Bugaboo Stream Restoration
2005 Year One Monitoring Report

NCEEP Project Number 56

Submitted to:	NCDENR-Ecosystem Enhancement Program 1652 Mail Service Center Raleigh, NC 27699-1652
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Submitted:	September, 2006

Ecosystem Enhancement PROGRAM

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I. Executive Summary/Project Abstract

Little Bugaboo Creek starts in Lomax, North Carolina and joins Bugaboo Creek just north of Ronda, NC. The project location is about halfway between these two small towns. The center of the project is about 3 miles northwest of Ronda, NC. The project site is bounded to the north by Tharpe Road (SR 2012), White Plains (SR 1990) to the west and North Hoots Road (SR 2014) to the south.

The project restored 4,276 linear feet of main stem and 1,954 linear feet of a major unnamed tributary. The tributary restoration starts just below the culvert at Tharpe Road. This tributary flows generally south and joins the main channel about 200 feet above the end of the project. The start of the main channel restoration occurs at the property line of Woodie Farms and continues generally east until just past the confluence with the restored tributary where the main channel turns south and enters a bedrock-controlled section. There are the ruins of an old mill and dam just below the project end.

"The Ecosystem Enhancement Program (EEP) formally the North Carolina Wetlands Restoration Program (NCWRP) identified Little Bugaboo Creek (LBC) and an Unnamed Tributary to Little Bugaboo Creek (UT) as potential stream restoration sites in 2002. Existing conditions were surveyed and a restoration design was developed based upon the conditions of the channels, reference reaches, and goals of the project. The existing channel was severely eroding due to unlimited cattle access and a lack of vegetation. The farmers who owned the sections of the restoration project were concerned about losing valuable farmland. The design involved a Priority Level II restoration and LBC and the UT were designed to be Rosgen stream type "C". Section 2.0 describes in more detail the project background with Tables summarizing the goals, objectives, history, background, and contact information." (from the Earth Tech, Inc. As-built Report dated June 2005)

The Priority II restoration involved converting the impaired channels into sinuous channels that meander for a total of 6,326 linear feet as measured along the current thalwegs. Rock cross-vanes and rootwads were incorporated for aquatic habitat enhancement and bed and bank stability. A 50-foot riparian buffer on either side of the stream was planted with native vegetation.

Currently, the Little Bugaboo Creek project is meeting most of the goals and objectives of the restoration design. The design of the Little Bugaboo Creek restoration was completed during 2002 and construction was completed in 2003-04. There are some problem areas that appear to be continuing to deteriorate, and which would benefit from repair. Most of the project, however, appears stable and functional. The main channel does not appear to have sufficient woody stems to fulfill USACE requirements.

In their as-built (baseline) report of 2005, Earth Tech, Inc. noted the following:

"The vegetation … does not meet mitigation requirements. The stem count data collected indicates high tree mortality at the sixteen vegetation plots. Woody vegetation restoration within the riparian buffer of Little Bugaboo Creek and the UT is considered unsuccessful. On the main channel five of the eleven plots were significantly disturbed because of repair activities. The plots disturbed by channel repairs were replanted, but

plantings appeared concentrated closer to the channel. The disturbed conditions and planting patterns may have contributed to lower planting densities in these plots. Along the UT, four of the five plots were described as significantly wet or very wet. Only one of the wet plots has greater than 50% of the expected stems. One of the plots had a significant stand of black willows from natural regeneration. Other factors besides the repair work that could explain why the vegetation was not successful at this site include: drought/flashy flows; improper application (seeding, fertilizer, planting or timing) of vegetation seeds and stems; and mowing/grazing by cattle and farmer due to no fence in several locations. Recommendations include replanting trees to obtain mitigation requirements and controlling exotic species in the future.

The stream channel … has significant areas of bank erosion. These areas of erosion may be due to any of the following: lack of vegetation, improper installation and/or design of structures, stream design dimensionless ratios, the inner berm was not constructed as according to the plans for typical cross-sections, and overland flow/drainageways entering the stream channel. Twelve cross-sections were surveyed and pebble counts were performed at each cross-section. Two representative longitudinal profiles were surveyed along LBC and one along the UT. It is recommended that vegetation needs to be planted to help stabilize the stream banks and the major problem areas need to be watched over time to see if repair work is needed."

II. Project Background

The background information for this report is taken from the Earth Tech, Inc. As-built Report dated June 2005.

"The following was excerpted from the 2002 Little Bugaboo Creek Stream Restoration Plan report sections 1.1 and 2.1.1.

The Wilkes County Soil and Water Conservation District (WCSWCD) staff first identified LBC as a potential restoration site through their work with farmers throughout the county. The landowners main concern at that time was the loss of valuable farmland due to actively eroding streambanks. Un-restricted cattle access to the stream and the removal of vegetation along the banks by grazing were the main causes of degradation. Lands adjacent to the streams were being used for cattle production and the spreading of chicken litter. Prior to restoration, the pastures adjacent to the stream consisted of fescue with sparse trees along drainages. Most streambanks were vertical with little or no vegetation and were actively eroding. There were numerous signs of lateral meander migration. Prior to restoration, the main channel classified as a Rosgen 'F' type system where the channel had downcut and was eroding its banks to establish a floodplain at the new channel elevation. The existing channel appeared to be in a state of transition. Streambanks were very unstable and meanders were continuing to migrate, creating a wider floodplain as necessary to reach stability.

The combination of extreme streambank erosion, degraded vegetation, poor cattle management practices, and willing landowners mad this an excellent restoration site. Restoration required determining how far the stream had departed from its natural

stability and then establishing the stable form of the stream under the current hydrologic conditions within the drainage area. The restoration involved constructing a stable meander geometry, modifying channel cross-sections, and establishing a floodplain at the existing stream elevation, thus, restoring a stable dimension, pattern, and profile. This restoration was based on analysis of current watershed hydrologic conditions, field evaluation of the project site, and assessments of stable reference reaches. LBC was designed as a Rosgen type "E" channel and the UT was designed as a Rosgen type "C" channel.

A tributary to the Roaring River, Little Bugaboo Creek is located on agricultural land northeast of the town of Roaring River in Wilkes County, North Carolina (Figure 1). The headwaters of the project originate approximately 3 miles to the north-northwest of the restoration site. From the headwaters, LBC flows for approximately 4 miles before joining with Big Bugaboo Creek. An Unnamed Tributary to Little Bugaboo Creek enters LBC at the end of the project site and was included in the restoration project. The headwaters for the UT originate approximately 1.6 miles from the restoration site. From the headwaters, the UT flows for approximately 2.5 miles before the confluence with LBC. Several tributaries enter LBC along its extent.

The Priority II restoration involved increasing the existing streams length and providing a floodplain. Cross-vanes and rootwads were incorporated for aquatic habitat enhancement and bed and bank stability. A 50-foot riparian buffer on either side of the stream was planted with native vegetation."

1. Location and Setting

Little Bugaboo Creek starts in Lomax North Carolina and joins Bugaboo Creek just north of Ronda, NC. The project location is about halfway between these two small towns. The center of the project is about 3 miles northwest of Ronda, NC. The project site is bounded on the north by Tharpe Road (SR 2012), White Plains (SR 1990) on the west and North Hoots Road (SR 2014) on the south. See vicinity map on page 3.

The project restored 4,276 linear feet of main stem and 1,954 linear feet of a major unnamed tributary. The tributary restoration starts just below the culvert at Tharpe Road. This tributary flows generally south and joins the main channel about 200 feet above the end of the project. The start of the main channel restoration occurs at the property line of Woodie Farms and continues generally east until just past the confluence with the restored tributary where the main channel turns south and enters a bedrock-controlled section. There are the ruins of an old mill and dam just below the project end.

Ecosystem Enhancement Program

N

Vicinity Map

0 375 750 1,500 Feet

EcoLogic Associates, PC April 2006

Little Bugaboo Stream Restoration
EEP Project # 56, MY 1 (2005)
Wilkes County, NC

Source:
Maptech USGS Topographic Series, Maptech Inc.
www.maptech.com/topo
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2. Structure and Objectives

Little Bugaboo Creek was enhanced/restored through the North Carolina Ecosystem Enhancement Program (NCEEP). Table I and Table II summarize the goals and objectives of the project. (from the Earth Tech, Inc. As-built Report dated June 2005)

Table I. Project Structure Table* Project Number and Name: 56 (Little Bugaboo Creek)	
Segment/Reach ID	**Linear Feet**
Little Bugaboo Creek	4,276 lf
UT to Little Bugaboo	1,954 lf

Table II. Project Objectives Table* Project Number and Name: 56 (Little Bugaboo Creek)			
Segment/Reach ID	***Objectives***	**Linear Feet or Acreage**	**Comment**
Little Bugaboo Creek	Restore 4,276.4 linear feet of Little Bugaboo Creek (as measured along the thalweg)	4,276 lf	
	Provide a stable stream channel that neither aggrades nor degrades while maintaining its dimension, pattern, and profile with the capacity to transport its watershed's water and sediment load		
	Improve water quality and reduce further property loss by stabilizing eroding stream banks		
	Reconnect the stream to its floodplain or establish a new floodplain at a lower elevation		
	Improve aquatic habitat with the use of natural material stabilization structures such as root wads, rock vanes, woody debris and a riparian buffer		
	Provide aesthetic value, wildlife habitat and bank stability through the creation or enhancement of a riparian zone		
UT to Little Bugaboo Creek	Restore 1,954 linear feet along the tributary (as measured along the thalweg);	1,954 lf	
	Provide a stable stream channel that neither aggrades nor degrades while maintaining its dimension, pattern, and profile with the capacity to transport its watershed's water and sediment load		
	Improve water quality and reduce further property loss by stabilizing eroding stream banks		
	Reconnect the stream to its floodplain or establish a new floodplain at a lower elevation		
	Improve aquatic habitat with the use of natural material stabilization structures such as root wads, rock vanes, woody debris and a riparian buffer		
	Provide aesthetic value, wildlife habitat and bank stability through the creation or enhancement of a riparian zone		

* from Earth Tech, Inc. As-built Report dated June 2005

3. Project History and Background

The following history and background information for this report is taken from the Earth Tech, Inc. As-built Report dated June 2005.

"The Little Bugaboo Creek restoration site begins approximately 4,420 feet from the confluence of LBC and UT. The project also includes the restoration of 1,954 feet of an unnamed tributary (UT). The project is located within the property boundaries of five different landowners. LBC flows from northwest to southeast through a 200 to 400-foot wide floodplain that narrows to less than 100-feet for the last 1,500-feet of the project. The UT flows from north to south through a 100 to 150-foot wide valley. The UT is much straighter than LBC, although both show signs of increasing their sinuosity over time.

Historically, a mill and dam were located about 150-feet below the confluence of LBC and UT. The milldam backed up water within approximately half of the project length (believed to be about elevation 1,107 feet). Both streams had incised down to bedrock through the alluvial sediments of the historic pond. The dam was removed near the beginning of the 20th century. It is not known when the dam was constructed.

Landuse throughout the restoration site is predominantly agricultural land presently being used for cattle production and the spreading of chicken litter. Fences within the project area divide pastureland but did not restrict cattle access to the streams and drainages for a majority of the site prior to restoration. LBC is bound upstream and downstream by bedrock outcroppings that result in significant (greater then 10-feet of fall) waterfalls. The UT is bound upstream by an outcropping of bedrock and downstream by the confluence with LBC. The lower 1,600 feet of LBC and 450 feet of the UT did have fencing along one side of each respective stream prior to restoration, which restricted cattle access.

The causes of impairment throughout the restoration site were:

- Cattle access to the stream and riparian areas;
- Incision partially due to aggradation of material from the historic milldam below the end of the project limits;
- Indications of previous channelization along the reach; and
- Removal of riparian vegetation.

Cattle access to the stream and riparian areas directly resulted in streambank erosion prior to restoration. Continual grazing limited the ability of vegetation to reestablish itself along the majority of the stream. Dense rooting vegetation along the stream banks was extremely sparse for large lengths of the stream. Additional degradation resulted from historic channelization of the streams and tributaries. In an effort to maximize available land for chicken litter spreading, landowners had straightened sections of LBC. This increased the channel slope and significantly modified the channel dimension, pattern, and profile. The downstream portions of both reaches were deeply incised partially due to the alluvial sediments that deposited during the existence of the downstream milldam.

After the milldam was removed, a head cut worked up from the mill site through the deposited sediments.

Exhibit Table III summarizes the project activity with the year of planned completion and actual completion. This table will need to be updated for each additional year of monitoring after year 1. Exhibit Table IV gives the project contact information for designer, contractors, and who performed the monitoring. Exhibit Table V summarizes the background information for the project. The design involved a Priority Level II restoration and LBC and the UT were designed to be a Rosgen stream type "C"."

Table III. Project Activity and Reporting History*
Project Number and Name: 56 (Little Bugaboo Creek)

Activity or Report	Calendar Year of Completion of Planned Completion	Actual Completion Date
Restoration Plan	2002	2002
Mitigation Plan	2005	2005
Construction	2003	2003/2004
Temporary S&E mix applied to entire project area	2003/2004	2003/2004
As-Built Report	2004	2005
Permanent seed mix applied	2004	2004
Containerized and B&B plantings	2004	2004
Structural maintenance	2004	2004
Initial Baseline Monitoring	2004	2005
Year 1 Monitoring	2005	2005
Year 2 Monitoring	2006	
Year 3 Monitoring	2007	
Supplemental Planting of containerized material		
Year 4 Monitoring	2008	
Year 5 Monitoring	2009	

* background data from Earth Tech, Inc. As-built Report dated June 2005

Table IV. Project Contact Table* Project Number and Name: 56 (Little Bugaboo Creek)	
Designer	Earth Tech of North Carolina 701 Corporate Center Drive, Suite 475 Raleigh, NC 27607
Primary project design POC	Jan Patterson P.E.
Construction Contractor	Dixie Grading and Equipment Company 5228 W. US HWY 421 Wilkesboro, NC 28697
Construction contractor POC	Randall Miles 336-973-7281
Planting Contractor	Carolina Environmental Contracting, Inc. P.O. Box 1905 Mt. Airy, NC 27030
Planting contractor POC	Joanne Cheatham 919-868-2807
Seeding Contractor	Carolina Environmental Contracting, Inc. P.O. Box 1905 Mt. Airy, NC 27030
Seeding contractor POC	Joanne Cheatham 919-868-2807
Seed Mix Sources	Unknown
Nursery Stock Suppliers	Unknown
Monitoring Performers (2005)	EcoLogic Associates, P.C. 4321-A South Elm-Eugene St. Greensboro, NC 27406
Stream Monitoring POC	Kyle Hoover (336) 355-1108
Vegetation Monitoring POC	Moni Bates (336) 335-1108

Table V. Project Background Table* Project Number: 56 (Little Bugaboo Creek)	
Project County	Wilkes County
Drainage Area (LBC/UT)	3.45/1.4 sq miles
Drainage impervious cover estimate (%)	Estimated at <5%
Stream Order	2nd/1st
Physiographic Region	Piedmont/Foothills
Ecoregion	Northern Inner Piedmont (45e)
Rosgen Classification of As-built	C
Cowardin Classification	Riverine
Dominant soil types	Chewacla and Rion
Reference site ID	Basin Creek
USGS HUC for Project	03040101
USGS HUC for Reference	05050001
NCDWQ Sub-basin for Project and Reference	030701
NCDWQ classification for Project	C
NCDWQ classification for Reference	UNKNOWN
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor	N/A
% of project easement fenced	100% - heavy cattle grazing

* background data from Earth Tech, Inc. As-built Report dated June 2005

4. Monitoring Plan View

Please see following insert (Figure 3)

III. Project Condition and Monitoring Results

A. Vegetation Assessment

1. Soil Data

Preliminary soil data was taken from the Earth Tech, Inc. As-built Report dated June 2005 and cited therein as being from the Soil Survey of Wilkes County North Carolina (1997).

Table VI. Preliminary Soil Data*

Series	Max Depth (in.)	% Clay in Surface Horizon	K	T	OM % (Surface)
CkA - *Chewacla* loam - 0 to 2% frequently flooded	60	10 - 25	5	5	1 - 4
RnE - *Rion* fine sandy loam – 15 to 20% slope	40 (over saprolite)	5 - 20	3	3	0.5 - 2

* from Earth Tech, Inc. As-built Report dated June 2005

2. Problem Areas Table (Vegetation)

Vegetation within the riparian buffer of Little Bugaboo Creek varies in success. Much of the buffer is covered with dense, lush, native herbaceous vegetation. Live stakes are marginally healthy in certain areas, although many were washed out due to bank sloughing. Planted trees and shrubs are doing fair to poor throughout the entire buffer, better on the tributary than the main stem. This is the only restoration we have seen with access gates to the easement area along the main stem. This allows the landowner to mow within the fence. There is currently one mower width cut within the easement along the fence. This effectively reduces the functional buffer by about one acre. Few trees were counted in most vegetation monitoring plots, and some areas large enough to have a 10x10 meter plot had no woody species evident. Although some live stakes were thriving, mostly on the tributary, many stakes and banks were missing along the main stem.

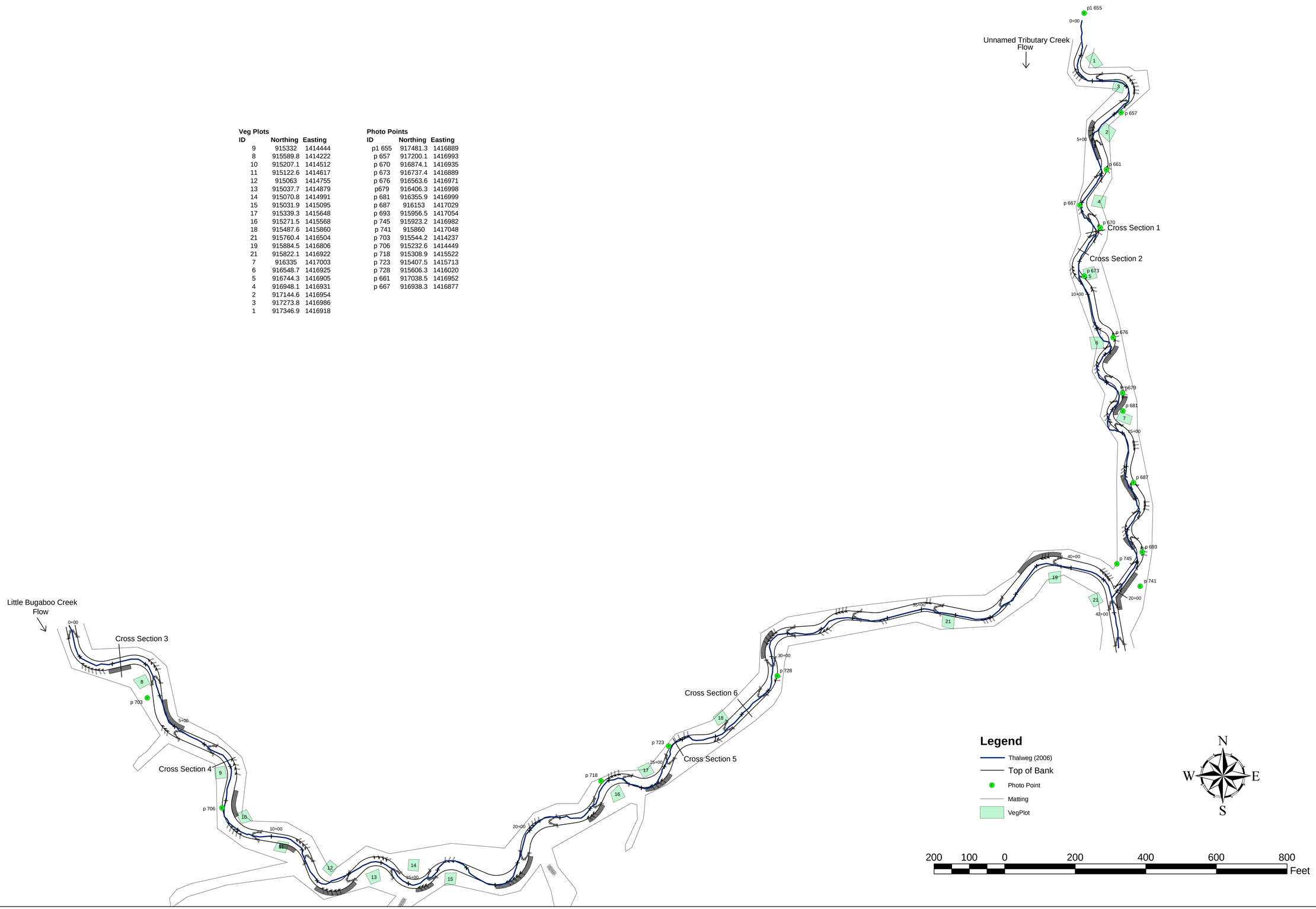
Recommendations include replanting larger containerized trees to obtain mitigation requirements and staking in areas where erosion is problematic. Although invasive vegetation is not a major issue on this project site, exotic invasive species present include *Microstegium vimineum* (Japanese grass), *Lonicera japonica* (Japanese honeysuckle), *Rosa multiflora* (Multiflora rose) and *Ligustrum* sp. (Privet). Control measures may be necessary if these species become denser.

Veg Plots

ID	Northing	Easting
9	915332	1414444
8	915589.8	1414222
10	915207.1	1414512
11	915122.6	1414617
12	915063	1414755
13	915037.7	1414879
14	915070.8	1414991
15	915031.9	1415095
17	915339.3	1415648
16	915271.5	1415568
18	915487.6	1415860
21	915760.4	1416504
19	915884.5	1416806
21	915822.1	1416922
7	916335	1417003
6	916548.7	1416925
5	916744.3	1416905
4	916948.1	1416931
2	917144.6	1416954
3	917273.8	1416986
1	917346.9	1416918

Photo Points

ID	Northing	Easting
p1 655	917481.3	1416889
p 657	917200.1	1416993
p 670	916874.1	1416935
p 673	916737.4	1416889
p 676	916563.6	1416971
p679	916406.3	1416998
p 681	916355.9	1416999
p 687	916153	1417029
p 693	915956.5	1417054
p 745	915923.2	1416982
p 741	915860	1417048
p 703	915544.2	1414237
p 706	915232.6	1414449
p 718	915308.9	1415522
p 723	915407.5	1415713
p 728	915606.3	1416020
p 661	917038.5	1416952
p 667	916938.3	1416877



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Ecosystem Enhancement Program

Project:
Little Bugaboo Stream Restoration
Wilkes County, NC

Prepared For:
NC Ecosystem Enhancement Program

Project Number:
56

Map Title:
Monitoring Plan View

Monitoring Year:
1 (2005)

Date:
2/27/06

Figure Number:
3

No Table VII or Appendix 3 photos are presented due to the absence of significant vegetation problems unrelated to bank erosion and loss. In their 2005 as-built report, Earth Tech noted the following, "There were numerous areas throughout the project on LBC that lacked vegetation on the banks. The UT had only a few minor problem areas. Exhibit Table VII describes the vegetative problem areas (which also correspond to the stream bank erosion areas)."

3. Vegetation Problem Areas Plan View

Please see Appendix A.1 for Vegetation PAPV

4. Stem Counts

Please see following page for Table VIII

Please see Appendix A.2 for raw data tables

5. Vegetation Plot Photos

Please see Appendix A.4 for Veg Plot Photos

Table VIII. Stem counts for each species arranged by plot.
EEP Project Number: 56
Segment Reach: Little Bugaboo Creek & Trib

Species	Plots																					Year 1 Totals	Initial Totals	Survival %
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21			
Earth Tech Plot #	116			115		114	112	101			102	103	104	105				109						
Shrubs																								
Alnus serrulata	4		3				2		2	1			2	1			1	2	1			19	NA	
Cornus amomum	16		9		1																	26	NA	
Sambucus canadensis	2			2					2		3										1	10	NA	
Salix sericea					2		4				2											8	NA	
Salix nigra					1																	1	NA	
Aronia arbutifolia						1									2		1	2			2	8	NA	
Viburnum nudum											2	1	1			1		1				6	NA	
Trees																								
Platanus occidentalis	12	8	5	1	2	6	8	4	2	7	3	2		4	3	2		1	1	6	6	83	NA	
Juglans nigra	1	6		1	1	1					1	3	2	2					2		1	21	NA	
Betula nigra	2	7				4		1				1			1						3	19	NA	
Fraxinus pennsylvanica	4	8		3			2	2		1	1		3	1			2		2		14	43	NA	
Quercus sp	5				3		1			1		1	1									12	NA	
Liriodendron tulipifera						1																1	NA	
Ilex opaca								1				1										2	NA	
Prunus sp												1		1								2	NA	
Crataegus sp								1														1	NA	

NA = Tabulation format and incomplete plot correlation does not permit comparison as shown .

B. Stream Assessment

1. Problem Areas Plan View

The Little Bugaboo Creek restoration has deteriorated since construction. Most of the structures appear to be functioning well, a few need repair. Several locations on the main stem have central bars forming and this increases the stress on the banks leading to failure.

Please see Appendix B.1 for Stream PAPV

2. Problem Areas Table Summary

Table IXa. Stream Problem Areas
EEP Project Number: 56
Segment Reach: Little Bugaboo Creek

Feature Issue	Station	Suspected Cause	Photo number	Severity
bank erosion	0+50	scour	p697	yellow
bank erosion	1+75	scour	p699-700	yellow
bank erosion	3+25	mass wasting	p701	red
bank erosion	4+20	scour	p702	red
structure degradation	4+90	mass wasting	p704	red
bank erosion	7+95	scour	p705	yellow
structure degradation	8+40	high flow	p707	yellow
bank erosion	9+00	mass wasting	p708	yellow
structure degradation	9+50	stability	p709	red
bank erosion	11+10	scour	p710	red
channel	11+35	stability	p711	red
bank erosion	14+25	scour	p712	red
structure degradation	16+00	scour	p713	red
bank erosion	16+25	stability	p714	red
structure degradation	17+05	mass wasting	p715	red
bank erosion	21+60	overland flow	p716	yellow
bank erosion	21+90	scour	p717	yellow
bank erosion	23+25	mass wasting	p719	yellow
bank erosion	24+90	scour	p721	red
structure degradation	25+25	stability	p722	yellow
channel	26+15	stability	p724	red
bank erosion	26+30	mass wasting	p724	red
bank erosion	27+00	scour	p725	red
structure degradation	27+50	high flow	p726	red
bank erosion	29+60	scour	p727	yellow
bank erosion	31+40	scour	p730	yellow

Table IXa. Stream Problem Areas EEP Project Number: 56 Segment Reach: Little Bugaboo Creek				
Feature Issue	**Station**	**Suspected Cause**	**Photo number**	**Severity**
bank erosion	32+60	scour	p731	yellow
bank erosion	35+00	scour	p732	yellow
bank erosion	37+40	mass wasting	p735	yellow
bank erosion	37+95	mass wasting	p736	red
bank erosion	41+60	mass wasting	p737	red
structure degradation	41+80	stability	p738	red
bank erosion	41+95	scour	p739	yellow
bank erosion	42+25	mass wasting	p740	yellow
structure degradation	42+60	stability	p742	red

Table IXb. Stream Problem Areas EEP Project Number: 56 Segment Reach: UT to Little Bugaboo Creek				
Feature Issue	**Station**	**Suspected Cause**	**Photo number**	**Severity**
bank erosion	0+85	scour	p656	yellow
bank erosion	5+35	mass wasting	p659	yellow
bank erosion	5+40	scour	p658	yellow
structure degradation	5+95	high flow	p660	yellow
structure degradation	6+10	stability	p662	yellow
bank erosion	6+50	scour	p663	red
bank erosion	7+15	scour	p665	red
structure degradation	7+25	high flow	p666	red
bank erosion	7+55	mass wasting	p668	yellow
bank erosion	8+00	scour	p669	yellow
bank erosion	8+25	scour	p671	red
structure degradation	9+35	high flow	p672	red
bank erosion	11+00	scour	p674	yellow
bank erosion	11+75	mass wasting	p675	yellow
structure degradation	12+40	high flow	p677	red
bank erosion	12+60	scour	p678	yellow
bank erosion	14+50	mass wasting	p680	yellow
bank erosion	15+10	scour	p682	yellow
bank erosion	16+00	mass wasting	p683	yellow
bank erosion	16+40	Scour	p684-6	yellow
structure degradation	16+60	high flow	p688	red
structure degradation	17+50	scour	p689	red
bank erosion	18+15	scour	p690	yellow
bank erosion	18+75	scour	p692	yellow

3. Numbered Issues Photo Section

Please see Appendix B.2

4. Fixed Photo Station Points

Please see Appendix B.3

5. Stability Assessment

Table Xa. Categorical Stream Feature Visual Stability Assessment Project Number: 56 Segment/Reach: Little Bugaboo Creek						
	2004	2005	2006	2007	2008	2009
Feature	**Initial***	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
A. Riffles	100%	100%				
B. Pools	100%	100%				
C. Thalweg	100%	100%				
D. Meanders	100%	NA				
E. Bed General	100%	100%				
F. Channel General	100%	100%				
G. Banks	100%	NA				
H. Vanes/J Hooks etc.	100%	NA				
I. Wads and Boulders	100%	NA				

NA = Historical project documents necessary to provide this data were unavailable at the time of this table preparation.

* Assumed 100% at completion/acceptance of project.

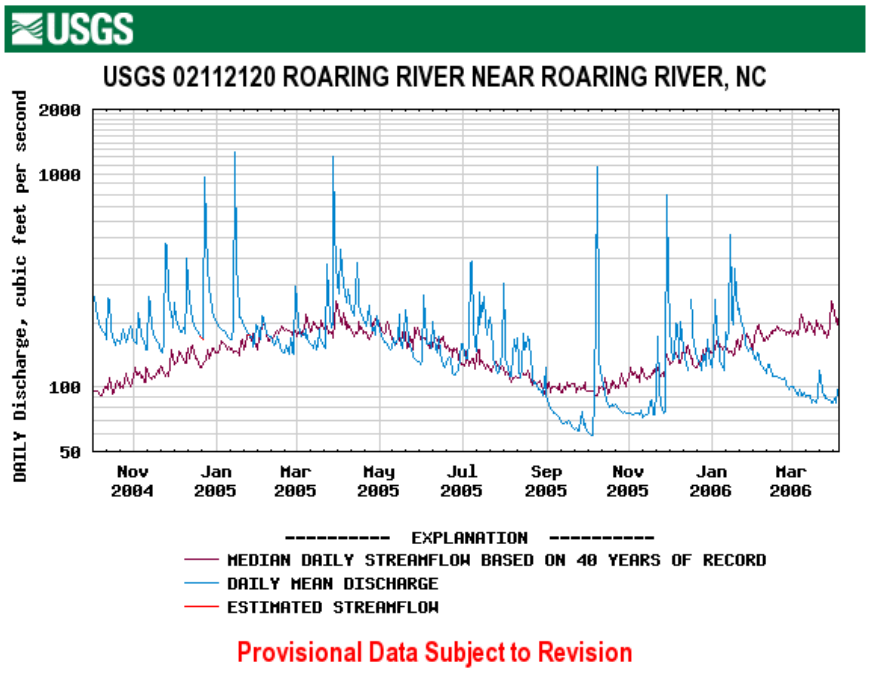
Table Xb. Categorical Stream Feature Visual Stability Assessment Project Number: 56 Segment/Reach: UT to Little Bugaboo Creek						
	2004	2005	2006	2007	2008	2009
Feature	**Initial***	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
A. Riffles	100%	100%				
B. Pools	100%	100%				
C. Thalweg	100%	100%				
D. Meanders	100%	NA				
E. Bed General	100%	100%				
F. Channel General	100%	100%				
G. Banks	100%	NA				
H. Vanes/J Hooks etc.	100%	NA				
I. Wads and Boulders	100%	NA				

NA = Historical project documents necessary to provide this data were unavailable at the time of this table preparation.

* Assumed 100% at completion/acceptance of project.

6. Quantitative Morphology

No crest gages are installed at this site to document bankfull events. Therefore, potential occurrence was extrapolated based on USGS stream gage discharge data for the Roaring River near Roaring River, NC. The gage is located about 3 miles from the project site in the same watershed and has a drainage area of 128 square miles. An estimate of the number of bankfull events in 2005 was made by comparing the stream discharges from the USGS data in cubic feet per second (cfs) against the bankfull discharge estimated from the drainage area on the Rural Piedmont Regional Curve. According to the regional curve, a bankfull event occurs on a stream with a 128-mi^2 drainage area when the discharge is about 2,930 cfs. Based on this primary surrogate USGS data, an estimated zero (0) bankfull events occurred in 2005.



Please see pages14-17 for Table XI and XII

IV. Methodology Section

The methods used to generate the data in this monitoring report are standard fluvial geomorphology techniques as described in *Applied River Morphology*, 1996, D.L. Rosgen and related publications from US Forest Service and the interagency Stream Mitigation Guidelines, 2003, USACOE, USEPA, NCWRC, NCDENR-DWQ.

EcoLogic conducted field monitoring without the benefit of an as-built report or data (provided later during preparation of this report), so we relied on visual and

electromagnetic surveys to attempt to locate prior monitoring features. In spite of these efforts, we could not locate prior feature indicators in the field except for two vegetation plots. Eight (8) more vegetation plots were correlated in the field based on mapped locations.

EcoLogic's field morphology survey was conducted using a Nikon total station and the data was analyzed and displayed using RiverMorph version 3.1 software. The pebble counts were conducted using Pocket RiverMorph software and a PDA. The vegetation problem areas and structural problem areas were noted in the field on the PDA. Photographs were taken at medium-high resolution using a Nikon Coolpix 4600 digital camera.

GPS location information was collected using a Trimble Geo XT handheld mapping grade GPS unit. GPS locations were collected on all problem areas, photo points and at least one corner of each vegetation-monitoring plot.

Vegetation monitoring plots were marked in the field by placing a steel conduit with orange flagged at each corner. In addition, the upstream, outside corner was marked with a three-foot length of white plastic pipe tied with orange flagging. Individual plants in the monitoring plots were tied with orange flagging.

Table XIa. Baseline Morphology and Hydraulic Summary
Project Number: 56
Segment/Reach: Little Bugagoo Creek

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	Avg^	Min	Max	Med
BF Width (ft)	NA	NA	NA			21.9	26	35.5	30.75	20	21.5	20.75			25.8	20.3	44	28.8
Floodprone Width (ft)	NA	NA	NA			NA			90			130			255	87.5	100	100
BF Cross Sectional Area (ft2)	NA	NA	NA			50.4	54	87.7	70.85	40.9	42.8	41.85			55.7	53.9	67.5	60.1
BF Mean Depth (ft)	NA	NA	NA			2.28	1.9	2.9	2.4	2	2	2			2.15	1.4	3.2	2.2
BF Max Depth (ft)	NA	NA	NA			NA	2.7	4.1	3.4	2.5	2.7	2.6			3.5	3.6	4.6	4.1
Width/Depth Ratio	NA	NA	NA			NA	8.8	17.4	13.1	9.8	10.8	10.3			12	12	32.6	12.6
Entrenchment Ratio	NA	NA	NA			NA			2.7			65			9.9	3.1	3.5	3.3
Wetted Perimeter(ft)	NA	NA	NA			26.5	29.8	41.3	35.55	24	25.5	24.75			30.1	32.7	46.8	33.3
Hydraulic radius (ft)	NA	NA	NA			1.91	1.812	2.123	1.993	1.704	1.678	1.691			1.85	1.3	2	1.9
Pattern																		
Channel Beltwidth (ft)	NA	NA	NA	NA	NA	NA	36	140	88	31	44	37.5	NA	NA	NA	63	122	92.5
Radius of Curvature (ft)	NA	NA	NA	NA	NA	NA	62	234	148	42	63	52.5	72.9	102.9	87.9	60	110	85
Meander Wavelength (ft)	NA	NA	NA	NA	NA	NA	133	590	361.5	185	260	222.5	196	366	281	206	366	286
Meander Width ratio	NA	NA	NA	NA	NA	NA	4.4	19.3	11.85	8.9	12.6	10.75	6.5	12.2	9.35	7.2	12.7	9.9
Profile																		
Riffle length (ft)	NA	NA	NA	NA	NA	NA				23	78	50.5				3	91	47
Riffle slope (ft/ft)	NA	NA	NA	NA	NA	NA				0.02	0.02	0.02			0.01	0	0.2	0.1
Pool length (ft)	NA	NA	NA	NA	NA	NA				8	32	20				47	94	70.5
Pool spacing (ft)	NA	NA	NA	NA	NA	NA	57	287	172	98	180	139	106	217	161.5	121	127	124
Substrate																		
d50 (mm)	NA	NA	NA	NA	NA	NA			0.25			3				0.25	11.3	5.8
d84 (mm)	NA	NA	NA	NA	NA	NA			23			50				1	64	32.5
Additional Reach Parameters																		
Valley Length (ft)	NA	NA	NA	NA	NA	NA												3,420
Channel Length (ft)	NA	NA	NA	NA	NA	NA												4,276
Sinuosity	NA	NA	NA	NA	NA	NA			1.3			1.1			1.2			1.3
Water Surface Slope (ft/ft)	NA	NA	NA	NA	NA	NA			0			0.01			0.01	0	0.01	0.01
BF slope (ft/ft)	NA	NA	NA	NA	NA	NA										0	0.01	0
Rosgen Classification	NA	NA	NA	NA	NA	NA	Bc, C, E, & F			E4			C			C		
Number of Bankfull Events	NA	NA	NA	NA	NA	NA				NA	NA	NA	NA	NA	NA	NA	NA	NA
Extent of BF floodplain (acres)	NA	NA	NA	NA	NA	NA				NA	NA	NA	NA	NA	NA	NA	NA	NA
*BEHI	NA	NA	NA	NA	NA	NA	20.3	47.9	34.1	NA	NA	NA	NA	NA	NA	NA	NA	NA
*Habitat Index	NA	NA	NA	NA	NA	NA				NA	NA	NA	NA	NA	NA	NA	NA	NA
*Macrobenthos	NA	NA	NA	NA	NA	NA				NA	NA	NA	NA	NA	NA	NA	NA	NA

NA = Historical project data necessary to provide this data were unavailable.

Table XIb. Baseline Morphology and Hydraulic Summary																		
Project Number: 56																		
Segment/Reach: UT to Little Bugagoo Creek																		
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	Avg^	Min	Max	Med
BF Width (ft)	NA	NA	NA			15.55	17.5	18	17.75	29.5	36.9	33.2			18	14.8	31	18.6
Floodprone Width (ft)	NA	NA	NA						38			329			170	61	75	68
BF Cross Sectional Area (ft2)	NA	NA	NA			27.55	21.2	21.9	21.55	64.9	71.9	68.4			27	22.1	34.4	30.9
BF Mean Depth (ft)	NA	NA	NA			1.74	1.2	1.2	1.2	1.9	2.2	2.05			1.5	1.1	2.3	1.4
BF Max Depth (ft)	NA	NA	NA				2.2	2.3	2.25	3	3.2	3.1			2.1	2.64	3.8	3.1
Width/Depth Ratio	NA	NA	NA				14.4	14.8	14.6	13.4	19.4	16.4			12	11.2	17.2	14.2
Entrenchment Ratio	NA	NA	NA				1.8	2.5	2.15			8.9			9.4	3.47	3.8	3.6
Wetted Perimeter(ft)	NA	NA	NA				19.9	20.4	20.15	33.3	41.3	37.3			21	19.4	33.2	21.3
Hydraulic radius (ft)	NA	NA	NA				1.07	1.07	1.07	1.95	1.74	1.84			1.29	1	1.8	1.2
Pattern																		
Channel Beltwidth (ft)	NA	NA	NA	NA	NA	NA	26	74	50	59	75	67				40	131	59.5
Radius of Curvature (ft)	NA	NA	NA	NA	NA	NA	27	98	62.5	40.1	69.3	54.7	1.8	3.7	2.8			
Meander Wavelength (ft)	NA	NA	NA	NA	NA	NA	87	355	221			350	129	224	176.5	130	204	175
Meander Width ratio	NA	NA	NA	NA	NA	NA	4.9	19.9	12.4			10.5	9	12	10.5	7.01	11	9.43
Profile																		
Riffle length (ft)	NA	NA	NA	NA	NA	NA				10	245	127.5				22	28	25
Riffle slope (ft/ft)	NA	NA	NA	NA	NA	NA						0.02			0.02	0	0.2	0.1
Pool length (ft)	NA	NA	NA	NA	NA	NA				8	32	20				47	94	70.5
Pool spacing (ft)	NA	NA	NA	NA	NA	NA	33	176	104.5	271	334	302.5	64	166	115	121	127	124
Substrate																		
d50 (mm)	NA	NA	NA	NA	NA	NA			5			58				0.5	5.7	3.1
d84 (mm)	NA	NA	NA	NA	NA	NA			23			180				8	32	20
Additional Reach Parameters																		
Valley Length (ft)	NA	NA	NA	NA	NA	NA												1,603
Channel Length (ft)	NA	NA	NA	NA	NA	NA												1,954
Sinuosity	NA	NA	NA	NA	NA	NA			1.2						1.3			1.2
Water Surface Slope (ft/ft)	NA	NA	NA	NA	NA	NA			0.01			0.014			0.01			0.01
BF slope (ft/ft)	NA	NA	NA	NA	NA	NA												0.01
Rosgen Classification	NA	NA	NA	NA	NA	NA	C and F			C4			C and F			C		
Number of Bankfull Events	NA	NA	NA	NA	NA	NA				NA	NA	NA	NA	NA	NA	NA	NA	NA
Extent of BF floodplain (acres)	NA	NA	NA	NA	NA	NA				NA	NA	NA	NA	NA	NA	NA	NA	NA
*BEHI	NA	NA	NA	NA	NA	NA	21.5	45.5	33.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
*Habitat Index	NA	NA	NA	NA	NA	NA				NA	NA	NA	NA	NA	NA	NA	NA	NA
*Macrobenthos	NA	NA	NA	NA	NA	NA				NA	NA	NA	NA	NA	NA	NA	NA	NA
NA = Historical project data necessary to provide this data were unavailable.																		

Table XIIa. Morphology and Hydraulic Monitoring Summary																								
Project Number: 56																								
Segment/Reach: Little Bugaboo Creek																								
Parameter	Cross Section 3 2+10						Cross Section 4 6+75						Cross Section 5 25+75						Cross Section 6 28+15					
	Riffle						Pool						Pool						Riffle					
Dimension	MY1	MY2	MY3	MY4	YM5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
BF Width (ft)	27.1						20.6						31.3						17.8					
Floodprone Width (ft)	91.3						68.8						52.8						39					
BF Cross Sectional Area (ft2)	63.2						34						47						20.6					
BF Mean Depth (ft)	2.3						1.7						1.5						1.2					
BF Max Depth (ft)	4.7						3.7						5						2.4					
Width/Depth Ratio	11.6						12.5						20.8						15.5					
Entrenchment Ratio	3.4						3.3						1.7						2.2					
Wetted Perimeter(ft)	30						22.9						36.2						19.3					
Hydraulic radius (ft)	2.1						1.5						1.3						1.1					
Substrate																								
d50 (mm)	4.71						0.29						0.29						21.13					
d84 (mm)	14.72						2.33						2						54.5					
Parameter	MY-01 (2005)			MY-02 (2006)			MY-03 (2007)			MY-04 (2008)			MY-05 (2009)											
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med						
Channel Beltwidth (ft)	16	115	70																					
Radius of Curvature (ft)	42	121	72																					
Meander Wavelength (ft)	105	210	163																					
Meander Width ratio	3.8	11.6	7.4																					
Profile																								
Riffle length (ft)	13.8	48.5	29.1																					
Riffle slope (ft/ft)	0.0065	0.034	0.0154																					
Pool length (ft)	9.23	94.6	44.5																					
Pool spacing (ft)	16.2	175.3	80.5																					
Additional Reach Parameters																								
Valley Length (ft)		2975																						
Channel Length (ft)		4293																						
Sinuosity		1.4																						
Water Surface Slope (ft/ft)		0.57%																						
BF slope (ft/ft)		0.53%																						
Rosgen Classification		B																						
Number of Bankfull Events		0 est.																						
Extent of BF floodplain (area)		3.9ac																						
BEHI*		NA																						
Habitat Index*		NA																						
Macrobenthos*		NA																						
	NA = Historical project documents necessary to provide this data were unavailable at the time of this report submission.																							

Table XIIb. Morphology and Hydraulic Monitoring Summary																		
Project Number: 56																		
Segment/Reach: UT to Little Bugaboo Creek																		
Parameter	Cross Section 1 8+00						Cross Section 2 8+75											
	Pool						Riffle											
Dimension	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+						
BF Width (ft)	23.5						18.8											
Floodprone Width (ft)	52						32.4											
BF Cross Sectional Area (ft2)	38.3						30.7											
BF Mean Depth (ft)	1.6						1.6											
BF Max Depth (ft)	3.8						3.2											
Width/Depth Ratio	14.4						11.5											
Entrenchment Ratio	2.2						1.7											
Wetted Perimeter(ft)	25.7						20.7											
Hydraulic radius (ft)	1.5						1.5											
Substrate																		
d50 (mm)	0.2						23.4											
d84 (mm)	0.7						51.3											
Parameter	MY-01 (2005)			MY-02 (2006)			MY-03 (2007)			MY-04 (2008)			MY-05 (2009)					
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	25	132	47															
Radius of Curvature (ft)	20	92	48.5															
Meander Wavelength (ft)	75	230	100															
Meander Width ratio	3.9	12.2	5.3															
Profile																		
Riffle length (ft)	12.3	36.9	22															
Riffle slope (ft/ft)	0.00753	0.058	0.024															
Pool length (ft)	15.8	66.8	32.2															
Pool spacing (ft)	15.8	130.2	56.1															
Additional Reach Parameters																		
Valley Length (ft)		1585																
Channel Length (ft)		2013																
Sinuosity		1.3																
Water Surface Slope (ft/ft)		1.11%																
BF slope (ft/ft)		0.011																
Rosgen Classification		B/C																
Number of Bankfull Events		0 est.																
Extent of BF floodplain (area)		2.3ac																
BEHI*		NA																
Habitat Index*		NA																
Macrobenthos*		NA																
	NA = Historical project documents necessary to provide this data were unavailable at the time of this report submission.																	

Appendix A. 1

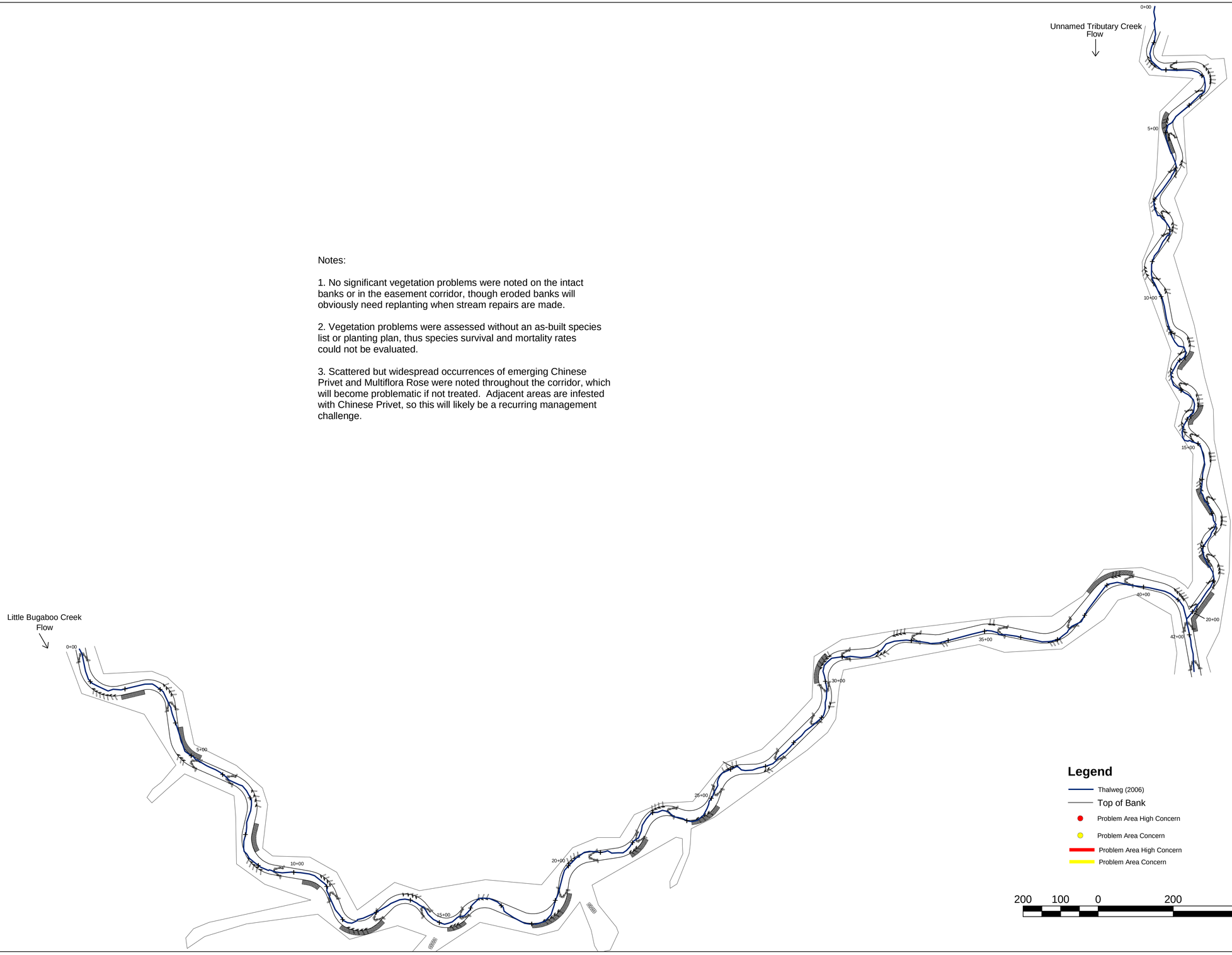
Appendix A. 1

Notes:

1. No significant vegetation problems were noted on the intact banks or in the easement corridor, though eroded banks will obviously need replanting when stream repairs are made.

2. Vegetation problems were assessed without an as-built species list or planting plan, thus species survival and mortality rates could not be evaluated.

3. Scattered but widespread occurrences of emerging Chinese Privet and Multiflora Rose were noted throughout the corridor, which will become problematic if not treated. Adjacent areas are infested with Chinese Privet, so this will likely be a recurring management challenge.



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Ecosystem Enhancement Program

Project: Little Bugaboo Stream Restoration
Wilkes County, NC

Prepared For: NC Ecosystem Enhancement Program

Project Number: 56

Map Title: Veg PAPV

Monitoring Year: 1 (2005)

Date: 2/27/06

Figure Number: 2

Appendix A. 2

Raw Data-Stem Counts	
NC EEP Project #: 56	Date:
Project Name: Little Bugaboo Creek	Staff Name: Ken Bridle
Monitoring Contractor: EcoLogic	Staff Name: Kyle Hoover
County: Wilkes	
8 Digit Catalog Unit: 03040101	
Stream/Wetland Name: Bugaboo Creek	

Plot Location		
Plot ID	**Species**	**Stem #**
1	*Alnus serrulata*	4
	Cornus amomum	16
	Sambucus canadensis	2
	Platanus occidentalis	12
	Juglans nigra	1
	Betula nigra	2
	Fraxinus pennsylvanica	4
	Quercus sp	5

Plot Location		
Plot ID	**Species**	**Stem #**
2	*Platanus occidentalis*	8
	Juglans nigra	6
	Betula nigra	7
	Fraxinus pennsylvanica	8

Plot Location		
Plot ID	**Species**	**Stem #**
3	*Alnus serrulata*	3
	Cornus amomum	9
	Platanus occidentalis	5

Plot Location		
Plot ID	**Species**	**Stem #**
4	*Sambucus canadensis*	2
	Platanus occidentalis	1
	Juglans nigra	1
	Fraxinus pennsylvanica	3

Plot Location		
Plot ID	**Species**	**Stem #**
5	*Cornus amomum*	1
	Salix sericea	2
	Salix nigra	1
	Platanus occidentalis	2
	Juglans nigra	1
	Quercus sp	3

Plot Location		
Plot ID	**Species**	**Stem #**
6	*Aronia arbutifolia*	1
	Platanus occidentalis	6
	Juglans nigra	1
	Betula nigra	4
	Liriodendron tulipifera	1

Plot Location		
Plot ID	**Species**	**Stem #**
7	*Alnus serrulata*	2
	Salix sericea	4
	Platanus occidentalis	8
	Fraxinus pennsylvanica	2
	Quercus sp	1

Plot Location		
Plot ID	**Species**	**Stem #**
8	*Platanus occidentalis*	4
	Betula nigra	1
	Fraxinus pennsylvanica	2
	Ilex opaca	1
	Crataegus sp	1

Plot Location		
Plot ID	**Species**	**Stem #**
9	*Alnus serrulata*	2
	Sambucus canadensis	2
	Platanus occidentalis	2

Plot Location		
Plot ID	**Species**	**Stem #**
10	*Alnus serrulata*	1
	Platanus occidentalis	7
	Fraxinus pennsylvanica	1
	Quercus sp	1

Raw Data-Stem Counts	
NC EEP Project #: 56	Date:
Project Name: Little Bugaboo Creek	Staff Name: Ken Bridle
Monitoring Contractor: EcoLogic	Staff Name: Kyle Hoover
County: Wilkes	
8 Digit Catalog Unit: 03040101	
Stream/Wetland Name: Bugaboo Creek	

Plot Location		
Plot ID	**Species**	**Stem #**
11	*Sambucus canadensis*	3
	Salix sericea	2
	Viburnum nudum	2
	Platanus occidentalis	3
	Juglans nigra	1
	Fraxinus pennsylvanica	1

Plot Location		
Plot ID	**Species**	**Stem #**
12	*Viburnum nudum*	1
	Platanus occidentalis	2
	Juglans nigra	3
	Betula nigra	1
	Quercus sp	1
	Ilex opaca	1
	Prunus sp	1

Plot Location		
Plot ID	**Species**	**Stem #**
13	*Alnus serrulata*	2
	Viburnum nudum	1
	Juglans nigra	2
	Fraxinus pennsylvanica	3
	Quercus sp	1

Plot Location		
Plot ID	**Species**	**Stem #**
14	*Alnus serrulata*	1
	Platanus occidentalis	4
	Juglans nigra	2
	Fraxinus pennsylvanica	1
	Prunus sp	1

Plot Location		
Plot ID	**Species**	**Stem #**
15	**Species**	
	Aronia arbutifolia	2
	Platanus occidentalis	3
	Betula nigra	1

Plot Location		
Plot ID	**Species**	**Stem #**
16	*Viburnum nudum*	**1**
	Platanus occidentalis	2

Plot Location		
Plot ID	**Species**	**Stem #**
17	*Alnus serrulata*	**1**
	Aronia arbutifolia	1
	Fraxinus pennsylvanica	2

Plot Location		
Plot ID	**Species**	**Stem #**
18	*Alnus serrulata*	**2**
	Aronia arbutifolia	2
	Viburnum nudum	1
	Platanus occidentalis	1

Plot Location		
Plot ID	**Species**	**Stem #**
19	*Alnus serrulata*	
	Platanus occidentalis	1
	Juglans nigra	1
	Fraxinus pennsylvanica	2

Plot Location		
Plot ID	**Species**	**Stem #**
20	*Platanus occidentalis*	6

Plot Location		
Plot ID	**Species**	**Stem #**
21	*Sambucus canadensis*	1
	Aronia arbutifolia	2
	Platanus occidentalis	6
	Juglans nigra	1
	Betula nigra	3
	Fraxinus pennsylvanica	14

Appendix A. 3

Vegetation Problem Area Photos (N.A)

Appendix A. 4

Vegetation Monitoring Plot Photos

Veg. Plot 1

Veg Plot 2

Veg. Plot 3

Veg. Plot 4

Veg. Plot 5

Veg. Plot 6

Vegetation Monitoring Plot Photos

Veg. Plot 7

Veg. Plot 8

Veg. Plot 9

Veg. Plot 10

Veg. Plot 11

Veg. Plot 12

Veg. Plot 13

Veg. Plot 14

Veg. Plot 15

Veg. Plot 16

Veg. Plot 17

Veg. Plot 18

Vegetation Monitoring Plot Photos

Veg. Plot 19

Veg. Plot 20

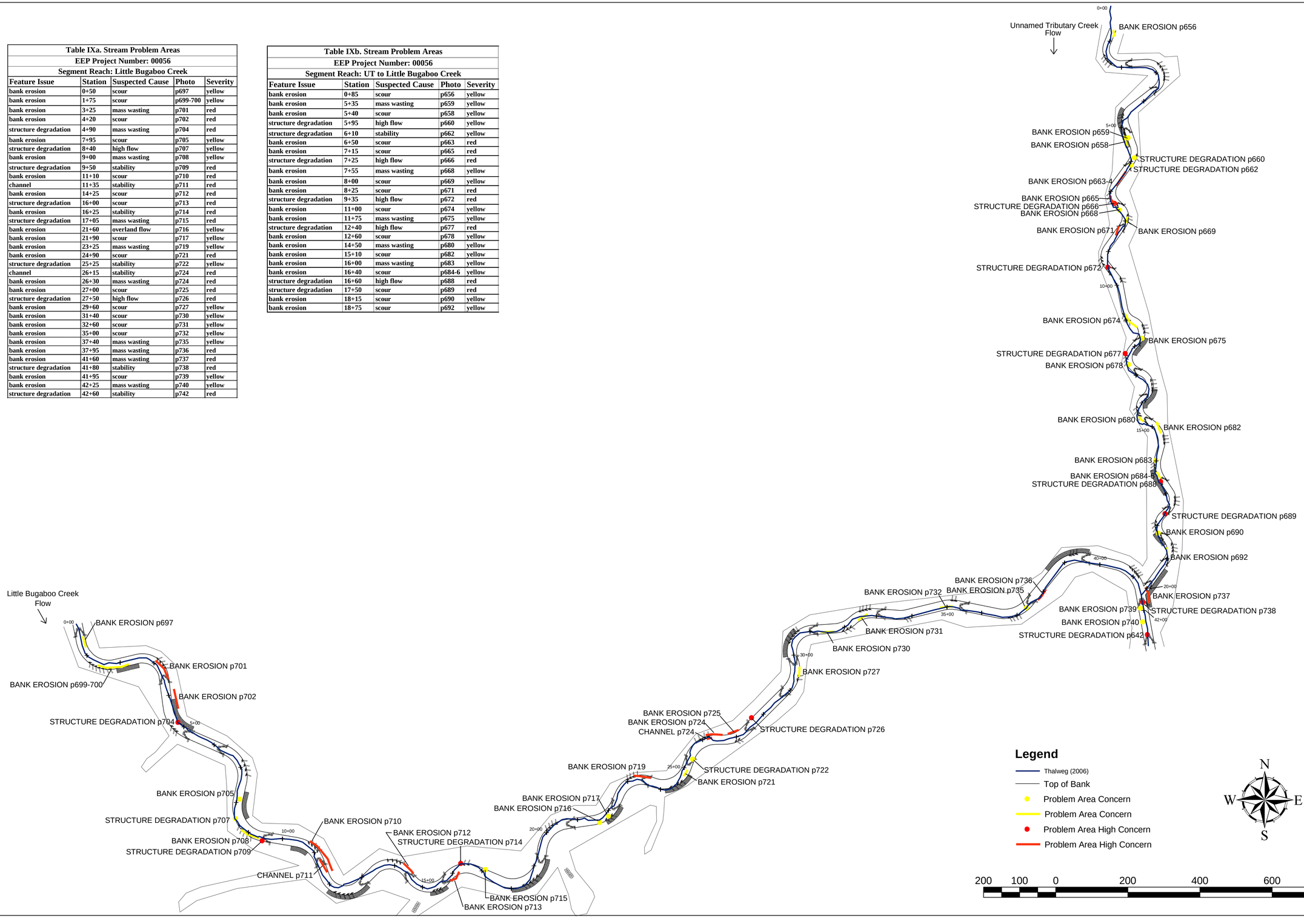
Veg. Plot 21

Appendix B. 1

Appendix B. 1

Table IXa. Stream Problem Areas				
EEP Project Number: 00056				
Segment Reach: Little Bugaboo Creek				
Feature Issue	**Station**	**Suspected Cause**	**Photo**	**Severity**
bank erosion	0+50	scour	p697	yellow
bank erosion	1+75	scour	p699-700	yellow
bank erosion	3+25	mass wasting	p701	red
bank erosion	4+20	scour	p702	red
structure degradation	4+90	mass wasting	p704	red
bank erosion	7+95	scour	p705	yellow
structure degradation	8+40	high flow	p707	yellow
bank erosion	9+00	mass wasting	p708	yellow
structure degradation	9+50	stability	p709	red
bank erosion	11+10	scour	p710	red
channel	11+35	stability	p711	red
bank erosion	14+25	scour	p712	red
structure degradation	16+00	scour	p713	red
bank erosion	16+25	stability	p714	red
structure degradation	17+05	mass wasting	p715	red
bank erosion	21+60	overland flow	p716	yellow
bank erosion	21+90	scour	p717	yellow
bank erosion	23+25	mass wasting	p719	yellow
bank erosion	24+90	scour	p721	red
structure degradation	25+25	stability	p722	yellow
channel	26+15	stability	p724	red
bank erosion	26+30	mass wasting	p724	red
bank erosion	27+00	scour	p725	red
structure degradation	27+50	high flow	p726	red
bank erosion	29+60	scour	p727	yellow
bank erosion	31+40	scour	p730	yellow
bank erosion	32+60	scour	p731	yellow
bank erosion	35+00	scour	p732	yellow
bank erosion	37+40	mass wasting	p735	yellow
bank erosion	37+95	mass wasting	p736	red
bank erosion	41+60	mass wasting	p737	red
structure degradation	41+80	stability	p738	red
bank erosion	41+95	scour	p739	yellow
bank erosion	42+25	mass wasting	p740	yellow
structure degradation	42+60	stability	p742	red

Table IXb. Stream Problem Areas				
EEP Project Number: 00056				
Segment Reach: UT to Little Bugaboo Creek				
Feature Issue	**Station**	**Suspected Cause**	**Photo**	**Severity**
bank erosion	0+85	scour	p656	yellow
bank erosion	5+35	mass wasting	p659	yellow
bank erosion	5+40	scour	p658	yellow
structure degradation	5+95	high flow	p660	yellow
structure degradation	6+10	stability	p662	yellow
bank erosion	6+50	scour	p663	red
bank erosion	7+15	scour	p665	red
structure degradation	7+25	high flow	p666	red
bank erosion	7+55	mass wasting	p668	yellow
bank erosion	8+00	scour	p669	yellow
bank erosion	8+25	scour	p671	red
structure degradation	9+35	high flow	p672	red
bank erosion	11+00	scour	p674	yellow
bank erosion	11+75	mass wasting	p675	yellow
structure degradation	12+40	high flow	p677	red
bank erosion	12+60	scour	p678	yellow
bank erosion	14+50	mass wasting	p680	yellow
bank erosion	15+10	scour	p682	yellow
bank erosion	16+00	mass wasting	p683	yellow
bank erosion	16+40	scour	p684-6	yellow
structure degradation	16+60	high flow	p688	red
structure degradation	17+50	scour	p689	red
bank erosion	18+15	scour	p690	yellow
bank erosion	18+75	scour	p692	yellow



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Ecosystem Enhancement Program

Project: Little Bugaboo Stream Restoration, Wilkes County, NC

Prepared For: NC Ecosystem Enhancement Program

Project Number: 56

Map Title: Stream PAPV

Monitoring Year: 1 (2005)

Date: 2/27/06

Figure Number: 1

Appendix B.2

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Appendix B.3

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Appendix B.4

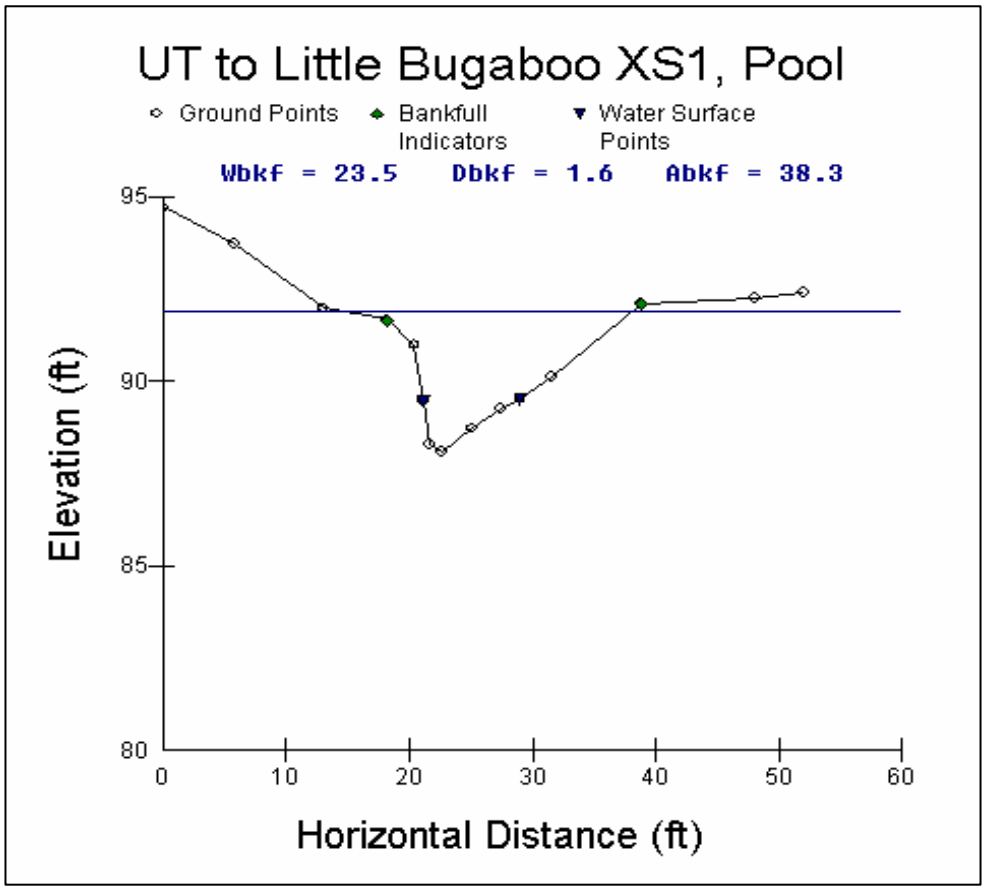
Table B1a. Qualitative Visual Stability Assessment						
Project Number: 56						
Segment/Reach: Little Bugaboo Creek						
Feature Category	Metric (per as-built and reference baselines)	(# Stable) Number performing as intended	Total number per as-built	Total number / feet in unstable state	% Perform in stable condition	Feature Perform. Mean or Total
A. Riffles	1. Present?	27	27	0	100	
	2. Armor stable (e.g. no displacement)?	27	27	0	100	
	3. Facet grade appears stable?	27	27	0	100	
	4. Stable interval grade?	27	27	0	100	
	5. Feature spacing appropriate?	27	27	0	100	
	embedding/fining?	27	27	0	100	
	7. Depth appears appropriate for current discharge?	27	27	0	100	
	8. Length appropriate?	27	27	0	100	
						100
B. Pools	1. Present? (e.g not subject to severe aggradation?) 4	49	49	0	100	
	2. Sufficiently deep (Max Pool D:Mean Bkf >1.6?)	49	49	0	100	
	3. Thalweg located outer bend?	49	49	0	100	
	4. Spacing appropriate?	49	49	0	100	
	5. Non-aggrading (not filling)?	49	49	0	100	
	6. Length appropriate?	49	49	0	100	100
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	49	49	0	100	
	2. Downstream of meander (glide/inflection) centering?	49	49	0	100	100
D. Meanders	1. Outer bend in state of limited/controlled erosion?	49	49	0	100	
	2. Of those eroding, # w/concomitant point bar formation?	2	NA	65	NA	NA
	3. Apparent Rc within spec?	NA	NA	NA	NA	NA
	4. Sufficient floodplain access and relief?	All	NA	None	100	NA
E. Bed - General	1. General channel bed aggradation areas (bar formation)	All	NA	None	100	
	2. Channel bed degradation – areas of increasing down-cutting or head cutting?	All	NA	None	100	100

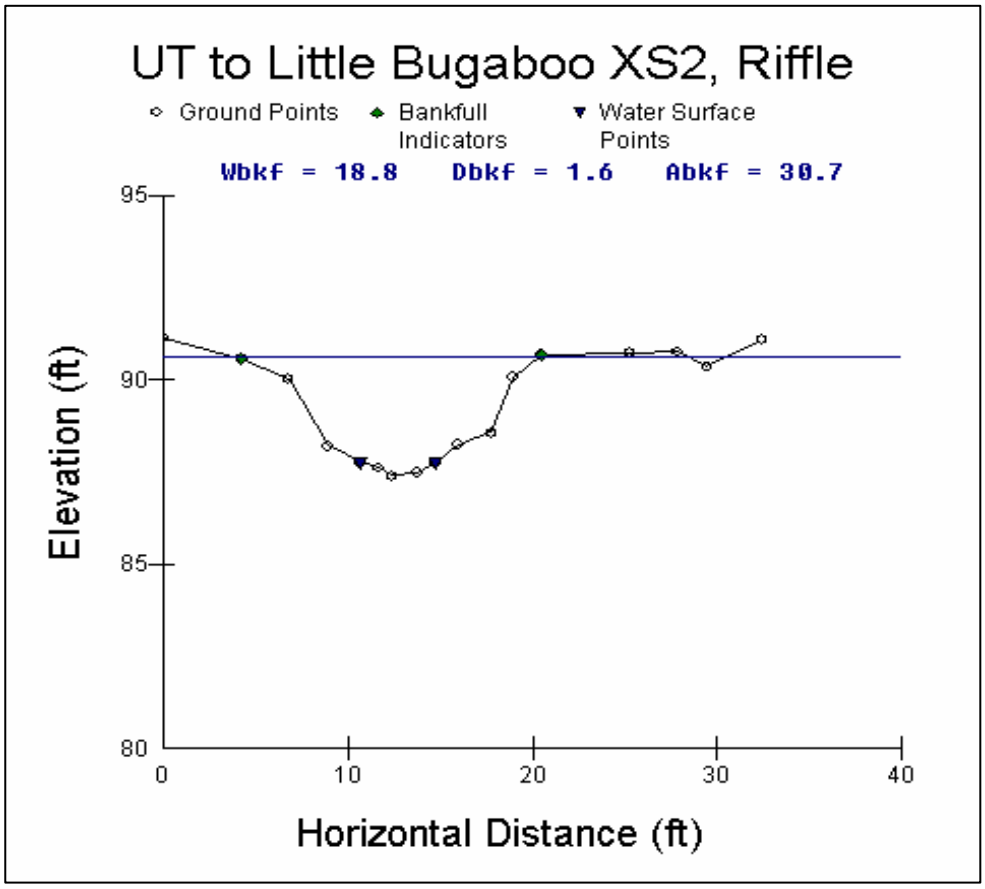
Table B1a. Qualitative Visual Stability Assessment						
Project Number: 56						
Segment/Reach: Little Bugaboo Creek						
F. Channel Capac./Dimen.	1. Channel width: depth appears out of design/type spec?	All	NA	None	100	100
G. Banks	1. Apparent scour points from channel processes	16	NA	410	NA	16
	2. Apparent cut points from overland flow	All	NA	None	100	
	3. Apparent cut or scour from flood water re-entry to channel (e.g. inadequate floodplain access?)	All	NA	None	100	NA
	4. Tension cracks	All	NA	None	100	NA
	5. Unstable cantilever blocks (e.g. height/undercut/soil type versus vegetation penetration and extent)	All	NA	None	100	NA
	6. Bank gradient in excess of 40%?	All	NA	None	100	NA
	7. Collapse/slumping	8	NA	205	NA	8
	8. Ratio of bank height: bankfull height elevated	All	NA	None	100	NA
H. Vanes	1. Free of back or arm scour?	25	30	4/40	83	25
	2. Height appropriate?	All	NA	None	100	NA
	3. Angle and geometry appear appropriate?	All	NA	None	100	NA
	4. Free of piping or other structural failures?	All	NA	None	100	NA
I. Wads/ Boulders	1. Free of scour?	48	172	None	28	48
	2. Footing stable?	All	NA	None	100	NA
NA = Historical project documents necessary to provide this data were unavailable at the time of this table preparation.						

Table B1b. Qualitative Visual Stability Assessment						
Project Number: 56						
Segment/Reach: UT to Little Bugaboo Creek						
Feature Category	Metric (per as-built and reference baselines)	(# Stable) Number performing as intended	Total number per as-built	Total number / feet in unstable state	% Perform in stable condition	Feature Perform. Mean or Total
A. Riffles	1. Present?	12	12	0	100	
	2. Armor stable (e.g. no displacement)?	12	12	0	100	
	3. Facet grade appears stable?	12	12	0	100	
	4. Stable interval grade?	12	12	0	100	
	5. Feature spacing appropriate?	12	12	0	100	
	embedding/fining?	12	12	0	100	
	7. Depth appears appropriate for current discharge?	12	12	0	100	
	8. Length appropriate?	12	12	0	100	
						100
B. Pools	1. Present? (e.g not subject to severe aggradation?) 4	30	30	0	100	
	2. Sufficiently deep (Max Pool D:Mean Bkf >1.6?)	30	30	0	100	
	3. Thalweg located outer bend?	30	30	0	100	
	4. Spacing appropriate?	30	30	0	100	
	5. Non-aggrading (not filling)?	30	30	0	100	
	6. Length appropriate?	30	30	0	100	100
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	30	30	0	100	
	2. Downstream of meander (glide/inflection) centering?	30	30	0	100	100
D. Meanders	1. Outer bend in state of limited/controlled erosion?	30	30	0	100	
	2. Of those eroding, # w/concomitant point bar formation?	0	NA	0	NA	NA
	3. Apparent Rc within spec?	NA	NA	NA	NA	NA
	4. Sufficient floodplain access and relief?	All	NA	None	100	NA
E. Bed - General	1. General channel bed aggradation areas (bar formation)	All	NA	None	100	
	2. Channel bed degradation – areas of increasing down-cutting or head cutting?	All	NA	None	100	100
F. Channel Capac./Dimen.	1. Channel width: depth appears out of design/type spec?	All	NA	None	100	100

Table B1b. Qualitative Visual Stability Assessment						
Project Number: 56						
Segment/Reach: UT to Little Bugaboo Creek						
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
G. Banks	1. Apparent scour points from channel processes	18	NA	335	NA	18
	2. Apparent cut points from overland flow	All	NA	None	100	
	3. Apparent cut or scour from flood water re-entry to channel (e.g. inadequate floodplain access?)	All	NA	None	100	NA
	4. Tension cracks	All	NA	None	100	NA
	5. Unstable cantilever blocks (e.g. height/undercut/soil type versus vegetation penetration and extent)	All	NA	None	100	NA
	6. Bank gradient in excess of 40%?	All	NA	None	100	NA
	7. Collapse/slumping	5	NA	107	NA	5
	8. Ratio of bank height: bankfull height elevated	All	NA	None	100	NA
H. Vanes	1. Free of back or arm scour?	4	16	4/40	25	4
	2. Height appropriate?	All	NA	None	100	NA
	3. Angle and geometry appear appropriate?	All	NA	None	100	NA
	4. Free of piping or other structural failures?	All	NA	None	100	NA
I. Wads/ Boulders	1. Free of scour?	28	29	None	97	28
	2. Footing stable?	All	NA	None	100	NA
NA = Historical project documents necessary to provide this data were unavailable at the time of this table preparation.						

Appendix B.5


UT to Little Bugaboo XS1, Pool
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 23.5 Dbkf = 1.6 Abkf = 38.3
Elevation (ft)
95
90
85
80
0
10
20
30
40
50
60
Horizontal Distance (ft)


UT to Little Bugaboo XS2, Riffle
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 18.8 Dbkf = 1.6 Abkf = 30.7
Elevation (ft)
95
90
85
80
0
10
20
30
40
Horizontal Distance (ft)

River Name: Yadkin
Reach Name: UT to Little Bugaboo
Cross Section Name: XS1, Pool
Survey Date: 02/15/06

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	94.6963406	LB
5.76	0	93.7127905	
13.09	0	91.9693142	
18.14	0	91.6481056	BKF
20.42	0	90.955454	
21.12	0	89.4462642	LEW
21.71	0	88.2991459	
22.69	0	88.0888246	TW1.4
25.06	0	88.7129469	
27.38	0	89.2544997	
29.01	0	89.5153977	REW
31.59	0	90.1048773	
38.9	0	92.08358	BKF
48.09	0	92.2311918	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	95.65	95.65	95.65
Bankfull Elevation (ft)	91.87	91.87	91.87
Floodprone Width (ft)	52	-----	-----
Bankfull Width (ft)	23.46	11.73	11.73
Entrenchment Ratio	2.22	-----	-----
Mean Depth (ft)	1.63	1.74	1.52
Maximum Depth (ft)	3.78	3.78	2.85
Width/Depth Ratio	14.38	6.74	7.71
Bankfull Area (sq ft)	38.26	20.41	17.85
Wetted Perimeter (ft)	25.72	16.49	14.93
Hydraulic Radius (ft)	1.49	1.24	1.2
Begin BKF Station	14.65	14.65	26.38
End BKF Station	38.11	26.38	38.11

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope			
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

River Name: Yadkin
Reach Name: UT to Little Bugaboo
Cross Section Name: XS2, Riffle
Survey Date: 02/15/06

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	91.1111817	LB
4.26	0	90.54876	BKF
6.8	0	90.0007867	
8.94	0	88.2023451	
10.69	0	87.7403323	LEW
11.65	0	87.6013233	
12.41	0	87.3844957	TW.4
13.77	0	87.4868834	
14.73	0	87.744367	REW
16	0	88.2439841	
17.79	0	88.5579516	
18.97	0	90.0633847	
20.51	0	90.6861274	BKF
25.29	0	90.7266117	
29.46	0	90.3420739	
32.43	0	91.0918254	RB

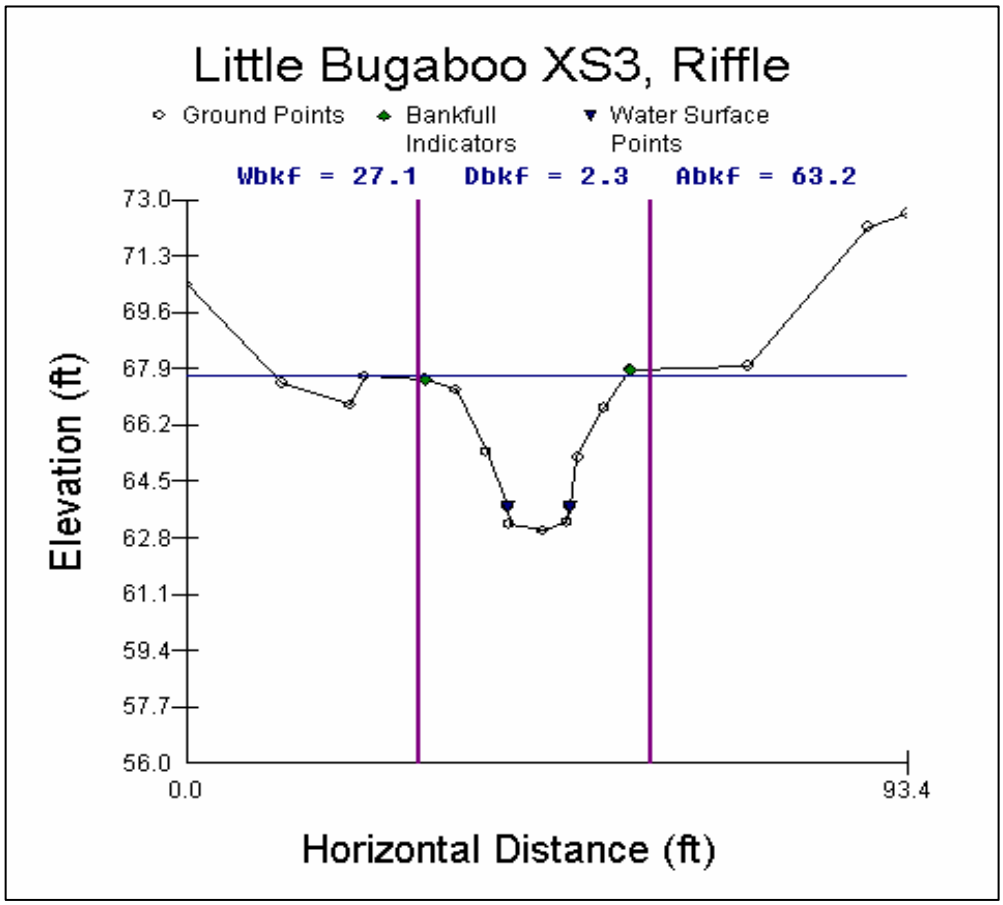
Cross Sectional Geometry

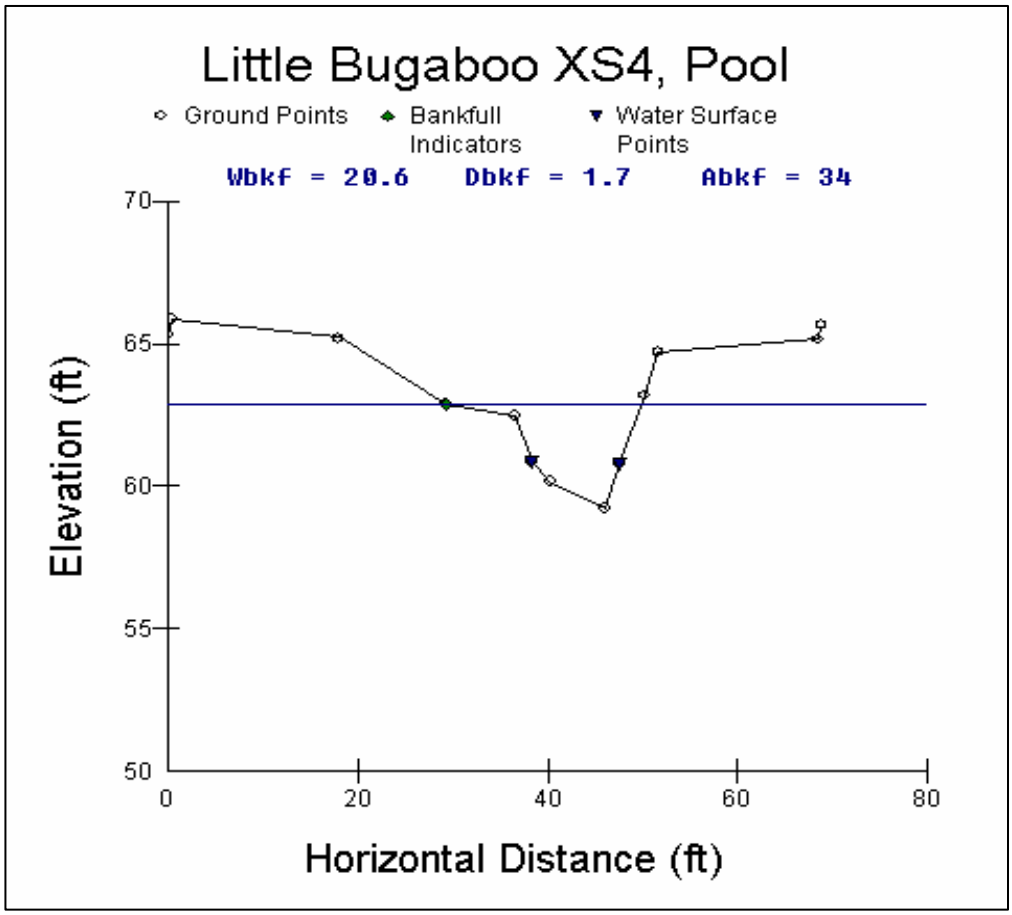
	Channel	Left	Right
Floodprone Elevation (ft)	93.86	93.86	93.86
Bankfull Elevation (ft)	90.62	90.62	90.62
Floodprone Width (ft)	32.43	-----	-----
Bankfull Width (ft)	18.81	9.41	17.43
Entrenchment Ratio	1.72	-----	-----
Mean Depth (ft)	1.63	1.73	1.54
Maximum Depth (ft)	3.24	3.24	3.18
Width/Depth Ratio	11.51	5.43	6.12
Bankfull Area (sq ft)	30.74	16.3	14.44
Wetted Perimeter (ft)	20.7	13.41	13.65
Hydraulic Radius (ft)	1.48	1.22	1.06
Begin BKF Station	3.72	3.72	13.13
End BKF Station	30.56	13.13	30.56

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope			
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


Little Bugaboo XS3, Riffle
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 27.1
Dbkf = 2.3
Abkf = 63.2
73.0
71.3
69.6
67.9
66.2
64.5
62.8
61.1
59.4
57.7
56.0
Elevation (ft)
0.0
93.4
Horizontal Distance (ft)


Little Bugaboo XS4, Pool
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 20.6
Dbkf = 1.7
Abkf = 34
70
65
60
55
50
Elevation (ft)
0
20
40
60
80
Horizontal Distance (ft)

River Name: Yadkin
Reach Name: Little Bugaboo Creek
Cross Section Name: XS3, Riffle
Survey Date: 02/22/06

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	70.4312774	RB
12.39	0	67.4654023	
21.25	0	66.8011098	
23.1	0	67.6636585	
30.9	0	67.555481	BKF
34.82	0	67.2535995	
41.63	0	63.7038055	REW
41.77	0	63.1918679	
46.1	0	63.0061499	TW.8
49.25	0	63.2399769	
49.7	0	63.7087944	LEW
50.63	0	65.1960047	
54.09	0	66.7285157	
57.55	0	67.8660316	BKF
72.69	0	67.9770072	
88.23	0	72.1729918	LPIN
93.45	0	72.5827671	LB

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	72.41	72.41	72.41
Bankfull Elevation (ft)	67.71	67.71	67.71
Floodprone Width (ft)	91.3	-----	-----
Bankfull Width (ft)	27.08	4.22	22.86
Entrenchment Ratio	3.37	-----	-----
Mean Depth (ft)	2.33	0.25	2.72
Maximum Depth (ft)	4.7	0.41	4.7
Width/Depth Ratio	11.6	16.63	8.41
Bankfull Area (sq ft)	63.17	1.07	62.1
Wetted Perimeter (ft)	30.02	4.78	26.06
Hydraulic Radius (ft)	2.1	0.22	2.38
Begin BKF Station	30	30	34.22
End BKF Station	57.08	34.22	57.08

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope			
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

River Name: Yadkin
Reach Name: Little Bugaboo Creek
Cross Section Name: XS4, Pool
Survey Date: 02/22/06

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	65.3180266	RB
0.56	0	65.8377423	RPIN
18.01	0	65.1989124	
29.36	0	62.8959492	BKF
36.55	0	62.4577395	
38.28	0	60.8661932	REW
0 40.24	0	60.1506255	
46.06	0	59.2013098	TW1.7
47.56	0	60.7996061	LEW
50.25	0	63.1759825	
51.67	0	64.7067626	
68.57	0	65.1339066	LB
68.81	0	65.661978	LPIN

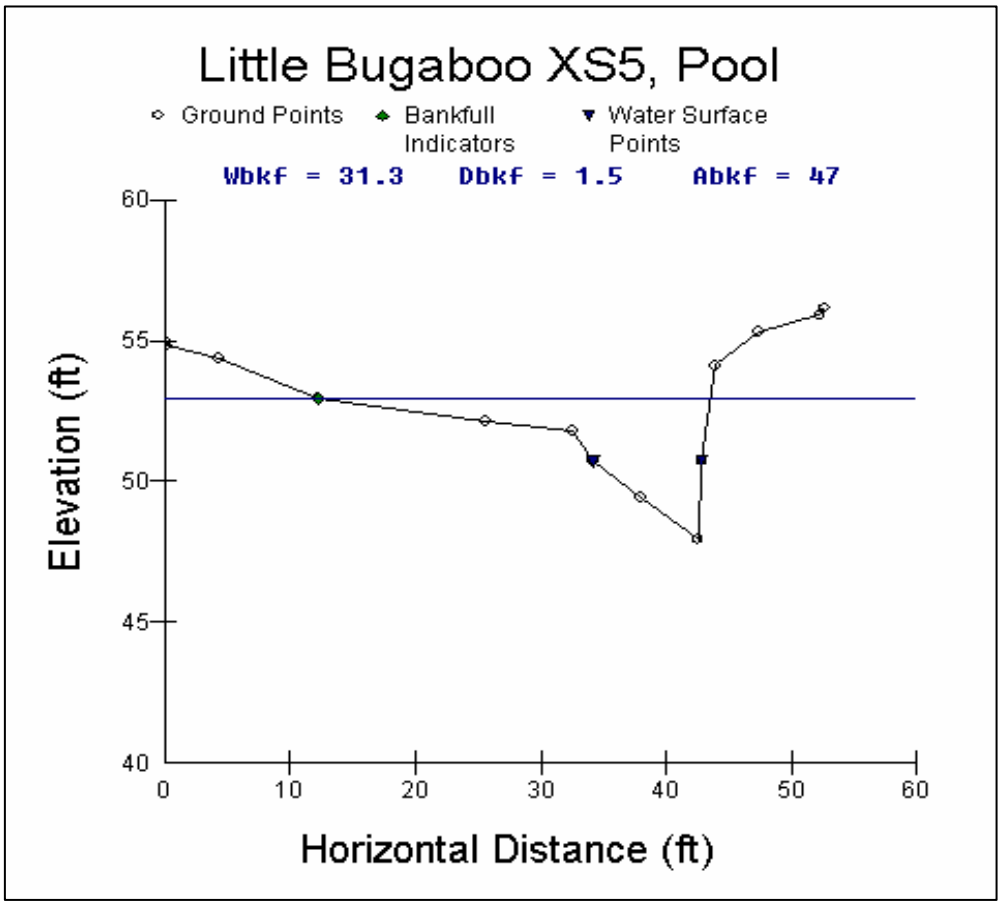
Cross Sectional Geometry

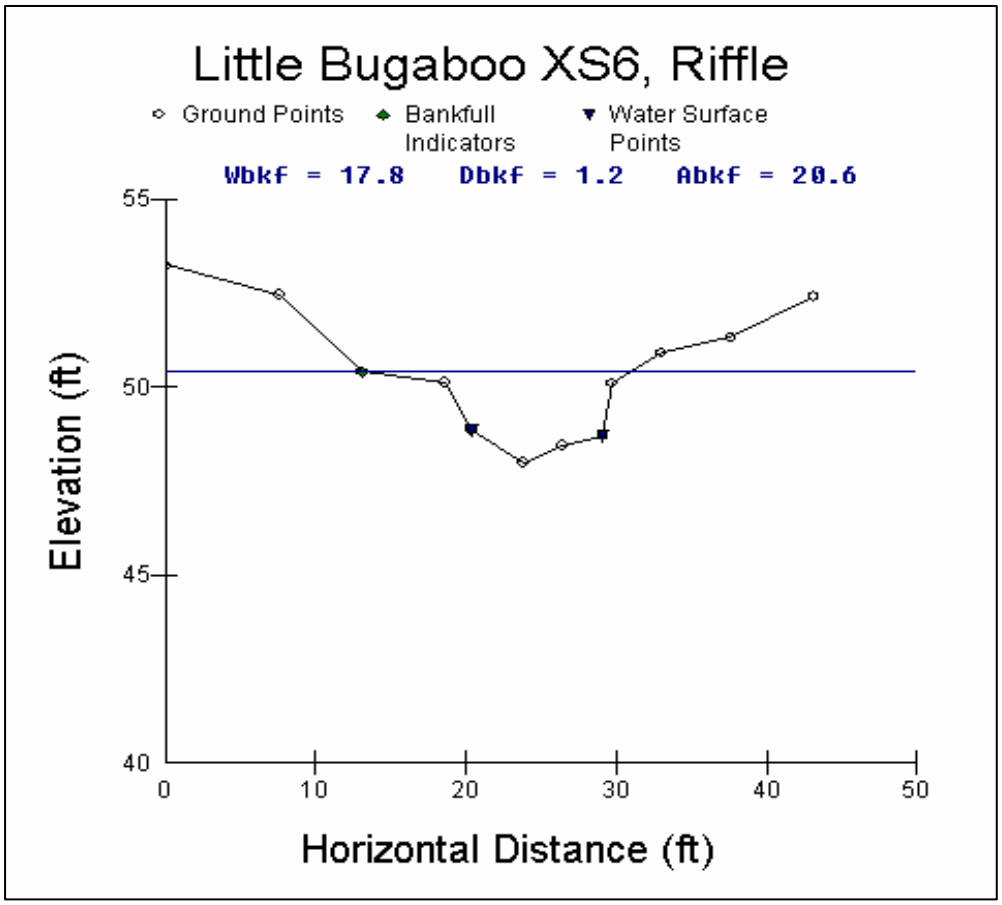
	Channel	Left	Right
Floodprone Elevation (ft)	66.6	66.6	66.6
Bankfull Elevation (ft)	62.9	62.9	62.9
Floodprone Width (ft)	68.81	-----	-----
Bankfull Width (ft)	20.6	8.53	12.07
Entrenchment Ratio	3.34	-----	-----
Mean Depth (ft)	1.65	0.35	2.57
Maximum Depth (ft)	3.7	1.66	3.7
Width/Depth Ratio	12.46	24.34	4.69
Bankfull Area (sq ft)	34.04	2.99	31.05
Wetted Perimeter (ft)	22.92	10.67	15.56
Hydraulic Radius (ft)	1.49	0.28	2
Begin BKF Station	29.34	29.34	37.87
End BKF Station	49.94	37.87	49.94

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope			
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


Little Bugaboo XS5, Pool
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 31.3
Dbkf = 1.5
Abkf = 47
Elevation (ft)
60
55
50
45
40
0
10
20
30
40
50
60
Horizontal Distance (ft)


Little Bugaboo XS6, Riffle
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 17.8
Dbkf = 1.2
Abkf = 20.6
Elevation (ft)
55
50
45
40
0
10
20
30
40
50
Horizontal Distance (ft)

River Name: Yadkin
Reach Name: Little Bugaboo Creek
Cross Section Name: XS5, Pool
Survey Date: 02/22/06

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	55.0055041	RPIN
0.27	0	54.8004174	
4.37	0	54.3603588	
12.26	0	52.932718	BKF
25.66	0	52.1290246	
32.61	0	51.7627549	
34.25	0	50.6840685	REW
38.05	0	49.4251686	
42.55	0	47.9150432	TW2.8
42.87	0	50.7289073	LEW
43.97	0	54.1146377	
47.47	0	55.3211592	
52.27	0	55.8928577	LB
52.75	0	56.1544137	LPIN

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	57.94	57.94	57.94
Bankfull Elevation (ft)	52.93	52.93	52.93
Floodprone Width (ft)	52.75	-----	-----
Bankfull Width (ft)	31.28	15.64	15.64
Entrenchment Ratio	1.69	-----	-----
Mean Depth (ft)	1.5	0.47	2.54
Maximum Depth (ft)	5.01	0.92	5.01
Width/Depth Ratio	20.81	33.43	6.16
Bankfull Area (sq ft)	47.02	7.32	39.7
Wetted Perimeter (ft)	36.2	16.59	21.45
Hydraulic Radius (ft)	1.3	0.44	1.85
Begin BKF Station	12.31	12.31	27.95
End BKF Station	43.59	27.95	43.59

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope			
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

River Name: Yadkin
Reach Name: Little Bugaboo Creek
Cross Section Name: XS6, Riffle
Survey Date: 02/22/06

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	53.2314118	RPIN
7.56	0	52.4535274	
13.08	0	50.3924305	BKF
18.59	0	50.0997513	
20.38	0	48.8561937	REW
23.82	0	47.975908	TW.8
26.4	0	48.4422401	
29.12	0	48.6990805	LEW
29.76	0	50.0925932	
33.04	0	50.8954932	
37.64	0	51.3091594	
43.14	0	52.394815	LPIN

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	52.8	52.8	52.8
Bankfull Elevation (ft)	50.39	50.39	50.39
Floodprone Width (ft)	38.99	-----	-----
Bankfull Width (ft)	17.85	9.22	8.62
Entrenchment Ratio	2.18	-----	-----
Mean Depth (ft)	1.15	0.64	1.7
Maximum Depth (ft)	2.41	2.04	2.41
Width/Depth Ratio	15.46	14.32	5.07
Bankfull Area (sq ft)	20.61	5.94	14.66
Wetted Perimeter (ft)	19.34	11.72	11.69
Hydraulic Radius (ft)	1.07	0.51	1.25
Begin BKF Station	13.13	13.13	22.35
End BKF Station	30.97	22.35	30.97

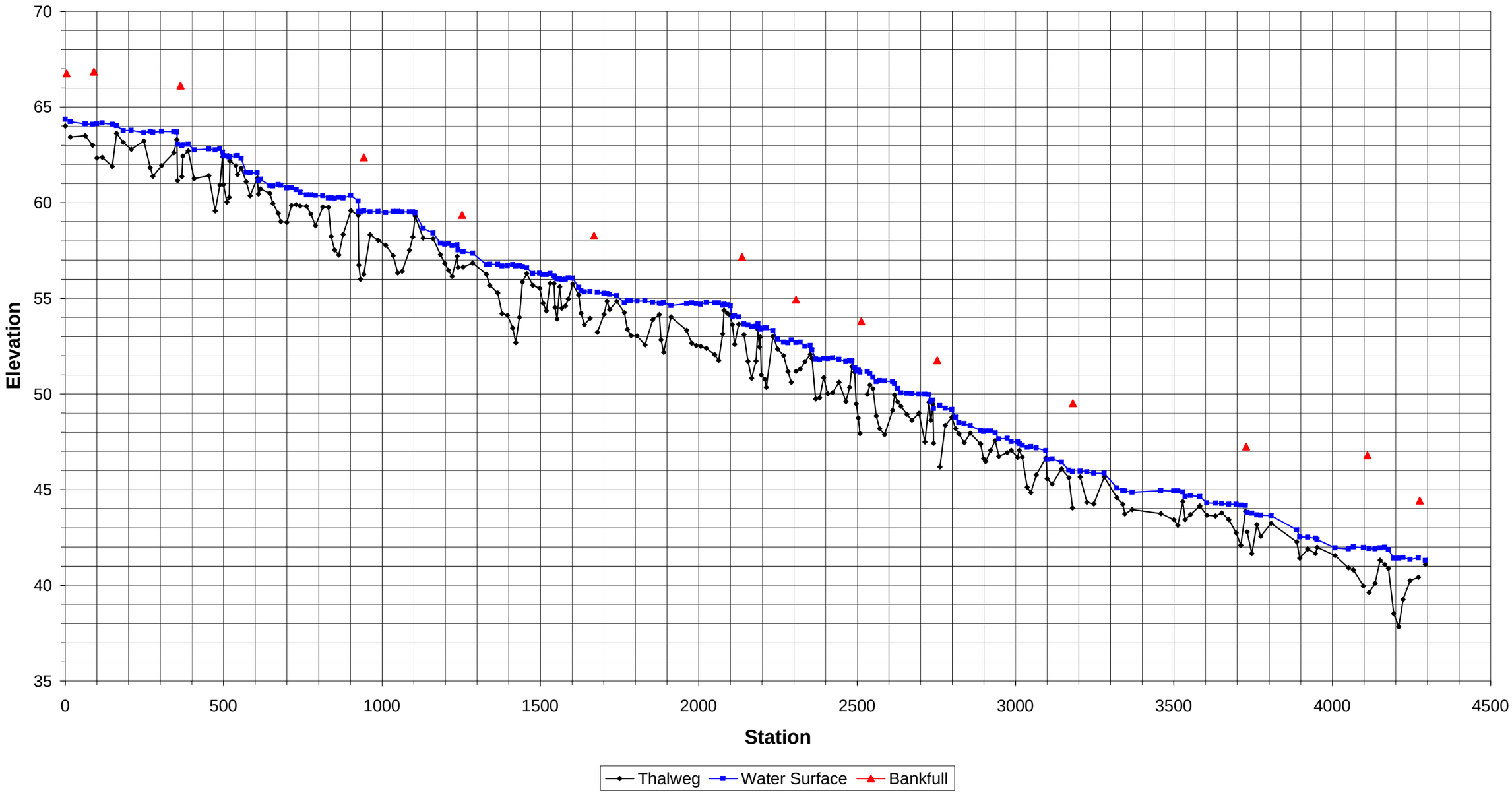
Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope			
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

Appendix B.6

Little Bugaboo Creek Long Profile



River Basin: Yadkin			
Reach Name: Little Bugaboo Creek			
Profile Name: Little Bugaboo Creek			
Survey Date: 02/15/06			

Survey Data			
STA	**Thalweg**	**Water Surface**	**Bankfull**
0	64.005	64.355	
4.159			66.759
16.078	63.427	64.227	
63.103	63.504	64.104	
85.888	62.998	64.098	
90.142			66.851
99.935	62.331	64.131	
116.318	62.37	64.17	
147.875	61.897	64.097	
162.17	63.63	64.03	
183.305	63.162	63.762	
207.95	62.783	63.783	
248.184	63.217	63.667	
268.45	61.829	63.729	
276.483	61.375	63.675	
303.88	61.932	63.732	
343.426	62.61	63.71	
352.285	63.298	63.698	
354.498	61.147	63.047	
364.479			66.117
367.898	61.362	62.962	
371.784	62.431	63.031	
388.528	62.696	63.046	
406.778	61.251	62.751	
453.814	61.406	62.806	
473.633	59.559	62.759	
488.25	60.921	62.821	
496.271	62.401	62.63	
499.542	60.944	62.444	
510.669	60.034	62.434	
517.389	60.287	62.387	
519.485	62.175	62.4	
539.066	61.939	62.439	
544.147	61.457	62.457	
555.212	61.816	62.316	
571.276	61.09	61.59	
583.535	60.366	61.566	
605.801	61.274	61.574	
610.202	60.456	61.156	
616.619	60.712	61.212	
646.062	60.494	60.894	
655.134	59.967	60.867	
672.582	59.448	60.948	
680.13	58.999	60.899	

River Basin: Yadkin			
Reach Name: Little Bugaboo Creek			
Profile Name: Little Bugaboo Creek			
Survey Date: 02/15/06			

Survey Data			
STA	**Thalweg**	**Water Surface**	**Bankfull**
699.857	58.973	60.773	
713.868	59.861	60.79	
729.335	59.888	60.688	
741.745	59.834	60.534	
761.234	59.805	60.405	
775.286	59.409	60.409	
790.316	58.791	60.391	
812.915	59.782	60.36	
831.34	59.748	60.248	
839.83	58.245	60.245	
850.41	57.518	60.218	
863.202	57.271	60.271	
877.738	58.345	60.245	
901.695	59.578	60.378	
924.137	59.335	60.085	
926.969	56.738	59.538	
931.82	55.997	59.497	
942.797			62.364
942.797	56.26	59.56	
962.521	58.32	59.52	
987.658	58.036	59.536	
1011.693	57.773	59.473	
1035.098	57.236	59.536	
1049.889	56.332	59.532	
1063.229	56.417	59.517	
1086.157	57.513	59.513	
1097.01	58.207	59.507	
1104.846	59.303	59.453	
1129.504	58.158	58.658	
1161.605	58.111	58.411	
1183.995	57.275	57.875	
1197.801	56.824	57.824	
1210.051	56.459	57.859	
1221.519	56.155	57.755	
1237.132	57.189	57.789	
1239.957	56.622	57.522	
1252.672			59.354
1255.583	56.631	57.431	
1285.945	56.851	57.351	
1329.458	56.258	56.758	
1339.785	55.683	56.783	
1365.322	55.284	56.784	
1378.819	54.197	56.697	
1395.586	54.106	56.706	
1412.354	53.451	56.751	

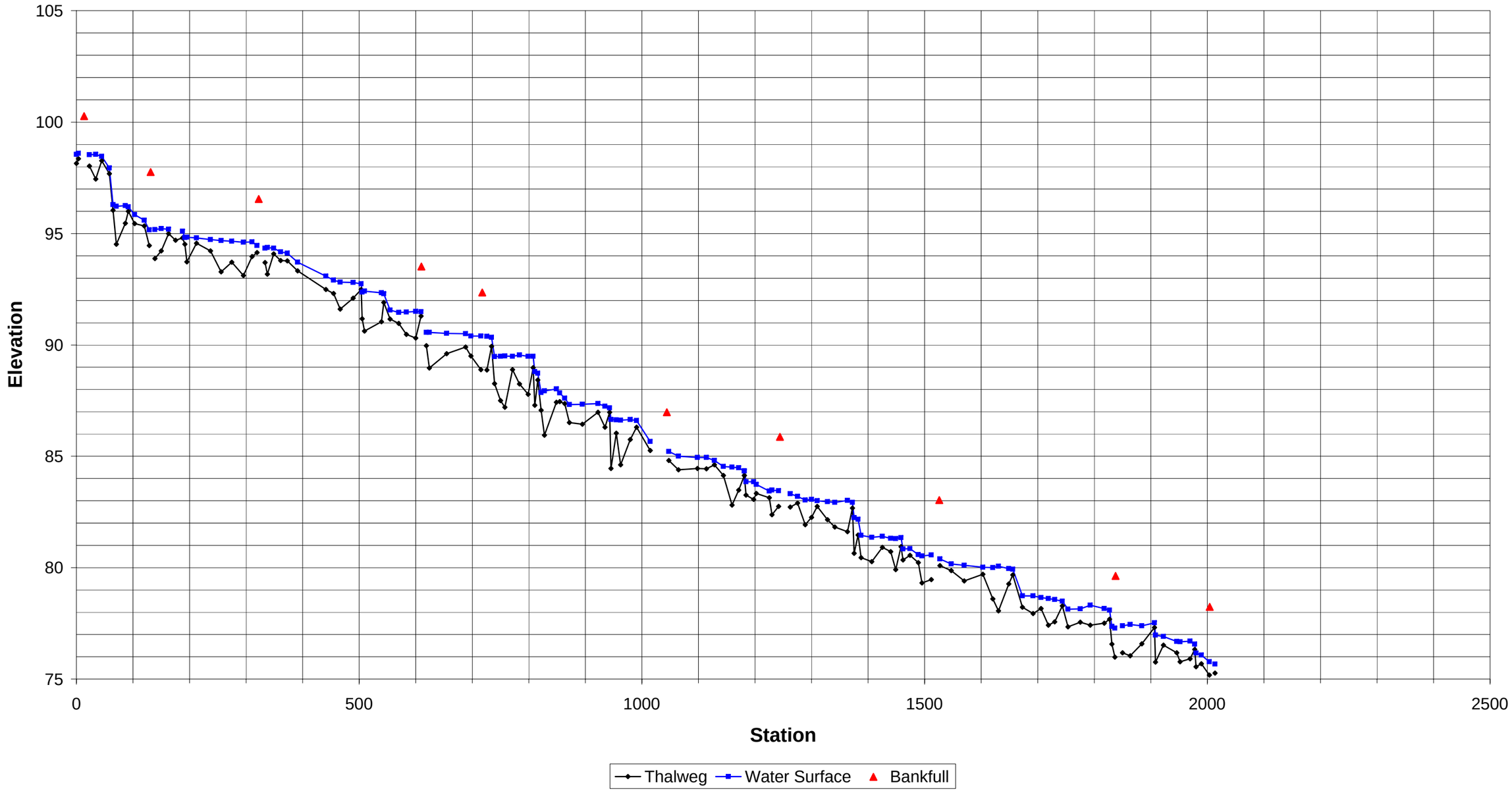
River Basin: Yadkin			
Reach Name: Little Bugaboo Creek			
Profile Name: Little Bugaboo Creek			
Survey Date: 02/15/06			

Survey Data			
STA	**Thalweg**	**Water Surface**	**Bankfull**
1422.24	52.683	56.683	
1433.757	54.001	56.701	
1443.049	55.855	56.655	
1456.791	56.285	56.585	
1476.071	55.688	56.288	
1497.859	55.514	56.314	
1508.003	54.735	56.235	
1518.674	54.344	56.244	
1530.401	55.791	56.291	
1543.614	55.768	56.168	
1546.139	54.513	56.113	
1552.573	53.917	56.017	
1561.261	55.615	56.015	
1567.117	54.48	55.98	
1578.691	54.601	56.001	
1588.819	54.971	56.071	
1602.173	55.742	56.042	
1620.766	55.177	55.577	
1628.355	54.208	55.408	
1639.227	53.63	55.33	
1656.465	53.954	55.354	
1669.736			58.282
1680.074	53.215	55.315	
1700.795	54.164	55.264	
1710.501	54.84	55.24	
1719.038	54.415	55.215	
1741.287	54.843	55.143	
1765.003	54.251	54.751	
1774.931	53.375	54.875	
1785.767	53.054	54.854	
1804.982	53.036	54.836	
1829.879	52.553	54.853	
1854.363	53.887	54.787	
1875.099	54.144	54.744	
1880.637	52.824	54.724	
1889.425	52.18	54.78	
1912.681	54.024	54.624	
1962.181	53.326	54.726	
1977.69	52.648	54.748	
1992.395	52.526	54.726	
2006.477	52.492	54.692	
2023.626	52.384	54.784	
2049.764	52.059	54.759	
2063.229	51.755	54.755	
2075.686	53.14	54.64	

River Basin: Yadkin			
Reach Name: Little Bugaboo Creek			
Profile Name: Little Bugaboo Creek			
Survey Date: 02/15/06			

Survey Data			
STA	**Thalweg**	**Water Surface**	**Bankfull**
2079.45	54.373	54.69	
2089.917	54.21	54.66	
2099.426	54.101	54.601	
2105.753	53.63	54.03	
2113.052	52.596	54.096	
2125.61	53.633	54.033	
2136.28			57.168
2142.458	53.109	53.659	
2155.751	51.711	53.611	
2167.336	50.821	53.521	
2180.35	51.732	53.532	
2186.696	53.367	53.667	
2191.612	52.453	53.453	
2194.129	52.973	53.373	
2197.627	50.991	53.391	
2209.396	50.761	53.461	
2213.653	50.343	53.443	
2233.827	53.017	53.317	
2249.223	52.353	52.853	
2267.859	52.006	52.706	
2281.54	51.172	52.672	
2292.036	50.615	52.815	
2306.949			54.935
2306.949	51.184	52.684	
2320.639	51.301	52.701	
2334.854	51.698	52.498	
2352.151	52.073	52.523	
2356.862	51.856	52.306	
2368.865	49.733	51.833	
2381.231	49.799	51.799	
2394.335	50.856	51.856	
2407.113	50.019	51.84	

UT to Little Bugaboo Long Profile



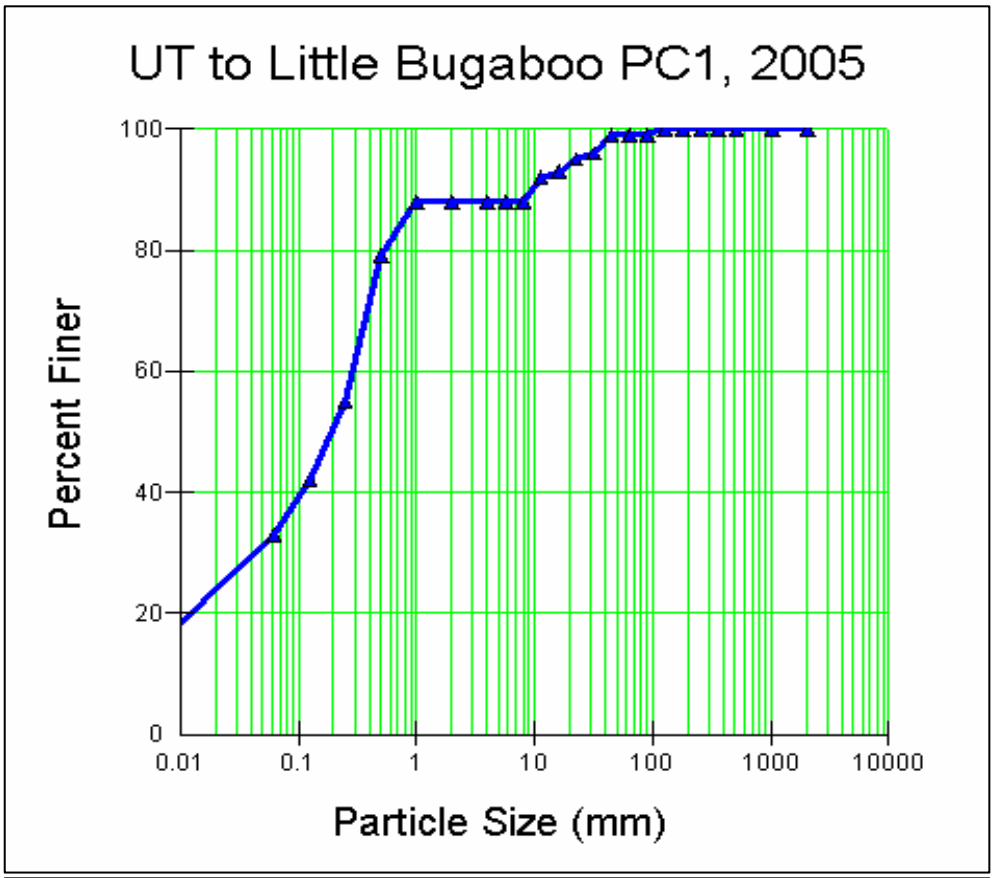
River Basin: Yadkin			
Reach Name: UT to Little Bugaboo Creek			
Profile Name: UT to Little Bugaboo Creek			
Survey Date: 02/15/06			

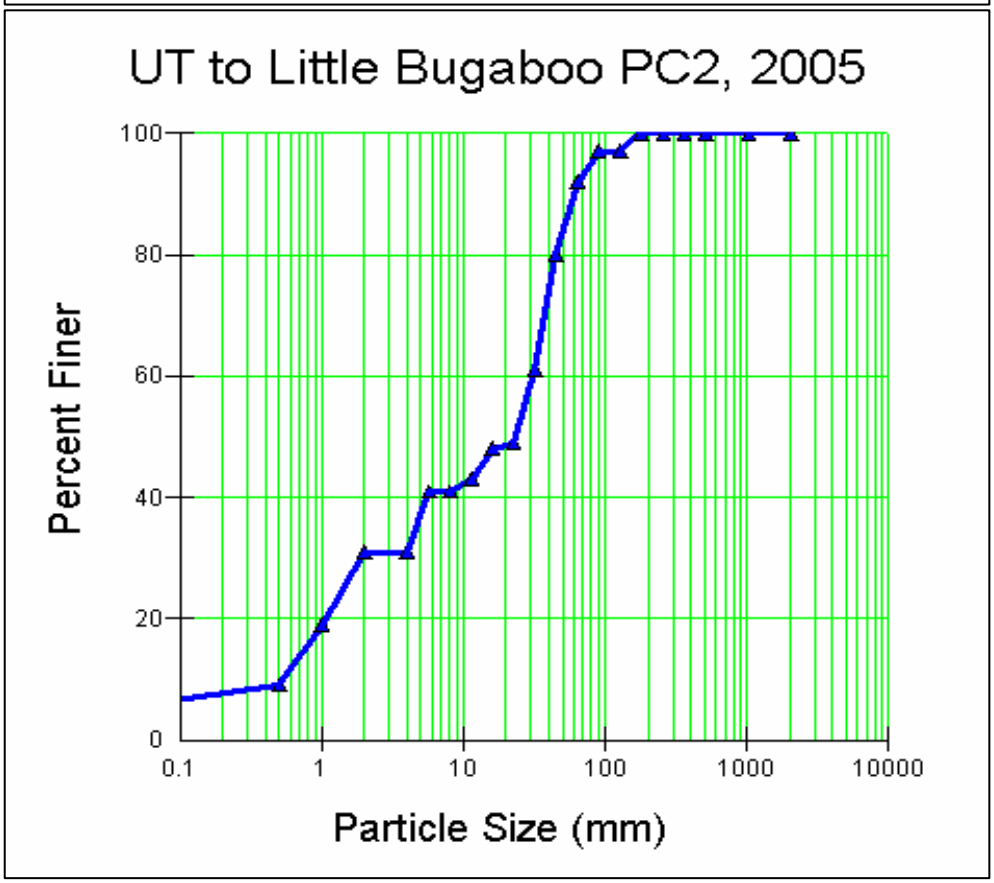
Survey Data			
STA	Thalweg	Water Surface	Bankfull
0	98.153	98.553	
3.483	98.35	98.6	
13.605			100.268
23.007	98.033	98.533	
34.157	97.448	98.548	
44.658	98.264	98.464	
58.461	97.688	97.938	
64.835	96.047	96.297	
70.722	94.521	96.221	
86.445	95.452	96.252	
91.619	95.99	96.19	
102.7	95.448	95.848	
119.901	95.339	95.589	
128.77	94.462	95.162	
131.454			97.751
138.715	93.872	95.172	
150.245	94.212	95.212	
162.968	94.993	95.193	
175.185	94.689		
187.374	94.806	95.106	
191.987	94.517	94.817	
195.459	93.73	94.83	
212.276	94.556	94.806	
237.295	94.223	94.723	
255.693	93.274	94.674	
274.657	93.706	94.656	
295.306	93.113	94.613	
310.343	93.971	94.621	
319.197	94.15	94.45	
322.188			96.552
333.417	93.69	94.34	
337.902	93.167	94.367	
348.687	94.087	94.337	
361.029	93.779	94.179	
373.185	93.768	94.118	
391.004	93.316	93.716	
441.155	92.486	93.086	
454.456	92.3	92.9	
466.282	91.612	92.812	
489.474	92.103	92.803	
503.249	92.492	92.742	
505.288	91.174	92.374	
509.418	90.619	92.419	

River Basin: Yadkin			
Reach Name: UT to Little Bugaboo Creek			
Profile Name: UT to Little Bugaboo Creek			
Survey Date: 02/15/06			

Survey Data			
STA	Thalweg	Water Surface	Bankfull
539.44	91.032	92.332	
543.55	91.899	92.299	
554.716	91.164	91.564	
569.767	90.956	91.456	
583.766	90.471	91.471	
600.094	90.307	91.507	
609.442	91.287	91.487	
609.752			93.523
618.685	89.964	90.564	
624.11	88.967	90.567	
654.81	89.61	90.51	
688.099	89.899	90.499	
697.768	89.493	90.393	
715.209	88.889	90.389	
717.355			92.356
725.762	88.876	90.376	
733.889	89.94	90.34	
739.704	88.266	89.466	
749.863	87.492	89.492	
757.674	87.203	89.503	
771.212	88.885	89.485	
783.454	88.248	89.548	
799.053	87.789	89.489	
807.602	88.981	89.481	
810.593	87.296	88.796	
816.067	88.428	88.728	
821.633	87.06	87.86	
827.823	85.939	87.939	
848.577	87.42	88.02	
854.868	87.448	87.848	
863.333	87.358	87.608	
871.988	86.517	87.317	
894.992	86.434	87.334	
922.403	86.97	87.37	
934.8	86.302	87.252	
942.853	86.971	87.171	
945.143	84.455	86.655	
954.593	86.031	86.631	
962.424	84.618	86.618	
979.606	85.75	86.65	
990.368	86.303	86.603	
1014.864	85.262	85.662	
1044.316			86.976

Appendix B.7


UT to Little Bugaboo PC1, 2005
Percent Finer
100
80
60
40
20
0
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)


UT to Little Bugaboo PC2, 2005
Percent Finer
100
80
60
40
20
0
0.1
1
10
100
1000
10000
Particle Size (mm)

River Name: Yadkin
Reach Name: UT to Little Bugaboo
Sample Name: PC1
Survey Date: 02/15/06

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	33	33.00	33.00
0.062 - 0.125	9	9.00	42.00
0.125 - 0.25	13	13.00	55.00
0.25 - 0.50	24	24.00	79.00
0.50 - 1.0	9	9.00	88.00
1.0 - 2.0	0	0.00	88.00
2.0 - 4.0	0	0.00	88.00
4.0 - 5.7	0	0.00	88.00
5.7 - 8.0	0	0.00	88.00
8.0 - 11.3	4	4.00	92.00
11.3 - 16.0	1	1.00	93.00
16.0 - 22.6	2	2.00	95.00
22.6 - 32.0	1	1.00	96.00
32 - 45	3	3.00	99.00
45 - 64	0	0.00	99.00
64 - 90	0	0.00	99.00
90 - 128	1	1.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
2048 -	0	0.00	100.00

D16 (mm)	0.03
D35 (mm)	0.08
D50 (mm)	0.2
D84 (mm)	0.78
D95 (mm)	22.6
D100 (mm)	128
Silt/Clay (%)	33
Sand (%)	55
Gravel (%)	11
Cobble (%)	1
Boulder (%)	0
Bedrock (%)	0

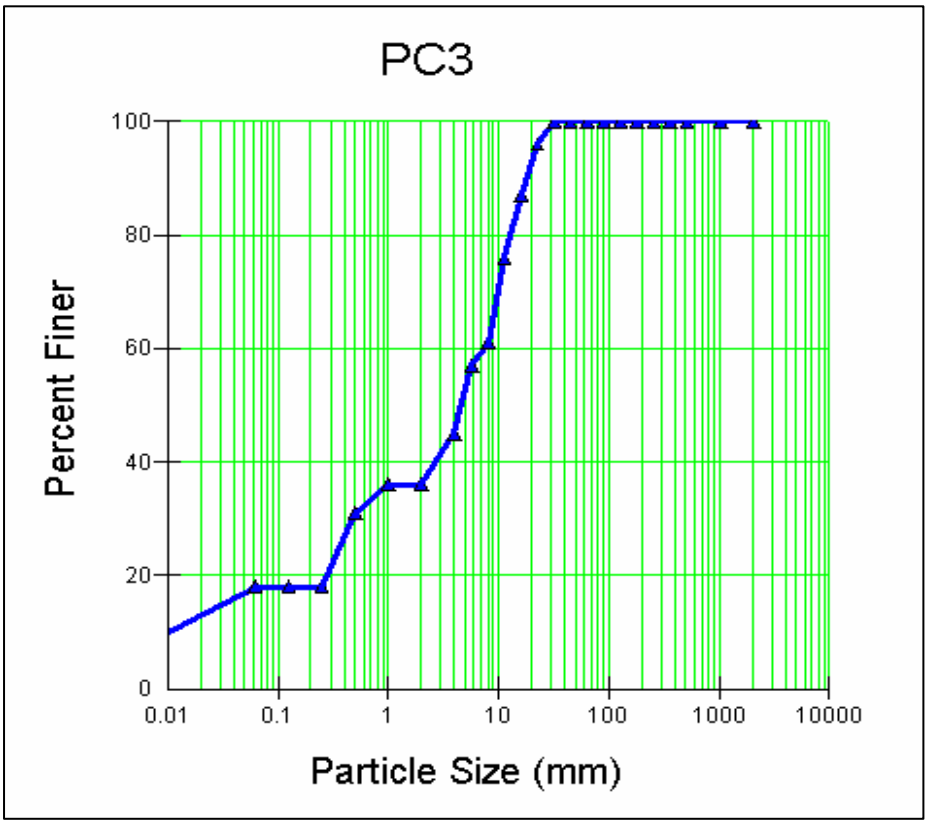
Total Particles = 100.

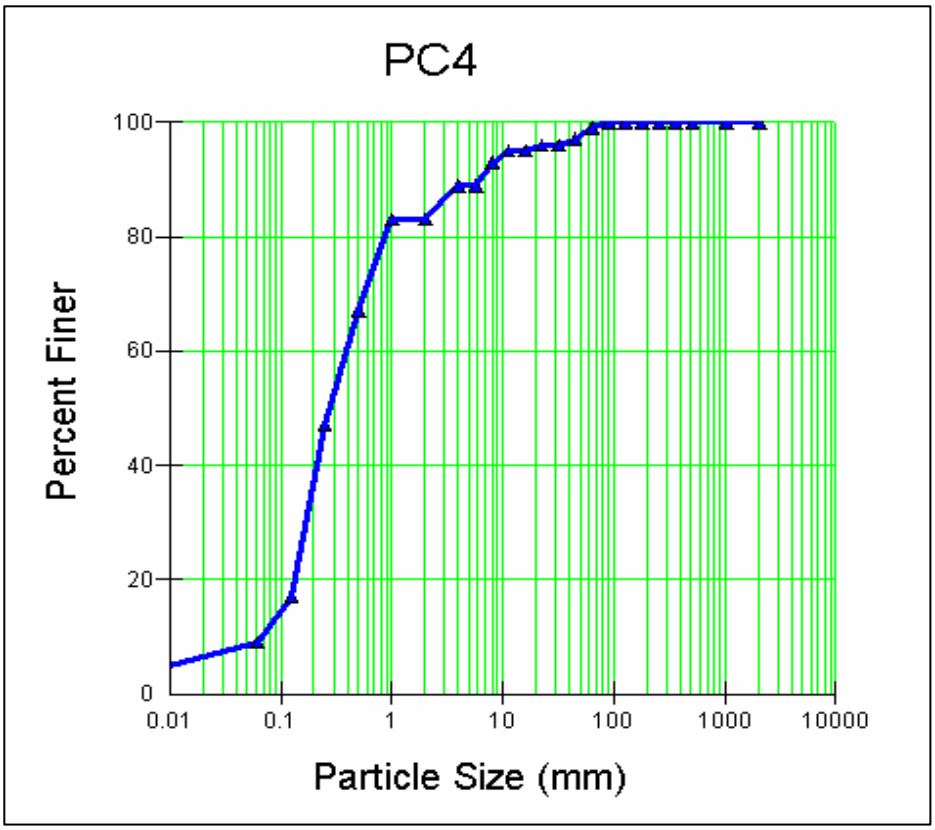
River Name: Yadkin
Reach Name: UT to Little Bugaboo
Sample Name: PC2
Survey Date: 02/15/06

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	0	0.00	0.00
0.125 - 0.25	0	0.00	0.00
0.25 - 0.50	9	9.00	9.00
0.50 - 1.0	10	10.00	19.00
1.0 - 2.0	12	12.00	31.00
2.0 - 4.0	0	0.00	31.00
4.0 - 5.7	10	10.00	41.00
5.7 - 8.0	0	0.00	41.00
8.0 - 11.3	2	2.00	43.00
11.3 - 16.0	5	5.00	48.00
16.0 - 22.6	1	1.00	49.00
22.6 - 32.0	12	12.00	61.00
32 - 45	19	19.00	80.00
45 - 64	12	12.00	92.00
64 - 90	5	5.00	97.00
90 - 128	0	0.00	97.00
128 - 180	3	3.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
2048 -	0	0.00	100.00

D16 (mm)	0.85
D35 (mm)	4.68
D50 (mm)	23.38
D84 (mm)	51.33
D95 (mm)	79.6
D100 (mm)	180
Silt/Clay (%)	0
Sand (%)	31
Gravel (%)	61
Cobble (%)	8
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.


PC3
Percent Finer
100
80
60
40
20
0
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)


PC4
Percent Finer
100
80
60
40
20
0
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)

River Name: Yadkin
Reach Name: Little Bugaboo Creek
Sample Name: PC3
Survey Date: 02/22/06

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	18	18.00	18.00
0.062 - 0.125	0	0.00	18.00
0.125 - 0.25	0	0.00	18.00
0.25 - 0.50	13	13.00	31.00
0.50 - 1.0	5	5.00	36.00
1.0 - 2.0	0	0.00	36.00
2.0 - 4.0	9	9.00	45.00
4.0 - 5.7	12	12.00	57.00
5.7 - 8.0	4	4.00	61.00
8.0 - 11.3	15	15.00	76.00
11.3 - 16.0	11	11.00	87.00
16.0 - 22.6	9	9.00	96.00
22.6 - 32.0	4	4.00	100.00
32 - 45	0	0.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
2048 -	0	0.00	100.00

D16 (mm)	0.06
D35 (mm)	0.9
D50 (mm)	4.71
D84 (mm)	14.72
D95 (mm)	21.87
D100 (mm)	32
Silt/Clay (%)	18
Sand (%)	18
Gravel (%)	64
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

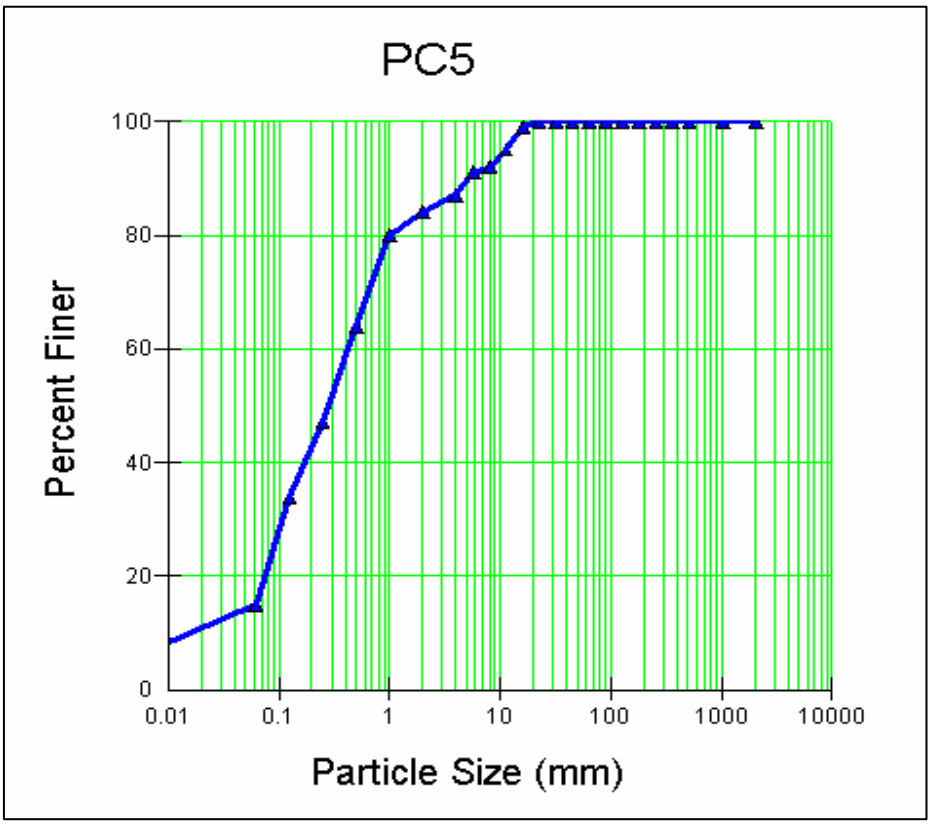
Total Particles = 100.

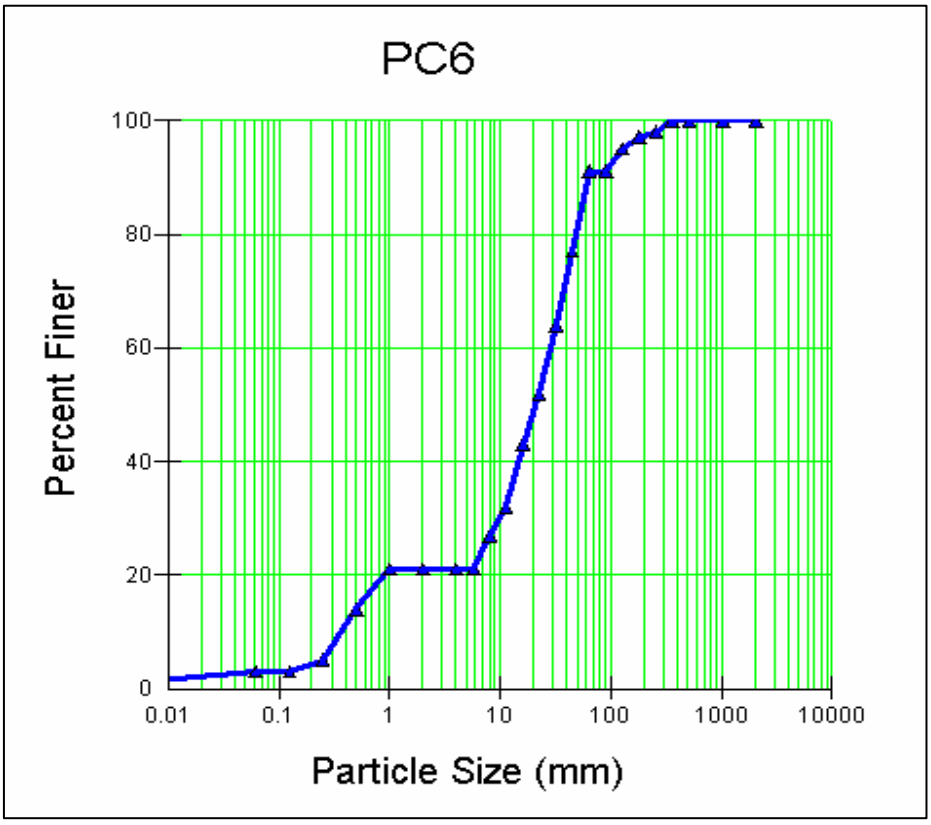
River Name: Yadkin
Reach Name: Little Bugaboo Creek
Sample Name: PC4
Survey Date: 02/22/06

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	9	9.00	9.00
0.062 - 0.125	8	8.00	17.00
0.125 - 0.25	30	30.00	47.00
0.25 - 0.50	20	20.00	67.00
0.50 - 1.0	16	16.00	83.00
1.0 - 2.0	0	0.00	83.00
2.0 - 4.0	6	6.00	89.00
4.0 - 5.7	0	0.00	89.00
5.7 - 8.0	4	4.00	93.00
8.0 - 11.3	2	2.00	95.00
11.3 - 16.0	0	0.00	95.00
16.0 - 22.6	1	1.00	96.00
22.6 - 32.0	0	0.00	96.00
32 - 45	1	1.00	97.00
45 - 64	2	2.00	99.00
64 - 90	1	1.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
2048 -	0	0.00	100.00

D16 (mm)	0.12
D35 (mm)	0.2
D50 (mm)	0.29
D84 (mm)	2.33
D95 (mm)	11.3
D100 (mm)	90
Silt/Clay (%)	9
Sand (%)	74
Gravel (%)	16
Cobble (%)	1
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.


PC5
Percent Finer
100
80
60
40
20
0
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)


PC6
Percent Finer
100
80
60
40
20
0
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)

River Name: Yadkin
Reach Name: Little Bugaboo Creek
Sample Name: PC5
Survey Date: 02/22/06

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	15	15.00	15.00
0.062 - 0.125	19	19.00	34.00
0.125 - 0.25	13	13.00	47.00
0.25 - 0.50	17	17.00	64.00
0.50 - 1.0	16	16.00	80.00
1.0 - 2.0	4	4.00	84.00
2.0 - 4.0	3	3.00	87.00
4.0 - 5.7	4	4.00	91.00
5.7 - 8.0	1	1.00	92.00
8.0 - 11.3	3	3.00	95.00
11.3 - 16.0	4	4.00	99.00
16.0 - 22.6	1	1.00	100.00
22.6 - 32.0	0	0.00	100.00
32 - 45	0	0.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
2048 -	0	0.00	100.00

D16 (mm)	0.07
D35 (mm)	0.13
D50 (mm)	0.29
D84 (mm)	2
D95 (mm)	11.3
D100 (mm)	22.6
Silt/Clay (%)	15
Sand (%)	69
Gravel (%)	16
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.

River Name: Yadkin
Reach Name: Little Bugaboo Creek
Sample Name: PC6
Survey Date: 02/22/06

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	3	3.00	3.00
0.062 - 0.125	0	0.00	3.00
0.125 - 0.25	2	2.00	5.00
0.25 - 0.50	9	9.00	14.00
0.50 - 1.0	7	7.00	21.00
1.0 - 2.0	0	0.00	21.00
2.0 - 4.0	0	0.00	21.00
4.0 - 5.7	0	0.00	21.00
5.7 - 8.0	6	6.00	27.00
8.0 - 11.3	5	5.00	32.00
11.3 - 16.0	11	11.00	43.00
16.0 - 22.6	9	9.00	52.00
22.6 - 32.0	12	12.00	64.00
32 - 45	13	13.00	77.00
45 - 64	14	14.00	91.00
64 - 90	0	0.00	91.00
90 - 128	4	4.00	95.00
128 - 180	2	2.00	97.00
180 - 256	1	1.00	98.00
256 - 362	2	2.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
2048 -	0	0.00	100.00

D16 (mm)	0.64
D35 (mm)	12.58
D50 (mm)	21.13
D84 (mm)	54.5
D95 (mm)	128
D100 (mm)	361.99
Silt/Clay (%)	3
Sand (%)	18
Gravel (%)	70
Cobble (%)	7
Boulder (%)	2
Bedrock (%)	0

Total Particles = 100.