Year 3 Monitoring Report

County Line Creek (High Vista) Stream Restoration

February 2006
S&EC Project No. 9445.D1
EEP Project No. 00044

Designed by Kimley-Horn

Prepared for

Ecosystem Enhancement PROGRAM

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

Table of Contents

I. Executive Summary / Project Abstract

Due to historic channel modifications such as channelization and vegetation clearing, the restoration reach of County Line Creek was in an impaired state. The project, located in Henderson and Buncombe Counties, was designed by Kimley-Horn and Associates, Inc, using natural channel design methods. The restoration was completed in 2002. This report serves as the Year 3 (2005) Annual Monitoring Report.

Monitoring of the vegetated buffer was performed during the growing season of 2005, by Soil & Environmental Consultants, PA. Stem counts were preformed within the established vegetation monitoring plots.

The physical stream channel was surveyed and a visual stability assessment was performed for the County Line Creek Stream Restoration project. While there are several stable areas along the restored channel, the severity of some of the problem areas on this project currently warrant repair. These problem areas are shown on the Problem Area Plan View. In 2006, the fourth year of required monitoring will commence.

II. Project Background

The background information for this report is referenced from previous monitoring reports submitted by Kimley-Horn and Associates, Inc., and the Biological and Agricultural Engineering Department at North Carolina State University.

A. Location and Setting

The County Line Creek stream restoration site is located approximately nine miles south of Asheville and nine miles northwest of Hendersonville, NC. The project area is immediately west of NC Highway 191 within the High Vista Estates and Golf Course. Portions of the stream serve as the Henderson/Buncombe county line. The site is shown in Figure 1.

B. Structure and Objectives

The objectives of this project are "to design adjustments to the stream reach that will increase its long-term stability and create a more functional riparian ecological community. The design for the existing stream will adjust geomorphic dimensions, patterns, and profiles. The proposed changes reflect stable conditions of reference reaches and their current geomorphic conditions. Additionally, vegetated buffers will be created that match proximal natural ecological communities found in similar physiographic and climatic regions. The reach will be redesigned to maximize natural design in light of the needs of the golf course and physical constraints within the project area (*County Line Creek High Vista Estates and Golf Course Stream Restoration: Executive Summary of Design* 2001)."

The project included 3,500 linear feet of stream restoration within County Line Creek These figures are shown in Tables I and II.

Table I: Project Structure Table
County Line Creek Stream Restoration Site (EEP Project #00044)

Segment/Reach ID	Linear Feet or Acreage
County Line Creek	3,500 linear feet

Table II: Project Objectives Table
County Line Creek Stream Restoration Site (EEP Project #00044)

Segment/Reach ID	Objectives	Linear Feet or Acreage	Comment
County Line Creek	Restoration	3,500 lf	

C. Project History and Background

The project consisted of the analysis of the 0.35 square mile portion of the County Line Creek Watershed. The land uses within the drainage area primarily consist of residential, and golf course. Construction was completed in July 2002

NCEEP coordinated with citizens groups and local leaders to initiate this restoration project. The project focused on the restoration of approximately 3,500 linear feet of degraded stream within the High Vista Estates. The restoration of this portion of County Line Creek was warranted due to severe bank erosion, channel widening, and the loss of aquatic habitat resulting from stream channelization, lack of riparian vegetation, and watershed development. The goal of the project was to develop a stable stream channel with reduced bank erosion, efficient sediment transport, enhanced habitat, and improved aesthetics (*County Line Creek High Vista Estates and Golf Course Stream Restoration: Executive Summary of Design* 2001).

Table III: Project Activity and Reporting History
County Line Creek Stream Restoration Site (EEP Project #00044)

Activity or Report	Calendar Year of Completion or Planned Completion	Actual Completion Date
Restoration Plan	2002	
Mitigation Plan		
Construction	2002	Aug-02
As-Built report	2002	Oct-02
Final Planting	2002	Dec-02
Vegetation Plots Established	2003	Jan-03
Initial-Year 1 monitoring	2003	Dec-03
Year 2 monitoring	2004	Dec-04
Year 3 monitoring	2005	Dec-05
Year 4 monitoring	2006	
Year 5 monitoring	2007	

The project was designed by Kimley-Horn and Associates, Inc. The construction contractor is unknown. Monitoring activities for Year 1 was performed by Kimley-Horn, while Year 2 activities were performed by NCSU. Additional information regarding contractors is shown in Table IV.

Table IV: Project Contact Table
County Line Creek Stream Restoration Site (EEP Project #00044)

Designer	Kimley-Horn and Associates, Inc. 3001 Weston Parkway Cary, NC 27513
Monitoring Performers	Soil & Environmental Consultants, PA 11010 Raven Ridge Road Raleigh, NC 27614
Stream Monitoring POC	Rebecca Wargo, S&EC
Vegetation Monitoring POC	Jessica Regan, S&EC

The project is located along the Henderson/Buncombe county line, portions of which are located within the Blue Ridge Belt of the Mountains of North Carolina. The site is located within a moderately rural area. Additional information regarding these streams is included as Table V.

Table V: Project Background Table
County Line Creek Stream Restoration Site (EEP Project # 00044)

Project County	Henderson/Buncombe
Drainage Area	0.35 sq. miles
Drainage impervious cover estimate (%)	10%
Stream Order	1st /2nd
Physiographic Region	Mountain
Ecoregion	Blue Ridge Belt
Rosgen Classification of As-Built	B4/C4
Dominant Soil Types	Codorus, Hayesville, Delanco
USGS HUC for Project and Reference	06010105
NCDWQ Sub-basin for Project and Reference	040302
NCDWQ classification for Project	N/A
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor	N/A
% of project easement fenced	None

D. Monitoring Plan View

A series of monitoring devices were previously established on-site. A total of four (4) individual cross-sections were located. Cross-sections were surveyed from left to right facing downstream. Each cross-section is also a designated photographic point that will be photographed annually. There are eleven (11) permanent photo points located at various points along the length of the channel. The locations of all monitoring devices are shown on Sheets 1 through 4 (Monitoring Plan View).

III. Project Condition and Monitoring Results

A. Vegetation Assessment

Planted zones related to the stream restoration consisted of the riparian buffer zone and the stream banks. The riparian buffer zone initiates at the top of the bank and continues out perpendicular from the stream. The planted stream bank initiates at the normal base flow elevation and extends to the top of bank or interface with the flood plain.

The riparian buffer zone was planted with bare root trees and containerized shrubs. As described and depicted in the approved restoration plan, shrub species were planted in play over zones and the bare-root stock was planted on the remaining acreage where future tree height would not affect the field of vision for players.

1. Soil Data

The project site is located in the Blue Ridge Belt region of the North Carolina Mountain physiographic province. Soils present in the riparian areas adjacent to County Line Creek are characteristic of those found in alluvial landforms in the Blue Ridge Belt. However, extensive grading and filling associated with the golf course has likely modified much of the naturally occurring soils on site.

Codorus soils (*Fluvaquentic Dystrudepts*) are the prevalent map unit along the channel. Formed in recently deposited alluvial materials, they are very deep, moderately well drained and somewhat well drained soils. Delanco soils (*Aquic Hapludults*) are a second prevalent map unit along the channel. Formed on terraces, in the heads of drainageways and on nearly level concave colluvial areas, they are very deep, moderately well drained and somewhat poorly drained soils. Hayesville soils (*Typic Kanhapludults*) are present along the channel to a lesser extent. These soils are formed in residuum weathered from igneous and high-grade metamorphic rocks such as granite, granodiorite, mica gneiss and schist; but in some places formed from thickly-bedded metagraywacke and metasandstone.

In the upland areas surrounding the project, Elsinboro (*Typic Hapludults*), Bradson (*Typic Hapludults*), and Brevard (*Typic Hapludults*), which are often mapped on terraces, are the predominate soil series. These soils series are all closely associated with the Blue Ridge Belt landscape.

Table VI: Preliminary Soil Data
County Line Creek Stream Restoration Site (EEP Project # 00044)

Series	Max Depth (in.)	% Clay on Surface	K	T	OM %
Bradson (BaB, BaC)	75	7-27	0.24	5	1.0-4.0
Brevard (BrC, BrE, BrF)	90	10-25	0.24	5	1.0-5.0
Codorus (Co)	60	15-25	0.37	5	2.0-4.0
Elsinboro (EnB)	60	8-18	0.37	5	1.0-2.0
Hayesville (HyB, HyC, HyE)	72	10-25	0.24	4	1.0-3.0

2. Problem Areas Plan View (vegetation)

Upon inspection on August 10, 2005, it was noted that there were no vegetative problem areas.

3. Vegetative Problem Areas Plan View

Upon inspection on August 10, 2005, it was noted that there were no vegetative problem areas.

4. Stem Counts

On August 10, 2005, S&EC conducted vegetation counts within each established plot as described above. The results of this survey are shown below in Table VIII.

Table VIII: Stem Counts for Each Species Arranged by Plot
County Line Creek Stream Restoration Site (EEP Project # 00044)

Species	Plots								Totals
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	
Trees									
Salix nigra **(Black Willow)**	13		6		7				26
Platanus occidentalis **(American Sycamore)**		1							1
Populus deltoides **(Eastern Cotton-wood)**	1		5						6
Fraxinus pennsylvanica **(Green Ash)**				3					3
Shrubs									
Sambucus canadensis **(Elderberry)**	1						4		5
Viburnum dentatum **(Arrow-wood)**	3		4						7
Cornus amomum **(Silky Dogwood)**	19		8		15		12	17	71
Year 3 Totals	**37**	**1**	**23**	**3**	**22**	**0**	**16**	**17**	119
Initial Totals	62	34	52	23	50	21	50	62	212
Survival % Per Plot	60%	3%	44%	13%	44%	0%	32%	27%	

5. Vegetation Photo Plots

Photos taken during the August 10, 2005 Vegetation Sampling event are included as Appendix A.

B. Stream Assessment

S&EC encountered vertical and horizontal errors in the northings, eastings, and elevations provided for the benchmarks in the as-built. This data has prevented the comparison of profiles between monitoring years, since it is not possible to distinguish between departure due to changes in stream morphology, and differences due to survey error. For this reason, only sections of the 2004 profile that appeared to be in the same survey projection was overlaid with the 2005 profile. There appeared to be very little departure due to survey error in the cross-sections.

1. Problem Areas Plan View (stream)

An assessment of the stability of the channel was preformed on August 10, 2005, by S&EC. Several areas of concern were observed and documented including localized bank scour and several failing structures. These problem areas are shown on Sheets 5 through 8 (Problem Area Plan View).

2. Problem Areas Table Summary

Table IX: Stream Problem Areas
County Line Creek Stream Restoration Site (EEP Project # 00044)

Feature Issues	Station numbers	Suspected Cause	Photo number
Bank Scour	31+59 to 31+72	High velocity/excess shear	Stream Problem Area Photos 1-2
	29+68	Structure scour	
	27+50 to 26+92	High velocity/excess shear	
	27+28	Scour at rootwad	
	15' up UT to 23+78	High velocity/excess shear	
	13+12	Scour at structure	
Failing Structures	34+75	Rock shift at apex of vane	Stream Problem Area Photos 2-4
	34+00	Large drop over structure	
	29+68	Rootwad scour (span channel)	
	28+94	Large drop over structure	
	27+28	Scour at rootwad	
	13+12	Scour at structure	
	4+27	Large drop over structure -scour at structure	
	1+80	Water flowing under vane	

3. Numbered Issues Photo Section

Representative photos of each category of stream problem area were taken and are shown in Appendix B.

4. Fixed photo station photos

Photos from established photo stations were collected on August 10, 2005 during

the stream survey. These photos are included in Appendix B along with the photos taken during the 2004 monitoring year.

5. Stability Assessment

A visual qualitative assessment was performed to inspect channel facets, meanders, bed, banks, and installed structures. This visual assessment was confirmed and enhanced with a quantitative assessment of the physical stream survey. The goal of this assessment is to provide a percentage of the features listed in Table X that are in a state of stability. Table X was compiled from the data in Table B1 in Appendix B of this report.

Table X: Categorical Stream Feature Visual Stability Assessment
County Line Creek Stream Restoration Site (EEP #00044)

Feature	MY-1 2005	MY-2 2004	MY-3 2005
A. Riffles	*	*	87%
B. Pools	*	*	95%
C. Thalweg	*	*	100%
D. Meanders	*	*	78%
E. Bed General	*	*	82%
F. Channel General	*	*	N/A
G. Banks	*	*	92%
H. Vanes/ J Hooks, etc.	*	*	88%
I. Wads and Boulders	*	*	52%

* Items denoted with an asterisk have not been provided due to: lack of data provided for previous monitoring years, incorrect data provided for previous monitoring years, or these are items outside the scope of this year's monitoring effort.

6. Quantitative Morphology

The following tables (Table XI and Table XII) summarize the quantitative data collected from the cross-sectional and longitudinal stream survey. This data was analyzed and summarized, and then compared with baseline data types available for this project. It should be noted that bankfull indicators on-site (other than the constructed bench) were difficult to recognize in this channel since there have been several bank and structure failures. For this reason, the SRI Mountain curve was used to determine an average bankfull cross-sectional area, and bankfull was placed at the elevation that would yield this area (for 2005 cross-sections). This elevation is higher than the bench that has been constructed in portions of the reach. When the elevations chosen for bankfull (2005 – based on the regional curve) were plotted on the longitudinal profile, the points formed a reasonably uniform slope that was consistent with the water surface slope. While it is difficult to exactly identify the location of bankfull on this project, the baseline

that has been chosen for 2005 is consistent with the regional curve and will provide accurate illustrations of departure if bankfull is located in the same manner for future years of monitoring. The Quantitative Morphology Tables illustrate the degree of departure, if any, of the current channel from the baseline data. Tables XI and XII were compiled from the cross-section and profile raw data and plots located in Appendix B of this report.

Based on a review of available site data and observations made during 2005 site visits, no crest gauge has been installed on the site. A review of available on-line USGS gauge sites was performed to determine if a suitable surrogate gauge was present in the area. No nearby gauge was identified. The closest USGS gauge to the site was on the French Broad River (new Fletcher, NC, Gauge Identification Number 03447687) which is approximately 3.314 miles from the project site. Based on this large distance, significant disparity in watershed sizes, and topographic variation, it is unlikely that a conclusive determination regarding the number of bankfull events experienced on the restoration site could be made.

Table XI. Baseline Morphology and Hydraulic Summary
HIGH VISTA STREAM RESTORATION SITE (EEP Project #00044)

Parameter	Pre-Existing Condition			Project Reference Stream			Design			As-built		
Dimension	Min	Max	Avg.	Min	Max	Avg.	Min	Max	Avg.	Min	Max	Avg.
BF Width (ft)	3	8	6	*	*	*	6	9	*	*	*	8.9
Floodprone Width (ft)	19	73	40	*	*	*	*	*	>20.0	*	*	19
BF Cross Sectional Area (ft^2)	8	11	10	*	*	*	3.3	5.1	*	*	*	4.3
BF Mean Depth (ft)	1	3.3	2	*	*	*	0.5	0.6	*	*	*	0.5
BF Max Depth (ft)	*	*	*	*	*	*	0.8	1.2	*	*	*	1.05
Width/Depth Ratio	1	8	2.7	*	*	*	12	15	*	*	*	18.5
Entrenchment Ratio	3	12	6.7	*	*	*	*	*	>2.2	*	*	2.1
Wetted Perimeter(ft)	*	*	*	*	*	*	*	*	*	*	*	*
Hydraulic radius (ft)	*	*	*	*	*	*	*	*	*	*	*	*
Pattern												
Channel Beltwidth (ft)	*	*	*	*	*	*	*	*	*	*	*	*
Radius of Curvature (ft)	*	*	*	*	*	*	*	*	*	*	*	*
Meander Wavelength (ft)	*	*	*	*	*	*	*	*	*	*	*	*
Meander Width ratio	*	*	*	*	*	*	*	*	*	*	*	*
Profile												
Riffle length (ft)	*	*	*	*	*	*	*	*	*	*	*	*
Riffle slope (ft/ft)	0.01	0.1	0.04	*	*	*	0.04	0.1	*	*	*	0.05
Pool length (ft)	*	*	*	*	*	*	*	*	*	*	*	*
Pool spacing (ft)	*	*	*	*	*	*	*	*	30	*	*	50.3
Substrate												
d50 (mm)	*	*	*	*	*	*	*	*	*	*	*	*
d84 (mm)	*	*	*	*	*	*	*	*	*	*	*	*
Additional Reach Parameters												
Valley Length (ft)		*			*			*			*	
Channel Length (ft)		*			*			*			*	
Sinuosity		*			*			*			*	
Water Surface Slope (ft/ft)		*			*			*			*	
BF slope (ft/ft)		*			*			*			*	
Rosgen Classification		Incised E,F,G			*			B4			B4/C4	
*Habitat Index		*			*			*			*	
*Macrobenthos		*			*			*			*	

* Items denoted with an asterisk have not been provided due to: lack of data provided for previous monitoring years, incorrect data provided for previous monitoring years, or these are items outside the scope of this year's monitoring effort.

Exhibit Table XII. Morphology and Hydraulic Monitoring Summary
HIGH VISTA STREAM RESTORATION SITE (EEP Project #00044)

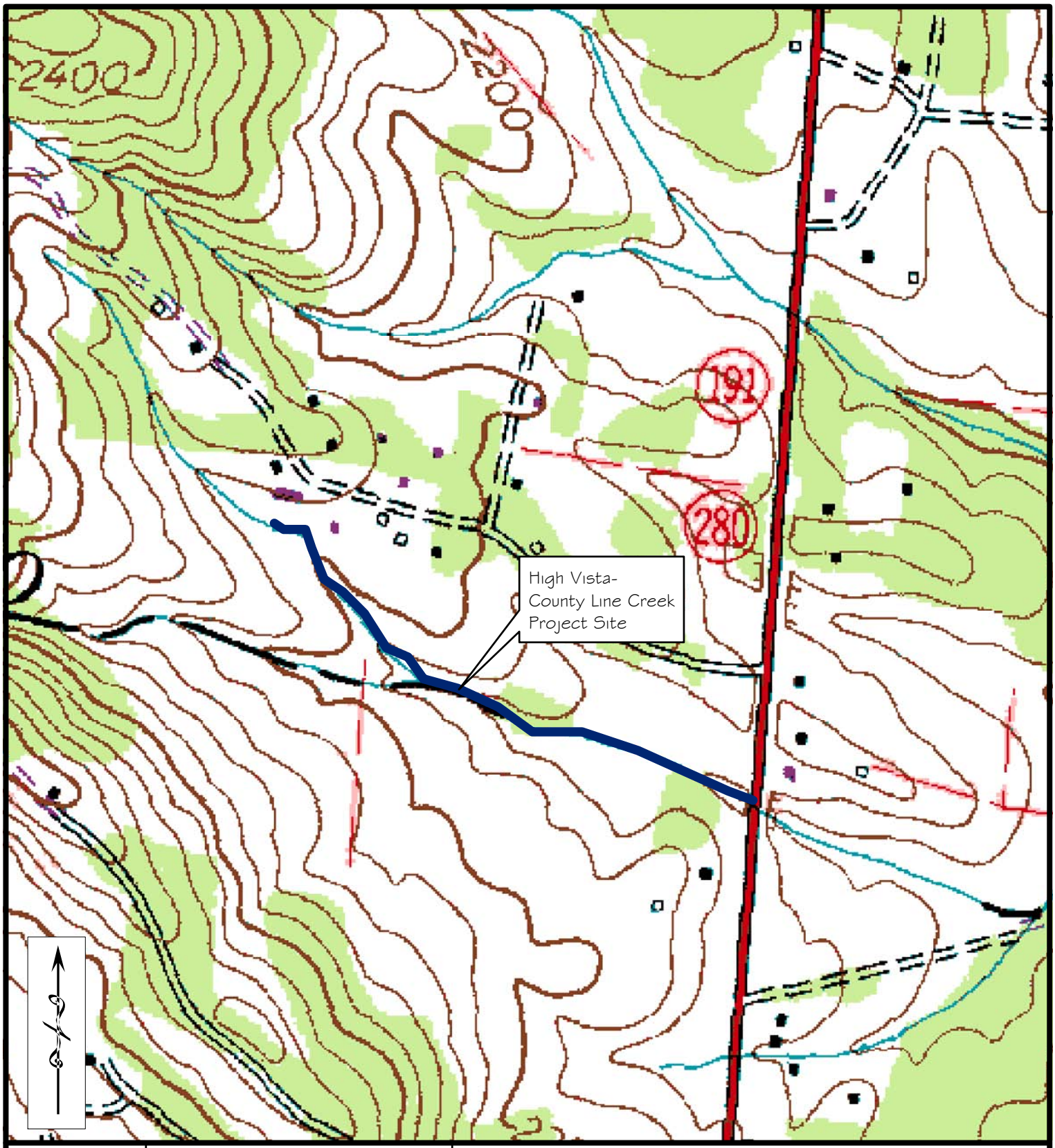
Parameter	RIFFLE 1				POOL 1				RIFFLE 2				POOL 2			
Dimension	AS BUILT	MY1	MY2	MY3	AS BUILT	MY1	MY2	MY3	AS BUILT	MY1	MY2	MY3	AS BUILT	MY1	MY2	MY3
	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005	2002	2003	2004	2005
BF Width (ft)	*	*	3.7	16.32	*	*	6	14.36	*	*	18	9.93	*	*	11.4	11.62
Floodprone Width (ft	*	*	*	32.29	*	*	*	25.46	*	*	*	23.7	*	*		17.92
BF Cross Sectional Area (ft^2)	*	*	2.1	9.62	*	*	2	11.83	*	*	18.4	9.57	*	*	25.1	11.26
BF Mean Depth (ft)	*	*	0.6	0.59	*	*	0.3	0.82	*	*	1	0.96	*	*	2.2	0.97
BF Max Depth (ft)	*	*	1	1.46	*	*	1.4	1.64	*	*	3	1.81	*	*	3.3	1.6
Width/Depth Ratio	*	*	6.4	27.7	*	*	18.2	17.44	*	*	17.7	10.3	*	*	5.2	11.99
Entrenchment Ratio	*	*	*	1.98	*	*	*	1.77	*	*	*	2.39	*	*	*	1.54
Wetted Perimeter(ft)	*	*	*	17.44	*	*	*	14.96	*	*	*	11.88	*	*	*	12.97
Hydraulic radius (ft)	*	*	*	0.55	*	*	*	0.79	*	*	*	0.81	*	*	*	0.87
Substrate																
d50 (mm)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
d84 (mm)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Parameter	As-built (2002)			MY-1 (2003)			MY-2 (2004)			MY-3 (2005)		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft	*	*	*	*	*	*	*	*	*	38.44	109.59	67.73
Radius of Curvature (ft)	*	*	*	*	*	*	*	*	*	23.31	56.7	32.99
Meander Wavelength (ft)	*	*	*	*	*	*	*	*	*	82.53	463.94	173.38
Meander Width ratio	*	*	*	*	*	*	*	*	*	2.92765	8.34653	5.15842
Profile												
Riffle length (ft)	*	*	*	*	*	*	*	*	*	*	*	*
Riffle slope (ft/ft)	*	*	0.045	*	*	0.05	*	*	*	0.01868	0.02739	0.02431
Pool length (ft)	*	*	*	*	*	*	*	*	*	8.84	31.68	18.34
Pool spacing (ft)	*	*	30	*	*	54.5	*	*	*	12.16	76.62	49.29
Additional Reach Parameters												
Valley Length (ft		*			*			*			2977	
Channel Length (ft		*			*			*			3513	
Sinuosity		*			*			*			1.18	
Water Surface Slope (ft/ft)		*			*			*			*	
BF slope (ft/ft)		*			*			*			0.02431	
Rosgen Classification											B4	
Habitat Index*		*			*			*			*	
Macrobenthos*		*			*			*			*	

* Items denoted with an asterisk have not been provided due to: lack of data provided for previous monitoring years, incorrect data provided for previous monitoring years, or these are items outside the scope of this year's monitoring effort.

IV. Methodology Section

No unavoidable deviations from initially prescribed methodologies were implemented as a part of monitoring Year 3 activities.



Project No. 9445.D1	Figure 1 - Vicinity Map	
Project Mgr.: JR	High Vista- County Line Creek NCEEP Year 3 of 5 Henderson/ Buncombe County, NC	
Scale: 1" = 500'	Skyland Quadrangle	
12/08/05		

S&EC
Soil & Environmental Consultants, PA
11010 Raven Ridge Rd • Raleigh, NC 27614
(919) 846-5900 • (919) 846-9467
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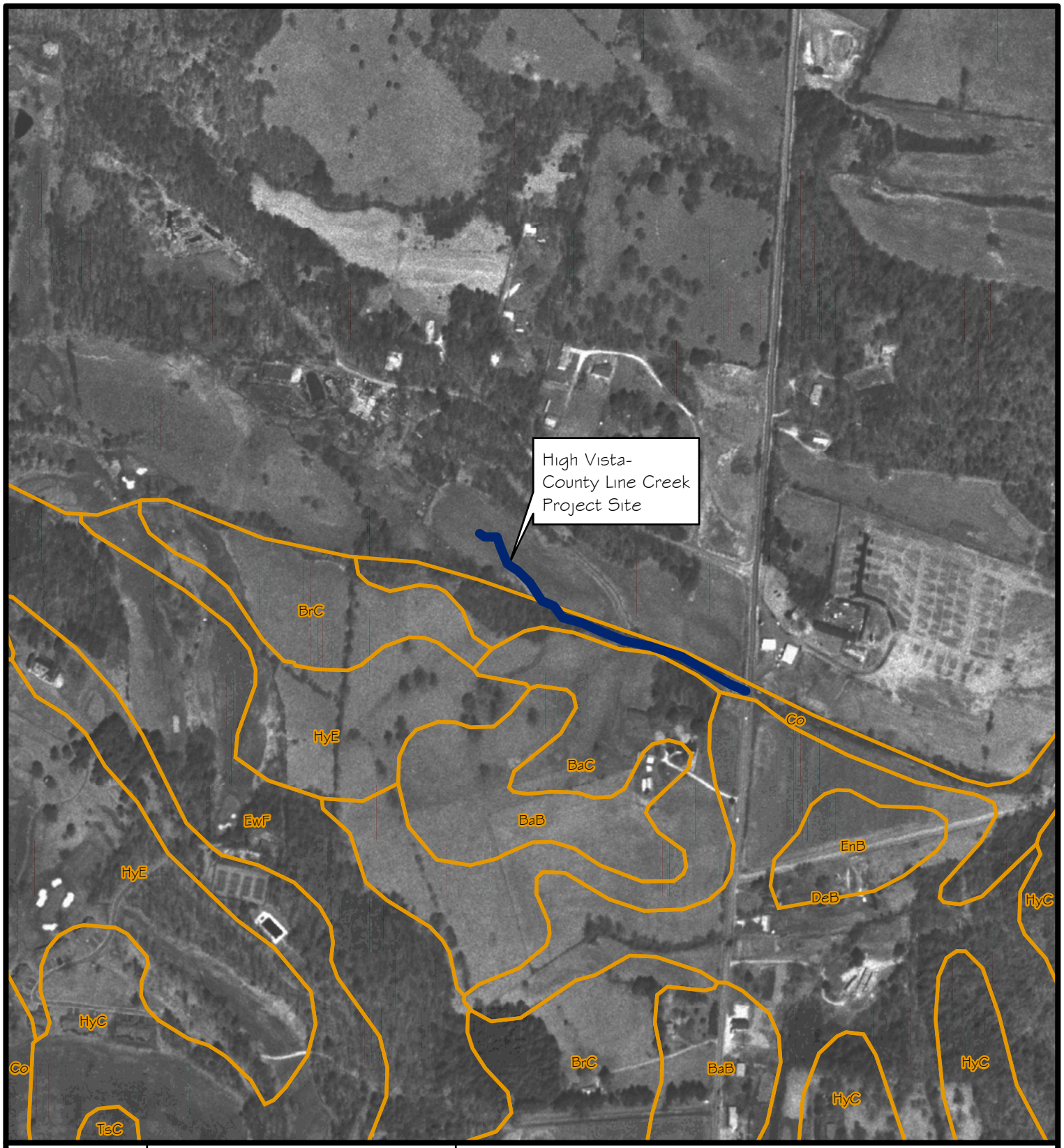

Project No. 9445.D1	Figure 2 - NRCS Soil Survey Map High Vista-County Line Creek NCEEP Year 3 of 5 Henderson/ Buncombe County, NC	
Project Mgr.: JR		
Scale: 1" = 500'		
12/08/05	Henderson County Soil Survey	

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11010 Raven Ridge Rd.• Raleigh, NC 27614
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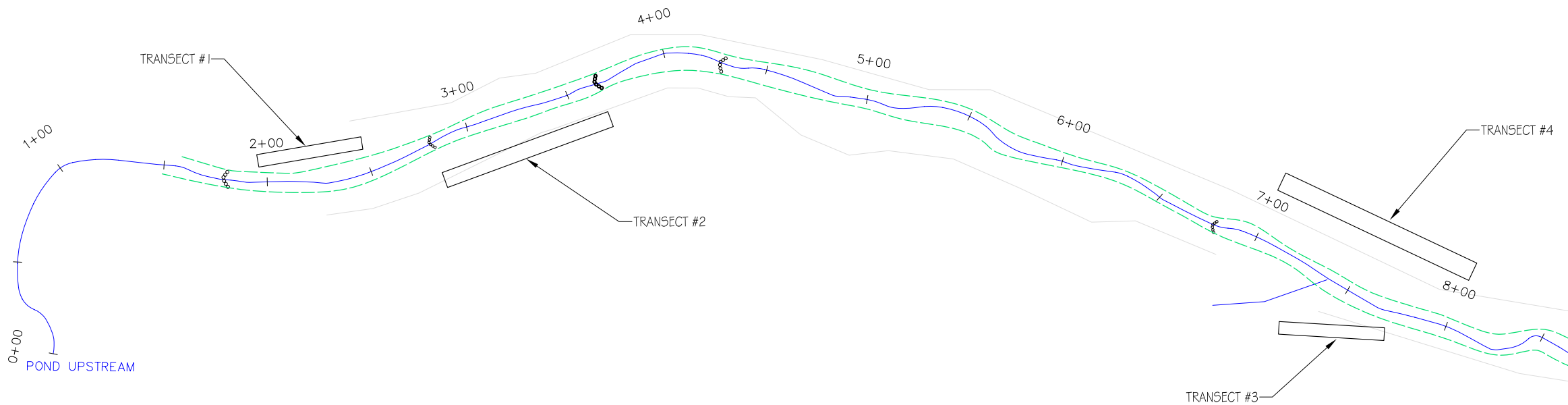
High Vista Estates Stream Restoration
Monitoring Year 3 of 5

Legend

- In-Steam Structure
- Stream Centerline
- Bankfull
- Top of Bank
- Cross-Section
- Culvert/Bridge

PS #9



NORTH

SCALE 1" = 60'

30 0 60

Notes:

1.) General site data provided by NCEEP. Original restoration design prepared by EcoLogic Associates.

2.) All locations are approximate.

MONITORING PLAN VIEW

NOVEMBER 2005

Project No.: 9445.01 | Proj. Mgr.: PKS | Drawn: JER
Project: HIGH VISTA ESTATES STREAM RESTORATION
Location: HENDERSON / BUNCOMBE CO. | Client: NCEEP | Scale: 1" = 60'
Sheet Title: MONITORING PLAN VIEW - SEGMENT 1 | Sheet No.: 1 OF 8

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Ecosystem Enhancement Program

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Legend

- In-Steam Structure
- Stream Centerline
- Bankfull
- Top of Bank
- Cross-Section
- Culvert/Bridge

NORTH

SCALE 1" = 60'

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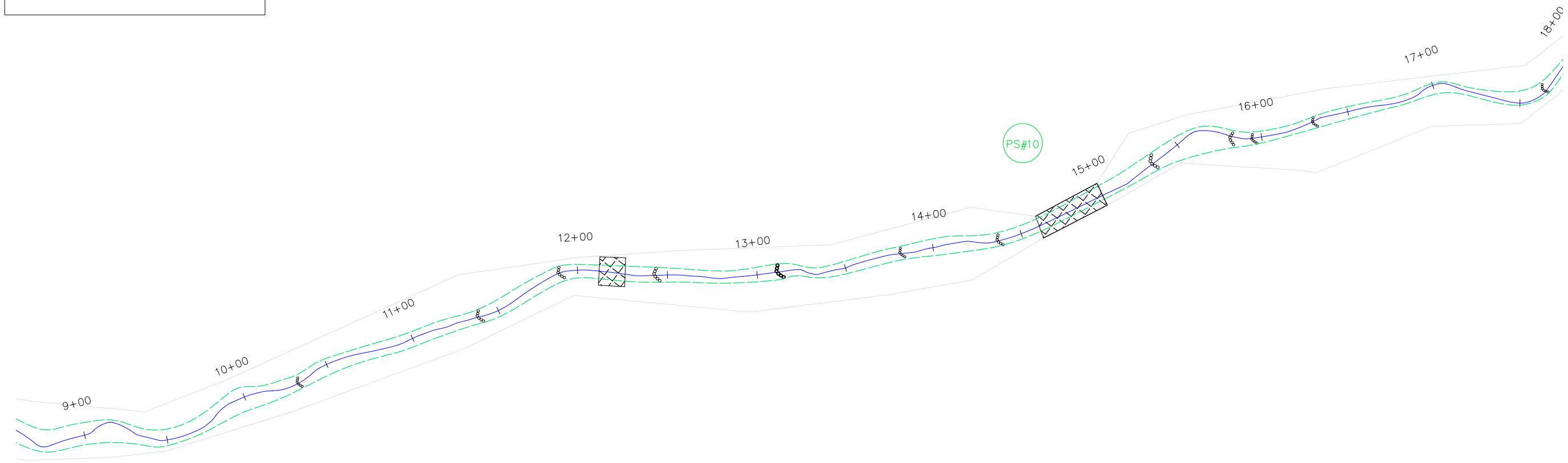

Notes:

1.) General site data provided by NCEEP. Original restoration design prepared by EcoLogic Associates.

2.) All locations are approximate.

MONITORING PLAN VIEW

NOVEMBER 2005

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Project: HIGH VISTA ESTATES STREAM RESTORATION

Location: HENDERSON / BUNCOMBE CO. | Client: NCEEP

Sheet Title: MONITORING PLAN VIEW - SEGMENT 2

Project No.: 9445.D1 | Proj. Mgr.: PKS | Drawn: JER | Scale: 1" = 60' | Sheet No.: 2 of 8

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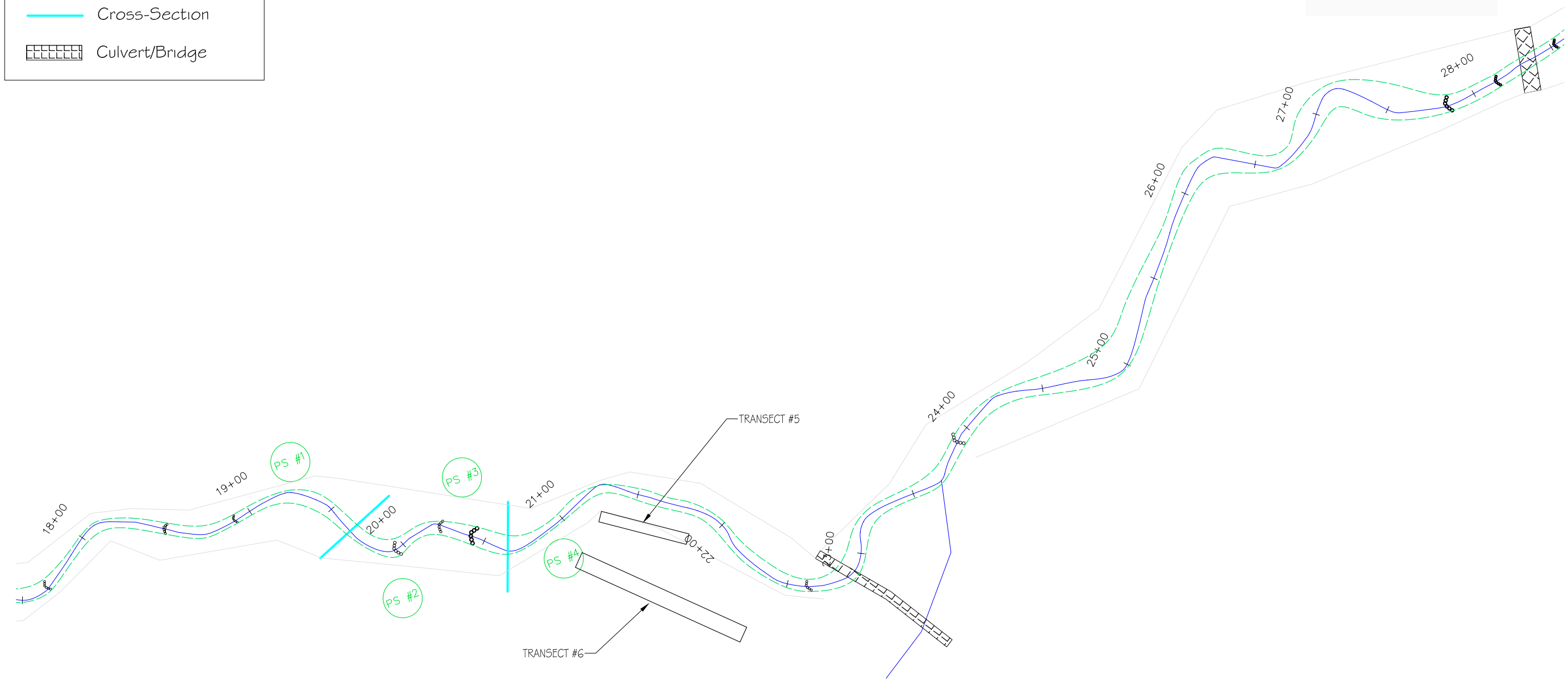
Legend

- In-Steam Structure
- Stream Centerline
- Bankfull
- Top of Bank
- Cross-Section
- Culvert/Bridge

NORTH

SCALE 1" = 60'

30 0 60



Notes:

1.) General site data provided by NCEEP. Original restoration design prepared by EcoLogic Associates.
2.) All locations are approximate.

MONITORING PLAN VIEW

NOVEMBER 2005

File: Ecologs7-9\9445.01\PAP\PAPV.dwg

Project No.: 9445.01 | Drawn: JER
Proj. Mgr.: PKS | Scale: 1" = 60'
Project: HIGH VISTA ESTATES STREAM RESTORATION
Location: HENDERSON / BUNCOMBE CO. | Client: NCEEP
Sheet Title: MONITORING PLAN VIEW - SEGMENT 3 | Sheet No.: 3 of 8

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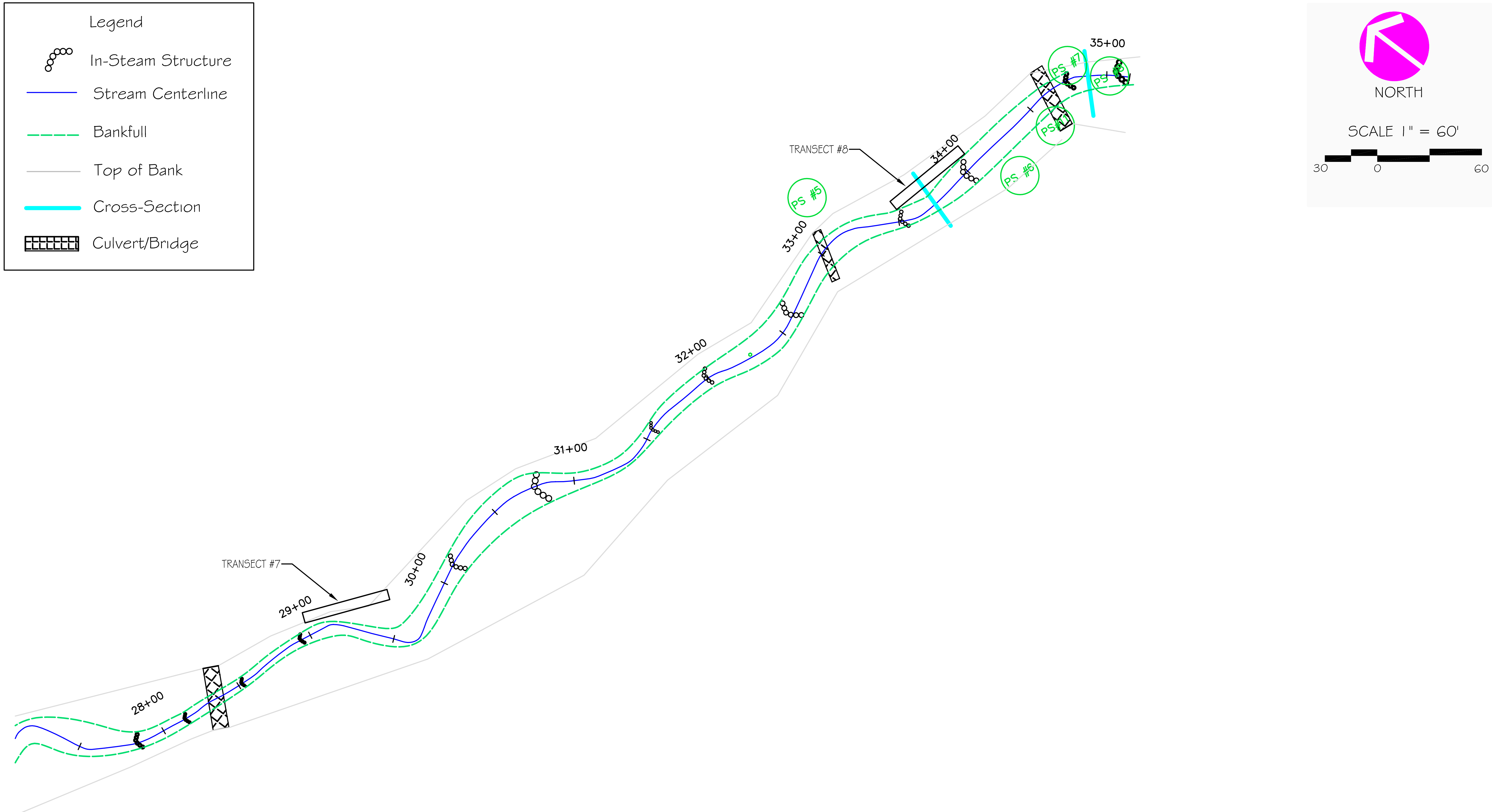

Notes:

1.) General site data provided by NCEEP. Original restoration design prepared by EcoLogic Associates.

2.) All locations are approximate.

MONITORING PLAN VIEW

NOVEMBER 2005

File: Sec\Jobs7-9k\9445.D1\PAPV\PAPV.dwg

Ecosystem Enhancement Program

S&EC

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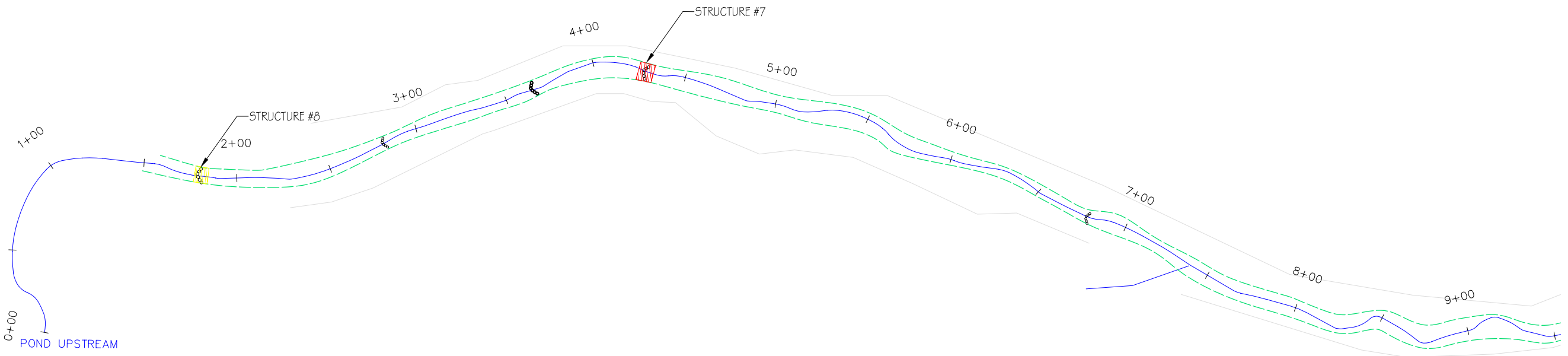
Project: HIGH VISTA ESTATES STREAM RESTORATION	Project No.: 9445.D1
Location: HENDERSON / BUNCOMBE CO. Client: NCEEP	Proj. Mgr.: PKS Drawn: JER
	Scale: 1" = 60'
Sheet Title: MONITORING PLAN VIEW - SEGMENT 4	Sheet No.: 4 of 8

Legend

- In-Steam Structure
- Stream Centerline
- Bankfull
- Top of Bank
- Cross-Section
- Culvert/Bridge



NORTH

SCALE 1" = 60'

30 0 60

Notes:

1.) General site data provided by NCEEP. Original restoration design prepared by EcoLogic Associates.
2.) Site evaluation prepared by Soil and Environmental Consultants, PA on 8/10/2005
3.) All locations are approximate.

PAPV LEGEND

- STREAM PROBLEM AREAS-STRESSED
- STREAM PROBLEM AREAS-FAILING
- VEGETATION PROBLEM AREAS-MODERATE
- VEGETATION PROBLEM AREAS-SEVERE

PROBLEM AREA PLAN VIEW

NOVEMBER 2005

File: S:\cvl\Jobs\7-9\9445.01\PAPV\PAPV.dwg

Project No.: 9445.01 | Drawn: JER
Proj. Mgr.: PKS | Scale: 1" = 60'
Project: HIGH VISTA ESTATES STREAM RESTORATION
Location: HENDERSON / BUNCOMBE CO. | Client: NCEEP
Sheet Title: PAPV - SEGMENT 1 | Sheet No.: 5 OF 8

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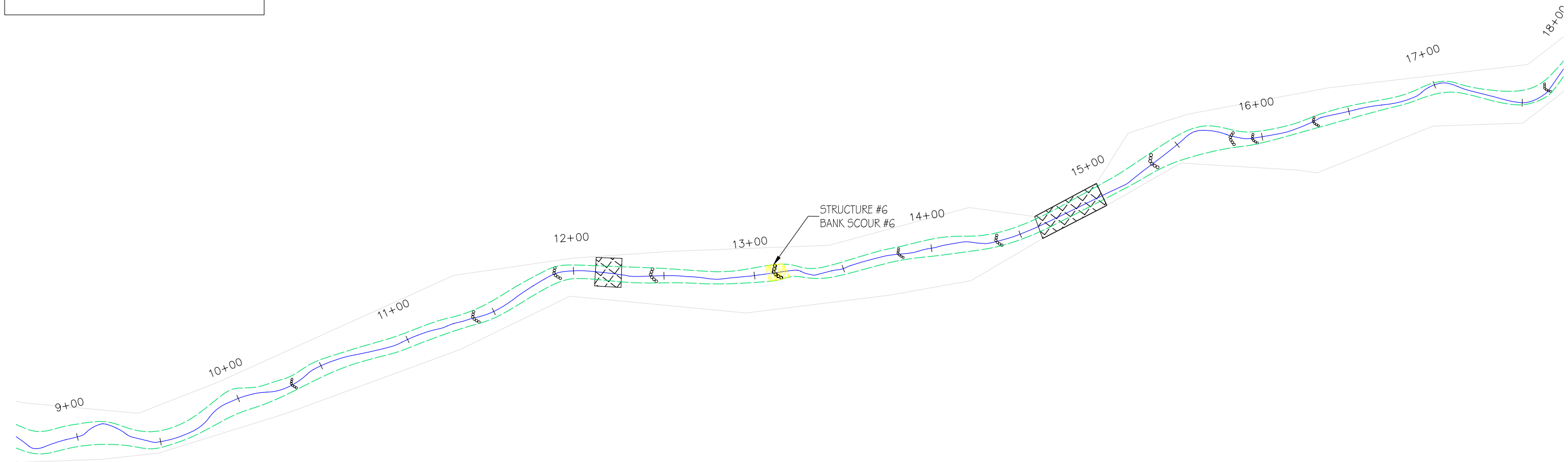
Legend

- In-Steam Structure
- Stream Centerline
- Bankfull
- Top of Bank
- Cross-Section
- Culvert/Bridge

NORTH

SCALE 1" = 60'

30 0 60



Notes:

1.) General site data provided by NCEEP. Original restoration design prepared by EcoLogic Associates.
2.) Site evaluation prepared by Soil and Environmental Consultants, PA on 8/10/2005
3.) All locations are approximate.

PAPV LEGEND

- STREAM PROBLEM AREAS-STRESSED
- STREAM PROBLEM AREAS-FAILING
- VEGETATION PROBLEM AREAS-MODERATE
- VEGETATION PROBLEM AREAS-SEVERE

PROBLEM AREA PLAN VIEW

NOVEMBER 2005

File: S:\cJobs\7-9\9445.01\PAPV\PAPV.dwg

Project No.: 9445.01 | Drawn: JER
Proj. Mgr.: PKS | Scale: 1" = 60'
Project: HIGH VISTA ESTATES STREAM RESTORATION
Location: HENDERSON / BUNCOMBE CO. | Client: NCEEP
Sheet Title: PAPV - SEGMENT 2 | Sheet No.: 6 of 8

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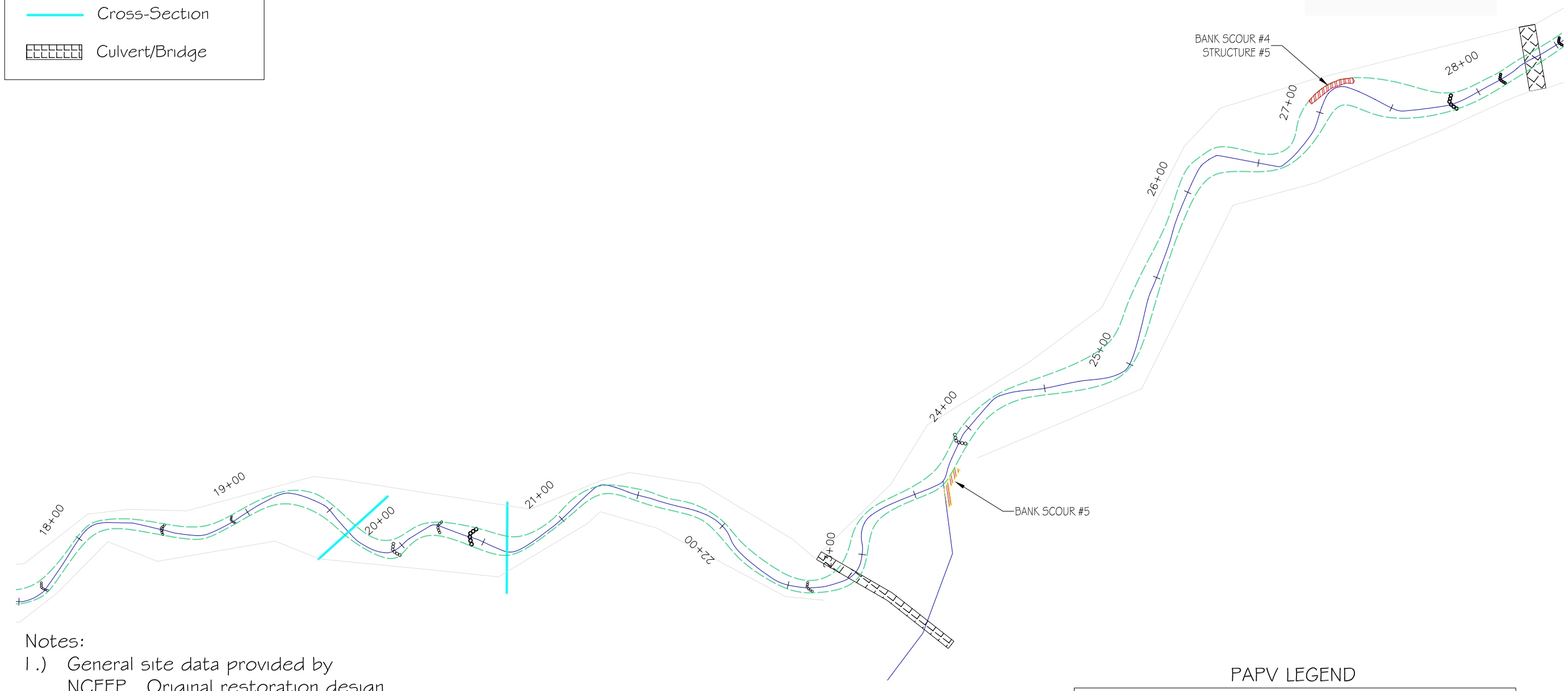
Legend

- In-Steam Structure
- Stream Centerline
- Bankfull
- Top of Bank
- Cross-Section
- Culvert/Bridge

NORTH

SCALE 1" = 60'

30 0 60



Notes:

1.) General site data provided by NCEEP. Original restoration design prepared by EcoLogic Associates.
2.) Site evaluation prepared by Soil and Environmental Consultants, PA on 8/10/2005
3.) All locations are approximate.

PAPV LEGEND

- STREAM PROBLEM AREAS-STRESSED
- STREAM PROBLEM AREAS-FAILING
- VEGETATION PROBLEM AREAS-MODERATE
- VEGETATION PROBLEM AREAS-SEVERE

PROBLEM AREA PLAN VIEW

NOVEMBER 2005

File: S:\ecology7-9\9445.01\PAPV\PAPV.dwg

Project No.: 9445.01 | Drawn: JER
Proj. Mgr.: PKS | Scale: 1" = 60'
Project: HIGH VISTA ESTATES STREAM RESTORATION
Location: HENDERSON / BUNCOMBE CO. | Client: NCEEP
Sheet Title: PAPV - SEGMENT 3 | Sheet No.: 7 of 8

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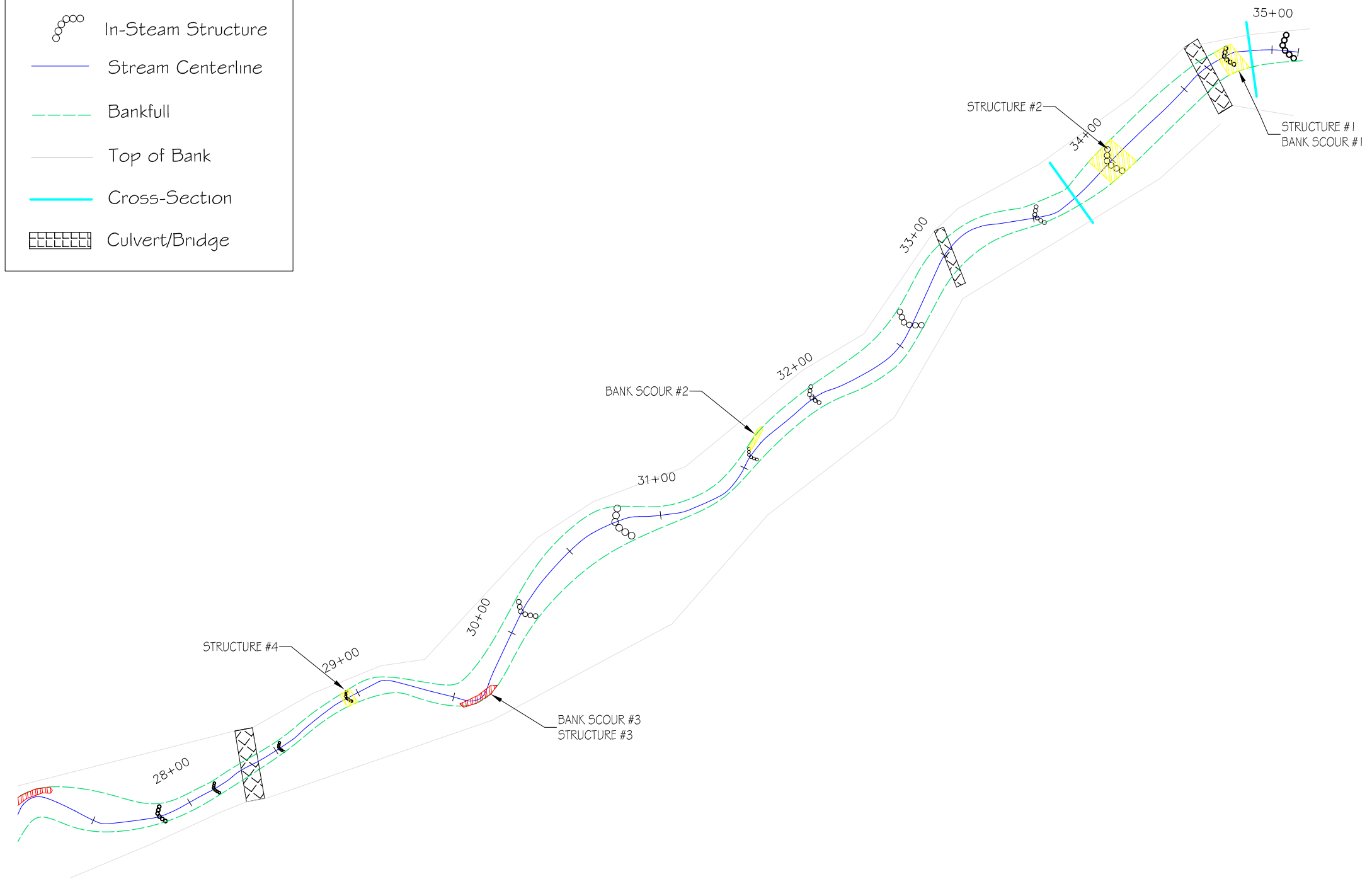
S&EC

Ecosystem Enhancement Program

Legend

- In-Steam Structure
- Stream Centerline
- Bankfull
- Top of Bank
- Cross-Section
- Culvert/Bridge



NORTH

SCALE 1" = 60'

30 0 60

Notes:

1.) General site data provided by NCEEP. Original restoration design prepared by EcoLogic Associates.
2.) Site evaluation prepared by Soil and Environmental Consultants, PA on 8/10/2005
3.) All locations are approximate.

PAPV LEGEND

- STREAM PROBLEM AREAS-STRESSED
- STREAM PROBLEM AREAS-FAILING
- VEGETATION PROBLEM AREAS-MODERATE
- VEGETATION PROBLEM AREAS-SEVERE

PROBLEM AREA PLAN VIEW

NOVEMBER 2005

File: S:\cJobs7-9\9445.01\PAPV\PAPV.dwg

Project: HIGH VISTA ESTATES STREAM RESTORATION
Location: HENDERSON / BUNCOMBE CO.
Sheet Title: PAPV - SEGMENT 4

Project No.: 9445.01
Proj. Mgr.: PK5
Drawn: JER
Scale: 1" = 60'
Client: NCEEP
Sheet No.: 8 of 8

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APPENDIX A

APPENDIX A –

Vegetation Survey Data Tables

Table VIII: Stem Counts for Each Species Arranged by Plot
County Line Creek Stream Restoration Site (EEP Project # 00044)

Species	Plots								Year 3 Totals
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	
Trees									
***Salix nigra* (Black Willow)**	13		6		7				26
***Platanus occidentalis* (American Sycamore)**		1							1
***Populus deltoides* (Eastern Cotton-wood)**	1		5						6
***Fraxinus pennsylvanica* (Green Ash)**				3					3
Shrubs									
***Sambucus canadensis* (Elderberry)**	1						4		5
***Viburnum dentatum* (Arrow-wood)**	3		4						7
***Cornus amomum* (Silky Dogwood)**	19		8		15		12	17	71
Year 3 Totals	**37**	**1**	**23**	**3**	**22**	**0**	**16**	**17**	119
Year 1 Totals	41	1	27	3	29	0	17	20	138
Initial Totals	62	34	52	23	50	21	50	62	212
Survival % Per Plot	60%	3%	44%	13%	44%	0%	32%	27%	

EEP Stem Count Data Sheet

EEP Project #:	**00044**	**Date:**	8/10/2005
Project Name:	**High Vista**	**Staff Name:**	J. Regan
Monitoring Contractor:	**S&EC**	**Staff Name:**	
County:	**Buncombe**		
8 Digit Catalog Unit	**06010105**		
Stream/Wetland Name:	**County Line Creek**		

Plot Location

Plot ID	Species		Stem #
1	Black Willow		13
1	Arrow-wood		3
1	Silky Dogwood		19
1	Eastern Cottonwood		1
1	Elderberry		1
1			

Plot Location

Plot ID	Species		Stem #
5	Black Willow		7
5	Arrow-wood		
5	Silky Dogwood		15
5	Eastern Cottonwood		
5	Elderberry		
5			

Plot Location

Plot ID	Species		Stem #
2	American Sycamore		1
2			
2			
2			
2			
2			

Plot Location

Plot ID	Species		Stem #
6			
6			
6			
6			
6			
6			

Plot Location

Plot ID	Species		Stem #
3	Black Willow		6
3	Arrow-wood		4
3	Silky Dogwood		8
3	Eastern Cottonwood		5
3	Elderberry		
3			

Plot Location

Plot ID	Species		Stem #
7	Black Willow		
7	Arrow-wood		
7	Silky Dogwood		12
7	Eastern Cottonwood		
7	Elderberry		4
7			

Plot Location

Plot ID	Species		Stem #
4	Green Ash		3
4			
4			
4			
4			
4			

Plot Location

Plot ID	Species		Stem #
8	Black Willow		
8	Arrow-wood		
8	Silky Dogwood		17
8	Eastern Cottonwood		
8	Elderberry		
8			

APPENDIX A –

Vegetation Monitoring Plot Photos

Vegetation Plot #1—Year 3 (2005)

Vegetation Plot #2—Year 3 (2005)

Vegetation Plot #3—Year 3 (2005)

Vegetation Plot #4—Year 3 (2005)

Vegetation Plot #5—Year 3 (2005)

Vegetation Plot #6—Year 3 (2005)

Vegetation Plot #7—Year 3 (2005)

Vegetation Plot #8—Year 3 (2005)

APPENDIX B

APPENDIX B –

Representative Stream Problem Area Photos

Figure 1— Typical Bank Scour

Figure 2—Typical Bank Scour / Failing Structure

Figure 3—Typical Failing Structure

Figure 4—Typical Failing Structure

APPENDIX B –

Stream Photo Point Photos

Figure 1— Photo Point # 1 (2004)

Figure 2—Photo Point # 1 (2005)

Figure 3—Photo Point # 2 (2004)

Figure 4—Photo Point # 2 (2005)

Figure 5—Photo Point # 3 (2004)

Figure 6—Photo Point # 3 (2005)

Figure 7 -Photo Point # 4 (2004)

Figure 8—Photo Point # 4 (2005)

Figure 9—Photo Point # 5 (2004)

Figure 10—Photo Point # 5 (2005)

Figure 11—Photo Point # 6 (2004)

Figure 12—Photo Point # 6 (2005)

Figure 13—Photo Point # 7 (2004)

Figure 14—Photo Point # 7 (2005)

Figure 15—Photo Point # 8 (2004)

Figure 16—Photo Point # 8 (2005)

Figure 17—Photo Point # 9 (2004)

Figure 18—Photo Point # 9 (2005)

Figure 19—Photo Point # 10 (2004)

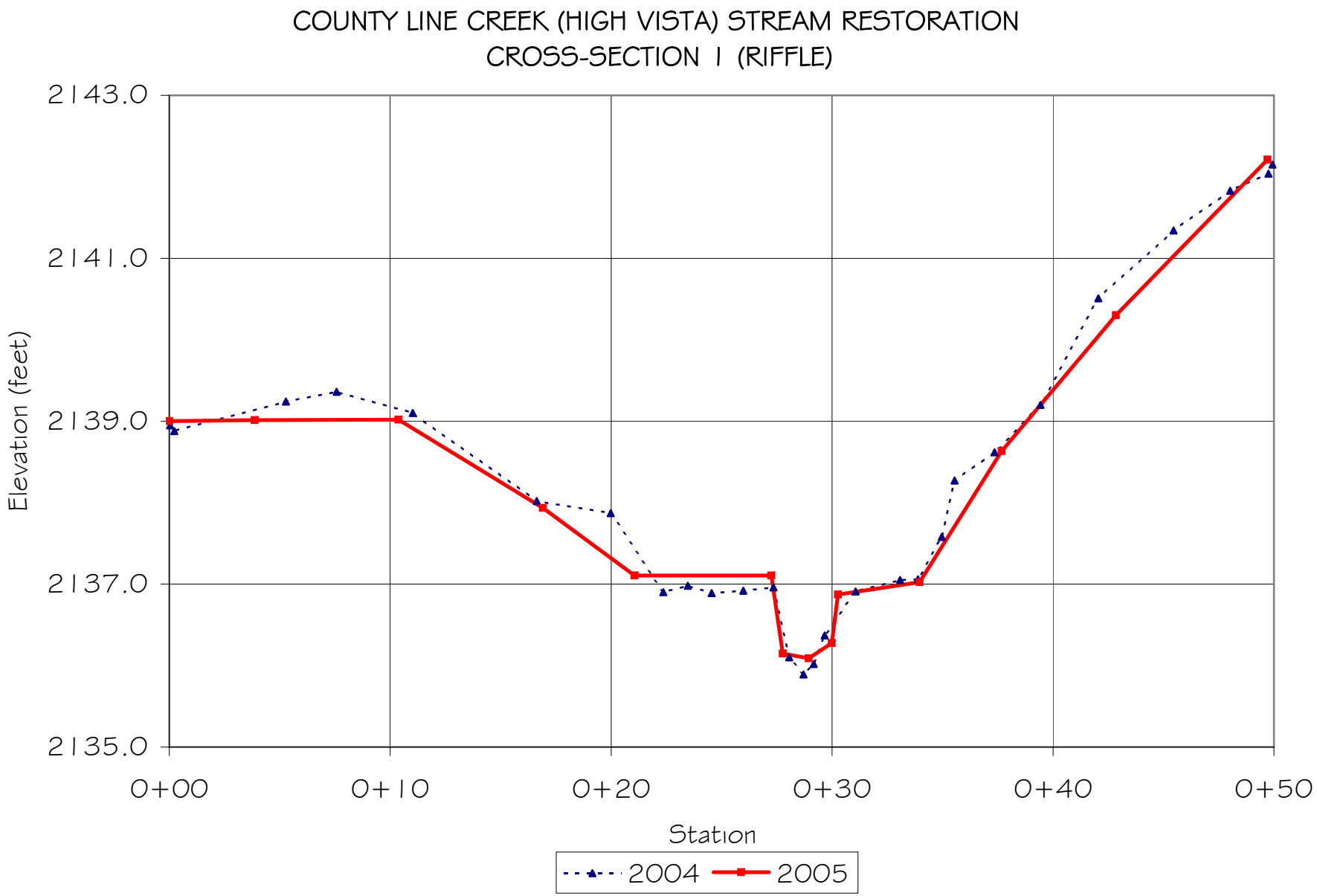
Figure 20—Photo Point # 10 (2005)

Figure 21—Photo Point # 11 (2004)

Figure 22—Photo Point # 11 (2005)

APPENDIX B –

Cross-section Data


COUNTY LINE CREEK (HIGH VISTA) STREAM RESTORATION
CROSS-SECTION 1 (RIFFLE)
2143.0
2141.0
2139.0
2137.0
2135.0
Elevation (feet)
0+00
0+10
0+20
0+30
0+40
0+50
Station
2004
2005

RIVERMOI CROSS SECTION SUMMARY

River Name: High Vista
Reach Name: 2005
Cross Section Name: XS1
Survey Date: 1/5/2006

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

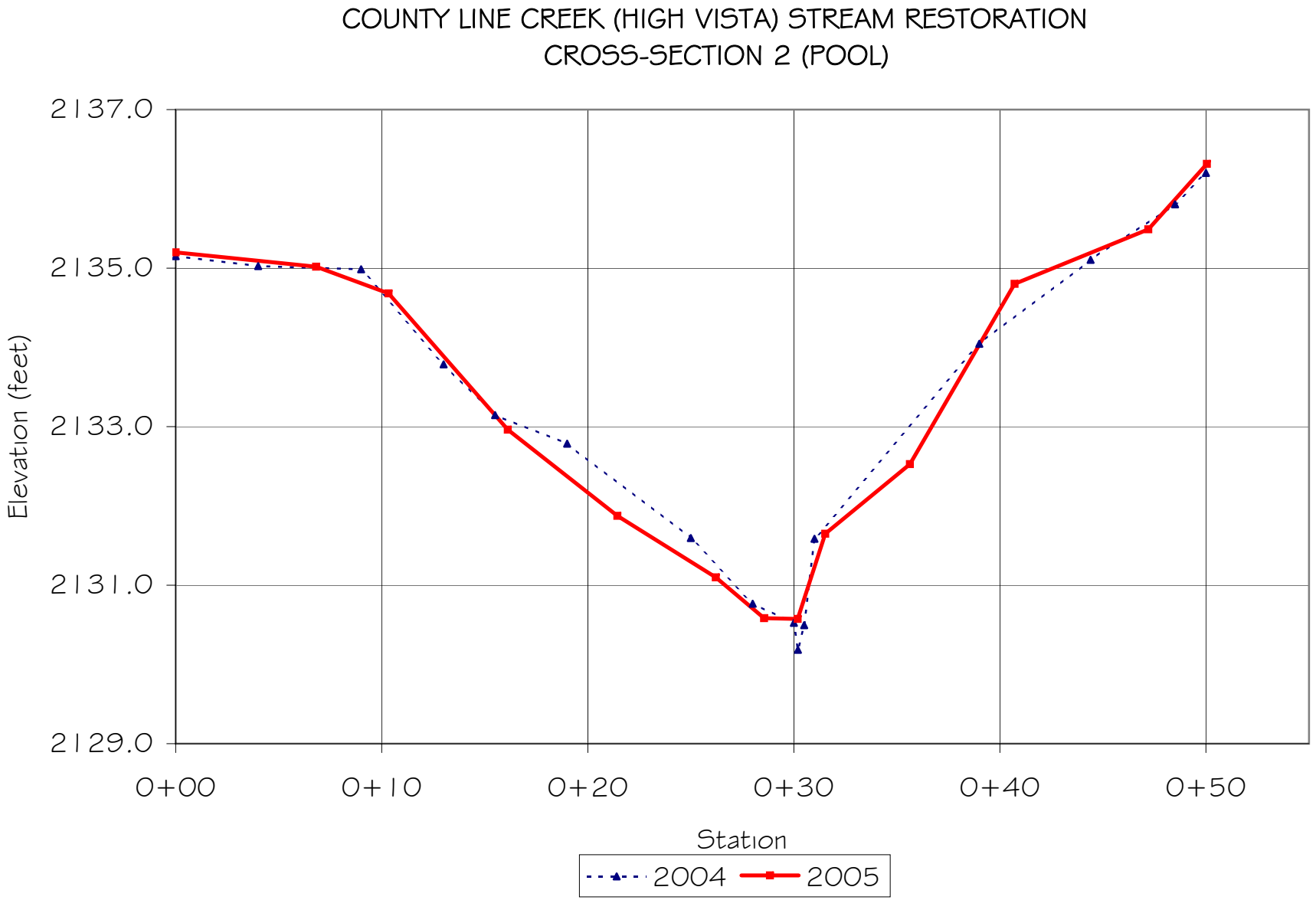
TAPE	FS	ELEV	NOTE
0	0	2139	
3.86	0	2139.01	
10.37	0	2139.02	
16.91	0	2137.94	
21.06	0	2137.11	
27.25	0	2137.11	
27.77	0	2136.15	
28.94	0	2136.09	
29.99	0	2136.28	
30.27	0	2136.87	
33.96	0	2137.02	
37.68	0	2138.63	
42.85	0	2140.3	
49.7	0	2142.21	

Cross Sectional Geometry

Floodprone	Elevation	(ft)	2139.01
Bankfull	Elevation	(ft)	2137.55
Floodprone	Width	(ft)	32.29
Bankfull	Width	(ft)	16.32
Entrenchm	Ratio		1.98
Mean	Depth	(ft)	0.59
Maximum	Depth	(ft)	1.46
Width/Dept	Ratio		27.7
Bankfull	Area	(sq	9.62
Wetted	Perimeter	(ft)	17.44
Hydraulic	Radius	(ft)	0.55
Begin	BKF	Station	18.86
End	BKF	Station	35.18

Cross-section 1—Year 2 (2004)

Cross-section 1—Year 3 (2005)


COUNTY LINE CREEK (HIGH VISTA) STREAM RESTORATION
CROSS-SECTION 2 (POOL)
2137.0
2135.0
2133.0
2131.0
2129.0
Elevation (feet)
0+00
0+10
0+20
0+30
0+40
0+50
Station
2004
2005

RIVERMOI CROSS SECTION SUMMARY

River Name: High Vista
Reach Name: 2005
Cross Section Name: XS2
Survey Date: 1/5/2006

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

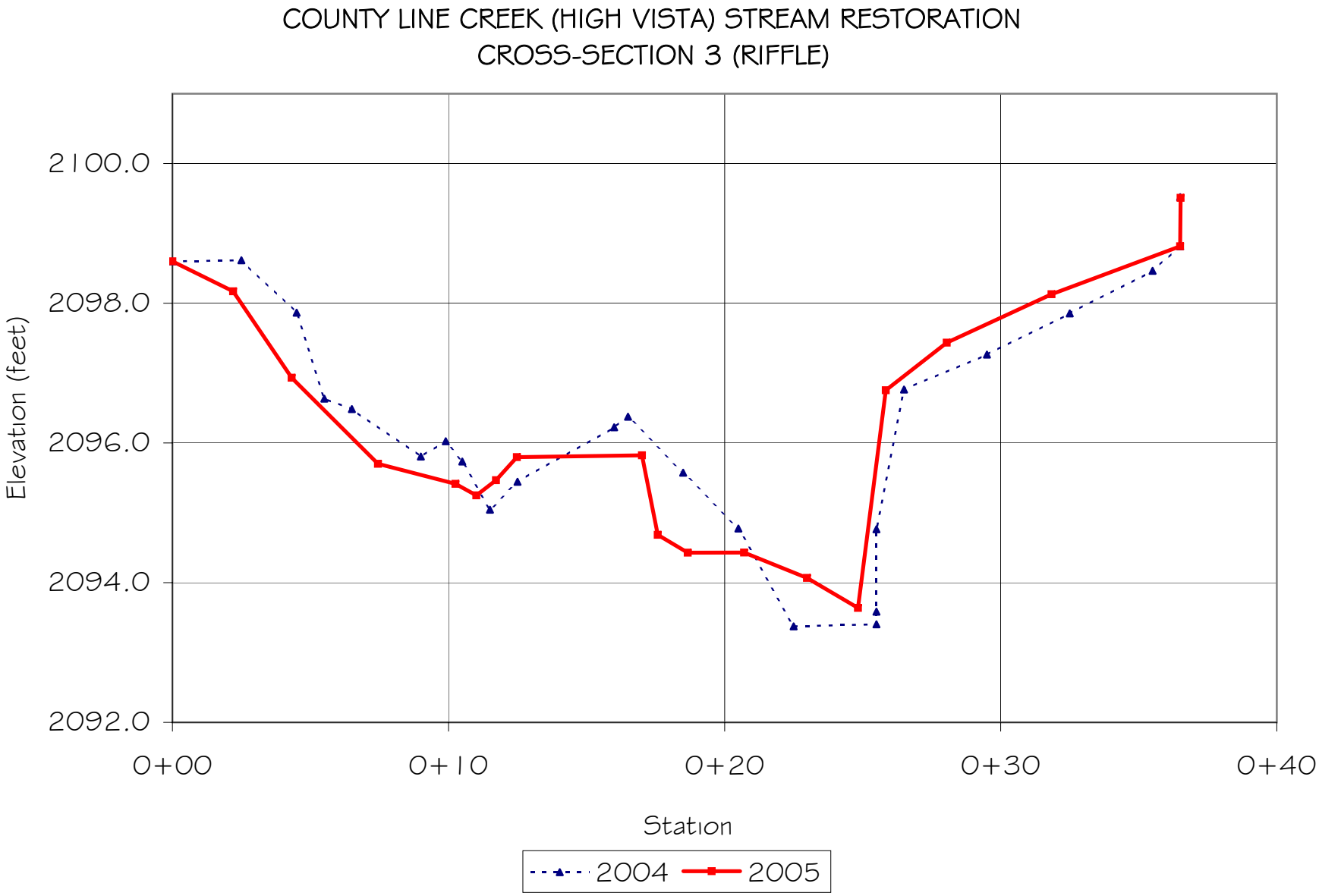
TAPE	FS	ELEV	NOTE
0	0	2135.2	
6.82	0	2135.02	
10.33	0	2134.68	
16.12	0	2132.96	
21.44	0	2131.87	
26.21	0	2131.1	
28.56	0	2130.58	
30.19	0	2130.57	
31.53	0	2131.65	
35.64	0	2132.53	
40.71	0	2134.8	
47.2	0	2135.49	
50.05	0	2136.31	

Cross Sectional Geometry

Floodprone	Elevation	(ft)	2133.85
Bankfull	Elevation	(ft)	2132.21
Floodprone	Width	(ft)	25.46
Bankfull	Width	(ft)	14.36
Entrenchm	Ratio		1.77
Mean	Depth	(ft)	0.82
Maximum	Depth	(ft)	1.64
Width/Dept	Ratio		17.44
Bankfull	Area	(sq	11.83
Wetted	Perimeter	(ft)	14.96
Hydraulic	Radius	(ft)	0.79
Begin	BKF	Station	19.78
End	BKF	Station	34.15

Cross-section 2—Year 2 (2004)

Cross-section 2—Year 3 (2005)


COUNTY LINE CREEK (HIGH VISTA) STREAM RESTORATION
CROSS-SECTION 3 (RIFFLE)
2100.0
2098.0
2096.0
2094.0
2092.0
Elevation (feet)
0+00
0+10
0+20
0+30
0+40
Station
2004
2005

RIVERMOI CROSS SECTION SUMMARY

River Name: High Vista
Reach Name: 2005
Cross Section Name: XS3
Survey Date: 1/5/2006

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	2098.6	
2.2	0	2098.17	
4.32	0	2096.93	
7.45	0	2095.7	
10.25	0	2095.42	
11.01	0	2095.25	
11.72	0	2095.47	
12.48	0	2095.8	
17.01	0	2095.82	
17.58	0	2094.68	
18.67	0	2094.43	
20.7	0	2094.43	
22.98	0	2094.07	
24.83	0	2093.64	
25.84	0	2096.76	
28.04	0	2097.44	
31.84	0	2098.13	
36.5	0	2098.82	
36.51	0	2099.51	

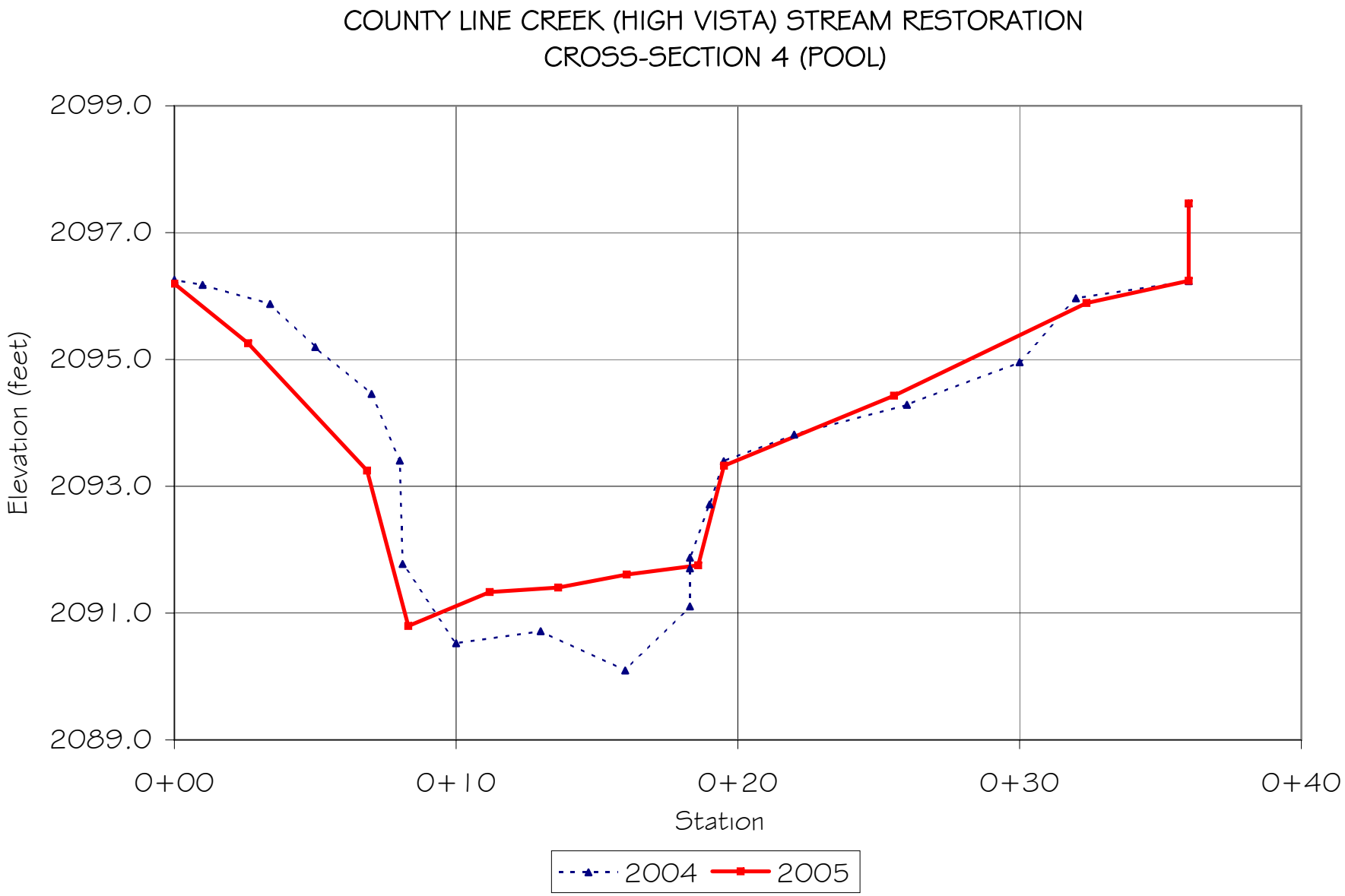
Cross Sectional Geometry

Floodprone	Elevation	(ft)	2097.26
Bankfull	Elevation	(ft)	2095.45
Floodprone	Width	(ft)	23.7
Bankfull	Width	(ft)	9.93
Entrenchm	Ratio		2.39
Mean	Depth	(ft)	0.96
Maximum	Depth	(ft)	1.81
Width/Dept	Ratio		10.3

Bankfull	Area	(sq	9.57
Wetted	Perimeter	(ft)	11.88
Hydraulic	Radius	(ft)	0.81
Begin	BKF	Station	9.95
End	BKF	Station	25.42

Cross-section 3—Year 2 (2004)

Cross-section 3—Year 3 (2005)


COUNTY LINE CREEK (HIGH VISTA) STREAM RESTORATION
CROSS-SECTION 4 (POOL)
2099.0
2097.0
2095.0
2093.0
2091.0
2089.0
Elevation (feet)
0+00
0+10
0+20
0+30
0+40
Station
2004
2005

RIVERMOI CROSS SECTION SUMMARY

River Name: High Vista
Reach Name: 2005
Cross Section Name: XS4
Survey Date: 1/5/2006

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	2096.2	
2.62	0	2095.26	
6.84	0	2093.25	
8.3	0	2090.8	
11.19	0	2091.33	
13.62	0	2091.4	
16.05	0	2091.61	
18.59	0	2091.75	
19.51	0	2093.33	
25.54	0	2094.43	
32.37	0	2095.89	
36	0	2096.24	
36	0	2097.46	

Cross Sectional Geometry

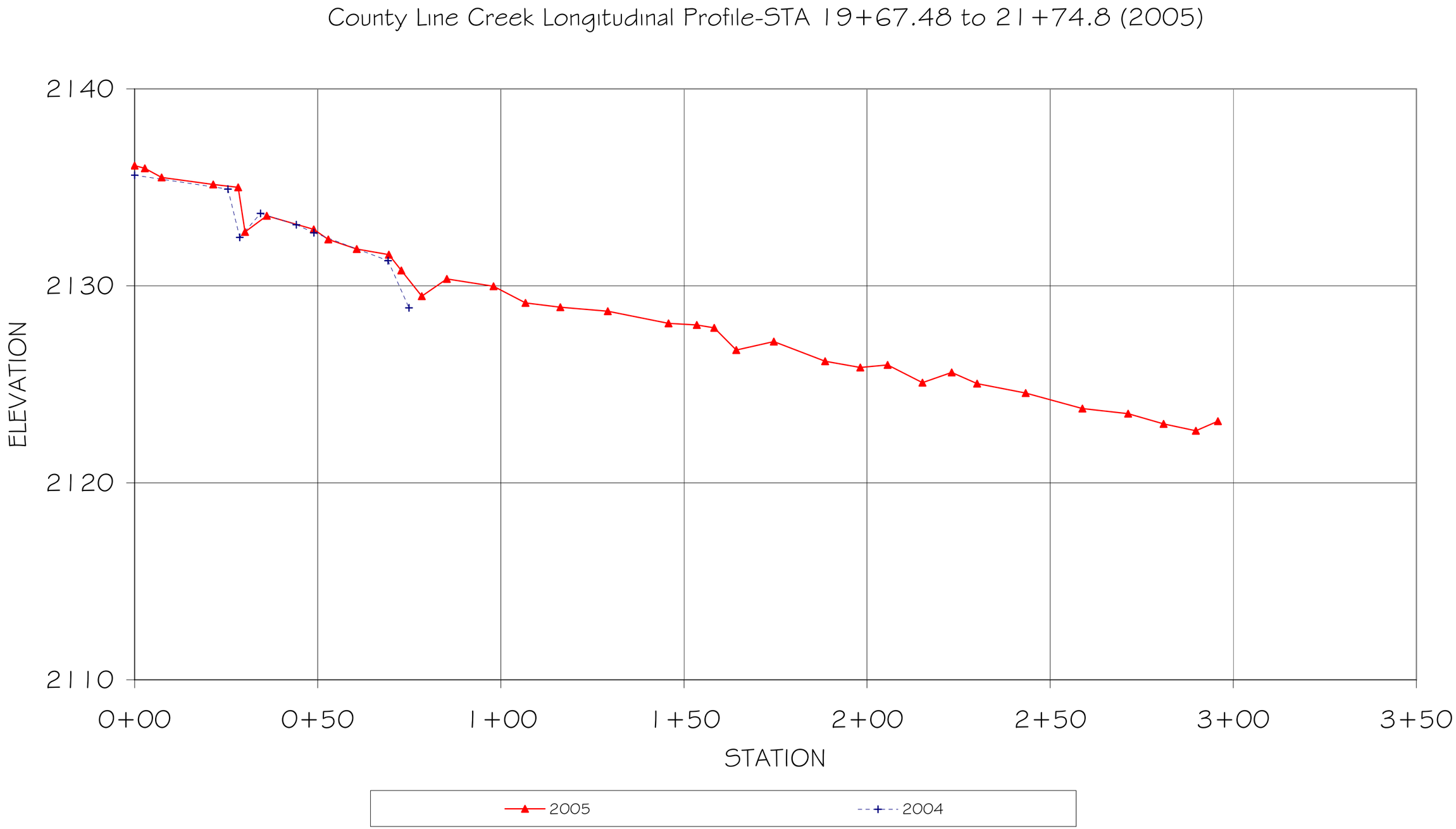
Floodprone	Elevation	(ft)	2094
Bankfull	Elevation	(ft)	2092.4
Floodprone	Width	(ft)	17.92
Bankfull	Width	(ft)	11.62
Entrenchm	Ratio		1.54
Mean	Depth	(ft)	0.97
Maximum	Depth	(ft)	1.6
Width/Dept	Ratio		11.99
Bankfull	Area	(sq	11.26
Wetted	Perimeter	(ft)	12.97
Hydraulic	Radius	(ft)	0.87
Begin	BKF	Station	7.35
End	BKF	Station	18.97

Cross-section 4—Year 2 (2004)

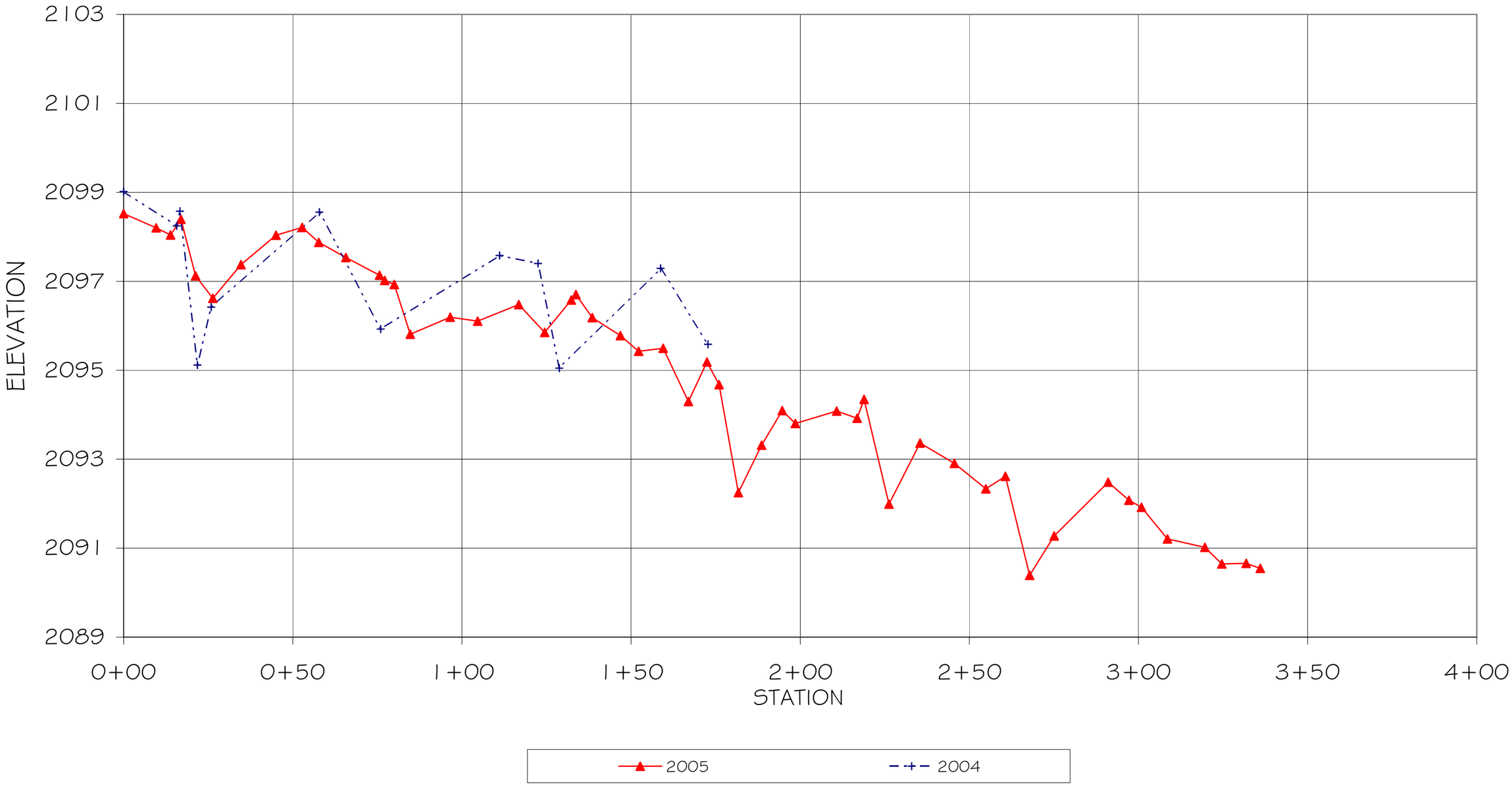
Cross-section 4—Year 3 (2005)

APPENDIX B –

Longitudinal Profile


County Line Creek Longitudinal Profile-STA 19+67.48 to 21+74.8 (2005)
2140
2130
2120
2110
ELEVATION
0+00
0+50
1+00
1+50
2+00
2+50
3+00
3+50
STATION
2005
2004

County Line Creek Longitudinal Profile-STA 32+44 to 35+18.6 (2005)



2005 Data

Reach 1 (XSs 3&4)

Point	Northing	Easting	Elevation	Comment	Distance	Station		Use this column	Adjusted elevation (-0.42 from elevation given)	NC StateStation	NC State Cross-Vane Elevation	
118	295813.4	1088855.2	2098.315	tw	0.00	0.00	31+98.5	32+44.0	2097.8948			
119	295818.4	1088858	2097.928	tw	5.69	0+05.7	32+04.2	32+49.7	2097.5076			
120	295821.3	1088861.6	2097.789	tw	4.72	0+10.4	32+08.9	32+54.4	2097.3693			
121	295822.5	1088863.3	2097.656	tw	2.07	0+12.5	32+11.0	32+56.5	2097.2357			
122	295824.3	1088866	2097.38	struct	3.19	0+15.7	32+14.2	32+59.7	2096.9601	32+60.0	2097.4	
123	295825.9	1088868	2096.565	struct	2.55	0+18.2	32+16.7	32+62.2	2096.1454			
124	295828.3	1088871.5	2096.226	tw	4.31	0+22.5	32+21.0	32+66.5	2095.8063			
125	295834.1	1088877.1	2095.834	tw	7.99	0+30.5	32+29.0	32+74.5	2095.4144			
126	295838.2	1088884.5	2097.039	tw	8.52	0+39.1	32+37.6	32+83.1	2096.6186			
127	295843.9	1088889.6	2096.828	tw	7.60	0+46.7	32+45.2	32+90.7	2096.4076			
129	295849.8	1088896.2	2096.922	tw	8.85	0+55.5	32+54.0	32+99.5	2096.5017			
131	295855.9	1088898.9	2096.417	tw	6.69	0+62.2	32+60.7	33+06.2	2095.9971			
132	295861.6	1088905.7	2096.868	tw	8.91	0+71.1	32+69.6	33+15.1	2096.448			
133	295867.8	1088908.4	2096.717	tw	6.78	0+77.9	32+76.4	33+21.9	2096.2965			
134	295871.2	1088909.1	2096.499	tw	3.42	0+81.3	32+79.8	33+25.3	2096.0792			
135	295876.6	1088908.9	2096.19	tw	5.45	0+86.8	32+85.3	33+30.8	2095.7702			
136	295881.9	1088907.1	2095.802	tw	5.59	0+92.3	32+90.8	33+36.3	2095.3819			
137	295885.5	1088905.3	2095.966	tw	3.97	0+96.3	32+94.8	33+40.3	2095.5456			
140	295894.2	1088905.4	2095.115	tw	8.71	1+05.0	33+03.5	33+49.0	2094.695			
141	295898.9	1088908	2095.451	struct	5.40	1+10.4	33+08.9	33+54.4	2095.0307	33+51.0	2095.83	3.40
142	295903.4	1088908.5	2093.824	struct	4.49	1+14.9	33+13.4	33+58.9	2093.4038			
143	295915.7	1088910.5	2093.529	tw	12.51	1+27.4	33+25.9	33+71.4	2093.1091			
144	295920.7	1088910.3	2094.497	tw	4.97	1+32.4	33+30.9	33+76.4	2094.0773			
145	295930.9	1088917.9	2094.575	tw	12.72	1+45.1	33+43.6	33+89.1	2094.1548			
146	295937.8	1088923.3	2094.526	struct	8.80	1+53.9	33+52.4	33+97.9	2094.1058	33+97.0	2094.41	0.30
147	295939.6	1088925.5	2092.612	struct	2.85	1+56.8	33+55.3	34+00.8	2092.1916			
148	295944.7	1088931.8	2092.55	tw	8.11	1+64.9	33+63.4	34+08.9	2092.1302			
150	295949.6	1088933.9	2093.597	tw	5.30	1+70.2	33+68.7	34+14.2	2093.1767			
151	295962.1	1088940.5	2093.248	tw	14.14	1+84.3	33+82.8	34+28.3	2092.8281			
152	295973	1088944.8	2092.647	struct	11.78	1+96.1	33+94.6	34+40.1	2092.2272			
153	295976.8	1088946.3	2091.616	struct	4.00	2+00.1	33+98.6	34+44.1	2091.1958			
154	295986.3	1088951.6	2091.386	tw	10.96	2+11.1	34+09.6	34+55.1	2090.9656			
155	295990.4	1088954.5	2092.278	tw	5.00	2+16.1	34+14.6	34+60.1	2091.8576			
156	296001.7	1088959.5	2092.98	tw	12.37	2+28.4	34+26.9	34+72.4	2092.56			
157	296006.7	1088959.8	2092.857	struct	4.99	2+33.4	34+31.9	34+77.4	2092.4374	34+76.0	2093.3	0.86
158	296013	1088961	2091.57	struct	6.41	2+39.8	34+38.3	34+83.8	2091.1496			
159	296019.2	1088965.6	2091.545	tw	7.70	2+47.5	34+46.0	34+91.5	2091.1246			
160	296027.1	1088961	2091.467	tw	9.14	2+56.7	34+55.2	35+00.7	2091.0466			
161	296044.3	1088956.3	2090.86	tw	17.90	2+74.6	34+73.1	35+18.6	2090.4395			

Reach 2 (XS 1&2)

Point	Northing	Easting	Elevation	Comment	Distance	Station						
189	1088632	294760.43	2136.045	tw	0.00	0.00	19+45.0	19+67.5	2135.6251			
190	1088624	294763.04	2136.634	tw	8.34	0+08.3	19+53.3	19+75.8	2136.214			
191	1088620	294766.7	2135.992	tw	5.71	0+14.1	19+59.1	19+81.6	2135.5719			
192	1088616	294773.07	2135.497	tw	7.28	0+21.3	19+66.3	19+88.8	2135.077			
193	1088613	294780.43	2135.424	struct	7.79	0+29.1	19+74.1	19+96.6	2135.0044	19+95.0	2134.92	
194	1088614	294786.64	2133.511	struct	6.21	0+35.3	19+80.3	20+02.8	2133.091			
195	1088616	294792.72	2133.816	tw	6.60	0+41.9	19+86.9	20+09.4	2133.3957			
196	1088621	294801.25	2133.388	tw	9.74	0+51.7	19+96.7	20+19.2	2132.9681			
197	1088621	294806.84	2132.968	tw	5.62	0+57.3	20+02.3	20+24.8	2132.5475			
198	1088622	294812.03	2131.894	tw	5.24	0+62.5	20+07.5	20+30.0	2131.474			

199	1088620	294815.51	2131.963	tw	4.15	0+66.7	20+11.7	20+34.2	2131.5428			
200	1088615	294819	2132.288	tw	6.17	0+72.9	20+17.9	20+40.4	2131.8678			
201	1088611	294824.64	2132.1	struct	6.57	0+79.4	20+24.4	20+46.9	2131.6798	20+41.0	2132.33	
202	1088611	294826.64	2129.902	struct	2.07	0+81.5	20+26.5	20+49.0	2129.4824			
203	1088608	294831	2129.196	tw	5.29	0+86.8	20+31.8	20+54.3	2128.7755			
204	1088603	294834.69	2130.233	tw	5.81	0+92.6	20+37.6	20+60.1	2129.8128			
205	1088597	294843.76	2130.78	tw	10.95	1+03.6	20+48.6	20+71.1	2130.3597			
206	1088596	294845.64	2130.311	tw	2.29	1+05.8	20+50.8	20+73.3	2129.8906			
220	1088599	294852.48	2129.568	tw	7.38	1+13.2	20+58.2	20+80.7	2129.1476			
221	1088601	294861.49	2128.915	tw	9.18	1+22.4	20+67.4	20+89.9	2128.4946			
222	1088604	294874.71	2128.959	tw	13.74	1+36.1	20+81.1	21+03.6	2128.539			
224	1088614	294887.53	2128.239	tw	15.81	1+52.0	20+97.0	21+19.5	2127.8185			
225	1088621	294895.53	2128.299	tw	10.79	1+62.7	21+07.7	21+30.2	2127.8789			
226	1088623	294900.31	2127.705	tw	5.26	1+68.0	21+13.0	21+35.5	2127.2849			
227	1088622	294907.12	2127.058	tw	6.84	1+74.8	21+19.8	21+42.3	2126.6384			
228	1088619	294911.86	2127.627	tw	6.05	1+80.9	21+25.9	21+48.4	2127.2073			
229	1088615	294916.19	2127.062	tw	5.43	1+86.3	21+31.3	21+53.8	2126.642			
230	1088609	294925.98	2126.362	tw	11.44	1+97.8	21+42.8	21+65.3	2125.9415			
231	1088606	294934.91	2126.122	tw	9.58	2+07.3	21+52.3	21+74.8	2125.7016			

New pts TW

Reach 1 (XSs 3&4)

Point	Northing	Easting	Elevation	Comment	Distance	Station
7055	632030.3	934125.43	2136.105	tw	0.00	0.00
7054	632027.5	934125.1	2135.966	tw	2.79	0+02.8
7056	632023	934125.29	2135.504	tw	4.57	0+07.4
7057	632010.2	934131.29	2135.145	tw	14.11	0+21.5
7058	632006.9	934137.25	2135.002	tw@str	6.80	0+28.3
7059	632005.9	934138.89	2132.736	tw	1.90	0+30.2
7060	632004.8	934144.69	2133.556	tw	5.92	0+36.1
7061	632000.3	934156.73	2132.867	tw	12.84	0+48.9
7062	631997.5	934159.54	2132.359	STR	3.97	0+52.9
7063	631990.4	934162.54	2131.873	tw	7.74	0+60.6
7064	631981.8	934164.28	2131.583	tw	8.79	0+69.4
7065	631978.9	934166.09	2130.786	tw@str	3.41	0+72.8
7066	631973.4	934167.35	2129.472	tw	5.58	0+78.4
7067	631966.6	934167.38	2130.356	tw	6.85	0+85.3
7068	631954.6	934171.64	2129.98	tw	12.75	0+98.0
7069	631952.6	934180.13	2129.134	tw	8.70	1+06.7
7070	631948.7	934188.81	2128.912	tw	9.53	1+16.2
7071	631943.8	934200.79	2128.714	tw	12.96	1+29.2
7072	631942.4	934217.31	2128.096	tw	16.58	1+45.8
7073	631942.3	934225.02	2128.014	tw	7.70	1+53.5
7074	631941.7	934229.75	2127.866	tw@str	4.77	1+58.3
7075	631937.7	934234.29	2126.745	tw	6.04	1+64.3
7076	631927.9	934237.3	2127.173	tw	10.25	1+74.6
7077	631914.6	934241.54	2126.175	tw	13.98	1+88.5
7078	631906.1	934246.03	2125.855	tw	9.62	1+98.2
7079	631898.9	934247.96	2125.987	tw	7.46	2+05.6
7080	631889.7	934250.43	2125.083	tw	9.51	2+15.1
7081	631882.3	934253.56	2125.603	tw	7.99	2+23.1
7082	631875.5	934254.66	2125.04	tw	6.95	2+30.1
7083	631863	934250.29	2124.562	tw	13.24	2+43.3
7084	631847.9	934246.78	2123.772	tw	15.49	2+58.8
7085	631835.4	934247.49	2123.513	tw	12.49	2+71.3
7086	631825.8	934248.68	2122.994	tw	9.70	2+81.0

Reach 1 (XSs 3&4)

Point	Northing	Easting	Elevation	Comment	Distance	Station
1677	632030.6251	934126.2785	2135.6196	T	0.00	0.00
1681	632006.7927	934135.2492	2134.9158	RV	25.46	0+25.5
1684	632006.2996	934138.4754	2132.4594	MP	3.26	0+28.7
1686	632005.1971	934144.0312	2133.6751	R	5.66	0+34.4
1690	632001.9052	934153.216	2133.1001	T	9.76	0+44.1
1693	632000.1778	934157.6893	2132.6981	T	4.80	0+48.9
1698	631981.3936	934165.2838	2131.2802	T	20.26	0+69.2
1701	631976.0459	934167.3196	2128.8844	MP	5.72	0+74.9
1707	631987.4953	934162.5214	2132.7886	R	12.41	0+87.3
1719	631961.1423	934168.5366	2130.0407	T	27.03	1+14.4
1724	631953.0291	934176.9107	2132.0595	T	11.66	1+26.0
1726	631967.5096	934168.6939	2130.577	R	16.65	1+42.7
1730	631949.1523	934187.0405	2128.483	T	25.95	1+68.6
1732	631943.3123	934206.8738	2128.2698	T	20.68	1+89.3
1738	631944.1752	934202.1383	2128.3589	T	4.81	1+94.1
1741	631942.591	934214.5657	2129.0261	T	12.53	2+06.7
1744	631941.6537	934216.1556	2128.0513	R	1.85	2+08.5
1748	631939.9028	934232.5545	2126.9609	P	16.49	2+25.0
1751	631936.3205	934234.861	2126.403	M	4.26	2+29.3
1753	631931.5229	934236.6773	2127.0747	R	5.13	2+34.4
1755	631920.1814	934238.8449	2126.4931	T	11.55	2+45.9
1760	631911.7374	934243.6859	2125.9721	T	9.73	2+55.7
1764	631908.6784	934245.3905	2125.4439	T	3.50	2+59.2
1768	631898.5974	934247.5058	2126.3145	T	10.30	2+69.5
1771	631893.2644	934249.4132	2125.8016	T	5.66	2+75.1
1775	631882.7223	934253.1618	2125.2811	T	11.19	2+86.3
1777	631875.225	934254.2258	2124.9481	T	7.57	2+93.9
1780	631872.0927	934254.9838	2125.351	R	3.22	2+97.1
1784	631855.0144	934247.8886	2124.1549	T	18.49	3+15.6
1793	631838.5006	934247.5674	2123.8886	R	16.52	3+32.1
1797	631828.7097	934247.811	2123.2949	T	9.79	3+41.9
1798	631821.526	934251.8333	2125.1271	T	8.23	3+50.1
1802	631814.4029	934255.4301	2123.428	RV	7.98	3+58.1

7087	631817.3	934251.11	2122.64	tw	8.81	2+89.8
7088	631813.3	934255.61	2123.128	tw@cv	6.00	2+95.8

Reach 2 (XSs 1&2)

Point	Northing	Easting	Elevation	Comment	Distance	Station
7042	631561.3	935025.23	2098.521	tw	0.00	0.00
7043	631558.4	935034.4	2098.201	tw	9.62	0+09.6
7044	631557	935038.42	2098.041	tw	4.26	0+13.9
7045	631555.8	935041.28	2098.394	tw@str	3.07	0+16.9
7046	631555.1	935045.52	2097.122	tw	4.31	0+21.3
7047	631554.1	935050.54	2096.618	tw	5.12	0+26.4
7048	631551.1	935058.3	2097.374	tw	8.32	0+34.7
7049	631547.6	935068.07	2098.035	tw	10.35	0+45.1
7050	631541.8	935073.15	2098.211	tw	7.73	0+52.8
7051	631540	935077.71	2097.875	tw	4.91	0+57.7
7000	631536.9	935085.11	2097.535	tw	8.01	0+65.7
7001	631538.5	935094.91	2097.136	tw	9.95	0+75.7
7002	631538.9	935096.41	2097.019	tw	1.52	0+77.2
7003	631539.8	935099.07	2096.928	tw@str	2.84	0+80.0
7004	631540.4	935103.77	2095.81	tw	4.73	0+84.7
7005	631541	935115.54	2096.192	tw	11.80	0+96.5
7007	631541.7	935123.62	2096.105	tw	8.11	1+04.6
7008	631545.9	935135.05	2096.477	tw	12.17	1+16.8
7009	631544.3	935142.52	2095.851	tw	7.65	1+24.5
7010	631545	935150.35	2096.579	tw	7.86	1+32.3
7011	631544.6	935151.65	2096.703	tw@str	1.37	1+33.7
7012	631544.3	935156.46	2096.183	tw@str	4.82	1+38.5
7013	631540.3	935163.75	2095.78	tw	8.33	1+46.8
7014	631535.3	935165.86	2095.427	tw	5.41	1+52.3
7015	631529.3	935169.96	2095.495	tw	7.24	1+59.5
7016	631524.4	935175.56	2094.297	tw	7.46	1+67.0
7017	631523.8	935180.99	2095.185	tw	5.47	1+72.4
7018	631521.6	935183.85	2094.676	tw@str	3.59	1+76.0
7019	631517.9	935188.21	2092.248	tw	5.71	1+81.7
7020	631513.6	935193.53	2093.316	tw	6.86	1+88.6
7021	631510.2	935198.59	2094.093	tw@x3	6.10	1+94.7
7022	631509.6	935202.42	2093.803	tw	3.89	1+98.6
7023	631509.8	935214.63	2094.082	tw	12.21	2+10.8
7024	631510.2	935220.68	2093.922	tw	6.06	2+16.8
7025	631511	935222.54	2094.345	tw@str	2.03	2+18.9
7026	631511	935229.92	2091.991	tw	7.38	2+26.2
7027	631510.1	935239.05	2093.362	tw	9.17	2+35.4
7028	631508.5	935249.07	2092.907	tw	10.15	2+45.6
7029	631505.8	935257.99	2092.334	tw	9.32	2+54.9
7030	631505.2	935263.71	2092.616	tw@str	5.76	2+60.6
7031	631502.3	935270.31	2090.389	tw	7.19	2+67.8
7032	631500.7	935277.35	2091.275	tw	7.23	2+75.1
7034	631496.2	935292.7	2092.484	tw	15.98	2+91.0
7035	631492	935297.2	2092.077	tw	6.13	2+97.2
7036	631490.9	935300.7	2091.919	tw	3.70	3+00.9
7037	631490.6	935308.4	2091.208	tw	7.70	3+08.6
7038	631481.5	935314.66	2091.02	tw	11.06	3+19.6
7039	631477.1	935317.06	2090.645	tw	5.01	3+24.6
7040	631471	935320.84	2090.659	tw	7.19	3+31.8
7041	631467.9	935323.57	2090.546	tw	4.17	3+36.0

Reach 2 (XSs 1&2)

Point	Northing	Easting	Elevation	Comment	Distance	Station
2082	631559.8706	935024.6307	2099.0182	T	0.00	0.00
2086	631555.6027	935039.7439	2098.245	T	15.70	0+15.7
2090	631556.033	935040.6007	2098.5761	RV	0.96	0+16.7
2096	631554.8589	935045.6009	2095.1157	M	5.14	0+21.8
2098	631557.2593	935042.2967	2096.4175	P	4.08	0+25.9
2100	631541.8322	935070.3097	2098.5546	R	31.98	0+57.9
2103	631549.481	935053.8763	2095.9251	T	18.13	0+76.0
2107	631537.4456	935086.8802	2097.5797	T	35.13	1+11.1
2111	631538.5945	935098.2078	2097.4011	RV	11.39	1+22.5
2113	631542.0223	935103.4713	2095.0482	M	6.28	1+28.8
2120	631546.6423	935133.0494	2097.2912	R	29.94	1+58.7
2122	631542.7218	935119.5698	2095.5838	T	14.04	1+72.8
2129	631547.601	935146.4448	2096.6001	T	27.31	2+00.1
2133	631543.5309	935156.6635	2095.6667	T	11.00	2+11.1
2135	631539.8628	935161.311	2095.7001	T	5.92	2+17.0
2139	631535.1655	935165.8355	2095.8313	T	6.52	2+23.5
2141	631522.9429	935180.3795	2094.9779	T	19.00	2+42.5
2148	631516.7183	935186.612	2092.1481	M	8.81	2+51.3
2171	631510.8135	935222.5304	2094.4135	RV	36.40	2+87.7
2174	631512.3935	935224.5943	2092.7558	T	2.60	2+90.3
2175	631512.3158	935224.4583	2094.0639	T	0.16	2+90.5
2176	631508.7167	935231.8172	2091.2649	M	8.19	2+98.7
2180	631509.3201	935244.0996	2093.015	T	12.30	3+11.0
2184	631503.5384	935260.8597	2093.7087	T	17.73	3+28.7
2187	631501.933	935272.9219	2093.8848	T	12.17	3+40.9
2190	631503.0438	935280.9205	2093.5995	T	8.08	3+48.9
2194	631499.2628	935292.9059	2092.9593	T	12.57	3+67.3
2198	631494.8308	935299.6102	2093.3035	RV	8.04	3+67.3
2205	631494.5653	935302.2038	2090.0276	M	2.61	3+67.3
2218	631482.432	935312.8591	2091.3069	T	16.15	3+67.3
2221	631467.6197	935323.7514	2090.9494	T	18.39	3+67.3

RIVERMOI REACH SUMMARY

River Name: High Vista
Reach Name: 2005

Stream Type	Valley Type	D50(mm)	Val	Slope
b4	0 0	41.71	0.35	

Dimension Summary

Variable			Min	Avg	Max
Floodprone	Width	(ft)	23.7	28	32.29
Riffle	Area	(Sq ft)	9.57	9.6	9.62
Max	Riffle	Depth (ft)	1.46	1.64	1.81
Mean	Riffle	Depth (ft)	0.59	0.78	0.96
Riffle	Width	(ft)	9.93	13.13	16.32
Pool	Area	(Sq ft)	11.26	11.55	11.83
Max	Pool	Depth (ft)	1.6	1.62	1.64
Mean	Pool	Depth (ft)	0.82	0.9	0.97
Pool	Width	(ft)	11.62	12.99	14.36

Pattern Summary

Variable			Min	Avg	Max
Sinuosity				1.18	
Meander	Wavelengt	(ft)	82.53	173.38	463.94
Radius	of	Curvature	23.31	32.99	56.7
Belt	Width	(ft)	38.44	67.73	109.59

Profile Summary

Variable			Min	Avg	Max
S	riffle	(ft/ft)	0.01868	0.02431	0.02739
S	pool	(ft/ft)	0	0.00153	0.00472
S	run	(ft/ft)	0.08249	0.30641	1.01874
S	glide	(ft/ft)	0.02166	0.11	0.21447
P	-	P	12.16	49.29	76.62
P	length	(ft)	8.84	18.34	31.68
Dmax	riffle	(ft)	1.46	1.64	1.81
Dmax	pool	(ft)	1.6	1.62	1.64
Dmax	run	(ft)	0	0	0
Dmax	glide	(ft)	0	0	0
Bankfull	Slope	(ft/ft)		0.02431	

Hydraulic Summary

Variable			Min	Avg	Max
Discharge	(cfs)			41.71	
Velocity	(fps)			4.34	
Hyd	Radius	(ft)	0.55	0.68	0.81
Bkf	Shear	(lb/	0.83	1.03	1.23

RIVERMOI REACH SUMMARY

River Name: High Vista
Reach Name: 2005

Dimension Summary

Variable				Min	Avg	Max
Wfpa	/	Wbkf		1.81	2.13252	2.45925
Pool	Area	/	Abkf	1.17292	1.20313	1.23229
Max	Pool	Depth	/DBKF	2.05128	2.07692	2.10256
Mean	Pool	Depth	/DBKF	1.05128	1.15385	1.24359
Pool	Width	/	Wbkf	0.885	0.98934	1.09368

Pattern Summary

Variable				Min	Avg	Max
Sinuosity					1.18	
Lm	/	W	bkf	6.28561	13.20487	35.33435
Rc	/	W	bkf	1.77532	2.51257	4.31835
Wblt	/	Wbkf	(MWR)	2.92765	5.15842	8.34653

Profile Summary

Variable	Min	Avg	Max					
S	riffle	/	S	bkf	(ft/ft)	0.76841	1	1.1267
S	pool	/	S	bkf	(ft/ft)	0	0.06294	0.19416
S	run	/	S	bkf	(ft/ft)	3.39325	12.60428	41.90621
S	glide	/	S	bkf	(ft/ft)	0.89099	4.52489	8.8223
P	-	P	/	W	bkf	0.92612	3.754	5.83549
P	length	/	W	bkf	(ft)	0.67327	1.3968	2.4128
Dmax	riffle	/	D	bkf	(ft)	1.87179	2.10256	2.32051
Dmax	pool	/	D	bkf	(ft)	2.05128	2.07692	2.10256
Bankfull	Slope	(ft/ft)					0.02431	

Hydraulic Summary

Variable					Min	Avg	Max
Q	bkf					41.71	
V	bkf	(fps)				4.34	
HR	/	D	bkf	(ft)	0.70513	0.87179	1.03846
Bkf	Shear	(lb/	sq	ft)	0.83	1.03	1.23

Table B1. Qualitative Visual Stability Assessment Date:
August 10, 2005 Project # 9445.D1

Feature Category	Metric (per As-built and reference baselines	(# stable) Number performing as intended	Total number per As-built	Total Number / feet in unstable state	% perfor. in stable condition	Feature Perform. Mean or Total
A. Riffles	1. Present?	10	10	NA	100%	
	2. Armor stable (e.g. no displacement)?	8	10	NA	80%	
	3. Facet grade appears stable?	9	10	NA	90%	
	4. Stable interval grade?	9	10	NA	90%	
	5. Feature spacing appropriate?	6	10	NA	60%	
	6. Minimal evidence of embedding/fining?	10	10	NA	100%	
	7. Depth appears appropriate for current discharge?	10	10	NA	N/A	
	8. Length appropriate?	N/A	10	NA	N/A	**87%**
B. Pools	1. Present? (e.g. not subject to severe aggradation?)	10	10	NA	100%	
	2. Suffieciently deep (Max Pool D:Mean Bkf>1.6)	8	10	NA	80%	
	3. Thalweg located outer bend?	10	10	NA	100%	
	4. Spacing appropriate?	6	10	NA	N/A	
	5. Non-aggrading (not filling)?	10	10	NA	100%	
	6. Length appropriate?	N/A	10	NA	N/A	**95%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	10	10	NA	100%	
	2. Downstream of meander (glide/inflection) centering?	10	10	NA	100%	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	18	20	NA	90%	
	2. Of those eroding, # w/ concomitant point bar formation?	14	20	NA	70%	
	3. Apparent Rc within spec?	N/A	20	NA	N/A	
	4. Sufficient floodplain access and relief?	15	20	NA	75%	**78%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	NA	NA	150	96%	
	2. Channel bed degradation - areas of increasing down cutting or head cutting?	NA	NA	1124	68%	**82%**
F. Channel Capac./Dimen	1. Channel width: depth appears out of design/type spec?	NA	NA	N/A	N/A	**N/A**
G. Banks	1. Apparent scour points from channel processes	NA	NA	535.8	85%	
	2. Apparent cut points from overland flow	NA	NA	0	100%	
	3. Apparent cut or scour from flood water re-entry to channel (e.g. inadequate floodplain access?)	NA	NA	0	100%	
	4. Tension cracks	NA	NA	0	100%	
	5. Bank gradient in excess of 40%?	NA	NA	564.89	84%	
	6. Collapse/slumping	NA	NA	412.3	88%	
	7. Ratio of bank height: bankfull height elevated	NA	NA	564.89	84%	**92%**
H. Vanes	1. Free of back or arm scour?	32	36	NA	89%	
	2. Height appropriate?	34	36	NA	94%	
	3. Angle and geometry appear appropriate?	30	36	NA	83%	
	4. Free of piping or other structural failures?	30	36	NA	83%	**88%**
I. Wads/Boulders	1. Free of scour?	11	21	NA	52%	
	2. Footing stable?	11	21	NA	52%	**52%**

Notes: