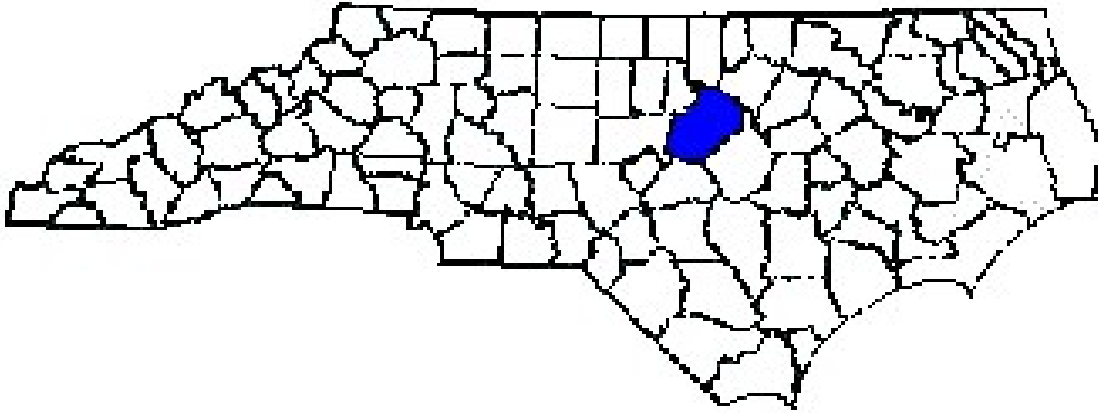


# ANNUAL REPORT FOR 2016



**R-2635C UT to Reedy Branch**  
**Wake County**  
**USACE Action ID: 2007-02903-292**  
**NCDWR Project #: 20071470**



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## **SUMMARY**

The following report summarizes the stream monitoring activities that have occurred during 2016 at the R-2635C UT to Reedy Branch Mitigation Site in Wake County. The site was constructed during 2016 by the North Carolina Department of Transportation (NCDOT). The site was designed as stream mitigation for impacts associated with the construction of Transportation Improvement Program (TIP) number R-2635C. This report provides the monitoring results for the first formal year of monitoring (Year 2016). The Year 2016 monitoring period is the first of five scheduled years of monitoring (See Success Criteria Section 2.1). No hydrologic monitoring is required for this project; however, vegetation monitoring is required for five years.

Based on the overall conclusions of monitoring, the UT to Reedy Branch site has met the required monitoring protocols for the first formal year of monitoring. Based on comparing the monitoring data to the as-built, the stream channel remains stable throughout the Site at this time. The stream bank is heavily vegetated for the first year of monitoring.

Vegetation monitoring results will be submitted in the 2017 monitoring report once the streambank and buffer reforestation has been completed.

NCDOT will continue stream monitoring at the UT to Reedy Branch Mitigation Site in 2017.

## 1.0 INTRODUCTION

### 1.1 Project Description

The following report summarizes the stream monitoring activities that have occurred during 2016 at the R-2635C UT to Reedy Branch Mitigation Site. The site is situated directly east of I-540 (see Figure 1). The site was constructed to provide mitigation for stream impacts associated with construction of Transportation Improvement Program (TIP) number R-2635. The site is composed of one reach of an Unnamed Tributary (UT) of Reedy Branch (upstream of the newly constructed roadway corridor).

The mitigation project includes 662 linear feet of Priority II stream restoration. Construction was completed in June 2016 by NCDOT. Stream restoration involved the installation of rock cross vanes, rock sills, rock j-hooks, rock toe protection, geo-lifts, constructed riffles, construction of a new stream channel, and construction of the floodplain through Priority II restoration reaches to allow for overbank flooding. It also included the installation of coir fiber matting/roles along the stream banks. Live stakes are to be installed along the streambanks and bareroot seedlings within the buffer area during the dormant season between December 2016 and March 2017.

### 1.2 Purpose

For a mitigation site to be considered successful, it must meet the success criteria. This report details the monitoring in 2016 at the UT to Reedy Branch Mitigation Site. Hydrologic monitoring was not required for the Site.

### 1.3 Project History

March 2011	Construction Completed
July 2011	Stream Channel Monitoring (Year 1)
January/July 2012	Stream Channel Monitoring (Year 2)
January/June 2013	Stream Channel Monitoring (Year 3)
January/August 2014	Stream Channel Monitoring (Year 4)
February 2016	Remediation Design Plans Completed
June 2016	Remediation Construction Completed
October 2016	As-Built Survey Completed
December 2016	Stream Channel Monitoring (Year 1 Restart)
January 2017	Streambank Reforestation Completed

### 1.4 Debit Ledger

The entire UT to Reedy Branch stream mitigation site was used at a 1:1 ratio for the R-2635C project to compensate for unavoidable stream impacts.





**Figure 1: Project Vicinity Map**  
R-2635C UT to Reedy Branch Stream Mitigation  
Guilford County, SC

## **2.0 STREAM ASSESSMENT**

### **2.1 Success Criteria**

The stream mitigation site shall be monitored for five years or until success criteria are satisfied. Monitoring protocols shall follow the Monitoring Level I outlined in the Stream Mitigation Guidelines, April 2003. NCDOT will evaluate the success of the stream relocation project based on guidance provided by the Stream Mitigation Guidelines disseminated by the United States Army Corps of Engineers-Wilmington District. The survey of channel dimension will consist of permanent cross sections placed at four cross sections (two riffles and two pools). Annual photographs showing both banks and upstream and downstream views will be taken from permanent, mapped photo points. The survey of the longitudinal profile will represent distinct areas of restoration and will cover a cumulative total of approximately 662 linear feet of channel. The entire restored length of stream will be investigated for channel stability and in-stream structure functionality. Any evidence of channel instability will be identified, mapped and photographed. Pebble counts shall not be conducted. The monitoring shall be conducted annually for a minimum of five (5) years after final planting. The monitoring results shall be submitted to DWR in a final report within sixty (60) days after completing monitoring. After 5 years, the NCDOT shall contact the DWR to schedule a site visit to “close out” the mitigation site.

#### **Vegetation Success**

The success of vegetation and plantings will be measured through stem counts. Permanent quadrants will be used to sample the riparian buffer and restoration wetlands. Survival of the live stakes will be determined by visual observation throughout the five-year monitoring period.

Bare root vegetation will be evaluated using two staked survival plots. Plots will be 50ft. by 50ft. If site conditions prevent a 50ft. by 50ft. plot, then the plot will have varying dimensions to encompass an area of 2,500 ft<sup>2</sup>. All flagged stems will be counted in those plots. Success will be defined as 320 stems per acre after three years and 260 stems per acre after five years. All vegetation monitoring will be conducted during the growing season.

### **2.2 Stream Description**

#### **2.2.1 Post-Construction Conditions**

The mitigation project includes 662 linear feet of Priority II stream restoration. Construction was completed in June 2016 by NCDOT.

Stream restoration involved the installation of rock cross vanes, rock sills, rock j-hooks, rock toe protection, geo-lifts, constructed riffles, construction of a new stream channel, and construction of the floodplain through Priority II restoration reaches to allow for overbank flooding. It also included the installation of coir fiber matting/roles along the stream banks. Live stakes are to be installed along the streambanks and bareroot seedlings within the buffer area during the dormant season between December 2016 and March 2017.

### **2.2.2 Monitoring Conditions**

The objective of the R-2635C Mitigation Site restoration was to build a C5 stream type as identified in the Rosgen's Applied River Morphology. A total of four cross sections were surveyed. For this report, only the riffle cross sections were used in the comparison of channel morphology in Table 1.

**Table 1. Abbreviated Morphological Summary  
R-2635C - Cross Sections #2 and #3**

Variable	Proposed	As-built		Monitoring Year 1 - 2016	
		Cross Section #2 (Riffle)	Cross Section #3 (Riffle)	Cross Section #2 (Riffle)	Cross Section #3 (Riffle)
Drainage Area (mi <sup>2</sup> )	0.67	0.67	0.67	0.67	0.67
Bankfull Width (ft)	13.00	16.92	14.77	16.38	15.35
Bankfull Mean Depth (ft)	1.20	0.62	0.77	0.58	0.79
Width/Depth Ratio	10.80	27.29	19.18	28.24	19.43
Bankfull Cross Sectional Area (ft <sup>2</sup> )	16.00	10.51	11.34	9.47	12.10
Maximum Bankfull Depth (ft)	1.80	1.11	1.15	1.08	1.19
Floodprone Area (ft)	85	33	30	34	32
Entrenchment Ratio	6.50	1.94	2.03	2.07	2.08

\*Drainage Area, Floodprone Width, and Slope are averaged values only.

\*Riffle values are used for classification purposes.

\*Note: Portions of the as-built survey were completed using survey-grade gps while the MY1 survey was completed using a total station referencing base control points. This may lead to some variance in the cross-section comparison.

## **2.3 Results of the Stream Assessment**

### **2.3.1 Site Data**

The assessment included the survey of 4 cross sections and the longitudinal profile of UT to Reedy Branch Mitigation Site established by the NCDOT after construction. Four cross sections were established during the 2016 as-built survey/monitoring. Cross section locations were subsequently based on the stationing of the longitudinal profile and are presented below. The locations of the cross sections and longitudinal profiles are shown in Appendix A.

- ◆ Cross Section #1: UT to Reedy Branch, Station 10+60 linear feet, midpoint of pool
- ◆ Cross Section #2: UT to Reedy Branch, Station 12+05 linear feet, midpoint of riffle
- ◆ Cross Section #3: UT to Reedy Branch, Station 14+75 linear feet, midpoint of riffle
- ◆ Cross Section #4: UT to Reedy Branch, Station 15+61 linear feet, midpoint of pool

Based on visual assessment and comparisons of the as-built to MY1 monitoring data, the channel and all four cross sections appear stable with little or no active bank erosion. Graphs of the cross sections are presented in Appendix A. The longitudinal profile showed that the channel was stable for the 2016 MY1 monitoring evaluation. Photo points 1 through 4 presented in Appendix B show steady growth of herbaceous and woody vegetation. Based on field observations (sand deposits and wrack lines) at least one bankfull event has occurred since construction was completed on this site. Pebble counts were not required per the permit conditions and therefore were not completed. All other monitoring activities will continue to be completed by NCDOT throughout the five-year monitoring period.

### **3.0 OVERALL CONCLUSIONS AND RECOMMENDATIONS**

The UT to Reedy Branch Mitigation Site has met the required monitoring protocols for the first formal year of monitoring. Based on comparisons of the as-built to the MY1 monitoring data and visual assessment, the stream channel and structures remains stable throughout the site at this time. Vegetation monitoring results will be submitted in the 2017 monitoring report once the streambank and buffer reforestation has been completed.

NCDOT will continue stream and vegetation monitoring at the UT to Reedy Branch Mitigation Site in 2017.

### **4.0 REFERENCES**

R-2635C On-Site Stream Mitigation Plan; Wake County, NC, Project No. 35520.1.1, February 2007

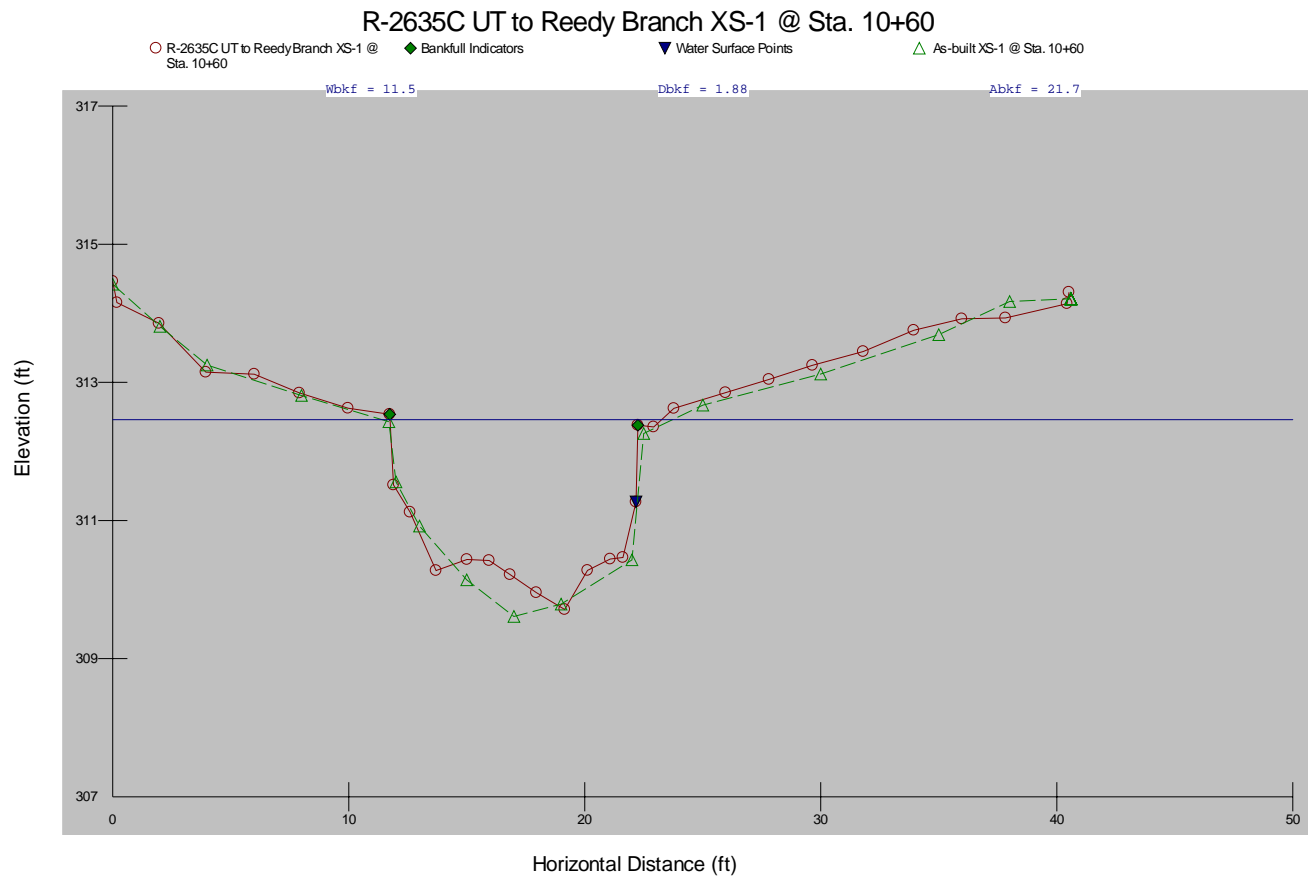
As-Built Report/Record Drawings for R-2635C Mitigation Site, Wake County, NC, October 18, 2016.

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

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

**APPENDIX A**

**CROSS SECTION COMPARISONS**  
**&**  
**LONGTITUDINAL PROFILE**

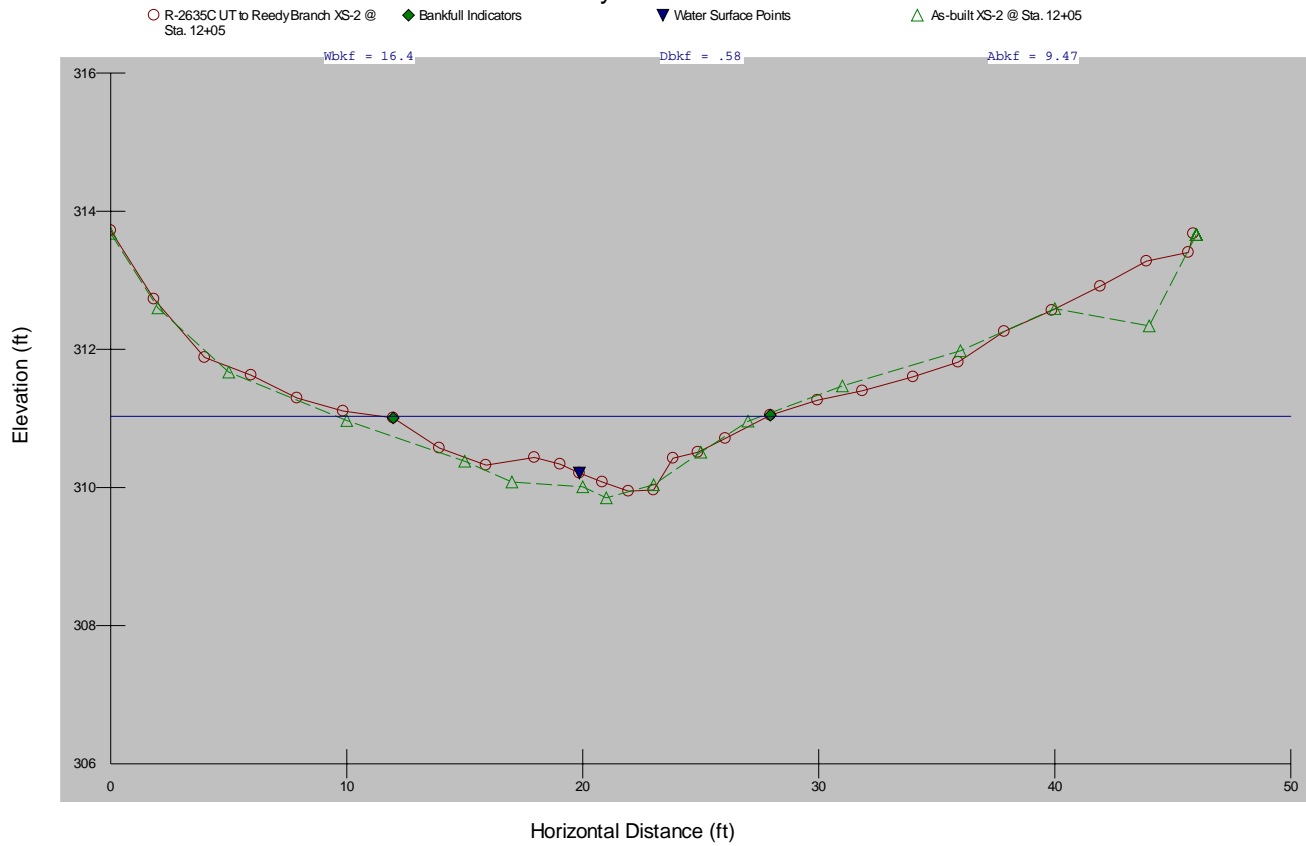


Cross-Section #1 (Pool) Abbreviated Morphological Summary				
	As-built	2016	2017	2018
Bankfull Width (ft)	10.8	11.5		
Bankfull Mean Depth (ft)	2.53	1.88		
Bankfull Cross Sectional Area (ft <sup>2</sup> )	27.3	21.67		
Maximum Bankfull Depth (ft)	3.2	2.75		

\*According to the Rosgen Classification of Natural Rivers Floodprone width, entrenchment ratio, and width depth ratio are not measured in pool, glide, or run features

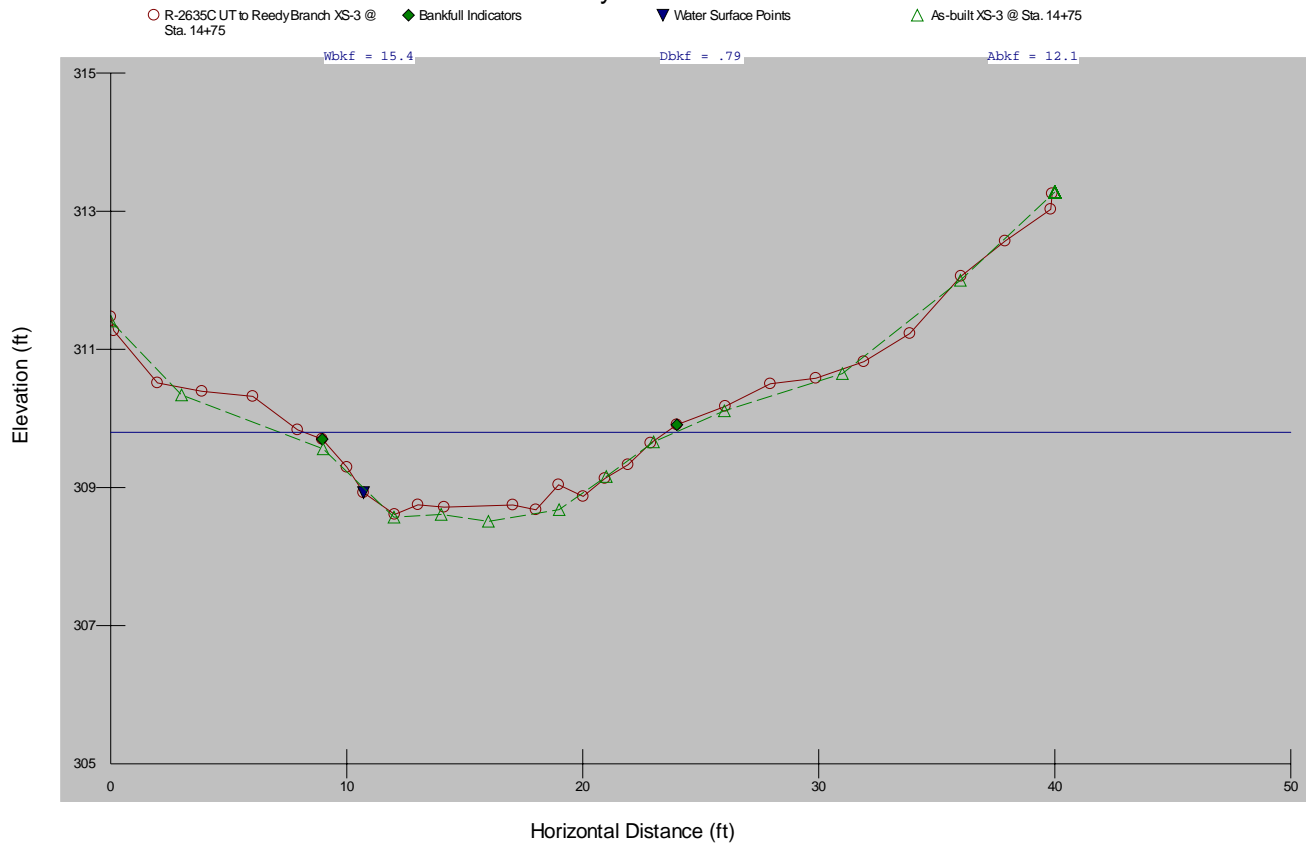


### R-2635C UT to Reedy Branch XS-2 @ Sta. 12+05

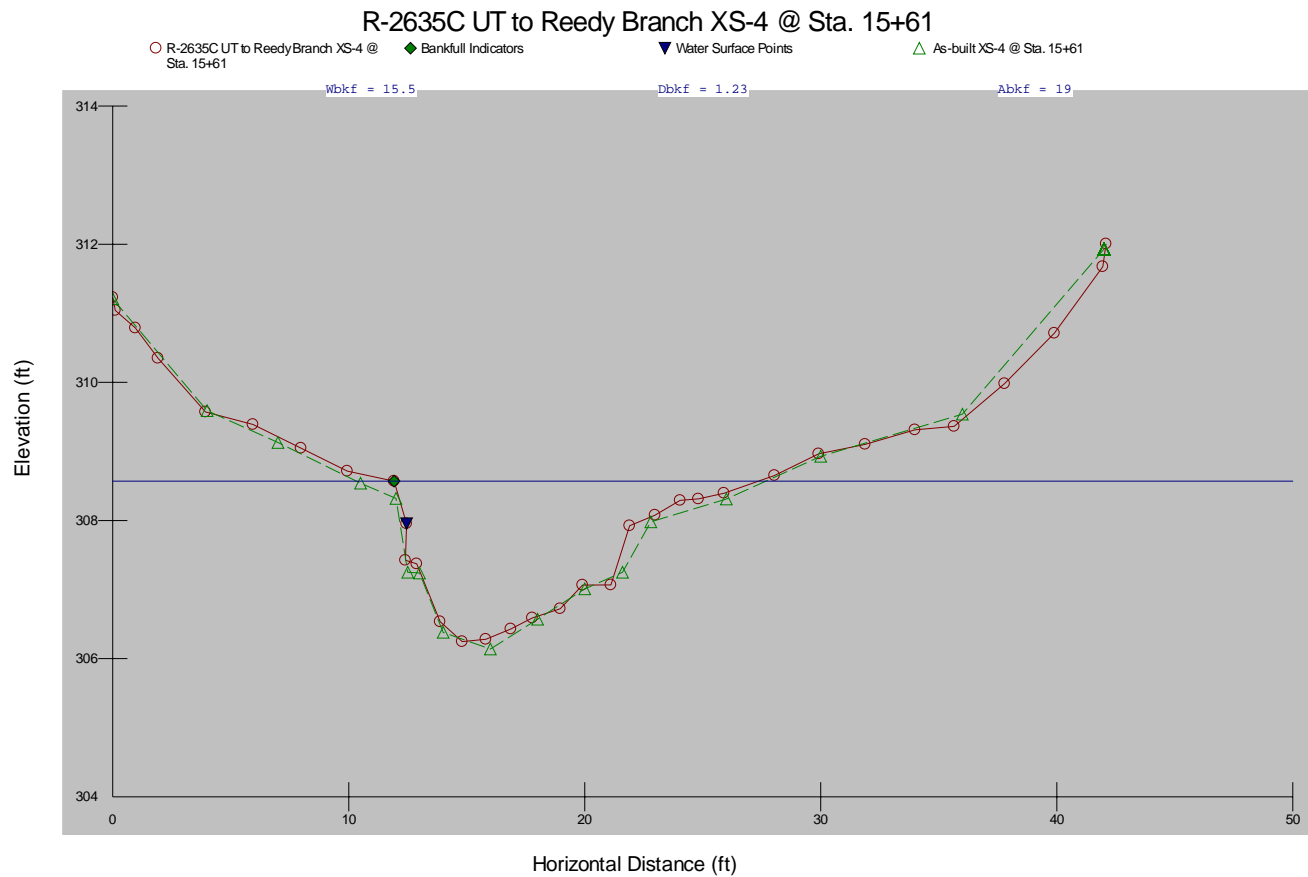


Cross-Section #2 (Riffle) Abbreviated Morphological Summary				
	As-built	2016	2017	2018
Bankfull Width (ft)	16.92	16.38		
Bankfull Mean Depth (ft)	0.62	0.58		
Width/Depth Ratio	27.29	28.24		
Bankfull Cross Sectional Area (ft <sup>2</sup> )	10.51	9.47		
Maximum Bankfull Depth (ft)	1.11	1.08		
Width of the Floodprone Area (ft)	32.88	33.82		
Entrenchment Ratio	1.94	2.07		

### R-2635C UT to Reedy Branch XS-3 @ Sta. 14+75



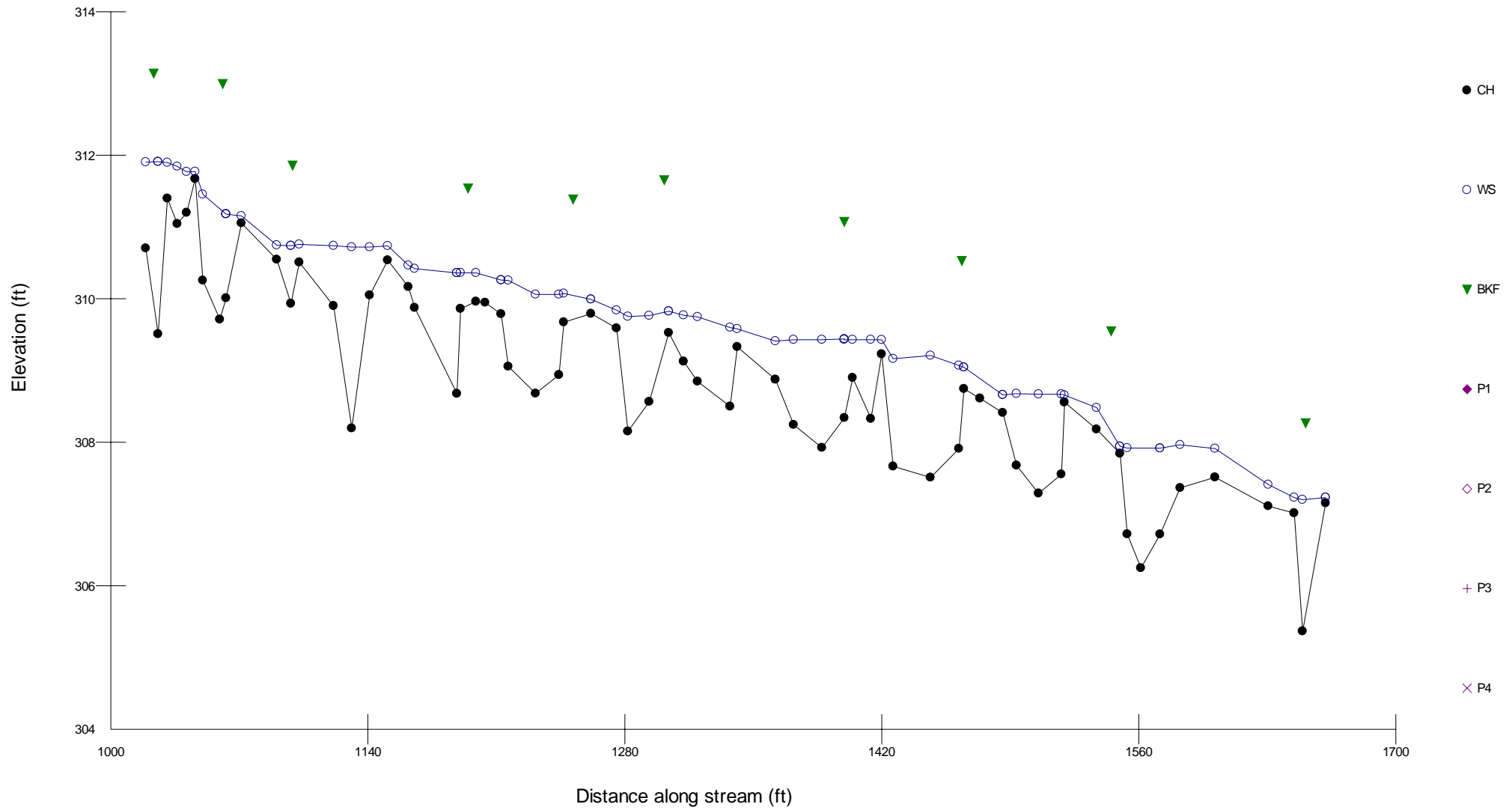
Cross-Section #3 (Riffle) Abbreviated Morphological Summary				
	As-built	2016	2017	2018
Bankfull Width (ft)	14.77	15.35		
Bankfull Mean Depth (ft)	0.77	0.79		
Width/Depth Ratio	19.18	19.43		
Bankfull Cross Sectional Area (ft <sup>2</sup> )	11.34	12.1		
Maximum Bankfull Depth (ft)	1.15	1.19		
Width of the Floodprone Area (ft)	29.91	31.89		
Entrenchment Ratio	2.03	2.08		



Cross-Section #4 (Pool) Abbreviated Morphological Summary				
	As-built	2016	2017	2018
Bankfull Width (ft)	16.98	15.45		
Bankfull Mean Depth (ft)	1.19	1.23		
Bankfull Cross Sectional Area (ft <sup>2</sup> )	20.15	18.96		
Maximum Bankfull Depth (ft)	2.4	2.32		

\*According to the Rosgen Classification of Natural Rivers Floodprone width, entrenchment ratio, and width depth ratio are not measured in pool, glide, or run features

2016 Year 1 R-2635C Longitudinal Profile



**APPENDIX B**  
**SITE PHOTOGRAPHS**



## UT to Reedy Branch



Photo Point #1 (Upstream)



Photo Point #1 (Downstream)



Photo Point #2 (Upstream)



Photo Point #2 (Downstream)



Photo Point #3 (Upstream)



Photo Point #3 (Downstream)



## UT to Reedy Branch



Photo Point #4 (Upstream)

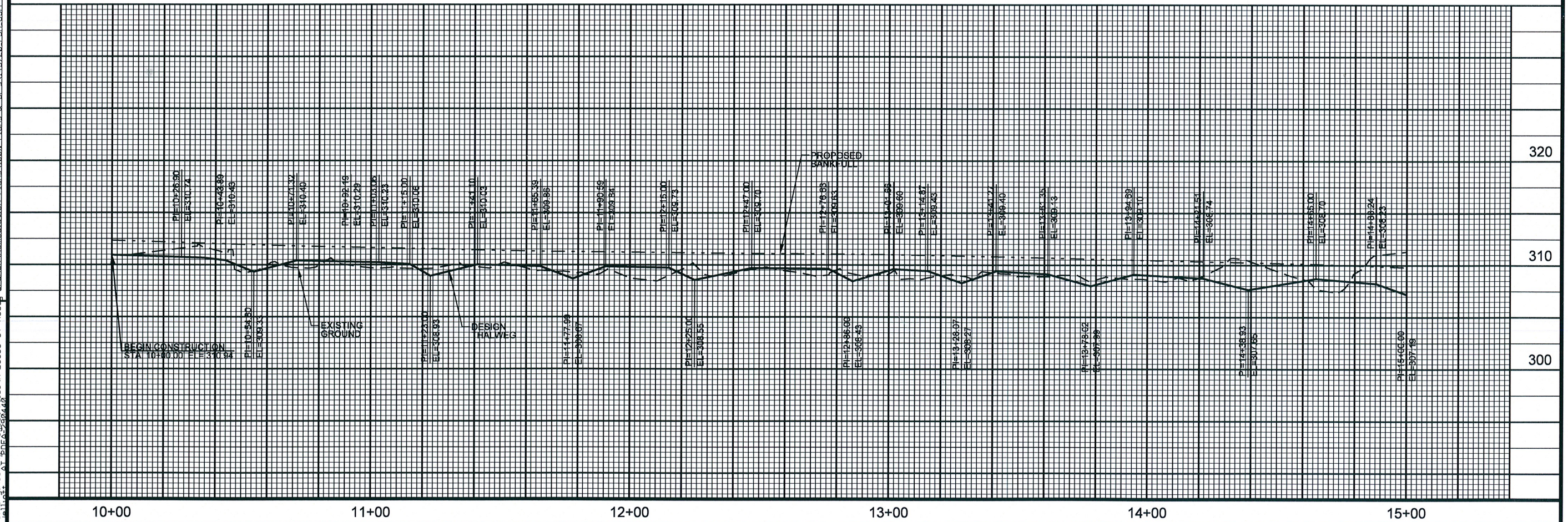
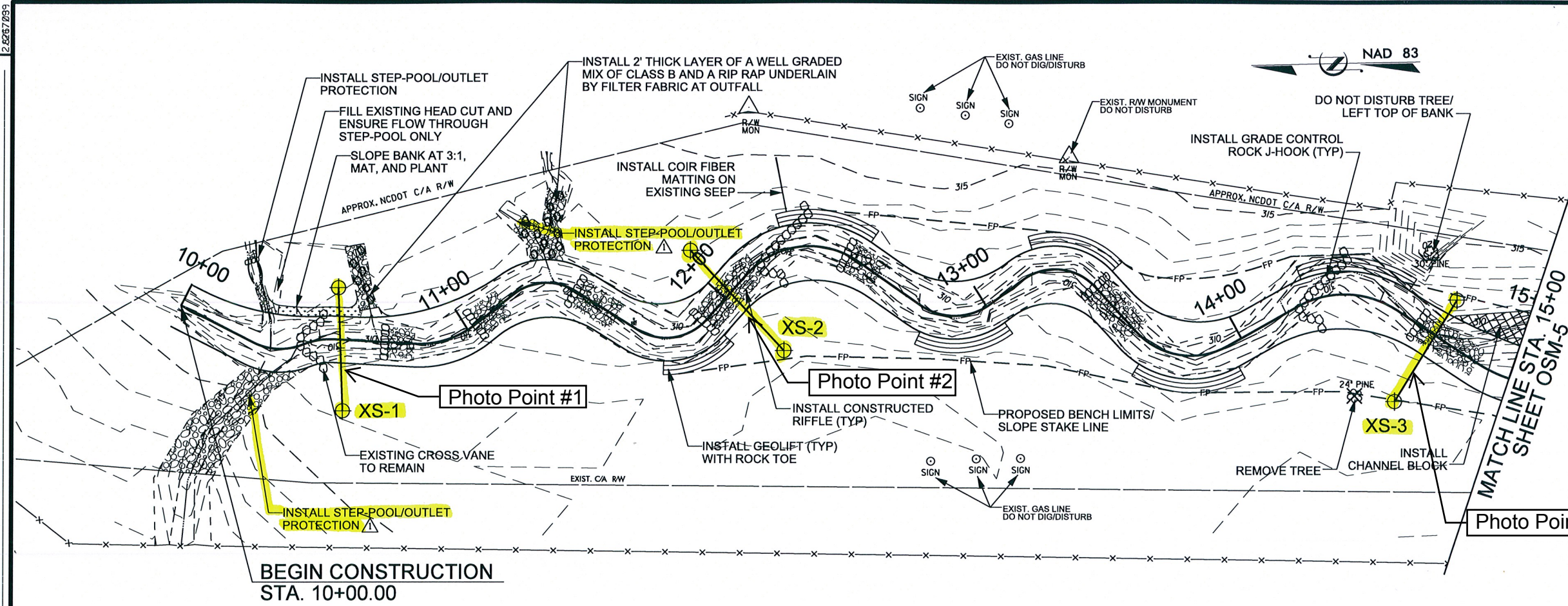


Photo Point #4 (Downstream)

## **APPENDIX C**

### **CROSS SECTION, VEGETATION PLOT & PHOTO POINT LOCATIONS (AS-BUILT PLANS)**





REVISIONS

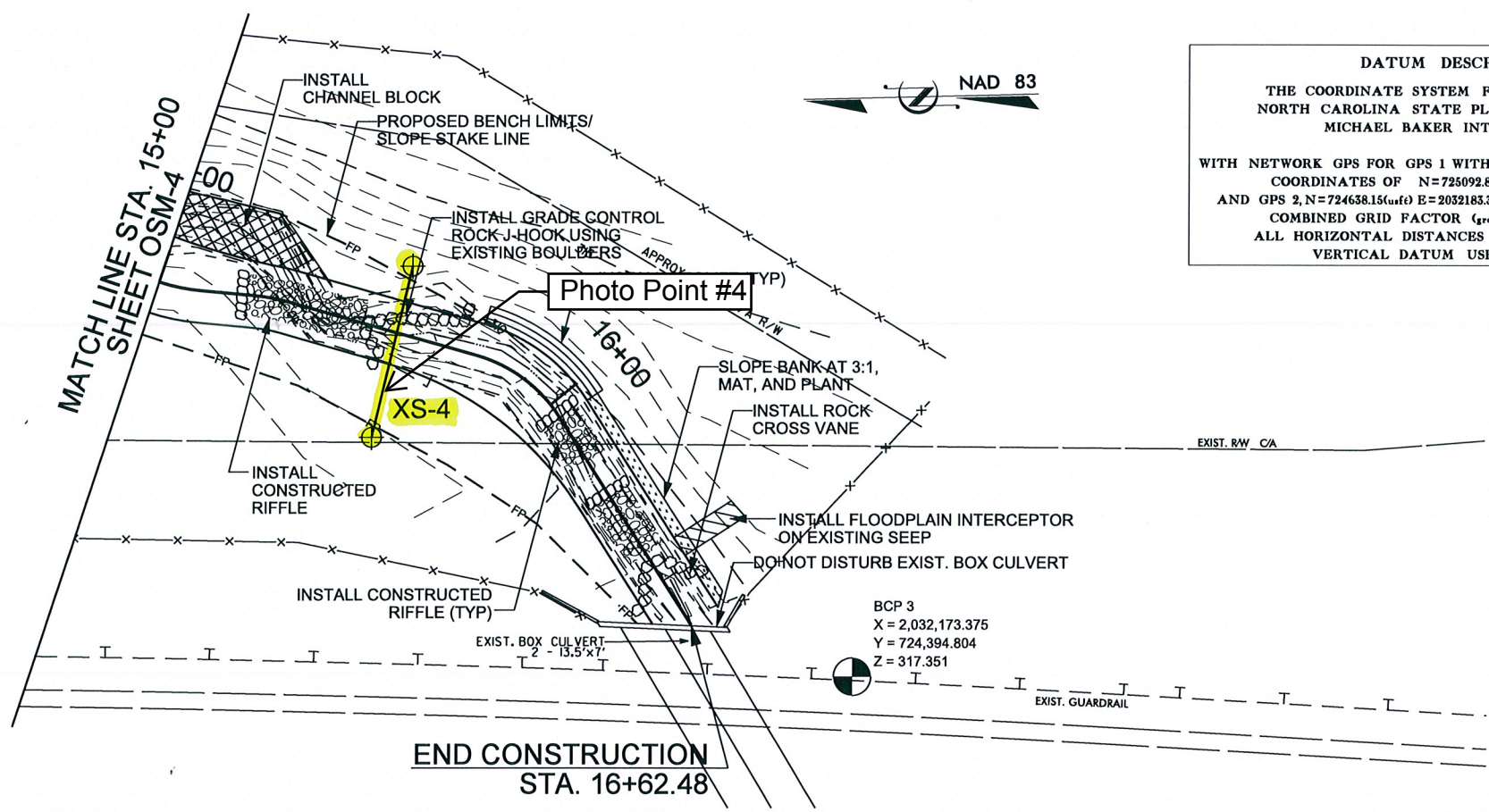
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2/28/2016

REVISIONS



**DATUM DESCRIPTION**  
THE COORDINATE SYSTEM FOR THIS PROJECT IS NORTH CAROLINA STATE PLANE ESTABLISHED BY MICHAEL BAKER INTERNATIONAL  
WITH NETWORK GPS FOR GPS 1 WITH NAD 83 STATE PLANE GRID COORDINATES OF N=725092.81(usft), E=2032231.76(usft) AND GPS 2, N=724638.15(usft) E=2032183.31 (usft), WITH AN AVERAGE COMBINED GRID FACTOR (ground to grid) of 0.99998806. ALL HORIZONTAL DISTANCES ARE GRID DISTANCES. VERTICAL DATUM USED IS NAVD 88.

PROJECT REFERENCE NO.	SHEET NO.
R-2635C	OSM-5
PROJECT ENGINEER	
	
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