cross-Sectional Area (ft^2)	82.5	82.2	84.2	83.7	80.9	
Bankfull Mean Depth (ft)	2.9	2.8	2.9	2.9	2.8	
Bankfull Maximum Depth (ft)	5.6	5.8	5.9	6.0	6.0	
Width/Depth Ratio	10.0	10.6	10.0	10.2	10.1	
Entrenchment Ratio	2.0	1.9	>2.0	>2.0	>2.0	
Bank Height Ratio*	1.3	1.3	1.3	1.3	1.3	
Cross-Sectional Area Between End Pins (ft^2)	-	-	-	193.7	189.8	
d50 (mm)	-	-	-	-	-	

* Bank Height Ratios for MY1 and MY2 were recalculated for the MY3 report using the top of bank elevation provided in the baseline report, which will be used for the remainder of the monitoring period for consistency.

Appendix E

Hydrologic Data

Table 11. Verification of Bankfull Events Project Number and Name: 224 - Little Grassy Creek			
Date of Data Collection	**Date of Occurrence**	**Method**	**Photo Number**
11/18/2009	11/13/2009	Evaluation of Rainfall Data	N/A