Hanging Rock
EEP Project Closeout Summary

Project ID and Status	
Name	Hanging Rock
EEP ID #	165
County	Avery
Type	Stream
Status	5 years of monitoring complete

Project Setting & Classification	
Basin	Watauga
Physigraphic Region	Blue Ridge
Ecoregion	High Mountain (66i)
USGS Hydro Unit	6010103020010
NCDWQ Subbasin	8-22-5
Thermal Regime	Cold
Trout Water	Yes
Designer	Buck Engineering
Monitoring	Mulkey, Ecologic, MACTEC, Equinox

Project Timeline	
Mitigation / Restoration Plan *	Nov 2001
Final Design - 90%	-
Construction	Sep 2003
Temporary S&E Mix Applied to Project	Sep 2003
Live Stakes and Bare Root Trees Plant	Spring 2004
Structural maintenance (Streambank re	2004
Baseline / Year 1 Monitoring	March 2005
Year 2 Monitoring	April 2006
Year 3 Monitoring	April 2007
Year 4 Monitoring	April 2008
Year 5 Monitoring	May 2009

Background

The Hanging Rock stream restoration site is located in Avery County within the New River Basin.
implemented by the NCDOT in the fall of 2003 along approximately 2800 feet of perennial stream. Prior to implementation, site streams had been straightened and the entire project extent lacked riparian woody vegetation and was being actively grazed. Pre-restoration bank height ratios (BHR's) ranged up from 1.3 indicating that Hanging Rock Creek was not able to inundate the floodplain and dissipate energy during bankfull and larger flow events. The drainage area for the project is 3.0 square miles.

Goals and Objectives

· Restore the channel to a natural stable form;
· Improve floodplain and wetland functionality;
· Reduce the sediment load discharged to the Elk River;
· Restore native floodplain vegetation through a forested riparian buffer;
· Improve the trout fishery and natural aesthetics of the stream corridor; and
· Acquire mitigation credits for other unavoidable impacts to streams within the same Cataloging Unit (06010103).

Project Restoration Components and Mitigation Assets

Stream			Asset Data							
	Drainage/Hydrology Component	Restoration Component	Asset			Ratio				
			Map #	Approach	Level	Multip	Feet	SMU	Acres	WMU
	Hanging Rock Creek	Reach 1	1	P1	R	1.00	2535	2535	-	-
	Unnamed Tributary	Reach 2	2	P2	R	1.00	234	234	-	-

Asset Summary

Level	Ratio	Multip	Feet	SMU	Acres	WMU
R	1:1	1.00	2769	2769	-	-

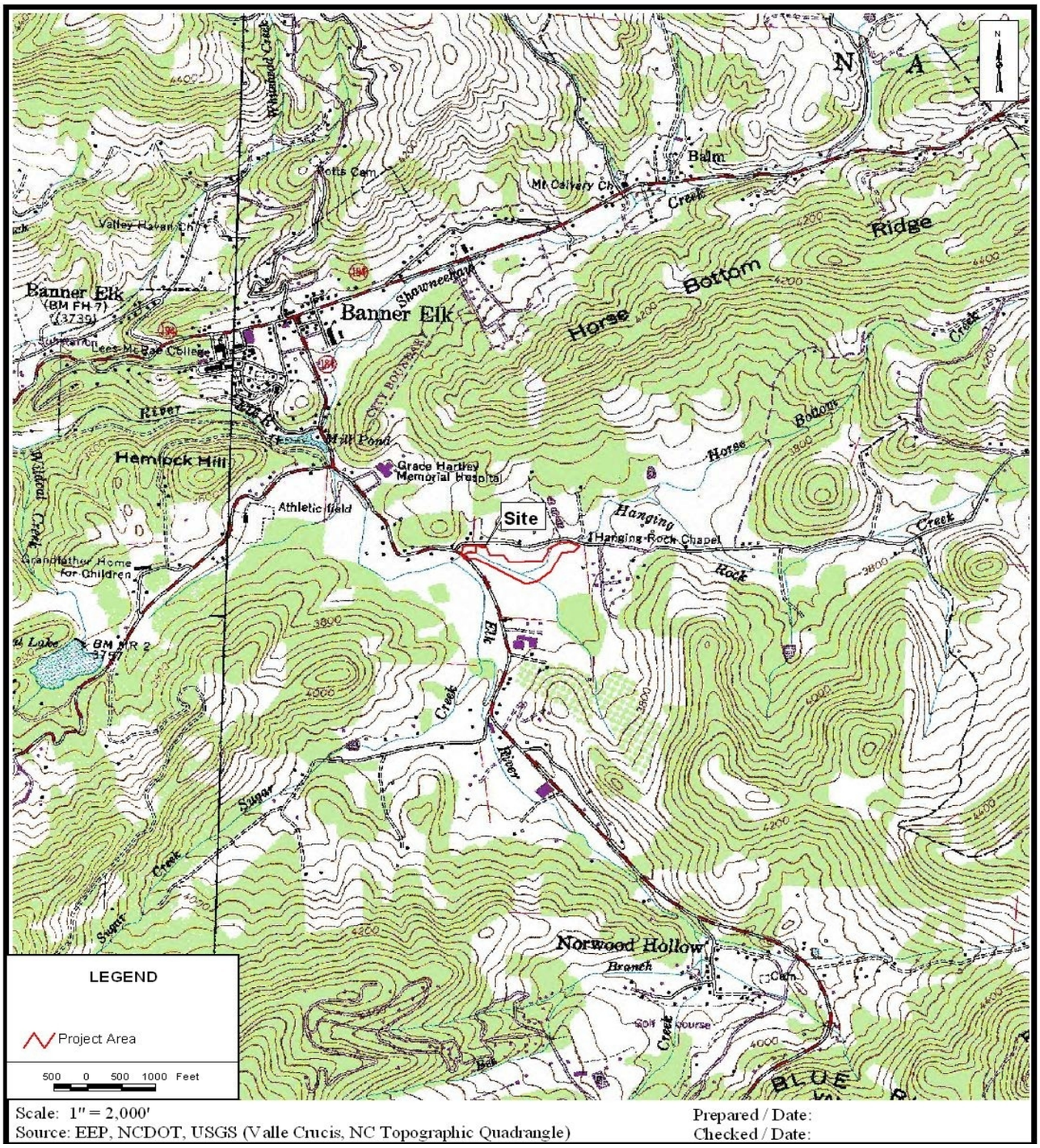
Project Ratios

	Level	Ratio	Multiplier
Stream/Wetland	R	1	1.000
Wetland	E	2	0.500
Stream	EI	1.5	0.667
Stream	EII	2	0.500
Wetland	C	3	0.333
Stream/Wetland	P	5	0.200

Watershed Data and Characteristics						
	Wetland	DA	Stream	%	Land	
P/I/E	Type	(SM)	Order	Imper	Use	303d
P	-	3	3rd	<3%	Ag, Forest, Resid	No
P	-	0.26	1st	<3%	Ag, Forest, Resid	No

Results

According to data collected over a five-year monitoring period, the Hanging Rock project has demonstrated morphologic stability and is functioning as intended. Repeat channel X-sections (N = 7) and longitudinal pro surveys document channel stability with some modest X-section narrowing. The "Bank" feature category of the 2008 Visual Stability Assessment rated at 93% and 100% for the mainstem and UT, respectively. The Vanes/J-Hooks feature category rated lower (79%) for the mainstem, but grade control has been maintained along the project reaches. The average planted stem density determined from 2008 surveys was 222 stem acre, below the established criteria of 260 stems per acre at the end of monitoring year 5. Vegetation plots #4 and #8 fell below the criteria and both were impacted by unauthorized mowing in 2007. EEP took action stop the mowing activities, and only minor impacts were noted in 2008 and 2009. Additionally, when naturally recruited stems were counted in 2008, total average stem density was determined to be 455 stems per ac



Hanging Rock project located in Avery County in the vicinity of Banner Elk. Take NC 184 to Dobbins Road which crosses to upstream end of the mainstem reach.

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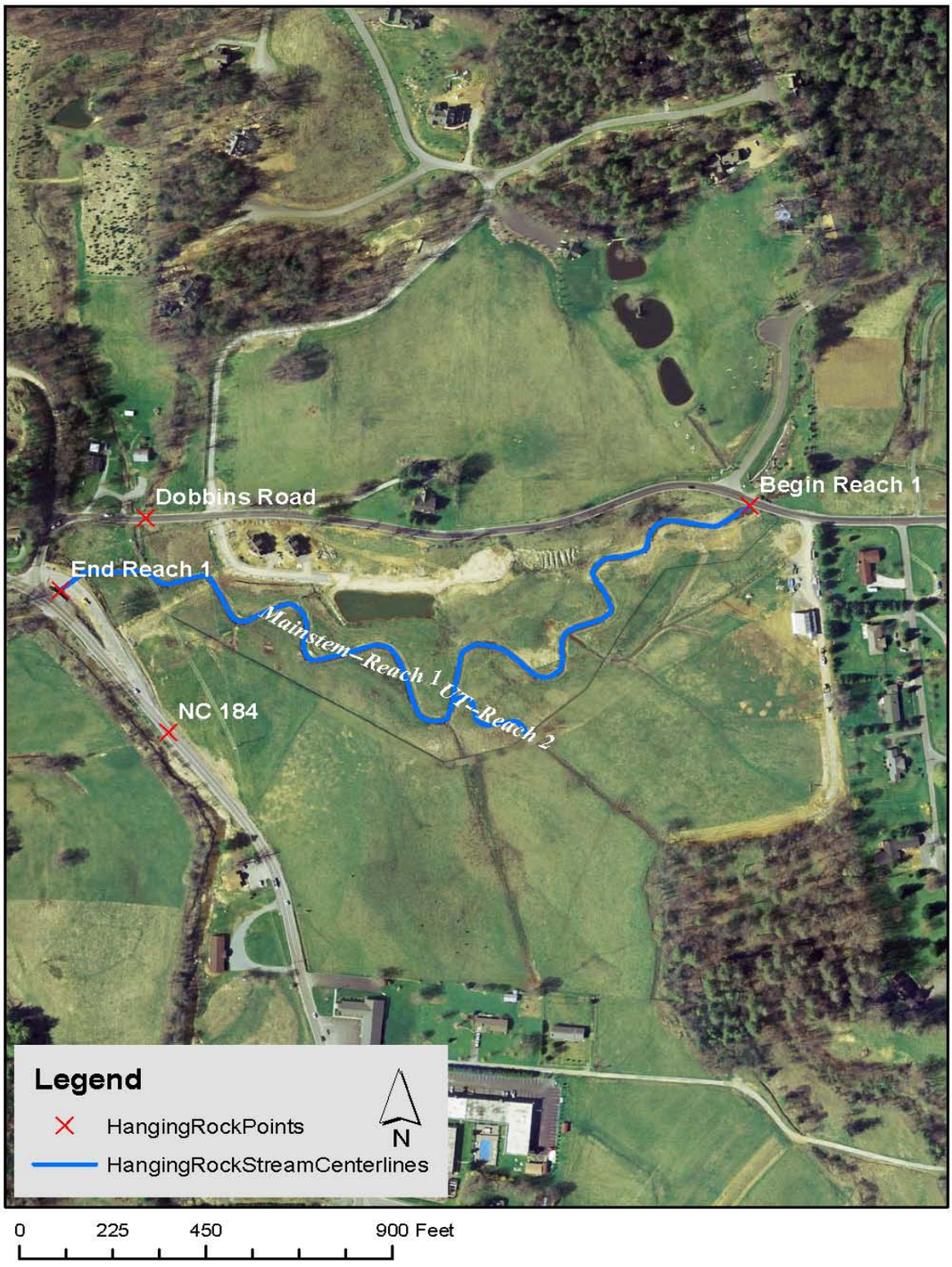
Hanging Rock Restoration Project
Avery County, NC



Hanging Rock reach map on 2005 aerial photography.

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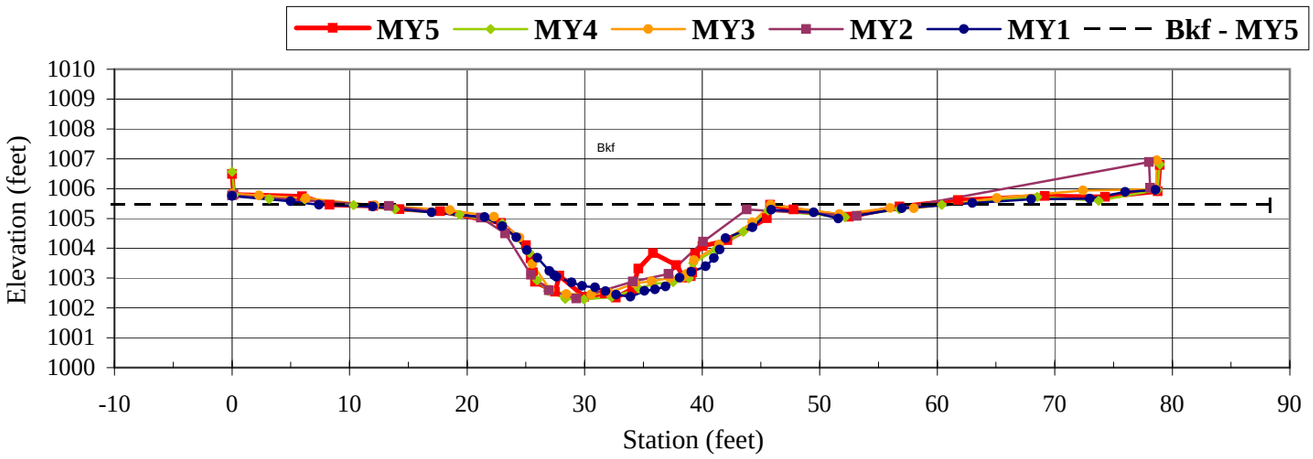
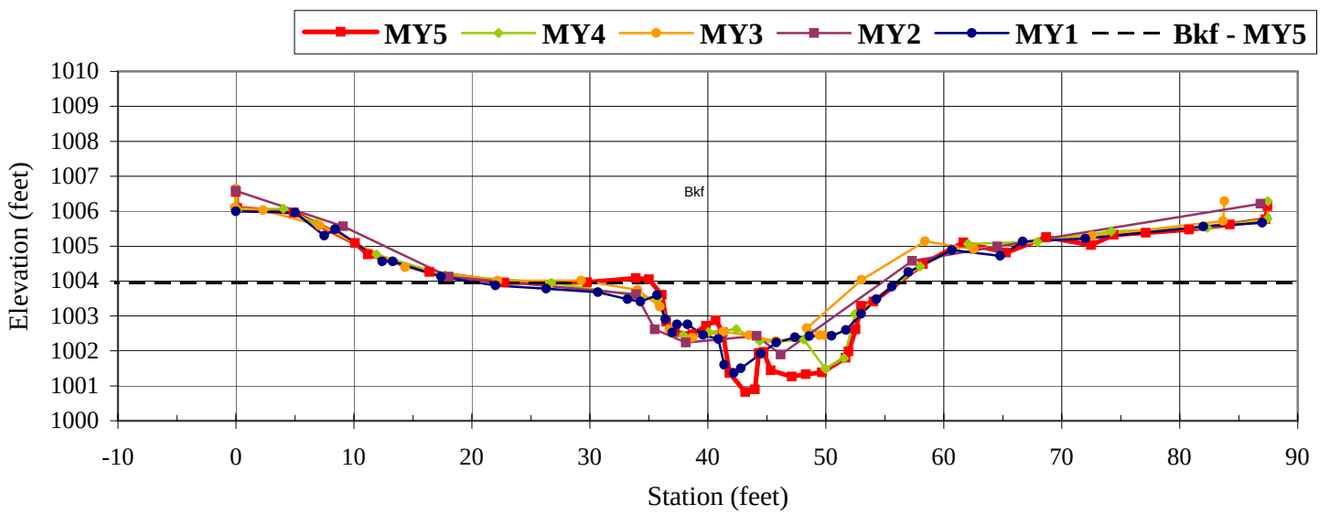
Hanging Rock Creek Cross Section #1 - Riffle

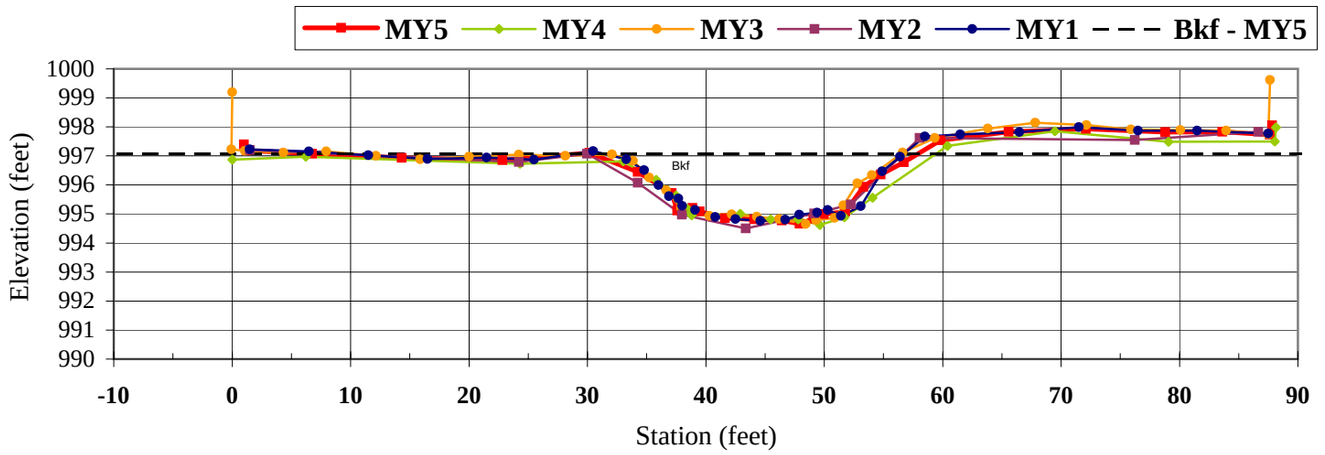


Hanging Rock Creek Cross Section #3 - Riffle

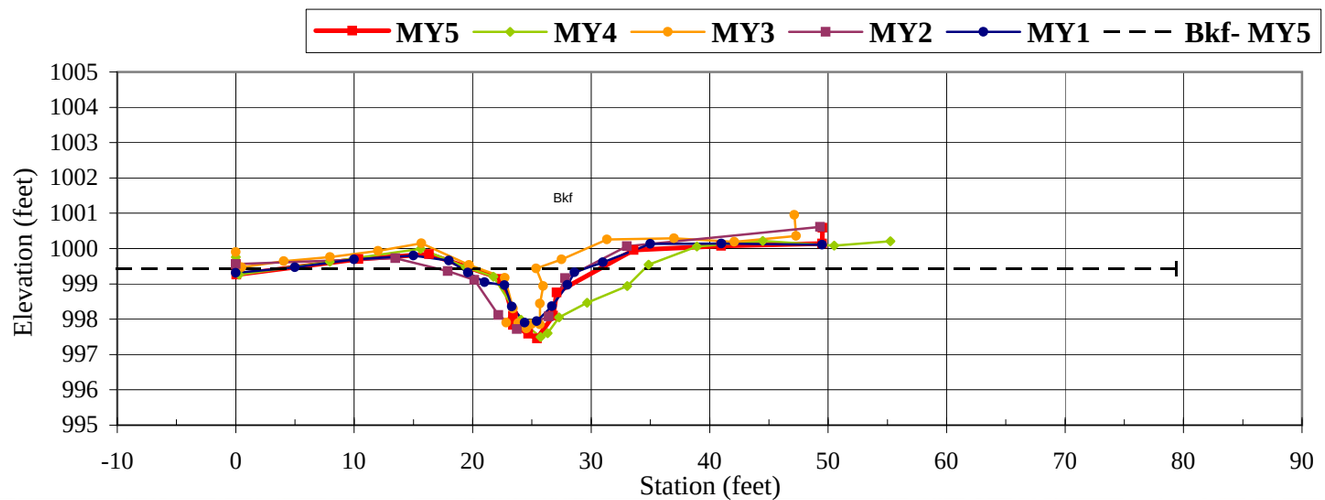


Hanging Rock repeat riffle X-section surveys. Plots are at a similar scale with modest vertical exageration for comparison. Time series demonstrates channel stability. Please note that MY1 is the As-built datum as was common with NCDOT.

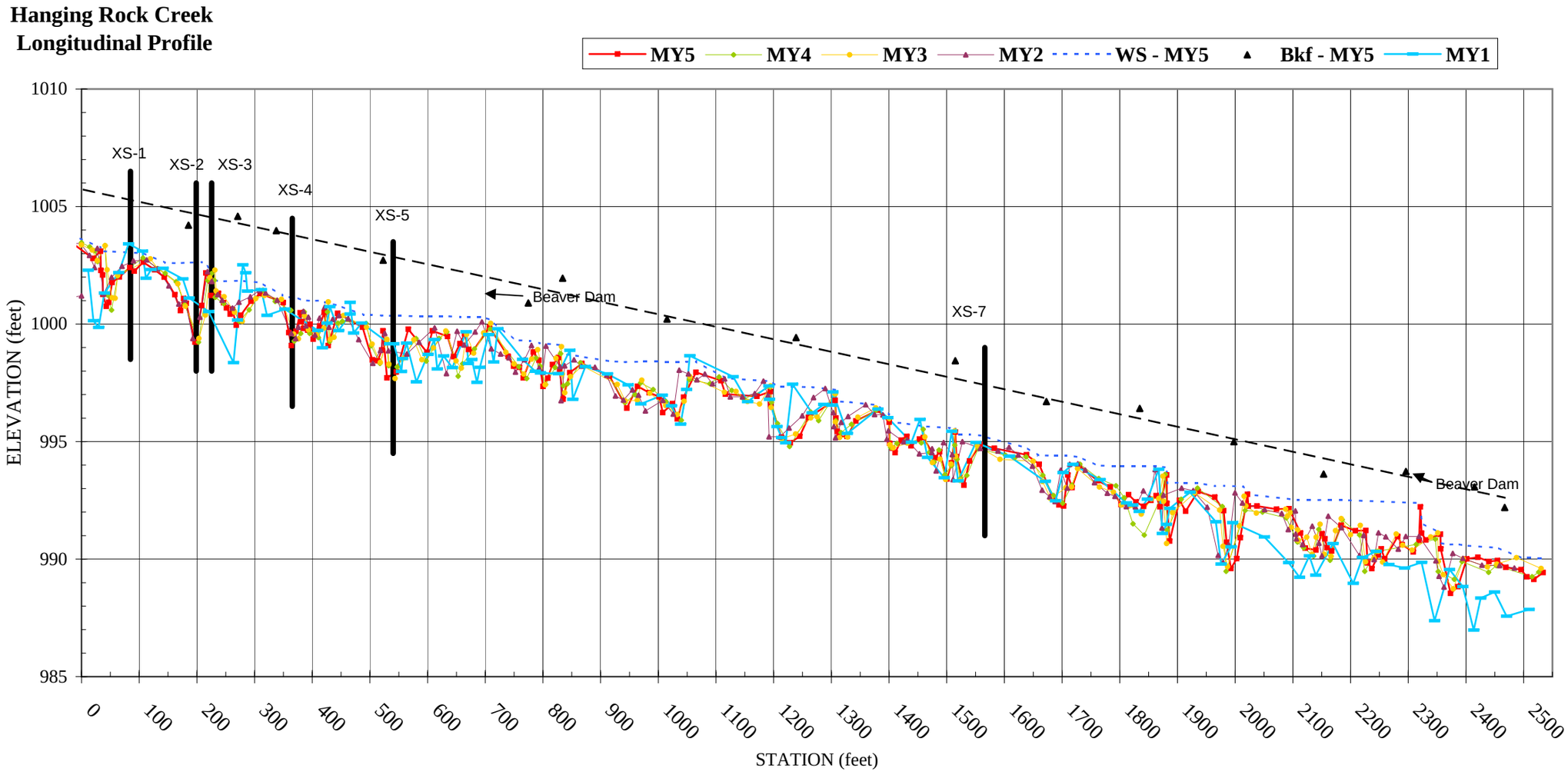
Hanging Rock Creek Cross Section #7 - Riffle



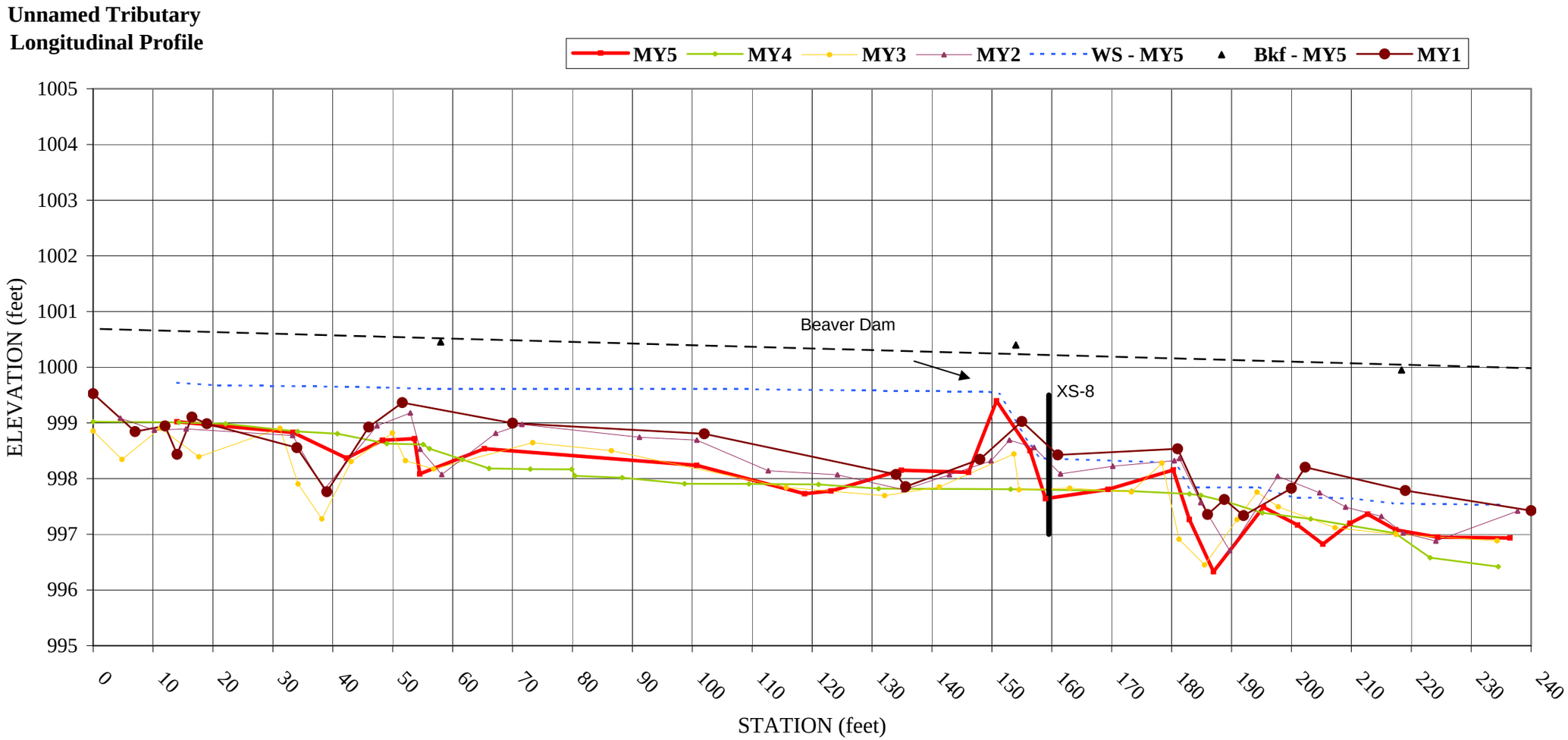
Unnamed Tributary Cross Section #8 - Run



Hanging Rock and UT repeat riffle X-section surveys. Plots are at a similar scale with modest vertical exageration for comparison. Time series demonstrates channel stability. Please note that MY1 is the As-built datum as was common with NCDOT.



Hanging Rock repeat longitudinal profile surveys. Time series indicates maintenance of project grade and stability of riffle and pool channel units. MY1 is the As-built datum. Please note that beaver dams mapped in 2008 were subsequently removed.



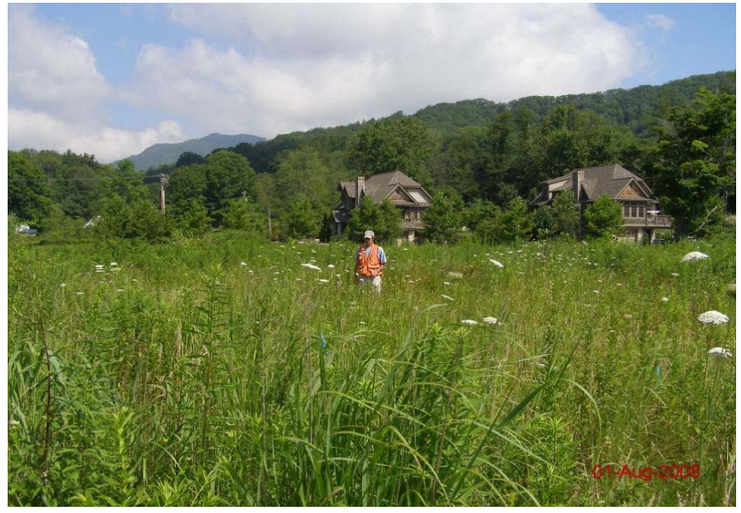
UT to Hanging Rock repeat longitudinal profile surveys. Datum issues may have contributed to the appearance of thalweg downcutting over the time series. MY1 is the As-built datum. Beaver dams mapped in 2008 were subsequently removed.

Table A5. Stem Count by Plot and Species Hanging Rock Creek / Project No. 165												
	Species	**Total stems**	**No. plots**	**Avg. no. stems**	**00165-01-0001-year:5**	**00165-01-0002-year:5**	**00165-01-0003-year:5**	**00165-01-0004-year:5**	**00165-01-0005-year:5**	**00165-01-0006-year:5**	**00165-01-0007-year:5**	**00165-01-0008-year:5**
	Cephalanthus occidentalis	1	1	1					1			
	Cornus amomum	5	2	2.5	4				1			
	Diospyros virginiana	8	5	1.6		1			1	1	2	3
	Juglans nigra	22	7	3.14	1	5	3	1	1	4	7	
	Salix nigra	1	1	1					1			
	Betula lenta var. lenta	16	6	2.67	1	8	1	1	4		1	
	Lyonia ligustrina var. ligustrina	1	1	1	1							
	Platanus occidentalis var. occidentalis	32	7	4.71	4	5	8	4		5	4	2
	Prunus serotina var. serotina	4	2	2.5					3			1
Total	**9**	**90**			**11**	**19**	**12**	**6**	**12**	**10**	**14**	**6**

Vegetation plot # 2

Vegetation plot # 4

Vegetation plot # 5



Vegetation plot # 8

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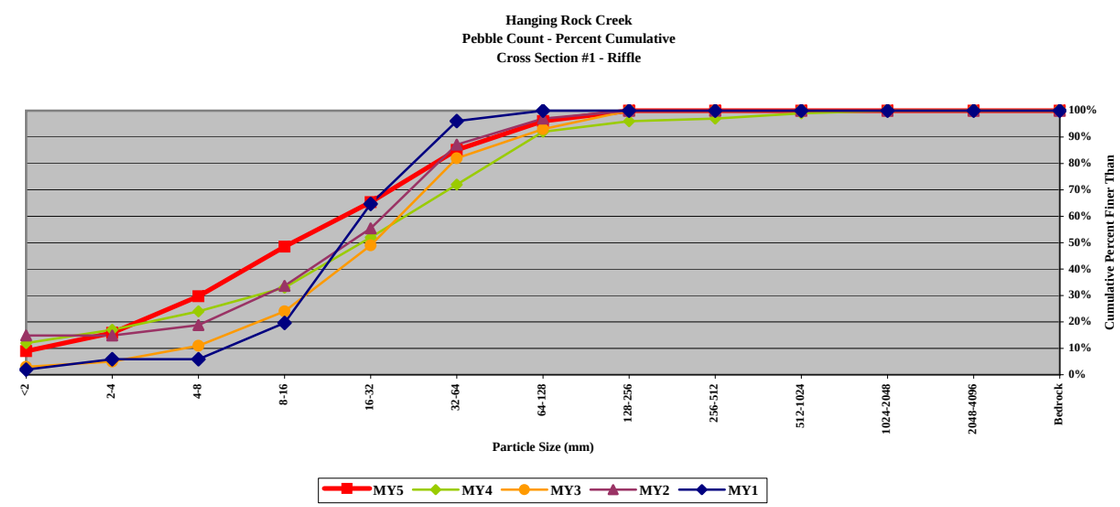
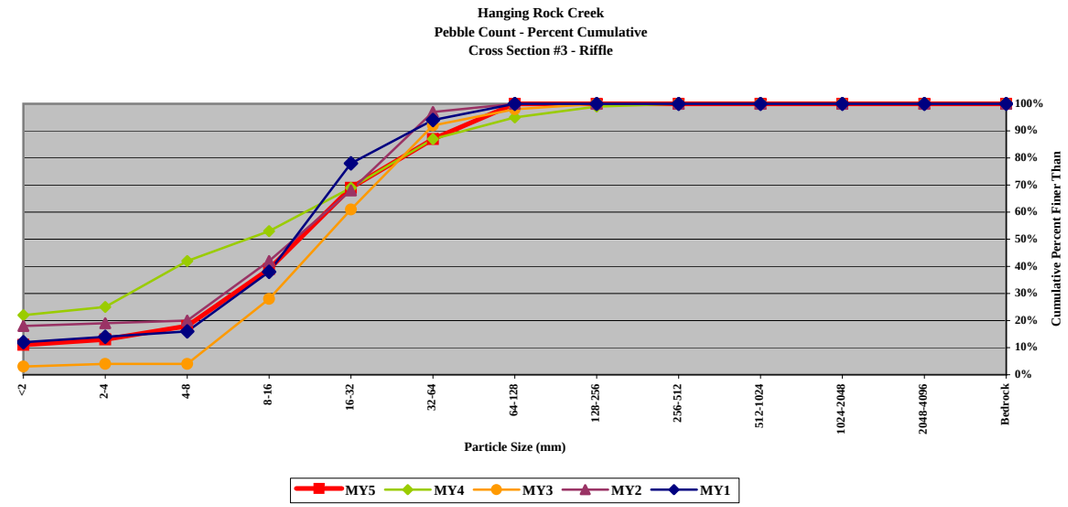
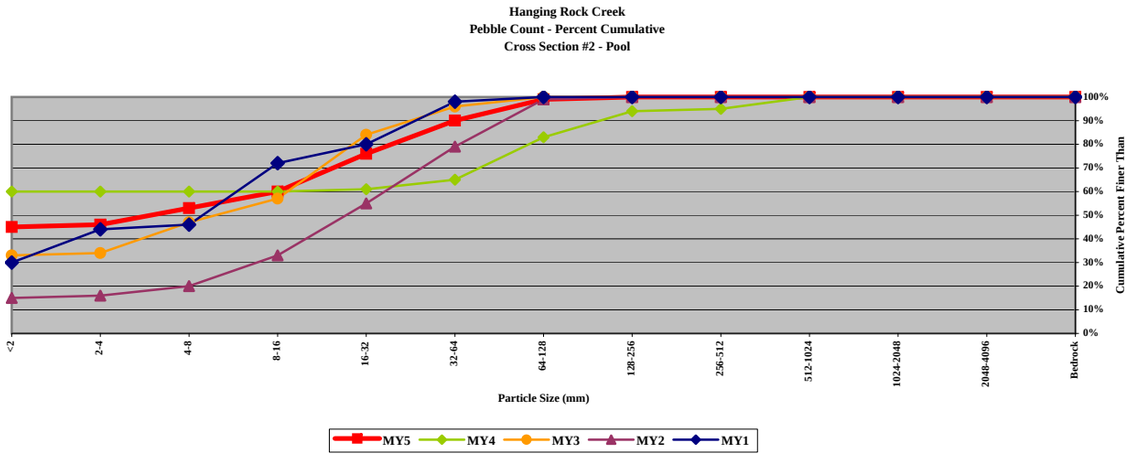
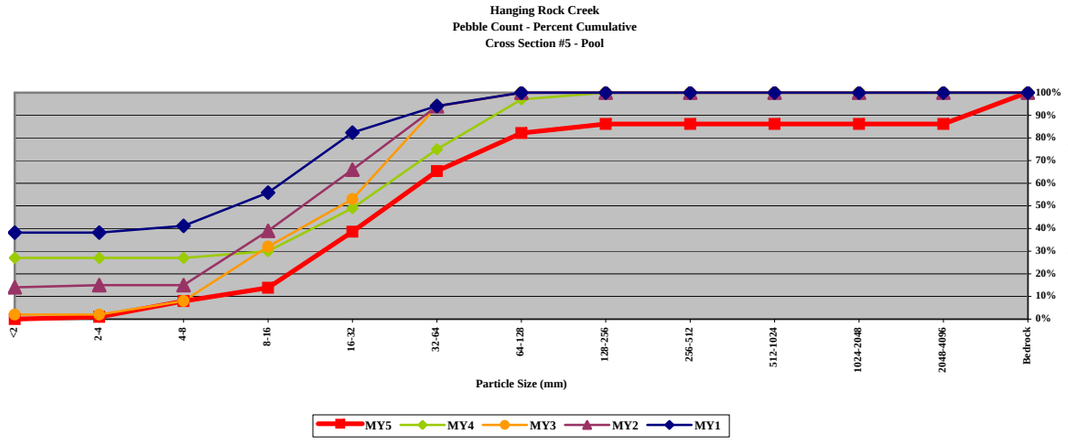
Particle Size Distribution Data









Median grain size for riffle and run X-section pebble counts (N = 4) for monitoring year 5 ranged from medium to coarse gravel.
Pebble count data from same X-sections shown earlier in the report.

Table 5. Verification of Bankfull Events Hanging Rock Creek / Project No. 165			
Date of Data Collection	**Date of Occurrence**	**Method**	**Photo # (if available)**
2004	August 2004	USGS Gage Station 03479000	
2004	August 2004	USGS Gage Station 03479000	
2004	August 2004	USGS Gage Station 03479000	
April 2007	1/14/2005	USGS Gage Station 03479000	
April 2007	11/29/2005	USGS Gage Station 03479000	
April 2007	1/18/2006	USGS Gage Station 03479000	
April 2007	11/16/2006	USGS Gage Station 03479000	
6/25/2008	3/4/2008	Wrack lines	
9/4/2008	8/27/2008	Crest Gauge	

Banfull Flow Events

Based on a proxy USGS real time gauge station and on-site observations, the Hanging Rock project has conveyed bankfull events in 2004, 2005, 2006, and 2008.

Photograph of Hanging Rock Ck during Hurricane Francis in September 2004.

Conclusions

The Hanging Rock stream restoration project has demonstrated geomorphic stability and vegetative success during 5 years of monitoring data collection. Vegetated streambanks and overbank flow events show that project goals are being met. Additionally, native floodplain vegetation is developing, particularly with the natural recruitment of native woody stems. As such, we believe the Hanging Rock project is successful and should be submitted for regulatory closure.

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