North Fork Mountain Creek
Stream & Wetland Restoration

Year 2 of 7 Final Monitoring Report

Catawba County, North Carolina
NCEEP Project Number: 94151
Contract Number: 002024

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1.0 SUMMARY

This annual monitoring report details the geomorphology, hydrology, and vegetation monitoring activities completed during the 2013 (Year 2 of 7) growing season on the North Fork Mountain Creek Stream & Wetland Mitigation Site. Construction of the site, including planting of trees and shrubs, was completed in May 2012.

This report presents the results of data collected from 26 cross sections, 2 crest gauges, 10 automated groundwater monitoring stations, 1 automated rain gauge, 14 vegetation monitoring plots, and 31 photographic reference locations; as specified in the approved Restoration Plan and Baseline Report (EBX 2009, 2012). Comparisons to reference data and the baseline report are included. Per EEP's request, a 7-year monitoring protocol was adopted at the end of MY2. To meet requirements of this protocol, bank pin arrays were installed at 12 monitored pool cross section locations at the beginning of MY3 and will be monitored during each scheduled cross-section monitoring event.

The stream design for the North Fork Mountain Creek Site involved restoration and enhancement associated with four stream reaches. Wetland components included riparian wetland restoration and creation. The Baseline survey documented the project generated 5,299 stream mitigation units and 2.81 riparian wetland mitigation units. An additional 0.97 acres of existing wetlands were preserved on the site; however, no mitigation credit is being claimed for this wetland preservation acreage per RFP 16-001117.

The Year 2 stream channel data indicates that the restored stream is generally stable and is providing the intended habitat and hydrologic functions. With the exception of several isolated areas of stream bed aggradation/degradation, the cross sections and visual assessments indicate little adjustment in stream dimension when compared to the as-built conditions. One bankfull event occurred at the project site during 2013.

During MY2, eight of the ten groundwater gauges met the 8% hydroperiod success criteria. Hydroperiods within 12 inches of the surface ranged from approximately 1.7 to 53.8 percent. Of note, gauge malfunctions on site led to missing data at all gauges between July 26 and August 15, resulting in the maximum number of consecutive days being limited to 127 days (53.8%). Values for gauges 3, 6, 7, 8, and 9 may be lower as a result. Looking in comparison, groundwater at the South Fork reference site met the criteria for 100 percent during the growing season (Table 7; Appendix E). Rainfall data indicate precipitation at the North Fork Mountain Creek was about 29% below normal for Catawba County (Table 8) over the period monitored in 2013. In comparison, precipitation was approximately 20% above normal at the Hickory NC-CT-2 station.

Vegetation plot data for Year 2 indicates planted stem densities were between 607 and 1,295 stems per acre with an average of 910 planted stems per acre for the entire restoration site. Only 1% of planted stems were dead or missing. Five commonly encountered woody volunteer species were document during the vegetation surveys. Herbaceous vegetation in plots dropped from 97% coverage in MY1 to 82% coverage in MY2; however, with the exception of a several small depauperate areas, was well established throughout the project site. Herbicide treatment of exotic invasive plants scattered throughout the site contributed to the success of the herbaceous vegetation.

Summary information/data related to the occurrence of such things as beaver or encroachment, and statistics related to performance of various project and monitoring elements can be found in the tables and figures in the report appendices. Additional background and supporting information can be found in the Baseline Monitoring Report (EBX 2012) and in the Mitigation Plan (EBX 2011) documents.

2.0 INTRODUCTION

2.1 Project Description

The North Fork Mountain Creek Stream and Wetland Mitigation Site was identified and developed through the North Carolina Ecosystem Enhancement Program (NCEEP) full delivery process. The site is located approximately six miles south of Catawba, North Carolina in southeastern Catawba County (Figure 1). The project lies within the Piedmont physiographic region (NCGS 2004) and USGS (2002) Level III ecoregion. The North Fork Mountain Creek watershed is within Catawba River Basin 14-digit Hydrologic Unit Code 03050101150030 and the North Carolina Division of Water Quality (NCDWQ) sub-basin 03-08-32 (NCDWQ 2010).

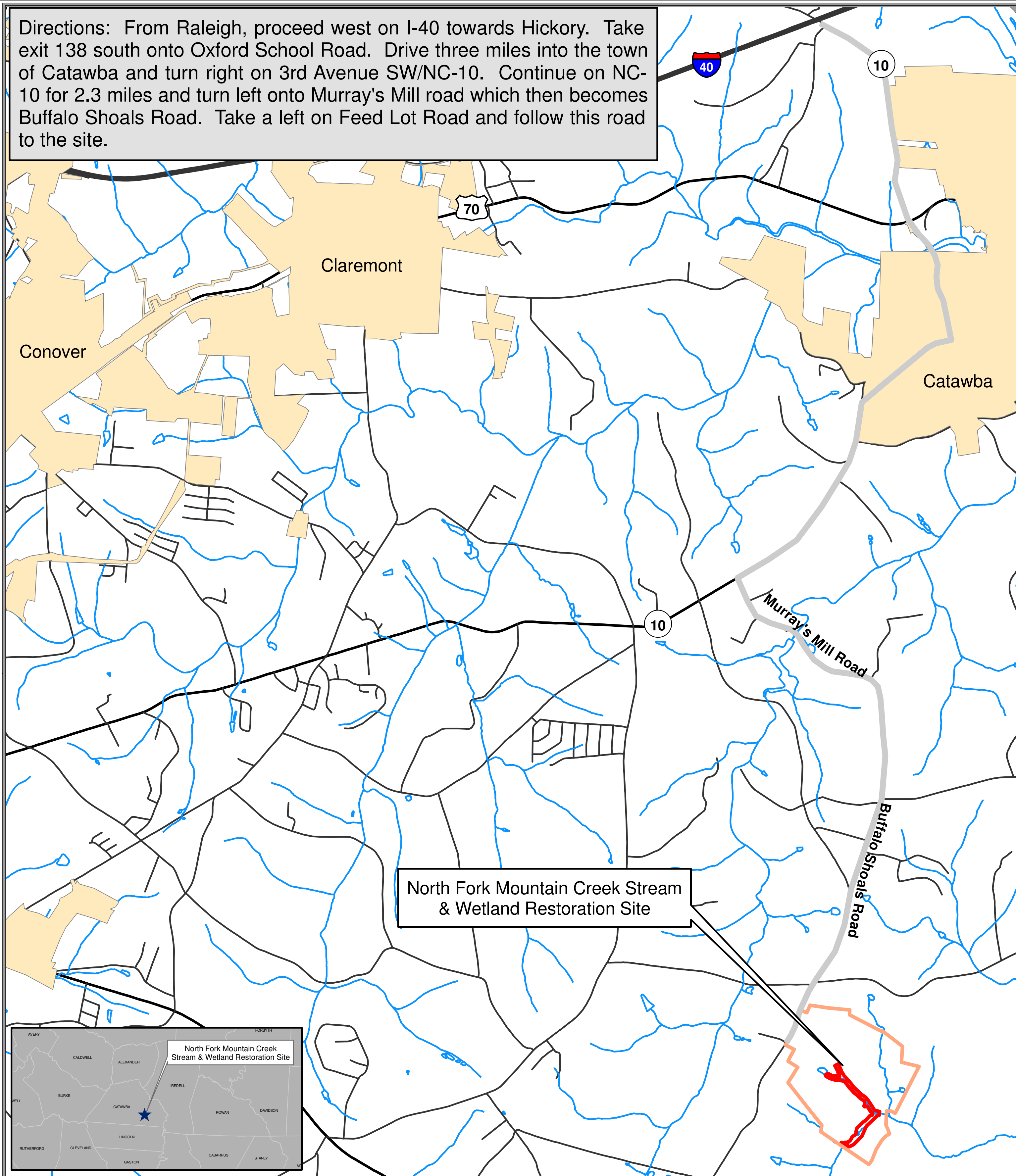
The project drains 960 acres of the North Fork Mountain Creek watershed that ranges in elevation from 875 to 1,065 feet above mean sea level (Figure 2). According to the Catawba County soil survey (NRCS 2010) the riparian corridor of the entire project is underlain by Chewacla loam (ChA) soils.

The mitigation site encompasses 17.2 acres containing 5,299 linear feet (lf) of stream channel and 4.44 acres of wetlands. The project consists of four reaches; reach 1 is on the mainstem of North Fork Mountain Creek, while reaches 2, 3, and 4 are on primary and secondary unnamed tributaries (UT1 and UT2) of North Fork Mountain Creek (Figure 3). An additional 0.97 acres of existing wetlands were preserved on the site; however, no mitigation credit is being claimed for this wetland preservation acreage per RFP 16-001117.

Channel restoration involving improved pattern, dimension, and longitudinal profile was completed on all four stream reaches. Priority I and II approaches were applied to the mainstem North Fork Mountain Creek (Rosgen 1996; NCSRI 2004), while only a Priority II approach was used on the tributary reaches. A total of 1.17 acres of wetlands were restored along reaches 1, 2, 3, and 4, while 3.27 acres of wetlands were created along reaches 2 and 4 (Figure 3).

Prior to restoration the stream channels and wetlands were highly disturbed due to the presence of livestock that had unrestricted access to the riparian areas and stream channels. The riparian vegetation was decimated by overgrazing and trampling. The subsequently bare banks were then subject to severe erosion that was only exacerbated by hooves of the cattle.

The 2013 monitoring season represents Year 2 (MY2) of the required seven-year monitoring period. Monitoring during 2013 included stream, wetland, and vegetation monitoring stations (Figure 3) as approved in the Baseline Monitoring Plan (EBX 2012).



EBX

EQUINOX ENVIRONMENTAL CONSULTATION & DESIGN

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Figure 1. Vicinity Map
North Fork Mountain Creek
Mitigation Site
Catawba County, NC

0 0.5 1 2 Miles

Property Boundary
Easement
Streams
Roads

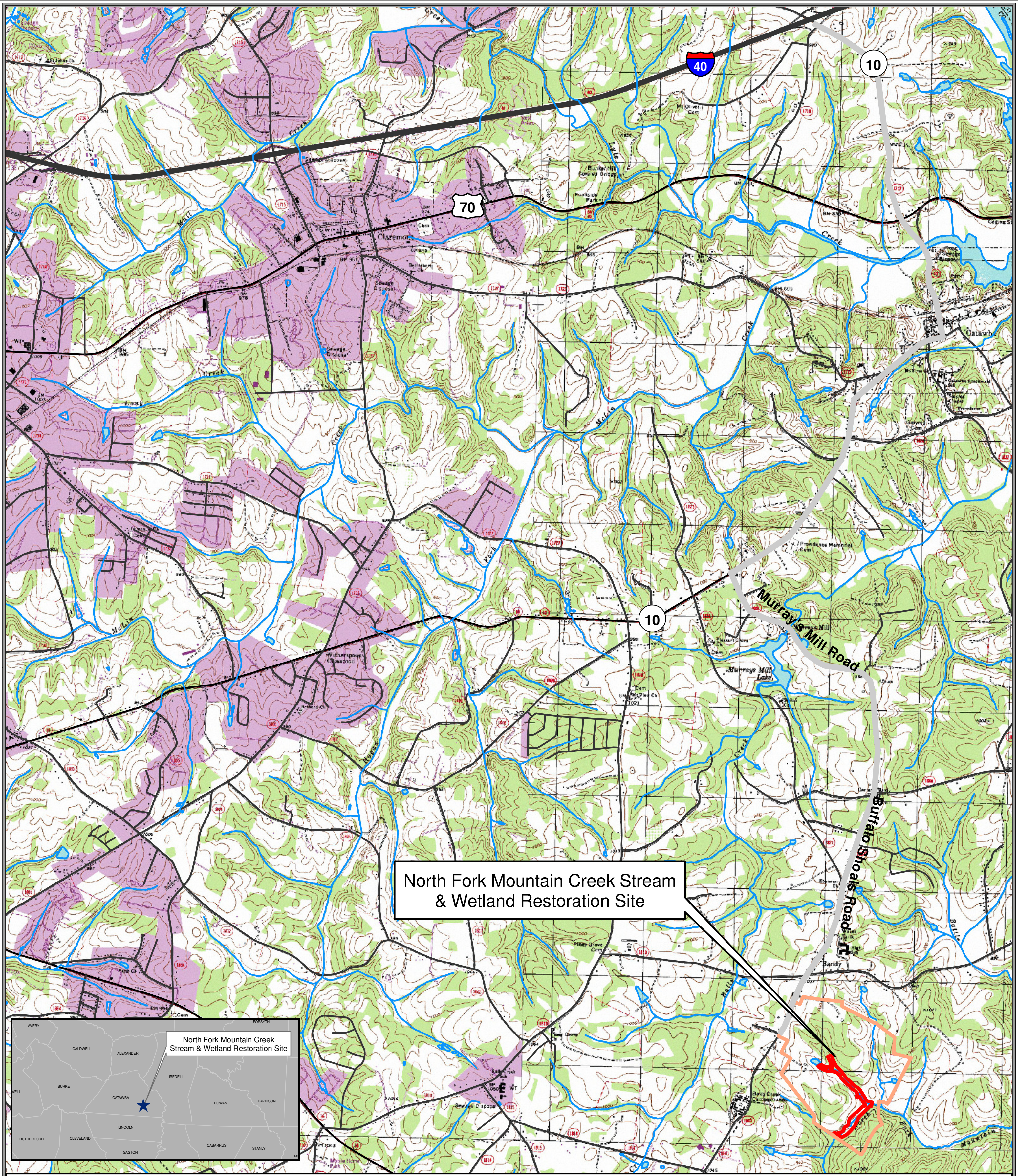
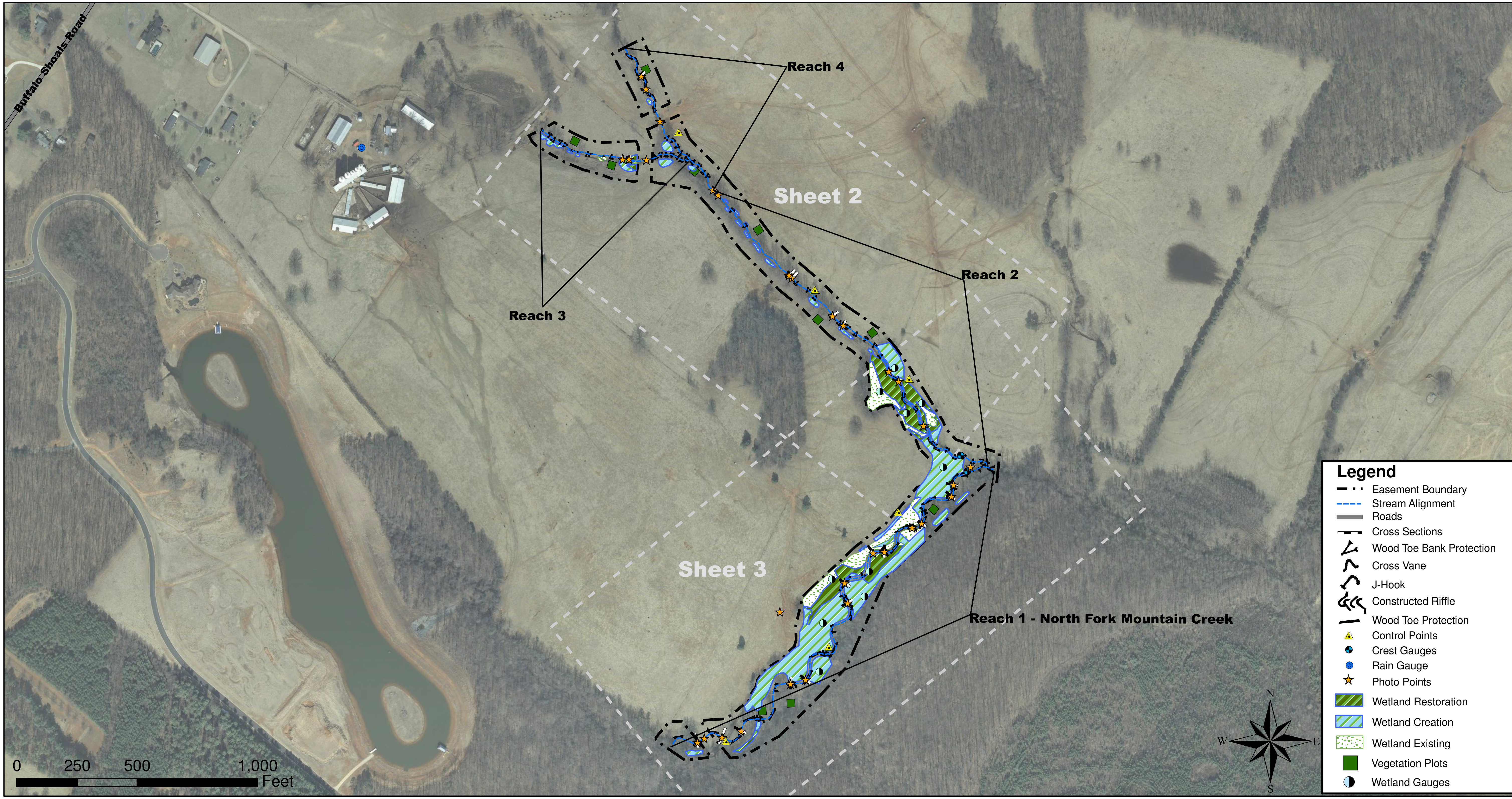


Figure 2. USGS Map
North Fork Mountain Creek
Mitigation Site
Catawba County, NC

Property Boundary
Easement
Streams
Roads

0 0.5 1 2 Miles

Figure 3. Monitoring Plan



Prepared for	Project: North Fork Mountain Creek Stream and Wetland Restoration Monitoring Plan Catawba County, North Carolina	Notes: 1) 2010 Aerial Photo 2) Base Map Data Provided by Stantec.	Prepared by
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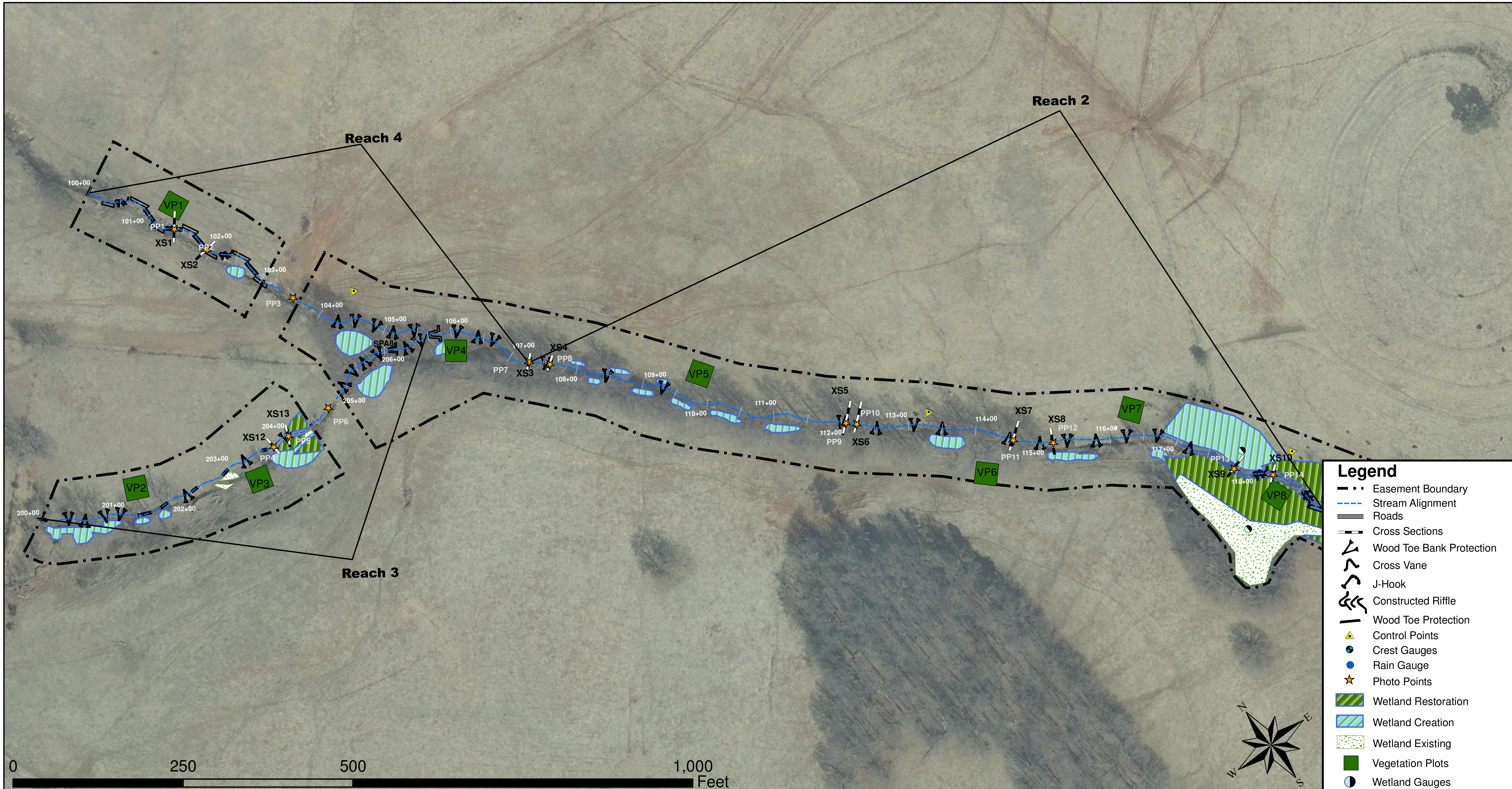
Figure 3. Monitoring Plan



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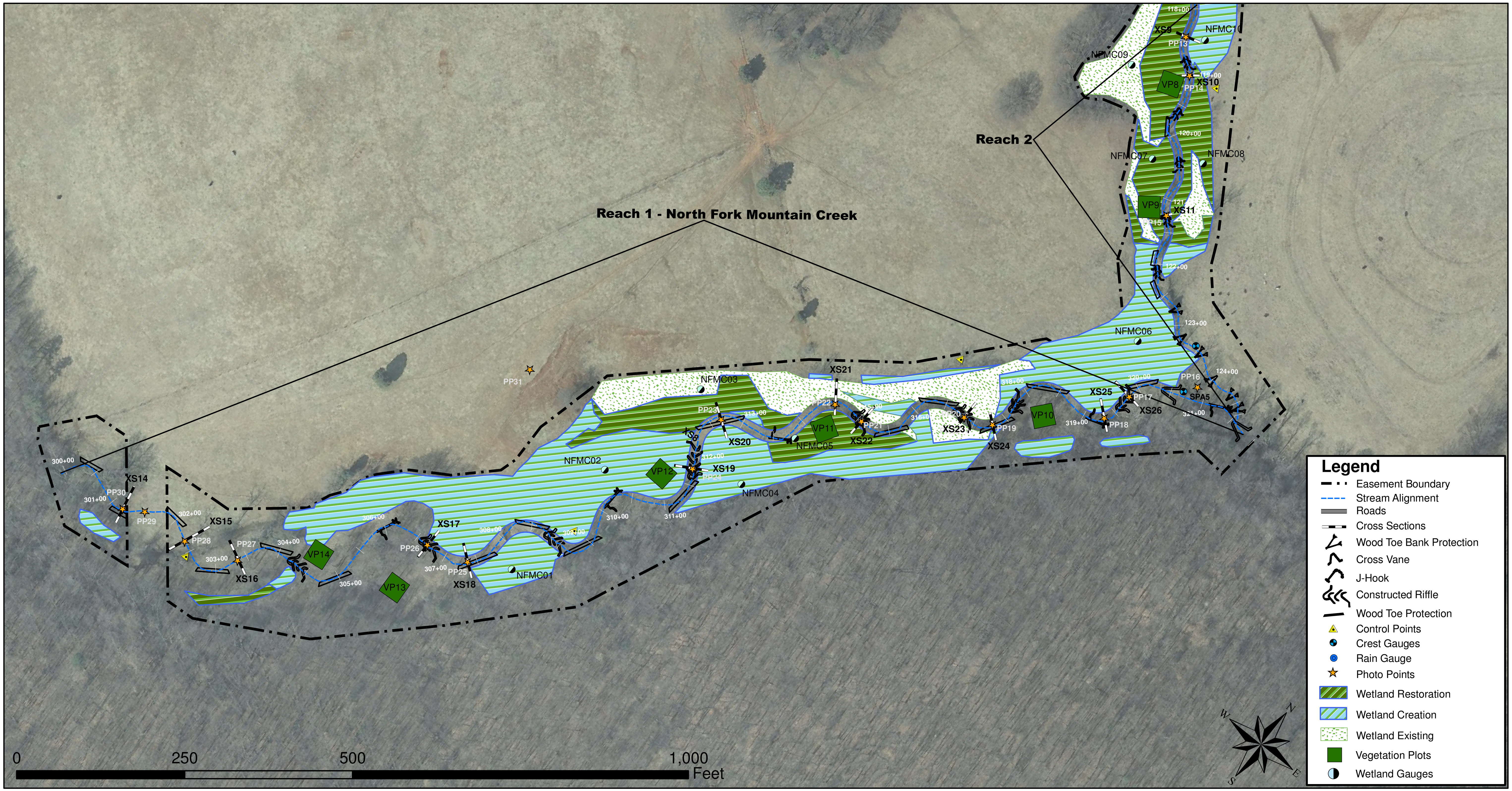
EBX	Sheet 2 of 3		EQUINOX ENVIRONMENTAL CONSULTATION & DESIGN
		Project Number	
		NCEEP # 94151	

Figure 3. Monitoring Plan



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2.2 Project Purpose

The objective of the project was to provide 5,000 stream mitigation units (SMU's) and 3.4 riparian wetland mitigation units (WMU's) for the NCEEP full delivery process in the Catawba 03-08-32 sub-basin. In conjunction with providing mitigation credits; riparian habitat, aquatic habitat, and water quality improvements are an expected result of the ecological restoration and enhancement practices implemented on this site.

The North Fork Mountain Creek Baseline Report (EBX 2012) documented 5,299 linear feet of stream restoration (Table 1). Wetland mitigation components stated within the Baseline Report documented restoration of 1.17 acres of riparian wetlands and creation of an additional 3.27 riparian wetlands for a total of 2.81 WMUs (Table 1). An additional 0.97 acres of existing wetlands were preserved at the site, but for which no WMU credits were allowed per the RFP.

Table 1. Project Mitigation Structure and Objectives

Reach Name	As-Built Length (feet)	Riparian Wetland (acres)	Non-Riparian Wetland (acres)	Total Wetland (acres)	Restoration Approach
NFMC-4	2,231				Restoration – P1/P2
UT1-1	698				Restoration – P1
UT1-2	1,756				Restoration – P1
UT2-3	614				Restoration – P1
W-R[1]		1.17		4.44	Restoration
W-C[1]		3.27[2]			Creation
W-P[1,3]		0.97[3]		0.97[3]	Preservation
Total Site	5,299	4.44		4.44	
Total Mitigation Units	5,299	2.81			

[1]W-R = wetlands restoration; W-C = wetlands creation; W-P = wetlands preservation.
[2]Wetland creation mitigation ratio was 2:1 as agreed upon with the USACE during the 401/404 permitting process (EBX 2012).
[3]Existing wetlands were preserved on the site, but no WMUs were credited to the project.

Annual monitoring of the site is required to demonstrate successful mitigation based on criteria established in the Restoration Plan (EBX 2011) and through a comparison to as-built and reference conditions (EBX 2012). The success criteria components adhere to guidance provided by the United States Army Corps of Engineers (USACE) – Wilmington District (USACE 2003; NCEEP 2011) and as prescribed by NCEEP in the restoration plan. Stream, hydrology, and vegetation monitoring are conducted annually for seven years or until success criteria have been met. This Annual Monitoring Report details the results of the monitoring efforts for MY2 at the North Fork Mountain Creek Stream and Wetland Mitigation Site. Findings of the MY2 monitoring efforts are described within the following sections and noted on the current condition plan view (CCPV) in Appendix A.

2.3 Project History and Schedule

Construction was completed in the spring of 2012 and the seventh year of monitoring is expected to be completed by the end of 2018 (Table 2). Service providers and primary contacts for the North Fork Mountain Creek project are listed in Table 3.

Table 2. Project Activity and Reporting History

Activity or Report	Data Collection Complete	Completion or Delivery
Restoration Plan	July 2011	July 2011
Final Design - Construction Plans	N/A	October 2011
Construction	N/A	May 2012
Temporary S&E mix applied to entire project	N/A	May 2012
Permanent seed mix applied to Reach	N/A	May 2012
Mitigation Plan / As-Built (Year 0 Monitoring - baseline)	June 2012	August 2012
Exotic Invasive Plant Control	June 2012	June 2012
Year 1 Monitoring – 2012	December 2012	January 2013
Year 2 Monitoring – 2013	November 2013	November 2013
Year 3 Monitoring – 2014		
Year 4 Monitoring – 2015		
Year 5 Monitoring – 2016		

Table 3. Project Contacts (NCEEP Project No. 94151)

Contact	Provider Information
Designer Primary Project Design POC	Stantec Consulting, Inc. 801 Jones Franklin Rd. Suite 300 Raleigh, NC 27606 David Bidelspach (919) 218-0864
Construction Contractor Construction Contractor POC	North State Environmental, Inc. 2889 Lowery St. Winston-Salem, NC 27101 Darrell Westmoreland (336) 725-2010 Nate Martin (336) 725-2010
Planting Contractor 1 Planting Contractor 1 POC	New Forest Services 313 Condon Road Manistee, MI 49660 Brian Jarvinen (231) 590-9198
Planting Contractor 2 Planting Contractor 2 POC	Strader Farms, LLC Kenneth Strader
Seed Mix Sources	Green Resource 5204 Highgreen Court Colfax, NC 27235
Nursery Stock Suppliers	ArborGen (Trees and Livestakes) Blenheim, SC Strader Farms (Livestakes)
Baseline Monitoring Performers (Year 0)	Stantec Consulting Services, Inc. 801 Jones Franklin Rd Suite 300 Raleigh, NC 27606
Stream Monitoring POC	Tim Taylor (704) 329-0900
Vegetation Monitoring POC	N/A
Wetland Monitoring POC	N/A
Annual Monitoring Performers (Year 1-5)	Equinox Environmental Consultation and Design, Inc. 37 Haywood St. Suite 100 Asheville, NC 28801
Stream Monitoring POC	Steve Melton (828) 253-6856
Vegetation Monitoring POC	Steve Melton (828) 253-6856
Wetland Monitoring POC	Steve Melton (828) 253-6856

3.0 STREAM MONITORING

The following success criteria descriptions are taken verbatim from the North Fork Mountain Creek Restoration Plan (EBX 2011).

3.1 Stream Success Criteria

Success criteria pertain to the stability of the restored channel's dimension, pattern, and sediment transport. The restored channel must demonstrate the general maintenance of a stable cross-section and have hydrologic access to the floodplain over the monitoring period. The restoration reach should mimic reference reach conditions and the channel will be considered stable if there are little or insignificant changes from the as-built dimensions. Some change in stream dimension is natural and expected.

3.1.1 Pattern Features and Cross-section Dimensions

Traditionally, the success of a stream's pattern and dimension is determined utilizing the dimensionless ratios of reference reaches. The range of values for the dimensionless ratios of the reference reaches are applied to the design reaches. In this case, design reaches are deemed successful if the variability of its pattern and dimension remain within the range of the dimensionless ratios taken from the reference reaches, plus or minus one-half the value of that range. For the North Fork Mountain Creek restoration project, dimensionless ratios of the design reaches vary slightly from the dimensionless ratios of the reference reaches. As a result, the restoration will be determined to be successful if the dimensionless ratios of the pattern and dimension of the restoration reaches remain within their 'as-built' range, plus or minus one-half the value of the range of the dimensionless ratios of the reference reaches. Pattern features (bedform distributions and riffle/pool lengths and slopes) should demonstrate little adjustment within the 7-year monitoring period. In terms of sediment transport, no significant trend in the aggradational or depositional potential of the restoration reaches should occur over the monitoring period. A minimum of two-bankfull events must be documented by crest gage [data] within the standard monitoring period.

3.2 Stream Morphology Monitoring Plan

The stability of the stream channel is being monitored for 7 years or until success criteria are met. The entire project is being monitored in depth for cross-sectional dimension and substrate composition as detailed below. These monitoring data are being collected in years 1, 2, 3, 5, and 7. The locations of the individual stream monitoring components described below are shown in Figure 3. The monitoring plan incorporates modified monitoring requirements as issued by NCEEP (2011) that were not specified in the original restoration plan (EBX 2011).

3.2.1 Visual Assessment

A visual assessment of stream stability is achieved by walking the all project reaches. Visual assessments are included to identify problem areas not encountered during cross-section measurement or visible in the graphical and tabular presentations of the monitoring data. Problem areas found during the visual assessments are documented by photos in Appendix D and their locations displayed on the CCPV (Appendix A).

3.2.2 Cross-Sections

A total of 26 cross-sections were installed as part of the baseline data collection effort; 14 in riffles and 12 in pools. Cross-sectional measurements are being collected in years 1, 2, 3, 5, and 7. Data collected and calculated for each cross-section will include, at a minimum, cross-sectional area, bankfull width, bankfull mean depth, bankfull max depth, flood-prone width, width-to-depth ratio, and entrenchment ratio. Stream type will be determined in riffle cross-sections only. Data is reported in graphical and tabular formats with each year's data overlain on the plots to allow changes in cross-sectional dimensions to be identified. Post-restoration, BEHI and near bank stress will not be monitored.

3.2.3 Bank Pin Arrays

At the beginning of MY3, a total of 12 bank pin arrays were installed at each monitored pool cross-section to measure erosion on the project site. Pins were installed flush with the face of the stream bank, and length of exposed pin will be documented at each cross-section monitoring event.

3.2.4 Longitudinal

As per the recent guidance issued by NCEEP (2011), longitudinal profile data is collected only during the baseline survey unless monitoring demonstrates channel bank or bed instability, in which case the USACE may require additional channel profile data be collected from channel reaches of concern and to track changes in the channel stability. In lieu of the longitudinal profile data, extra cross-sections are being monitored. Should the USACE require longitudinal data be collected, they will be included in Appendix C of the monitoring reports and compared to baseline conditions.

3.2.6 Pattern

As per the recent guidance issued by NCEEP (2011), pattern data is collected only during the baseline survey unless monitoring demonstrates channel bank or bed instability, in which case the USACE may require additional channel profile data be collected from channel reaches of concern and to track changes in the channel stability. In lieu of the longitudinal profile data, extra cross-sections are being monitored. Should the USACE require longitudinal data be collected, they will be included in Appendix C of the monitoring reports and compared to baseline conditions.

3.2.5 Substrate

Pebble counts are being taken during monitoring years 1, 2, 3, 5, and 7 at each of the 14 riffle cross-sections (Figure 3) as well as one reach-wide count within each of the four delineated stream reaches (EBX 2012). Pebble counts are collected utilizing methods adapted from Harrelson et al. (1994). At each sample locations a minimum of 100 particles are selected at random and measured. Sampled materials are placed into size classes using the traditional Wentworth scale classes subdivided based on phi scale. These classes are grouped into broader sediment size categories (e.g. sand, gravel, or cobble) and are utilized to compare substrate changes from as-built conditions. Data is reported in graphical and tabular formats with each year's data overlain on the plots to allow trends in substrate composition to the identified. The D50, D84, and D95 particle sizes will be identified.

3.2.6 Photo Reference Stations

A total of 31 photo stations were established throughout the site to subjectively evaluate overall trends in project progression and general site conditions over the duration of the monitoring effort. For convenience, the photo stations were renumbered in a more logical sequence that differs from the baseline document (EBX 2012) and are labeled on the CCPV to correspond with the photos in Appendix D. Additionally, the entire site is visually assessed annually to document stream (SPA) and wetland (WPA) problem areas. Once identified, problems areas will be monitored and conditions photo-documented in all subsequent monitoring years.

3.3 Stream Morphology Monitoring Results

The MY2 annual reference station photos were taken in January 2013 to document general conditions of the site. Stream cross-section and substrate data were collected in July 2013. Visual assessments and bankfull flow documentation were noted during each site visit.

3.2.1 Visual Assessment

Results from the MY2 visual monitoring effort indicated that all reaches generally remain in a stable condition and are functioning as designed. Several areas of riffle degradation and piping through structures were identified (Table 4 and Appendix D). Additionally, one area of Japanese honeysuckle (*Lonicera japonica*) and one area of low stem densities was identified within the easement. Prior to the MY1 visual assessment, other invasive exotic plants such as multiflora rose (*Rosa multiflora*), privet (*Ligustrum sp*.), and Johnson grass (*Sorghum halepense)* were found to be scattered throughout the easement area (Appendix A). Herbicides were applied to control these plants and to allow the new vegetation to become established. The herbicide treatments were effective in eliminating many of these plants. The treated areas will be closely observed for the remainder of the monitoring period.

Table 4. Stream and Vegetation Problem Areas Requiring Observation

Problem Area and Type[1]	Feature	Reach	STA	Description	Recommendation
1-S	Riffle	1	305+50	Degradation	Continue to monitor
2-S	Riffle	1	318+50	Degradation	Continue to monitor
3-S	Riffle	1	320+50	Degradation	Continue to monitor
4-S	Riffle	1	315+75	Degradation	Continue to monitor
5-S	Riffle	1	314+00	Degradation	Continue to monitor
6-S	Riffle	1	310+00	Degradation	Continue to monitor
7-S	Riffle	1	308+00	Degradation	Continue to monitor
8-S	Riffle	2	123+25	Degradation	Continue to monitor
9-V	Bench	2	118+00	Low Stem Density	Replant
10-V	Easement	3	201+50	Exotic Invasive	Treatment
11-S	Riffle/Structure	4	101+50	Stressed Structure	Continue to monitor
12-S	Structure	4	102+30	Stressed Structure	Continue to monitor

[1]S = stream problem area; V = vegetation problem area

3.3.2 Cross-Sections

Cross-sectional data collected during MY2 have been compared with the baseline data set (Table 5; Appendices B and C). Except for cross-sections 9, 11, and 21, the MY2 channel cross-sectional data shows minimal changes since the baseline data were collected, indicating that the overall stream dimensions have remained stable. Cross-sections 9 and 21 have cut down approximately 0.5 feet. MY1 data at cross-section 11 indicated that the bank migrated laterally approximately 2.5 feet when compared to the baseline data; however, field observation determined this to be incorrect and was attributed to inconsistencies in surveying the correct pins between monitoring years. Cross-section data for MY1 and MY2 data are consistent, suggesting that the initial baseline survey may have used the incorrect pin when surveying. The misalignment of cross-sections 1 and 2 were due to the fact that the baseline survey pins could not be located and new pins were installed for the MY1 survey. Every effort was made to install the new pins as close as possible to the original cross-section location.

Table 5. Summary of Mean Morphologic Monitoring Parameter Values

North Fork Mountain Creek – Reach 1 (n = 8)						
Parameter	**As-Built[1]**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Bankfull Cross-Section Area Abkf (sq ft)	22.3	21.0	18.8			
Bankfull Width Wbkf (ft)	18.6	18.8	17.8			
Bankfull Width/Depth Ratio	15.7	17.0	17.6			
Bankfull Mean Depth Dbkf (ft)	1.2	1.1	1.0			
Bankfull Max Depth Dmax (ft)	2.1	2.2	2.1			

[1]As-built data taken from Stantec (2012).

Unnamed Tributary 1 – Reach 2 (n = 5)						
Parameter	**As-Built[1]**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Bankfull Cross-Section Area A_{bkf} (sq ft)	8.9	8.0	8.6			
Bankfull Width W_{bkf} (ft)	12.0	11.8	11.9			
Bankfull Width/Depth Ratio	18.5	18.3	17.4			
Bankfull Mean Depth D_{bkf} (ft)	0.7	0.7	0.7			
Bankfull Max Depth D_{max} (ft)	1.4	1.4	1.6			

[1]As-built data taken from Stantec (2012).

Table 5 Continued. Summary of Mean Morphologic Monitoring Parameter Values

Unnamed Tributary 1 – Reach 4 (n = 1)						
Parameter	**As-Built[1]**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Average Bankfull Cross-Section Area A_{bkf} (sq ft)	4.7	4.2	3.1			
Average Bankfull Width W_{bkf} (ft)	7.8	8.4	8.4			
Average Bankfull Width/Depth Ratio	12.8	16.5	22.8			
Average Bankfull Mean Depth D_{bkf} (ft)	0.6	0.5	0.4			
Average Bankfull Max Depth D_{max} (ft)	0.9	0.8	0.6			

[1]As-built data taken from Stantec (2012).

Unnamed Tributary 2 – Reach 3 (n = 1)						
Parameter	**As-Built[1]**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Bankfull Cross-Section Area A_{bkf} (sq ft)	4.2	3.8	3.8			
Bankfull Width W_{bkf} (ft)	7.2	8.3	7.9			
Bankfull Width/Depth Ratio	12.5	17.9	16.4			
Bankfull Mean Depth D_{bkf} (ft)	0.6	0.5	0.5			
Bankfull Max Depth D_{max} (ft)	1.0	0.9	0.9			

[1]As-built data taken from Stantec (2012).

3.3.3 Bank Pin Arrays
Bank pin arrays were not installed until the beginning of MY3. Data will be reported in future monitoring reports.

3.3.4 Longitudinal Profile
Longitudinal profile data were not collected as part of the MY2 monitoring effort. It will be collected only if the USACE determines it is necessary to document channel instability. Baseline longitudinal profile attributes are documented in Appendix C.

3.3.5 Pattern
Pattern data were not collected as part of the MY1 monitoring effort. It will be collected only if the USACE determines it is necessary to document channel instability. Baseline pattern attributes are documented in Appendix C.

3.3.6 Substrate
Pebble count data collected during MY2 indicates that, with the exception of Reach 4, substrates are fairly evenly distributed among size classes (Appendix B). Reach 4 is dominated by silt/clay

particles, most likely a result of cattle access upstream of the project; however, this could also be a result of excessive vegetation in the channel trapping fine sediments. Of note, substrate in Reaches 1 and 2 were noticeably coarser this year; possibly as a result of high flows in spring and early summer flushing fine sediments out of the riffles.

3.3.7 Photo Reference Stations

The MY2 reference station photos are included in Appendix D. Other than the problem areas identified in the visual assessment, the site is performing well. Stream channels and banks are stable with no significant bank erosion or sloughing. Vegetation, both herbaceous and woody stems in the wetland and upland areas, appears to becoming well established throughout the site. With but one exception, exotic invasive plant infestations have not become established.

3.4 Stream Conclusions

The MY2 morphological monitoring and visual assessments indicate a stable system when compared to the as-built conditions (Tables 4 and 5; Appendices B and C). While the majority of pools and riffles were of appropriate depth, stream areas of concern identified during MY2 were primarily associated with isolated cases of riffle degradation. These areas, along with the two vegetation problem areas, will be monitored during subsequent years to document changes in their function. If it is determined these areas become problematic to project success, repair recommendations will be proposed and appropriate action will be taken.

4.0 HYDROLOGY

4.1 Hydrologic Success Criteria

4.1.1 Streams
A minimum of two-bankfull events must be documented by the crest gages within the 7-year monitoring period. Qualifying events may not occur within the same monitoring year.

4.1.2 Wetlands
As per USACE guidelines, wetlands exhibiting water within 12 inches of the surface consecutively between 5% and 12.5% of the growing season in most years may be considered wetlands (USACE 1987, 1992). The growing season at the North Fork Mountain Creek site extends from March 21 to November 11, a total of 236 days (EBX 2012). Restored wetland hydrology is being compared to reference wetland hydrology both on-site and at the South Fork project (NCEEP Project No. 346, unpublished data). Based on data collected on-site, an 8% hydroperiod will be used as success criteria for this project.

4.2 Hydrology Monitoring Plan

4.2.1 Streams
Two crest gages were installed on the site post-construction (Figure 3); one is located on Reach 1 - North Fork Mountain Creek, while the other is positioned on the lower end of Reach 2 on UT1. The crest gauges are being monitored to verify the occurrence of bankfull events over the 5-year monitoring period. The crest gauges are checked during each site visit to document the highest flow between visits. Gauge height readings are recorded during each visit; digital images of floodplain debris lines and sediment deposition are being taken to document annual bankfull events.

4.2.2 Wetlands
Visual monitoring of all wetland creation and restoration areas are being conducted two times per year and a minimum of five months apart, in each of the required five years of post-construction monitoring. Visual monitoring is conducted by walking through each wetland area to identify and document areas of low stem densities or poor plant vigor, invasive plant species, beaver activity, herbivory, easement encroachments, indicators of livestock access, or other issues of concern.

Groundwater-Groundwater levels within the wetland creation and restoration areas are being monitored using 10 automated groundwater gauges (Figure 3). The groundwater gauges are distributed across the project site and in association with both existing and created/restored wetland areas. The gauges were installed at a minimum depth of 48 inches below the ground surface. Groundwater levels will be monitored annually for all five years unless the success criteria are not met at which time the USACE may require additional monitoring. At a minimum, the gauges will continuously record groundwater levels for the entire growing season, March 21 through November 11, as described in the Baseline Report (EBX 2012).

As stated in the Restoration Plan (EBX 2011), the hydrology success criteria for the North Fork Mountain Creek site is based on improvements to the frequency and duration of soil saturation of the restored wetlands. Wetland performance will be compared to both on-site and off-site (South Fork Project; NCEEP Project Number 346, unpublished data) reference gauge data. The groundwater hydrological characteristics of the existing reference wetlands serve as the target performance standard for the restored wetlands. The restored wetlands are in similar landscape positions and should have hydrological responses similar to the reference wetlands.

To determine the average daily groundwater level, wetland gauges record water level in the monitoring wells twice a day. Suspected erroneous readings are checked to validate the readings. Where inconsistencies occur, the erroneous measures are excluded from the daily average calculations.

Rainfall-As part of the monitoring program automated rain gauges were installed on-site and at the South Fork project locations. They are located in open areas to prevent inaccurate readings due to overhead vegetation. The gauges automatically record rainfall with a tipping bucket calculated to record to 0.01 of an inch. Rain gauge data is downloaded bi-monthly and the units checked for malfunctions at the same time. Daily rainfall readings are summed to obtain monthly totals. Additional rainfall data for corresponding periods is downloaded from the NCCRONOS (2012) web site for the Hickory NC-CT-2 weather station. Long-term precipitation data for Catawba County was obtained from the NRCS National Water and Climate Center (NRCS 2002) web site.

Data Interpretation- The following hydroperiod statistics were calculated for each monitoring station:

1) Most consecutive days and percent of the growing season that the water table was within 12 inches of the soil surface;
2) Cumulative number of days and percent of growing season that the water table was within 12 inches of the soil surface; and
3) Number of times the water table rose to within 12 inches of the soil surface.

Individual groundwater and rain gauge data graphs were plotted and are presented in Appendix E. The graphs provide a visual representation of the relationship between rainfall events and groundwater level fluctuations among gauges. These comparisons are used to evaluate groundwater levels in relation to the hydrologic success criteria.

4.3 Results of Hydrology Monitoring

4.3.1 Streams

Since project completion in June 2012 two bankfull events have occurred at the project site. An initial bankfull event occurred in August 2012, which registered 0.58 feet above bankfull on UT1 - Reach 2 (Table 6). The crest gauge on North Fork Mountain Creek - Reach 1 was damaged from the event and, as a consequence, the water level above bankfull could not be determined; however, the event was photo-documented (Appendix D). A second event was documented using wrack lines in January 2013.

Table 6. Crest Gauge Data

Month/Year Recorded	Documentation[1]	North Fork Mountain Creek Reach 1 (feet above bankfull)	UT1 Reach 2 (feet above bankfull)
August 2012	Crest Gauge/Wrack Lines	--[2]	0.58
January 2013	Wrack Lines	--	--

[1]See Appendix D for photo documentation.
[2]Crest Gauge was damaged from bankfull event; no reading was obtained.

4.3.2 Wetland Hydrology

During MY2, eight of the ten groundwater gauges met the 8% hydroperiod success criteria. Hydroperiods within 12 inches of the surface ranged from approximately 1.7 to 53.8 percent. Of note, gauge malfunctions on site led to missing data at all gauges between July 26 and August 15, resulting in the maximum number of consecutive days being limited to 127 days (53.8%). Values for gauges 3, 6, 7, 8, and 9 may be lower as a result. Looking in comparison, groundwater at the South Fork reference site met the criteria for 100 percent during the growing season (Table 7; Appendix E).

Cumulatively, nine of the ten gauges showed groundwater levels to be within 12 inches of the surface during the growing season. Values ranged between 3.8 and 91.1 percent of the growing season. Groundwater levels at the South Fork reference site appear to have been within 12 inches of the surface for 100% of the growing season if errant data are ignored.

Rainfall data indicate precipitation at the North Fork Mountain Creek was about 29% below normal for Catawba County (Table 8) over the period monitored in 2013. In comparison, precipitation was approximately 20% above normal at the Hickory NC-CT-2 station.

Table 7. Wetland Hydrologic Monitoring Results

2013 Maximum Hydroperiod (Growing Season March 21 – November 11; 236 Days)																									
Gauge ID	Year 5		Year 4		Year 3		Year 2		Year 1[1]		Year 5		Year 4		Year 3		Year 2		Year 1[1]		Year 5	Year 4	Year 3	Year 2	Year 1
	Consecutive		Consecutive		Consecutive		Consecutive		Consecutive		Cumulative		Cumulative		Cumulative		Cumulative		Cumulative						
	Days	Percent of Growing Season	Days	Percent of Growing Season	Days	Percent of Growing Season	Days	Percent of Growing Season	Days	Percent of Growing Season	Days	Percent of Growing Season	Days	Percent of Growing Season	Days	Percent of Growing Season	Days	Percent of Growing Season	Days	Percent of Growing Season	Occurrences				
NFMC01							32	13.6	4	1.7							76	32.2	12	5.1				9	6
NFMC02							67	28.4	86	36.4							136	57.6	142	60.2				8	6
NFMC03							127	53.8	57	24.2							215	91.1	116	49.2				1	10
NFMC04							10	4.2	5	2.1							55	23.3	15	6.4				15	9
NFMC05							4	1.7	1	0.4							9	3.8	1	0.4				7	1
NFMC06							127	53.8	87	36.9							209	88.6	137	58.1				4	7
NFMC07							127	53.8	171	72.5							215	91.1	171	72.5				1	1
NFMC08							127	53.8	57	24.2							205	86.9	122	51.7				5	10
NFMC09							127	53.8	102	43.2							196	83.1	156	66.1				2	4
NFMC10							36	15.3	12	5.1							104	44.1	40	16.9				11	11
South Fork							236	100	136	57.62							236	100	233	98.72				1	22

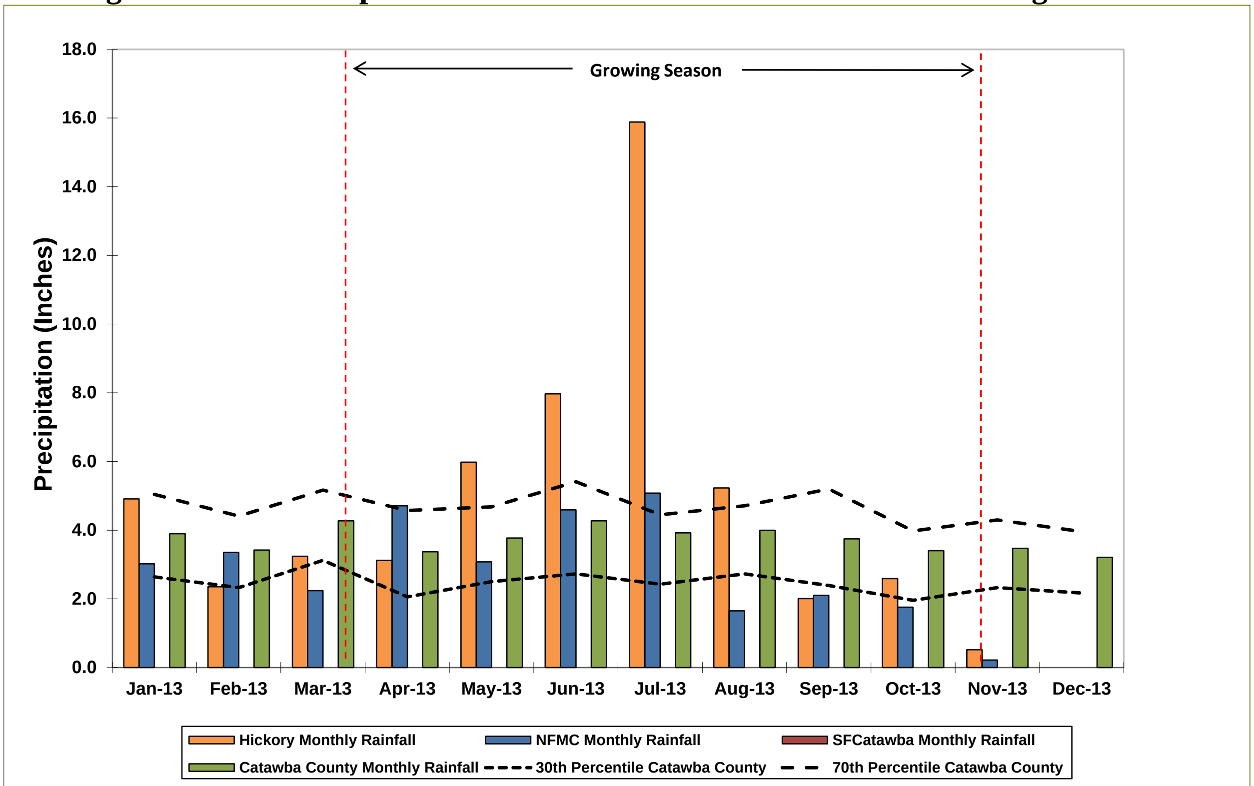
[1]Groundwater gauges not installed at North Fork Mountain Creek site until May 25, 2012, resulting in only 171 of the 236 days of the growing season during the MY1 monitoring period.

Table 8. Comparison of Normal Rainfall to 2013 Observed Rainfall

Month	Catawba County[1]			NCCRONOS Hickory NC-CT-2[1] (inches)	North Fork Mountain Creek Precipitation (Inches)[2]	South Fork Mountain Creek Precipitation (Inches)[3]
	Average (inches)	Normal Limits (inches)				
		30 Percent	70 Percent			
January	3.9	2.64	5.04	4.91	3.02	NA
February	3.42	2.33	4.41	2.35	3.35	NA
March	4.27	3.12	5.17	3.24	2.24	NA
April	3.37	2.06	4.57	3.12	4.71	NA
May	3.77	2.5	4.68	5.98	3.08	NA
June	4.27	2.73	5.41	7.97	4.59	NA
July	3.92	2.43	4.45	15.88	5.08	NA
August	4	2.73	4.71	5.23	1.65	NA
September	3.75	2.39	5.2	2.01	2.1	NA
October	3.4	1.96	3.98	2.59	1.76	NA
November	3.47	2.33	4.3	0.52	0.22	NA
December	3.21	2.17	3.96			NA
Annual		40.76	47.22	---	---	---
Average	44.75	---	---	---	---	---
Period Total	---	---	---	53.80	31.8	NA

[1]Source NRCS (2002); NCCRONOS (2012); data retrieved for same days as NFMC and South Fork data.
[2] Rain gauge malfunction from July 26-August 15.
[3] Rain Gauge Malfunction; Data will be included in final report

Figure 4. 2013 Precipitation for the North Fork Mountain Creek Mitigation Site



*North Fork Mountain Creek Rain Gauge Malfunction; No data collected between July 26 and August 15.

**South Fork Rain Gauge Malfunction; Data will be included in final draft.

4.4 Hydrology Conclusions

One bankfull event was documented during 2012 (MY1) and one during 2013 (MY2); meeting the bankfull success criteria of two bankfull events during different monitoring years.

Groundwater levels at all gauge stations except MW7 and MW9 appear to be closely related to rainfall events. MW7 is located in a large wetland restoration area, whereas MW9 is located in an existing wetland area. Gauges MW4 and MW5 failed to meet hydrology criteria for a second year in a row. Although, below average precipitation at the mitigation site may be affecting the success of these areas, the persistence of low hydroperiods at MW7 and MW9 cause concern for the long term success of these areas. Continued monitoring of the groundwater levels and rainfall will determine if wetland function is returning to the restored and created wetlands at the North Fork Mountain Creek Mitigation Site.

5.0 VEGETATION

5.1 Vegetation Success Criteria

The vegetative success of the Piedmont/Low Mountain Alluvial Forest and the Mesic Mixed Hardwood Forest will be evaluated based on the species density and percent survival. Vegetation monitoring will be considered successful if at least 260 woody stems/acre are surviving at the end of five years. Five year old desirable native volunteer species will be counted towards the 260 woody stems/acre threshold. Red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*) and pine (*Pinus* sp.) will be excluded from the desirable species list.

5.2 Vegetation Monitoring Plan

Fourteen 10 m X 10 m plots covering approximately 2.0% of the restoration areas were established within the project area (Figure 3). Five plots are located on North Fork Mountain Creek (Reach 1), seven are on UT1 (Reaches 2 and 4), and two are on UT2 (Reach 3). Vegetative sample plots are being quantitatively monitored during September of monitoring year 1 and June of years 2, 3, 4, and 5. Vegetation monitoring follows the CVS-EEP Level 2 Protocol for Recording Vegetation, version 4.2 (Lee et al. 2008) and includes analysis of species composition, density, and percent survival. The four corners of each plot were permanently located with rebar and photos of each plot taken from the origin are included in Appendix D. The vegetation monitoring plan included 23 tree and shrub species (Table 9)

Vegetative problem areas (VPAs) identified in the project are described and photo-documented. Once identified, these sites will be observed throughout the remainder of the monitoring period. Vegetative problems include areas that either lack vegetation or include populations of exotic vegetation. The root causes of these problems will be identified and remedial action recommendations included in monitoring reports.

Table 9. Planted Tree Species

Common Name	Scientific Name	FAC Status
Willow Oak	*Quercus phellos*	FACW-
Water Oak	*Quercus nigra*	FAC
Swamp Chestnut Oak	*Quercus michauxii*	FACW-
White Oak	*Quercus alba*	FACU
Northern Red Oak	*Quercus rubra*	FACU
Laurel Oak	*Quercus laurifolia*	FACW
Shumard Oak	*Quercus shumardii*	FACW-
Overcup Oak	*Quercus lyrata*	OBL
Flowering Dogwood	*Cornus florida*	FACU
Silky Dogwood	*Cornus amomum*	FACW+
River Birch	*Betula nigra*	FACW
Yellow Poplar	*Liriodendron tulipifera*	FAC

Table 9 Continued. Planted Tree Species

Common Name	*Scientific Name*	FAC Status
Tag Alder	*Alnus serrulata*	FACW+
American Sycamore	*Platanus occidentalis*	FACW-
Green Ash	*Fraxinus pennsylvanica*	FACW
Buttonbush	*Cepalanthus occidentalis*	OBL
Ironwood	*Carpinus caroliniana*	FAC
Eastern Cottonwood	*Populus deltoids*	FAC+
Black Walnut	*Juglans nigra*	FACU
Eastern Redbud	*Cercis canadensis*	FACU
Northern Spicebush	*Lindera benzoin*	FACW
Blackgum	*Nyssa sylvatica*	FAC
Bald Cypress	*Tastodium distichum*	OBL

5.3 Results of Vegetation Monitoring

Results from the Year 2 vegetation monitoring documented 12 planted tree and shrub species within the monitoring plots (Table 10). Planted stem densities for the 10 plots ranged from 607 to 1,295 stems per acre (Table 11). Average planted stem density for the entire restoration site was found to be 910 stems per acre. Only 1% of planted stems were found to be dead or missing during MY2 monitoring. Planted stem mortality was highest at VP9, although the majority (85%) of planted stems observed in MY1 had good or excellent vigor scores.

A visual estimate of herbaceous vegetation cover within the monitoring plots is provided to assess the overall stability of the restoration site (Table 12). On average, herbaceous vegetation coverage is estimated to be 82% with individual plot values ranging from 60% to 100%.

Observations of herbaceous cover outside of the plots were noted during the visual assessment and are documented in Appendix A; representative photos are included in Appendix D. Herbaceous cover typically consists of dogfennel (*Eupatorium capillifolium*), goldenrod (*Solidago sp.*), horsenettle (*Solanum carolinensis*), soft rush (*Juncus effusus*), daisy fleabane (*Erigeron annuus*), and tickseed sunflower (*Bidens polylepis*). Overall, herbaceous cover has become well established and is expected to increase as a result of natural recruitment from adjacent wooded areas.

Table 10. Results of 2013 Vegetation Monitoring by Plot

Scientific Name	Common Name	Species Type	Current Plot Data (MY2 2013): 171300307-01-0001			171300307-01-0002			171300307-01-0003			171300307-01-0004			171300307-01-0005			171300307-01-0006			171300307-01-0007		
			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 var. rubrum	red maple	Tree																					
Alnus serrulata	hazel alder	Shrub										1	1	2									
Betula nigra	river birch	Tree																					
Carpinus caroliniana	American hornbeam	Tree																					
Carpinus caroliniana var. caroliniana	Coastal American Hornbeam	Tree																					
Cephalanthus occidentalis	common buttonbush	Shrub																					
Cornus amomum	silky dogwood	Shrub	1	1	1				3	3	3												
Diospyros virginiana	common persimmon	Tree																					
Fraxinus pennsylvanica	green ash	Tree	1	1	1	4	4	4	1	1	1	9	9	9				1	1	1	4	4	4
Juglans nigra	black walnut	Tree							3	3	3	1	1	1									
Liquidambar styraciflua	sweetgum	Tree																					
Liriodendron tulipifera	tuliptree	Tree	3	3	3	2	2	2	5	5	5	2	2	2	9	9	9	6	6	6			
Liriodendron tulipifera var. tulipifera	Tulip-tree, Yellow Poplar, Wh	Tree												4									3
Nyssa sylvatica	blackgum	Tree																					
Platanus occidentalis	American sycamore	Tree	1	1	1	3	3	3	2	2	2	12	12	12	4	4	4	2	2	2	15	15	15
Platanus occidentalis var. occidentalis	Sycamore, Plane-tree	Tree																					
Prunus serotina var. serotina	black cherry	Tree						1						1						1			
Quercus	oak	Tree																					
Quercus alba	white oak	Tree	4	4	4	1	1	1	1	1	1				6	6	6	4	4	4	3	3	3
Quercus phellos	willow oak	Tree	1	1	1	7	7	7	7	7	7	6	6	6	4	4	4	5	5	5	8	8	8
Quercus rubra	northern red oak	Tree	4	4	4	1	1	1							2	2	2	1	1	1	2	2	2
Rhus	sumac	shrub																					
Rhus aromatica var. aromatica	fragrant sumac	Shrub									4			1			1						
Rhus glabra	smooth sumac	shrub																					1
Salix nigra	black willow	Tree												3									
Unknown		Shrub or Tree																					
Stem count			15	15	15	18	18	19	22	22	26	31	31	41	25	25	26	19	19	20	32	32	36
size (ares)			1			1			1			1			1			1			1		
size (ACRES)			0.02			0.02			0.02			0.02			0.02			0.02			0.02		
Species count			7	7	7	6	6	7	7	7	8	6	6	10	5	5	6	6	6	7	5	5	7
Stems per ACRE			607	607	607	728.4	728.4	768.9	890.3	890.3	1052	1255	1255	1659	1012	1012	1052	768.9	768.9	809.4	1295	1295	1457

Scientific Name	Current Plot Data (MY2 2013): 171300307-01-0008			171300307-01-0009			171300307-01-0010			171300307-01-0011			171300307-01-0012			171300307-01-0013			171300307-01-0014			Annual Means: MY2 (2013)			MY1 (2012)			MY0 (2012)		
	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	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum var. rubrum																					1			1						
Alnus serrulata									10			33	1	1	3	2	2	2			1	4	4	51	3	3	17	3	3	3
Betula nigra	4	4	4	2	2	2	5	5	5				7	7	7				3	3	3	21	21	21	24	24	24	25	25	25
Carpinus caroliniana							1	1	1	4	4	4	2	2	2							7	7	7	7	7	7	8	8	8
Carpinus caroliniana var. caroliniana							1	1	1													1	1	1						
Cephalanthus occidentalis												3	2	2	2	1	1	1	1	1	1	4	4	7	4	4	4	4	4	4
Cornus amomum																		1			1	4	4	6	3	3	3			
Diospyros virginiana			2									1												3						
Fraxinus pennsylvanica	2	2	2	4	4	4	2	2	2	3	3	3	1	1	1	1	1	1	7	7	7	40	40	40	41	41	41	44	44	44
Juglans nigra			1				2	2	2	1	1	1				1	1	2	3	3	4	11	11	14	10	10	10	11	11	11
Liquidambar styraciflua									5									10						15			10			
Liriodendron tulipifera							5	5	5	3	3	3				3	3	3	2	2	2	40	40	40	41	41	45	47	47	47
Liriodendron tulipifera var. tulipifera									1									3						11						
Nyssa sylvatica																											5			
Platanus occidentalis	12	12	12	12	12	12	3	3	3	9	9	9	8	8	8	2	2	2	1	1	1	86	86	86	86	86	86	91	91	91
Platanus occidentalis var. occidentalis			3																					3						
Prunus serotina var. serotina																								3						
Quercus																									3	3	3	28	28	28
Quercus alba																						19	19	19	5	5	5			
Quercus phellos	6	6	6	6	6	6	4	4	4	4	4	4	3	3	3	4	4	4	2	2	2	67	67	67	62	62	62	49	49	49
Quercus rubra																1	1	1				11	11	11	23	23	23	31	31	31
Rhus																											5			
Rhus aromatica var. aromatica																								6						
Rhus glabra																								1						
Salix nigra			1						1						1									6			3			
Unknown																												1	1	1
Stem count	24	24	31	24	24	24	23	23	40	24	24	61	24	24	27	15	15	30	19	19	23	315	315	419	312	312	353	342	342	342
size (ares)	1			1			1			1			1			1			1			14			14			14		
size (ACRES)	0.02			0.02			0.02			0.02			0.02			0.02			0.02			0.35			0.35			0.35		
Species count	4	4	8	4	4	4	8	8	12	6	6	9	7	7	8	8	8	11	7	7	10	13	13	22	13	13	17	12	12	12
Stems per ACRE	971.2	971.2	1255	971.2	971.2	971.2	930.8	930.8	1619	971.2	971.2	2469	971.2	971.2	1093	607	607	1214	768.9	768.9	930.8	910.5	910.5	1211	901.9	901.9	1020	988.6	988.6	988.6

Table 11. Summary of Vegetation Monitoring Results

Reach ID	Plot ID	Stems Planted	2012 Stems	Percent Survival	Stems per Acre					
					Stems Planted 2012	2012 Year 1	2013 Year 2	2014 Year 3	2015 Year 4	2016 Year 5
NFMC-1	VP10	24	23	96	971	931	931			
	VP11	26	24	92	1,052	971	971			
	VP12	24	24	100	971	971	971			
	VP13	17	15	88	688	647	607			
	VP14	17	19	112	688	647	769			
UT1-2	VP5	26	25	96	1,052	1,012	1,012			
	VP6	20	19	95	809	769	769			
	VP7	36	32	89	1,456	1,214	1,295			
	VP8	24	24	100	971	971	971			
	VP9	32	24	75	1,295	1,052	971			
UT1-4	VP1	23	15	65	931	607	607			
	VP4	31	31	100	1,254	1,255	1,255			
UT2-3	VP2	18	18	100	728	688	728			
	VP3	24	22	92	971	890	890			
				Averages	989	902	911			

Table 12. Estimated Herbaceous Total Percent Cover

Reach ID	Plot ID	Estimated Herbaceous Cover (%)
NFMC-1	VP10	90
	VP11	60
	VP12	60
	VP13	95
	VP14	90
UT1-2	VP5	90
	VP6	65
	VP7	90
	VP8	100
	VP9	98
UT1-4	VP1	75
	VP4	60
UT2-3	VP2	75
	VP3	95

Fourteen commonly encountered woody volunteer or natural species were documented during the MY2 vegetation monitoring surveys (Table 13). As expected, the diversity of recruits rose from five taxa in MY1 to fourteen in MY2 and is anticipated to increase in diversity and stems as the project continues to establish.

Table 13. Volunteer Tree Species Documented

Common Name	Scientific Name	Indicator Status
Black Cherry	*Prunus serotina*	FACU
Black Walnut	*Juglans nigra*	FACU
Black Willow	*Salix nigra*	OBL
Blackgum	*Nyssa sylvatica*	FAC
Brookside Alder	*Alnus serrulata*	OBL
Common Buttonbush	*Cephalanthus occidentalis*	OBL
Common Persimmon	*Diospyros virginiana*	FAC
Silky Dogwood	*Cornus amomum*	FACW
Sumac	*Rhus spp.*	No Indicator
Sweetgum	*Liquidambar styraciflua*	FAC+
Sweet-Gum	*Liquidambar styraciflua*	FAC
Sycamore	*Platanus occidentalis*	FACW
Tag Alder	*Alnus serrulata*	FACW+
Yellow Poplar	*Liriodendron tulipifera*	FAC

5.4 Vegetation Conclusions

Overall, planted stems are surviving well at the North Fork Mountain Creek Stream and Wetland Restoration Site. Density of planted stems at all vegetation monitoring plots are well above the final success criterion of 260 woody stems/per acre that must be met at the end of five years. Average stem density across the whole site for planted and volunteers combined is approximately 1,211 stems per acre.

Herbaceous vegetation coverage dropped from 97% to 82% between MY1 and MY2, respectively. Some very small depauperate areas were observed; however, herbaceous vegetation is becoming well established overall, and efforts to reduce competition from invasive exotic plant species appear to have been effective in allowing the native plants to thrive. Additional herbicide treatments were applied in the late summer months of 2013 in order to control persisting invasive exotic plant populations, as well to suppress the aggressive native cattail (*Typha* sp.) populations that were beginning to invade large areas of wetland along NFMC-1.

6.0 CONCLUSIONS AND RECOMENDATIONS

Monitoring Year 2 data provides insight into the performance of the North Fork Mountain Creek Restoration Project. A summary of observed conditions and recommendations is provided below.

- Stream channels remained intact through another bankfull event in January 2013. Generally, stream problem areas are restricted to isolated cases of bed degradation and aggradation; however, several areas of riffle degradation on the mainstem of North Fork Mountain Creek do warrant continued monitoring.

- One bankfull event was documented during 2012 (MY1) and one during 2013 (MY2); meeting the bankfull success criteria of two bankfull events during different monitoring years. Groundwater levels at all gauge stations except MW7 and MW9 appear to be closely related to rainfall events. MW7 is located in a large wetland restoration area, whereas MW9 is located in an existing wetland area. Gauges MW4 and MW5 failed to meet hydrology criteria for a second year in a row. Although, below average precipitation at the mitigation site may be affecting the success of these areas, the persistence of low hydroperiods at MW7 and MW9 cause concern for the long term success of these areas. Continued monitoring of the groundwater levels and rainfall will determine if wetland function is returning to the restored and created wetlands at the North Fork Mountain Creek Mitigation Site.

- Vegetation is becoming well-established throughout the project. Planted stems are surviving well and recruitment of woody volunteers and herbaceous vegetation is increasing throughout the project as a whole.

- Invasive exotic vegetation identified in several areas across the site has been treated with selective herbicides to allow native plant species to compete and succeed. These areas appear to have been controlled successfully, but should be monitored in the future to avoid their reestablishment from seeds that may remain in the soil or which may be transported from outside the site.

Overall the stream, hydrologic, and vegetative conditions at the North Fork Mountain Creek Mitigation Site appear to be performing as expected less than one year after construction. No changes in the monitoring plan are recommended at this time.

7.0 REFERENCES

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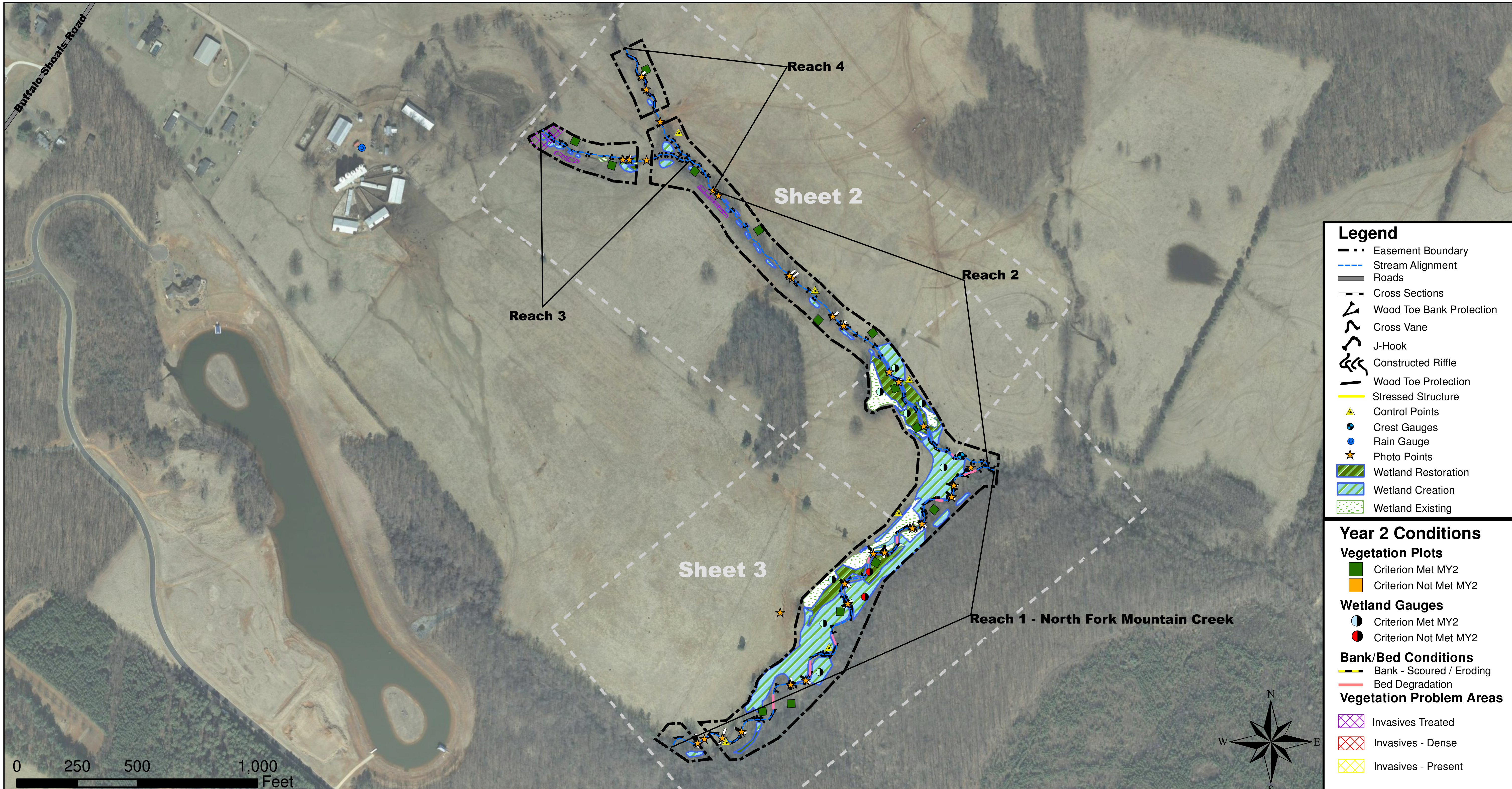
APPENDIX A

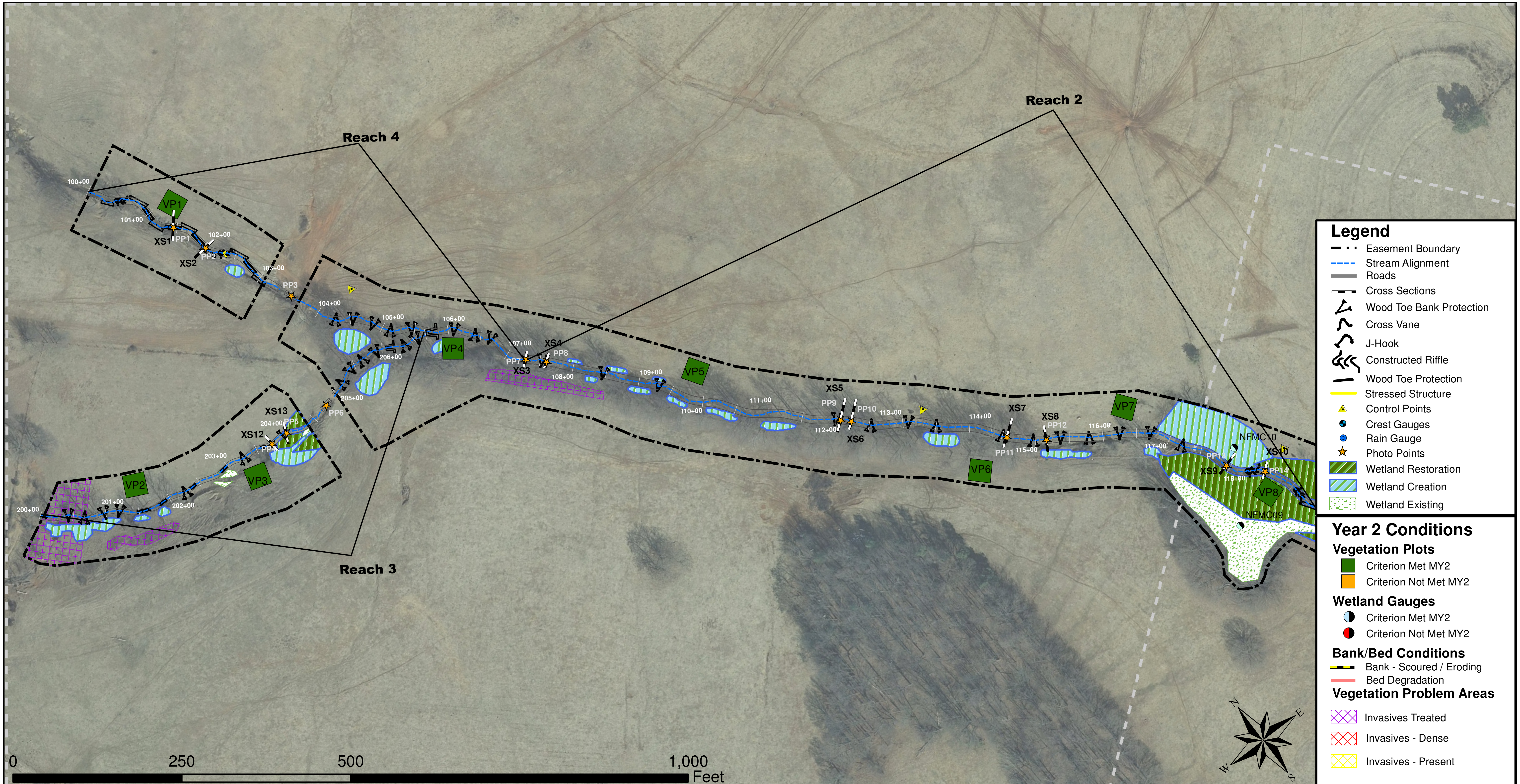
Current Condition Plan View

Figure 2. Integrated Current Condition Plan View Draft



Prepared for	Project: North Fork Mountain Creek Stream and Wetland Restoration Year 2 Monitoring Catawba County, North Carolina	Notes: 1) 2010 Aerial Photo 2) Base Map Data Provided by Stantec.	Prepared by
EBX	Sheet 1 of 3		EQUINOX ENVIRONMENTAL CONSULTATION & DESIGN
	Date	Project Number	
	November 2013	NCEEP # 94151	

Figure 2. Integrated Current Condition Plan View Draft



Prepared for	Project:	Notes:	Prepared by
EBX	North Fork Mountain Creek Stream and Wetland Restoration Year 2 Monitoring Catawba County, North Carolina	1) 2010 Aerial Photo 2) Base Map Data Provided by Stantec.	EQUINOX ENVIRONMENTAL CONSULTATION & DESIGN
	Sheet 2 of 3		
	Date	Project Number	
	November 2013	NCEEP # 94151	

Figure 2. Integrated Current Condition Plan View Draft

Prepared for	Project: North Fork Mountain Creek Stream and Wetland Restoration Year 2 Monitoring Catawba County, North Carolina	Notes: 1) 2010 Aerial Photo 2) Base Map Data Provided by Stantec.	Prepared by
EBX	Sheet 3 of 3		EQUINOX ENVIRONMENTAL CONSULTATION & DESIGN
	Date	Project Number	
	November 2013	NCEEP # 94151	

APPENDIX B

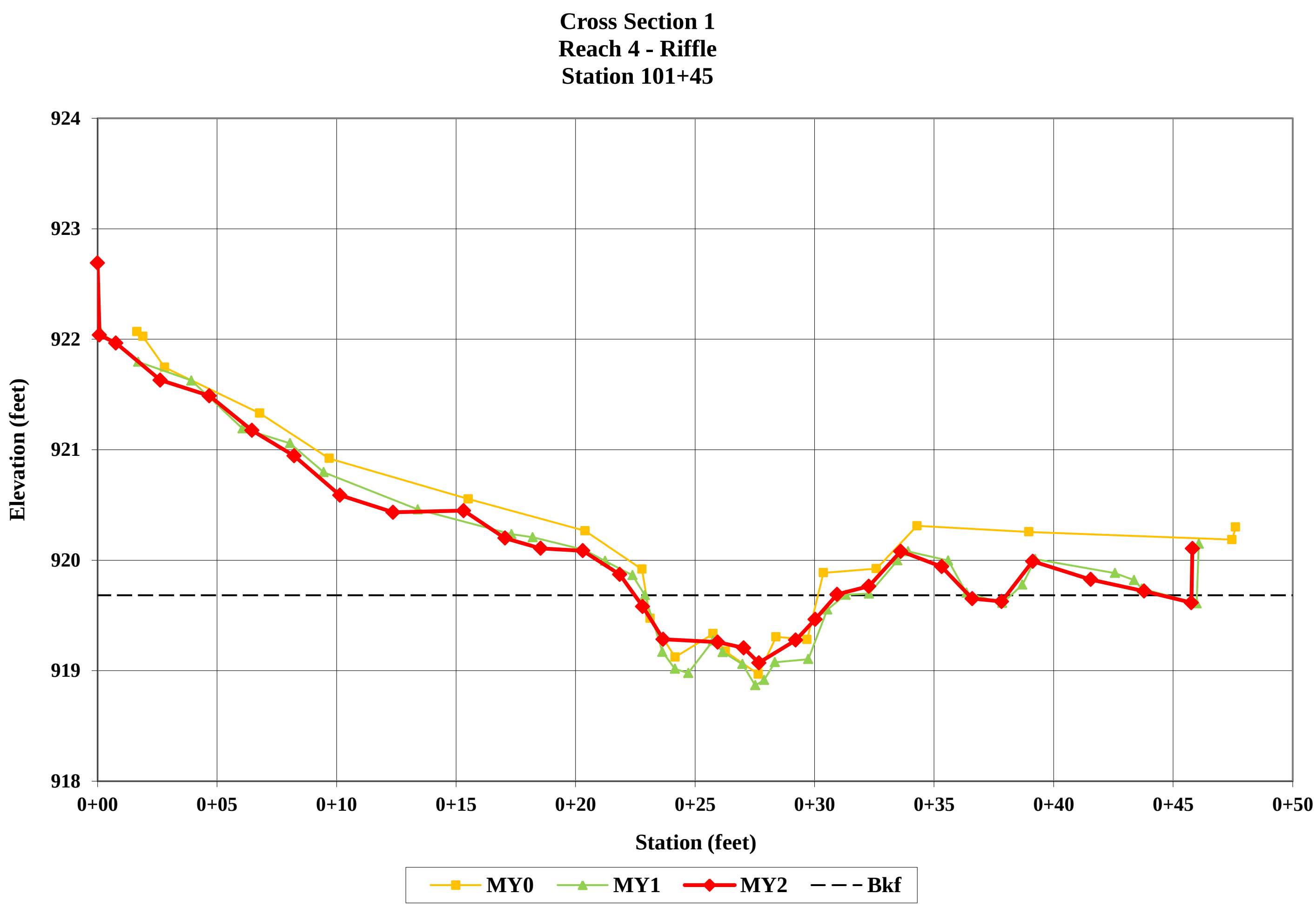
2013 Cross-Section and Substrate Data

This page reserved for longitudinal profile figures should monitoring efforts demonstrate channel or bed instability and the USACE require such data be collected along reaches of concern and to track changes in channel stability.

Cross Section 1 Reach 4 – Riffle

Left Bank Descending

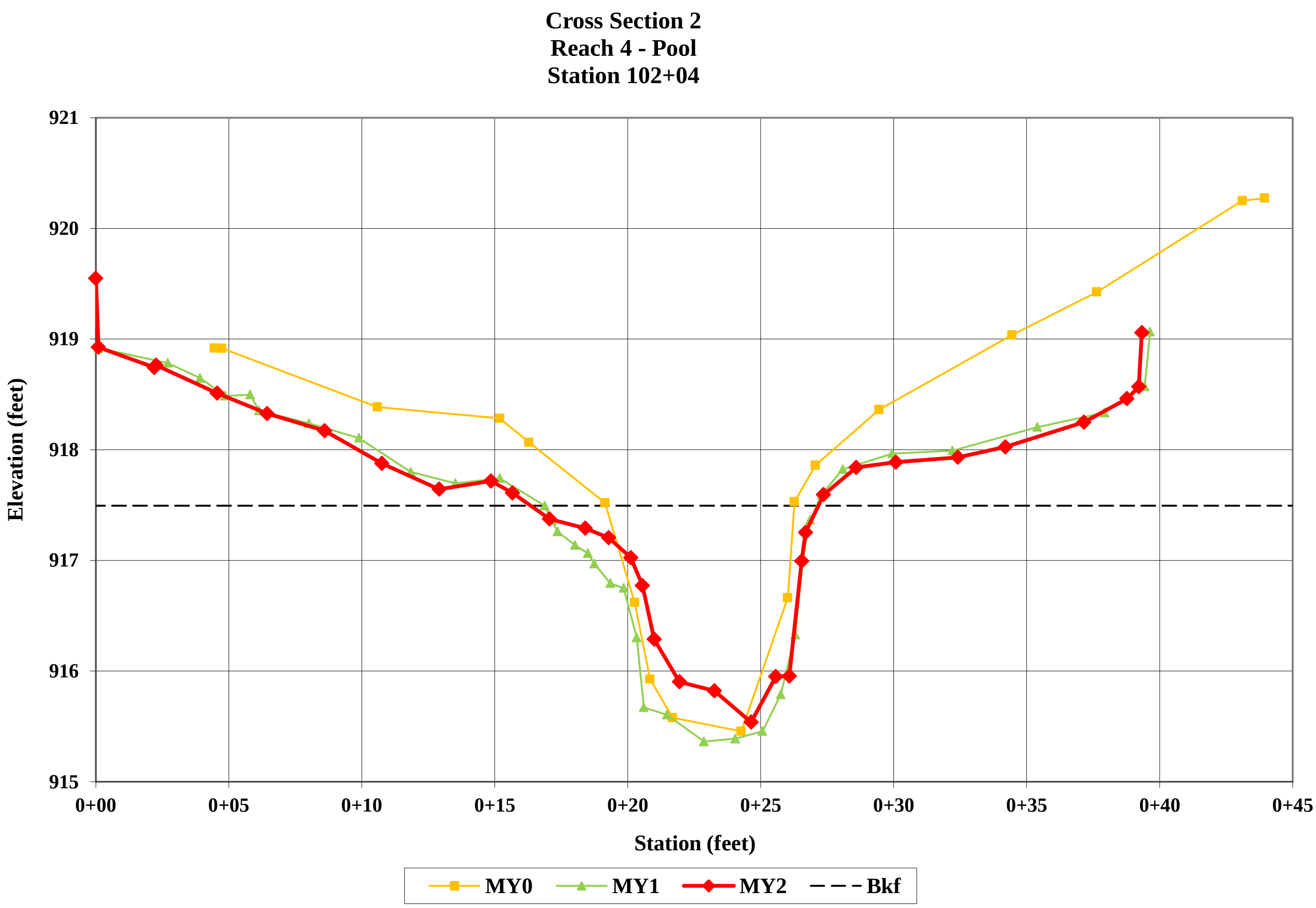
Right Bank Descending



Cross Section 2 Reach 4 – Pool

Left Bank Descending

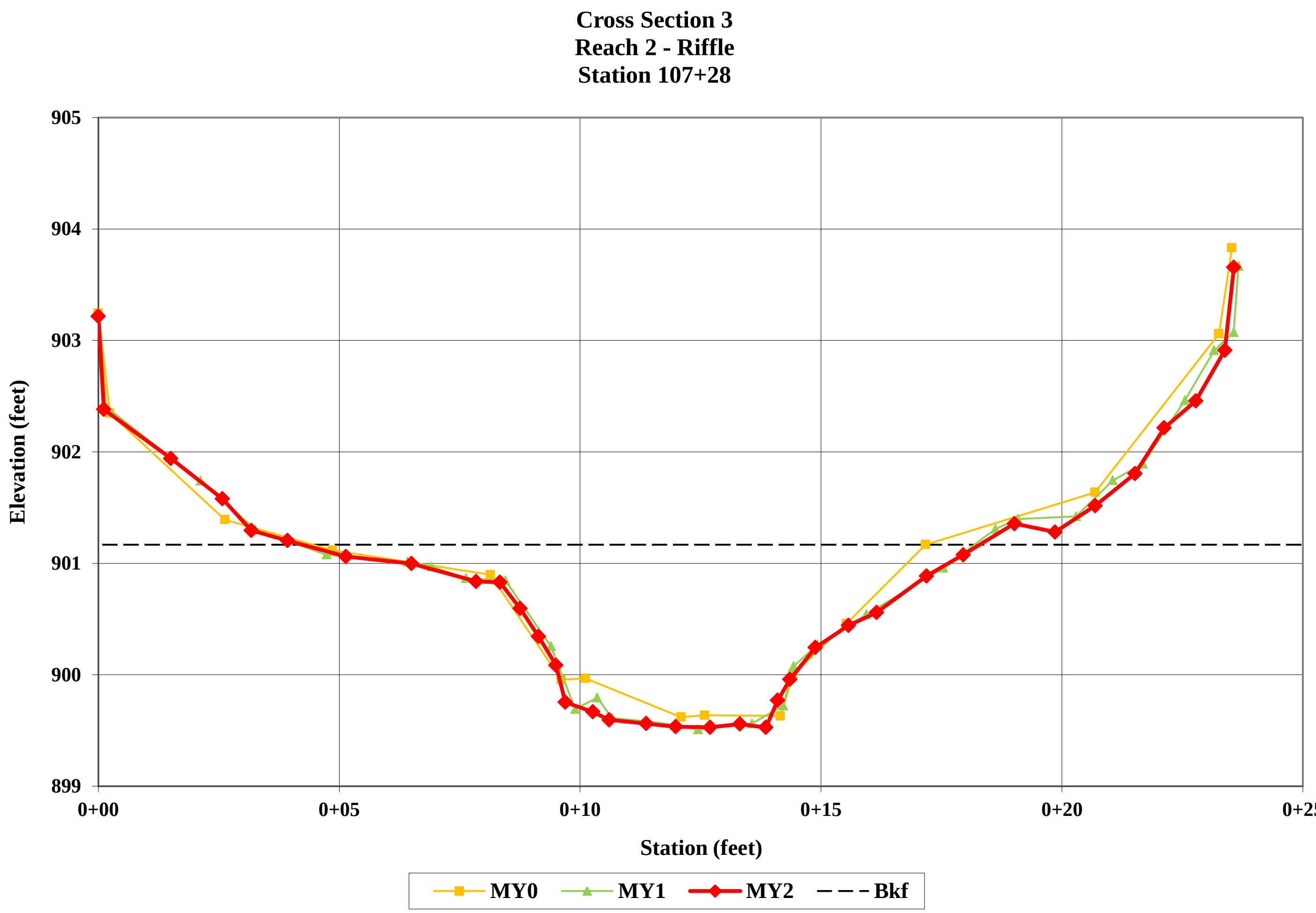
Right Bank Descending



Cross Section 3 Reach 2 – Riffle

Left Bank Descending

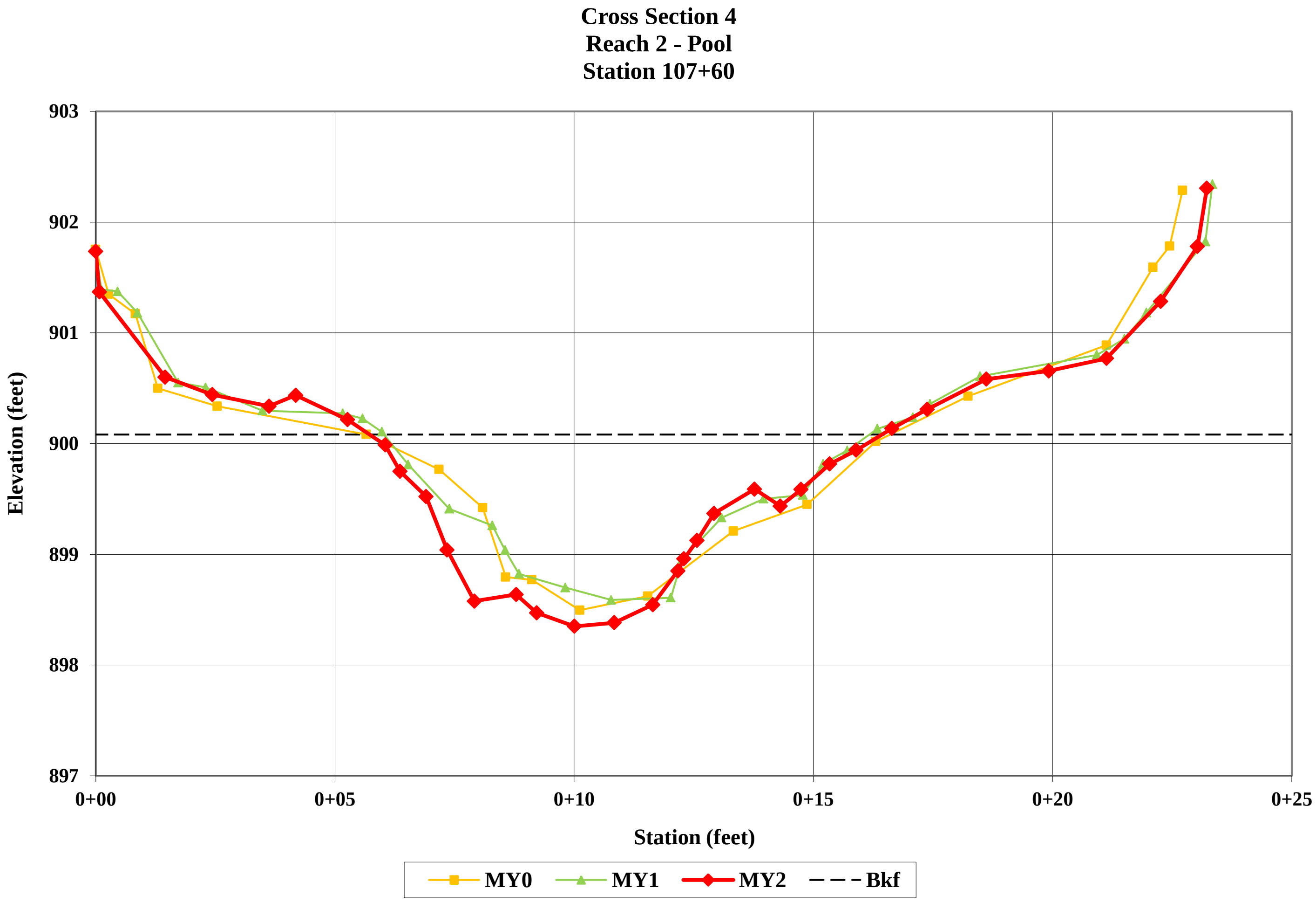
Right Bank Descending



Cross Section 4 Reach 2 – Pool

Left Bank Descending

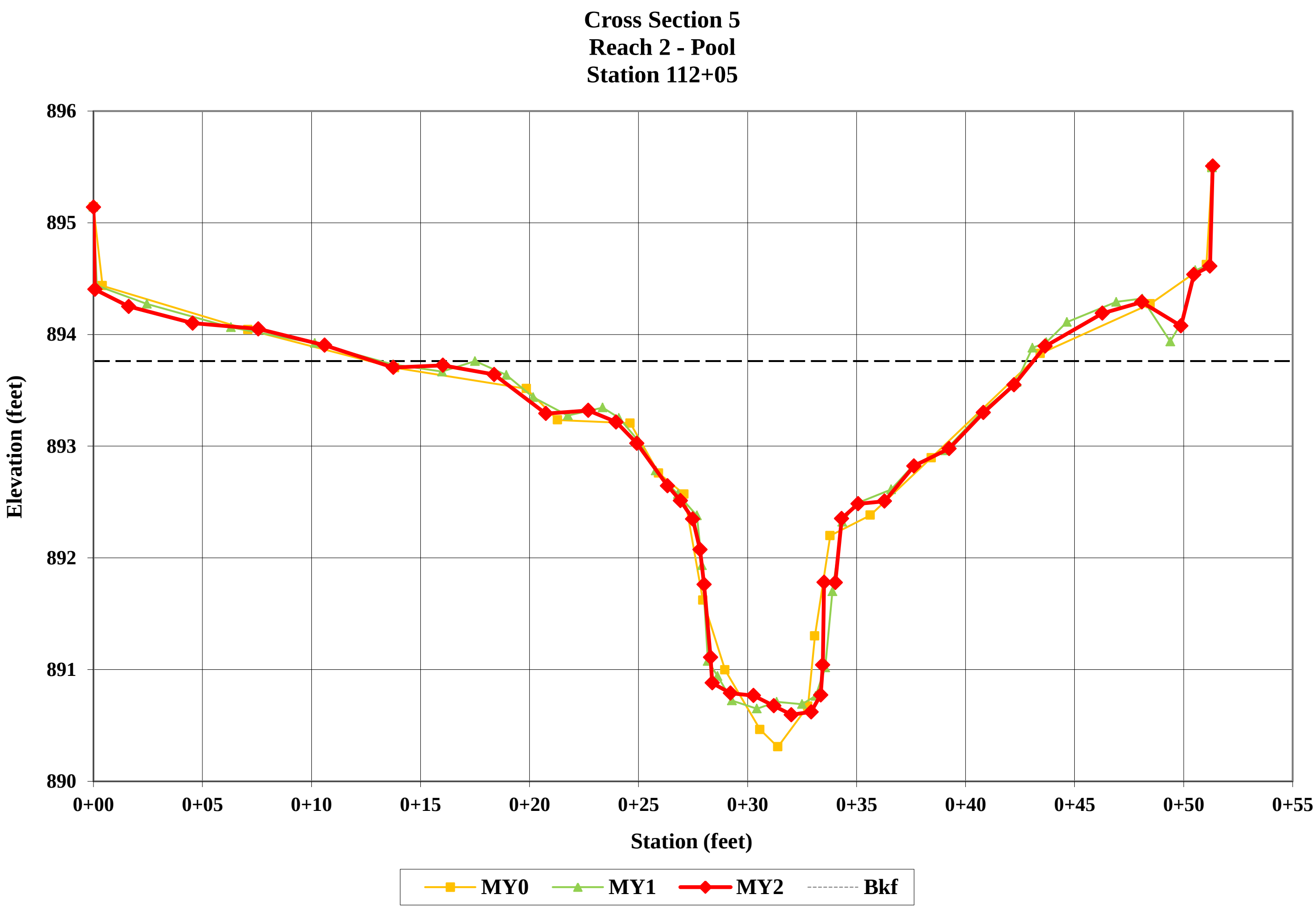
Right Bank Descending



Cross Section 5 Reach 2 – Pool

Left Bank Descending

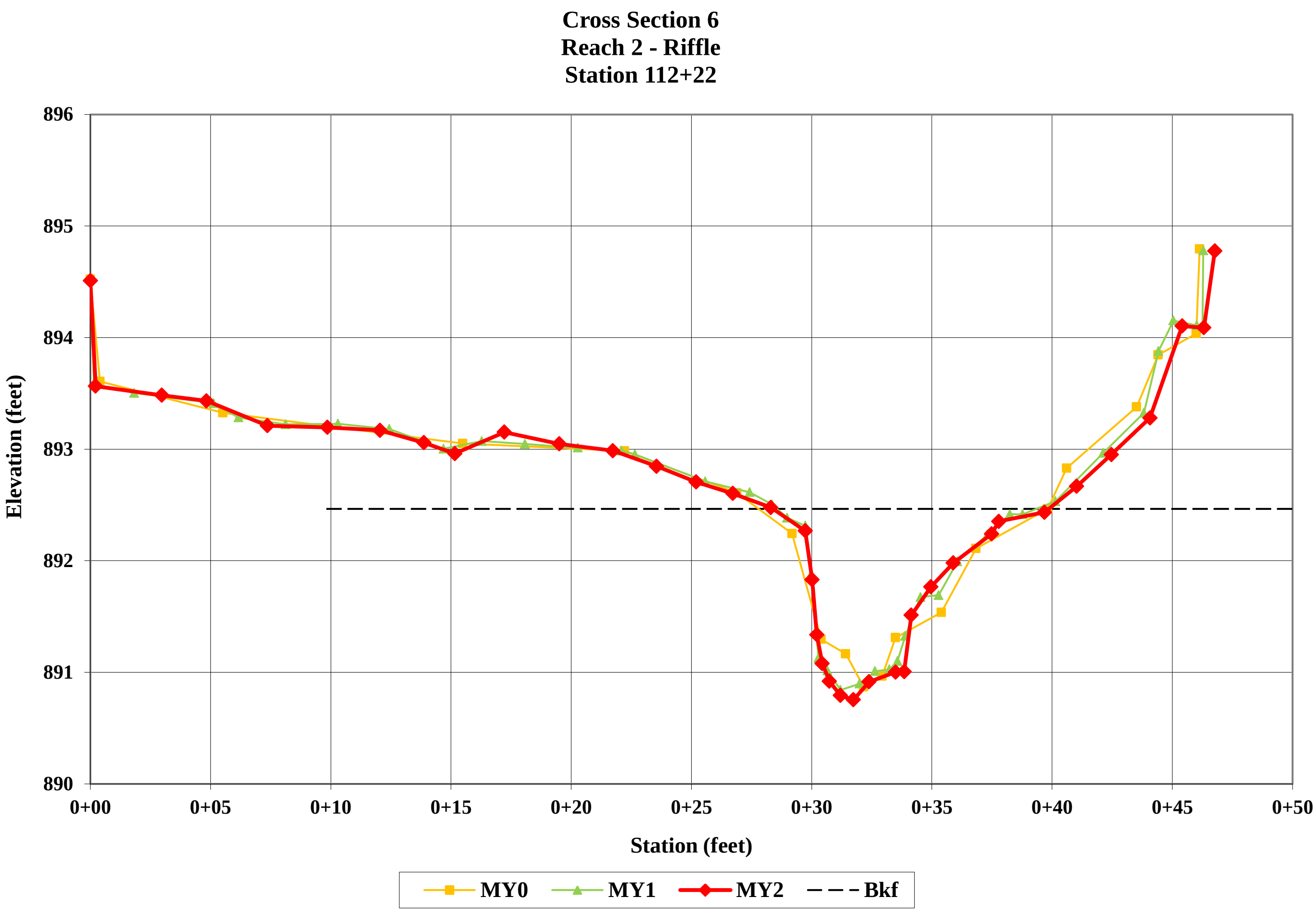
Right Bank Descending



Cross Section 6 Reach 2 – Riffle

Left Bank Descending

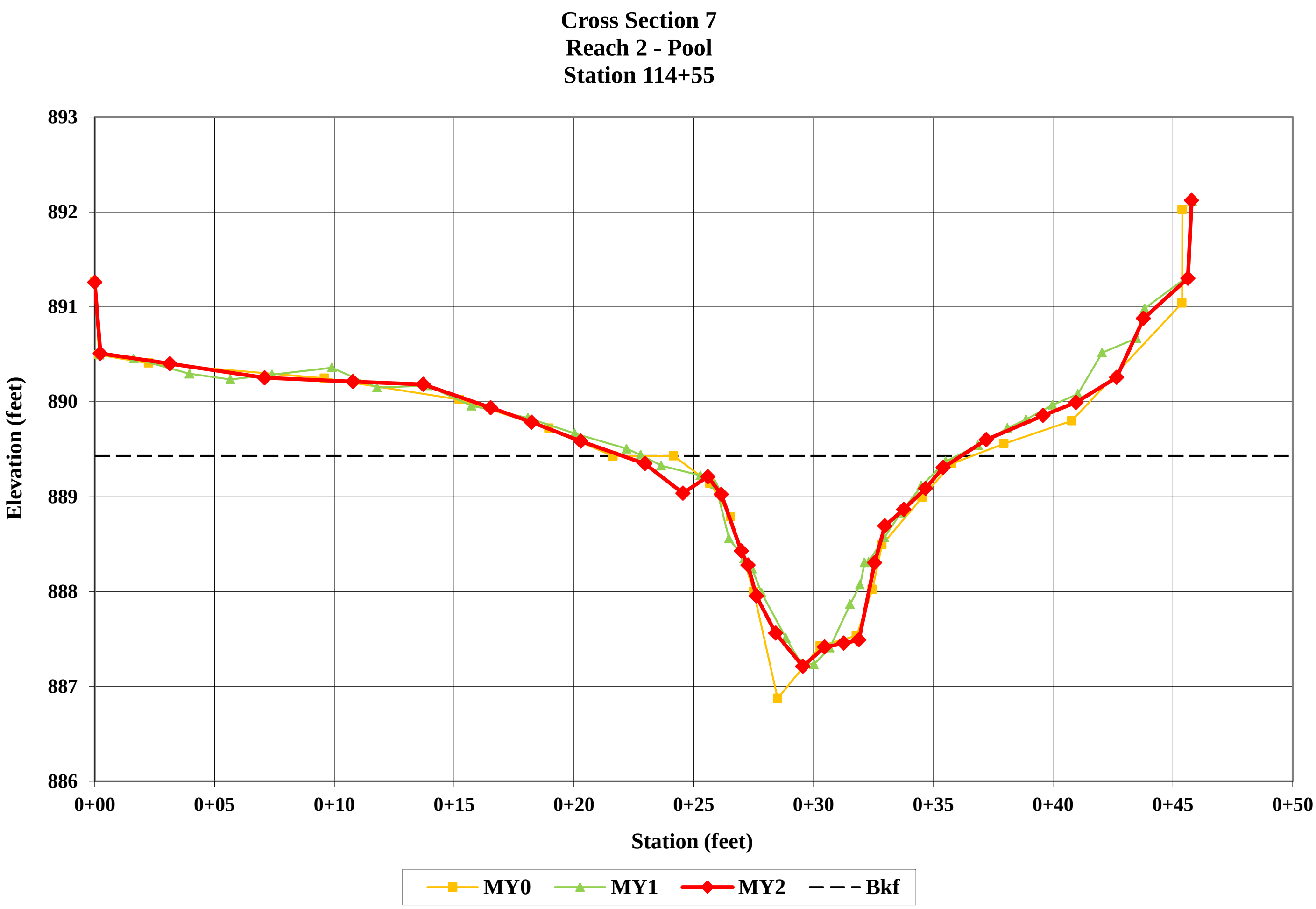
Right Bank Descending



Cross Section 7 Reach 2 – Pool

Left Bank Descending

Right Bank Descending

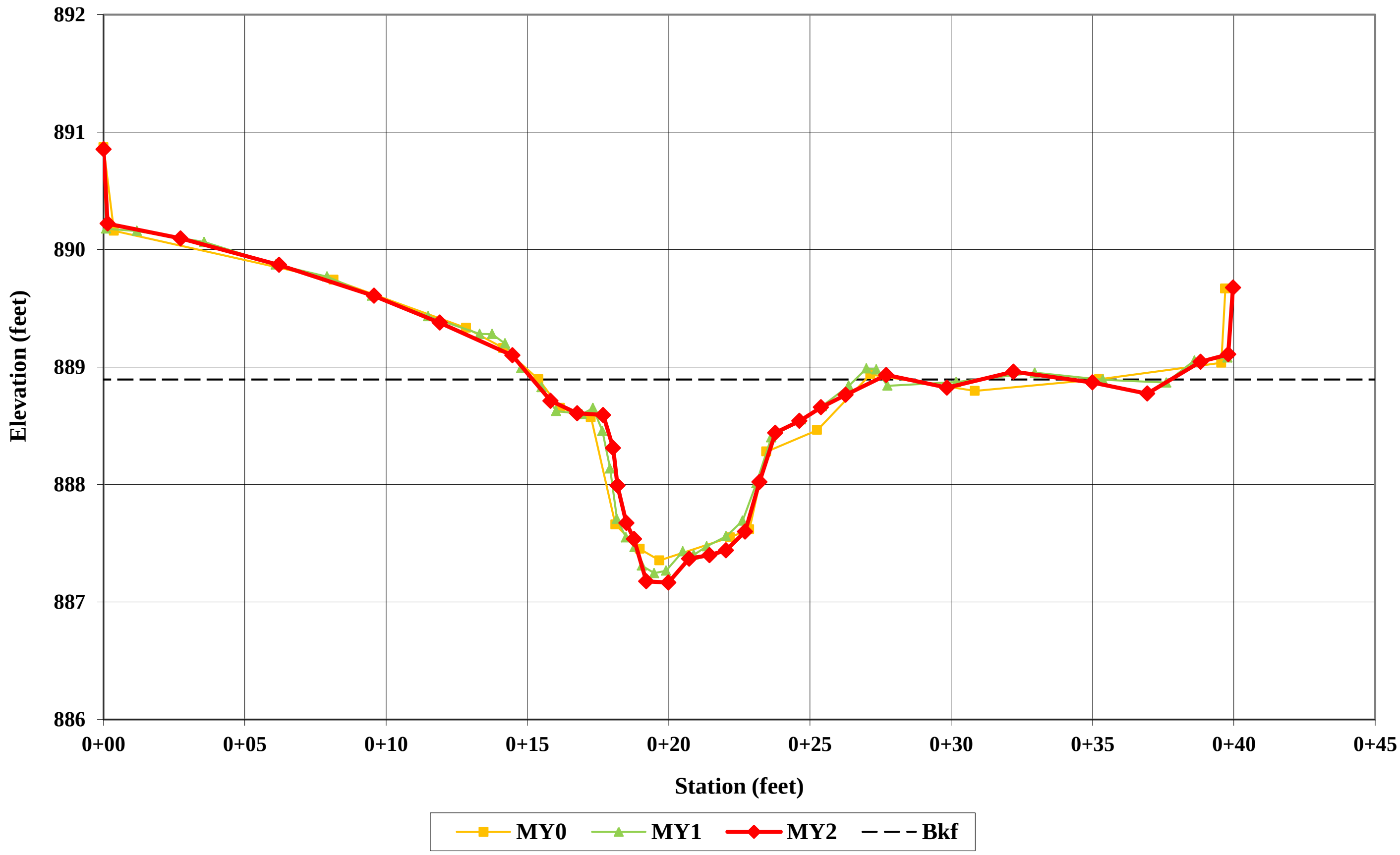


Cross Section 8 Reach 2 – Riffle

Left Bank Descending

Right Bank Descending

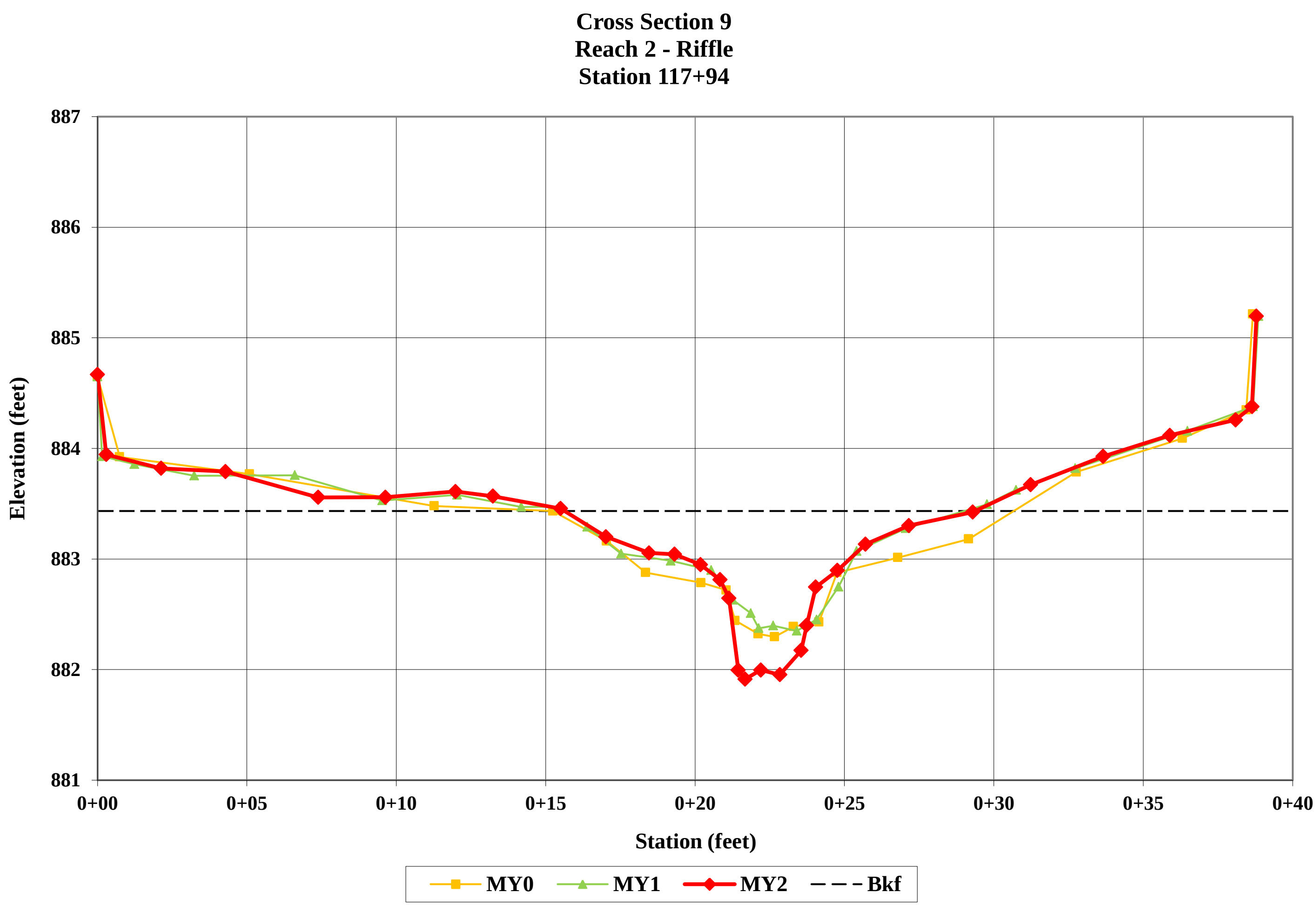
Cross Section 8
Reach 2 - Riffle
Station 115+16



Cross Section 9 Reach 2 – Riffle

Left Bank Descending

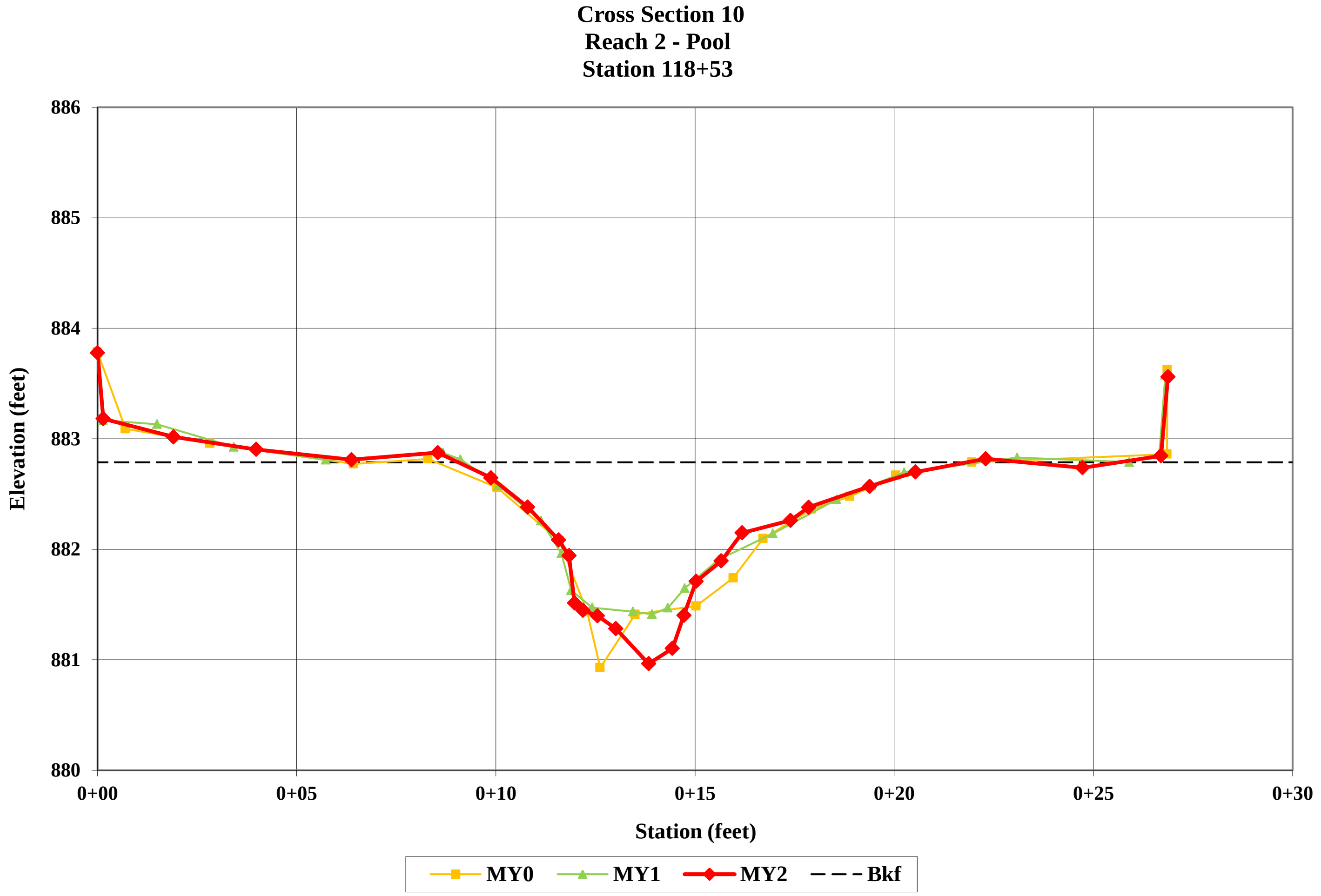
Right Bank Descending



Cross Section 10 Reach 2 – Pool

Left Bank Descending

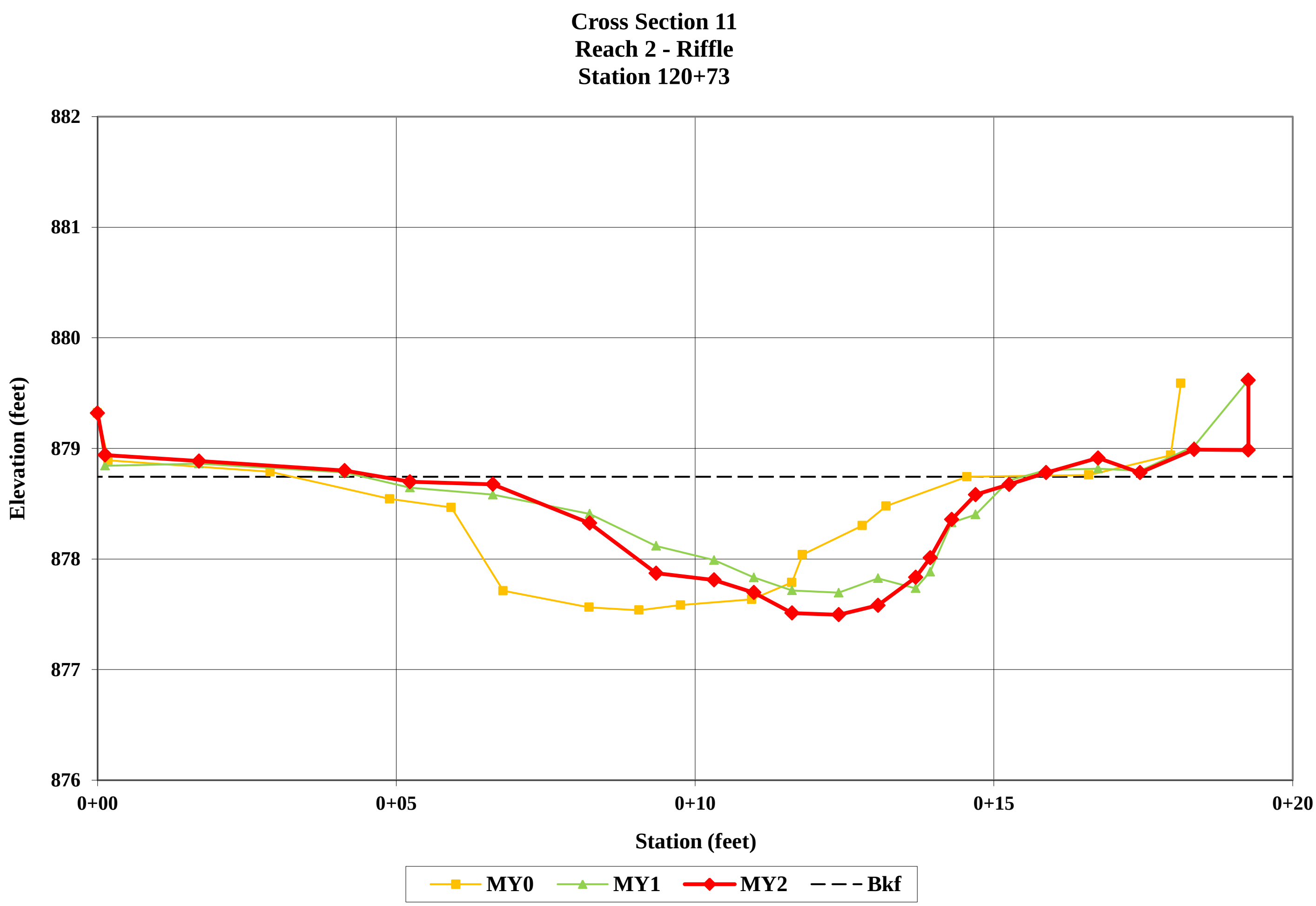
Right Bank Descending



Cross Section 11 Reach 2 – Riffle

Left Bank Descending

Right Bank Descending

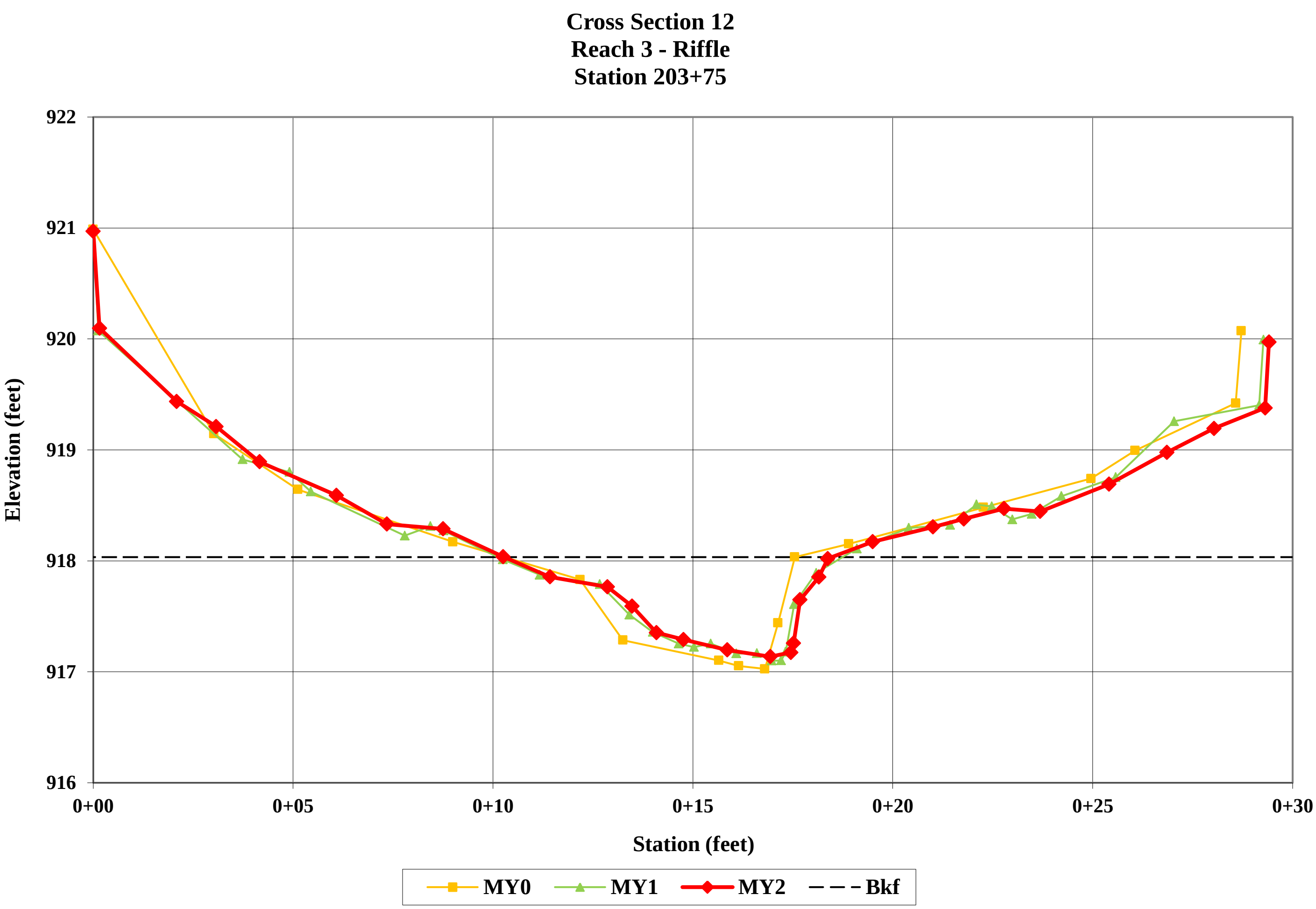


*The shift represented in the above figure is due to an inconsistency in surveying the correct pins between monitoring years.

Cross Section 12 Reach 3 – Riffle

Left Bank Descending

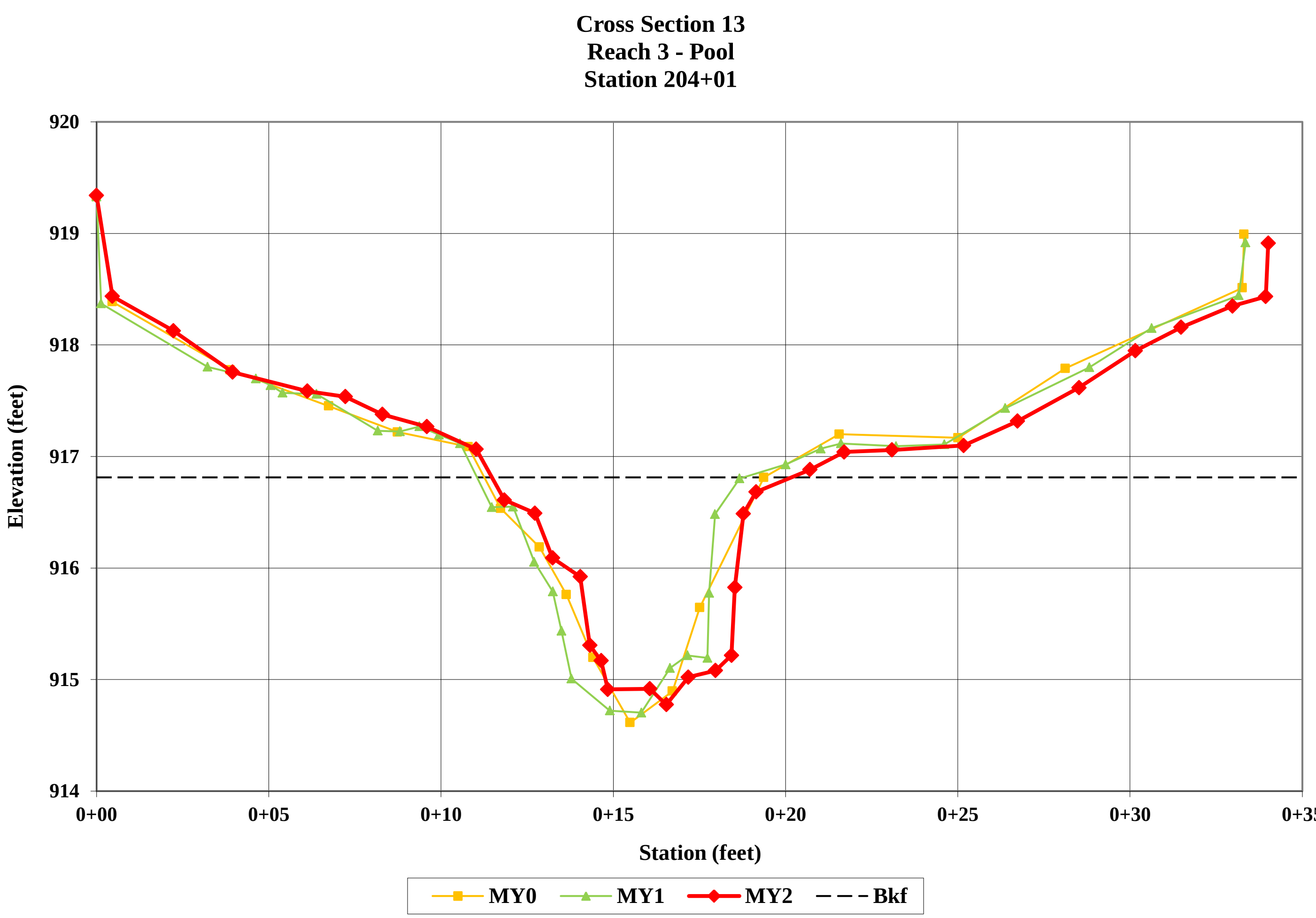
Right Bank Descending



Cross Section 13 Reach 3 – Pool

Left Bank Descending

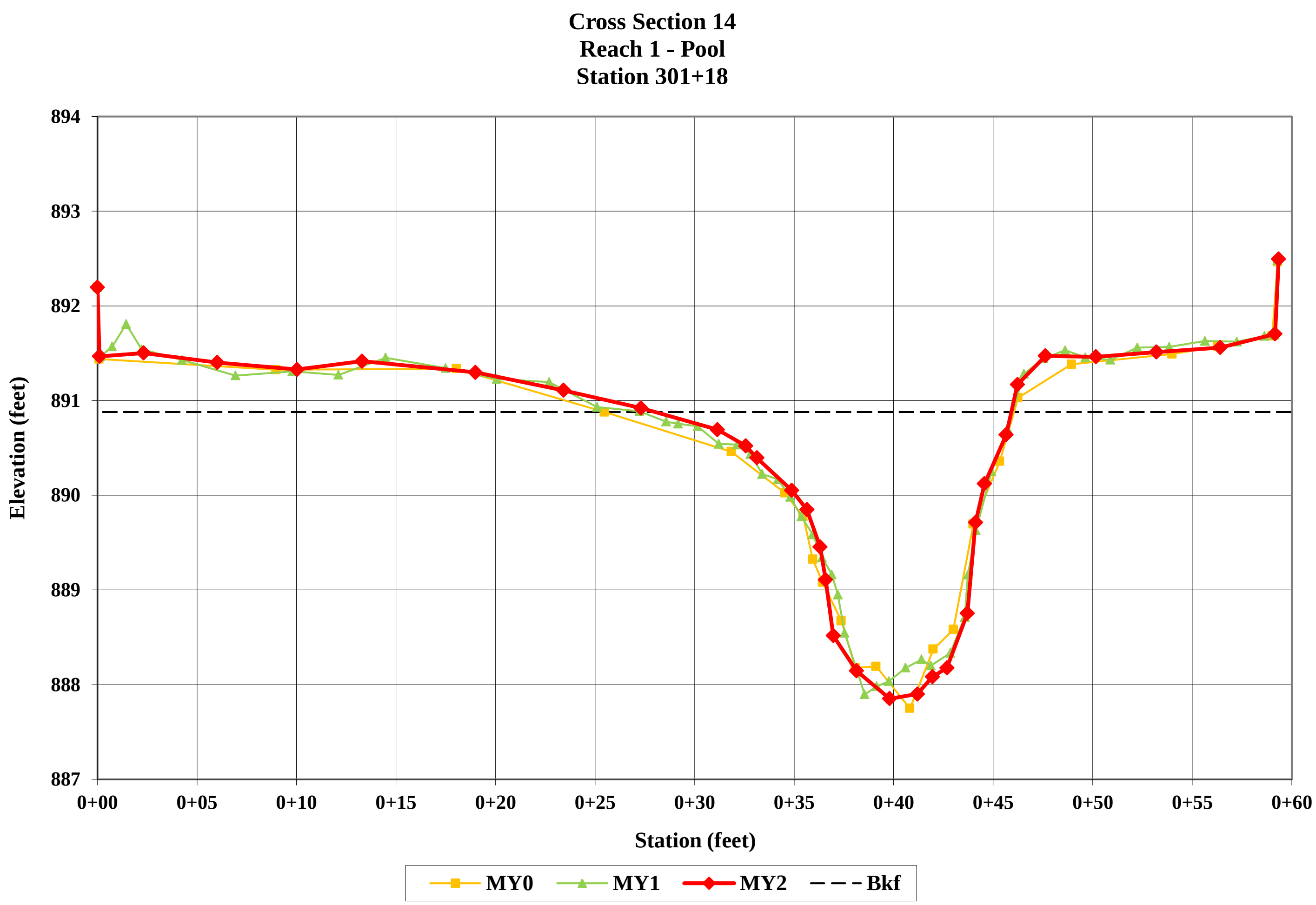
Right Bank Descending



Cross Section 14 Reach 1 – Pool

Left Bank Descending

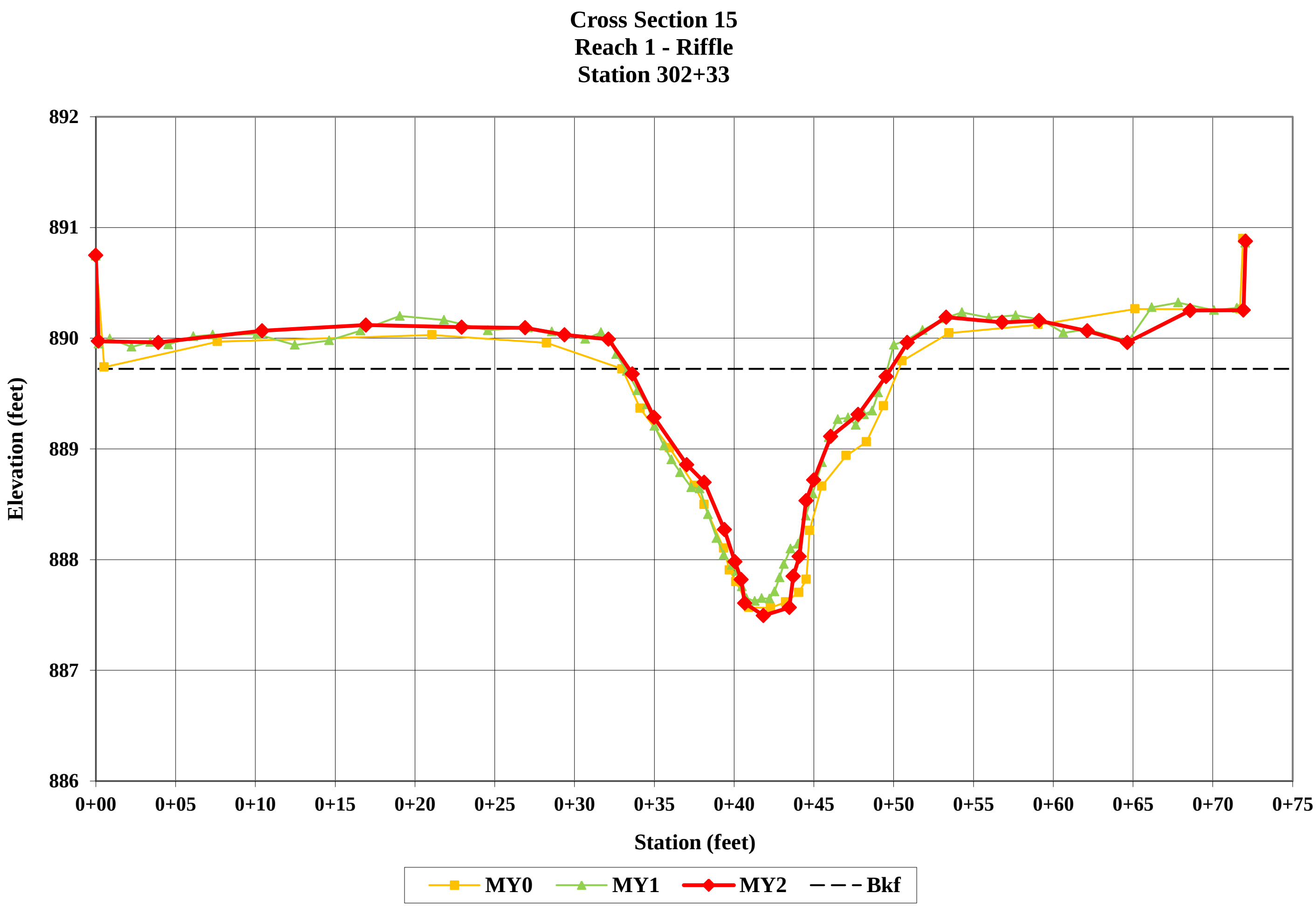
Right Bank Descending



Cross Section 15 Reach 1 – Riffle

Left Bank Descending

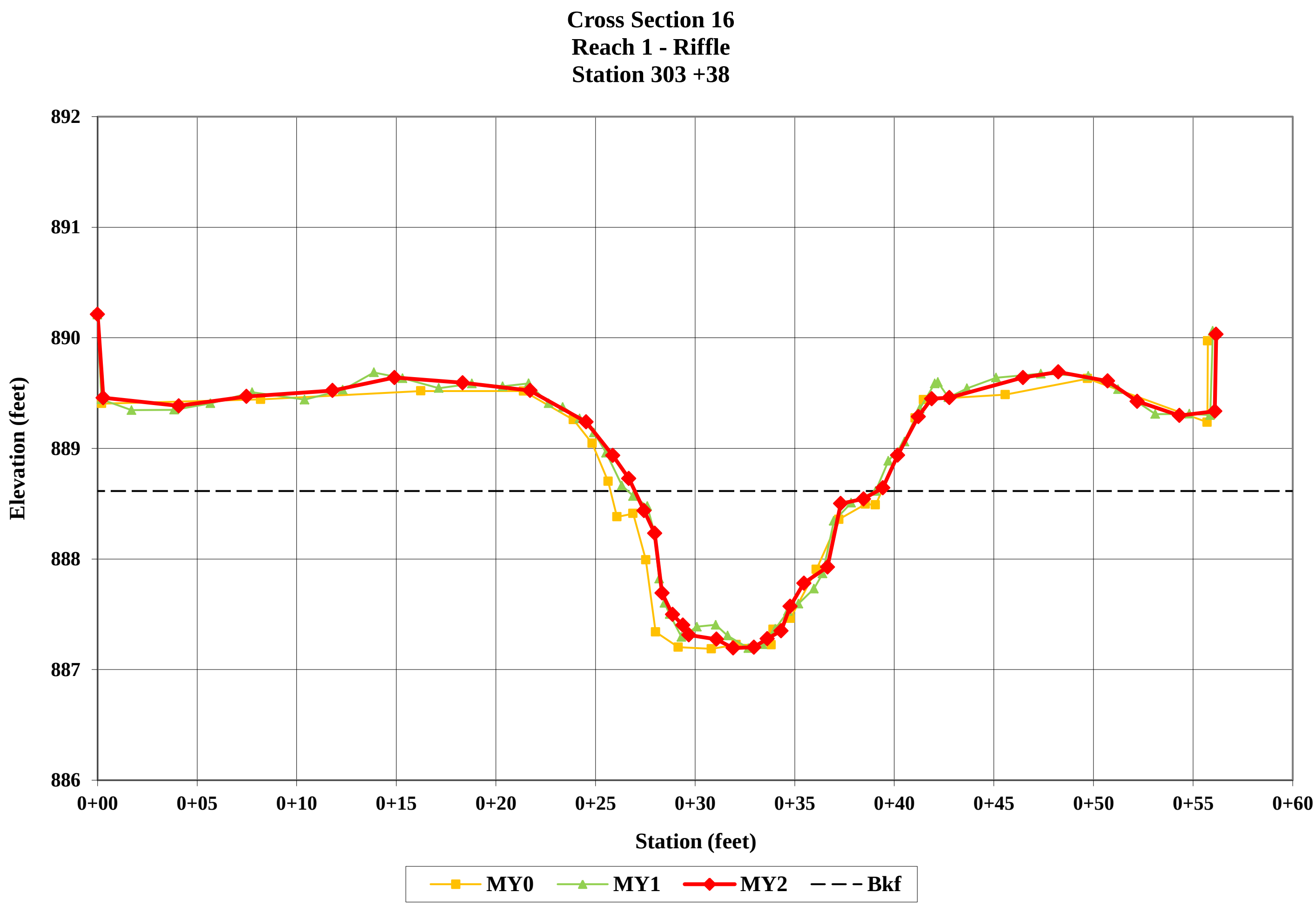
Right Bank Descending



Cross Section 16 Reach 1 – Riffle

Left Bank Descending

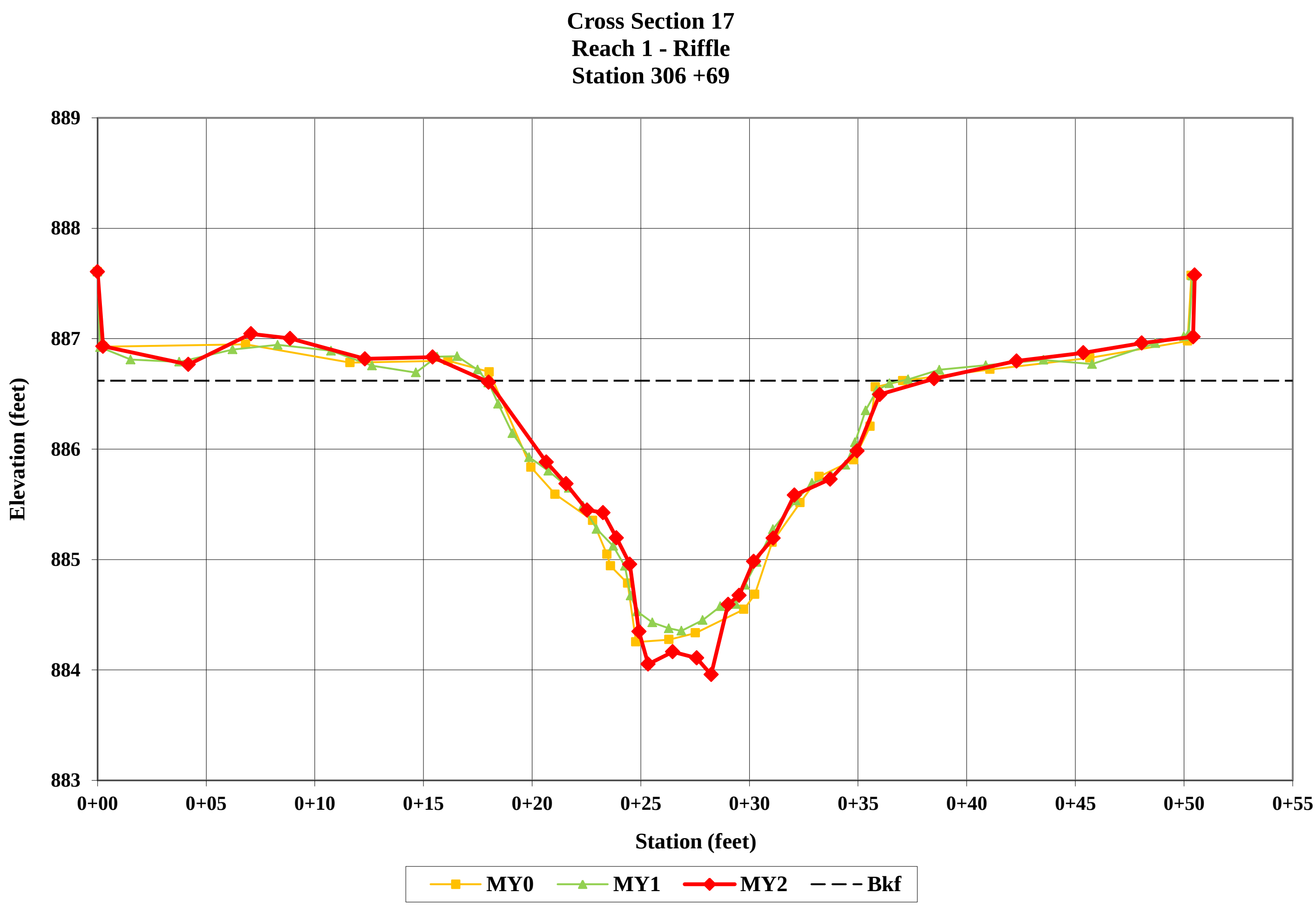
Right Bank Descending



Cross Section 17 Reach 1 – Riffle

Left Bank Descending

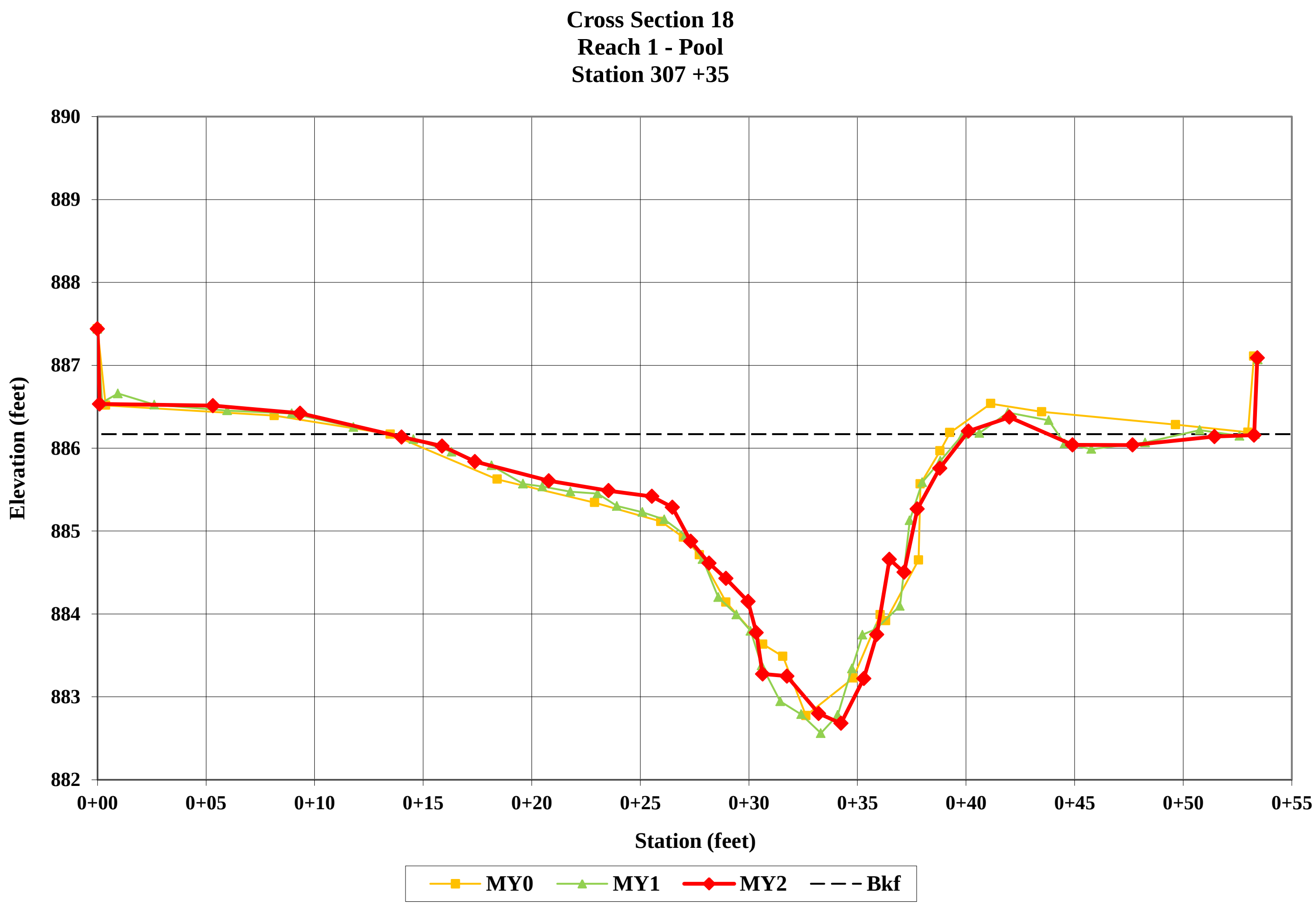
Right Bank Descending



Cross Section 18 Reach 1 – Pool

Left Bank Descending

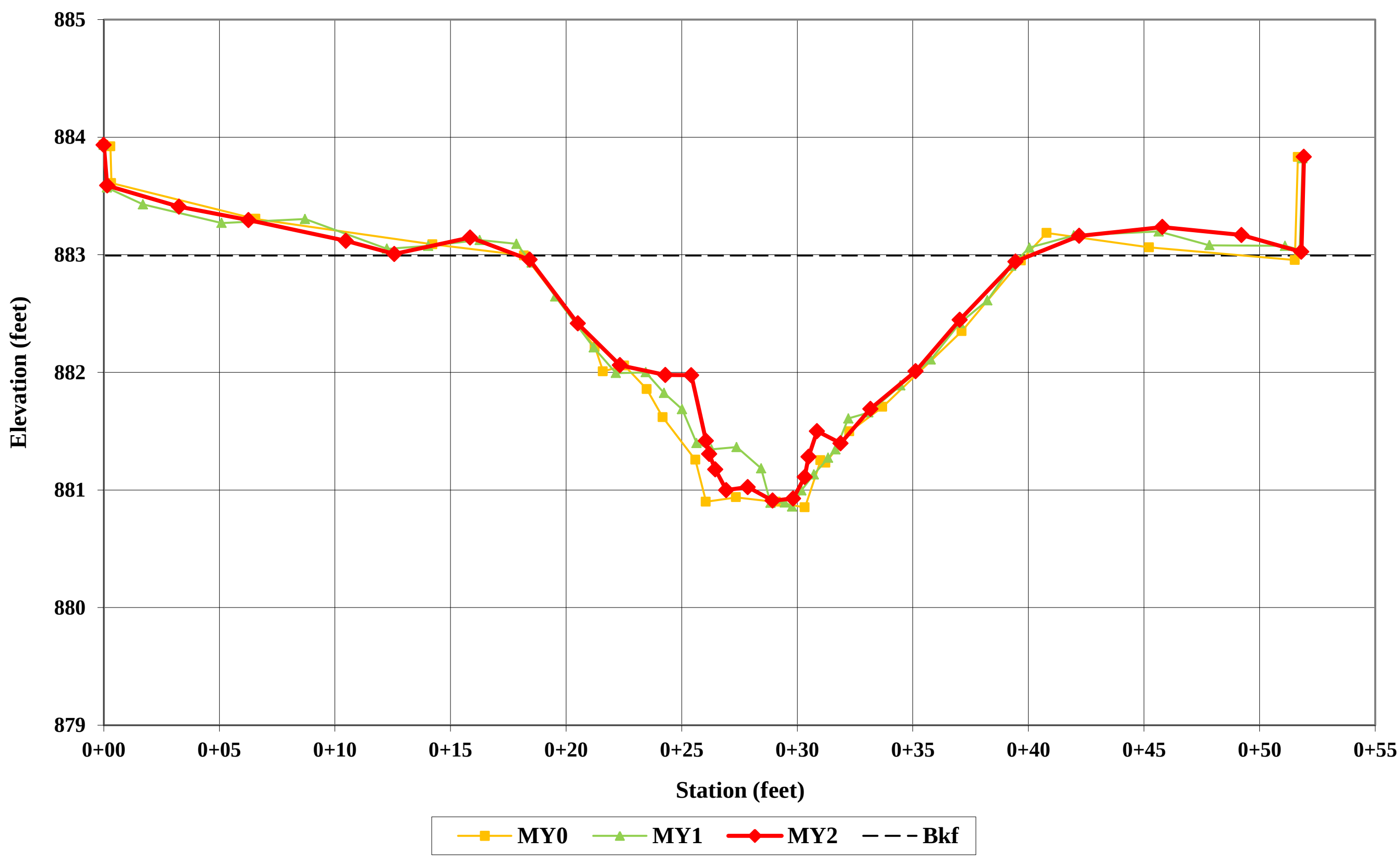
Right Bank Descending



Cross Section 19 Reach 1 – Riffle

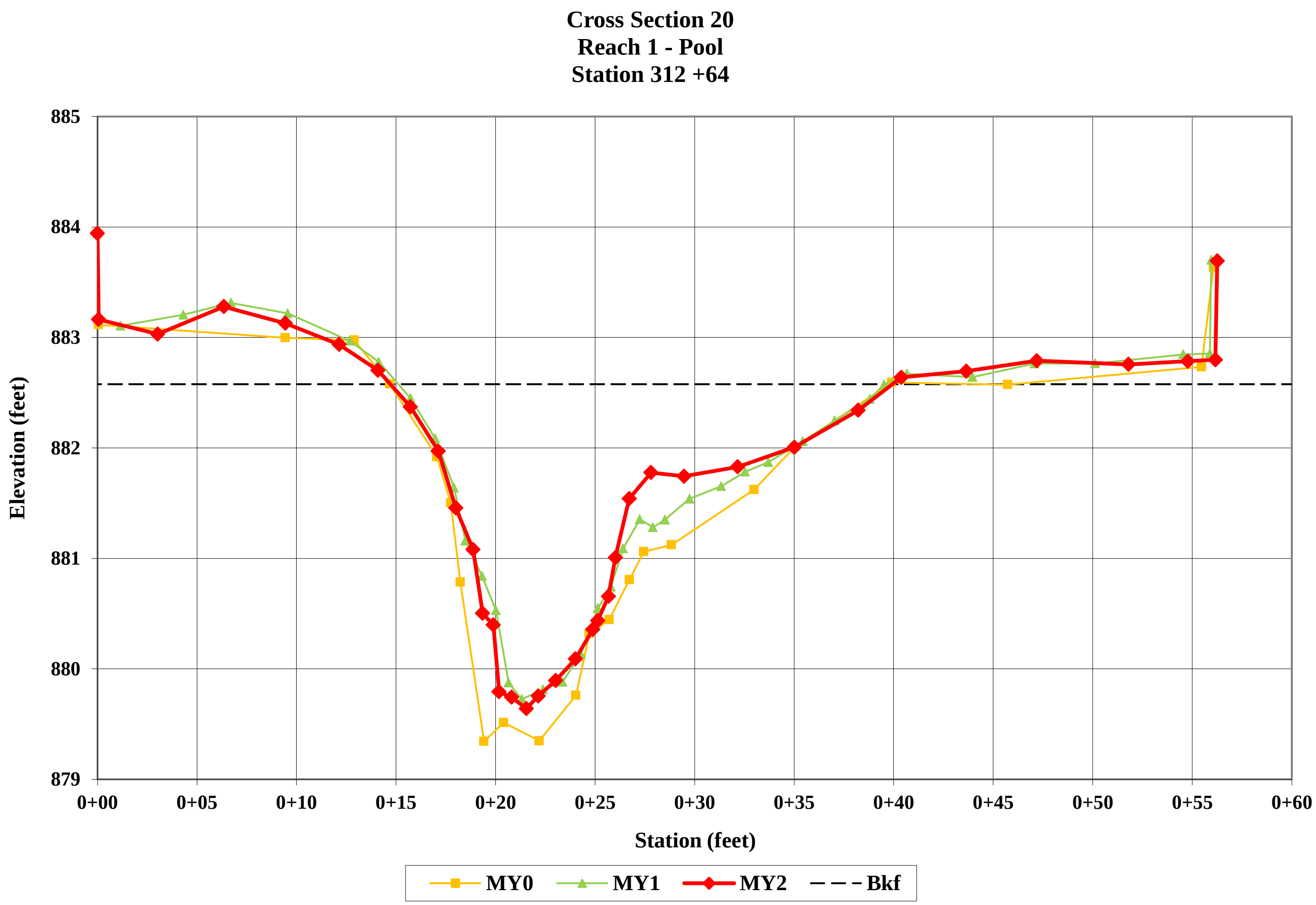
Left Bank Descending

Right Bank Descending



Cross Section 20 Reach 1 – Pool

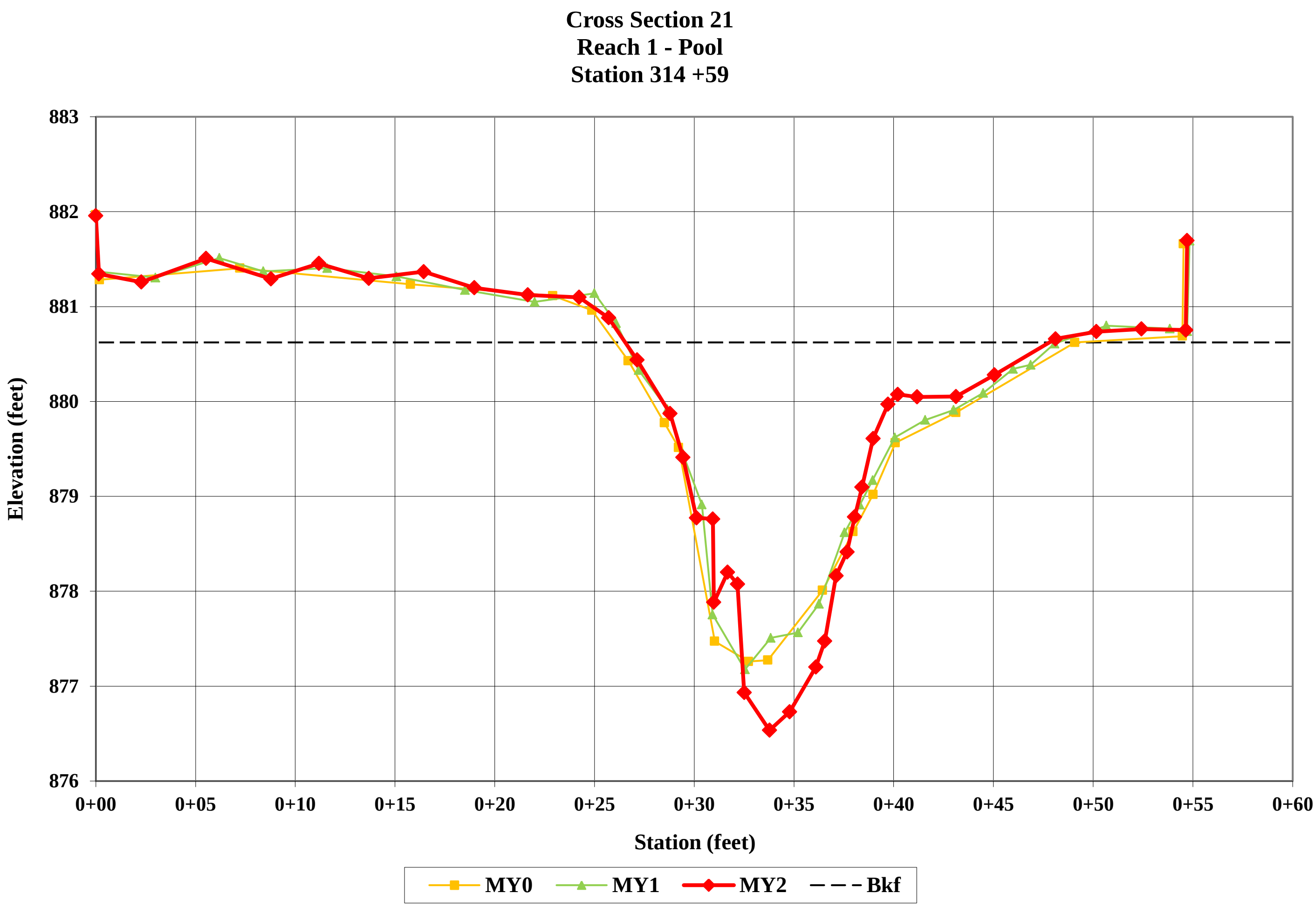
Left Bank Descending Right Bank Descending



Cross Section 21 Reach 1 – Pool

Left Bank Descending

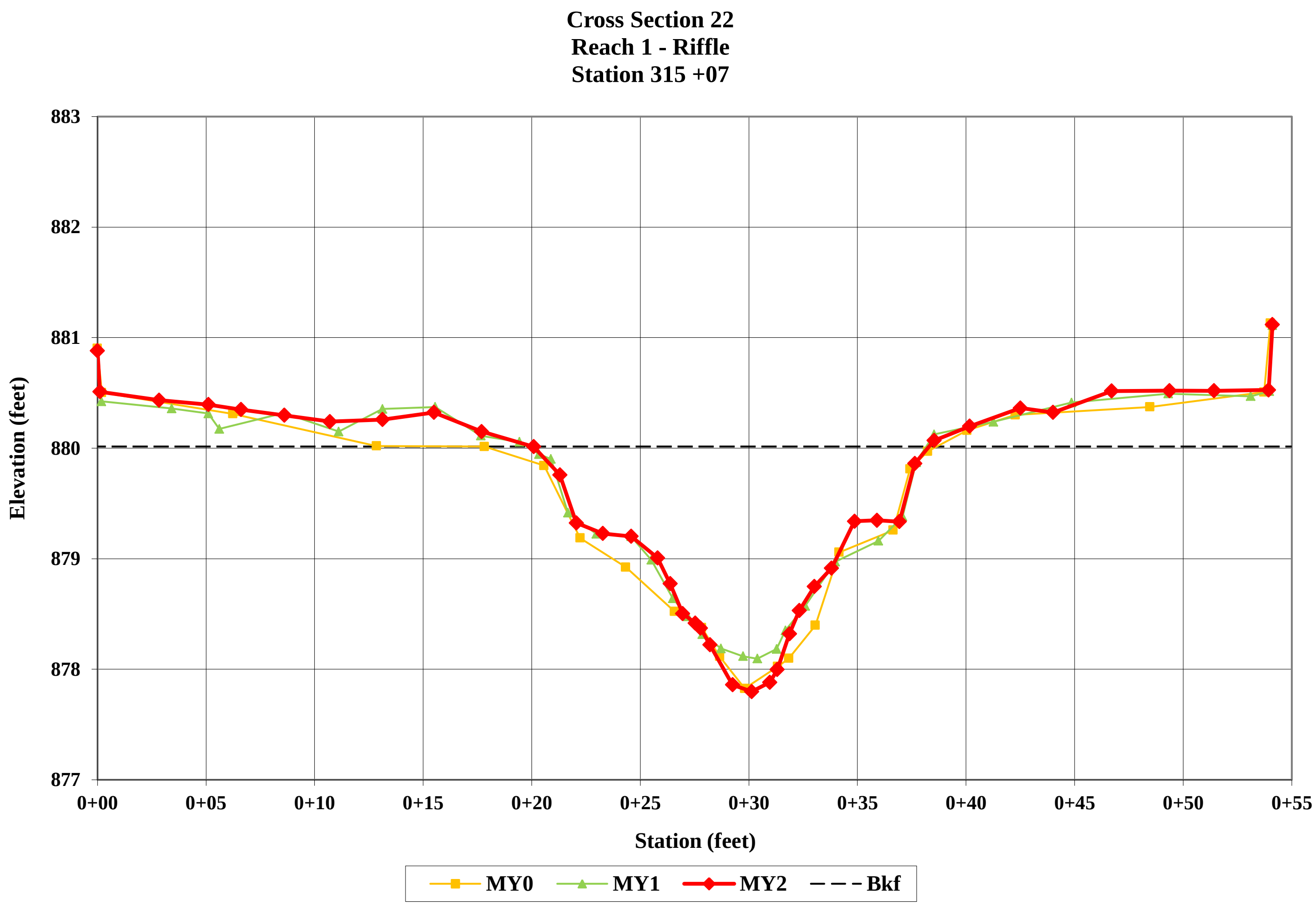
Right Bank Descending



Cross Section 22 Reach 1 – Riffle

Left Bank Descending

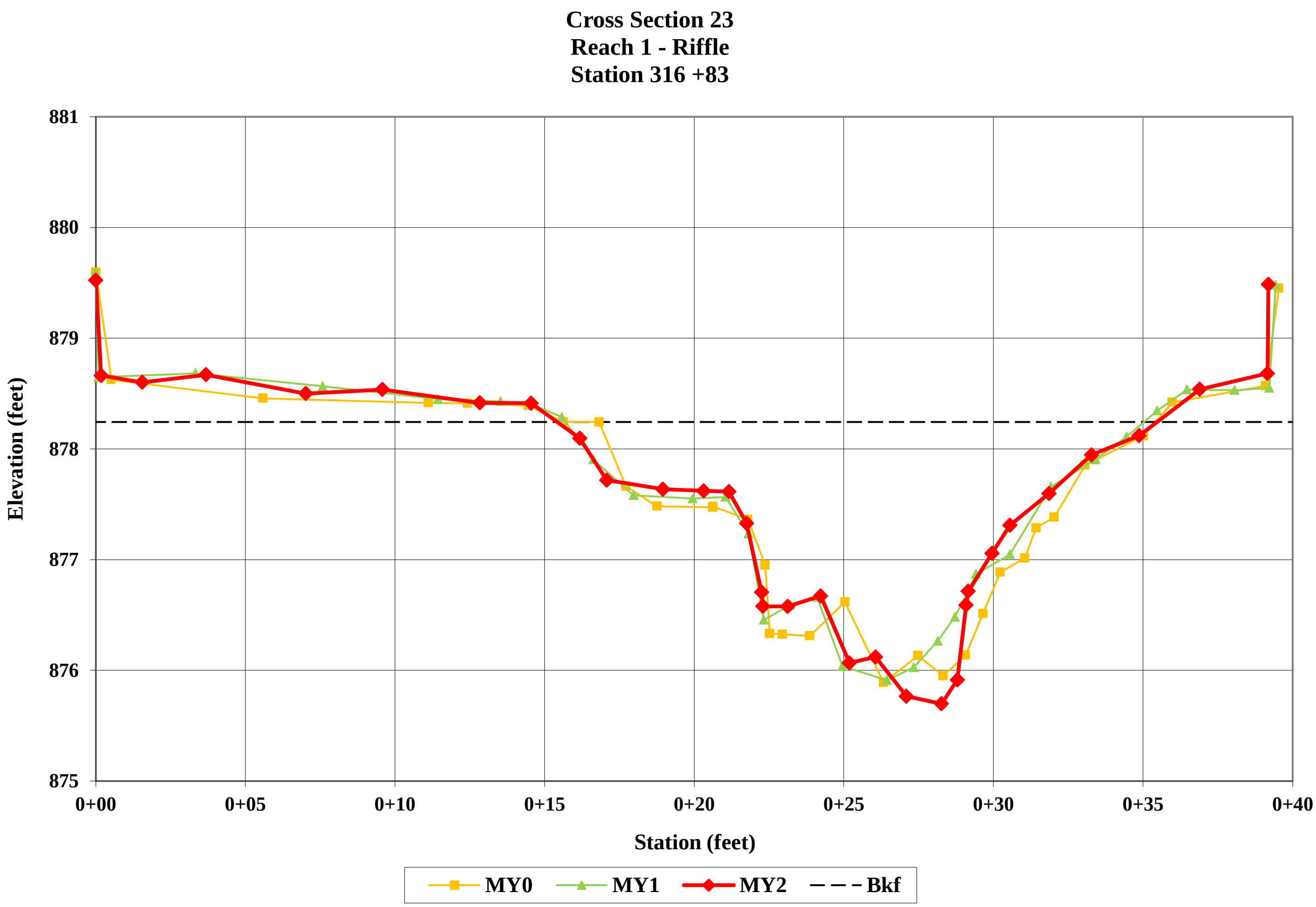
Right Bank Descending



Cross Section 23 Reach 1 – Riffle

Left Bank Descending

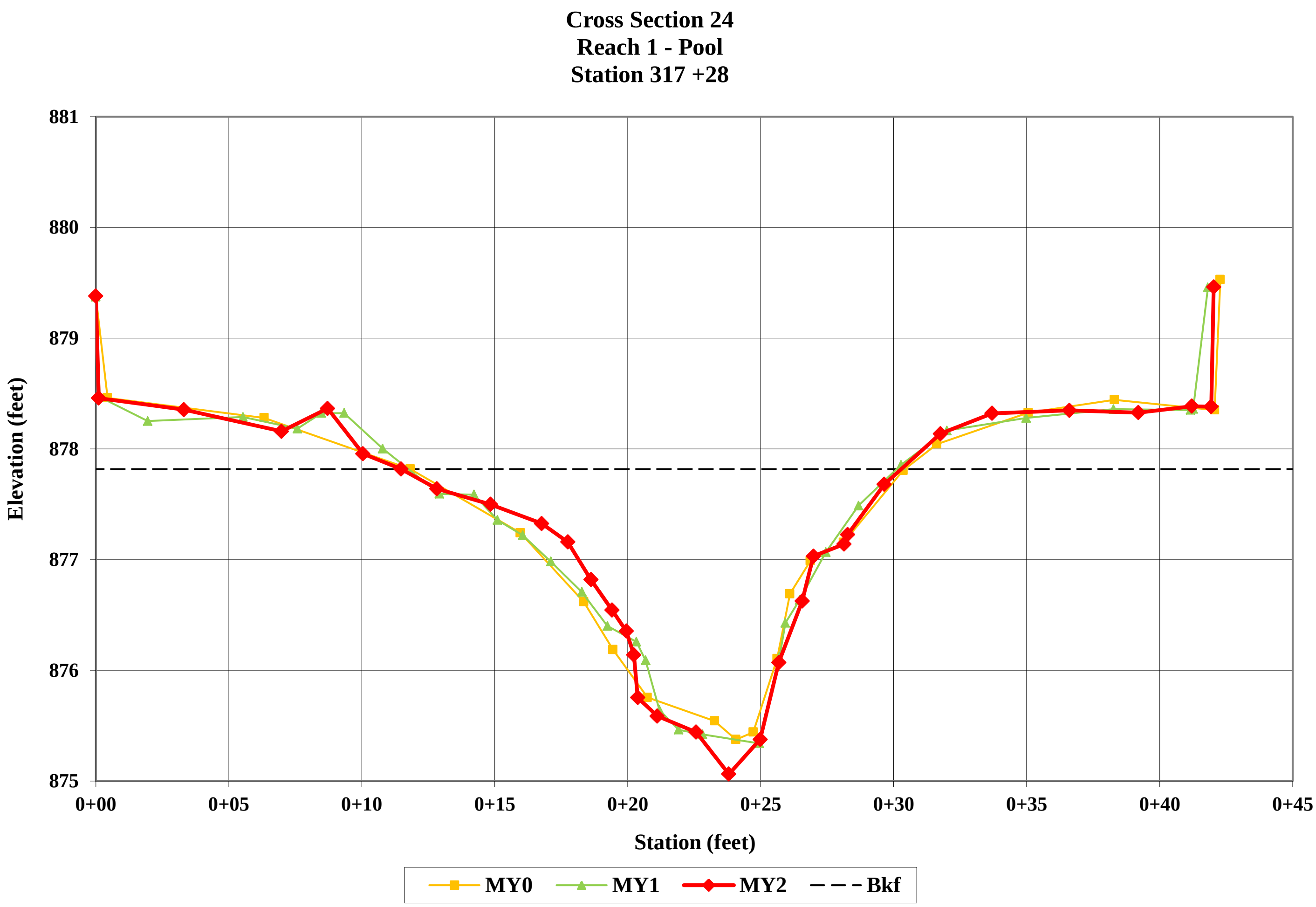
Right Bank Descending



Cross Section 24 Reach 1 – Pool

Left Bank Descending

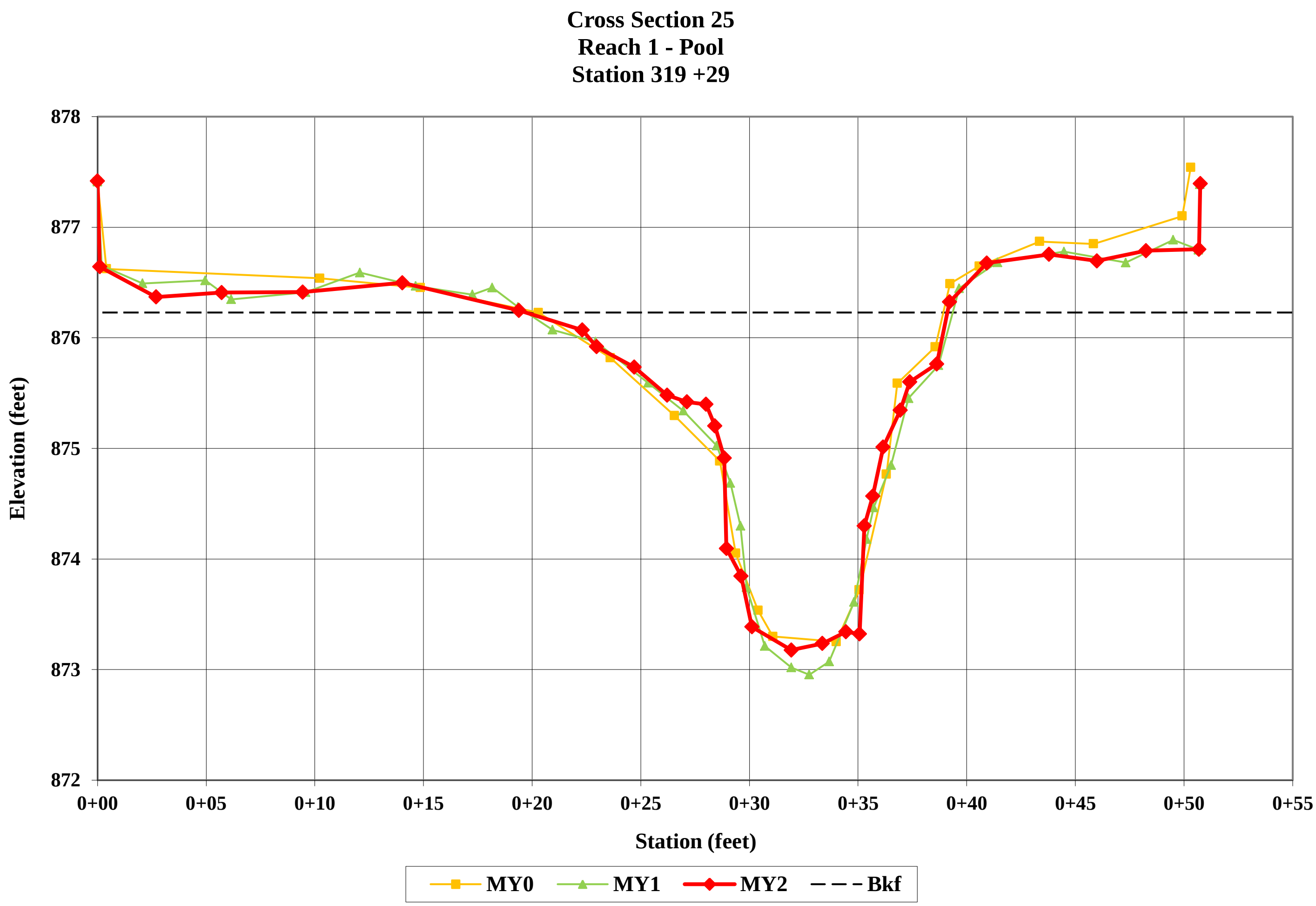
Right Bank Descending



Cross Section 25 Reach 1 – Pool

Left Bank Descending

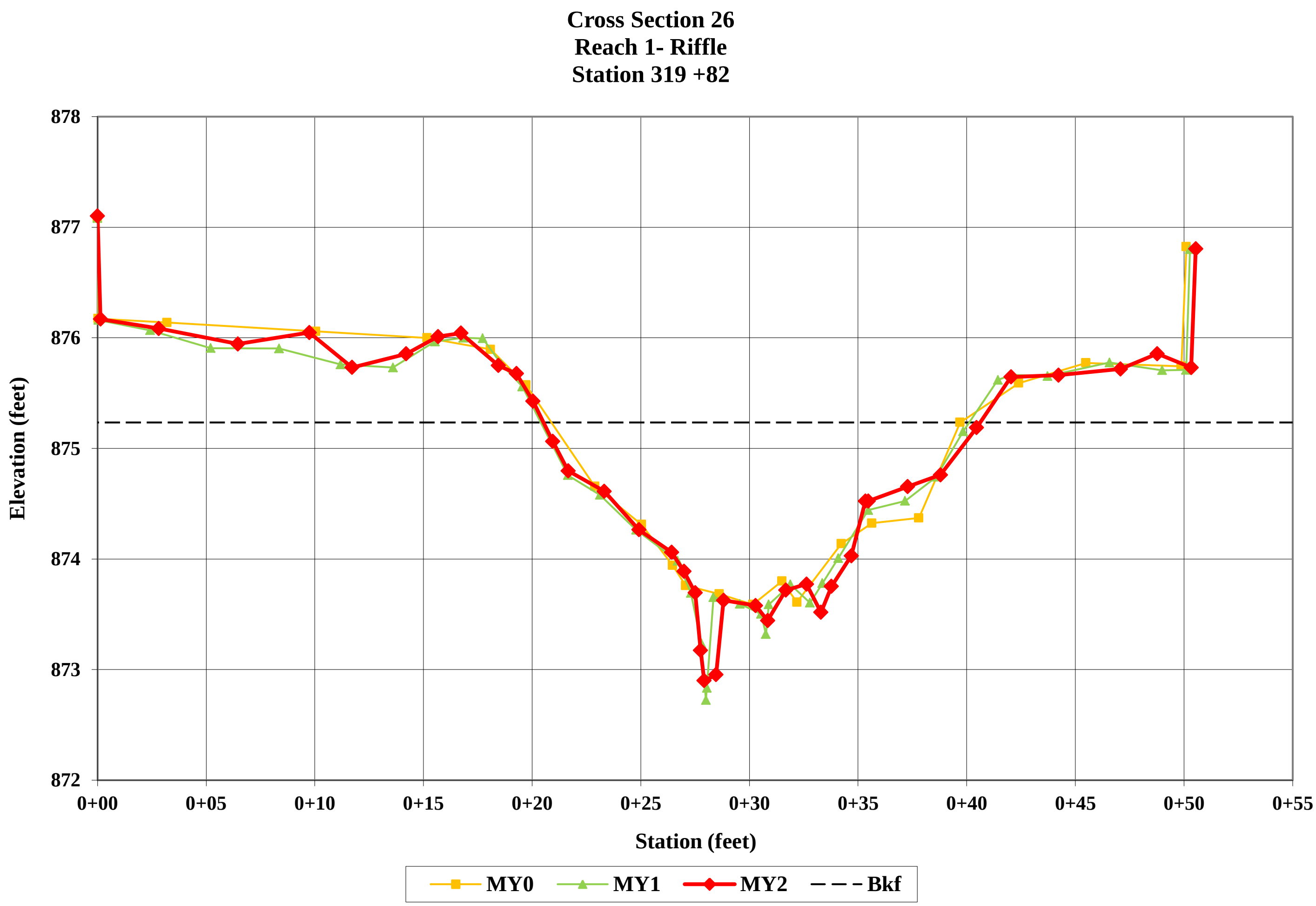
Right Bank Descending



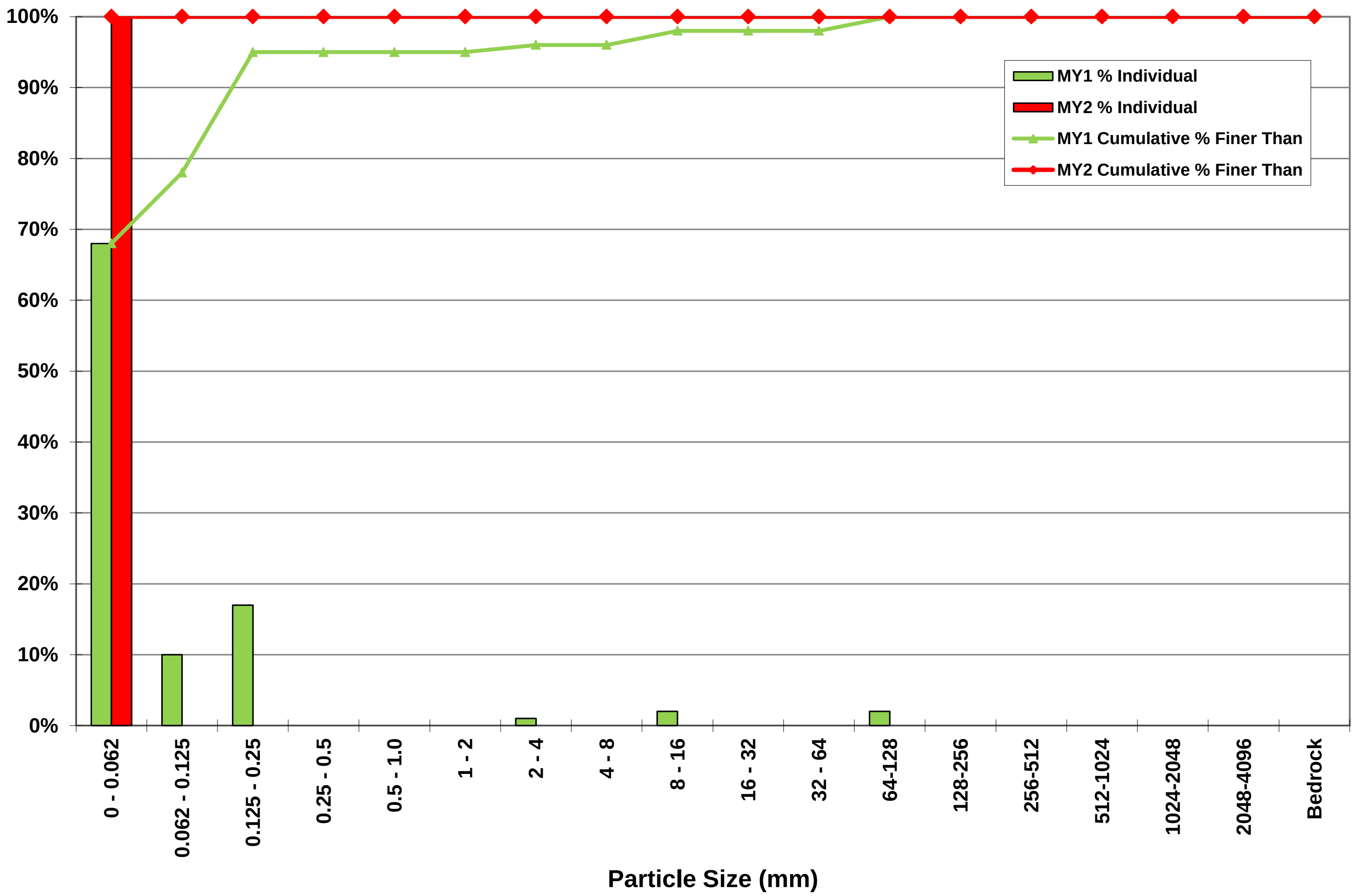
Cross Section 26 Reach 1 – Riffle

Left Bank Descending

Right Bank Descending

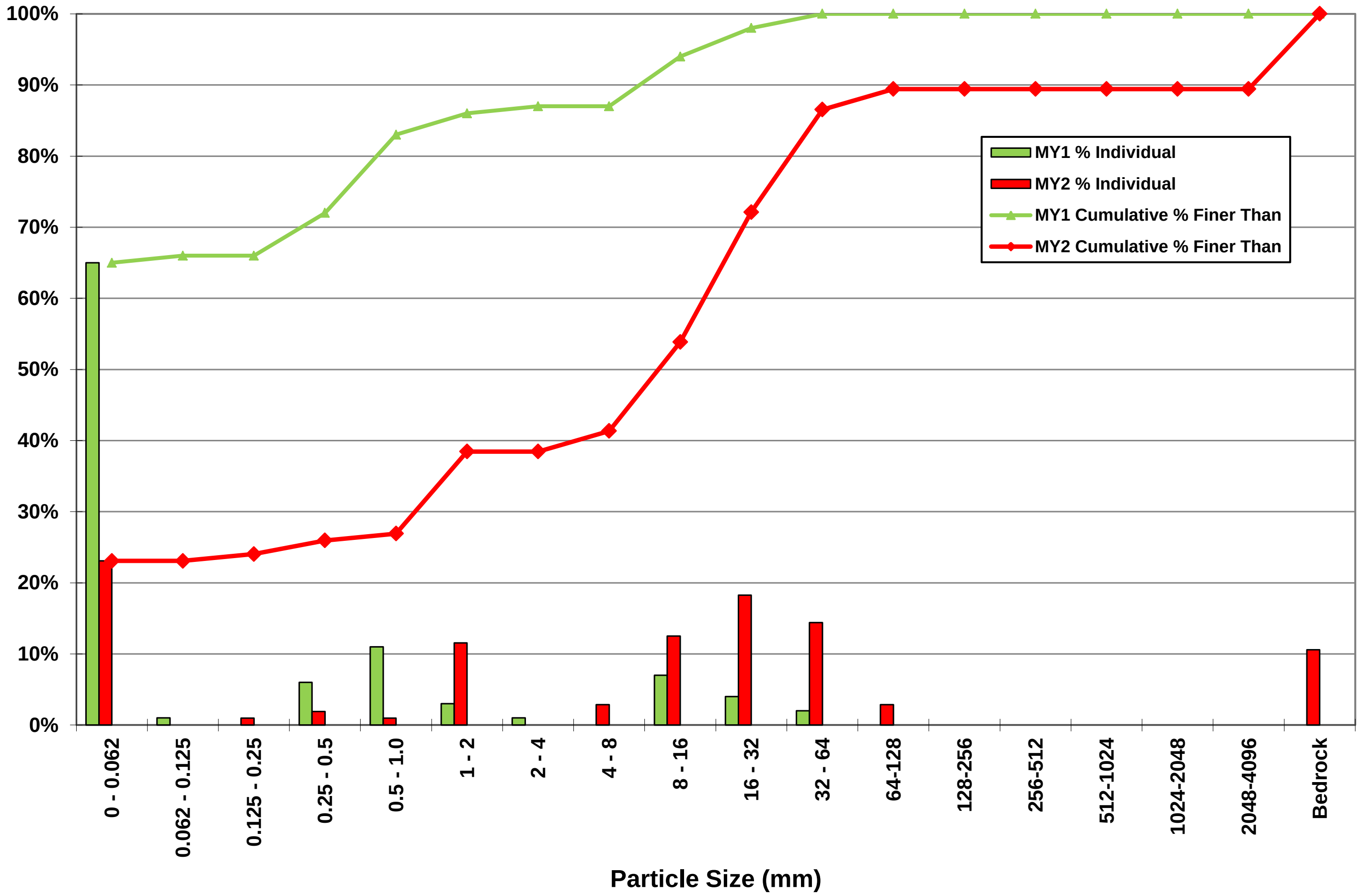


Cross Section 1 Reach 4 – Riffle
Pebble Count



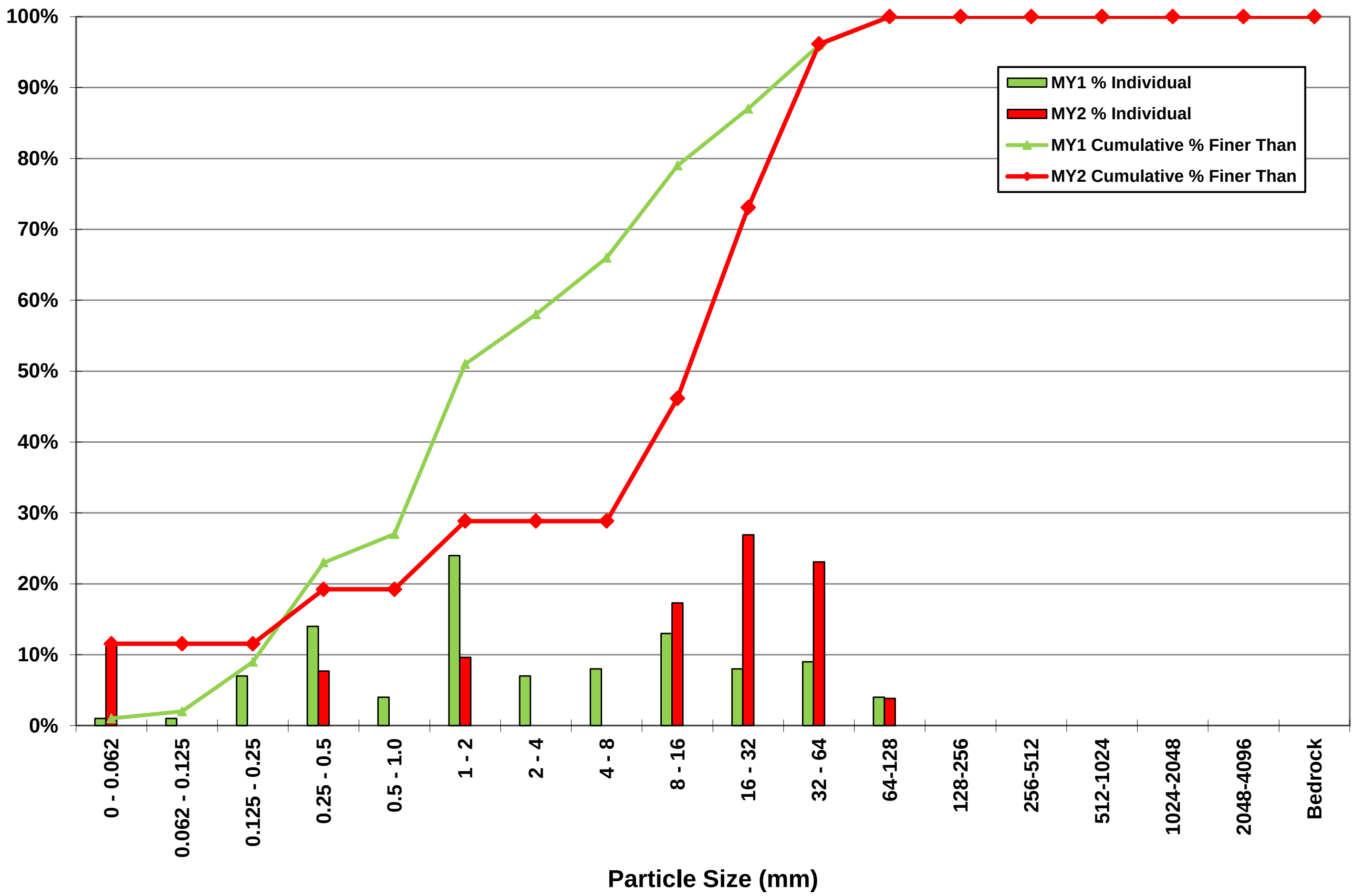
Summary Data	
D50	0.062 mm
D84	0.062 mm
D95	0.062 mm

Cross Section 3 Reach 2 – Riffle
Pebble Count



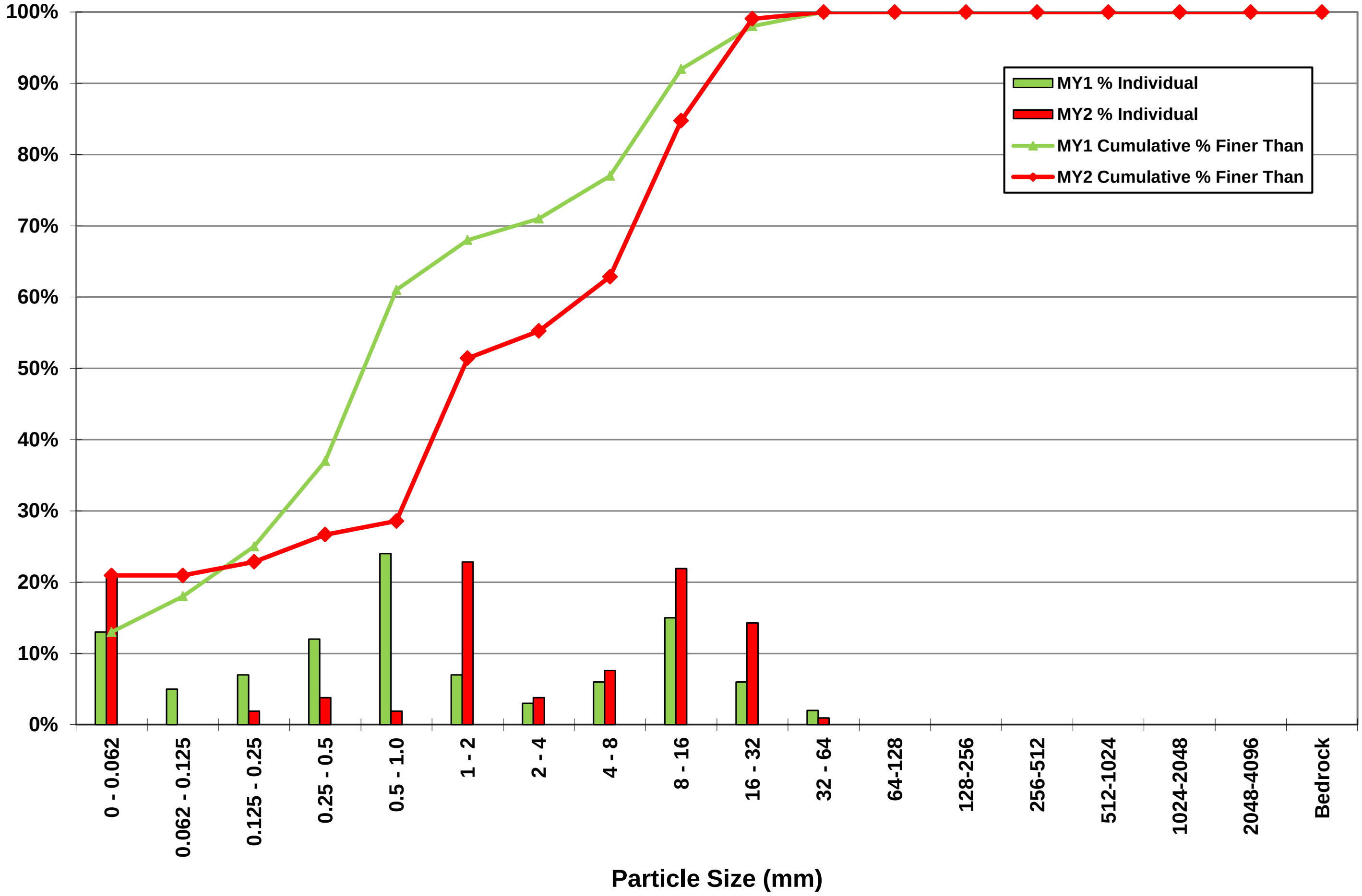
Summary Data	
D50	11 mm
D84	36 mm
D95	57 mm

Cross Section 6 Reach 2 – Riffle
Pebble Count



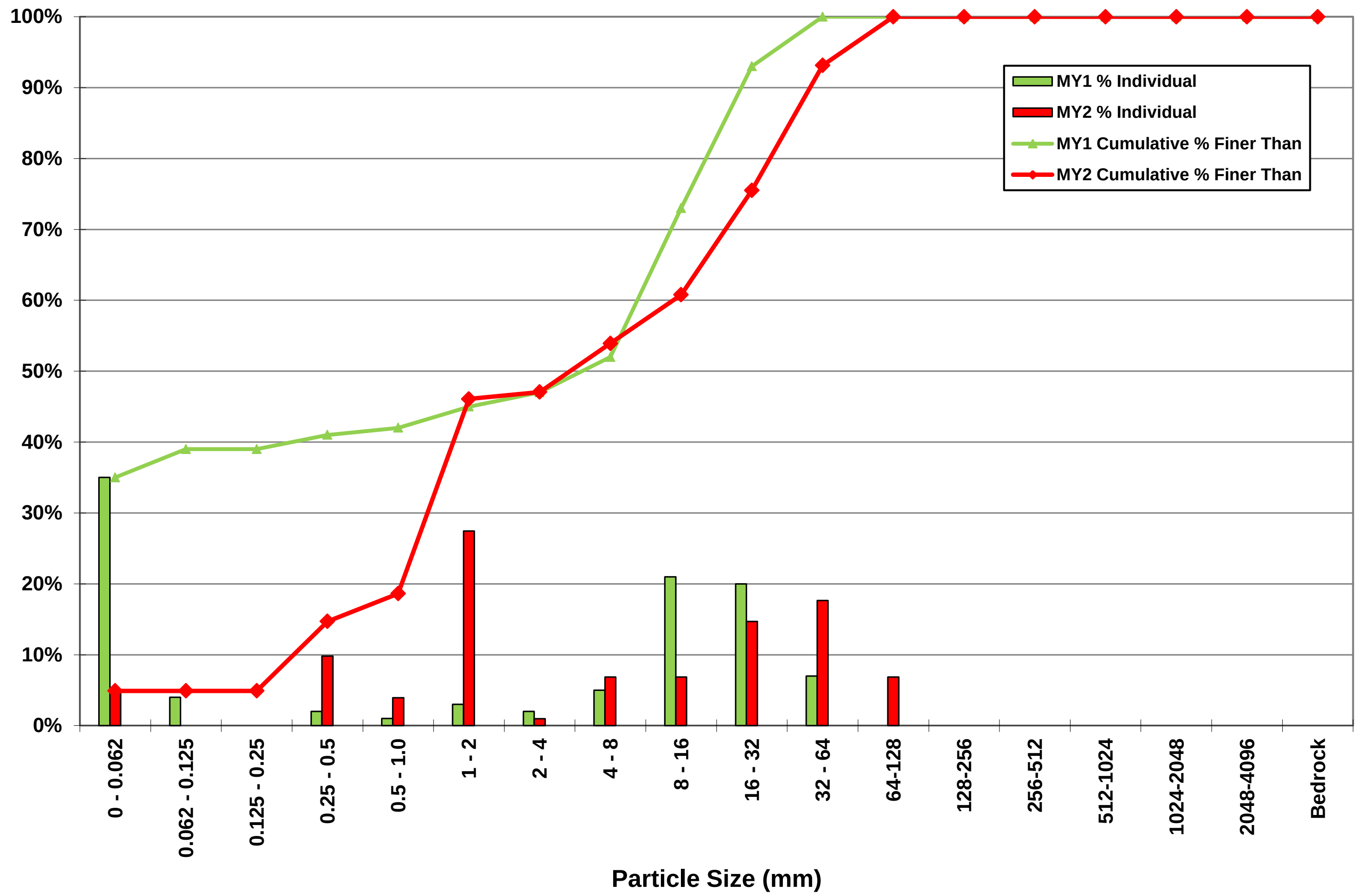
Summary Data	
D50	18 mm
D84	41 mm
D95	61 mm

Cross Section 8 Reach 2 – Riffle
Pebble Count



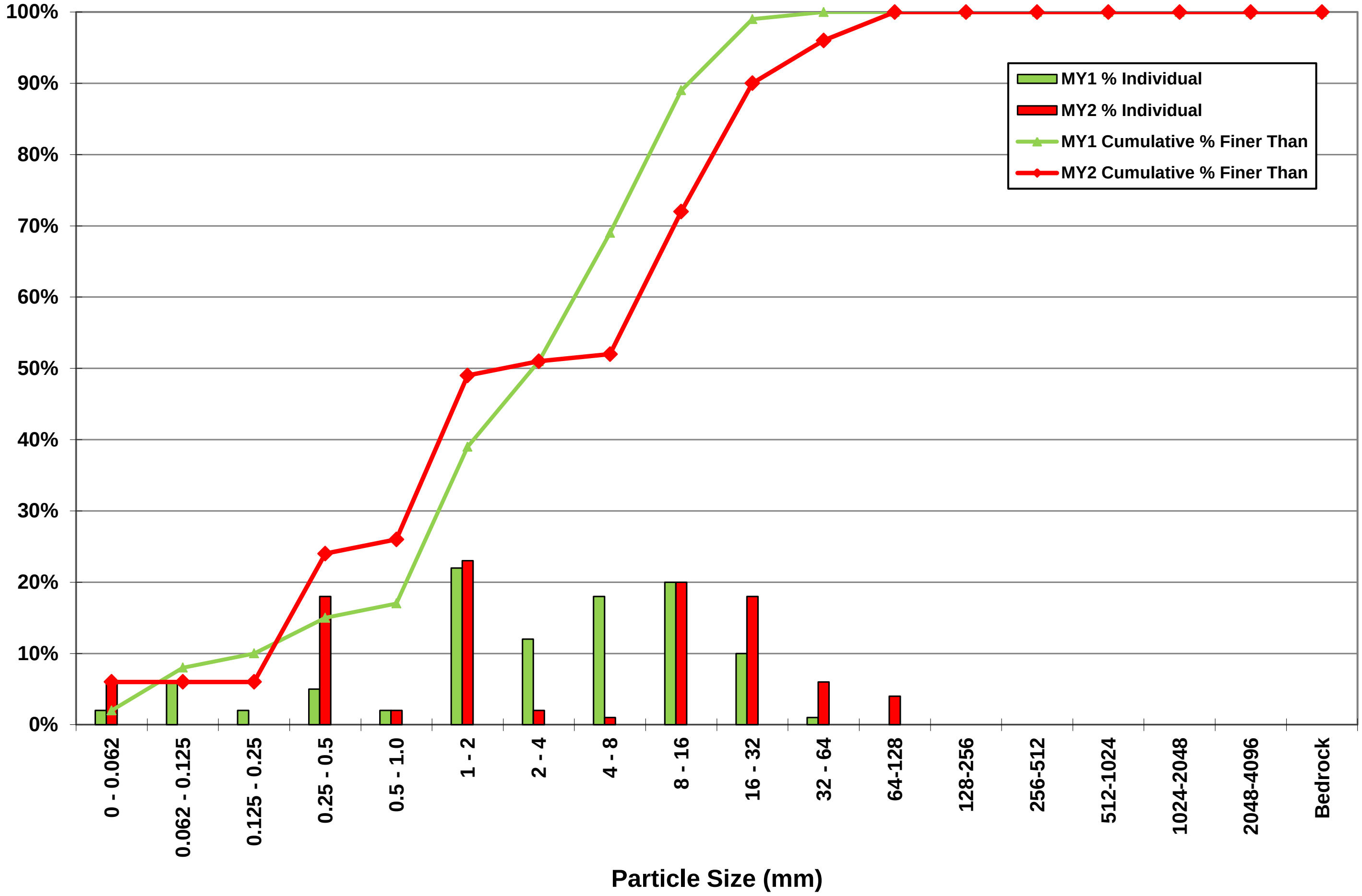
Summary Data	
D50	1.9 mm
D84	16 mm
D95	23 mm

Cross Section 9 Reach 2 – Riffle
Pebble Count



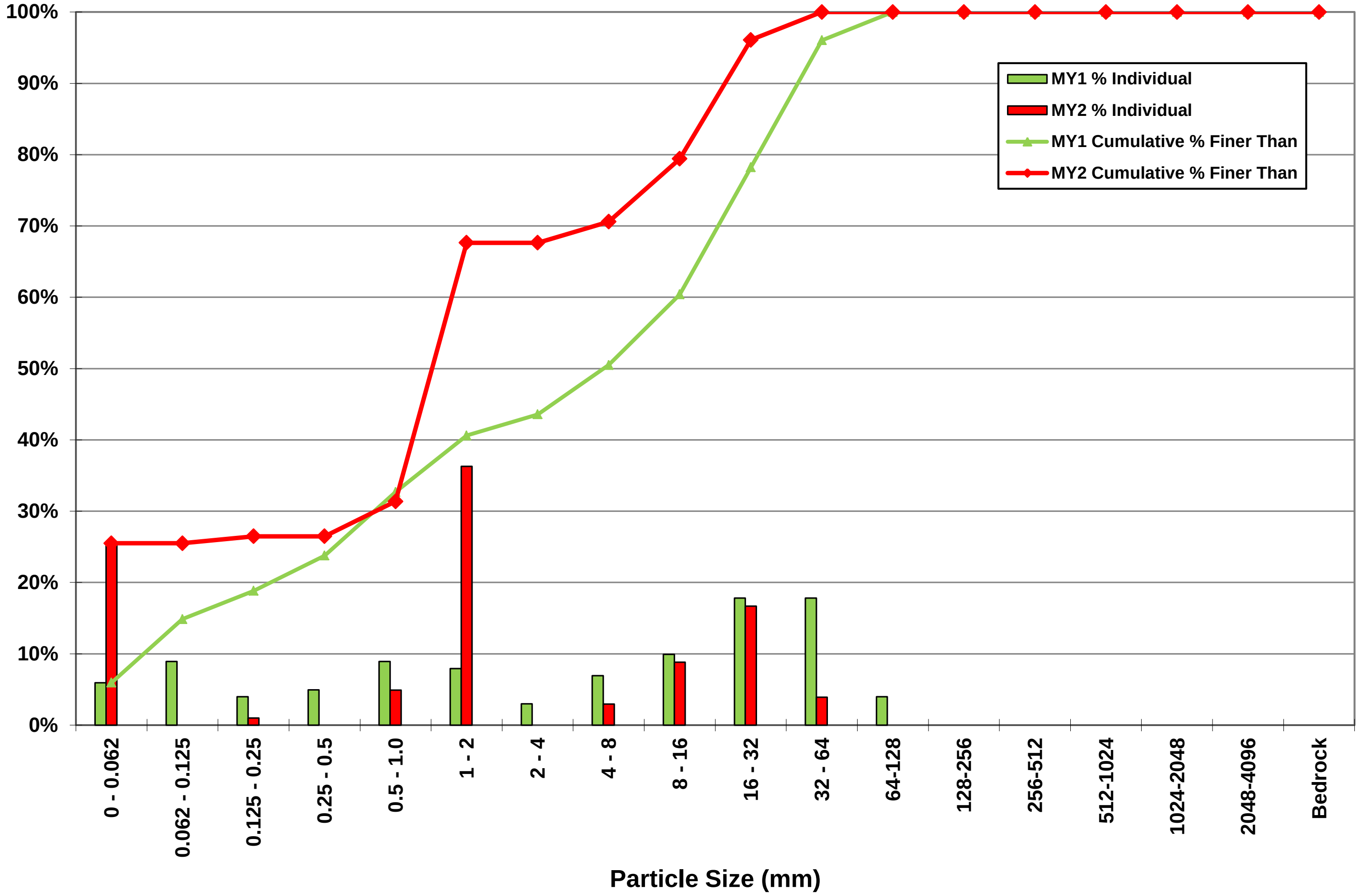
Summary Data	
D50	5.1 mm
D84	47 mm
D95	71 mm

Cross Section 11 Reach 2 – Riffle
Pebble Count



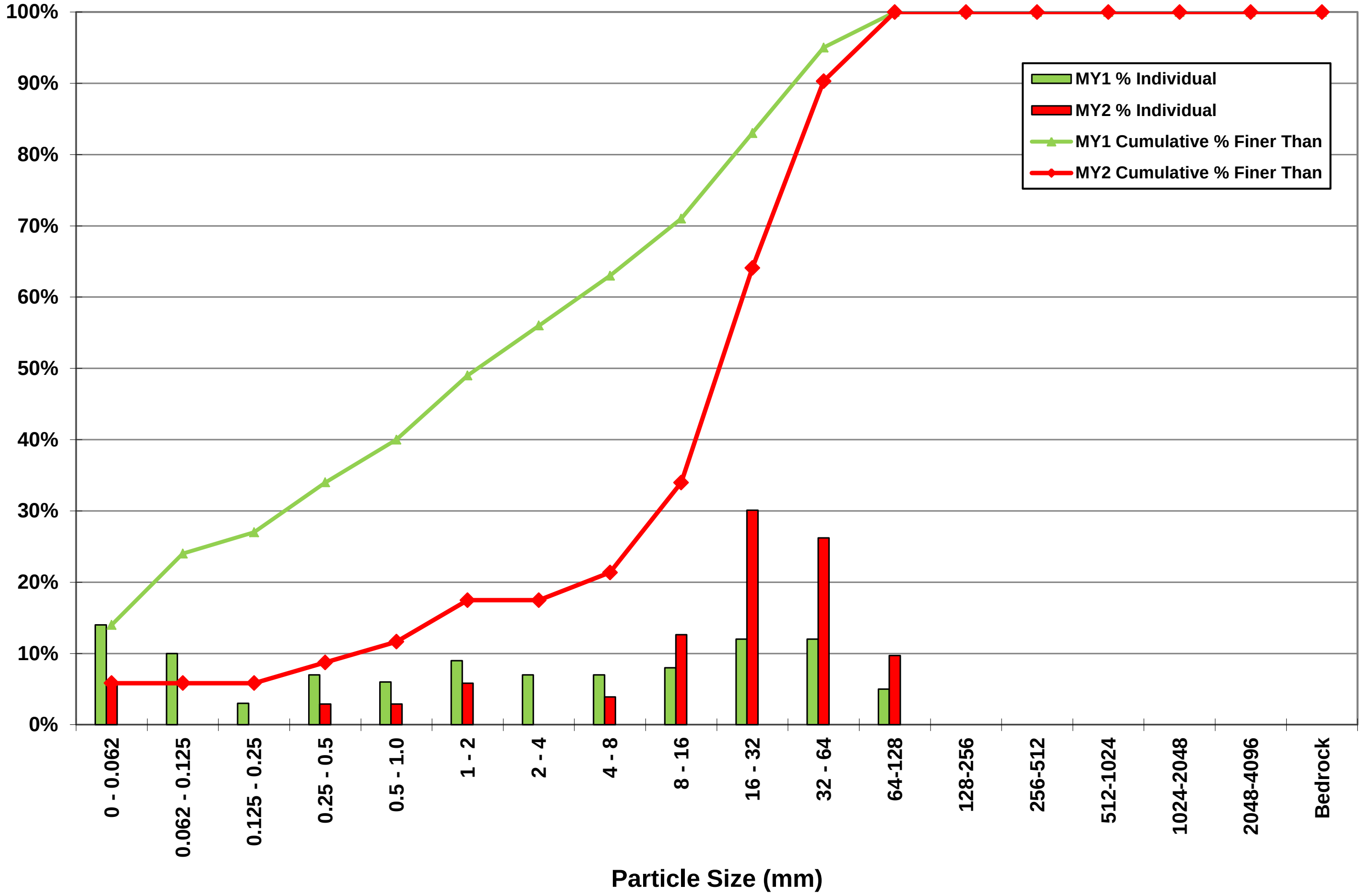
Summary Data	
D50	2.8 mm
D84	26 mm
D95	57 mm

Cross Section 12 Reach 3 – Riffle
Pebble Count



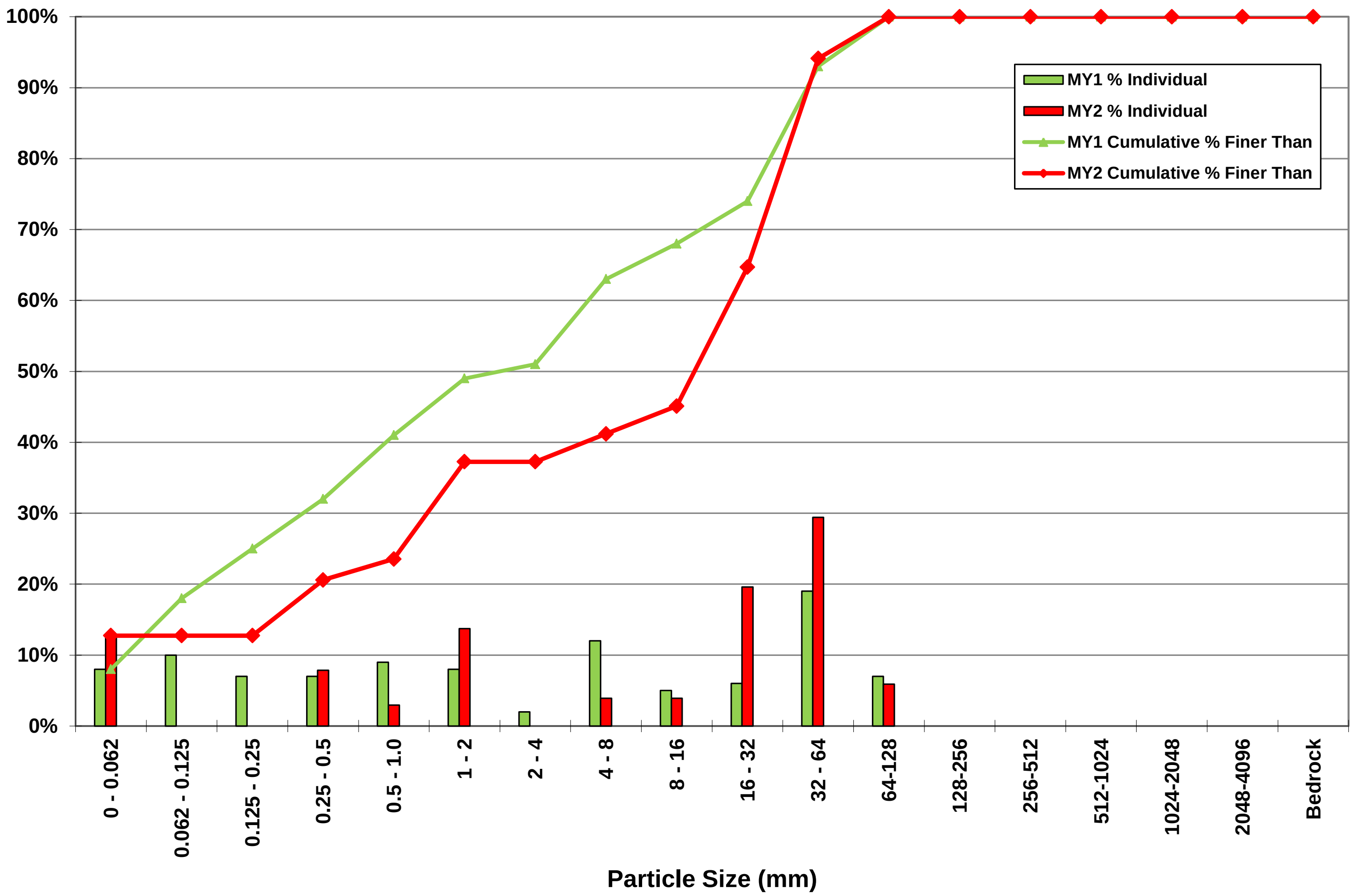
Summary Data	
D50	1.4 mm
D84	19 mm
D95	31 mm

Cross Section 15 Reach 1 – Riffle
Pebble Count



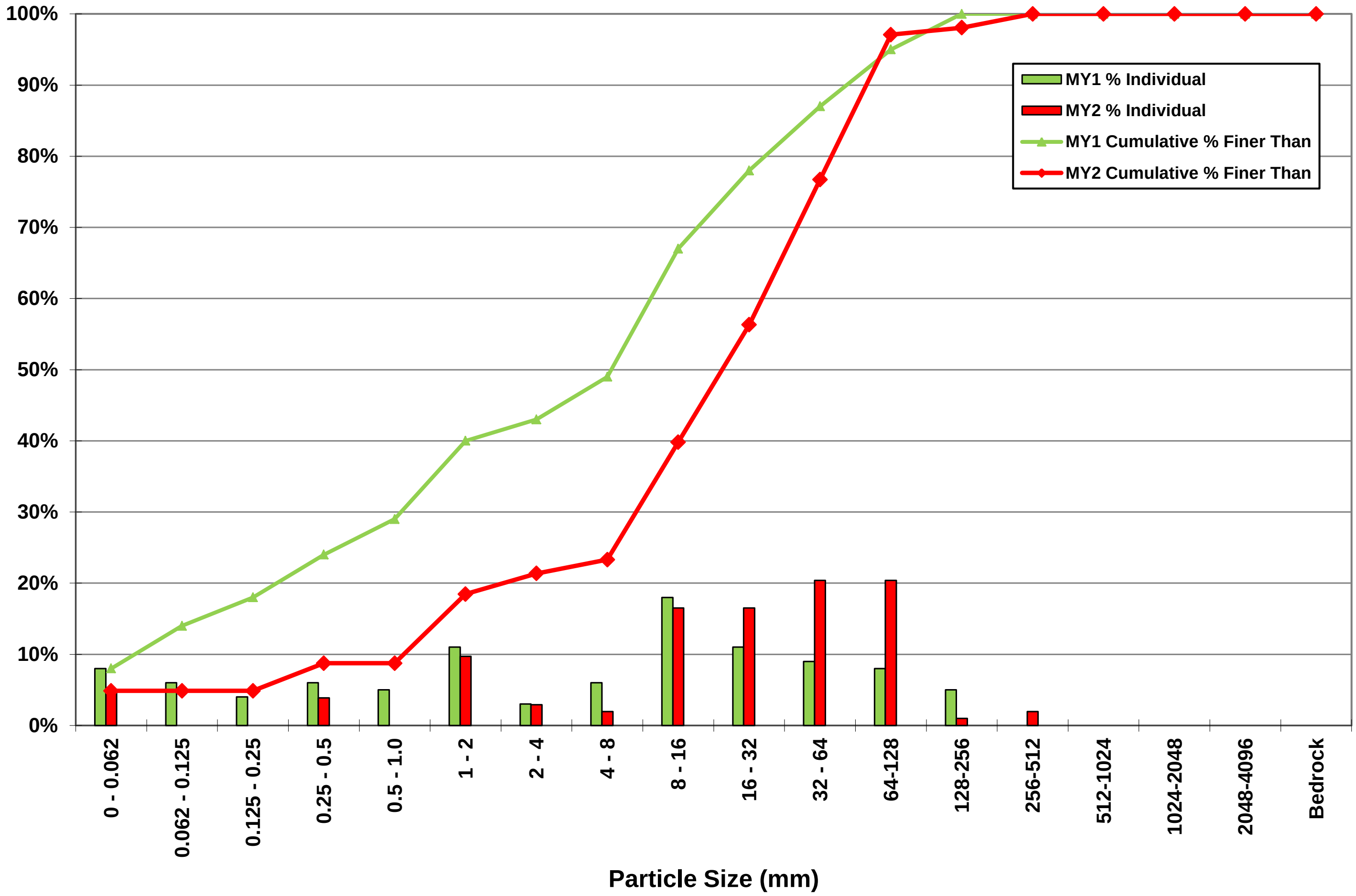
Summary Data	
D50	24 mm
D84	54 mm
D95	81 mm

Cross Section 16 Reach 1 – Riffle
Pebble Count



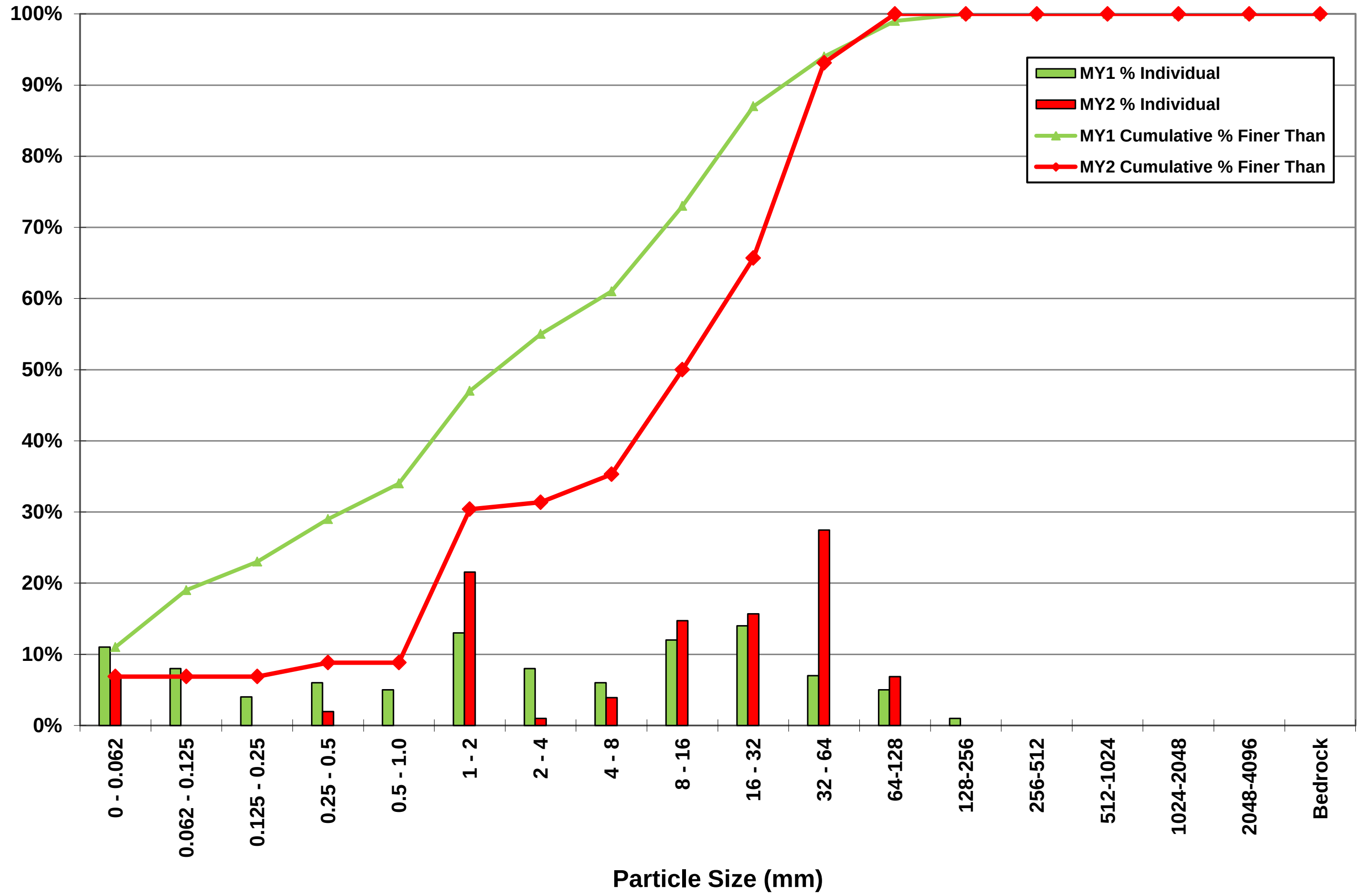
Summary Data	
D50	20 mm
D84	45 mm
D95	67 mm

Cross Section 17 Reach 1 – Riffle
Pebble Count



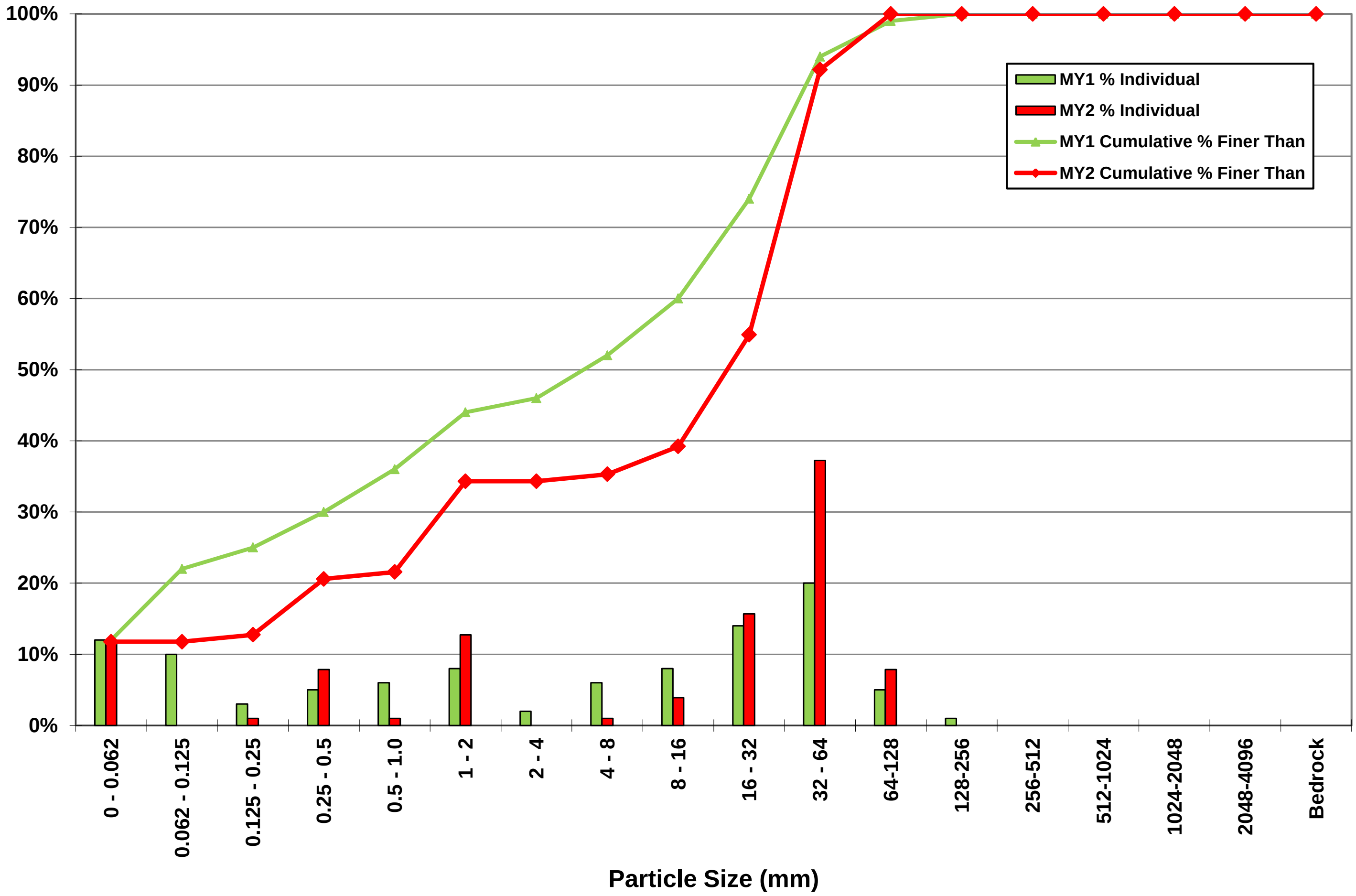
Summary Data	
D50	23 mm
D84	91 mm
D95	120 mm

Cross Section 19 Reach 1 – Riffle
Pebble Count



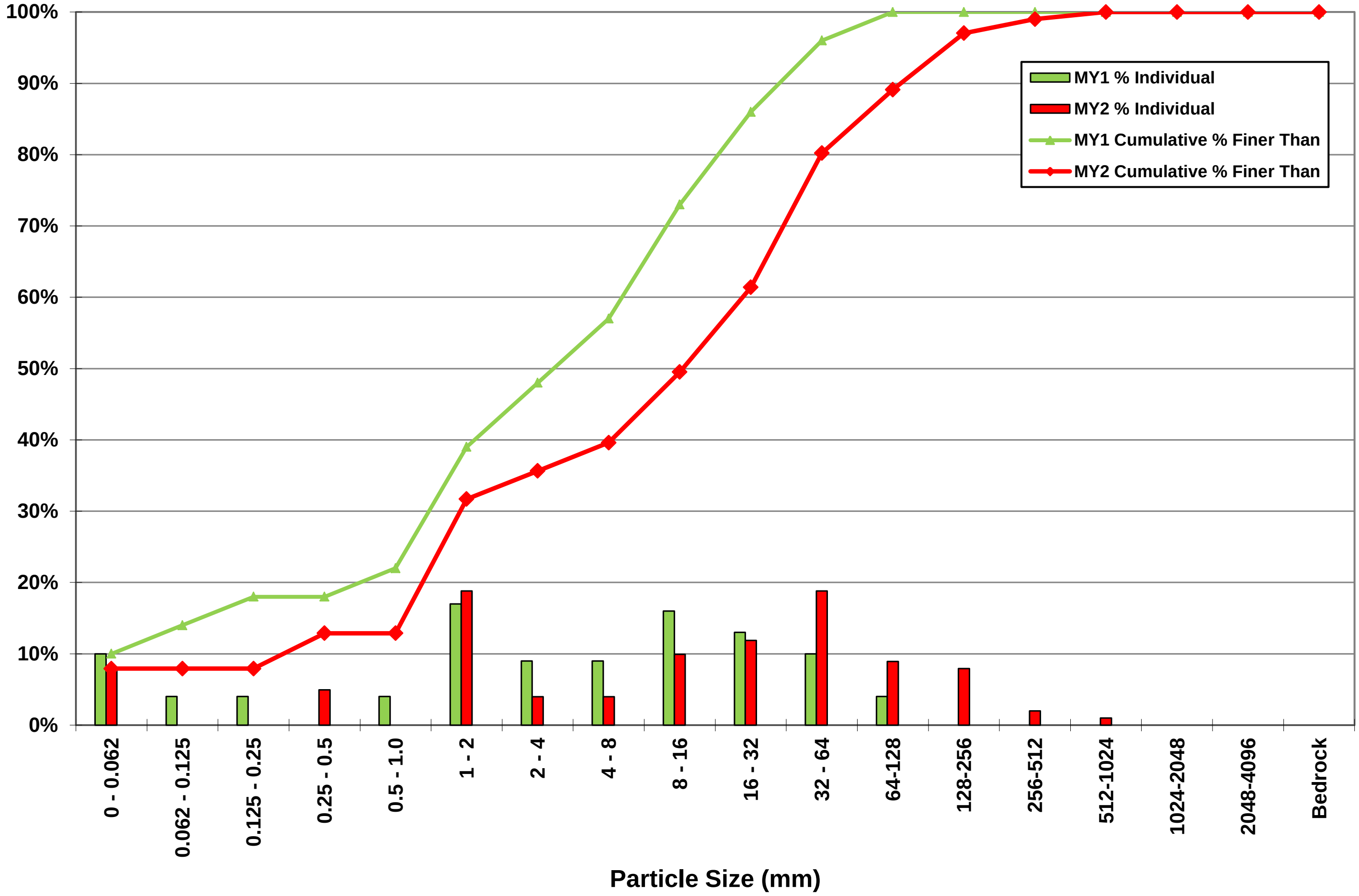
Summary Data	
D50	16 mm
D84	47 mm
D95	73 mm

Cross Section 22 Reach 1 – Riffle
Pebble Count



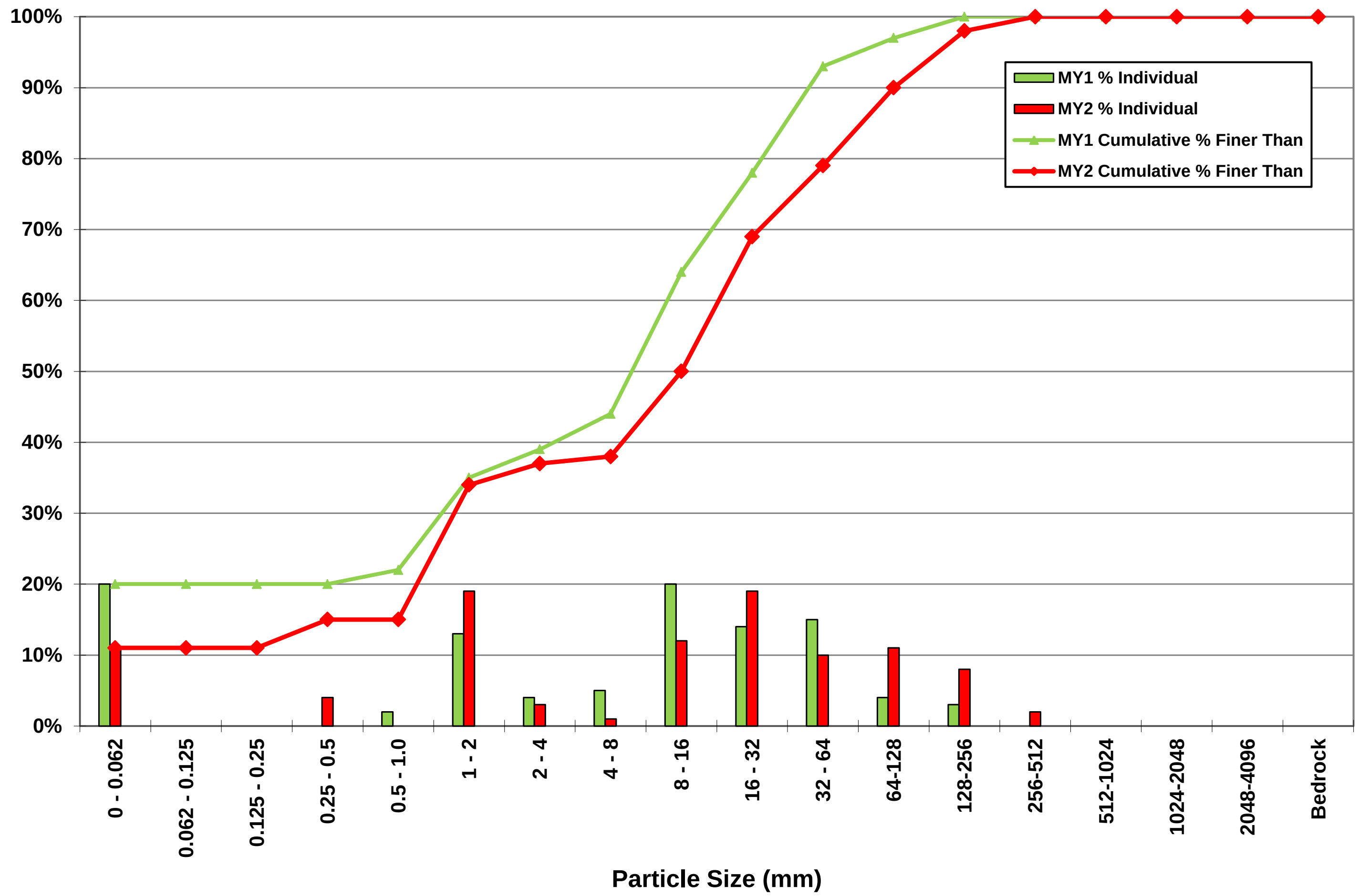
Summary Data	
D50	28 mm
D84	56 mm
D95	74 mm

Cross Section 23 Reach 1 – Riffle
Pebble Count



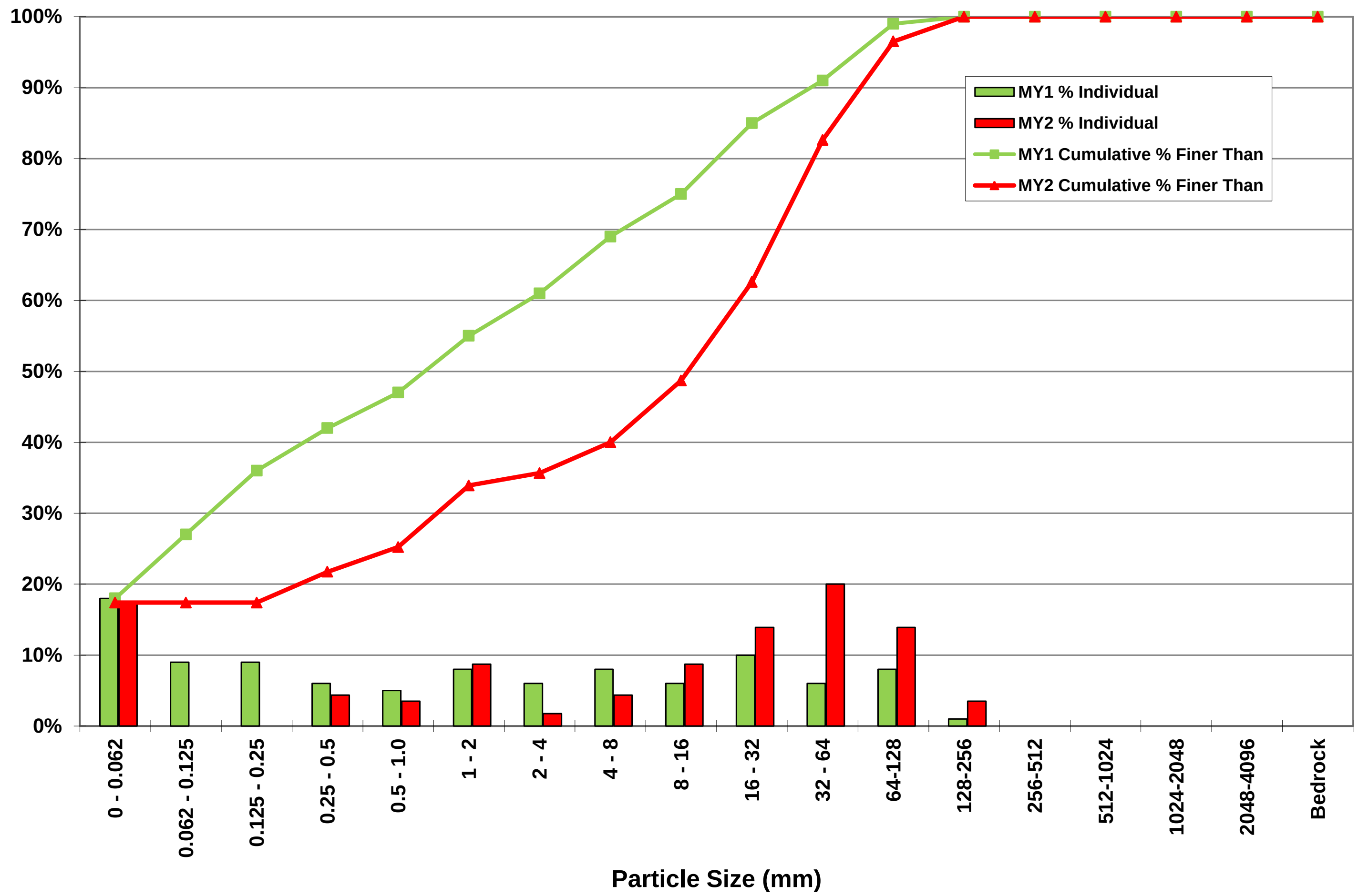
Summary Data	
D50	17 mm
D84	75 mm
D95	180 mm

Cross Section 26 Reach 1 – Riffle
Pebble Count



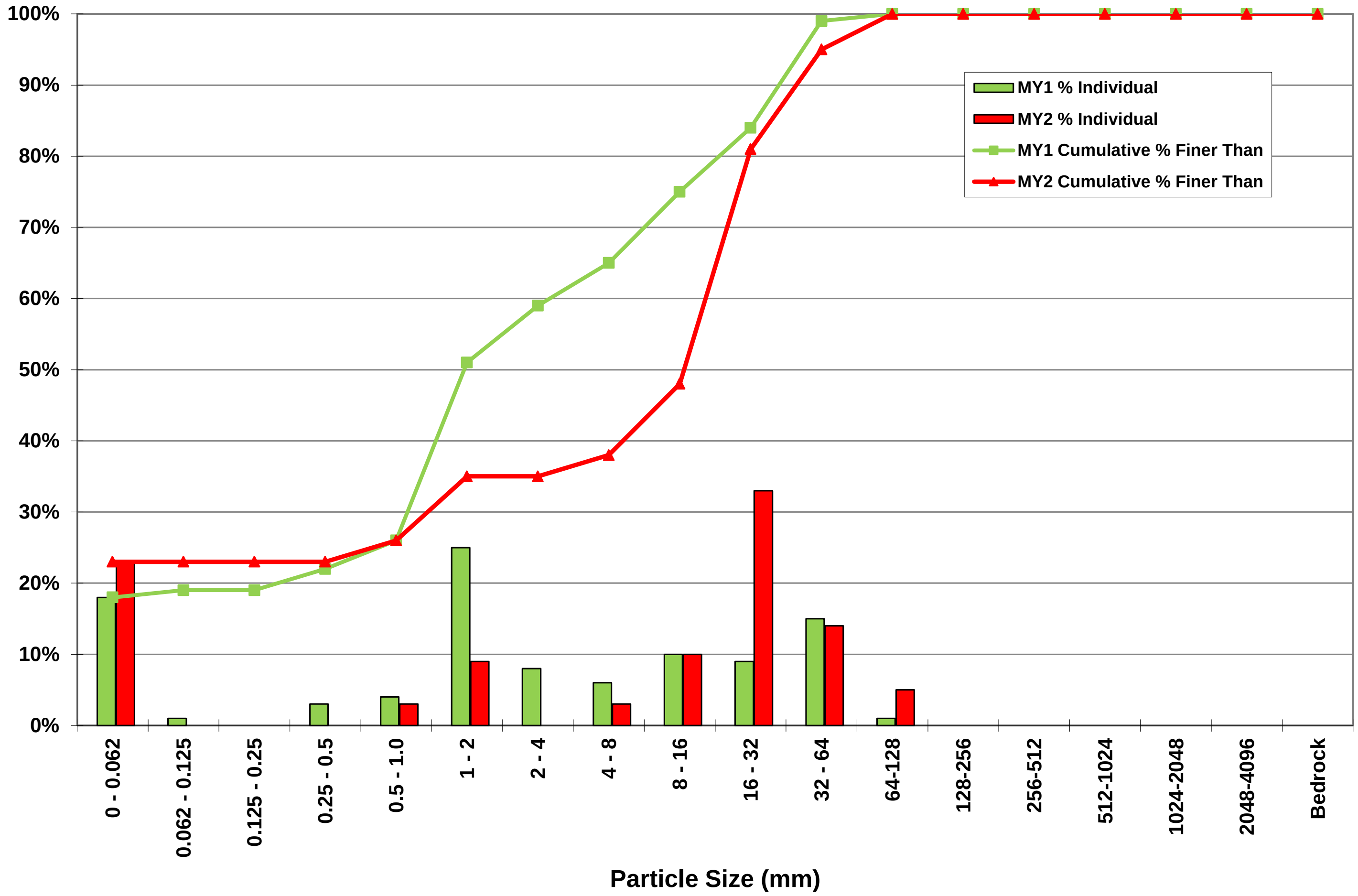
Summary Data	
D50	16 mm
D84	95 mm
D95	170 mm

Reach 1 - Reachwide
Pebble Count



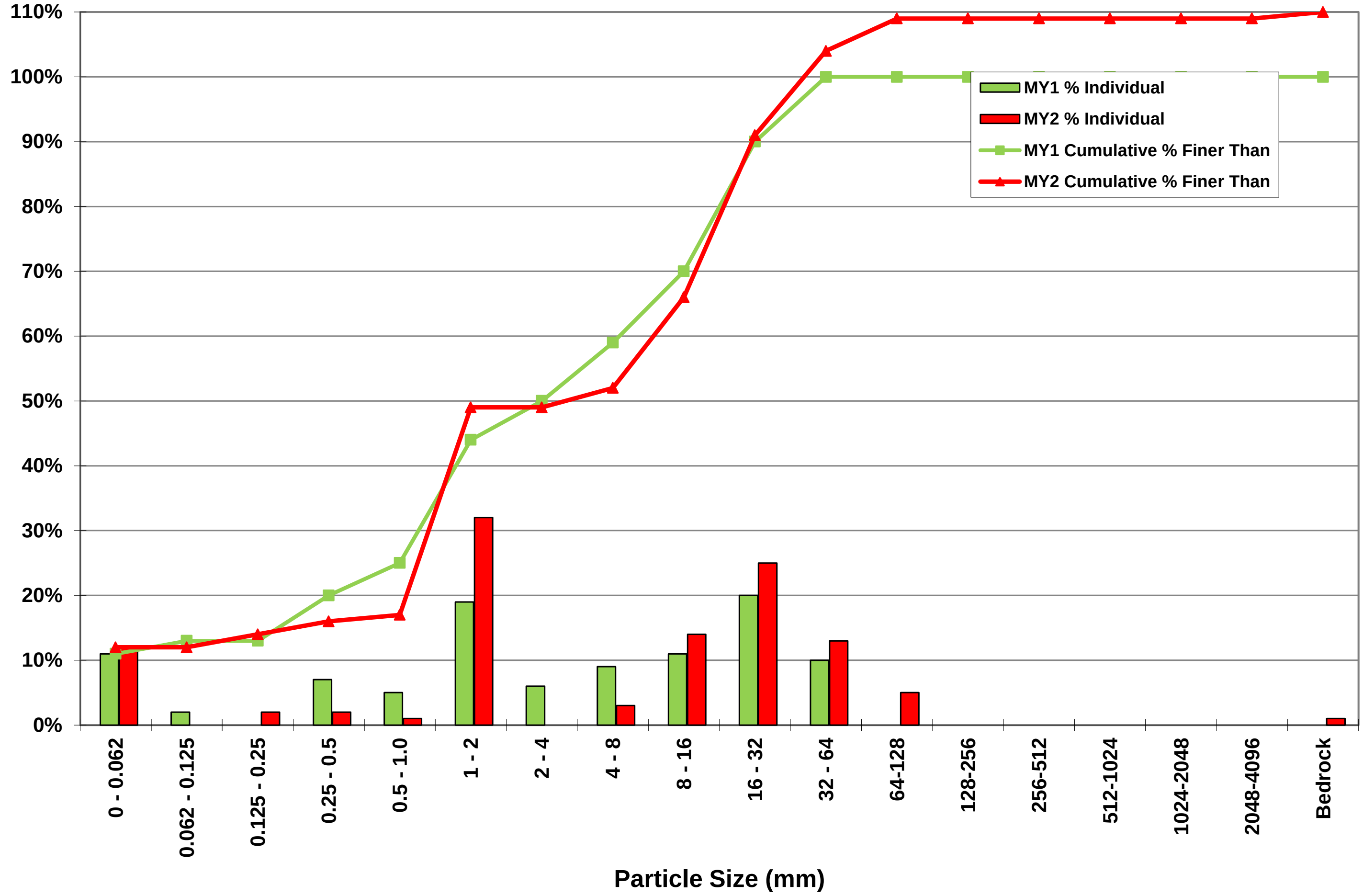
Summary Data	
D50	18 mm
D84	69 mm
D95	120 mm

Reach 2 Reachwide Pebble Count

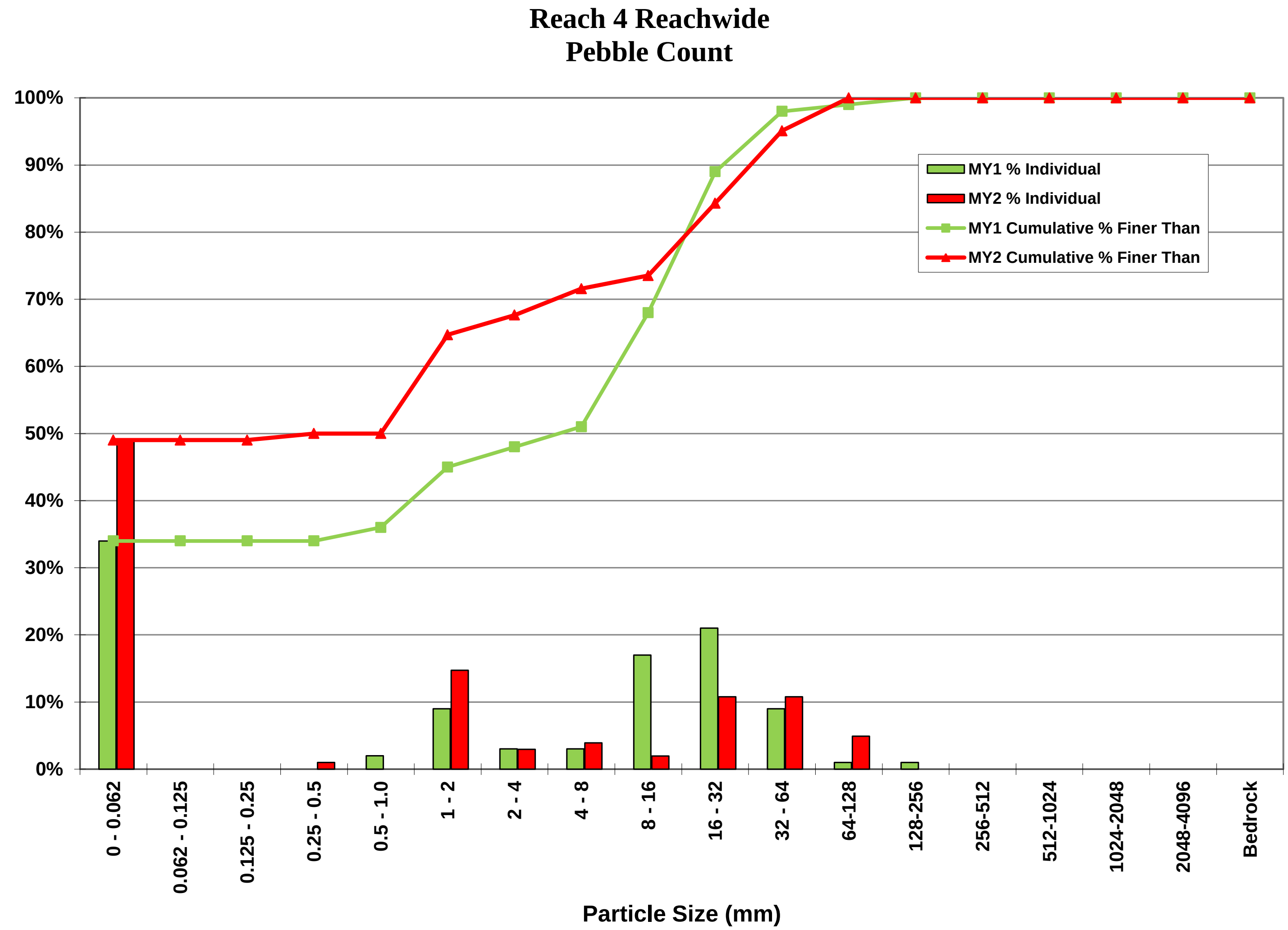


Summary Data	
D50	17 mm
D84	38 mm
D95	64 mm

Reach 3 Reachwide
Pebble Count



Summary Data	
D50	9.1 mm
D84	33 mm
D95	62 mm



Summary Data	
D50	0.35 mm
D84	32 mm
D95	64 mm

APPENDIX C

2013 Morphologic Monitoring Parameters

Unnamed Tributary 1 – Reach 4												
Parameter	**Cross Section 1 @ STA 101+45 Riffle**						**Cross Section 2 @ STA 102+04 Pool**					
Dimension	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
BF Width (ft)	7.8	8.4	8.4				7.1	10.2	10.8			
Floodprone Width (ft)	50.0	>40.0	>40.0				34.2	>40.0	>40			
BF Cross Sectional Area (ft^2)	4.7	4.2	3.1				10.6	13.6	10.5			
BF Mean Depth (ft)	0.6	0.5	0.4				1.5	1.3	1.0			
BF Max Depth (ft)	0.9	0.8	0.6				2.1	2.1	2.0			
Width/Depth Ratio	12.8	16.5	22.8				4.8	7.7	11.2			
Entrenchment Ratio	6.4	5.0	5.0				4.8	2.4	2.2			
Wetted Perimeter (ft)	N/A[1]	8.8	8.6				N/A[1]	11.9	12.2			
Hydraulic Radius (ft)	N/A[1]	0.5	0.4				N/A[1]	1.1	0.9			

[1]N/A = Not available in Baseline Report

Unnamed Tributary 1 – Reach 2												
Parameter	**Cross Section 3 @ STA 107+28 Riffle**						**Cross Section 4 @ STA 107+60 Pool**					
Dimension	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
BF Width (ft)	12.8	14.4	14.5				10.9	9.3	10.8			
Floodprone Width (ft)	22.5	>25	>25				22.2	>20	>20			
BF Cross Sectional Area (ft^2)	10.1	11.5	11.7				9.2	8.0	10.5			
BF Mean Depth (ft)	0.8	0.8	0.8				0.8	0.9	1.0			
BF Max Depth (ft)	1.6	1.7	1.7				1.6	1.5	1.8			
Width/Depth Ratio	16.2	18.0	17.9				13.0	10.9	11.2			
Entrenchment Ratio	1.0	1.6	1.6				2.0	2.2	1.9			
Wetted Perimeter (ft)	N/A[1]	15.2	15.3				N/A[1]	10.0	11.8			
Hydraulic Radius (ft)	N/A[1]	0.8	0.8				N/A[1]	0.8	0.9			

[1]N/A = Not available in Baseline Report

Unnamed Tributary 1 – Reach 2												
Parameter	**Cross Section 5 @ STA 112+05 Pool**						**Cross Section 6 @ STA 112+22 Riffle**					
Dimension	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
BF Width (ft)	9.6	9.8	10.2				12.0	11.4	12.1			
Floodprone Width (ft)	50.9	>50	>50				45.8	>40	>40			
BF Cross Sectional Area (ft^2)	11.0	11.3	11.3				8.7	8.5	8.8			
BF Mean Depth (ft)	1.2	1.2	1.1				0.7	0.7	0.7			
BF Max Depth (ft)	2.3	2.0	2.0				1.6	1.7	1.7			
Width/Depth Ratio	8.3	8.4	9.1				16.6	15.2	16.5			
Entrenchment Ratio	5.3	5.2	5.0				3.8	4.1	3.8			
Wetted Perimeter (ft)	N/A[1]	11.6	12.3				N/A[1]	12.5	13.2			
Hydraulic Radius (ft)	N/A[1]	1.0	0.9				N/A[1]	0.7	0.7			

[1]N/A = Not available in Baseline Report

Unnamed Tributary 1 – Reach 2												
Parameter	**Cross Section 7 @ STA 114+55 Pool**						**Cross Section 8 @ STA 115+16 Riffle**					
Dimension	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
BF Width (ft)	15.0	12.7	13.6				11.9	11.4	12.3			
Floodprone Width (ft)	45.4	>40.0	>40.0				50.0	>40.0	>40			
BF Cross Sectional Area (ft^2)	13.7	11.8	12.8				10.2	9.1	9.4			
BF Mean Depth (ft)	0.9	0.9	0.9				0.9	0.8	0.8			
BF Max Depth (ft)	2.6	2.2	2.2				1.6	1.7	1.7			
Width/Depth Ratio	16.5	13.6	14.5				13.9	14.3	16.0			
Entrenchment Ratio	3.0	3.6	3.4				4.2	3.5	3.3			
Wetted Perimeter (ft)	N/A[1]	13.7	14.9				N/A[1]	12.4	13.3			
Hydraulic Radius (ft)	N/A[1]	0.9	0.9				N/A[1]	0.7	0.7			

[1]N/A = Not available in Baseline Report

Unnamed Tributary 1 – Reach 2												
Parameter	**Cross Section 9 @ STA 117+94 Riffle**						**Cross Section 10 @ STA 118+53 Pool**					
Dimension	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
BF Width (ft)	15.4	12.8	13.0				13.7	13.3	13.0			
Floodprone Width (ft)	40.0	>40	>40				30.0	>150.0	>150.0			
BF Cross Sectional Area (ft^2)	8.1	6.1	6.6				8.8	8.1	8.6			
BF Mean Depth (ft)	0.5	0.5	0.5				0.6	0.6	0.7			
BF Max Depth (ft)	1.1	1.1	1.5				1.9	1.4	1.8			
Width/Depth Ratio	29.0	26.8	25.9				21.3	21.8	19.8			
Entrenchment Ratio	2.6	3.0	3.0				2.2	11.3	15.3			
Wetted Perimeter (ft)	N/A[1]	13.1	13.9				N/A[1]	13.8	14.0			
Hydraulic Radius (ft)	N/A[1]	0.5	0.5				N/A[1]	0.6	0.6			

[1]N/A = Not available in Baseline Report

Unnamed Tributary 1 – Reach 2												
Parameter	**Cross Section 11 @ STA 120+73 Riffle**											
Dimension	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
BF Width (ft)	11.3	9.0	7.8									
Floodprone Width (ft)	30.0	>150.0	>150.0									
BF Cross Sectional Area (ft^2)	7.4	4.7	4.9									
BF Mean Depth (ft)	0.7	0.5	0.6									
BF Max Depth (ft)	1.2	1.0	1.2									
Width/Depth Ratio	17.1	17.0	12.4									
Entrenchment Ratio	2.7	16.7	25.7									
Wetted Perimeter (ft)	N/A[1]	9.4	8.4									
Hydraulic Radius (ft)	N/A[1]	0.5	0.6									

[1]N/A = Not available in Baseline Report

Unnamed Tributary 2 – Reach 3												
Parameter	**Cross Section 12 @ STA 203+75 Riffle**						**Cross Section 13 @ STA 204+01 Pool**					
Dimension	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
BF Width (ft)	7.2	8.3	7.9				8.1	7.6	8.6			
Floodprone Width (ft)	22.8	>30	>30				33.2	>30	>30			
BF Cross Sectional Area (ft^2)	4.2	3.8	3.8				9.1	9.4	9.4			
BF Mean Depth (ft)	0.6	0.5	0.5				1.1	1.2	1.1			
BF Max Depth (ft)	1.0	0.9	0.9				2.2	2.1	2.0			
Width/Depth Ratio	12.5	17.9	16.4				7.2	6.1	7.9			
Entrenchment Ratio	3.2	2.7	2.8				4.1	4.4	3.9			
Wetted Perimeter (ft)	N/A[1]	8.7	8.3				N/A[1]	9.6	10.5			
Hydraulic Radius (ft)	N/A[1]	0.4	0.5				N/A[1]	1.0	0.9			

[1]N/A = Not available in Baseline Report

North Fork Mountain Creek – Reach 1												
Parameter	**Cross Section 14 @ STA 301+18 Pool**						**Cross Section 15 @ STA 302+33 Riffle**					
Dimension	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
BF Width (ft)	20.6	19.4	18.3				17.3	16.3	16.2			
Floodprone Width (ft)	59.3	>150.0	>150.0				100.0	>150.0	>150.0			
BF Cross Sectional Area (ft^2)	25.6	25.0	25.5				19.9	17.0	16.7			
BF Mean Depth (ft)	1.2	1.3	1.4				1.2	1.0	1.0			
BF Max Depth (ft)	3.1	3.0	3.0				2.2	2.1	2.2			
Width/Depth Ratio	16.6	15.0	13.1				15.1	15.6	15.7			
Entrenchment Ratio	2.9	7.7	8.2				5.8	9.2	9.3			
Wetted Perimeter (ft)	N/A[1]	21.2	20.2				N/A[1]	17.0	17.1			
Hydraulic Radius (ft)	N/A[1]	1.2	1.3				N/A[1]	1.1	1.0			

[1]N/A = Not available in Baseline Report

North Fork Mountain Creek – Reach 1												
Parameter	**Cross Section 16 @ STA 303+38 Riffle**						**Cross Section 17 @ STA 306+69 Riffle**					
Dimension	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
BF Width (ft)	19.3	18.6	18.7				17.5	18.6	19.8			
Floodprone Width (ft)	55.7	>150.0	>150.0				50.3	>150.0	>150.0			
BF Cross Sectional Area (ft^2)	25.4	22.4	22.5				23.9	23.0	23.8			
BF Mean Depth (ft)	1.3	1.2	1.2				1.4	1.2	1.2			
BF Max Depth (ft)	2.3	2.2	2.2				2.3	2.2	2.6			
Width/Depth Ratio	14.8	15.4	15.6				12.7	15.0	16.5			
Entrenchment Ratio	2.9	8.1	8.0				2.9	8.1	7.6			
Wetted Perimeter (ft)	N/A[1]	19.6	19.7				N/A[1]	19.3	21.0			
Hydraulic Radius (ft)	N/A[1]	1.1	1.1				N/A[1]	1.2	1.1			

[1]N/A = Not available in Baseline Report

North Fork Mountain Creek – Reach 1												
Parameter	**Cross Section 18 @ STA 307+35 Pool**						**Cross Section 19 @ STA 311+76 Riffle**					
Dimension	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
BF Width (ft)	25.8	27.8	27.2				21.7	21.5	22.3			
Floodprone Width (ft)	53.3	>150.0	>150.0				100.0	>150.0	>150.0			
BF Cross Sectional Area (ft^2)	35.1	36.0	34.0				25.8	23.9	23.3			
BF Mean Depth (ft)	1.4	1.3	1.3				1.2	1.1	1.0			
BF Max Depth (ft)	3.4	3.6	3.5				2.1	2.1	2.1			
Width/Depth Ratio	19.0	21.5	21.7				18.2	19.4	21.4			
Entrenchment Ratio	2.1	5.4	5.5				4.6	7.0	6.7			
Wetted Perimeter (ft)	N/A[1]	29.8	29.3				N/A[1]	22.1	23.1			
Hydraulic Radius (ft)	N/A[1]	1.2	1.2				N/A[1]	1.1	1.0			

[1]N/A = Not available in Baseline Report

North Fork Mountain Creek – Reach 1												
Parameter	**Cross Section 20 @ STA 312+64 Pool**						**Cross Section 21 @ STA 314+59 Pool**					
Dimension	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
BF Width (ft)	25.3	24.8	25.1				23.0	21.4	21.0			
Floodprone Width (ft)	56.1	>150.0	>150.0				54.5	>150.0	>150.0			
BF Cross Sectional Area (ft^2)	36.7	30.3	28.8				34.2	31.5	31.9			
BF Mean Depth (ft)	1.5	1.2	1.1				1.5	1.5	1.5			
BF Max Depth (ft)	3.3	2.9	3.0				3.4	3.4	4.1			
Width/Depth Ratio	17.4	20.3	22.0				15.5	14.5	13.9			
Entrenchment Ratio	2.2	6.0	6.0				2.4	7.0	7.1			
Wetted Perimeter (ft)	N/A[1]	25.9	26.7				N/A[1]	23.2	24.5			
Hydraulic Radius (ft)	N/A[1]	1.2	1.1				N/A[1]	1.4	1.3			

[1]N/A = Not available in Baseline Report

North Fork Mountain Creek – Reach 1												
Parameter	**Cross Section 22 @ STA 315+07 Riffle**						**Cross Section 23 @ STA 316+83 Riffle**					
Dimension	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
BF Width (ft)	20.7	18.2	18.1				18.6	19.0	19.6			
Floodprone Width (ft)	54.0	>150.0	>150.0				39.5	>150.0	>150.0			
BF Cross Sectional Area (ft^2)	22.0	19.6	19.6				22.7	21.0	21.0			
BF Mean Depth (ft)	1.1	1.1	1.1				1.2	1.1	1.1			
BF Max Depth (ft)	2.2	1.9	2.2				2.4	2.3	2.5			
Width/Depth Ratio	19.6	17.0	16.7				15.2	17.3	18.3			
Entrenchment Ratio	2.6	8.2	8.3				2.1	7.9	7.6			
Wetted Perimeter (ft)	N/A[1]	18.9	18.9				N/A[1]	20.2	21.2			
Hydraulic Radius (ft)	N/A[1]	1.0	1.0				N/A[1]	1.0	1.0			

[1]N/A = Not available in Baseline Report

North Fork Mountain Creek – Reach 1												
Parameter	**Cross Section 24 @ STA 317+28 Pool**						**Cross Section 25 @ STA 319+29 Pool**					
Dimension	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
BF Width (ft)	18.6	18.2	18.6				18.7	19.4	18.9			
Floodprone Width (ft)	42.3	>150.0	>150.0				50.3	>150.0	>150.0			
BF Cross Sectional Area (ft^2)	21.2	20.7	20.5				26.2	26.3	25.3			
BF Mean Depth (ft)	1.1	1.1	1.1				1.4	1.4	1.3			
BF Max Depth (ft)	2.5	2.5	2.7				3.0	3.2	3.0			
Width/Depth Ratio	16.3	16.0	16.8				13.3	14.2	14.1			
Entrenchment Ratio	2.3	8.2	8.1				2.7	7.7	7.9			
Wetted Perimeter (ft)	N/A[1]	19.3	20.0				N/A[1]	21.1	21.4			
Hydraulic Radius (ft)	N/A[1]	1.1	1.0				N/A[1]	1.2	1.2			

[1]N/A = Not available in Baseline Report

North Fork Mountain Creek – Reach 1												
Parameter	**Cross Section 26 @ STA 319+82 Riffle**											
Dimension	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
BF Width (ft)	18.8	19.5	19.9									
Floodprone Width (ft)	50.1	>150.0	>150.0									
BF Cross Sectional Area (ft^2)	19.4	19.8	19.9									
BF Mean Depth (ft)	1.0	1.0	1.0									
BF Max Depth (ft)	1.6	2.5	2.3									
Width/Depth Ratio	18.2	19.3	19.9									
Entrenchment Ratio	2.7	7.7	7.5									
Wetted Perimeter (ft)	N/A[1]	21.4	21.4									
Hydraulic Radius (ft)	N/A[1]	0.9	0.9									

[1]N/A = Not available in Baseline Report

Table provided as a place holder should longitudinal profile data be required by the USACE in a future monitoring year. Table has been populated with baseline data for reference.

North Fork Mountain Creek – Reach 1																		
Parameter	**Baseline**			**MY1**			**MY2**			**MY3**			**MY4**			**MY5**		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	46.13	93.89	67.24															
Radius of Curvature (ft)	28.20	54.20	37.60															
Meander Wavelength (ft)	121.67	331.59	209.50															
Meander Width Ratio	2.48	5.05	3.62															
Profile																		
Riffle Length (ft)	13.82	92.66	53.03															
Riffle Slope (ft/ft)	0.004	0.043	0.0178															
Pool Length (ft)	21.23	80.26	49.49															
Pool Spacing (ft)	62.18	147.20	98.91															
Additional Reach Parameters																		
Valley Length (ft)	N/A[1]																	
Channel Length (ft)	2,135																	
Sinuosity	1.25																	
Water Surface Slope (ft/ft)	N/A[1]																	
BF Slope (ft/ft)	0.0081																	
Rosgen Classification	C4																	

[1]N/A = Not available in Baseline Report

Unnamed Tributary 1 – Lower Reach – Reach 2																		
Parameter	**Baseline**			**MY1**			**MY2**			**MY3**			**MY4**			**MY5**		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	14.27	32.41	20.57															
Radius of Curvature (ft)	14.18	66.62	22.61															
Meander Wavelength (ft)	76.24	107.14	92.01															
Meander Width Ratio																		
Profile																		
Riffle Length (ft)	7.49	34.11	18.09															
Riffle Slope (ft/ft)	0.012	0.675	0.033															
Pool Length (ft)	11.58	36.99	17.71															
Pool Spacing (ft)	24.37	60.68	41.80															
Additional Reach Parameters																		
Valley Length (ft)	N/A[1]																	
Channel Length (ft)	1,700																	
Sinuosity	1.03																	
Water Surface Slope (ft/ft)	N/A[1]																	
BF Slope (ft/ft)	0.0162																	
Rosgen Classification	C4																	

[1]N/A = Not available in Baseline Report

Unnamed Tributary 1 – Upper Reach – Reach 4																		
Parameter	**Baseline**			**MY1**			**MY2**			**MY3**			**MY4**			**MY5**		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	11.09	28.74	22.28															
Radius of Curvature (ft)	18.69	56.01	26.29															
Meander Wavelength (ft)	56.93	95.78	64.68															
Meander Width Ratio	1.42	3.68	2.86															
Profile																		
Riffle Length (ft)	8.68	32.84	20.45															
Riffle Slope (ft/ft)	0.017	0.084	0.049															
Pool Length (ft)	5.59	34.45	21.66															
Pool Spacing (ft)	26.46	52.95	42.05															
Additional Reach Parameters																		
Valley Length (ft)	N/A[1]																	
Channel Length (ft)	702																	
Sinuosity	1.06																	
Water Surface Slope (ft/ft)	N/A[1]																	
BF Slope (ft/ft)	0.0342																	
Rosgen Classification	C4b																	

[1]N/A = Not available in Baseline Report

Unnamed Tributary 2 – Reach 3																		
Parameter	**Baseline**			**MY1**			**MY2**			**MY3**			**MY4**			**MY5**		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	7.66	18.12	12.81															
Radius of Curvature (ft)	17.03	50.06	26.34															
Meander Wavelength (ft)	20.09	97.59	59.35															
Meander Width Ratio	1.06	2.51	1.77															
Profile																		
Riffle Length (ft)	5.89	27.77	16.95															
Riffle Slope (ft/ft)	0.009	0.089	0.053															
Pool Length (ft)	7.48	26.49	10.59															
Pool Spacing (ft)	22.28	44.22	29.34															
Additional Reach Parameters																		
Valley Length (ft)	N/A[1]																	
Channel Length (ft)	610																	
Sinuosity	1.02																	
Water Surface Slope (ft/ft)	N/A[1]																	
BF Slope (ft/ft)	0.0412																	
Rosgen Classification	C4b																	

APPENDIX D

2013 Site Photos

Reach 4 Permanent Photo Points

Reach 4 – Permanent Photo Point 1
Downstream
January 29, 2013

Reach 4 – Permanent Photo Point 2
Downstream
January 29, 2013

Reach 4 Permanent Photo Points

Reach 4 – Permanent Photo Point 3
Downstream
January 29, 2013

Reach 4 – Permanent Photo Point 3
Upstream
January 29, 2013

Reach 3 Permanent Photo Points

Reach 3 – Permanent Photo Point 4
Downstream
January 29, 2013

Reach 3 – Permanent Photo Point 5
Downstream
January 29, 2013

Reach 3 Permanent Photo Points

Reach 3 – Permanent Photo Point 6
Downstream
January 29, 2013

Reach 3 – Permanent Photo Point 6
Upstream
January 29, 2013

Reach 2 Permanent Photo Points

Reach 2 – Permanent Photo Point 7
Downstream
January 29, 2013

Reach 2 – Permanent Photo Point 8
Downstream
January 29, 2013

Reach 2 Permanent Photo Points

Reach 2 – Permanent Photo Point 9
Downstream
January 29, 2013

Reach 2 – Permanent Photo Point 10
Downstream
January 29, 2013

Reach 2 Permanent Photo Points

Reach 2 – Permanent Photo Point 11
Downstream
January 29, 2013

Reach 2 – Permanent Photo Point 12
Downstream
January 29, 2013

Reach 2 Permanent Photo Points

Reach 2 – Permanent Photo Point 13
Downstream
January 29, 2013

Reach 2 – Permanent Photo Point 14
Downstream
January 29, 2013

Reach 2 Permanent Photo Points

Reach 2 – Permanent Photo Point 15
Downstream
January 29, 2013

Reach 2 – Permanent Photo Point 16
North
January 29, 2013

Reach 2 Permanent Photo Points

Reach 2 – Permanent Photo Point 16
Northwest
January 29, 2013

Reach 1 Permanent Photo Points

Reach 1 – Permanent Photo Point 16
Southwest
January 29, 2013

Reach 1 – Permanent Photo Point 17
Downstream
January 29, 2013

Reach 1 Permanent Photo Points

Reach 1 – Permanent Photo Point 18
Downstream
January 29, 2013

Reach 1 – Permanent Photo Point 19
Downstream
January 29, 2013

Reach 1 Permanent Photo Points

Reach 1 – Permanent Photo Point 20
Downstream
January 29, 2013

Reach 1 – Permanent Photo Point 21
Downstream
January 29, 2013

Reach 1 Permanent Photo Points

Reach 1 – Permanent Photo Point 22
Downstream
January 29, 2013

Reach 1 – Permanent Photo Point 23
Downstream
January 29, 2013

Reach 1 Permanent Photo Points

Reach 1 – Permanent Photo Point 24
Downstream
January 29, 2013

Reach 1 – Permanent Photo Point 25
Downstream
January 29, 2013

Reach 1 Permanent Photo Points

Reach 1 – Permanent Photo Point 26
Downstream
January 29, 2013

Reach 1 – Permanent Photo Point 27
Downstream
January 29, 2013

Reach 1 Permanent Photo Points

Reach 1 – Permanent Photo Point 28
Downstream
January 29, 2013

Reach 1 – Permanent Photo Point 29
Downstream
January 29, 2013

Reach 1 Permanent Photo Points

Reach 1 – Permanent Photo Point 29
Upstream
January 29, 2013

Reach 1 – Permanent Photo Point 30
Downstream
January 29, 2013

Reach 1 Permanent Photo Points

Reach 1 – Permanent Photo Point 31
Northeast
January 29, 2013

Reach 1 – Permanent Photo Point 31
Southeast
January 29, 2013

Reach 1 Permanent Photo Points

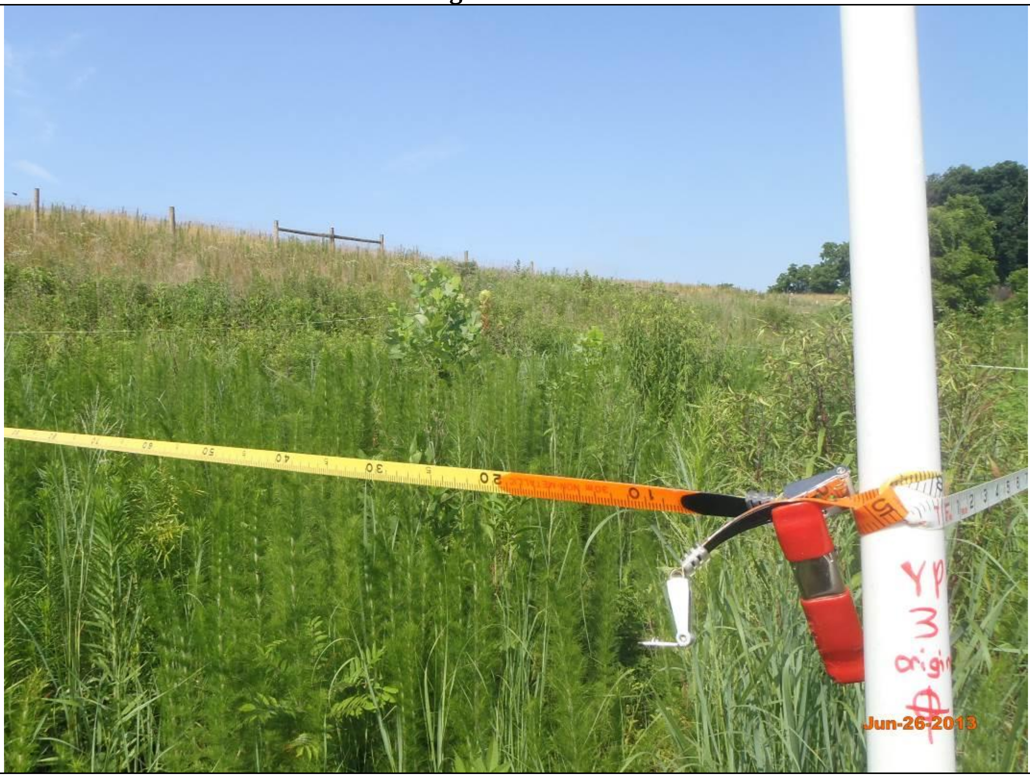
Reach 1 – Permanent Photo Point 31
South
January 29, 2013

Vegetation Plots

Vegetation Plot 1

Vegetation Plot 2

Vegetation Plots



Vegetation Plot 3

Vegetation Plot 4

Vegetation Plots

Vegetation Plot 5

Vegetation Plot 6

Vegetation Plots

Vegetation Plot 7

Vegetation Plot 8

Vegetation Plots

Vegetation Plot 9

Vegetation Plot 10

Vegetation Plots

Vegetation Plot 11

Vegetation Plot 12

Vegetation Plots

Vegetation Plot 13

Vegetation Plot 14

Representative Photos Documenting Bankfull Event

Reach 2 Sta. 118+00 – Wrack Lines

Reach 1 Sta. 311+00 – Wrack Lines

Reach 1 Representative Photos of Stream and Vegetation Areas Requiring Observation

1-S Reach 1 Sta. 305+50 – Riffle Degradation

Reach 3 Representative Photos of Stream and Vegetation Areas Requiring Observation

5-V Reach 3 Sta. 200+00 – Isolated Area of Japanese honeysuckle *Lonicera japonica* treated

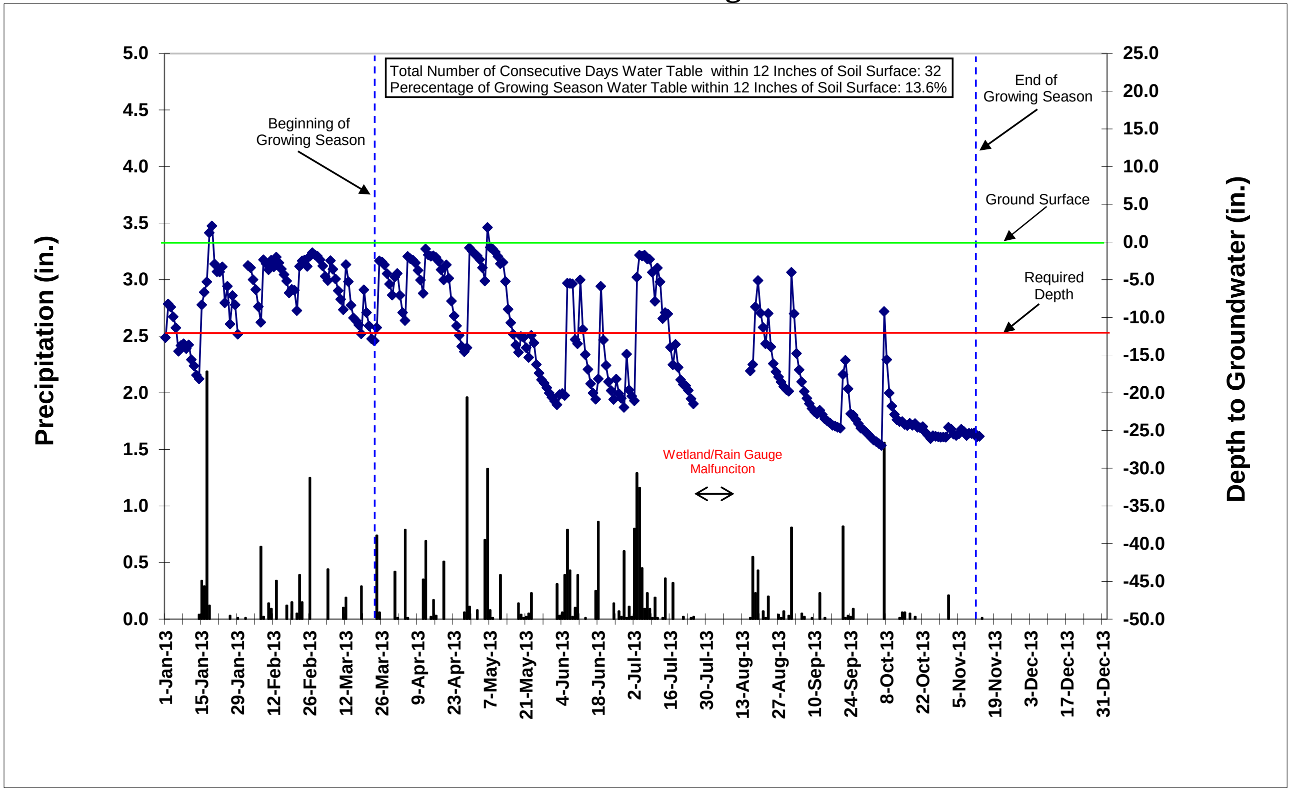
Reach 4 Representative Photos of Stream and Vegetation Areas Requiring Observation

6-S Reach 4 Sta. 102+30 – Stressed Structure

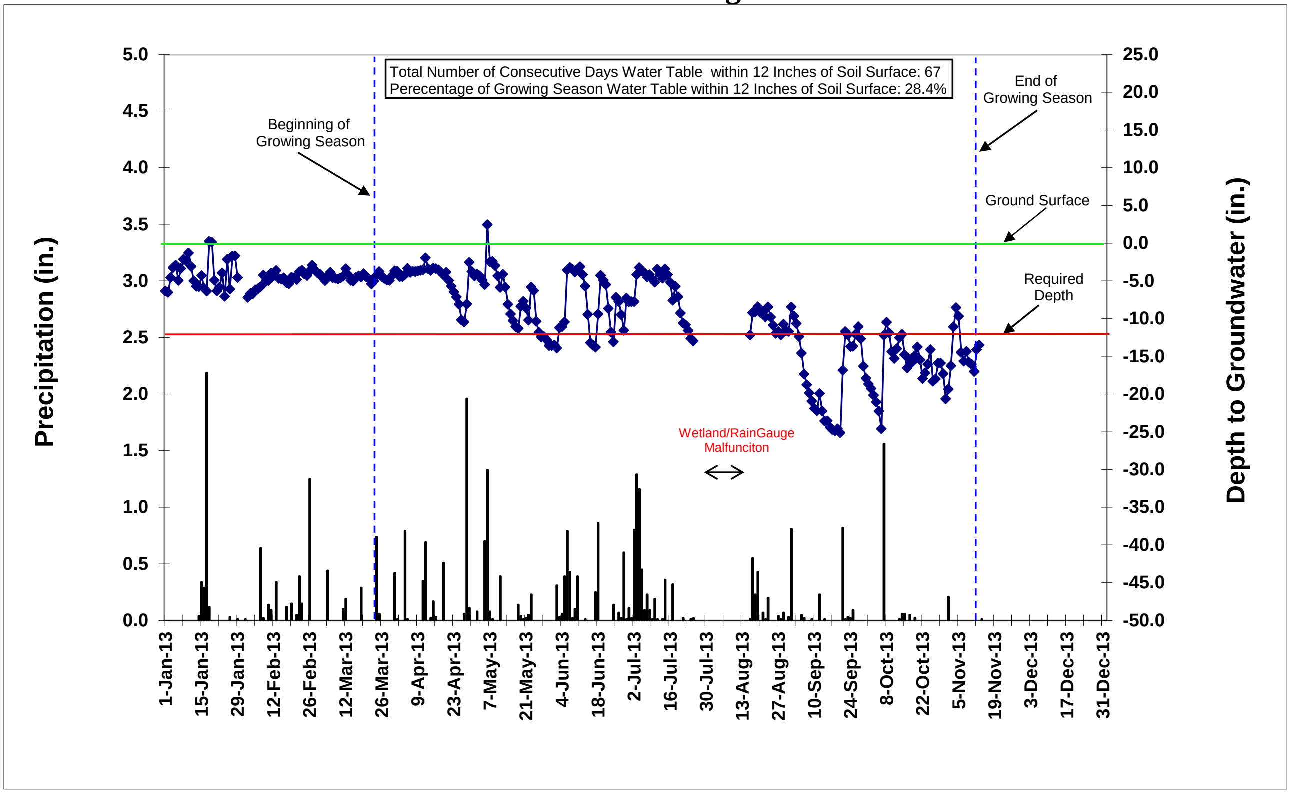
APPENDIX E

2013 Wetland Gauge Data

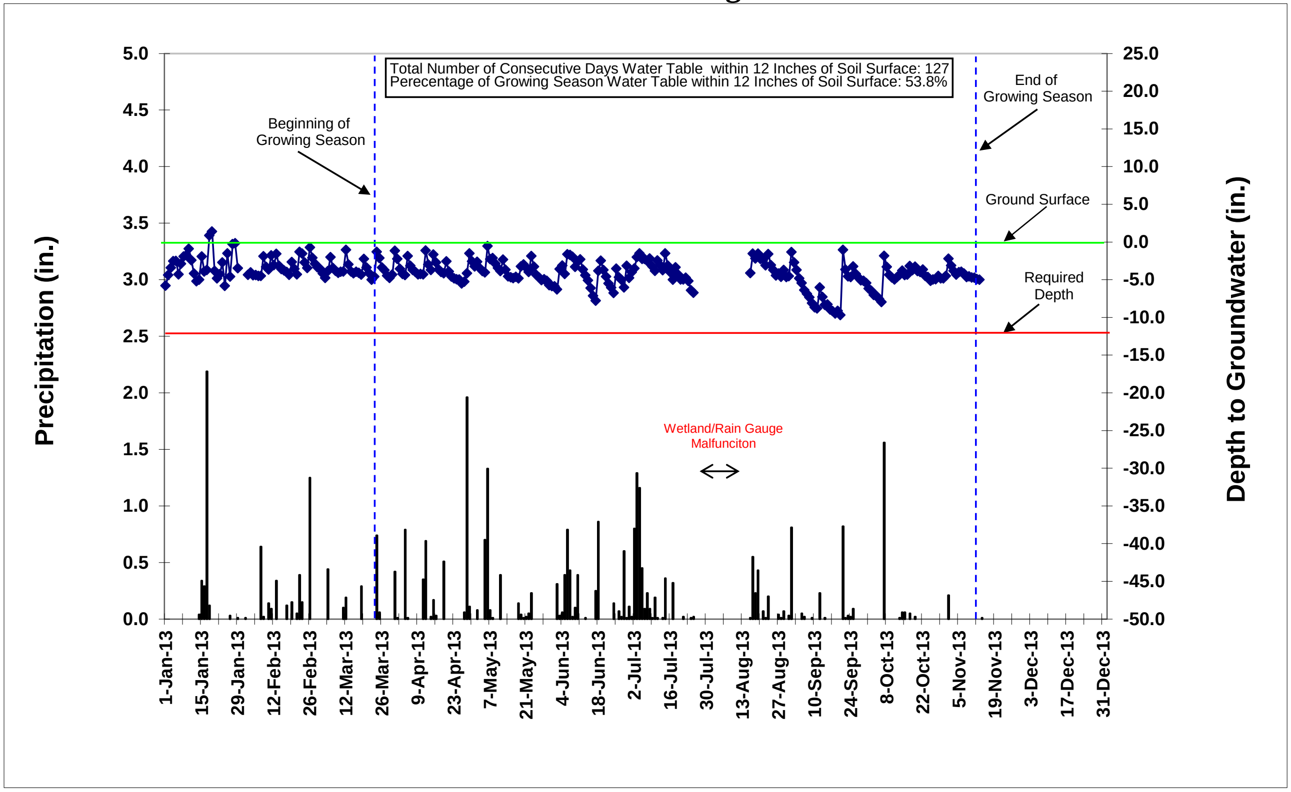
Reach 1 – Wetland Gauge NFMC01



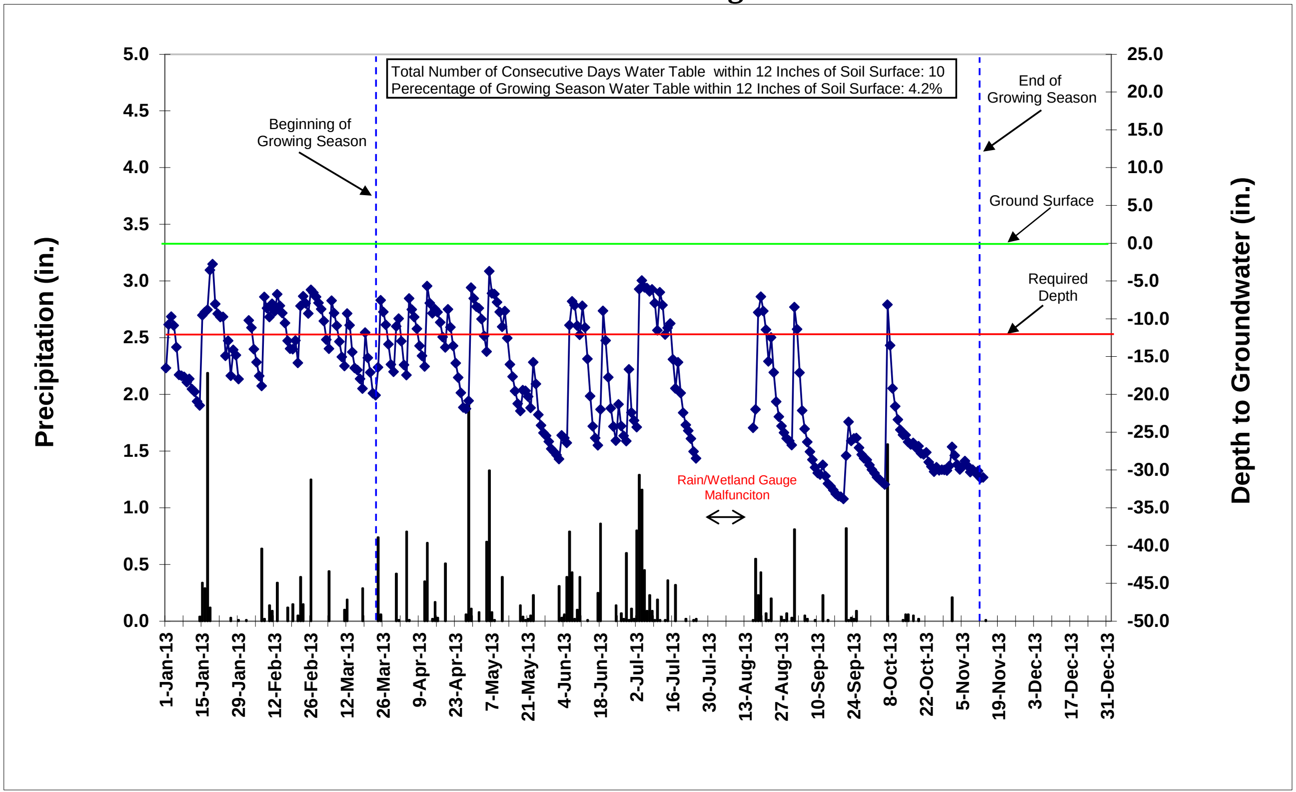
Reach 1 – Wetland Gauge NFMC02



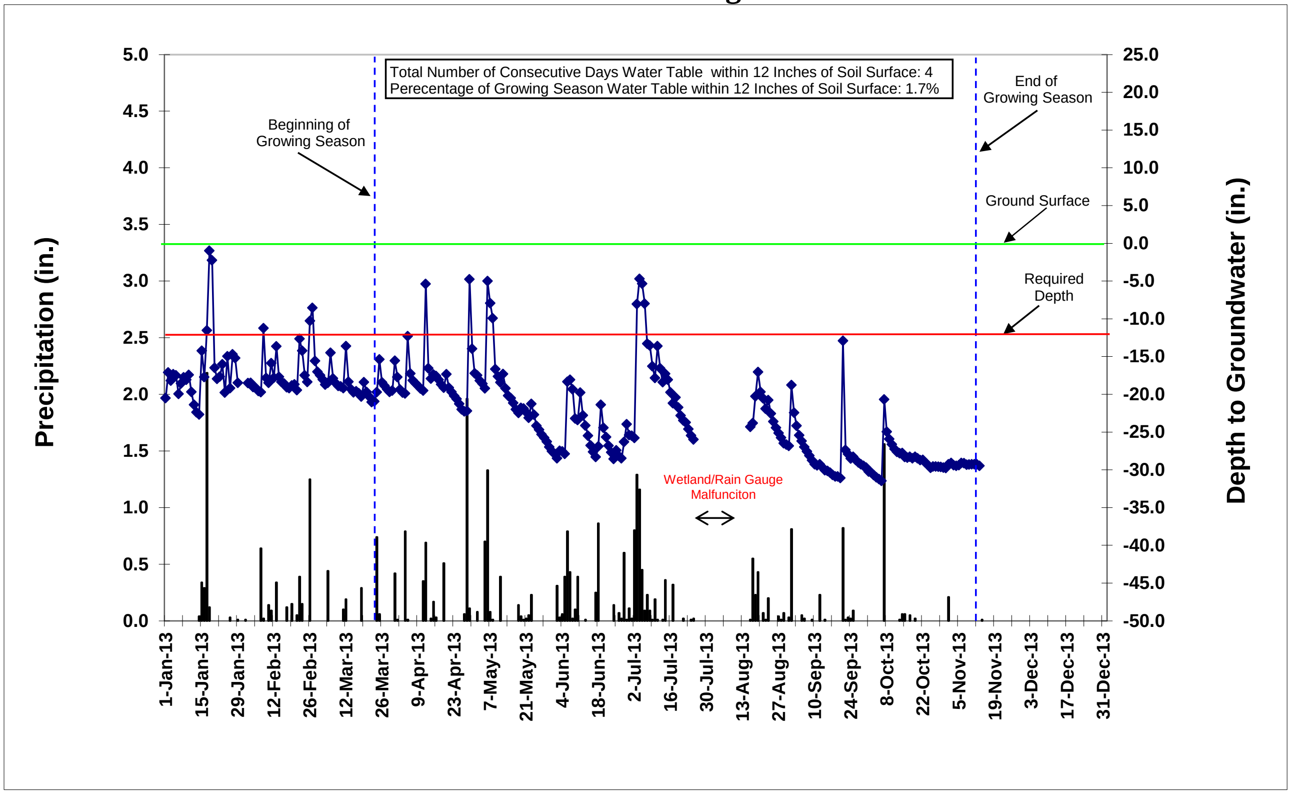
Reach 1 – Wetland Gauge NFMC03



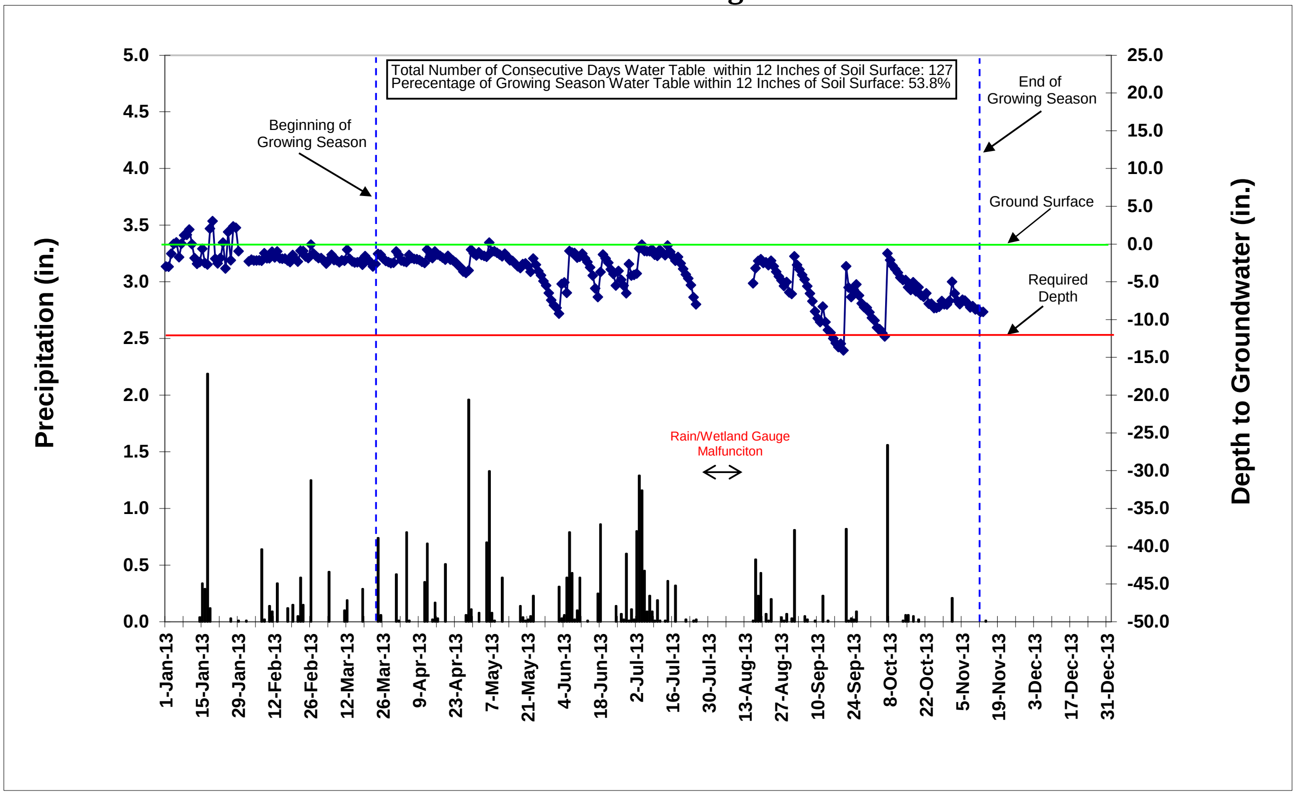
Reach 1 – Wetland Gauge NFMC04



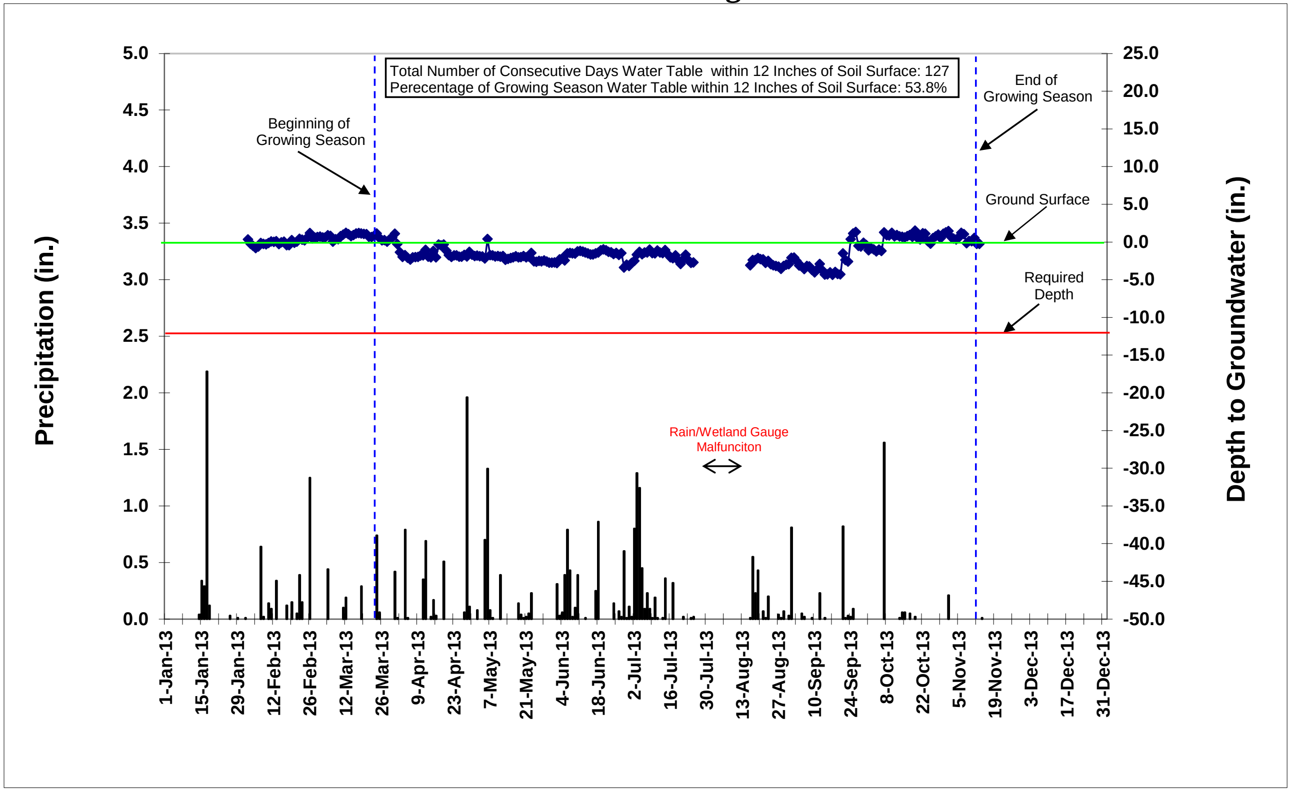
Reach 1 – Wetland Gauge NFMC05



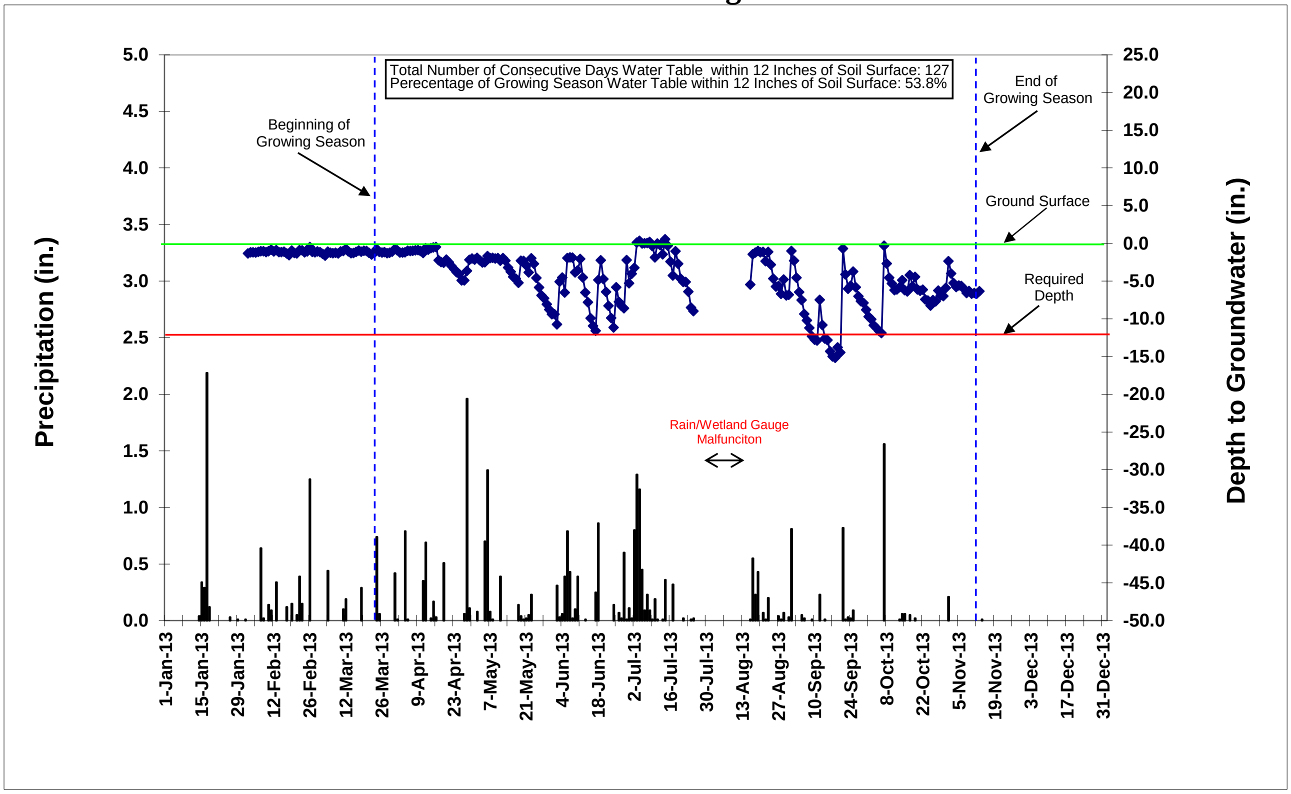
Reach 1 – Wetland Gauge NFMC06



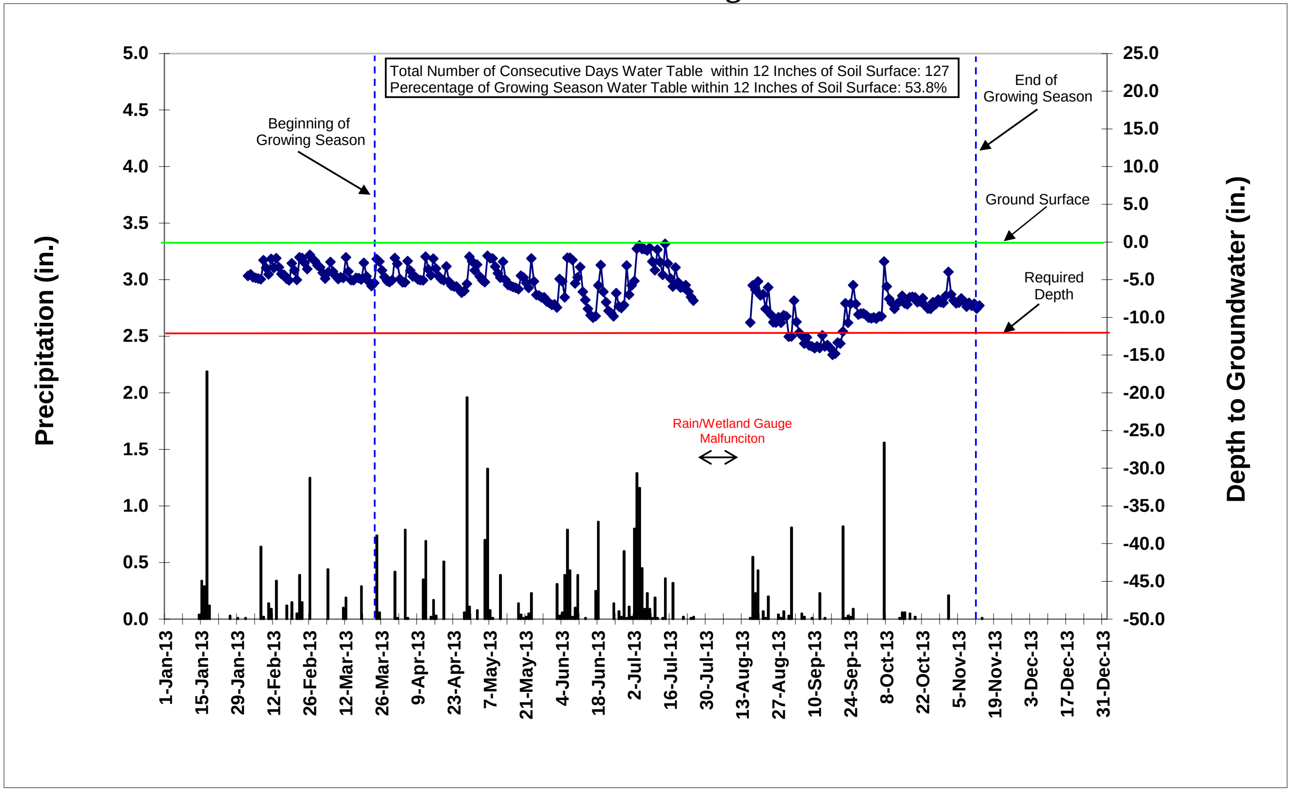
Reach 2 – Wetland Gauge NFMC07



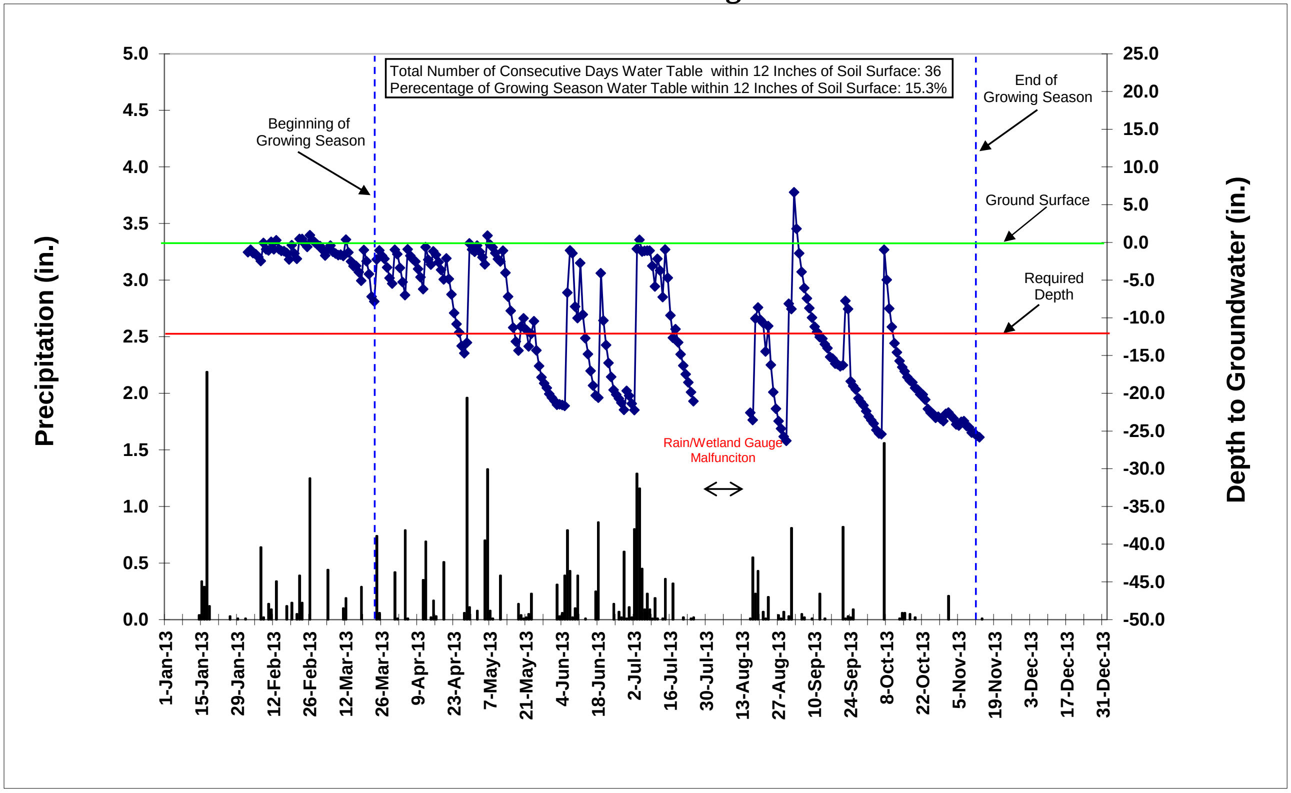
Reach 2 – Wetland Gauge NFMC08



Reach 2 – Wetland Gauge NFMC09



Reach 2 – Wetland Gauge NFMC10



South Fork Catawba – Reference Gauge