# MONITORING YEAR 3, 4, AND 5 REPORT

# BOWLIN-PEAK CREEK MITIGATION SITE

Ashe County, North Carolina

## FINAL

EEP Project Number: 92606
Contract Number: D06082; Task Order: 06NW01-1

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Ecosystem Enhancement PROGRAM

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# 1 Executive Summary

This report summarizes the 2010 monitoring year 3 (MY3), 2011 MY4, and 2012 MY5 condition of the Peak Creek mitigation project on 2,719 linear feet (lf) of Peak Creek, located in the New River drainage, Ashe County, North Carolina. Existing condition and as-built data comparisons are presented where possible.

The enhancement project's original goal was to improve aquatic habitat, riparian area vegetation, and stream channel stability in order for the North Carolina Department of Transportation (NCDOT) to meet its off-site stream mitigation requirements for the U.S. 421 (Transportation Improvement Project number [TIP] R-0529) road improvement project in Watauga County. This was accomplished by installing root wads, rock cross vanes, and rock vanes to increase fish habitat diversity, stabilizing, resloping, and revegetating eroding stream banks to make the banks more resistant to erosion and flooding, eradicating invasive exotic plant species, and implementing a farm management plan to reduce stream impacts from livestock (NCWRC 2009). Project construction was completed in October 2007.

The stream visual assessments suggested the stream channel and banks were stable for the first three monitoring years, with some minor adjustments. Beaver activity and multiple greater than bankfull storm events during the winter of 2010-2011 caused site specific channel adjustments. Two high priority stream problem areas were identified in MY4, a beaver dam at station 6+22 and an eroding stream bank at a meander bend at station 11+20. The eroding meander bend and a beaver dam at station 18+11 were identified during the MY5 survey. Low priority problem areas were stabilized using live stakes and beaver dams were removed after each morphological survey. At MY5 the majority of features scored above 93% on qualitative visual stability assessment; riffle stability scored the lowest at 78%.

The enhancement work changed the profile of the stream channel through the addition of log and rock structures with their associated pools and the relocation of approximately 100 lf of stream channel. As expected, the stream channel adjusted slightly since the as-built survey. Most adjustments were site specific and occurred in MY4 and MY5. The seven permanent stream channel cross-sections, four riffles and three pools, indicated the site was relatively stable. Bankfull bunches developed in 4 cross-sections. Only one, cross-section 2 was permanently impacted by an upstream beaver dam in MY4, but remained stable in MY5. Cross-section substrate particle size has fluctuated slightly since construction, the bed material generally has remained in the gravel and cobble categories. Over the monitoring period, there has been an increase in fine particle sized substrate in the pools due to upstream sources of sediment and sediment accumulating behind beaver dams.

Planted vegetation performance, when live stakes are included, exceeded the USACE requirement for 260 stems per acre through the fifth year of monitoring in all three vegetation monitoring plots (USACE 2003). With the addition of natural stem contributions, the vegetation plots had an average stem density of 3,858 stems per acre in MY5. Invasive exotic vegetation still persists throughout the project site. Five years of herbicide treatment has significantly reduced the quantity, size and seed bank of the plants.

The visual assessment, geomorphic, and vegetative surveys indicate some minor stream channel adjustments have occurred since construction. With only small isolated areas of channel bed material aggradation and channel bank instability observed, the Peak Creek mitigation site is meeting all morphometric and riparian vegetation success criteria for the five years of monitoring. We recommend that 1) this site be considered stabilized and released from further monitoring and 2) a long-term multiflora rose control plan should be implemented to prevent the species from displacing native plants within the easement area before they have matured.

## 2 Project Goals, Background, and Attributes

This monitoring report describes the project's background and summarizes stream channel and vegetation monitoring for monitoring year (MY) 3, MY4 and MY5 completed during 2010, 2011 and 2012 on 2,719 linear feet (lf) of Peak Creek and compares it with the as-built conditions to the extent possible.

### 2.1 Location and Setting

Peak Creek is a tributary to the South Fork New River in the New River drainage in Ashe County, North Carolina. Peak Creek (Appendix A Figure A.1.) is located in the Blue Ridge Province of the Appalachian Mountains. The watershed upstream of the project site has an area of approximately 4.4 square miles. The project is 4.1 miles southwest of Laurel Springs, 12.2 miles southeast of Jefferson, and 30.8 miles northwest of Wilkesboro.

Land uses within the watershed consist mostly of rural farms containing pastures and forested wood lots. The less steep valley floors are used to raise crops and graze livestock. While a significant portion of the watershed remains in second growth forest, some Christmas tree farms have been developed.

### 2.2 Project Goals and Objectives

The project's original goal was to improve aquatic habitat and riparian area vegetation and to reestablish channel stability in order for the NCDOT to meet its off-site stream mitigation requirements for the US 421 (TIP number R-0529) road improvement project in Watauga County. This will be discussed further in the Section 2.4. Project History, Contracts, and Attribute Data.

The objectives of the Bowlin-Peak Creek enhancement project were as follows (Mickey and Scott 2002):

1. Increase fish habitat diversity by installing root wads, rock cross vanes, and rock vanes.
2. Stabilize, slope and vegetate eroding stream banks to make the banks more resistant to erosion and flooding.
3. Eradicate invasive exotic species such as multiflora rose *Rosa multiflora*.
4. Construct a stable stream crossing at the existing ford location.
5. Exclude livestock from the riparian zone by installing exclusionary fencing and providing an alternate drinking water source.
6. Plant native trees, shrubs, and ground cover on all disturbed banks and along the channel to provide long-term bank stability, stream shading, and cover and food for wildlife.
7. Provide long-term protection of the stream and riparian corridor by the purchase of a permanent conservation easement.

## 2.3 Project Structure, Restoration Type, and Approach

### 2.3.1 Project Structure

The project area consists of two separate reaches, reach 1 (station 1+34 to 18+50) is protected by a conservation easement on both sides of the creek, whereas reach 2 (stations 0+00 to 1+34 and 18+50 to 27+90) has a conservation easement on only one side of the creek. (Appendix A Figure A.2. and Table A.1.). In reach 2 the conservation easement line is located along the center line of the stream and only protects the left stream bank. There were no differences in geomorphology, hydrology, or soils of the two reaches; therefore, the same type of approach (enhancement I) was used throughout the project. The two reaches are distinguished only for purposes of determining mitigation credits; reach 2 was not included as an expected asset. For the remainder of this document, the two reaches will be considered as one.

### 2.3.2 Restoration Type and Approach

Historic dredging of the stream channel, gravel mining, and poor riparian zone management on the Bowlin-Peak Creek site resulted in stream bank instability at numerous locations, adverse water quality impacts through increased sedimentation, and degraded aquatic habitat (Mickey and Scott 2002). The narrow riparian zone, <15 feet on each bank, was fairly intact along sections of the stream and consisted primarily of tag alder *Alnus serrulata*, multiflora rose, silky dogwood *Cornus amomum*, red maple *Acer rubrum*, and black cherry *Prunus serotina*. Most of the vegetated stream banks were stable, except in areas where multiflora rose predominated.

The desire to protect existing vegetation and the narrow width of the conservation easement limited the stream improvement options to enhancement I (Appendix A Table A.1.). The average width of the conservation easement from one side of the easement to the other is approximately 66 ft, ranging from 50 ft to 85 ft. The enhancement plan included reshaping eroding stream banks while leaving as much of the existing native vegetation intact; installation of in-stream structures to improve bank stability and aquatic habitat; physical removal and herbicide treatment of multiflora rose; re-vegetating the banks with native plant species; and construction of fencing for livestock exclusion and installation of an alternative watering source. Peak Creek's degraded C4 stream type (Rosgen 1996) was enhanced to more stable C4, E4, and F4 stream types (NCWRC 2009).

## 2.4 Project History, Contracts, and Attribute Data

The project's background and history are summarized in Appendix A Tables A.2.-A.4.:

- Appendix A Table A.2. – reporting and milestone history for the project.
- Appendix A Table A.3. − contact information for the project's consultants, contractors, and suppliers.
- Appendix A Table A.4. – general geographical, morphological, and water quality characteristics of the project.

It should be noted that this site was identified and established under older mitigation permitting guidance and that the narrower conservation easement width and portions of the stream being protected on only one side of the stream bank were acceptable at the time.

The NCDOT had contracted with the NCWRC to provide off-site stream mitigation for impacts from the relocation of US 421 (TIP number R-0529) from the South Fork New River in Boone to the Blue Ridge Parkway in Deep Gap. For that project, a total of 14,814 linear feet of stream mitigation were required by the United States Army Corps of Engineers (USACE) Section 404 permit and 7,407 linear feet of mitigation were required by the North Carolina Division of Water Quality (NCDWQ) Section 401 water quality certification. Subsequent mitigation sites were originally permitted under the US 421 project and not via individual permits. The USACE Section 404 permit (Action ID No. 19970761) was issued on 4 May 1998 and the NCDWQ Section 401 permit (Project number 970616) was issued on 20 April 1998.

The Peak Creek site on the Bowlin property was presented to the US 421 mitigation review team as a potential mitigation site in 2000; in 2002 the landowners agreed to the proposed conservation easement boundary. The pre-construction notification and the Peak Creek site mitigation plan were submitted to the USACE and NCDWQ in May 2003. The plan was approved by NCDWQ (Certification number 030599) on 29 May 2003 (NCWRC 2009). No comments were received from the USACE; therefore it was assumed that the project was approved under the general permit conditions. Acquisition of the conservation easement was delayed due to problems obtaining valid appraisals. The NCDWQ permit was reissued on 15 August 2006 (Appendix E). In attempting to renew the USACE permit, it was determined that the original permit had expired, negating the NCDWQ August 2006 permit and requiring new permits to be obtained. A conservation easement on the property was purchased in the fall of 2006. In 2006, responsibility for this site was transferred from NCDOT to the EEP. Under a new memorandum of agreement and interagency contract, EEP tasked the NCWRC to complete this project. New Section 404 (Action ID No. 200702632; 11 Aug 2007) and Section 401 (Project number 030599; 20 Aug 2007) permits were obtained.

### 2.5 Monitoring Plan Views

The monitoring plan view is located in Appendix A Figure A.3.

## 3 Methods

### 3.1 Stream Morphology

Four representative riffle and three representative pool cross-sections were measured, the longitudinal profile surveyed, and stream stability was visually assessed on 12-13 April 2010 for MY3, on 19 April 2011 and 26 May 2011 for MY4, and on 9-10 April 2012 for MY5. Cross-section and reach-wide pebble count data were collected on 28 June 2010 for MY3, on 19 April 2011 and 26 May 2011 for MY4, and on 21 May 2012 for MY5. The measured and surveyed data were taken using standard stream survey techniques (Harrelson et al. 1994, EEP 2006). A Nikon DTM 821 total station was used to survey the stream's pattern, profile, and cross-sectional dimensions. Mountain and piedmont regional hydraulic geometry curve data were used to evaluate bankfull elevation conditions in the field (Harman et al. 1999). Cross-section data were used to classify the stream based on existing morphological features of the stream channel and valley type (Rosgen 1994, 1996). Site conditions were analyzed using RIVERMorph stream assessment and restoration software, Version 4.3 (RSARS 2008) and AutoCAD Version 2004.0.0. Detailed methods and deviations in standard methods are detailed in individual sections below.

### 3.2 Hydrology

A crest gage was installed during construction to monitor on-site occurrence of bankfull events (NCWRC 2009). The crest gage bankfull water elevation is approximately 2.8 ft above the channel bed. The crest gage was checked every time the site was visited and bankfull or near bankfull events were recorded. Wrack lines and deposition areas were photographed to augment gage readings. Additionally, the United States Geological Survey's (USGS) South Fork New River flow gage data (gage number 03161000 located near Jefferson, North Carolina) was reviewed to corroborate the occurrence of bankfull events at the Peak Creek site. Bankfull discharge at the South Fork New River flow gage was estimated by using the established gage height vs. discharge relationship calculated from historic gage data and relating the bankfull elevation in the field to the gage height. Bankfull discharge was estimated at 3,220 cubic feet per second at the South Fork New River gage station (Mickey and Scott 2002).

### 3.3 Vegetation

Vegetation surveys were completed on 28 June 2010 for MY3, on 15 June 2011 for MY4, and on 14 June 2012 for MY5 and followed the EEP and the Carolina Vegetation Survey level 2 protocol (Lee et al. 2006). Monitoring followed standard regulatory guidance, procedures, and success criteria (USACE 2003).

## 4 Project Conditions and Monitoring Results

### 4.1 Morphological Stream Assessment

#### 4.1.1 Bank Stability Assessment

Bank erosion hazard index and near bank sheer stress are used to estimate sediment export from stream bank erosion (Rosgen 2006). They were not assessed for pre-construction conditions and, therefore, not required to determine the success of the project. However, a visual stability assessment cataloging bank erosion was carried out in lieu of the BEHI and reported for all 5 years (see Section 4.1.4 Stability Assessment).

#### 4.1.2 Stream Problem Areas

The stream problem areas plan view, stream problem areas summary table, and photographs are located in Appendix A Figure A.3, Appendix B Table B.1.1, and Appendix B Section 1, respectively.

One stream problem area was identified in MY3 and seven stream problem areas were identified in MY4. The MY3 stream problem area at station 7+15 was also identified as a medium priority area in MY4 and MY5 (Appendix B Section 1: photo SPA MY3&4-3). The site was also identified as an area of concern during the MY1 and MY2 surveys. It consists of 30 lf of eroding left stream bank from station 7+15 to station 7+45 that has migrated 7 feet to the left since the MY0 survey. Because this area has not stabilized in the last 5 years, we reshaped approximately 15 lf of bank by hand and installed live stakes using on site material on 29 April 2012 (Appendix B Section 1: photo SPA MY5-2).

Two high priority stream problem areas were identified in MY4. On 3 Feb 2011, a beaver dam was identified at station 6+22 (Appendix B Section 1: photo SPA MY4-1). The dam caused sediment to fill in the pool behind the dam and backed water up to station 4+18. The dam was removed on 19 April 2011. The second high priority problem area in MY4 and subsequently identified in MY5, consisted of 30 lf of a left eroding stream bank at the meander bend at station 11+20 (Appendix B Section 1: photo SPA MY4-4). This was caused by at least one greater than bankfull storm event during the winter of 2010-2011. In addition to the bank erosion, the storm event caused the elevation of the head of the riffle at station 11+44 to increase 0.7 ft, submerging the log vane at station 11+11. The log vane no longer functions properly.

One additional medium priority problem area was identified in MY4 and subsequently in MY5. The log cross vane at station 6+47 located downstream of the beaver dam (Appendix B Section 1: photo SPA MY4-2) was damaged after a winter 2010 storm event. It is suspected that water falling over the dam had greater stream power, moved larger substrate in the stream channel, deepened the stream channel below the log cross vane and resulted in water piping under the right vane arm. The right stream bank only migrated 0.5ft since MY3 and appears stable.

Three low priority problem areas were identified in MY4 (Appendix B Section 1: photos SPA MY4-5, SPA MY4-6 and SPA MY4-7). Live stakes were planted at these sites on 19 April 2011 to help stabilize the banks. Many of the live stakes did not survive the late planting date and beaver ate the plants at station 17+30. All three sites were identified as low priority in MY5.

On 9 April 2012, a beaver dam was identified at station 18+11. The dam caused sediment to fill in the pool behind the dam and backed water up to station 16+75. The dam was removed on 29 May 2012 and the fine sediment appeared to be flushing out of the pool.

The log cross-vane at site SPA MY4-2 and the eroding left stream bank at site SPA MY3&4-3 have yet to stabilize. However, these issue areas represent approximately 1% of the total bank footage and the impact associated with repairs involving heavy equipment is not warranted.

#### 4.1.3 Fixed Point Photographs

Fixed station photographs document pre- and post-construction conditions and are located in Appendix B, Section 2.

### 4.1.4 Stability Assessment

A visual stability assessment was performed during all monitoring year surveys (Appendix B Table B.3.2). The as-built categorical features were determined from the as-built report and plan view drawing and assumed to be stable immediately following construction (NCWRC 2009). As such, channel features, including meanders, stream bed, stream banks, and in-stream structures were examined for stability and enumerated during monitoring surveys (Appendix B Table B.3.1 and Table B.3.2). Based on the morphological data and the visual stability assessment, all stream feature categories were found to be over 92% stable for MY1, MY2 and MY3. The stream feature categories for riffles, pool and thalweg declined to 83%, 88% and 80% in MY4 and 78%, 80% and 80% in MY5. This decline is attributed to the addition of beaver dams filling pools and backing water over riffles and changes in channel morphology from frequent bankfull or greater storm events. As the stream channel adjusted, the number of riffles and pools declined from 30 and 29 in the as-built condition to 25 and 25 in MY5, with most of the changes occurring in MY4 and MY5 as a result of beaver activity. In addition, four of the existing riffles at the upstream portion of the project became embedded with fine sediment. Other riffles did not have stable substrate or the facet slope was too steep, especially in areas around the beaver dams. Sediment from the breached beaver dam in MY4 and from upstream sources appeared to settle in at least 6 pools in MY5; reducing the pool's depth and some cases length. This downward trend in habitat quality metrics should stabilize and will hopefully improve as sediment from the beaver dams move through the project site.

Overall the site is relatively stable. Most of the stream banks, bed and rock and woody structures are preforming as expected. Ninety-eight percent of the stream banks were identified as stable in MY5. Streams are dynamic systems and some level of adjustment is expected. The majority of the changes in the substrate and bedform habitat quality metrics are considered localized and tied to transient factors such as beaver impoundment and upstream inputs.

### 4.1.5 Quantitative Measures Summary

Morphological data is summarized in the following:

- Appendix B Table B.4.1 summarizes the pre-construction, reference reach, design, as-built, and monitoring quantitative morphological data collected from the cross-section surveys, longitudinal profile surveys, and pebble counts for Peak Creek.
- Appendix B Table B.4.2 summarizes the as-built and monitoring quantitative morphological data collected for each cross-section.
- Annual cross-section plots are located in Appendix B Section B.5.
- Annual longitudinal profile plots are located in Appendix B Section B.6.
- Annual pebble count cumulative frequency distribution plots are located in Appendix B section B.7.

These data will be compared with previous survey data and will be used to illustrate the degree of departure of the stream channel and substrate characteristics, if any, from the desired condition.

#### 4.1.5.1 Profile

The enhancement work changed the profile of the stream channel through the addition of log and rock structures with their associated pools and the relocation of approximately 100 lf of stream channel. Monitoring year data were compared with as-built conditions.

The entire project's stream channel profile was surveyed in every monitoring year. Feature lengths, slopes, depths, and spacing were calculated following each monitoring survey (Appendix B Table B.4.1). Channel slope has remained unchanged over the course of monitoring at 0.0093 ft/ft. Riffle lengths remained relatively stable from the as-built survey to MY3 and ranged from 1.8 ft to 128.0 ft in the three monitoring years with means of 34.0 in MY1, 33.0 in MY2 and 35.1 in MY3. They varied little from the as-built survey, with a range of 6.4 ft to 123.6 ft and a mean of 30.8 ft. In MY4 the mean riffle length decreased to 28.9 ft, with a range of 8.1 ft to 75.1 ft. This decrease is partly associated with the shallow pool at station 13+46 dividing a long riffle. The mean riffle length increased in MY5 to 39.0 ft partly as a result of the pool at station 13+46 filled in and became associated with the riffle.

Mean riffle slope decreased from the as-built survey, 0.021 to 0.017 in MY1, remained at 0.0017 in MY2 and decreased slightly to 0.0015 in MY3. The riffles slopes are not outside of the norms and may have been readjusting to something closer to its pre-construction condition. However, mean riffle slopes increased to 0.020 in MY4 and 0.024 in MY5. The beaver dams were included in riffle slopes and may have caused the increase in mean slope.

The annual longitudinal profile overlays (Appendix B.6) suggest the stream channel adjusted slightly between the as-built survey and MY1 (NCWRC 2011). The stream channel appeared stable from MY1 to MY3. The longitudinal profile adjusted again in MY4 and MY5 due to the presence of beaver dams and the increased frequency and magnitude of bankfull or greater storm events. Most of the adjustments were site specific and did not affect the stream's overall longitudinal profile or pattern. Logging upstream of the project site may be responsible for some of the channel aggradation.

A beaver dam at station 6+22 was identified during the MY4. The stream channel elevation increased 1.7 ft at the beaver dam in MY4. The stream channel aggraded in the pool behind the beaver dam and at a pool located at station 3+02. In addition, the stream channel thalweg elevation decreased approximately 1.9 ft in MY4, a decrease of approximately 2.3 ft from the as-built condition in the pool downstream of the beaver dam at station 6+44. The deepening pool in itself is not a concern; however, the additional bank scouring may have contributed to the instability of the log cross-vane at the head of the pool (SPA MY4-2) by undermining the footer on the right bank. After the beaver dam was breached, the MY5 survey indicated the stream channel elevation at the beaver dam decreased 1.5 ft. However, the stream channel elevation for the pool at station 3+02 did not change. The stream channel at station 3+02, a pool aggraded in MY4 and remained shallow in MY5. The thalweg elevation increased approximately 0.4 ft in MY5 in the pool below the beaver dam.

The pool at station 9+44 filled in with sediment in MY4 and became part of the riffle. This section of stream did not change in MY5.

In MY4, approximately 30 lf of the stream channel migrated to the right starting at station 11+20. This was caused by at least one greater than bankfull storm event during the winter of 2010-2011. In addition to the bank erosion, the storm event caused the elevation of the head of the riffle at station 11+44 to increase 0.7 ft, submerging the log vane at station 11+11. The pool's thalweg elevation at station 11+20 increased by approximately 0.7 ft and a new pool was created downstream at station 11+52. The log vane was still submerged in MY5; however, the pool's thalweg elevation at station 11+20 decreased 0.5 ft, almost back to the MY3 elevation. The new pool at station 11+52 was still present in MY5 and appeared stable.

The thalweg elevation for the pool at station 12+18 increased 1.0 ft in MY4, while the pool at station 13+46 filled in completely and became part of a long riffle. Both pools remained at their new elevation in MY5.

A beaver dam was identified at station 18+14 in MY5. The stream channel elevation increased 0.7 ft at the beaver dam and caused sediment to fill in the pool behind the dam. The beaver dam backed water up to station 16+75 submerging a pool and riffle. The dam was removed after the MY5 morphological survey.

#### 4.1.5.2 Dimension

Seven cross-sections were surveyed in 2012 and compared with previous cross-section measurements (Appendix B, Table B.4.1, Table B.4.2 and Appendix B Section B.5; NCWRC 2011). The current / developing bankfull feature for cross-sections 4 and 6 were used to calculate dimension morphological data instead of the fixed bankfull pin elevation. The current / developing bankfull features appeared to represent a more accurate bankfull elevation and were stable. This resulted in a minor increase in variation because these measurements were not taken from a fixed location. Cross-sectional dimensions in all cross-sections showed some adjustments in thalweg depths and minor lateral movement of the channel when compared with previous years' monitoring survey data. Some of the cross-sections exhibit some buildup of the stream banks due to deposition of soil materials during bankfull or greater than bankfull storm events. The stream channel and stream banks were relatively stable for most cross-sections throughout the five years of monitoring. However, the dimension morphology in cross-section 2 changed significantly in MY4 due to impacts from an upstream beaver dam.

Specific details of the individual cross-sections are listed below and in Appendix B.5 Annual Cross-section Overlay:

- Cross-section 1 transects a riffle. The cross-section dimension was relatively stable between MY0 and MY3, with approximately 0.3 ft of sediment deposited on the left stream bank. The stream channel thalweg elevation increased 0.3 ft in MY4 and moved to the right. An additional 0.5 ft of sediment was deposited on the left stream bank. This was the result of several large bankfull events and the stream channel elevation being raised by the downstream beaver dam. The beaver dam was removed after the MY4 survey. The MY5 survey indicates the stream channel cut back down to the MY0 elevation. Additional sediment was deposited on the stream banks and began developing a bankfull bench at a different elevation. The stream banks are stable and well vegetated.

- Cross-section 2 transects a pool and the downstream portion of a log cross-vane. The cross-section dimension was relatively stable between MY0 and MY3. The stream channel thalweg elevation decreased approximately 1.9 ft in MY4 and decreased approximately 2.3 ft from the as-built condition. Additionally, the right bank migrated approximately 0.5 ft to the right. Although not shown on the cross-section overlay, the stream was piping under the right arm of the log cross vane. This change in channel dimension in MY4 was the result of several bankfull storm events falling over a 1.8 ft tall beaver dam 25 ft upstream of the log cross vane. This increased the water's stream power and its ability to move larger sediment. The thalweg elevation increased approximately 0.4 ft in MY5 and the right bank eroded an additional 0.6 ft.
- Cross-section 3 transects a pool downstream of a rock cross-vane. The MY1 cross-section was survey slightly upstream of the as-built and MY2 surveys. The large hump in the middle of the MY1 stream channel is a boulder from the rock cross-vane. The stream channel remained stable in MY3 and aggraded 0.1 ft in MY4. Greater than bankfull storm events soured the left stream bank at the bankfull bench elevation in MY4. The stream channel thalweg elevation decreased approximately 0.3 ft in MY5, back to the MY1 elevation and the stream banks have remained stable.
- Cross-section 4 transects a riffle. The stream channel and banks along this cross-section has remained stable since MY0. Minor changes in the stream channel thalweg elevation had occurred. The left stream bank bankfull bench continued to developed and increased in elevation by 0.5 ft between the MY2 survey and MY5. Both stream banks are well vegetated.
- Cross-section 5 transects a pool and the downstream portion of a rock J-hook on the left stream bank. The thalweg moved approximately 1.2 ft to the right between the as-built survey and MY1 and remained stable until MY5. The MY5 transect suggests the left stream bank migrated approximately 1.7 ft to the right. This is highly unlikely. The discrepancy is just a function of not surveying the exact same points every year. The stream banks are well vegetated and have remained stable since MY0.
- Cross-section 6 transects a riffle. The stream channel and banks have remained stable the since the as-built survey with only minor channel adjustments. In MY5, the cross-section transected the head of a pool caused by a downstream beaver dam. The stream channel thalweg moved slightly to the right as a point bar formed on the left bank. The beaver dam was removed after the MY5 survey and water appeared to flush out the finer sediment in the point bar.
- Cross-section 7 transects a riffle. No enhancement activities were performed at this cross-section. Approximately 1.6 ft of the right bank sloughed off between the as-built survey and MY1. The thalweg shifted to the center of the channel in MY4 and back to the right in MY5. The stream channel and banks have remained stable since the MY1 survey.

#### 4.1.5.3 Pattern

Enhancement work was mainly oriented towards reshaping banks to establish a bankfull bench and did not change the stream pattern. Because only minor modifications were made to the stream pattern and significant geomorphological changes did not occur during the five years of monitoring, additional data analysis (Appendix B Table B.4.1.) was not performed in MY5.

#### 4.1.5.4 Substrate Data

The reach-wide substrate particle analysis over all monitoring years revealed that the D50 and D84 have ranged from 29.9 mm to 64.0 mm, coarse to very coarse gravel and 88.3 mm to 174.2 mm, small to large cobble, respectively (Appendix B Section 7). Sand accumulated in the pools in MY1 and MY2 and was flushed out by the numerous storm events that occurred during MY3. The D50 substrate particle size decreased in MY4 and MY5 from 56.1 mm in MY3 to 48.7 mm and 29.9 mm, respectively. This decrease was probably the result of sediment accumulating behind the beaver dams.

Substrate particle counts also were conducted at each of the seven established cross-sections. Particle data from the four riffle cross-sections were pooled to generate statistical values for each monitoring year. The riffle mean D50 particle size remained relatively consistent throughout all monitoring years and ranged from 49.9 mm to 32.6 mm (Appendix B Table B.4.1, Table B.4.2). Substrate particle counts were consistent throughout all monitoring years for riffle cross-sections 1, 4 and 7. Cross-section 6 substrate particle counts were stable from MY0 to MY4, but decreased from 52.9 mm in MY4 to 4.9 mm in MY5. The beaver dam at station 18+11 created a pool that backed water over cross-section 6. Fine particulate sediment deposited in the pool behind the dam.

The D50 particle size for each of the three pool cross-sections also are summarized in Appendix B Table B.4.2 and Appendix B Section 7. Substrate particle counts for cross-section 2 remained relatively consistent (D50: 31.1 mm – 49.3 mm) through all monitoring years except in MY2 when the D50 particle size increased to 74.1 mm. The D50 substrate particle size for cross-section 3 decreased from 20.7 mm – coarse gravel in MY0 to 9.9 mm – medium gravel in MY2. This increase in smaller particles could have been a result of sediment from logging practices upstream of the project site. Substrate particle size then increased to 27.3 mm – coarse gravel in MY3 and 48.8 mm – very coarse gravel in MY4 and remained as very coarse gravel in MY5. The change over monitoring years in D50 particle size for cross-section 5 was similar to cross-section 3.

### 4.2 Hydrologic Criteria

One bankfull measurement was recorded from the on-site crest gage in MY3 and four were recorded in MY4, none were recorded in MY5, making a total of seven recorded events since construction ended in November 2007 (Appendix B Table B.8.1). Wrack lines above the bankfull bench were identified visually on 9 April 2012 in MY5. At least one bankfull event was recorded in every monitoring year. Additionally, three near bankfull or greater discharge events were identified at the USGS South Fork New River flow gage station near Jefferson, North Carolina in MY3, four were identified MY4, and five were identified in MY5 (Appendix B Table B.8.1 and Figure B.9.1). A total of sixteen near bankfull or greater discharge events were identified at the USGS South Fork New River gage station since construction ended. The project has exceeded the USACE requirement of having at least two bankfull events measured in separate monitoring years (USACE 2003).

## 4.3 Vegetation Assessment

Each monitoring year's vegetation was surveyed in three 100 $m^2$ representative plots (Appendix A Figure A.3). Vegetation data, including plot attributes and vegetation metadata, stem counts, plant vigor, and plant damage are presented in Appendix C Tables C.1.3.-C.1.8. The total stem counts for the three vegetation plots increased from 126 (1700 stems/acre) in the as-built survey to 274 (3,696 stems/acre) in MY3, decreased slightly in MY4 to 258 (3,480 stems/acre) and increased to 286 (3,858 stems/acre) in MY5. The riparian area was forested prior construction and the increase in stems is attributed to native volunteer plants establishing throughout the riparian area. The existing and natural/volunteer vegetation account for the majority of plants in every plot; however, the planted vegetation including live stakes in each plot still exceeds the USACE requirement of 260 stems/acres in MY5 (USACE 2003).

A majority of the planted stems in each monitoring year were considered to be in good to excellent condition, 78% in MY1, 66% in MY2, 70% in MY3, 80% in MY4 and 85% in MY5. It appears the planted vegetation took several years to get established. The early decrease in planted stem vigor was expected due to the number of bare root trees planted, the fact that a vegetation plot is located near a public fishing access area, and the established deer population in the area. Deer, beaver and insects were the primary cause of damage to planted vegetation.

### 4.3.1 Vegetative Problem Areas

There were no vegetation problem areas identified in the first three monitoring years. Five vegetation problem areas were identified in MY4 and four in MY5 (Appendix C Section 2). All vegetation problem areas appear to be due to beaver activity. Site VPA MY4-2 appeared to recover from the beaver activity by MY5 and was drastically reduced in size. In MY4, site VPA MY4-5 was flooded due to the beaver dam and the vegetation grew back after the dam was removed. Site VPA MY5-4 was added in MY5 and was near the new beaver dam. Most of these problem areas are small and don't require additional planting. Site VPA MY5-4 is on the outside of a meander bend and planting additional live stakes at the toe of the slope would help ensure long-term stream bank stability. However, the mature riparian vegetation should supply an adequate seed source for natural volunteers to colonize these sites.

Multiflora rose was identified as a problem at the site prior to construction and was often located in areas with eroding stream banks (NCWRC 2009). The physical removal of plants during construction and the subsequent annual spring herbicide treatments for the past five years have greatly reduced the number of plants. Multiflora rose is still found throughout the project site in limited quantities. Plants are typically small and appear to come from the existing seed bank. Multiflora rose will be an ongoing problem at this site because of the existing seed bed, the presence of additional plants in the adjacent pasture and in the riparian area upstream of the project.

### 4.4 Farm Management Plan

The livestock management program was installed during construction and included the improvement of the existing stream-crossing, installation of four watering tanks, drilling of a well and pump installation, and fencing to exclude livestock from the riparian zone (NCWRC 2009). Damaged fence at the ford crossing was identified during a routine inspection on 3 February 2011. It consisted of several wooden fence posts knocked over and the fence being clogged with debris. The fence was repaired on 26 May 2011. Besides the incidence mention above, all best management practices have functioned throughout the monitoring period and were functioning properly at the time of the MY5 vegetation survey.

### 4.5 Summary

Since completion of the Bowlin-Peak Creek mitigation project in November 2007, one as-built survey and five monitoring surveys have been conducted. The monitoring surveys reveal that the project site is in large part performing as designed with minimal changes in any of the major morphological components. The site remained stable with no major failures to structures for the first three monitoring years. Some damage occurred to stream banks and two structures in MY4 and MY5 as a result beaver activity and multiple greater than bankfull storm events. The longitudinal profile and the cross-sections have revealed some aggradation and degradation of the stream thalweg during the five-year monitoring period as well. However, this was localized and primarily the result of beaver dams and upstream inputs. Although substrate particle size has fluctuated slightly since construction, the bed material generally has remained in the gravel and cobble categories. There has been an increase in fine particle sized substrate in the pools due to upstream sources of sediment and sediment accumulating behind beaver dams. The riparian vegetation is flourishing, preserving bank integrity and channel sinuosity. There have been seven bankfull events identified at the project site since construction ended in 2007. With little exception, the stream channel, banks and constructed log and rock structures remain stable and are preforming as desired.

We recommend that 1) this site be considered stabilized and released from further monitoring and 2) a long-term multiflora rose control plan should be implemented to prevent the species from displacing native plants within the easement area before they have matured.

## 5 Acknowledgements

M. Fowlkes, J Hubbell, S. Gouge and J. Ferguson of the NCWRC collected and analyzed the field data; M. Fowlkes prepared this report.

## 6 References


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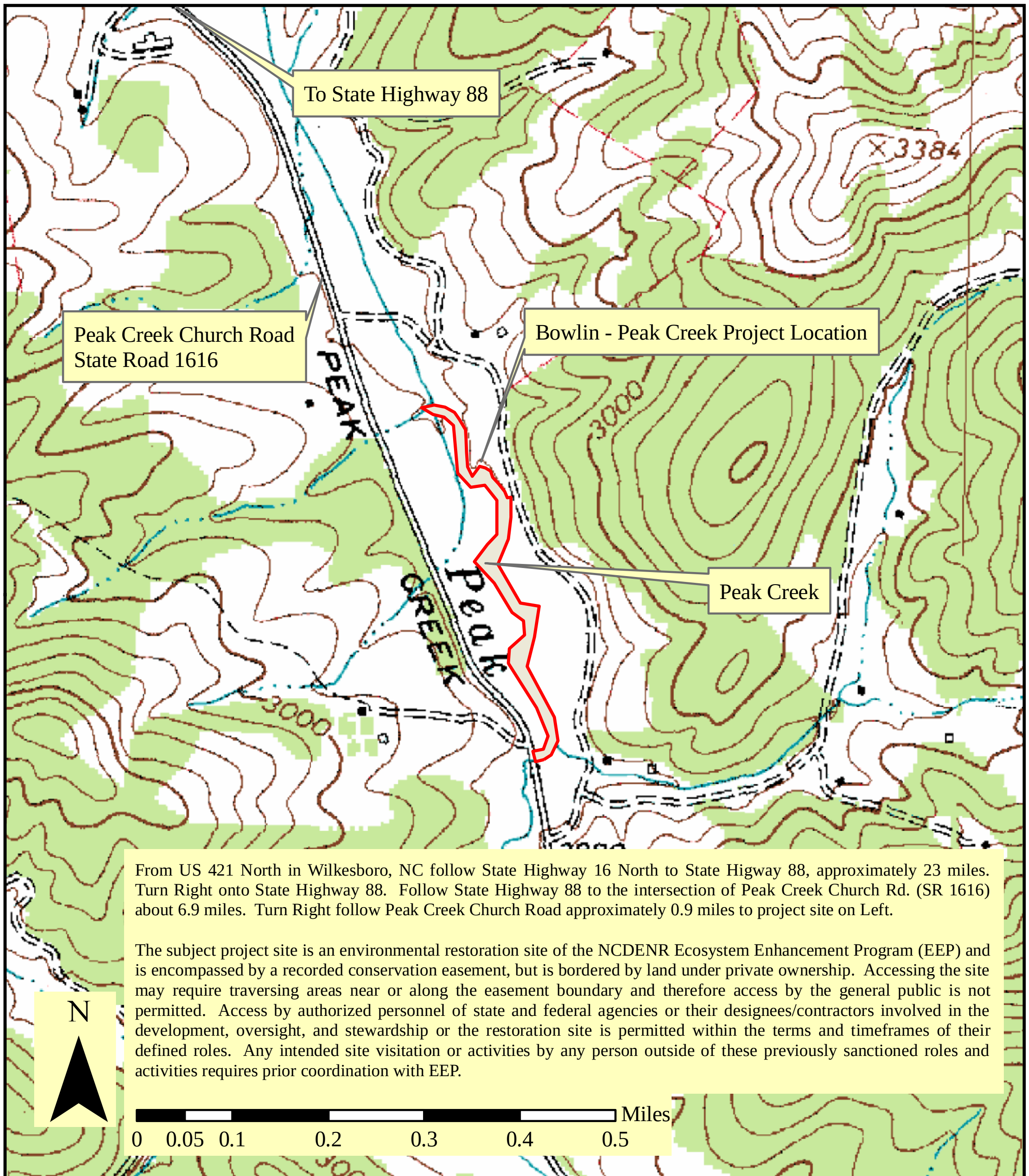
## Appendix A   General Tables and Figures

Figure A.1  Vicinity Map.

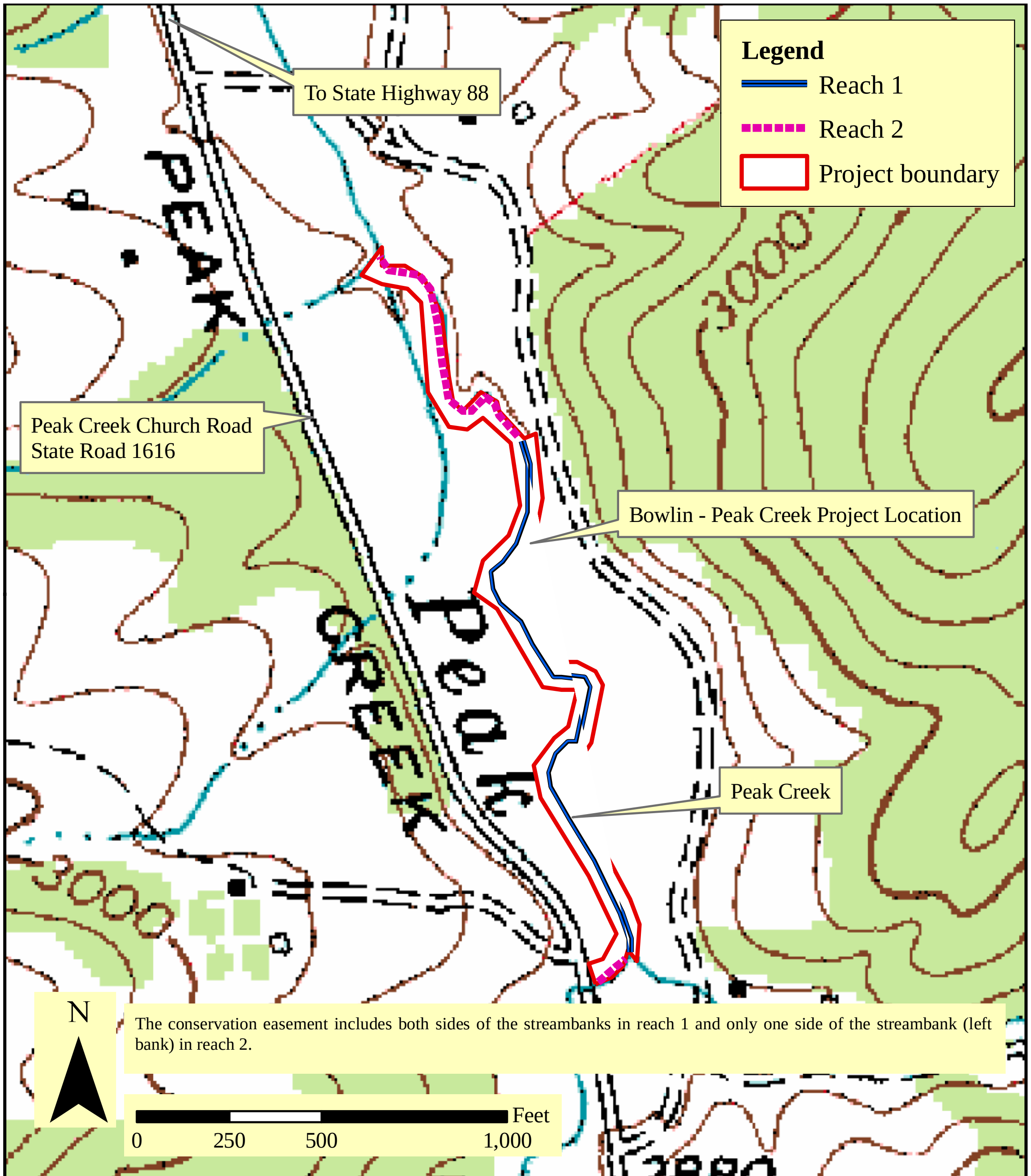



Ecosystem Enhancement Program

Project Vicinity Map.
Bowlin - Peak Creek Mitigation Site
EEP Project Number: 92606, As-built (2007)
Ashe County, North Carolina
May 2008

Source:
United States Department of the Interior, Geological Survey
Laurel Springs Quadrangle, 7.5 Minute Series (Topographic).

Figure A.2 Project Component and Asset Map.




Project Component Map.
Bowlin - Peak Creek Mitigation Site
EEP Project Number: 92606, As-built (2007)
Ashe County, North Carolina
May 2008

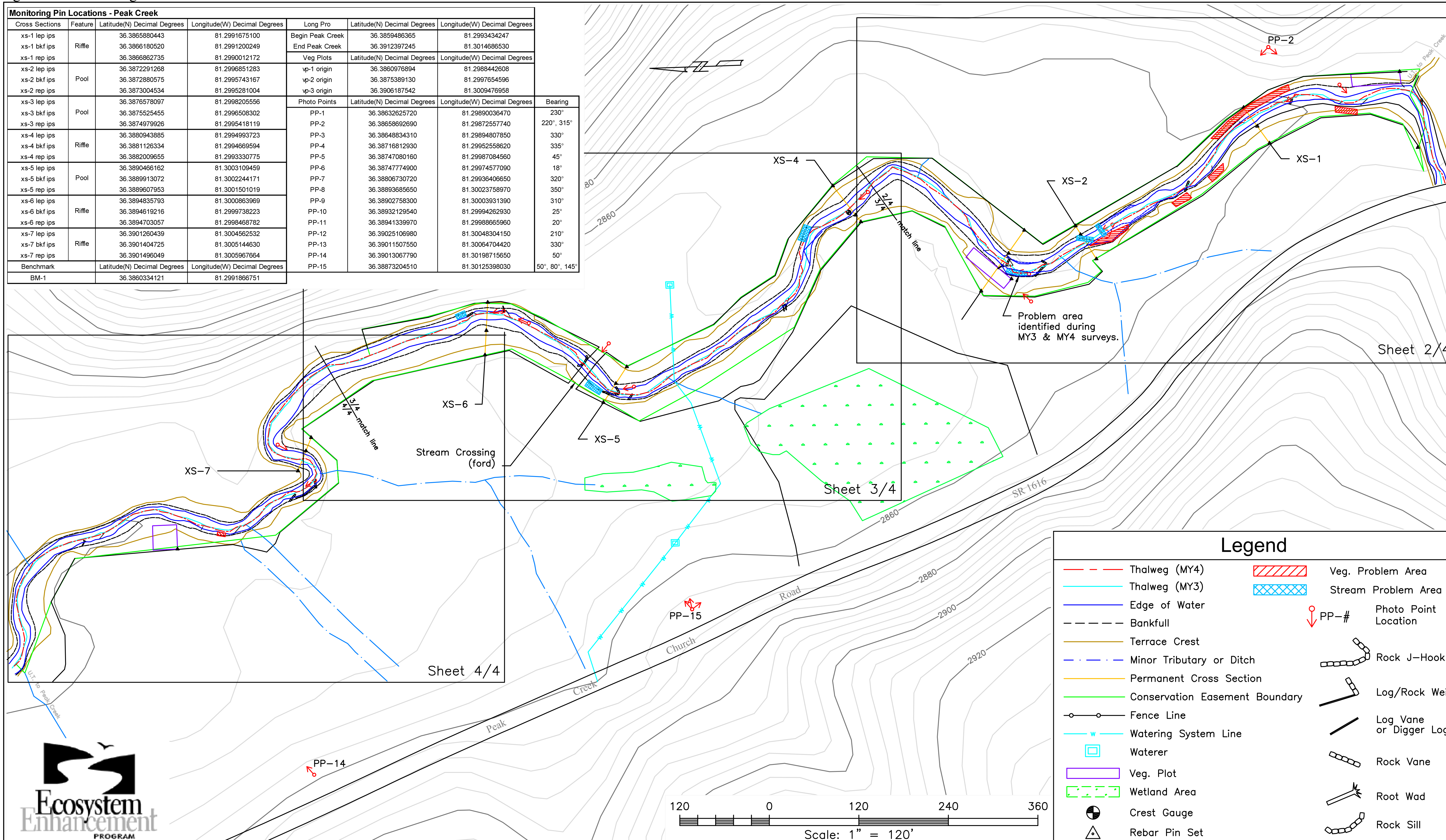
Source:
United States Department of the Interior, Geological Survey
Laurel Springs Quadrangle, 7.5 Minute Series (Topographic).

Figure A.3 Monitoring Plan Views.

**Monitoring Pin Locations - Peak Creek**

| Cross Sections | Feature | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees |
|---|---|---|---|
| xs-1 lep ips | Riffle | 36.3865880443 | 81.2991675100 |
| xs-1 bkf ips | | 36.3866180520 | 81.2991200249 |
| xs-1 rep ips | | 36.3866862735 | 81.2990012172 |
| xs-2 lep ips | Pool | 36.3872291268 | 81.2996851283 |
| xs-2 bkf ips | | 36.3872880575 | 81.2995743167 |
| xs-2 rep ips | | 36.3873004534 | 81.2995281004 |
| xs-3 lep ips | Pool | 36.3876578097 | 81.2998205556 |
| xs-3 bkf ips | | 36.3875525455 | 81.2996508302 |
| xs-3 rep ips | | 36.3874979926 | 81.2995418119 |
| xs-4 lep ips | Riffle | 36.3880943885 | 81.2994993723 |
| xs-4 bkf ips | | 36.3881126334 | 81.2994669594 |
| xs-4 rep ips | | 36.3882009655 | 81.2993330775 |
| xs-5 lep ips | Pool | 36.3890466162 | 81.3003109459 |
| xs-5 bkf ips | | 36.3889913072 | 81.3002244171 |
| xs-5 rep ips | | 36.3889607953 | 81.3001501019 |
| xs-6 lep ips | Riffle | 36.3894835793 | 81.3000863969 |
| xs-6 bkf ips | | 36.3894619216 | 81.2999738223 |
| xs-6 rep ips | | 36.3894703057 | 81.2998468782 |
| xs-7 lep ips | Riffle | 36.3901260439 | 81.3004562532 |
| xs-7 bkf ips | | 36.3901404725 | 81.3005144630 |
| xs-7 rep ips | | 36.3901496049 | 81.3005967664 |
| Benchmark | | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees |
| BM-1 | | 36.3860334121 | 81.2991866751 |

| Long Pro | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees | |
|---|---|---|---|
| Begin Peak Creek | 36.3859486365 | 81.2993434247 | |
| End Peak Creek | 36.3912397245 | 81.3014686530 | |
| Veg Plots | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees | |
| vp-1 origin | 36.3860976894 | 81.2988442608 | |
| vp-2 origin | 36.3875389130 | 81.2997654596 | |
| vp-3 origin | 36.3906187542 | 81.3009476958 | |
| Photo Points | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees | Bearing |
| PP-1 | 36.38632625720 | 81.29890036470 | 230° |
| PP-2 | 36.38658692690 | 81.29872557740 | 220°, 315° |
| PP-3 | 36.38648834310 | 81.29894807850 | 330° |
| PP-4 | 36.38716812930 | 81.29952558620 | 335° |
| PP-5 | 36.38747080160 | 81.29987084560 | 45° |
| PP-6 | 36.38747774900 | 81.29974577090 | 18° |
| PP-7 | 36.38806730720 | 81.29936406650 | 320° |
| PP-8 | 36.38893685650 | 81.30023758970 | 350° |
| PP-9 | 36.38902758300 | 81.30003931390 | 310° |
| PP-10 | 36.38932129540 | 81.29994262930 | 25° |
| PP-11 | 36.38941339970 | 81.29988665960 | 20° |
| PP-12 | 36.39025106980 | 81.30048304150 | 210° |
| PP-13 | 36.39011507550 | 81.30064704420 | 330° |
| PP-14 | 36.39013067790 | 81.30198715650 | 50° |
| PP-15 | 36.38873204510 | 81.30125398030 | 50°, 80°, 145° |

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336.527.1547 OFFICE
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Bowlin - Peak Creek Stream Enhancement Project
Ashe County EEP Project Number 92606
MY3 & MY4 Overall Plan View

SURVEYED BY: JW,MF DATE: 04/10 & 04/11
DRAWN BY: JF DATE: 02/12
REVISION: DATE:
CAD FILE ID: Bowlin MY3 Plan.dwg

SHEET 1 OF 4

Figure A.3 Monitoring Plan Views.

**Monitoring Pin Locations - Peak Creek**

| Cross Sections | Feature | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees |
|---|---|---|---|
| xs-1 lep ips | Riffle | 36.3865880443 | 81.2991675100 |
| xs-1 bkf ips | | 36.3866180520 | 81.2991200249 |
| xs-1 rep ips | | 36.3866862735 | 81.2990012172 |
| xs-2 lep ips | Pool | 36.3872291268 | 81.2996851283 |
| xs-2 bkf ips | | 36.3872880575 | 81.2995743167 |
| xs-2 rep ips | | 36.3873004534 | 81.2995281004 |
| xs-3 lep ips | Pool | 36.3876578097 | 81.2998205556 |
| xs-3 bkf ips | | 36.3875525455 | 81.2996508302 |
| xs-3 rep ips | | 36.3874979926 | 81.2995418119 |
| xs-4 lep ips | Riffle | 36.3880943885 | 81.2994993723 |
| xs-4 bkf ips | | 36.3881126334 | 81.2994669594 |
| xs-4 rep ips | | 36.3882009655 | 81.2993330775 |
| xs-5 lep ips | Pool | 36.3890466162 | 81.3003109459 |
| xs-5 bkf ips | | 36.3889913072 | 81.3002244171 |
| xs-5 rep ips | | 36.3889607953 | 81.3001501019 |
| xs-6 lep ips | Riffle | 36.3894835793 | 81.3000863969 |
| xs-6 bkf ips | | 36.3894619216 | 81.2999738223 |
| xs-6 rep ips | | 36.3894703057 | 81.2998468782 |
| xs-7 lep ips | Riffle | 36.3901260439 | 81.3004562532 |
| xs-7 bkf ips | | 36.3901404725 | 81.3005144630 |
| xs-7 rep ips | | 36.3901496049 | 81.3005967664 |
| **Benchmark** | | **Latitude(N) Decimal Degrees** | **Longitude(W) Decimal Degrees** |
| BM-1 | | 36.3860334121 | 81.2991866751 |

| Long Pro | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees |
|---|---|---|
| Begin Peak Creek | 36.3859486365 | 81.2993434247 |
| End Peak Creek | 36.3912397245 | 81.3014686530 |
| **Veg Plots** | **Latitude(N) Decimal Degrees** | **Longitude(W) Decimal Degrees** |
| vp-1 origin | 36.3860976894 | 81.2988442608 |
| vp-2 origin | 36.3875389130 | 81.2997654596 |
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| Photo Points | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees | Bearing |
|---|---|---|---|
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| PP-2 | 36.38658692690 | 81.29872557740 | 220°, 315° |
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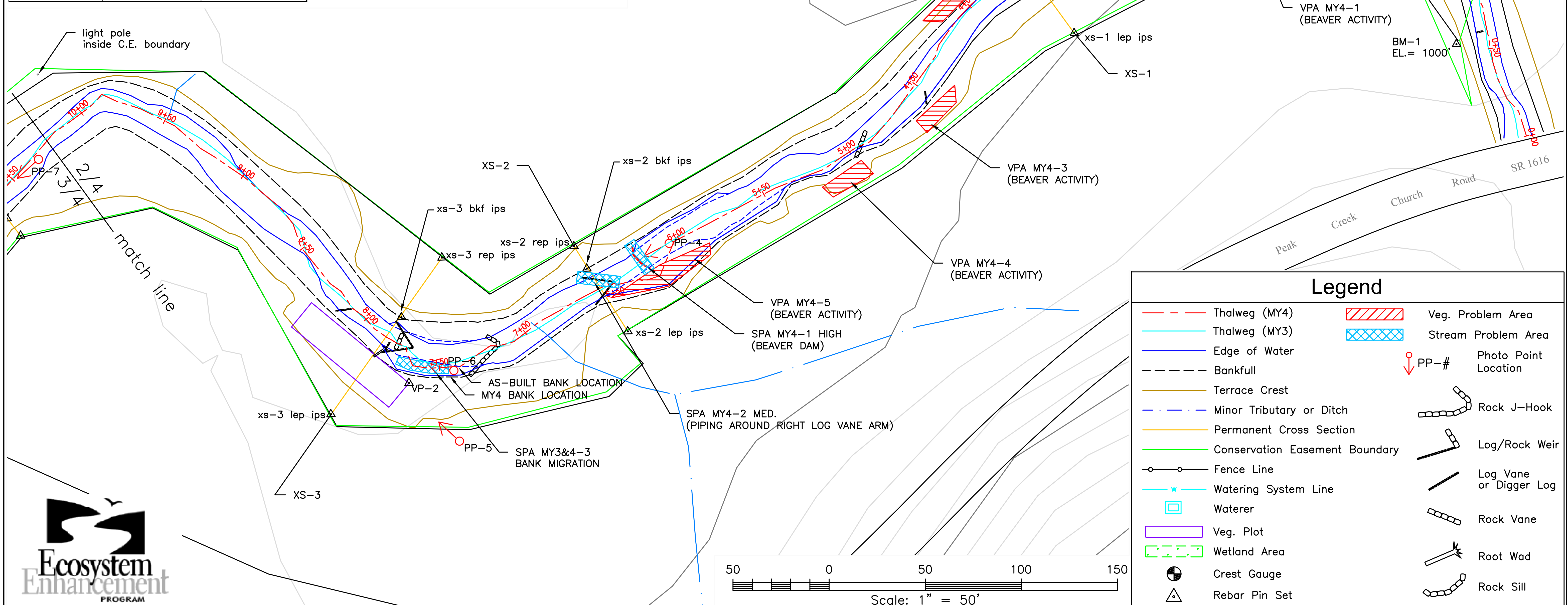
| PP-6 | 36.38747774900 | 81.29974577090 | 18° |
| PP-7 | 36.38806730720 | 81.29936406650 | 320° |
| PP-8 | 36.38893685650 | 81.30023758970 | 350° |
| PP-9 | 36.38902758300 | 81.30003931390 | 310° |
| PP-10 | 36.38932129540 | 81.29994262930 | 25° |
| PP-11 | 36.38941339970 | 81.29988665960 | 20° |
| PP-12 | 36.39025106980 | 81.30048304150 | 210° |
| PP-13 | 36.39011507550 | 81.30064704420 | 330° |
| PP-14 | 36.39013067790 | 81.30198715650 | 50° |
| PP-15 | 36.38873204510 | 81.30125398030 | 50°, 80°, 145° |

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|---|---|---|---|
| NORTH CAROLINA WILDLIFE RESOURCES COMMISSION<br>WATERSHED ENHANCEMENT GROUP<br>P.O. BOX 387 336.527.1547 OFFICE<br>ELKIN, NORTH CAROLINA 28621 336.527.1548 FAX | Bowlin - Peak Creek Stream Enhancement Project<br>Ashe County EEP Project Number 92606<br>MY3 & MY4 Plan View Sta. 0+00 - Sta. 10+25 | SURVEYED BY: JW, MF DATE: 04/10 & 04/11<br>DRAWN BY: JF DATE: 02/12<br>REVISION: DATE:<br>CAD FILE ID: Bowlin MY3 Plan.dwg | SHEET<br>2<br>OF 4 |

Figure A.3 Monitoring Plan Views.

**Monitoring Pin Locations - Peak Creek**

| Cross Sections | Feature | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees |
|---|---|---|---|
| xs-1 lep ips | Riffle | 36.3865880443 | 81.2991675100 |
| xs-1 bkf ips | | 36.3866180520 | 81.2991200249 |
| xs-1 rep ips | | 36.3866862735 | 81.2990012172 |
| xs-2 lep ips | Pool | 36.3872291268 | 81.2996851283 |
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| xs-3 lep ips | Pool | 36.3876578097 | 81.2998205556 |
| xs-3 bkf ips | | 36.3875525455 | 81.2996508302 |
| xs-3 rep ips | | 36.3874979926 | 81.2995418119 |
| xs-4 lep ips | Riffle | 36.3880943885 | 81.2994993723 |
| xs-4 bkf ips | | 36.3881126334 | 81.2994669594 |
| xs-4 rep ips | | 36.3882009655 | 81.2993330775 |
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| xs-7 bkf ips | | 36.3901404725 | 81.3005144630 |
| xs-7 rep ips | | 36.3901496049 | 81.3005967664 |

| Benchmark | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees |
|---|---|---|
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| Long Pro | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees |
|---|---|---|
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| End Peak Creek | 36.3912397245 | 81.3014686530 |

| Veg Plots | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees |
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| vp-2 origin | 36.3875389130 | 81.2997654596 |
| vp-3 origin | 36.3906187542 | 81.3009476958 |

| Photo Points | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees | Bearing |
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| PP-2 | 36.38658692690 | 81.29872557740 | 220°, 315° |
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| PP-4 | 36.38716812930 | 81.29952558620 | 335° |
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| PP-11 | 36.38941339970 | 81.29988665960 | 20° |
| PP-12 | 36.39025106980 | 81.30048304150 | 210° |
| PP-13 | 36.39011507550 | 81.30064704420 | 330° |
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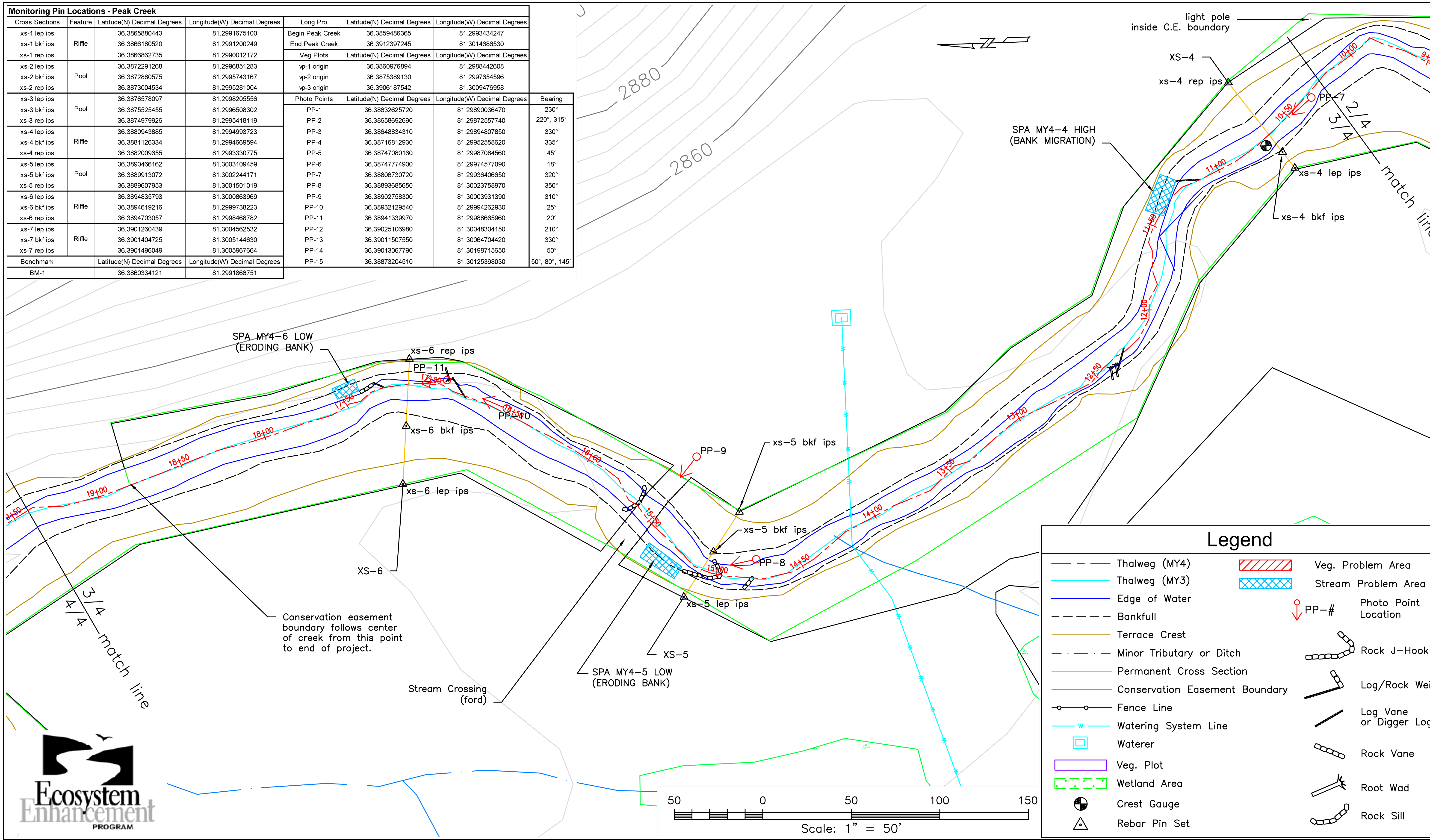
| PP-15 | 36.38873204510 | 81.30125398030 | 50°, 80°, 145° |

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Bowlin - Peak Creek Stream Enhancement Project
Ashe County EEP Project Number 92606
MY3 & MY4 Plan View Sta.10+25 - Sta.19+40

SURVEYED BY: JW, MF DATE: 04/10 & 04/11
DRAWN BY: JF DATE: 02/12
REVISION: DATE:
CAD FILE ID: Bowlin MY3 Plan.dwg

SHEET 3 OF 4

Figure A.3 Monitoring Plan Views.

**Monitoring Pin Locations - Peak Creek**

| Cross Sections | Feature | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees |
|---|---|---|---|
| xs-1 lep ips | Riffle | 36.3865880443 | 81.2991675100 |
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| Benchmark | | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees |
| BM-1 | | 36.3860334121 | 81.2991866751 |

| Long Pro | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees | |
|---|---|---|---|
| Begin Peak Creek | 36.3859486365 | 81.2993434247 | |
| End Peak Creek | 36.3912397245 | 81.3014686530 | |
| Veg Plots | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees | |
| vp-1 origin | 36.3860976894 | 81.2988442608 | |
| vp-2 origin | 36.3875389130 | 81.2997654596 | |
| vp-3 origin | 36.3906187542 | 81.3009476958 | |
| Photo Points | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees | Bearing |
| PP-1 | 36.38632625720 | 81.29890036470 | 230° |
| PP-2 | 36.38658692690 | 81.29872557740 | 220°, 315° |
| PP-3 | 36.38648834310 | 81.29894807850 | 330° |
| PP-4 | 36.38716812930 | 81.29952558620 | 335° |
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| PP-7 | 36.38806730720 | 81.29936406650 | 320° |
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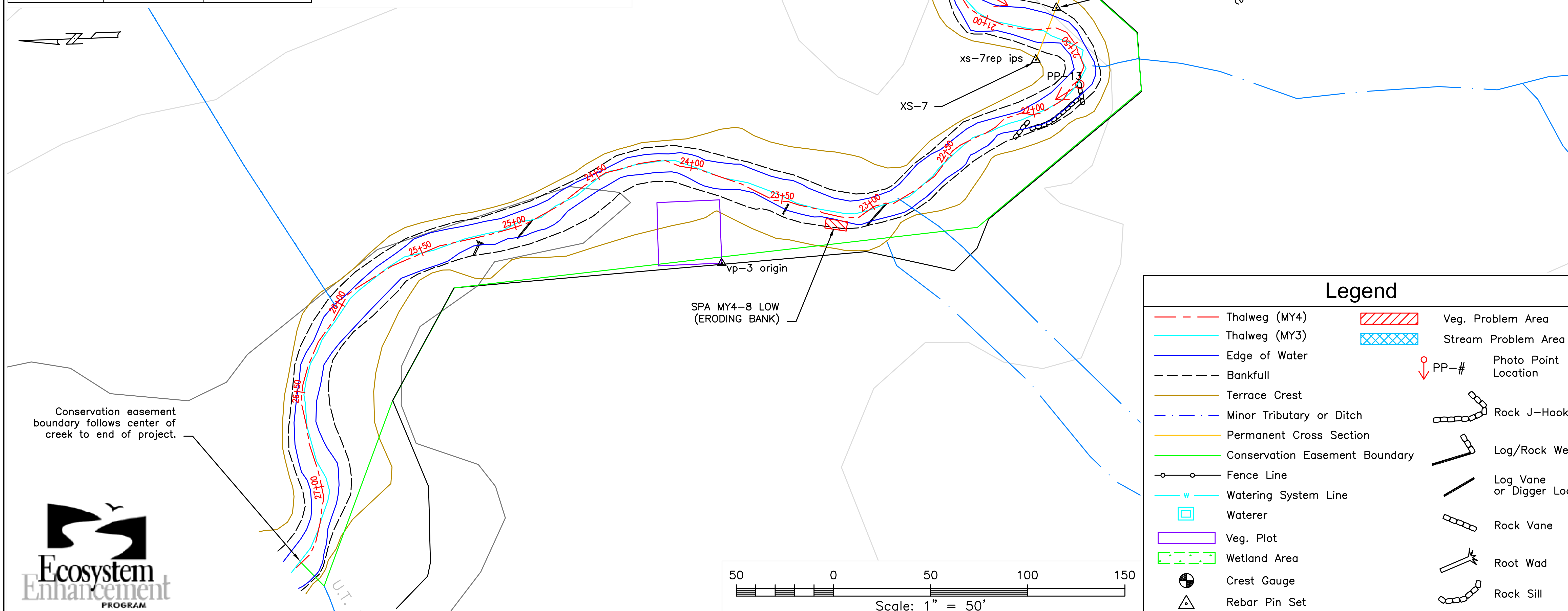


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Bowlin - Peak Creek Stream Enhancement Project
Ashe County EEP Project Number 92606
MY3 & MY4 Plan View Sta.19+40 - Sta.27+40

SURVEYED BY: JW, MF DATE: 04/10 & 04/11
DRAWN BY: JF DATE: 02/12
REVISION: DATE:
CAD FILE ID: Bowlin MY3 Plan.dwg

SHEET 4 OF 4

Figure A.3 Monitoring Plan Views.

**Monitoring Pin Locations - Peak Creek**

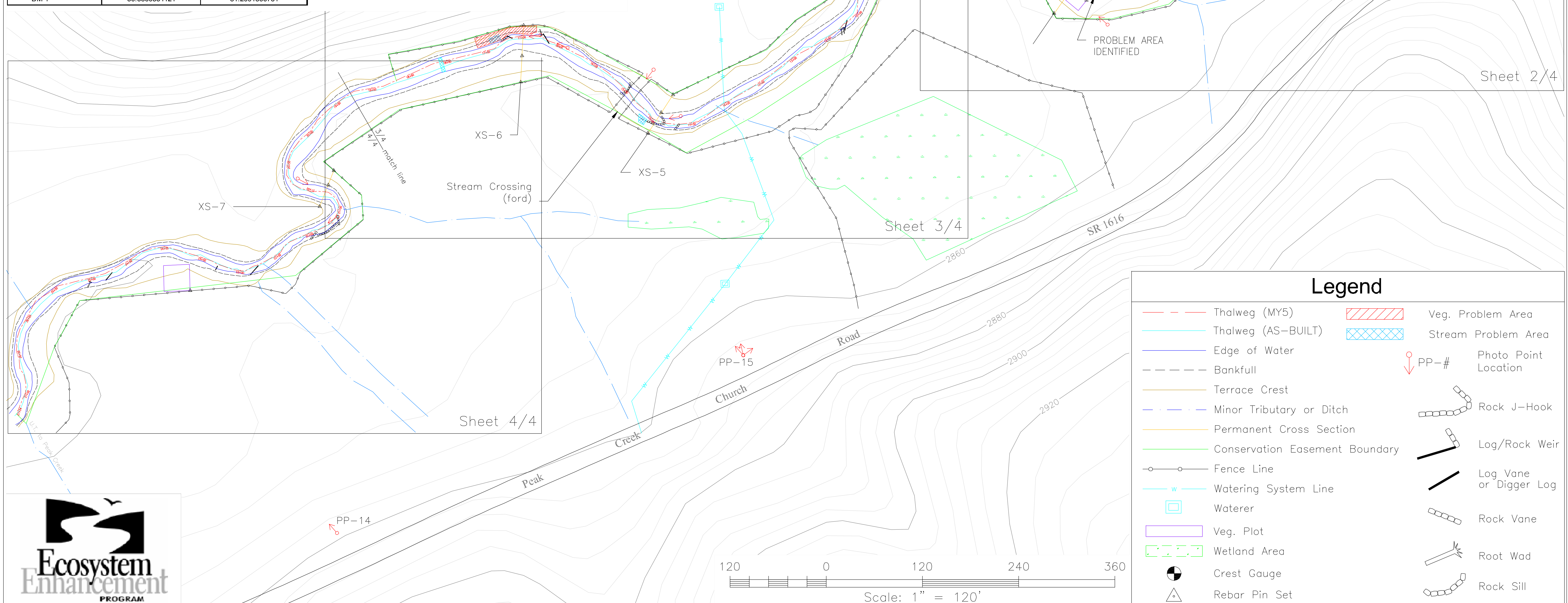
| Cross Sections | Feature | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees |
|---|---|---|---|
| xs-1 lep ips | Riffle | 36.3865880443 | 81.2991675100 |
| xs-1 bkf ips | | 36.3866180520 | 81.2991200249 |
| xs-1 rep ips | | 36.3866862735 | 81.2990012172 |
| xs-2 lep ips | Pool | 36.3872291268 | 81.2996851283 |
| xs-2 bkf ips | | 36.3872880575 | 81.2995743167 |
| xs-2 rep ips | | 36.3873004534 | 81.2995281004 |
| xs-3 lep ips | Pool | 36.3876578097 | 81.2998205556 |
| xs-3 bkf ips | | 36.3875525455 | 81.2996508302 |
| xs-3 rep ips | | 36.3874979926 | 81.2995418119 |
| xs-4 lep ips | Riffle | 36.3880943885 | 81.2994993723 |
| xs-4 bkf ips | | 36.3881126334 | 81.2994669594 |
| xs-4 rep ips | | 36.3882009655 | 81.2993330775 |
| xs-5 lep ips | Pool | 36.3890466162 | 81.3003109459 |
| xs-5 bkf ips | | 36.3889913072 | 81.3002244171 |
| xs-5 rep ips | | 36.3889607953 | 81.3001501019 |
| xs-6 lep ips | Riffle | 36.3894835793 | 81.3000863969 |
| xs-6 bkf ips | | 36.3894619216 | 81.2999738223 |
| xs-6 rep ips | | 36.3894703057 | 81.2998468782 |
| xs-7 lep ips | Riffle | 36.3901260439 | 81.3004562532 |
| xs-7 bkf ips | | 36.3901404725 | 81.3005144630 |
| xs-7 rep ips | | 36.3901496049 | 81.3005967664 |

| Benchmark | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees |
|---|---|---|
| BM-1 | 36.3860334121 | 81.2991866751 |

| Long Pro | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees |
|---|---|---|
| Begin Peak Creek | 36.3859486365 | 81.2993434247 |
| End Peak Creek | 36.3912397245 | 81.3014686530 |

| Veg Plots | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees |
|---|---|---|
| vp-1 origin | 36.3860976894 | 81.2988442608 |
| vp-2 origin | 36.3875389130 | 81.2997654596 |
| vp-3 origin | 36.3906187542 | 81.3009476958 |

| Photo Points | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees | Bearing |
|---|---|---|---|
| PP-1 | 36.38632625720 | 81.29890036470 | 230° |
| PP-2 | 36.38658692690 | 81.29872557740 | 220°, 315° |
| PP-3 | 36.38648834310 | 81.29894807850 | 330° |
| PP-4 | 36.38716812930 | 81.29952558620 | 335° |
| PP-5 | 36.38747080160 | 81.29987084560 | 45° |
| PP-6 | 36.38747774900 | 81.29974577090 | 18° |
| PP-7 | 36.38806730720 | 81.29936406650 | 320° |
| PP-8 | 36.38893685650 | 81.30023758970 | 350° |
| PP-9 | 36.38902758300 | 81.30003931390 | 310° |
| PP-10 | 36.38932129540 | 81.29994262930 | 25° |
| PP-11 | 36.38941339970 | 81.29988665960 | 20° |
| PP-12 | 36.39025106980 | 81.30048304150 | 210° |
| PP-13 | 36.39011507550 | 81.30064704420 | 330° |
| PP-14 | 36.39013067790 | 81.30198715650 | 50° |
| PP-15 | 36.38873204510 | 81.30125398030 | 50°, 80°, 145° |




NORTH CAROLINA WILDLIFE RESOURCES COMMISSION
WATERSHED ENHANCEMENT GROUP
P.O. BOX 387
ELKIN, NORTH CAROLINA 28621
336.527.1547 OFFICE
336.527.1548 FAX

Bowlin - Peak Creek Stream Enhancement Project
Ashe County
EEP Project Number 92606
MY5 Overall Plan View

SURVEYED BY: JCF, MDF
DATE: 04/12
DRAWN BY: JCF
DATE: 01/13
REVISION:
DATE:
CAD FILE ID: Bowlin MY5 Plan.dwg

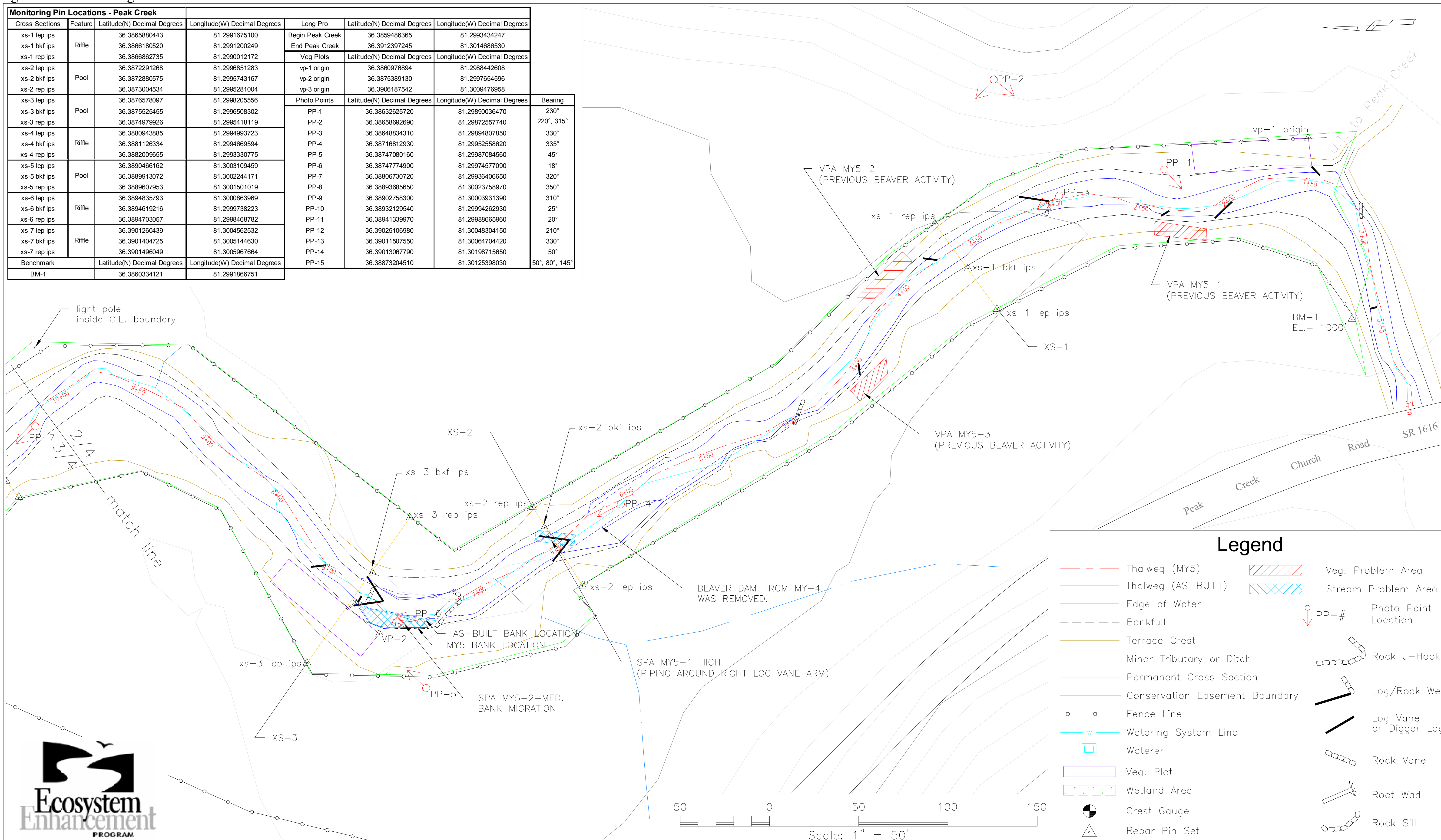
SHEET 1 OF 4

Figure A.3 Monitoring Plan Views.

**Monitoring Pin Locations - Peak Creek**

| Cross Sections | Feature | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees |
|---|---|---|---|
| xs-1 lep ips | Riffle | 36.3865880443 | 81.2991675100 |
| xs-1 bkf ips | | 36.3866180520 | 81.2991200249 |
| xs-1 rep ips | | 36.3866862735 | 81.2990012172 |
| xs-2 lep ips | Pool | 36.3872291268 | 81.2996851283 |
| xs-2 bkf ips | | 36.3872880575 | 81.2995743167 |
| xs-2 rep ips | | 36.3873004534 | 81.2995281004 |
| xs-3 lep ips | Pool | 36.3876578097 | 81.2998205556 |
| xs-3 bkf ips | | 36.3875525455 | 81.2996508302 |
| xs-3 rep ips | | 36.3874979926 | 81.2995418119 |
| xs-4 lep ips | Riffle | 36.3880943885 | 81.2994993723 |
| xs-4 bkf ips | | 36.3881126334 | 81.2994669594 |
| xs-4 rep ips | | 36.3882009655 | 81.2993330775 |
| xs-5 lep ips | Pool | 36.3890466162 | 81.3003109459 |
| xs-5 bkf ips | | 36.3889913072 | 81.3002244171 |
| xs-5 rep ips | | 36.3889607953 | 81.3001501019 |
| xs-6 lep ips | Riffle | 36.3894835793 | 81.3000863969 |
| xs-6 bkf ips | | 36.3894619216 | 81.2999738223 |
| xs-6 rep ips | | 36.3894703057 | 81.2998468782 |
| xs-7 lep ips | Riffle | 36.3901260439 | 81.3004562532 |
| xs-7 bkf ips | | 36.3901404725 | 81.3005144630 |
| xs-7 rep ips | | 36.3901496049 | 81.3005967664 |
| **Benchmark** | | **Latitude(N) Decimal Degrees** | **Longitude(W) Decimal Degrees** |
| BM-1 | | 36.3860334121 | 81.2991866751 |

| Long Pro | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees | |
|---|---|---|---|
| Begin Peak Creek | 36.3859486365 | 81.2993434247 | |
| End Peak Creek | 36.3912397245 | 81.3014686530 | |
| **Veg Plots** | **Latitude(N) Decimal Degrees** | **Longitude(W) Decimal Degrees** | |
| vp-1 origin | 36.3860976894 | 81.2988442608 | |
| vp-2 origin | 36.3875389130 | 81.2997654596 | |
| vp-3 origin | 36.3906187542 | 81.3009476958 | |
| **Photo Points** | **Latitude(N) Decimal Degrees** | **Longitude(W) Decimal Degrees** | **Bearing** |
| PP-1 | 36.38632625720 | 81.29890036470 | 230° |
| PP-2 | 36.38658692690 | 81.29872557740 | 220°, 315° |
| PP-3 | 36.38648834310 | 81.29894807850 | 330° |
| PP-4 | 36.38716812930 | 81.29952558620 | 335° |
| PP-5 | 36.38747080160 | 81.29987084560 | 45° |
| PP-6 | 36.38747774900 | 81.29974577090 | 18° |
| PP-7 | 36.38806730720 | 81.29936406650 | 320° |
| PP-8 | 36.38893685650 | 81.30023758970 | 350° |
| PP-9 | 36.38902758300 | 81.30003931390 | 310° |
| PP-10 | 36.38932129540 | 81.29994262930 | 25° |
| PP-11 | 36.38941339970 | 81.29988665960 | 20° |
| PP-12 | 36.39025106980 | 81.30048304150 | 210° |
| PP-13 | 36.39011507550 | 81.30064704420 | 330° |
| PP-14 | 36.39013067790 | 81.30198715650 | 50° |
| PP-15 | 36.38873204510 | 81.30125398030 | 50°, 80°, 145° |

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336.527.1548 FAX


Bowlin - Peak Creek Stream Enhancement Project
Ashe County
EEP Project Number 92606

MY5 Plan View Sta. 0+00 - Sta. 10+25

| | |
|---|---|
| SURVEYED BY: JCF, MDF | DATE: 04/12 |
| DRAWN BY: JCF | DATE: 01/13 |
| REVISION: | DATE: |
| CAD FILE ID: Bowlin MY3 Plan.dwg | |

SHEET 2 OF 4

Figure A.3 Monitoring Plan Views.

**Monitoring Pin Locations - Peak Creek**

| Cross Sections | Feature | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees |
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| xs-1 lep ips | Riffle | 36.3865880443 | 81.2991675100 |
| xs-1 bkf ips | | 36.3866180520 | 81.2991200249 |
| xs-1 rep ips | | 36.3866862735 | 81.2990012172 |
| xs-2 lep ips | Pool | 36.3872291268 | 81.2996851283 |
| xs-2 bkf ips | | 36.3872880575 | 81.2995743167 |
| xs-2 rep ips | | 36.3873004534 | 81.2995281004 |
| xs-3 lep ips | Pool | 36.3876578097 | 81.2998205556 |
| xs-3 bkf ips | | 36.3875525455 | 81.2996508302 |
| xs-3 rep ips | | 36.3874979926 | 81.2995418119 |
| xs-4 lep ips | Riffle | 36.3880943885 | 81.2994993723 |
| xs-4 bkf ips | | 36.3881126334 | 81.2994669594 |
| xs-4 rep ips | | 36.3882009655 | 81.2993330775 |
| xs-5 lep ips | Pool | 36.3890466162 | 81.3003109459 |
| xs-5 bkf ips | | 36.3889913072 | 81.3002244171 |
| xs-5 rep ips | | 36.3889607953 | 81.3001501019 |
| xs-6 lep ips | Riffle | 36.3894835793 | 81.3000863969 |
| xs-6 bkf ips | | 36.3894619216 | 81.2999738223 |
| xs-6 rep ips | | 36.3894703057 | 81.2998468782 |
| xs-7 lep ips | Riffle | 36.3901260439 | 81.3004562532 |
| xs-7 bkf ips | | 36.3901404725 | 81.3005144630 |
| xs-7 rep ips | | 36.3901496049 | 81.3005967664 |
| Benchmark | | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees |
| BM-1 | | 36.3860334121 | 81.2991866751 |

| Long Pro | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees | |
|---|---|---|---|
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| Veg Plots | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees | |
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| vp-2 origin | 36.3875389130 | 81.2997654596 | |
| vp-3 origin | 36.3906187542 | 81.3009476958 | |
| Photo Points | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees | Bearing |
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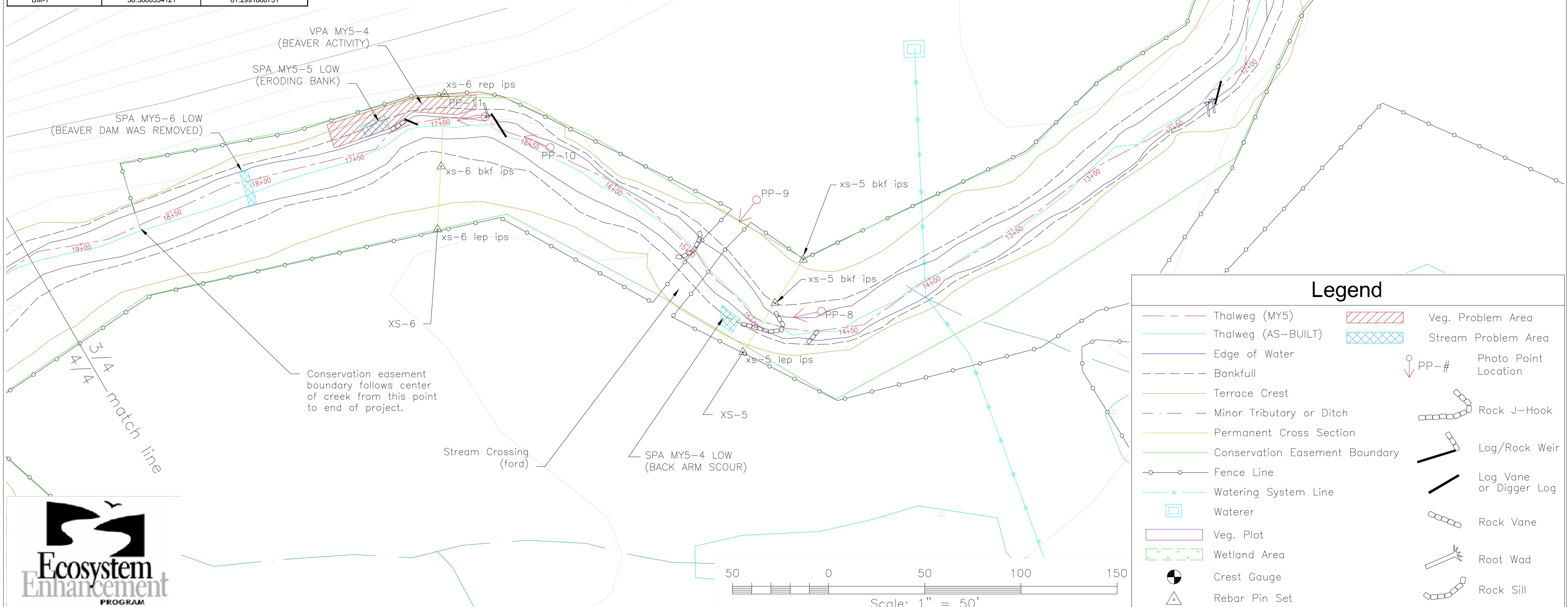
| PP-2 | 36.38658692690 | 81.29872557740 | 220°, 315° |
| PP-3 | 36.38648834310 | 81.29894807850 | 330° |
| PP-4 | 36.38716812930 | 81.29952558620 | 335° |
| PP-5 | 36.38747080160 | 81.29987084560 | 45° |
| PP-6 | 36.38747774900 | 81.29974577090 | 18° |
| PP-7 | 36.38806730720 | 81.29936406650 | 320° |
| PP-8 | 36.38893685650 | 81.30023758970 | 350° |
| PP-9 | 36.38902758300 | 81.30003931390 | 310° |
| PP-10 | 36.38932129540 | 81.29994262930 | 25° |
| PP-11 | 36.38941339970 | 81.29988665960 | 20° |
| PP-12 | 36.39025106980 | 81.30048304150 | 210° |
| PP-13 | 36.39011507550 | 81.30064704420 | 330° |
| PP-14 | 36.39013067790 | 81.30198715650 | 50° |
| PP-15 | 36.38873204510 | 81.30125398030 | 50°, 80°, 145° |

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Bowlin - Peak Creek Stream Enhancement Project
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MY5 Plan View Sta.10+25 - Sta.19+40

| | |
|---|---|
| SURVEYED BY: JCF, MDF | DATE: 04/12 |
| DRAWN BY: JCF | DATE: 01/13 |
| REVISION: | DATE: |
| CAD FILE ID: Bowlin MY3 Plan.dwg | |

SHEET 3 OF 4

Figure A.3 Monitoring Plan Views.

| Monitoring Pin Locations - Peak Creek | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Cross Sections | Feature | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees | Long Pro | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees | | |
| xs-1 lep ips | Riffle | 36.3865880443 | 81.2991675100 | Begin Peak Creek | 36.3859486365 | 81.2993434247 | | |
| xs-1 bkf ips | | 36.3866180520 | 81.2991200249 | End Peak Creek | 36.3912397245 | 81.3014686530 | | |
| xs-1 rep ips | | 36.3866862735 | 81.2990012172 | Veg Plots | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees | | |
| xs-2 lep ips | Pool | 36.3872291268 | 81.2996851283 | vp-1 origin | 36.3860976894 | 81.2988442608 | | |
| xs-2 bkf ips | | 36.3872880575 | 81.2995743167 | vp-2 origin | 36.3875389130 | 81.2997654596 | | |
| xs-2 rep ips | | 36.3873004534 | 81.2995281004 | vp-3 origin | 36.3906187542 | 81.3009476958 | | |
| xs-3 lep ips | Pool | 36.3876578097 | 81.2998205556 | Photo Points | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees | Bearing | |
| xs-3 bkf ips | | 36.3875525455 | 81.2996508302 | PP-1 | 36.38632625720 | 81.29890036470 | 230° | |
| xs-3 rep ips | | 36.3874979926 | 81.2995418119 | PP-2 | 36.38658692690 | 81.29872557740 | 220°, 315° | |
| xs-4 lep ips | Riffle | 36.3880943885 | 81.2994993723 | PP-3 | 36.38648834310 | 81.29894807850 | 330° | |
| xs-4 bkf ips | | 36.3881126334 | 81.2994669594 | PP-4 | 36.38716812930 | 81.29952558620 | 335° | |
| xs-4 rep ips | | 36.3882009655 | 81.2993330775 | PP-5 | 36.38747080160 | 81.29987084560 | 45° | |
| xs-5 lep ips | Pool | 36.3890466162 | 81.3003109459 | PP-6 | 36.38747774900 | 81.29974577090 | 18° | |
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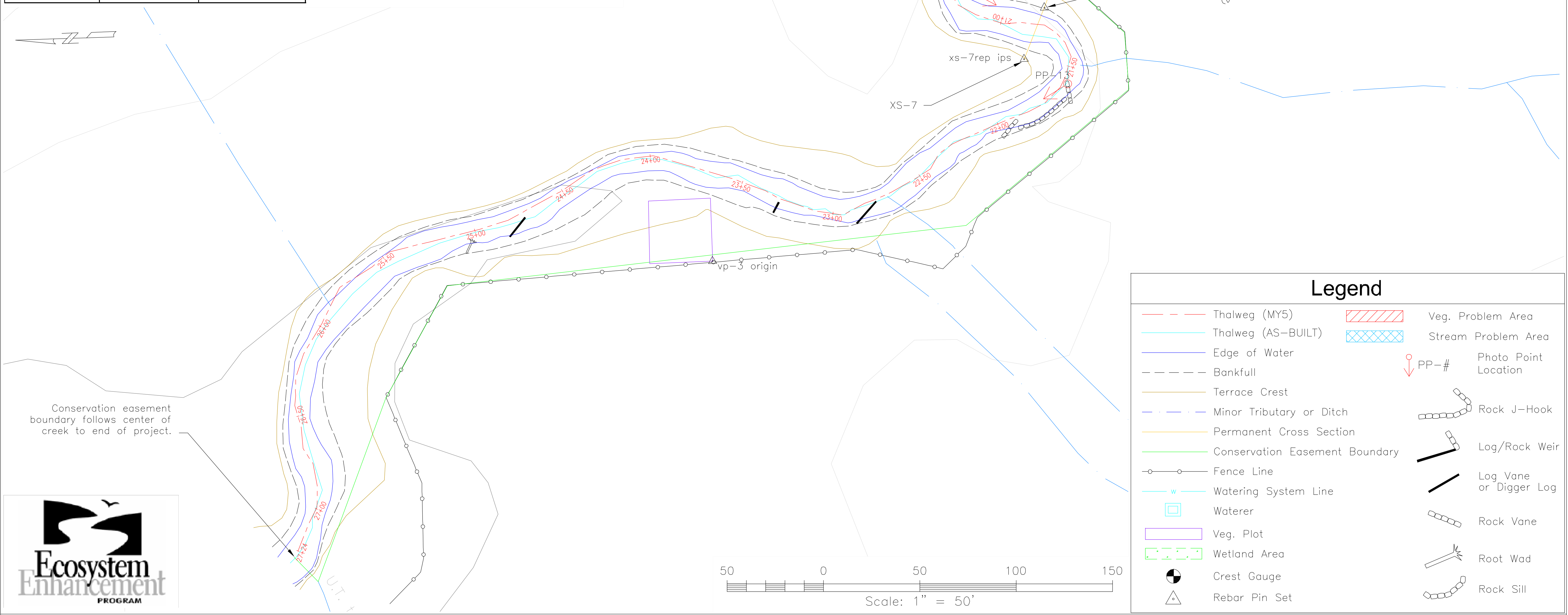
| xs-5 rep ips | | 36.3889607953 | 81.3001501019 | PP-8 | 36.38893685650 | 81.30023758970 | 350° | |
| xs-6 lep ips | Riffle | 36.3894835793 | 81.3000863969 | PP-9 | 36.38902758300 | 81.30003931390 | 310° | |
| xs-6 bkf ips | | 36.3894619216 | 81.2999738223 | PP-10 | 36.38932129540 | 81.29994262930 | 25° | |
| xs-6 rep ips | | 36.3894703057 | 81.2998468782 | PP-11 | 36.38941339970 | 81.29988665960 | 20° | |
| xs-7 lep ips | Riffle | 36.3901260439 | 81.3004562532 | PP-12 | 36.39025106980 | 81.30048304150 | 210° | |
| xs-7 bkf ips | | 36.3901404725 | 81.3005144630 | PP-13 | 36.39011507550 | 81.30064704420 | 330° | |
| xs-7 rep ips | | 36.3901496049 | 81.3005967664 | PP-14 | 36.39013067790 | 81.30198715650 | 50° | |
| Benchmark | | Latitude(N) Decimal Degrees | Longitude(W) Decimal Degrees | PP-15 | 36.38873204510 | 81.30125398030 | 50°, 80°, 145° | |
| BM-1 | | 36.3860334121 | 81.2991866751 | | | | | |

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Bowlin - Peak Creek Stream Enhancement Project
Ashe County EEP Project Number 92606
MY5 Plan View Sta.19+40 - Sta.27+40

| | |
|---|---|
| SURVEYED BY: JCF, MDF | DATE: 04/12 |
| DRAWN BY: JCF | DATE: 01/13 |
| REVISION: | DATE: |
| CAD FILE ID: Bowlin MY3 Plan.dwg | |

SHEET 4 OF 4

Table A.1 Project Components.

| Project Segment or Reach ID | Existing feet/Acres | Restoration Level[a] | Approach[b] | Restored Feet/Acres | Stationing | Buffer Acres | Comment |
|---|---|---|---|---|---|---|---|
| Peak Creek Reach 1 | 1,707 lf | EI | P3 | 1,773 lf | 1+34-19+07 | 1.5 | Installed rock vanes, rock j-hooks, root wads, digger logs, and log vanes, sloped banks and created bankfull benches on both sides of the stream. |
| Peak Creek Reach 2[c] | 1,003 lf | EI | P3 | 1,003 lf | 0+0-1+34<br>18+50-27+19 | 0.5 | Installed rock vanes, rock j-hooks, root wads, digger logs, and log vanes, sloped banks and created bankfull benches on one side of the stream channel. |

**Component Summations**

| Restoration Level | Stream (lf) | Riparian Wetland (Acre) | | Non-Riparian (Acres) | Upland (Acre) | Buffer (Acre) | BMP |
|---|---|---|---|---|---|---|---|
| | | Riverine | Non-Riverine | | | | |
| Restoration | | | | | | | |
| Enhancement | | | | | | | |
| Enhancement I[c] | 1773 | | | | | | |
| Enhancement II | | | | | | | |
| Creation | | | | | | | |
| Preservation | | | | | | | |
| HQ Preservation | | | | | | | |
| | | | | | | | |
| **Totals** | **1773** | **0** | | **0** | **0** | **0** | **BMP Count** |

(shaded) = Non-Applicable

R = Restoration | EII = Enhancement II | P3 = Priority 3 | lf = Linear Feet

EI = Enhancment I | S = Stabilization | SS = Stream Bank Stabilization

[a]Source: USACE 2003.

[b]Source: Rosgen 2006.

[c]Reach 2 was excluded from the Component Summation Totals because the conservation easement protects only one side of the stream channel.

Table A.2 Project Activity and Reporting History.

| Activity or Report | Data Collection Complete | Actual Completion or Delivery |
|---|---|---|
| Restoration Plan | Apr 2002 | Dec 2002 |
| Final Design | Apr 2002 | Dec 2002 |
| **NCDWQ 401 Water Quality Certification** | NA | May 2003, Aug 2007 |
| **USACE 404 Permit** | NA | Apr 1998[a], Aug 2007 |
| **Acquired conservation easement** | NA | Sep 2006 |
| **Erosion and Sediment Control Design Plan Approved** | NA | May 2007 |
| **Trout Buffer waiver** | NA | Jun 2007 |
| Treat invasive species with herbicide | NA | Apr 2007 |
| Construction | NA | Nov 2007 |
| Temporary seed mix applied to entire project area | NA | Nov 2007 |
| Permanent seed mix applied to entire project area | NA | Nov 2007 |
| Bare root and live stakes plantings for the entire project area | NA | Feb 2008 |
| Mitigation/As-built (Year 0 Monitoring - baseline) | Dec 2007, Feb 2008 | May 2009 |
| Treat invasive species with herbicide | NA | Apr 2008 |
| Year 1 Monitoring | Sep 2008 | Nov 2010 |
| Treat invasive species with herbicide | NA | Apr 2009 |
| Year 2 Monitoring | May 2009, Jun 2009 | Nov 2010 |
| Treat invasive species with herbicide | NA | Apr 2010 |
| Year 3 Monitoring | May 2010, Jun 2010 | Apr 2013 |
| Treat invasive species with herbicide | NA | Apr 2011 |
| Removed beaver dam at station 6+22, installed livestakes at three problem sites | NA | Apr 2011 |
| Repaired fence at stream ford | | May 2011 |
| Year 4 Monitoring | May 2011, Jun 2011 | Apr 2013 |
| Treat invasive species with herbicide | NA | Apr 2012 |
| Reshaped bank and installed livestakes at station 7+15 | NA | Apr 2012 |
| Removed beaver dam at station 18+11 | NA | May 2012 |
| Year 5 Monitoring | May 2012, Jun 2012 | Apr 2013 |

[a]The project was originally permitted under the 1998 USACE 404 permit for the relocation of US421 (TIP number R-0529).

Table A.3 Project Contact Table.

| | |
|---|---|
| **Designer**<br>North Carolina Wildlife Resources Commission<br>Watershed Enhancement Group<br>Field Office | Mr. Joseph H. Mickey, Mr. Mark Fowlkes<br>1701 Mail Service Center<br>Raleigh, NC 27699-1701<br>(336) 527-1547 |
| **Construction Contractor**<br>North Carolina Wildlife Resources Commission<br>Watershed Enhancement Group<br>Field Office | Mr. Mark Fowlkes<br>P.O. Box 387<br>Elkin, NC 28621<br>(336) 527-1547 |
| **Sub-Construction Contractor**<br>Yadkin Valley Construction, Inc. Grading and Fencin | Mr. Terry Benton<br>2961 Old 60 Hwy<br>Ronda, NC 28670<br>(336) 984-2219 |
| **Planting Contractor**<br>North Carolina Wildlife Resources Commission<br>Watershed Enhancement Group<br>Field Office | Mr. Mark Fowlkes<br>P.O. Box 387<br>Elkin, NC 28621<br>(336) 527-1547 |
| **Seeding Contractor**<br>North Carolina Wildlife Resources Commission<br>Watershed Enhancement Group<br>Field Office | Mr. Mark Fowlkes<br>P.O. Box 387<br>Elkin, NC 28621<br>(336) 527-1547 |
| **Seed Mix Sources** | New England Wetland Plants, Inc. (413) 548-8000 |
| **Nursery Stock Suppliers** | North Carolina Forest Service (888) NC-Trees |
| | River Bend Farms (336) 366-2982 |
| | Foggy Mountain Nursery (336) 977-2958 |
| **Monitoring Performers**<br>North Carolina Wildlife Resources Commission<br>Watershed Enhancement Group<br>Field Office | Mr. Mark Fowlkes<br>P.O. Box 387<br>Elkin, NC 28621<br>(336) 527-1547 |

## Table A.4 Project Attribute Table.

| | |
|---|---|
| Project County | Ashe |
| Physiographic Region<br>Reference: http://www.geology.enr.state.nc.us/proj_earth/proj_earth.htm | Blue Ridge Province |
| Ecoregion (Reference: USACE 2003) | New River Plateau |
| Project River Basin | New River |
| USGS HUC for Project (14 digit) | 05050001020050 |
| NCDWQ Sub-basin for Project | 05-07-01 |
| Within extent of EEP Watershed Plan? | Yes |
| NCWRC Class (Warm, Cool, Cold) | Cold |
| Percent of project easement fenced or demarcated | 100 |
| Beaver activity observed during design phase? | Yes |
| | |
| Restoration Component Attribute Table | |
| | Peak Creek |
| Drainage Area (square miles) | 4.44 |
| Stream Order (Reference: USGS 1:24,000 Topographic maps) | Third |
| Restored length (ft) | 2719 |
| Perennial or Intermittent | Perennial |
| Watershed type (Rural, Urban, Developing, etc.) | Rural |
| Watershed LULC Distribution (e.g.) (percent) | |
| Residential | <1% |
| Ag-Row Crop | <1% |
| Ag-Livestock | 24% |
| Forested | 74% |
| Watershed impervious cover (percent) | <10% |
| NCDWQ AU/Index number | 10-1-35 (2)a |
| NCDWQ Classification | B Tr+ |
| 303d listed? | No; Peak Creek 303d listed 3.3 miles downstream of project |
| Upstream 303d listed segment? | No |
| Reasons for 303d listing or stressor | Toxic impacts and habitat degradation |
| NCDWQ 404 Water Quality Certification Number | 3626 |
| USACE 401 Action ID Number | 200702632 |
| Total acreage of easement | 3 |
| Total vegetated acreage within easement | 2 |
| Total planted acreage as part of the restoration | 1 |
| Rosgen stream classification of pre-existing | C4 |
| Rosgen stream classification of as-built | C4 |
| Valley Type | VIII |
| Valley Slope | 1.3% |
| Valley side slope range (e.g. 2-3%) | 25-45% |
| Valley toe slope range (e.g. 2-3%) | 15-25% |
| Cowardin classification (Reference: Coward 1979) | Riverine, upper perennial, unconsolidated bottom |
| Trout Waters Designation | Tr |
| Species of concern, endangered, etc.? (Y/N) | Bog turtle |
| Dominant soil series and characteristics | |
| Series | Toxaway |
| Depth | 0 to 72 inches |
| Clay percent | 17% |
| K | 0.17 |
| T | 5 |

N/A = Not applicable "-" = Items that are unavailable U = Unknown

## Appendix B   Morphological Summary Data

### B.1   Representative Stream Problem Area Photographs

Table B.1.1  Stream Problem Areas.

| Stream Problem Areas | | | | | |
|---|---|---|---|---|---|
| Identification | Feature/Issue | Station Number/Range | Suspected Cause | Priority | Photograph Number |
| MY1 | | | | | |
| | Eroding left bank | 7+15 | Unstable bank | Medium | PA1_08Sep2008 |
| | Center bar | 12+44 | Excess sediment in channel | Low | PA2_08Sep2008 |
| | Center/transverse bar | 19+89 | Historic gravel mining | Low | PA3_08Sep2008 |
| MY2 | | | | | |
| | Eroding left bank | 7+15 | Unstable bank | Medium | PA1_20May2009 |
| | Center/transverse bar | 19+89 | Historic gravel mining | Low | PA2_20May2009 |
| MY3 | | | | | |
| SPA MY3&4-3 | Eroding left bank | 7+15 | Unstable bank | Medium | SPA MY3-1 |
| MY4 | | | | | |
| SPA MY4-1 | Beaver dam | 6+22 | Beavers | High | SPA MY4-1 |
| SPA MY4-2 | Piping under right vane arm | 6+47 | High flows over beaver dam | Medium | SPA MY4-2 |
| SPA MY3&4-3 | Eroding left bank | 7+20 | Unstable bank | Medium | SPA MY4-3 |
| SPA MY4-4 | Right bank migration | 11+20 | Unstable bank/back arm scour | High | SPA MY4-4 |
| SPA MY4-5 | Eroding left bank | 15+25 | Back arm scour | Low | SPA MY4-5 |
| SPA MY4-6 | Eroding right bank | 17+30 | Bank scour | Low | SPA MY4-6 |
| SPA MY4-7 | Eroding left bank | 23+25 | Back arm scour | Low | SPA MY4-7 |
| MY5 | | | | | |
| SPA MY5-1 | Piping under right vane arm | 6+47 | High flows over beaver dam | Medium | SPA MY5-1 |
| SPA MY5-2 | Eroding left bank | 7+20 | Unstable bank | Medium | SPA MY5-2 |
| SPA MY5-3 | Right bank migration | 11+15 | Unstable bank/back arm scour | High | SPA MY5-3 |
| SPA MY5-4 | Eroding left bank | 15+10 | Back arm scour | Low | SPA MY5-4 |
| SPA MY5-5 | Eroding right bank | 17+30 | Bank scour | Low | SPA MY5-5 |
| SPA MY5-6 | Beaver dam | 18+11 | Beavers | High | SPA MY5-6 |

MY3 Problem Area Photographs

SPA MY3&4-3, eroding left bank:
14 Mar 10.

MY4 Problem Area Photographs

SPA MY4-1, beaver dam, 3 Feb 11.

SPA MY4-1, after removal of beaver dam, 19 Apr 11.

SPA MY4-2, piping under right vane arm, 3 Feb 11

.

SPA MY4-3, eroding left bank, 3 Feb 11.


SPA MY4-4, right bank migration, 3 Feb 11.


SPA MY4-5, eroding left bank, 19 Apr 11.


SPA MY4-5, repair of eroding left bank, 19 Apr 11.


SPA MY4-6, eroding right bank, 19 Apr 11.


SPA MY4-6, repair of eroding right bank, 19 Apr 11.

SPA MY4-7, eroding left bank, 19 Apr 11.

SPA MY4-7, repair of eroding left bank, 19 Apr 11.

MY5 Problem Area Photographs

SPA MY5-1, piping under right vane arm, 9 Apr 12.

SPA MY5-2, eroding left bank, 9 Apr 12.

SPA MY5-2, repair of eroding left bank, 29 May 12


SPA MY5-3, right bank migration, 9 Apr 12.


SPA MY5-4, eroding left bank, 21 May 12.


SPA MY5-5, eroding right bank from beaver activity, 21 May 12.

SPA MY5-6, beaver dam, 10 Apr 12.

SPA MY5-6, after removal of beaver dam, 29 May 12.

## B.2 Stream Photograph Points


PS-1, bearing 230°: 17 Apr 02.


PS-1, bearing 230°: 26 Mar 08.


PS-1, bearing 230°: 08 Sep 08.


PS-1, bearing 230°: 20 May 09.


PS-1, bearing 230°: 14 Mar 10.


PS-1, bearing 230°: 26 May 11.


PS-1, bearing 230°:  09 Apr 12.


PS-2, bearing 220°:  29 Jan 08.


PS-2, bearing 220°:  08 Sep 08.


PS-2, bearing 220°:  20 May 09.


PS-2, bearing 220°:  02 Jul 10.


PS-2, bearing 220°:  26 May 11.


PS-2, bearing 220°:  09 Apr 12.


PS-2, bearing 315°:  29 Jan 08.


PS-2, bearing 315°:  08 Sep 08.


PS-2, bearing 315°:  20 May 09.


PS-2, bearing 315°:  02 Jul 10.


PS-2, bearing 315°:  26 May 11.


PS-2, bearing 315°:  09 Apr 12.


PS-3, bearing 330°:  17 Apr 02.


PS-3, bearing 330°:  19 Sep 07.


PS-3, bearing 330°:  25 Sep 07.


PS-3, bearing 330°:  08 Sep 08.


PS-3, bearing 330°:  20 May 09.


PS-3, bearing 330°:  12 Apr 10.


PS-3, bearing 330°:  14 Apr 11.


PS-3, bearing 330°:  09 Apr 12.


PS-4, bearing 335°:  17 Apr 02.


PS-4, bearing 335°:  01 Jan 08.


PS-4, bearing 335°:  08 Sep 08.


PS-4, bearing 335°:  20 May 09.


PS-4, bearing 335°:  12 Apr 10.


PS-4, bearing 335°:  14 Apr 11.


PS-4, bearing 335°:  09 Apr 12.


PS-5, bearing 35°:  24 Sep 02.


PS-5, bearing 45°:  26 Mar 08.  Note:  stream channel moved to the right.


PS-5, bearing 35°:  08 Sep 08.


PS-5, bearing 35°:  20 May 09.


PS-5, bearing 35°:  02 Jul 10.


PS-5, bearing 35°:  14 Apr 11.


PS-5, bearing 35°:  09 Apr 12.


PS-6, bearing 18°:  08 Jan 08.


PS-6, bearing 18°:  08 Sep 08.


PS-6, bearing 18°:  20 May 09.


PS-6, bearing 18°:  12 Apr 10.


PS-6, bearing 18°:  14 Apr 11.


PS-6, bearing 18°:  09 Apr 12.

Pre-construction view of cross-section 4 at station 10+43 looking upstream; 17 Apr 02.

PS-7, bearing 320°: Post-construction view of cross-section 4 at station 10+43 looking down stream; 08 Jan 08.

PS-7, bearing 320°: 08 Sep 08.

PS-7, bearing 320°: 20 May 09.

PS-7, bearing 320°: 12 Apr 10.

PS-7, bearing 320°: 14 Apr 11.


PS-7, bearing 320°:  09 Apr 12.


PS-8, bearing 350°:  17 Apr 02.


PS-8, bearing 350°:  26 Mar 08.


PS-8, bearing 350°:  08 Sep 08.


PS-8, bearing 350°:  20 May 09.


PS-8, bearing 350°:  12 Apr 10.


PS-8, bearing 350°:  15 Apr 11.


PS-8, bearing 350°:  09 Apr 12.


PS-9, bearing 310°: 17 Apr 02.


PS-9, bearing 310°: 26 Mar 08.


PS-9, bearing 310°: 08 Sep 08.


PS-9, bearing 310°: 20 May 09.


PS-9, bearing 310°: 02 Jul 10.


PS-9, bearing 310°: 26 May 11.


PS-9, bearing 310°:  09 Apr 12.


PS-10, bearing 25°:  17 Apr 02.


PS-10, bearing 25°:  26 Mar 08.


PS-10, bearing 25°:  08 Sep 08.


PS-10, bearing 25°:  20 May 09.


PS-10, bearing 25°:  12 Apr 10.


PS-10, bearing 25°:  15 Apr 11.


PS-10, bearing 25°:  09 Apr 12.


PS-11, bearing 20°: Pre-construction view of cross-section 6 at station 20+90; 19 Mar 07.


PS-11, bearing 20°: Post-construction view of cross-section 6 at station 20+90; 08 Jan 08.


PS-11, bearing 20°: 08 Sep 08.


PS-11, bearing 20°: 20 May 09.


PS-11, bearing 20°: 12 Apr 10.


PS-11, bearing 20°: 15 Apr 11.

PS-11, bearing 20°:  09 Apr 12.

PS-12, bearing 210°:  17 Apr 02.

PS-12, bearing 210°:  08 Jan 08.

PS-12, bearing 210°:  08 Sep 08.

PS-12, bearing 210°:  20 May 09.

PS-12, bearing 210°:  13 Apr 10.

PS-12, bearing 210°:  15 Apr 11.


PS-12, bearing 210°:  09 Apr 12.


PS-13, bearing 330°:  19 Mar 07.


PS-13, bearing 330°:  26 Mar 08.


PS-13, bearing 330°:  08 Sep 08.


PS-13, bearing 330°:  20 May 09.


PS-13, bearing 330°:  14 Mar 10.


PS-13, bearing 330°:  15 Apr 11.


PS-13, bearing 330°:  09 Apr 12.


PS-14, bearing 50°: 29 Jan 08.


PS-14, bearing 50°: 11 Sep 08.


PS-14, bearing 50°: 20 May 09.


PS-14, bearing 50°: 02 Jul 10.


PS-14, bearing 50°: 26 May 11.


PS-14, bearing 50°: 09 Apr 12.


PS-15, bearing 50°:  29 Jan 08.


PS-15, bearing 50°:  11 Sep 08.


PS-15, bearing 50°:  20 May 09.


PS-15, bearing 50°:  02 Jul 10.


PS-15, bearing 50°:  26 May 11.


PS-15, bearing 50°:  09 Apr 12.


PS-15, bearing 80°:  29 Jan 08.


PS-15, bearing 80°:  11 Sep 08.


PS-15, bearing 80°:  20 May 09.


PS-15, bearing 80°:  02 Jul 10.


PS-15, bearing 80°:  26 May 11.


PS-15, bearing 80°:  09 Apr 12.

PS-15, bearing 145°: 29 Jan 08.

PS-15, bearing 145°: 11 Sep 08.

PS-15, bearing 145°: 20 May 09.

PS-15, bearing 145°: 02 Jul 10.

PS-15, bearing 145°: 26 May 11.

PS-15, bearing 145°: 09 Apr 12.

## B.3 Qualitative Visual Stability Assessment

Table B.3.1 Categorical Stream Feature Visual Stability Assessment Summary.

| **Features** | **Initial** | **MY1** | **MY2** | **MY3** | **MY4** | **MY5** |
|---|---|---|---|---|---|---|
| A. Riffles | 100% | 99% | 100% | 97% | 83% | 78% |
| B. Pools | 100% | 94% | 94% | 92% | 88% | 80% |
| C. Thalweg | 100% | 93% | 93% | 93% | 80% | 80% |
| D. Meanders | 100% | 98% | 98% | 98% | 94% | 94% |
| E. Bed General | 100% | 99% | 100% | 100% | 98% | 99% |
| F. Bank Condition | 100% | 99% | 99% | 99% | 98% | 98% |
| G. Vanes / J Hooks etc. | 100% | 97% | 97% | 97% | 94% | 93% |
| F. Wads and Boulders | 100% | 100% | 100% | 100% | 100% | 100% |

Table B.3.2 Visual Morphological Stability Assessment.

| MY3 Visual Morphological Stability Assessment | | | | | | | |
|---|---|---|---|---|---|---|---|
| Feature Category | Metric (per As-built and references baselines) | (# Stable) Number Performing as Intended | Total Number per As-built | Total Number feet in unstable state[1] | Percent Perform In Stable Condition[2] | Feature Performance Mean or Total[3] |
| A. Riffles | 1. Present? | 29 | 30 | NA | 97% | |
| | 2. Armor stable (e.g. no displacement)? | 29 | 30 | NA | 97% | |
| | 3. Facet grade appears stable? | 29 | 30 | NA | 97% | |
| | 4. Minimal evidence of embedding/fining? | 29 | 30 | NA | 97% | |
| | 5. Length appropriate? | 29 | 30 | NA | 97% | 97% |
| B. Pools | 1. Present? (e.g. not subject to severe aggrad. Or migrat.?)[4] | 27 | 28 | NA | 96% | |
| | 2. Sufficiently deep (Max Pool D:Mean BKF>1.6? | 25 | 28 | NA | 89% | |
| | 3. Length appropriate? | 25 | 28 | NA | 89% | 92% |
| C. Thalweg | 1. Upstream of meander bend (run/inflection) centering?[5] | 14 | 15 | NA | 93% | |
| | 2. Downstream of meander (glide/inflection) centering?[5] | 14 | 15 | NA | 93% | 93% |
| D. Meanders | 1. Outer bend in state of limited/controlled erosion? | 12 | 13 | NA | 92% | |
| | 2. Of those eroding, # w/concomitant point bar formation? | 0 | 0 | NA | 100% | |
| | 3. Apparent Rc within spec? | 13 | 13 | NA | 100% | |
| | 4. Sufficient floodplain access and relief? | 13 | 13 | NA | 100% | 98% |
| E. Bed General | 1. General channel bed aggradation areas (bar formation) | NA | NA | 10 | 100% | |
| | 2. Channel bed degradation - areas of increasing downcutting or head cutting? | NA | NA | 0 | 100% | 100% |
| F. Bank[6] | 1. Actively eroding, wasting, or slumping bank | 0 | 0 | 30 | 99% | 99% |
| G. Vanes | 1. Free of back or arm scour? | 22 | 24 | NA | 92% | |
| | 2. Height appropriate? | 23 | 24 | NA | 96% | |
| | 3. Angle and geometry appear appropriate? | 24 | 24 | NA | 100% | |
| | 4. Free of piping or other structural failures? | 24 | 24 | NA | 100% | 97% |
| H. Wads/ Boulders | 1. Free of scour? | 4 | 4 | NA | 100% | |
| | 2. Footing stable? | 4 | 4 | NA | 100% | 100% |

1. Metrics that are spatial estimates that are continuous variables should be entered as:

The number of locals over the reach for which the failing condition is observed / followed by the total linear distance (feet) or area for which the failing or unstable condition is observed.

2. In the case of categorical metrics for which a feature count is involved, this is simply calculated as the number of functional features that are in a stated of stability as a percentage of the total. In the case of those metrics based on footage or aerial extent it is that amount in a state of failure or instability expressed as a porportion of the total amount of that feature. The resulting proportion is then subtracted from 1 and then multiplied by 100 to give a percentage that represents the proportion of that feature category in a state of apparent stability

3. The mean of the metrics for a givien feature category.

4. Was the feature actually present as compared to the As-built or has the featrue been completely obsucred (aggraded) of removed (degraded)

5. Is the thalweg centering up on the channel between meander bends?

6. Amount of active bank failure/erosion. This should be the tally of all stressed and failing banks from the problem area plan view, which can then be calculated as indicated in footnote 1 above.

| MY4 Visual Morphological Stability Assessment | | | | | | |
|---|---|---|---|---|---|---|
| Feature Category | Metric (per As-built and references baselines) | (# Stable) Number Performing as Intended | Total Number per As-built | Total Number feet in unstable state[1] | Percent Perform In Stable Condition[2] | Feature Performance Mean or Total[3] |
| A. Riffles | 1. Present? | 26 | 30 | NA | 87% | |
| | 2. Armor stable (e.g. no displacement)? | 25 | 30 | NA | 83% | |
| | 3. Facet grade appears stable? | 25 | 30 | NA | 83% | |
| | 4. Minimal evidence of embedding/fining? | 22 | 30 | NA | 73% | |
| | 5. Length appropriate? | 26 | 30 | NA | 87% | 83% |
| B. Pools | 1. Present? (e.g. not subject to severe aggrad. Or migrat.?)[4] | 26 | 28 | NA | 93% | |
| | 2. Sufficiently deep (Max Pool D:Mean BKF>1.6? | 23 | 28 | NA | 82% | |
| | 3. Length appropriate? | 25 | 28 | NA | 89% | 88% |
| C. Thalweg | 1. Upstream of meander bend (run/inflection) centering?[5] | 12 | 15 | NA | 80% | |
| | 2. Downstream of meander (glide/inflection) centering?[5] | 12 | 15 | NA | 80% | 80% |
| D. Meanders | 1. Outer bend in state of limited/controlled erosion? | 10 | 13 | NA | 77% | |
| | 2. Of those eroding, # w/concomitant point bar formation? | 1 | 0 | NA | 100% | |
| | 3. Apparent Rc within spec? | 13 | 13 | NA | 100% | |
| | 4. Sufficient floodplain access and relief? | 13 | 13 | NA | 100% | 94% |
| E. Bed General | 1. General channel bed aggradation areas (bar formation) | NA | NA | 70 | 97% | |
| | 2. Channel bed degradation - areas of increasing downcutting or head cutting? | NA | NA | 20 | 99% | 98% |
| F. Bank[6] | 1. Actively eroding, wasting, or slumping bank | 0 | 0 | 90 | 98% | 98% |
| G. Vanes | 1. Free of back or arm scour? | 20 | 24 | NA | 83% | |
| | 2. Height appropriate? | 23 | 24 | NA | 96% | |
| | 3. Angle and geometry appear appropriate? | 24 | 24 | NA | 100% | |
| | 4. Free of piping or other structural failures? | 23 | 24 | NA | 96% | 94% |
| H. Wads/ Boulders | 1. Free of scour? | 4 | 4 | NA | 100% | |
| | 2. Footing stable? | 4 | 4 | NA | 100% | 100% |

1. Metrics that are spatial estimates that are continuous variables should be entered as:

The number of locals over the reach for which the failing condition is observed / followed by the total linear distance (feet) or area for which the failing or unstable condition is observed.

2. In the case of categorical metrics for which a feature count is involved, this is simply calculated as the number of functional features that are in a stated of stability as a percentage of the total. In the case of those metrics based on footage or aerial extent it is that amount in a state of failure or instability expressed as a porportion of the total amount of that feature. The resulting proportion is then subtracted from 1 and then multiplied by 100 to give a percentage that represents the proportion of that feature category in a state of apparent stability

3. The mean of the metrics for a givien feature category.

4. Was the feature actually present as compared to the As-built or has the featrue been completely obsucred (aggraded) of removed (degraded)

5. Is the thalweg centering up on the channel between meander bends?

6. Amount of active bank failure/erosion. This should be the tally of all stressed and failing banks from the problem area plan view, which can then be calculated as indicated in footnote 1 above.

| MY5 Visual Morphological Stability Assessment | | | | | | |
|---|---|---|---|---|---|---|
| Feature Category | Metric (per As-built and references baselines) | (# Stable) Number Performing as Intended | Total Number per As-built | Total Number feet in unstable state[1] | Percent Perform In Stable Condition[2] | Feature Performance Mean or Total[3] |
| A. Riffles | 1. Present? | 25 | 30 | NA | 83% | |
| | 2. Armor stable (e.g. no displacement)? | 24 | 30 | NA | 80% | |
| | 3. Facet grade appears stable? | 24 | 30 | NA | 80% | |
| | 4. Minimal evidence of embedding/fining? | 21 | 30 | NA | 70% | |
| | 5. Length appropriate? | 23 | 30 | NA | 77% | 78% |
| B. Pools | 1. Present? (e.g. not subject to severe aggrad. Or migrat.?)[4] | 25 | 28 | NA | 89% | |
| | 2. Sufficiently deep (Max Pool D:Mean BKF>1.6? | 19 | 28 | NA | 68% | |
| | 3. Length appropriate? | 23 | 28 | NA | 82% | 80% |
| C. Thalweg | 1. Upstream of meander bend (run/inflection) centering?[5] | 12 | 15 | NA | 80% | |
| | 2. Downstream of meander (glide/inflection) centering?[5] | 12 | 15 | NA | 80% | 80% |
| D. Meanders | 1. Outer bend in state of limited/controlled erosion? | 10 | 13 | NA | 77% | |
| | 2. Of those eroding, # w/concomitant point bar formation? | 1 | 0 | NA | 100% | |
| | 3. Apparent Rc within spec? | 13 | 13 | NA | 100% | |
| | 4. Sufficient floodplain access and relief? | 13 | 13 | NA | 100% | 94% |
| E. Bed General | 1. General channel bed aggradation areas (bar formation) | NA | NA | 80 | 97% | |
| | 2. Channel bed degradation - areas of increasing downcutting or head cutting? | NA | NA | 0 | 100% | 99% |
| F. Bank[6] | 1. Actively eroding, wasting, or slumping bank | NA | NA | 90 | 98% | 98% |
| G. Vanes | 1. Free of back or arm scour? | 21 | 24 | NA | 88% | |
| | 2. Height appropriate? | 21 | 24 | NA | 88% | |
| | 3. Angle and geometry appear appropriate? | 24 | 24 | NA | 100% | |
| | 4. Free of piping or other structural failures? | 23 | 24 | NA | 96% | 93% |
| H. Wads/ Boulders | 1. Free of scour? | 4 | 4 | NA | 100% | |
| | 2. Footing stable? | 4 | 4 | NA | 100% | 100% |

1. Metrics that are spatial estimates that are continuous variables should be entered as:

The number of locals over the reach for which the failing condition is observed / followed by the total linear distance (feet) or area for which the failing or unstable condition is observed.

2. In the case of categorical metrics for which a feature count is involved, this is simply calculated as the number of functional features that are in a stated of stability as a percentage of the total. In the case of those metrics based on footage or aerial extent it is that amount in a state of failure or instability expressed as a porportion of the total amount of that feature. The resulting proportion is then subtracted from 1 and then multiplied by 100 to give a percentage that represents the proportion of that feature category in a state of apparent stability

3. The mean of the metrics for a givien feature category.

4. Was the feature actually present as compared to the As-built or has the featrue been completely obsucred (aggraded) of removed (degraded)

5. Is the thalweg centering up on the channel between meander bends?

6. Amount of active bank failure/erosion. This should be the tally of all stressed and failing banks from the problem area plan view, which can then be calculated as indicated in footnote 1 above.

## B.4 Morphological Summary Tables

### Table B.4.1 Baseline Stream Data Summary.

| Parameter | Regional Curve Interval | | | Pre-Existing Condition | | | Reference Reach(es) Data | | | Design | | | As-built / Baseline | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dimension and Substrate – Riffle** | LL | UL | Eq. | Min | Max | Mean | Min | Max | Typical | Min | Max | Typical | Min | Max | Median | Mean | SD | n |
| Bankfull Width (ft) | | 34.0 | | 22.4 | 44.9 | 33.2 | | | 28.1 | 28.4 | 35.8 | 34.0 | 20.6 | 36.8 | 31.6 | 30.1 | 7.4 | 4 |
| Floodprone Width (ft) | | | | 66.0 | 100.0 | 100.0 | | | 125.0 | 100.0 | 300.0 | 100.0 | 48.3 | 166.8 | 94.9 | 101.2 | 53.0 | 4 |
| Bankfull Cross-Sectional Area ($ft^2$) | 56.0 | 60.0 | $=20.87x^{0.68}$ | 52.3 | 61.3 | 56.9 | | | 62.0 | 56.0 | 60.0 | 58.0 | 35.3 | 60.4 | 47.9 | 47.9 | 11.8 | 4 |
| Bankfull Mean Depth (ft) | | 1.8 | | 1.3 | 2.6 | 1.7 | | | 2.2 | 1.6 | 2.1 | 1.8 | 1.0 | 2.0 | 1.8 | 1.6 | 0.5 | 4 |
| Bankfull Max Depth (ft) | | | | 3.4 | 3.8 | 3.5 | | | 3.1 | 3.0 | 3.4 | 3.5 | 2.5 | 3.5 | 2.8 | 2.9 | 0.4 | 4 |
| Width/Depth Ratio | | | | 8.8 | 34.9 | 19.4 | | | 12.7 | 13.8 | 21.7 | >12.0 | 10.4 | 34.6 | 18.5 | 20.5 | 10.7 | 4 |
| Entrenchment Ratio | | | | 1.5 | 4.5 | 3.0 | | | 4.4 | | | >2.2 | 1.4 | 5.9 | 3.3 | 3.5 | 1.9 | 4 |
| Bank Height Ratio | | | | 1.0 | 1.3 | 1.1 | | | 1.2 | 1.0 | 1.04 | 1.03 | 1.0 | 2.1 | 1.6 | 1.6 | 0.5 | 4 |
| Bankfull Wetted Perimeter (ft) | | | | 26.2 | 46.8 | 34.1 | | | 30.5 | | | | 24.2 | 39.6 | 33.9 | 32.9 | 7.1 | 4 |
| Hydraulic Radius (ft) | | | | 1.2 | 2.2 | 1.7 | | | 2.0 | | | | 0.9 | 1.8 | 1.6 | 1.5 | 0.4 | 4 |
| D50 (mm) | | | | | | 36.9 | | | 15.9 | | | Gravel | 34.8 | 42.4 | 40.5 | 39.5 | 3.7 | 4 |
| **Profile** | | | | | | | | | | | | | | | | | | |
| Riffle Length (ft) | | | | 30.0 | 247.0 | 100.0 | 24.0 | 132.0 | 78.0 | | | | 6.4 | 123.6 | 28.5 | 30.8 | 22.9 | 30 |
| Riffle Slope (ft/ft) | | | | 0.007 | 0.027 | 0.015 | 0.002 | 0.018 | 0.015 | | | | 0.002 | 0.054 | 0.019 | 0.021 | 0.014 | 30 |
| Pool Length (ft) | | | | 14.0 | 89.0 | 50.0 | 10.0 | 66.0 | 66.0 | | | | 4.5 | 81.2 | 30.8 | 35.1 | 19.4 | 29 |
| Pool Max depth (ft) | | | | | | 5.0 | | | 3.3 | | | | 2.8 | 6.4 | 4.1 | 4.2 | 0.6 | 31 |
| Pool to Pool Spacing (ft) | | | | 36.0 | 264.0 | 100.0 | 44.0 | 225.0 | 80.0 | | | | 34.8 | 194.3 | 80.6 | 91.6 | 40.5 | 28 |
| **Pattern** | | | | | | | | | | | | | | | | | | |
| Channel Beltwidth (ft) | | | | 64.0 | 68.0 | 66.0 | | | 240.0 | | | | 35.8 | 63.0 | 53.3 | 51.2 | 11.6 | 6 |
| Radius of Curvature (ft) | | | | 10 | 15.4 | 12.7 | 10 | 15.4 | 12.7 | | | | 16.3 | 43.3 | 30.2 | 30.8 | 10.3 | 9 |
| Rc:Bankfullwidth (ft/ft) | | | | 0.3 | 0.5 | 0.4 | | | 0.5 | | | | 0.5 | 1.4 | 0.9 | 0.9 | 0.4 | 6 |
| Meander Wavelength (ft) | | | | 68.0 | 100.0 | 84.0 | 335.0 | 440.0 | 380.0 | | | | 57.0 | 132.8 | 117.1 | 106.1 | 28.3 | 6 |
| Meander Width Ratio | | | | 1.9 | 2.0 | 2.0 | | | 8.5 | | | | 1.9 | 4.4 | 3.9 | 3.5 | 0.9 | 6 |

| Parameter | MY1 | | | | | | MY2 | | | | | | MY3 | | | | | | MY4 | | | | | | MY5 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dimension and Substrate – Riffle** | Min | Max | Median | Mean | SD | n | Min | Max | Median | Mean | SD | n | Min | Max | Median | Mean | SD | n | Min | Max | Median | Mean | SD | n | Min | Max | Median | Mean | SD | n |
| Bankfull Width (ft) | 20.6 | 39.6 | 32.2 | 31.2 | 7.9 | 4 | 20.8 | 38.5 | 34.8 | 32.2 | 7.8 | 4 | 20.7 | 41.6 | 32.5 | 31.8 | 8.8 | 4 | 20.7 | 40.4 | 30.8 | 30.7 | 8.5 | 4 | 20.7 | 37.9 | 26.4 | 27.9 | 7.6 | 4 |
| Floodprone Width (ft) | 57.1 | 185.9 | 95.5 | 108.5 | 58.5 | 4 | 57.9 | 176.6 | 95.2 | 106.2 | 54.2 | 4 | 58.8 | 179.8 | 95.2 | 107.2 | 55.3 | 4 | 47.7 | 160.0 | 95.2 | 99.5 | 50.5 | 4 | 49.0 | 183.7 | 94.9 | 105.6 | 59.9 | 4 |
| Bankfull Cross-Sectional Area ($ft^2$) | 39.5 | 69.2 | 51.0 | 52.7 | 14.6 | 4 | 40.6 | 65.2 | 51.9 | 52.4 | 11.7 | 4 | 41.5 | 66.3 | 50.2 | 52.0 | 11.9 | 4 | 33.8 | 65.2 | 47.5 | 48.5 | 13.2 | 4 | 33.5 | 63.5 | 51.3 | 49.9 | 12.8 | 4 |
| Bankfull Mean Depth (ft) | 1.2 | 2.0 | 1.9 | 1.7 | 0.4 | 4 | 1.2 | 2.1 | 1.7 | 1.7 | 0.4 | 4 | 1.2 | 2.0 | 1.8 | 1.7 | 0.4 | 4 | 1.0 | 2.1 | 1.7 | 1.6 | 0.5 | 4 | 1.4 | 2.3 | 1.8 | 1.8 | 0.4 | 4 |
| Bankfull Max Depth (ft) | 2.5 | 3.7 | 3.0 | 3.0 | 0.5 | 4 | 2.7 | 3.5 | 3.0 | 3.0 | 0.4 | 4 | 2.6 | 3.5 | 3.0 | 3.0 | 0.4 | 4 | 2.4 | 3.7 | 2.8 | 2.9 | 0.5 | 4 | 2.5 | 3.7 | 3.0 | 3.1 | 0.5 | 4 |
| Width/Depth Ratio | 10.2 | 28.3 | 19.3 | 19.3 | 7.9 | 4 | 9.7 | 28.7 | 21.9 | 20.6 | 7.9 | 4 | 10.4 | 28.4 | 20.8 | 20.1 | 8.5 | 4 | 9.7 | 34.5 | 19.9 | 21.0 | 11.0 | 4 | 9.1 | 22.6 | 16.0 | 15.9 | 5.5 | 4 |
| Entrenchment Ratio | 1.7 | 6.0 | 3.2 | 3.5 | 1.8 | 4 | 1.7 | 5.0 | 3.2 | 3.3 | 1.4 | 4 | 1.7 | 6.0 | 3.1 | 3.5 | 1.8 | 4 | 1.4 | 5.8 | 3.2 | 3.4 | 1.8 | 4 | 2.1 | 6.3 | 3.3 | 3.7 | 1.8 | 4 |
| Bank Height Ratio | 1.0 | 2.0 | 1.5 | 1.5 | 0.6 | 4 | 1.0 | 2.0 | 1.4 | 1.4 | 0.5 | 4 | 1.0 | 1.9 | 1.4 | 1.4 | 0.5 | 4 | 1.0 | 2.0 | 1.4 | 1.5 | 0.5 | 4 | 1.0 | 2.2 | 1.4 | 1.5 | 0.6 | 4 |
| Bankfull Wetted Perimeter (ft) | 22.7 | 47.5 | 33.7 | 34.4 | 10.2 | 4 | 23.2 | 41.3 | 36.5 | 34.4 | 7.8 | 4 | 22.8 | 44.2 | 34.3 | 33.9 | 8.9 | 4 | 23.1 | 42.6 | 32.6 | 32.7 | 8.3 | 4 | 23.4 | 40.5 | 28.2 | 30.1 | 7.7 | 4 |
| Hydraulic Radius (ft) | 1.1 | 1.9 | 1.6 | 1.6 | 0.3 | 4 | 1.1 | 1.9 | 1.6 | 1.6 | 0.3 | 4 | 1.2 | 1.8 | 1.6 | 1.6 | 0.3 | 4 | 1.0 | 1.9 | 1.6 | 1.5 | 0.4 | 4 | 1.3 | 2.0 | 1.7 | 1.7 | 0.3 | 4 |
| D50 (mm) | 34.4 | 60.0 | 37.9 | 42.6 | 11.9 | 4 | 37.4 | 57.7 | 49.9 | 48.7 | 8.4 | 4 | 31.1 | 39.7 | 34.6 | 35.0 | 3.9 | 4 | 24.2 | 52.9 | 38.2 | 38.4 | 11.8 | 4 | 4.9 | 56.9 | 34.3 | 32.6 | 21.5 | 4 |
| **Profile** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Riffle Length (ft) | 4.3 | 128.0 | 25.8 | 34.0 | 27.3 | 29 | 1.8 | 126.8 | 28.9 | 33.0 | 25.6 | 29 | 6.4 | 118.3 | 30.8 | 35.1 | 23.7 | 29 | 8.1 | 75.1 | 22.7 | 28.9 | 20.6 | 26 | 3.2 | 178.8 | 32.5 | 39.0 | 36.7 | 25 |
| Riffle Slope (ft/ft) | 0.001 | 0.065 | 0.015 | 0.017 | 0.013 | 29 | 0.003 | 0.055 | 0.015 | 0.017 | 0.012 | 29 | 0.002 | 0.061 | 0.014 | 0.015 | 0.012 | 29 | 0.001 | 0.087 | 0.014 | 0.020 | 0.020 | 26 | 0.004 | 0.109 | 0.019 | 0.024 | 0.024 | 25 |
| Pool Length (ft) | 8.8 | 85.0 | 26.2 | 32.2 | 19.4 | 28 | 4.8 | 76.5 | 24.6 | 27.8 | 18.4 | 28 | 9.8 | 73.0 | 27.9 | 29.8 | 18.4 | 28 | 7.8 | 103.9 | 25.6 | 31.6 | 20.6 | 26 | 7.2 | 84.7 | 27.8 | 30.6 | 20.4 | 24 |
| Pool Max depth (ft) | 3.1 | 6.8 | 4.2 | 4.2 | 0.7 | 29 | 3.2 | 7.1 | 4.4 | 4.4 | 0.7 | 29 | 3.1 | 7.0 | 4.3 | 4.3 | 0.7 | 29 | 3.4 | 7.3 | 4.5 | 4.6 | 0.8 | 27 | 3.1 | 7.3 | 4.3 | 4.4 | 0.9 | 25 |
| Pool to Pool Spacing (ft) | 25.9 | 192.0 | 84.1 | 94.6 | 39.4 | 28 | 40.2 | 192.2 | 97.5 | 100.0 | 37.0 | 28 | 34.7 | 186.2 | 89.4 | 95.0 | 38.9 | 28 | 48.6 | 203.1 | 96.6 | 101.9 | 39.0 | 26 | 21.7 | 240.1 | 96.4 | 110.1 | 57.7 | 24 |
| **Pattern** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Channel Beltwidth (ft) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Radius of Curvature (ft) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rc:Bankfullwidth (ft/ft) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Meander Wavelength (ft) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Meander Width Ratio | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| Parameter | Regional Curve | | | Pre-Existing Condition | Reference Reach(es) Data | Design | As-built / Baseline | MY1 | MY2 | MY3 | MY4 | MY5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Substrate, bed and transport parameters** | | | | | | | | | | | | |
| [a]Ri % / Ru % / P % / G % / S % | | | | 65.0 35.0 | 58.0 42.0 | | 34.6 10.2 38.1 17.1 | 36.7 15.1 33.6 14.6 | 36.0 18.4 29.2 16.4 | 37.9 14.8 31.1 16.2 | 29.0 20.8 21.7 18.5 | 36.0 20.2 27.1 16.6 |
| [a]SC % / Sa % / G % / C % / B % / Be % | | | | 10.0 18.0 50.0 31.0 0.0 0.0 | 11.0 20.0 35.0 33.0 1.0 0.0 | | | | | | | |
| [a]D16 / D35 / D50 / D84 / $Di^p$ / $Di^{sp}$ | | | | 0.8 7.9 22.4 78.0 101.0 300.0 110.0 | 0.2 3.4 15.9 107.0 164.0 | | | | | | | |
| Reach Sheer Stress (competency) lb/.ft[b] | | | | 0.9 | | 0.9 | 1.1 | | | | | |
| Max part size (mm) mobilized at bankfull | | | | 350.0 | | 140.7 | 159.9 | | | | | |
| Stream Power (transport capacity) W/m[b] | | | | | | 93.2 | 99.8 | | | | | |
| **Additional Reach Parameters** | | | | | | | | | | | | |
| Drainage Area ($mi^2$) | | | | 4.4 | 4.5 | 4.5 | 4.4 | 4.4 | 4.4 | 4.4 | 4.4 | 4.4 |
| Impervious cover estimate (%) | | | | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| Rosgen Classification | | | | C4 | C4 | C4 | C4, B4c, F4 | B4c, C4, E4 | B4c, C4, E4 | B4c, C4, E4 | B4c, C4, E4 | B4c, C4, E4 |
| Bankfull Velocity (fps) | | | | 6.2 | | 6.2 | 6.12 | | | | | |
| Bankfull Discharge (cfs) | | 254.9 | $=84.6x^{0.74}$ | 350 | | 350 | 338.4 | | | | | |
| Valley Length (ft) | | | | 2,065 | 520 | 2,065 | 2,065 | 2,065 | 2,065 | 2,065 | 2,065 | 2,065 |
| Channel Thalweg Length (ft) | | | | 2,710 | 864 | 2,710 | 2,719 | 2,715 | 2,723 | 2,718 | 2,746 | 2,724 |
| Sinuosity (ft) | | | | 1.3 | 1.6 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 |
| Water Surface Slope (Channel) (ft/ft) | | | | 0.0097 | 0.0077 | 0.0097 | 0.0093 | 0.0093 | 0.0093 | 0.0093 | 0.0093 | 0.0093 |
| Bankfull Slope (ft/ft) | | | | 0.0091 | 0.0077 | 0.0097 | 0.0091 | 0.0091 | 0.0091 | 0.0091 | 0.0091 | 0.0091 |

[a]Riffle, Run, Pool, Glide, Step; Subpavement Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock, $Di^p$ = max pavement, $Di^{sp}$ = max subpave. Shaded cells indicate that these will typically not be filled in

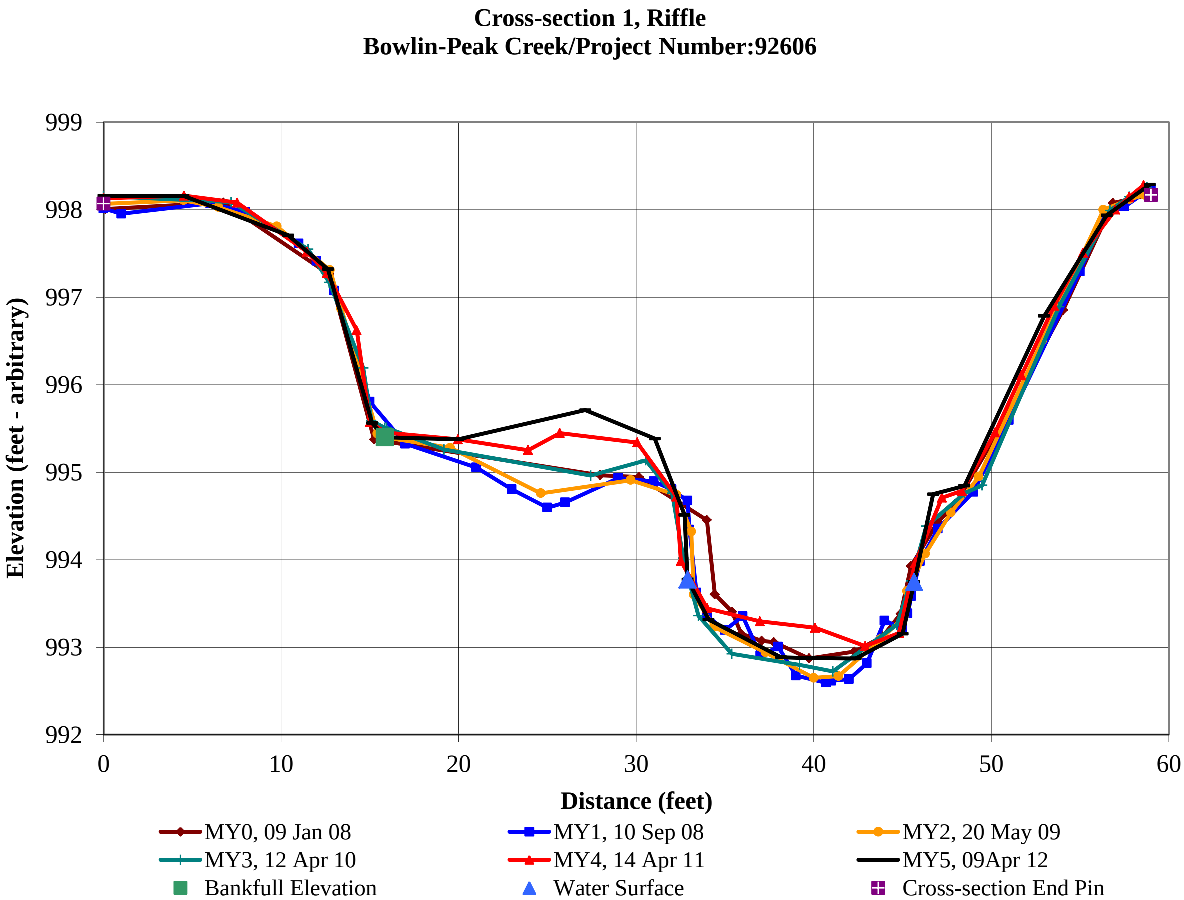
[b] Methodology described in report and RiverMorph (2008).

Table B.4.2 Morphology and Hydraulic Summary (Dimensional Parameters - Cross Section).

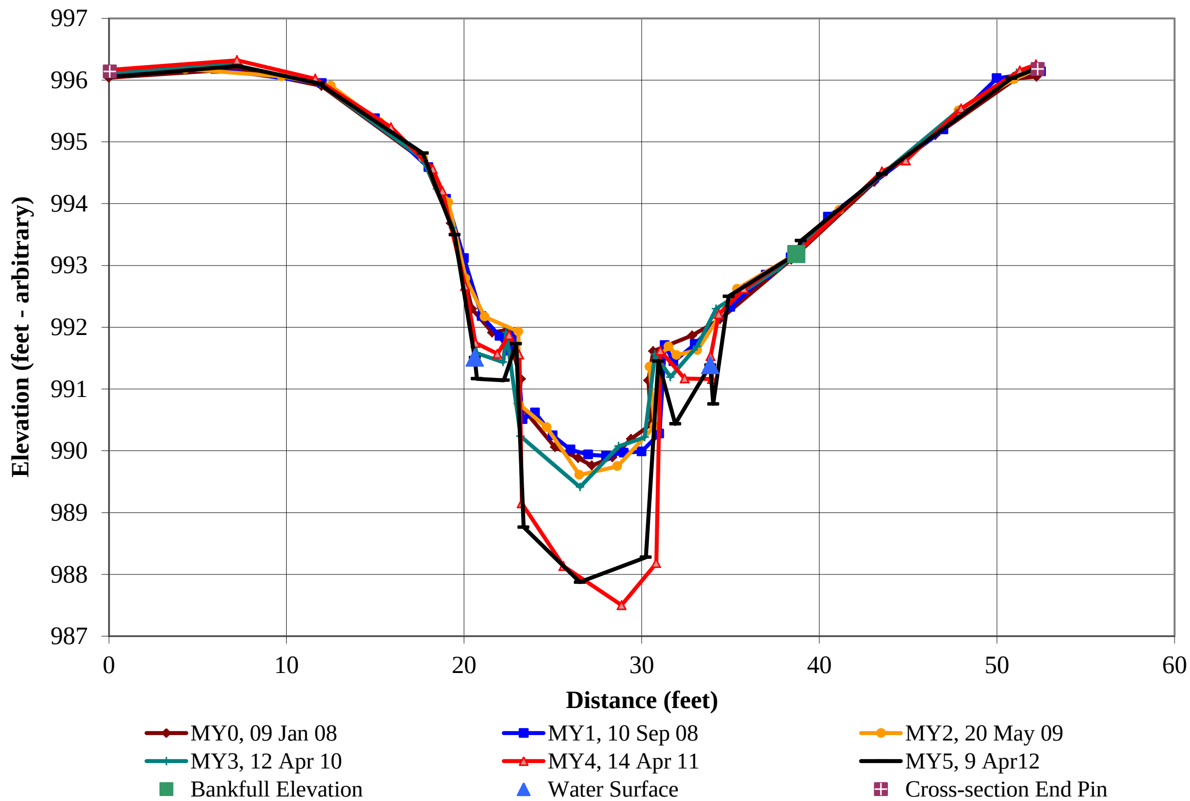
| | Cross Section 1 at Station 3+56 (Riffle) | | | | | | Cross Section 2 at Station 6+39 (Pool) | | | | | | Cross Section 3 at Station 7+62 (Pool) | | | | | | Cross Section 4 at Station 10+43 (Riffle) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dimension and Substrate** | MY0 | MY1 | MY2 | MY3 | MY4 | MY5 | MY0 | MY1 | MY2 | MY3 | MY4 | MY5 | MY0 | MY1 | MY2 | MY3 | MY4 | MY5 | MY0 | MY1 | MY2 | MY3 | MY4 | MY5 |
| **Based on fixed baseline bankfull elevation** | | | | | | | | | | | | | | | | | | | | | | | | |
| Bankfull Width (ft) | 34.9 | 33.4 | 34.2 | 35.0 | 34.2 | 23.5 | 18.7 | 18.4 | 18.8 | 18.8 | 19.0 | 18.0 | 19.9 | 21.2 | 19.3 | 19.8 | 22.4 | 23.3 | 25.8 | 25.4 | 25.8 | 25.5 | 24.5 | 24.4 |
| Floodprone Width (ft) | 48.3 | 57.1 | 57.9 | 58.8 | 47.7 | 49.0 | 159.7 | 159.7 | 159.7 | 159.7 | 159.7 | 159.7 | 218.4 | 218.4 | 218.4 | 218.4 | 218.4 | 218.4 | 121.7 | 113.2 | 124.4 | 113.8 | 103.9 | 126.2 |
| Bankfull Cross-sectional Area ($ft^2$) | 35.3 | 39.5 | 40.6 | 43.1 | 33.8 | 33.5 | 32.4 | 33.5 | 33.7 | 36.7 | 52.2 | 52.6 | 48.5 | 50.7 | 52.8 | 55.8 | 54.6 | 62.6 | 48.5 | 46.8 | 48.0 | 44.4 | 42.8 | 44.2 |
| Bankfull Mean Depth (ft) | 1.0 | 1.2 | 1.2 | 1.2 | 1.0 | 1.4 | 1.7 | 1.8 | 1.8 | 2.0 | 2.7 | 2.9 | 2.4 | 2.4 | 2.7 | 2.9 | 2.4 | 2.7 | 1.9 | 1.8 | 1.9 | 1.7 | 1.8 | 1.8 |
| Bankfull Max Depth (ft) | 2.5 | 2.7 | 2.7 | 2.8 | 2.4 | 2.5 | 3.3 | 3.2 | 3.6 | 3.7 | 5.7 | 5.3 | 3.9 | 4.1 | 4.1 | 4.0 | 3.9 | 4.2 | 2.8 | 2.7 | 2.7 | 2.8 | 2.5 | 2.8 |
| Bankfull Width/Depth Ratio | 34.6 | 28.3 | 28.7 | 28.4 | 34.5 | 16.4 | 10.8 | 10.1 | 10.5 | 9.6 | 7.0 | 6.2 | 8.1 | 8.8 | 7.1 | 7.0 | 9.2 | 8.7 | 13.7 | 13.8 | 13.9 | 14.6 | 14.0 | 13.4 |
| Bankfull Entrenchment Ratio | 1.4 | 1.7 | 1.7 | 1.7 | 1.4 | 2.1 | 8.6 | 8.7 | 8.5 | 8.5 | 8.4 | 8.9 | 11.0 | 10.3 | 11.3 | 11.1 | 9.8 | 9.4 | 4.7 | 4.5 | 4.8 | 4.5 | 4.3 | 5.2 |
| Bankfull Bank Height Ratio | 2.1 | 2.0 | 2.0 | 1.9 | 2.0 | 2.2 | 1.9 | 1.9 | 1.8 | 1.7 | 1.3 | 1.5 | 1.2 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.2 | 1.1 | 1.2 | 1.1 | 1.1 |
| **Based on current/developing bankfull feature** | | | | | | | | | | | | | | | | | | | | | | | | |
| Bankfull Width (ft) | | | | | | | | | | | | | | | | | | | 28.2 | 31.1 | 35.3 | 29.9 | 27.5 | 29.4 |
| Floodprone Width (ft) | | | | | | | | | | | | | | | | | | | 166.8 | 185.9 | 176.6 | 179.8 | 160.0 | 183.7 |
| Bankfull Cross-sectional Area ($ft^2$) | | | | | | | | | | | | | | | | | | | 55.0 | 60.6 | 59.3 | 57.4 | 50.8 | 55.3 |
| Bankfull Mean Depth (ft) | | | | | | | | | | | | | | | | | | | 2.0 | 2.0 | 1.7 | 1.9 | 1.9 | 1.9 |
| Bankfull Max Depth (ft) | | | | | | | | | | | | | | | | | | | 3.0 | 3.2 | 30.8 | 3.2 | 2.8 | 3.2 |
| Bankfull Width/Depth Ratio | | | | | | | | | | | | | | | | | | | 14.5 | 15.9 | 21.0 | 15.6 | 14.9 | 15.6 |
| Bankfull Entrenchment Ratio | | | | | | | | | | | | | | | | | | | 5.9 | 6.0 | 5.0 | 6.0 | 5.8 | 6.3 |
| Bankfull Bank Height Ratio | | | | | | | | | | | | | | | | | | | 1.4 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Cross-sectional Area between end pins ($ft^2$) | 141.4 | 146.9 | 148.9 | 151.8 | 143.0 | 150.0 | 113.3 | 115.8 | 116.0 | 118.0 | 134.8 | 130.6 | 152.8 | 164.2 | 162.7 | 165.3 | 163.0 | 169.7 | 79.9 | 78.3 | 78.2 | 79.2 | 76.7 | 81.7 |
| D50 | 38.5 | 39.9 | 57.7 | 32.8 | 24.2 | 37.4 | 49.3 | 35.0 | 74.1 | 40.0 | 31.1 | 32.0 | 20.7 | 19.3 | 9.9 | 27.3 | 48.8 | 43.7 | 34.8 | 36.0 | 37.4 | 39.7 | 40.0 | 31.1 |

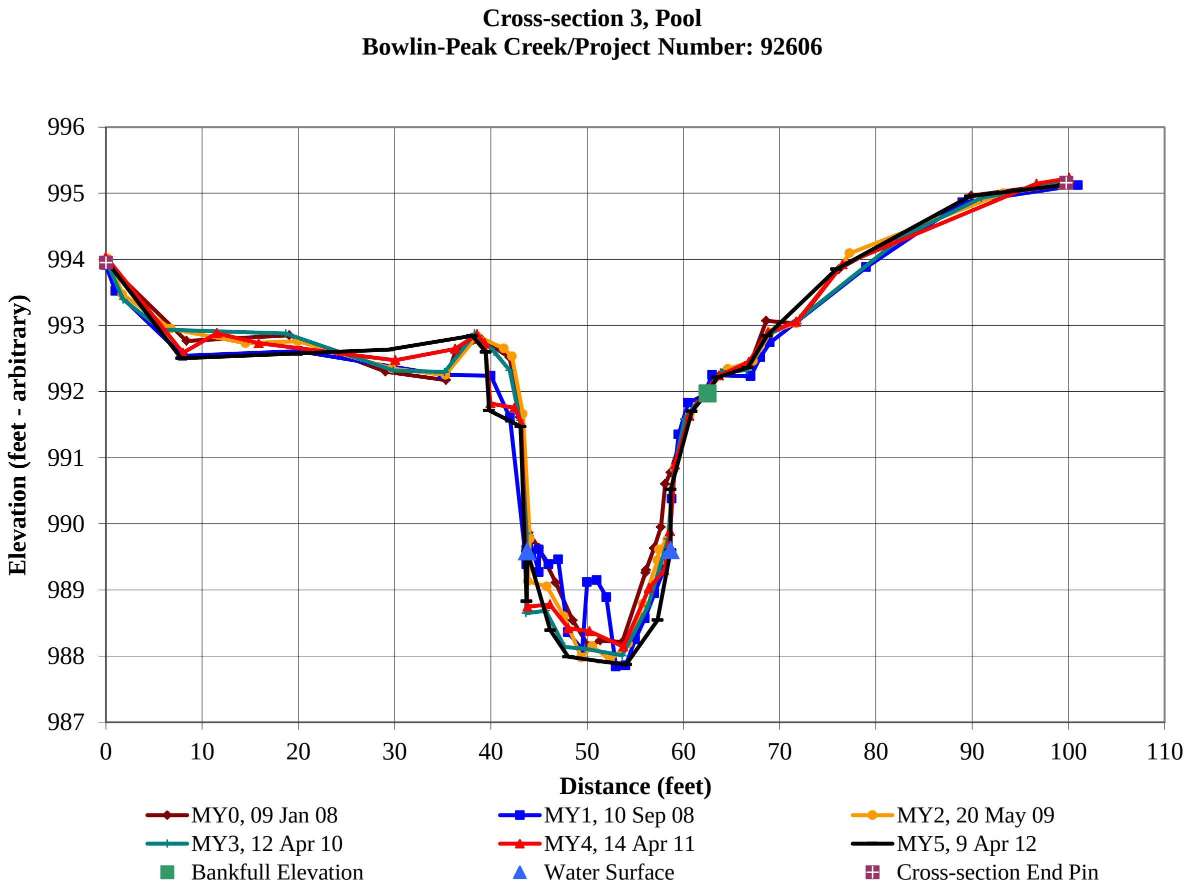
| | Cross Section 5 at Station 14+80 (Pool) | | | | | | Cross Section 6 at Station 16+80 (Riffle) | | | | | | Cross Section 7 at Station 20+97 (Riffle) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dimension and Substrate** | MY0 | MY1 | MY2 | MY3 | MY4 | MY5 | MY0 | MY1 | MY2 | MY3 | MY4 | MY5 | MY0 | MY1 | MY2 | MY3 | MY4 | MY5 |
| **Based on fixed baseline bankfull elevation** | | | | | | | | | | | | | | | | | | |
| Bankfull Width (ft) | 20.4 | 20.5 | 21.1 | 20.9 | 21.1 | 20.4 | 25.4 | 25.9 | 27.0 | 26.9 | 29.2 | 28.3 | 20.6 | 20.6 | 20.8 | 20.7 | 20.7 | 20.7 |
| Floodprone Width (ft) | 171.9 | 171.9 | 171.9 | 171.9 | 171.9 | 171.9 | 86.7 | 88.0 | 89.3 | 94.8 | 120.3 | 108.0 | 70.0 | 70.0 | 70.0 | 70.0 | 70.0 | 70.0 |
| Bankfull Cross-sectional Area ($ft^2$) | 48.3 | 48.1 | 49.3 | 49.6 | 49.8 | 43.0 | 33.2 | 34.8 | 36.1 | 39.0 | 42.1 | 36.7 | 40.8 | 41.4 | 44.6 | 41.5 | 44.2 | 47.2 |
| Bankfull Mean Depth (ft) | 2.4 | 2.3 | 2.3 | 2.4 | 2.4 | 2.1 | 1.3 | 1.4 | 1.3 | 1.5 | 1.4 | 1.3 | 2.0 | 2.0 | 2.1 | 2.0 | 2.1 | 2.3 |
| Bankfull Max Depth (ft) | 4.8 | 4.7 | 4.6 | 4.4 | 4.7 | 4.2 | 2.7 | 2.7 | 2.7 | 2.7 | 3.0 | 2.9 | 2.7 | 2.5 | 2.8 | 2.6 | 2.8 | 2.8 |
| Bankfull Width/Depth Ratio | 8.6 | 8.8 | 9.1 | 8.8 | 9.0 | 9.7 | 19.6 | 19.2 | 20.2 | 18.6 | 20.3 | 21.8 | 10.4 | 10.2 | 9.7 | 10.4 | 9.7 | 9.1 |
| Bankfull Entrenchment Ratio | 8.4 | 8.4 | 8.1 | 8.2 | 8.1 | 8.4 | 3.4 | 3.4 | 3.3 | 3.5 | 4.1 | 3.8 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 |
| Bankfull Bank Height Ratio | 1.1 | 1.0 | 1.1 | 1.0 | 1.0 | 1.1 | 1.3 | 1.4 | 1.3 | 1.3 | 1.2 | 1.3 | 1.9 | 2.0 | 1.8 | 1.9 | 1.9 | 1.7 |
| **Based on current/developing bankfull feature** | | | | | | | | | | | | | | | | | | |
| Bankfull Width (ft) | | | | | | | 36.8 | 39.6 | 38.5 | 41.6 | 40.4 | 37.9 | | | | | | |
| Floodprone Width (ft) | | | | | | | 119.7 | 121.0 | 120.3 | 120.3 | 120.3 | 119.8 | | | | | | |
| Bankfull Cross-sectional Area ($ft^2$) | | | | | | | 60.4 | 69.2 | 65.2 | 66.3 | 65.2 | 63.5 | | | | | | |
| Bankfull Mean Depth (ft) | | | | | | | 1.6 | 1.8 | 1.7 | 1.6 | 1.6 | 1.7 | | | | | | |
| Bankfull Max Depth (ft) | | | | | | | 3.5 | 3.7 | 3.5 | 3.5 | 3.7 | 3.7 | | | | | | |
| Bankfull Width/Depth Ratio | | | | | | | 22.5 | 22.7 | 22.8 | 26.0 | 24.9 | 22.6 | | | | | | |
| Bankfull Entrenchment Ratio | | | | | | | 3.3 | 3.1 | 3.1 | 2.9 | 3.0 | 3.2 | | | | | | |
| Bankfull Bank Height Ratio | | | | | | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | | | | | | |
| Cross-sectional Area between end pins ($ft^2$) | 124.0 | 122.5 | 127.6 | 125.0 | 122.5 | 120.5 | 176.4 | 177.5 | 178.7 | 179.9 | 175.2 | 172.0 | 101.4 | 102.6 | 102.0 | 101.0 | 102.4 | 101.3 |
| D50 | 67.1 | 54.5 | 12.5 | 16.8 | 31.1 | 30.3 | 42.4 | 60.0 | 50.9 | 31.1 | 52.9 | 4.9 | 42.4 | 34.4 | 48.8 | 36.4 | 46.9 | 56.9 |

## B.5 Annual Overlays of Cross-Section Plots

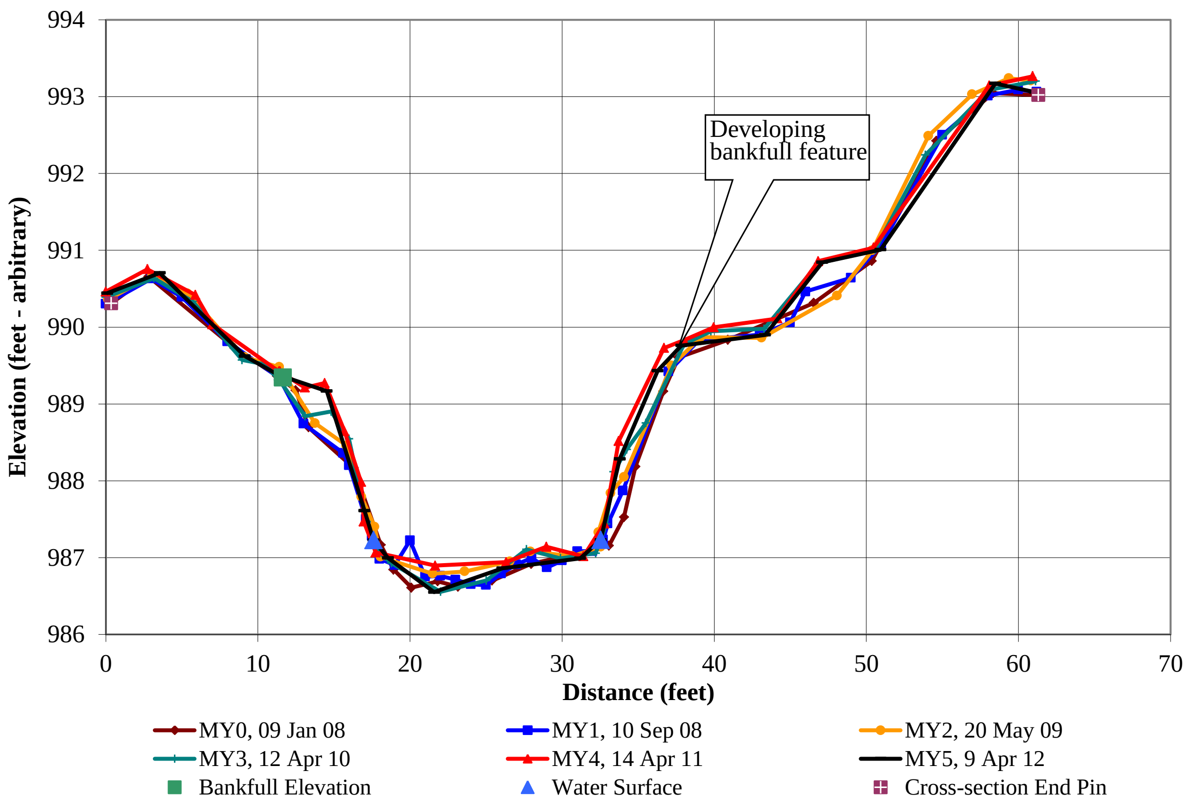


**Cross-section 2, Pool**
**Bowlin-Peak Creek/Project Number:92606**

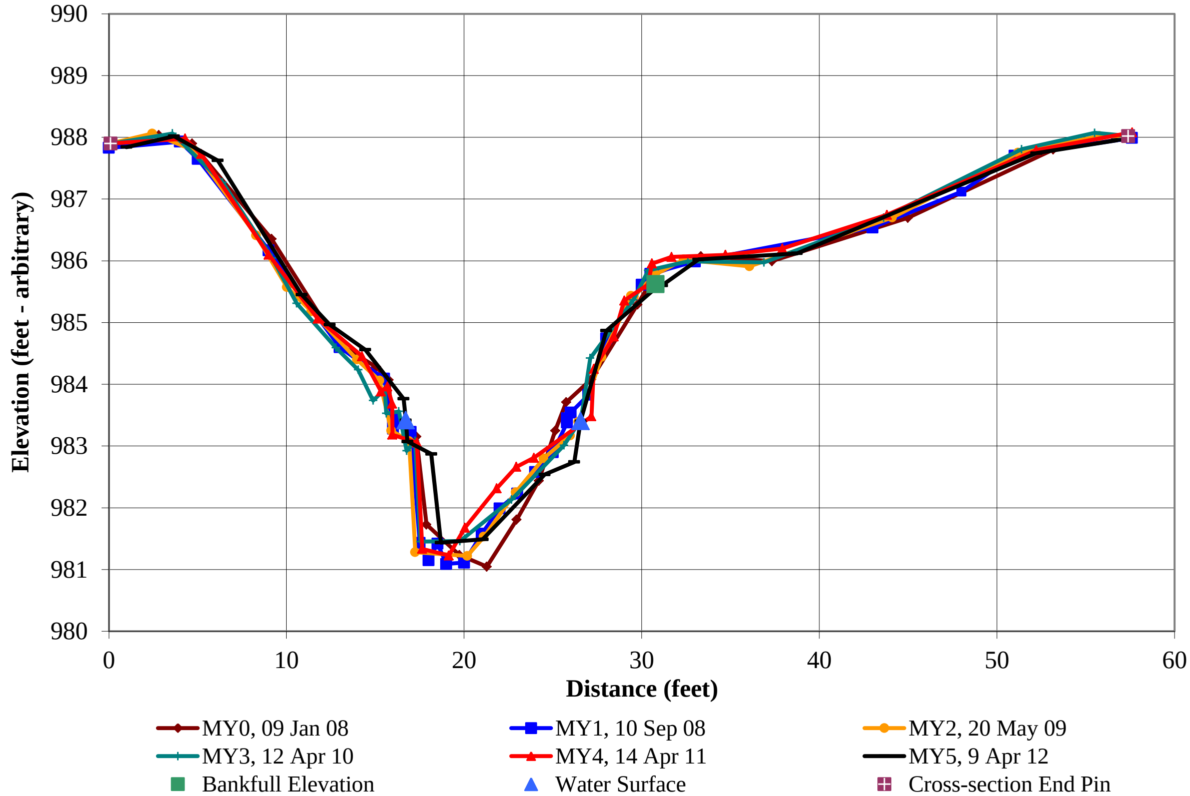



Cross-section 3, Pool
Bowlin-Peak Creek/Project Number: 92606
Elevation (feet - arbitrary)
996
995
994
993
992
991
990
989
988
987
0
10
20
30
40
50
60
70
80
90
100
110
Distance (feet)
MY0, 09 Jan 08
MY1, 10 Sep 08
MY2, 20 May 09
MY3, 12 Apr 10
MY4, 14 Apr 11
MY5, 9 Apr 12
Bankfull Elevation
Water Surface
Cross-section End Pin

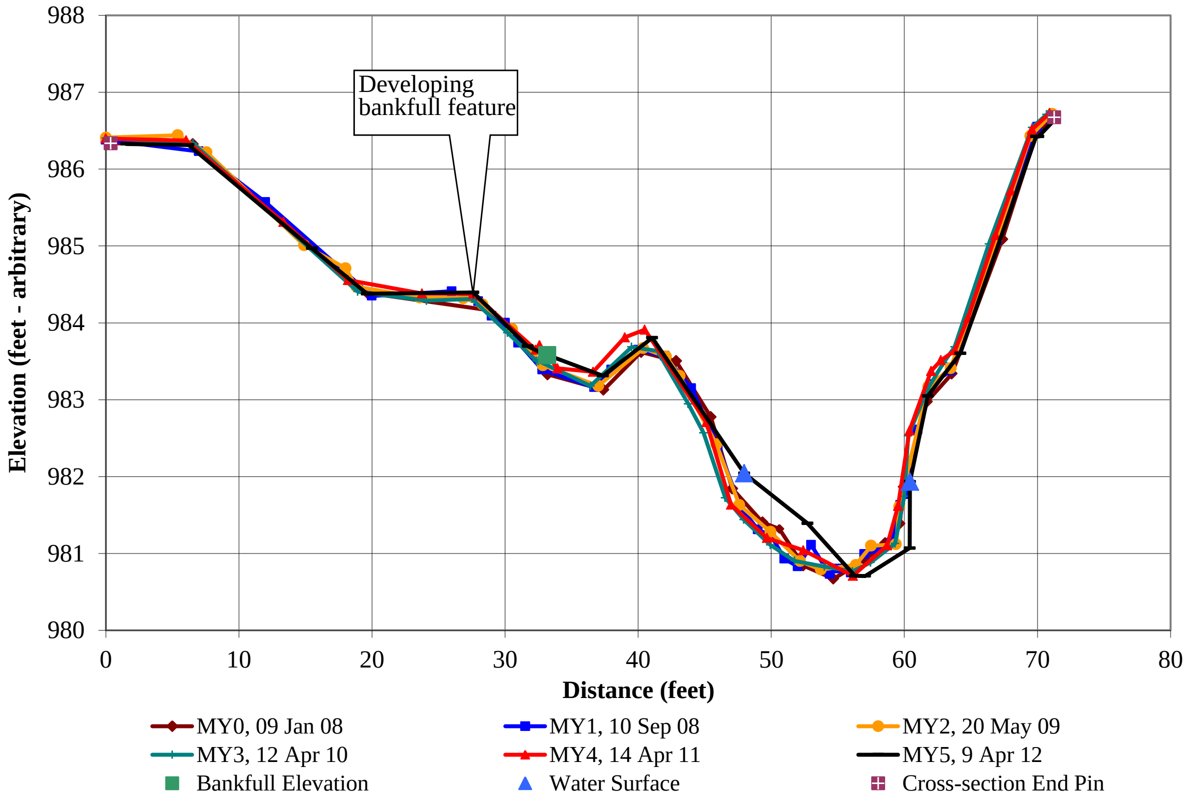
**Cross-section 4, Riffle**
**Bowlin-Peak Creek/Project Number: 92606**



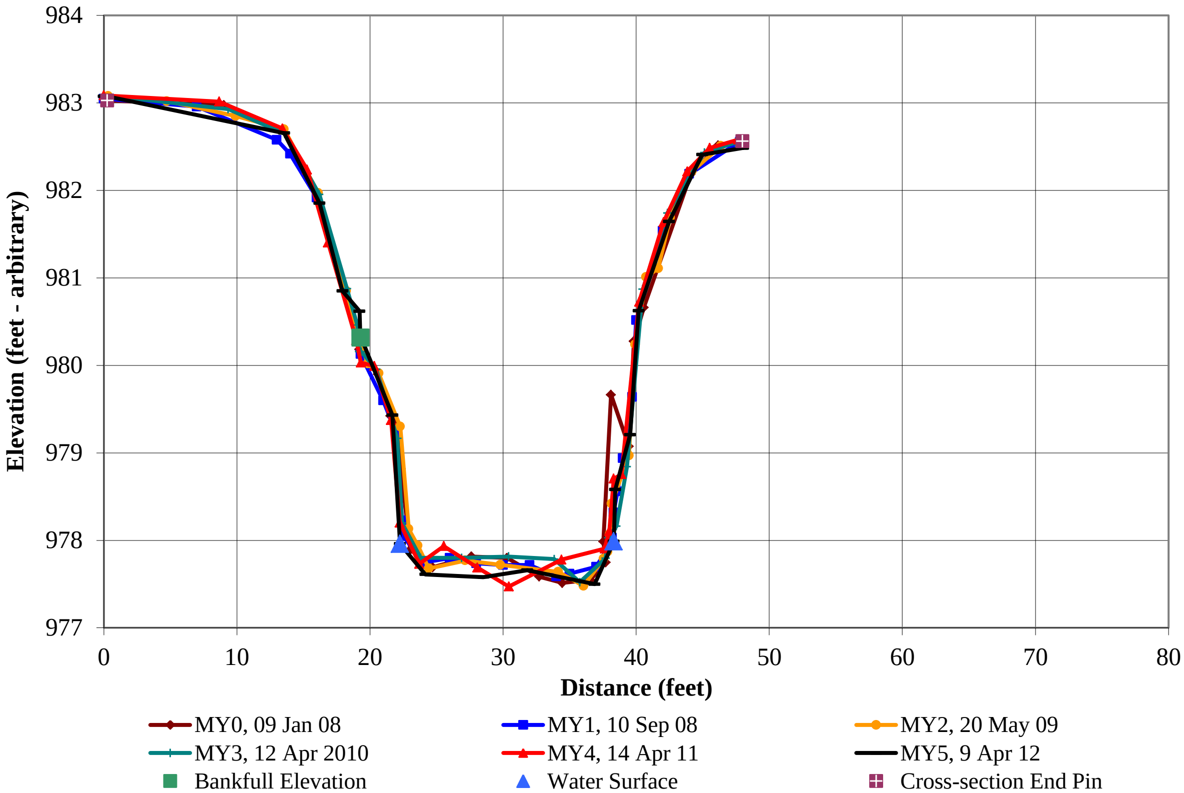
## Cross-section 5, Pool
## Bowlin-Peak Creek/Project Number:92606



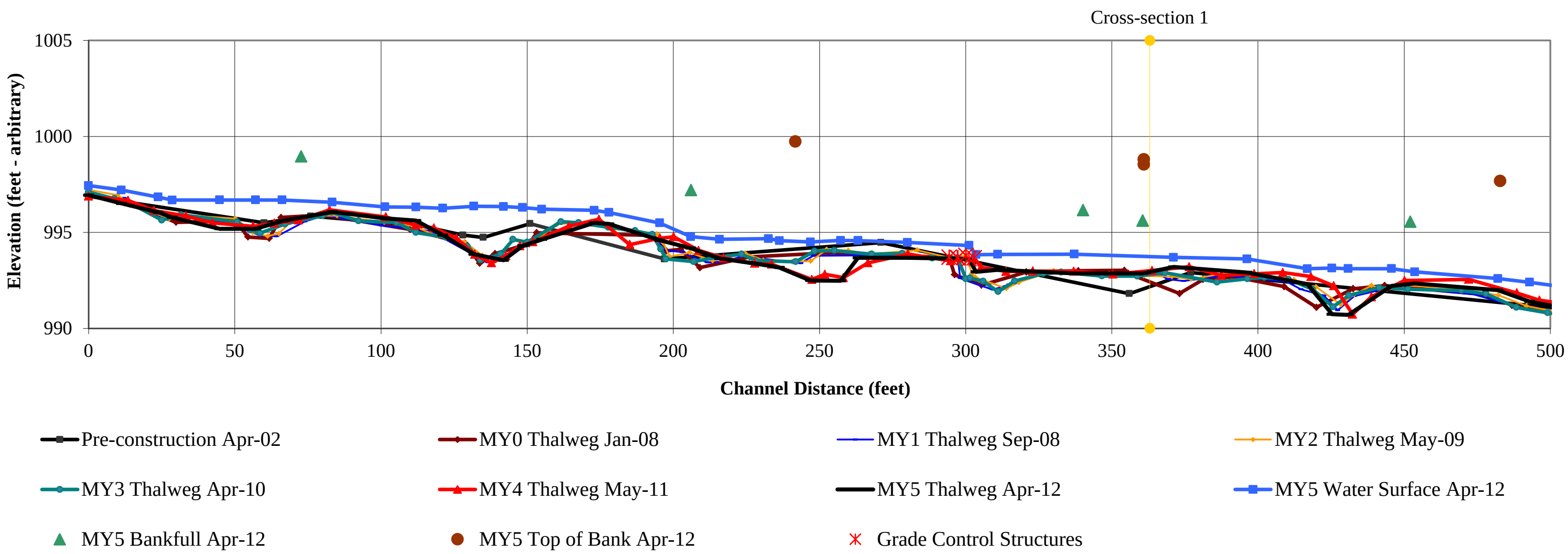
**Cross-section 6, Riffle**
**Bowlin-Peak Creek/Project Number:92606**

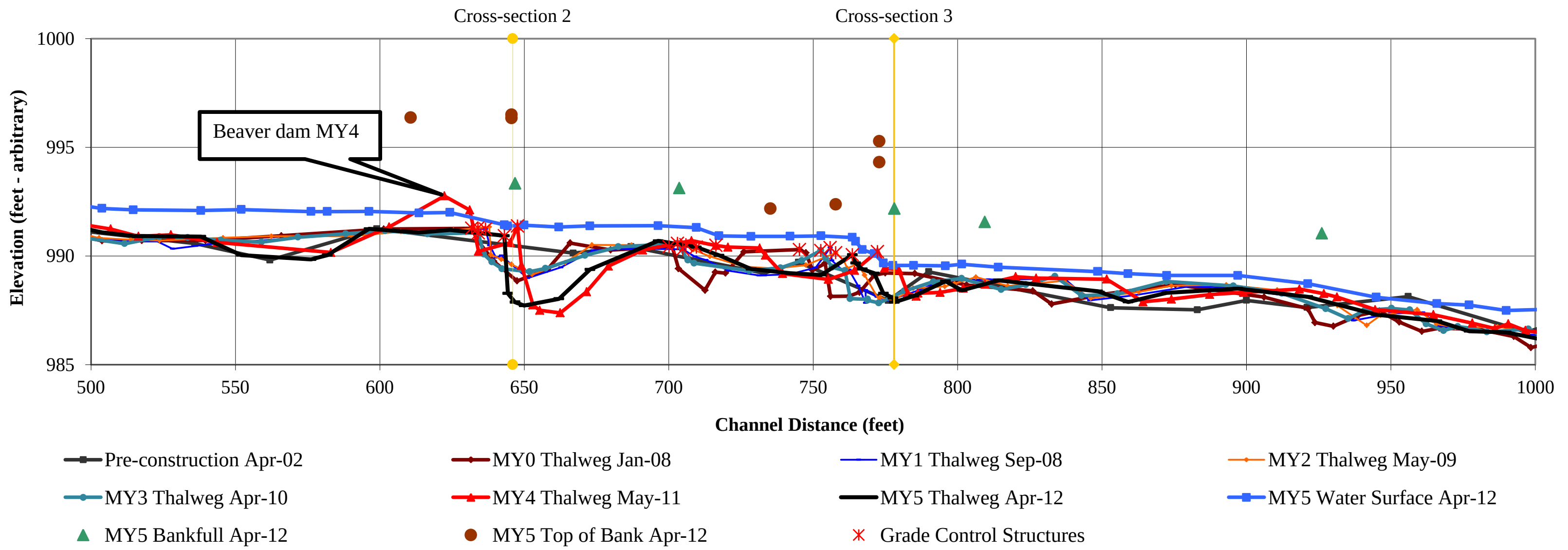


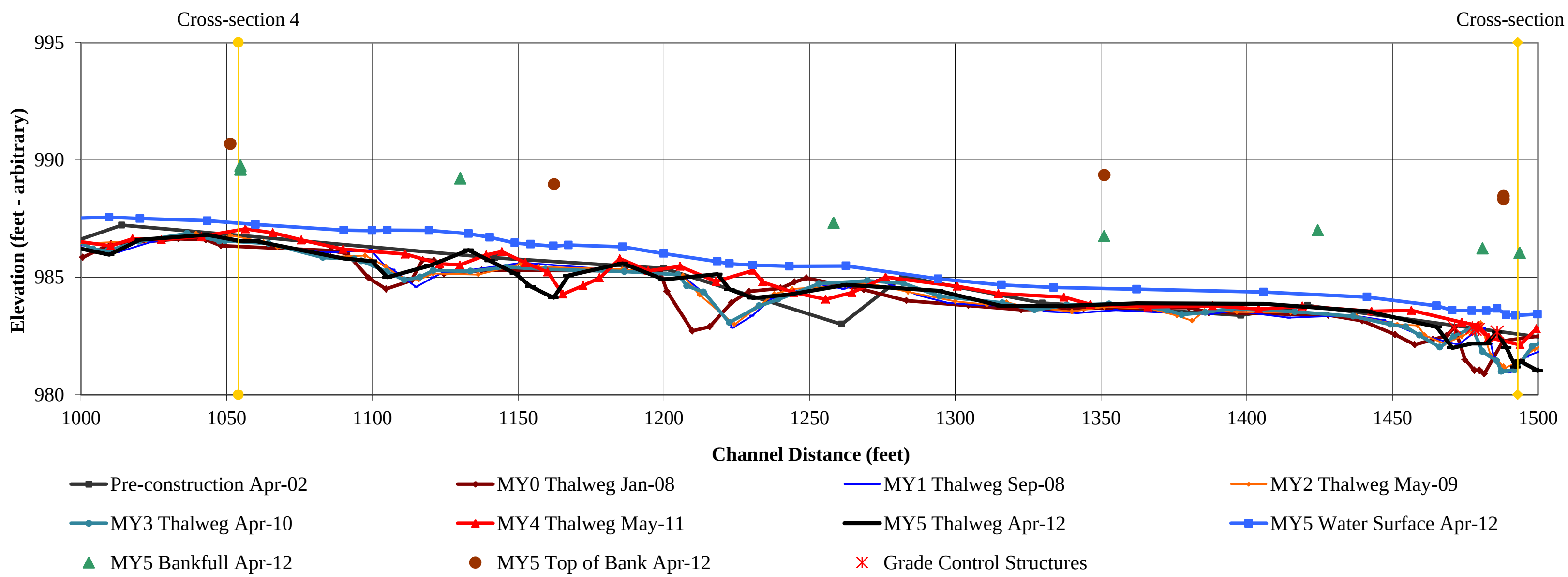
**Cross-section 7, Riffle**
**Bowlin-Peak Creek/Project Number: 92606**

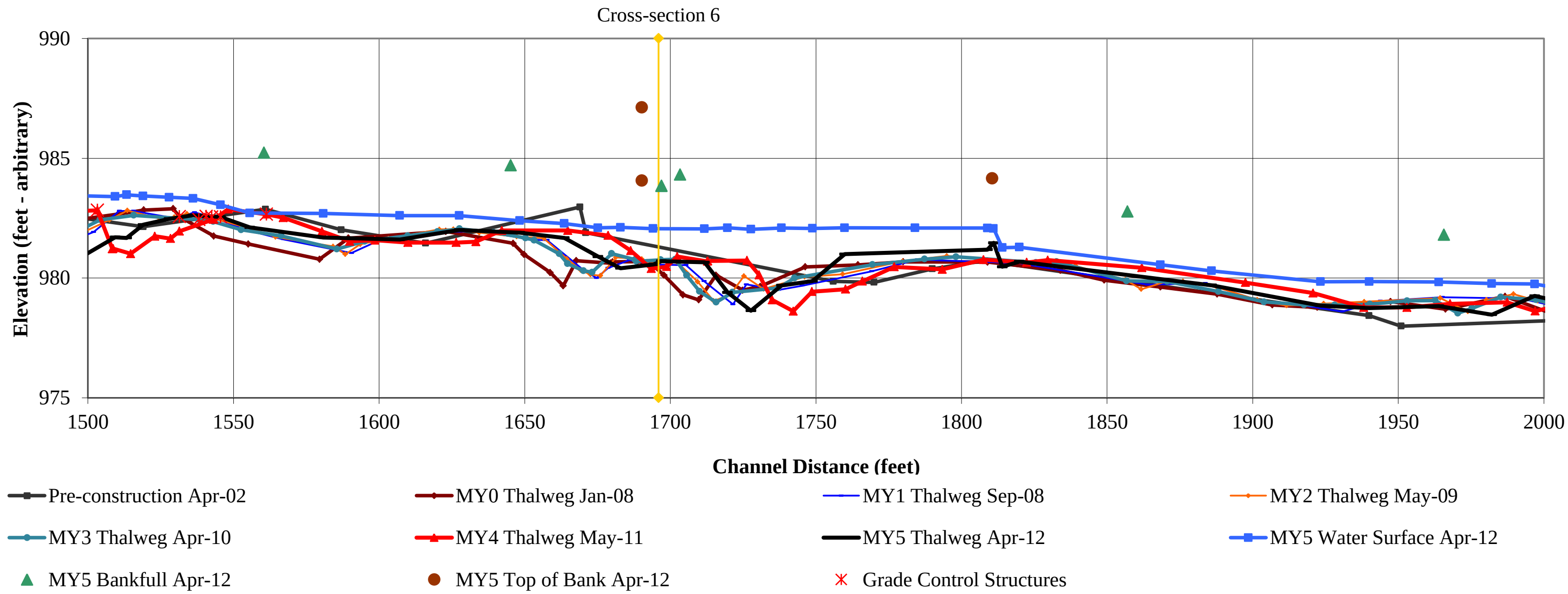


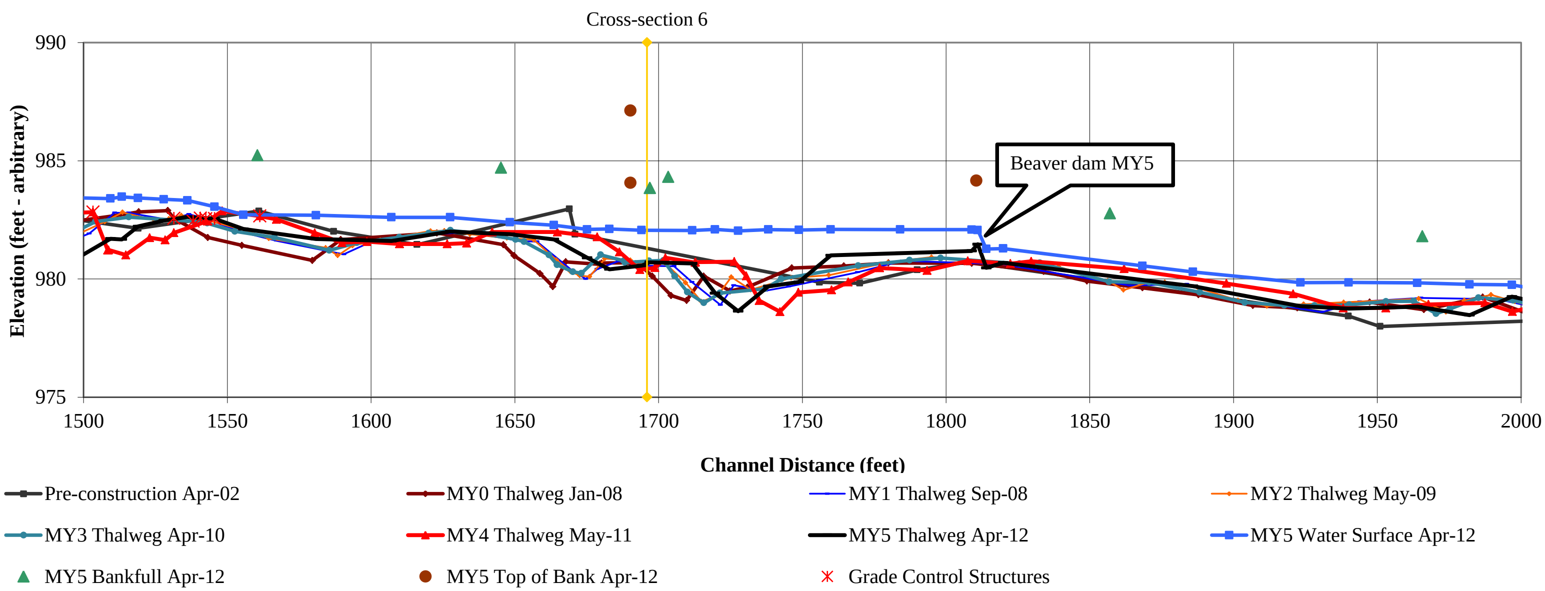
## B.6 Annual Overlays of Longitudinal Profile Plots

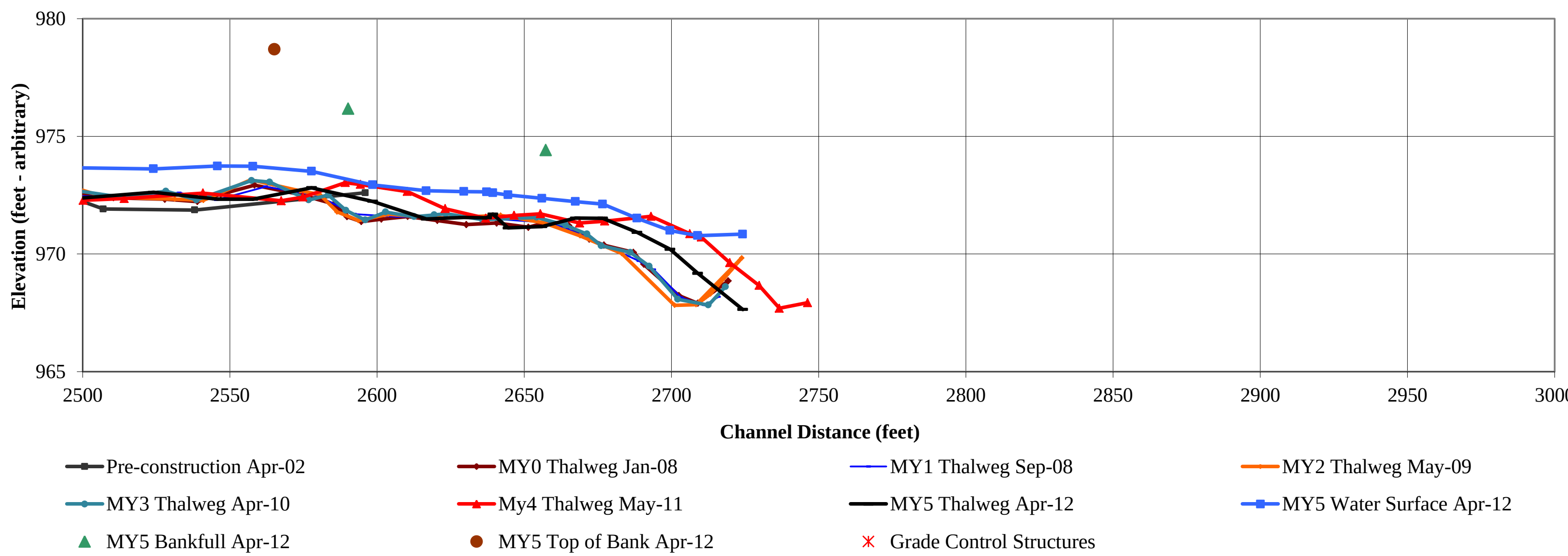



Cross-section 2
Cross-section 3
Beaver dam MY4
Elevation (feet - arbitrary)
1000
995
990
985
500
550
600
650
700
750
800
850
900
950
1000
Channel Distance (feet)
Pre-construction Apr-02
MY0 Thalweg Jan-08
MY1 Thalweg Sep-08
MY2 Thalweg May-09
MY3 Thalweg Apr-10
MY4 Thalweg May-11
MY5 Thalweg Apr-12
MY5 Water Surface Apr-12
MY5 Bankfull Apr-12
MY5 Top of Bank Apr-12
Grade Control Structures


Cross-section 4
Cross-section 5
Elevation (feet - arbitrary)
995
990
985
980
1000
1050
1100
1150
1200
1250
1300
1350
1400
1450
1500
Channel Distance (feet)
Pre-construction Apr-02
MY0 Thalweg Jan-08
MY1 Thalweg Sep-08
MY2 Thalweg May-09
MY3 Thalweg Apr-10
MY4 Thalweg May-11
MY5 Thalweg Apr-12
MY5 Water Surface Apr-12
MY5 Bankfull Apr-12
MY5 Top of Bank Apr-12
Grade Control Structures

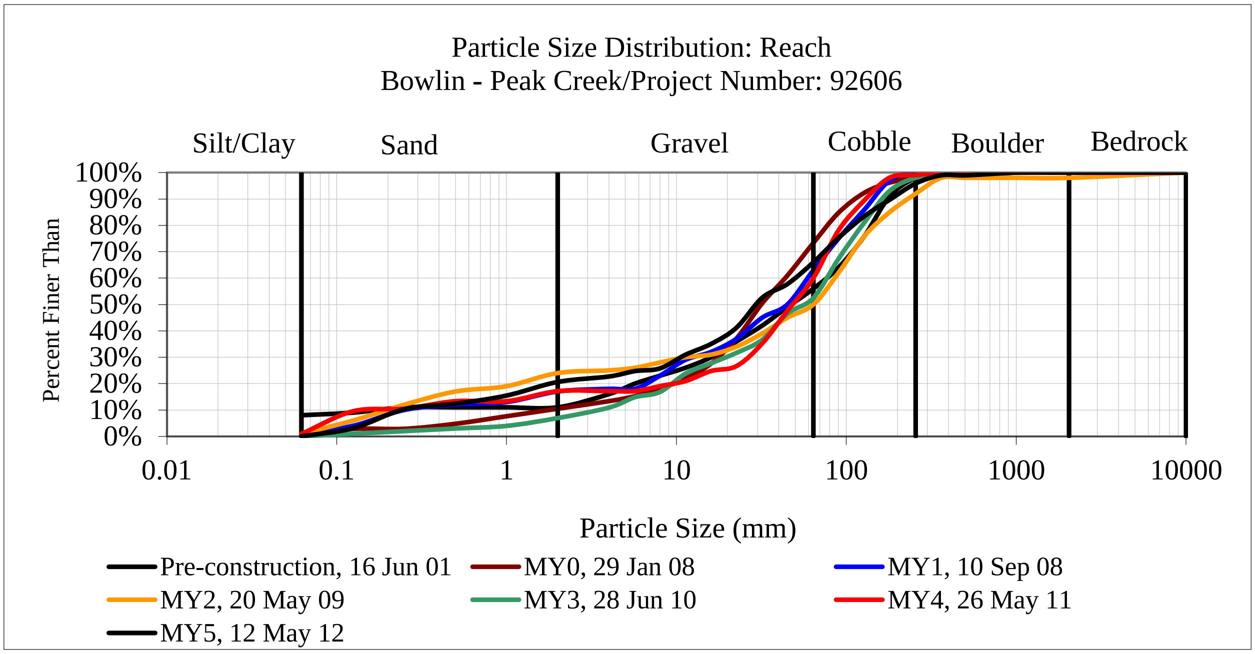

Cross-section 6
990
985
980
975
Elevation (feet - arbitrary)
1500
1550
1600
1650
1700
1750
1800
1850
1900
1950
2000
Channel Distance (feet)
Pre-construction Apr-02
MY0 Thalweg Jan-08
MY1 Thalweg Sep-08
MY2 Thalweg May-09
MY3 Thalweg Apr-10
MY4 Thalweg May-11
MY5 Thalweg Apr-12
MY5 Water Surface Apr-12
MY5 Bankfull Apr-12
MY5 Top of Bank Apr-12
Grade Control Structures


Cross-section 6
Beaver dam MY5
990
985
980
975
Elevation (feet - arbitrary)
1500
1550
1600
1650
1700
1750
1800
1850
1900
1950
2000
Channel Distance (feet)
Pre-construction Apr-02
MY0 Thalweg Jan-08
MY1 Thalweg Sep-08
MY2 Thalweg May-09
MY3 Thalweg Apr-10
MY4 Thalweg May-11
MY5 Thalweg Apr-12
MY5 Water Surface Apr-12
MY5 Bankfull Apr-12
MY5 Top of Bank Apr-12
Grade Control Structures

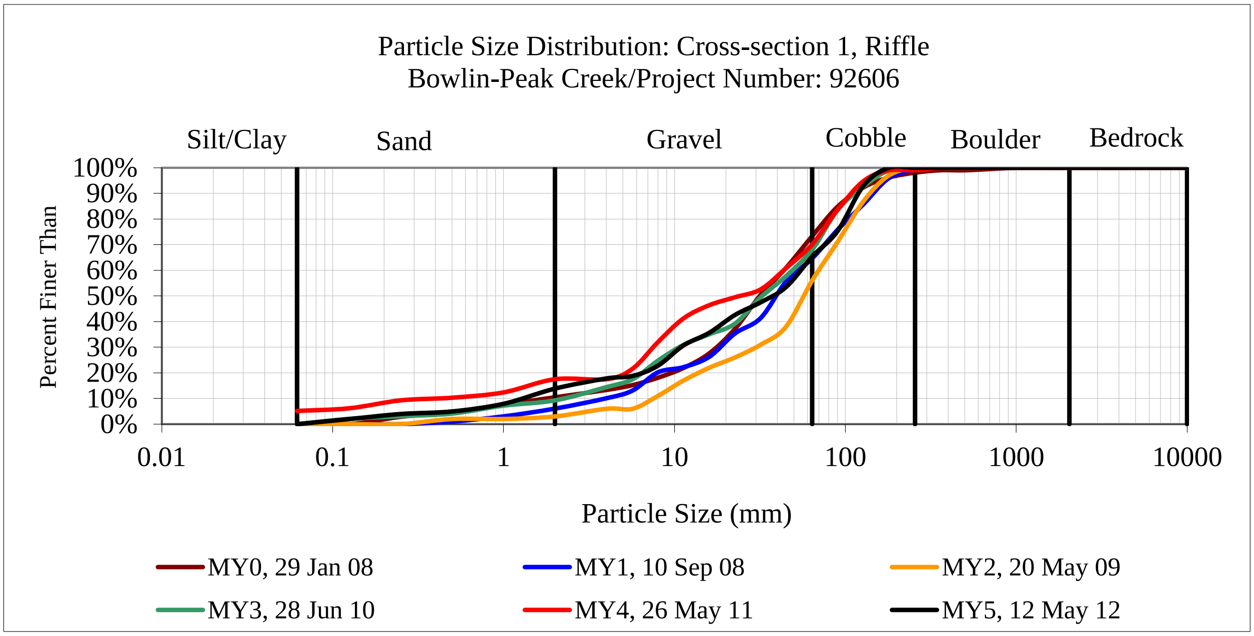


980
975
970
965
Elevation (feet - arbitrary)
2500
2550
2600
2650
2700
2750
2800
2850
2900
2950
3000
Channel Distance (feet)
Pre-construction Apr-02
MY0 Thalweg Jan-08
MY1 Thalweg Sep-08
MY2 Thalweg May-09
MY3 Thalweg Apr-10
My4 Thalweg May-11
MY5 Thalweg Apr-12
MY5 Water Surface Apr-12
MY5 Bankfull Apr-12
MY5 Top of Bank Apr-12
Grade Control Structures

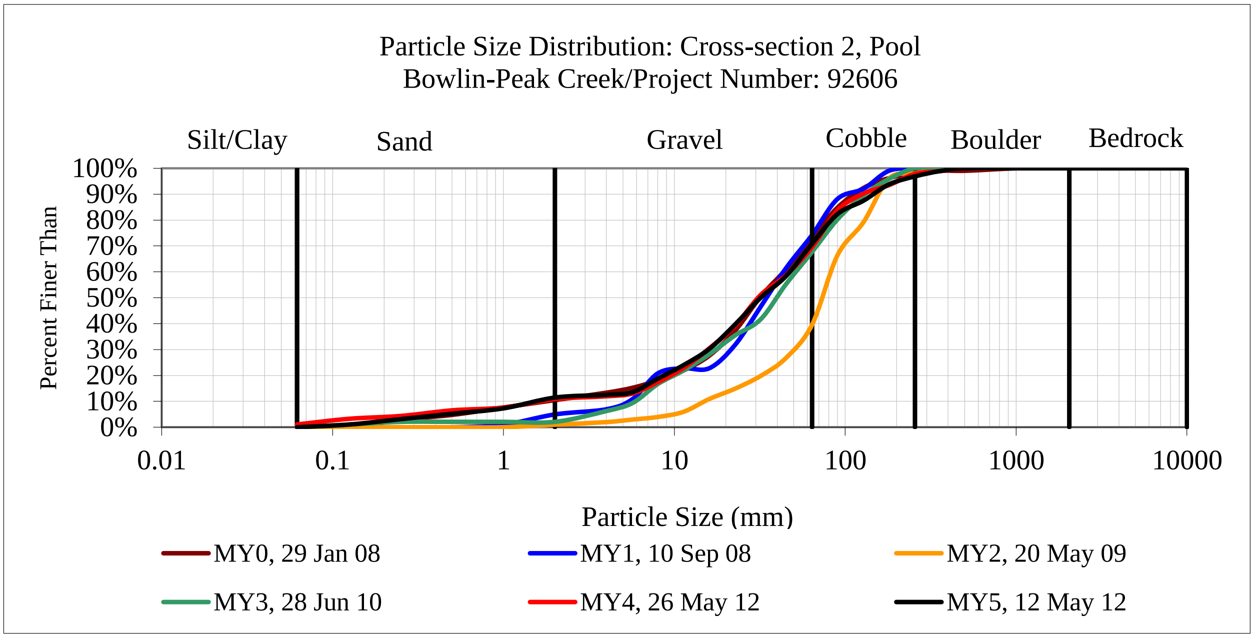
## B.7 Pebble Count Cumulative Frequency Distribution Plots



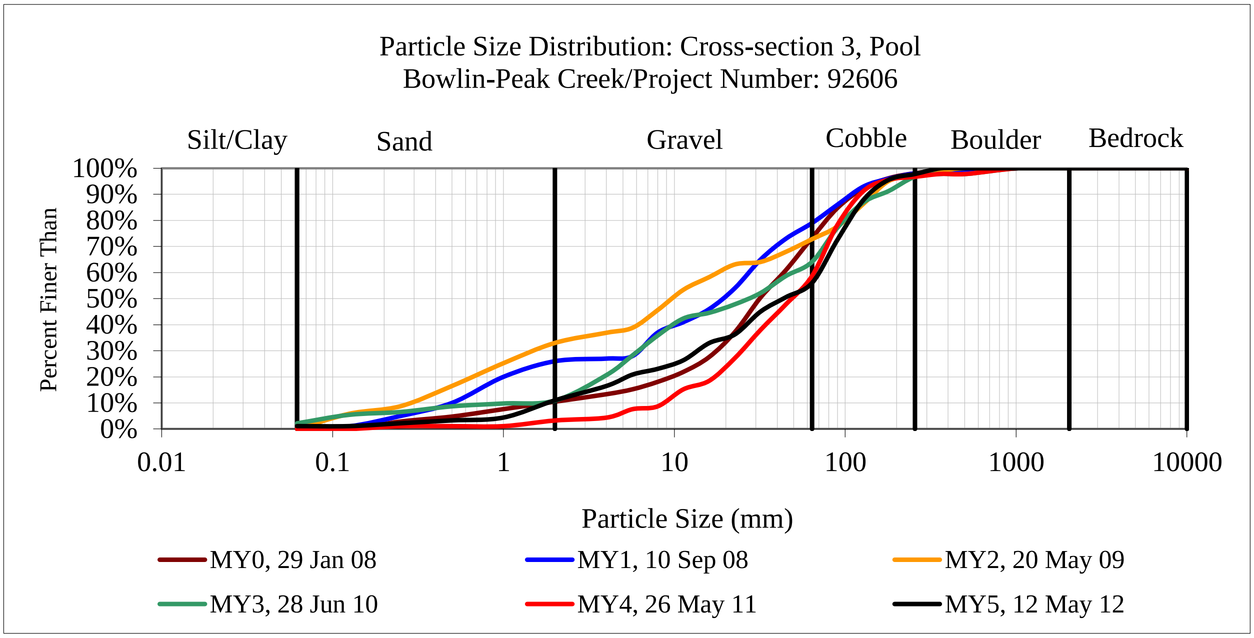

| **Size Class Index** | **Particle size (mm) in year sampled** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Pre-construction** | **MY0** | **MY1** | **MY2** | **MY3** | **MY4** | **MY5** |
| D16 | 4.0 | 6.3 | 1.8 | 0.5 | 7.04 | 1.7 | 1.1 |
| D35 | 21.5 | 21.1 | 20.0 | 24.5 | 28.9 | 31.7 | 15.9 |
| D50 | 47.7 | 31.7 | 45.0 | 64.0 | 56.08 | 48.7 | 29.9 |
| D84 | 155.7 | 88.3 | 121.1 | 174.2 | 140.3 | 109.6 | 132.1 |
| D95 | 223.4 | 163.8 | 170.6 | 309.0 | 209.63 | 161.2 | 245.5 |
| D100 | 362.0 | 1,024.0 | 256.0 | Bedrock | 511.98 | 362.0 | 1024.0 |



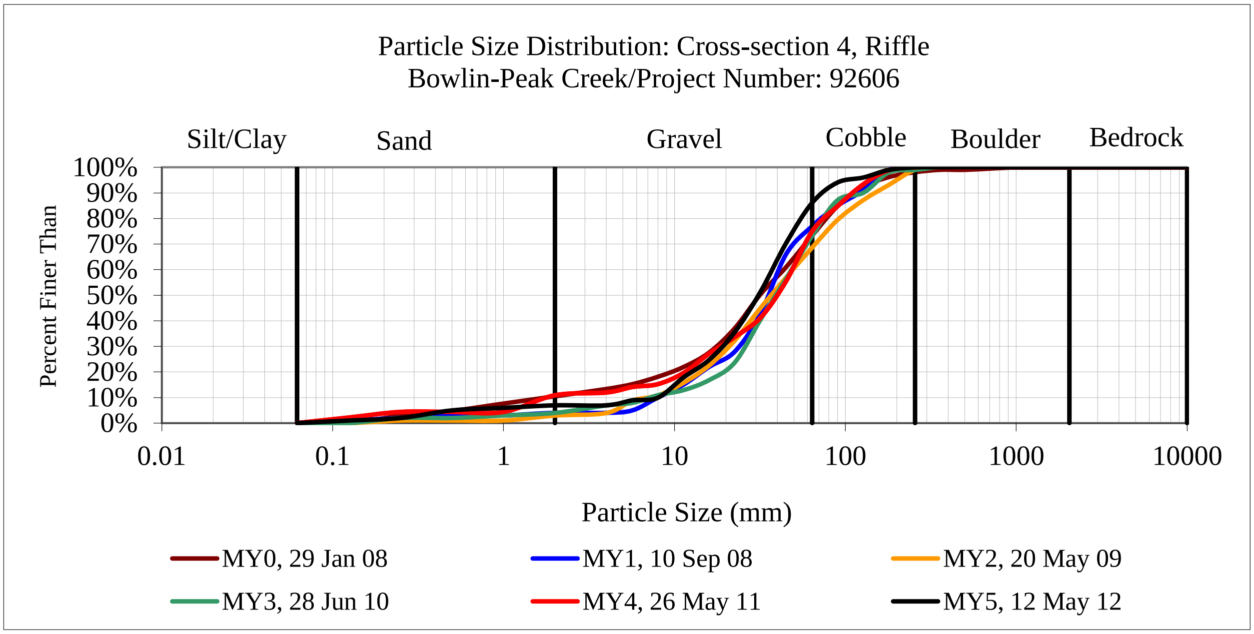

| Size Class | Particle size (mm) in year sampled | | | | | |
|---|---|---|---|---|---|---|
| Index | MY0 | MY1 | MY2 | MY3 | MY4 | MY5 |
| D16 | 6.3 | 6.6 | 10.8 | 4.9 | 1.7 | 3.1 |
| D35 | 21.1 | 22.4 | 39.4 | 15.9 | 9.1 | 15.4 |
| D50 | 31.7 | 39.9 | 57.7 | 32.8 | 24.2 | 37.4 |
| D84 | 88.3 | 121.0 | 120.9 | 92.0 | 91.6 | 108.7 |
| D95 | 163.8 | 175.1 | 169.6 | 146.7 | 129.9 | 142.5 |
| D100 | 1,024.0 | 362.0 | 256.0 | 256.0 | 362.0 | 180.0 |



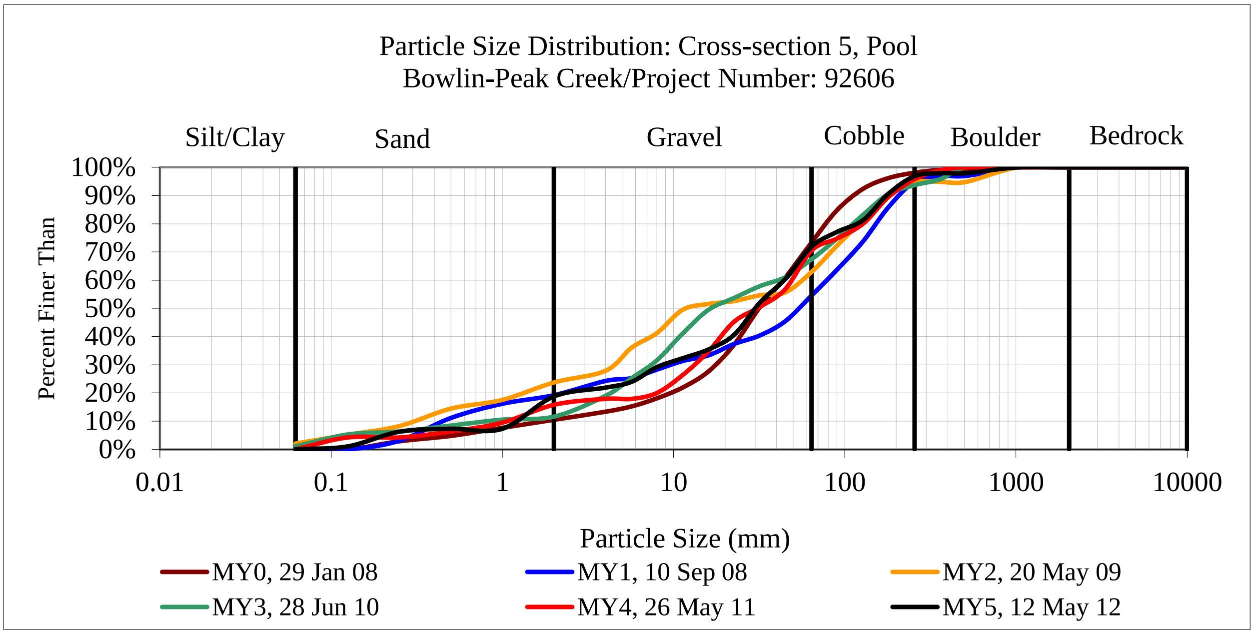

| **Size Class Index** | **Particle size (mm) in year sampled** | | | | | |
|---|---|---|---|---|---|---|
| | **MY0** | **MY1** | **MY2** | **MY3** | **MY4** | **MY5** |
| D16 | 18.9 | 6.9 | 24.8 | 7.8 | 7.3 | 6.8 |
| D35 | 34.4 | 24.7 | 57.2 | 22.2 | 19.5 | 19.4 |
| D50 | 49.3 | 35.0 | 74.1 | 40.0 | 31.1 | 32.0 |
| D84 | 88.5 | 82.3 | 142.8 | 105.4 | 91.8 | 102.5 |
| D95 | 104.3 | 149.9 | 176.8 | 173.1 | 206.6 | 210.5 |
| D100 | 256.0 | 256.0 | 361.0 | 256.0 | 512.0 | 512.0 |



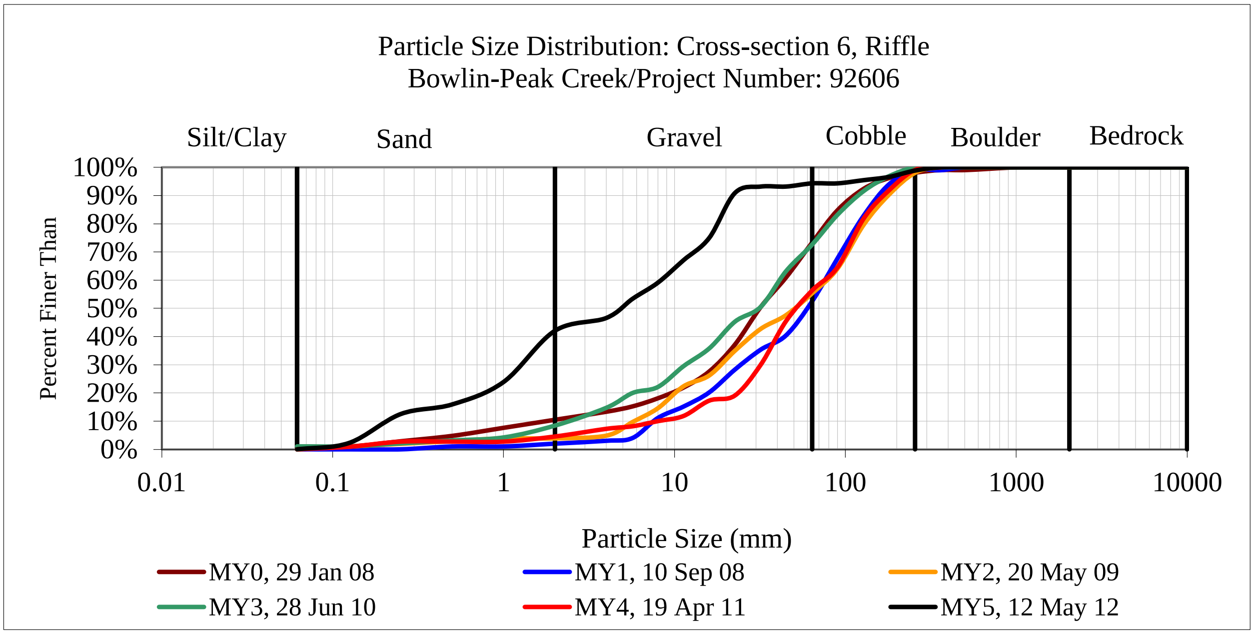

| Size Class | Particle size (mm) in year sampled | | | | | |
|---|---|---|---|---|---|---|
| **Index** | **MY0** | **MY1** | **MY2** | **MY3** | **MY4** | **MY5** |
| D16 | 6.3 | 0.8 | 0.5 | 3.1 | 12.4 | 3.8 |
| D35 | 14.4 | 7.5 | 3.0 | 7.7 | 29.4 | 20.1 |
| D50 | 20.7 | 19.3 | 9.9 | 27.3 | 48.8 | 43.7 |
| D84 | 48.5 | 82.6 | 117.5 | 116.5 | 106.7 | 118.3 |
| D95 | 79.3 | 162.7 | 179.1 | 231.7 | 172.2 | 175.9 |
| D100 | 180.0 | 1,024.0 | 512.0 | 1,024.0 | 1,024.0 | 362.0 |



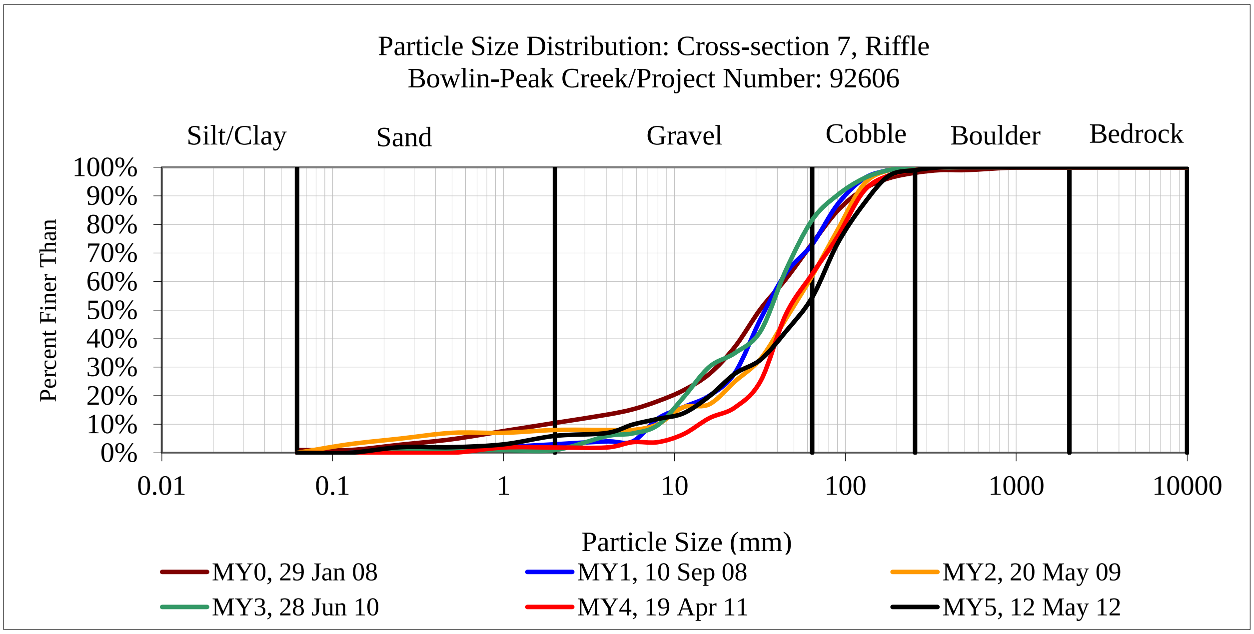

| Size Class | Particle size (mm) in year sampled | | | | | |
|---|---|---|---|---|---|---|
| **Index** | **MY0** | **MY1** | **MY2** | **MY3** | **MY4** | **MY5** |
| D16 | 9.4 | 12.0 | 11.5 | 15.0 | 8.6 | 10.5 |
| D35 | 22.2 | 27.0 | 25.6 | 28.9 | 24.2 | 22.2 |
| D50 | 34.8 | 36.0 | 37.4 | 39.7 | 40.0 | 31.1 |
| D84 | 79.3 | 86.8 | 112.3 | 84.1 | 87.9 | 61.4 |
| D95 | 127.6 | 154.0 | 204.0 | 160.2 | 142.6 | 108.0 |
| D100 | 362.0 | 256.0 | 362.0 | 362.0 | 256.0 | 256.0 |




| **Size Class Index** | **Particle size (mm) in year sampled** | | | | | |
|---|---|---|---|---|---|---|
| | **MY0** | **MY1** | **MY2** | **MY3** | **MY4** | **MY5** |
| D16 | 21.8 | 1.0 | 0.8 | 3.2 | 2.2 | 1.8 |
| D35 | 38.6 | 18.7 | 5.5 | 9.2 | 16.2 | 15.4 |
| D50 | 67.1 | 54.5 | 12.5 | 16.8 | 31.1 | 30.3 |
| D84 | 141.8 | 172.0 | 142.3 | 133.9 | 150.0 | 143.3 |
| D95 | 268.5 | 258.6 | 526.9 | 322.3 | 246.5 | 233.3 |
| D100 | 2,047.9 | 1,024.0 | 1,024.0 | 512.0 | 512.0 | 1024.0 |




| **Size Class Index** | **Particle size (mm) in year sampled** | | | | | |
|---|---|---|---|---|---|---|
| | **MY0** | **MY1** | **MY2** | **MY3** | **MY4** | **MY5** |
| D16 | 5.1 | 12.1 | 8.6 | 4.4 | 14.9 | 0.5 |
| D35 | 23.8 | 31.5 | 22.7 | 15.4 | 36.2 | 1.6 |
| D50 | 42.4 | 60.0 | 50.9 | 31.1 | 52.9 | 4.9 |
| D84 | 114.4 | 133.5 | 149.4 | 93.8 | 139.3 | 19.7 |
| D95 | 180.0 | 196.0 | 226.1 | 161.8 | 213.2 | 112.9 |
| D100 | 265.0 | 512.0 | 362.0 | 256.0 | 362.0 | 362.0 |




| Size Class Index | Particle size (mm) in year sampled | | | | | |
|---|---|---|---|---|---|---|
| | MY0 | MY1 | MY2 | MY3 | MY4 | MY5 |
| D16 | 15.2 | 11.3 | 11.3 | 10.1 | 22.7 | 13.0 |
| D35 | 27.7 | 26.1 | 33.9 | 22.7 | 37.4 | 35.1 |
| D50 | 42.4 | 34.4 | 48.8 | 36.4 | 46.9 | 56.9 |
| D84 | 81.9 | 84.4 | 104.3 | 71.3 | 109.9 | 119.4 |
| D95 | 122.0 | 123.8 | 138.4 | 120.7 | 159.6 | 169.3 |
| D100 | 256.0 | 256.0 | 256.0 | 256.0 | 362.0 | 362.0 |

B.8 Bankfull Verification Data and Photographs

Table B.8.1 Verification of Bankfull Events.

| Date of Data Collection | Date of Occurrence | Method | Photograph Number |
|---|---|---|---|
| | 05-Mar-2008 | 3,780 CFS at S. Fork New River USGS gage | |
| | 27-Aug-2008 | 3,590 CFS at S. Fork New River USGS gage | |
| 08-Sep-2008 | Unknown | 2.95 ft on Crest gage | |
| 11-May-2009 | Unknown | 2.86 ft on Crest gage | |
| | 27-May-2009 | 3,240 CFS at S. Fork New River USGS gage | |
| | 17-Jan-2010 | 5,180 CFS at S. Fork New River USGS gage | |
| | 25-Jan-2010 | 4,650 CFS at S. Fork New River USGS gage | |
| | 22-Mar-2010 | 3,870 CFS at S. Fork New River USGS gage | |
| 12-Apr-2010 | Unknown | Rack line 0.2 ft above bankful bench elevation | BF1 |
| 12-Apr-2010 | Unknown | 2.91 ft on Crest gage | |
| | 1-Dec-2010 | 4070 CFS at S. Fork New River USGS gage | |
| 3-Feb-2011 | Unknown | Rack line above bankfull bench | BF2, BF3 |
| | 6-Mar-2011 | 3,730 CFS at S. Fork New River USGS gage | |
| | 7-Mar-2011 | 3,730 CFS at S. Fork New River USGS gage | |
| 11-Apr-2011 | Unknown | 4.3 ft on Crest gage | |
| 14-Apr-2011 | Unknown | Rack line 3.2 ft above stream channel bottom | |
| | 16-Apr-2011 | 7,590 CFS at S. Fork New River USGS gage | |
| | 16-Apr-2011 | Landowner indicated a 5 in. rain event occurred | |
| | 17-Apr-2011 | 6,190 CFS at S. Fork New River USGS gage | |
| 19-Apr-2011 | Unknown | 3.2 ft on Crest gage | |
| 26-May-2011 | Unknown | 3.2 ft on Crest gage | |
| | 6-Sep-2011 | 3,140 CFS at S. Fork New River USGS gage | |
| | 7-Sep-2011 | 3,160 CFS at S. Fork New River USGS gage | |
| | 25-Sep-2011 | 2,950 CFS at S. Fork New River USGS gage | |
| | 29-Nov-2011 | 5,120 CFS at S. Fork New River USGS gage | |
| | 7-Dec-2011 | 2,840 CFS at S. Fork New River USGS gage | |
| 9-Apr-2012 | Unknown | Rack line above bankfull bench | BF4 |

Note: Bankfull at the Peak Creek site was determined to correspond to 3,220 cubic feet per second at the South Fork New River gage station.

BF1, orange flag identifies top of rack line: 12 Apr 10.

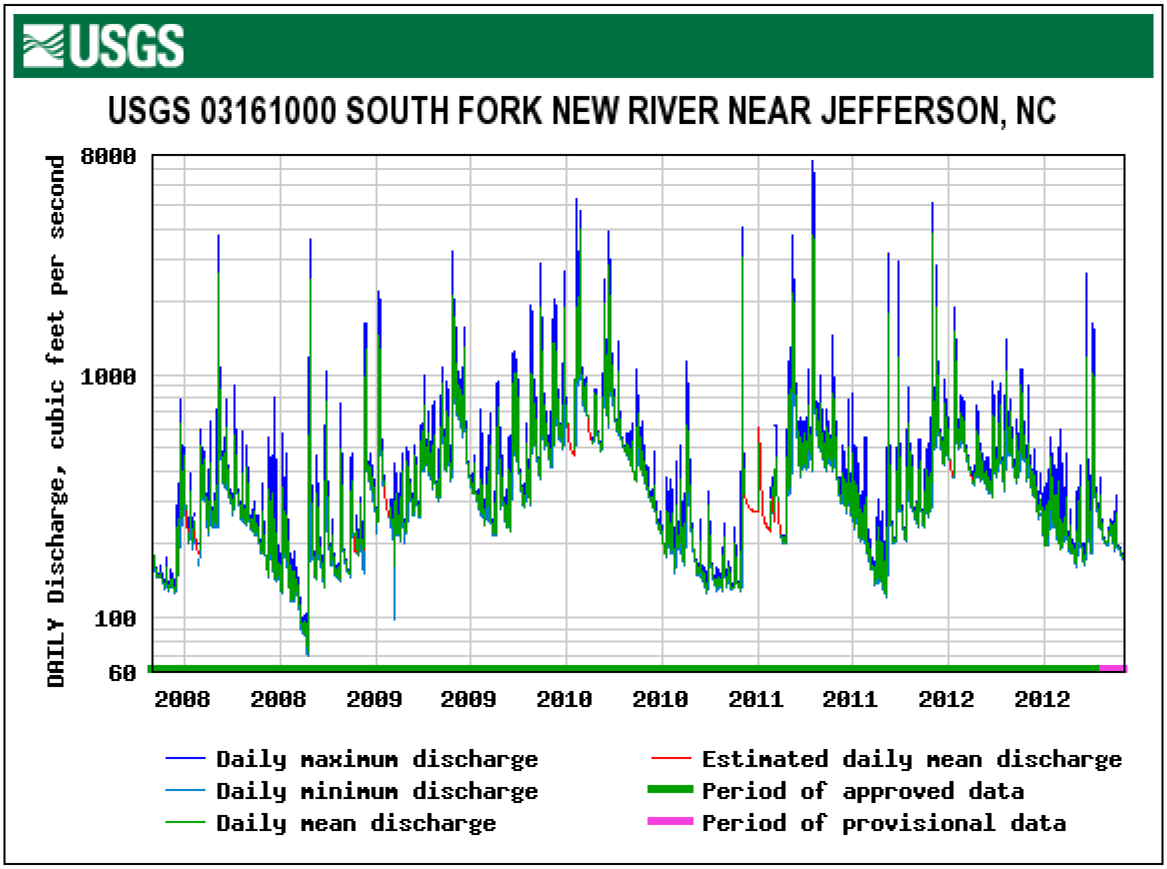
BF2, sediment and rack line on top of bankfull bench: 03 Feb 11.

BF3, sediment and rack line on ford: 03 Feb 11.

BF4, rack line on vegetation: 09 Apr 12.

B.9 Hydrologic Data

Figure B.9.1 USGS Hydrograph.




Note: Bankfull at the Peak Creek site was determined to correspond to 3,220 cubic feet per second at the South Fork New River gage station.

# Appendix C Vegetation Data

## C.1 Vegetation Data Summary Tables

Table C.1.1 Vegetation Plot Attribute Data.

| MY3 Vegetation Plot Attribute Data | | | | | | |
|---|---|---|---|---|---|---|
| Plot Identification | Community Type | Planting Zone Identification | Reach Identification | Associated Gauge(s) | Method[a] | CVS Level |
| 92606-Elkin-VP1 | Riparian | N/A | Peak Creek | No | N/A | 2 |
| 92606-Elkin-VP2 | Riparian | N/A | Peak Creek | No | N/A | 2 |
| 92606-Elkin-VP3 | Riparian | N/A | Peak Creek | No | N/A | 2 |

N/A = Not applicable.

[a]Denote method if other than CVS method.

| MY4 Vegetation Plot Attribute Data | | | | | | |
|---|---|---|---|---|---|---|
| Plot Identification | Community Type | Planting Zone Identification | Reach Identification | Associated Gauge(s) | Method[a] | CVS Level |
| 92606-Elkin-VP1 | Riparian | N/A | Peak Creek | No | N/A | 2 |
| 92606-Elkin-VP2 | Riparian | N/A | Peak Creek | No | N/A | 2 |
| 92606-Elkin-VP3 | Riparian | N/A | Peak Creek | No | N/A | 2 |

N/A = Not applicable.

[a]Denote method if other than CVS method.

| MY5 Vegetation Plot Attribute Data | | | | | | |
|---|---|---|---|---|---|---|
| Plot Identification | Community Type | Planting Zone Identification | Reach Identification | Associated Gauge(s) | Method[a] | CVS Level |
| 92606-Elkin-VP1 | Riparian | N/A | Peak Creek | No | N/A | 2 |
| 92606-Elkin-VP2 | Riparian | N/A | Peak Creek | No | N/A | 2 |
| 92606-Elkin-VP3 | Riparian | N/A | Peak Creek | No | N/A | 2 |

N/A = Not applicable.

[a]Denote method if other than CVS method.

Table C.1.2  Vegetation Metadata.

| MY3 Vegetation Metadata. | |
|---|---|
| **Report Prepared By** | Mark Fowlkes |
| **Date Prepared** | 40514.6326 |
| **Database Name** | NCWRCElkin-2010-A.mdb |
| **Database Location** | C:\Documents and Settings\Mark Fowlkes\My Documents\EEP - DOT Mitigation\Projects - 421\CVS_vegetation |
| **Computer Name** | DCZLLYB1 |
| **File Size** | 60350464 |
| **DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT------------** | |
| **Metadata** | Description of database file, the report worksheets, and a summary of project(s) and project data. |
| **Project Planted** | Each project is listed with its PLANTED stems per acre, for each year.  This excludes live stakes. |
| **Project 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** | 92606 |
| **project Name** | Bowlin-Peak Creek |
| **Description** | Enhanced approximately 2,800 ft of Peak Creek on the Bowlin property.  The enhncement included: bank sloping, placement of rock and log vanes, and rootwads.  The site was replanted with native vegetation upon completion of the project. |
| **River Basin** | New |
| **Length (ft)** | |
| **Stream-to-edge width (ft)** | |
| **Area (sq m)** | 8093.71 |
| **Required Plots (calculated)** | 3 |
| **Sampled Plots** | 0 |

| MY4 Vegetation Metadata. | |
|---|---|
| **Report Prepared By** | Mark Fowlkes |
| **Date Prepared** | 1/31/2013 16:18 |
| **Database Name** | NCWRCElkin-2011-Bowlin.mdb |
| **Database Location** | C:\Documents and Settings\Mark Fowlkes\My Documents\EEP - DOT Mitigation\CVS_vegetation |
| **Computer Name** | DCZLLYB1 |
| **File Size** | 60592128 |
| **DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT------------** | |
| **Metadata** | Description of database file, the report worksheets, and a summary of project(s) and project data. |
| **Project Planted** | Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes. |
| **Project 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** | 92606 |
| **project Name** | Bowlin-Peak Creek |
| **Description** | Enhanced approximately 2,800 ft of Peak Creek on the Bowlin property. The enhncement included: bank sloping, placement of rock and log vanes, and rootwads. The site was replanted with native vegetation upon completion of the project. |
| **River Basin** | New |
| **Length (ft)** | |
| **Stream-to-edge width (ft)** | |
| **Area (sq m)** | 8093.71 |
| **Required Plots (calculated)** | 3 |
| **Sampled Plots** | 0 |

| MY5 Vegetation Metadata. | |
|---|---|
| **Report Prepared By** | Mark Fowlkes |
| **Date Prepared** | 2/4/2013 18:47 |
| **Database Name** | NCWRCElkin-2012-Bowlin.mdb |
| **Database Location** | C:\Documents and Settings\Mark Fowlkes\My Documents\EEP - DOT Mitigation\CVS_vegetation |
| **Computer Name** | DCZLLYB1 |
| **File Size** | 49057792 |
| **DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT------------** | |
| **Metadata** | Description of database file, the report worksheets, and a summary of project(s) and project data. |
| **Project Planted** | Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes. |
| **Project 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** | 92606 |
| **project Name** | Bowlin-Peak Creek |
| **Description** | Enhanced approximately 2,800 ft of Peak Creek on the Bowlin property. The enhncement included: bank sloping, placement of rock and log vanes, and rootwads. The site was replanted with native vegetation upon completion of the project. |
| **River Basin** | New |
| **Length (ft)** | |
| **Stream-to-edge width (ft)** | |
| **Area (sq m)** | 8093.71 |
| **Required Plots (calculated)** | 3 |
| **Sampled Plots** | 0 |

Table C.1.3 Vegetation Vigor by Species.

| MY3 Vegetation Vigor by Species. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Vigor Class[a] | | | | | | |
| **Species** | **Common Name** | **4** | **3** | **2** | **1** | **0** | **Missing** | **Unknown** |
| *Acer saccharum* | Sugar maple | 1 | | 1 | | | | |
| *Betula nigra* | River birch | | 1 | | | | | |
| *Cornus amomum* | Silky dogwood | 1 | 2 | | | | | |
| *Juglans nigra* | Black walnut | | 1 | | | 1 | | |
| *Quercus alba* | White oak | 2 | 1 | | | | | |
| *Rhododendron calendulaceu* | Flame azalea | | 1 | 2 | | | | |
| *Rhododendron catawbiense* | Catawba rosebay | 1 | 1 | | | | | |
| *Rhododendron maximum* | Great laurel | 1 | | | | | | |
| *Robinia pseudoacacia* | Black locust | 3 | 1 | | | | | |
| *Salix sericea* | Silky willow | | 1 | 1 | | | | |
| *Sambucus canadensis* | Common Elderberry | | | | | 1 | | |
| *Tsuga caroliniana* | Carolina hemlock | 1 | | | | | | |
| *Carpinus caroliniana* | American hornbeam | 1 | | | | | | |
| *Vaccinium sp.* | Blueberry | 1 | 2 | 1 | | | | |
| *Lindera benzoin* | Northern spicebush | | 1 | 3 | | | | |
| *Physocarpus opulifolius* | Common ninebark | | 2 | | | | | |
| *Acer rubrum* | Red maple | | | 1 | | | | |
| **Total: 17** | **17** | **12** | **14** | **9** | | **2** | | |

[a]4 = Excellent, 3 = Good, 2 = Weak, 1 = Unlikely to survive, 0 = Dead, Missing = Plant missing

| MY4 Vegetation Vigor by Species. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Vigor Class[a] | | | | | | |
| **Species** | **Common Name** | **4** | **3** | **2** | **1** | **0** | **Missing** | **Unknown** |
| *Acer saccharum* | Sugar maple | 1 | 1 | | | | | |
| *Betula nigra* | River birch | | 1 | | | | | |
| *Cornus amomum* | Silky dogwood | 1 | 2 | | | | | |
| *Juglans nigra* | Black walnut | 1 | | | | | | |
| *Quercus alba* | White oak | 2 | 1 | | | | | |
| *Rhododendron calendulaceum* | Flame azalea | | 1 | 2 | | | | |
| *Rhododendron catawbiense* | Catawba rosebay | 1 | 1 | | | | | |
| *Rhododendron maximum* | Great laurel | | | 1 | | | | |
| *Robinia pseudoacacia* | Black locust | 2 | 2 | | | | | |
| *Salix sericea* | Silky willow | | 2 | | | | | |
| *Tsuga caroliniana* | Carolina hemlock | 1 | | | | | | |
| *Carpinus caroliniana* | American hornbeam | | 1 | | | | | |
| *Vaccinium* | Blueberry | | 3 | 1 | | | | |
| *Lindera benzoin* | Northern spicebush | 1 | | 2 | | 1 | | |
| *Physocarpus opulifolius* | Common ninebark | | 2 | | | | | |
| *Acer rubrum* | Red maple | | 1 | | | | | |
| **Total: 16** | **16** | **10** | **18** | **6** | | **1** | | |

[a]4 = Excellent, 3 = Good, 2 = Weak, 1 = Unlikely to survive, 0 = Dead, Missing = Plant missing

| MY5 Vegetation Vigor by Species. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Vigor Class[a] | | | | | | |
| **Species** | **CommonName** | **4** | **3** | **2** | **1** | **0** | **Missing** | **Unknown** |
| *Acer saccharum* | Sugar maple | 1 | | 1 | | | | |
| *Betula nigra* | River birch | 1 | | | | | | |
| *Cornus amomum* | Silky dogwood | 2 | 1 | | | | | |
| *Juglans nigra* | Black walnut | | 1 | | | | | |
| *Quercus alba* | White oak | 3 | | | | | | |
| *Rhododendron calendulaceum* | Flame azalea | 1 | 1 | 1 | | | | |
| *Rhododendron catawbiense* | Catawba rosebay | | 2 | | | | | |
| *Rhododendron maximum* | Great laurel | | 1 | | | | | |
| *Robinia pseudoacacia* | Black locust | 2 | 2 | | | | | |
| *Salix sericea* | Silky willow | 1 | | 1 | | | | |
| *Tsuga caroliniana* | Carolina hemlock | 1 | | | | | | |
| *Carpinus caroliniana* | American hornbeam | 1 | | | | | | |
| *Vaccinium* | Blueberry | 4 | | | | | | |
| *Lindera benzoin* | Northern spicebush | | 1 | 2 | | | | |
| *Physocarpus opulifolius* | Common ninebark | 1 | 1 | | | | | |
| *Acer rubrum* | Red maple | | 1 | | | | | |
| **Total: 16** | **16** | **18** | **11** | **5** | | | | |

[a]4 = Excellent, 3 = Good, 2 = Weak, 1 = Unlikely to survive, 0 = Dead, Missing = Plant missing

Table C.1.4  Vegetation Damage by Species.

| MY3 Vegetation Damage by Species. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Species** | **Common Name** | **All Damage Categories** | **No Damage** | **Beaver** | **Deer** | **Human Trample** | **Insects** | **Unknown** | **Vine Strangulation** |
| *Acer rubrum* | Red maple | 1 | | 1 | | | | | |
| *Acer saccharum* | Sugar maple | 1 | 1 | | | | | 1 | |
| *Betula nigra* | River birch | 0 | 1 | | | | | | |
| *Carpinus caroliniana* | American hornbeam | 0 | 1 | | | | | | |
| *Cornus amomum* | Silky dogwood | 1 | 2 | | | | 1 | | |
| *Juglans nigra* | Black walnut | 2 | | | 1 | | | 1 | |
| *Lindera benzoin* | Northern spicebush | 3 | 1 | | 1 | | | 2 | |
| *Physocarpus opulifolius* | Common ninebark | 0 | 2 | | | | | | |
| *Quercus alba* | White oak | 1 | 2 | | | 1 | | | |
| *Rhododendron calendulace* | Flame azalea | 1 | 2 | | 1 | | | | |
| *Rhododendron catawbiense* | Catawba rosebay | 1 | 1 | | | 1 | | | |
| *Rhododendron maximum* | Great laurel | 0 | 1 | | | | | | |
| *Robinia pseudoacacia* | Black locust | 1 | 3 | | | | | 1 | |
| *Salix sericea* | Silky willow | 2 | | | | | 2 | | |
| *Sambucus canadensis* | Common Elderberry | 1 | | | | | | 1 | |
| *Tsuga caroliniana* | Carolina hemlock | 1 | | | | | | | 1 |
| *Vaccinium sp.* | Blueberry | 0 | 4 | | | | | | |
| **Total: 17** | **17** | **16** | **21** | **1** | **3** | **2** | **3** | **6** | **1** |

| MY4 Vegetation Damage by Species. | | | | | |
|---|---|---|---|---|---|
| **Species** | **CommonName** | **All Damage Categories** | **No Damage** | **Insects** | **Unknown** |
| *Acer rubrum* | red maple | 1 | | 1 | |
| *Acer saccharum* | sugar maple | 0 | 2 | | |
| *Betula nigra* | river birch | 1 | | 1 | |
| *Carpinus caroliniana* | American hornbeam | 0 | 1 | | |
| *Cornus amomum* | silky dogwood | 0 | 3 | | |
| *Juglans nigra* | black walnut | 0 | 1 | | |
| *Lindera benzoin* | northern spicebush | 0 | 4 | | |
| *Physocarpus opulifolius* | common ninebark | 0 | 2 | | |
| *Quercus alba* | white oak | 0 | 3 | | |
| *Rhododendron calendulaceum* | flame azalea | 1 | 2 | 1 | |
| *Rhododendron catawbiense* | Catawba rosebay | 1 | 1 | 1 | |
| *Rhododendron maximum* | great laurel | 0 | 1 | | |
| *Robinia pseudoacacia* | black locust | 0 | 4 | | |
| *Salix sericea* | silky willow | 1 | 1 | 1 | |
| *Tsuga caroliniana* | Carolina hemlock | 0 | 1 | | |
| *Vaccinium* | blueberry | 1 | 3 | | 1 |
| **Total: 16** | **16** | **6** | **29** | **5** | **1** |

| MY5 Vegetation Damage by Species. | | | | | | |
|---|---|---|---|---|---|---|
| **Species** | **CommonName** | **All Damage Categories** | **No Damage** | **Beaver** | **Deer** | **Insects** |
| *Acer rubrum* | Red maple | 1 | | 1 | | |
| *Acer saccharum* | Sugar maple | 0 | 2 | | | |
| *Betula nigra* | River birch | 0 | 1 | | | |
| *Carpinus caroliniana* | American hornbeam | 0 | 1 | | | |
| *Cornus amomum* | Silky dogwood | 0 | 3 | | | |
| *Juglans nigra* | Black walnut | 1 | | | 1 | |
| *Lindera benzoin* | Northern spicebush | 0 | 3 | | | |
| *Physocarpus opulifolius* | Common ninebark | 1 | 1 | | 1 | |
| *Quercus alba* | White oak | 0 | 3 | | | |
| *Rhododendron calendulaceum* | Flame azalea | 1 | 2 | | | 1 |
| *Rhododendron catawbiense* | Catawba rosebay | 0 | 2 | | | |
| *Rhododendron maximum* | Great laurel | 0 | 1 | | | |
| *Robinia pseudoacacia* | Black locust | 1 | 3 | | 1 | |
| *Salix sericea* | Silky willow | 1 | 1 | 1 | | |
| *Tsuga caroliniana* | Carolina hemlock | 0 | 1 | | | |
| *Vaccinium* | Blueberry | 0 | 4 | | | |
| **Total: 16** | **16** | **6** | **28** | **2** | **3** | **1** |

Table C.1.5 Vegetation Damage by Plot.

| MY3 Vegetation Damage by Plot | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Plot** | **All Damage Categories** | **No Damage** | **Beaver** | **Deer** | **Human Trample** | **Insects** | **Unknown** | **Vine Strangulation** |
| 92606-Elkin-VP1-Year:3 | 6 | 5 | 1 | 1 | | 2 | 2 | |
| 92606-Elkin-VP2-Year:3 | 6 | 10 | | | 2 | 1 | 2 | 1 |
| 92606-Elkin-VP3-Year:3 | 4 | 6 | | 2 | | | 2 | |
| **Total: 3** | **16** | **21** | **1** | **3** | **2** | **3** | **6** | **1** |

| MY4 Vegetation Damage by Plot | | | | |
|---|---|---|---|---|
| **Plot** | **All Damage Categories** | **No Damage** | **Insects** | **Unknown** |
| 92606-Elkin-VP1-Year:4 | 2 | 8 | 2 | |
| 92606-Elkin-VP2-Year:4 | 1 | 15 | 1 | |
| 92606-Elkin-VP3-Year:4 | 3 | 6 | 2 | 1 |
| **Total: 3** | **6** | **29** | **5** | **1** |

| MY5 Vegetation Damage by Plot | | | | | |
|---|---|---|---|---|---|
| **Plot** | **All Damage Categories** | **No Damage** | **Beaver** | **Deer** | **Insects** |
| 92606-Elkin-VP1-Year:5 | 4 | 5 | 2 | 2 | |
| 92606-Elkin-VP2-Year:5 | 0 | 16 | | | |
| 92606-Elkin-VP3-Year:5 | 2 | 7 | | 1 | 1 |
| **Total: 3** | **6** | **28** | **2** | **3** | **1** |

Table C.1.6 Planted Stems Counted by Plot and Species.

| MY3 Planted Stems Counted by Plot and Species. | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Species** | **Common Name** | **Total Planted Stems** | **Number of Plots** | **Average Number of Stems** | **Plot 92606-Elkin-VP1-Year:3** | **Plot 92606-Elkin-VP2-Year:3** | **Plot 92606-Elkin-VP3-Year:3** |
| *Acer rubrum* | Red maple | 1 | 1 | 1 | 1 | | |
| *Acer saccharum* | Sugar maple | 2 | 1 | 2 | | 2 | |
| *Betula nigra* | River birch | 1 | 1 | 1 | | 1 | |
| *Carpinus caroliniana* | American hornbeam | 1 | 1 | 1 | | 1 | |
| *Cornus amomum* | Silky dogwood | 3 | 2 | 1.5 | 2 | 1 | |
| *Juglans nigra* | Black walnut | 1 | 1 | 1 | 1 | | |
| *Lindera benzoin* | Northern spicebush | 4 | 3 | 1.33 | 1 | 2 | 1 |
| *Physocarpus opulifolius* | Common ninebark | 2 | 1 | 2 | 2 | | |
| *Quercus alba* | White oak | 3 | 2 | 1.5 | 1 | 2 | |
| *Rhododendron calendulaceum* | Flame azalea | 3 | 2 | 1.5 | | 2 | 1 |
| *Rhododendron catawbiense* | Catawba rosebay | 2 | 2 | 1 | | 1 | 1 |
| *Rhododendron maximum* | Great laurel | 1 | 1 | 1 | | 1 | |
| *Robinia pseudoacacia* | Black locust | 4 | 2 | 2 | | 1 | 3 |
| *Salix sericea* | Silky willow | 2 | 1 | 2 | 2 | | |
| *Tsuga caroliniana* | Carolina hemlock | 1 | 1 | 1 | | 1 | |
| *Vaccinium sp.* | Blueberry | 4 | 2 | 2 | | 1 | 3 |
| **Total: 16** | **16** | **35** | **16** | | **10** | **16** | **9** |

| MY4 Planted Stems Counted by Plot and Species. | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Species** | **CommonName** | **Total Planted Stems** | **Number of Plots** | **Average Number of Stems** | **Plot 92606-Elkin-VP1-Year:4** | **Plot 92606-Elkin-VP2-Year:4** | **Plot 92606-Elkin-VP3-Year:4** |
| *Acer rubrum* | Red maple | 1 | 1 | 1 | 1 | | |
| *Acer saccharum* | Sugar maple | 2 | 1 | 2 | | 2 | |
| *Betula nigra* | River birch | 1 | 1 | 1 | | 1 | |
| *Carpinus caroliniana* | American hornbeam | 1 | 1 | 1 | | 1 | |
| *Cornus amomum* | Silky dogwood | 3 | 2 | 1.5 | 2 | 1 | |
| *Juglans nigra* | Black walnut | 1 | 1 | 1 | 1 | | |
| *Lindera benzoin* | Northern spicebush | 3 | 2 | 1.5 | | 2 | 1 |
| *Physocarpus opulifolius* | Common ninebark | 2 | 1 | 2 | 2 | | |
| *Quercus alba* | white oak | 3 | 2 | 1.5 | 1 | 2 | |
| *Rhododendron calendulaceum* | Flame azalea | 3 | 2 | 1.5 | | 2 | 1 |
| *Rhododendron catawbiense* | Catawba rosebay | 2 | 2 | 1 | | 1 | 1 |
| *Rhododendron maximum* | Great laurel | 1 | 1 | 1 | | 1 | |
| *Robinia pseudoacacia* | Black locust | 4 | 2 | 2 | | 1 | 3 |
| *Salix sericea* | Silky willow | 2 | 1 | 2 | 2 | | |
| *Tsuga caroliniana* | Carolina hemlock | 1 | 1 | 1 | | 1 | |
| *Vaccinium* | Blueberry | 4 | 2 | 2 | | 1 | 3 |
| **Total: 16** | **16** | **34** | **16** | | **9** | **16** | **9** |

| MY5 Planted Stems Counted by Plot and Species. | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Species** | **CommonName** | **Total Planted Stems** | **Number of Plots** | **Average Number of Stems** | **Plot 92606-Elkin-VP1-Year:5** | **Plot 92606-Elkin-VP2-Year:5** | **Plot 92606-Elkin-VP3-Year:5** |
| *Acer rubrum* | Red maple | 1 | 1 | 1 | 1 | | |
| *Acer saccharum* | Sugar maple | 2 | 1 | 2 | | 2 | |
| *Betula nigra* | River birch | 1 | 1 | 1 | | 1 | |
| *Carpinus caroliniana* | American hornbeam | 1 | 1 | 1 | | 1 | |
| *Cornus amomum* | Silky dogwood | 3 | 2 | 1.5 | 2 | 1 | |
| *Juglans nigra* | Black walnut | 1 | 1 | 1 | 1 | | |
| *Lindera benzoin* | Northern spicebush | 3 | 2 | 1.5 | | 2 | 1 |
| *Physocarpus opulifolius* | Common ninebark | 2 | 1 | 2 | 2 | | |
| *Quercus alba* | White oak | 3 | 2 | 1.5 | 1 | 2 | |
| *Rhododendron calendulaceum* | Flame azalea | 3 | 2 | 1.5 | | 2 | 1 |
| *Rhododendron catawbiense* | Catawba rosebay | 2 | 2 | 1 | | 1 | 1 |
| *Rhododendron maximum* | Great laurel | 1 | 1 | 1 | | 1 | |
| *Robinia pseudoacacia* | Black locust | 4 | 2 | 2 | | 1 | 3 |
| *Salix sericea* | Silky willow | 2 | 1 | 2 | 2 | | |
| *Tsuga caroliniana* | Carolina hemlock | 1 | 1 | 1 | | 1 | |
| *Vaccinium* | Blueberry | 4 | 2 | 2 | | 1 | 3 |
| **Total: 16** | **16** | **34** | **16** | | **9** | **16** | **9** |

Table C.1.7  All Stems Counted by Plot and Species.

| MY3 All Stems Counted by Plot and Species. | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Species** | **CommonName** | **Total Stems** | **Number of Plots Species Were Found** | **Average Number of Stems** | **Plot 92606-Elkin-VP1-Year:3** | **Plot 92606-Elkin-VP2-Year:3** | **Plot 92606-Elkin-VP3-Year:3** |
| *Acer rubrum* | Red maple | 3 | 2 | 1.5 | 1 | | 2 |
| *Acer saccharum* | Sugar maple | 2 | 1 | 2 | | 2 | |
| *Alnus serrulata* | Hazel alder | 120 | 3 | 40 | 99 | 19 | 2 |
| *Betula nigra* | River birch | 1 | 1 | 1 | | 1 | |
| *Carpinus caroliniana* | American hornbeam | 1 | 1 | 1 | | 1 | |
| *Cornus amomum* | Silky dogwood | 4 | 2 | 2 | 2 | 2 | |
| *Crataegus sp.* | Hawthorn | 55 | 1 | 55 | | | 55 |
| *Fraxinus pennsylvanica* | Green ash | 1 | 1 | 1 | | | 1 |
| *Juglans nigra* | Black walnut | 2 | 2 | 1 | 1 | | 1 |
| *Lindera benzoin* | Northern spicebush | 28 | 3 | 9.33 | 6 | 2 | 20 |
| *Physocarpus opulifolius* | Common ninebark | 24 | 3 | 8 | 22 | 1 | 1 |
| *Prunus serotina var. serotina* | Black cherry | 1 | 1 | 1 | | 1 | |
| *Quercus alba* | White oak | 3 | 2 | 1.5 | 1 | 2 | |
| *Rhododendron calendulaceum* | Flame azalea | 3 | 2 | 1.5 | | 2 | 1 |
| *Rhododendron catawbiense* | Catawba rosebay | 2 | 2 | 1 | | 1 | 1 |
| *Rhododendron maximum* | Great laurel | 1 | 1 | 1 | | 1 | |
| *Robinia pseudoacacia* | Black locust | 4 | 2 | 2 | | 1 | 3 |
| *Salix nigra* | Black willow | 3 | 1 | 3 | 3 | | |
| *Salix sericea* | silky willow | 5 | 2 | 2.5 | 4 | 1 | |
| *Sambucus canadensis* | Common Elderberry | 1 | 1 | 1 | 1 | | |
| *Spiraea sp.* | Spirea | 7 | 1 | 7 | 7 | | |
| *Tsuga caroliniana* | Carolina hemlock | 1 | 1 | 1 | | 1 | |
| *Vaccinium sp.* | Blueberry | 4 | 2 | 2 | | 1 | 3 |
| **Total: 23** | **23** | **276** | **23** | | **147** | **39** | **90** |

| MY4 All Stems Counted by Plot and Species. | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Species** | **CommonName** | **Total Stems** | **Number of Plots Species Were Found** | **Average Number of Stems** | **Plot 92606-Elkin-VP1-Year:4** | **Plot 92606-Elkin-VP2-Year:4** | **Plot 92606-Elkin-VP3-Year:4** |
| *Acer rubrum* | red maple | 4 | 2 | 2 | 1 | | 3 |
| *Acer saccharum* | sugar maple | 2 | 1 | 2 | | 2 | |
| *Alnus serrulata* | hazel alder | 74 | 3 | 24.67 | 49 | 23 | 2 |
| *Betula nigra* | river birch | 1 | 1 | 1 | | 1 | |
| *Calycanthus floridus* | eastern sweetshrub | 2 | 1 | 2 | 2 | | |
| *Carpinus caroliniana* | American hornbeam | 1 | 1 | 1 | | 1 | |
| *Cornus amomum* | silky dogwood | 7 | 2 | 3.5 | 3 | 4 | |
| *Crataegus* | hawthorn | 43 | 1 | 43 | | | 43 |
| *Juglans nigra* | black walnut | 2 | 2 | 1 | 1 | | 1 |
| *Lindera benzoin* | northern spicebush | 35 | 3 | 11.67 | 9 | 2 | 24 |
| *Physocarpus opulifolius* | common ninebark | 41 | 2 | 20.5 | 15 | 26 | |
| *Prunus serotina* | black cherry | 10 | 3 | 3.33 | 3 | 1 | 6 |
| *Quercus alba* | white oak | 3 | 2 | 1.5 | 1 | 2 | |
| *Rhododendron calendulaceum* | flame azalea | 3 | 2 | 1.5 | | 2 | 1 |
| *Rhododendron catawbiense* | Catawba rosebay | 2 | 2 | 1 | | 1 | 1 |
| *Rhododendron maximum* | great laurel | 1 | 1 | 1 | | 1 | |
| *Robinia pseudoacacia* | black locust | 4 | 2 | 2 | | 1 | 3 |
| *Salix nigra* | black willow | 1 | 1 | 1 | 1 | | |
| *Salix sericea* | silky willow | 4 | 2 | 2 | 2 | 2 | |
| *Sambucus canadensis* | Common Elderberry | 1 | 1 | 1 | | 1 | |
| *Spiraea* | spirea | 13 | 1 | 13 | 13 | | |
| *Tsuga caroliniana* | Carolina hemlock | 1 | 1 | 1 | | 1 | |
| *Vaccinium* | blueberry | 4 | 2 | 2 | | 1 | 3 |
| **Total: 23** | **23** | **259** | **23** | | **100** | **72** | **87** |

| MY5 All Stems Counted by Plot and Species. | | | | | | | |
|---|---|---|---|---|---|---|---|
| Species | CommonName | Total Stems | Number of Plots Species Were Found | Average Number of Stems | Plot 92606-Elkin-VP1-Year:5 | Plot 92606-Elkin-VP2-Year:5 | Plot 92606-Elkin-VP3-Year:5 |
| *Acer rubrum* | Red maple | 4 | 2 | 2 | 1 | | 3 |
| *Acer saccharum* | Sugar maple | 2 | 1 | 2 | | 2 | |
| *Alnus serrulata* | Hazel alder | 70 | 3 | 23.33 | 48 | 19 | 3 |
| *Betula nigra* | River birch | 1 | 1 | 1 | | 1 | |
| *Calycanthus floridus* | Eastern sweetshrub | 1 | 1 | 1 | 1 | | |
| *Carpinus caroliniana* | American hornbeam | 1 | 1 | 1 | | 1 | |
| *Cornus amomum* | Silky dogwood | 6 | 2 | 3 | 3 | 3 | |
| *Crataegus* | Hawthorn | 38 | 1 | 38 | | | 38 |
| *Juglans nigra* | Black walnut | 1 | 1 | 1 | 1 | | |
| *Lindera benzoin* | Northern spicebush | 30 | 3 | 10 | 10 | 3 | 17 |
| *Physocarpus opulifolius* | Common ninebark | 80 | 3 | 26.67 | 29 | 38 | 13 |
| *Prunus serotina* | Black cherry | 11 | 3 | 3.67 | 5 | 1 | 5 |
| *Quercus alba* | White oak | 4 | 2 | 2 | 2 | 2 | |
| *Rhododendron calendulaceum* | Flame azalea | 3 | 2 | 1.5 | | 2 | 1 |
| *Rhododendron catawbiense* | Catawba rosebay | 2 | 2 | 1 | | 1 | 1 |
| *Rhododendron maximum* | Great laurel | 1 | 1 | 1 | | 1 | |
| *Robinia pseudoacacia* | Black locust | 4 | 2 | 2 | | 1 | 3 |
| *Salix nigra* | Black willow | 2 | 2 | 1 | 1 | 1 | |
| *Salix sericea* | Silky willow | 2 | 1 | 2 | 2 | | |
| *Spiraea* | Spirea | 18 | 1 | 18 | 18 | | |
| *Tsuga caroliniana* | Carolina hemlock | 1 | 1 | 1 | | 1 | |
| *Vaccinium* | Blueberry | 4 | 2 | 2 | | 1 | 3 |
| **Total: 22** | **22** | **286** | **22** | | **121** | **78** | **87** |

# Table C.1.8 Planted and Total Stem Counts

| | | | Current Plot Data (MY4 2011) | | | | | | | | | Annual Means | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | E92606-Elkin-VP1 | | | E92606-Elkin-VP2 | | | E92606-Elkin-VP3 | | | MY4 (2011) | | | MY3 (2010) | | | MY2 (2009) | | | MY1 (2008) | | | MY0 (2008) | | |
| **Scientific Name** | **Common Name** | **Species Type** | PnoLS | P-all | T | PnoLS | P-all | T | PnoLS | P-all | T | PnoLS | P-all | T | PnoLS | P-all | T | PnoLS | P-all | T | PnoLS | P-all | T | PnoLS | P-all | T |
| Acer rubrum | red maple | Tree | 1 | 1 | 1 | | | | | | 3 | 1 | 1 | 4 | 1 | 1 | 3 | 1 | 1 | 2 | 1 | 1 | 4 | 1 | 1 | 3 |
| Acer saccharum | sugar maple | Shrub Tree | | | | 2 | 2 | 2 | | | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Alnus serrulata | hazel alder | Shrub Tree | | | 49 | | | 23 | | | 2 | | | 74 | | | 120 | | | 80 | | | 53 | | | 47 |
| *Betula nigra* | river birch | Tree | | | | 1 | 1 | 1 | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 3 |
| *Calycanthus floridus* | eastern sweetshrub | Shrub | | | 2 | | | | | | | | | 2 | | | | | | | | | | | | |
| *Carpinus caroliniana* | American hornbeam | Shrub Tree | | | | 1 | 1 | 1 | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| *Cornus amomum* | silky dogwood | Shrub | | 2 | 3 | | 1 | 4 | | | | | 3 | 7 | | 3 | 4 | | 3 | 3 | | 3 | 3 | | 4 | 4 |
| *Crataegus* | hawthorn | Shrub Tree | | | | | | | | | 43 | | | 43 | | | 55 | | | 59 | | | 4 | | | 14 |
| *Fraxinus pennsylvanica* | green ash | Tree | | | | | | | | | | | | | | | 1 | | | 1 | | | 1 | | | |
| *Juglans nigra* | black walnut | Tree | 1 | 1 | 1 | | | | | | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| *Lindera benzoin* | northern spicebush | Shrub Tree | | | 8 | 2 | 2 | 2 | 1 | 1 | 24 | 3 | 3 | 34 | 4 | 4 | 28 | 4 | 4 | 16 | 5 | 5 | 20 | 6 | 6 | 6 |
| *Physocarpus opulifolius* | common ninebark | Shrub | | 2 | 15 | | | 26 | | | | | 2 | 41 | | 2 | 24 | | 2 | 62 | | 2 | 31 | | 3 | 10 |
| *Prunus serotina* | black cherry | Shrub Tree | | | 3 | | | 1 | | | 6 | | | 10 | | | | | | 14 | | | 5 | | | |
| *Prunus serotina var. serotina* | black cherry | Shrub Tree | | | | | | | | | | | | | | | 1 | | | | | | | | | |
| *Quercus alba* | white oak | Tree | 1 | 1 | 1 | 2 | 2 | 2 | | | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| *Quercus rubra* | northern red oak | Tree | | | | | | | | | | | | | | | | | | 1 | | | 1 | 1 | 1 | 1 |
| *Rhododendron calendulaceum* | flame azalea | Shrub | | | | 2 | 2 | 2 | 1 | 1 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| *Rhododendron catawbiense* | Catawba rosebay | Shrub Tree | | | | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| *Rhododendron maximum* | great laurel | Shrub Tree | | | | 1 | 1 | 1 | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| *Robinia pseudoacacia* | black locust | Tree | | | | 1 | 1 | 1 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 |
| *Salix nigra* | black willow | Tree | | | 1 | | | | | | | | | 1 | | | 3 | | | 1 | | | 1 | | | 1 |
| *Salix sericea* | silky willow | Shrub Tree | | 2 | 2 | | | 2 | | | | | 2 | 4 | | 2 | 5 | | 2 | 3 | | 2 | 2 | | 2 | 2 |
| *Sambucus canadensis* | Common Elderberry | Shrub Tree | | | | | | 1 | | | | | | 1 | | | | | 1 | 1 | | 2 | 2 | | 1 | 1 |
| *Sassafras albidum* | sassafras | Shrub Tree | | | | | | | | | | | | | | | | | | | | | | | | 10 |
| *Spiraea* | spirea | Shrub | | | 13 | | | | | | | | | 13 | | | 7 | | | 3 | | | | | | |
| *Tsuga caroliniana* | Carolina hemlock | Tree | | | | 1 | 1 | 1 | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| *Vaccinium* | blueberry | Shrub Vine Tree | | | | 1 | 1 | 1 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| | | **Stem count** | 3 | 9 | 99 | 15 | 16 | 72 | 9 | 9 | 87 | 27 | 34 | 258 | 28 | 35 | 274 | 29 | 37 | 270 | 32 | 41 | 153 | 35 | 45 | 126 |
| | | **size (ares)** | 1 | | | 1 | | | 1 | | | 3 | | | 3 | | | 3 | | | 3 | | | 3 | | |
| | | **size (ACRES)** | 0.02 | | | 0.02 | | | 0.02 | | | 0.07 | | | 0.07 | | | 0.07 | | | 0.07 | | | 0.07 | | |
| | | **Species count** | 3 | 6 | 12 | 11 | 12 | 17 | 5 | 5 | 10 | 13 | 16 | 23 | 13 | 16 | 22 | 13 | 17 | 24 | 13 | 17 | 23 | 14 | 18 | 22 |
| | | **Stems per ACRE** | 121.41 | 364.22 | 4006.4 | 607.03 | 647.5 | 2913.7 | 364.22 | 364.22 | 3520.8 | 364.22 | 458.64 | 3480.3 | 377.71 | 472.13 | 3696.1 | 391.2 | 499.11 | 3642.2 | 431.66 | 553.07 | 2063.9 | 472.13 | 607.03 | 1699.7 |

## C.2 Vegetation Problem Area Photographs

There were no vegetation problem areas in MY1, MY2 and MY3.

Table C.2.1 Vegetation Problem Areas.

| **Vegetation Problem Areas** | | | | |
|---|---|---|---|---|
| Identification | Feature/Issue | Station Number/Range | Suspected Cause | Photograph Number |
| MY4 | | | | |
| VPA MY4-1 | Left stream bank | 2+20 - 2+40 | Beavers | VPA MY4-1 |
| VPA MY4-2 | Right stream bank | 3+00 - 4+15 | Beavers | VPA MY4-2 |
| VPA MY4-3 | Left stream bank | 4+40 - 4+60 | Beavers | VPA MY4-3 |
| VPA MY4-4 | Left stream bank | 4+90 - 5+15 | Beavers | VPA MY4-4 |
| VPA MY4-5 | Left stream bank | 5+80 - 6+50 | Beavers | VPA MY4-5 |
| MY5 | | | | |
| VPA MY5-1 | Left stream bank | 2+20 - 2+40 | Previous beaver activity | VPA MY5-1 |
| VPA MY5-2 | Right stream bank | 3+75 - 4+15 | Previous beaver activity | VPA MY5-2 |
| VPA MY5-3 | Left stream bank | 4+40 - 4+60 | Previous beaver activity | VPA MY5-3 |
| VPA MY5-4 | Right stream bank | 16+75 - 17+60 | Beaver activity | VPA MY5-4 |

MY4 Vegetation Problem Area Photographs


VPA MY4-1, 14 Apr 11.


VPA MY4-2, 14 Apr 11.


VPA MY4-3, 14 Apr 11.


VPA MY4-4, 14 Apr 11


VPA MY4-5, 14 Apr 11.

MY5 Vegetation Problem Area Photographs


VPA MY5-1, 09 Apr 12.


VPA MY5-2, 21 May 12.


VPA MY5-3, 29 May 12.


VPA MY5-4, 21 May 12.

## C.3 Vegetation Monitoring Plot Photographs


Vegetation plot 92606-01-VP1a, monitoring year 0, 20 Mar 08.


Vegetation plot 92606-01-VP1b, monitoring year 0, 20 Mar 08.


Vegetation plot 92606-01-VP1a, monitoring year 1, 02 Sep 08.


Vegetation plot 92606-01-VP1b, monitoring year 1, 02 Sep 08.


Vegetation plot 92606-01-VP1a, monitoring year 2, 02 Jun 09.


Vegetation plot 92606-01-VP1b, monitoring year 2, 02 Jun 09.


Vegetation plot 92606-01-VP1a,
monitoring year 3, 02 Jul 10.


Vegetation plot 92606-01-VP1b,
monitoring year 3, 02 Jul 10.


Vegetation plot 92606-01-VP1a,
monitoring year 4, 05 Jul 11.


Vegetation plot 92606-01-VP1b,
monitoring year 4, 05 Jul 11.


Vegetation plot 92606-01-VP1a,
monitoring year 5, 14 Jun 12.


Vegetation plot 92606-01-VP1b,
monitoring year 5, 14 Jun 12.


Vegetation plot 92606-01-VP2a, monitoring year 0, 20 Mar 08.


Vegetation plot 92606-01-VP2b, monitoring year 0, 20 Mar 08.


Vegetation plot 92606-01-VP2a, monitoring year 1, 02 Sep 08.


Vegetation plot 92606-01-VP2b, monitoring year 1, 02 Sep 08.


Vegetation plot 92606-01-VP2a, monitoring year 2, 02 Jun 09.


Vegetation plot 92606-01-VP2b, monitoring year 2, 02 Jun 09.


Vegetation plot 92606-01-VP2a, monitoring year 3, 02 Jul 10.


Vegetation plot 92606-01-VP2b, monitoring year 3, 02 Jul 10.


Vegetation plot 92606-01-VP2a, monitoring year 4, 05 Jul 11.


Vegetation plot 92606-01-VP2b, monitoring year 4, 05 Jul 11.


Vegetation plot 92606-01-VP2a, monitoring year 5, 14 Jun 12.


Vegetation plot 92606-01-VP2b, monitoring year 5, 14 Jun 12.


Vegetation plot 92606-01-VP3a, monitoring year 0, 20 Mar 08.


Vegetation plot 92606-01-VP3b, monitoring year 0, 20 Mar 08.


Vegetation plot 92606-01-VP3a, monitoring year 1, 02 Sep 08.


Vegetation plot 92606-01-VP3b, monitoring year 1, 02 Sep 08.


Vegetation plot 92606-01-VP3a, monitoring year 2, 02 Jun 09.


Vegetation plot 92606-01-VP3b, monitoring year 2, 02 Jun 09.


Vegetation plot 92606-01-VP3a,
monitoring year 3, 02 Jul 10.


Vegetation plot 92606-01-VP3b,
monitoring year 3, 02 Jul 10.


Vegetation plot 92606-01-VP3a,
monitoring year 4, 05 Jul 11.


Vegetation plot 92606-01-VP3b,
monitoring year 4, 05 Jul 11.


Vegetation plot 92606-01-VP3a,
monitoring year 5, 14 Jun 12.


Vegetation plot 92606-01-VP3b,
monitoring year 5, 14 Jun 12.