Lyle Creek Restoration

2003 Annual Monitoring Report

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March, 2004

Ecosystem Enhancement PROGRAM

NCDENR

NC STATE UNIVERSITY

2003 Lyle Creek Monitoring Abstract

An Unnamed Tributary to Lyle Creek was enhanced/restored through the North Carolina Wetlands Restoration Program (NCWRP). The objectives of the project are to:

1.) Establish an stable dimension, pattern and profile on 2260 feet of Lyle Creek
2.) Improve habitat within Little Lyle Creek
3.) Establish an riparian buffer along Lyle Creek

This is the 2nd year of the 5-year monitoring plan for Lyle Creek.

Table 1A. Background Information

Project Name	Lyle Creek
Designer's Name	Eco-Science Corporation 1101 Haynes Street, Suite 101 Raleigh, NC 27604
Contractor's Name	North State Environmental, Inc.
Project County	Catawba County, North Carolina
Directions to Project Site	From Interstate I-40 take Exit 138. Head south on Oxford School Rd for 0.1 mile. Turn right on Wyke Rd follow Wyke Rd for 1 mile. Turn Right on US-70, follow US-70 for 0.2 mile. The project approximately located 1000ft upstream of the US-70 Bridge over Lyle Creek.
Drainage Area	0.5 sq. mi.
USGS Hydro Unit	3050101
NCDWQ Subbasin	11-01-76
Project Length	2,400 Linear feet
Restoration Approach	1,345-feet of dimension, pattern, and profile 1,055-feet of bank and riparian enhancement
Date of Completion	July, 2002
Monitoring Dates	February, 2003; November, 2003

Results and Discussion

Overall, while the majority of the stream is functioning and is holding grade, the stream has two major areas of concern that total 425 linear feet and should be maintained as soon as possible. Table 2 shows a summary of monitoring measurement results. Overall the project is performing well. Channel dimension, pattern, and profile are similar to as-built conditions with the exceptions of some limited areas of bank slumping and the 425 linear feet of concern. Vegetation is not succeeding to levels required for mitigation credit. Placed structures are holding grade and functioning well. Concerns include two headcuts, areas with bank slumping and erosion, piping and large drops off a few structures

Table 2A. Summary of Channel Conditions

DIMENSION	Lyle Creek In-Place Reach Cross-section #1 Pool		Lyle Creek In-Place Reach Cross-section #2 Riffle		Lyle Creek In-Place Reach Cross-section #3 Riffle		Lyle Creek Relocation Reach Cross-section #4 Riffle		Lyle Creek Relocation Reach Cross-section #5 Riffle		Lyle Creek Relocation Reach Cross-section #6 Pool		Lyle Creek Relocation Reach Cross-section #7 Riffle	
	As-built	2003	As-built	2003	As-built	2003	As-built	2003	As-built	2003	As-built	2003	As-built	2003
Bankfull Cross-sectional Area	20.8	14.1	16.5	28.1	15.6	26.1	17.5	17.8	16.9	20.7	19.6	27.3	15.2	16.2
Bankfull Width	16.3	16.5	11.8	18.6	13.2	16.2	10.8	10.8	10.7	13.9	12.8	13.5	11.2	11.2
Bankfull Mean Depth	1.3	0.9	1.4	1.5	1.2	1.6	1.6	1.6	1.6	1.5	1.5	2.0	1.4	1.4
Bankfull Max Depth	3.1	1.7	2.2	2.4	2.2	2.0	2.7	2.6	2.5	2.6	2.8	2.7	2.2	2.1

PATTERN	Lyle Creek As-built			Lyle Creek 2003			Lyle Creek (in place) As-built			Lyle Creek (in place) 2003		
	Minimum	Maximum	Median	Minimum	Maximum	Median	Minimum	Maximum	Median	Minimum	Maximum	Median
Meander Wave Length	33	114	63	49	150	71	Not Reported			59	177	149
Radius of Curvature	14.9	37.5	22.4	16.7	38.5	20.9	Not Reported			13.3	48.6	30.9
Beltwidth	33	141	88	22	56	33	Not Reported			42	109	55

PROFILE	Lyle Creek As-built			Lyle Creek 2003			Lyle Creek (in place) As-built			Lyle Creek (in place) 2003		
	Minimum	Maximum	Median	Minimum	Maximum	Median	Minimum	Maximum	Median	Minimum	Maximum	Median
Riffle Length	Not Reported			7	39	17	Not Reported			9	68	21
Riffle Slope	0.00%	3.64%	1.41%	0.56%	4.94%	1.71%	Not Reported			0.17%	4.74%	2.12%
Pool Length	14	64	27	9	41	23	Not Reported			11	49	27
Pool to Pool Spacing	22	161	54	27	176	46	Not Reported			28	140	66

SUBSTRATE	Lyle Creek Cross-section #1 Pool		Lyle Creek Cross-section #2 Riffle		Lyle Creek Cross-section #3 Riffle		Lyle Creek Cross-section #4 Riffle		Lyle Creek Cross-section #5 Riffle		Lyle Creek Cross-section #6 Pool		Lyle Creek Cross-section #7 Riffle	
	As-built	2003	As-built	2003	As-built	2003	As-built	2003	As-built	2003	As-built	2003	As-built	2003
D50	0.09	0.29	0.19	0.29	0.19	0.45	0.19	0.11	0.19	0.33	0.09	0.71	0.19	0.34
D85	0.52	0.76	15.91	13.33	15.91	1.01	15.91	3.11	15.91	17.52	0.52	31.78	15.91	3.00

VEGETATION	Quad 1 Lyle Creek		Quad 2 Lyle Creek		Quad 3 Lyle Creek		Quad 4 Lyle Creek	
	Observed	Planted	Observed	Planted	Observed	Planted	Observed	Planted
Tree Stratum (trees/acre)	720	0	520	40	600	240	12560	0
Shrub Stratum (% cover)	1.0	-	1.0	-	8.5	-	15.5	-
Herb Stratum (%cover)	62.5	-	184	-	171.5	-	152.2	-

The following areas of concern should be monitored closely and considered for repair as suggested:

- **Easement Limits**
  - NCWRP should work with landowners to ensure easement limits are maintained and that cattle stay out of the riparian area.
- **Areas of major head cuts**
  - There are two areas of major head cut approximately 425 ft
  - The first area has a maximum head cut of one foot and is approximately 190 ft in length this head cut is located from station 13+20 to 15+10. There is still two hundred foot upstream until the next structure controlling grade
  - The first area has a maximum head cut of six inches and is approximately 235 ft in length this head cut is located from station 17+90 to 20+25. There is still three hundred foot upstream until the next structure controlling grade
- **Areas with bank slumping**
  - These areas should be planted heavily with live stakes to help establish root mass along the channel bank.
  - These areas should be monitored closely during upcoming site visits to determine if the problem is localized to more regional in scale.
  - Overland flow may need to be routed away from areas that show signs of severe bank erosion
- **Areas lacking stream features**
  - There are seven riffles that were constructed that do not exist in the longitudinal profile measured during the 2003 monitoring
  - Some of the riffles that have been removed as a result of the major head cuts in the two sections listed above
  - The remainder of the failed riffles have been transformed into runs or glides
- **Areas showing stream pattern adjustments**
  - There are two areas that have shown a significant change in stream pattern
  - The first section is from station 14+00 to 15+00 there is half of a meander wavelength that has been straightened into a long run this is the result of the head cut mentioned above
  - The second section is from station 20+50 to 22+20 there an entire meander wavelength that has been straightened into a run followed by a long step pool feature at the end of the project.
- **Vegetation Concerns**
  - Natural regeneration appears to be dominant and should continue to be monitored for growth habits.
  - Planting more trees if required for mitigation at this time the tree stems per acre is 70 but it appears that natural regeneration will be able to raise the tree stems per acre to the level for mitigation credit
  - It is recommended to stake in areas where erosion is problematic in a few areas, particularly on outside meander bends
  - The invasive vegetation requires no treatment at this time.
  - Adjacent side slope should be stabilized to reduced sediment from washing into the creek.

Photos

The following are photographs of typical sections and areas of concern throughout the project.

Typical Riffle on Lyle Creek.

Typical Pool on Lyle Creek.

Issue Photo 1
Cattle within the Lyle Creek Easement.

Issue Photo 2 – Station 11+00
Bank undercutting due to lack of vegetation.

Issue Photo 3 and 4 – Station 16+90
Bank failure due to overland flow.

Issue Photo 5 – Station 10+40
Bank failure under matting.

Issue Photo 6 – Station 15+80
Bank erosion due to lack of vegetation.

Issue Photo 7 – Station 15+00
Bank Failure under matting.

Issue Photo 8 – Station 13+70
Severe bank erosion.

Issue Photo 9 – Station 13+40
Scour around upstream side of cross vane wing.

Issue Photo 9A – Station 18+50
Scour around upstream side of cross vane wing.

Issue Photo 9B – Station 19+70
Scour below cross vane.

Figure 1. Project Plan view.

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Tables and Figures

1.0 BACKGROUND INFORMATION

The background information for this report is referenced from previous monitoring reports conducted by Eco-Science, Inc. The following was excerpted from 2003 Eco-Science monitoring report:

> The N.C. Wetlands Restoration Program (WRP) has developed a stream mitigations site within the northeastern Piedmont region of the Catawba River basin. As part of this effort, WRP has implemented detailed mitigation plans for the Lyle Creek Mitigation Site (hereafter referred to as the "Site"), an approximately 12.4-acre tract located along an unnamed tributary to Lyle Creek, approximately 3 miles west of the Catawba River. This region of the state is located within U.S. Geological Survey subbasin 03050101 (USGS 1974) (Figure 1). The Site is situated between U.S. Interstate Route 40 (I-40) and U.S. Route 70, approximately three miles west of the Catawba and Iredell County line.
>
> The Site historically was utilized for agricultural hay production and livestock grazing. On-site streams are characterized as first- to second-order streams which have been degraded by past land uses, including vegetation clearing, dredging, straightening activities, and livestock trampling. Dredging and straightening appears to have been conducted to facilitate agricultural production and to expedite drainage from the Site. Straightening of the channel and channel instability from livestock trampling appears to have resulted in an entrenched stream channel with headcut migration occurring through the Site.
>
> Stream mitigation activities have been designed to restore the stream features and functions similar to those exhibited by reference streams in the region. Site alterations designed to restore characteristic stream channel dimension, pattern, and profile include 1) installation of grade control/bank stabilization structures (cross vane weirs, J-hook vanes, and log vanes), excavation of bankfull benches, channel backfilling to design depth, bank stabilization through installation rootwad structures and erosion control matting, and excavation of channel on new location. Tree and shrub planting is expected to be conducted in the fall 2002 to facilitate the establishment of diagnostic natural communities. Vegetation planting has not been documented as part of this as-built report.
>
> After implementation, the Site is expected to support 12.4 acres of riverine and adjacent slope forest encompassing 2,400 linear feet of restored stream channel (1,345 linear feet restored on new alignment and 1,055 linear feet restored in place). Stream enhancement/preservation activities will also be undertaken along approximately 800 linear feet of a secondary, unnamed tributary through bare root plantings and livestock exclusion.

1.1 Goals and Objective

The goals and objectives of this project are as follows.

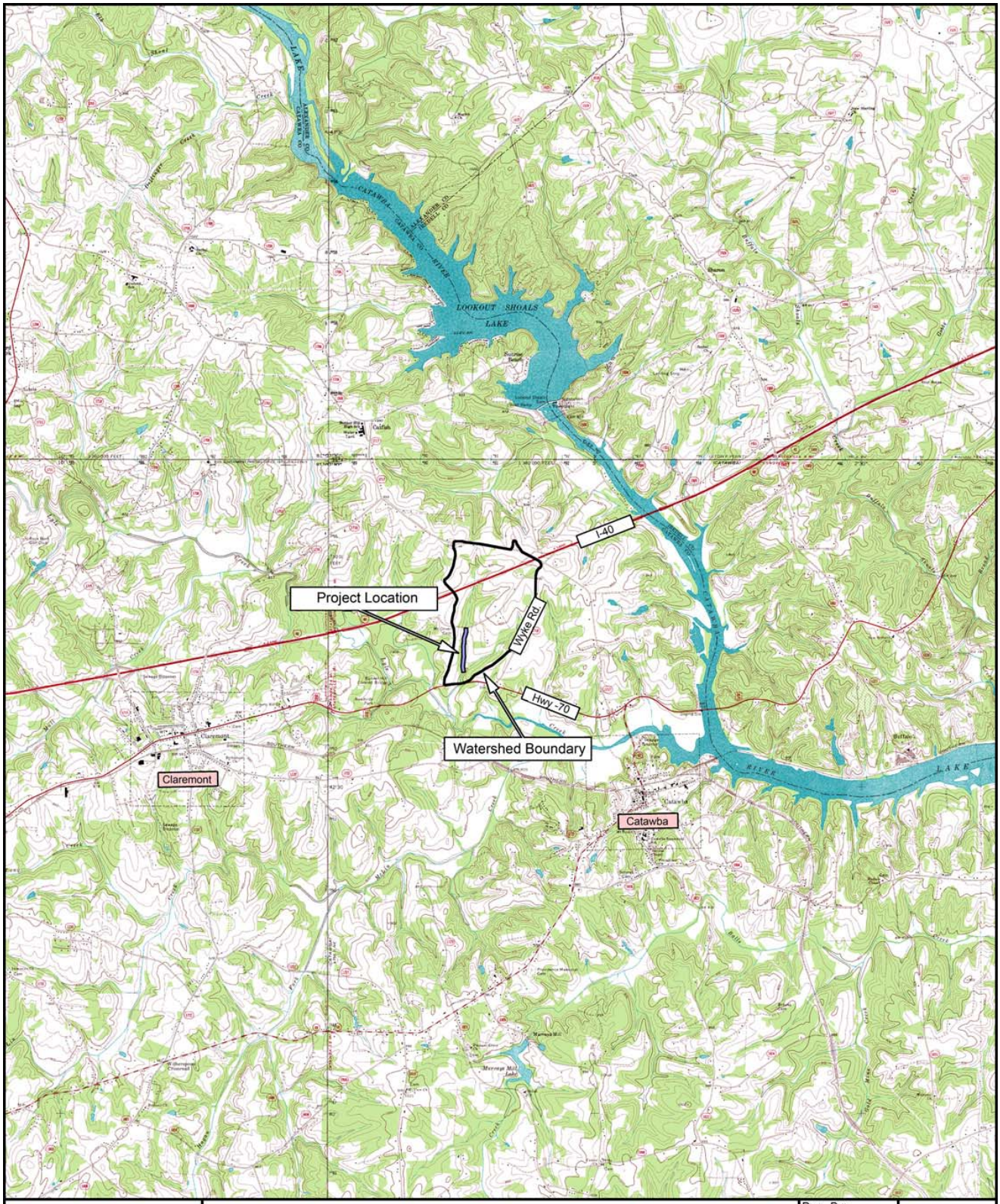
1.) Restore 2,400 linear feet of an unnamed tributary to Lyle Creek.
2.) Enhance the riparian area through planting native species
3.) Exclude cattle access to the unnamed tributary to Lyle Creek and 800 linear feet of a secondary unnamed tributary.

1.2 Project Location

The Lyle Creek restoration project is located in Catawba County. From Interstate I-40 take Exit 138. Head south on Oxford School Rd for 0.1 mile. Turn right on Wyke Rd follow Wyke Rd for 1 mile. Turn Right on US-70, follow US-70 for 0.2 mile. The project approximately located 1000ft upstream of the US-70 Bridge over Lyle Creek.

1.3 Project Description

The restoration of 2,400 linear feet of an unnamed tributary to Lyle Creek consists of relocating 1,345 linear feet of the existing channel away from a previously straightened ditch, stabilizing and enhancing 1,055 linear feet of channel in place and preserving through the use of fencing and re-vegetating 800 linear feet of a secondary unnamed tributary. Restoration included the incorporation of rock cross vane structures to establish grade and enhance habitat. The area was planted with native bare root seedlings and herbaceous cover to enhance the riparian areas and stabilize the streambanks. The relocated section included reconnecting a previously incised channel to its adjacent floodplain. The un-relocated section was not incised.



NC STATE UNIVERSITY

Department of Biological & Agricultural Engineering

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Project Location: Lyle Creek

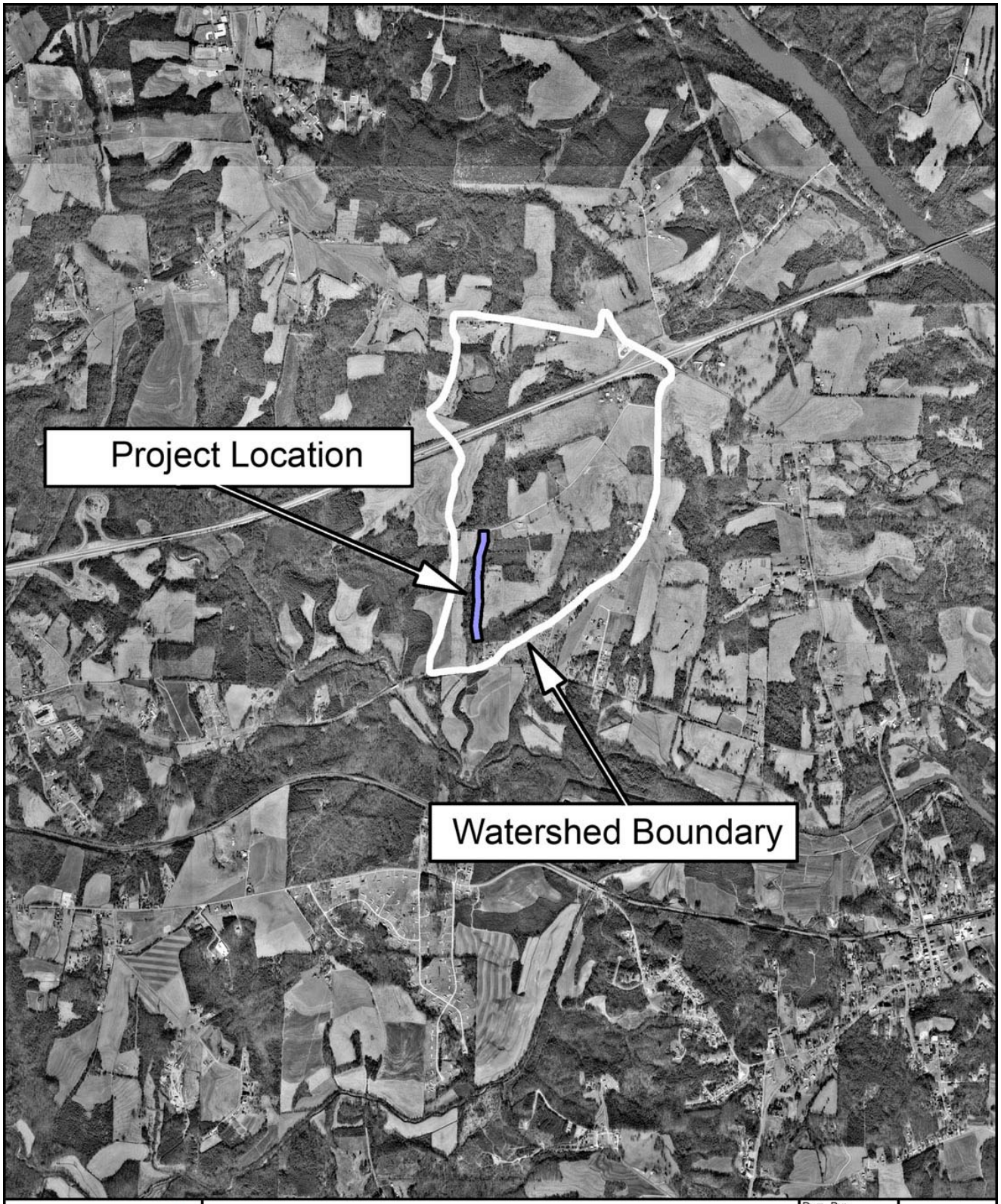
Catawba County, North Carolina

EEP Monitoring Report

SCALE 1:60,000

Dwn. By: MVH
Ckd By: DAB
Date: March 2004

FIGURE 1



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Aerial Watershed Photo: Lyle Creek
Catawba County, North Carolina

EEP Monitoring Report

SCALE 1:30,000
0 1 MILE
0 1000 2000 3000 4000 5000 FEET

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Dwn. By: MVH
Ckd By: DAB
Date: March 2004

FIGURE 2

Figure 3. Plan view of As-built conditions
(To be attached)
showing all structures with station numbers
showing vegetation permanent plots
showing permanent cross-sections and benchmarks
showing vegetation plots
showing monitoring gauges

Figure 4. Plan view of 2003 overlain on As-built
(To be attached)

2.0 YEAR 2003 RESULTS AND DISCUSSION

Year 2003 monitoring results are shown for Lyle Creek Monitoring.

2.1 Vegetation

The following describes the results of 2003 vegetation monitoring conducted at the Lyle Creek Restoration Site. Sampling and analysis methods used can be found in the appendix. Modifications to those methods are described below. Using the Draft Vegetation Monitoring Plan for NCWRP Riparian Buffer and Wetland Restoration Projects, 4 vegetation monitoring plots were randomly located within the riparian buffer of the Lyle Creek project. No reference area was studied; therefore no comparisons could be made to reference conditions.

2.1.1 Results and Discussion

Vegetation within the riparian buffer of Lyle Creek is overall considered successful. The herbaceous layer was well established and diverse. *Panicum* spp. (deertongue and switchgrass) *Juncus* spp. (rushes) and *Carex* spp. (sedges) were most notably dominant throughout. Streambanks and floodplain areas were well covered with herbaceous plants. Shrub species, particularly those sprouting from livestakes are performing well. In the majority of areas where livestakes were planted, they are alive and growing. There is also a large number of naturally regeneration shrub species throughout the project area.

Overall number of planted trees was low. Extrapolation from the four plots resulted in an overall average of approximately 70 planted trees per acre for this restoration site. If natural regeneration is included with planted trees, the number is increased to an average of approximately 3600 trees per acre. This is not surprising given that there is a healthy mature overstory covering most of the project site which contributes greatly to the native seedbank. Both of these estimates are based on a diverse mix of species as well. Natural regeneration obviously plays an important role in the restoration of this site.

Wetland pockets throughout the riparian area also provide a diverse habitat for both plants and animals. These areas contained many different species of wetland plants and also serve as breeding grounds for numerous amphibians.

Microstegium vimineum was the only major invasive exotic plant located within these areas. In several plots it was the dominant herbaceous plant.

A slope are outside of the project easement has not re-vegetated since construction. It is believed that soil was borrowed from this area and re-vegetation efforts have failed. Although this area is outside of the project easement, rills have formed on the steeper sections of the slope. Sediment is washing into the channel from this area potentially degrading the habitat within the channel. This area should be stabilized with top soil, fertilizer and native herbaceous cover.

Recommendations include planting more trees if required for mitigation. Natural regeneration appears to be dominant, however, and should continue to be monitored for

growth habits. It is recommended to stake in areas where erosion is problematic in a few areas, particularly on outside meander bends. The invasive vegetation should also be monitored over time to determine if it will be a limiting factor in native plant growth in the future. No treatment is recommended at this time.

2.2 Morphology

Restored channel dimension, pattern, profile and substrate were examined during the 2003 monitoring.

2.2.1 Results and Discussion

New location Reach of Lyle Creek

Channel profile along the relocation section of Lyle Creek has shown two areas of significant down-cutting. The first area is held by a structure at station 15+09 and works upstream 190 feet but has the potential to migrate another 200 foot until it reaches the next structure. The maximum head cut in this section is one foot. This head cut is possibly caused by a designed decrease in riffle slope from the structure at station 15+09. Another compounding factor may have been that the riffle features in this section were built with the highest bankfull area and the channel cross-sectional area is increasing due to significant bank erosion. The second area of down cutting is held by a structure at station 20+30 and works upstream 235 feet but has the potential to migrate another 300 foot until it reaches the next structure. The maximum head cut in this section is six inches. During the monitoring, the cause of this head cut was not identified. The number of defined riffles in the bedform has decreased from 20 in 2002, to 13 in 2003. The average riffle length has also decreased to 17 feet. This is also consistent with pebble count results which show a significant increase in fine particles since construction in the cross sections located within the head cut regions, and no significant change in the pebble count results from the other cross sections. Hardened riffle areas are not maintaining elevation throughout the relocated entire reach. The structures are maintaining the grade and in general look good. Eco-Science results were recalculated using NCSU techniques for consistency purposes. Data was examined but field identified features were retained.

Cross-sections 4 through 7 are located within the relocated reach. Cross-sections 4 and 7 show little change from as-built conditions. Cross sections 5 and 6 have increased in area due to the effects of incision from the above-mentioned headcut and channel widening due to bank erosion. See table 1 for summary results and the appendix for detailed data results.

Structures within this reach remain as constructed for the most part. A few of the cross vanes are showing signs of piping and have drops on the downstream side up to one foot. Several meander bends are eroding due to the combination of channel incision and lack of rootmass. These areas should be monitored closely in future monitoring.

Previous channel substrate measurements were conducted for regions instead of specific cross sections. Typical sections were selected and used as a standard for comparison purposes. Future monitoring will allow direct comparisons. Channel substrate in the riffle sections continue have very little change. The d50 decreased from 0.19mm to 0.11mm in

riffle 4, the d50 increased from 0.19mm to 0.33mm in riffle 5, and the d50 increased from 0.19mm to 0.34mm in riffle 7. There are areas of coarse sediments consisting of cobbles and the channel bed in the riffles are maintaining a mostly gravel substrate. The pool cross-section d50 has increases as well, from 0.09mm to 0.71mm, but not a significantly.

Channel pattern appears to have been maintained since construction. A few of the outside meander bends are experiencing slight migration through bank slumping but no excessive migration is evident and no shoot cut-offs are apparent.

In Place Reach of Lyle Creek

Channel profile along the in place section of has remained similar to as-built conditions. Two cross vane structures near the tie-in with the relocated reach have one-foot drops. These areas should be watched closely in future monitoring periods to ensure the structures do not fail. The remaining area appears to be functioning well. The previous survey of this area did not match up very well with the 2003 survey due to file conversion difficulties. Pools and riffles identified in the field matched up with 2003 survey data and profile or planform appeared to be located correctly so 2003 data will be used as base data for future monitoring periods.

Cross-sections 1 through 3 are located within the in-place reach. Cross-section 1 (pool) showed a decrease in cross sectional area, from 20.8 to 14.1 square feet. This is likely due to the building of the point bar and decrease in stream maximum depth. Stream depth likely decreased because of the lower floodplain constructed adjacent to the creek which lowered shear stress around the meander bend. Future monitoring will confirm these theories. Cross-sections 2 and 3 showed an increase in cross-sectional area, 9 square foot increase for both. This was due to the increase in channel width. The channel widened after construction. These areas have vegetated with a dense herbaceous cover. This vegetation has stabilized the stream banks and is likely going to narrow the channel as sediment becomes entrained. Future monitoring will validate this. See table 1 for summary results and the appendix for detailed data results.

Previous channel substrate measurements were conducted for regions instead of specific cross sections. Typical sections were selected and used as a standard for comparison purposes. Future monitoring will allow direct comparisons. Channel substrate cross-section 1, pool, increased in coarseness slightly since construction. Cross-section 2, riffle remained consistent to as-built conditions. Cross-section 3, riffle decreased in particle size on the upper end of the scale with d85 of 15.91 to 1.01mm. This are will be monitored in future monitoring periods to examine trends. Because the base data is not specifically from this location, no trends can be generated.

Channel pattern appears to have been maintained since construction. Channel banks are well vegetated and no areas of active erosion were evident.

Table 1. Summary of Channel Conditions

DIMENSION	Lyle Creek In-Place Reach Cross-section #1 Pool		Lyle Creek In-Place Reach Cross-section #2 Riffle		Lyle Creek In-Place Reach Cross-section #3 Riffle		Lyle Creek Relocation Reach Cross-section #4 Riffle		Lyle Creek Relocation Reach Cross-section #5 Riffle		Lyle Creek Relocation Reach Cross-section #6 Pool		Lyle Creek Relocation Reach Cross-section #7 Riffle	
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LYLE CREEK IN PLACE LONG PROFILE

Figure 5
Lyle Creek Inplace Channel
Catawba County, NC
2003 Annual Monitoring Report
Longitudinal Profile

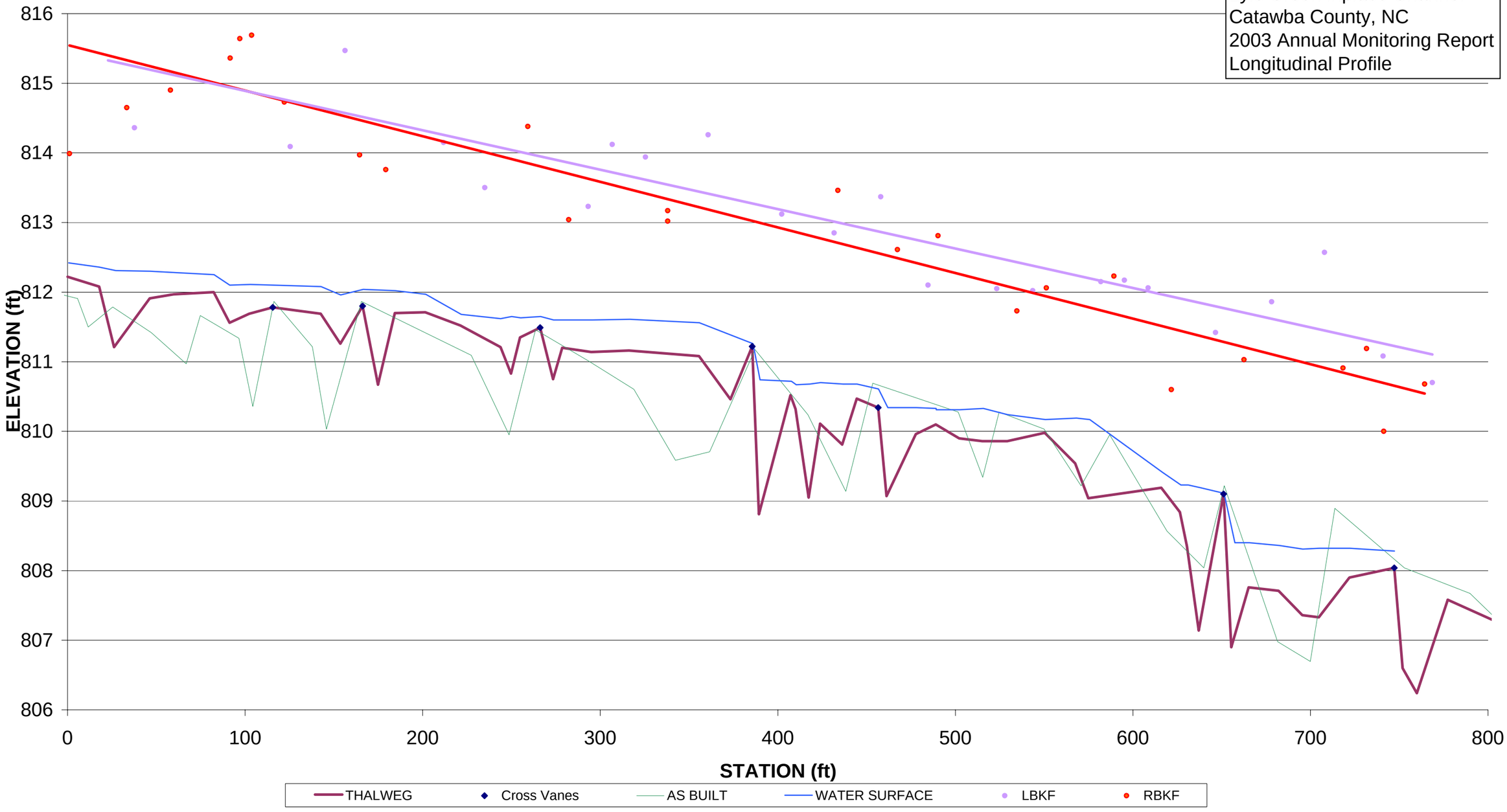
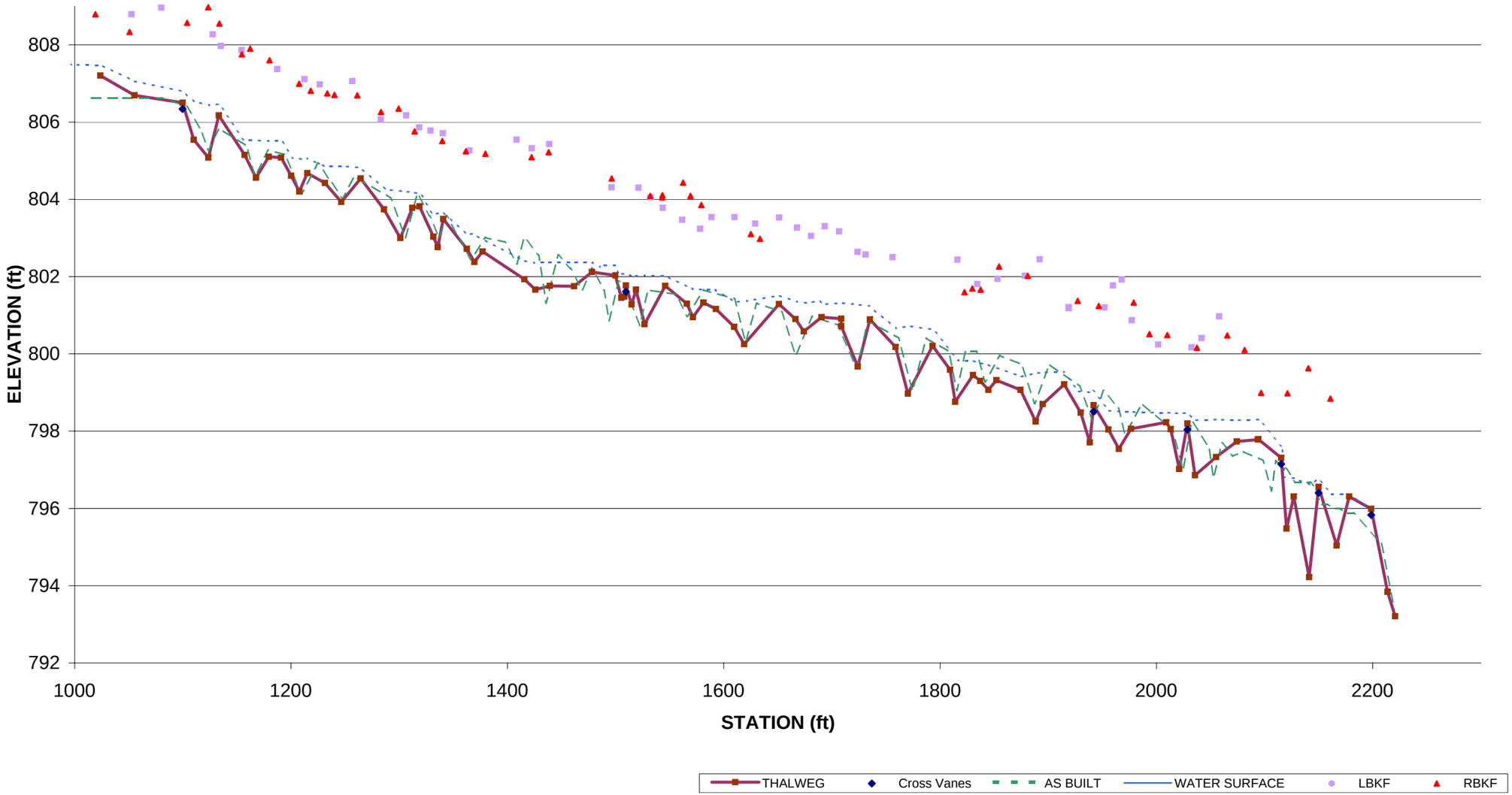


Figure 5
Lyle Creek New Channel
Catawba County, NC
2003 Annual Monitoring Report
Longitudinal Profile



2.3 Areas of Concern

The following areas of concern should be monitored closely and considered for repair as suggested:

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  - The first section is from station 14+00 to 15+00 there is half of a meander wavelength that has been straightened into a long run this is the result of the head cut mentioned above
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- **Vegetation Concerns**
  - Natural regeneration appears to be dominant and should continue to be monitored for growth habits.
  - Planting more trees if required for mitigation at this time the tree stems per acre is 70 but it appears that natural regeneration will be able to raise the tree stems per acre to the level for mitigation credit

- It is recommended to stake in areas where erosion is problematic in a few areas, particularly on outside meander bends
- The invasive vegetation requires no treatment at this time.
- Adjacent side slope should be stabilized to reduced sediment from washing into the creek.

2.4 Photo Log

2.4 Photo Log

PHOTO PLOT 1

J-Hook

Looking Downstream

PHOTO PLOT 2

Looking Upstream

Looking Downstream

PHOTO PLOT 3

Looking Upstream

Looking Downstream

PHOTO PLOT 4

Looking Upstream

Looking Downstream

PHOTO PLOT 5

Cross-Vane Weir

Looking Downstream

PHOTO PLOT 6

Looking Upstream

Looking Downstream

PHOTO PLOT 7

Looking Upstream

Looking Down-valley

PHOTO PLOT 8

Looking Upstream

Looking Downstream

PHOTO PLOT 9

Looking Upstream

Looking Downstream

PHOTO PLOT 10

Looking Downstream

PHOTO PLOT 11

Looking Upstream

Looking Downstream

PHOTO PLOT 12

Looking Upstream

Looking Downstream

Appendices

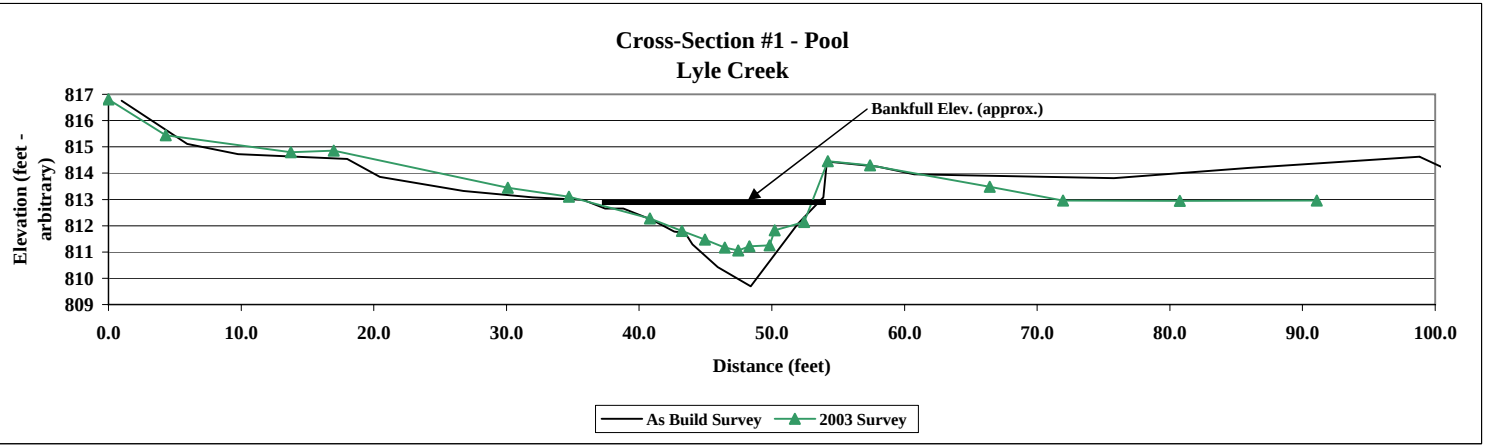
A. Methods
    1. Vegetation
    2. Morphology
B. Vegetation data
    1. Listed by plot
    2. Species, number and age
    3. Analysis of planted vs. natural recruitment
C. Morphology Data
    1. Cross-section data and plotted
    2. Longitudinal data and plotted
    3. Pebble count data and plotted
    4. Pattern

Project Name	Lyle Creek
Cross Section	#1
Feature	Pool
Date	11/4/03
Crew	Shaffer, Bidelspach, Clinton

2002 As Build Survey			2003 2003 Survey		
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
1.0	816.76		0.0	816.81	
5.9	815.11		4.3	815.44	
9.8	814.73		13.8	814.8	
18.0	814.53		17.0	814.86	
20.5	813.86		30.1	813.45	
26.8	813.32		34.7	813.1	
32.0	813.08		40.8	812.28	
35.8	812.99		43.2	811.8	
37.4	812.65		45.0	811.47	
38.8	812.65		46.5	811.17	
41.0	812.21		47.5	811.06	
42.6	811.78		48.3	811.22	
43.5	811.73		49.8	811.25	
44.0	811.29		50.2	811.82	
45.9	810.42		52.4	812.14	
48.4	809.70		54.2	814.46	
52.0	812.07		57.4	814.3	
53.9	813.08		66.4	813.48	
54.2	814.44		72.0	812.96	
58.0	814.24		80.8	812.94	
60.7	813.95		91.1	812.96	
75.8	813.81				
85.9	814.20				
98.8	814.63				
102.9	813.66				
109.8	811.29				
118.0	811.82				
125.9	814.82				
133.6	815.84				

Photo of Cross-Section #1 - Looking Downstream

	2002	**2003**
Area	20.79	14.07
Width	16.3	16.5
Mean Depth	1.3	0.9
Max Depth	3.1	1.7

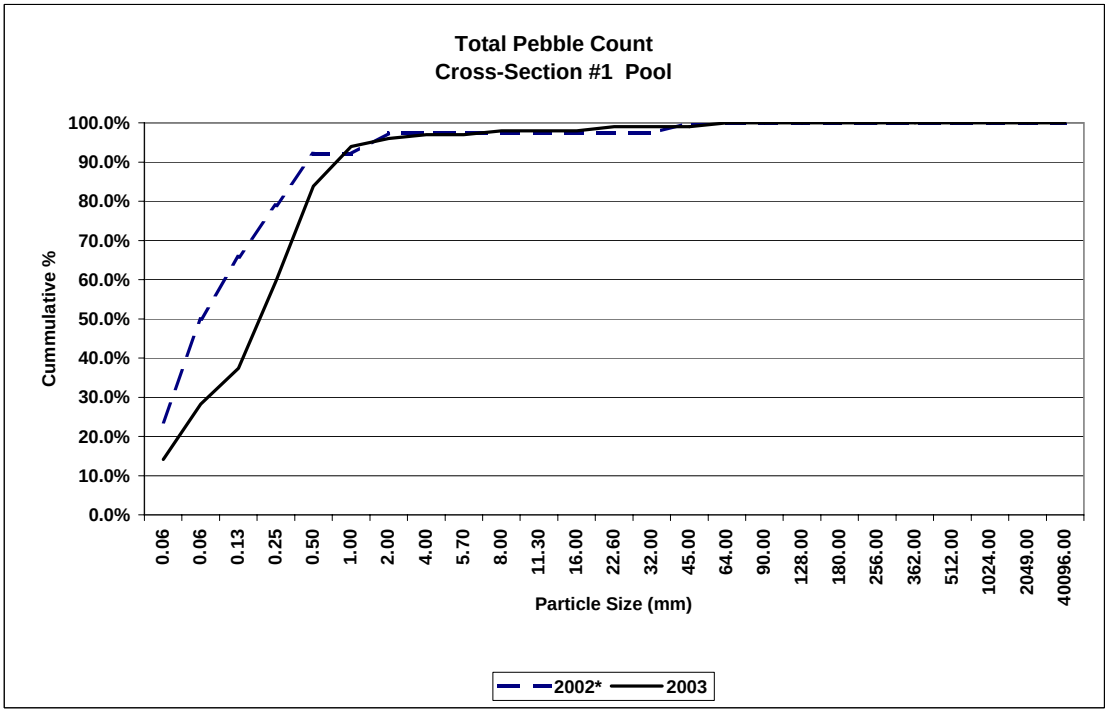


Project Name	Lyle Creek
Cross Section	#1
Feature	Pool
Date	11/4/03
Crew	Shaffer, Bidelspach, Clinton

* 2002 pebble count is a typical riffle sections used as basline information.

			2002*			2003			
Description	**Material**	**Size (mm)**	**Pool**	**%**	**Cum %**	**Riffle - Bed**	**Riffle - Bank**	**%**	**Cum %**
Silt/Clay	silt/clay	0.061	9	23.7%	23.7%	0	14	14.1%	14.1%
Sand	very fine sand	0.062	10	26.3%	50.0%	0	14	14.1%	28.3%
	fine sand	0.125	6	15.8%	65.8%	0	9	9.1%	37.4%
	medium sand	0.25	5	13.2%	78.9%	8	14	22.2%	59.6%
	course sand	0.50	5	13.2%	92.1%	15	9	24.2%	83.8%
	very course sand	1.0	0	0.0%	92.1%	9	1	10.1%	93.9%
Gravel	very fine gravel	2.0	2	5.3%	97.4%	1	1	2.0%	96.0%
	fine gravel	4.0	0	0.0%	97.4%	1	0	1.0%	97.0%
	fine gravel	5.7	0	0.0%	97.4%	0	0	0.0%	97.0%
	medium gravel	8.0	0	0.0%	97.4%	0	1	1.0%	98.0%
	medium gravel	11.3	0	0.0%	97.4%	0	0	0.0%	98.0%
	course gravel	16.0	0	0.0%	97.4%	0	0	0.0%	98.0%
	course gravel	22.6	0	0.0%	97.4%	0	1	1.0%	99.0%
	very course gravel	32	0	0.0%	97.4%	0	0	0.0%	99.0%
	very course gravel	45	1	2.6%	100.0%	0	0	0.0%	99.0%
Cobble	small cobble	64	0	0.0%	100.0%	0	1	1.0%	100.0%
	medium cobble	90	0	0.0%	100.0%	0	0	0.0%	100.0%
	large cobble	128	0	0.0%	100.0%	0	0	0.0%	100.0%
	very large cobble	180	0	0.0%	100.0%	0	0	0.0%	100.0%
Boulder	small boulder	256	0	0.0%	100.0%	0	0	0.0%	100.0%
	small boulder	362	0	0.0%	100.0%	0	0	0.0%	100.0%
	medium boulder	512	0	0.0%	100.0%	0	0	0.0%	100.0%
	large boulder	1024	0	0.0%	100.0%	0	0	0.0%	100.0%
	very large boulder	2049	0	0.0%	100.0%	0	0	0.0%	100.0%
Bedrock	bedrock	40096	0	0.0%	100.0%	0	0	0.0%	100.0%
TOTAL / %of whole count			38	100.0%		34	65	100.0%	

	d16	**d35**	**d50**	**d85**	**d95**
2002*	0.00	0.08	0.09	0.52	2.33
2003	0.07	0.16	0.29	0.76	2.29

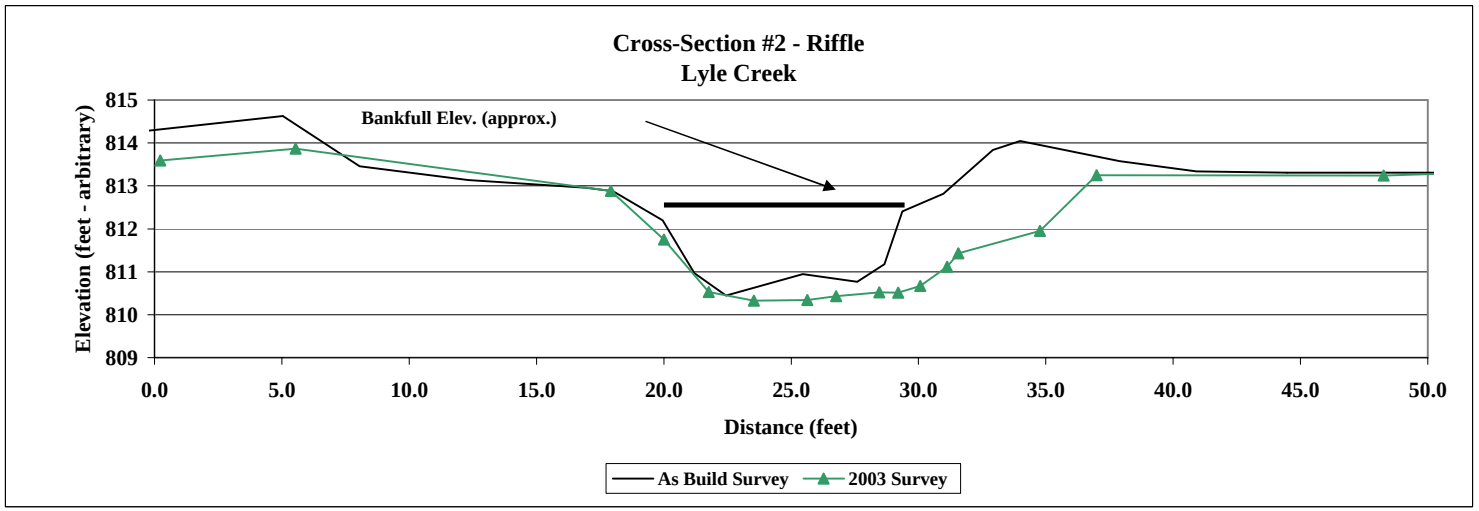


Project Name	Lyle Creek
Cross Section	#2
Feature	Riffle
Date	11/4/03
Crew	Shaffer, Bidelspach, Clinton

2002 As Build Survey			2003 2003 Survey		
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
-28.0	812.58		0.2	813.59	
-13.1	813.46		5.5	813.87	
5.0	814.63		17.9	812.88	
8.1	813.46		20.0	811.75	
12.3	813.14		21.8	810.53	
16.9	812.96		23.5	810.33	
18.0	812.87		25.6	810.34	
20.0	812.20		26.8	810.43	
21.2	810.97		28.5	810.52	
22.4	810.44		29.2	810.51	
25.5	810.94		30.1	810.67	
27.6	810.77		31.1	811.12	
28.7	811.18		31.6	811.43	
29.4	812.40		34.8	811.95	
31.0	812.81		37.0	813.25	
32.9	813.84		48.3	813.24	
34.0	814.04		55.1	813.37	
37.9	813.57		59.5	813.34	
40.9	813.34				
44.5	813.31				
59.0	813.31				

Photo of Cross-Section #2 - Looking Upstream

	2002	2003
Area	16.50	28.07
Width	11.8	18.6
Mean Depth	1.4	1.5
Max Depth	2.2	2.4

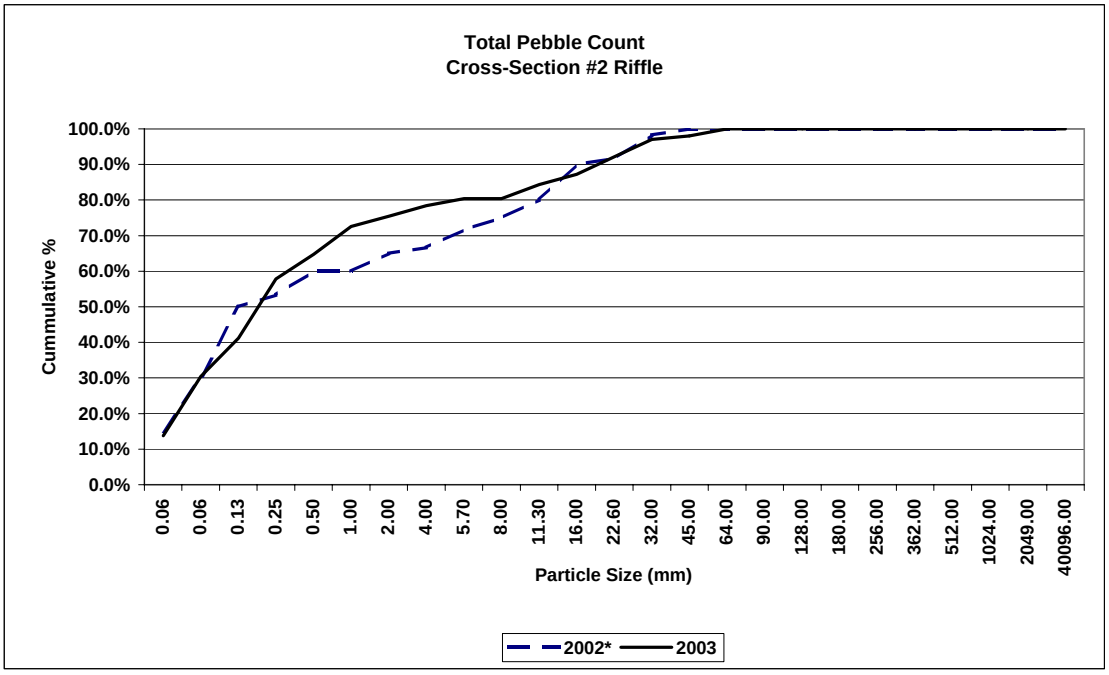


Project Name	Lyle Creek
Cross Section	#2
Feature	Riffle
Date	11/4/03
Crew	Shaffer, Bidelspach, Clinton

* 2002 pebble count is a typical riffle sections used as basline information.

			2002*			2003			
Description	**Material**	**Size (mm)**	**Riffle**	**%**	**Cum %**	**Riffle - Bed**	**Riffle - Bank**	**%**	**Cum %**
Silt/Clay	silt/clay	0.061	9	15.0%	15.0%	0	14	13.7%	13.7%
Sand	very fine sand	0.062	9	15.0%	30.0%	0	17	16.7%	30.4%
	fine sand	0.125	12	20.0%	50.0%	4	7	10.8%	41.2%
	medium sand	0.25	2	3.3%	53.3%	11	6	16.7%	57.8%
	course sand	0.50	4	6.7%	60.0%	6	1	6.9%	64.7%
	very course sand	1.0	0	0.0%	60.0%	8	0	7.8%	72.5%
Gravel	very fine gravel	2.0	3	5.0%	65.0%	3	0	2.9%	75.5%
	fine gravel	4.0	1	1.7%	66.7%	3	0	2.9%	78.4%
	fine gravel	5.7	3	5.0%	71.7%	2	0	2.0%	80.4%
	medium gravel	8.0	2	3.3%	75.0%	0	0	0.0%	80.4%
	medium gravel	11.3	3	5.0%	80.0%	4	0	3.9%	84.3%
	course gravel	16.0	6	10.0%	90.0%	3	0	2.9%	87.3%
	course gravel	22.6	1	1.7%	91.7%	5	0	4.9%	92.2%
	very course gravel	32	4	6.7%	98.3%	5	0	4.9%	97.1%
	very course gravel	45	1	1.7%	100.0%	1	0	1.0%	98.0%
Cobble	small cobble	64	0	0.0%	100.0%	2	0	2.0%	100.0%
	medium cobble	90	0	0.0%	100.0%	0	0	0.0%	100.0%
	large cobble	128	0	0.0%	100.0%	0	0	0.0%	100.0%
	very large cobble	180	0	0.0%	100.0%	0	0	0.0%	100.0%
Boulder	small boulder	256	0	0.0%	100.0%	0	0	0.0%	100.0%
	small boulder	362	0	0.0%	100.0%	0	0	0.0%	100.0%
	medium boulder	512	0	0.0%	100.0%	0	0	0.0%	100.0%
	large boulder	1024	0	0.0%	100.0%	0	0	0.0%	100.0%
	very large boulder	2049	0	0.0%	100.0%	0	0	0.0%	100.0%
Bedrock	bedrock	40096	0	0.0%	100.0%	0	0	0.0%	100.0%
TOTAL / %of whole count			60	100.0%		57	45	100.0%	

	d16	**d35**	**d50**	**d85**	**d95**
2002*	0.06	0.12	0.19	15.91	32.90
2003	0.07	0.13	0.29	13.33	33.80

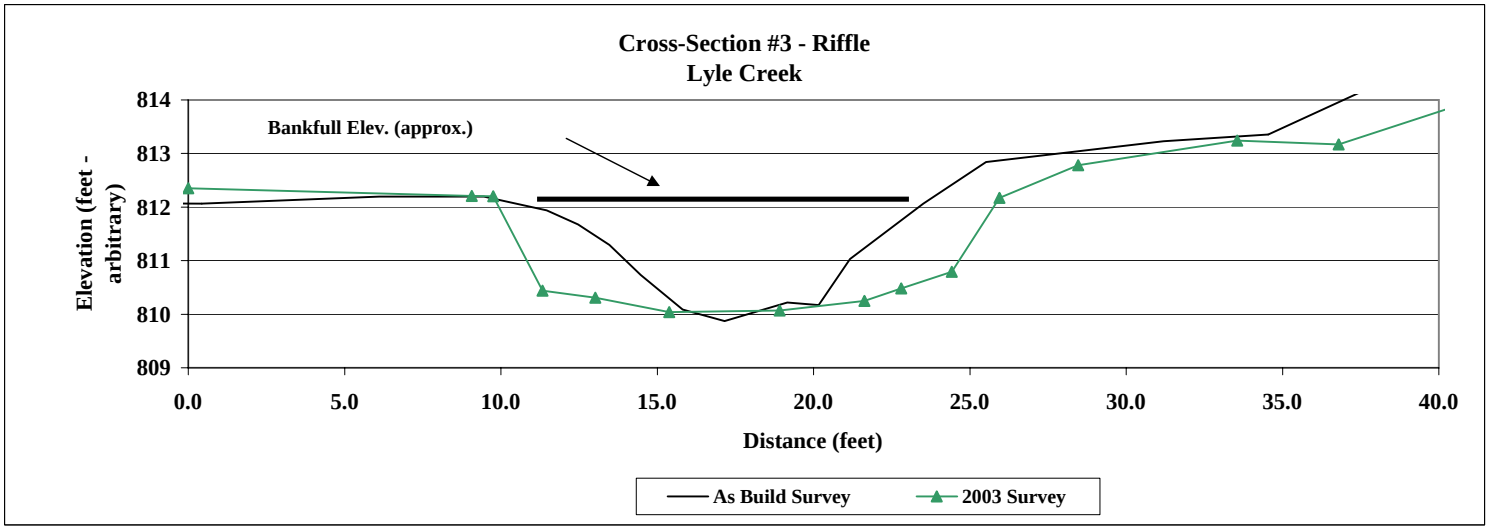


Project Name	Lyle Creek
Cross Section	#3
Feature	Riffle
Date	11/4/03
Crew	Shaffer, Bidelspach, Clinton

2002 As Build Survey			2003 2003 Survey		
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
-48.4	812.54		0.0	812.35	
-34.4	812.15		9.1	812.21	
0.4	812.07		9.8	812.2	
6.1	812.20		11.3	810.44	
9.5	812.20		13.0	810.31	
11.5	811.94		15.4	810.04	
12.5	811.68		18.9	810.07	
13.5	811.29		21.6	810.25	
14.5	810.73		22.8	810.48	
15.8	810.09		24.4	810.79	
17.2	809.87		26.0	812.17	
19.2	810.22		28.5	812.78	
20.2	810.17		33.6	813.24	
21.2	811.03		36.8	813.17	
23.5	812.07		41.9	814.14	
25.5	812.84		53.2	815.21	
31.2	813.23				
34.5	813.36				
38.6	814.43				

Photo of Cross-Section #3 - Looking Downstream

	2002	**2003**
Area	15.60	26.08
Width	13.2	16.2
Mean Depth	1.2	1.6
Max Depth	2.2	2.0

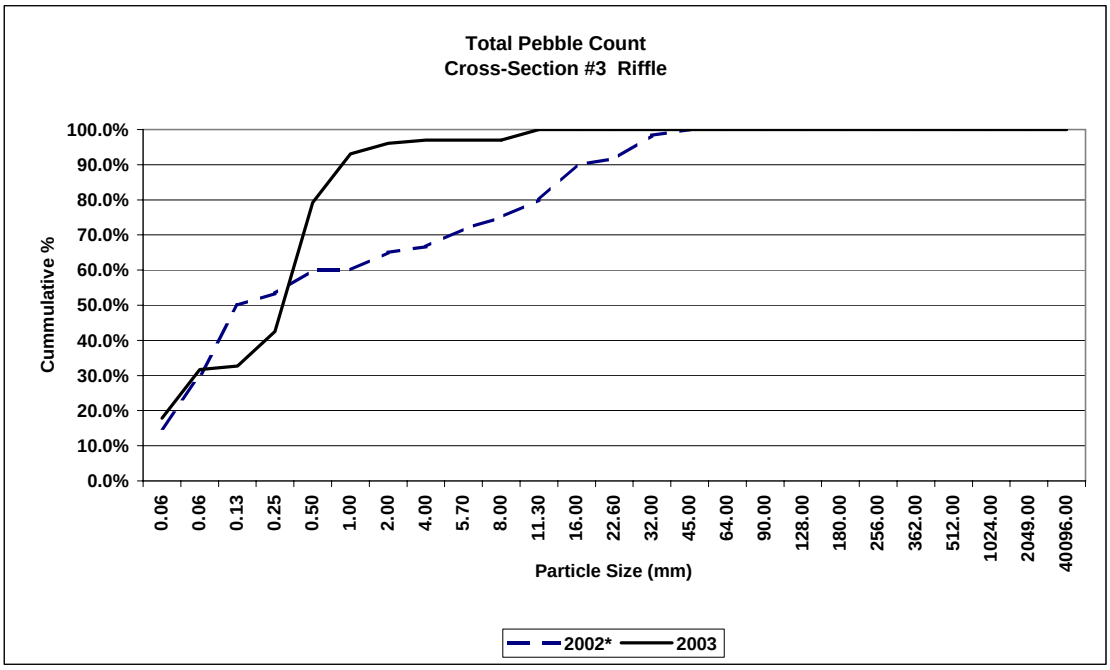


Project Name	Lyle Creek
Cross Section	#3
Feature	Riffle
Date	11/4/03
Crew	Shaffer, Bidelspach, Clinton

* 2002 pebble count is a typical riffle sections used as basline information.

			2002*			2003			
Description	**Material**	**Size (mm)**	**Riffle**	**%**	**Cum %**	**Riffle - Bed**	**Riffle - Bank**	**%**	**Cum %**
Silt/Clay	silt/clay	0.061	9	15.0%	15.0%	0	18	17.8%	17.8%
Sand	very fine sand	0.062	9	15.0%	30.0%	2	12	13.9%	31.7%
	fine sand	0.125	12	20.0%	50.0%	0	1	1.0%	32.7%
	medium sand	0.25	2	3.3%	53.3%	7	3	9.9%	42.6%
	course sand	0.50	4	6.7%	60.0%	25	12	36.6%	79.2%
	very course sand	1.0	0	0.0%	60.0%	10	4	13.9%	93.1%
Gravel	very fine gravel	2.0	3	5.0%	65.0%	3	0	3.0%	96.0%
	fine gravel	4.0	1	1.7%	66.7%	1	0	1.0%	97.0%
	fine gravel	5.7	3	5.0%	71.7%	0	0	0.0%	97.0%
	medium gravel	8.0	2	3.3%	75.0%	0	0	0.0%	97.0%
	medium gravel	11.3	3	5.0%	80.0%	3	0	3.0%	100.0%
	course gravel	16.0	6	10.0%	90.0%	0	0	0.0%	100.0%
	course gravel	22.6	1	1.7%	91.7%	0	0	0.0%	100.0%
	very course gravel	32	4	6.7%	98.3%	0	0	0.0%	100.0%
	very course gravel	45	1	1.7%	100.0%	0	0	0.0%	100.0%
Cobble	small cobble	64	0	0.0%	100.0%	0	0	0.0%	100.0%
	medium cobble	90	0	0.0%	100.0%	0	0	0.0%	100.0%
	large cobble	128	0	0.0%	100.0%	0	0	0.0%	100.0%
	very large cobble	180	0	0.0%	100.0%	0	0	0.0%	100.0%
Boulder	small boulder	256	0	0.0%	100.0%	0	0	0.0%	100.0%
	small boulder	362	0	0.0%	100.0%	0	0	0.0%	100.0%
	medium boulder	512	0	0.0%	100.0%	0	0	0.0%	100.0%
	large boulder	1024	0	0.0%	100.0%	0	0	0.0%	100.0%
	very large boulder	2049	0	0.0%	100.0%	0	0	0.0%	100.0%
Bedrock	bedrock	40096	0	0.0%	100.0%	0	0	0.0%	100.0%
TOTAL / %of whole count			60	100.0%		51	50	100.0%	

	d16	**d35**	**d50**	**d85**	**d95**
2002*	0.06	0.12	0.19	15.91	32.90
2003	0.00	0.23	0.45	1.01	2.47

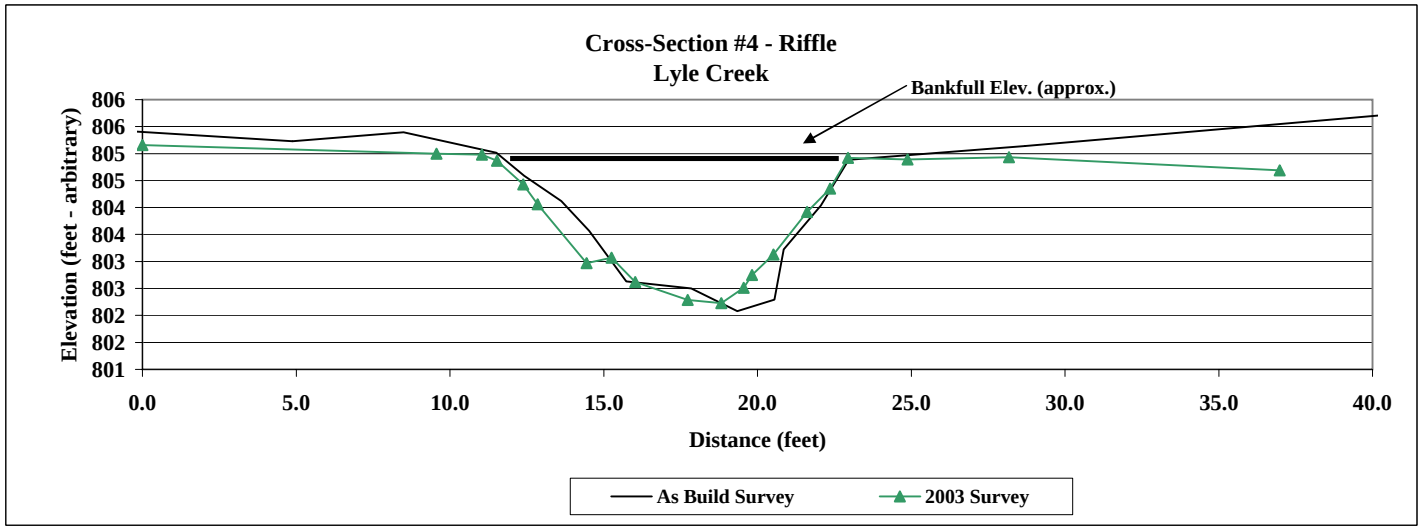


Project Name	Lyle Creek
Cross Section	#4
Feature	Riffle
Date	11/4/03
Crew	Shaffer, Bidelspach, Clinton

2002 As Build Survey			2003 2003 Survey		
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
-90.4	808.12		0.0	805.16	
-85.6	806.93		9.6	805	
-80.5	806.16		11.0	804.98	
-58.4	805.61		11.5	804.87	
-34.6	805.65		12.4	804.43	
-26.5	804.84		12.9	804.06	
-9.6	804.84		14.4	802.97	
-2.4	805.48		15.3	803.07	
4.9	805.23		16.0	802.62	
8.5	805.40		17.7	802.29	
11.5	805.01		18.8	802.23	
12.4	804.59		19.6	802.51	
13.6	804.12		19.8	802.75	
14.5	803.57		20.5	803.13	
15.7	802.63		21.6	803.92	
17.8	802.50		22.4	804.35	
19.3	802.08		22.9	804.92	
20.6	802.29		24.9	804.89	
20.9	803.23		28.2	804.93	
22.1	804.03		37.0	804.69	
23.0	804.89				
28.7	805.14				
42.6	805.82				
67.6	808.21				

Photo of Cross-Section #4 - Looking Downstream

	2002	**2003**
Area	17.49	17.76
Width	10.8	10.8
Mean Depth	1.6	1.6
Max Depth	2.7	2.6

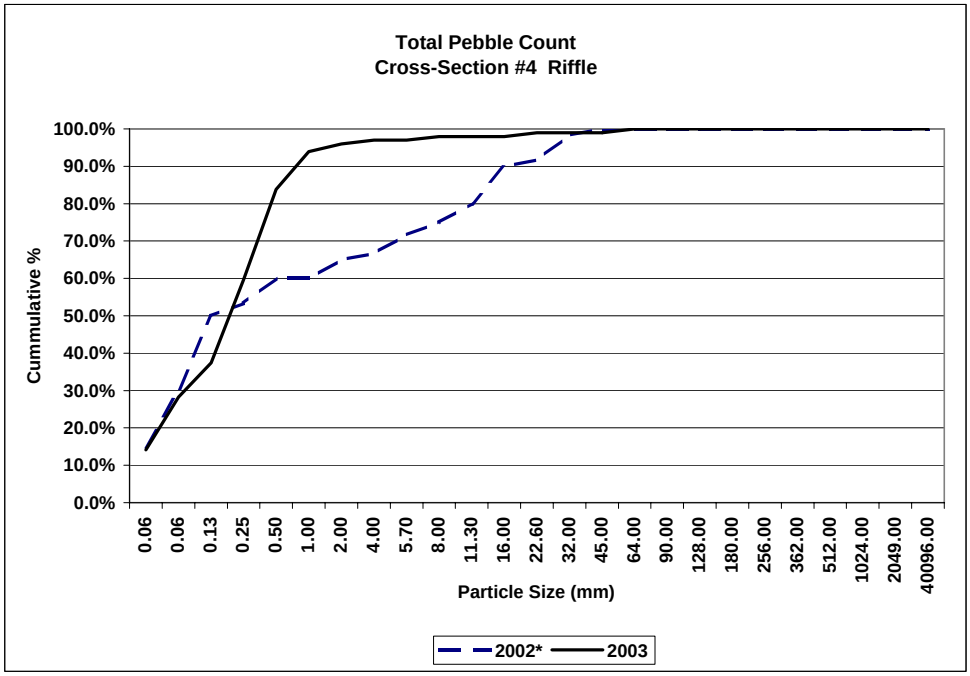


Project Name	Lyle Creek
Cross Section	#4
Feature	Riffle
Date	11/4/03
Crew	Shaffer, Bidelspach, Clinton

* 2002 pebble count is a typical riffle sections used as basline information.

			2002*			2003			
Description	**Material**	**Size (mm)**	**Riffle**	**%**	**Cum %**	**Riffle - Bed**	**Riffle - Bank**	**%**	**Cum %**
Silt/Clay	silt/clay	0.061	9	15.0%	15.0%	30	4	36.6%	36.6%
Sand	very fine sand	0.062	9	15.0%	30.0%	10	2	12.9%	49.5%
	fine sand	0.125	12	20.0%	50.0%	2	2	4.3%	53.8%
	medium sand	0.25	2	3.3%	53.3%	2	6	8.6%	62.4%
	course sand	0.50	4	6.7%	60.0%	9	8	18.3%	80.6%
	very course sand	1.0	0	0.0%	60.0%	0	1	1.1%	81.7%
Gravel	very fine gravel	2.0	3	5.0%	65.0%	0	2	2.2%	83.9%
	fine gravel	4.0	1	1.7%	66.7%	0	2	2.2%	86.0%
	fine gravel	5.7	3	5.0%	71.7%	0	3	3.2%	89.2%
	medium gravel	8.0	2	3.3%	75.0%	0	1	1.1%	90.3%
	medium gravel	11.3	3	5.0%	80.0%	0	0	0.0%	90.3%
	course gravel	16.0	6	10.0%	90.0%	0	0	0.0%	90.3%
	course gravel	22.6	1	1.7%	91.7%	0	4	4.3%	94.6%
	very course gravel	32	4	6.7%	98.3%	0	1	1.1%	95.7%
	very course gravel	45	1	1.7%	100.0%	0	2	2.2%	97.8%
Cobble	small cobble	64	0	0.0%	100.0%	0	0	0.0%	97.8%
	medium cobble	90	0	0.0%	100.0%	0	1	1.1%	98.9%
	large cobble	128	0	0.0%	100.0%	0	1	1.1%	100.0%
	very large cobble	180	0	0.0%	100.0%	0	0	0.0%	100.0%
Boulder	small boulder	256	0	0.0%	100.0%	0	0	0.0%	100.0%
	small boulder	362	0	0.0%	100.0%	0	0	0.0%	100.0%
	medium boulder	512	0	0.0%	100.0%	0	0	0.0%	100.0%
	large boulder	1024	0	0.0%	100.0%	0	0	0.0%	100.0%
	very large boulder	2049	0	0.0%	100.0%	0	0	0.0%	100.0%
Bedrock	bedrock	40096	0	0.0%	100.0%	0	0	0.0%	100.0%
TOTAL / %of whole count			60	100.0%		53	40	100.0%	

	d16	**d35**	**d50**	**d85**	**d95**
2002*	0.06	0.12	0.19	15.91	32.90
2003	0.00	0.00	0.11	3.11	31.22

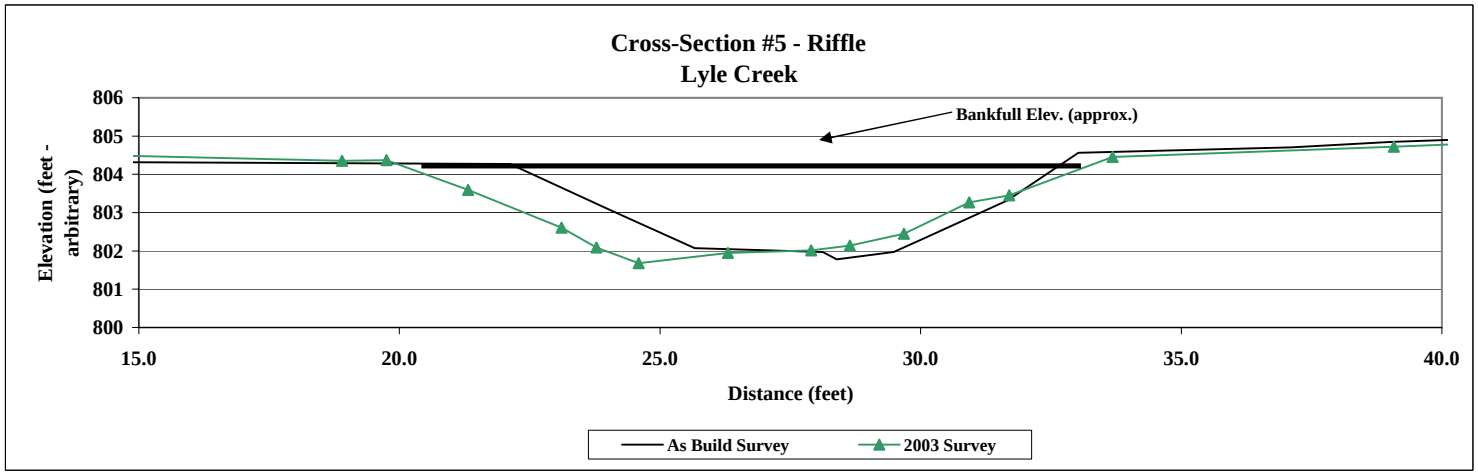


Project Name	Lyle Creek
Cross Section	#5
Feature	Riffle
Date	11/4/03
Crew	Shaffer, Bidelspach, Clinton

2002 As Build Survey			2003 2003 Survey		
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
-82.0	807.34		0.0	804.51	
-77.9	806.24		9.4	804.54	
-70.0	805.47		14.9	804.48	
-52.0	804.85		18.9	804.35	
-38.9	805.09		19.8	804.37	
-29.9	804.70		21.3	803.59	
-16.0	804.66		23.1	802.61	
1.1	804.46		23.8	802.09	
14.2	804.32		24.6	801.68	
22.1	804.27		26.3	801.95	
24.0	803.08		27.9	802.01	
25.7	802.07		28.6	802.14	
28.1	801.98		29.7	802.45	
28.4	801.78		30.9	803.27	
29.5	801.98		31.7	803.45	
30.0	802.31		33.7	804.45	
31.7	803.32		39.1	804.72	
33.0	804.56		45.9	805.1	
37.1	804.70				
39.0	804.85				
49.1	805.33				
59.2	809.16				

Photo of Cross-Section #5 - Looking Downstream

	2002	**2003**
Area	16.92	20.73
Width	10.7	13.9
Mean Depth	1.6	1.5
Max Depth	2.5	2.6

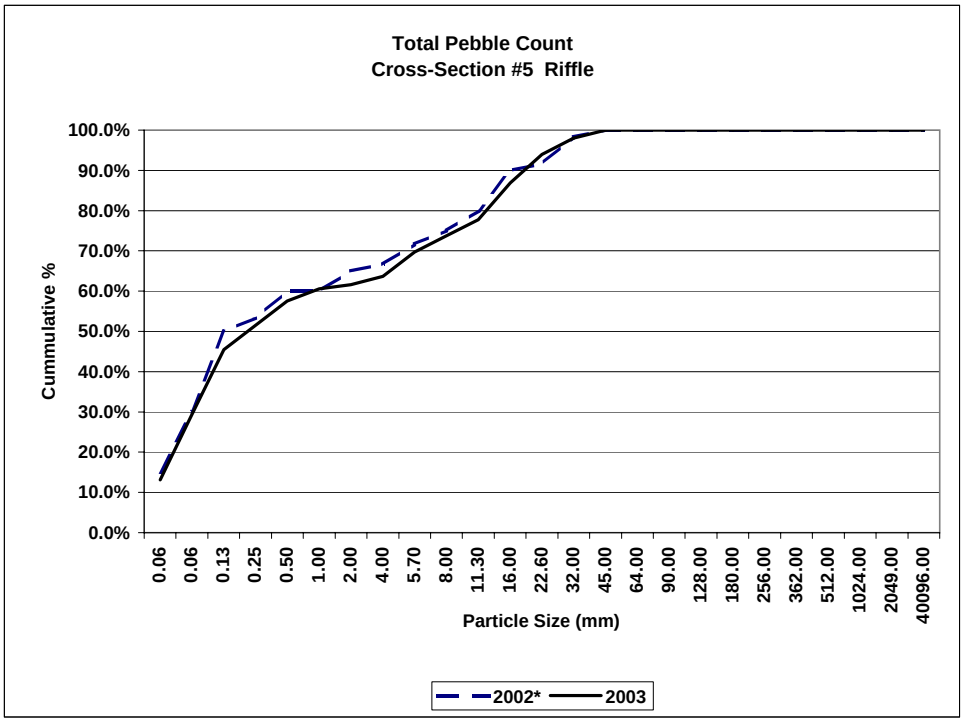


Project Name	Lyle Creek
Cross Section	#5
Feature	Riffle
Date	11/4/03
Crew	Shaffer, Bidelspach, Clinton

* 2002 pebble count is a typical riffle sections used as basline information.

			2002*			2003			
Description	**Material**	**Size (mm)**	**Riffle**	**%**	**Cum %**	**Riffle - Bed**	**Riffle - Bank**	**%**	**Cum %**
Silt/Clay	silt/clay	0.061	9	15.0%	15.0%	12	1	13.1%	13.1%
Sand	very fine sand	0.062	9	15.0%	30.0%	16	0	16.2%	29.3%
	fine sand	0.125	12	20.0%	50.0%	12	4	16.2%	45.5%
	medium sand	0.25	2	3.3%	53.3%	0	6	6.1%	51.5%
	course sand	0.50	4	6.7%	60.0%	0	6	6.1%	57.6%
	very course sand	1.0	0	0.0%	60.0%	0	3	3.0%	60.6%
Gravel	very fine gravel	2.0	3	5.0%	65.0%	0	1	1.0%	61.6%
	fine gravel	4.0	1	1.7%	66.7%	0	2	2.0%	63.6%
	fine gravel	5.7	3	5.0%	71.7%	0	6	6.1%	69.7%
	medium gravel	8.0	2	3.3%	75.0%	0	4	4.0%	73.7%
	medium gravel	11.3	3	5.0%	80.0%	0	4	4.0%	77.8%
	course gravel	16.0	6	10.0%	90.0%	0	9	9.1%	86.9%
	course gravel	22.6	1	1.7%	91.7%	0	7	7.1%	93.9%
	very course gravel	32	4	6.7%	98.3%	0	4	4.0%	98.0%
	very course gravel	45	1	1.7%	100.0%	0	2	2.0%	100.0%
Cobble	small cobble	64	0	0.0%	100.0%	0	0	0.0%	100.0%
	medium cobble	90	0	0.0%	100.0%	0	0	0.0%	100.0%
	large cobble	128	0	0.0%	100.0%	0	0	0.0%	100.0%
	very large cobble	180	0	0.0%	100.0%	0	0	0.0%	100.0%
Boulder	small boulder	256	0	0.0%	100.0%	0	0	0.0%	100.0%
	small boulder	362	0	0.0%	100.0%	0	0	0.0%	100.0%
	medium boulder	512	0	0.0%	100.0%	0	0	0.0%	100.0%
	large boulder	1024	0	0.0%	100.0%	0	0	0.0%	100.0%
	very large boulder	2049	0	0.0%	100.0%	0	0	0.0%	100.0%
Bedrock	bedrock	40096	0	0.0%	100.0%	0	0	0.0%	100.0%
TOTAL / %of whole count			60	100.0%		40	59	100.0%	

	d16	**d35**	**d50**	**d85**	**d95**
2002*	0.06	0.12	0.19	15.91	32.90
2003	0.07	0.13	0.33	17.52	30.24



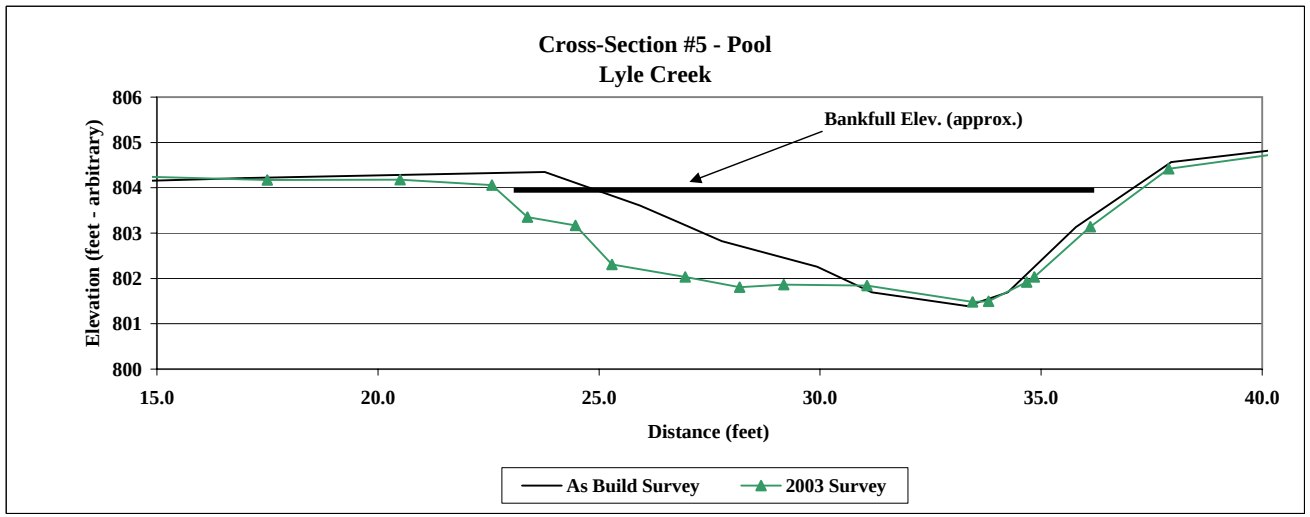
Project Name	Lyle Creek
Cross Section	#6
Feature	Pool
Date	11/4/03
Crew	Shaffer, Bidelspach, Clinton

2002 As Build Survey		
Station	**Elevation**	**Notes**
-81.3	807.30	
-77.3	806.22	
-69.3	805.48	
-51.1	804.83	
-38.2	805.09	
-29.2	804.70	
-15.1	804.61	
1.9	804.43	
13.9	804.13	
17.0	804.22	
23.8	804.35	
25.9	803.61	
26.9	803.22	
27.8	802.83	
29.9	802.26	
31.2	801.70	
33.3	801.39	
34.2	801.70	
35.8	803.13	
37.9	804.57	
42.9	805.13	
47.8	805.43	
58.9	806.57	

2003 2003 Survey		
Station	**Elevation**	**Notes**
0.2	804.51	
12.9	804.29	
17.5	804.17	
20.5	804.18	
22.6	804.06	
23.4	803.35	
24.5	803.17	
25.3	802.31	
27.0	802.03	
28.2	801.81	
29.2	801.86	
31.1	801.84	
33.5	801.48	
33.8	801.5	
34.7	801.92	
34.9	802.03	
36.1	803.14	
37.9	804.42	
40.6	804.78	
45.3	805.09	
49.5	805.51	

Photo of Cross-Section #6 - Looking Downstream

	2002	**2003**
Area	19.64	27.31
Width	12.8	13.5
Mean Depth	1.5	2.0
Max Depth	2.8	2.7

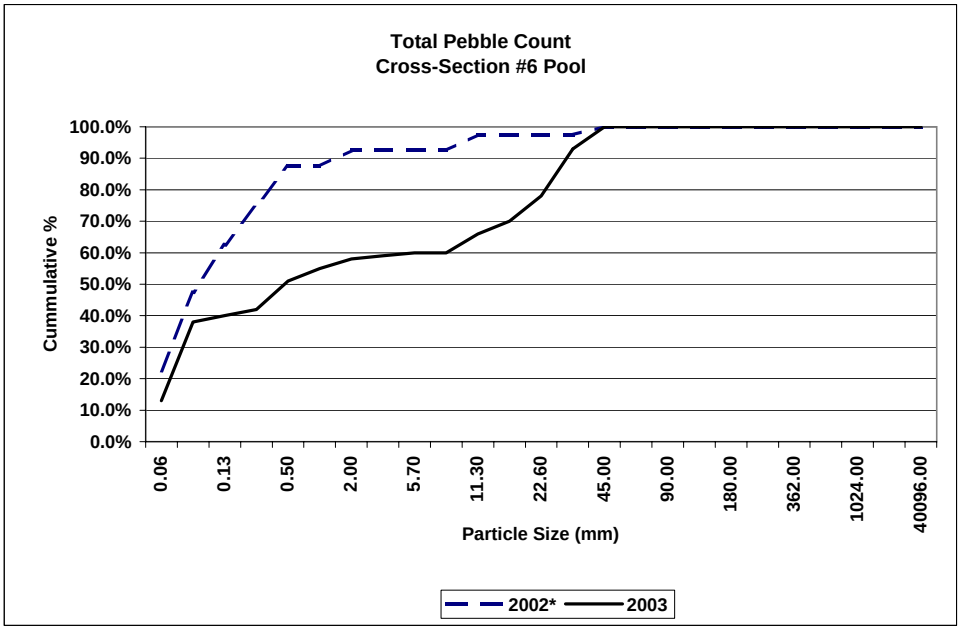


Project Name	Lyle Creek
Cross Section	#6
Feature	Pool
Date	11/4/03
Crew	Shaffer, Bidelspach, Clinton

* 2002 pebble count is a typical riffle sections used as basline information.

			2002*			2003			
Description	**Material**	**Size (mm)**	**Pool**	**%**	**Cum %**	**Riffle - Bed**	**Riffle - Bank**	**%**	**Cum %**
Silt/Clay	silt/clay	0.061	9	22.5%	22.5%	13	0	13.0%	13.0%
Sand	very fine sand	0.062	10	25.0%	47.5%	24	1	25.0%	38.0%
	fine sand	0.125	6	15.0%	62.5%	2	0	2.0%	40.0%
	medium sand	0.25	5	12.5%	75.0%	1	1	2.0%	42.0%
	course sand	0.50	5	12.5%	87.5%	0	9	9.0%	51.0%
	very course sand	1.0	0	0.0%	87.5%	0	4	4.0%	55.0%
Gravel	very fine gravel	2.0	2	5.0%	92.5%	0	3	3.0%	58.0%
	fine gravel	4.0	0	0.0%	92.5%	0	1	1.0%	59.0%
	fine gravel	5.7	0	0.0%	92.5%	0	1	1.0%	60.0%
	medium gravel	8.0	0	0.0%	92.5%	0	0	0.0%	60.0%
	medium gravel	11.3	2	5.0%	97.5%	0	6	6.0%	66.0%
	course gravel	16.0	0	0.0%	97.5%	0	4	4.0%	70.0%
	course gravel	22.6	0	0.0%	97.5%	0	8	8.0%	78.0%
	very course gravel	32	0	0.0%	97.5%	0	15	15.0%	93.0%
	very course gravel	45	1	2.5%	100.0%	0	7	7.0%	100.0%
Cobble	small cobble	64	0	0.0%	100.0%	0	0	0.0%	100.0%
	medium cobble	90	0	0.0%	100.0%	0	0	0.0%	100.0%
	large cobble	128	0	0.0%	100.0%	0	0	0.0%	100.0%
	very large cobble	180	0	0.0%	100.0%	0	0	0.0%	100.0%
Boulder	small boulder	256	0	0.0%	100.0%	0	0	0.0%	100.0%
	small boulder	362	0	0.0%	100.0%	0	0	0.0%	100.0%
	medium boulder	512	0	0.0%	100.0%	0	0	0.0%	100.0%
	large boulder	1024	0	0.0%	100.0%	0	0	0.0%	100.0%
	very large boulder	2049	0	0.0%	100.0%	0	0	0.0%	100.0%
Bedrock	bedrock	40096	0	0.0%	100.0%	0	0	0.0%	100.0%
TOTAL / %of whole count			40	100.0%		40	60	100.0%	

	d16	**d35**	**d50**	**d85**	**d95**
2002*	0.00	0.08	0.11	0.65	11.65
2003	0.07	0.09	0.71	31.78	43.07

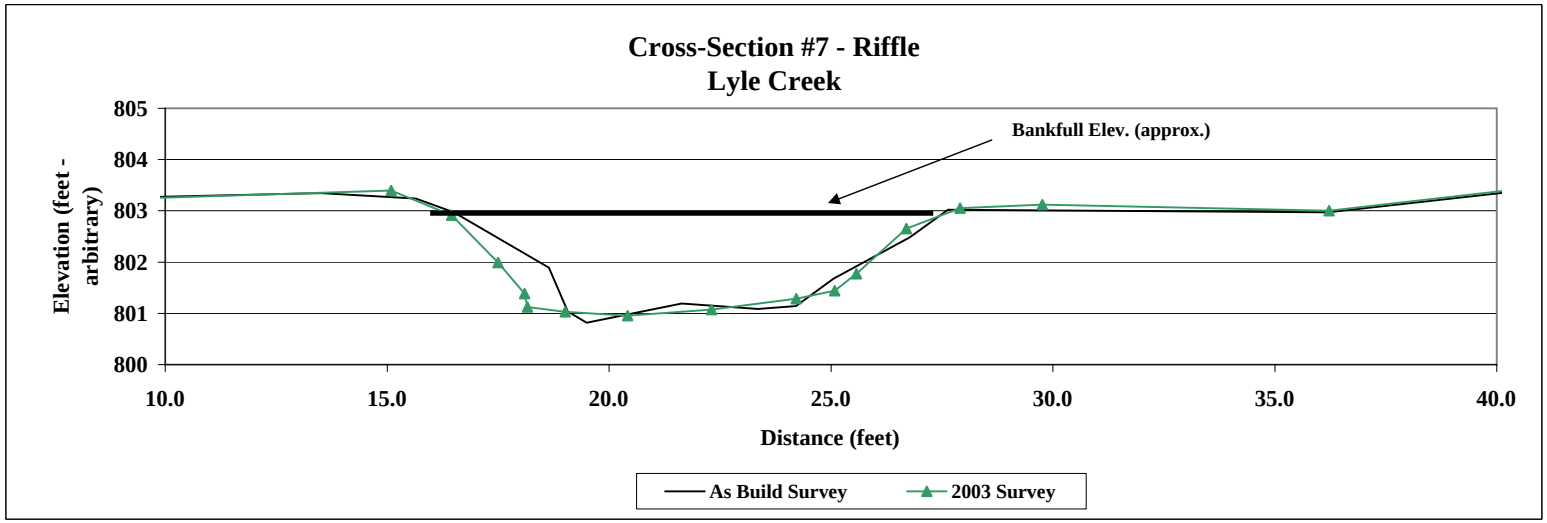


Project Name	Lyle Creek
Cross Section	#7
Feature	Riffle
Date	11/4/03
Crew	Shaffer, Bidelspach, Clinton

2002 As Build Survey			2003 2003 Survey		
Station	**Elevation**	**Notes**	**Station**	**Elevation**	**Notes**
5.4	803.18		0.0	803.143	
13.5	803.35		8.6	803.223	
15.6	803.24		15.1	803.393	
16.5	802.97		16.5	802.913	
18.6	801.89		17.5	801.99	
19.1	801.03		18.1	801.383	
19.5	800.82		18.2	801.123	
21.6	801.20		19.0	801.033	
23.4	801.09		20.4	800.953	
24.2	801.14		22.3	801.073	
25.1	801.68		24.2	801.283	
26.8	802.49		25.1	801.443	
27.6	803.02		25.6	801.773	
36.2	802.97		26.7	802.653	
41.8	803.51		27.9	803.053	
53.7	804.31		29.8	803.123	
68.7	804.42		36.2	803.003	
76.9	804.47		42.8	803.643	
86.7	805.39				

Photo of Cross-Section #7 - Looking Downstream

	2002	**2003**
Area	15.24	16.20
Width	11.2	11.2
Mean Depth	1.4	1.4
Max Depth	2.2	2.1

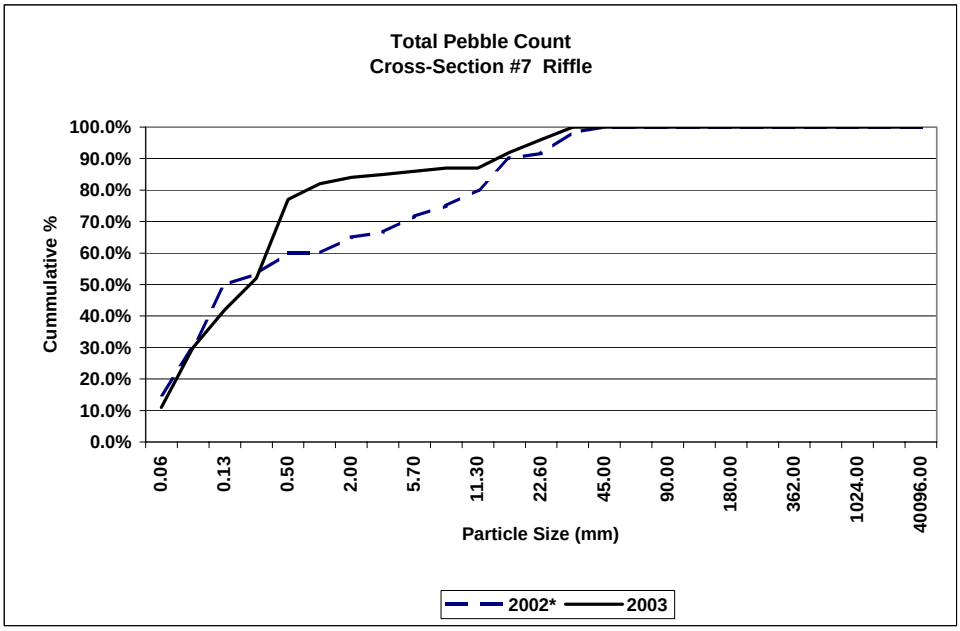


Project Name	Lyle Creek
Cross Section	#7
Feature	Riffle
Date	11/4/03
Crew	Shaffer, Bidelspach, Clinton

* 2002 pebble count is a typical riffle sections used as basline information.

			2002*			2003			
Description	**Material**	**Size (mm)**	**Riffle**	**%**	**Cum %**	**Riffle - Bed**	**Riffle - Bank**	**%**	**Cum %**
Silt/Clay	silt/clay	0.061	9	15.0%	15.0%	0	11	11.0%	11.0%
Sand	very fine sand	0.062	9	15.0%	30.0%	3	16	19.0%	30.0%
	fine sand	0.125	12	20.0%	50.0%	6	6	12.0%	42.0%
	medium sand	0.25	2	3.3%	53.3%	10	0	10.0%	52.0%
	course sand	0.50	4	6.7%	60.0%	25	0	25.0%	77.0%
	very course sand	1.0	0	0.0%	60.0%	5	0	5.0%	82.0%
Gravel	very fine gravel	2.0	3	5.0%	65.0%	2	0	2.0%	84.0%
	fine gravel	4.0	1	1.7%	66.7%	1	0	1.0%	85.0%
	fine gravel	5.7	3	5.0%	71.7%	1	0	1.0%	86.0%
	medium gravel	8.0	2	3.3%	75.0%	1	0	1.0%	87.0%
	medium gravel	11.3	3	5.0%	80.0%	0	0	0.0%	87.0%
	course gravel	16.0	6	10.0%	90.0%	5	0	5.0%	92.0%
	course gravel	22.6	1	1.7%	91.7%	4	0	4.0%	96.0%
	very course gravel	32	4	6.7%	98.3%	4	0	4.0%	100.0%
	very course gravel	45	1	1.7%	100.0%	0	0	0.0%	100.0%
Cobble	small cobble	64	0	0.0%	100.0%	0	0	0.0%	100.0%
	medium cobble	90	0	0.0%	100.0%	0	0	0.0%	100.0%
	large cobble	128	0	0.0%	100.0%	0	0	0.0%	100.0%
	very large cobble	180	0	0.0%	100.0%	0	0	0.0%	100.0%
Boulder	small boulder	256	0	0.0%	100.0%	0	0	0.0%	100.0%
	small boulder	362	0	0.0%	100.0%	0	0	0.0%	100.0%
	medium boulder	512	0	0.0%	100.0%	0	0	0.0%	100.0%
	large boulder	1024	0	0.0%	100.0%	0	0	0.0%	100.0%
	very large boulder	2049	0	0.0%	100.0%	0	0	0.0%	100.0%
Bedrock	bedrock	40096	0	0.0%	100.0%	0	0	0.0%	100.0%
TOTAL / %of whole count			60	100.0%		67	33	100.0%	

	d16	**d35**	**d50**	**d85**	**d95**
2002*	0.06	0.12	0.19	15.91	32.90
2003	0.07	0.13	0.34	3.00	25.30



Project Name	Little Pine and Brush Creeks
Task	Feature Slope and Length Calculations
Date	9/30/03
Crew	Shaffer, Bidelspach, Clinton

2003 Data

Little Pine

Riffle Station	Change	Bed elevation	Water elevation	change	slope
85		95.48	96.1		
132	47	94.73	95.8	0.3	0.64%
204		95.07	95.55		
222	18	93.91	95.07	0.48	2.67%
266		94.12	95.01		
308	42	93.86	94.74	0.27	0.64%
390		93.37	94.33		
486	96	92.02	93.06	1.27	1.32%
574		92.23	93.14		
601	27	91.68	92.55	0.59	2.19%
728		91.8	92.48		
759	31	90.83	91.7	0.78	2.52%

Pool	length	p-p spacing
18.75		
85.85	67.1	
222		
266	44	191.7
330		
390	60	116
486		
574	88	170
601		
722	121	131.5
773		
873	100	161.5

	min	max	median
Length	18.0	96.0	36.5
Slope	0.64%	2.67%	1.75%
Length	44.0	121.0	77.6
Spacing	116	192	162

Brush Creek

Riffle Station	Change	Water elevation	change	slope
0		92.68		
114	114	91.81	0.87	0.76%
408		91.78		
559	151	91.59	0.19	0.13%
736		91.47		
796	60	90.88	0.59	0.98%
935		90.77		
1281	346	89.71	1.06	0.31%
1591		89.76		
1682	91	89.52	0.24	0.26%
1898		89.3		
1951	53	88.84	0.46	0.87%

Pool	length	p-p spacing
114		
408	294	
557		
736	179	385.5
1280		
1591	311	789
1682		
1898	216	354.5
1951		
2177	226	274

	min	max	median
Length	53.0	346.0	102.5
Slope	0.13%	0.98%	0.53%
Length	179.0	311.0	226.0
Spacing	274	789	370

PROFILE	Little Pine As-built - 2001			Brush Creek As-built - 2001			Little Pine 2003			Brush Creek 2003		
	Minimum	Maximum	Median	Minimum	Maximum	Median	Minimum	Maximum	Median	Minimum	Maximum	Median
Riffle Length	6.1	46.8	18.4	20	417	32.9	18	96	36.5	53	346	102.5
Riffle Slope	1.17%	2.79%	1.61%	0.24%	1.65%	1.35%	0.64%	2.67%	1.75%	0.13%	0.98%	0.53%
Pool Length	34.1	111.6	44.5	51	348	187	44	121	77.55	179	311	226
Pool to Pool Spacing	51	150.3	63.7	53	966	359	116	191.7	161.5	274	789	370

Project Nam	Lyle Creek
Task	Channel Pattern Measurements
Date	11/4/03
Crew	Shaffer, Bidelspach, Clinton

Lyle Creek In Place				Lyle Creek		
Radius of Curvature	**Meander Wavelength**	**Channel Beltwidth**		**Radius of Curvature**	**Meander Wavelength**	**Channel Beltwidth**
13.3	58.9	109.2		16.7	48.8	21.7
30.8	105.5	42.0		16.9	53.8	22.0
24.3	107.1	45.7		17.2	58.9	22.3
21.4	123.2	45.9		17.7	60.2	24.4
42.8	124.2	46.4		18.1	61.7	25.4
31.0	148.8	51.3		18.3	62.0	27.1
24.9	152.4	57.9		18.9	62.3	30.3
32.9	152.5	60.1		19.2	62.9	31.0
31.8	155.8	61.8		20.4	63.6	31.3
38.5	160.8	80.3		20.4	64.7	32.9
21.2	177.1	50.0		20.7	70.0	33.0
22.5				21.1	71.4	33.1
48.6				21.1	72.2	34.4
37.2				22.6	72.3	35.7
29.1				22.6	76.0	37.7
40.4				23.4	76.7	38.0
				23.6	89.1	40.5
				24.2	90.0	40.6
				25.0	90.2	42.1
				27.5	101.0	42.4
				32.4	118.2	49.2
				38.5	150.4	55.7
13.3	58.9	42.0	***min***	16.7	48.8	21.7
48.6	177.1	109.2	***max***	38.5	150.4	55.7
30.9	148.8	51.3	***median***	20.9	70.7	33.0

Lyle Creek Stream Restoration
Catawba County, NC

Quad 1

Tree Stratum

Species	Height (cm)	Diameter (mm)	Radius (mm)	Σ X-sec. (mm²)	Rel. x-sec (%)	Density	Rel. Density (%)	Rank (Importance)	Average
Liriodendron tulipifera	9	1	0.5	0.8	**95.8**	**17**	**94.4**	1	95.13889
	9	1	0.5	0.8					
	4	0.5	0.25	0.2					
	4	0.5	0.25	0.2					
	4	0.5	0.25	0.2					
	4	0.5	0.25	0.2					
	4	0.5	0.25	0.2					
	3	0.5	0.25	0.2					
	3	0.5	0.25	0.2					
	3	0.5	0.25	0.2					
	3	0.5	0.25	0.2					
	3	0.5	0.25	0.2					
	3	0.5	0.25	0.2					
	3	0.5	0.25	0.2					
	3	0.5	0.25	0.2					
	3	0.5	0.25	0.2					
	3	0.5	0.25	0.2					
Total				**4.5**					
Betula nigra	2	0.5	0.25	0.2	**4.2**	**1**	**5.6**	2	4.861111
Total				**0.2**					
Overall Total				**4.7**	**100.0**	**18.0**	**100.0**		100
Total Trees per acre						720			
Planted trees per acre						0			

Shrub Stratum

Species	Cover (%)	Rel. cover (%)	Density	Rel. Density (%)	Rank (Importance)
Alnus serrulata	0.5	50	1	50	1
Unknown	0.5	50	1	50	1

Herb Stratum

Species	Cover (%)	Rel. cover (%)	Rank (Importance)
Panicum sp.	40	64.0	1
Paspalum sp.	0.5	0.8	5
Eupatorium capillifolium	0.5	0.8	5
Hystrix patula	0.5	0.8	5
Trifolium sp.	5	8.0	3
Festuca sp.	1	1.6	4
Microstegium vimineum	15	24.0	2
Total	**62.5**	100.0	

Lyle Creek Stream Restoration
Catawba County, NC

Quad 2

Tree Stratum

Species	Height (cm)	Diameter (mm)	Radius (mm)	Σ X-sec. (mm²)	Rel. x-sec (%)	Density	Rel. Density (%)	Rank (Importance)	Average
Liriodendron tulipifera	5	1	0.5	0.8	**0.0**	**9**	**69.2**	1	34.62038
	5	1	0.5	0.8					
	5	1	0.5	0.8					
	5	1	0.5	0.8					
	5	1	0.5	0.8					
	5	1	0.5	0.8					
	5	1	0.5	0.8					
	5	1	0.5	0.8					
	5	1	0.5	0.8					
Total				**7.1**					
Betula nigra	73	3							
	3000	430							
	3000	280							
	3000	300	150	70685.8	**100.0**	**4**	**30.8**	2	65.37962
Total				**70685.8**					
Overall Total				**70692.9**	**100.0**	**13.0**	**100.0**		100
Total Trees per acre						520			
Planted trees per acre						40			

Shrub Stratum

Species	Cover (%)	Rel. cover (%)	Density	Rel. Density (%)	Rank (Importance)
Salix nigra	0.5	50	4	0.7	2
Cornus amomum	0.5	50	6	1.0	1

Herb Stratum

Species	Cover (%)	Rel. cover (%)	Rank (Importance)
Festuca sp.	75	40.8	2
Juncus sp.	5	2.7	4
Echinochloa crusgalli	15	8.2	3
Eupatorium sp.	5	2.7	4
Panicum virgatum	2	1.1	5
Aster sp.	2	1.1	5
Microstegium	80	43.5	1
Total	**184**	100.0	

Lyle Creek Stream Restoration
Catawba County, NC

Quad 3

Tree Stratum

Species	Height (cm)	Diameter (mm)	Radius (mm)	Σ X-sec. (mm²)	Rel. x-sec (%)	Density	Rel. Density (%)	Rank (Importance)	Average
Liriodendron tulipifera	3000	1500	750	1767145.9	**100.0**	**7**	**46.7**	**1**	73.33174
	3000	550	275	237582.9					
	3000	550	275	237582.9					
	3000	42	21	1385.4					
	9	0.5	0.25	0.2					
	14	2	1	3.1					
	10	1	0.5	0.8					
Total			**1322.75**	**2243701.3**					
Platanus occidentalis	38	4	2	12.6	**0.0**				
	21	2	1	3.1		**2**	**13.3**	**2**	13.33333
Total			**3**	**15.7**					
Quercus shumardii	55	7	3.5	38.5	**0.0**	**1**	**6.7**	**3**	3.334191
Total		7	**3.5**	**38.5**					
Morus rubra	37	2	1	3.1	**0.0**	**1**	**6.7**	**3**	3.333403
Total			**1**	**3.1**					
Celtis occidentalis	42	3	1.5	7.1	**0.0**	**2**	**13.3**	**2**	6.666894
	29	2	1	3.1					
Total		**5**	**2.5**	**10.2**					
Cornus florida	18	1	0.5	0.8	**0.0**	**1**	**6.7**	**3**	3.333351
Total			**0.5**	**0.8**					
Carpinus caroliniana	21	2	1	3.1	**0.0**	**1**	**6.7**	**3**	3.333403
Total			**1**	**3.1**					
Overall Total				**2243772.8**	**100.0**	**15.0**	**86.7**		

Total Trees per acre 600
Planted trees per acre 240

Shrub Stratum

Species	Cover (%)	Rel. cover (%)	Density	Rel. Density (%)	Rank (Importance)
Salix nigra	4	47.1	36	60	1
Sambucus canadensis	0.5	5.9	3	5	3
Cornus amomum	4	47.1	21	35	2

Herb Stratum

Species	Cover (%)	Rel. cover (%)	Rank (Importance)
Aster sp.	15	8.7	3
Microstegium	90	52.5	1
Carex sp.	15	8.7	3
Juncus sp.	15	8.7	3
Polygonum sp.	25	14.6	2
Viola sp.	1	0.6	5
Trifolium sp.	0.5	0.3	6
Verbesina occidentalis	10	5.8	4
Total	**171.5**	100.0	

Lyle Creek Stream Restoration
Catawba County, NC

Quad 4

Tree Stratum

Species	Height (cm)	Diameter (mm)	Radius (mm)	Σ X-sec. (mm²)	Rel. x-sec (%)	Density	Rel. Density (%)	Rank (Importance)	Average
Total									
Liquidambar styraciflua	10	1	0.5	0.8	**25.7**	**59**	**18.8**	**3**	22.22099
	10	1	0.5	0.8					
	10	1	0.5	0.8					
	10	1	0.5	0.8					
	10	1	0.5	0.8					
	10	1	0.5	0.8					
	10	1	0.5	0.8					
	10	1	0.5	0.8					
	10	1	0.5	0.8					
	10	1	0.5	0.8					
	10	1	0.5	0.8					
	10	1	0.5	0.8					
	10	1	0.5	0.8					
	10	1	0.5	0.8					
	10	1	0.5	0.8					
	10	1	0.5	0.8					
	10	1	0.5	0.8					
	10	1	0.5	0.8					
	10	1	0.5	0.8					
	10	1	0.5	0.8					
	10	1	0.5	0.8					
	15	1	0.5	0.8					
	15	1	0.5	0.8					
	15	1	0.5	0.8					
	15	1	0.5	0.8					
	15	1	0.5	0.8					
	15	1	0.5	0.8					
	15	1	0.5	0.8					
	15	1	0.5	0.8					
	15	1	0.5	0.8					
	15	1	0.5	0.8					
	22	1	0.5	0.8					
	22	1	0.5	0.8					
	22	1	0.5	0.8					
	22	1	0.5	0.8					
	22	1	0.5	0.8					
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	22	1	0.5	0.8					
	22	1	0.5	0.8					
	22	1	0.5	0.8					
	22	1	0.5	0.8					
	22	1	0.5	0.8					
	7	1	0.5	0.8					
	7	1	0.5	0.8					
	7	1	0.5	0.8					
	7	1	0.5	0.8					
	7	1	0.5	0.8					
	7	1	0.5	0.8					
	7	1	0.5	0.8					
	7	1	0.5	0.8					
	7	1	0.5	0.8					
	7	1	0.5	0.8					
	7	1	0.5	0.8					
	7	1	0.5	0.8					
	7	1	0.5	0.8					
Total			**29.5**	**46.3**	**25.7**				

Liriodendron tulipifera	7	1	0.5	0.8		**19**	**6.1**	4	
	7	1	0.5	0.8					
	7	1	0.5	0.8					
	7	1	0.5	0.8					
	7	1	0.5	0.8					
	7	1	0.5	0.8					
	7	1	0.5	0.8					
	7	1	0.5	0.8					
	7	1	0.5	0.8					
	7	1	0.5	0.8					
	7	1	0.5	0.8					
	11	1	0.5	0.8					
	11	1	0.5	0.8					
	11	1	0.5	0.8					
	11	1	0.5	0.8					
	11	1	0.5	0.8					
	13	1	0.5	0.8					
	13	1	0.5	0.8					
	13	1	0.5	0.8					
Total			**9.5**	**14.9**	**8.3**				
Liquidambar styraciflua	16	1	0.5	0.8	**3.9**	**9**	**2.9**	**5**	3.389643
	16	1	0.5	0.8					
	16	1	0.5	0.8					
	16	1	0.5	0.8					
	16	1	0.5	0.8					
	16	1	0.5	0.8					
	16	1	0.5	0.8					
	10	1	0.5	0.8					
	15	1	0.5	0.8					
Total		1	**4.5**	**7.1**	**3.9**				
Carpinus caroliniana	33	4	2	12.6	**7.0**	**1**	**0.3**	**6**	3.637497
Total			**2**	**12.6**	**7.0**				
Betula nigra	2.5	0.5	0.25	0.2	**18.3**	**66**	**21.0**	**2**	19.63999
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
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	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	22	1	0.5	0.8					
	29	2	1	3.1					
	7.5	1	0.5	0.8					
	7.5	1	0.5	0.8					
	7.5	1	0.5	0.8					

	7.5	1	0.5	0.8					
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	7.5	1	0.5	0.8					
	7.5	1	0.5	0.8					
	7.5	1	0.5	0.8					
	7.5	1	0.5	0.8					
	29	2	1	3.1					
	13	1	0.5	0.8					
	13	1	0.5	0.8					
	13	1	0.5	0.8					
Total		**48**	**24**	**33.0**	**18.3**				
Acer rubrum	2.5	0.5	0.25	0.2	**37.0**	**160**	**51.0**	**1**	43.95597
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
	2.5	0.5	0.25	0.2					
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	2.5	0.5	0.25	0.2					
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2.5	0.5	0.25	0.2
2.5	0.5	0.25	0.2
2.5	0.5	0.25	0.2
2.5	0.5	0.25	0.2
2.5	0.5	0.25	0.2
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2.5	0.5	0.25	0.2
2.5	0.5	0.25	0.2
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2.5	0.5	0.25	0.2
2.5	0.5	0.25	0.2
2.5	0.5	0.25	0.2
2.5	0.5	0.25	0.2
2.5	0.5	0.25	0.2
7.5	1	0.5	0.8
7.5	1	0.5	0.8
7.5	1	0.5	0.8
7.5	1	0.5	0.8
7.5	1	0.5	0.8
7.5	1	0.5	0.8
7.5	1	0.5	0.8
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	7.5	1	0.5	0.8			
	7.5	1	0.5	0.8			
	7.5	1	0.5	0.8			
	12.5	1	0.5	0.8			
	12.5	1	0.5	0.8			
	12.5	1	0.5	0.8			
	12.5	1	0.5	0.8			
	12.5	1	0.5	0.8			
	12.5	1	0.5	0.8			
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	12.5	1	0.5	0.8			
	12.5	1	0.5	0.8			
	12.5	1	0.5	0.8			
	12.5	1	0.5	0.8			
	12.5	1	0.5	0.8			
	12.5	1	0.5	0.8			
	12.5	1	0.5	0.8			
	12.5	1	0.5	0.8			
	12.5	1	0.5	0.8			
Total			**55.0**	**66.8**	**37.0**		
Overall Total			124.5	**180.6**	**100.0**	**314**	**100**
Total Trees per acre						12560	
Planted trees per acre						0	

Shrub Stratum

Species	**Cover (%)**	**Rel. cover (%)**	**Density**	**Rel. Density (%)**	**Rank (Importance)**
Cornus amomum	15	0.97	31	0.91	1
Salix nigra	0.5	0.03	3	0.09	2

Herb Stratum

Species	**Cover (%)**	**Rel. cover (%)**	**Rank (Importance)**
Panicum virgatum	35	23.0	3
Bidens sp.	45	29.5	1
Carex sp.	15	9.8	4
Eupatorium sp.	2	1.3	7
Unknown	5	3.3	6
Aster sp.	0.5	0.3	8
Microstegium	10	6.6	5
Panicum clandestinum	40	26.2	2
Total	**152.5**	100.0	