Little Bugaboo Creek Stream Restoration
2006 Monitoring Report
Monitoring Year Two

Ecosystem Enhancement Program Project Number 00056

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

Prepared by:
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Project Designed by:
EarthTech of NC, Inc.
701 Corporate Center Drive, Suite 475
Raleigh, NC 27607

Submitted: January 19, 2007

Ecosystem Enhancement PROGRAM

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1.0 EXECUTIVE SUMMARY/PROJECT ABSTRACT

URS Corporation (URS) was retained by the North Carolina Ecosystem Enhancement Program (EEP) to conduct stream monitoring at the Little Bugaboo Creek stream restoration project, located in Wilkes County, North Carolina. The stream monitoring effort conducted by URS in October 2006 represents Monitoring Year 2 for this project. Prior to the monitoring effort, URS received a digital As-Built drawing for the project site from EEP. In addition, URS received a As-Built/Monitoring Year 1 Report prepared by EarthTech (EarthTech 2005), aand a Year 1 Monitoring Report prepared by EcoLogic Associates, P.C (EcoLogic 2006).

The Ecosystem Enhancement Program (EEP), formerly the Wetlands Restoration Program (WRP) identified Little Bugaboo Creek and an Unnamed Tributary to Little Bugaboo Creek as potential stream restoration sites in 2002. The existing channels were actively eroding due to unlimited cattle access and lack of streamside vegetation. The design used a Priority Level II restoration approach. Little Bugaboo Creek and the Unnamed Tributary were designed as type C channels. A total of 6,230 linear feet of stream channel was restored.

Prior to restoration, the pastures adjacent to the channel consisted of fescue with sparse trees along drainages. The banks along much of the reach were vertical and supported little to no vegetation. The main channel was classified as a type F stream because the channel was downcutting and was eroding its banks to establish a floodplain at a lower elevation.

The Priority II restoration involved increasing the existing 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 was planted on both sides of the restored stream channel.

The Little Bugaboo Creek restoration site is in overall poor condition. The site is characterized by severe bank erosion, accelerated channel widening, and associated aggradation. While some of the rock structures are functioning properly and providing crucial grade control, many of them are failing. These problems may be due to any number of reasons, and likely a combination of several factors. Because the problems with the site are not isolated, but are systemic, it is suspected that there were problems with the original design and/or construction of the project. The channel dimensions as well as the structures may have been designed or built incorrectly. The failure of the vegetation has likely contributed to the excessive bank erosion. The bed features are in fair condition, with many riffles and pools; however the placement of the features is often inappropriate, with riffles located in meander bends and pools located in straight reaches.

In comparison with the cross section data from the 2005 As-built/Year 1 Monitoring Report (EarthTech, June 2005), the channel dimensions appear smaller and more narrow. Cross sectional area, bankfull width, and width to depth ratios have decreased, while entrenchment ratios have increased. However, field observations show that in many areas not captured by the cross sections, the channel size is increasing laterally due to mass wasting of banks. Both the mainstem of Little Bugaboo Creek and the Unnamed Tributary were classified as C channels on the As-built, but have both transitioned to E channels according to the 2006 monitoring. This classification was based on the narrower width to depth ratios of the riffle cross sections (< 10) as well as field observations that the stream has steep banks and is not building or maintaining point bars typical of C channels.

Of course, all of the cross section parameters are based on the selected bankfull elevation, which can be especially problematic in newly restored or very unstable stream systems. There are often no bankfull indicators in newly restored streams, as they may not have experienced enough (or any) bankfull events to form reliable indicators. Deposition on the floodplain or other evidence of flow may be present, but without hydrologic data there is no way to know if these flows correspond to a bankfull event or a greater-than-bankfull event. In restored streams, it is presumed that the channel was designed and built so

that the top of bank equals bankfull, and the top of bank is often the only reliable indicator of bankfull elevation. In the case of Little Bugaboo Creek, it is suspected that the channel is oversized and the top of bank is higher than bankfull, but because of the recent construction and repair work, as well as actively eroding banks, it is impossible to discern another reliable bankfull indicator. Therefore, in most instances URS placed the bankfull elevation at the top of bank.

Vegetation survival at the site is also poor. According to the 2005 As-built/Year 1 Monitoring Report, five of the vegetation plots were significantly disturbed due to repair activities along Little Bugaboo Creek. The plots disturbed by channel repairs were replanted, but planting appear to be concentrated close to the channel, leaving much of the upper floodplain/upland void of woody vegetation. The 2005 Year One Monitoring Report (EcoLogic 2006) found insufficient stems to fulfill USACE requirements. Herbaceous grasses and herbs dominated much of the buffer area during the 2006 Year Two monitoring event. Common species include wiregrass (*Aristida* spp.), dogfennel (*Eupatorium capillifolium*), goldenrod (*Solidago* spp.), and bluestem (*Andropogon* spp.). URS recommends testing site soils, fertilizing where necessary based on soil tests, and replanting stems in areas unlikely to meet survivability requirements for mitigation credit.

2.0 PROJECT BACKGROUND

2.1 PROJECT OBJECTIVES

The main objective of the restoration project was to construct a stable meander geometry, modify the channel cross sections, and establish a floodplain at the existing stream elevation, thus restoring a stable dimension, pattern, and profile. Specific project objectives included the following:

1. Restore 4,276 linear feet of Little Bugaboo Creek and 1,954 linear feet of an Unnamed Tributary to Little Bugaboo Creek.
2. 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.
3. Improve water quality and reduce further property loss by stabilizing eroding stream banks.
4. Reconnect the stream to its floodplain or establish a new floodplain at a lower elevation.
5. Improve aquatic habitat with the use of natural material stabilization structures such as root wads, rock vanes, woody debris and a riparian buffer.
6. Provide aesthetic value, wildlife habitat and a bank stability through the creation or enhancement of a riparian zone.

2.2 PROJECT STRUCTURE, MITIGATION TYPE, AND APPROACH

Prior to restoration, the pastures adjacent to the channel consisted of fescue with sparse trees along drainages. The banks along much of the reach were vertical and supported little to no vegetation. The main channel was classified as a type F stream because the channel was downcutting and was eroding its banks to establish a floodplain at a lower elevation.

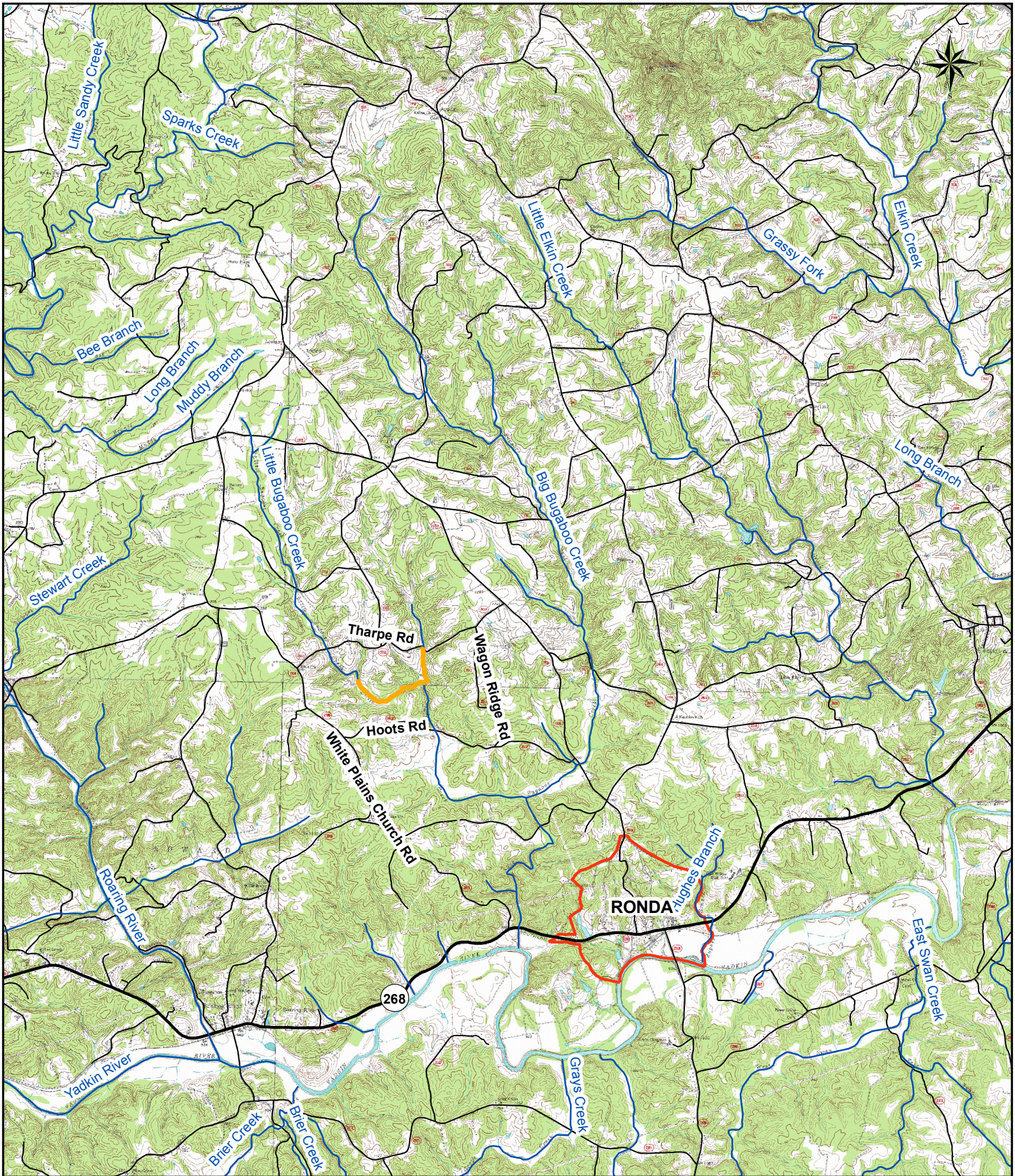
The Priority II restoration involved increasing the existing stream length and providing a floodplain. Cross vanes and rootwads were incorporated for aquatic habitat enhancement and bed and bank stability. A 50-foot riparian buffer was planted using native vegetation. Cattle were fenced from the riparian area. Little Bugaboo Creek and the Unnamed Tributary were designed as type C channels. A total of 6,230 linear feet of stream channel was restored.

2.3 LOCATION AND SETTING

Little Bugaboo Creek is located on agricultural land approximately seven miles east-northeast of North Wilkesboro, just northwest of the town of Ronda in Wilkes County, North Carolina (Figure 1). The headwaters of the project originate approximately three miles to the north-northwest of the restoration site. From the headwaters, Little Bugaboo Creek flows for approximately four miles before its confluence with Big Bugaboo Creek. An Unnamed Tributary to Little Bugaboo Creek enters Little Bugaboo Creek at the end of the project site. The headwaters of the Unnamed Tributary originate approximately 1.6 miles from the restoration site. From its headwaters, the Unnamed Tributary flows for approximately 2.5 miles before the confluence with Little Bugaboo Creek.

To travel to the site from Raleigh, take I-40 West towards Greensboro. Merge onto US-421 North via Exit 188 toward Yadkinville/Wilkesboro Take the Clingman Road/Somers Road Exit - Exit 272 toward NC-268. Make a right onto NC-268 and then a right onto Old Traphill Road. Old Traphill Road joins Hoots Road.

The project is contained within the property of five landowners. The project reach is bound to the north by Tharpe Road and to the south by Hoots Road.



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URS

Prepared For:
NC Ecosystem Enhancement Program

Ecosystem Enhancement Program

Project:
Little Bugaboo Creek Stream Restoration
Wilkes County, NC

Monitoring Year:
2 (2006)

Project Number:
00056

Date:
January 2007

Legend
- Project Reach
- City Boundary

Figure 1
Project Vicinity

0 0.5 1 Miles

2.4 PROJECT HISTORY AND BACKGROUND

The Little Bugaboo Creek Stream Restoration project was designed by EarthTech and constructed in the fall and winter of 2003 to 2004. The Mitigation and As-built Plan were completed in June 2005. Year One Monitoring was conducted by EcoLogic in the winter of 2006. The estimated restoration length was 6,230 linear feet. This length includes 4,276 feet of Little Bugaboo Creek and 1,954 feet of an Unnamed Tributary to Little Bugaboo Creek.

Historically, a mill and dam were located approximately 150 feet below the confluence of Little Bugaboo Creek and the Unnamed Tributary. The mill dam backed up water within approximately half of the project reach. 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.

Land use throughout the restoration site is agricultural. The primary use is cattle production and the spreading of chicken litter. Fences within the project area did not restrict cattle access to streams and drainages in the area. Cattle access to the stream and riparian areas resulted in streambank erosion prior to restoration. Continual grazing limited the ability of vegetation to reestablish itself along the majority of the reach. Additional degradation resulted from historic channelization of both reaches.

Table I. Project Mitigation Structure and Objectives Table
Little Bugaboo Creek
EEP Project Number 00056

Project Segment or Reach ID	Existing Feet*	Mitigation Type	Approach	Linear Footage	Mitigation Ratio*	Mitigation Units*	Stationing**	Comment
Unnamed Tributary	1,954	R	PII	1,925			0+00 to 19+54	
Little Bugaboo Creek	4,276	R	PII	4,232			0+00 to 42+76	

* Existing Feet, Mitigation Ratios, and Units not provided in previous report
** Stationing follows the Year One Monitoring Report (EcoLogic 2006)
R= Restoration P1= Priority I EI= Enhancement I PII= Priority II
EII= Enhancement II PIII= Priority III S= Stabilization SS= Stream Bank Stabilization

Table II. Project Activity and Reporting History Little Bugaboo Creek EEP Project Number 00056			
Activity or Report	**Scheduled Completion**	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration Plan	2002	Unknown	2002
Construction	2003	Unknown	2003/2004
Permanent seed mix applied	2004	Unknown	2004
Live stakes and woody plants	2004	Unknown	2004
Final Walk Through	Unknown	Unknown	Unknown
As-Built Report/Mitigation Plan	2004	Unknown	June 2005
Year 1 Monitoring	Fall 2005	Unknown	June 2006
Year 2 Monitoring	Fall 2006	November 2006	December 2006
Year 3 Monitoring	--	--	--
Year 4 Monitoring	--	--	--
Year 5 Monitoring	--	--	--
Year + Monitoring	--	--	--

Table III. Project Contact Table Little Bugaboo Creek EEP Project Number 00056	
Designer Primary project design POC	EarthTech of NC, Inc. 701 Corporate Center Drive, Suite 475 Raleigh, NC 27607 Bill Jenkins PE, RLA 919-854-6228
Construction Contractor Construction contractor POC	Dixie Grading and Equipment Company 5228 W US HWY 421 Wilkesboro, NC 28697 Randall Miles 336-973-7281
Planting Contractor Planting contractor POC	Carolina Environmental PO Box 1905 Mt. Airy, NC 27030 Joanne Chetham 336-320-3849
Seeding Contractor Seeding contractor POC	Carolina Environmental PO Box 1905 Mt. Airy, NC 27030 Joanne Chetham 336-320-3849
Seed Mix Sources	Unknown
Nursery Stock Suppliers	Unknown
2004 Monitoring Performers	Earth Tech of North Carolina 701 Corporate Center Drive, Suite 475 Raleigh NC 27607
Stream Monitoring POC – Ron Johnson	919-854-6210
Vegetation Monitoring POC – Jane Almon	919-854-7745

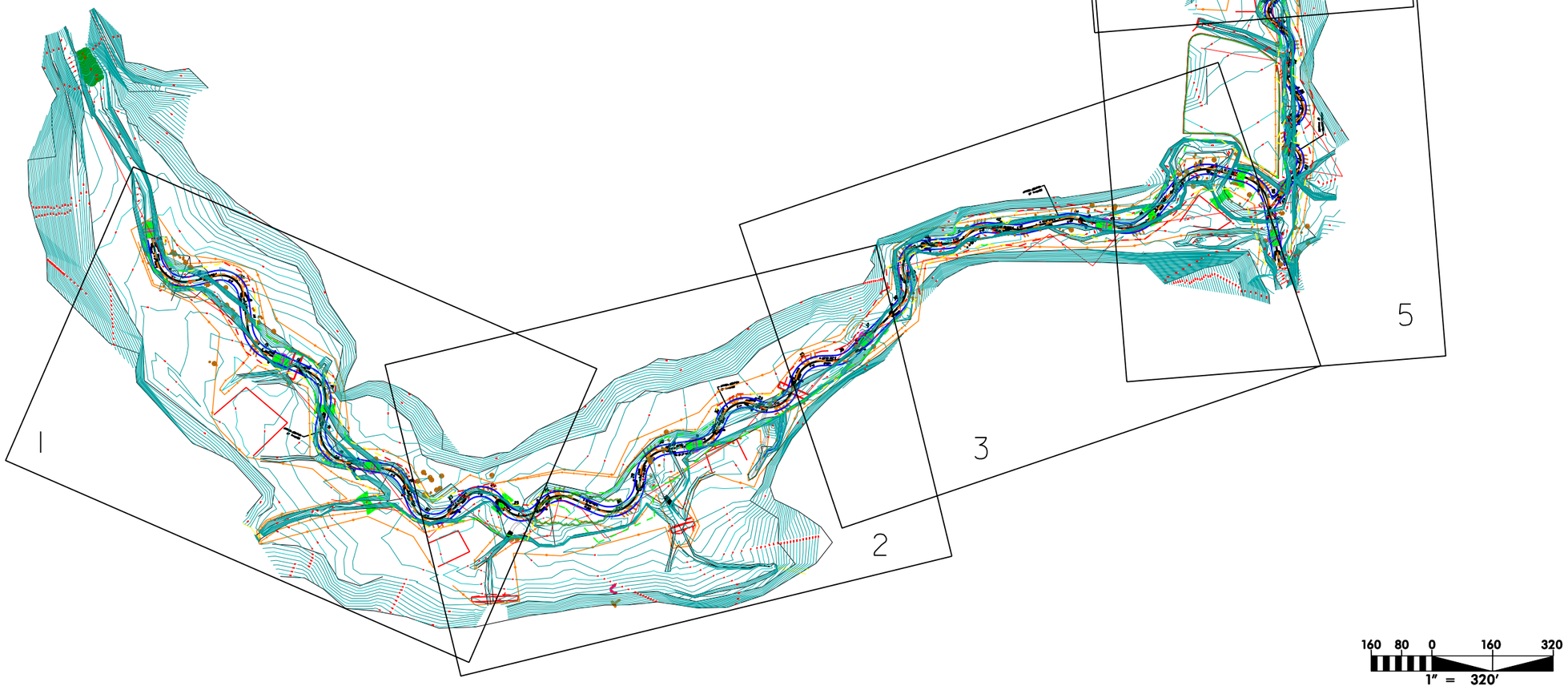
2005 Monitoring Performers	EcoLogic Associates, P.C. 4321-A S. Elm-Eugene St. Greensboro, NC 27406
Stream Monitoring POC – Kyle Hoover	336-355-1108
Vegetation Monitoring POC – Moni Bates	336-335-1108
2006 Monitoring Performers	URS Corporation – North Carolina 1600 Perimeter Park Drive, Suite 400 Morrisville, NC 27560 919-461-1100
Monitoring POC – Kathleen McKeithan	919-461-1597

Table IV. Project Background Table Little Bugaboo Creek EEP Project Number 00056		
Project County		Wilkes County
Drainage Area	Little Bugaboo	3.45 square miles
	Unnamed Tributary	1.4 square miles
Drainage impervious cover estimate (%)		2
Stream Order	Little Bugaboo	3rd
	Unnamed Tributary	3rd
Physiographic Region		Piedmont/Foothills
Ecoregion		Northern Inner Piedmont (45e)
Rosgen Classification of As-Built		C
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		03-07-01 – Project
NCDWQ classification for Project and Reference		C – Project
Any portion of any project segment 303d listed?		No
Any portion of any project segment upstream of a 303d listed segment?		No
Reasons for 303d listing or stressor		NA
% of project easement fenced		Approximately 80% - no cattle in upper reach

2.5 MONITORING PLAN VIEW

See Figure 2. Monitoring Plan View.

Veg Plots			Photo Points		
ID	Northing	Easting	ID	Northing	Easting
9	915332	1414444	655	917481.3	1416889
8	915589.8	1414222	657	917200.1	1416993
10	915207.1	1414512	670	916874.1	1416935
11	915122.6	1414617	673	916737.4	1416889
12	915063	1414755	676	916563.6	1416971
13	915037.7	1414879	679	916406.3	1416998
14	915070.8	1414991	681	916355.9	1416999
15	915031.9	1415095	687	916153	1417029
17	915339.3	1415648	693	915956.5	1417054
16	915271.5	1415568	745	915923.2	1416982
18	915487.6	1415860	741	915860	1417048
21	915760.4	1416504	703	915544.2	1414237
19	915884.5	1416806	706	915232.6	1414449
21	915822.1	1416922	718	915308.9	1415522
7	916335	1417003	723	915407.5	1415713
6	916548.7	1416925	728	915606.3	1416020
5	916744.3	1416905	661	917038.5	1416952
4	916948.1	1416931	667	916938.3	1416877
2	917144.6	1416954			
3	917273.8	1416986			
1	917346.9	1416918			



160 80 0 160 320
1" = 320'

BASE MAP IS DESIGN PLANS PROVIDED BY EEP.

REVISIONS

NO.	DATE

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PROJECT: LITTLE BUGABOO STREAM RESTORATION 2006 MONITORING REPORT

TITLE: KEY PLAN

CLIENT: NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

Ecosystem Enhancement

FIGURE 2

DATE: DEC 2006

TECHNICIAN: EHJ

CHECKED BY: KM

MONITORING YEAR 2

EEP PROJECT NO. 00056

SHEET NO. 0

BEGIN CONSTRUCTION
CREV 10+00.00

TEMPORARY LIVESTOCK FENCE
(DOUBLE STRAND ELECTRIC FENCE)
(TO REMAIN AFTER COMPLETION OF WORK)
LIMITS OF CONSTRUCTION

GRADING LIMITS

CROSS SECTION 3

PERMANENT CONSERVATION EASEMENT
(FENCE TO BE INSTALLED BY OTHERS)

CHANNEL PLUG (TYP.)
SEE DETAIL (9 / C-9)

IMPERVIOUS DIKE (TYP.)
SEE DETAIL (18 / C-10)

PERMANENT CONSERVATION EASEMENT
(FENCE TO BE INSTALLED BY OTHERS)

GRADING LIMITS

REALIGN DRAINAGE SWALE
SEE DETAIL A

PROPOSED CROSSING
SEE DETAIL (19 / C-8)

EXISTING CROSSING

CROSS SECTION 4

TEMPORARY STREAM CROSSING
SEE DETAIL

PERMANENT CONSERVATION EASEMENT
(FENCE TO BE INSTALLED BY OTHERS)

TEMPORARY LIVESTOCK FENCE
(DOUBLE STRAND ELECTRIC FENCE)
(TO REMAIN AFTER COMPLETION OF WORK)
LIMITS OF CONSTRUCTION

MATCH LINE - STA 23+85

TEMPORARY LIVESTOCK FENCE
(DOUBLE STRAND ELECTRIC FENCE)
(TO REMAIN AFTER COMPLETION OF WORK)
LIMITS OF CONSTRUCTION

STAGING AND STOCKPILE AREA

TEMPORARY SILT FENCE

APPROX. LOCATION
OF THALWEG

TEMPORARY STREAM
CROSSING

TEMPORARY SILT FENCE

STAGING AND
STOCKPILE AREA

TEMPORARY LIVESTOCK FENCE
(DOUBLE STRAND ELECTRIC FENCE)
(TO REMAIN AFTER COMPLETION OF WORK)
LIMITS OF CONSTRUCTION

PERMANENT CONSERVATION EASEMENT
(FENCE TO BE INSTALLED BY OTHERS)

CONSTRUCTION ACCESS PATH,
ENTIRE LENGTH ALSO
CONSIDERED WITHIN THE
CONSTRUCTION LIMITS FOR A
WIDTH OF 16'(10 WIDE PLUS
SHOULDER)

TO CONSTRUCTION
ENTRANCE
SEE DETAIL (20 / C-12)

VP8 VP9 VP10 VP11 VP12 VP13

P703 P706

C-1 C-2 C-3 C-4 C-5 C-6 C-7 C-8

CROSS SECTION #1 CROSS SECTION #2 CROSS SECTION #3 CROSS SECTION #4 CROSS SECTION #5

S 17° 59' 37" E 524.45'

N 16° 41' 00" E 83.00'

S 17° 59' 37" E 85.00'

S 17° 59' 37" E 85.00'

S 80° 32' 46" E 46.50'

S 80° 44' 41" E 413.71'

N 45° 06' 56" E 532.41'

REPLACE 48" CMP

48" CMP

INV: 117.08'

LEGEND

CROSS VANE*
* See Detail on Plan Sheet C-8

ROOT WAD*
* See Detail on Plan Sheet C-8

NOTE: Structure placement on Plan Sheets are for location only. Actual placement shall be directed by Resident Engineer.

VEGETATION PLOTS

PHOTO POINTS

40 30 0 40 80
1" = 80'

BASE MAP IS DESIGN PLANS PROVIDED BY EEP.

REVISIONS

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PROJECT: LITTLE BUCABOO
STREAM RESTORATION
2006 MONITORING REPORT

TITLE: MONITORING PLAN VIEW

CLIENT: NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

Ecosystem Enhancement Program

FIGURE 2

DATE: DEC 2006

TECHNICIAN: EHJ

CHECKED BY: KM

MONITORING
YEAR 2

EEP PROJECT NO.
00056

SHEET NO.
1

MATCH LINE - STA 23+85

MATCH LINE - STA 36+10

TEMPORARY LIVESTOCK FENCE (DOUBLE STRAND ELECTRIC FENCE) (TO REMAIN AFTER COMPLETION OF WORK) LIMITS OF CONSTRUCTION

PERMANENT CONSERVATION EASEMENT (FENCE TO BE INSTALLED BY OTHERS)

GRADING LIMITS

CROSS SECTION 5

P723

APPROX. LOCATION OF THALWEG

P718

VPI7

VPI6

VPI5

VPI4

ROCK SILT SCREEN (TYP.) SEE DETAIL 15 C-16

TEMPORARY STREAM CROSSING SEE DETAIL 11 C-9

℄ STREAM (SREV)

CHANNEL PLUG (TYP.) SEE DETAIL 9 C-9

PROPOSED CROSSING SEE DETAIL 19 C-9

GRADING LIMITS

REALIGN DRAINAGE SWALE SEE DETAIL A

SOIL STOCKPILE AREA

STEP-POOL OUTFALL SEE DETAIL 12 C-9

PERMANENT CONSERVATION EASEMENT (FENCE TO BE INSTALLED BY OTHERS)

REALIGN DRAINAGE SWALE SEE DETAIL A

TEMPORARY LIVESTOCK FENCE (DOUBLE STRAND ELECTRIC FENCE) (TO REMAIN AFTER COMPLETION OF WORK)

REALIGN DRAINAGE SWALE SEE DETAIL A

STEP-POOL OUTFALL SEE DETAIL 12 C-9

GRADING LIMITS

CLEANOUT DITCH TO DAYLIGHT FROM PROPOSED PIPE INVERT

MIN.EL.1111.0

MIN.EL.111.50

APPROXIMATELY 30' HEAD DITCH

DIRT PATH IMPROVEMENTS SEE DETAIL 21 C-12

40' 18" RCP

TEMPORARY LIVESTOCK FENCE (DOUBLE STRAND ELECTRIC FENCE) (TO REMAIN AFTER COMPLETION OF WORK) LIMITS OF CONSTRUCTION

EXISTING WETLAND AREA

MIN.EL.1117.0

MIN.EL.1118.0

INV.1115.5

28" 18" RCP

DIRT PATH IMPROVEMENTS SEE DETAIL 22 C-12

LEGEND

CROSS VANE*

* See Detail on Plan Sheet C-8

ROOT WAD*

* See Detail on Plan Sheet C-8

NOTE: Structure placement on Plan Sheets are for location only. Actual placement shall be directed by Resident Engineer.

VEGETATION PLOTS

PHOTO POINTS

40 30 0 40 80

1" = 80'

BASE MAP IS DESIGN PLANS PROVIDED BY EEP.

REVISIONS

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TITLE: MONITORING PLAN VIEW

CLIENT: NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

Ecosystem Enhancement Program

FIGURE 2

DATE: DEC 2006

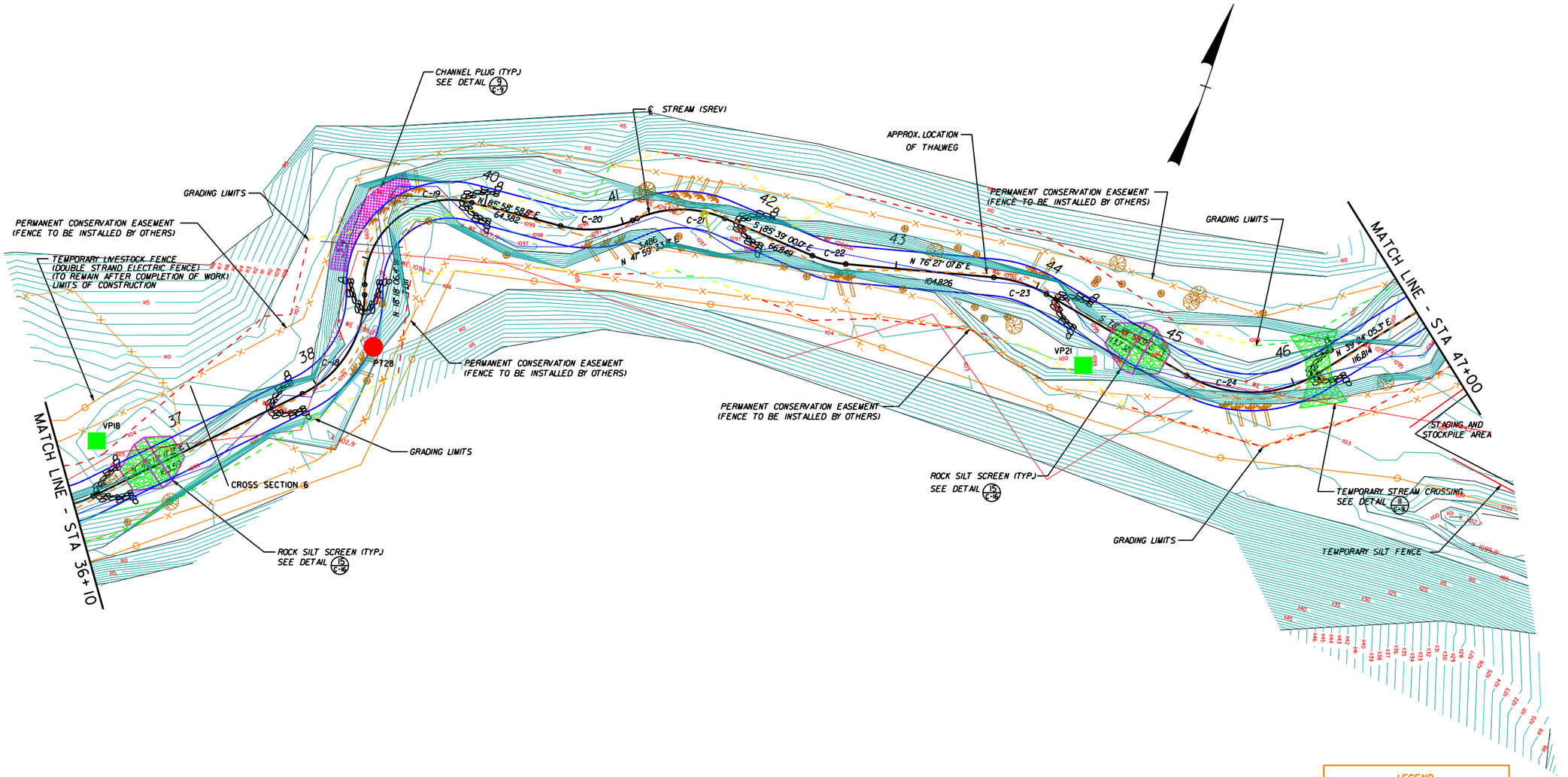
TECHNICIAN: EHJ

CHECKED BY: KM

MONITORING YEAR 2

EEP PROJECT NO. 00056

SHEET NO. 2



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Ecosystem Enhancement Program

FIGURE 2

DATE: DEC 2006

TECHNICIAN: EHJ

CHECKED BY: KM

MONITORING YEAR 2

EEP PROJECT NO. 00056

SHEET NO. 3

PROPOSED CROSSING SEE DETAIL 19 C-9

ARMOR LEFT BANK WITH CLASS B STONE

BEGIN CONSTRUCTION TRIB 10+00.00

℄ STREAM (TRIBUTARY)

GRADING LIMITS

PERMANENT CONSERVATION EASEMENT (FENCE TO BE INSTALLED BY OTHERS)

APPROX. LOCATION OF THALWEG

MATCH LINE - TRIB- STA 21+00

VP1

VP2

VP3

VP4 CROSS SECTION 1

VP5

P657

P661

P670

P673

MAINTAIN TREE

CHANNEL PLUG (TYP.) SEE DETAIL 9 C-9

CROSS SECTION 2

PERMANENT CONSERVATION EASEMENT (FENCE TO BE INSTALLED BY OTHERS)

TEMPORARY SILT FENCE

IMPERVIOUS DIKE (TYP.) SEE DETAIL 18 C-10

GRADING LIMITS

ROCK SILT SCREEN (TYP.) SEE DETAIL 15 C-16

STAGING AND STOCKPILE AREA

TEMPORARY LIVESTOCK FENCE (DOUBLE STRAND ELECTRIC FENCE) (TO REMAIN AFTER COMPLETION OF WORK) LIMITS OF CONSTRUCTION

TEMPORARY CONSTRUCTION ENTRANCE SEE DETAIL 10 C-9

TEMPORARY LIVESTOCK FENCE (DOUBLE STRAND ELECTRIC FENCE) (TO REMAIN AFTER COMPLETION OF WORK) LIMITS OF CONSTRUCTION

LEGEND

CROSS VANE*

* See Detail on Plan Sheet C-8

ROOT WAD*

* See Detail on Plan Sheet C-8

NOTE: Structure placement on Plan Sheets are for location only. Actual placement shall be directed by Resident Engineer.

VEGETATION PLOTS

PHOTO POINTS

40 30 0 40 80

1" = 80'

BASE MAP IS DESIGN PLANS PROVIDED BY EEP.

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Ecosystem Enhancement Program

FIGURE 2

DATE: DEC 2006

TECHNICIAN: EHJ

CHECKED BY: KM

MONITORING YEAR 2

EEP PROJECT NO. 00056

SHEET NO. 4

LEGEND	
CROSS VANE* * See Detail on Plan Sheet C-8	
ROOT WAD* * See Detail on Plan Sheet C-8	

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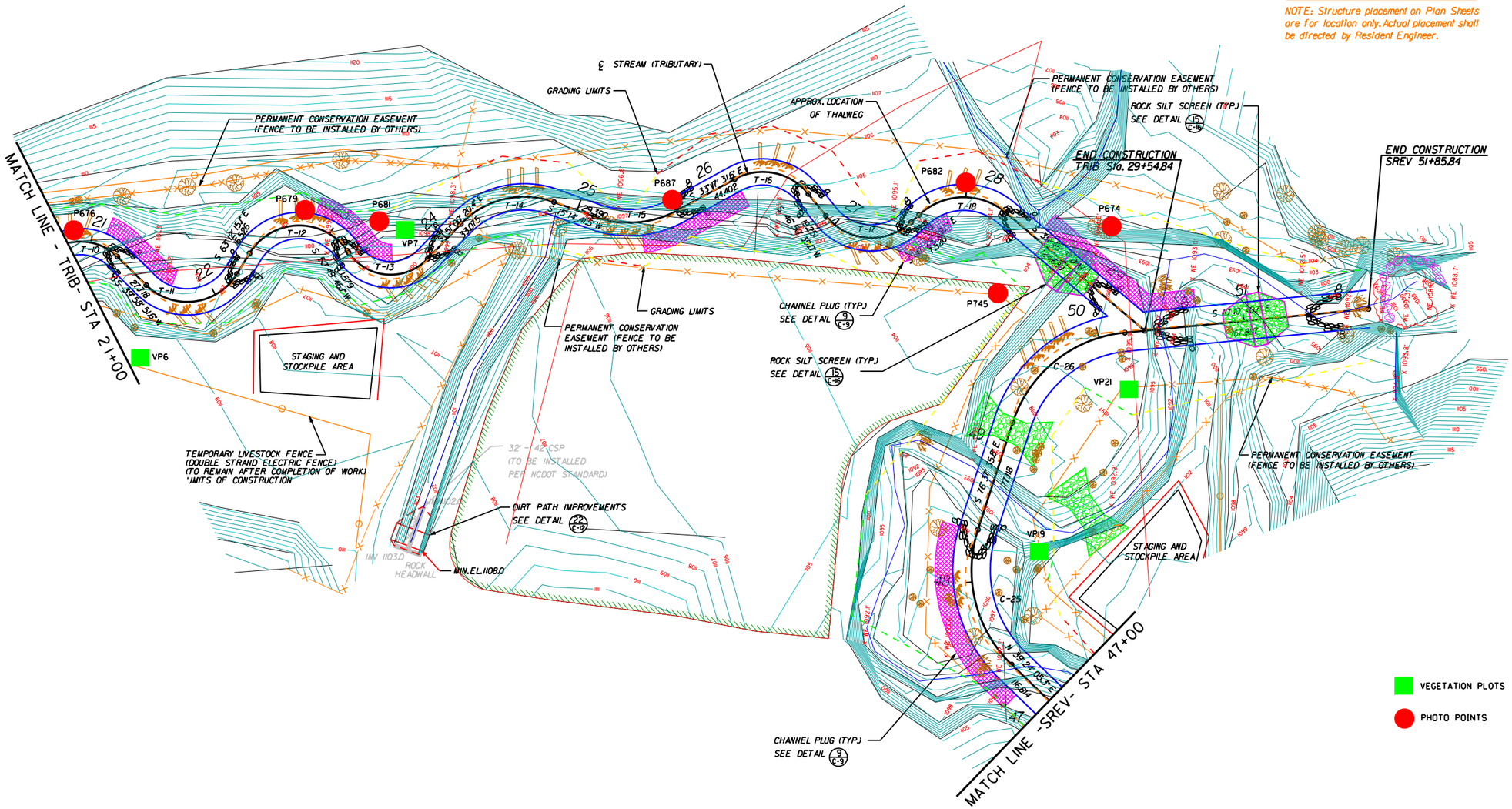

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Ecosystem Enhancement Program

FIGURE 2

DATE: DEC 2006

TECHNICIAN: EHJ

CHECKED BY: KM

MONITORING YEAR 2

EEP PROJECT NO. 00056

SHEET NO. 5

3.0 PROJECT CONDITION AND MONITORING RESULTS

3.1 VEGETATION ASSESSMENT

3.1.1 Vegetative Problem Areas

No Vegetative Problem Areas were identified during Year 1 Monitoring. Notes provided on the Vegetative Problem Areas Plan View were as follows:

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.

Twenty-two Vegetative Problem Areas were found at the Little Bugaboo site during the 2006 Year 2 monitoring. Major issues included bare banks as a result of erosion and scour and poor survivability. Herbaceous grasses and herbs dominated much of the buffer area during the 2006 Year Two monitoring event. Thick mats of herbaceous vegetation were observed. Common species include wiregrass (*Aristida* spp.), dogfennel (*Eupatorium capillifolium*), goldenrod (*Solidago* spp.), and bluestem (*Andropogon* spp.). It is likely that the presence and density of the above-mentioned native herbs is to blame for size and survivability issues. The small planted stems are not successfully competing for space, light, and nutrients. The Vegetative Problem Areas Tables are located in Appendix A-I. Vegetative Problem Area Photos are located in Appendix A-II.

3.1.2 Vegetative Problem Areas Plan View

The Vegetative Problem Areas Plan View is located in Appendix A-III.

3.2 STREAM ASSESSMENT

3.2.1 Procedural Items

3.2.1.1 Morphometric Criteria

Dimension and profile were sampled at a rate per the 2003 USACE Stream Mitigation Guidelines as follows:

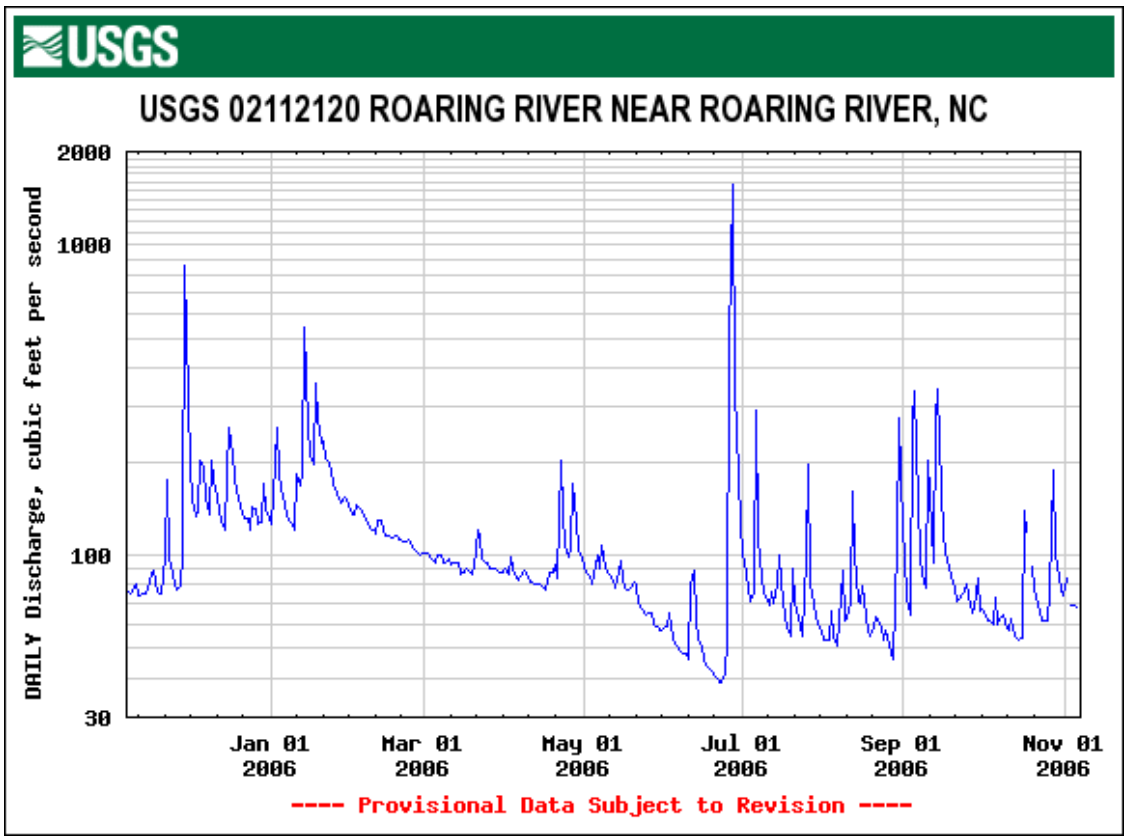
Dimension: Six permanent cross sections were surveyed. Two are located on the Unnamed Tributary (one riffle and one pool) and four are located on Little Bugaboo Creek (two riffles and two pools). At the instruction of the EEP Project Manager, URS surveyed the cross-sections established by EcoLogic for the Year 1 Monitoring Report. The cross-section numbers and locations do not correspond to the As-Built cross-sections established by EarthTech. The survey includes points measured at all breaks in slope, including top of bank, bankfull, and thalweg.

Profile: A longitudinal profile survey was performed on the entire project reach (6,157 linear feet). 4,232 linear feet were surveyed on Little Bugaboo Creek and 1,925 linear feet were surveyed on the Unnamed Tributary. Survey points include measurements taken in the thalweg at the beginning of each stream feature such as riffle, run, glide, and pool, as well as the maximum pool depth, bankfull, and top of bank.

3.2.1.2 Hydrologic Criteria

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 (USGS 2006). The USGS gage plot is shown below (Figure 4). The gage is located less than five miles from the project site and has a drainage area of 128 square miles. An estimate of the number of bankfull events in 2006 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 square mile drainage area when the discharge is about 2,500 cfs. This discharge was not exceeded in the past year, indicating that the Roaring River has not had a bankfull event this year (as of November 7, 2006). Little Bugaboo Creek is in close proximity to the Roaring River. Therefore, it is likely that the project site did not experience a bankfull event in 2006.

Figure 4. USGS Stream Gage Discharge Data



3.2.1.3 Bank Stability Assessments

A detailed BEHI and NBS assessment was not required for the Little Bugaboo Creek Stream Restoration site during this monitoring year. According to the 2006 Monitoring Guidelines (EEP 2006), an assessment is required during year 5, post construction only.

3.2.2 Stream Problem Areas

There were 35 Stream Problem Areas identified on Little Bugaboo Creek in 2005. In 2006, 40 Stream Problem Areas were identified. There were 24 Stream Problem Areas identified on the Unnamed Tributary in 2005. In 2006, 25 Stream Problem Areas were identified. The Stream Problem Areas Plan View, tables, and photographs are located in Appendices B-I, B-II, and B-III respectively.

Field observations show that in many areas, not captured by the cross sections, the channel size is increasing laterally. Bank erosion in the form of mass wasting and scour was prevalent in Little Bugaboo Creek and the Unnamed Tributary. Underlying causes of erosional problems are difficult to determine at this stage since URS was not involved with the design, construction, or follow-up maintenance phases of this project. Immediate causes are attributed to easily erodible, sandy substrate that dominates the streambank soils. Insufficient vegetative protection has likely contributed to erosion problems as well. Ultimate causes for the erosion problems may be attributed to problems with the project design and/or the implementation of the design during construction activities.

Per the 2005 As-Built/Monitoring Year 1 Report provided by EarthTech, “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 according to the plans for typical cross

sections, and overland flow/drainageways entering the stream channel." URS is assuming the above-mentioned problems to be the cause of many of the problem areas observed in 2006.

3.2.3 Fixed Photo Station Photos

Fixed Photo Station photos are located in Appendix B-IV. Photo Station photo 670 is missing due to camera error.

3.2.4 Stability Assessment

Table Va. Categorical Stream Feature Visual Stability Assessment (% Functioning)
Unnamed Tributary
Little Bugaboo Creek
EEP Project Number 00056

Feature	Initial*	MY-01**	MY-02	MY-03	MY-04	MY-05
A. Riffle	100	N/A	96			
B. Pool	100	N/A	91			
C. Thalweg	100	N/A	100			
D. Meanders	100	N/A	67			
E. Bed General	100	N/A	100			
F. Bank Condition	100	N/A	91			
G. Vanes / J Hooks	100	N/A	95			
H. Wads and Boulders	100	N/A	89			

* It is assumed that all were 100 percent functional upon completion of construction.
**No stability data are presented in previous report.

Table Vb. Categorical Stream Feature Visual Stability Assessment (% Functioning)
Little Bugaboo Creek
Little Bugaboo Creek
EEP Project Number 00056

Feature	Initial*	MY-01**	MY-02	MY-03	MY-04	MY-05
A. Riffle	100	N/A	92			
B. Pool	100	N/A	87			
C. Thalweg	100	N/A	88			
D. Meanders	100	N/A	67			
E. Bed General	100	N/A	98			
F. Bank Condition			86			
G. Vanes / J Hooks	100	N/A	82			
H. Wads and Boulders	100	N/A	75			

* It is assumed that all were 100 percent functional upon completion of construction.
**No stability data are presented in previous report.

3.2.5 Quantitative Measures Tables (Morphology and Hydrology)

Table VIa. Baseline Morphology and Hydraulic Summary – Unnamed Tributary Little Bugaboo Creek EEP Project Number 00056																		
Parameter	**USGS Gage Data**			**Regional Curve Interval**			**Pre-Existing Condition**			**Project Reference Stream**			**Design**			**As-built**		
Dimension	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
BF Width (ft)	--	--	--	7.5	30	16.5	17.5	18	17.75	29.5	36.9	33.2	--	--	18	14.8	31	18.6
Floodprone Width (ft)	--	--	--	--	--	--	--	--	38	--	--	329	--	--	170	61	75	68.0
BF Cross Sectional Area (ft^2)	--	--	--	13	50	26	21.2	21.9	21.55	64.9	71.9	68.4	--	--	27	22.1	34.4	30.9
BF Mean Depth (ft)	--	--	--	1.0	2.6	1.8	1.2	1.2	1.2	1.9	2.2	2.05	--	--	1.5	1.1	2.3	1.4
BF Max Depth (ft)	--	--	--	--	--	--	2.2	2.3	2.25	3	3.2	3.1	--	--	2.1	2.64	3.8	3.1
Width/Depth Ratio	--	--	--	--	--	--	14.4	14.8	14.6	13.4	19.4	16.4	--	--	12	11.2	17.2	14.2
Entrenchment Ratio	--	--	--	--	--	--	1.8	2.5	2.15	--	--	8.9	--	--	9.4	3.47	3.8	3.6
Bank Height Ratio	--	--	--	--	--	--	1.9	4.5	2.8	1.0	1.0	1.0	--	--	--	--	--	--
Wetted Perimeter (ft)	--	--	--	--	--	--	19.9	20.4	20.15	33.3	41.3	37.3	--	--	21	19.4	33.2	21.3
Hydraulic radius (ft)	--	--	--	--	--	--	1.07	1.07	1.07	1.95	1.74	1.84	--	--	1.29	1.0	1.8	1.2
Pattern																		
Channel Beltwidth (ft)	--	--	--	--	--	--	26	74	50	59	75	67	--	--	--	40	131	59.5
Radius of Curvature (ft)	--	--	--	--	--	--	27	98	62.5	40.1	69.3	54.7	1.8	3.7	2.8	--	--	--
Meander Wavelength (ft)	--	--	--	--	--	--	87	355	221	--	--	350	129	224	176.5	130	204	175
Meander Width Ratio	--	--	--	--	--	--	4.9	19.9	12.4	--	--	10.5	9	12	10.5	7.01	11.00	9.43

Table VIa. Baseline Morphology and Hydraulic Summary – Unnamed Tributary Little Bugaboo Creek EEP Project Number 00056																		
Parameter	**USGS Gage Data**			**Regional Curve Interval**			**Pre-Existing Condition**			**Project Reference Stream**			**Design**			**As-built**		
Dimension	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
Profile																		
Riffle Length (ft)	--	--	--	--	--	--	--	--	--	10	245	127.5	--	--	--	22	28	25
Riffle Slope (ft/ft)	--	--	--	--	--	--	--	--	--	--	--	0.02	--	--	0.02	0.00	0.20	0.10
Pool Length (ft)	--	--	--	--	--	--	--	--	--	8	32	20	--	--	--	47	94	70.5
Pool Spacing (ft)	--	--	--	--	--	--	33	176	104.5	271	334	302.5	64	166	115.0	121	127	124
Substrate																		
d50 (mm)	--	--	--	--	--	--	--	--	5	--	--	58	--	--	--	0.5	5.7	3.1
d84 (mm)	--	--	--	--	--	--	--	--	23	--	--	180	--	--	--	8	32	20
Additional Reach Parameters																		
Valley Length (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1603
Channel Length (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1954
Sinuosity	--	--	--	--	--	--	--	--	1.2	--	--	--	--	--	1.3	--	--	1.2
Water Surface Slope (ft/ft)	--	--	--	--	--	--	--	--	0.01	--	--	0.014	--	--	0.01	--	--	0.01
BF Slope (ft/ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.01
Rosgen Classification	--	--	--	--	--	--	--	--	C and F	--	--	C4	--	--	C and F	--	--	C

Exhibit Table VIb. Baseline Morphology and Hydraulic Summary – Little Bugaboo Creek Little Bugaboo Creek EEP Project Number 00056																		
Parameter	**USGS Gage Data**			**Regional Curve Interval**			**Pre-Existing Condition**			**Project Reference Stream**			**Design**			**As-built**		
Dimension	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
BF Width (ft)	--	--	--	12	40	23	26	35.5	30.75	20	21.5	20.75	--	--	25.8	20.3	44	28.8
Floodprone Width (ft)	--	--	--	--	--	--	--	--	90	--	--	130	--	--	255	87.5	100	100
BF Cross Sectional Area (ft^2)	--	--	--	27	100	51	54	87.7	70.85	40.9	42.8	41.85	--	--	55.7	53.9	67.5	60.1
BF Mean Depth (ft)	--	--	--	1.5	3.3	2.4	1.9	2.9	2.4	2	2	2	--	--	2.15	1.4	3.2	2.2
BF Max Depth (ft)	--	--	--	--	--	--	2.7	4.1	3.4	2.5	2.7	2.6	--	--	3.5	3.6	4.6	4.1
Width/Depth Ratio	--	--	--	--	--	--	8.8	17.4	13.1	9.8	10.8	10.3	--	--	12	12	32.6	12.6
Entrenchment Ratio	--	--	--	--	--	--	--	--	2.7	--	--	65	--	--	9.9	3.1	3.5	3.3
Bank Height Ratio	--	--	--	--	--	--	1.9	4.5	2.8	1.0	1.0	1.0	--	--	--	--	--	--
Wetted Perimeter (ft)	--	--	--	--	--	--	29.8	41.3	35.55	24	25.5	24.75	--	--	30.1	32.7	46.8	33.3
Hydraulic radius (ft)	--	--	--	--	--	--	1.812	2.123	1.993	1.704	1.678	1.691	--	--	1.850	1.3	2.0	1.9
Pattern																		
Channel Beltwidth (ft)	--	--	--	--	--	--	36	140	88	31	44	37.5	NA	NA	NA	63	122	92.5
Radius of Curvature (ft)	--	--	--	--	--	--	62	234	148	42	63	52.5	72.9	102.9	87.9	60	110	85
Meander Wavelength (ft)	--	--	--	--	--	--	133	590	361.5	185	260	222.5	196	366	281	206	366	286
Meander Width Ratio	--	--	--	--	--	--	4.4	19.3	11.85	8.9	12.6	10.75	6.5	12.2	9.35	7.2	12.7	9.9

Exhibit Table VIb. Baseline Morphology and Hydraulic Summary – Little Bugaboo Creek Little Bugaboo Creek EEP Project Number 00056																		
Parameter	**USGS Gage Data**			**Regional Curve Interval**			**Pre-Existing Condition**			**Project Reference Stream**			**Design**			**As-built**		
Dimension	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
Profile																		
Riffle Length (ft)	--	--	--	--	--	--	--	--	--	23	78	50.5	--	--	--	3	91	47
Riffle Slope (ft/ft)	--	--	--	--	--	--	--	--	--	0.02	0.02	0.02	--	--	0.01	0.00	0.20	0.10
Pool Length (ft)	--	--	--	--	--	--	--	--	--	8	32	20	--	--	--	47	94	70.5
Pool Spacing (ft)	--	--	--	--	--	--	57	287	172	98	180	139	106	217	161.5	121	127	124
Substrate																		
d50 (mm)	--	--	--	--	--	--	--	--	0.25	--	--	3	--	--	--	0.25	11.3	5.8
d84 (mm)	--	--	--	--	--	--	--	--	23	--	--	50	--	--	--	1	64	32.5
Additional Reach Parameters																		
Valley Length (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3420
Channel Length (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4276
Sinuosity	--	--	--	--	--	--	--	--	1.3	--	--	1.1	--	--	1.2	--	--	1.3
Water Surface Slope (ft/ft)	--	--	--	--	--	--	--	--	0.00	--	--	0.01	--	--	0.01	0.00	0.01	0.01
BF Slope (ft/ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--		0.00	0.01	0.00
Rosgen Classification	--	--	--	--	--	--	--	--	Bc, C, E, F	--	--	E4	--	--	C	--	--	C

Exhibit Table VIIa. Morphology and Hydraulic Monitoring Summary Unnamed Tributary Little Bugaboo Creek EEP Project Number 00056												
Parameter	**Cross Section 1 Pool**						**Cross Section 2 Riffle**					
Dimension	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**
BF Width (ft)	23.5	13.8					18.8	17.4				
Floodprone Width (ft)	52	>42.7					32.4	>81.0				
BF Cross Sectional Area (ft^2)	38.3	23.3					30.7	30.5				
BF Mean Depth	1.6	1.7					1.6	1.8				
BF Max Depth	3.8	3.5					3.2	3.2				
Width/Depth Ratio	14.4	8.2					11.5	9.9				
Entrenchment Ratio	2.2	>3.1					1.7	>4.7				
Bank Height Ratio	--	1.0					--	1.0				
Wetted Perimeter (ft)	25.7	17.5					20.7	19.6				
Hydraulic radius (ft)	1.5	1.3					1.5	1.6				
Substrate												
d50 (mm)	0.2	12					23.4	22				
d84 (mm)	0.7	68					51.3	68				

Exhibit Table VIIb. Morphology and Hydraulic Monitoring Summary – Unnamed Tributary Little Bugaboo Creek EEP Project Number 00056																		
Parameter	**MY1**			**MY2**			**MY3**			**MY4**			**MY5**			**MY+**		
Pattern	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
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	3	70	28												
Riffle Slope (ft/ft)	0.001	0.058	0.024	0.006	0.067	0.021												
Pool Length (ft)	15.8	66.8	32.2	15	43	28												
Pool Spacing (ft)	15.8	130.2	56.1	31	196	95												
Additional Reach Parameters																		
Valley Length (ft)	--	--	1585	--	--	1585												
Channel Length (ft)	--	--	2013	--	--	1925												
Sinuosity	--	--	1.3	--	--	1.2												
Water Surface Slope (ft/ft)	--	--	1.11	--	--													
BF Slope (ft/ft)	--	--	0.011	--	--	0.011												
Rosgen Classification	--	--	B/C	--	--	E4												

Exhibit Table VIIc. Morphology and Hydraulic Monitoring Summary
Little Bugaboo Creek
Little Bugaboo Creek
EEP Project Number 00056

Parameter	Cross Section 3 Run (MY1 Riffle)						Cross Section 4 Riffle (MY1 Pool)						Cross Section 5 Pool						Cross Section 6 Riffle					
Dimension	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**
BF Width (ft)	27.1	19.3					20.6	14.0					31.3	27.3					17.8	13.3				
Floodprone Width (ft)	91.3	91					68.8	49.3					52.8	>50					39	45.0				
BF Cross Sectional Area (ft^2)	63.2	45.7					34	21.6					47	31					20.6	23.1				
BF Mean Depth	2.3	2.4					1.7	1.5					1.5	1.1					1.2	1.7				
BF Max Depth	4.7	4.2					3.7	2.6					5	4.4					2.4	2.5				
Width/Depth Ratio	11.6	8.2					12.5	9.1					20.8	24.1					15.5	7.7				
Entrenchment Ratio	3.4	4.7					3.3	3.5					1.7	>1.8					2.2	3.4				
Bank Height Ratio	--	1.0					--	1.0					--	1.4					--	1.0				
Wetted Perimeter (ft)	30	21.8					22.9	15.8					36.2	32.4					19.3	14.8				
Hydraulic radius (ft)	2.1	2.1					1.5	1.4					1.3	1.0					1.1	1.6				
Substrate																								
d50 (mm)	4.71	6					0.29	13					0.29	0.94					21.13	48				
d84 (mm)	14.72	64					2.33	59					2	48					54.5	130				

Exhibit Table VIId. Morphology and Hydraulic Monitoring Summary – Little Bugaboo Creek Little Bugaboo Creek EEP Project Number 00056																		
Parameter	**MY1**			**MY2**			**MY3**			**MY4**			**MY5**			**MY+**		
Pattern	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
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	10.0	128.0	55												
Riffle Slope (ft/ft)	0.007	0.034	0.015	0.002	0.026	0.012												
Pool Length (ft)	9.23	94.6	44.5	16.0	131.0	45												
Pool Spacing (ft)	16.2	175.3	80.5	43.0	347.0	120												
Additional Reach Parameters																		
Valley Length (ft)	--	--	2975	--	--	2975												
Channel Length (ft)	--	--	4293	--	--	4232												
Sinuosity	--	--	1.4	--	--	1.4												
Water Surface Slope (ft/ft)	--	--	0.57	--	--	0.55												
BF Slope (ft/ft)	--	--	0.53	--	--	0.56												
Rosgen Classification	--	--	B	--	--	E4												

Appendix A
(Click here)

APPENDIX A

VEGETATION RAW DATA

Table A1. Vegetation Metadata

Report Prepared By	Susan Shelingoski
Date Prepared	1/15/2007 13:09
database name	CVS_EEP_DataEntry_v202.mdb
database location	P:\Jobs3\31825348_Monitoring
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	This worksheet, which is a summary of the project and the project data.
Plots	List of plots surveyed.
Vigor	Frequency distribution of vigor classes.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Stem Count by Plot and Spp	Count of living stems of each species for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	56
project Name	Little Bugaboo Creek
Description	Stream Restoration
length (ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	14

Table A2. Vegetation Vigor by Species

	Species	4	3	2	1	0	Missing
	EMPTY_MODULE: This module has no species in it, but was sampled.						
	Alnus serrulata	13					
	Aronia arbutifolia		2				
	Betula nigra	3					
	Callicarpa americana	4		1			
	Cornus racemosa	18					
	Fraxinus pennsylvanica	24	1	2			
	Nyssa sylvatica	8	3	1			
	Pinus virginiana						
	Quercus alba	8	2				
	Rhus glabra	10					
	Salix nigra	3					
	Sambucus canadensis	13	1				
	Rhus copallinum	2					
	Ilex opaca		1				
	Liriodendron tulipifera	2					
	Platanus occidentalis	52	3				
	Prunus	7	2				
	Acer negundo	10	1	1			
	Acer rubrum						
TOT:	**20**	**177**	**16**	**5**			

Table A3. Vegetation Damage by Species

	Species	All Damage Categories	(no damage)
	Acer negundo	15	15
	Acer rubrum	2	2
	Alnus serrulata	15	15
	Aronia arbutifolia	2	2
	Betula nigra	4	4
	Callicarpa americana	5	5
	Cornus racemosa	19	19
	EMPTY_MODULE: This module has no species in it, but was sampled.	3	3
	Fraxinus pennsylvanica	27	27
	Ilex opaca	1	1
	Liriodendron tulipifera	2	2
	Nyssa sylvatica	13	13
	Pinus virginiana	1	1
	Platanus occidentalis	60	60
	Prunus	9	9
	Quercus alba	11	11
	Rhus copallinum	6	6
	Rhus glabra	10	10
	Salix nigra	3	3
	Sambucus canadensis	14	14
TOT:	**20**	**222**	**222**

Table A4. Vegetation Damage by Plot

No damage was recorded within the plots.

Table A5. Stem Count by Plot and Species

	Species	Total Stems	# plots	avg# stems	plot 056-01-0001	plot 056-01-0002	plot 056-01-0004	plot 056-01-0006	plot 056-01-0007	plot 056-01-0008	plot 056-01-0011	plot 056-01-0012	plot 056-01-0013	plot 056-01-0014	plot 056-01-0015	plot 056-01-0016	plot 056-01-0019	plot 056-01-0021
	Acer negundo	12	1	12														12
	Alnus serrulata	13	7	1.86	4	1			3		1		2	1			1	
	Aronia arbutifolia	2	1	2														2
	Betula nigra	3	3	1							1		1					1
	Callicarpa americana	5	4	1.25	2	1						1					1	
	Cornus racemosa	18	3	6		16						1	1					
	Fraxinus pennsylvanica	27	10	2.7		6	4	2	2		2	1	3	1			1	5
	Ilex opaca	1	1	1						1								
	Liriodendron tulipifera	2	2	1				1										1
	Nyssa sylvatica	12	6	2		3		4			1			1			2	1
	Platanus occidentalis	55	13	4.23	13	8	1	4	7	3	4	1		4	1	2	1	6
	Prunus	9	5	1.8				1				3		1	3			1
	Quercus alba	10	4	2.5	6	1					2		1					
	Rhus copallinum	2	2	1										1	1			
	Rhus glabra	10	4	2.5		5	1				3	1						
	Salix nigra	3	1	3					3									
	Sambucus canadensis	14	4	3.5		3	2				7							2
TOT:	**17**	**198**	**17**		**25**	**44**	**8**	**12**	**15**	**4**	**21**	**8**	**8**	**9**	**5**	**2**	**6**	**31**

Exhibit Table A6a. Vegetative Problem Areas – Unnamed Tributary Little Bugaboo Creek EEP Project Number 00056				
Feature #	**Feature/Issue**	**Station #/Range**	**Probable Cause**	**Photo #**
UTVPA1	Bare bank	0+15	Scour	UTVPA1
UTVPA2	Bare bank	1+90	Scour	UTVPA2
UTVPA3	Bare bank	8+00	Scour	UTVPA3
UTVPA4	Bare bank	14+60	Scour	UTVPA4
UTVPA5	Bare bank	15+05	Scour	UTVPA5
UTVPA6	Exotic population	16+00	Chinese privet	UTVPA6
UTVPA7	Exotic population	18+80	Chinese privet	UTVPA7
UTVPA8	Bare bank	20+00	Scour	UTVPA8

Exhibit Table A6b. Vegetative Problem Areas – Little Bugaboo Creek Little Bugaboo Creek EEP Project Number 00056				
Feature #	**Feature/Issue**	**Station #/Range**	**Probable Cause**	**Photo #**
VPA1	Poor survivability	0+00 to 5+60	Thick herbaceous vegetation	VPA1
VPA2	Bare bank	3+30	Bank erosion	VPA2
VPA3	Bare bank	14+80	Bank erosion	VPA3
VPA4	Bare bank	11+00	Scour	VPA4
VPA5	Bare bank	14+00	Scour	VPA5
VPA6	Bare floodplain	15+00	Aggradation	VPA6
VPA7	Bare bank	22+80	Scour	VPA7
VPA8	Bare bank	25+00	Scour	VPA8
VPA9	Bare bank	26+00	Scour	VPA9
VPA10	Bare bank	30+00	Scour	VPA10
VPA11	Bare bank	37+20	Scour	VPA11
VPA12	Bare bank	38+00	Scour	VPA12
VPA13	Bare bank	40+60	Beaver damage	VPA13
VPA14	Bare bank	41+60	Scour	VPA14

UNNAMED TRIBUTARY


UTVPA1 facing left bank


UTVPA2 facing left bank


UTVPA3 facing right bank


UTVPA4 facing right bank


UTVPA5 facing right bank


UTVPA6 facing left bank, upstream


UTVPA7 facing left bank, downstream


UTVPA8 facing upstream

LITTLE BUGABOO CREEK


VPA1 on left bank, facing downstream


VPA2 facing left bank


VPA3 facing left bank


VPA4 facing left bank, upstream


VPA5 facing left bank


VPA6 on right bank


VPA7 facing left bank


VPA8 facing left bank


VPA9 facing left bank


VPA10 facing left bank


VPA11 facing right bank

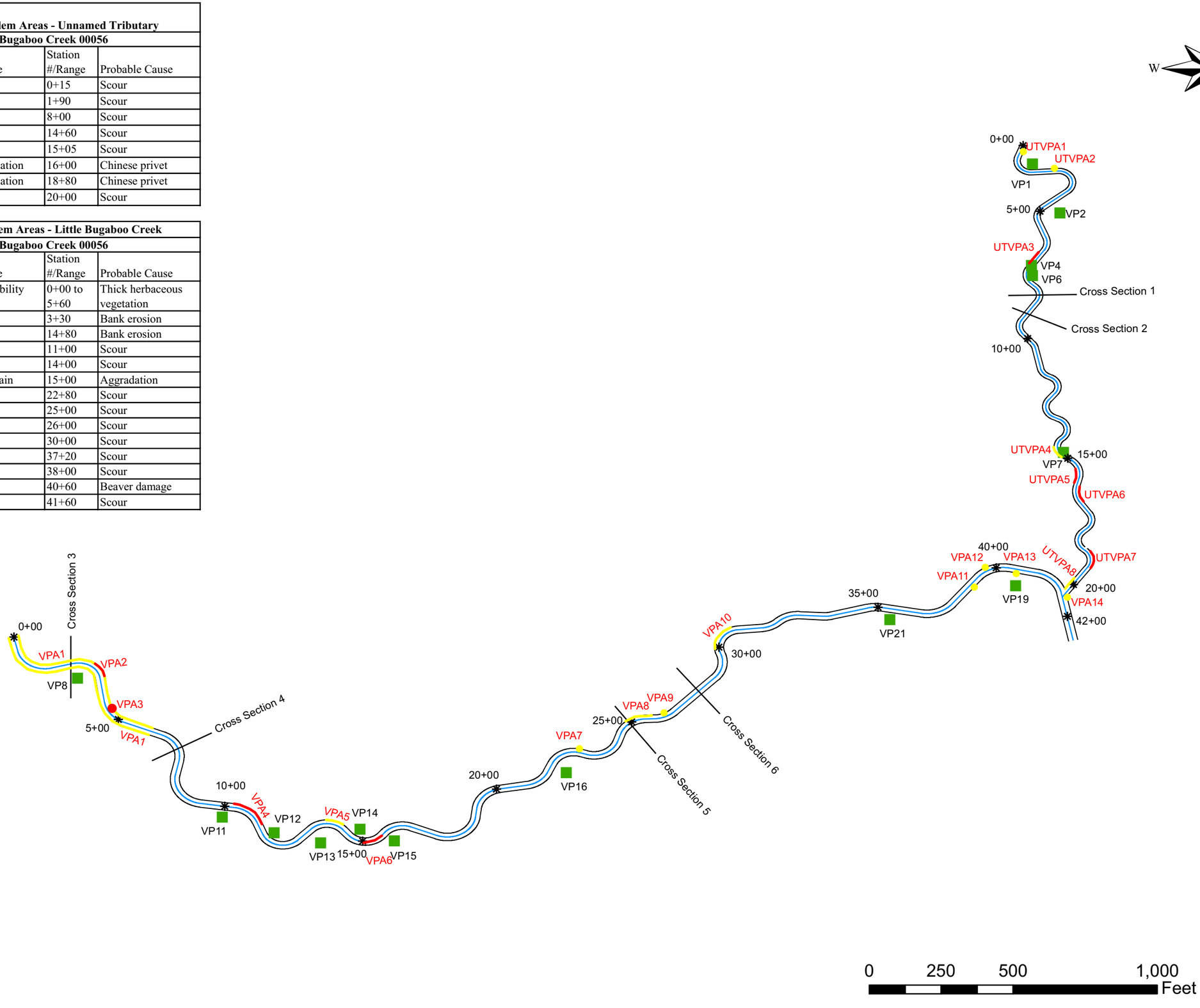

VPA12 facing left bank


VPA13 on right bank


VPA14 facing left bank

Vegetative Problem Areas - Unnamed Tributary			
Little Bugaboo Creek 00056			
Feature #	Feature/Issue	Station #/Range	Probable Cause
UTVPA1	Bare bank	0+15	Scour
UTVPA2	Bare bank	1+90	Scour
UTVPA3	Bare bank	8+00	Scour
UTVPA4	Bare bank	14+60	Scour
UTVPA5	Bare bank	15+05	Scour
UTVPA6	Exotic population	16+00	Chinese privet
UTVPA7	Exotic population	18+80	Chinese privet
UTVPA8	Bare bank	20+00	Scour

Vegetative Problem Areas - Little Bugaboo Creek			
Little Bugaboo Creek 00056			
Feature #	Feature/Issue	Station #/Range	Probable Cause
VPA1	Poor survivability	0+00 to 5+60	Thick herbaceous vegetation
VPA2	Bare bank	3+30	Bank erosion
VPA3	Bare bank	14+80	Bank erosion
VPA4	Bare bank	11+00	Scour
VPA5	Bare bank	14+00	Scour
VPA6	Bare floodplain	15+00	Aggradation
VPA7	Bare bank	22+80	Scour
VPA8	Bare bank	25+00	Scour
VPA9	Bare bank	26+00	Scour
VPA10	Bare bank	30+00	Scour
VPA11	Bare bank	37+20	Scour
VPA12	Bare bank	38+00	Scour
VPA13	Bare bank	40+60	Beaver damage
VPA14	Bare bank	41+60	Scour



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NC Ecosystem
Enhancement Program

Project:

Little Bugaboo Creek
Stream Restoration
Wilkes County, NC

Monitoring Year:

2 (2006)

Project Number:

00056

Date:

January 2007

Legend

- Problem Area Concern
- Problem Area High Concern
- Problem Area High Concern
- Problem Area Concern
- Stations
- Cross Sections
- Vegetation Plots
- As-built Centerline
- As-built Streambank

Figure 3
Vegetative
Problem Areas
Plan View


VP1


VP2


VP4


VP6


VP7


VP8


VP11


VP12


VP13


VP14


VP15


VP16


VP19


VP21

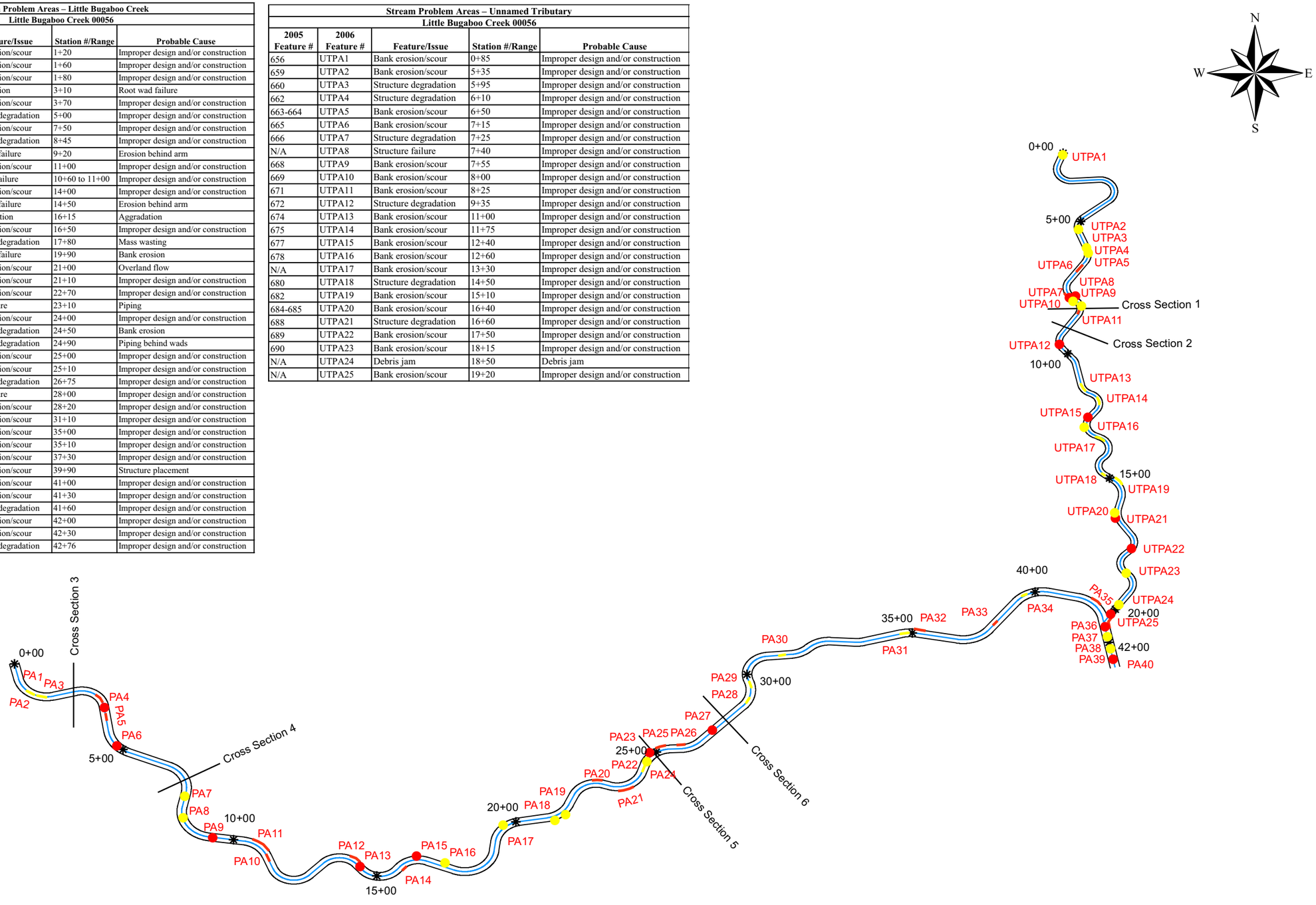
Appendix B
(Click here)

APPENDIX B

GEOMORPHIC RAW DATA

Stream Problem Areas – Little Bugaboo Creek				
Little Bugaboo Creek 00056				
2005 Feature #	2006 Feature #	Feature/Issue	Station #/Range	Probable Cause
699	PA1	Bank erosion/scour	1+20	Improper design and/or construction
700	PA2	Bank erosion/scour	1+60	Improper design and/or construction
701	PA3	Bank erosion/scour	1+80	Improper design and/or construction
N/A	PA4	Bank erosion	3+10	Root wad failure
702	PA5	Bank erosion/scour	3+70	Improper design and/or construction
704	PA6	Structure degradation	5+00	Improper design and/or construction
705	PA7	Bank erosion/scour	7+50	Improper design and/or construction
707	PA8	Structure degradation	8+45	Improper design and/or construction
709	PA9	Structure failure	9+20	Erosion behind arm
711	PA10	Bank erosion/scour	11+00	Improper design and/or construction
710	PA11	Channel failure	10+60 to 11+00	Improper design and/or construction
712	PA12	Bank erosion/scour	14+00	Improper design and/or construction
N/A	PA13	Structure failure	14+50	Erosion behind arm
N/A	PA14	Bar formation	16+15	Aggradation
714	PA15	Bank erosion/scour	16+50	Improper design and/or construction
715	PA16	Structure degradation	17+80	Mass wasting
N/A	PA17	Structure failure	19+90	Bank erosion
716	PA18	Bank erosion/scour	21+00	Overland flow
717	PA19	Bank erosion/scour	21+10	Improper design and/or construction
719	PA20	Bank erosion/scour	22+70	Improper design and/or construction
N/A	PA21	Bank failure	23+10	Piping
721	PA22	Bank erosion/scour	24+00	Improper design and/or construction
722	PA23	Structure degradation	24+50	Bank erosion
N/A	PA24	Structure degradation	24+90	Piping behind wads
725	PA25	Bank erosion/scour	25+00	Improper design and/or construction
724	PA26	Bank erosion/scour	25+10	Improper design and/or construction
726	PA27	Structure degradation	26+75	Improper design and/or construction
N/A	PA28	Bank failure	28+00	Improper design and/or construction
727	PA29	Bank erosion/scour	28+20	Improper design and/or construction
730	PA30	Bank erosion/scour	31+10	Improper design and/or construction
732	PA31	Bank erosion/scour	35+00	Improper design and/or construction
735	PA32	Bank erosion/scour	35+10	Improper design and/or construction
736	PA33	Bank erosion/scour	37+30	Improper design and/or construction
N/A	PA34	Bank erosion/scour	39+90	Structure placement
N/A	PA35	Bank erosion/scour	41+00	Improper design and/or construction
737	PA36	Bank erosion/scour	41+30	Improper design and/or construction
738	PA37	Structure degradation	41+60	Improper design and/or construction
739	PA38	Bank erosion/scour	42+00	Improper design and/or construction
740	PA39	Bank erosion/scour	42+30	Improper design and/or construction
742	PA40	Structure degradation	42+76	Improper design and/or construction

Stream Problem Areas – Unnamed Tributary				
Little Bugaboo Creek 00056				
2005 Feature #	2006 Feature #	Feature/Issue	Station #/Range	Probable Cause
656	UTPA1	Bank erosion/scour	0+85	Improper design and/or construction
659	UTPA2	Bank erosion/scour	5+35	Improper design and/or construction
660	UTPA3	Structure degradation	5+95	Improper design and/or construction
662	UTPA4	Structure degradation	6+10	Improper design and/or construction
663-664	UTPA5	Bank erosion/scour	6+50	Improper design and/or construction
665	UTPA6	Bank erosion/scour	7+15	Improper design and/or construction
666	UTPA7	Structure degradation	7+25	Improper design and/or construction
N/A	UTPA8	Structure failure	7+40	Improper design and/or construction
668	UTPA9	Bank erosion/scour	7+55	Improper design and/or construction
669	UTPA10	Bank erosion/scour	8+00	Improper design and/or construction
671	UTPA11	Bank erosion/scour	8+25	Improper design and/or construction
672	UTPA12	Structure degradation	9+35	Improper design and/or construction
674	UTPA13	Bank erosion/scour	11+00	Improper design and/or construction
675	UTPA14	Bank erosion/scour	11+75	Improper design and/or construction
677	UTPA15	Bank erosion/scour	12+40	Improper design and/or construction
678	UTPA16	Bank erosion/scour	12+60	Improper design and/or construction
N/A	UTPA17	Bank erosion/scour	13+30	Improper design and/or construction
680	UTPA18	Structure degradation	14+50	Improper design and/or construction
682	UTPA19	Bank erosion/scour	15+10	Improper design and/or construction
684-685	UTPA20	Bank erosion/scour	16+40	Improper design and/or construction
688	UTPA21	Structure degradation	16+60	Improper design and/or construction
689	UTPA22	Bank erosion/scour	17+50	Improper design and/or construction
690	UTPA23	Bank erosion/scour	18+15	Improper design and/or construction
N/A	UTPA24	Debris jam	18+50	Debris jam
N/A	UTPA25	Bank erosion/scour	19+20	Improper design and/or construction



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Legend

- Problem Area Concern
- Problem Area High Concern
- Problem Area Concern
- Problem Area High Concern
- Stations
- Cross Sections
- As-built Centerline
- As-built Streambank

Figure 5
Stream
Problem Areas
Plan View

Exhibit Table B1a. Stream Problem Areas – Unnamed Tributary Little Bugaboo Creek EEP Project Number 00056				
Feature #	**Feature/Issue**	**Station # /Range**	**Probable Cause**	**Photo #**
UTPA1	Bank erosion/scour	0+85	Improper design and/or construction	UTPA1
UTPA2	Bank erosion/scour	5+35	Improper design and/or construction	UTPA2
UTPA3	Structure degradation	5+95	Improper design and/or construction	UTPA3
UTPA4	Structure degradation	6+10	Improper design and/or construction	UTPA4
UTPA5	Bank erosion/scour	6+50	Improper design and/or construction	UTPA5
UTPA6	Bank erosion/scour	7+15	Improper design and/or construction	UTPA6
UTPA7	Structure degradation	7+25	Improper design and/or construction	UTPA7
UTPA8	Structure failure	7+40	Improper design and/or construction	UTPA8
UTPA9	Bank erosion/scour	7+55	Improper design and/or construction	UTPA9
UTPA10	Bank erosion/scour	8+00	Improper design and/or construction	UTPA10
UTPA11	Bank erosion/scour	8+25	Improper design and/or construction	UTPA11
UTPA12	Structure degradation	9+35	Improper design and/or construction	UTPA12
UTPA13	Bank erosion/scour	11+00	Improper design and/or construction	UTPA13
UTPA14	Bank erosion/scour	11+75	Improper design and/or construction	UTPA14
UTPA15	Bank erosion/scour	12+40	Improper design and/or construction	UTPA15
UTPA16	Bank erosion/scour	12+60	Improper design and/or construction	UTPA16
UTPA17	Bank erosion/scour	13+30	Improper design and/or construction	UTPA17
UTPA18	Structure degradation	14+50	Improper design and/or construction	UTPA18
UTPA19	Bank erosion/scour	15+10	Improper design and/or construction	UTPA19
UTPA20	Bank erosion/scour	16+40	Improper design and/or construction	UTPA20
UTPA21	Structure degradation	16+60	Improper design and/or construction	UTPA21
UTPA22	Bank erosion/scour	17+50	Improper design and/or construction	UTPA22
UTPA23	Bank erosion/scour	18+15	Improper design and/or construction	UTPA23
UTPA24	Debris jam	18+50	Debris jam	UTPA24
UTPA25	Bank erosion/scour	19+20	Improper design and/or construction	UTPA25

Exhibit Table B1b. Stream Problem Areas – Little Bugaboo Creek Little Bugaboo Creek EEP Project Number 00056				
Feature #	**Feature/Issue**	**Station # /Range**	**Probable Cause**	**Photo #**
PA1	Bank erosion/scour	1+20	Improper design and/or construction	PA1
PA2	Bank erosion/scour	1+60	Improper design and/or construction	PA2
PA3	Bank erosion/scour	1+80	Improper design and/or construction	PA3
PA4	Bank erosion	3+10	Root wad failure	PA4
PA5	Bank erosion/scour	3+70	Improper design and/or construction	PA5
PA6	Structure degradation	5+00	Improper design and/or construction	PA6
PA7	Bank erosion/scour	7+50	Improper design and/or construction	PA7
PA8	Structure degradation	8+45	Improper design and/or construction	PA8
PA9	Structure failure	9+20	Erosion behind arm	PA9
PA10	Bank erosion/scour	11+00	Improper design and/or construction	PA11
PA11	Channel failure	10+60 to 11+00	Improper design and/or construction	PA10
PA12	Bank erosion/scour	14+00	Improper design and/or construction	PA12
PA13	Structure failure	14+50	Erosion behind arm	PA13
PA14	Bar formation	16+15	Aggradation	PA14
PA15	Bank erosion/scour	16+50	Improper design and/or construction	PA15
PA16	Structure degradation	17+80	Mass wasting	PA16
PA17	Structure failure	19+90	Bank erosion	PA17
PA18	Bank erosion/scour	21+00	Overland flow	PA18
PA19	Bank erosion/scour	21+10	Improper design and/or construction	PA19
PA20	Bank erosion/scour	22+70	Improper design and/or construction	PA20
PA21	Bank failure	23+10	Piping	PA21
PA22	Bank erosion/scour	24+00	Improper design and/or construction	PA22
PA23	Structure degradation	24+50	Bank erosion	PA23
PA24	Structure degradation	24+90	Piping behind wads	PA24
PA25	Bank erosion/scour	25+00	Improper design and/or construction	PA25
PA26	Bank erosion/scour	25+10	Improper design and/or construction	PA26
PA27	Structure degradation	26+75	Improper design and/or construction	PA27
PA28	Bank failure	28+00	Improper design and/or construction	PA28
PA29	Bank erosion/scour	28+20	Improper design and/or construction	PA29
PA30	Bank erosion/scour	31+10	Improper design and/or construction	PA30
PA31	Bank erosion/scour	35+00	Improper design and/or construction	PA31
PA32	Bank erosion/scour	35+10	Improper design and/or construction	PA32
PA33	Bank erosion/scour	37+30	Improper design and/or construction	PA33
PA34	Bank erosion/scour	39+90	Structure placement	PA34
PA35	Bank erosion/scour	41+00	Improper design and/or construction	PA35
PA36	Bank erosion/scour	41+30	Improper design and/or construction	PA36
PA37	Structure degradation	41+60	Improper design and/or construction	PA37
PA38	Bank erosion/scour	42+00	Improper design and/or construction	PA38
PA39	Bank erosion/scour	42+30	Improper design and/or construction	PA39
PA40	Structure degradation	42+76	Improper design and/or construction	PA40

UNNAMED TRIBUTARY


UTPA1 facing right bank


UTPA2 facing downstream


UTPA3 facing downstream


UTPA4 facing upstream


UTPA5 facing downstream


UTPA6 facing right bank


UTPA7 facing right bank


UTPA8 facing upstream


UTPA9 facing upstream


UTPA10 facing right bank, downstream


UTPA11 facing right bank


UTPA12 facing upstream


UTPA13 facing downstream


UTPA14 facing downstream


UTPA15 facing right bank


UTPA16 facing downstream


UTPA17 facing downstream


UTPA18 facing upstream


UTPA19 facing left bank


UTPA20 facing right bank


UTPA21 facing downstream, right bank


UTPA22 facing upstream


UTPA23 facing upstream


UTPA24 facing downstream


UTPA25 facing downstream

LITTLE BUGABOO CREEK


PA1 facing right bank


PA2 facing upstream


PA3 facing downstream, left bank


PA4 facing left bank


PA5 facing downstream


PA6 facing left bank


PA7 facing right bank


PA8 facing right bank


PA9 facing downstream


PA10 facing upstream


PA11 facing downstream


PA12 facing downstream


PA13 facing downstream


PA14 facing upstream


PA15 facing downstream


PA16 facing left bank


PA17 facing left bank


PA18 facing right bank


PA19 facing right bank


PA20 facing left bank


PA21 facing right bank


PA22 facing left bank


PA23 facing downstream from left bank


PA24 facing left bank


PA25 facing left bank


PA26 facing upstream


PA27 facing left bank


PA28 facing upstream


PA29 facing downstream


PA30 facing downstream


PA31 facing left bank


PA32 facing upstream


PA33 facing right bank


PA34 facing downstream


PA35 facing downstream


PA36 facing junction with UT


PA37 facing upstream at junction with UT


PA38 facing right bank


PA39 facing downstream


PA40 facing upstream

UNNAMED TRIBUTARY


P655


P657


P661


P667


P673


P676


P679


P681


P687


P693


P741


P745

LITTLE BUGABOO CREEK


P703


P706


P718


P723


P728

Exhibit Table B2a. Visual Morphological Stability Assessment
Unnamed Tributary
Little Bugaboo Creek
EEP Project Number 00056

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*	Present?	20	12	0	100	
	Armor stable (no displacement)?	20	12	0	100	
	Facet grade appears stable?	20	12	0	100	
	Minimal evidence of embedding/fining?	20	12	0	100	
	Length appropriate?	16	12	4	80	
						96
B. Pools**	Present (not subject to severe aggrad. or migration)?	22	30	0	100	
	Sufficiently deep (max pool D:mean Bkf >1.6)	19	30	3	86	
	Length appropriate?	19	30	3	86	
						91
C. Thalweg	Upstream of meander bend (run/inflection) centering?	9	9	0	100	
	Downstream of meander (glide/inflection) centering?	9	9	0	100	
						100
D. Meanders	Outer bend in state of limited/controlled erosion?	3	9	6	33	
	Of those eroding, # w/concomitant point bar formation?	3	9	6	33	
	Apparent Rc within spec?	9	9	0	100	
	Sufficient floodplain access and relief?	9	9	0	100	
						67
E. Bed General	General channel bed aggradation areas (bar formation)	1925	1925	0	100	
	Channel bed degradation–areas of increasing downcutting/headcutting?	1925	1925	0	100	
						100
F. Bank	Actively eroding, wasting, or slumping bank	1925	1925	170/1925	91	
						91
Vanes***	Free of back or arm scour?	12	16	3	80	
	Height appropriate?	15	16	0	100	
	Angle and geometry appear appropriate?	15	16	0	100	
	Free of piping or other structural failures?	15	16	0	100	
						95
Wads/ Boulders	Free of scour?	14	18	4	78	
	Footing stable?	18	18	0	100	
						89

* 12 riffles were reported in the As-built report. Twenty were observed during 2006 monitoring
** 30 pools were reported in the As-built report. Twenty-two were observed during 2006 monitoring.
*** 16 vanes were reported in the As-built report. Fifteen were observed during 2006 monitoring.

Exhibit Table B2b. Visual Morphological Stability Assessment
Little Bugaboo Creek
Little Bugaboo Creek
EEP Project Number 00056

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*	Present?	25	27	0	100	
	Armor stable (no displacement)?	25	27	0	100	
	Facet grade appears stable?	25	27	0	100	
	Minimal evidence of embedding/fining?	25	27	0	100	
	Length appropriate?	15	27	10	60	
						92
B. Pools**	Present (not subject to severe aggrad. or migration)?	36	49	0	100	
	Sufficiently deep (max pool D:mean Bkf >1.6)	29	49	7	80	
	Length appropriate?	29	49	7	80	
						87
C. Thalweg	Upstream of meander bend (run/inflection) centering?	12	12	0	100	
	Downstream of meander (glide/inflection) centering?	9	12	3	75	
						88
D. Meanders	Outer bend in state of limited/controlled erosion?	3	12	9	25	
	Of those eroding, # w/concomitant point bar formation?	5	12	7	42	
	Apparent Rc within spec?	12	12	12	100	
	Sufficient floodplain access and relief?	12	12	12	100	
						67
E. Bed General	General channel bed aggradation areas (bar formation)	4276	4276	0	100	
	Channel bed degradation–areas of increasing downcutting/headcutting?	4076	4276	4/200	95	
						98
F. Bank	Actively eroding, wasting, or slumping bank	4276	4276	600/4276		
						86
G. Vanes	Free of back or arm scour?	12	19	7	63	
	Height appropriate?	19	19	0	100	
	Angle and geometry appear appropriate?	19	19	0	100	
	Free of piping or other structural failures?	12	19	7	63	
						82
H. Wads/ Boulders	Free of scour?	17	26	9	65	
	Footing stable?	22	26	4	85	
						75

* 27 riffles were reported in the As-built report. Twenty-five were observed during 2006 monitoring
** 49 pools were reported in the As-built report. Thirty-six were observed during 2006 monitoring.
*** 49 thalwegs and meanders were reported in the As-built report. Fifteen were observed during 2006 monitoring.

Two cross sections were not able to be located during 2006 monitoring. In instances where cross sections were not located, URS re-established the cross sections. Data from these cross sections are not comparable to data reported in 2005 monitoring reports. The re-establishment of pins effectively relocates the cross sections.

URS has plotted these data on the same graph for reference only. The data and/or graph should not be used to interpret channel change. Such cross sections include:

- Little Bugaboo Creek, cross section 3
- Little Bugaboo Creek, cross section 4

UNNAMED TRIBUTARY

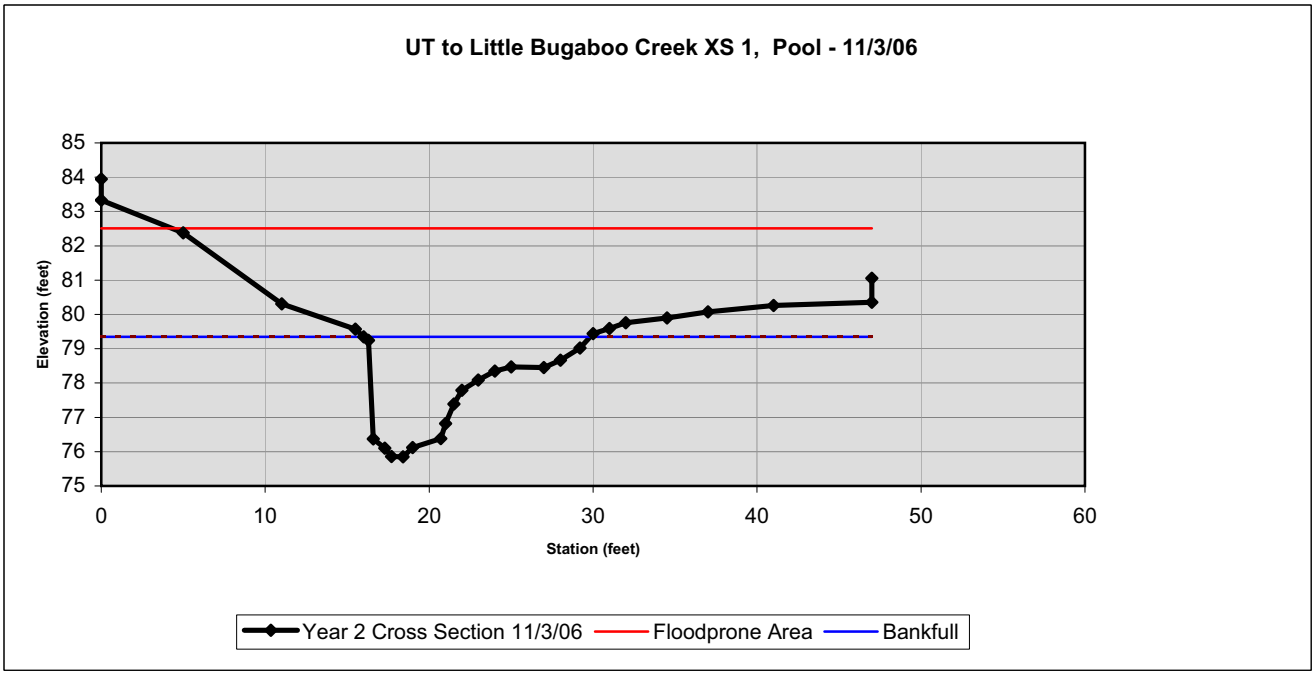
As-Built and MY1 cross section data were not provided.

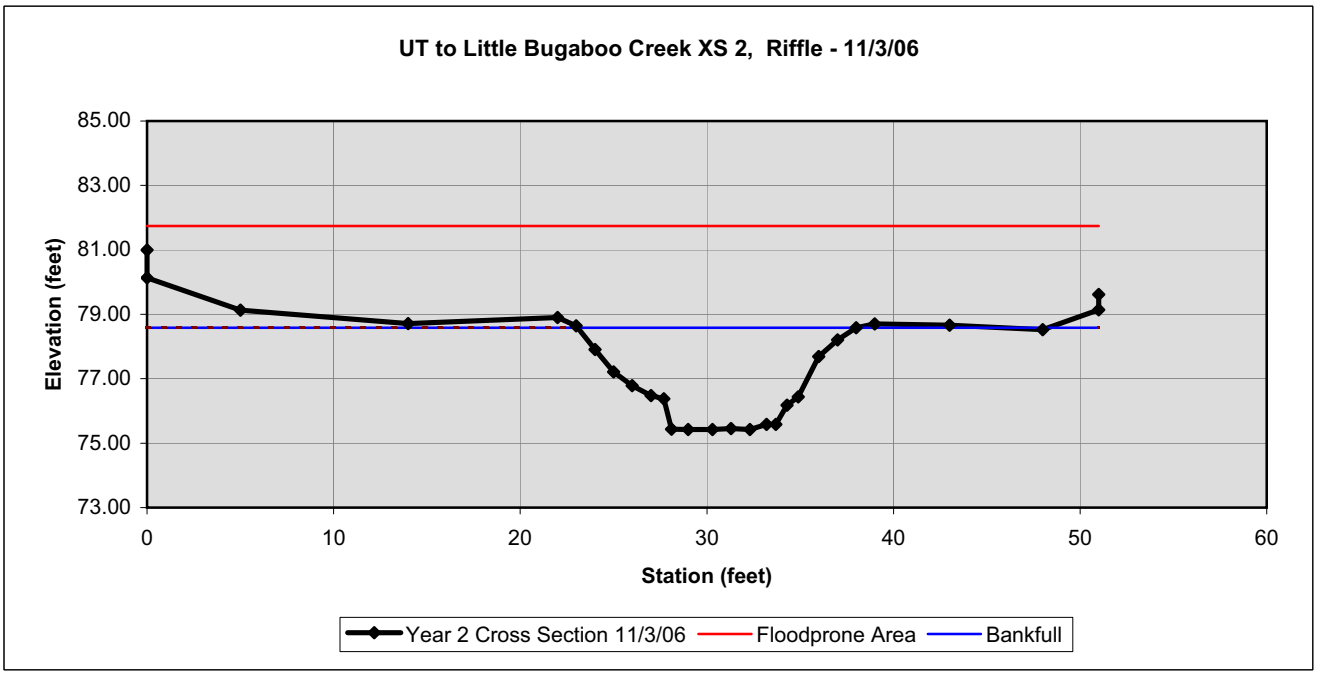

XS1 facing left bank


XS1 facing right bank


XS2 facing left bank


XS2 facing right bank


UT to Little Bugaboo Creek XS 1, Pool - 11/3/06
Elevation (feet)
85
84
83
82
81
80
79
78
77
76
75
0
10
20
30
40
50
60
Station (feet)
Year 2 Cross Section 11/3/06
Floodprone Area
Bankfull


UT to Little Bugaboo Creek XS 2, Riffle - 11/3/06
Elevation (feet)
85.00
83.00
81.00
79.00
77.00
75.00
73.00
0
10
20
30
40
50
60
Station (feet)
Year 2 Cross Section 11/3/06
Floodprone Area
Bankfull

LITTLE BUGABOO CREEK


XS3 facing left bank


XS3 facing right bank


XS4 facing left bank

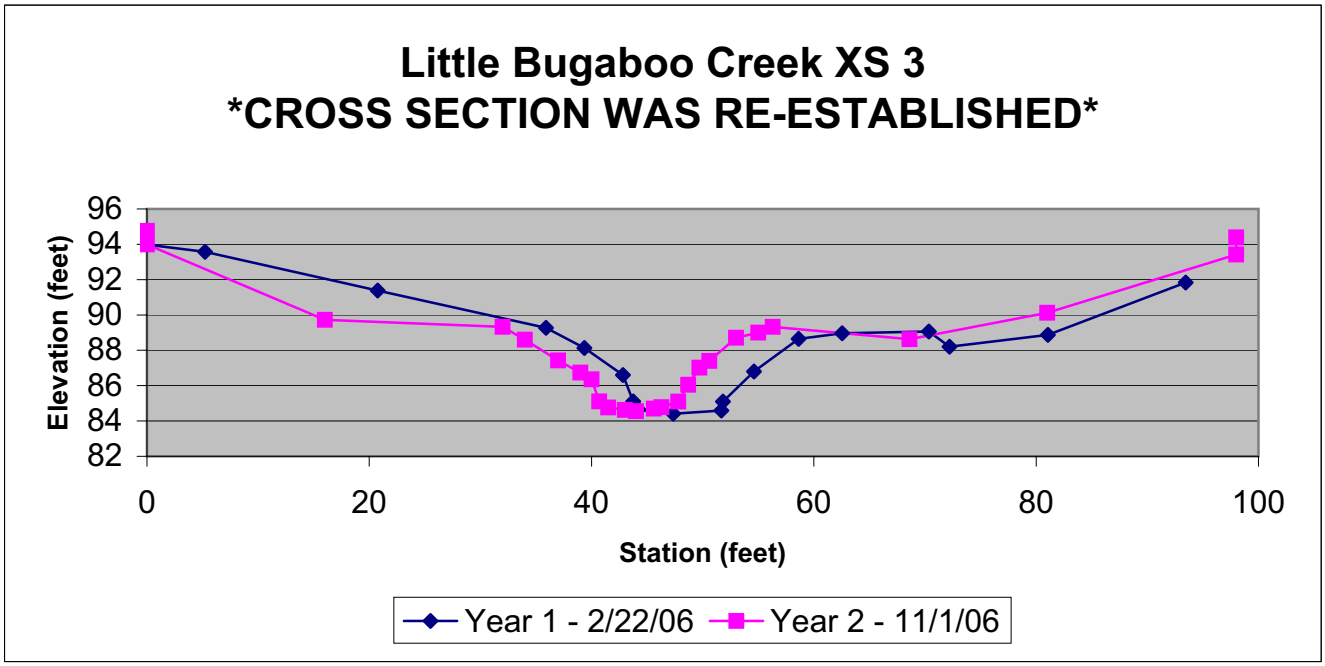

XS4 facing right bank

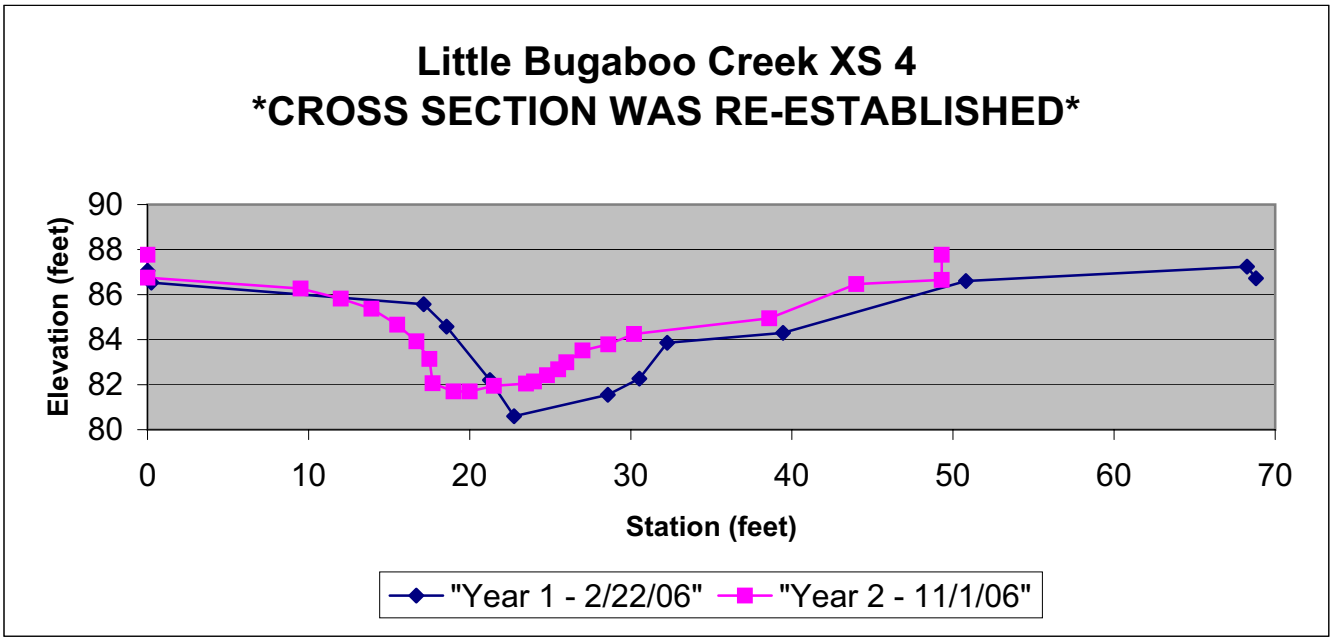

XS5 facing left bank

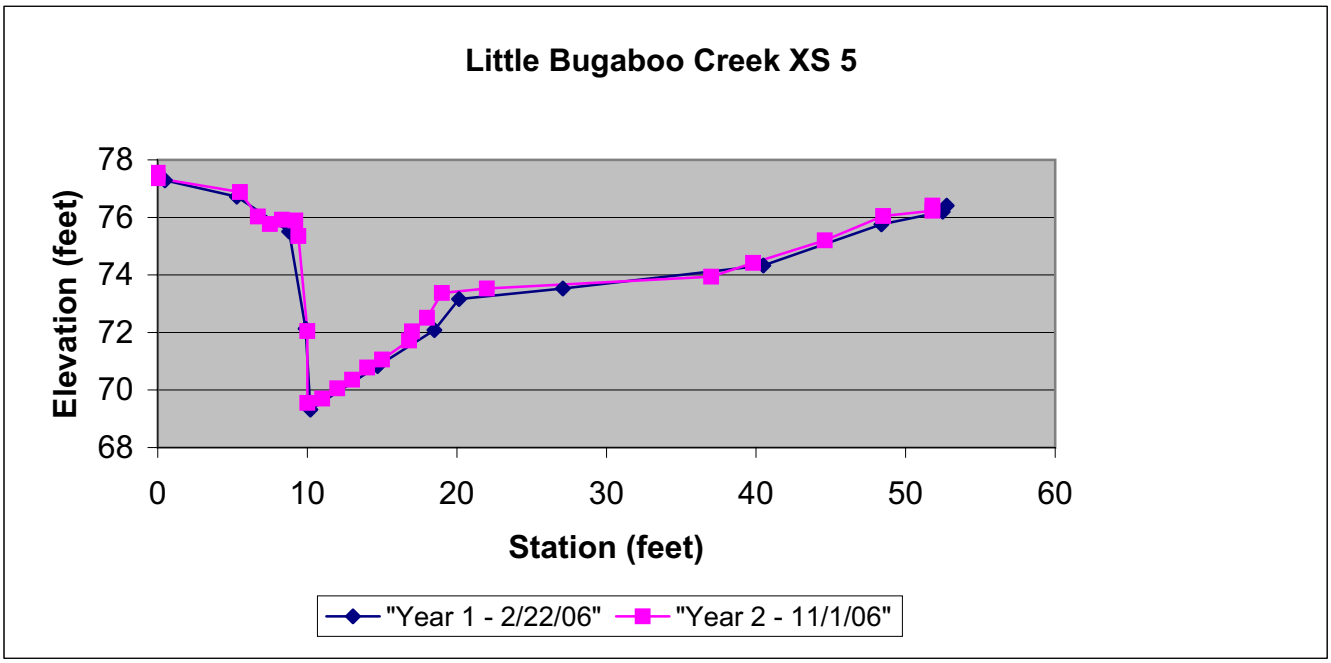

XS5 facing right bank

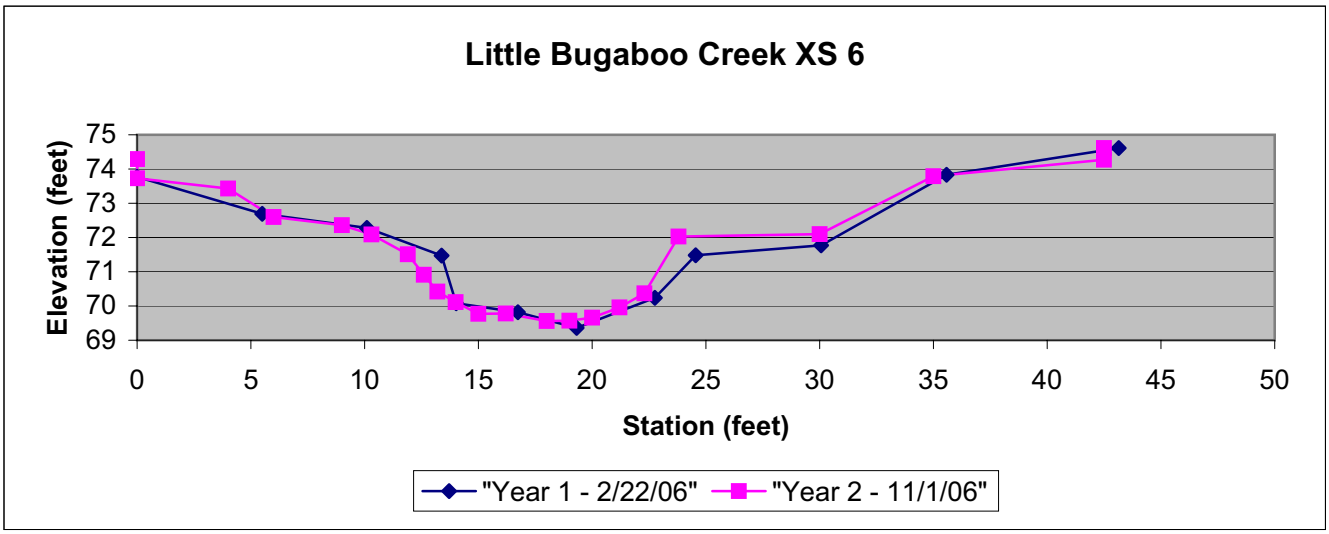

XS6 facing left bank


XS6 facing right bank


Little Bugaboo Creek XS 3
CROSS SECTION WAS RE-ESTABLISHED
Elevation (feet)
96
94
92
90
88
86
84
82
0
20
40
60
80
100
Station (feet)
Year 1 - 2/22/06
Year 2 - 11/1/06


Little Bugaboo Creek XS 4
CROSS SECTION WAS RE-ESTABLISHED
Elevation (feet)
90
88
86
84
82
80
0
10
20
30
40
50
60
70
Station (feet)
"Year 1 - 2/22/06"
"Year 2 - 11/1/06"

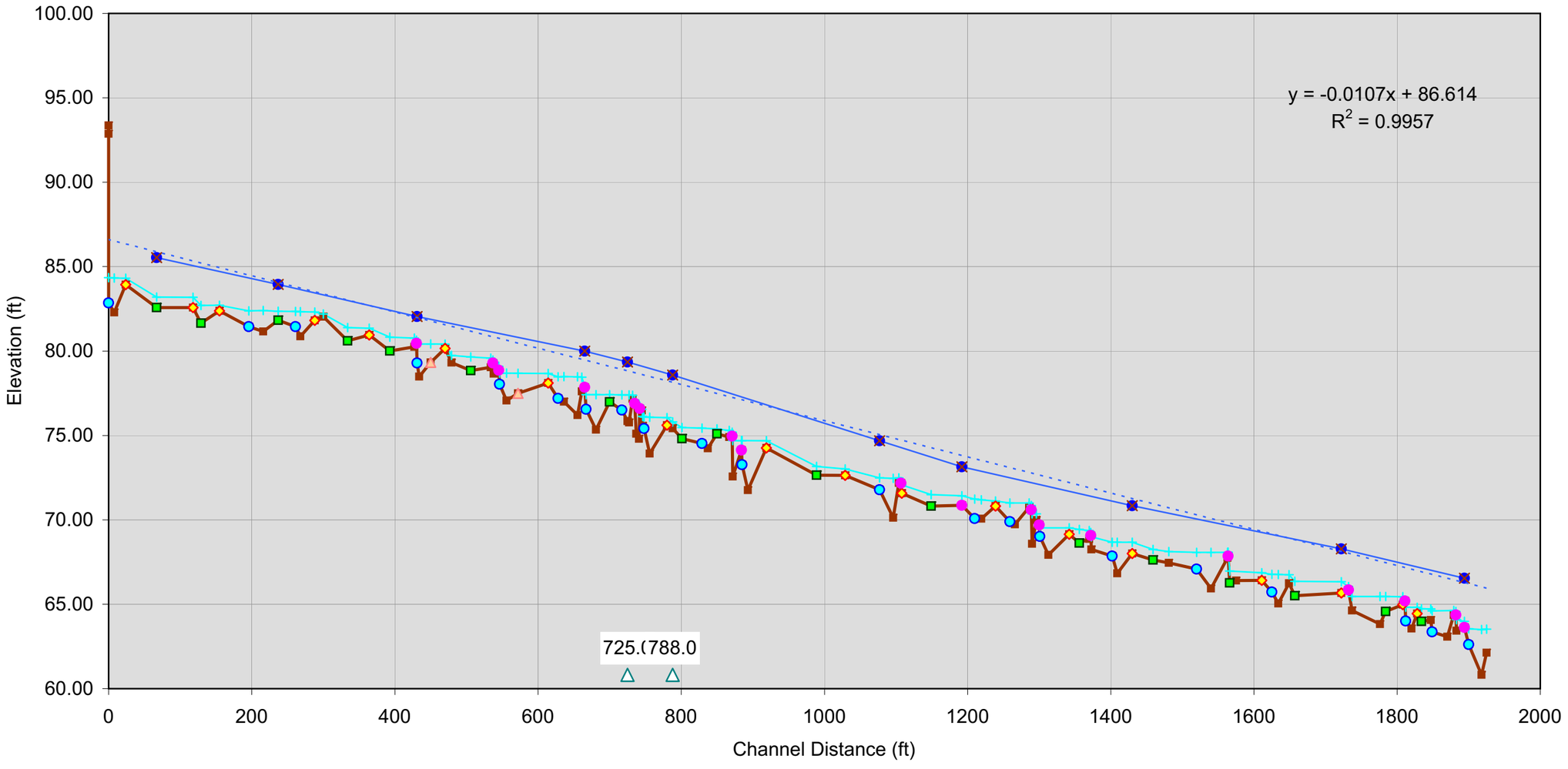

Little Bugaboo Creek XS 5
Elevation (feet)
78
76
74
72
70
68
0
10
20
30
40
50
60
Station (feet)
"Year 1 - 2/22/06"
"Year 2 - 11/1/06"


Little Bugaboo Creek XS 6
Elevation (feet)
75
74
73
72
71
70
69
0
5
10
15
20
25
30
35
40
45
50
Station (feet)
"Year 1 - 2/22/06"
"Year 2 - 11/1/06"

UNNAMED TRIBUTARY

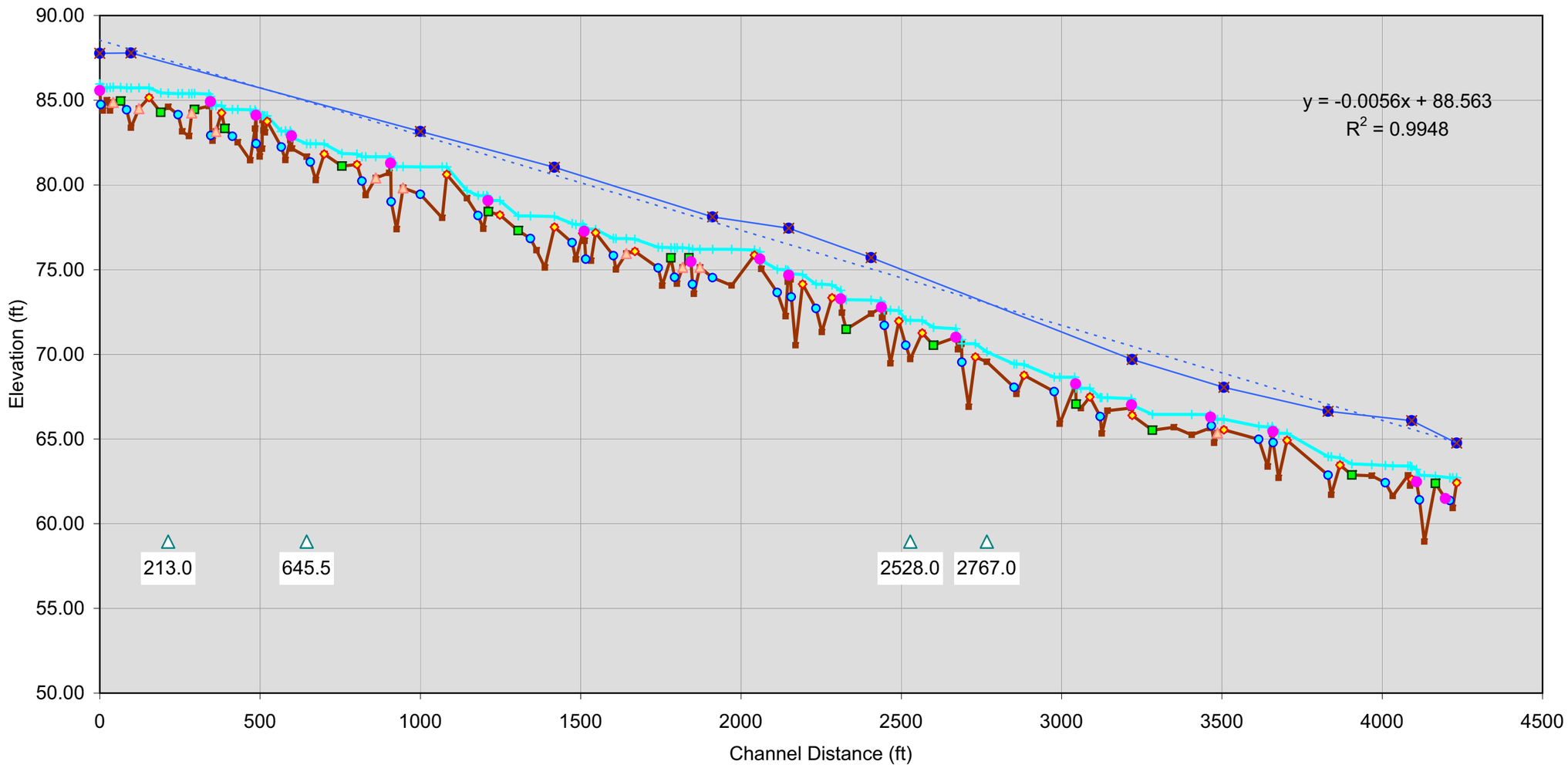
As-Built and MY1 longitudinal data were not provided.

UT to Little Bugaboo Creek 11/3/06



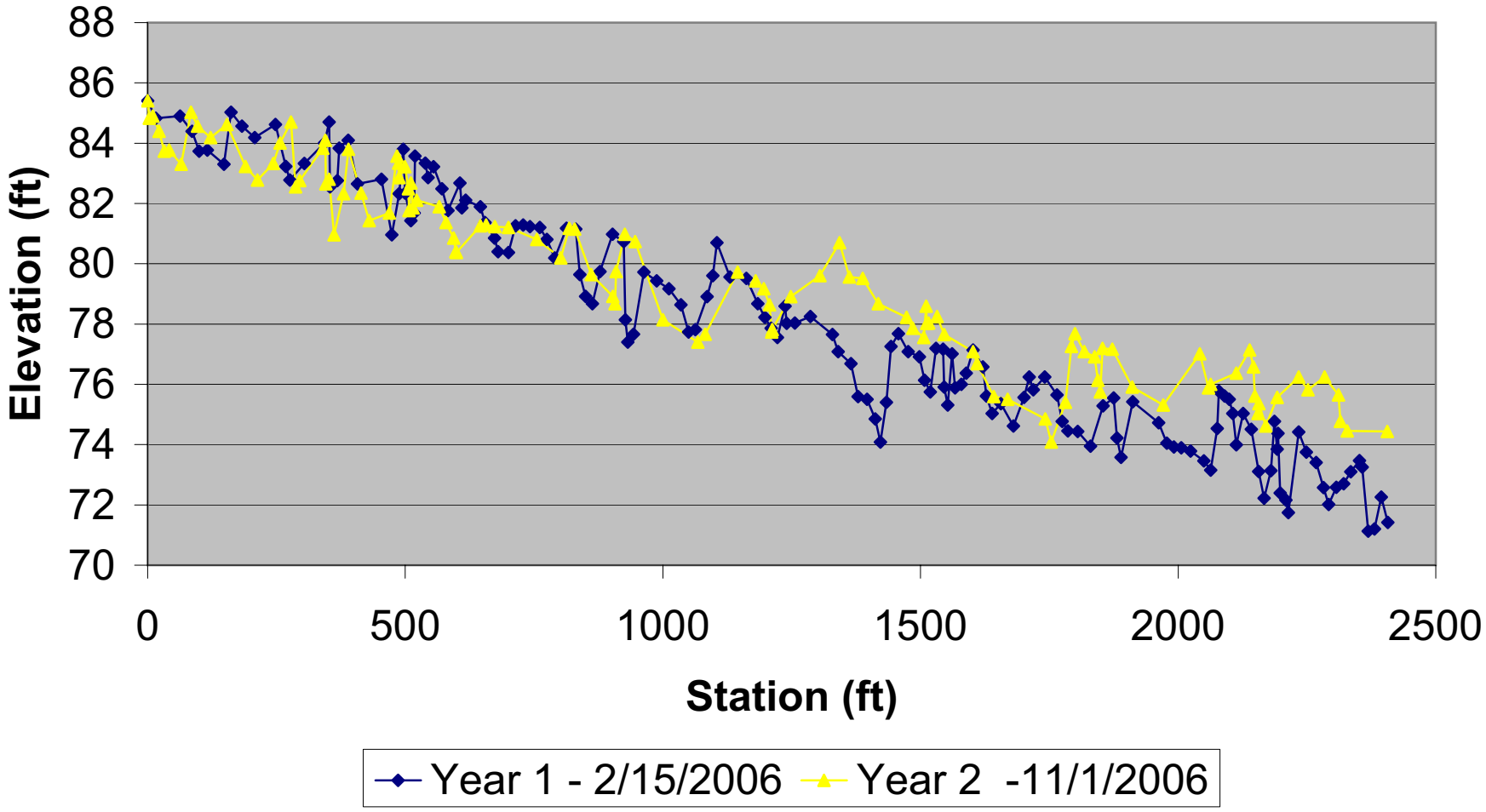
LITTLE BUGABOO CREEK

Little Bugaboo Creek 11/1/06



Little Bugaboo Creek

PROFILE GRAPHS MAY NOT ALIGN HORIZONTALLY. ECOLOGIC STATIONING WILL DIFFER FROM URS STATIONING.



UNNAMED TRIBUTARY

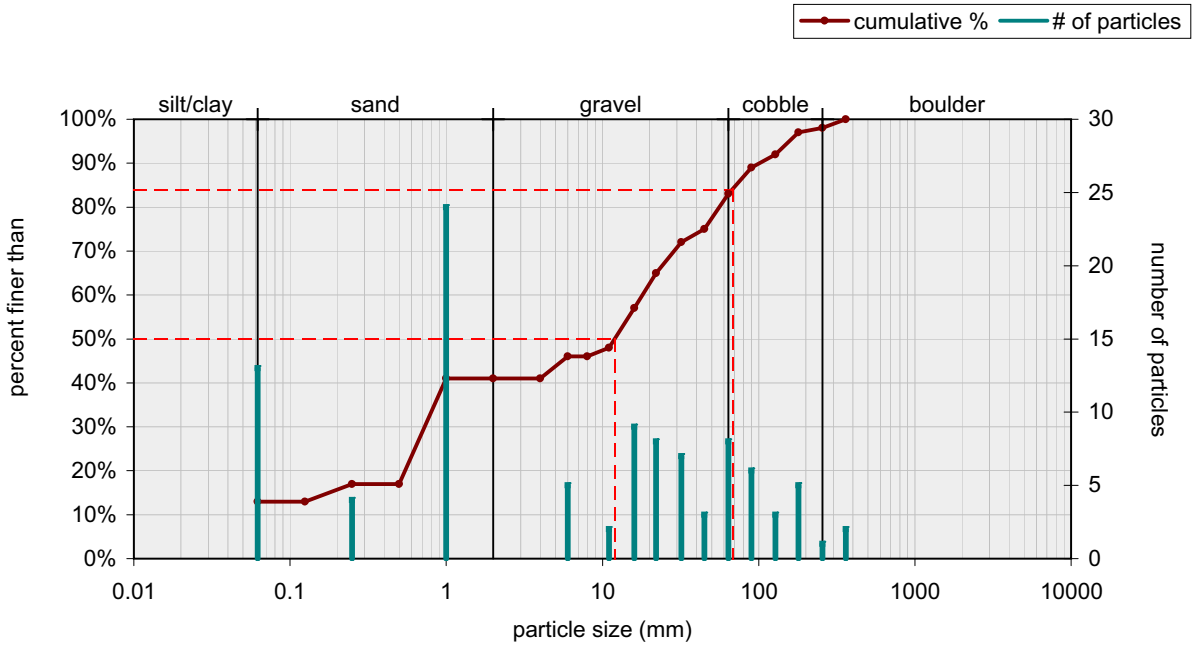
1) Individual Pebble Count

Two individual samples may be entered below. Select sample type for each.

Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**13**
very fine sand	0.062 - 0.125	
fine sand	0.125 - 0.25	**4**
medium sand	0.25 - 0.5	
coarse sand	0.5 - 1	**24**
very coarse sand	1 - 2	
very fine gravel	2 - 4	
fine gravel	4 - 6	**5**
fine gravel	6 - 8	
medium gravel	8 - 11	**2**
medium gravel	11 - 16	**9**
coarse gravel	16 - 22	**8**
coarse gravel	22 - 32	**7**
very coarse gravel	32 - 45	**3**
very coarse gravel	45 - 64	**8**
small cobble	64 - 90	**6**
medium cobble	90 - 128	**3**
large cobble	128 - 180	**5**
very large cobble	180 - 256	**1**
small boulder	256 - 362	**2**
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		100
bedrock ----------		
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		100

Note:



Size (mm)	
D16	0.21
D35	0.84
D50	12
D65	22
D84	68
D95	160

Size Distribution	
mean	3.8
dispersion	31.4
skewness	-0.32

Type	
silt/clay	13%
sand	28%
gravel	42%
cobble	15%
boulder	2%

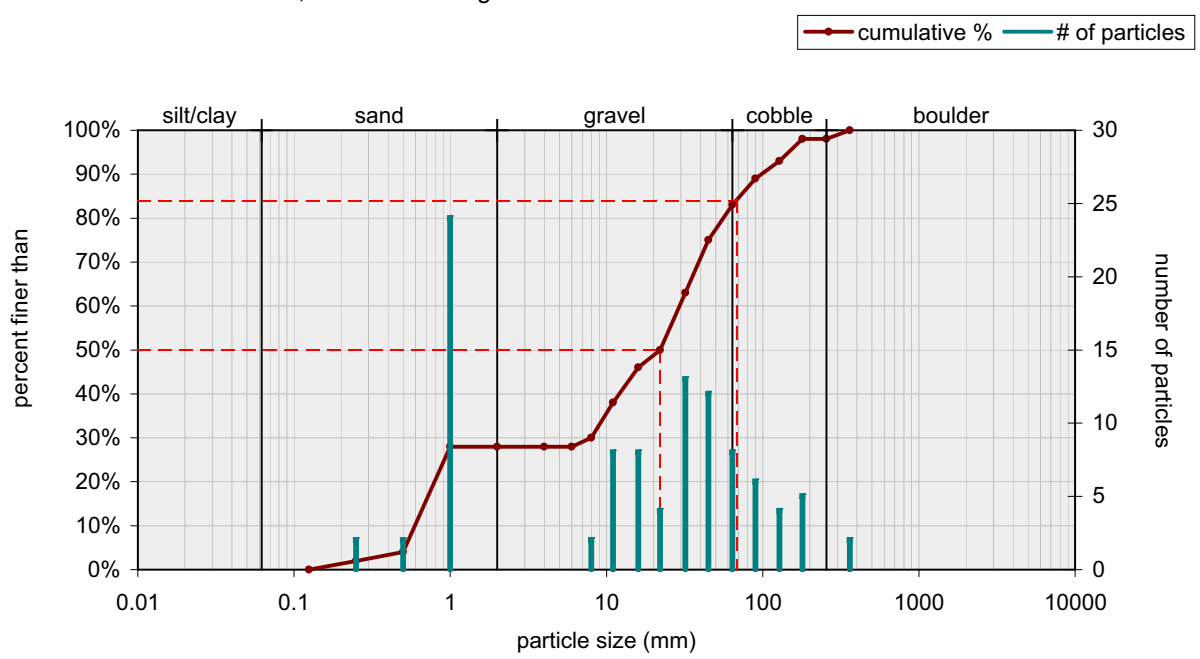
1) Individual Pebble Count

Two individual samples may be entered below. Select sample type for each.

Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	
very fine sand	0.062 - 0.125	
fine sand	0.125 - 0.25	**2**
medium sand	0.25 - 0.5	**2**
coarse sand	0.5 - 1	**24**
very coarse sand	1 - 2	
very fine gravel	2 - 4	
fine gravel	4 - 6	
fine gravel	6 - 8	**2**
medium gravel	8 - 11	**8**
medium gravel	11 - 16	**8**
coarse gravel	16 - 22	**4**
coarse gravel	22 - 32	**13**
very coarse gravel	32 - 45	**12**
very coarse gravel	45 - 64	**8**
small cobble	64 - 90	**6**
medium cobble	90 - 128	**4**
large cobble	128 - 180	**5**
very large cobble	180 - 256	
small boulder	256 - 362	**2**
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		100
bedrock ----------		
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		100

Note:



Size (mm)	
D16	0.71
D35	9.8
D50	22
D65	34
D84	68
D95	150

Size Distribution	
mean	6.9
dispersion	17.0
skewness	-0.36

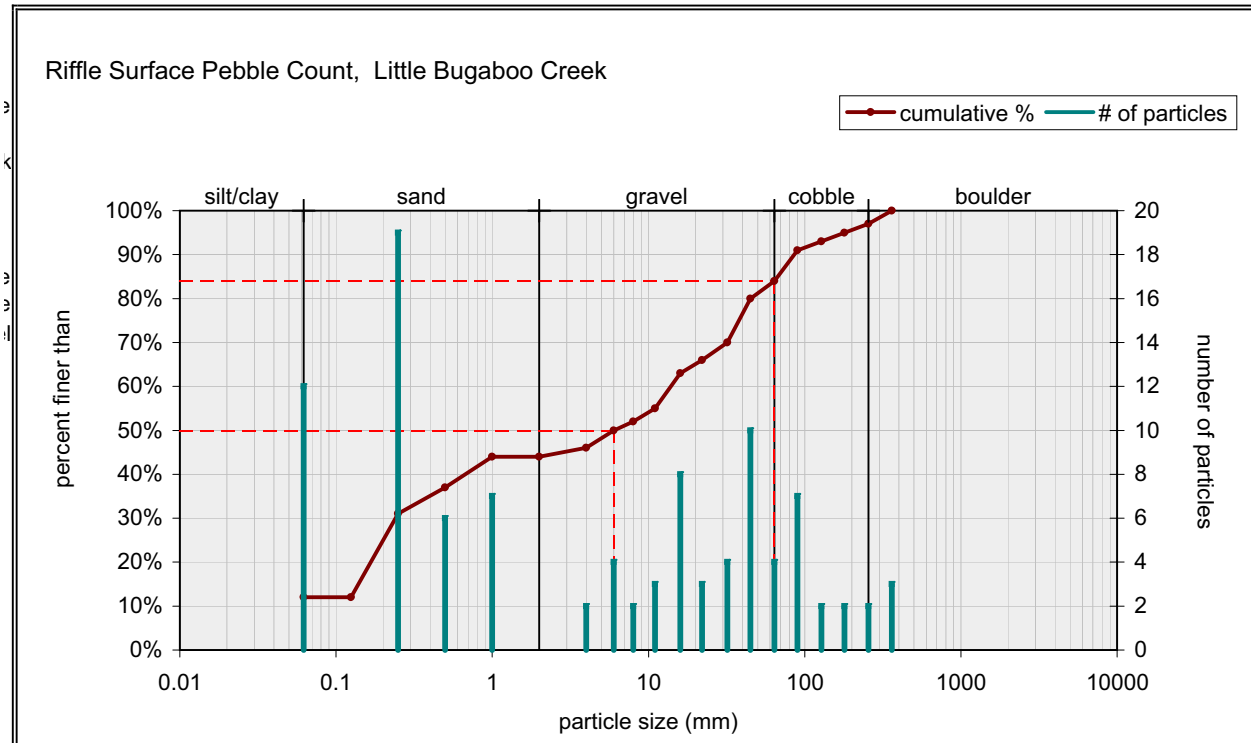
Type	
silt/clay	0%
sand	28%
gravel	55%
cobble	15%
boulder	2%

LITTLE BUGABOO CREEK

Riffle Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**12**
very fine sand	0.062 - 0.125	
fine sand	0.125 - 0.25	**19**
medium sand	0.25 - 0.5	**6**
coarse sand	0.5 - 1	**7**
very coarse sand	1 - 2	
very fine gravel	2 - 4	**2**
fine gravel	4 - 6	**4**
fine gravel	6 - 8	**2**
medium gravel	8 - 11	**3**
medium gravel	11 - 16	**8**
coarse gravel	16 - 22	**3**
coarse gravel	22 - 32	**4**
very coarse gravel	32 - 45	**10**
very coarse gravel	45 - 64	**4**
small cobble	64 - 90	**7**
medium cobble	90 - 128	**2**
large cobble	128 - 180	**2**
very large cobble	180 - 256	**2**
small boulder	256 - 362	**3**
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		100
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
total count:		100

Note:



Size (mm)	
D16	0.14
D35	0.4
D50	6
D65	20
D84	64
D95	180

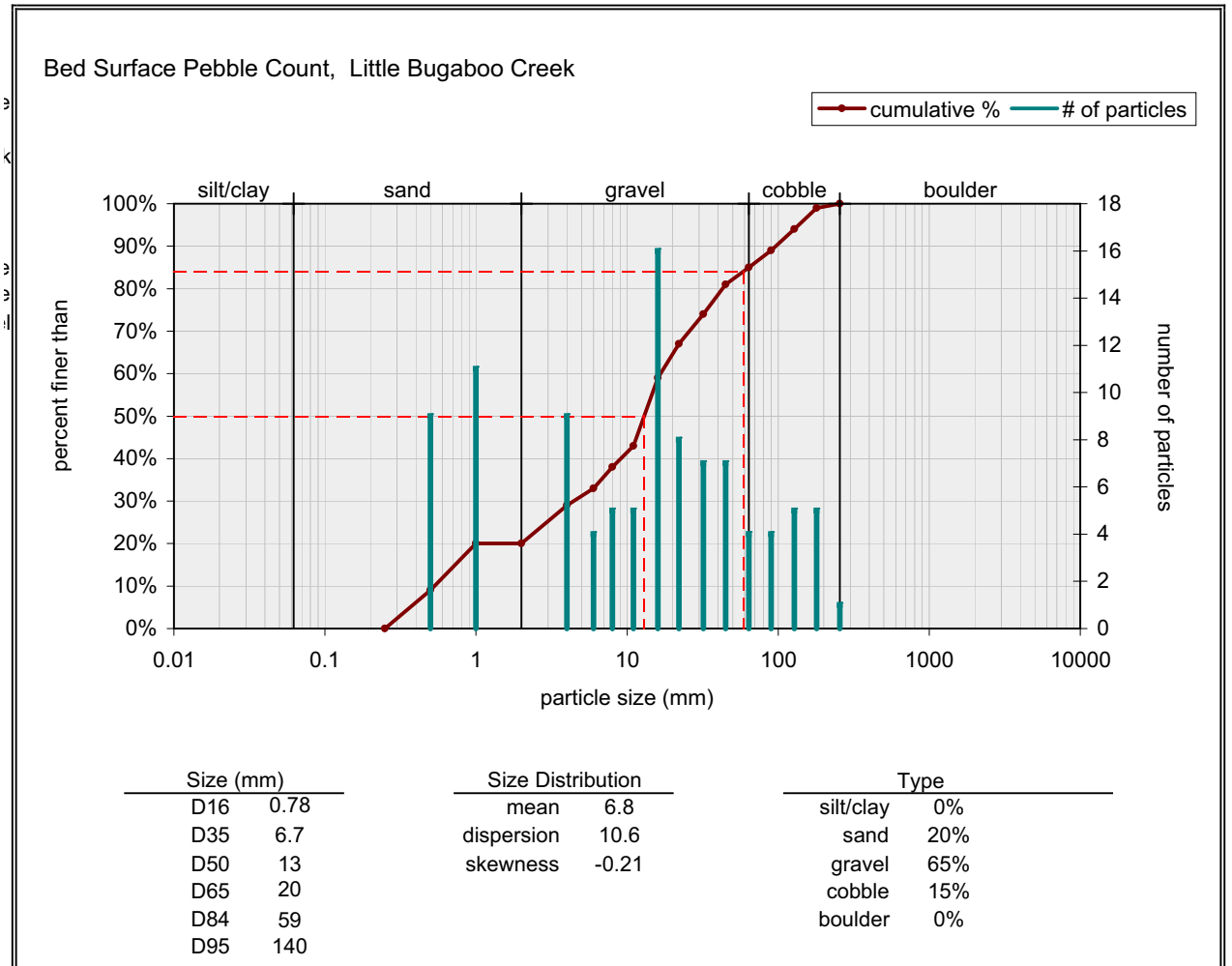
Size Distribution	
mean	3.0
dispersion	26.8
skewness	-0.19

Type	
silt/clay	12%
sand	32%
gravel	40%
cobble	13%
boulder	3%

Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	
very fine sand	0.062 - 0.125	
fine sand	0.125 - 0.25	
medium sand	0.25 - 0.5	**9**
coarse sand	0.5 - 1	**11**
very coarse sand	1 - 2	
very fine gravel	2 - 4	**9**
fine gravel	4 - 6	**4**
fine gravel	6 - 8	**5**
medium gravel	8 - 11	**5**
medium gravel	11 - 16	**16**
coarse gravel	16 - 22	**8**
coarse gravel	22 - 32	**7**
very coarse gravel	32 - 45	**7**
very coarse gravel	45 - 64	**4**
small cobble	64 - 90	**4**
medium cobble	90 - 128	**5**
large cobble	128 - 180	**5**
very large cobble	180 - 256	**1**
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		100
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
total count:		100

Note:



Size (mm)	
D16	0.78
D35	6.7
D50	13
D65	20
D84	59
D95	140

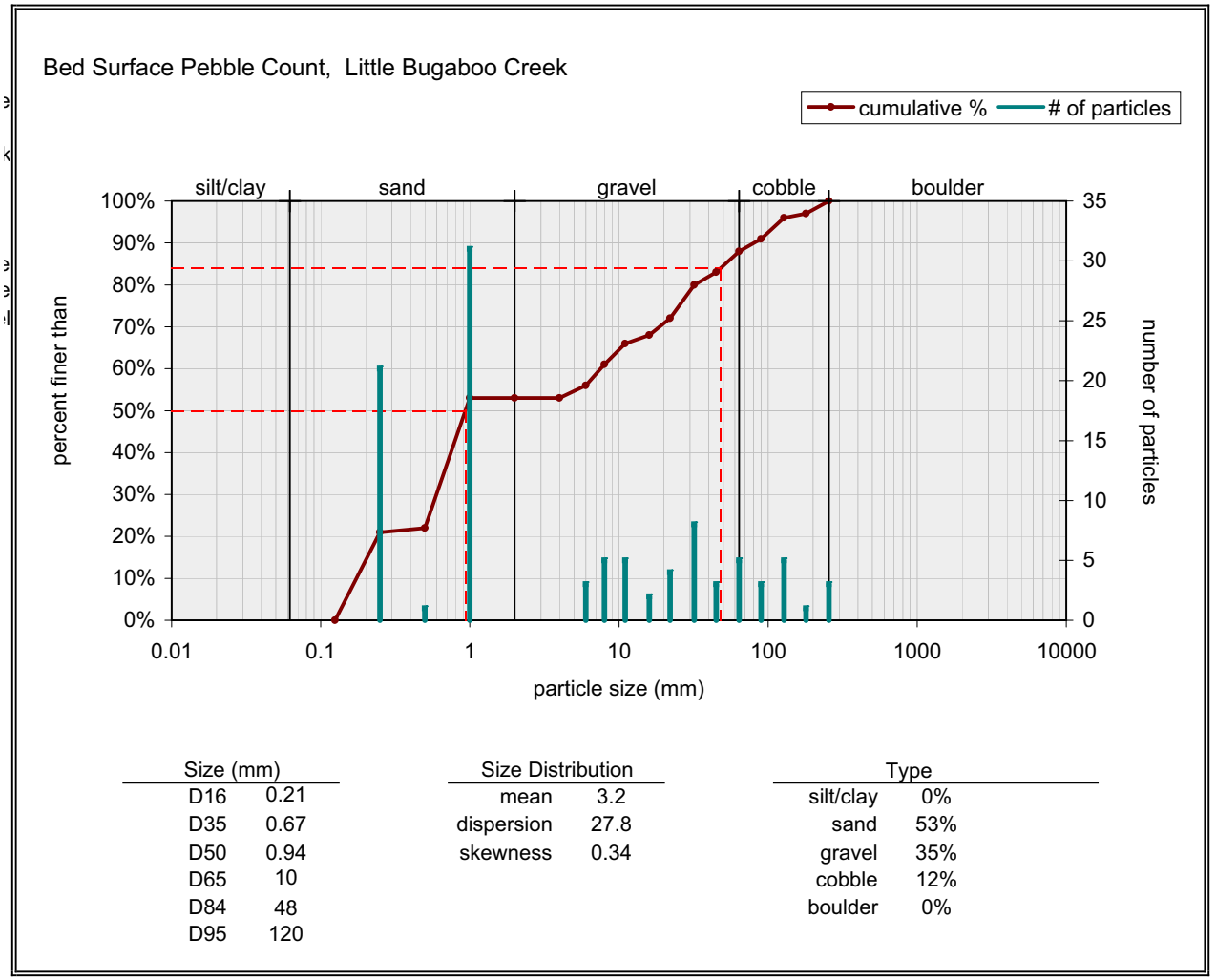
Size Distribution	
mean	6.8
dispersion	10.6
skewness	-0.21

Type	
silt/clay	0%
sand	20%
gravel	65%
cobble	15%
boulder	0%

Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	
very fine sand	0.062 - 0.125	
fine sand	0.125 - 0.25	**21**
medium sand	0.25 - 0.5	**1**
coarse sand	0.5 - 1	**31**
very coarse sand	1 - 2	
very fine gravel	2 - 4	
fine gravel	4 - 6	**3**
fine gravel	6 - 8	**5**
medium gravel	8 - 11	**5**
medium gravel	11 - 16	**2**
coarse gravel	16 - 22	**4**
coarse gravel	22 - 32	**8**
very coarse gravel	32 - 45	**3**
very coarse gravel	45 - 64	**5**
small cobble	64 - 90	**3**
medium cobble	90 - 128	**5**
large cobble	128 - 180	**1**
very large cobble	180 - 256	**3**
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		100
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
total count:		100

Note:



Size (mm)	
D16	0.21
D35	0.67
D50	0.94
D65	10
D84	48
D95	120

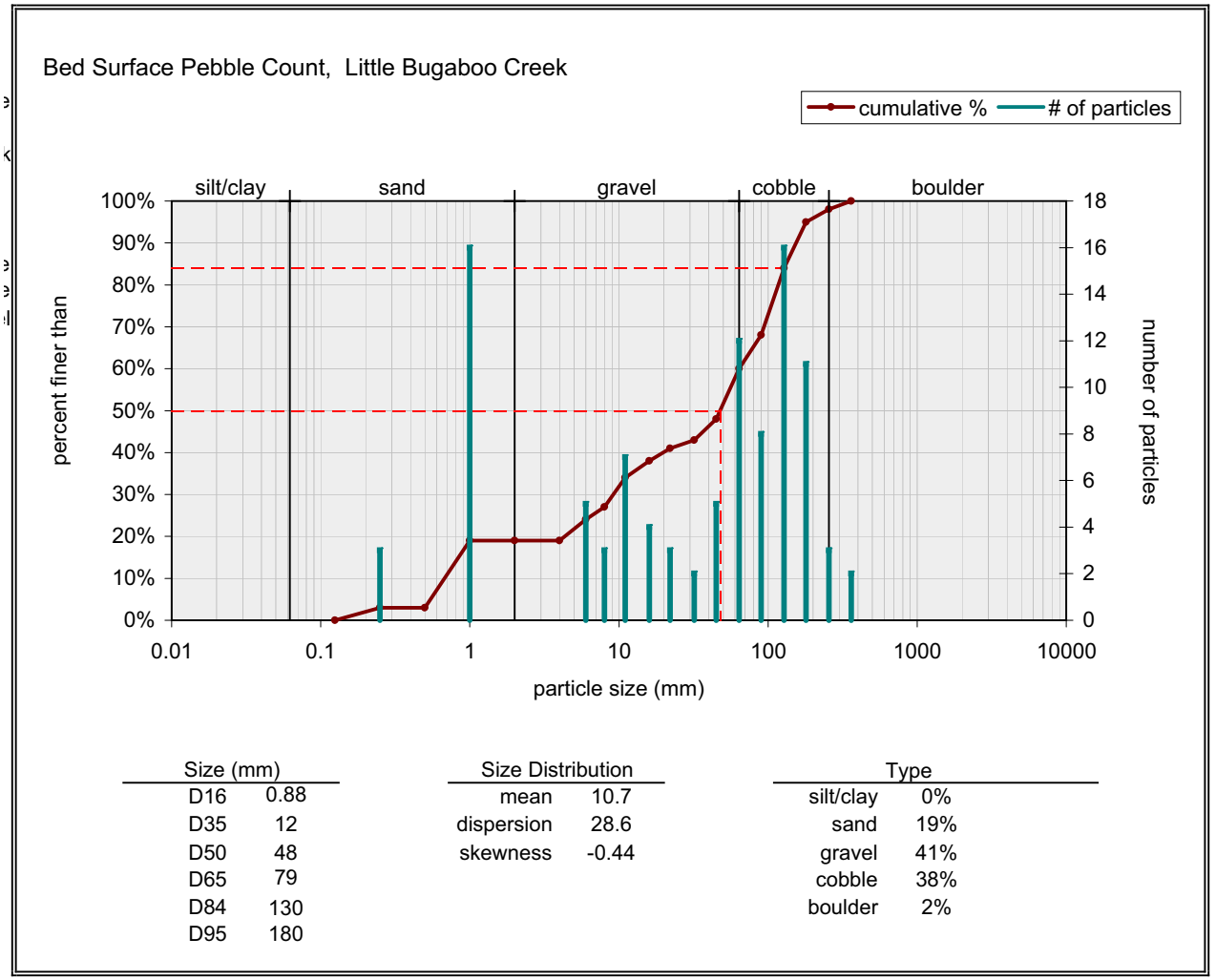
Size Distribution	
mean	3.2
dispersion	27.8
skewness	0.34

Type	
silt/clay	0%
sand	53%
gravel	35%
cobble	12%
boulder	0%

Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	
very fine sand	0.062 - 0.125	
fine sand	0.125 - 0.25	**3**
medium sand	0.25 - 0.5	
coarse sand	0.5 - 1	**16**
very coarse sand	1 - 2	
very fine gravel	2 - 4	
fine gravel	4 - 6	**5**
fine gravel	6 - 8	**3**
medium gravel	8 - 11	**7**
medium gravel	11 - 16	**4**
coarse gravel	16 - 22	**3**
coarse gravel	22 - 32	**2**
very coarse gravel	32 - 45	**5**
very coarse gravel	45 - 64	**12**
small cobble	64 - 90	**8**
medium cobble	90 - 128	**16**
large cobble	128 - 180	**11**
very large cobble	180 - 256	**3**
small boulder	256 - 362	**2**
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		100
bedrock ----------		
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		100

Note:



Size (mm)	
D16	0.88
D35	12
D50	48
D65	79
D84	130
D95	180

Size Distribution	
mean	10.7
dispersion	28.6
skewness	-0.44

Type	
silt/clay	0%
sand	19%
gravel	41%
cobble	38%
boulder	2%