

Price Park Stream Restoration

2003 Annual Monitoring Report



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1619 Mail Service Center
Raleigh, NC 27699-1619

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March, 2004



NC STATE UNIVERSITY

2003 Price Park Stream Restoration Monitoring Abstract

An unnamed Tributary to Horsepen Creek, henceforth referred to as Price Park, was enhanced/restored through the North Carolina Ecosystem Enhancement Program (NCEEP). The goals and objectives of this project are as follows:

- 1.) Restore 1,776-linear feet of unnamed tributary to Horsepen Creek.
- 2.) Establish a riparian zone surrounding restored channel.

This is the 3rd year of the 5-year monitoring plan for Price Park Stream Restoration.

Table 1A. Background Information

Project Name	Price Park - unnamed Tributary to Horsepen Creek
Designer's Name	Earth Tech of NC, Inc 701 Corporate Center Drive, Suite 475 Raleigh, NC 27607
Contractor's Name	SEI, Inc
Project County	Guilford County
Directions to Project Site	Guilford College Road Exit off I-40. Follow north to New Garden Road. After passing Guilford College and Jefferson School, turn right at the light. Follow to the bottom of the hill where the creek crosses the road at Price Park. The project is upstream and downstream of the road crossing and is fully contained within the limits of Price Park.
Drainage Area	1.0 sq mi
USGS Hydro Unit	3030002
NCDWQ Subbasin	16-11-5-1
Project Length	1,776 linear feet
Restoration Approach	- Restore 1,464 linear feet of impaired stream into 1,776 linear using Priority I techniques - 50 foot riparian buffer throughout the project
Date of Completion	August 2001 with modifications, Feb. 2002 and planting completed March 2002
Monitoring Dates	4-2002, 12-2002

Results and Discussion

Overall the majority of the stream is stable, there are areas of concern and areas of immediate need. Table 2A 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. Vegetation is not succeeding to levels required for mitigation credit.

Table 2A. Summary of Channel Conditions

DIMENSION	Price Park Cross-section #1 Riffle			Price Park Cross-section #2 Pool			Price Park Cross-section #3 Riffle			Price Park Cross-section #4 Riffle		
	As-built	Dec-02	2003	As-built	Dec-02	2003	As-built	Dec-02	2003	As-built	Dec-02	2003
	Bankfull Cross-sectional Area	24.1	25.6	37.0	50.6	49.3	44.9	31.9	28.4	31.9	36.7	43.4
Bankfull Width	13.3	14.8	15.0	22.2	21.0	21.2	14.0	14.0	14.7	17.2	19.1	17.2
Bankfull Mean Depth	1.8	1.7	2.5	2.3	2.3	2.1	2.3	2.0	2.2	2.1	2.3	2.1
Bankfull Max Depth	3.5	3.6	4.3	4.9	4.8	4.8	3.6	3.4	3.6	3.2	3.6	3.7

PATTERN	Price Park As-built			Price Park 2002			Price Park 2003		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean
	Meander Wave Length	127	183	150	118	197	162	63	254
Radius of Curvature	49	84	65	48	85	61	26	131	59
Beltwidth	49	80	-	52	95	-	35	169	79

PROFILE	Price Park As-built			Price Park 2003		
	Minimum	Maximum	Median	Minimum	Maximum	Median
	Riffle Length	Not Reported			9.46	59.45
Riffle Slope	Not Reported			0.56%	2.86%	1.42%
Run Length	Not Reported			29.4	87.3	41.8
Run Slope	Not Reported			-0.03%	0.69%	0.16%
Pool Length	Not Reported			22	62	38
Pool to Pool Spacing	21	153	92	64.5	343	91.5

SUBSTRATE	Price Park Cross-section #1 Riffle		Price Park Cross-section #2 Pool		Price Park Cross-section #3 Riffle		Price Park Cross-section #4 Riffle	
	As-built	2003	As-built	2003	As-built	2003	As-built	2003
	D50	0.34	0.11	0.26	1.45	0.16	0.14	0.25
D85	87.7	68.2	1.5	14.5	6.7	12.1	6.9	14.8

VEGETATION	Quad 1 - JP		Quad 2 - JP		Quad 3 -JP		Quad 4 - JP		Quad 5 -JP	
	Observed	Planted*	Observed	Planted*	Observed	Planted*	Observed	Planted*	Observed	Planted*
Tree Stratum (stems/acre)	160	0	280	40	40	0	120	120	80	80
Shrub Stratum (% cover)	0.5	n/a	0.5	n/a	0.5	n/a	1	n/a	0	n/a
Herb Stratum (%cover)	7.5	n/a	97	n/a	17.5	n/a	87	n/a	70	n/a

* Planted value represents number of stems observed that alive that were planted.

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

- The lack of successful vegetation in the riparian buffer
 - Supplemental plantings are needed to meet minimum density.
 - Soil should be tested for fertility and amended as directed.
- Down-cutting near channel confluence
 - This area should be monitored to ensure the down-cutting does not continue up through the project.
- Areas with bank erosion due to overland flow washing into the channel
 - These areas should be examined closely to see if a structure is necessary to provide a stable method of allowing the water to enter the channel or if vegetation will be adequate.
 - These areas should be monitored closely during upcoming site visits to monitor degradation.
- The lack of successful herbaceous cover along sections of the streambanks.
 - These areas should be reseeded.
 - It will be required to prepare a seedbed in order establish herbaceous cover.

Vegetation Overall

- Replanting trees to obtain mitigation requirements
 - The site could benefit from larger containerized trees both for bank stability and aesthetics.
- Stake only in areas where erosion is problematic
 - Live staking should also help in the establishment of herbaceous vegetation on the bare banks.
- Monitor invasive vegetation
 - Although invasive vegetation has not consumed this project site, there are numerous species that should be controlled now, most importantly kudzu and oriental bittersweet.

Photos

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

Price Park – Unnamed Tributary to Horsepen Creek



Typical Riffle.



Typical Pool.



**Issue Photo 1 - Station 3+00.
Bank scour below cross vane**



**Issue Photo 2 - Station 3+60.
Bank erosion behind rootwads.**



**Issue Photo 3 – Station 5+30
Unsecured matting and unvegetated bank.**



**Issue Photo 4 – Station 5+00
Erosion on bank below cross vane
and washed away matting**



**Issue Photo 5 – Station 6+50
Unprotected bank**



**Issue Photo 6 – Station 6+00
Cutting under cross vane**



**Issue Photo 7 – Station 7+40
Bank slump due to over-bank wash**



**Issue Photo 8 – Station 8+50
Bank slump due to over-bank wash**



**Issue Photo 9 – Station 13+70
Bank slump between root wads resulting
from overland flow**



**Issue Photo 10 – Station 14+10
Bank washout**



Issue Photo11 – Station 13+50
Erosion near drainage channel



Issue Photo 12 – Station 13+60
Overland flow eroding channel bank

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1.0 BACKGROUND INFORMATION

The background information for this report is referenced from previous monitoring reports conducted by Earth Tech, Inc. The following was excerpted from 2001 Earth Tech As-Built monitoring report section 1.1:

This site is located on the west side of Greensboro off New Garden Road. The stream reach is located at the entrance to Price Park on land that is held by the City of Greensboro (Figure 1). The stream is situated in the Upper Cape Fear River Basin (8-digit hydrologic code: 03030002). Jefferson Elementary is located to the west, Price Park to the east, and Guilford College is located south of the site. Local residents use the area surrounding the stream for walking, biking, and other recreational activities.

The stream is the unnamed tributary to Horsepen Creek, henceforth referred to as the Jefferson Pilot stream. This stream drains into a private pond that backs up the lower portion of the channel. The pond elevation was raised after the restoration construction was completed. From a review of historical aerial photographs, this second order stream appears to have been straightened prior to 1937 for agricultural purposes. The drainage area is approximately 1.0 square mile (Figure 1).

Prior to the restoration, a narrow riparian corridor existed along much of the stream banks and the channel was deeply incised with active erosion and undercutting. Within this buffer, the vegetation was relatively weedy and scrubby with only approximately 10 trees with a basal diameter greater than 10 inches. Development pressures continue to increase the urbanization in the Jefferson Pilot watershed and adjacent watersheds.

The Priority I restoration involved converting the 1436 ft straightened channel into a sinuous channel that meanders for a total of 1646 ft as measured along the centerline or 1,776 along the thalweg (Appendix A). Cross-vanes and rootwads were incorporated for aquatic habitat enhancement and bed and bank stability. A 50-foot riparian buffer on either side of the stream was planted with native vegetation. In addition, an aerial sanitary sewer line was re-aligned to be perpendicular to the stream flow and a gas line was re-routed under the stream channel.

Table 1 contains a schedule of events for the construction of the Jefferson Pilot stream.

Table 1. Schedule of Construction Events

Construction Event	Date
Channel construction	June-August 2001
Additional structure construction	February 25-28, 2002
Temporary Seeding	July-August 2001 February 2002 (limited to disturbed areas after construction of additional structures)

Permanent Seeding	August 2001
Planting of bare-root stock	February 18-19, 2002 & March 7, 2002
As-built Stream Survey	April 11, 2002
As-built Vegetation Survey	June 6, 2002

1.1 Goals and Objective

The goals and objectives of this project are as follows.

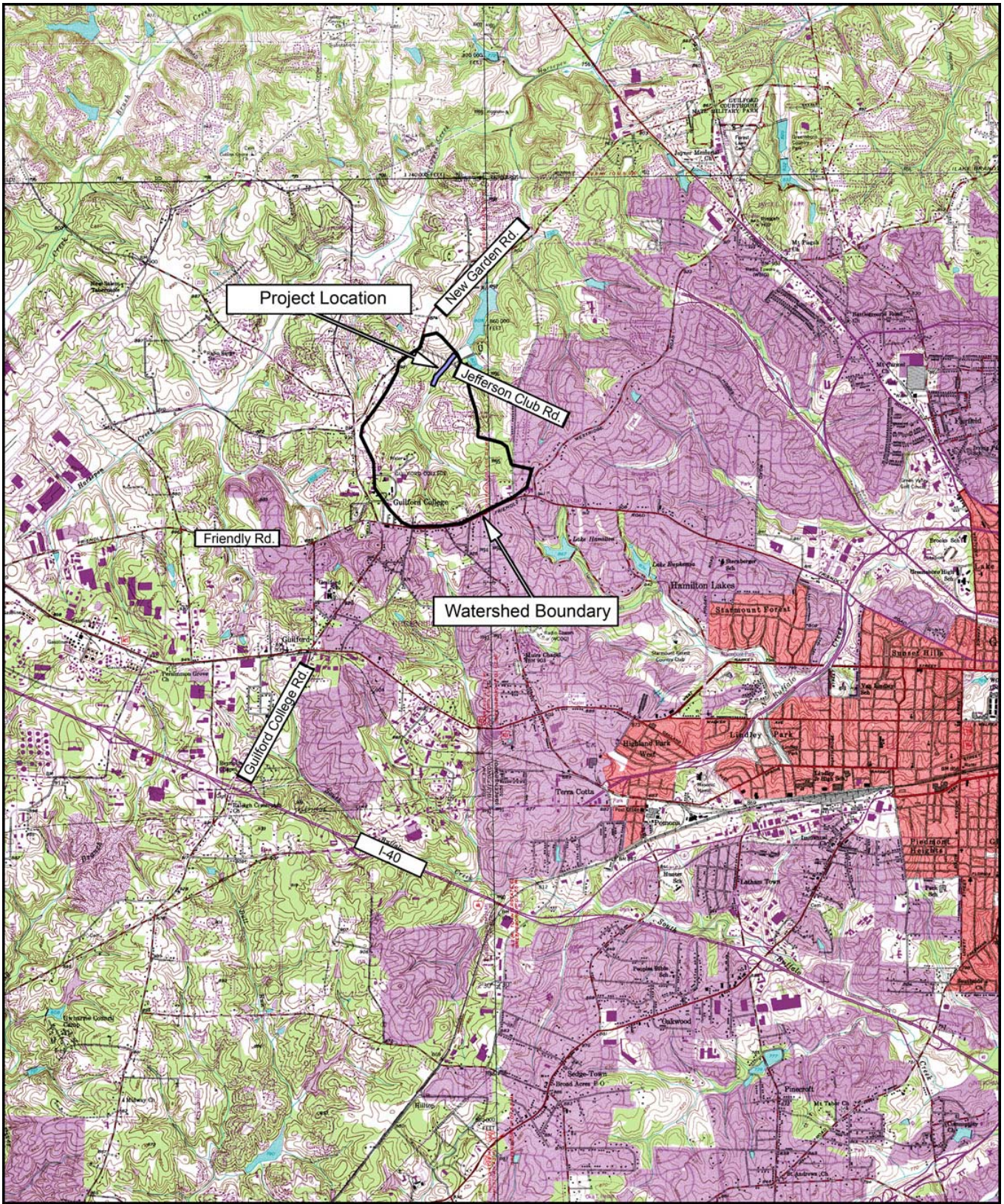
- 1.) Restore 1,776-linear feet of unnamed tributary to Horsepen Creek.
- 2.) Establish a riparian zone surrounding restored channel.

1.2 Project Location

The project is located in Greensboro, North Carolina. From Interstate I-40 exit on Guilford College road north. Follow Guildford College road for about 2 miles and near right onto New Garden road. Follow New Garden road for about 1 mile. Past Guildford College, turn right onto Jefferson Club road. The project is located at the bottom of the hill at the stream crossing. The culvert is located in the middle of the project.

1.3 Project Description

The restoration of 1,776 linear feet of the Unnamed Tributary to Horsepen Creek, hereafter referred to as Price Park, consists of re-meandering and re-connecting the existing channel to the floodplain. Riffle-pool bedform was constructed as well as a stable meander pattern developed from stable reference streams. Pools were maintained through the use of cross vane structures used to hold the bed elevation at the outlet of the pools. Rootwads were used to stabilize the outside of the meander bends. Vegetation was planted to establish a dense root mass along the stream banks and in the riparian zone.



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Department of Biological & Agricultural Engineering

Campus Box 7625
Raleigh, NC 27606

Project Location: Price Park
Guilford County, North Carolina

EEP Monitoring Report

SCALE 1:60,000



Dwn. By:

MVH

Ckd By:

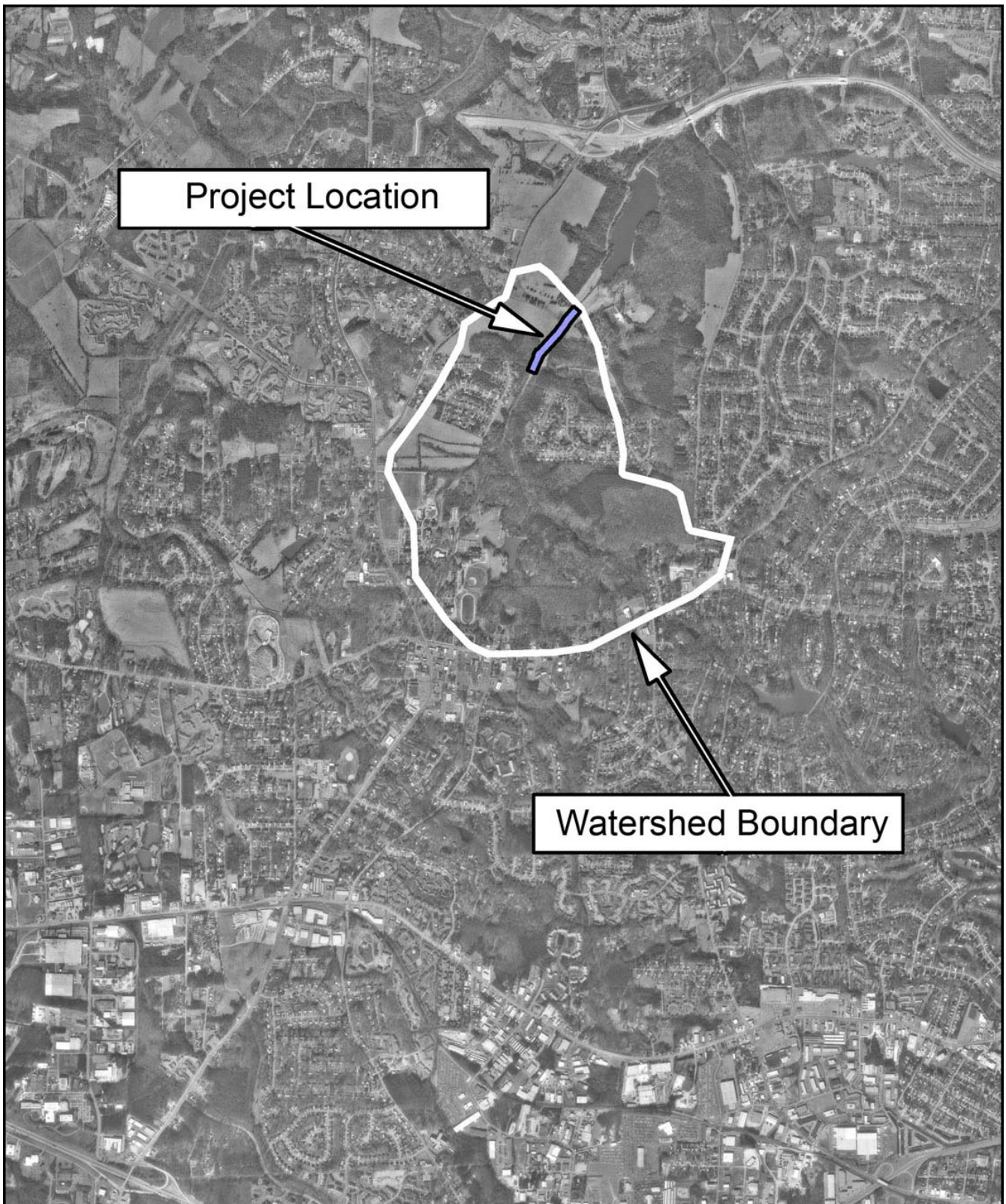
DAB

Date:

March 2004

FIGURE

1



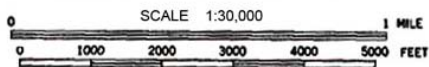
NC STATE UNIVERSITY

Department of Biological & Agricultural Engineering

Campus Box 7625
Raleigh, NC 27606

Aerial Watershed Photo: Price Park
Guilford County, North Carolina

EEP Monitoring
Report



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 Little Pine and Brush Creek Monitoring.

2.1 Vegetation

The following describes the results of 2003 vegetation monitoring conducted at the Price Park Stream 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, 5 vegetation monitoring plots were randomly located within the riparian buffer of the Price Park 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 this unnamed tributary to Horsepen Creek is overall considered unsuccessful. The upper portion of the restoration site (above road culvert) was scantily vegetated with very few native species. Vegetation below the culvert was slightly denser as the area was more wetland-like and contained wetter herbaceous species such as *Juncus* spp. (rushes) and *Carex* spp. (sedges). The planted native herbaceous vegetation noted was *Helianthus* spp. (sunflowers) and *Panicum* spp. (switchgrass and deertongue). These occurred mainly on the floodplain. The banks were largely devoid of vegetation. *Microstegium* and *Lespedeza* were among many exotics located within these areas.

Live stakes were absent throughout the entire project. Planted trees and shrubs are doing poorly throughout the entire buffer, although a few sycamores (*Platanus occidentalis*) were growing well at a few locations. Volunteer species of *Cornus amomum* (silky dogwood), *Alnus serrulata* (tag alder), and *Sambucus canadensis* (elderberry) are scattered sparsely throughout. Tree mortality was apparently high when compared to the number of trees initially planted. Extrapolation from the five plots resulted in an overall average of approximately 48 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 136 trees per acre. 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; however, more trees are needed to meet mitigation requirements.

Invasive plant species on the site included *Lonicera japonica* (Japanese honeysuckle), *Pueraria lobata* (kudzu), *Lespedeza cuneata*, *Celastrus orbiculatus* (oriental bittersweet), *Microstegium vimineum*, and *Rosa multiflora* (multiflora rose). Kudzu and oriental bittersweet are of major concern due to their prolific spreading and choking tendencies. Kudzu was documented both upstream and downstream of the culvert in small patches. Bittersweet was heavy in adjacent mature trees above the culvert and will likely work its way into the buffer. Multiflora rose, honeysuckle, and lespedeza were scattered throughout and nowhere abundant.

2.2 Morphology

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

2.2.1 Results and Discussion

Channel profile along Price Park has maintained grade over the past year for the majority of the restored reach. Some down cutting has occurred from station 10+37 to 16+00. Above the culvert, riffles are not present. Below most of the cross vanes is a scour pool followed by a run feature. Four riffles were observed along the project. Bedrock continues to define channel grade as the project approaches the culvert.

Pools throughout the project are maintaining scour depth throughout the project. Pool length appears to be increasing but no previous data was collected to validate this observation. Pool to pool spacing has increased but this is likely the inclusion of cross vane scour pools in previous analysis. Impacts of the downstream pond on the profile remain on the lower 250 feet of the project. Backwater at low flow reaches to station 15+00, crating a long pool.

Channel cross-sections have remained mostly consistent since construction. There are areas of bank slumping as evident in cross-section #3. Most bank slumping appears to be the result of overland flow washing into the channel. Cross-section #1 continues to show signs of enlarging due to channel down cutting. Cross-section #2 (pool) is decreasing in area as a result of aggrading along the inside meander. Cross-section #4 have remained similar in area to as-built conditions.

Channel substrate has remained similar to as-built conditions throughout the reach. Cross-section #1 has decreased in coarseness (d50 of 0.34mm to 0.11mm) but appears to have stabilized. The pool cross-section (#2) has coarsened since construction showing there is a significant amount of scour through the meander. Cross-sections #3 and #4 have remained very similar to as-built conditions.

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.

Channel banks throughout the project vary in condition from stable and well vegetated to eroded with no vegetation. Eroded areas appear to be the result of upland and floodplain drainage into the channel and lack of stream bank vegetation. This is a particular problem in areas where the new channel approached the old channel that we filled in (station 5+00). Stormwater appears to be traveling down the floodplain in the location of the old channel and intersecting the new channel in two locations (stations 3+50 and 5+00). In these areas, herbaceous vegetation has not established and the channel bank is scouring from the top down. Stormwater is also draining from depressions on the floodplain and entering the channel in concentrated form at stations 7+40, 8+50, 13+50 through 13+70 and 14+10. Streambanks in these areas are eroded as well. Vegetation along some of the streambanks is sparse and needs supplemental planting to establish root mass on the banks.

Table 2. Summary of Channel Conditions

DIMENSION	Price Park Cross-section #1 Riffle			Price Park Cross-section #2 Pool			Price Park Cross-section #3 Riffle			Price Park Cross-section #4 Riffle		
	As-built	Dec-02	2003	As-built	Dec-02	2003	As-built	Dec-02	2003	As-built	Dec-02	2003
	Bankfull Cross-sectional Area	24.1	25.6	37.0	50.6	49.3	44.9	31.9	28.4	31.9	36.7	43.4
Bankfull Width	13.3	14.8	15.0	22.2	21.0	21.2	14.0	14.0	14.7	17.2	19.1	17.2
Bankfull Mean Depth	1.8	1.7	2.5	2.3	2.3	2.1	2.3	2.0	2.2	2.1	2.3	2.1
Bankfull Max Depth	3.5	3.6	4.3	4.9	4.8	4.8	3.6	3.4	3.6	3.2	3.6	3.7

PATTERN	Price Park As-built			Price Park 2002			Price Park 2003		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean
	Meander Wave Length	127	183	150	118	197	162	63	254
Radius of Curvature	49	84	65	48	85	61	26	131	59
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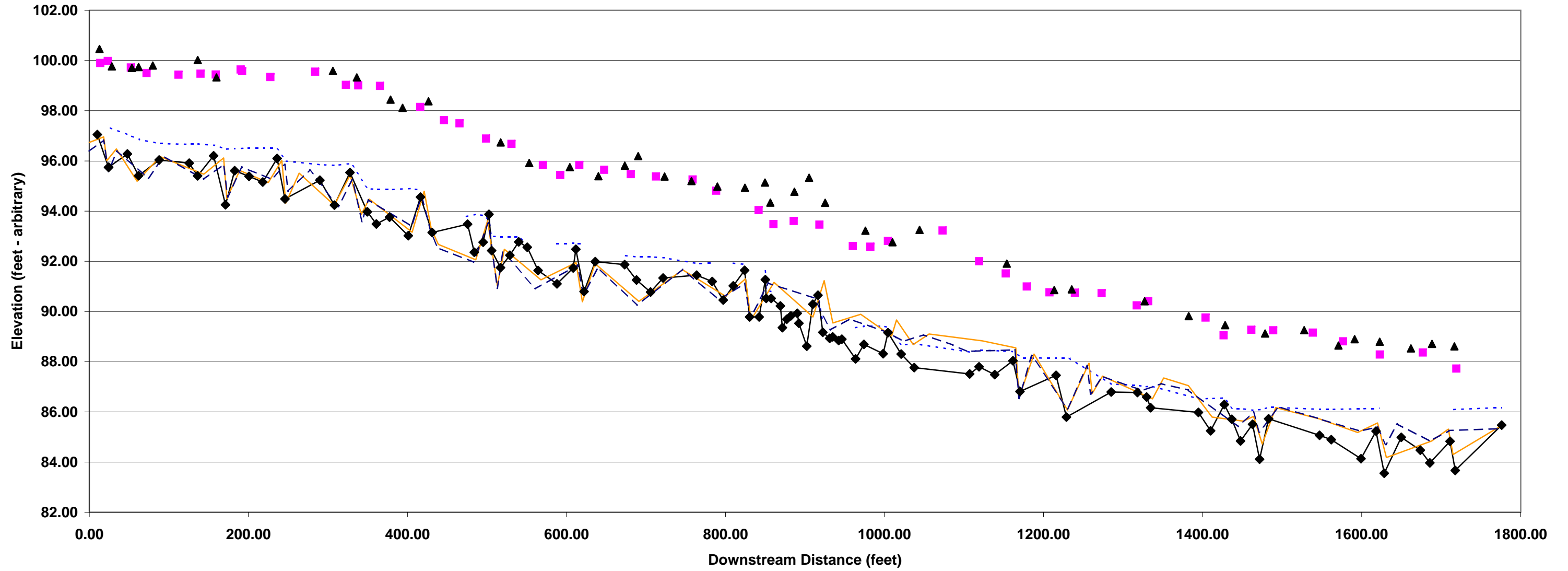
PROFILE	Price Park As-built			Price Park 2003		
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	Riffle Length	Not Reported			9.46	59.45
Riffle Slope	Not Reported			0.56%	2.86%	1.42%
Run Length	Not Reported			29.4	87.3	41.8
Run Slope	Not Reported			-0.03%	0.69%	0.16%
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Pool to Pool Spacing	21	153	92	64.5	343	91.5

SUBSTRATE	Price Park Cross-section #1 Riffle		Price Park Cross-section #2 Pool		Price Park Cross-section #3 Riffle		Price Park Cross-section #4 Riffle	
	As-built	2003	As-built	2003	As-built	2003	As-built	2003
	D50	0.34	0.11	0.26	1.45	0.16	0.14	0.25
D85	87.7	68.2	1.5	14.5	6.7	12.1	6.9	14.8

VEGETATION	Quad 1 - JP		Quad 2 - JP		Quad 3 -JP		Quad 4 - JP		Quad 5 -JP	
	Observed	Planted*	Observed	Planted*	Observed	Planted*	Observed	Planted*	Observed	Planted*
Tree Stratum (stems/acre)	160	0	280	40	40	0	120	120	80	80
Shrub Stratum (% cover)	0.5	n/a	0.5	n/a	0.5	n/a	1	n/a	0	n/a
Herb Stratum (%cover)	7.5	n/a	97	n/a	17.5	n/a	87	n/a	70	n/a

* Planted value represents number of stems observed that alive that were planted.

Price Park Stream Restoration
Longitudinal Profile - 2003



2.3 Areas of Concern

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

- The lack of successful vegetation in the riparian buffer
 - Supplemental plantings are needed to meet minimum density.
 - Soil should be tested for fertility and amended as directed.
- Down-cutting near channel confluence
 - This area should be monitored to ensure the down-cutting does not continue up through the project.
- Areas with bank erosion due to overland flow washing into the channel
 - These areas should be examined closely to see if a structure is necessary to provide a stable method of allowing the water to enter the channel or if vegetation will be adequate.
 - These areas should be monitored closely during upcoming site visits to monitor degradation.
- The lack of successful herbaceous cover along sections of the streambanks.
 - These areas should be reseeded.
 - It will be required to prepare a seedbed in order establish herbaceous cover.

Vegetation Overall

- Replanting trees to obtain mitigation requirements
 - The site could benefit from larger containerized trees both for bank stability and aesthetics.
- Stake only in areas where erosion is problematic
 - Live staking should also help in the establishment of herbaceous vegetation on the bare banks.
- Monitor invasive vegetation
 - Although invasive vegetation has not consumed this project site, there are numerous species that should be controlled now, most importantly kudzu and oriental bittersweet.

2.4 Photo Log

Price Park Photo Log

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 (DONE)
 - 2. Longitudinal data and plotted (DONE)
 - 3. Pebble count data and plotted (DONE)
 - 4. Pattern (DONE)

Project Name Price Park
Cross Section #1
Feature Riffle
Date 9/30/03
Crew Shaffer, Bidelspach, Clinton

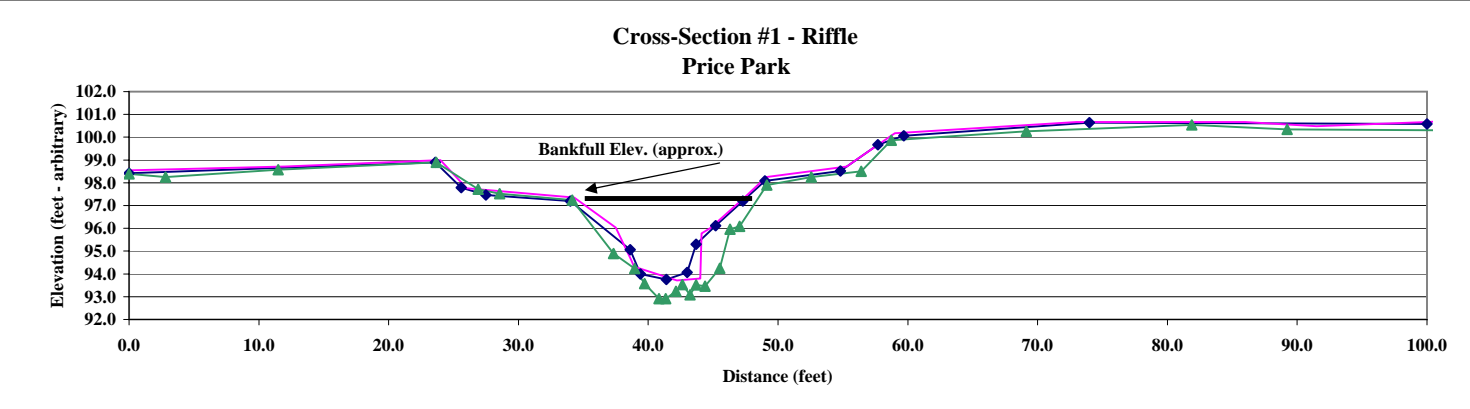
* Elevations adjusted up adjusted up 1.63

2001 As-Built Survey			2002 2002 Survey			2003 2003 Survey		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0.0	98.4	edge scrub v	0	98.55	LPIN GRD	0	98.3877	
23.6	98.9	LT BOB	12	98.72		2.81	98.25001	
25.6	97.8	Toe BOB	24	98.99	LT BOB	11.5	98.56661	LPIN GRD
27.5	97.5		26	97.76	Toe BOB	23.67	98.89014	LT BOB
34.0	97.2	LBKF	34.3	97.35	LBKF	26.91	97.71921	
38.6	95.1		37.5	96.03		28.56	97.51953	
39.4	94.0	LEW/WS	38.7	94.58		34.14	97.244	LBKF
41.4	93.8	TW	38.9	94.32	LEW	37.32	94.89443	
43.0	94.1	REW	42.2	93.71	TW	38.96	94.22712	
43.7	95.3		44	93.8	REW	39.72	93.56669	
45.2	96.1		44.1	95.78		40.82	92.9152	
47.3	97.2	RBKF	44.8	96.01		41.35	92.9173	
49.0	98.1		47.4	97.35		42.14	93.23559	
54.8	98.5	Toe BOB	49.1	98.25	RBKF	42.62	93.53453	TW
57.7	99.7	RT BOB	55.3	98.71	Toe BOB	43.21	93.08141	
59.7	100.1		56	98.99		43.7	93.5185	
74.0	100.6		59	100.17	RT BOB	44.38	93.45383	
100.0	100.6		73	100.67		45.51	94.24056	
124.0		edge g-way	86	100.67		46.3	95.96063	
			91.5	100.49		47.05	96.08462	
			100	100.67	RPIN GRD	49.14	97.90004	RBKF
			124	101.4	edge g-way	52.56	98.24567	
						56.42	98.5006	
						58.72	99.86416	
						69.13	100.2514	RPIN GRD
						81.89	100.5424	
						89.22	100.3363	
						101.78	100.3065	
						113.56	100.5393	
						122.79	100.8996	



Photo of Cross-Section #1 - Looking Downstream

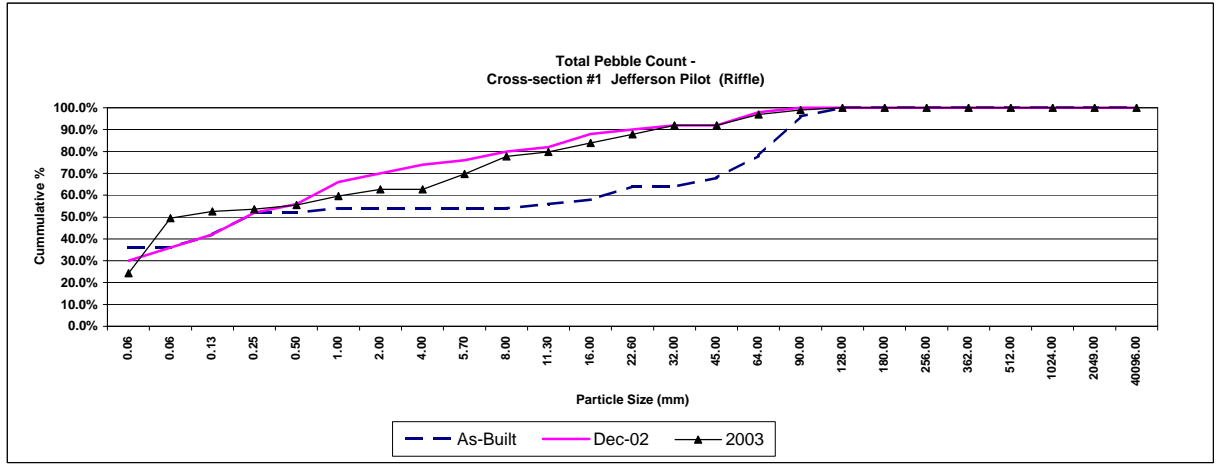
	As-Built	2002	2003
Area	24.1	25.64	36.99
Width	13.3	14.8	15.0
Mean Depth	1.8	1.7	2.5
Max Depth	3.5	3.6	4.3



Project Name	Jefferson Pilot
Cross Section	#1
Feature	Riffle
Date	12/17/02
Crew	Pace, Patterson

Description	Material	Size (mm)	As-Built			Dec-02			Bank	Bed	%	Cum %
			Riffle	%	Cum %	Riffle	%	Cum %				
Silt/Clay	silt/clay	0.061	18	36.0%	36.0%	15	30.0%	30.0%	15	9	24.2%	24.2%
Sand	very fine sand	0.062	0	0.0%	36.0%	3	6.0%	36.0%	24 1	1 2 1 2 4	25.3%	49.5%
	fine sand	0.125	3	6.0%	42.0%	3	6.0%	42.0%			3.0%	52.5%
	medium sand	0.25	5	10.0%	52.0%	5	10.0%	52.0%			1.0%	53.5%
	course sand	0.50	0	0.0%	52.0%	2	4.0%	56.0%			2.0%	55.6%
	very course sand	1.0	1	2.0%	54.0%	5	10.0%	66.0%			4.0%	59.6%
Gravel	very fine gravel	2.0	0	0.0%	54.0%	2	4.0%	70.0%		3 0 7 8 2 4 4 4 0	3.0%	62.6%
	fine gravel	4.0	0	0.0%	54.0%	2	4.0%	74.0%			0.0%	62.6%
	fine gravel	5.7	0	0.0%	54.0%	1	2.0%	76.0%			7.1%	69.7%
	medium gravel	8.0	0	0.0%	54.0%	2	4.0%	80.0%			8.1%	77.8%
	medium gravel	11.3	1	2.0%	56.0%	1	2.0%	82.0%			2.0%	79.8%
	course gravel	16.0	1	2.0%	58.0%	3	6.0%	88.0%			4.0%	83.8%
	course gravel	22.6	3	6.0%	64.0%	1	2.0%	90.0%			4.0%	87.9%
	very course gravel	32	0	0.0%	64.0%	1	2.0%	92.0%			4.0%	91.9%
	very course gravel	45	2	4.0%	68.0%	0	0.0%	92.0%			0.0%	91.9%
	Cobble	small cobble	64	5	10.0%	78.0%	3	6.0%			98.0%	
medium cobble		90	9	18.0%	96.0%	1	2.0%	100.0%	2.0%	99.0%		
large cobble		128	2	4.0%	100.0%	0	0.0%	100.0%	1.0%	100.0%		
very large cobble		180	0	0.0%	100.0%	0	0.0%	100.0%	0.0%	100.0%		
Boulder	small boulder	256	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
	small boulder	362	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
	medium boulder	512	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
	large boulder	1024	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
	very large boulder	2049	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
Bedrock	bedrock	40096	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
TOTAL / %of whole count			50	100.0%		50	100.0%		40	59	100.0%	

	d16	d35	d50	d85	d95
As-Built	0.06	0.06	0.34	87.67	107.22
Dec-02	0.06	0.09	0.34	15.53	65.75
2003	0.06	0.08	0.11	19.62	68.22



Project Name	Price Park
Cross Section	#2
Feature	Riffle
Date	9/30/03
Crew	Shaffer, Bidelspach, Clinton

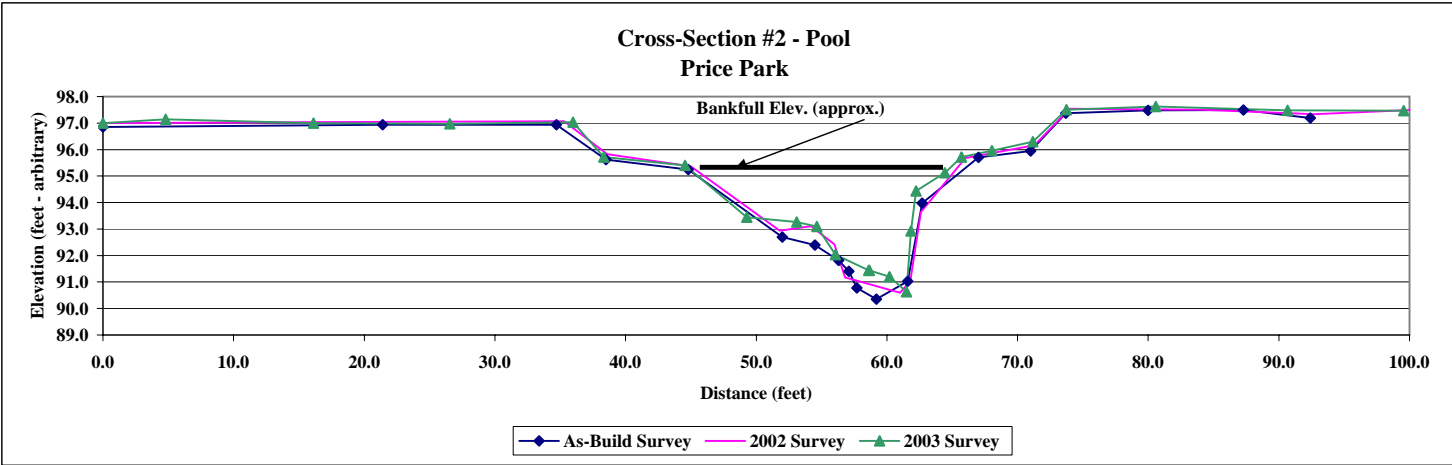
* Elevations adjusted up adjusted up 2.50

2001 As-Build Survey			2002 2002 Survey			2003 2003 Survey		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0.0	96.9	LPIN	0	97	LPIN GRD	0	97.00	LPIN GRD
21.4	96.9		15	97.03		4.81	97.14	
34.7	96.9	LT BOB	35.3	97.07	LT BOB	16.12	97.00	
38.5	95.6	Toe BOB	38.6	95.83	Toe BOB	26.54	96.98	
44.8	95.2	LBKF	45	95.37	LBKF	35.97	97.04	LT BOB
52.0	92.7		51.8	92.94	bench	38.34	95.72	Toe BOB
54.5	92.4		54.2	93.11		44.55	95.40	LBKF
56.3	91.8	LEW/WS	56	92.42		49.27	93.44	
57.1	91.4		56.8	91.17	LEW	53.1	93.27	
57.7	90.8		61	90.6	TW	54.65	93.09	
59.2	90.4	TW @ root	61.8	91.04		56.06	92.04	
61.6	91.0		62.6	93.64		58.62	91.44	
62.7	94.0		66	95.68	RBKF	58.67	91.44	
67.0	95.7	RBKF	71.3	96.16	Toe BOB	60.21	91.20	
71.0	96.0	Toe BOB	74	97.54	RT BOB	61.49	90.63	TW
73.7	97.4	RT BOB	84	97.5		61.83	92.93	
80.0	97.5		92.7	97.33		62.24	94.44	
87.3	97.5		100	97.49	RPIN GRD	64.43	95.12	
92.4	97.2					65.71	95.72	RBKF
100	97.29					68.03	95.96	Toe BOB
						71.17	96.29	
						73.74	97.50	RT BOB
						80.58	97.62	
						90.67	97.48	
						99.55	97.47	RPIN GRD



Photo of Cross-Section #2 - Looking Downstream

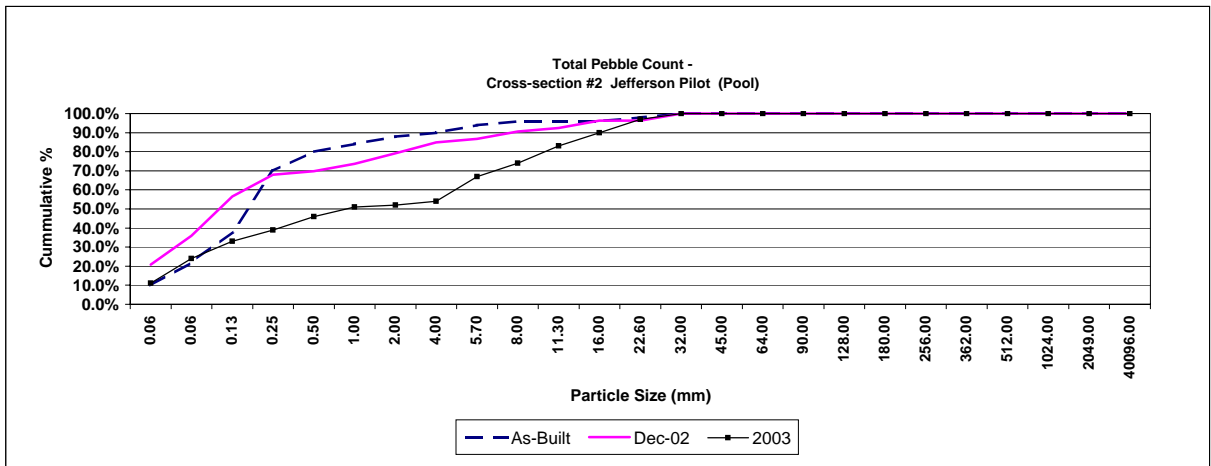
	As-Built	2002	2003
Area	50.6	49.28	44.90
Width	22.2	21.0	21.2
Mean Dept	2.3	2.3	2.1
Max Depth	4.9	4.8	4.8



Project Name	Jefferson Pilot
Cross Section	#2
Feature	Pool
Date	12/17/02
Crew	Pace, Patterson

Description	Material	Size (mm)	As-Built		Dec-02		Bank	Bed	%	Cum %		
			Pool	%	Pool	%						
Silt/Clay	silt/clay	0.061	5	10.0%	10.0%	11	20.8%	20.8%	11	0	11.0%	11.0%
Sand	very fine sand	0.062	6	12.0%	22.0%	8	15.1%	35.8%	13	0	13.0%	24.0%
	fine sand	0.125	8	16.0%	38.0%	11	20.8%	56.6%	9	0	9.0%	33.0%
	medium sand	0.25	16	32.0%	70.0%	6	11.3%	67.9%	6	0	6.0%	39.0%
	course sand	0.50	5	10.0%	80.0%	1	1.9%	69.8%	7	0	7.0%	46.0%
	very course sand	1.0	2	4.0%	84.0%	2	3.8%	73.6%	4	1	5.0%	51.0%
Gravel	very fine gravel	2.0	2	4.0%	88.0%	3	5.7%	79.2%	1	0	1.0%	52.0%
	fine gravel	4.0	1	2.0%	90.0%	3	5.7%	84.9%	0	2	2.0%	54.0%
	fine gravel	5.7	2	4.0%	94.0%	1	1.9%	86.8%	2	11	13.0%	67.0%
	medium gravel	8.0	1	2.0%	96.0%	2	3.8%	90.6%	1	6	7.0%	74.0%
	medium gravel	11.3	0	0.0%	96.0%	1	1.9%	92.5%	2	7	9.0%	83.0%
	course gravel	16.0	0	0.0%	96.0%	2	3.8%	96.2%	1	6	7.0%	90.0%
	course gravel	22.6	1	2.0%	98.0%	0	0.0%	96.2%	1	6	7.0%	97.0%
	very course gravel	32	1	2.0%	100.0%	2	3.8%	100.0%		3	3.0%	100.0%
	very course gravel	45	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
	Cobble	small cobble	64	0	0.0%	100.0%	0	0.0%	100.0%			0.0%
medium cobble		90	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
large cobble		128	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
very large cobble		180	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
Boulder	small boulder	256	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
	small boulder	362	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
	medium boulder	512	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
	large boulder	1024	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
	very large boulder	2049	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
Bedrock	bedrock	40096	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
TOTAL / %of whole count			50	100.0%		53	100.0%		58	42	100.0%	

	d16	d35	d50	d85	d95
As-Built	0.08	0.17	0.26	1.50	8.25
Dec-02	0.00	0.09	0.16	4.55	17.46
2003	0.07	0.25	1.35	14.46	25.01



Project Name Price Park
Cross Section #3
Feature Riffle
Date 9/30/03
Crew Shaffer, Bidelspach, Clinton

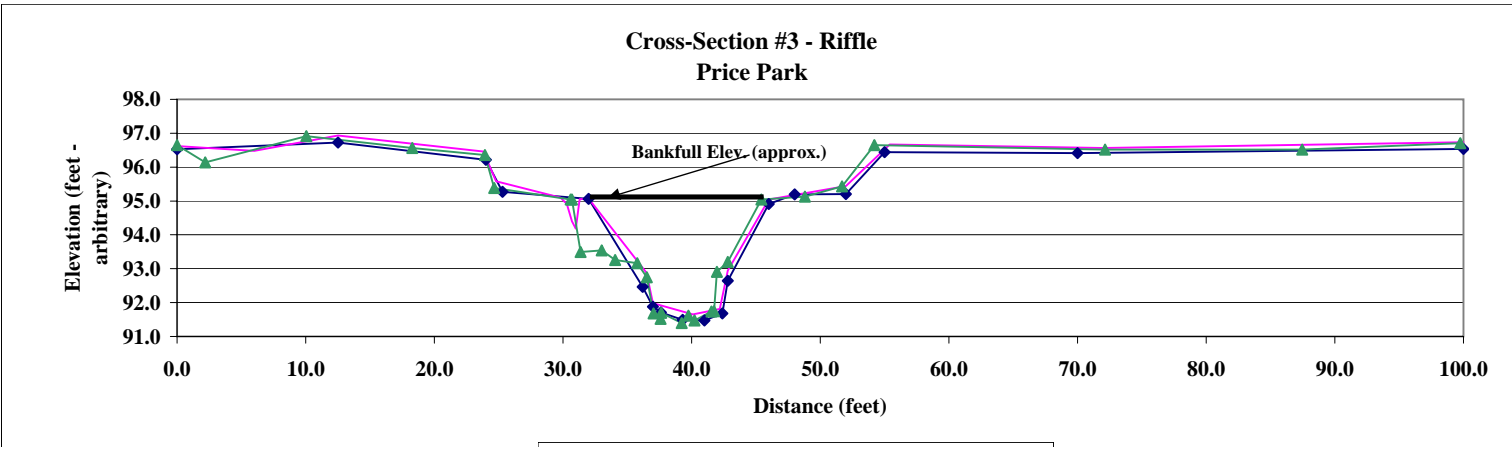
* Elevations adjusted up *adjusted up 2.51 feet

2001 As-Built Survey			2002 2002 Survey			2003 2003 Survey		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0.0	96.5	LPIN	0	96.62	LPIN GRD	0	96.65	LPIN GRD
12.5	96.7		6	96.48		2.2	96.14	
24.0	96.2	LT BOB	12.5	96.93		10.05	96.91	
25.3	95.3		23.8	96.46	LT BOB	18.28	96.56	
32.0	95.1	LBKF	24.8	95.58	Toe BOB	23.93	96.35	LT BOB
36.2	92.5		29.8	95.1	overland wa	24.66	95.38	Toe BOB
37.0	91.9		30.3	94.91	overland wa	30.59	95.04	
37.6	91.7	LEW/WS	30.7	94.4	overland wa	30.7	95.04	LBKF
39.3	91.5		31	94.18	overland wa	31.38	93.49	
41.0	91.5	TW	31.3	95.05		33.01	93.54	
42.4	91.7	REW	32	95.07	LBKF	34.05	93.26	
42.8	92.6		36.5	92.88		35.78	93.16	
46.0	94.9	RBKF	37	91.98	LEW	36.52	92.74	
48.0	95.2		40.1	91.65	TW	37.03	91.68	
52.0	95.2		42.2	91.81	REW	37.58	91.52	
55.0	96.4	RT BOB	42.8	92.95		37.64	91.70	
70.0	96.4		46	95.04	RBKF	39.23	91.40	TW
100.0	96.5	RPIN	52	95.44	Toe BOB	39.75	91.61	
			55.4	96.67	RT BOB	40.22	91.48	
			72	96.56		41.54	91.74	
			100	96.73	RPIN GRD	41.75	91.75	
						41.96	92.91	
						42.8	93.20	
						45.42	95.04	RBKF
						48.8	95.13	Toe BOB
						51.69	95.43	RT BOB
						54.21	96.65	
						72.15	96.52	
						87.47	96.52	
						99.76	96.71	RPIN GRD



Photo of Cross-Section #3 - Looking Upstream

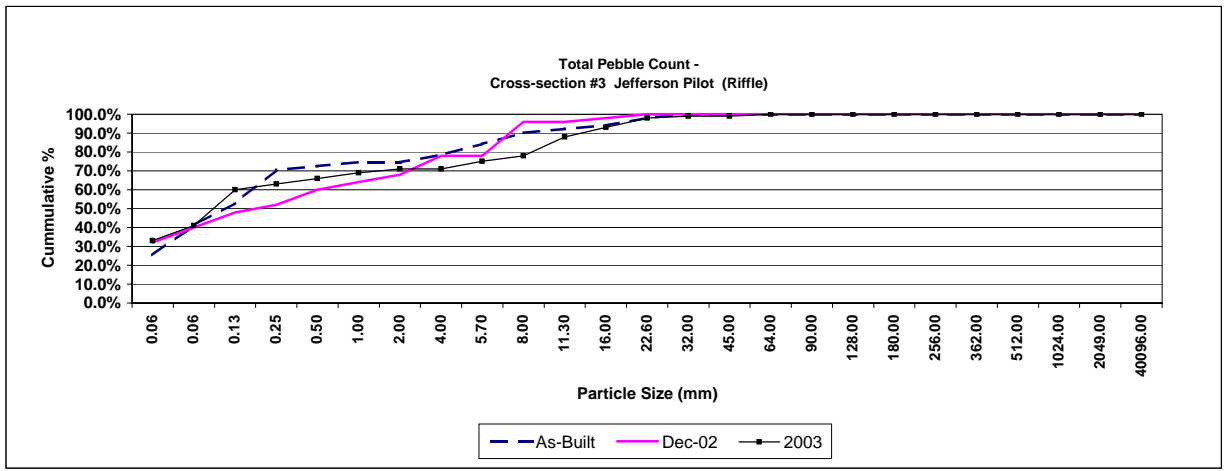
	As-Built	2002	2003
Area	31.9	28.41	31.86
Width	14.0	14.0	14.7
Mean Deptl	2.3	2.0	2.2
Max Depth	3.6	3.4	3.6



Project Name	Jefferson Pilot
Cross Section	#3
Feature	Riffle
Date	12/17/02
Crew	Pace, Patterson

Description	Material	Size (mm)	As-Built			Dec-02			Bank	Bed	%	Cum %
			Riffle	%	Cum %	Riffle	%	Cum %				
Silt/Clay	silt/clay	0.061	13	25.5%	25.5%	16	32.0%	32.0%	30	3	33.0%	33.0%
Sand	very fine sand	0.062	8	15.7%	41.2%	4	8.0%	40.0%	6	2	8.0%	41.0%
	fine sand	0.125	6	11.8%	52.9%	4	8.0%	48.0%			19.0%	60.0%
	medium sand	0.25	9	17.6%	70.6%	2	4.0%	52.0%			3.0%	63.0%
	course sand	0.50	1	2.0%	72.5%	4	8.0%	60.0%			3.0%	66.0%
	very course sand	1.0	1	2.0%	74.5%	2	4.0%	64.0%			3.0%	69.0%
Gravel	very fine gravel	2.0	0	0.0%	74.5%	2	4.0%	68.0%	1	3	2.0%	71.0%
	fine gravel	4.0	2	3.9%	78.4%	5	10.0%	78.0%			0.0%	71.0%
	fine gravel	5.7	3	5.9%	84.3%		0.0%	78.0%			4.0%	75.0%
	medium gravel	8.0	3	5.9%	90.2%	9	18.0%	96.0%			3.0%	78.0%
	medium gravel	11.3	1	2.0%	92.2%		0.0%	96.0%			10.0%	88.0%
	course gravel	16.0	1	2.0%	94.1%	1	2.0%	98.0%			5.0%	93.0%
	course gravel	22.6	2	3.9%	98.0%	1	2.0%	100.0%			5.0%	98.0%
	very course gravel	32	1	2.0%	100.0%		0.0%	100.0%			1.0%	99.0%
	very course gravel	45	0	0.0%	100.0%		0.0%	100.0%			0.0%	99.0%
	Cobble	small cobble	64	0	0.0%	100.0%		0.0%			100.0%	
medium cobble		90	0	0.0%	100.0%		0.0%	100.0%	0.0%	100.0%		
large cobble		128	0	0.0%	100.0%		0.0%	100.0%	0.0%	100.0%		
very large cobble		180	0	0.0%	100.0%		0.0%	100.0%	0.0%	100.0%		
Boulder	small boulder	256	0	0.0%	100.0%		0.0%	100.0%			0.0%	100.0%
	small boulder	362	0	0.0%	100.0%		0.0%	100.0%			0.0%	100.0%
	medium boulder	512	0	0.0%	100.0%		0.0%	100.0%			0.0%	100.0%
	large boulder	1024	0	0.0%	100.0%		0.0%	100.0%			0.0%	100.0%
	very large boulder	2049	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
Bedrock	bedrock	40096	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
TOTAL / %of whole count			51	100.0%		50	100.0%		50	50	100.0%	

	d16	d35	d50	d85	d95
As-Built	0.00	0.08	0.16	6.74	21.10
Dec-02	0.00	0.07	0.28	7.78	9.49
2003	0.00	0.07	0.14	12.05	22.50



Project Name	Price Park
Cross Section	#4
Feature	Riffle
Date	9/30/03
Crew	Shaffer, Bidelspach, Clinton

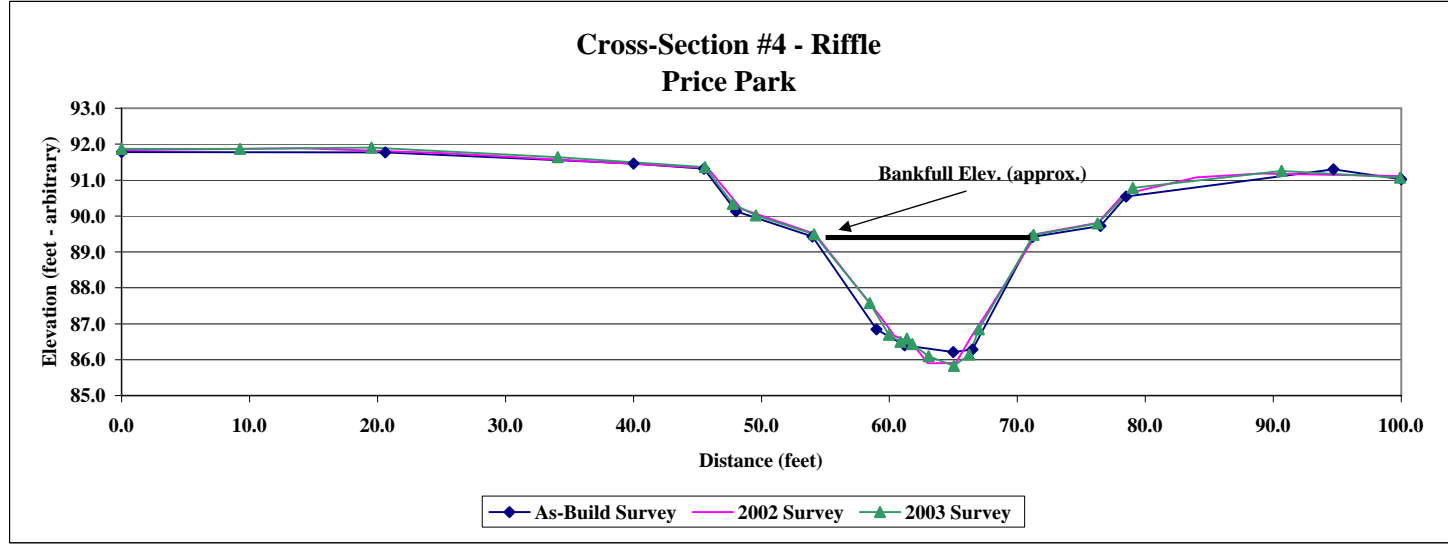
* Elevations adjusted up *adjusted by 2.43

2001 As-Built Survey			2002 2002 Survey			2003 2003 Survey		
Station	Elevation	Notes	Station	Elevation	Notes	Station	Elevation	Notes
0.0	91.8		0	91.83	LPIN GRD	0	91.87	LPIN GRD
20.6	91.8		14	91.89		9.24	91.87	
40.0	91.5		25	91.75		19.52	91.90	
45.5	91.3	LT BOB	45.8	91.33	LT BOB	34.09	91.63	
48.0	90.1		48.4	90.2	Toe BOB	45.58	91.36	LT BOB
54.0	89.4	LBKF	54.2	89.5	LBKF	47.77	90.34	Toe BOB
59.0	86.8		59.3	87.2		49.57	90.02	
61.2	86.4	LEW/WS	60.4	86.67	LEW/WS	54.12	89.49	LBKF
65.0	86.2	TW	61.8	86.45		58.46	87.57	
66.5	86.3	REW	63	85.9	TW	59.96	86.69	
71.2	89.4	RBKF	65.2	85.91		60.86	86.49	
76.5	89.7		66.4	86.64	REW	61.36	86.59	
78.5	90.5	RT BOB	67.5	87.24		61.8	86.44	
94.7	91.3		71.5	89.5	RBKF	63.07	86.09	
100.0	91.0		76.3	89.81	Toe BOB	65.05	85.83	TW
			78.3	90.6	RT BOB	66.25	86.14	
86.0		Sewerline C	84	91.08		66.99	86.84	
			89	91.18		71.27	89.47	RBKF
			100	91.11	RPIN GRD	76.27	89.79	Toe BOB
						79.03	90.78	RT BOB
						90.66	91.26	
						99.89	91.07	RPIN GRD



Photo of Cross-Section #4 - Looking Upstream

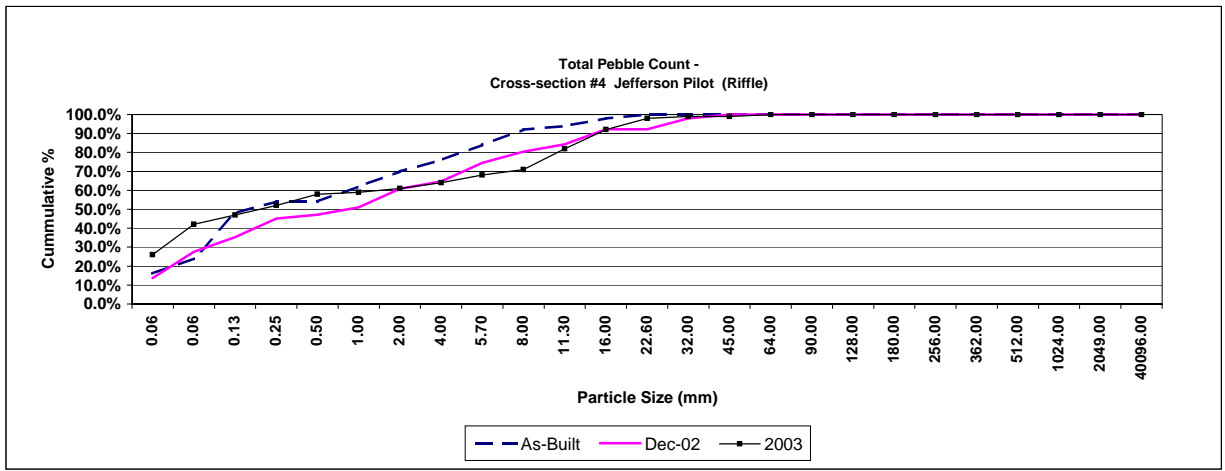
	As-Built	2002	2003
Area	36.7	43.36	36.28
Width	17.2	19.1	17.2
Mean Depth	2.1	2.3	2.1
Max Depth	3.2	3.6	3.7



Project Name	Jefferson Pilot
Cross Section	#4
Feature	Riffle
Date	12/17/02
Crew	Pace, Patterson

Description	Material	Size (mm)	As-Built			Dec-02			Riffle - Bank	Riffle - Bed	%	Cum %
			Riffle - Bed	%	Cum %	Riffle - Bed	%	Cum %				
Silt/Clay	silt/clay	0.061	8	16.0%	16.0%	7	13.7%	13.7%	24	2	26.0%	26.0%
Sand	very fine sand	0.062	4	8.0%	24.0%	7	13.7%	27.5%	16	0	16.0%	42.0%
	fine sand	0.125	12	24.0%	48.0%	4	7.8%	35.3%	4	1	5.0%	47.0%
	medium sand	0.25	3	6.0%	54.0%	5	9.8%	45.1%	2	3	5.0%	52.0%
	course sand	0.50	0	0.0%	54.0%	1	2.0%	47.1%	2	4	6.0%	58.0%
	very course sand	1.0	4	8.0%	62.0%	2	3.9%	51.0%		1	1.0%	59.0%
Gravel	very fine gravel	2.0	4	8.0%	70.0%	5	9.8%	60.8%		2	2.0%	61.0%
	fine gravel	4.0	3	6.0%	76.0%	2	3.9%	64.7%		3	3.0%	64.0%
	fine gravel	5.7	4	8.0%	84.0%	5	9.8%	74.5%	1	3	4.0%	68.0%
	medium gravel	8.0	4	8.0%	92.0%	3	5.9%	80.4%		3	3.0%	71.0%
	medium gravel	11.3	1	2.0%	94.0%	2	3.9%	84.3%	1	10	11.0%	82.0%
	course gravel	16.0	2	4.0%	98.0%	4	7.8%	92.2%		10	10.0%	92.0%
	course gravel	22.6	1	2.0%	100.0%	0	0.0%	92.2%		6	6.0%	98.0%
	very course gravel	32	0	0.0%	100.0%	3	5.9%	98.0%		1	1.0%	99.0%
	very course gravel	45	0	0.0%	100.0%	1	2.0%	100.0%		0	0.0%	99.0%
	Cobble	small cobble	64	0	0.0%	100.0%	0	0.0%	100.0%			1.0%
medium cobble		90	0	0.0%	100.0%	0	0.0%	100.0%		1	0.0%	100.0%
large cobble		128	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
very large cobble		180	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
Boulder	small boulder	256	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
	small boulder	362	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
	medium boulder	512	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
	large boulder	1024	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
	very large boulder	2049	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
Bedrock	bedrock	40096	0	0.0%	100.0%	0	0.0%	100.0%			0.0%	100.0%
TOTAL / %of whole count			50	100.0%	100.0%	51	100.0%	100.0%	50	50	100.0%	100.0%

	d16	d35	d50	d85	d95
As-Built	0.06	0.14	0.25	6.85	15.06
Dec-02	0.07	0.18	1.31	13.33	32.71
2003	0.00	0.08	0.30	14.78	23.30



Project Name	Jefferson Pilot
Task	Feature Slope and Length Calculations
Date	12/17/02
Crew	Bidelspach, Shaffer, Clinton

Data given is Head of Riffle and max pool, cannot calculate lengths or slope.

2003 Data

Price Park

Run	Station	Change	Bed elevation	Water elevation	change	slope
	88.17		96.04	96.69		
	124.21	36.04	95.91	96.67	0.02289	0.06%
	183.04		95.61	96.49		
	220.31	37.27	95.16	96.50	-0.0096	-0.03%
	247.95		94.48	95.99		
	289.70	41.75	95.23	95.85	0.14056	0.34%
	350.14		93.97	94.90		
	379.52	29.38	93.76	94.86	0.03611	0.12%
	608.74		91.73	92.72		
	687.99	79.25	91.25	92.17	0.54327	0.69%
	1021.26		88.31	88.66		
	1108.58	87.32	87.51	88.38	0.28008	0.32%
	1285.02		86.79	87.11		
	1335.78	50.76	86.16	87.03	0.0795	0.16%

Price Park

Riffle	Station	Change	Bed elevation	Water elevation	change	slope	
	540.36		92.78	92.98			
	549.82	9.46	92.56	92.71	0.27065	2.86%	Riffle
	722.91		91.33	92.14			
	763.83	40.92	91.45	91.91	0.22756	0.56%	Riffle
	1232.47		85.7912	88.15			
	1285.02	52.55	1285.00	87.11	1.03993	1.98%	Riffle
	1335.78		86.16	87.03			
	1395.23	59.45	85.98	86.52	0.51031	0.86%	Riffle

Pool	length	p-p spacing		min	max	median
47						
88	41		Riffle	Length 9.5	59.5	46.7
124				Slope 0.56%	2.86%	1.42%
157	33	73	Run	Length 29.4	87.3	41.8
200				Slope -0.03%	0.69%	0.16%
235	35	77	Pool	Length 22.0	62.0	38.0
289				Spacing 65	343	92
328	39	91				
379						
417	38	89.5				
474						
496	22	87				
549						
611	62	95				
687						
722	35	124.5				
783						
810	27	92				
1119						
1160	41	343				
1173						
1235	62	64.5				
1437						
1474	37	251.5				
1560						
1621	61	135				

PROFILE	Price Park As-built - 2001			Price Park 2003		
	Minimum	Maximum	Median	Minimum	Maximum	Median
Riffle Length	Not Reported			9.46	59.45	46.735
Riffle Slope	Not Reported			0.56%	2.86%	1.42%
Run Length	Not Reported			29.4	87.3	41.8
Run Slope	Not Reported			-0.03%	0.69%	0.16%
Pool Length	Not Reported			22	62	38
ool to Pool Spacing	51	150.3	63.7	64.5	343	91.5

Task	Channel Pattern Measurements
Date	9/30/03
Crew	Pace, Patterson

Jefferson Pilot		
Radius of Curvature	Meander Wavelength	Channel Beltwidth
59.5		49-80
64.5	127	
48.5	135	
59.5	139	
76.5	152	
68.5	150	
55.5	145	
72.5	174	
53.5	183	
69.5	166	
83.8		
64.0		52-95
47.5	118	
61.0	170	
59.5	197	
53.5	179	
61.5	123	
84.5		
47.5	118.0	<i>Min</i>
84.5	197.0	<i>Max</i>
63.5	154.1	<i>Avg</i>

Photo Reference Points

Price Park Stream Restoration Guilford County, North Carolina



As-built



2003

M1-US: Meander 1, looking in the upstream direction. Fenceline represents the beginning of the project and longitudinal profile. Note bar formation and vegetation establishment in this region.



As-built



2003

M1-DS: View from Meander 1, looking downstream towards M2.



M2-US: View from Meander 2 looking in the upstream direction towards M1.



M2-DS: View from Meander 2, looking downstream at M3.



M3-US: View from Meander 3 looking upstream.



As-built



2003

M3-DS: View from Meander 3 looking downstream towards a cross vane that was installed after the main construction period due to concerns with the grade downstream.



As-built



2003

M4-US: View from Meander 4 looking upstream at Meander 3.



As-built



2003

M4-DS: View from Meander 4 looking downstream towards Meander 5.



As-built



2003

M5-US: View from Meander 5 looking upstream towards Meander 4.62



As-built



2003

M5-DS: View from Meander 5 looking downstream towards Meander 6. 63



As-built



2003

M6-US: View from Meander 6 looking upstream towards Meander 5. Note rip-rap was installed at the end of construction due to bed downcutting. 64



M6-DS: View from Meander 6 looking downstream. 65



M7-US: View from Meander 7 looking upstream. 66



M7-DS: View from Meander 7 looking downstream. 67



M8-US: View from Meander 8 looking upstream. 68



M8-DS: View from Meander 8 looking downstream towards Meander 9. 69



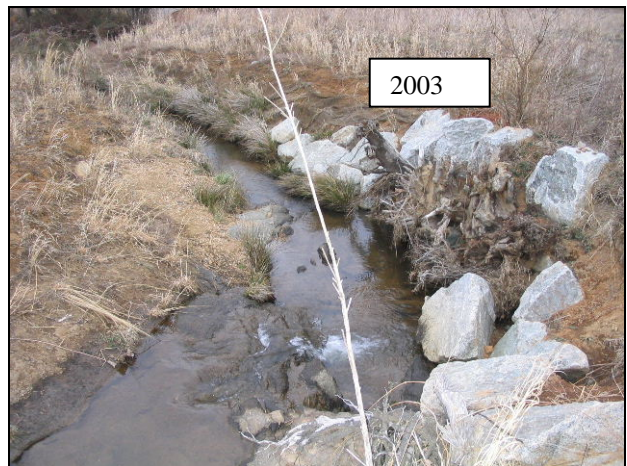
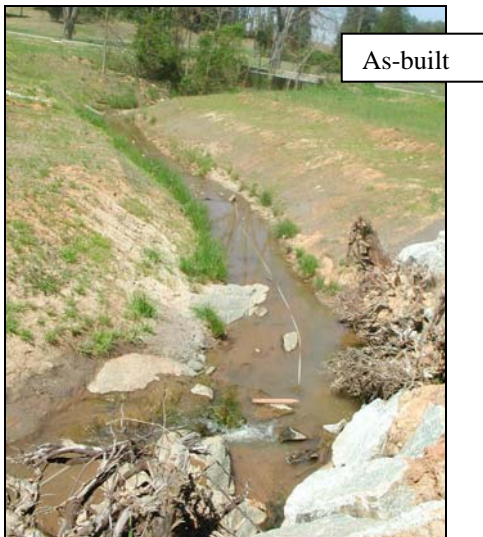
M9-US: View from Meander 9 looking upstream. 70



M9-DS: View from Meander 9 looking downstream. Note the point bar formation in the lower right corner of picture.71



M10-US: View from Meander 10 looking upstream. 72



M10-DS: View from Meander 10 looking downstream. Note the bedrock in the bed of the channel exposed during construction.73



As-built



2003

M11-US: View from Meander 11 looking upstream. 74



As-built



2003

M11-DS: View from Meander 11 looking downstream. Jefferson Club Road crosses the stream via this 14' x 7.5 box culvert. 75



As-built



2003

M12-US: View from Meander 12 looking upstream through the culvert. Note how the channel has narrowed and vegetated in the Year 1 photograph.76



M12-DS: View from Meander 12 looking downstream. 77



M13-US: View from Meander 13 looking upstream. 79



M13-DS: View from Meander 13 looking downstream. 80



M14-US: View from Meander 14 looking upstream. 81



M14-DS: View from Meander 14 looking downstream. Note stone step-pool outfall to connecting roadway drainage to stream channel.82



M15-US: View from Meander 15 looking upstream. 83



As-built



2003

M15-DS: View from Meander 15 looking downstream. Note this cross-vane was moved upstream into the meander to avoid a gas line during construction. In effect, the upper portion of the cross vane has been covered up by the point bar.⁸⁴



As-built



2003

M16-US: View from Meander 16 looking upstream. The aerial sewer line was re-routed to make it perpendicular to the stream.⁸⁵



As-built



2003

M16-DS: View from Meander 16 looking downstream. Cross-vane is drowned out due to backwater from the off-site lake downstream. ⁸⁶



As-built



2003

M17-US: View from Meander 17 looking upstream. 87



As-built



2003

M17-DS: View from Meander 17 looking downstream towards the double 10' x 8' box culvert. Cross-vane is drowned out.88