

YEAR 3 (2011)
ANNUAL MONITORING REPORT
THREE MILE CREEK RESTORATION SITE
AVERY COUNTY, NORTH CAROLINA
(Contract #16-D06125-A)

FULL DELIVERY PROJECT
TO PROVIDE STREAM AND WETLAND MITIGATION
IN THE FRENCH BROAD RIVER BASIN
CATALOGING UNIT 06010108



Prepared for:

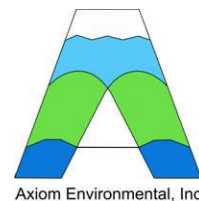
NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
RALEIGH, NORTH CAROLINA

Prepared by:



Restoration Systems, LLC
1101 Haynes Street, Suite 211
Raleigh, North Carolina 27604

And



Axiom Environmental, Inc.
20 Enterprise Street, Suite 7
Raleigh, North Carolina 27607

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EXECUTIVE SUMMARY

Restoration Systems, L.L.C. has completed restoration of streams and wetlands at the Three Mile Creek Restoration Site (hereafter referred to as the "Site") to assist the North Carolina Ecosystem Enhancement Program in fulfilling stream and wetland mitigation goals. The Site, located in southwestern Avery County approximately 5.2 miles northeast of Spruce Pine, North Carolina, provides 8103 stream mitigation units and 3.7 riparian wetland mitigation units as described in the As-Built Mitigation Plan dated April 2009. The Site is located in United States Geological Survey (USGS) Hydrologic Unit and Targeted Local Watershed 06010108010020 (North Carolina Division of Water Quality Subbasin 04-03-06) of the French Broad River Basin. This report serves as the Year 3 (2011) annual monitoring report.

Primary activities at the Site included 1) stream restoration, 2) stream enhancement, 3) stream preservation, 4) wetland restoration and enhancement, 5) soil scarification, and 6) plant community restoration. Project restoration efforts provide 8103 Stream Mitigation Units and 3.7 riverine Wetland Mitigation Units.

Eight vegetation plots (10-meter by 10-meter in size) were established and permanently monumented. These plots were surveyed in June 2011 for the Year 3 (2011) monitoring season. Vegetation sampling across the Site was above the required average density with 612 planted stems per acre surviving. In addition, each individual plot was above success criteria.

Eleven cross-sections and 3600 linear feet of longitudinal profiles were measured for the Year 3 (2011) monitoring. As a whole, monitoring measurements indicate that there have been minimal changes in both the longitudinal profile and cross-sections as compared to as-built data. The as-built channel geometry compares favorably with the emulated, stable E/C type stream reach as set forth in the detailed mitigation plan and construction plans. Current monitoring has demonstrated dimension, pattern, and profile were stable over the course of the monitoring period. During a heavy, flashy rain event in April 2011, an outer bend near Cross-section 6 was compromised; however, up- and downstream of the outerbend remained stable. The outer bend was repaired and replanted in September 2011, and is doing well. The outerbend will continue to be monitored closely. The only remaining stream problem area noted within the Site during the Year 3 (2011) monitoring year includes aggradation within a portion of Tributary 1. Aggradation has resulted from the installation of a dirt driveway on the neighboring property in 2010. This reach should be watched over time to ascertain any instability.

All three of the monitored gauges within restoration areas were inundated/saturated within 12 inches of the surface for greater than 12.5 percent of the growing season, which extends from May 1 to October 11 (163 days).

In summary, Site vegetation, streams, and wetland hydrology met success criteria for Year 3 (2011) monitoring.

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1.0 PROJECT BACKGROUND

1.1 Location and Setting

Restoration Systems, L.L.C. (Restoration Systems) has completed restoration of streams and wetlands at the Three Mile Creek Restoration Site (hereafter referred to as the “Site”) to assist the North Carolina Ecosystem Enhancement Program (NCEEP) in fulfilling stream and wetland mitigation goals. The Site, located in southwestern Avery County approximately 5.2 miles northeast of Spruce Pine, North Carolina, provides 8103 stream mitigation units and 3.7 riparian wetland mitigation units as described in the April 2009 As-Built Mitigation Plan (Figures 1 and 2, Appendix A). The Site is located in United States Geological Survey (USGS) Hydrologic Unit and Targeted Local Watershed 06010108010020 (North Carolina Division of Water Quality Subbasin 04-03-06) of the French Broad River Basin.

Directions to the Site:

- From Asheville or Raleigh, take I-40 to Marion; take NC 226 north through Linville Falls; go left on NC 194; site is ~4.5 miles on left
- Or, from Asheville take 19/23 North to 19E through Spruce Pine to NC 194
- Take a right on NC 194 and travel approximately 1.5 miles
- The Site is on the right
- Latitude, Longitude of Site: 35.9827°N, 81.9843°W (NAD83/WGS84)

1.2 Project Objectives

The primary components of the restoration project included 1) construction of a stable, riffle-pool stream channel; 2) enhancement of water quality functions within and downstream of the Site; 3) creation of a natural vegetated buffer along restored stream channels; 4) restoration of jurisdictional riverine wetlands in the Site; 5) improvement of aquatic habitat and species diversity by enhancing stream bed variability; and 6) restoration of wildlife functions associated with a riparian corridor/stable stream.

1.3 Project Structure, Restoration Type, and Approach

A 26.68-acre conservation easement was placed on the Site to incorporate all restoration activities. The Site contains 4.8 acres of hydric soil, Three Mile Creek, 12 unnamed tributaries (UTs) to Three Mile Creek, Fork Creek, and adjacent floodplains, which represent the primary hydrologic features of the Site. Prior to construction, the project was characterized by agricultural land utilized for Christmas tree and ornamental landscape nursery plant production, timber harvest, and livestock grazing. Agricultural practices included the maintenance and removal of riparian vegetation and relocation, dredging, and straightening of onsite streams. In addition, hydric soils were disturbed due to regular plowing and vegetation maintenance, hoof shear from livestock, and the removal of groundwater hydrology inputs from the rerouting and straightening of Site tributaries.

Restoration of Site streams and wetlands will result in positive benefits for water quality and biological diversity in the Three Mile Creek watershed. Targeted mitigation efforts at the Site were accomplished by:

1. Removing nonpoint and point sources of pollution associated with agricultural practices including a) cessation of broadcasting fertilizer, pesticides, and other agricultural chemicals into and adjacent to the Site and b) provide a forested riparian buffer to treat surface runoff.
2. Reducing sedimentation within onsite and downstream receiving waters by a) reducing bank erosion associated with vegetation maintenance and plowing adjacent to Site streams and wetlands and b) planting a forested riparian buffer adjacent to Site streams and wetlands.
3. Reestablishing stream stability and the capacity to transport watershed flows and sediment loads by restoring a stable dimension, pattern, and profile supported by natural in-stream habitat and grade/bank stabilization structures.

4. Promoting floodwater attenuation by a) reconnecting bankfull stream flows to the abandoned floodplain terrace; b) restoring secondary, dredged, straightened, and entrenched tributaries, thereby reducing floodwater velocities within smaller catchment basins; c) restoration of depressional floodplain wetlands and floodwater storage capacity within the Site, and d) revegetating Site floodplains to increase frictional resistance on floodwaters.
5. Improving aquatic habitat with bed variability and the use of in-stream structures upstream of a reach identified by the North Carolina Wildlife Resources Commission as supporting naturally reproducing rainbow trout populations.
6. Providing a terrestrial wildlife corridor and refuge in an area that is developed for agricultural production.

As constructed, the Site restored historic stream and wetland functions, which existed onsite prior to channel straightening and dredging, agricultural impacts, and vegetation removal. Stream construction of meandering, E/C stream channel resulted in 6057 linear feet of stream restoration, 618 linear feet of stream enhancement (Level I), 875 linear feet of stream enhancement (Level II), 6421 linear feet of stream preservation, 2.5 acres of riverine wetland restoration, and 2.3 acres of riverine wetland enhancement (Table 1).

Table 1. Site Restoration Structures and Objectives

Restoration Segment/ Reach ID*	Station Range	Mitigation Type	Priority Approach	Existing Linear Footage/ Acreage	Designed Linear Footage/ Acreage**	SMU/ WMU	Comment
Three Mile Creek	1+25-37+30	Restoration	1	3552	3495	3495	Restoration of a straightened channel on new location.
	37+30-42+15	Enhancement I	2	485	485	323.3	Restoration of dimension and profile in place.
Fork Creek	0+00-1+58	Enhancement II	NA	158	158	63.2	Removal of invasive species and supplemental planting.
Tributary 1	0+00-3+84	Restoration	1	172	384	384	Restoration of a straightened channel on new location.
Tributary 2	0+00-1+33	Enhancement I	2	133	133	88.7	Restoration of dimension and profile in place.
	NA	Enhancement II	NA	351	351	140.4	Removal of invasive species and supplemental planting.
Tributary 3	0+00-3+40	Restoration	1	252	340	340	Restoration of a ditched and disturbed channel on new location.
	NA	Preservation	NA	1808	1808	361.6	Preservation of existing reach
Tributary 4	0+00-2+28	Restoration	1	136	198	198	Restoration of a ditched and disturbed channel on new location.
	NA	Enhancement II	NA	366	366	146.4	Removal of invasive species and supplemental planting.
Tributary 5	0+00-2+44	Restoration	1	150	214	214	Restoration of a ditched and disturbed channel on new location.
	NA	Preservation	NA	931	931	186.2	Preservation of stable, forested stream reaches.
Tributary 6a	0+00-2+44	Restoration	1	124	214	214	Restoration of a ditched and disturbed channel on new location.
	NA	Preservation	NA	681	681	136.2	Preservation of stable, forested stream reaches.

Table 1. Site Restoration Structures and Objectives (continued)

Restoration Segment/ Reach ID*	Station Range	Mitigation Type	Priority Approach	Existing Linear Footage/ Acreage	Designed Linear Footage/ Acreage**	SMU/ WMU	Comment
Tributary 7	0+00-2+75	Restoration	1	146	245	245	Restoration of a ditched and disturbed channel on new location.
Tributary 8	0+00-3+43	Restoration	1	519	343	343	Restoration of a ditched and disturbed channel on new location.
	242	Restoration	1	242	242	242	Filling a ditched springhead systems and braiding restoration channel.
Tributary 9	0+00-0+43	NA	NA	0	43	0	Tie spring head to design channel.
Tributary 11a	0+00-0+92	Restoration	1	72	92	92	Restoration of a ditched and disturbed channel on new location.
	228	Restoration	1	228	228	228	Braiding surface flow of restoration channel.
	NA	Preservation	NA	49	49	9.8	Preservation of stable, forested stream reaches.
Tributary 11b	0+00-0+62	Restoration	1	51	62	62	Restoration of a ditched and disturbed channel on new location.
Preservation Tributaries	NA	Preservation	NA	2952	2952	590.4	Preservation of stable, forested stream reaches.
TOTAL SMUs						8103	
Riparian/ Riverine Wetlands	--	Restoration	--	--	2.5	2.5	Reconstructing site tributaries, filling ditched channels and ditches, rehydrating floodplain soils, and planting with native forest vegetation.
	--	Enhancement	--	--	2.3	1.2	Planting with native forest vegetation.
TOTAL WMUs						3.7	

* Locations of each tributary and restoration type are depicted on Sheets 1-23 in Appendix A (As-built Survey)

** Constructed linear footage excludes crossings or areas outside of easement; therefore, is slightly shorter than stationing depicts.

Priority Approach 1 – Convert incised stream to stable stream at historic floodplain elevation.

Priority Approach 2 – Convert incised stream to stable stream and reestablish floodplain at present location.

1.4 Project History and Background

Completed project activities, reporting history, completion dates, project contacts, and background information are summarized in Tables 2-4.

Table 2. Project Activity and Reporting History

Activity or Report	Data Collection Completion	Actual Completion or Delivery
Restoration Plan	August 2007	September 2007
Construction Completion	NA	January 2009
Site Planting	NA	February 2009
Mitigation Plan/As-builts	March 2009	April 2009
Year 1 Monitoring (2009)	October 2009	September 2009
Year 2 Monitoring (2010)	October 2010	September 2010
Year 3 Monitoring (2011)	October 2011	October 2011

Table 3. Project Contacts

Full Delivery Provider	Restoration Systems 1101 Haynes Street, Suite 211 Raleigh, North Carolina 27604 George Howard and John Preyer (919) 755-9490
Designer and Monitoring Performer	Axiom Environmental, Inc. 218 Snow Avenue Raleigh, NC 27603 Grant Lewis (919) 215-1693
Construction Contractor	Land Mechanics Designs, Inc. 126 Circle G Lane Willow Spring, North Carolina 27592 Lloyd Glover (919) 422-3392
Planting Contractor	Carolina Silvics 908 Indian Trail Road Edenton, North Carolina 27932 Dwight McKinney (252) 482-8491
Surveying Contractor	K2 Design Group, PA 5758 US Highway 70 East Goldsboro, North Carolina 27534 John Rudolph (919) 751-0075

Table 4. Project Background

Project County	Avery County, North Carolina
Drainage Area	Three Mile Creek: 5.1 square miles Fork Creek: 1.8 square miles Tributaries: 0.02-0.2 square mile
Drainage impervious cover estimate (%)	< 1
Stream Order	Three Mile Creek: Second and Third Fork Creek: Second Tributaries: First and Second
Physiographic Region	Blue Ridge
Ecoregion	Southern Crystalline Ridges and Mountains
Rosgen Classification of As-built	C/E-type
Dominant Soil Types	Chandler, Cullowhee, Nikwasi, Micaville, Saunook, Thunder
Reference Site ID	Stone Mountain and Cranberry Creek
USGS HUC	06010108010020
NCDWQ Subbasin	04-03-06
NCDWQ Classification	WS-IV Tr (Stream Index # 7-2-25-(0.7))
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	Yes, the receiving water of the North Toe River (Stream Index Number 7-2-[27.7]b) is listed for impaired biological integrity and turbidity
Reasons for 303d listing or stressor	Not Applicable
% of project easement fenced	+/- 8%

1.5 Monitoring Plan View

Monitoring activities for the Site, including relevant structures and utilities, project features, specific project structures, and monitoring features are detailed in the monitoring plan view in Figure 2 of Appendix A. Site features including vegetation, stream dimension (cross-sections), stream profile and pattern, wetland hydrology, and photographic documentation were monitored in Year 3 (2011).

2.0 PROJECT CONDITION AND MONITORING RESULTS

2.1 Vegetation Assessment

Following Site construction, eight plots (10-meter by 10-meter in size) were established and monumented with metal fence posts at all plot corners and PVC at each plot origin. Sampling was conducted as outlined in the *CVS-EEP Protocol for Recording Vegetation, Version 4.0* (Lee et al. 2006) (<http://cvs.bio.unc.edu/methods.htm>); results are included in Appendix B. The taxonomic standard for vegetation used for this document was *Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas* (Weakley 2007). The locations of vegetation monitoring plots were placed to accurately represent the entire Site and are depicted on the monitoring plan view in Appendix A.

2.1.1 Vegetation Success Criteria

Success criteria have been established to verify that the vegetation component supports community elements necessary for forest development. Success criteria are dependent upon density and growth of "Characteristic Tree Species." Characteristic Tree Species include planted species, species identified through inventory of a reference (relatively undisturbed) forest community used to orient the planting plan, and appropriate Schafale and Weakley (1990) community descriptions. All species planted and identified in the reference forest will be utilized to define "Characteristic Tree Species" as termed in the success criteria (Table 5).

Table 5. Characteristic Tree Species

Planted Species	Reference Species
Pawpaw (<i>Asimina triloba</i>)	Red maple (<i>Acer rubrum</i>)
Sugarberry (<i>Celtis laevigata</i>)	Ironwood (<i>Carpinus caroliniana</i>)
Redbud (<i>Cercis canadensis</i>)	Dogwood (<i>Cornus florida</i>)
Buttonbush (<i>Cephalanthus occidentalis</i>)	Strawberry bush (<i>Euonymous americana</i>)
Silky dogwood (<i>Cornus amomum</i>)	Spice bush (<i>Lindera benzoin</i>)
Persimmon (<i>Diospyros virginiana</i>)	Tulip poplar (<i>Liriodendron tulipifera</i>)
Green ash (<i>Fraxinus pennsylvanica</i>)	Sycamore (<i>Platanus occidentalis</i>)
Sycamore (<i>Platanus occidentalis</i>)	White pine (<i>Pinus strobes</i>)
Black cherry (<i>Prunus serotina</i>)	Black cherry (<i>Prunus serotina</i>)
White oak (<i>Quercus alba</i>)	White oak (<i>Quercus alba</i>)
Swamp chestnut oak (<i>Quercus michauxii</i>)	Red oak (<i>Quercus</i> sp.)
Cherrybark oak (<i>Quercus pagoda</i>)	Rhododendron (<i>Rhododendron</i> sp.)
Northern red oak (<i>Quercus rubra</i>)	Wild azalea (<i>Rhododendron periclymenoides</i>)
Elderberry (<i>Sambucus canadensis</i>)	Black locust (<i>Robinia pseudoacacia</i>)
	Hemlock (<i>Tsuga</i> sp.)

An average density of 320 stems per acre of Characteristic Tree Species must be surviving at the end of the third monitoring year. Subsequently, 290 Characteristic Tree Species per acre must be surviving at the end of year 4 and 260 Characteristic Tree Species per acre at the end of year 5.

If vegetation success criteria are not achieved, based on average density calculations from combined plots over the entire restoration area, supplemental planting may be performed with tree species approved by regulatory agencies. Supplemental planting will be performed as needed until achievement of vegetation success criteria.

2.1.2 Vegetative Problem Areas

No vegetation problem areas were identified within the Site during Year 3 (2011) Monitoring.

2.2 Stream Assessment

Eleven permanent cross-sections were established after construction was completed. Measurements of each cross-section include points at all breaks in slope including top of bank, bankfull, and thalweg. Riffle cross-sections are classified using the Rosgen stream classification system. Longitudinal profile measurements of 3600 linear feet of stream include thalweg, water surface, and bankfull; with each measurement taken at the head of facets (i.e. riffle, run, pool, and glide) in addition to the maximum pool depth.

2.2.1 Stream Success Criteria

Success criteria for stream restoration will include 1) successful classification of the reach as a functioning stream system (Rosgen 1996) and 2) channel variables indicative of a stable stream system. Annual monitoring will continue until success criteria are met and no less than two bankfull events have occurred, as determined by in situ crest gauge, otherwise monitoring will continue until the second bankfull event has occurred.

Visual assessment of in-stream structures will be conducted to determine if failure has occurred. Failure of a structure may be indicated by collapse of the structure, undermining of the structure, abandonment of the channel around the structure, and/or stream flow beneath the structure.

2.2.2 Bankfull Events

Two bankfull events were documented during the Year 3 (2011) monitoring period.

Table 6. Verification of Bankfull Events

Date of Data Collection	Date of Occurrence	Method	Photo (if available)
April 2011	March 5-6, 2011	Total of 2.5 inches* of rain documented between March 5-6, 2011 at weather station 2.7 miles southwest of site	Photo 1-2
May 2011	April 15-16, 2011	Total of 4.09 inches* of rain documented between April 15-16, 2011 at weather station 2.7 miles southwest of site	Photo 3-4

*Weather Underground 2011



2.2.3 Stream Problem Areas

During a heavy, flashy rain event in April 2011, an outer bend near Cross-section 6 was compromised; however, up- and downstream of the outerbend remained stable. The outer bend was repaired and replanted in September 2011, and is doing well (see photo). The outerbend will continue to be monitored closely. The only remaining stream problem area noted within the Site during the Year 3 (2011) monitoring year includes aggradation within a portion of Tributary 1. Aggradation has resulted from the installation of a dirt driveway on the neighboring property in 2010. This reach should be watched over time to ascertain any instability.



2.2.4 Categorical Stream Feature Visual Stability Assessment

The stream was visually inspected during the Year 3 (2011) monitoring period using eight feature categories and various metrics within each category. Assessment features included riffles, pools, thalweg, meanders, channel bed, structures, and root wads/boulders. A table for semi-quantitative assessments of the stream is included in Appendix C (Table C1). The mean percentage of performance for features is summarized in the table below.

Table 7. Categorical Stream Feature Visual Stability Assessment

Feature	Year 1 (2009)	Year 2 (2010)	Year 3 (2011)	Year 4 (2012)	Year 5 (2013)
A. Riffles	99%	99%	99%		
B. Pools	100%	100%	100%		
C. Thalweg	100%	100%	100%		
D. Meanders	100%	100%	100%		
E. Bed General	100%	100%	100%		
F. Banks	100%	100%	100%		
G. Vanes / J. Hooks, Etc.	100%	100%	100%		
H. Wads and Boulders	NA	NA	NA		

2.2.5 Quantitative Stream Measurements

During the Year 3 (2011) monitoring period 11 cross-sections and 3600 linear feet of longitudinal profile were measured. Permanent cross-sections and longitudinal profiles are included in Appendix C; each is graphically depicted for as-built through Year 3 (2011) for analysis. As a whole, monitoring measurements indicate minimal changes in both the longitudinal profile and cross-sections as compared to as-built data. The channel geometry compares favorably with the emulated, stable E/C type stream reach as set forth in the detailed mitigation plan and as constructed. Current monitoring has demonstrated dimension, pattern, and profile were stable over the course of the monitoring period. Table for baseline data and annual quantitative assessments are included below.

2.3 Wetland Assessment

Three groundwater gauges were installed in wetland restoration and enhancement areas to provide representative coverage of the Site. One additional gauge was placed in a reference wetland area. Graphs of groundwater hydrology and precipitation from a nearby rain station are included in Appendix D.

2.3.1 Wetland Success Criteria

Target hydrological characteristics include saturation or inundation for 5 to 12.5 percent of the growing season, during average climatic conditions. During growing seasons with atypical climatic conditions, groundwater gauges in reference wetlands may dictate threshold hydrology success criteria (75 percent of reference). These areas are expected to support hydrophytic vegetation. If wetland parameters are marginal as indicated by vegetation and/or hydrology monitoring, a jurisdictional determination will be performed.

2.3.2 Wetland Problem Areas

No wetland problem areas were identified within the Site during Year 3 (2011) monitoring.

2.3.3 Wetland Criteria Attainment

All three of the monitored gauges within restoration areas were inundated/saturated within 12 inches of the surface for greater than 12.5 percent of the growing season, which extends from May 1 to October 11 (163 days). Groundwater data presented in this document was collected through September 27, 2011; data will continue to be collected throughout the growing season and will be available upon request. Hydrographs containing groundwater and precipitation data for each gauge can be found in Appendix D.

**Table 8. Baseline Morphology and Hydraulic Summary
Threemile Creek**

Parameter	USGS Gage Data			Pre-Existing Condition			Project Reference Stream			Design			As-built				
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med		
Dimension	USGS gage data is unavailable for this project			17.4	23	20.7	27.2	33	30.1	21	29	25	23.1	27.8	26.1		
BF Width (ft)				32	250	100			100	50	350	250					250
Floodprone Width (ft)				36.5	53	43			46	36	53	45	46.5	55.3	53.1		
BF Cross Sectional Area (ft ²)				1.5	2.8	2.2	1.4	1.7	1.6	1.5	2.1	1.8	1.8	2.2	2.1		
BF Mean Depth (ft)				1.9	3.3	2.8	2.2	2.6	2.4	2	2.7	2.3	2.2	2.7	2.5		
BF Max Depth (ft)				6.6	14.5	10	16.1	23.8	20	12	16	14	12	15	12		
Width/Depth Ratio				1.5	8	6.5	3	3.7	3.4	2.2	7.4	4.4	9	11	10		
Entrenchment Ratio				1.9	2.5	1.8	1	1.6	1.3	1	1.3	1.1					1
Bank Height Ratio						===			===			===	25	29	28		
Wetted Perimeter (ft)						===			===			===	1.8	2	2		
Hydraulic radius (ft)																	
Pattern																	
Channel Beltwidth (ft)	No pattern of riffles and pools due to straightening activities			40	55	46.8	27	76	47	27	76	47	27	76	47		
Radius of Curvature (ft)				62.4	312.1	94.5	45	252	52	45	252	52	45	252	52		
Meander Wavelength (ft)				101.7	273.2	199.4	136	252	200	136	252	200	136	252	200		
Meander Width ratio				1.3	1.8	1.6	1.2	3	2	1.2	3	2	1.2	3	2		
Profile																	
Riffle length (ft)	No pattern of riffles and pools due to straightening activities					===			===			===	17	111	51		
Riffle slope (ft/ft)				0.26%	1.83%	1.18%	1.94%	2.91%	2.43%	0.43%	4.80%	1.54%					
Pool length (ft)						===			===			===	26	78	46		
Pool spacing (ft)				65.2	166.7	104.3	67	176	115	76	176	115	76	176	126		
Substrate																	
d50 (mm)			===			===			===			===			===		
d84 (mm)			===			===			===			===			===		
Additional Reach Parameters																	
Valley Length (ft)			===			===			===			===			4057		
Channel Length (ft)			===			===			===			===			3528		
Sinuosity			1.1			1.2			1.15			1.15			1.15		
Water Surface Slope (ft/ft)			1.03%			1.21%			0.97%			0.98%			0.98%		
BF slope (ft/ft)			===			===			===			===			===		
Rosgen Classification			C/E4			Cb3			Ce4			C/E			3/4		

**Table 9A. Morphology and Hydraulic Monitoring Summary
Threemile Creek - Stream and Wetland Restoration Site**

Parameter	Cross Section 1 Riffle (UT 8)						Cross Section 2 Pool (UT 8)						Cross Section 3 Riffle						Cross Section 4 Pool					
	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5
Dimension																								
BF Width (ft)	4.8	4.8	4.4	5.2			6.3	7.5	7.6	7.7			27.8	30.3	28.5	28.5			27.9	27.8	27.9	27.3		
Floodprone Width (ft)	250	250	250	250			----	----	----	----			250	250	250	250			----	----	----	----		
BF Cross Sectional Area (ft ²)	1.8	2.3	1.7	2.2			4.8	5.4	5.9	5.5			51.1	51.9	49.9	48.1			63.4	62.8	58.9	57.4		
BF Mean Depth (ft)	0.4	0.5	0.4	0.4			0.8	0.7	0.8	0.7			1.8	1.7	1.7	1.7			2.3	2.3	2.1	2.1		
BF Max Depth (ft)	0.6	0.8	0.7	0.7			1.3	1.2	1.3	1.2			2.2	2.3	2.2	2.9			3.7	3.6	3.4	3.4		
Width/Depth Ratio	12.8	10.2	11.3	12.3			----	----	----	----			15.1	17.7	16.3	16.9			----	----	----	----		
Entrenchment Ratio	52.1	51.6	56.6	48.1			----	----	----	----			9.0	8.2	8.8	8.8			----	----	----	----		
Bank Height Ratio	1.0	1.0	1.0	1.0			----	----	----	----			1.0	1.0	1.0	1.0			----	----	----	----		
Wetted Perimeter (ft)	5.1	5.1	4.7	5.6			6.9	8.0	8.2	8.2			29.0	31.2	29.3	30.0			29.6	29.6	29.9	29.3		
Hydraulic Radius (ft)	0.4	0.4	0.4	0.4			0.7	0.7	0.7	0.7			1.8	1.7	1.7	1.6			2.1	2.1	2	2		
Substrate																								
d50 (mm)	----	12.9	17.5	15			----	NA	0.2	0.3			----	23.4	35.4	35.4			----	2.4	1.3	2.2		
d84 (mm)	----	22	25	33			----	12	14	4			----	54	70	70			----	16	25	12		
Parameter	MY-00 (2008)			MY-01 (2009)			MY-02 (2010)			MY-03 (2011)			MY-04 (2012)			MY-05 (2013)								
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med						
Pattern																								
Channel Beltwidth (ft)	30	76	50	30	76	50	30	76	50	30	76	50												
Radius of Curvature (ft)	50	252	101	50	252	101	50	252	101	50	252	101												
Meander Wavelength (ft)	151	252	214	151	252	214	151	252	214	151	252	214												
Meander Width Ratio	1.2	3	2	1.2	3	2	1.2	3	2	1.2	3	2												
Profile																								
Riffle Length (ft)	17	111	51	21	121	53	23	117	51	11	141	50												
Riffle Slope (ft/ft)	0.43%	4.80%	1.54%	0.15%	3.08%	1.43%	0.65%	2.74%	1.42%	0.00%	7.11%	1.73%												
Pool Length (ft)	26	78	46	24	69	39	27	95	44	14	82	46												
Pool Spacing (ft)	76	176	126	76	176	126	76	176	126	76	176	126												
Additional Reach Parameters																								
Valley Length (ft)	3068			3085			3084			3111														
Channel Length (ft)	3,528			3,548			3547			3578														
Sinuosity	1.15			1.15			1.15			1.15														
Water Surface Slope (ft/ft)	0.0098			0.0097			0.0098			0.0097														
BF Slope (ft/ft)	-----			-----			-----			-----														
Rosgen Classification	C/E 3/4			C/E 3/4			C/E 3/4			C/E 3/4														

**Table 9B. Morphology and Hydraulic Monitoring Summary
Threemile Creek - Stream and Wetland Restoration Site**

Parameter	Cross Section 5 Riffle						Cross Section 6 Pool						Cross Section 7 Riffle						Cross Section 8 Pool					
	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5
Dimension																								
BF Width (ft)	26.4	28.6	29.6	29			21.6	21.2	21.5	19.5			23.1	23.6	23.6	24.2			25.7	27.2	26.7	27.1		
Floodprone Width (ft)	250	250	250	250			----	----	----	----			250	250	250	250			----	----	----	----		
BF Cross Sectional Area (ft ²)	55	60.6	61.3	59.4			49.9	48.1	54.6	44.1			46.5	49.9	48.7	47.1			52.1	52.4	51.2	51.4		
BF Mean Depth (ft)	2.1	2.1	2.1	2			2.3	2.3	2.5	2.3			2.0	2.1	2.1	1.9			2.0	1.9	1.9	1.9		
BF Max Depth (ft)	2.6	2.8	2.8	3			3.5	3.6	4.3	4.3			2.4	2.6	2.6	2.6			3.4	3.5	3.6	3.7		
Width/Depth Ratio	12.7	13.5	14.3	14.2			----	----	----	----			11.5	11.2	11.4	12.5			----	----	----	----		
Entrenchment Ratio	9.5	8.7	8.4	8.6			----	----	----	----			10.8	10.6	10.6	10.3			----	----	----	----		
Bank Height Ratio	1.0	1.0	1.0	1.0			----	----	----	----			1.0	1.0	1.0	1.0			----	----	----	----		
Wetted Perimeter (ft)	27.9	30	31	30.7			23.5	23.4	24.7	22.5			24.7	25.5	25.1	25.8			27.1	28.7	28.9	29.5		
Hydraulic Radius (ft)	2.0	2.0	2.0	1.9			2.1	2.1	2.2	2.0			1.9	2.0	1.9	1.8			1.9	1.8	1.8	1.7		
Substrate																								
d50 (mm)	----	----	29.1	49.1			----	----	11.5	2.8			----	----	48.5	47			----	8.7	1.7	2.8		
d84 (mm)	----	----	51	152			----	----	45	13			----	----	90	128			----	64	22	13		
Parameter	MY-00 (2008)			MY-01 (2009)			MY-02 (2010)			MY-03 (2011)			MY-04 (2012)			MY-05 (2013)								
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med						
Pattern																								
Channel Beltwidth (ft)	30	76	50	30	76	50	30	76	50	30	76	50												
Radius of Curvature (ft)	50	252	101	50	252	101	50	252	101	50	252	101												
Meander Wavelength (ft)	151	252	214	151	252	214	151	252	214	151	252	214												
Meander Width Ratio	1.2	3	2	1.2	3	2	1.2	3	2	1.2	3	2												
Profile																								
Riffle Length (ft)	17	111	51	21	121	53	23	117	51	11	141	50												
Riffle Slope (ft/ft)	0.43%	4.80%	1.54%	0.15%	3.08%	1.43%	0.65%	2.74%	1.42%	0.00%	7.11%	1.73%												
Pool Length (ft)	26	78	46	24	69	39	27	95	44	14	82	46												
Pool Spacing (ft)	76	176	126	76	176	126	76	176	126	76	176	126												
Additional Reach Parameters																								
Valley Length (ft)	3068			3085			3084			3111														
Channel Length (ft)	3,528			3,548			3547			3578														
Sinuosity	1.15			1.15			1.15			1.15														
Water Surface Slope (ft/ft)	0.0098			0.0097			0.0098			0.0097														
BF Slope (ft/ft)	-----			-----			-----			-----														
Rosgen Classification	C/E 3/4			C/E 3/4			C/E 3/4			C/E 3/4														

**Table 9C. Morphology and Hydraulic Monitoring Summary
Threemile Creek - Stream and Wetland Restoration Site**

Parameter	Cross Section 9 Riffle						Cross Section 10 Pool (UT 1)						Cross Section 11 Riffle (UT1)					
	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5	MY 0	MY1	MY2	MY3	MY4	MY5
Dimension																		
BF Width (ft)	25.7	26	25.8	27			9.5	9.7	9.1	8.7			6.4	6.2	6.6	8.8		
Floodprone Width (ft)	250	250	250	250			----	----	----	----			150	150	250	150		
BF Cross Sectional Area (ft ²)	55.3	53.7	50.4	48			6.1	6.4	3.1	3.4			5.3	6.2	0.5	1.1		
BF Mean Depth (ft)	2.2	2.1	2	1.8			0.6	0.7	0.3	0.4			0.8	0.6	0.1	0.1		
BF Max Depth (ft)	2.7	2.6	2.6	2.6			1.1	1	0.6	0.7			1.2	1	0.2	0.5		
Width/Depth Ratio	11.9	12.6	13.3	15.1			----	----	----	----			7.7	10.3	95.1	72.1		
Entrenchment Ratio	9.7	9.6	9.7	9.3			----	----	----	----			23.4	24.1	22.7	17		
Bank Height Ratio	1.0	1.0	1.0	1.0			----	----	----	----			1.0	1.0	1.0	1.0		
Wetted Perimeter (ft)	27.1	27.4	27.2	28.3			9.6	10.1	9.2	9.1			7.1	6.6	6.6	8.9		
Hydraulic Radius (ft)	2.0	2.0	1.9	1.7			0.6	0.6	0.3	0.4			0.7	0.6	0.1	0.1		
Substrate																		
d50 (mm)	----	34.8	48.5	47			----	NA	0.1	----			----	87	0.4	----		
d84 (mm)	----	114	90	128			----	NA	2	----			----	152	6	----		
Parameter	MY-00 (2008)			MY-01 (2009)			MY-02 (2010)			MY-03 (2011)			MY-04 (2012)			MY-05 (2013)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Pattern																		
Channel Beltwidth (ft)	30	76	50	30	76	50	30	76	50	30	76	50						
Radius of Curvature (ft)	50	252	101	50	252	101	50	252	101	50	252	101						
Meander Wavelength (ft)	151	252	214	151	252	214	151	252	214	151	252	214						
Meander Width Ratio	1.2	3	2	1.2	3	2	1.2	3	2	1.2	3	2						
Profile																		
Riffle Length (ft)	17	111	51	21	121	53	23	117	51	11	141	50						
Riffle Slope (ft/ft)	0.43%	4.80%	1.54%	0.15%	3.08%	1.43%	0.65%	2.74%	1.42%	0.00%	7.11%	1.73%						
Pool Length (ft)	26	78	46	24	69	39	27	95	44	14	82	46						
Pool Spacing (ft)	76	176	126	76	176	126	76	176	126	76	176	126						
Additional Reach Parameters																		
Valley Length (ft)	3068			3085			3084			3111								
Channel Length (ft)	3,528			3,548			3547			3578								
Sinuosity	1.15			1.15			1.15			1.15								
Water Surface Slope (ft/ft)	0.0098			0.0097			0.0098			0.0097								
BF Slope (ft/ft)	-----			-----			-----			-----								
Rosgen Classification	C/E 3/4			C/E 3/4			C/E 3/4			C/E 3/4								

Table 10. Wetland Criteria Attainment for Year 3 (2011)

Gauge ID	Hydrology Threshold Met?	Hydrophytic Vegetation Criteria Met? /Max Consecutive Days During Growing Season (Percentage)	Site Mean	Vegetation Plot ID	Vegetation Survival Threshold Met?	Site Mean
1	Yes	Yes/95 days (57 percent)	100 %	1	Yes	100 %
2	Yes	Yes/147 days (89 percent)		2	Yes	
3	Yes	Yes/101 days (61 percent)		3	Yes	
				4	Yes	
				5	Yes	
				6	Yes	
				7	Yes	
				8	Yes	

3.0 CONCLUSIONS

All three of the monitored gauges within restoration areas were inundated/saturated within 12 inches of the surface for greater than 12.5 percent of the growing season, which extends from May 1 to October 11 (163 days). A summary of groundwater gauge data is included in Table 11.

Table 11. Summary of Groundwater Gauge Results

Gauge	Success Criteria Achieved/Max Consecutive Days During Growing Season (Percentage)				
	Year 1 (2009)	Year 2 (2010)*	Year 3 (2011)	Year 4 (2012)	Year 5 (2013)
1	Yes/101 days (62.0 percent)	Yes/64 days (39 percent)	Yes/95 days (57 percent)		
2	Yes/163 days (100 percent)	Yes/91 days (100 percent)	Yes/147 days (89 percent)		
3	Yes/163 days (100 percent)	Yes/55 days (34 percent)	Yes/101 days (61 percent)		
Ref	53 days (32.5 percent)	49 days (30 percent)	32 days (20 percent)		

*Data has been collected through September 27, 2011 for the Year 3 (2011) monitoring season; data will continue to be collected throughout the remainder of the growing season and will be available upon request.

Vegetation sampling across the Site was above the required average density with 612 planted stems per acre surviving. In addition, each individual plot was above success criteria (Table 12).

Table 12. Summary of Planted Vegetation Plot Results

Plot	Planted Stems/Acre Counting Towards Success Criteria				
	Year 1 (2009)	Year 2 (2010)	Year 3 (2011)	Year 4 (2012)	Year 5 (2013)
1	405	445	526		
2	648	445	405		
3	567	364	486		
4	931	469	728		
5	526	526	526		
6	364	405	486		
7	1012	971	647		
8	1214	1214	1133		
Average of All Plots (1-8)	708	637	612		

4.0 REFERENCES

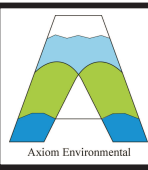
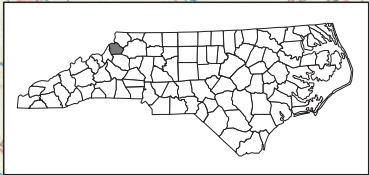
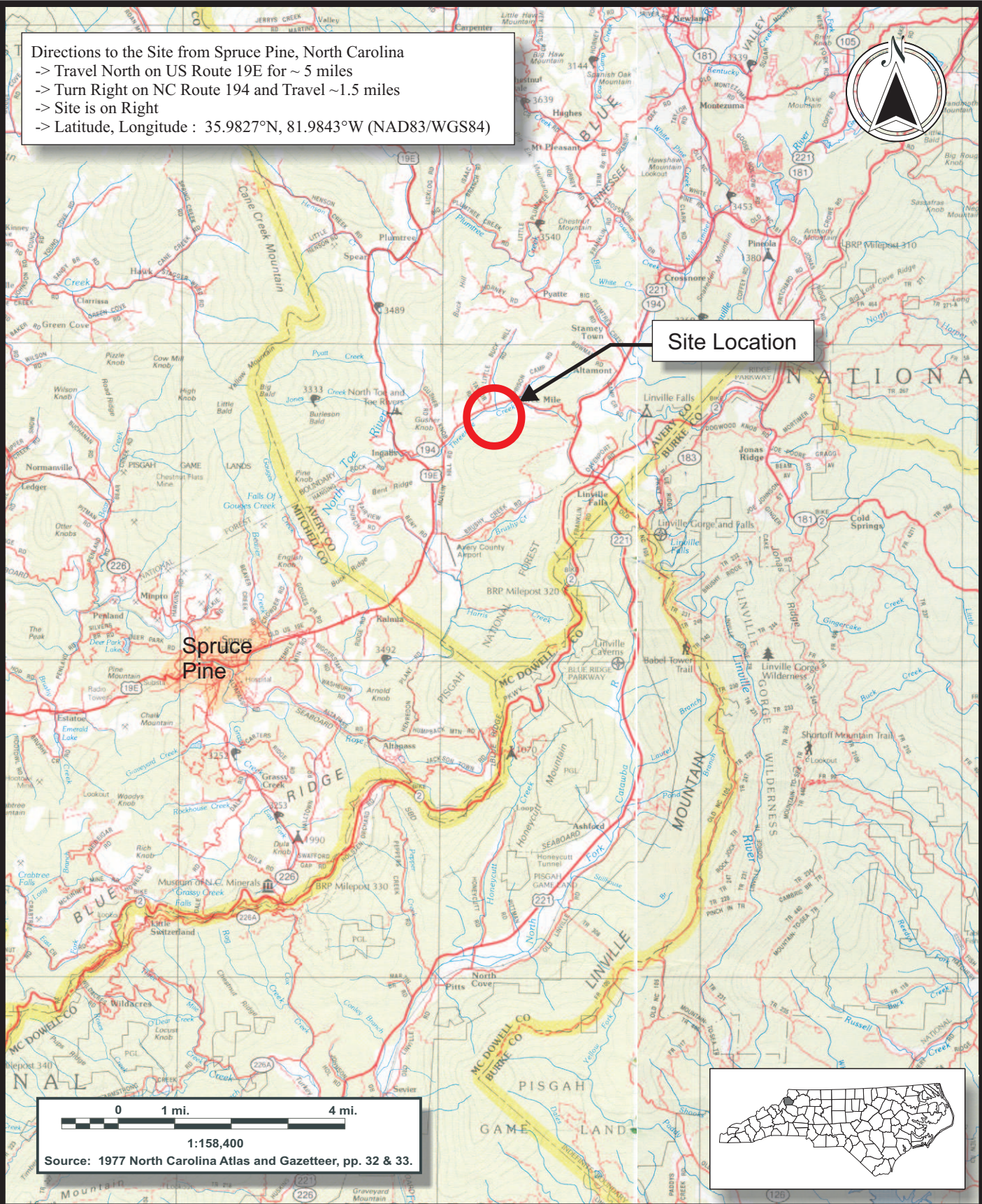
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**APPENDIX A
FIGURES**

Figure 1. Site Location

Figure 2. Monitoring Plan View

Directions to the Site from Spruce Pine, North Carolina
 -> Travel North on US Route 19E for ~ 5 miles
 -> Turn Right on NC Route 194 and Travel ~1.5 miles
 -> Site is on Right
 -> Latitude, Longitude : 35.9827°N, 81.9843°W (NAD83/WGS84)

















2126 Rowland Pond Dr
 Willow Spring, NC 27592
 (919) 215-1693
 (919) 341-3839 fax

SITE LOCATION
THREE MILE CREEK RESTORATION SITE
 Avery County, North Carolina

Dwn. by:	CLF
Ckd by:	WGL
Date:	Nov 2008
Project:	07-004

FIGURE
1

Legend

-  Easement Boundary
-  Groundwater Gauge Locations
-  Vegetation Plot Locations
-  Structure Photo Points
-  In-stream Structures
-  Cross-section Locations
-  Stream Restoration
-  Stream Enhancement (Level 1)
-  Stream Enhancement (Level 2)
-  Streams
-  Stream Monitoring Reach
-  Wetland Restoration Areas
-  Wetland Enhancement Areas
-  Marsh Treatment Areas



Project:

THREE MILE CREEK RESTORATION SITE

Avery County, NC

Title:

MONITORING PLAN VIEW

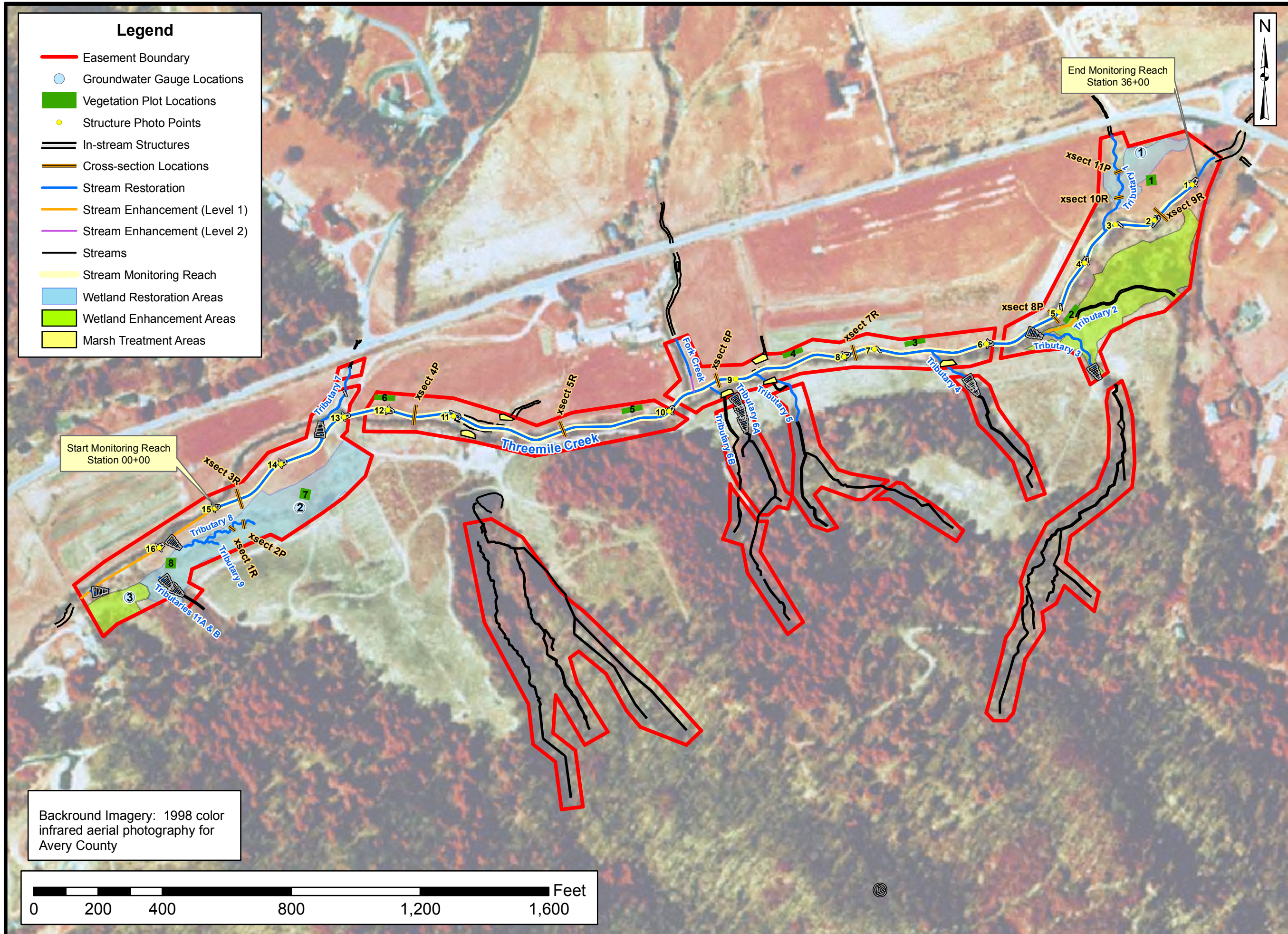
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Date: SEPT 2010

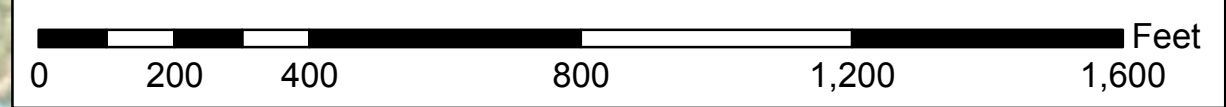
Scale: 1:3400

Project No.: 10-001

FIGURE 2



Background Imagery: 1998 color infrared aerial photography for Avery County



**APPENDIX B
VEGETATION DATA**

- 1. Vegetation Survey Data Tables**
- 2. Vegetation Monitoring Plot Photos**

Report Prepared By Corri Faquin
Date Prepared 7/11/2011 14:44
database name RestorationSystems-2011-A.mdb
database location C:\Axiom\Business\CVS
computer name CORRI-PC
file size 61538304

DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT-----

Metadata Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp Frequency distribution of vigor classes listed by species.
Damage List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp Damage values tallied by type for each species.
Damage by Plot Damage values tallied by type for each plot.
Planted Stems by Plot and Spp A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and spp A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.

PROJECT SUMMARY-----

Project Code Threemile
project Name Threemile Stream and Wetland Restoration Site
Description
River Basin
length(ft)
stream-to-edge width (ft)
area (sq m)
Required Plots (calculated)
Sampled Plots 8

Living planted stems, excluding live stakes, per acre: Negative (red) numbers indicate the project failed to reach requirements in a particular year.

Project Code	Project Name	River Basin	Year 3
Threemile	Threemile Stream and Wetland Restoration Site		612

Total stems, including planted stems of all kinds (including live stakes) and natural/volunteer stems:

Project Code	Project Name	River Basin	Year 3
Threemile	Threemile Stream and Wetland Restoration Site		688

Plot Data

Date Sampled	Planted Living Stems	Planted Living Stems EXCLUDING Live Stakes	Dead/Missing Stems	Natural (Volunteer) Stems	Total Living Stems	Total Living Stems EXCLUDING Live Stakes	Planted Living Stems per ACRE	Planted Living Stems EXCLUDING Live Stakes PER ACRE	Natural (Volunteer) Stems PER ACRE	Total Living Stems PER ACRE	Total Living Stems EXCLUDING Live Stakes PER ACRE	# species
6/27/2011	13	13	1	0	13	13	526	526	0	526	526	4
6/27/2011	10	10	4	6	16	16	405	405	243	647	647	5
6/27/2011	12	12	2	2	14	14	486	486	81	567	567	4
6/27/2011	18	18	3	2	20	20	728	728	81	809	809	4
7/27/2011	13	13	1	2	15	15	526	526	81	607	607	3
6/27/2011 to 6/28/2011	12	12	0	0	12	12	486	486	0	486	486	4
6/27/2011	16	16	12	2	18	18	647	647	81	728	728	3
6/27/2011 to 6/28/2011	28	27	3	0	28	27	1133	1093	0	1133	1093	6

Vigor

Vigor	Count	Percent
0	5	3.4
1	1	0.7
2	11	7.4
3	44	29.7
4	66	44.6
Missing	21	14.2

Vigor by Species

Species	CommonName	4	3	2	1	0	Missing	Unknown
<i>Alnus serrulata</i>	hazel alder	1						
<i>Asimina triloba</i>	pawpaw				1			
<i>Celtis laevigata</i>	sugarberry					1		
<i>Cephalanthus occidentalis</i>	common buttonbush	2	1					
<i>Cornus amomum</i>	silky dogwood	3						
<i>Diospyros virginiana</i>	common persimmon	3	12	6			12	
<i>Fraxinus pennsylvanica</i>	green ash	4	3					
<i>Quercus alba</i>	white oak	3	7				2	
<i>Quercus falcata</i>	southern red oak	5	2				1	
<i>Quercus michauxii</i>	swamp chestnut oak	10	7			1	2	
<i>Quercus pagoda</i>	cherrybark oak	1						
<i>Salix sericea</i>	silky willow	1						
<i>Cercis canadensis</i>	eastern redbud	2	3	4		1	2	
<i>Quercus rubra</i>	northern red oak	17	7	1		1	1	
<i>Platanus occidentalis</i>	American sycamore	14	2			1	1	
15	15	66	44	11	1	5	21	

Damage

Damage	Count	Percent Of Stems
(no damage)	111	75
Insects	12	8.1
Unknown	11	7.4
Site Too Wet	6	4.1
Vine Strangulation	3	2
Deer	3	2
Diseased	2	1.4

Damage by Species

Species	CommonName	Count of Damage Categories	(no damage)	Deer	Diseased	Insects	Site Too Wet	Unknown	Vine Strangulation
<i>Alnus serrulata</i>	hazel alder	0	1						
<i>Asimina triloba</i>	pawpaw	1						1	
<i>Celtis laevigata</i>	sugarberry	0	1						
<i>Cephalanthus occidentalis</i>	common buttonbush	0	3						
<i>Cercis canadensis</i>	eastern redbud	4	8					4	
<i>Cornus amomum</i>	silky dogwood	1	2			1			
<i>Diospyros virginiana</i>	common persimmon	10	23		2	2		6	
<i>Fraxinus pennsylvanica</i>	green ash	1	6						1
<i>Platanus occidentalis</i>	American sycamore	1	17			1			
<i>Quercus alba</i>	white oak	6	6				6		
<i>Quercus falcata</i>	southern red oak	1	7						1
<i>Quercus michauxii</i>	swamp chestnut oak	5	15			5			
<i>Quercus pagoda</i>	cherrybark oak	0	1						
<i>Quercus rubra</i>	northern red oak	7	20	3		3			1
<i>Salix sericea</i>	silky willow	0	1						
15	15	37	111	3	2	12	6	11	3

Damage by Plot

Plot	Count of Damage Categories	(No Damage)	Deer	Diseased	Insects	Site Too Wet	Unknown	Vine Strangulation
1	5	9	2		2			1
2	3	11			1		1	1
3	5	9		2	2		1	
4	5	16	1		4			
5	2	12			2			
6	2	10			1		1	
7	6	22					6	
8	9	22				6	2	1
8	37	111	3	2	12	6	11	3

Planted Stems by Plot and Species

Species	CommonName	Total Planted Stems	# plots	avg# stems	1	2	3	4	5	6	7	8
<i>Alnus serrulata</i>	hazel alder	1	1	1		1						
<i>Asimina triloba</i>	pawpaw	1	1	1			1					
<i>Cephalanthus occidentalis</i>	common buttonbush	3	2	1.5			1	2				
<i>Cercis canadensis</i>	eastern redbud	9	3	3						5	2	2
<i>Cornus amomum</i>	silky dogwood	3	3	1	1	1				1		
<i>Diospyros virginiana</i>	common persimmon	21	4	5.25	1	2	7				11	
<i>Fraxinus pennsylvanica</i>	green ash	7	2	3.5		4					3	
<i>Platanus occidentalis</i>	American sycamore	16	5	3.2		2	3	5	4	2		
<i>Quercus alba</i>	white oak	10	1	10								10
<i>Quercus falcata</i>	southern red oak	7	1	7								7
<i>Quercus michauxii</i>	swamp chestnut oak	17	3	5.67	1			8	8			
<i>Quercus pagoda</i>	cherrybark oak	1	1	1								1
<i>Quercus rubra</i>	northern red oak	25	5	5	10			3	1	4		7
<i>Salix sericea</i>	silky willow	1	1	1								1
14	14	122	14		13	10	12	18	13	12	16	28

ALL Stems by Plot and Species

Species	CommonName	Total Stems	# plots	avg# stems	1	2	3	4	5	6	7	8
<i>Alnus serrulata</i>	hazel alder	8	3	2.67		6		1	1			
<i>Asimina triloba</i>	pawpaw	1	1	1			1					
<i>Celtis laevigata</i>	sugarberry	1	1	1							1	
<i>Cephalanthus occidentalis</i>	common buttonbush	3	2	1.5			1	2				
<i>Cercis canadensis</i>	eastern redbud	10	3	3.33						5	3	2
<i>Cornus amomum</i>	silky dogwood	5	5	1	1	1		1	1	1		
<i>Diospyros virginiana</i>	common persimmon	23	4	5.75	1	2	9				11	
<i>Fraxinus pennsylvanica</i>	green ash	7	2	3.5		4					3	
<i>Pinus</i>	pine	1	1	1							1	
<i>Platanus occidentalis</i>	American sycamore	17	5	3.4		2	3	6	4	2		
<i>Quercus alba</i>	white oak	10	1	10								10
<i>Quercus falcata</i>	southern red oak	7	1	7								7
<i>Quercus michauxii</i>	swamp chestnut oak	18	3	6	2			8	8			
<i>Quercus pagoda</i>	cherrybark oak	1	1	1								1
<i>Quercus rubra</i>	northern red oak	26	5	5.2	10			4	1	4		7
<i>Salix</i>	willow	2	2	1		1					1	
<i>Salix sericea</i>	silky willow	1	1	1								1
17	17	141	17		14	16	14	22	15	12	20	28

Threemile Stream and Wetland Restoration Site
Year 3 (2011) Annual Monitoring
Vegetation Plot Photos
Taken July 2011



**APPENDIX C
GEOMORPHOLOGIC DATA**

- 1. Table C1. Qualitative Visual Stability Assessment**
- 2. Cross-section Plots and Tables**
- 3. Longitudinal Profile Plots**
- 4. Representative Structure Photographs**

**Table C1. Visual Morphological Stability Assessment
Threemile Creek**

Feature Category	Metric (per As-built and reference baselines)	(# Stable Number Performing as Intended)	Total number	Number / feet in unstable state	% Perform in Stable Condition	Feature Perform. Mean or Total
A. Riffles	1. Present	37	37	NA	100%	99%
	2. Armor stable (e.g. no displacement)?	37	37	NA	100%	
	3. Facet grade appears stable?	36	3737	NA	97%	
	4. Minimal evidence of embedding / fining?	37	37	NA	100%	
	5. Length appropriate?	36	37	NA	97%	
B. Pools	1. Present? (e.g. not subject to severe aggrad. Or migrat.?)	38	38	NA	100%	100%
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6?)	38	38	NA	100%	
	3. Length appropriate?	38	37	NA	100%	
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	37	37	NA	100%	100%
	2. Downstream of meander (glide/inflection) centering?	37	37	NA	100%	
D. Meanders	1. Outer bend in state of limited/controlled erosion?	38	38	NA	100%	100%
	2. Of those eroding, # w/concomitant point bar formation?	NA	NA	0	100%	
	3. Apparent Rc within spec?	38	38	NA	100%	
	4. Sufficient floodplain access and relief?	38	38	NA	100%	
E. Bed General	1. General channel bed aggradation areas (bar formation)	NA	NA	0	100%	100%
	2. Channel bed degradation – areas of increasing down-cutting or head cutting?	NA	NA	0	100%	
F. Bank	1. Actively eroding, wasting, or slumping bank	37	37	100	100%	100%
G. Vanes	1. Free of back or arm scour?	14	14	NA	NA	100%
	2. Height appropriate?	14	14	NA	NA	
	3. Angle and geometry appear appropriate?	14	14	NA	NA	
	4. Free of piping or other structural failures?	14	14	NA	NA	
H. Wads / Boulders	1. Free of scour?	NA	NA	NA	NA	NA
	2. Footing stable?	NA	NA	NA	NA	

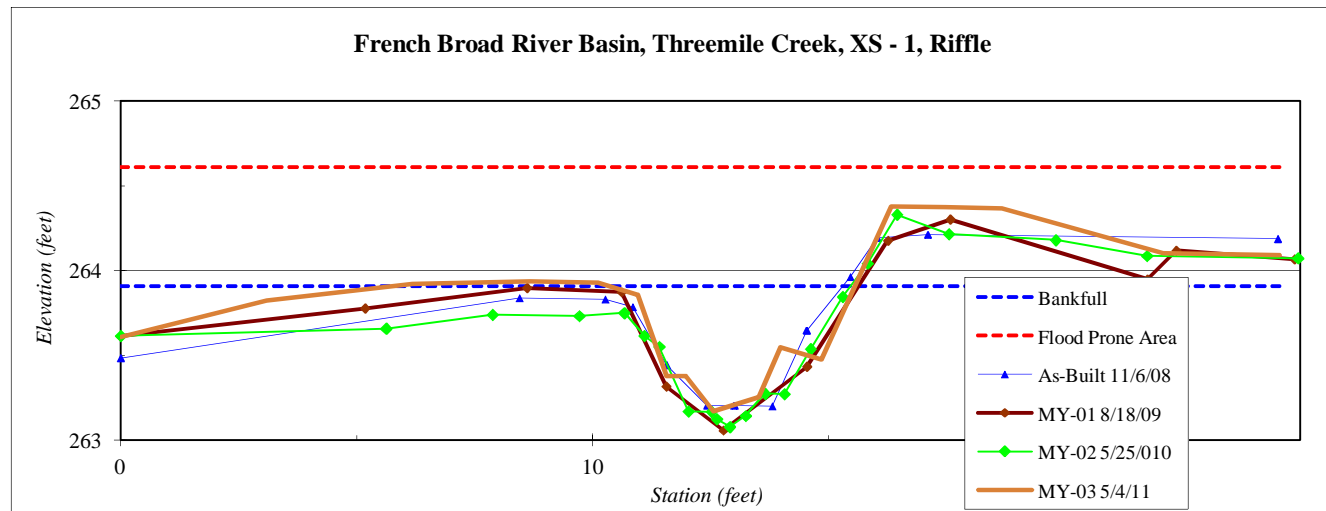
River Basin:	French Broad
Watershed:	Threemile Creek
XS ID	XS - 1, Riffle
Drainage Area (sq mi):	0.05
Date:	5/54/2011
Field Crew:	Dean, Thomas



Station	Elevation
0.00	263.61
3.10	263.82
6.18	263.92
8.68	263.94
10.12	263.93
10.97	263.86
11.57	263.38
11.98	263.38
12.56	263.17
13.52	263.25
13.98	263.55
14.86	263.47
16.33	264.38
17.47	264.38
18.67	264.37
22.10	264.10
24.6	264.09

SUMMARY DATA	
Bankfull Elevation:	263.9
Bankfull Cross-Sectional Area:	2.2
Bankfull Width:	5.2
Flood Prone Area Elevation:	264.6
Flood Prone Width:	>80
Max Depth at Bankfull:	0.7
Mean Depth at Bankfull:	0.4
W / D Ratio:	12.3
Entrenchment Ratio:	>5
Bank Height Ratio:	1.0

Stream Type	E
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River Basin:	French Broad
Watershed:	Threemile Creek
XS ID	XS - 3, Riffle
Drainage Area (sq mi):	4.7
Date:	5/4/2011
Field Crew:	Dean, Thomas

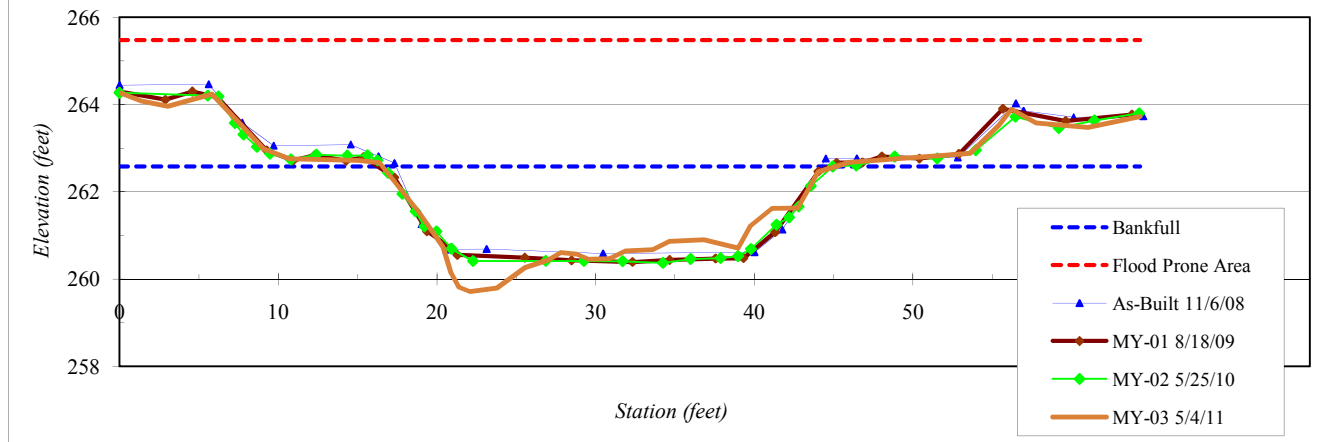


Stream Type	E/C
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Station	Elevation
0.00	264.27
1.33	264.09
3.05	263.96
5.83	264.24
9.10	262.97
10.69	262.75
15.03	262.72
16.37	262.67
18.90	261.52
20.40	260.74
20.87	260.15
21.38	259.82
22.09	259.72
23.79	259.79
25.6	260.27
27.0	260.44
27.8	260.61
28.8	260.58
29.6	260.46
30.9	260.47
31.9	260.65
33.6	260.68
34.7	260.87
36.8	260.90
39.0	260.71
39.7	261.22
41.1	261.62
42.72	261.63
44.02	262.45
45.98	262.68
53.61	262.89
55.39	263.52
56.20	263.90
57.75	263.58
61.02	263.48
64.31	263.73

SUMMARY DATA	
Bankfull Elevation:	262.6
Bankfull Cross-Sectional Area:	48.1
Bankfull Width:	28.5
Flood Prone Area Elevation:	265.5
Flood Prone Width:	>65
Max Depth at Bankfull:	2.9
Mean Depth at Bankfull:	1.7
W / D Ratio:	16.9
Entrenchment Ratio:	>5
Bank Height Ratio:	1.0

French Broad River Basin, Threemile Creek, XS - 3, Riffle



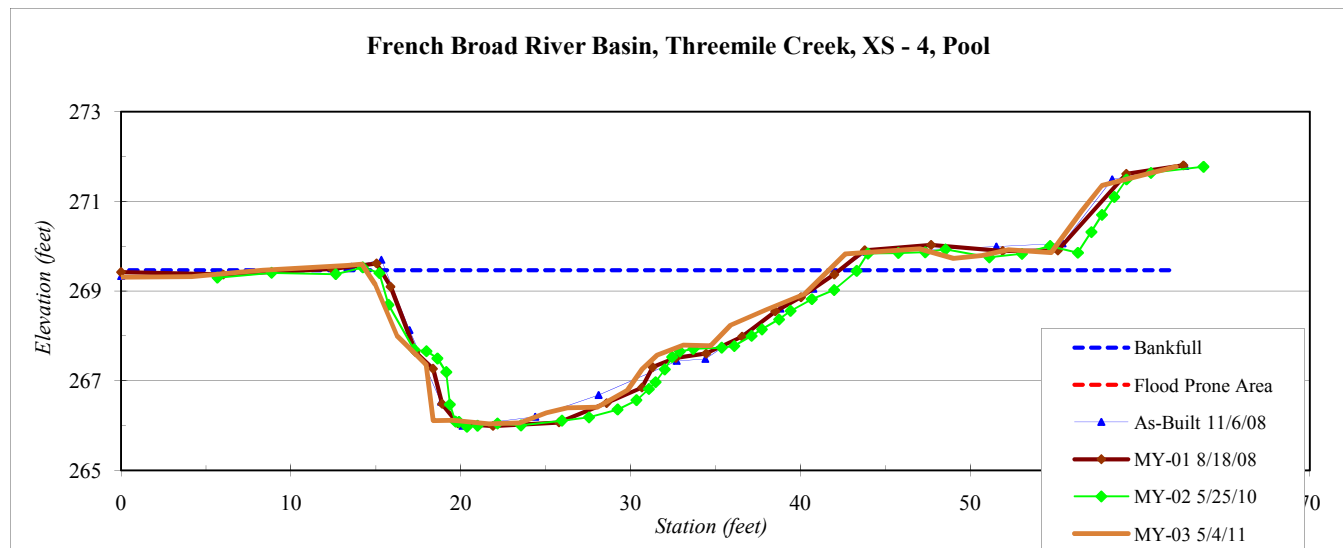
River Basin:	French Broad
Watershed:	Threemile Creek
XS ID	XS - 4, Pool
Drainage Area (sq mi):	4.7
Date:	5/4/2011
Field Crew:	Dean, Perkinson



Stream Type	E
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Station	Elevation
-0.5	269.3
4.1	269.3
6.8	269.4
8.3	269.5
13.3	269.6
14.2	269.6
15.0	269.1
16.3	268.0
17.5	267.5
18.0	267.4
18.4	266.1
19.5	266.1
21.7	266.0
23.5	266.1
25.0	266.28
26.3	266.39
28.0	266.40
29.8	266.79
30.7	267.26
31.5	267.57
33.1	267.79
34.7	267.78
35.9	268.24
38.0	268.58
40.3	268.93
42.7	269.83
47.0	269.94
49.0	269.73
50.7	269.79
52.3	269.92
54.8	269.85
56.5	270.77
57.8	271.35
62.1	271.77

SUMMARY DATA	
Bankfull Elevation:	269.5
Bankfull Cross-Sectional Area:	57.4
Bankfull Width:	27.3
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	3.4
Mean Depth at Bankfull:	2.1
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-



River Basin:	French Broad
Watershed:	Threemile Creek
XS ID	XS - 5, Riffle
Drainage Area (sq mi):	4.7
Date:	5/4/2011
Field Crew:	Dean, Thomas

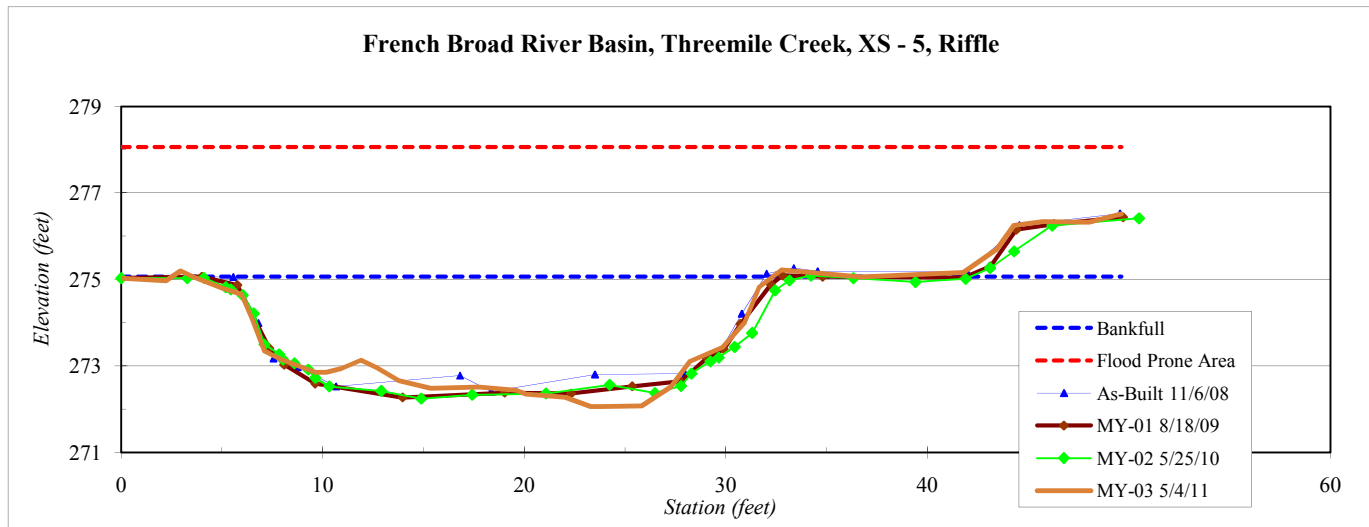


Stream Type E/C

Station	Elevation
0.0	275.0
2.2	275.0
2.9	275.2
3.6	275.1
4.9	274.8
6.0	274.7
6.5	274.1
7.1	273.3
7.9	273.1
9.6	272.8
10.2	272.8
10.9	272.9
11.9	273.1
12.7	272.95
13.8	272.66
15.4	272.48
17.7	272.51
19.6	272.44
20.1	272.35
22.0	272.27
23.3	272.06
23.8	272.06
25.8	272.08
27.3	272.52
28.2	273.10
29.8	273.43
30.9	273.99
31.6	274.82
32.8	275.22
36.7	275.06
41.8	275.16
43.5	275.70
44.3	276.25
45.8	276.34
48.0	276.32
49.6	276.51

SUMMARY DATA	
Bankfull Elevation:	275.1
Bankfull Cross-Sectional Area:	59.4
Bankfull Width:	29.0
Flood Prone Area Elevation:	278.1
Flood Prone Width:	>65
Max Depth at Bankfull:	3.0
Mean Depth at Bankfull:	2.0
W / D Ratio:	14.2
Entrenchment Ratio:	>5
Bank Height Ratio:	1.0

French Broad River Basin, Threemile Creek, XS - 5, Riffle



River Basin:	French Broad
Watershed:	Threemile Creek
XS ID	XS - 7, Riffle
Drainage Area (sq mi):	4.7
Date:	5/4/2011
Field Crew:	Dean, Thomas

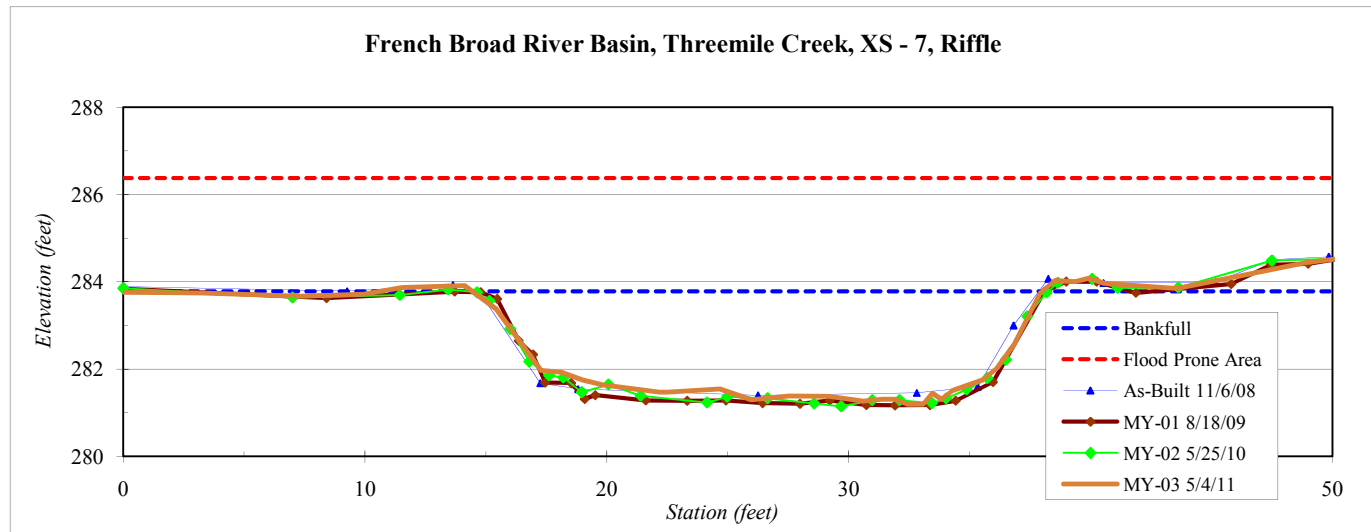
Station	Elevation
0.0	283.8
3.2	283.7
7.3	283.7
9.9	283.7
11.5	283.9
14.1	283.9
15.4	283.4
17.3	282.0
18.1	281.9
19.0	281.8
19.8	281.6
22.2	281.5
22.5	281.5
24.7	281.55
26.0	281.30
27.5	281.38
29.2	281.38
30.6	281.27
31.4	281.31
31.9	281.31
32.4	281.19
33.1	281.19
33.5	281.45
33.8	281.31
34.3	281.51
35.5	281.75
36.1	282.02
36.8	282.56
37.9	283.75
38.5	284.03
39.3	284.00
39.9	284.08
40.6	283.97
43.6	283.85
46.4	284.15
48.9	284.44

SUMMARY DATA	
Bankfull Elevation:	283.8
Bankfull Cross-Sectional Area:	47.1
Bankfull Width:	24.2
Flood Prone Area Elevation:	286.4
Flood Prone Width:	>65
Max Depth at Bankfull:	2.6
Mean Depth at Bankfull:	1.9
W / D Ratio:	12.4
Entrenchment Ratio:	>5
Bank Height Ratio:	1.0



Stream Type E/C

French Broad River Basin, Threemile Creek, XS - 7, Riffle



River Basin:	French Broad
Watershed:	Threemile Creek
XS ID	XS - 8, Pool
Drainage Area (sq mi):	4.7
Date:	5/4/2011
Field Crew:	Dean, Thomas

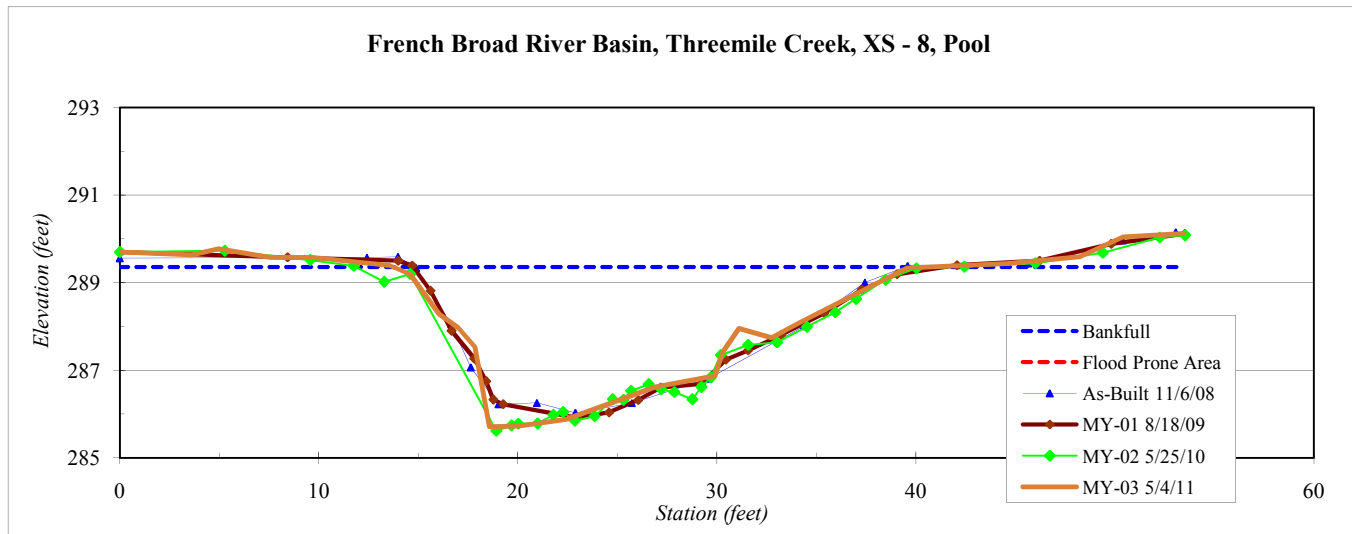
Station	Elevation
0.0	289.7
3.6	289.6
5.0	289.8
7.6	289.6
9.7	289.6
11.7	289.5
13.5	289.4
14.6	289.2
16.0	288.3
17.0	288.0
17.9	287.5
18.6	285.7
20.0	285.7
22.4	285.88
26.9	286.62
29.9	286.87
30.3	287.41
31.1	287.95
32.7	287.74
34.2	288.10
39.6	289.33
44.6	289.44
48.2	289.59
50.4	290.05
53.5	290.12

SUMMARY DATA	
Bankfull Elevation:	289.4
Bankfull Cross-Sectional Area:	51.4
Bankfull Width:	27.1
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	3.7
Mean Depth at Bankfull:	1.9
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-



Stream Type E/C

French Broad River Basin, Threemile Creek, XS - 8, Pool



River Basin:	French Broad
Watershed:	Threemile Creek
XS ID	XS - 9, Riffle
Drainage Area (sq mi):	4.7
Date:	5/4/2011
Field Crew:	Dean, Thomas

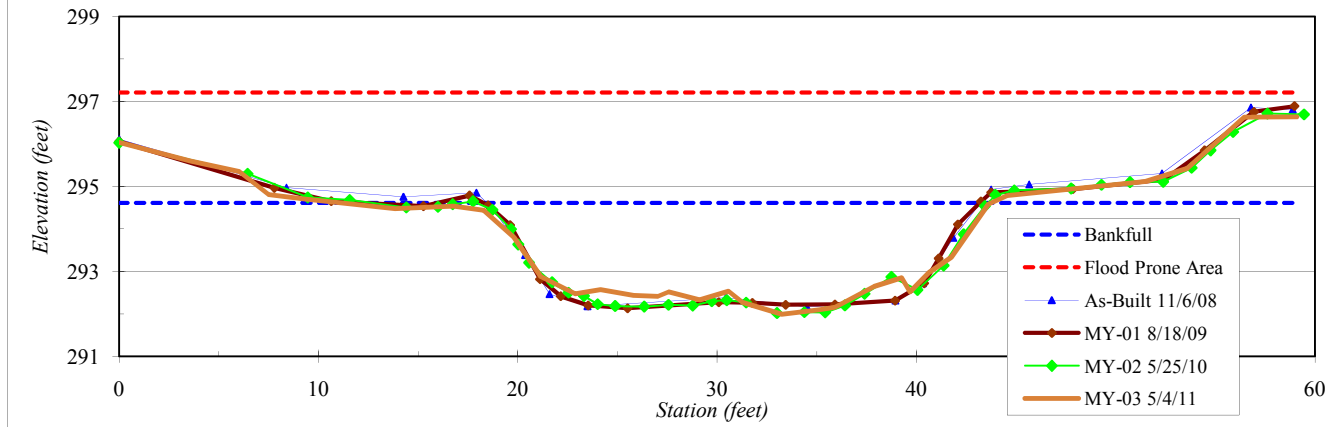


Stream Type	E/C
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Station	Elevation
0.0	296.0
3.6	295.6
6.0	295.3
7.5	294.8
9.2	294.7
13.8	294.5
16.8	294.5
18.3	294.4
19.8	293.8
21.1	292.9
22.9	292.5
24.1	292.6
25.8	292.4
27.0	292.41
27.6	292.52
29.1	292.33
30.6	292.53
31.3	292.27
33.3	291.99
35.1	292.10
35.9	292.16
37.9	292.65
39.3	292.85
39.7	292.52
40.6	292.98
41.7	293.33
43.6	294.58
44.6	294.78
51.5	295.12
53.6	295.43
56.5	296.63
59.1	296.63

SUMMARY DATA	
Bankfull Elevation:	294.6
Bankfull Cross-Sectional Area:	48.0
Bankfull Width:	27.0
Flood Prone Area Elevation:	297.2
Flood Prone Width:	>65
Max Depth at Bankfull:	2.6
Mean Depth at Bankfull:	1.8
W / D Ratio:	15.2
Entrenchment Ratio:	>5
Bank Height Ratio:	1.0

French Broad River Basin, Threemile Creek, XS - 9, Riffle



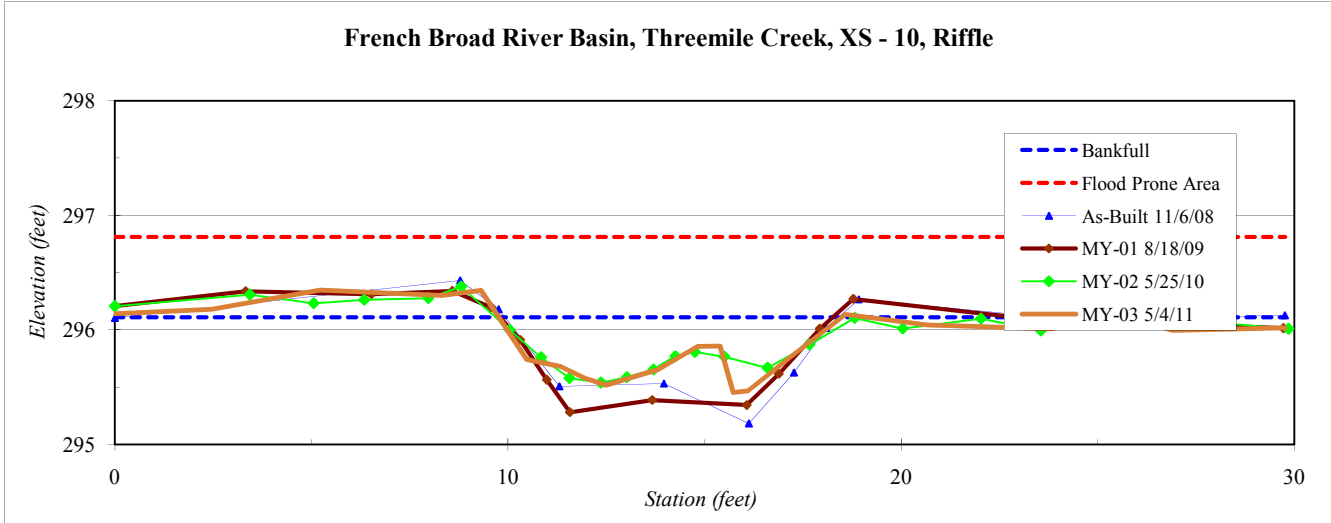
River Basin:	French Broad
Watershed:	Threemile Creek
XS ID	XS - 10, Riffle
Drainage Area (sq mi):	0.05
Date:	5/4/2011
Field Crew:	Dean, Thomas

Station	Elevation
0.0	296.1
2.5	296.2
5.2	296.3
8.3	296.3
9.3	296.3
10.5	295.7
11.3	295.7
11.9	295.6
12.5	295.5
13.8	295.7
14.8	295.9
15.4	295.9
15.7	295.5
16.1	295.47
17.3	295.79
18.6	296.13
20.7	296.04
23.8	296.01
25.4	296.15
26.9	295.99
29.8	296.02

SUMMARY DATA	
Bankfull Elevation:	296.1
Bankfull Cross-Sectional Area:	3.4
Bankfull Width:	8.7
Flood Prone Area Elevation:	296.8
Flood Prone Width:	>35
Max Depth at Bankfull:	0.7
Mean Depth at Bankfull:	0.4
W / D Ratio:	22.3
Entrenchment Ratio:	>5
Bank Height Ratio:	1.0



Stream Type E/C



River Basin:	French Broad
Watershed:	Threemile Creek
XS ID	XS - 11, Pool
Drainage Area (sq mi):	0.05
Date:	5/4/2011
Field Crew:	Dean, Thomas

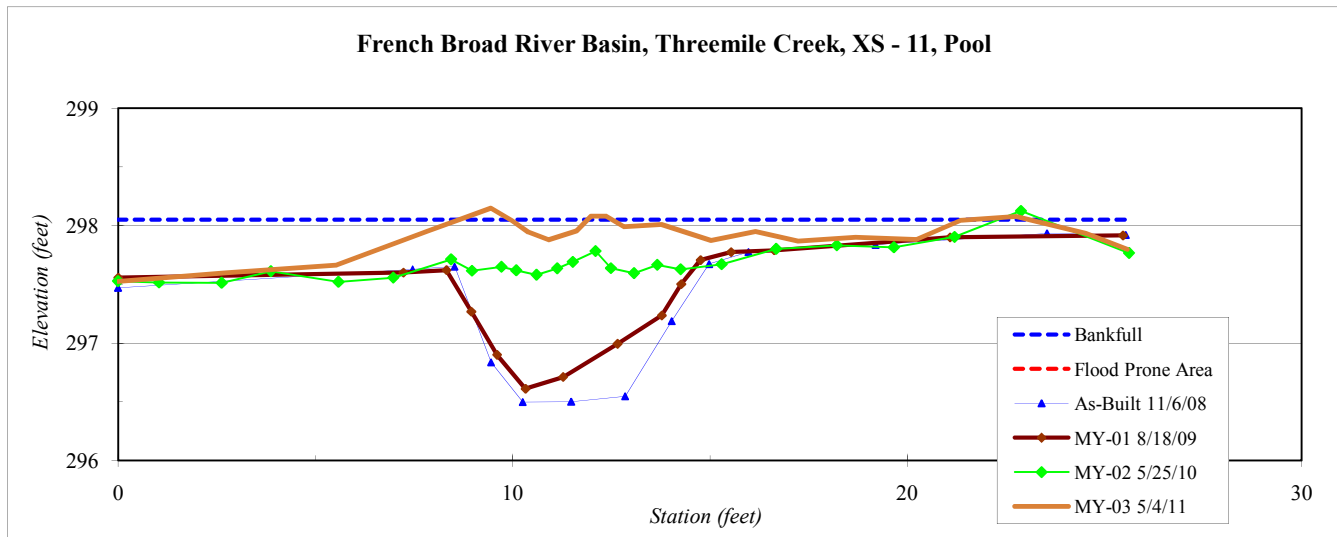


Stream Type	E/C
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Station	Elevation
0.0	297.5
2.7	297.6
5.5	297.7
7.8	298.0
9.4	298.1
10.0	298.0
10.4	297.9
10.9	297.9
11.6	298.0
12.0	298.1
12.4	298.1
12.8	298.0
13.8	298.0
15.0	297.87
16.2	297.95
17.2	297.87
18.7	297.90
20.2	297.88
21.4	298.05
22.8	298.08
24.5	297.93
25.6	297.80

SUMMARY DATA	
Bankfull Elevation:	298.1
Bankfull Cross-Sectional Area:	1.1
Bankfull Width:	8.8
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	0.5
Mean Depth at Bankfull:	0.1
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

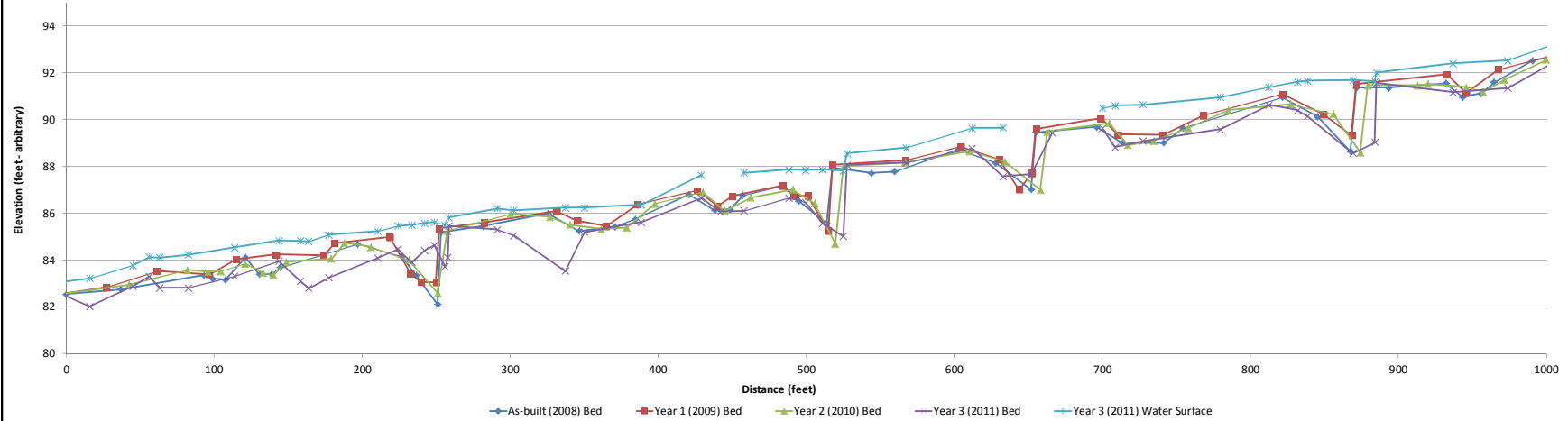
French Broad River Basin, Threemile Creek, XS - 11, Pool



Project Name Threemile Creek - Profile											
Reach 00+00 - 10+00											
Feature Profile											
Date 5/2/11											
Crew Dean, Thomas											
2008 As-built Survey			2009 Year 1 Monitoring /Survey			2010 Year 2 Monitoring /Survey			2011 Year 3 Monitoring /Survey		
Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation
0.0	82.5	82.6	-3.3	82.5	82.8	-3.0	82.5	82.8	-3.0	82.5	83.1
37.1	82.8	83.2	27.2	82.8	83.1	42.3	82.9	83.4	15.8	82.0	83.2
93.1	83.4	83.9	61.6	83.5	83.8	81.9	83.6	84.0	45.0	82.9	83.8
98.8	83.2	83.9	96.5	83.4	84.0	95.6	83.5	84.0	55.9	83.3	84.1
107.4	83.2	83.9	114.5	84.0	84.3	104.5	83.5	84.0	63.1	82.8	84.1
121.0	84.1	84.1	141.7	84.2	84.5	120.8	83.8	84.3	82.5	82.8	84.2
130.4	83.4	84.3	173.8	84.2	84.9	133.0	83.5	84.5	113.7	83.3	84.5
138.8	83.4	84.3	181.2	84.7	85.0	139.8	83.4	84.4	143.6	84.0	84.8
144.7	83.7	84.3	218.5	85.0	85.3	148.7	83.9	84.6	158.3	83.1	84.8
197.0	84.7	85.1	232.7	83.4	85.3	178.9	84.1	84.7	163.7	82.8	84.8
226.7	84.1	85.1	239.7	83.1	85.3	188.0	84.7	85.0	177.4	83.3	85.1
236.5	83.3	85.2	249.8	83.0	85.3	205.8	84.6	85.4	210.3	84.1	85.2
250.9	82.1	85.2	251.9	85.4	85.7	231.4	84.0	85.4	224.1	84.5	85.5
253.2	85.2	85.2	282.1	85.6	86.0	250.9	82.6	85.4	233.4	83.9	85.5
281.5	85.4	85.9	331.2	86.1	86.5	257.5	85.3	85.6	242.0	84.4	85.6
325.5	86.0	86.4	345.4	85.7	86.6	300.3	86.0	86.3	248.5	84.6	85.6
346.6	85.2	86.4	364.7	85.5	86.5	326.5	85.8	86.5	255.8	83.7	85.5
370.6	85.4	86.4	386.1	86.4	86.6	340.3	85.5	86.5	257.7	84.1	85.5
384.2	85.7	86.3	426.2	87.0	87.4	361.3	85.3	86.5	258.5	85.5	85.8
420.6	86.8	87.0	439.9	86.3	87.3	378.5	85.4	86.5	291.0	85.3	86.2
438.2	86.1	87.2	449.9	86.7	87.3	397.6	86.4	86.7	302.3	85.1	86.1
448.3	86.2	87.2	483.8	87.2	87.7	430.0	86.9	87.4	337.2	83.5	86.2
457.1	86.8	87.2	491.2	86.8	87.7	444.7	86.1	87.4	350.1	85.2	86.2
484.0	87.2	87.6	500.9	86.7	87.7	462.4	86.7	87.4	388.5	85.6	86.4
494.7	86.5	87.6	514.9	85.2	87.7	490.8	87.0	87.6	428.9	86.7	87.6
513.8	85.6	87.6	517.6	88.1	88.4	505.6	86.4	87.6	441.7	86.1	87.6
517.6	87.9	88.2	566.8	88.3	88.5	519.5	84.7	87.6	457.8	86.1	87.7

	As-built	2009	2010	2011
Avg. Water Surface Slope	0.0098	0.0097	0.0098	0.0097
Riffle Length	51	53	51	50
Avg. Riffle Slope	0.0154	0.0143	0.0148	0.0173
Pool Length	46	38	44	46
Pool to Pool Spacing	-----	0.0008	0.0038	0.0052

Threemile Creek Year 3 (2011) Profile - Reach 00+00 to 10+00

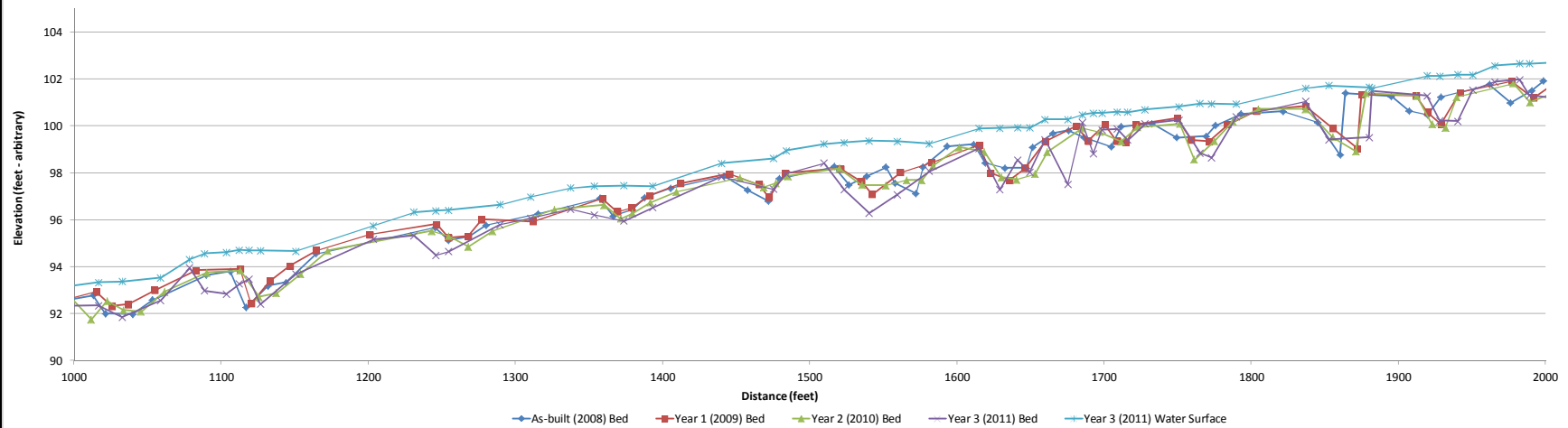


1387.8 96.9 97.3

Project Name Threemile Creek - Profile											
Reach 10+00 - 20+00											
Feature Profile											
Date 5/2/11											
Crew Dean, Thomas											
2008 As-built Survey			2009 Year 1 Monitoring /Survey			2010 Year 2 Monitoring /Survey			2011 Year 3 Monitoring /Survey		
Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation
0.0	82.5	82.6	967.1	92.1	92.5	999.7	92.6	93.0	990.6	92.3	93.1
37.1	82.8	83.2	1015.0	92.9	93.2	1011.6	91.8	93.2	1016.7	92.3	93.3
93.1	83.4	83.9	1025.6	92.3	93.3	1022.5	92.5	93.2	1032.7	91.9	93.4
98.8	83.2	83.9	1036.6	92.4	93.3	1033.7	92.1	93.3	1058.8	92.6	93.5
107.4	83.2	83.9	1054.6	93.0	93.3	1045.5	92.1	93.3	1078.4	94.0	94.3
121.0	84.1	84.1	1082.7	93.8	94.2	1061.4	92.9	93.3	1088.7	93.0	94.6
130.4	83.4	84.3	1113.0	93.9	94.4	1090.2	93.7	94.0	1103.5	92.8	94.6
138.8	83.4	84.3	1120.3	92.4	94.4	1113.1	93.8	94.4	1112.3	93.3	94.7
144.7	83.7	84.3	1132.9	93.4	94.4	1125.7	92.7	94.4	1119.0	93.5	94.7
197.0	84.7	85.1	1146.8	94.0	94.4	1137.4	92.9	94.4	1126.6	92.4	94.7
226.7	84.1	85.1	1164.5	94.7	94.9	1153.8	93.7	94.5	1150.6	93.7	94.7
236.5	83.3	85.2	1201.0	95.4	95.5	1172.3	94.7	95.0	1203.2	95.2	95.7
250.9	82.1	85.2	1246.3	95.8	96.1	1243.0	95.5	96.1	1231.1	95.3	96.3
253.2	85.2	85.2	1254.6	95.2	96.2	1254.6	95.3	96.1	1246.0	94.5	96.4
281.5	85.4	85.9	1267.6	95.3	96.2	1267.9	94.8	96.1	1254.4	94.6	96.4
325.5	86.0	86.4	1277.0	96.0	96.1	1284.4	95.5	96.1	1289.3	95.8	96.6
346.6	85.2		1311.8	95.9	96.6	1326.3	96.4	96.9	1310.1	96.1	97.0
370.6	85.4	86.4	1358.9	96.9	97.3	1360.3	96.6	97.2	1337.2	96.5	97.4
384.2	85.7	86.3	1369.2	96.3	97.3	1371.5	96.0	97.3	1353.4	96.2	97.4
420.6	86.8	87.0	1378.7	96.5	97.3	1379.2	96.3	97.2	1373.7	96.0	97.5
438.2	86.1	87.2	1391.4	97.0	97.4	1391.6	96.7	97.3	1393.1	96.5	97.4
448.3	86.2	87.2	1412.1	97.6	97.8	1409.4	97.2	97.7	1439.8	97.8	98.4
457.1	86.8	87.2	1445.4	98.0	98.2	1452.3	97.8	98.2	1475.3	97.3	98.6
484.0	87.2	87.6	1465.7	97.5	98.2	1468.7	97.4	98.3	1483.9	98.0	98.9
494.7	86.5	87.6	1472.2	97.0	98.2	1477.1	97.6	98.3	1509.6	98.4	99.2
513.8	85.6	87.6	1483.4	98.0	98.3	1485.0	97.9	98.3	1523.4	97.3	99.3
517.6	87.9	88.2	1520.9	98.2	98.8	1520.0	98.2	98.8	1540.3	96.3	99.4

	As-built	2009	2010	2011
Avg. Water Surface Slope	0.0098	0.0097	0.0098	0.0097
Riffle Length	51.0	52.9	51	50
Avg. Riffle Slope	0.0154	0.0143	0.0148	0.0173
Pool Length	46.0	38.0	44	46
Avg. Pool Slope	-----	0.0008	0.0038	0.0052

Threemile Creek Year 3 (2011) Profile - Reach 10+00 to 20+00

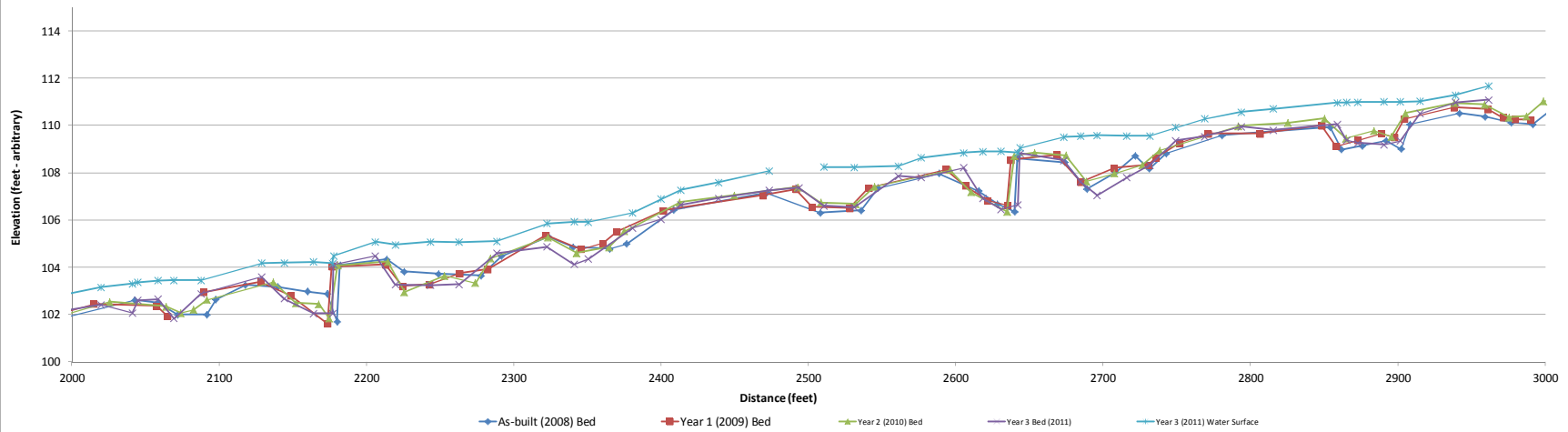


1387.8 96.9 97.3

Project Name Threemile Creek - Profile											
Reach 20+00 - 30+00											
Feature Profile											
Date 5/2/11											
Crew Dean, Thomas											
2008 As-built Survey			2009 Year 1 Monitoring /Survey			2010 Year 2 Monitoring /Survey			2011 Year 3 Monitoring /Survey		
Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation
0.0	82.5	82.6	1971.8	101.2	102.2	1974.2	101.0	102.3	1966.3	101.3	102.7
37.1	82.8	83.2	1990.1	102.0	102.2	1985.1	101.3	102.3	1981.4	101.2	102.7
93.1	83.4	83.9	2014.8	102.5	102.5	1996.8	102.0	102.3	1998.7	102.2	102.9
98.8	83.2	83.9	2057.5	102.4	102.9	2025.6	102.5	102.9	2019.8	102.4	103.2
107.4	83.2	83.9	2064.9	101.9	102.9	2064.2	102.3	103.0	2041.0	102.1	103.3
121.0	84.1	84.1	2077.4		102.9	2074.1	102.1	103.0	2044.9	102.6	103.4
130.4	83.4	84.3	2089.1	102.9	103.0	2082.5	102.2	103.0	2058.6	102.6	103.4
138.8	83.4	84.3	2127.9	103.4	103.6	2091.6	102.6	103.0	2069.2	101.8	103.5
144.7	83.7	84.3	2148.5	102.8	103.6	2136.7	103.4	103.7	2087.7	102.9	103.4
197.0	84.7	85.1	2173.6	101.6	103.6	2152.0	102.5	103.7	2128.7	103.6	104.2
226.7	84.1	85.1	2176.6	104.0	104.1	2167.6	102.4	103.7	2144.1	102.7	104.2
236.5	83.3	85.2	2212.9	104.1	104.4	2174.7	101.8	103.7	2164.1	102.0	104.2
250.9	82.1	85.2	2224.2	103.2	104.5	2180.4	104.1	104.3	2176.9	102.0	104.2
253.2	85.2	85.2	2242.6	103.3	104.4	2214.4	104.2	104.7	2177.8	104.1	104.5
281.5	85.4	85.9	2263.2	103.7	104.4	2225.7	103.0	104.7	2205.9	104.5	105.1
325.5	86.0	86.4	2282.2	103.9	104.5	2252.9	103.6	104.7	2219.5	103.3	105.0
346.6	85.2		2321.8	105.4	105.7	2274.0	103.3	104.7	2243.5	103.2	105.1
370.6	85.4	86.4	2345.4	104.8	105.6	2284.0	104.4	104.8	2262.7	103.3	105.1
384.2	85.7	86.3	2360.4	105.0	105.7	2323.1	105.3	105.7	2288.3	104.6	105.1
420.6	86.8	87.0	2369.9	105.5	105.6	2342.6	104.6	105.8	2322.5	104.9	105.9
438.2	86.1	87.2	2401.4	106.4	106.6	2364.6	104.9	105.8	2340.9	104.1	105.9
448.3	86.2	87.2	2468.9	107.0	107.5	2375.0	105.5	105.8	2350.2	104.3	105.9
457.1	86.8	87.2	2491.5	107.3	107.6	2412.6	106.8	107.0	2380.6	105.7	106.3
484.0	87.2	87.6	2502.3	106.6	107.6	2449.5	107.1	107.4	2398.8	106.0	106.9
494.7	86.5	87.6	2527.6	106.5	107.6	2492.4	107.4	107.8	2413.2	106.6	107.3
513.8	85.6	87.6	2540.7	107.4	107.6	2508.4	106.7	107.8	2438.9	106.9	107.6
517.6	87.9	88.7	2563.2	108.1	108.4	2537.1	106.7	107.8	2473.2	107.3	108.1

	As-built	2009	2010	2011
Avg. Water Surface Slope	0.0098	0.0097	0.0098	0.0097
Riffle Length	51.0	52.9	51	50
Avg. Riffle Slope	0.0154	0.0143	0.0148	0.0173
Pool Length	46.0	38.0	44	46
Avg. Pool Slope	-----	0.0008	0.0038	0.0052

Threemile Creek Year 3 (2011) Profile - Reach 20+00 to 30+00

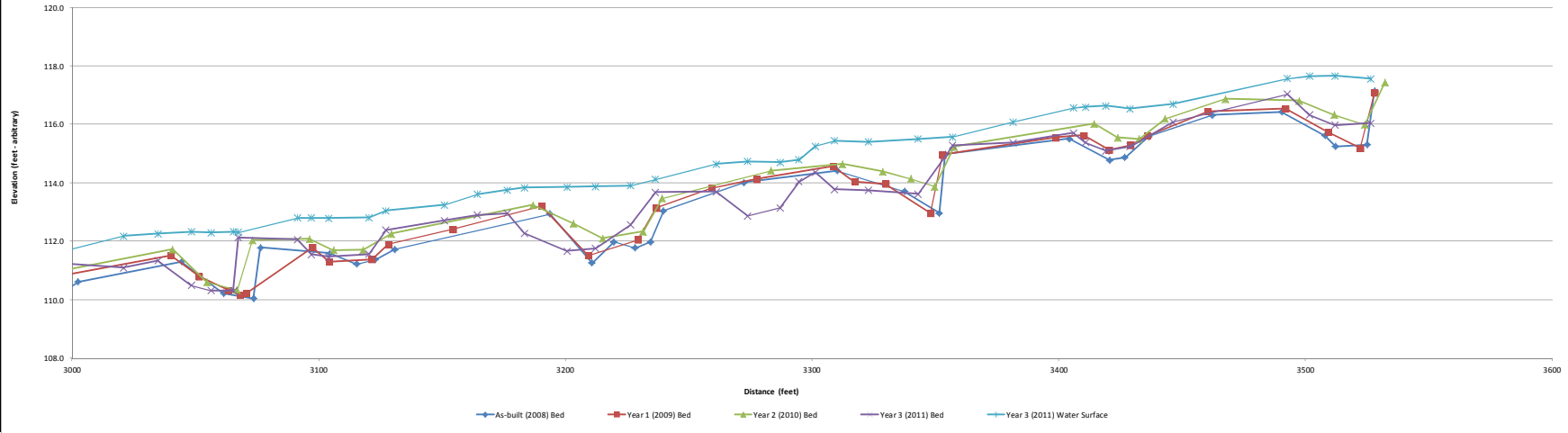


1387.8 96.9 97.3

Project Name Threemile Creek - Profile											
Reach 30+00 - 36+00											
Feature Profile											
Date 5/2/11											
Crew Dean, Thomas											
2008 As-built Survey			2009 Year 1 Monitoring /Survey			2010 Year 2 Monitoring /Survey			2011 Year 3 Monitoring /Survey		
Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation	Station	Bed Elevation	Water Elevation
0.0	82.5	82.6	2971.4	110.3	111.0	2975.5	110.3	111.3	2966.6	110.1	111.7
37.1	82.8	83.2	2979.2	110.3	111.0	2987.0	110.4	111.3	2984.6	110.4	111.7
93.1	83.4	83.9	2989.8	110.2	111.0	2998.6	111.0	111.3	2996.5	111.2	111.7
98.8	83.2	83.9	2994.6	110.8	111.1	3040.7	111.7	112.0	3020.7	111.1	112.2
107.4	83.2	83.9	3040.0	111.5	111.8	3054.6	110.6	112.1	3034.8	111.3	112.3
121.0	84.1	84.1	3051.5	110.8	111.8	3066.9	110.3	112.1	3048.2	110.5	112.3
130.4	83.4	84.3	3063.4	110.3	111.8	3073.0	112.0	112.3	3056.3	110.3	112.3
138.8	83.4	84.3	3068.0	110.2	111.8	3096.2	112.1	112.5	3065.3	110.3	112.3
144.7	83.7	84.3	3070.6	110.2	112.1	3105.9	111.7	112.5	3067.3	112.1	112.3
197.0	84.7	85.1	3097.3	111.8	112.1	3117.9	111.7	112.5	3091.3	112.1	112.8
226.7	84.1	85.1	3104.2	111.3	112.1	3129.4	112.3	112.5	3096.9	111.6	112.8
236.5	83.3	85.2	3121.4	111.4	112.1	3186.8	113.2	113.6	3103.8	111.5	112.8
250.9	82.1	85.2	3128.2	111.9	112.1	3203.1	112.6	113.6	3120.2	111.6	112.8
253.2	85.2	85.2	3154.3	112.4	112.7	3215.0	112.1	113.6	3127.1	112.4	113.1
281.5	85.4	85.9	3190.3	113.2	113.3	3231.5	112.3	113.6	3150.9	112.7	113.2
325.5	86.0	86.4	3209.2	111.5	113.3	3239.1	113.5	113.9	3164.1	112.9	113.6
346.6	85.2		3229.2	112.1	113.3	3283.3	114.4	114.8	3176.4	113.0	113.8
370.6	85.4	86.4	3236.7	113.1	113.5	3312.3	114.6	115.1	3183.3	112.3	113.8
384.2	85.7	86.3	3259.2	113.8	114.1	3328.5	114.4	115.2	3200.6	111.7	113.9
420.6	86.8	87.0	3277.5	114.1	114.5	3340.0	114.1	115.2	3212.1	111.8	113.9
438.2	86.1	87.2	3308.5	114.6	114.8	3349.7	113.9	115.2	3226.3	112.6	113.9
448.3	86.2	87.2	3317.1	114.0	114.8	3357.4	115.2	115.5	3236.4	113.7	114.1
457.1	86.8	87.2	3329.7	114.0	114.8	3414.4	116.0	116.3	3261.1	113.7	114.6
484.0	87.2	87.6	3347.9	113.0	114.8	3423.7	115.6	116.4	3273.7	112.9	114.7
494.7	86.5	87.6	3352.9	115.0	115.1	3432.5	115.5	116.4	3286.9	113.1	114.7
513.8	85.6	87.6	3398.6	115.6	115.9	3443.0	116.2	116.5	3294.6	114.0	114.8
517.6	87.9	88.2	3410.1	115.6	116.0	3467.4	116.9	117.1	3301.1	114.4	115.3

Avg. Water Surface Slope	As-built	2009	2010	2011
Rifle Length	0.0098	0.0097	0.0098	0.0097
Avg. Rifle Slope	51.0	52.9	51	50
Pool Length	0.0154	0.0143	0.0148	0.0173
Avg. Pool Slope	46.0	38.0	44	46
	-----	0.0008	0.0038	0.0052

Threemile Creek Year 3 (2011) Profile - Reach 30+00 to 36+00



1387.8 96.9 97.3

**Three Mile
Year 3 (2011) Annual Monitoring
Structure Photographs taken May 2011**



Cross-vane (Photo 1)



J-hook (Photo 2)



Log-Vane (Photo 3)



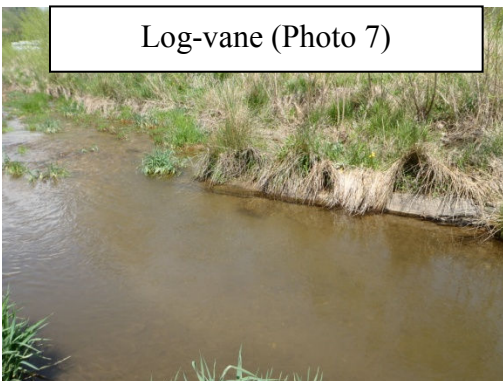
Cross-vane Station (Photo 4)



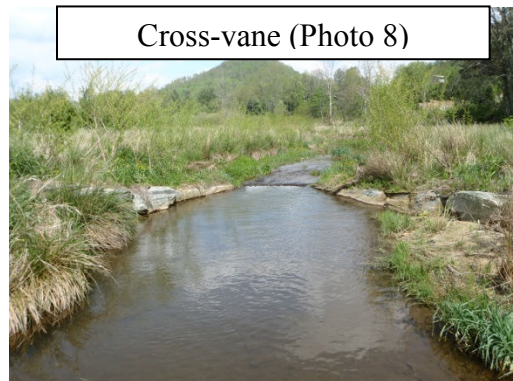
Log-vane (Photo 5)



Cross-vane (Photo 6)



Log-vane (Photo 7)



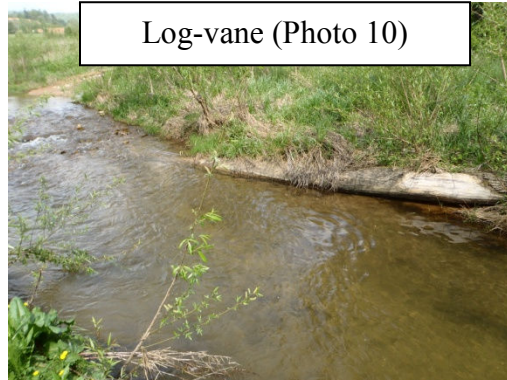
Cross-vane (Photo 8)

**Three Mile
Year 3 (2011) Annual Monitoring
Structure Photographs taken May 2010
(continued)**

Cross-vane (Photo 9)



Log-vane (Photo 10)



J-hook (Photo 11)



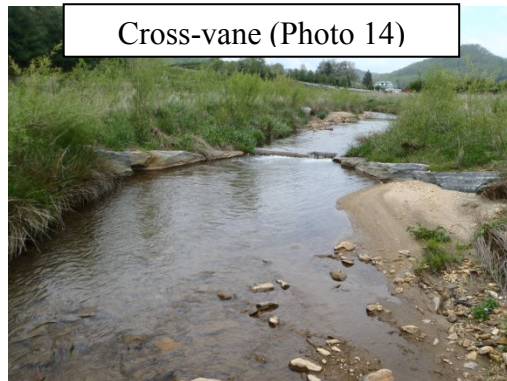
Cross-vane (Photo 12)



Cross-vane (Photo 13)



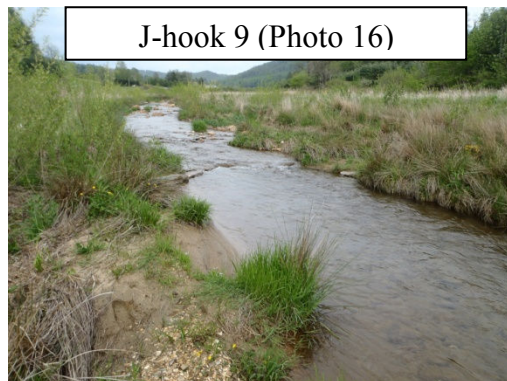
Cross-vane (Photo 14)



Cross-vane (Photo 15)

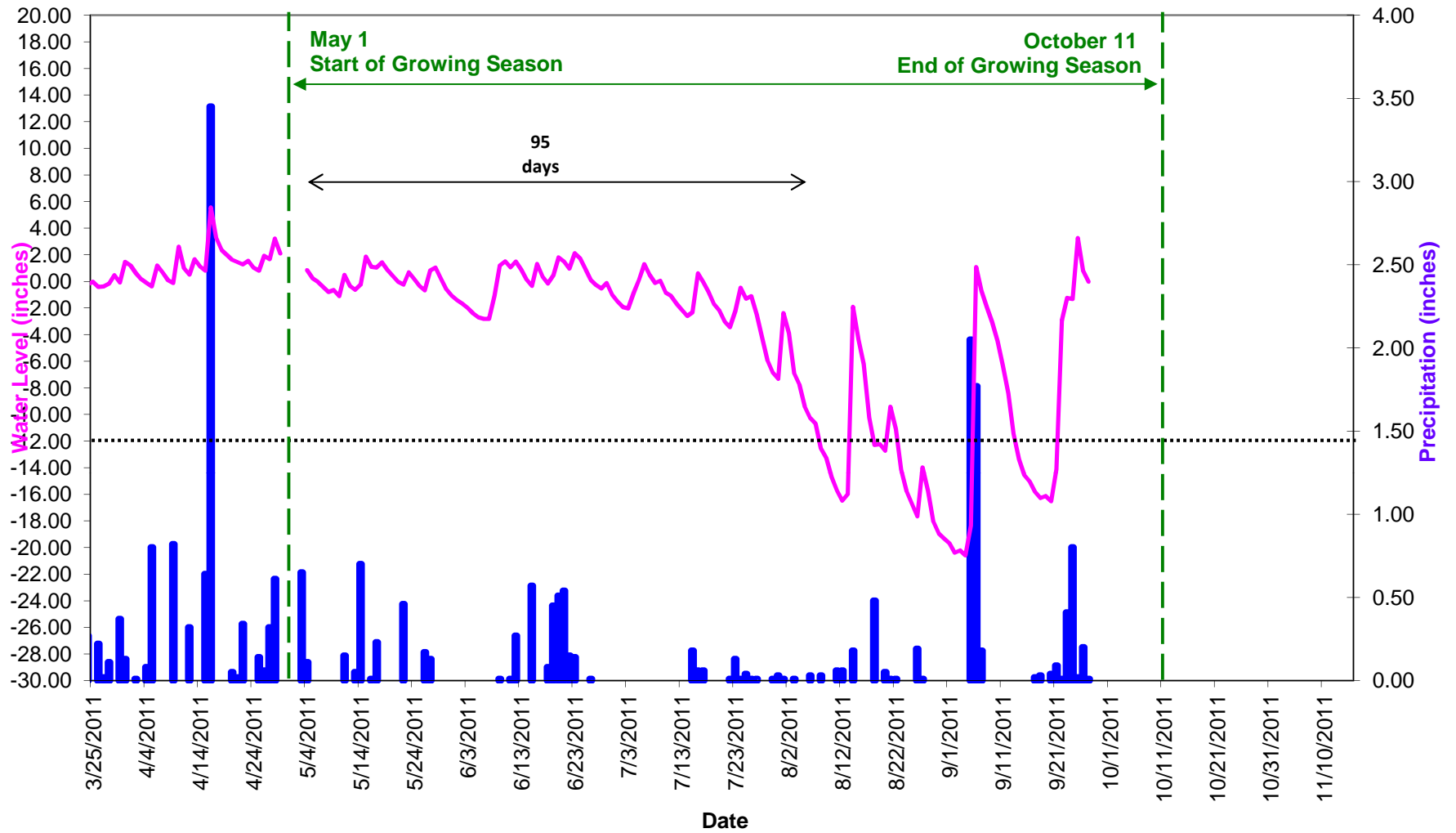


J-hook 9 (Photo 16)

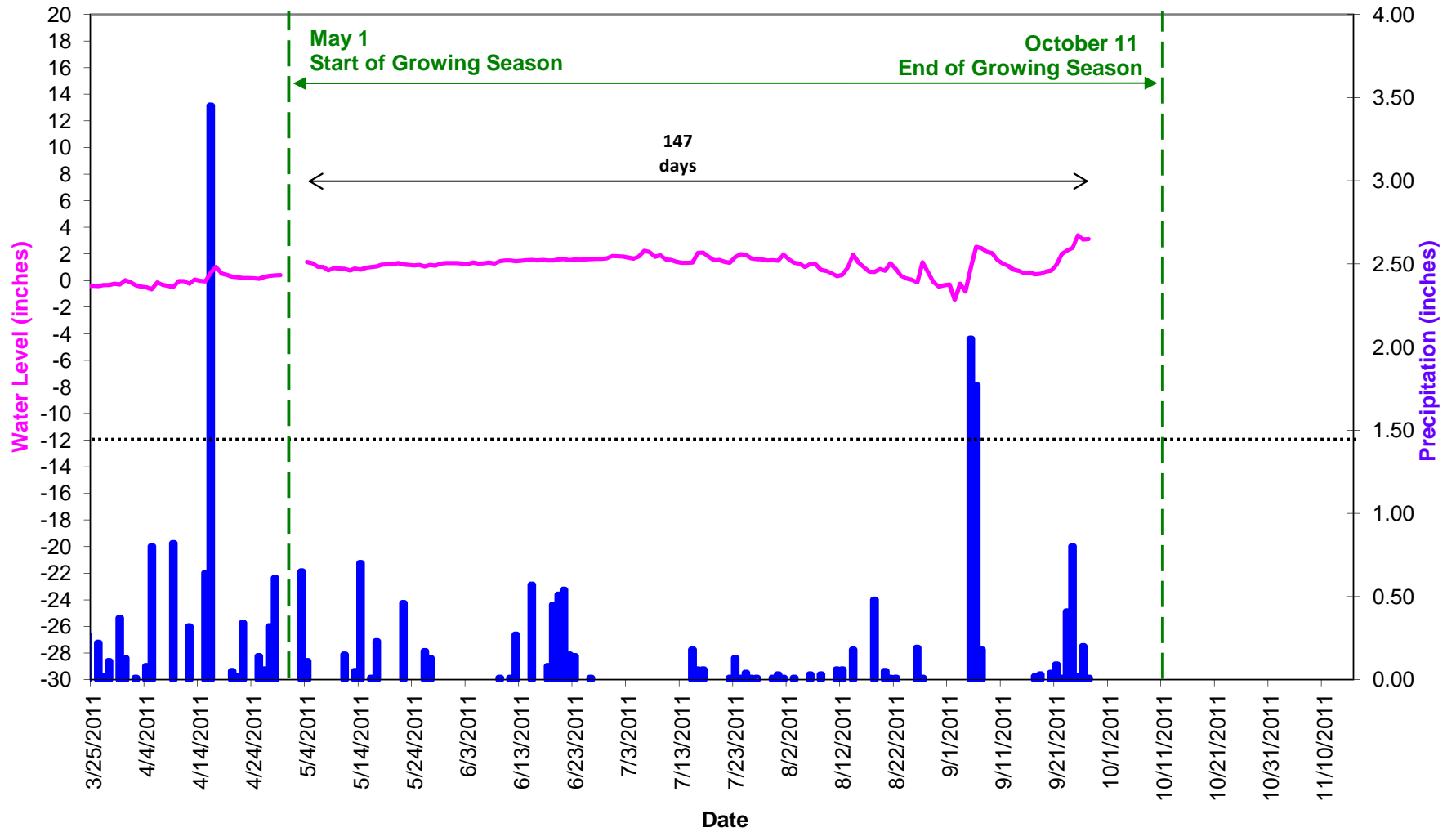


**APPENDIX D
HYDROLOGY DATA
2011 Groundwater Gauge Graphs**

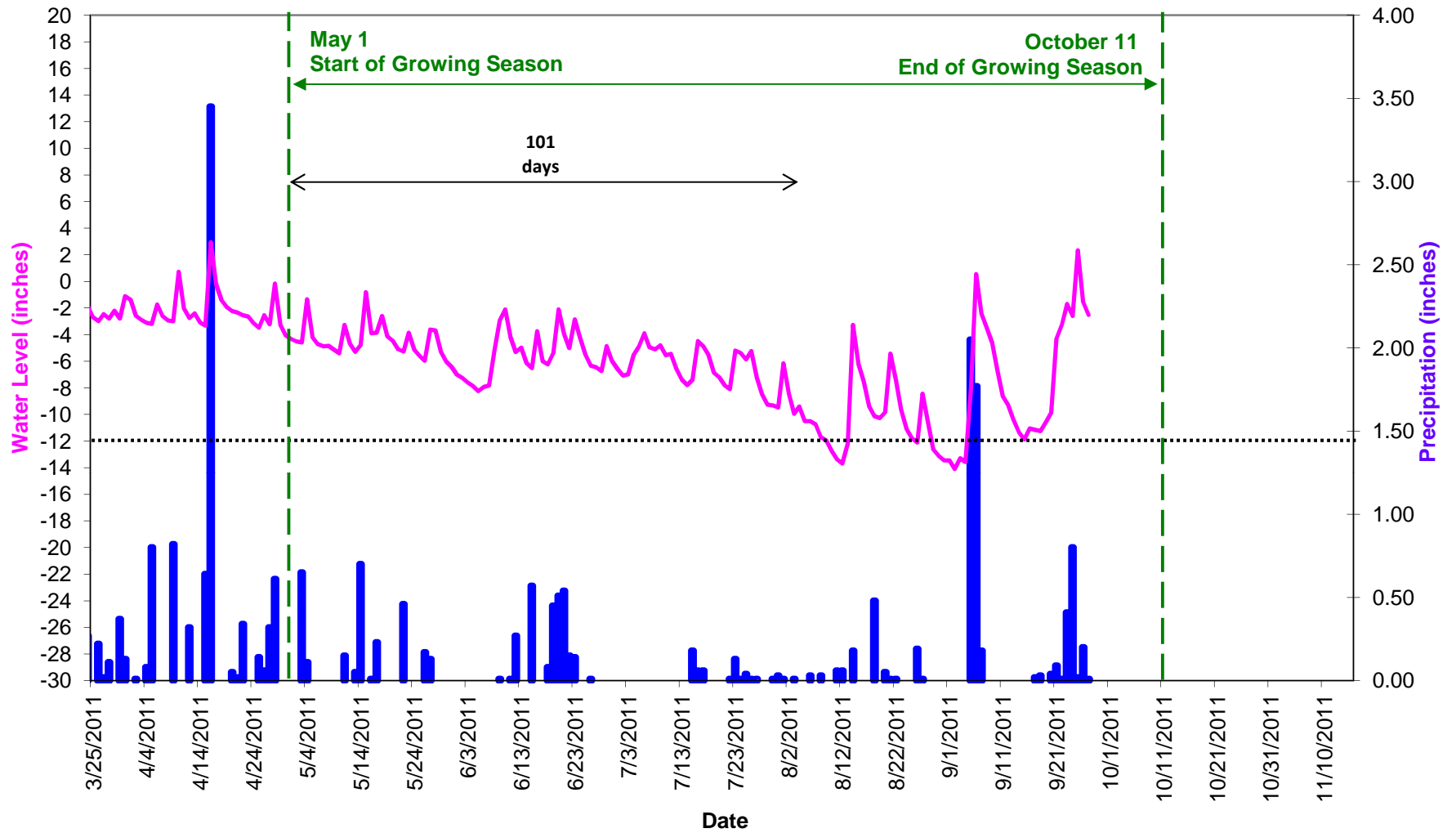
Threemile - Groundwater Gauge 1 Year 3 (2011 Data)



Threemile - Groundwater Gauge 2 Year 3 (2011 Data)



Threemile - Groundwater Gauge 3 Year 3 (2011 Data)



Threemile - Groundwater Reference Gauge Year 3 (2011 Data)

