

County Line Creek (High Vista) Monitoring Report Year 5 of 5 (2008)

Buncombe and Henderson Counties, North Carolina

USGS HUC: 06010105

Project ID No. 00044



Prepared for:



NCDENR-Ecosystem Enhancement Program

1652 Mail Service Center

Raleigh, North Carolina 27699-1652

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Executive Summary

The County Line Stream Restoration project falls within the USGS hydrologic unit **06010105**. The project stream (County Line Creek) lies within a golf course and the watershed includes low to medium density residential areas and forested areas. Prior to restoration work, landowners efforts to modify the channel through channelization and clearing riparian areas had impaired the ecological functions of the creek.

Kimley-Horn and Associates, Inc. (KHA) developed the plans for restoration using natural channel design methods. The original contractor implemented the plans and completed construction of the restored channel in 2002. During the winter of 2007, stream restoration contractors performed maintenance work on the lower 2,100 feet of the stream.

KHA performed vegetative monitoring during the late growing season of 2008. KHA assessed eight (8) vegetation quads. Combined stem counts for these plots equaled over 1,000 stems per acre. Year 5 success criteria require 260 stems per acre. Over the history of the project, landowners adjacent to the riparian buffer have disturbed or destroyed sections of the vegetation. KHA observed the sections of cleared areas in 2006, but did not observe evidence of additional clearings during site visits in 2007 or 2008. KHA was informed that EEP staff engaged the new management of the golf course and certain land owners to restate the easement requirements. Bollards with signage marking the boundary were installed and supplemental containerized plantings were added to any cleared areas in winter 2008 after the vegetation data was collected. Several sections of the riparian buffer lack any woody vegetation. Existing vegetation is dominated by live staking and early colonizers such as Eastern Cottonwood (*Populus deltoides*), Tulip Poplar (*Liriodendron tulipifera*), and Sycamore (*Plantanus occidentalis*). The high stem count is attributed to the abundance of colonizing species. Bare root plantings do not appear to have survived in large numbers. Exotic and invasive vegetation do not appear to be a significant problem.

KHA performed geomorphic assessments and surveys during the fall and winter of 2008. The geomorphic topographic survey included the section between stations 15+00 and 35+00. This section included the three primary longitudinal profiles and their cross sections and sections modified during the repair. Overall, the channel appeared to be stable with isolated areas of bank scour.

Due to the spatial extent of repairs to the channel in 2007, the survey data collected after the repair cannot be directly compared to the pre-repair data through meaningful overlays or trending. However, any post-repair data set will permit meaningful post-repair comparisons and data can be extracted from each of the pre-repair monitoring years individually, which will contribute to various performance/condition statistics for comparison to the pre-construction condition.

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1.0 Project Background

The background information for this report references previous monitoring reports submitted by Kimley-Horn and Associates, Inc., the Biological and Agricultural Engineering Department at North Carolina State University, and Soil and Environmental Consultants, PA.

1.1 Location and Setting

The County Line Creek stream restoration site lies within the USGS HUC **06010105**. The site lies approximately nine miles south of Asheville and nine miles northwest of Hendersonville, NC. The site 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 (See Figure 1).

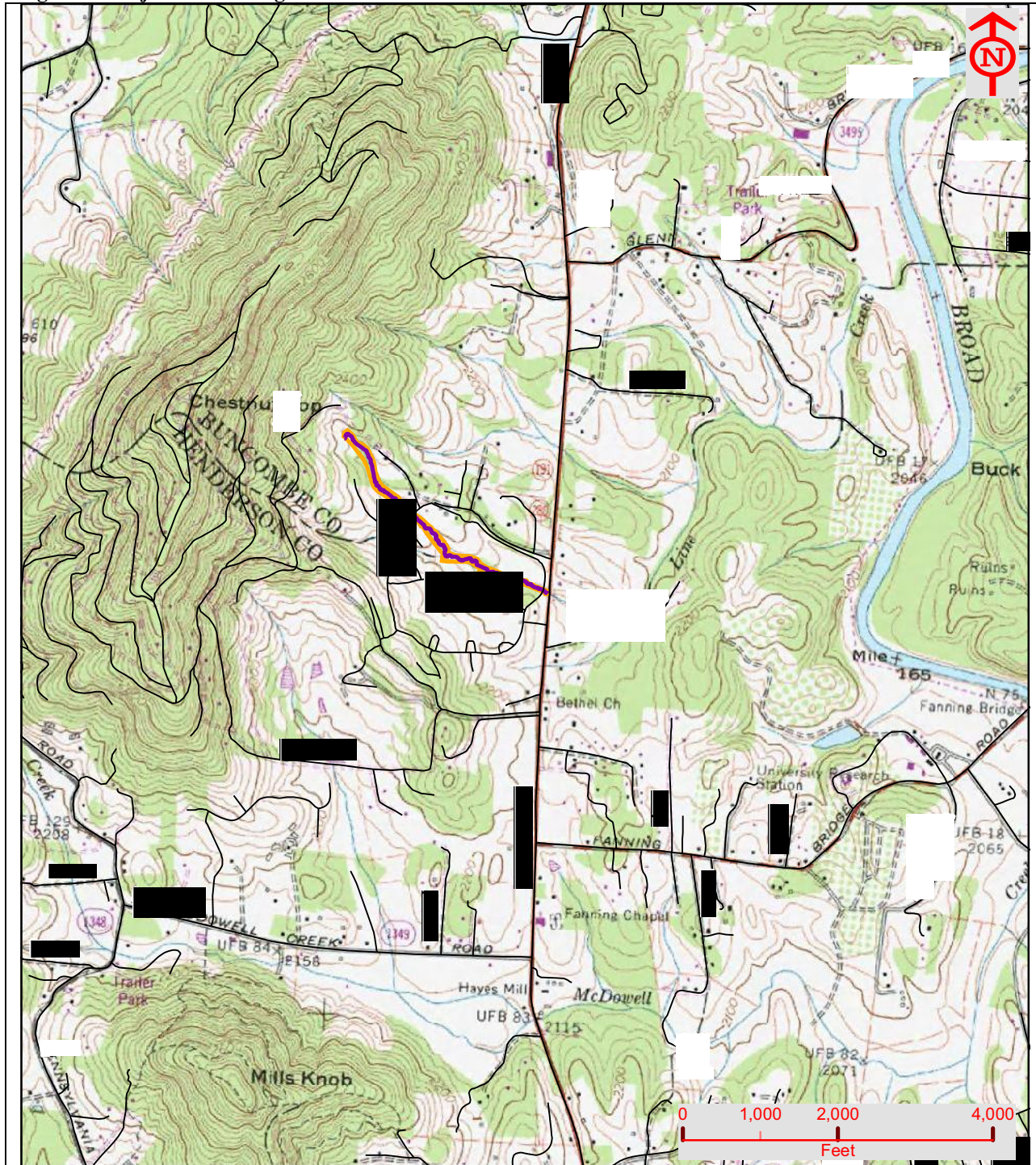
1.2 Project Structure, Mitigation Type, Approach and Objectives



Prior to restoration, the project reach exhibited severe bank erosion, channel widening, and the loss of aquatic habitat resulting from stream channelization, lack of riparian vegetation, and watershed development. The mitigation plan (*County Line Creek Mitigation Plan 2002*) stated the following goals for the project:

- Transform pre-existing altered stream corridor to a more stable and biologically active form
- Create stable stream dimension, profile, and pattern
- Establish adjacent riparian ecological community

As stated in Kimley-Horn's 2001 *County Line Creek High Vista Estates and Golf Course Stream Restoration: Executive Summary of Design* 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". Project Table I provides project mitigation structure and objectives.

Figure 1: Project Site Setting



Prepared For 	Project County Line Creek (High Vista) Stream Restoration Monitoring Year 5 – 2008 Buncombe and Henderson Counties, North Carolina	Prepared By  Kimley-Horn and Associates, Inc.	
		Date 6/1/09	Project Number 044

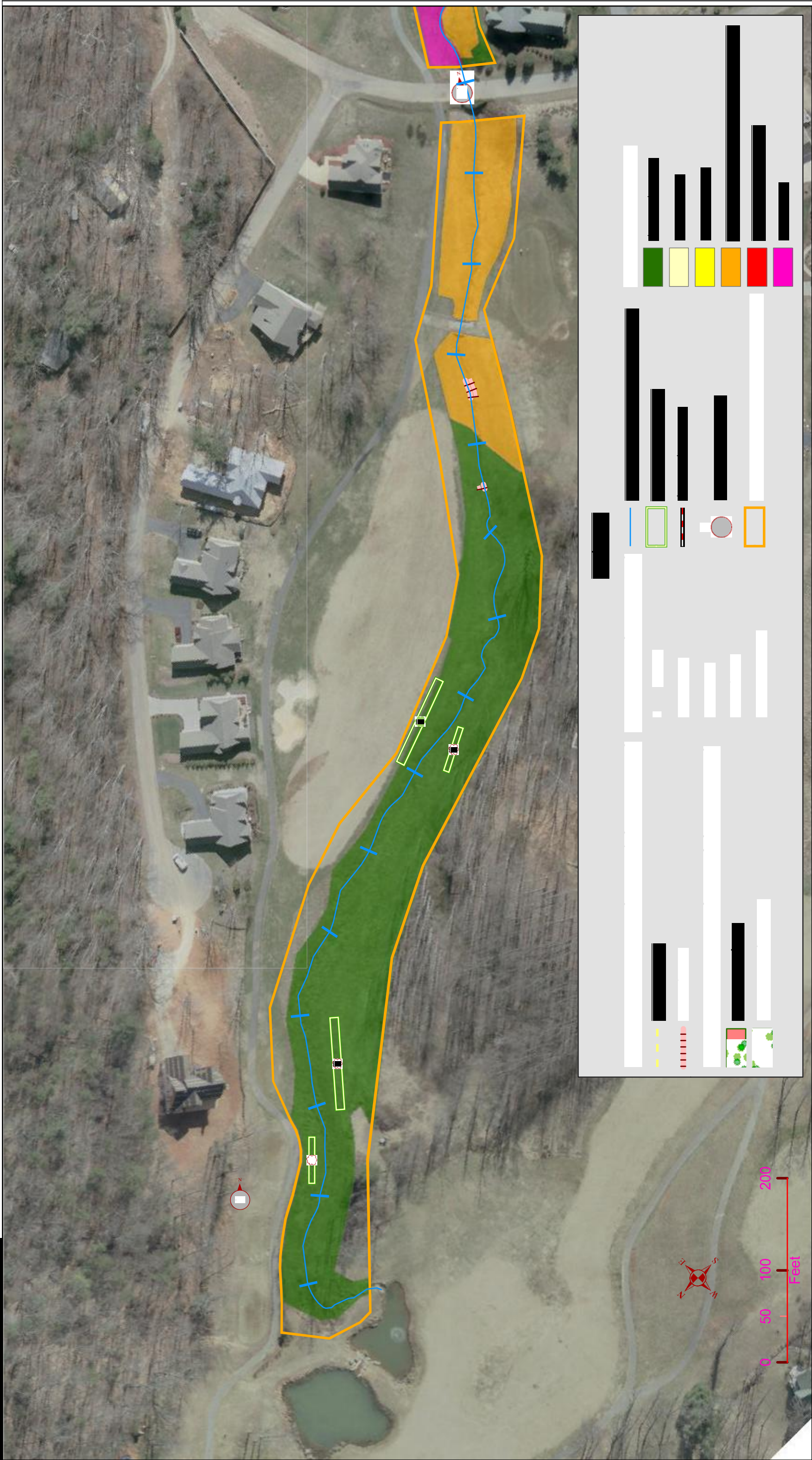
1.3 Project History and Background

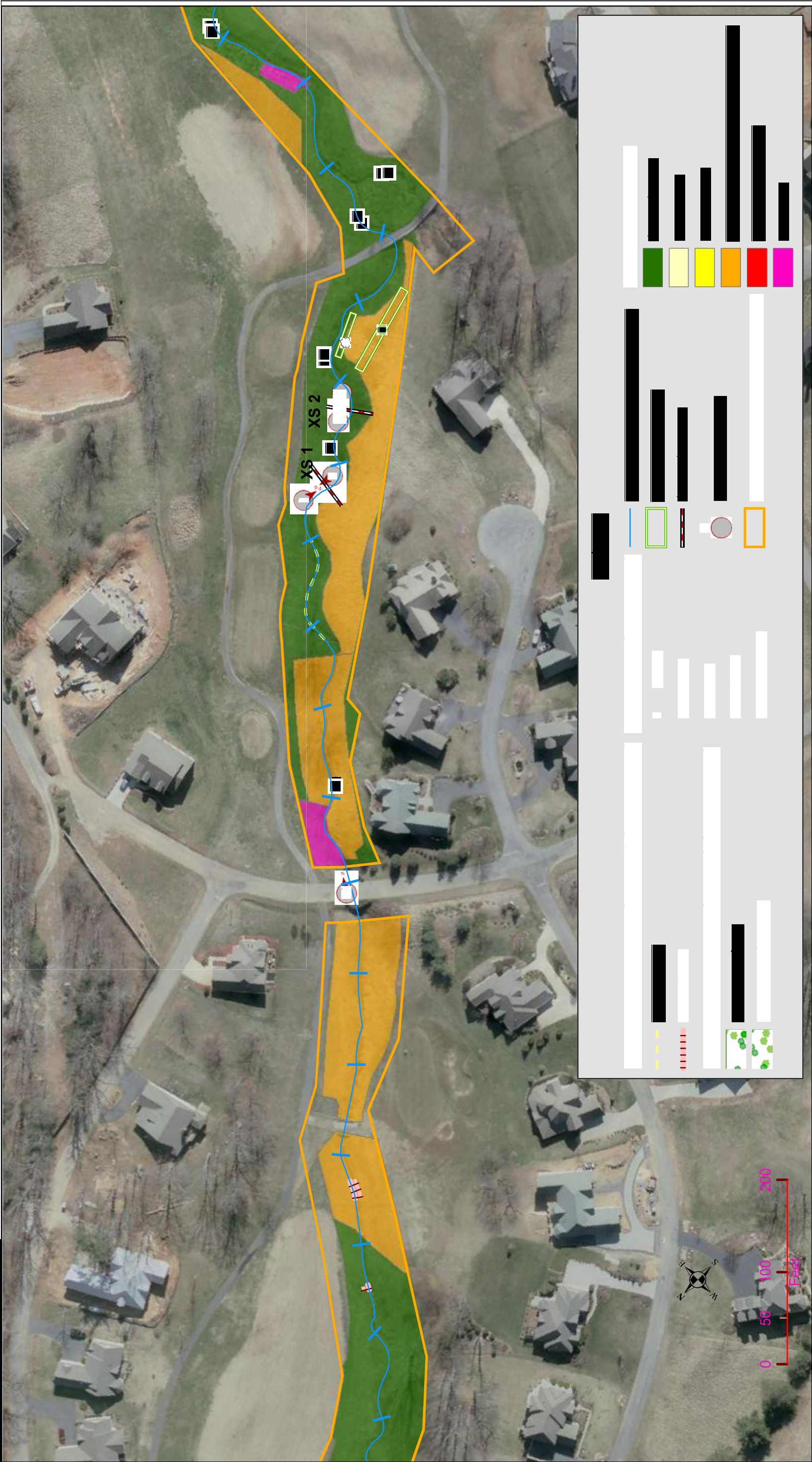
Construction of the project was completed in July 2002. Maintenance construction was completed in 2007. KHA completed monitoring activities for the As-Built and year 1. North Carolina State University completed monitoring for year 2 and Soil and Environmental Consultant, Inc. completed monitoring for year 3. Year 4 monitoring was performed by KHA in 2007. Project Table II provides additional details regarding the timeline of the project. Project Table III provides additional information regarding contractors.

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. Project Table IV provides additional information regarding this stream.

1.4 Monitoring Plan View

The monitoring plan assesses the project stream's geomorphology using a set of five (5) cross sections. The original As-Built included four (4) cross sections. An additional cross section was added after the maintenance work. The 2008 longitudinal profile covers the section between stations 19+00 and 35+00. This section includes the two (2) subsections that have been monitored since the As-Built. Eleven (11) permanent photo points provide for a visual comparison of key site features through time. The monitoring plan uses eight (8) randomly placed vegetation quads to assess riparian buffer restoration. Monitoring Plan View Sheets 1 to 3 show the locations of the monitoring features.







2.0 Project Conditions and Monitoring Results

2.1 Vegetation Assessment

Planted zones related to the stream restoration consisted of the riparian buffer zone and the stream banks. The riparian buffer zone begins at the top of the bank and continues out perpendicular from the stream. The planted stream bank begins 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.

KHA assessed the site vegetation in October 2008. Throughout the reach, stream bank vegetation regions, primarily consisting of planted live stakes and successional volunteers such as Eastern Cottonwood (*Populus deltoides*), Tulip Poplar (*Liriodendron tulipifera*), and Sycamore (*Plantanus occidentalis*), were performing well with the exception of a few isolated stretches. The riparian zone was not performing as well. In several areas, especially below station 31+50, the riparian regions had been cleared. Vegetation plots VP1, VP2, and VP4 were observed as lacking woody vegetation, most likely a result of clearing and maintenance by landowners. Invasive and nuisance species were not observed in populations that presented an immediate threat to the existing communities. Appendix A provides a summary of vegetative problem areas. Figures 2-4 show the problem areas.

KHA assessed eight (8) vegetation quads. Combined stem counts for these plots equaled over 1,000 stems per acre. Year 5 success criteria require 260 stems per acre. The high stem count is attributed to the abundance of colonizing species. Bare root plantings do not appear to have survived in large numbers.

2.2 Stream Assessment

KHA assessed the stream channel during the spring and fall of 2008. During the winter of 2006, stream restoration contractors performed maintenance work on the lower 2,100 feet of the stream. The maintenance included reshaping the channel and repairing and installing stabilization structures. Overall, the channel appeared stable with isolated sections of instability. A couple of regions of bank scour were observed between stations 14+10 to 33+00. Most of the riffles appeared to be stable with a few shorter and steeper than design criteria. In the upper reach, some of the pools appeared to be steeper than design criteria and may be becoming unstable. Most of the in-stream structures such as rock vanes were functional. Some were difficult to identify due to the age of the reach. Monitoring Plan View Sheets 1 through 3 show the location of the stream problem areas and table B1 in appendix B summarizes the stream problem areas.

Due to the spatial extent of repairs to the channel in 2007, the survey data collected after the repair cannot be directly compared to the pre-repair data through meaningful overlays or trending. However, any post-repair data set will permit meaningful post-repair comparisons and data can be extracted from each of the pre-repair monitoring years

individually, which will contribute to various performance/condition statistics for comparison to the pre-construction condition.

EEP installed a crest gage near permanent cross section XS-3. During the November field visit, the gage did not indicate that bankfull events had occurred since the last reading. Project Table V shows an empty record for bankfull events. Bankfull events have likely occurred on-site, but documentation does not currently exist within the monitoring record.

Project Table VI provides a categorical view of the stream visual stability assessment. The visual assessment shows an apparent increase in stability related to all metrics. This improvement reflects the maintenance work performed in 2007. Table B2 in appendix B provides a breakdown of the visual assessment.

Project Table VII and Project Table VIII summarize the site geomorphic assessment. KHA used bankfull elevations consistent with the first three (3) years of measurements (As-Built to MY 2). The older cross sections (XS1, XS2, XS3, and XS4) were significantly modified during maintenance. Consequently, the shape and hydraulic dimensions differed from previous years. Cross section XS1 had similar hydraulic dimensions compared to previous years. Appendix B provides photographs and graphing for geomorphic data.

3.0 Methodology

The monitoring methodology used during 2008 is consistent with the methods used in 2007.

PROJECT TABLES

Table I. Project Restoration Components
County Line Creek (High Vista) Stream Restoratin (EEP No. 00044)

Project Segment or Reach ID								Stationing	Comment
Main	3,500	R	P2	3,500	lf	1:1	3,500	0+00.0 - 35+00.0	
Mitigation Unit Summaries									
Stream (lf)	Riparian Wetland (Ac.)	Non-Riparian Wetland (Ac.)	Total Wetland (Ac.)	Buffer (Ac.)	Comment				
3,500	--	--	--	--					

**Table II. Project Activity and Reporting History
County Line Creek (High Vista) Stream Restoratin (EEP No. 00044)**

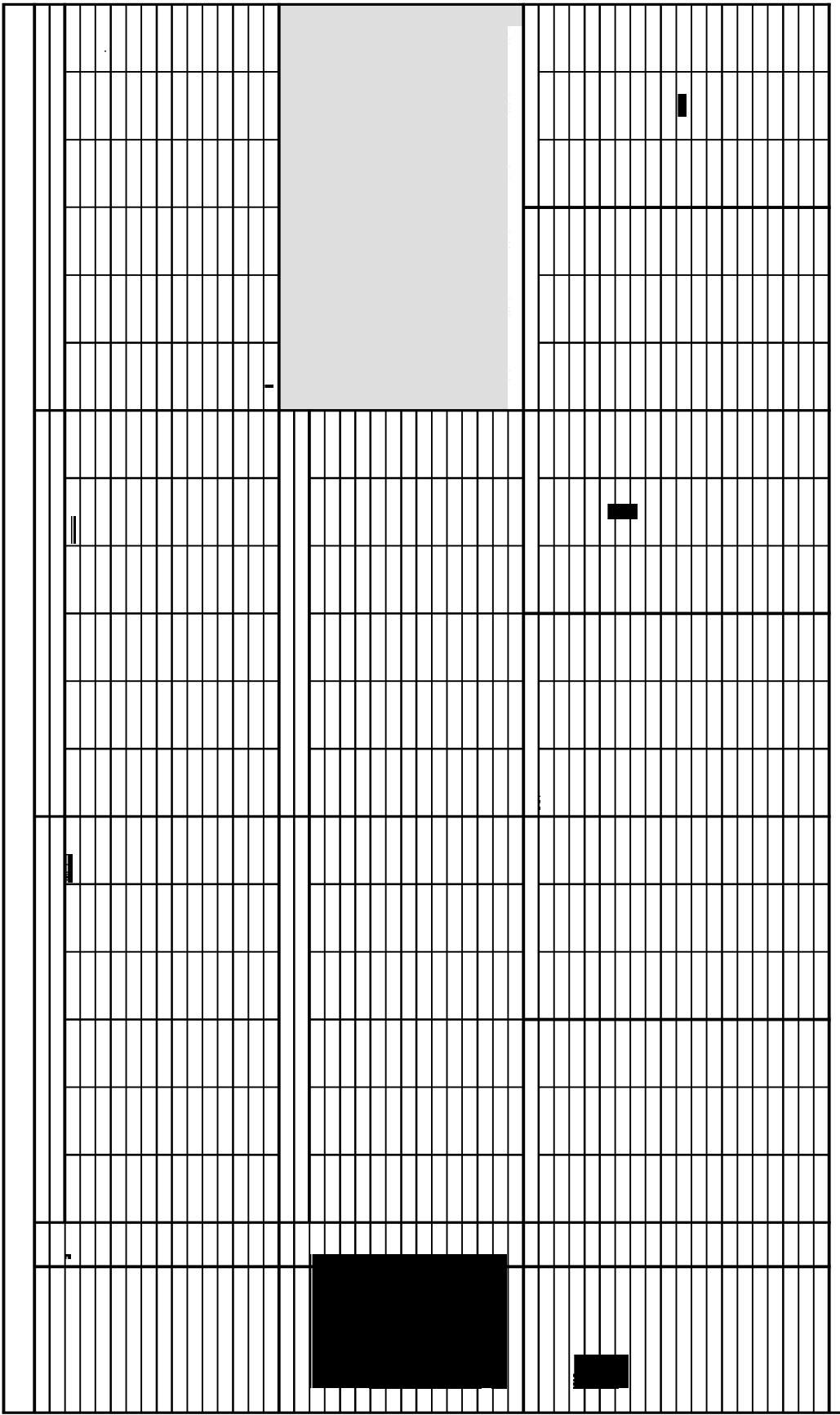
Activity or Report	Scheduled Completion	Data Collection Complete	Actual Completion or Delivery	Comments
Restoration Plan	2002		11/2001	
Final Design – 90%			2002	
Construction	2002		8/2002	
Maintenance /			2007	
Temporary S&E mix applied to entire project area				
Permanent seed mix applied				
Containerized and B&B plantings for reach/segments 1&2	2002			
Mitigation Plan / As-built (Year 0 Monitoring –	2002		10/2002	Performed by Kimley-Horn and Associates
Year 1 monitoring	2003	Oct-05	12/2003	Performed by Kimley-Horn and Associates
Year 2 Monitoring	2004	Oct-06	12/2004	Performed by N.C. State University
Year 3 Monitoring	2005		12/2005	Performed by Soil and Environmental Consultants
Year 4 Monitoring	2007	Nov-07	12/2007	Performed by Kimley-Horn and Associates
Year 5 Monitoring	2008	Dec-08		Performed by Kimley-Horn and Associates

Table III. Project Contact Table		
County Line Creek (High Vista) Stream Restoratin (EEP No. 00044)		
Designer	3001 Weston Parkway	
Kimley-Horn and Associates, Inc.	Cary, NC 27513	
Primary Designer POC	Will Wilhelm, P.E.	
Construction Contractor	6106 Corporate Park Drive	
Shamrock Environmental Corp.	Brown Summit, NC 27214	
Primary Contractor POC	Greg Kiser	
Construction Contractor Maintenance	126 Circle G Lane	
Land Mechanic Designs, Inc.	Willow Springs, NC 27592	
Primary Contractor POC		
Planting Contractor		
Planting contractor POC		
Seeding Contractor		
Planting contractor POC		
Seed Mix Sources		
Nursery Stock Suppliers		
Monitoring Performers	PO Box 33068	
Kimley-Horn and Associates	Raleigh, NC 27636	
Stream Monitoring POC	Daren Pait, P.E.	(919) 678-4155
Vegetation Monitoring POC	Daren Pait, P.E.	(919) 678-4155

Table IV. Project Background Table	
County Line Creek (High Vista) Stream Restoratin (EEP No. 00044)	
Project County	Henderson/Buncombe
Drainage Area	0.35 sq. miles
Drainage impervious cover estimate (%)	0.1
Stream Order	1st /2nd
Physiographic Region	Mountain
Ecoregion	Blue Ridge Belt
Rosgen Classification of As-built	B4/C4
Cowardin Classification	N/A
Dominant soil types	Codorus, Hayesville, Delanco
Reference site ID	N/A
USGS HUC for Project and Reference	6010105
NCDWQ Sub-basin for Project and Reference	04-3-2002
NCDWQ classification for Project and Reference	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	0%

**Table V. Categorical Stream Feature Visual Stability Assessment
County Line Creek (High Vista) Stream Restoratin (EEP No. 00044)**

Reach 1						
Feature	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
A. Riffles	--	--	--	87%	94%	94%
B. Pools	--	--	--	95%	93%	93%
C. Thalweg	--	--	--	100%	100%	100%
D. Meanders	--	--	--	78%	96%	96%
E. Bed General	--	--	--	82%	100%	99%
F. Bank Condition	--	--	--	92%	100%	100%
G. Vanes / J Hooks etc.	--	--	--	88%	93%	93%
H. Wads and Boulders	--	--	--	52%	78%	78%



APPENDIX A
VEGETATION MONITORING DATA



VQ 1 (2008)



VQ 2 (2008)



VQ 3 (2008)



VQ 4 (2008)



VQ 5 (2008)



VQ 6 (2008)



VQ 7 (2008)



VQ 8 (2008)



VP 1: Cleared buffer, no wooded species



VP 2: Lawn clippings in easement



VP 3: Privet patch



VP 4: Cleared and maintained to bank

APPENDIX B
STREAM MONITORING DATA



PS 1 (2008)



PS 2 (2008)



PS 3 (2008)



PS 4 (2008)



PS 5 (2008)



PS 6 (2008)



PS 7 (2008)



PS 8 (2008)



PS 9 (2008)

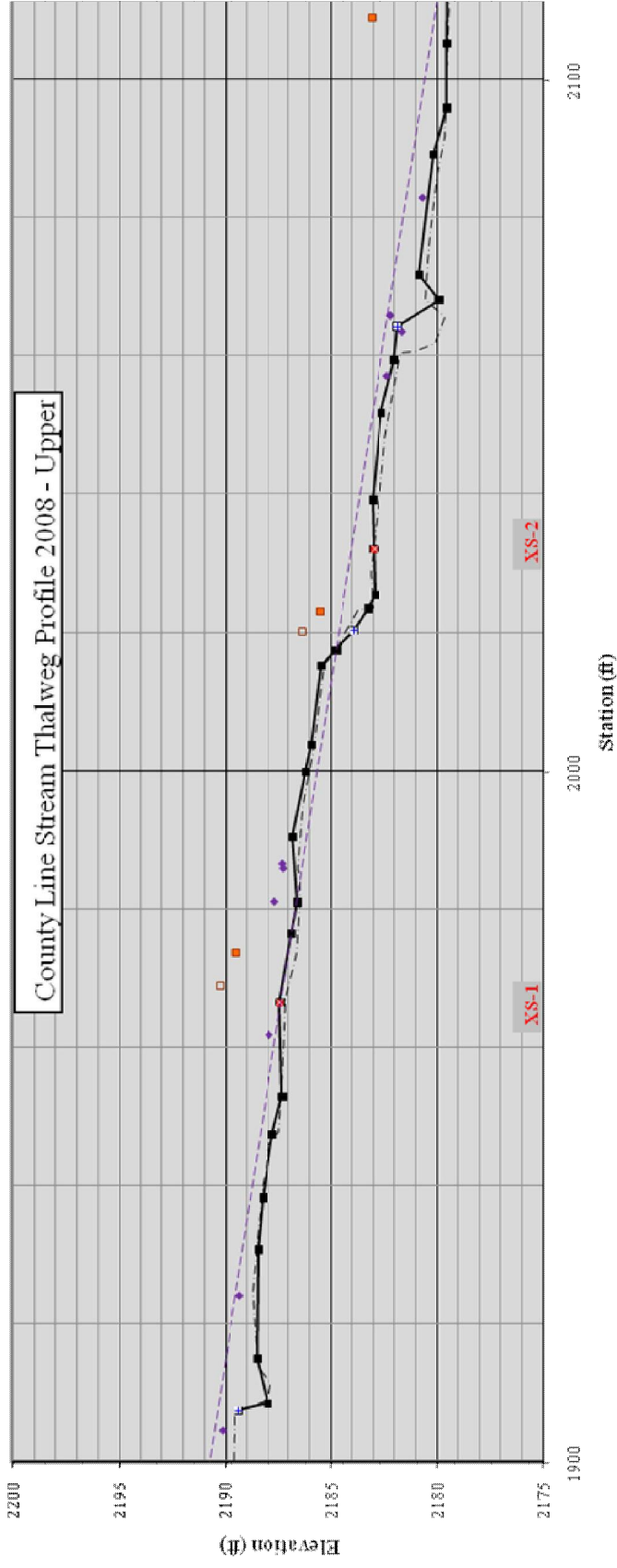


PS 10 (2008)



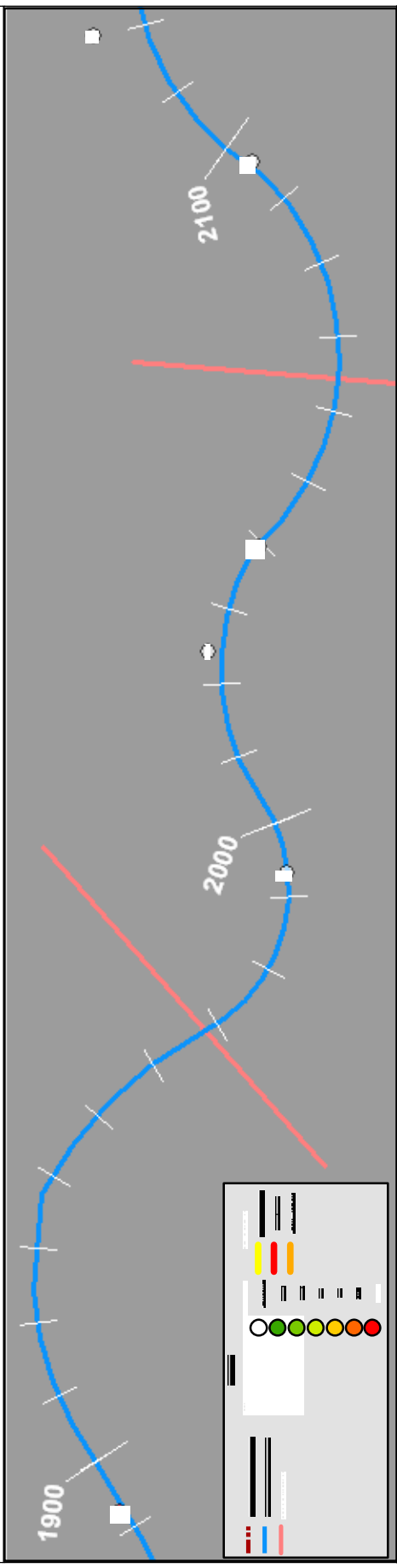
PS 11 (2008)

County Line Stream Thalweg Profile 2008 - Upper



Bankfull Slope
 $y = -0.0506x + 2286.8$

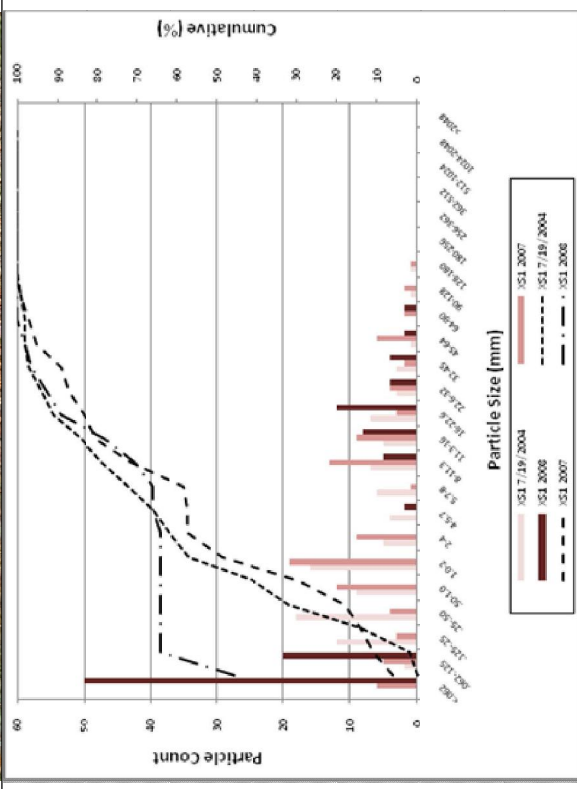
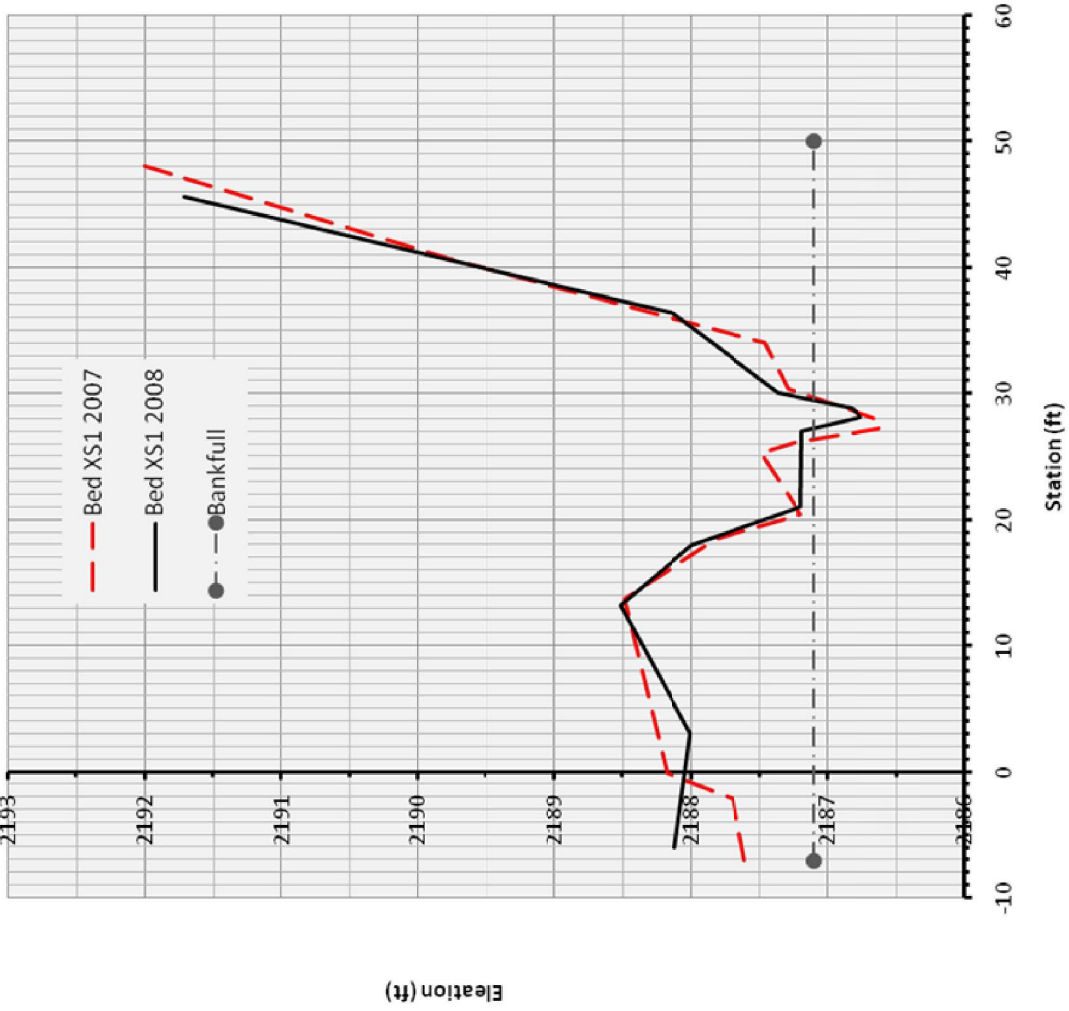
- Bankfull Elevation 2008
- In-Stream Structures 2008
- Cross Sections 2008
- Bed Elevation 2008
- Bed Elevation 2007
- Left TOB Elevation 2008
- Right TOB Elevation 2008



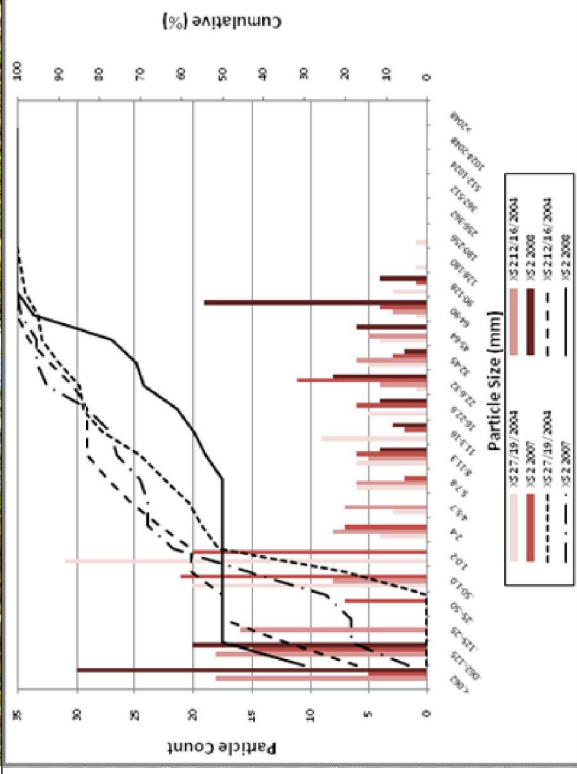
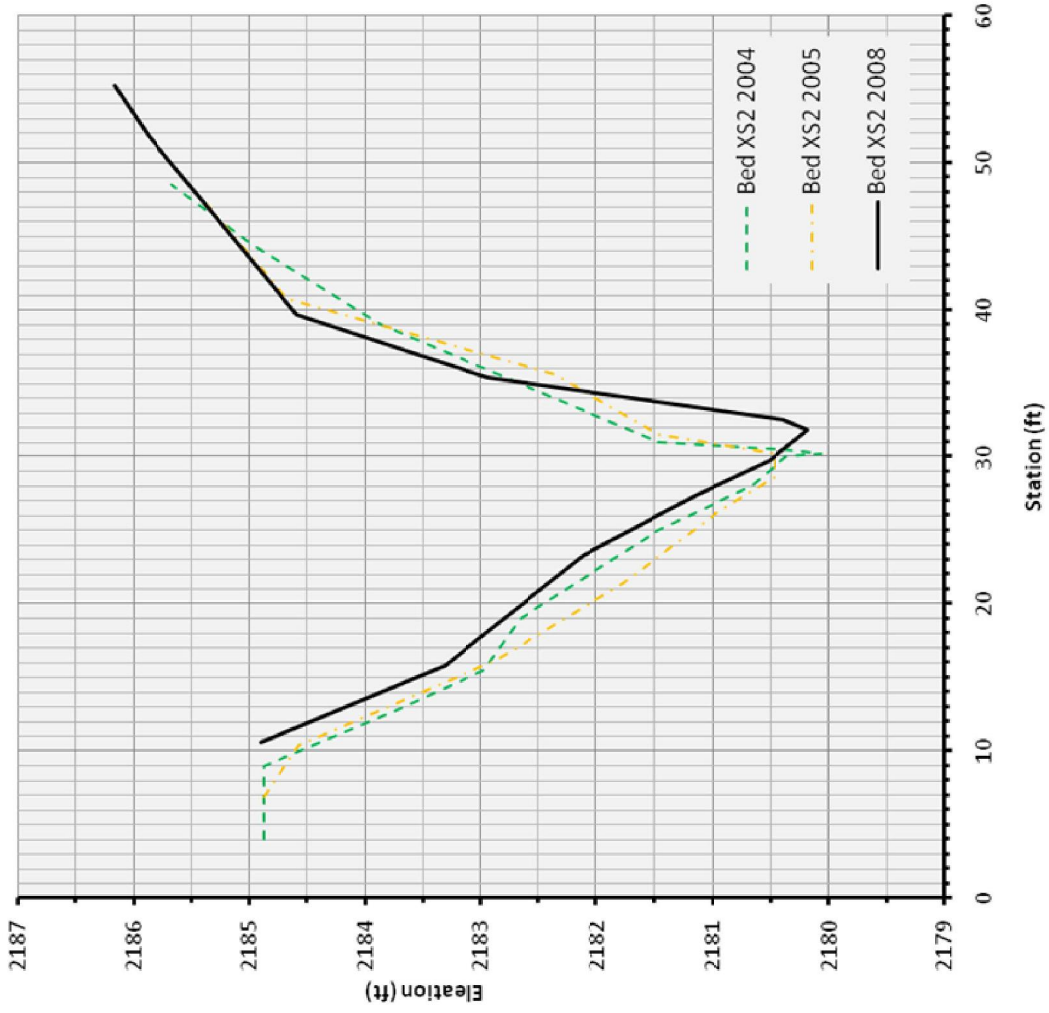
Legend for plan view map:

- Bankfull Elevation 2008 (Blue line)
- In-Stream Structures 2008 (Black squares)
- Cross Sections 2008 (Red squares)
- Bed Elevation 2008 (Black line)
- Bed Elevation 2007 (Dashed line)
- Left TOB Elevation 2008 (Orange line)
- Right TOB Elevation 2008 (Red line)
- Bankfull Slope (Dashed purple line)

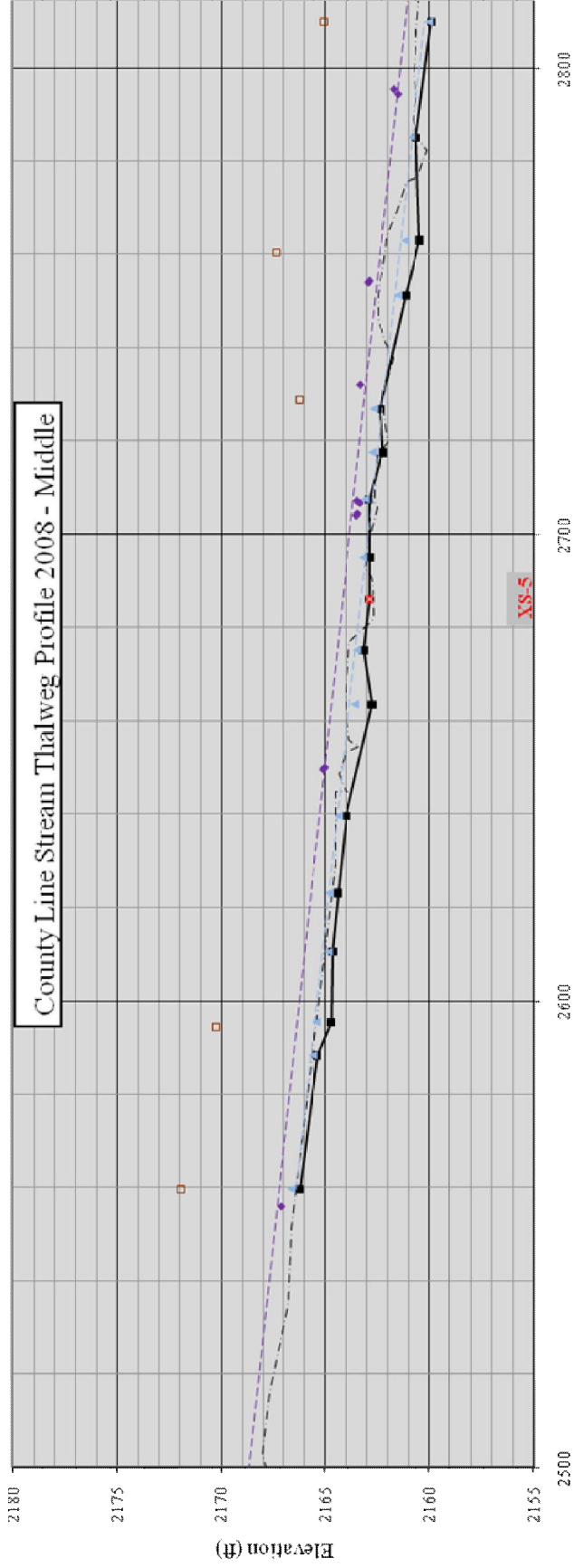
XS1 - RIFFLE



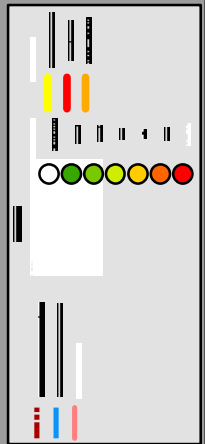
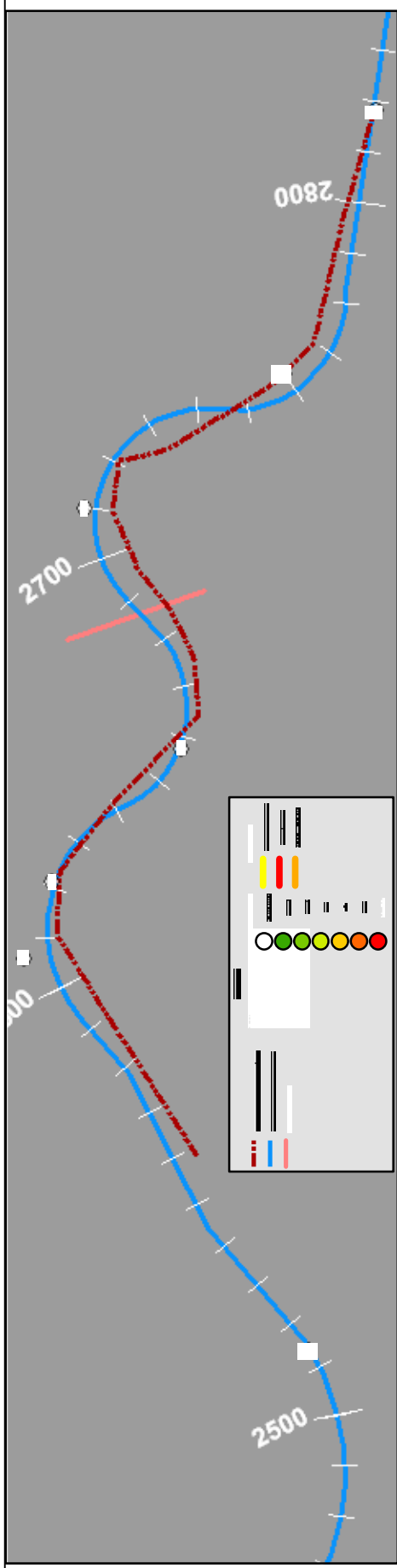
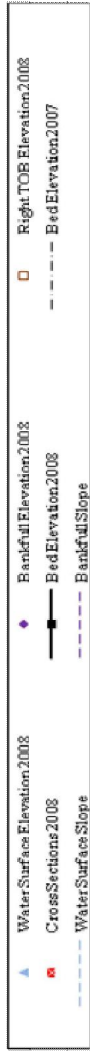
XS2 - POOL



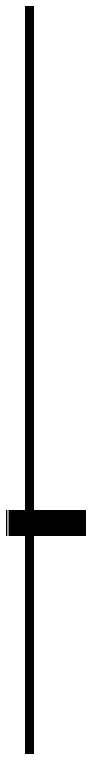
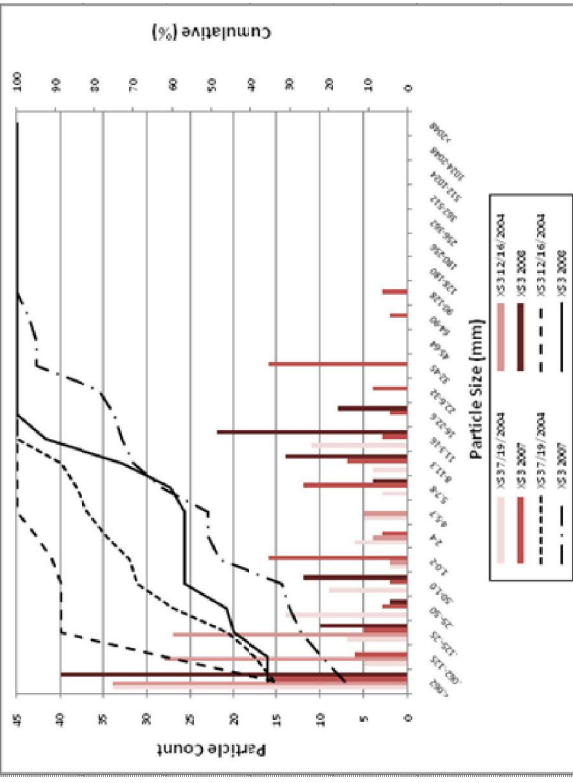
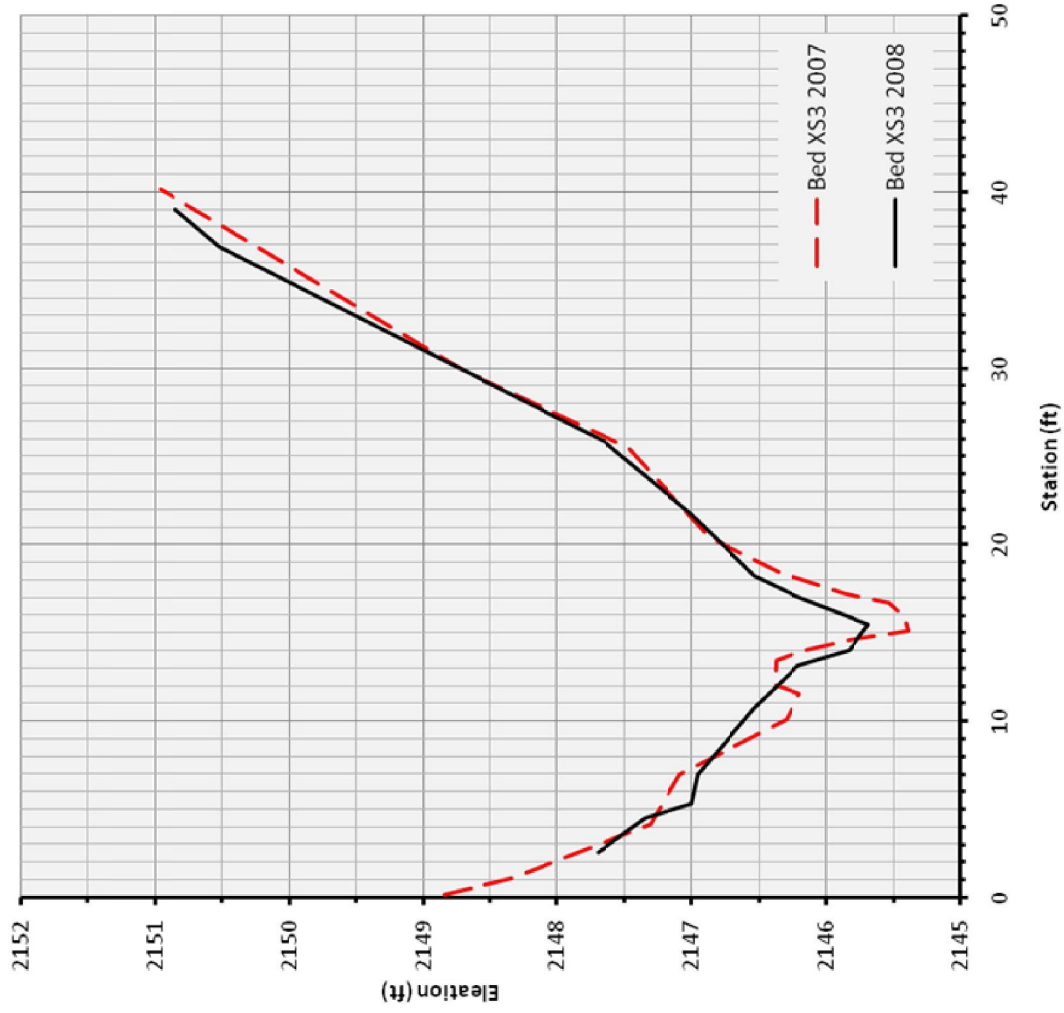
County Line Stream Thalweg Profile 2008 - Middle



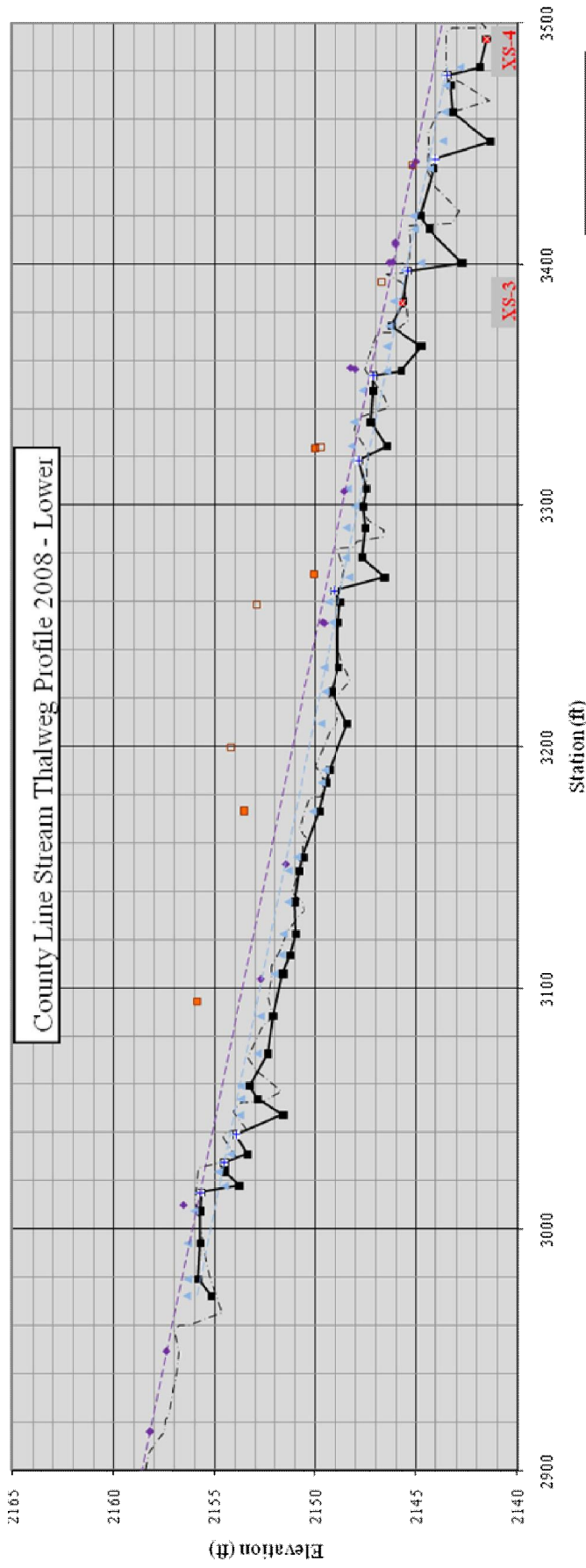
Water Surface Slope
 $y = -0.0246x + 2229.4$
 Bankfull Slope
 $y = -0.0241x + 2229.1$



XS3 - RIFFLE

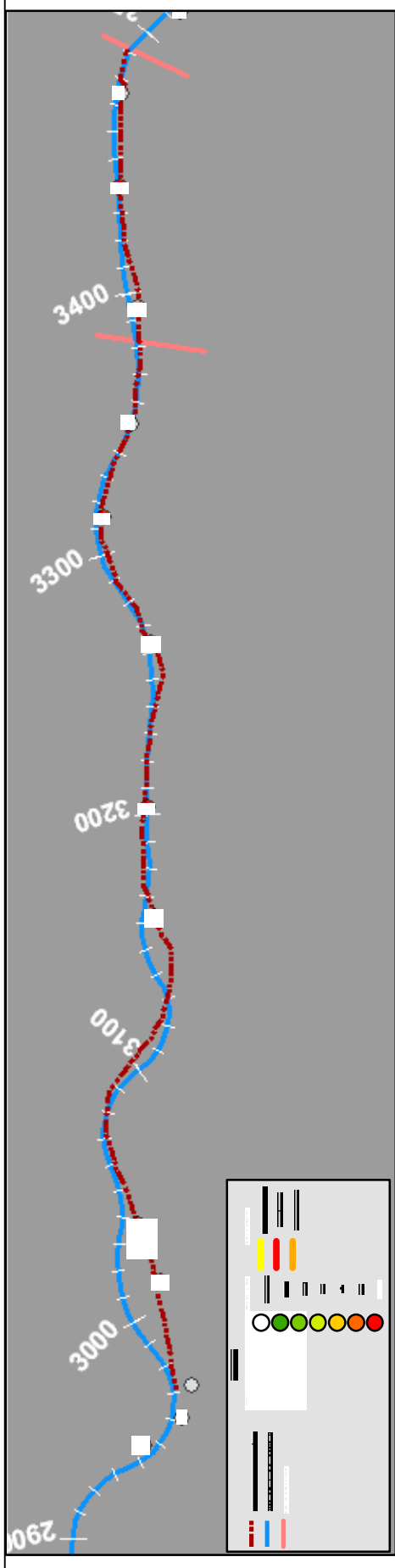


County Line Stream Thalweg Profile 2008 - Lower



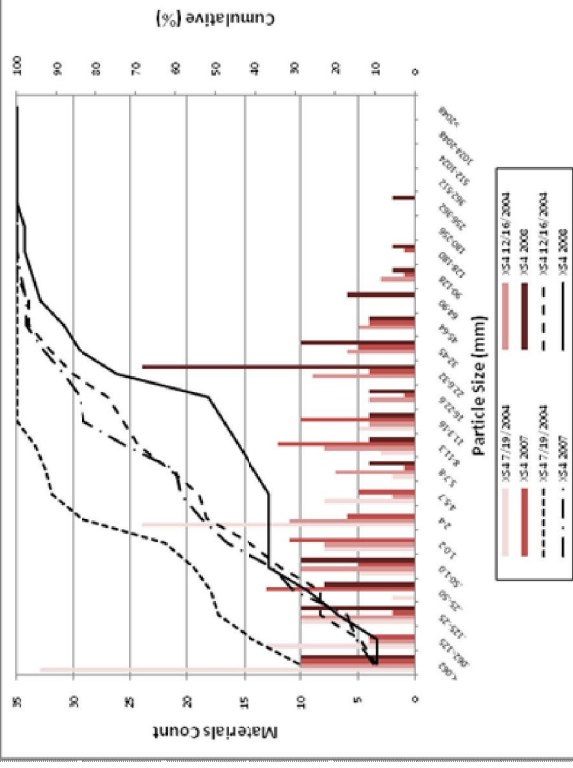
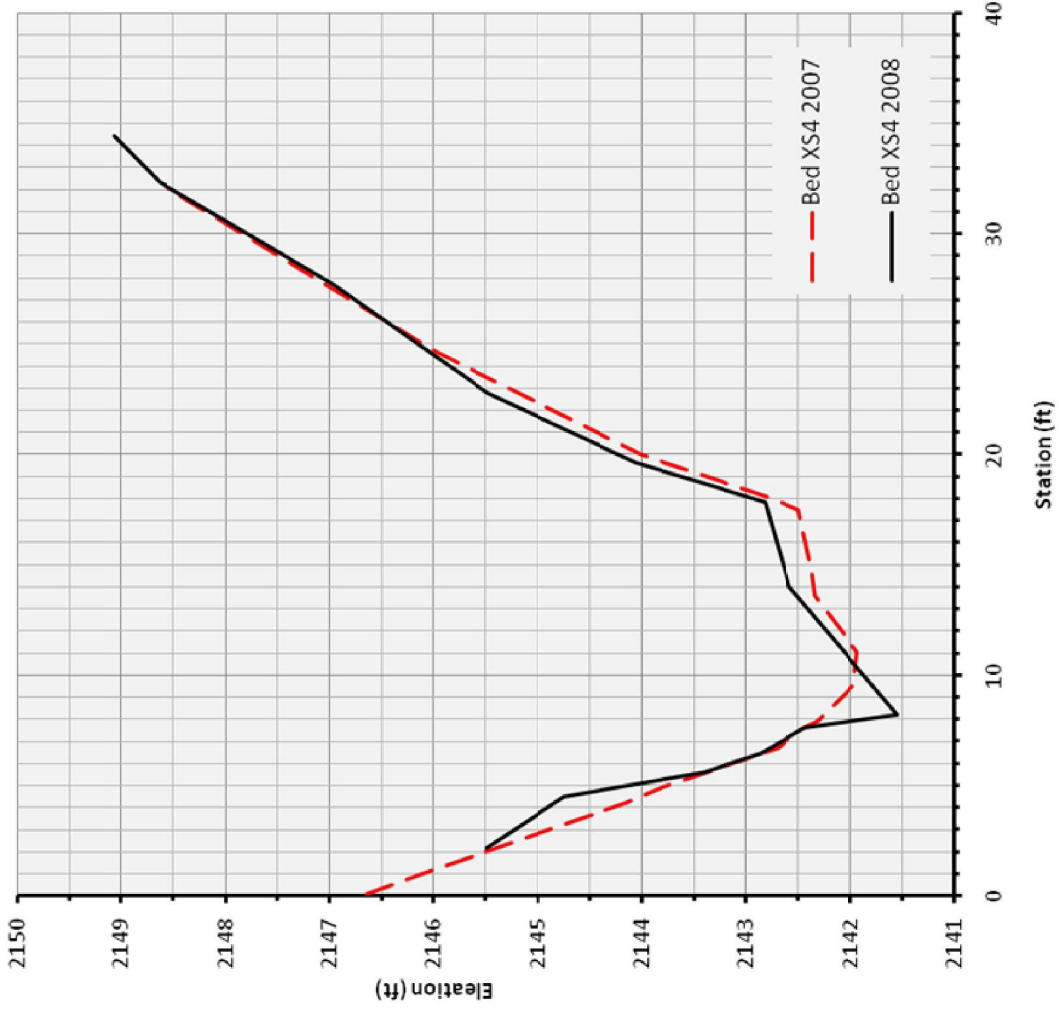
Water Surface Slope
 $y = -0.0244x + 2228.3$
 Bankfull Slope
 $y = -0.0249x + 2230.7$

- Water Surface Elevation 2008
- Right TOB Elevation 2008
- Bed Elevation 2008
- Bankfull Slope
- Left TOB Elevation 2008
- In-Stream Structures 2008
- Cross Sections 2008
- Water Surface Slope



- Water Surface Elevation 2008
- Right TOB Elevation 2008
- Bed Elevation 2008
- Bankfull Slope
- Left TOB Elevation 2008
- In-Stream Structures 2008
- Cross Sections 2008
- Water Surface Slope

XS4 - POOL



XS5 - RIFFLE

