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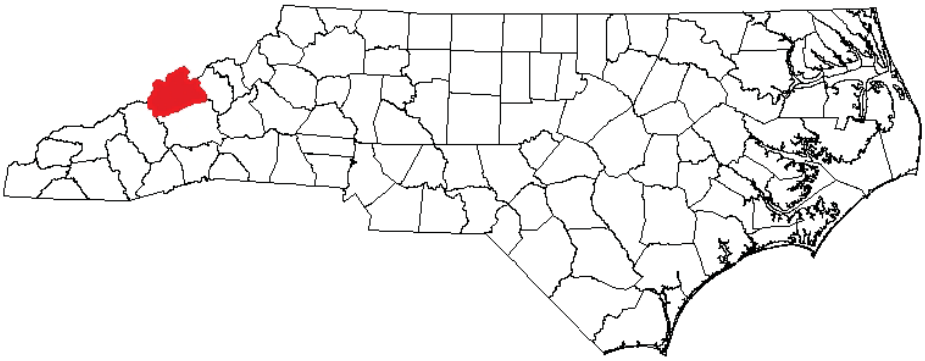
ANNUAL REPORT FOR 2003



Paint Fork Creek Stream Mitigation Site (Fosson Site)
Madison County
WBS Element 32573.4.1
TIP No. A-10WM

Prepared By:
Office of Natural Environment & Roadside Environmental Unit
North Carolina Department of Transportation
December 2003

Summary

The following report summarizes the stream monitoring activities that have occurred during the Year 2003 at the Fosson Site in Madison County. This site was designed and constructed during 1999 by the North Carolina Wildlife Resources Commission (NCWRC). This report provides the monitoring results for the first formal year of monitoring (Year 2003); however, it is actually the fourth year since construction. The Fosson Site will be monitored again in 2004. The actual timeline for formal monitoring will be decided by the Mitigation Review Team.

Based on the overall conclusions of monitoring along Paint Fork Creek and its associated tributaries, the Fosson Site has met the required monitoring protocols for the first year of monitoring. Localized areas of active bank scour and erosion exist; however, immediate stabilization is not required at this time. These areas and all other areas will continue to be monitored during 2004.

Based on information obtained from the USGS, the Fosson Site has met the required hydrologic monitoring protocols. The vegetative success criteria have also been met for the first year of monitoring. No biological sampling has been conducted to-date. It is unknown whether or not this sampling will be conducted as part of overall monitoring activities.

NCDOT will continue stream and vegetation monitoring at the site for 2004.

1.0 INTRODUCTION

1.1 Project Description

The following report summarizes the stream monitoring activities that have occurred during the Year 2003 at the Fosson Site. The site is situated immediately south and adjacent to Paint Fork Road (SR 1530) in the southeastern portion of Madison County (Figure 1). It is approximately 3.0 miles (4.5 kilometers) east-southeast of Mars Hill and nearly 14 miles (22.4 kilometers) north of Asheville. The Fosson Site was constructed as one of four projects to provide mitigation for stream impacts associated with Transportation Improvement Program (TIP) number A-10 in Madison County.

The mitigation project covers approximately 1,700 linear feet along the left bank (facing downstream) of Paint Fork Creek and one of its unnamed tributaries. Design and construction was implemented during 1999 by the North Carolina Wildlife Resources Commission (NCWRC). Stream restoration involved the installation of rootwads and rock vanes and sloping the adjacent streambanks to reduce overall erosion. It also included the installation of native vegetation.

1.2 Purpose

According to the as-built report (NCWRC, 2000), the objectives for this mitigation site were to improve water quality, riparian quality and stability, and fisheries habitat associated with Paint Fork Creek and one of its unnamed tributaries. The following specific objectives were proposed:

- Increase of the overall floodplain areas associated with Paint Fork Creek and its unnamed tributary;
- Reducing slopes along the southern streambanks of Paint Fork Creek and introducing vegetation to resist the effects of flooding;
- Installation of rootwads and/or vanes to alleviate active erosion and increase fisheries habitat;
- Planting of native trees, shrubs, and ground cover that will help to stabilize the stream banks, establish shade, and provide wildlife cover and food.

Successful stream mitigation is demonstrated by a stable channel that does not aggrade or degrade over time. It is also demonstrated by reduced erosion rates, the permanent establishment of native vegetation, and bed features consistent with the design stream type. Vegetation survival is based on federal guidelines denoting success criteria for wetland mitigation. Results of stream monitoring conducted during the 2003 growing season at the Fosson Site are included in this report.

Activities in 2003 reflect the first formal year of monitoring following the restoration efforts; however, it is the fourth year since construction. Included in this report are analyses on stability (primarily the longitudinal profile and cross sections), vegetative monitoring results, and site photographs.

1.3 Project History

The effort to provide stream mitigation for TIP No. A-10 began in 1996 with a Memorandum of Agreement (MOA) between the North Carolina Department of Transportation (NCDOT) with the NCWRC. The MOA was to provide 25,000 feet of mitigation for 9,990 feet of jurisdictional stream impacts. Subsequent amendments to the MOA were made to provide mitigation for additional stream impacts from TIP No. A-10. These amendments resulted in a total mitigation of over 26,000 feet.

The NCDOT worked with representatives from the NCWRC, U.S. Army Corps of Engineers, North Carolina Division of Water Quality, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, Natural Resources Conservation Service and Madison County Soil and Water Conservation District on a Mitigation Review Team. The purpose of the team was to develop criteria and policies for selecting stream reaches for mitigation.

The Fosson Site was one of the sites selected by the Mitigation Review Team to provide compensatory mitigation for TIP No. A-10. The mitigation plan for this mitigation site was developed during 1998 and approved by the team. The NCWRC implemented the project in 1999.

September 1999	Construction Completed.
September 1999	Site Planted with Native Perennial Seed Mix
December 2000	NCWRC Planted Live Stakes and Bare Rooted Trees
March – July 2003	Stream Channel Monitoring (1 yr.)
March – July 2003	Vegetation Monitoring (1 yr.)

1.4 Debit Ledger

The entire Fosson Site was used for TIP No. A-10 to compensate for unavoidable stream impacts related with roadway construction. This project generated 1,700 linear feet of stream credits.

2.0 STREAM ASSESSMENT

2.1 Success Criteria

The success criterion, as defined by the Mitigation Site Monitoring Protocol for the NCWRC/NCDOT Mitigation Program (2003), evaluates channel stability and improvements to fish habitat. Specifically, this evaluation includes all or a combination of the following parameters: channel stability, erosion control, seeding, woody vegetation, and overall response of fish and invertebrate populations for stream mitigation projects. This is to be accomplished using photo reference sites, stream dimension and profile, survival of planted vegetation, and direct sampling of important populations. The chart provided below further details the criteria used to evaluate success or failure at these mitigation sites.

NCWRC/ NCDOT Mitigation Monitoring Criteria

Measurement	Success (requires no action)	Failure	Action
Photo Reference Sites			
Longitudinal Photos Lateral Photos	No significant* aggradation, degradation, or erosion	Significant* aggradation, degradation, or erosion	When significant* aggradation, degradation or erosion occurs, remedial actions will be undertaken.
Channel Stability			
Cross-Sections Longitudinal Profiles Pebble Counts	Minimal evidence of instability (down-cutting, deposition, erosion, decrease in particle size)	Significant* evidence of instability	When significant* evidence of instability occurs, remedial actions will be undertaken.
Plant Survival			
Survival Plots	≥75% coverage in Photo Plots	<75% coverage in Photo Plots	Areas of less than 75% coverage will be re-seeded and/or fertilized, live stakes and bare-rooted trees will be replanted to achieve >80% survival.
Stake Counts	≥80% survival of stakes, 4/m2	<80% survival of stakes, 4/m2	
Tree Counts	≥80% survival of bare-rooted trees	<80% survival of bare-rooted trees	
Biological Indicators (only used for projects with potential to make watershed level changes)			
Invertebrate Pop. Fish Populations	Population measures remain to same or improve	Population measures indicate a negative trend	Reasons for failure will be evaluted and remedial action plans developed and implemented.
Overall success or failure will be based on success of 3 of the 4 criteria.			

*Significance or subjective determinations of success will be determined by a majority decision of the Mitigation Review Team

Federal guidelines for stream mitigation are relatively consistent with those protocols established by the NCWRC and NCDOT. These guidelines include the following main parameters: no less than two bankfull events for the five-year monitoring period, reference photos, plant survivability analyses, channel stability analyses, and biological data if specifically required by permit conditions (USACE, 2003). This report addresses all of the above mentioned parameters for both the NCWRC/NCDOT protocols and federal guidelines aside from shading and biological data, which was not required at this site.

Natural streams are dynamic systems that are in a constant state of change. Longitudinal profile and cross section surveys will differ from year to year based on changes in the watershed. Natural channel stability is achieved by allowing the stream to develop a proper dimension, pattern, and profile such that, over time, channel features are maintained and the stream system neither aggrades nor degrades. A stable stream consistently transports its sediment load, both in size and type, associated with local deposition and scour. Channel instability occurs when the scouring process leads to degradation, or excessive sediment deposition results in aggradation (Rosgen, 1996). The following surveys were conducted in support of the monitoring assessment:

- Longitudinal Profile Survey. This survey addressed the overall slope of the reach, as well as slopes between bed features. The bed features are secondary delineative criteria describing channel configuration in terms of riffle/pools, rapids, step/pools, cascades and convergence/divergence features which are inferred from channel plan form and

gradient. The surveys are compared on a yearly basis to note and/or compare aggradation, degradation, head cuts, and areas of mass wasting. The longitudinal profile is expected to change from year to year. Significant changes may require additional monitoring.

- Cross Section Surveys. These surveys addressed the following characteristics at various locations along the reach: entrenchment ratio, width/depth ratio, and dominant channel materials. The entrenchment ratio is a computed index value used to describe the degree of vertical containment. The width/depth ratio is an index value which indicates the shape of the channel cross section. The dominant channel materials refer to a selected size index value, the D_{50}, representing the most prevalent of one of six channel material types or size categories, as determined from a channel material size distribution index.

2.2 Stream Description

2.2.1 Pre-Construction Conditions

The Paint Fork Creek at the Fosson Site classified as a C4b stream type according to the Rosgen Classification of Natural Rivers. This was subsequently based on the low sinuosity, entrenchment, width/depth ratio, and substrate type. Sinuosity was low as compared with other C stream types (NCWRC, 2000). The unnamed tributary (UT) was characteristic of a B stream-type that had degraded into a G stream-type. The conditions of both channels have been strongly influenced by previous channelization and agriculture processes at both the site and throughout the watershed.

The main channel was eroding along most of this reach due to the presence of a berm along the north bank and row cropping on the south bank. The row cropping had limited the width of riparian vegetation between the field and the stream. Deep-water habitat was rare with few pools present. Bedrock was one of the contributing factors. Two locations were noted along the reach whereby the bedrock was causing additional erosion (NCWRC,2000).

2.2.2 Post-Construction Conditions

The mitigation of Paint Fork Creek and its unnamed tributary involved the construction of j-hook vanes, rock vanes, rootwad revetments, and additional bank sloping. Coir logs were used to further define and stabilize the streambanks. Throughout the entire reach the interberm was maintained, enhanced, or created as channel modifications were made. Unfortunately, the adjoining landowner along the right streambank withdrew from the program after designs and recommendations were made. The landowner did eventually carry out the recommended work. A conservation easement was ultimately established along the left streambank.

2.2.3 Monitoring Conditions

Paint Fork Creek was initially classified as a C4b stream type according to the Rosgen Classification of Natural Rivers. A total of six cross sections (five along Paint Fork Creek and one along its tributary) were surveyed. A comparison of channel morphology is presented in Table 1. Channel stationing is provided on Figure 2.

Table 1. Abbreviated Morphological Summary (Fosson Site)

Variable		Paint Fork Creek - Main Channel (Combined Cross Sections #7 Thru #12)						
		Pre-Const.*	As-Built*	Year 1	Year 2	Year 3**	Year 4**	Year 5**
Drainage Area (mi²)		12.9	12.9	12.9	12.9	12.9	12.9	12.9
Bankfull Width (ft)	Mean	-	-	25.1				
Bankfull Mean Depth (ft)	Mean	-	-	2.02				
Width/Depth Ratio	Mean	-	-	16.6				
Bankfull Cross Sectional Area (ft²)	Mean	-	-	59.9				
Maximum Bankfull Depth (ft)	Mean	-	-	3.4				
Width of Floodprone Area (ft)	Mean	-	-	158.4				
Entrenchment Ratio	Mean	-	-	5.16				
Slope		0.007	-	0.007				
Particle Sizes								
D_{16} (mm)		-	-	0.125				
D_{35} (mm)		-	-	0.5				
D_{50} (mm)		16.0	-	11.3				
D_{84} (mm)		-	-	32.0				
D_{95} (mm)		-	-	45.0				

* According to the NCWRC, comparisons of pre-construction, as-built, and monitoring data are not valid due to intangible factors. Monitoring data for subsequent years should be used as the basis of comparison.
** Year 3 through Year 5 Formal Monitoring has not been defined and may not be required.

2.3 Results of the Stream Assessment

2.3.1 Site Data

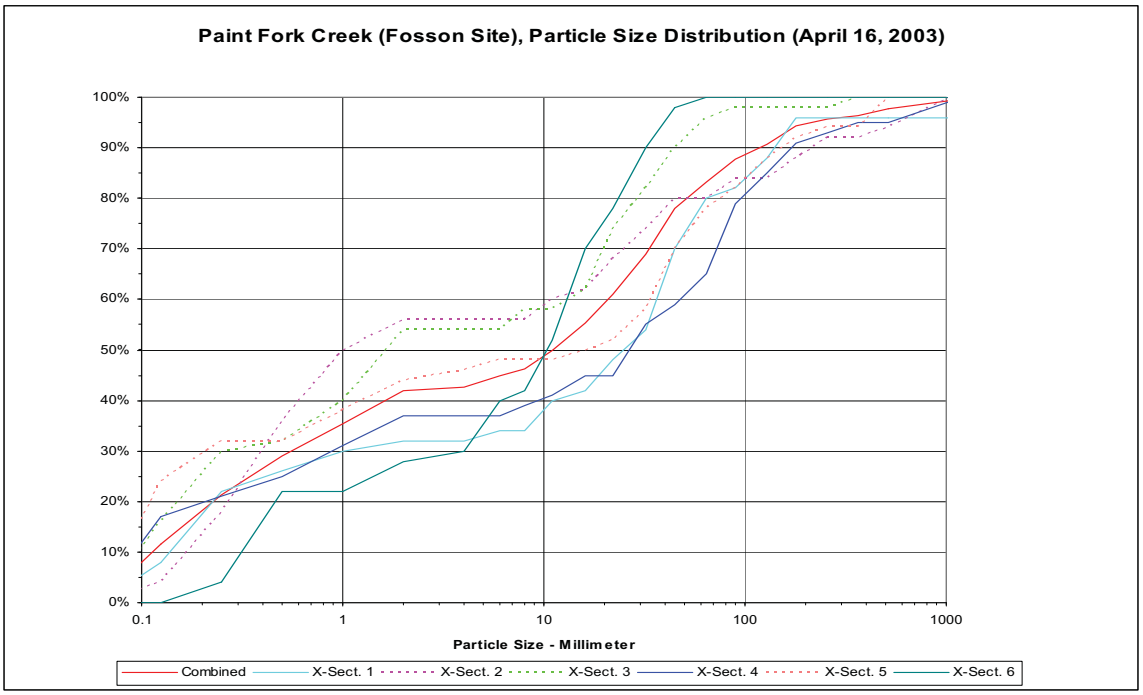
The assessment included the re-survey of six cross sections of the two streams and the longitudinal profile of Paint Fork Creek established by the NCWRC after construction. The length of the profile along Paint Fork Creek was approximately 1,000 linear feet. The profile associated with the UT was not surveyed. Cross section locations were subsequently based on the stationing of the longitudinal profile and are presented below. The locations of the cross sections and longitudinal profiles are shown in Appendix A.

- Cross Section #1. Paint Fork Creek, Station 9+66, midpoint of run
- Cross Section #2. Paint Fork Creek, Station 8+06, midpoint of run
- Cross Section #3. Paint Fork Creek, Station 5+86, midpoint of run
- Cross Section #4. Paint Fork Creek, Station 4+68, end of riffle
- Cross Section #5. Paint Fork Creek, Station 2+79, midpoint of run
- Cross Section #6. Unnamed Tributary, approximately 100 feet upstream on confluence, midpoint of riffle

All six cross sections have remained intact based on comparisons with as-built data and visual observations. Several benchmarks and existing stakes associated with the as-built surveys were not found; therefore exact data comparisons were not feasible. The Year 2003

data will be used for future comparisons. Based on the comparison of cross section survey results with the as-built sections, all six cross sections appear stable. These cross sections will be monitored during the next several years to determine the actual extent of aggradation or degradation. Survey data will also vary depending on actual location of rod placement and alignment; however, this information should remain similar in overall appearance. The cross section comparison is presented in Appendix B.

Pebble counts were taken at each cross section as a means to determine the extent of change in bed material during the monitoring period. No existing data was available Paint Fork Creek or its tributary. The comparison of pebble counts taken during the Year 2003 monitoring period noted that the combined D_{50} (50 percent of the sampled population is equal to or finer than the representative particle diameter) for the two streams was approximately 8.0 mm, which is indicative of a gravel-bed stream. The D_{50}s associated with Cross Sections #2 and #3 were 0.5 mm and 1.0 mm, respectively, and characteristic of a sand-bed stream type. However, the overall combined D_{50} of Paint Fork Creek was 11.3 mm. This is likely a result of watershed problems outside and upstream of the Fosson Site. The introduction of fine materials and the overall change in bedload across these two cross sections will be monitored. A chart depicting the particle size distributions for Paint Fork Creek and its tributary is presented below. Comparisons will be made between 2003 data and future monitoring efforts.



A longitudinal profile survey was conducted on the predetermined segment of Paint Fork Creek. Bank stability was assessed during the cross section and longitudinal profile surveys. Several areas of active scouring were observed. Descriptions relating to these areas are as follows:

Paint Fork Creek (Main Stem)

- Station 2+72. Active scouring was noted around the rootwad on the left bank (facing downstream). The scour does not appear to be compromising the structure. This area should be assessed during the next monitoring period to determine remedial actions, if necessary.
- Station 4+19. A small center bar was observed during low flow conditions; however, no active erosion was noted along the adjacent stream banks. This area should be assessed during the next monitoring period to determine remedial actions, if necessary.
- Station 5+03. Active erosion was noted along both stream banks at the bedrock seam crossing the channel. This area should be assessed during the next monitoring period to determine remedial actions, if necessary.

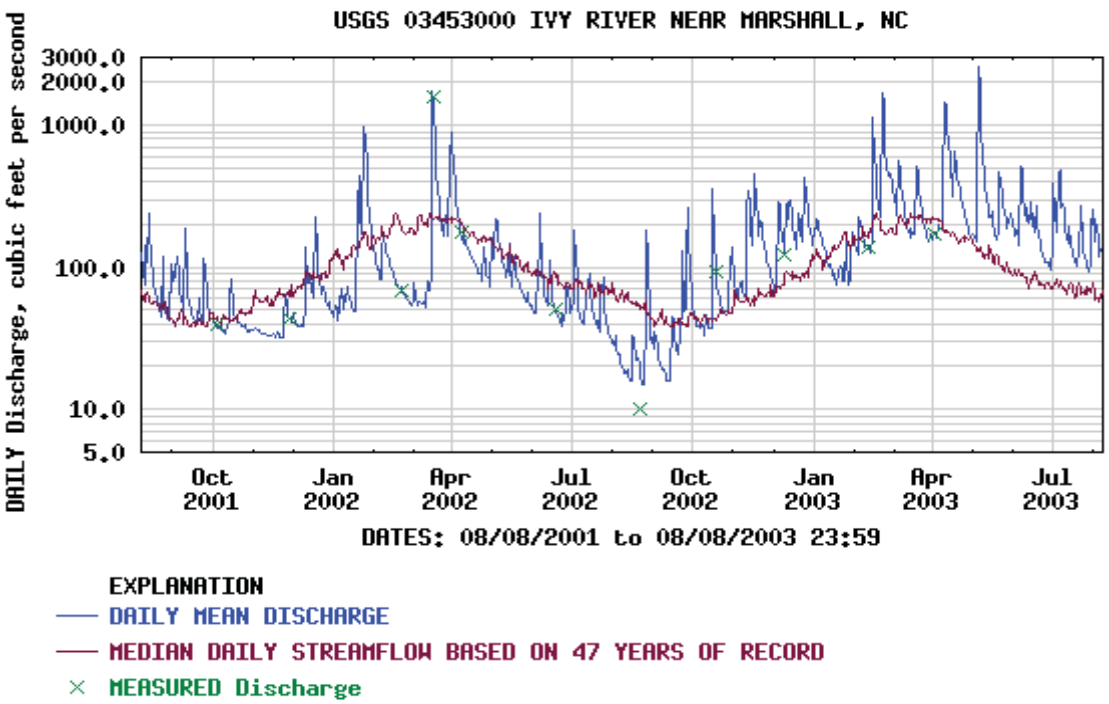
UT to Paint Fork Creek

- Cross Section #6. Deposition was noted along channel. The banks remain stable. This area should be assessed during the next monitoring period to determine remedial actions, if necessary.

2.3.2 Climatic Data

Monitoring requirements state that at least two bankfull events must be documented through the five-year monitoring period. No surface water gages exist on Paint Fork Creek or its tributaries. A review of known U.S. Geological Survey (USGS) surface water gages identified two gages within 10 miles (16 kilometers) of the mitigation site: one along the French Broad River approximately one mile downstream of Marshall and one along the Ivy River at the US 25/70 crossing between Marshall and Weaverville, immediately northwest of the Madison and Buncombe County boundary.

The Ivy River gage was utilized for this report since it is downstream and part of the overall watershed of Paint Fork Creek. It was also the smaller of the two gages (158 square-mile drainage area as compared to the 1,332 square-mile drainage area associated with the French Broad). The Ivy River gage more accurately reflects hydrology and precipitation in the project area. It is situated in USGS Hydrologic Unit 06010105. Datum of the gage is 1,700.41 feet above sea level NGVD29. Based on the drainage area associated with the gage, the correlated bankfull discharge according to the NC Rural Mountain Regional Curves (USACE, 2003) is between 450 and 500 cubic feet per second (cfs). A review of peak flows was conducted for the period between August 2001 and August 2003. According to the graph, there were 14 bankfull events occurring during this period, with seven of the events happening in 2003. Approximately five of these events over the two year period exceeded 1,000 cfs, well above the bankfull discharge. The USGS graph depicting these peak flows is presented below.



2.4 Conclusions

Paint Fork Creek and its tributary remain stable. Small, isolated areas of degradation exist along the two reaches; however, work associated with corrective actions would not likely result in overall benefit at this time. The NCDOT will monitor these areas of degradation again in 2004.

All six of the cross sections along Paint Fork Creek and its tributary remain stable. Monitoring associated with these cross sections will continue through 2004. In addition, the sediment load at Cross Sections #2 and #3 will also be monitored to determine the change, if any, in overall bed particle sizes.

Based on information obtained from the USGS, the Fosson Site has met the required monitoring protocols for hydrology. No supplemental work is proposed at this time.

3.0 VEGETATION

3.1 Success Criteria

The NCDOT will monitor the Paint Fork Creek Site for five years or until success criteria is met. A 320 stems per acre survival criterion for planted seedlings will be used to determine success for the first three years. The required survival criterion will decrease by 10 percent per year after the third year of vegetation monitoring (i.e., for an expected 290 stems per acre for year 4, and 260 stems per acre for year 5). The number of plants of one species will not exceed 20 percent of the total number of plants of all species planted.

3.2 Description of Species

According to the As-Built Report for the Fosson Mitigation Site, Paint Fork Creek, Madison County (2000), the following species were planted along the streambanks:

Live Stakes

Black willow (*Salix nigra*)
Silky willow (*Salix sericea*)
Silky dogwood (*Cornus amomum*)

Bare Rooted Trees

Black willow (*Salix nigra*)
Red-osier dogwood (*Cornus stonoifera*)
Willow oak (*Quercus phellos*)
River birch (*Betula nigra*)
Black walnut (*Juglans nigra*)
Elderberry (*Sambucus canadensis*)
Green ash (*Fraxinus pennsylvanica*)

Permanent Seeding Mix

Sensitive fern (*Onoclea sensibilis*)
Joe pye weed (*Eupatorium fistulosa*)
Swamp milkweed (*Asclepias incarnata*)
Eastern gamagrass (*Tripascum dactyloides*)
Creeping spikerush (*Eleocharis palustris*)
Green bulrush (*Scirpus atrovirens*)
Hop sedge (*Carex lupilina*)
Rice cut grass (*Leersia oryzoides*)
Soft rush (*Juncus effusus*)
Softstem bulrush (*Scirpus validus*)
Three square spikerush (*Scirpus americanus*)
Virginia wild rye (*Elymus virginicus*)
Woolgrass (*Scirpus cyperinus*)
Deertongue (*Panicum clandestinum*)
Button bush (*Cephalanthus occidentalis*)
Elderberry (*Sambucus canadensis*)
Red chokeberry (*Aronia arbutifolia*)
Silky dogwood (*Cornus amomum*)
Winterberry (*Ilex verticillata*)
Blackgum (*Nyssa sylvatica*)
Green ash (*Fraxinus pennsylvanica*)
Red maple (*Acer rubrum*)
Pin oak (*Quercus palustris*)
Black cherry (*Prunus serotina*)
Silver maple (*Acer saccharium*)

3.3 Plot Descriptions

Several vegetation plots were installed by the NCWRC during and immediately after construction. Since these plots were not staked and information regarding species was not available, eight new plots were randomly established along the left streambanks and floodplain within the project area. No plots were established on the right streambank due to the narrow riparian buffer. These eight plots included two large 1,000 square-foot areas along the left bank of Paint Fork Creek; Tree Plot A downstream of Point F7 on As-Built schematic presented in Appendix A and Tree Plot B near Point F4. The remaining six plots were one-meter square plots (12.1 square feet). Stakes were placed at all four edges of the 1,000 square-foot plots and at the two opposing edges of the 12.1 square-foot plots. These stakes were flagged and labeled for future identification. Vegetation (trees) within the two 1,000 square-foot plots were flagged, tagged, and numbered. The vegetation associated with the 12.1 square-foot plots were only flagged. Due to the narrow riparian area and ease of access, the locations of these plots were not surveyed.

Tree Plot A is oriented in an east-west direction between Cross Sections #4 and #5 along the left streambank. Silky dogwood, river birch, and elderberry are the dominant woody

species within the plot. Section 3.4 provides numerical counts for species found within Tree Plots A and B, as well as the six small plots.

Tree Plot B is also situated along the left streambank, between Cross Sections #2 and #3. It is oriented in an east-west direction. Dominant woody species observed silky dogwood, willow oak, river birch, elderberry, and green ash.

3.4 Results of Vegetation Monitoring

Vegetation Monitoring Statistics, by Plot																	
Plot No. (Type)	**Black Willow**	**Silky Willow**	**Silky Dogwood**	**Red-osier Dogwood**	**Willow Oak**	**River Birch**	**Black Walnut**	**Elderberry**	**Green Ash**	**Red Maple**	**Total 2003 (Year 1)**	**Total 2004 (Year 2)**	**Total 2005 (Year 3)**	**Total 2006 (Year 4)**	**Total 2007 (Year 5)**	**Total (at planting)**	**Density (Trees/Acre)**
Plot A (50'x20')			15			2		17			34					34	1,481
Plot B (50'x20')			7		3	4		6	2		22					22	958
											AVERAGE DENSITY						**1,219**

Vegetation Monitoring Statistics, by Plot																	
Plot No. (Type)	**Black Willow**	**Silky Willow**	**Silky Dogwood**	**Red-osier Dogwood**	**Willow Oak**	**River Birch**	**Black Walnut**	**Elderberry**	**Green Ash**	**Red Maple**	**Total 2003 (Year 1)**	**Total 2004 (Year 2)**	**Total 2005 (Year 3)**	**Total 2006 (Year 4)**	**Total 2007 (Year 5)**	**Total (at planting)**	**Density (Trees/Acre)**
Plot 1 (1 meter grid)	1		1								2					2	7,200
Plot 2 (1 meter grid)								1			1					1	3,600
Plot 3 (1 meter grid)			1								1					1	3,600
Plot 4 (1 meter grid)											0					0	0
Plot 5 (1 meter grid)											0					0	0
Plot 6 (1 meter grid)											0					0	0
											AVERAGE DENSITY						**2,400**

Site Notes:
Vegetation plots were established during the first year of monitoring. Several plots were installed during construction; however, these plots could not be located. Canary grass (*Phalaris* sp.) dominates the herbaceous stratum at the site, especially along Paint Fork Creek. This species is considered to be invasive; however, it provides excellent ground cover and rooting stability during the growing season. Specific notes regarding each plot are presented below.

Tree Plot A. Eight volunteer black locusts (*Robinia* sp.) were observed in the plot. Herbaceous species included canary grass, Japanese knotweed (*Fallopia japonica*), blackberry (*Rubus* sp.), vetch (*Vicia* sp.), goldenrod (*Solidago* sp.), plantain (*Plantago* sp.), onion (*Allium* sp.), and henbit (*Lamium* sp.).

Tree Plot B. No woody volunteers were observed. Herbaceous species included canary grass, Japanese knotweed, blackberry, plantain, henbit, and chickweed (*Stellaria* sp.).

Plot 1. Three silky dogwoods, three river birch, two black willows, and one willow oak were observed within five feet of the plot. Fescue (*Festuca* sp.) and dock (*Rumex* sp.) were observed in and immediately adjacent to the vegetation plot.

Plot 2. One green ash and one elderberry were observed within five feet of the plot. Canary grass and blackberry were observed in and immediately adjacent to the vegetation plot.

Plot 3. Three silky dogwoods, two green ash, and one black willow were observed within five feet of the plot. Fescue and onion were observed in and immediately adjacent to the vegetation plot.

Plot 4. Canary grass was observed in and immediately adjacent to the plot. One silky dogwood and one green ash were noted within five feet of the vegetation plot.

Plot 5. Canary grass and soft rush (*Juncus* sp.) were observed in and immediately adjacent to the plot. One river birch was noted within five feet of the vegetation plot.

Plot 6. Canary grass, soft rush, and multiflora rose (*Rosa multiflora*) were observed in and immediately adjacent to the plot. No woody stems were noted within five feet of the vegetation plot.

3.5 Conclusions

The 2003 vegetation monitoring of the site represents an average density of more than 1,000 trees per acre, well above the minimum required by the success criteria.

4.0 BIOLOGICAL INDICATORS

Personnel with the Tennessee Valley Authority (TVA) were to conduct biological sampling along Paint Fork Creek and its tributary. It is unknown at this time whether or not the sampling has been conducted at the mitigation site. If this information becomes available, it will be inserted into the report at a later time.

5.0 OVERALL CONCLUSIONS

The Fosson Site has met the required monitoring protocols for the first year of monitoring. Localized areas of active bank scour and erosion exist; however, immediate stabilization is not required at this time. These areas and all other areas will continue to be monitored during 2004. If significant problems are noted during the next monitoring period, NCDOT may conduct supplemental corrective-action work. This work would primarily include structure rehabilitation, bank stabilization, and additional riparian vegetation planting.

Based on information obtained from the USGS, the Fosson Site has met the required hydrologic monitoring protocols. The vegetative success criteria have also been met for the

first year of monitoring. No biological sampling has been conducted to-date. It is unknown whether or not this sampling will be conducted as part of overall monitoring activities.

NCDOT will continue stream and vegetation monitoring at the site for 2004.

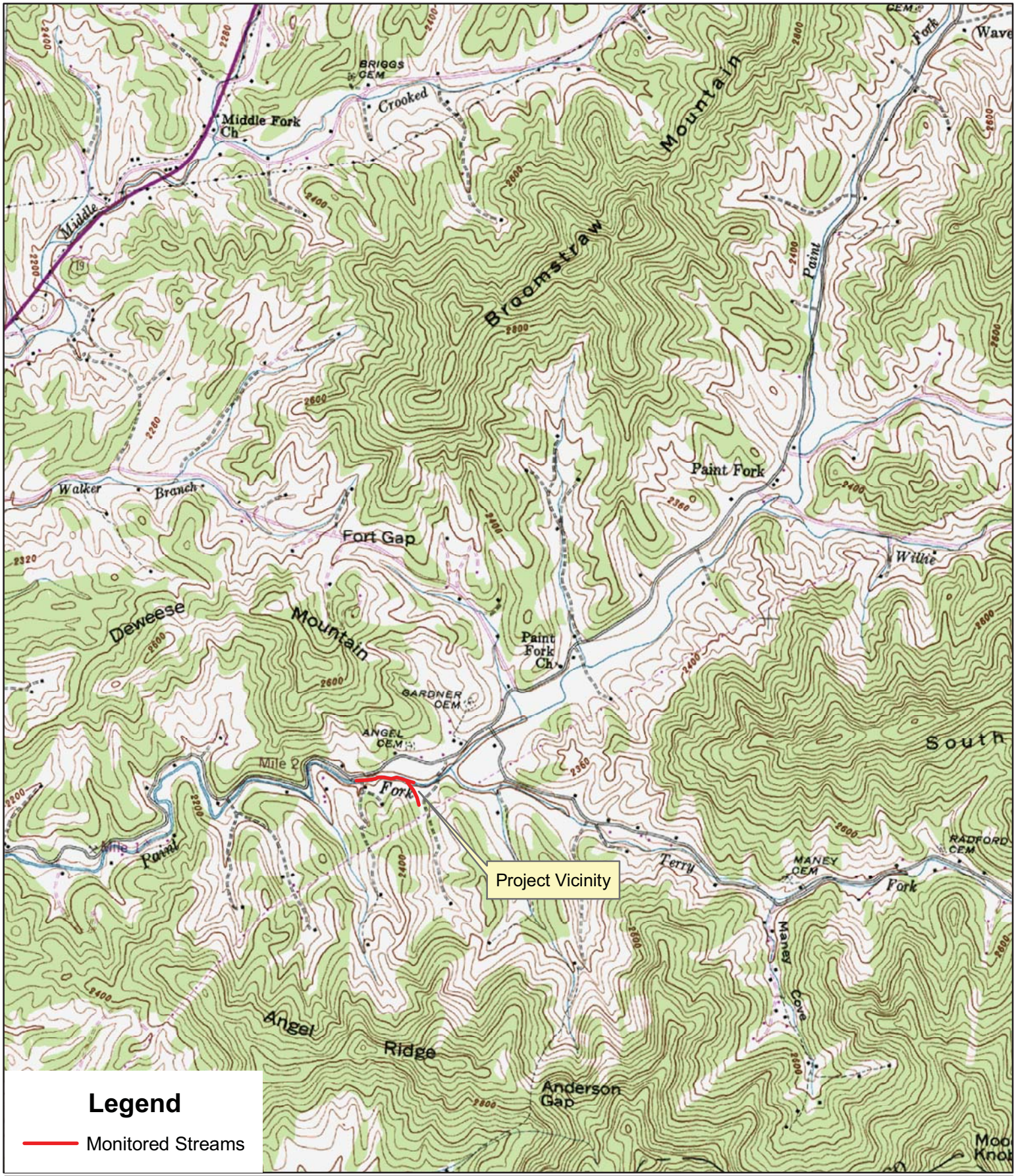
6.0 REFERENCES

North Carolina Wildlife Resources Commission (NCWRC), 2000. As-built Report for the Fosson Mitigation Site, Paint Fork Creek, Madison County.

Rosgen, D.L, 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, Colorado.

US Army Corps of Engineers (USACE), 2003. Stream Mitigation Guidelines. Prepared with cooperation from the US Environmental Protection Agency, NC Wildlife Resources Commission, and the NC Division of Water Quality.

US Geological Survey (USGS), 2003. Real-time Data for USGS 03453000 Ivy River near Marshall, NC. http://waterdata.usgs.gov/nc/nwis.



MULKEY ENGINEERS & CONSULTANTS

0 1,000 2,000 3,000 4,000 Feet

0 200 400 600 800 1,000 Meters

1:24,000

USGS 7.5-Minute Topographic Quadrangle: Barnardsville, NC

Figure No.

1

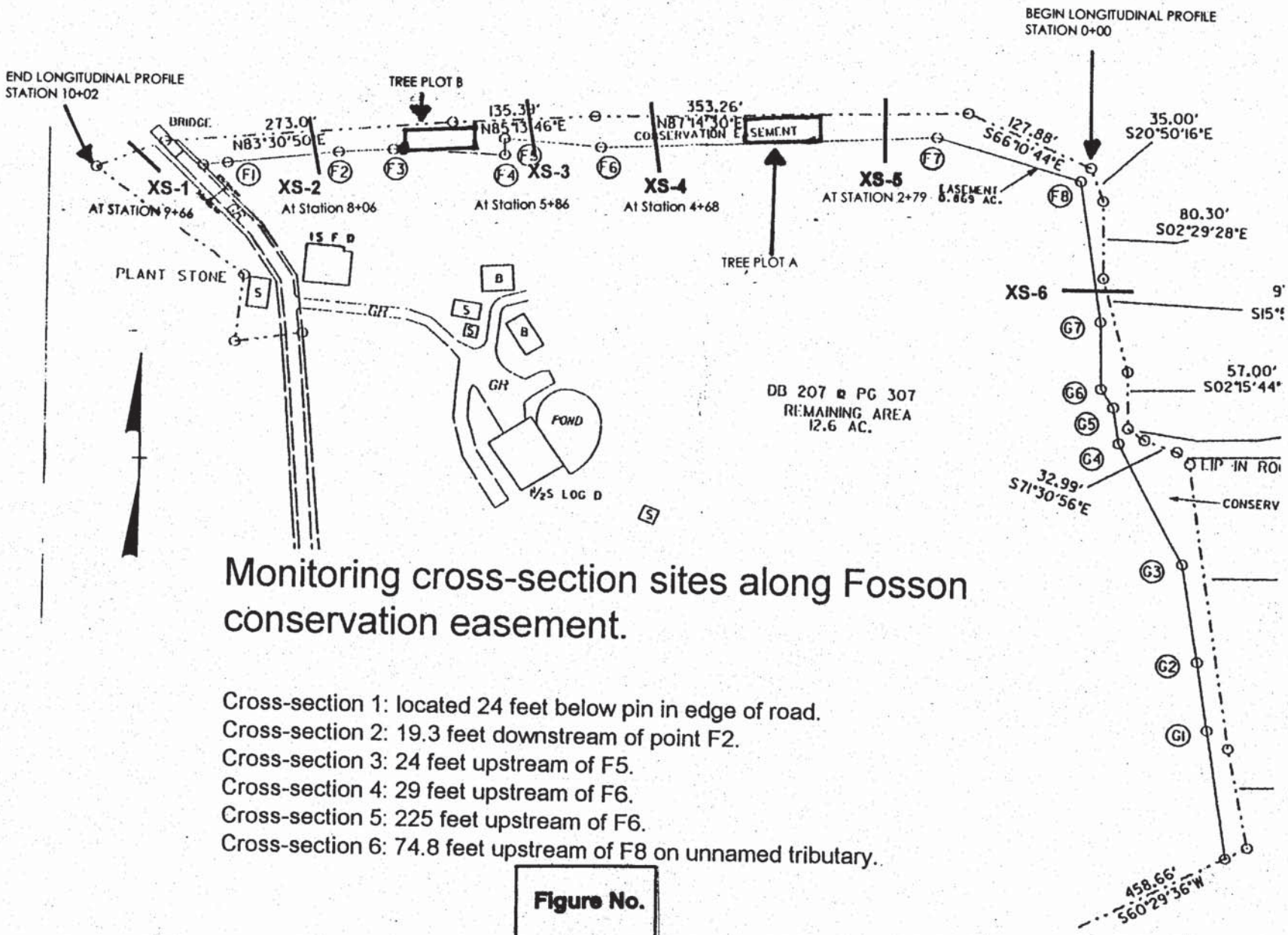
Prepared For:

PROJECT VICINITY

Fosson Stream Mitigation Site

Paint Fork Creek

Madison County, North Carolina



Monitoring cross-section sites along Fosson conservation easement.

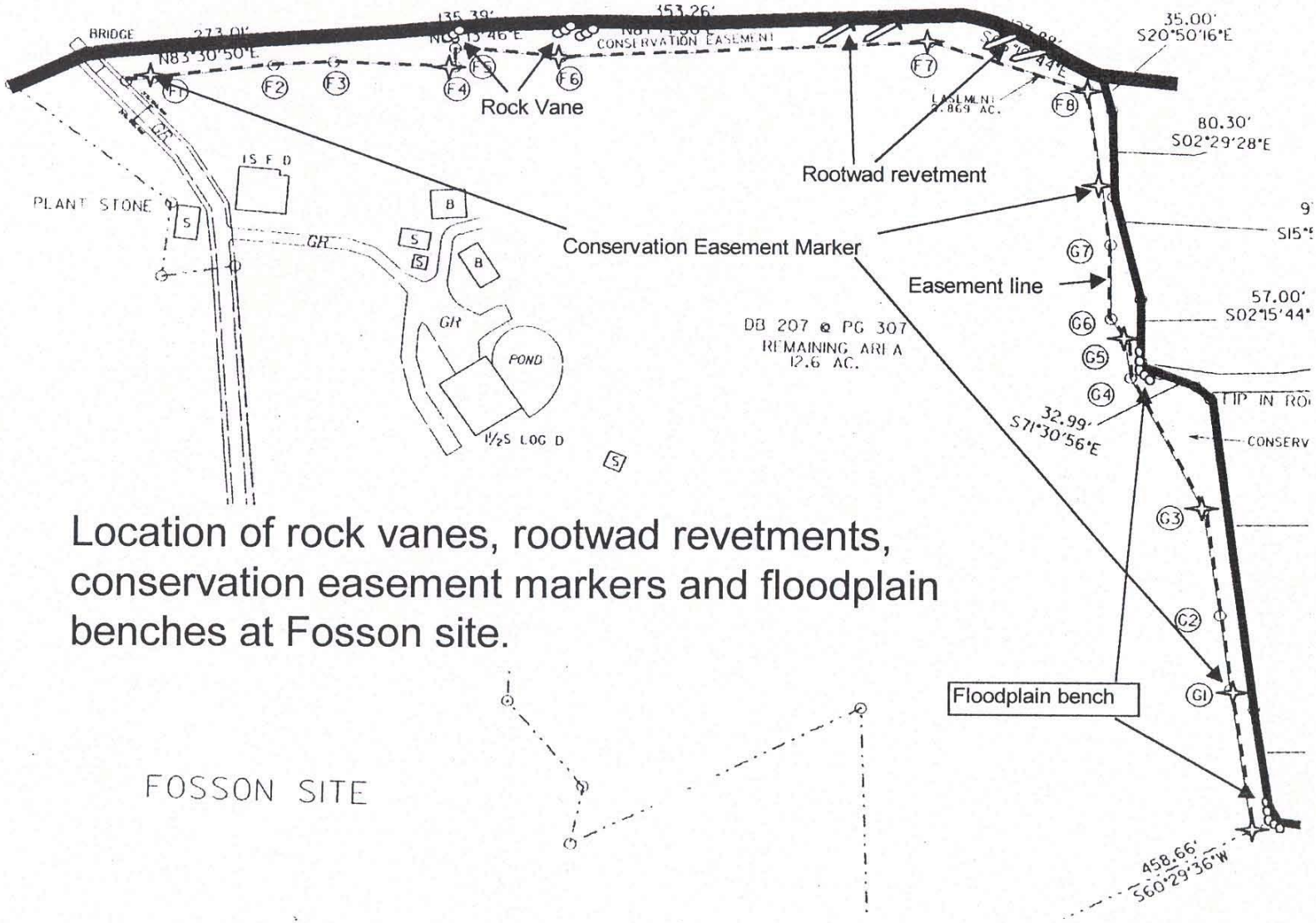
Cross-section 1: located 24 feet below pin in edge of road.
Cross-section 2: 19.3 feet downstream of point F2.
Cross-section 3: 24 feet upstream of F5.
Cross-section 4: 29 feet upstream of F6.
Cross-section 5: 225 feet upstream of F6.
Cross-section 6: 74.8 feet upstream of F8 on unnamed tributary.

Figure No.

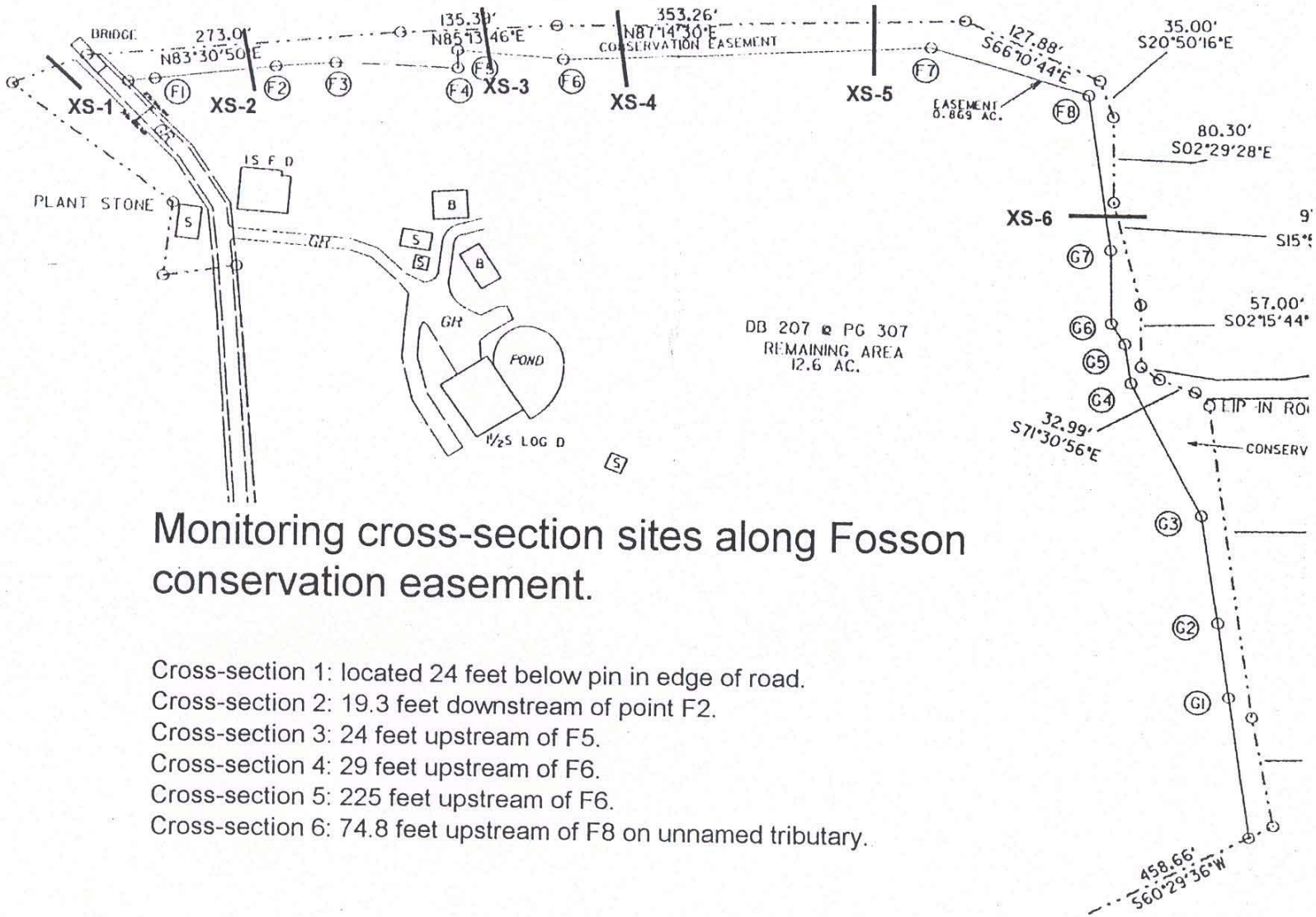
2

Paint Fork Creek – Fosson Site

APPENDIX A
AS-BUILT DATA

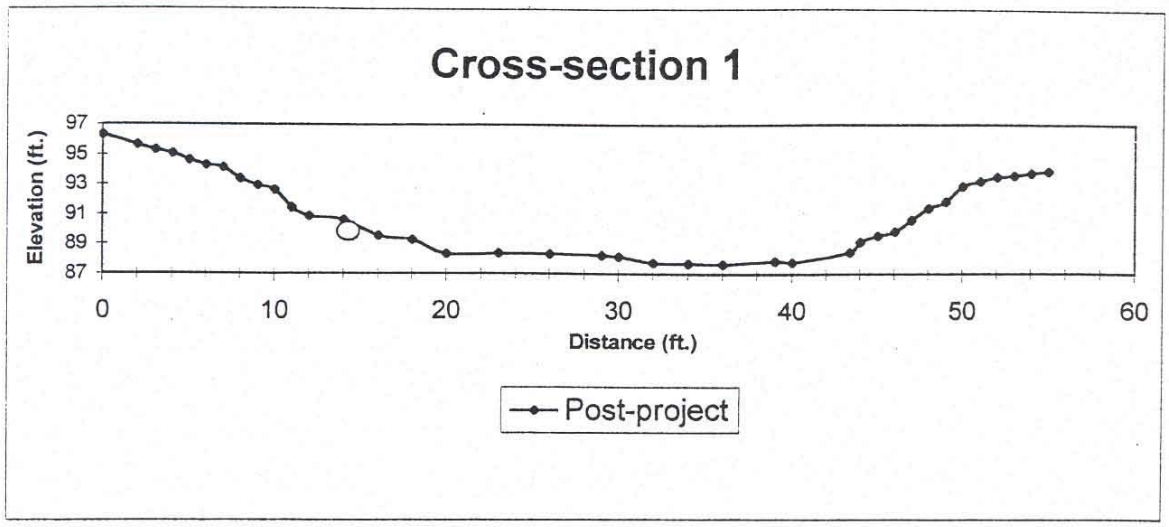


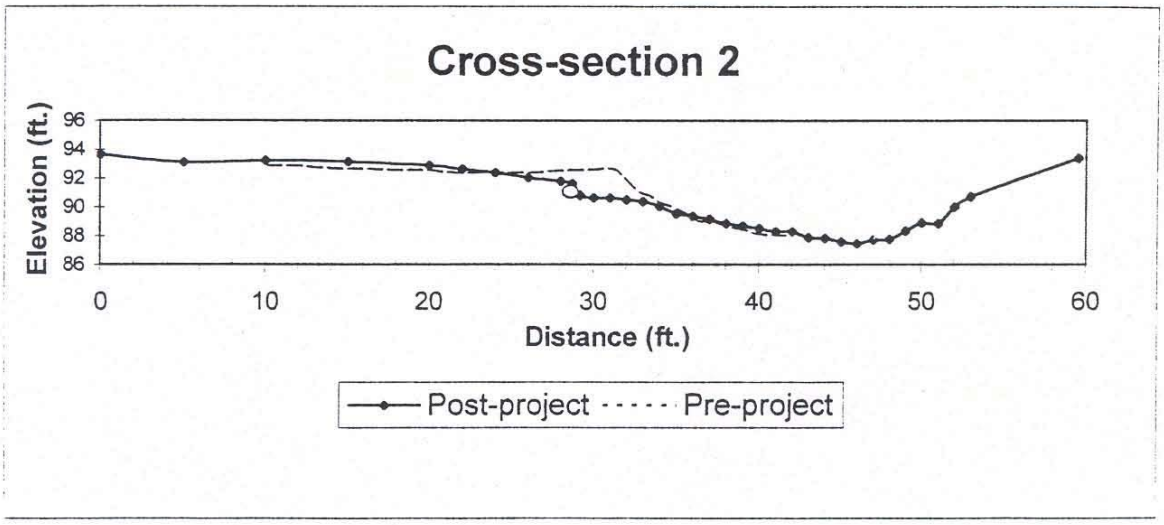
Location of rock vanes, rootwad revetments, conservation easement markers and floodplain benches at Fosson site.

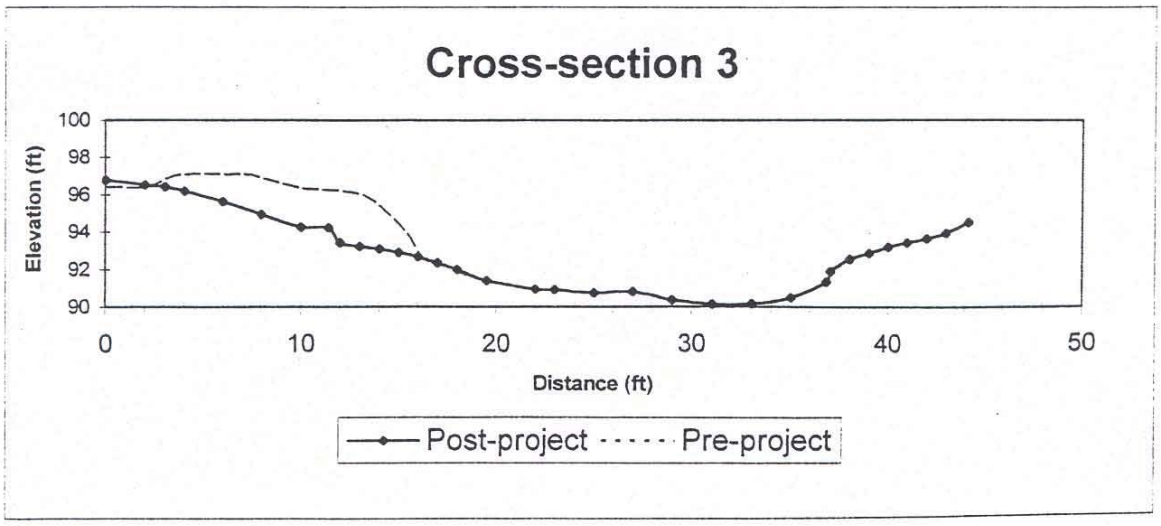


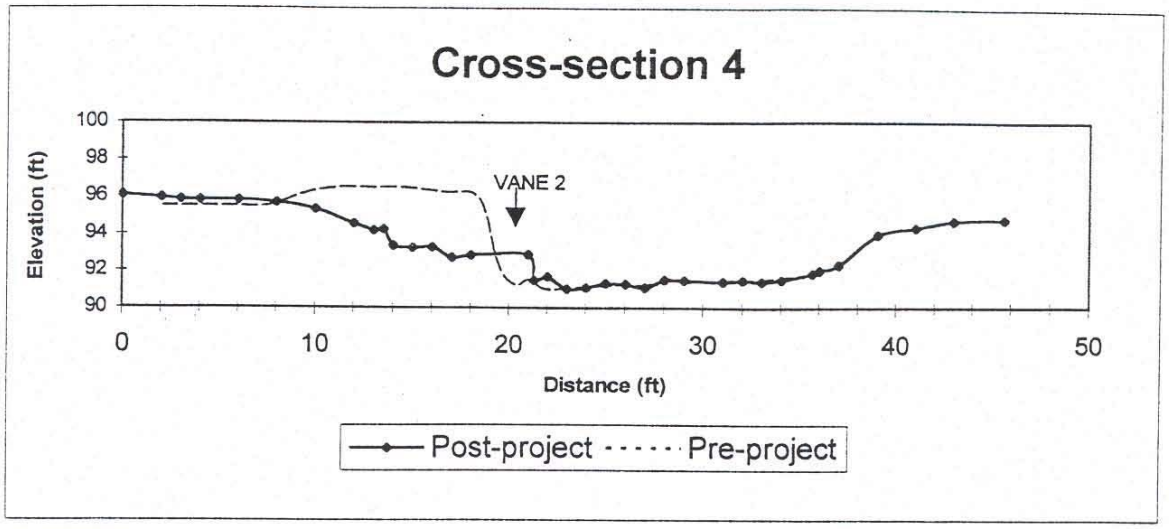
Monitoring cross-section sites along Fosson conservation easement.

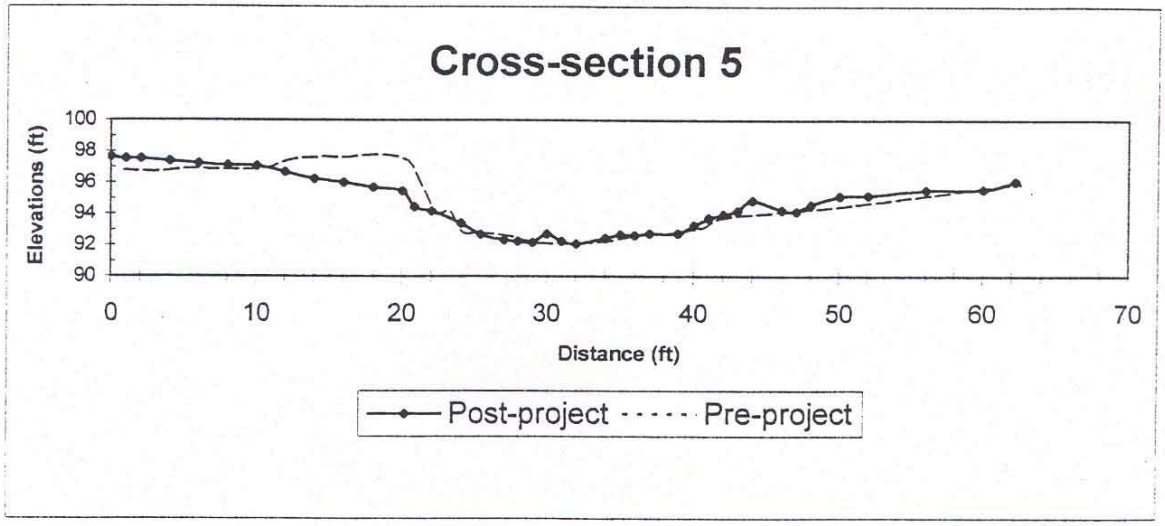
Cross-section 1: located 24 feet below pin in edge of road.
Cross-section 2: 19.3 feet downstream of point F2.
Cross-section 3: 24 feet upstream of F5.
Cross-section 4: 29 feet upstream of F6.
Cross-section 5: 225 feet upstream of F6.
Cross-section 6: 74.8 feet upstream of F8 on unnamed tributary.

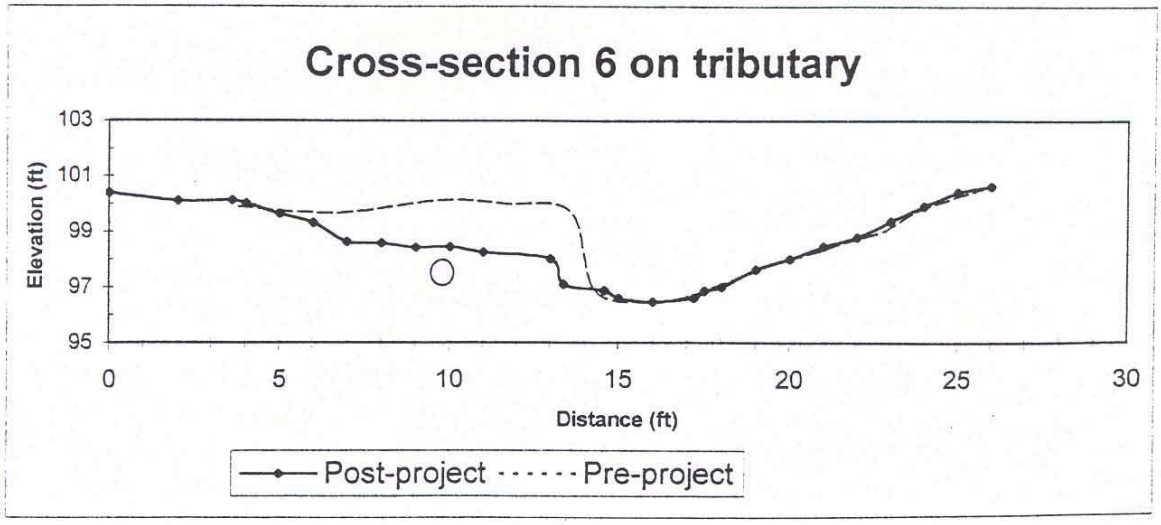

Cross-section 1
Elevation (ft.)
97
95
93
91
89
87
0
10
20
30
40
50
60
Distance (ft.)
Post-project

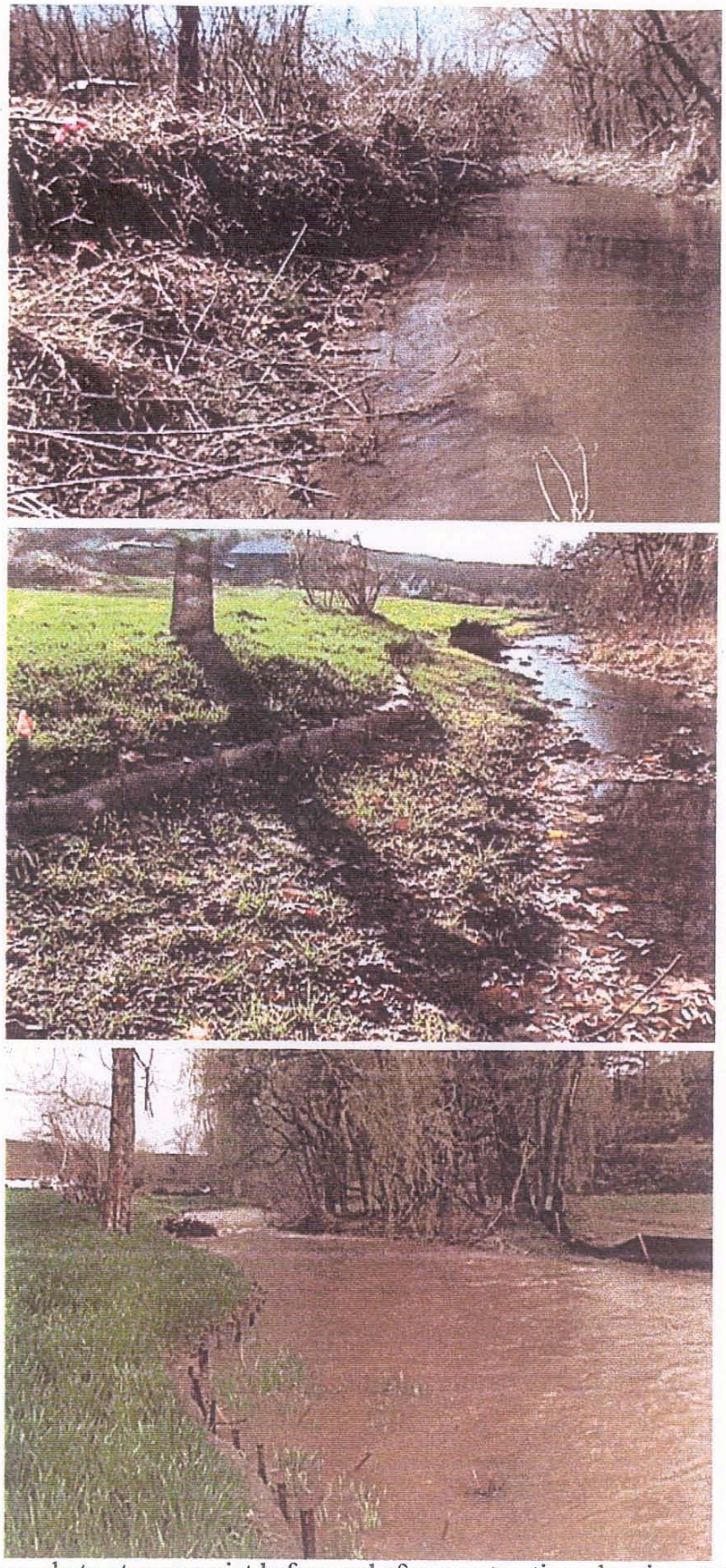

Cross-section 2
Elevation (ft.)
96
94
92
90
88
86
0
10
20
30
40
50
60
Distance (ft.)
Post-project
Pre-project


Cross-section 3
Elevation (ft)
100
98
96
94
92
90
0
10
20
30
40
50
Distance (ft)
Post-project
Pre-project


Cross-section 4
Elevation (ft)
100
98
96
94
92
90
VANE 2
0
10
20
30
40
50
Distance (ft)
Post-project
Pre-project


Cross-section 5
Elevations (ft)
100
98
96
94
92
90
0
10
20
30
40
50
60
70
Distance (ft)
Post-project
Pre-project

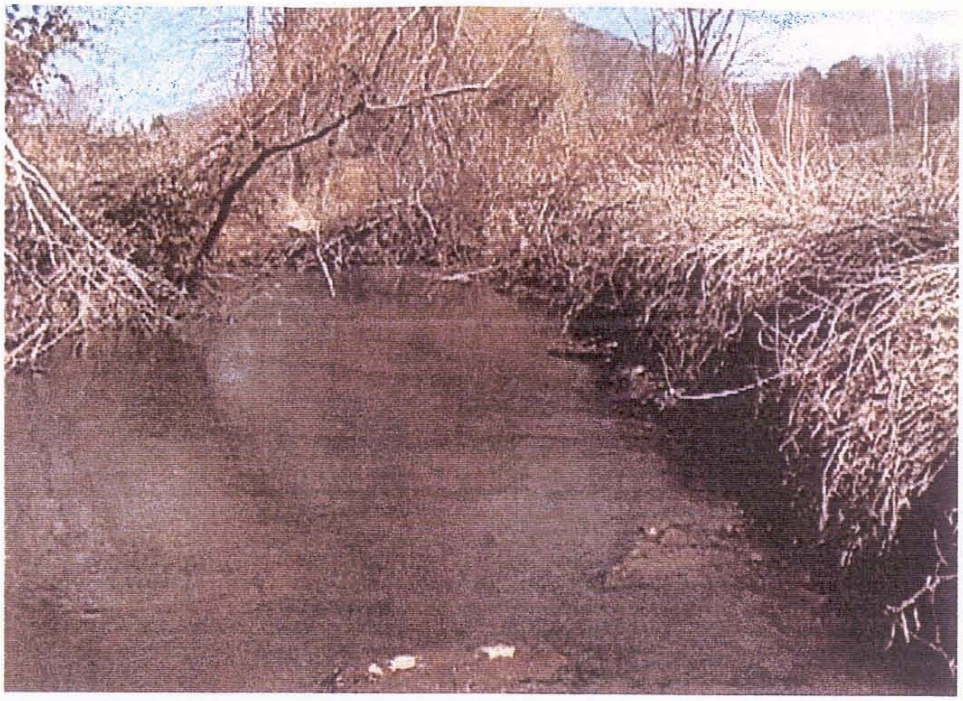

Cross-section 6 on tributary
Elevation (ft)
103
101
99
97
95
0
5
10
15
20
25
30
Distance (ft)
Post-project
Pre-project



Downstream photo at same point before and after construction, showing sycamore for reference. Bottom photo shows same site during bankfull event.

Downstream photo of same location showing lower rootwad revetment and banks before and after construction

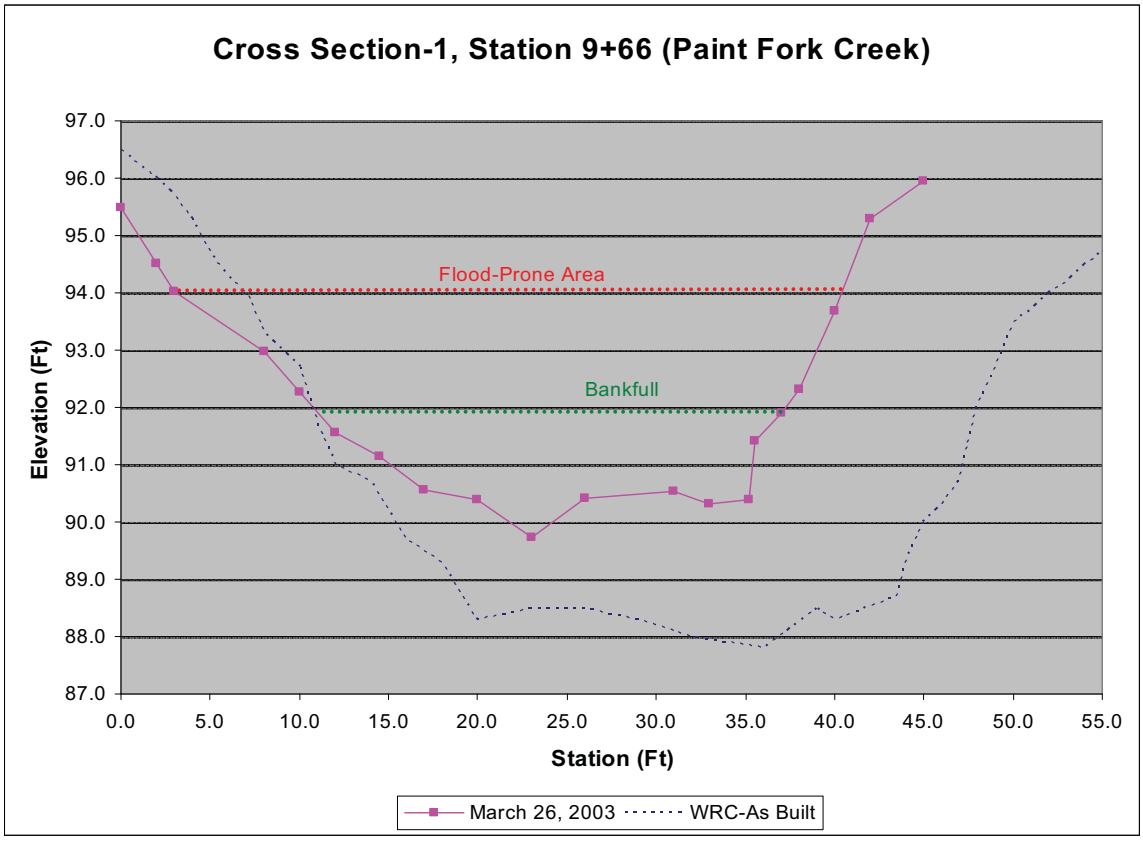
Photo downstream at same location before and after construction. Photos show the change in stream bank profile, stabilization with vegetation and erosion control materials and a rock vane constructed to direct flow toward the thalwag and reduce preassure on the near bank region.



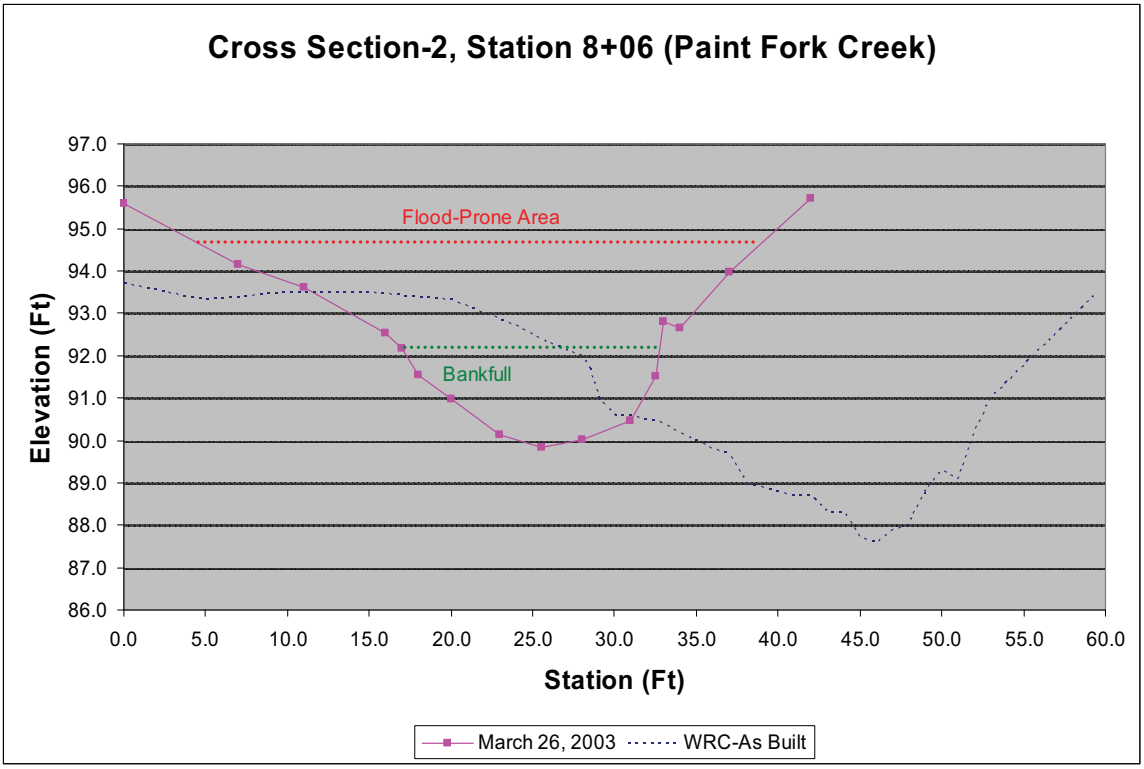
Upstream photo along lower end of site, showing the same location before and after construction. Note the willow tree and walnut trees (center top of photos) for reference. Vertical, eroding stream banks have been sloped and vegetated for greater stability.

APPENDIX B

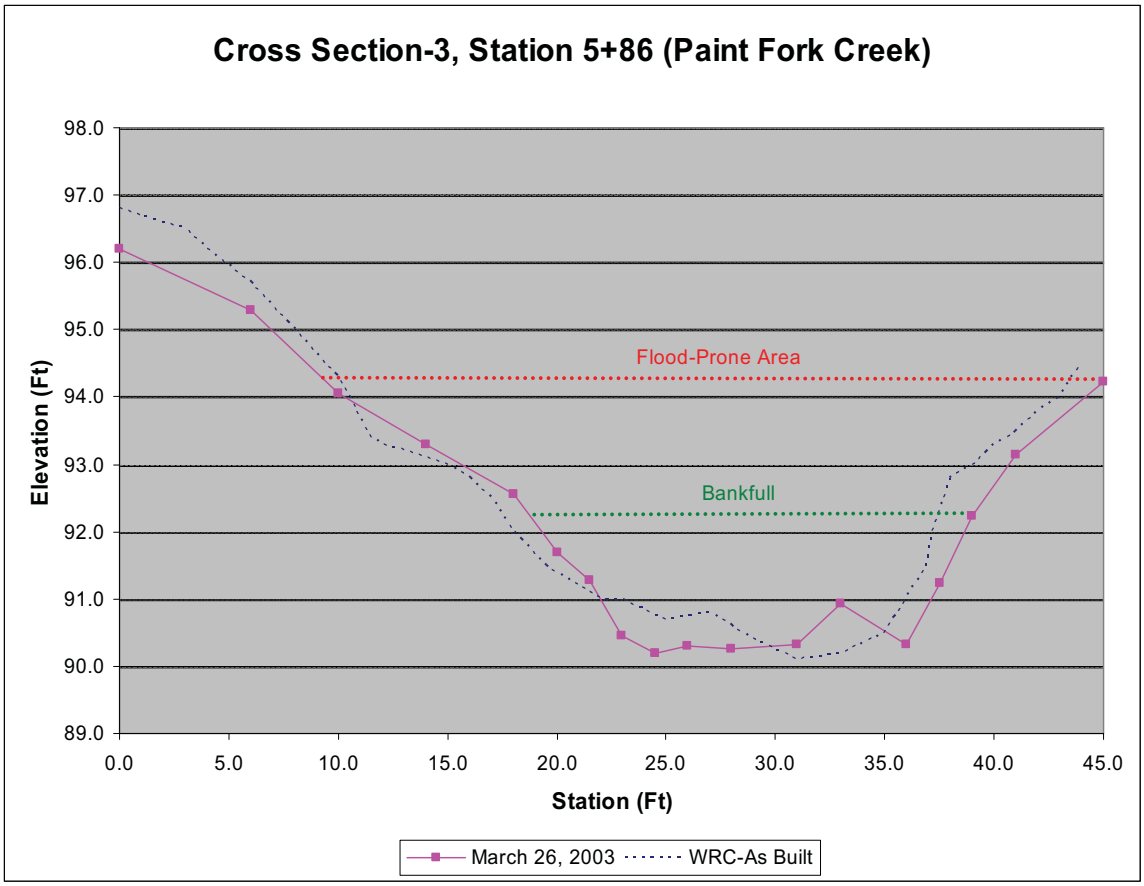
CROSS SECTIONS AND THE LONGITUDINAL PROFILE COMPARISON

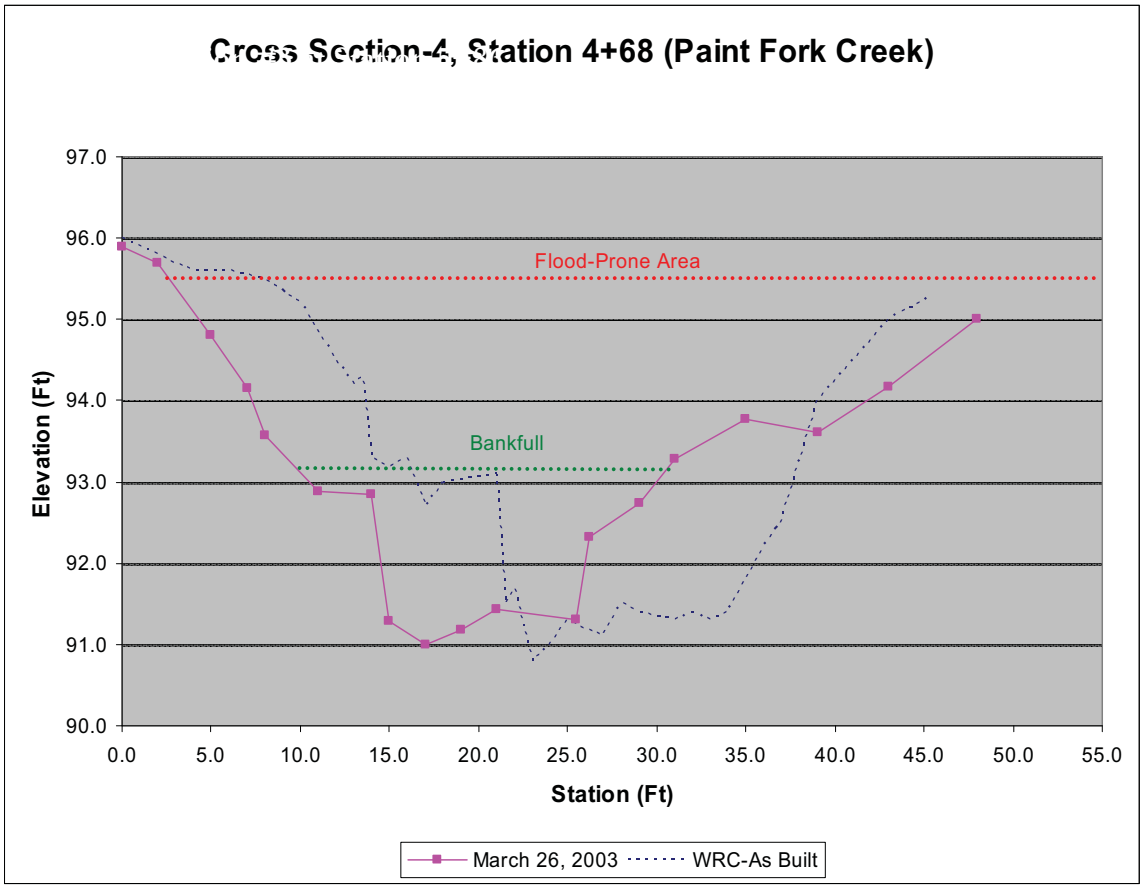

Cross Section-1, Station 9+66 (Paint Fork Creek)
Elevation (Ft)
97.0
96.0
95.0
94.0
93.0
92.0
91.0
90.0
89.0
88.0
87.0
Flood-Prone Area
Bankfull
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
55.0
Station (Ft)
March 26, 2003
WRC-As Built

Cross Section #1 at Station 9+66
near downstream end of project
on Paint Fork Creek

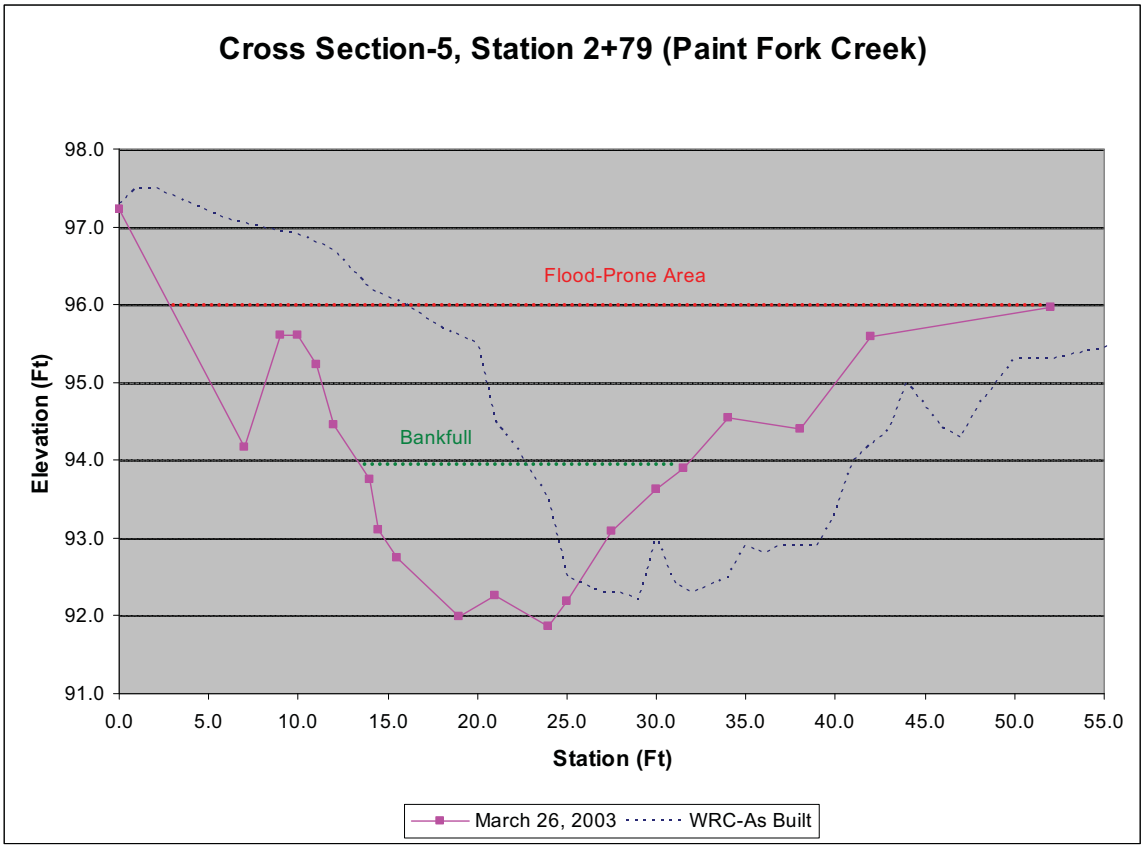

Cross Section-2, Station 8+06 (Paint Fork Creek)
Elevation (Ft)
97.0
96.0
95.0
94.0
93.0
92.0
91.0
90.0
89.0
88.0
87.0
86.0
Flood-Prone Area
Bankfull
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
55.0
60.0
Station (Ft)
March 26, 2003
WRC-As Built

Cross Section #2 at Station 8+06
on Paint Fork Creek

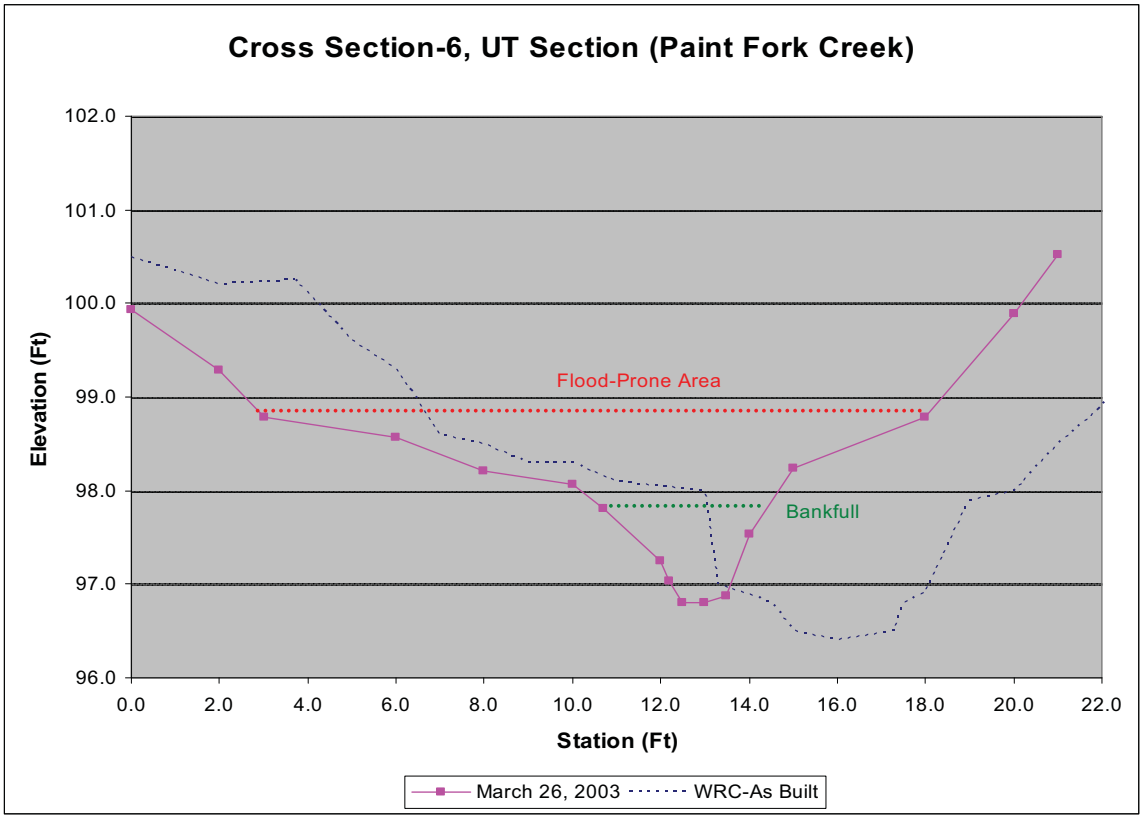

Cross Section-3, Station 5+86 (Paint Fork Creek)
Elevation (Ft)
98.0
97.0
96.0
95.0
94.0
93.0
92.0
91.0
90.0
89.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
Station (Ft)
Flood-Prone Area
Bankfull
March 26, 2003
WRC-As Built


Cross Section-4, Station 4+68 (Paint Fork Creek)
Elevation (Ft)
97.0
96.0
95.0
94.0
93.0
92.0
91.0
90.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
55.0
Station (Ft)
Flood-Prone Area
Bankfull
March 26, 2003
WRC-As Built

Cross Section #4 at Station 4+68
on Paint Fork Creek

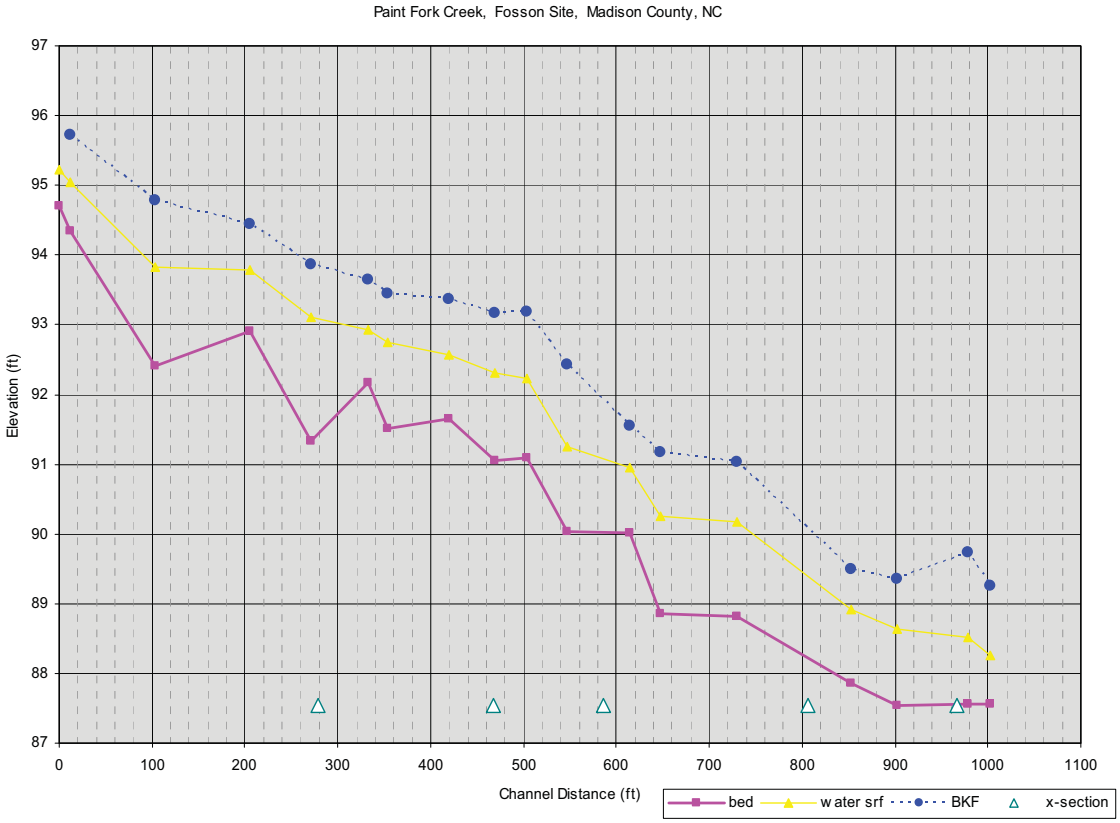

Cross Section-5, Station 2+79 (Paint Fork Creek)
Elevation (Ft)
98.0
97.0
96.0
95.0
94.0
93.0
92.0
91.0
Flood-Prone Area
Bankfull
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
55.0
Station (Ft)
March 26, 2003
WRC-As Built

Cross Section #5 at Station 2+79
on Paint Fork Creek


Cross Section-6, UT Section (Paint Fork Creek)
102.0
101.0
100.0
99.0
98.0
97.0
96.0
Elevation (Ft)
Flood-Prone Area
Bankfull
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
22.0
Station (Ft)
March 26, 2003
WRC-As Built

Cross Section #6 along
Unnamed Tributary to
Paint Fork Creek

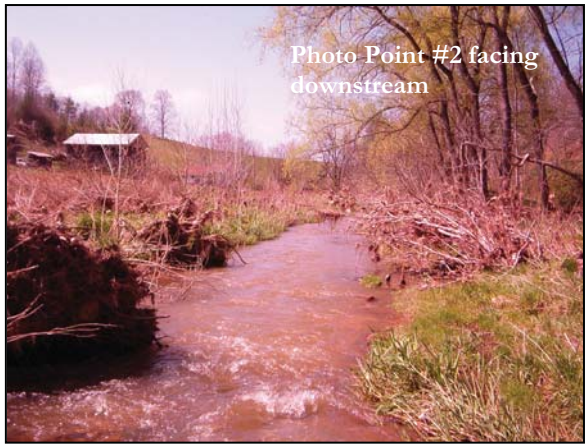
Longitudinal Profile – Paint Fork Creek



APPENDIX C

SITE PHOTOGRAPHS

Vegetation Plots

Vegetation Plots Continued

Paint Fork Creek