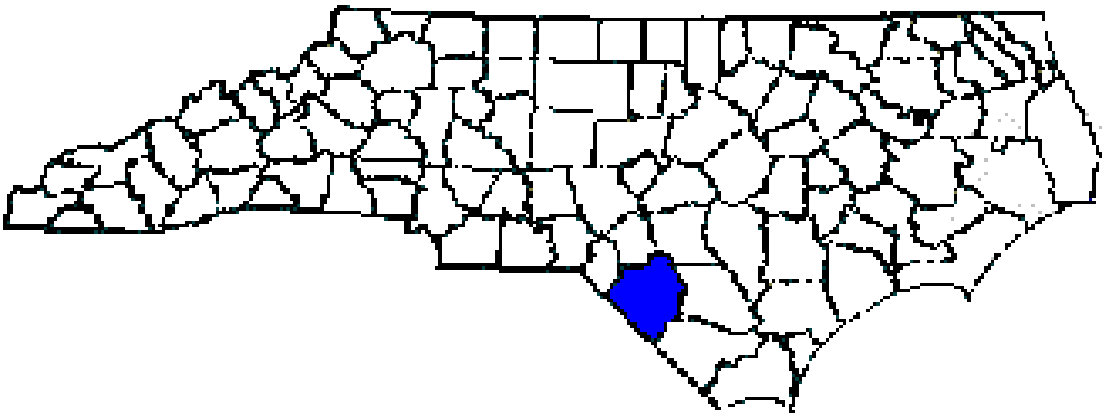
ANNUAL REPORT FOR 2009



Unnamed Tributary to Lumber River Mitigation Site
Robeson County
TIP No. R-0513WM

Prepared By:
Natural Environment Unit & Roadside Environmental Unit
North Carolina Department of Transportation
December 2009

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SUMMARY

The following report summarizes the stream monitoring activities that have occurred during 2009 at the Unnamed Tributaries to Lumber River (UT to Lumber River) Mitigation Site in Robeson County. The site was constructed during 2007 by the North Carolina Department of Transportation (NCDOT). This report provides the monitoring results for the second formal year of monitoring (Year 2009). The Year 2009 monitoring period is the second of five scheduled years for monitoring on UT to Lumber River (See Success Criteria Section 2.1).

Based on the overall conclusions of monitoring along UT to Lumber River, the site has met the required monitoring protocols for the second formal year of monitoring. Based on comparing the as-built and 2008 data to the 2009 monitoring data, the stream channel is stable at this time. The stream bank and buffer areas are highly vegetated for the second year of monitoring.

NCDOT will continue stream monitoring at the UT to Lumber River Mitigation Site for 2010.

1.0 INTRODUCTION

1.1 Project Description

The following report summarizes the stream monitoring activities that have occurred during 2009 at the UT to Lumber River Mitigation Site. The site is located adjacent to the US 74 westbound lanes and split by SR 1362 Daystorm Road near Maxton (Figure 1). The UT to Lumber River Mitigation Site was constructed to provide mitigation for stream impacts associated with Transportation Improvement Program (TIP) number R-0513 in Robeson County.

The mitigation project covers approximately 3,260 linear feet of Priority II stream restoration. Construction was completed in December 2007 by the North Carolina Department of Transportation (NCDOT). Stream restoration involved the installation of rock cross vanes, log cross vanes, log sills and rootwads, construction of a new stream channel and construction of the floodplain to allow for overbank flooding. It also included the installation of coir fiber matting and live stakes along the streambank and bareroot seedlings in the buffer area.

1.2 Purpose

In order for a mitigation site to be considered successful, the site must meet the success criteria. This report details the monitoring in 2009 at the UT to Lumber River Mitigation Site. Hydrologic monitoring was not required for the site.

1.3 Project History

December 2007	Construction Completed
March 2008	Planted Live Stakes and Bareroot Seedlings
August 2008	Kudzu Treated
August 2008	Vegetation Monitoring (1 yr.)
October 2008	Stream Channel Monitoring (1 yr.)
June 2009	Kudzu Treated
July 2009	Vegetation Monitoring (2 yr.)
November 2009	Stream Channel Monitoring (2 yr.)

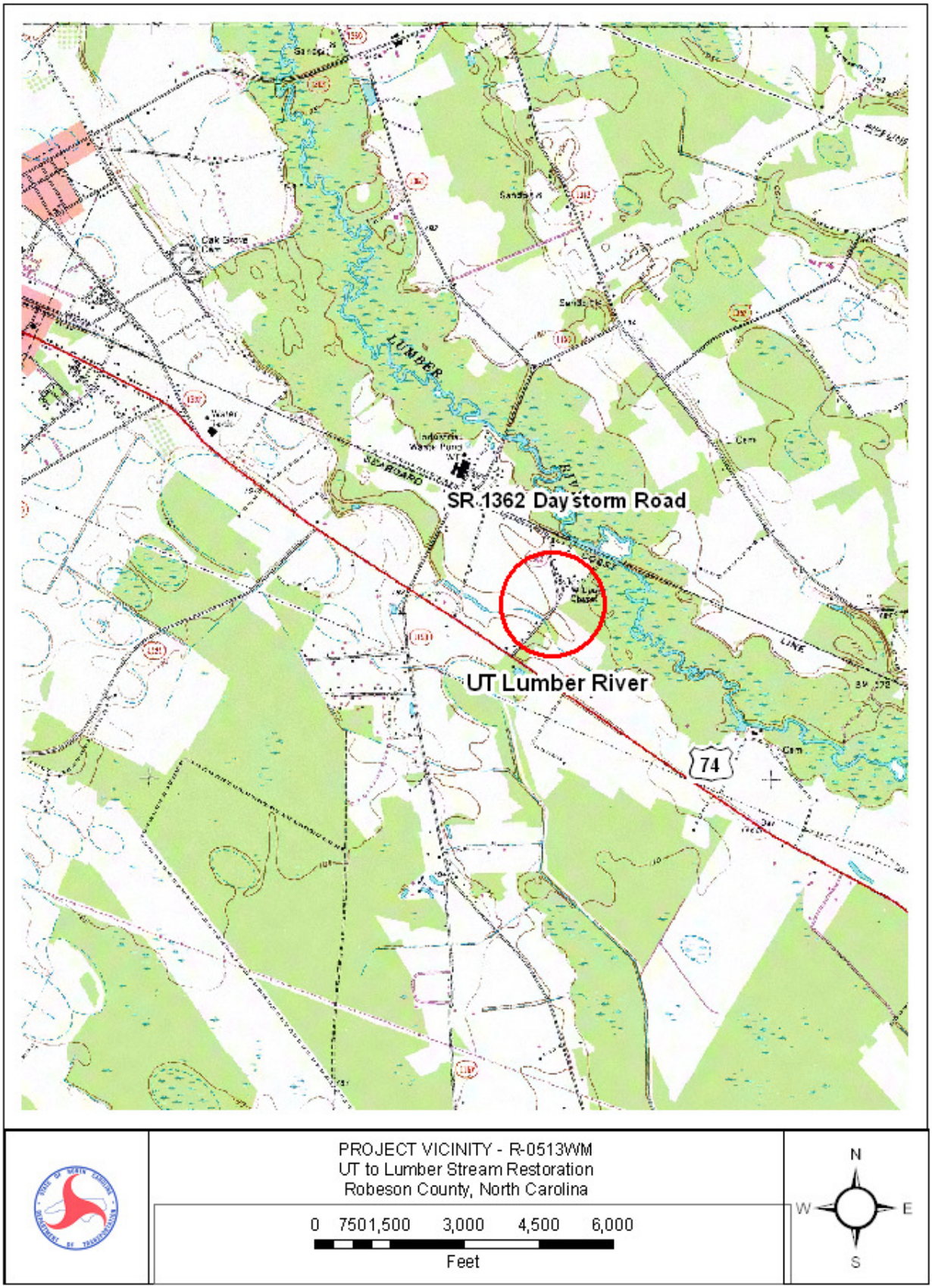


Figure 1. Vicinity Map

2.0 STREAM ASSESSMENT

2.1 Success Criteria

In accordance with the approved mitigation plan, NCDOT will evaluate the success of the stream restoration 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 approximately two cross sections (one riffle and one pool) per unique stream segment. The cross sections will represent approximately 50% riffles and 50% 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 3,000 linear feet of channel. Newly-constructed meanders will be surveyed to provide pattern measurements. 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.

Vegetation Success

The success of vegetation 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 5 year monitoring period.

Bare root vegetation will be evaluated using 5 staked survival plots. Plots will be 25 ft. by 25 ft. and all flagged stems will be counted in those plots. Success will be defined as 320 stems per acre after 3 years and 260 stems per acre after 5 years. All vegetation monitoring will be conducted during the growing season.

2.2 Stream Description

2.2.1 Post-Construction Conditions

The mitigation project covers approximately 3,260 linear feet of Priority II stream restoration. Construction was completed in December 2007 by NCDOT. Stream restoration involved the installation of rock cross vanes, log cross vanes, log sills and rootwads, construction of a new stream channel and construction of the floodplain to allow for overbank flooding. It also included the installation of coir fiber matting and live stakes along the streambank and bareroot seedlings in the buffer area.

2.2.2 Monitoring Conditions

The objective of the UT to Lumber River Mitigation Site restoration was to build a C5 stream type as identified in the Rosgen's Applied River Morphology. A total of eleven cross sections (five in a riffle, six in a pool) were surveyed. For this report, all cross sections were included in Table 1 but only cross sections containing riffles were used in the comparison of channel morphology.

Table 1. Abbreviated Morphological Summary (UT Lumber River Cross Sections #1, #3, #5, #7 & #11)							
Variable	**Proposed**	**Cross Section #1 (Riffle)**	**Cross Section #3 (Riffle)**	**Cross Section #5 (Riffle)**	**Cross Section #7 (Riffle)**	**Cross Section #11 (Riffle)**	**Min. - Max Values (Riffle Sections Only)**
		2009	**2009**	**2009**	**2009**	**2009**	**2009**
Drainage Area (sq. mi)	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Bankfull Width (ft)	13.0	11.20	11.40	9.31	13.0	12.57	9.31 - 13.0
Bankfull Mean Depth (ft)	0.70	0.54	0.53	0.49	0.79	0.76	0.49 - 0.79
Width/Depth Ratio	18.5	20.74	21.51	19.0	16.46	16.54	16.46 - 21.51
Bankfull Cross Sectional Area (ft^2)	9.30	6.03	6.06	4.52	10.26	9.54	6.03 - 10.26
Maximum Bankfull Depth (ft)	0.90	0.88	0.91	0.73	1.30	1.16	0.73 - 1.30
Floodprone Area (ft)	60	56	58	63	69	44	44 - 69
Entrenchment Ratio	4.60	5.05	5.09	6.77	5.31	3.50	3.50 - 6.77

*Drainage Area, Floodprone Width, and Slope are averaged values only.
*Riffle values are used for classification purposes.

2.3 Results of the Stream Assessment

2.3.1 Site Data

The assessment included the survey of eleven cross sections and the longitudinal profile of UT to Lumber River established by the NCDOT after construction. The length of the profile along UT to Lumber River was approximately 3,160 linear feet. Eleven cross sections were established during the 2008 monitoring year. 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 Lumber River, Station 279+00 linear feet, midpoint of riffle
- Cross Section #2. UT to Lumber River, Station 479+00 linear feet, midpoint of pool
- Cross Section #3. UT to Lumber River, Station 849+00 linear feet, midpoint of riffle
- Cross Section #4. UT to Lumber River, Station 964+00 linear feet, midpoint of pool
- Cross Section #5. UT to Lumber River, Station 1258+00 linear feet, midpoint of riffle
- Cross Section #6. UT to Lumber River, Station 1456+00 linear feet, midpoint of pool
- Cross Section #7. UT to Lumber River, Station 1874+00 linear feet, midpoint of riffle
- Cross Section #8. UT to Lumber River, Station 1913+00 linear feet, midpoint of pool
- Cross Section #9. UT to Lumber River, Station 2565+00 linear feet, midpoint of pool
- Cross Section #10. UT to Lumber River, Station 2852+00 linear feet, midpoint of pool
- Cross Section #11. UT to Lumber River, Station 3047+00 linear feet, midpoint of riffle

Based on comparisons of the as-built and 2008 data to the 2009 monitoring data, all eleven cross sections appear stable with little or no active bank erosion. Graphs of the cross sections are presented in Appendix A. Future survey data will vary depending on actual location of rod placement and alignment; however this information should remain similar in appearance.

2.4 Results of Stream and Buffer Vegetation

2.4.1 Description of Species

The following live stake species were planted on the streambank:

Cephalanthus occidentalis, Buttonbush

Cornus amomum, Silky Dogwood

The following tree species were planted in the buffer area:

Quercus falcate var. pagodaefolia, Cherrybark Oak

Quercus laurifolia, Laurel Oak

Quercus michauxii, Swamp Chestnut Oak

Quercus nigra, Water Oak

Myrica cerifera, Wax Myrtle

Nyssa sylvatica var. biflora, Swamp Blackgum

Nyssa aquatica, Water Tupelo

2.4.2 Results of Vegetation Monitoring

Table 2. Vegetation Monitoring Results: Five 25 ft. x 25 ft. vegetation plots were set to determine the trees per acre in the buffer area.

Plot #	Cherrybark Oak	Laurel Oak	Swamp Chestnut Oak	Water Oak	Wax Myrtle	Swamp Blackgum	Water Tupelo	Total (2 year)	Total (at planting)	Density (Trees/Acre)
1	1	1			1	1	5	9	19	322
2	3	2	2	1		2	2	12	21	389
3	4	1	1		1	5	5	17	22	525
4	3	1	3				8	15	22	464
5		1	1			2	14	18	25	490
Average Density (Trees/Acre)										438

Site Notes: The buttonbush and silky dogwood live stakes were surviving along the streambank. Other vegetation noted included *Juncus effuses* ragweed, smartweed, woolgrass, lespedeza, cattail, stinkweed, goldenrod, baccharis, red maple, tear-thumb, briars, black willow, fennel, and various grasses. Kudzu that was noted downstream of Daystorm Road was treated prior to construction and has been continually treated throughout the monitoring period.

2.4.3 Conclusions

There were five vegetation monitoring plots established throughout the buffer area. The 2009 vegetation monitoring of the site revealed an average tree density of 438 trees per acre. This average is above the minimum success criteria of 320 trees per acre after year two monitoring.

3.0 OVERALL CONCLUSIONS/RECOMMENDATIONS

The UT to Lumber River Mitigation Site has met the required monitoring protocols for the second formal year of monitoring. The channel and structures throughout the stream are stable at this time. The stream bank and buffer area are highly vegetated for the second year of monitoring.

NCDOT will continue stream monitoring at the UT to Lumber River Mitigation Site for 2010.

4.0 REFERENCES

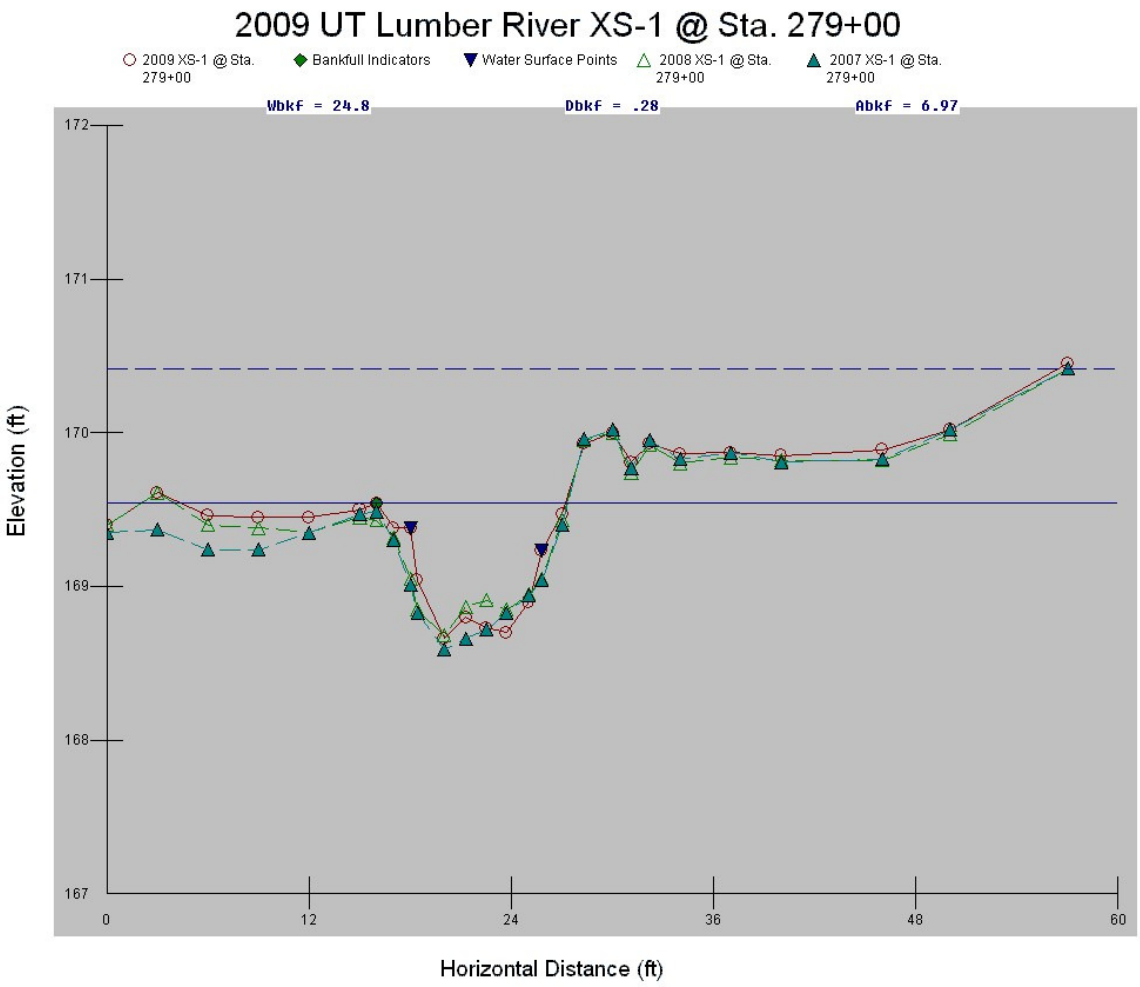
Wetland and Stream Mitigation Plan for UT to Lumber River; Robeson County, NC, February, 2006

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

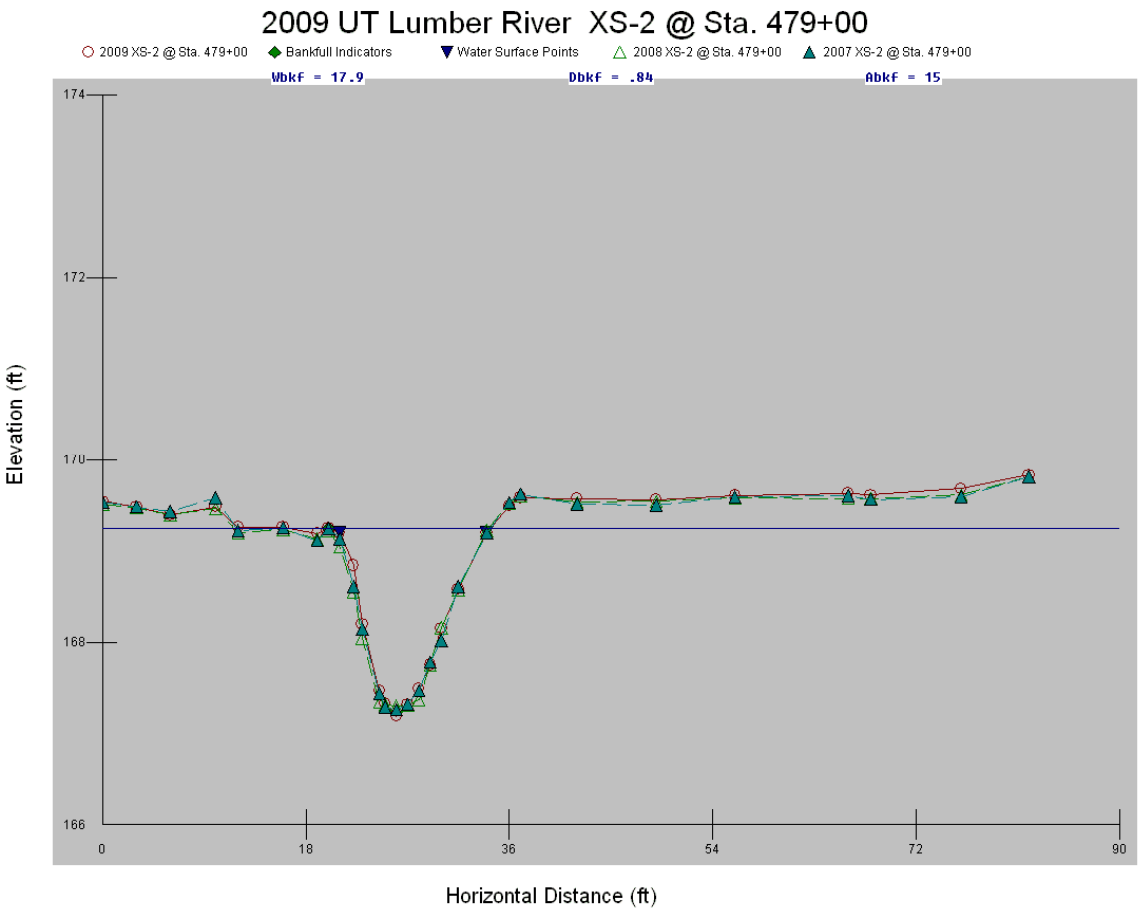
US Army Corps of Engineers (USACE), 2003. Stream Mitigation Guidelines. Prepared with cooperation from the US Environmental Protection Agency, NC Wildlife Resources Commission, and the NC Division of Water Quality.

APPENDIX A

CROSS SECTION COMPARISONS
&
LONGTITUDINAL PROFILE

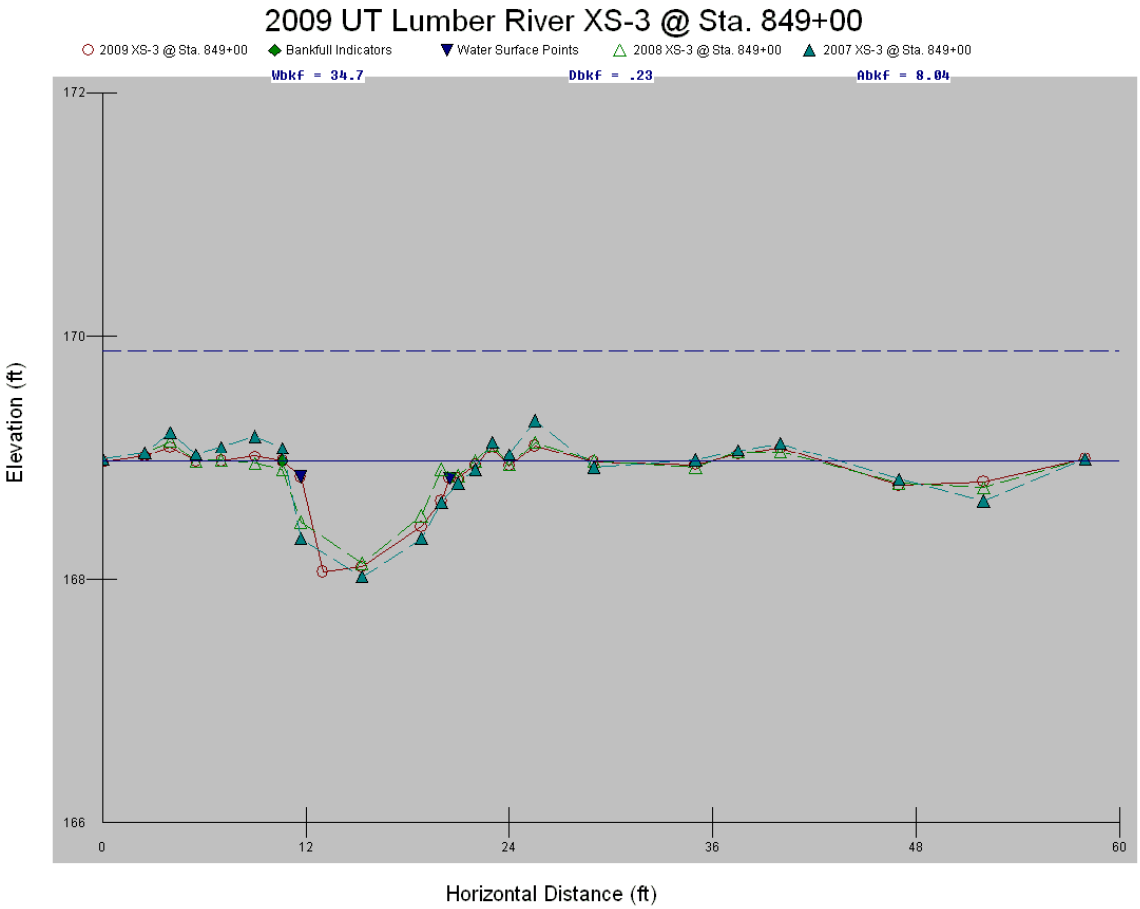


Cross-Section #1 (Riffle) Abbreviated Morphological Summary					
	2008	2009	2010	2011	2012
Bankfull Width (ft)	11.0	11.20			
Bankfull Mean Depth (ft)	0.45	0.54			
Width/Depth Ratio	24.44	20.74			
Bankfull Cross Sectional Area (ft^2)	4.98	6.03			
Maximum Bankfull Depth (ft)	0.75	0.88			
Width of the Floodprone Area (ft)	53	56			
Entrenchment Ratio	4.83	5.05			

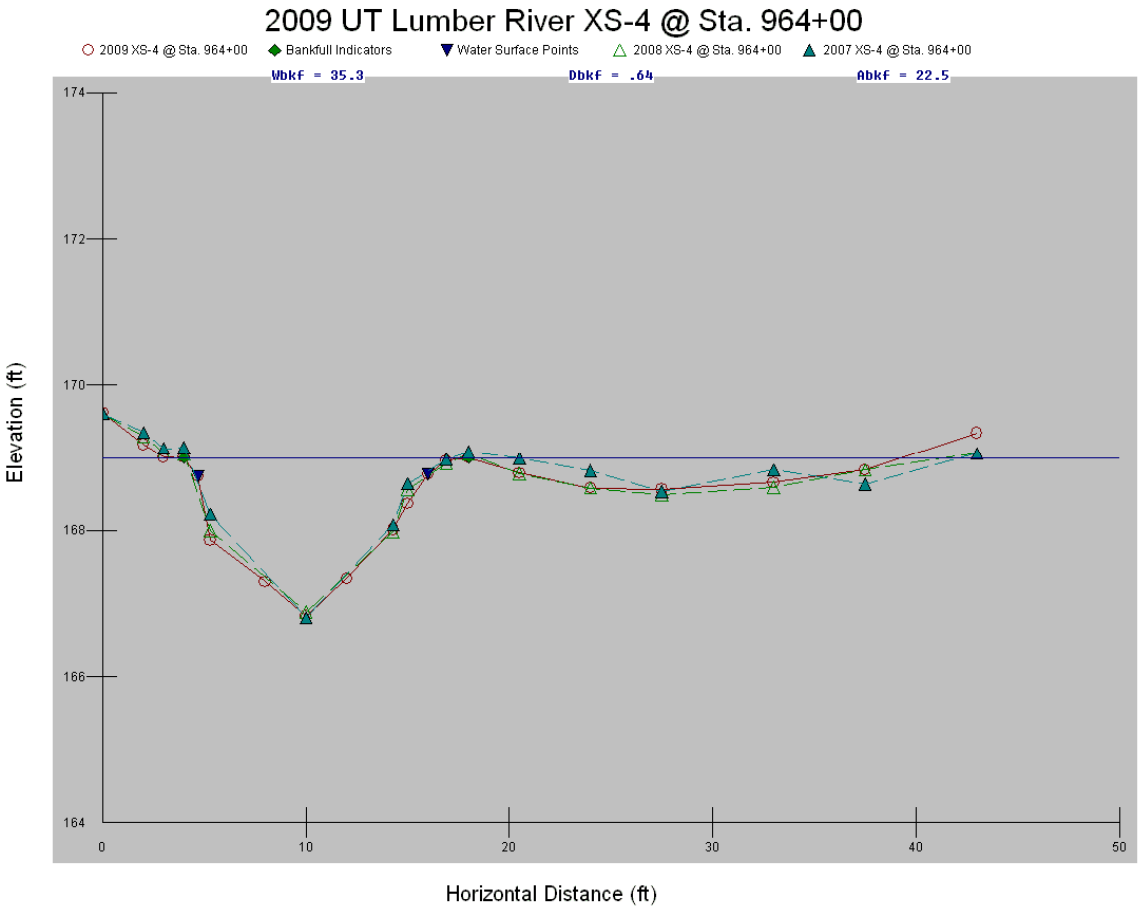


Cross-Section #2 (Pool) Abbreviated Morphological Summary*					
	2008	2009	2010	2011	2012
Bankfull Cross Sectional Area (ft^2)	15.31	15.05			
Maximum Bankfull Depth (ft)	1.92	2.06			
Bankfull Mean Depth (ft)	1.09	0.84			
Bankfull Width (ft)	14.0	17.92			

* According to the Rosgen Classification of Natural Rivers floodprone width, entrenchement ratio, and width depth ratio are not measured in pool, glide, or run features.

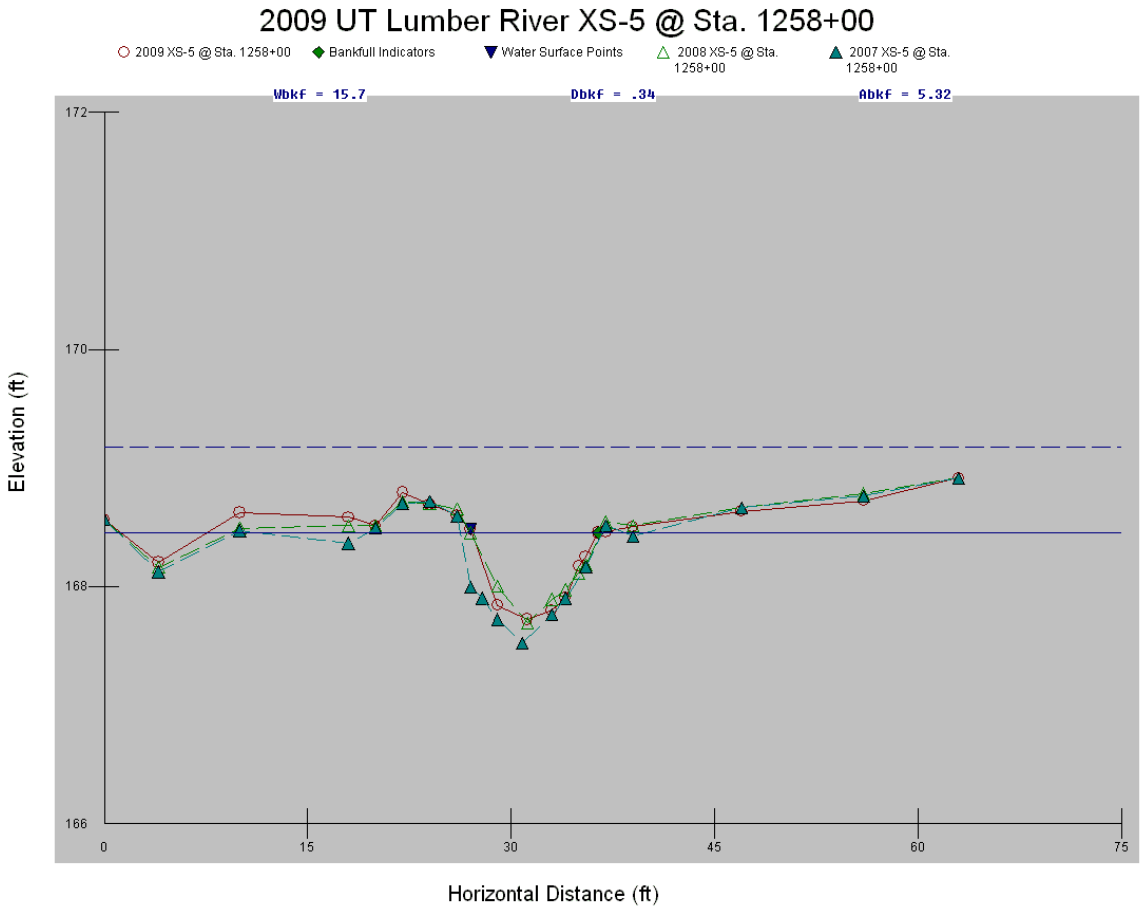


Cross-Section #3 (Riffle) Abbreviated Morphological Summary					
	2008	2009	2010	2011	2012
Bankfull Width (ft)	9.4	11.40			
Bankfull Mean Depth (ft)	0.49	0.53			
Width/Depth Ratio	19.18	21.51			
Bankfull Cross Sectional Area (ft^2)	4.64	6.06			
Maximum Bankfull Depth (ft)	0.77	0.91			
Width of the Floodprone Area (ft)	58	58			
Entrenchment Ratio	6.17	5.09			

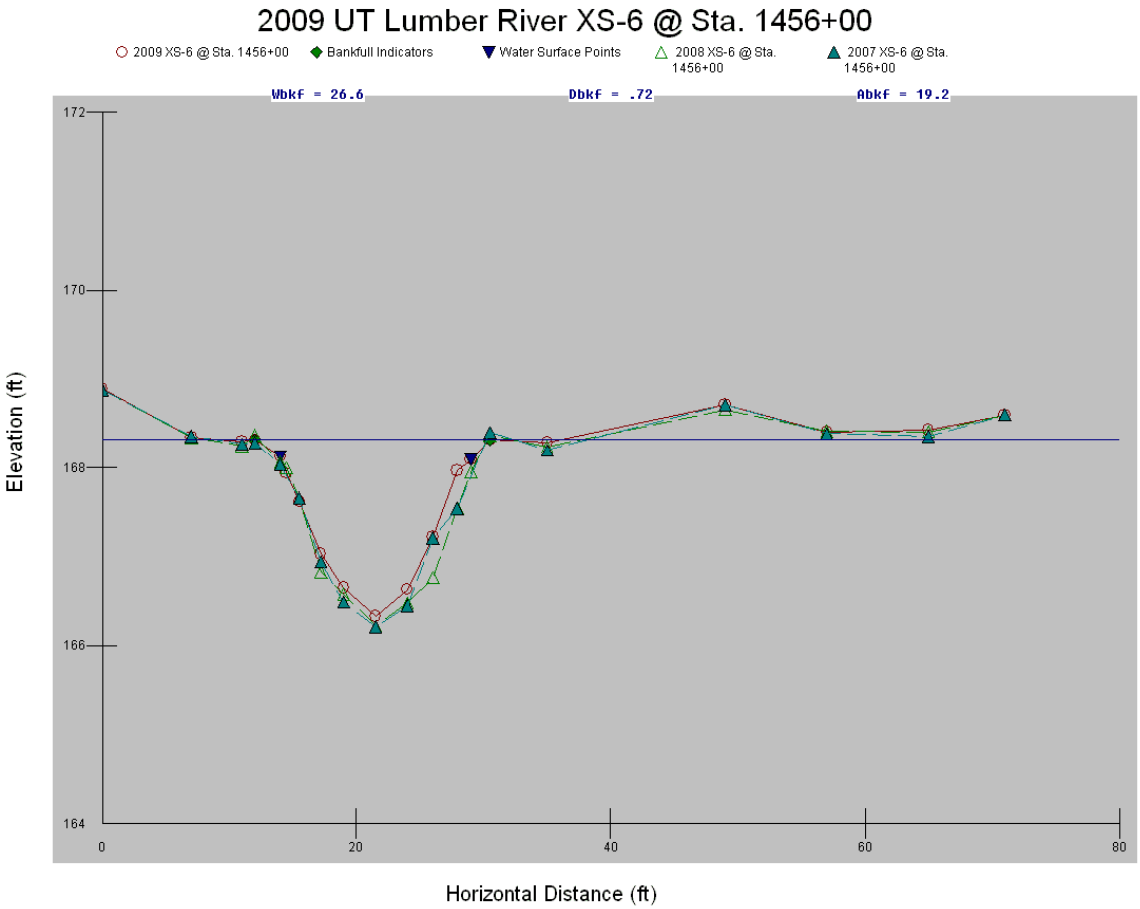


Cross-Section #4 (Pool) Abbreviated Morphological Summary*					
	2008	2009	2010	2011	2012
Bankfull Cross Sectional Area (ft^2)	16.42	17.90			
Maximum Bankfull Depth (ft)	2.17	2.29			
Bankfull Mean Depth (ft)	1.17	1.28			
Bankfull Width (ft)	14.0	14.0			

* 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.

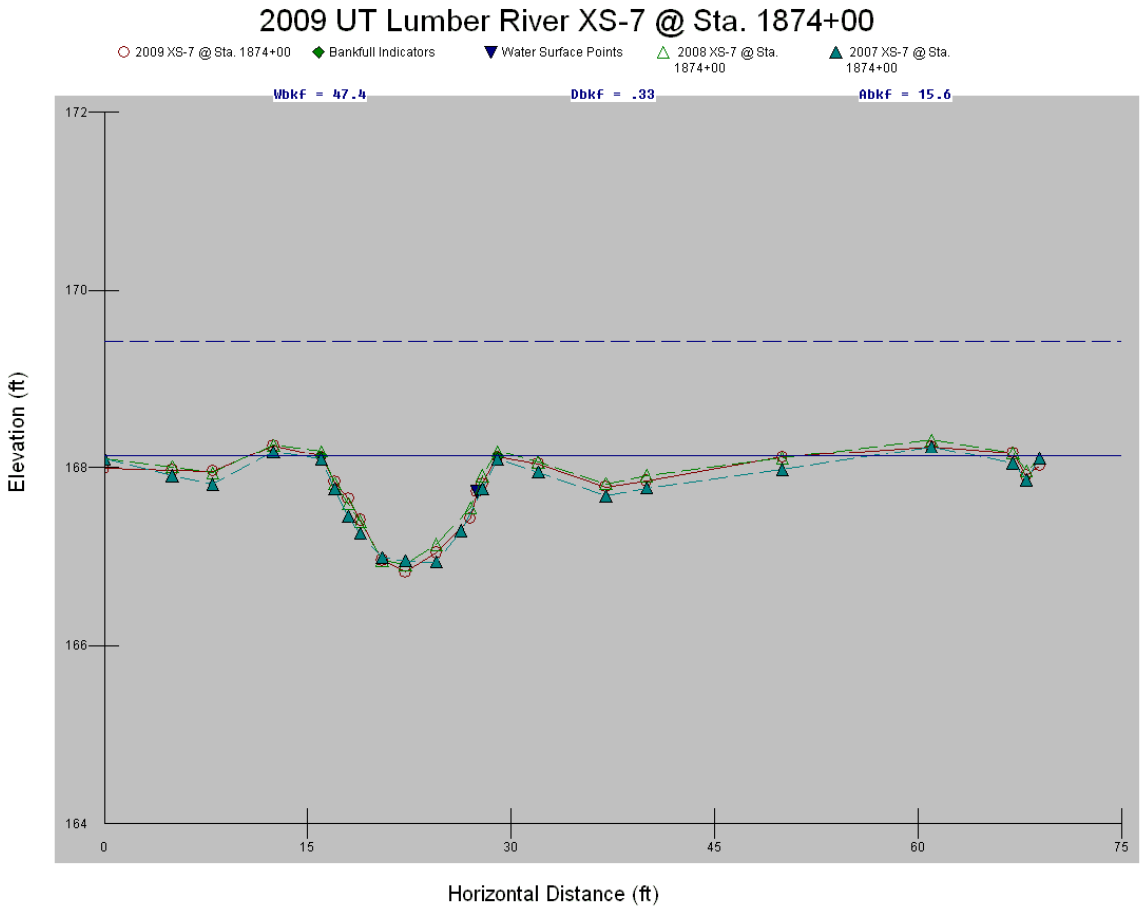


Cross-Section #5 (Riffle) Abbreviated Morphological Summary					
	2008	2009	2010	2011	2012
Bankfull Width (ft)	10.45	9.31			
Bankfull Mean Depth (ft)	0.49	0.49			
Width/Depth Ratio	21.33	19.0			
Bankfull Cross Sectional Area (ft^2)	5.11	4.52			
Maximum Bankfull Depth (ft)	0.85	0.73			
Width of the Floodprone Area (ft)	63	63			
Entrenchment Ratio	6.03	6.77			

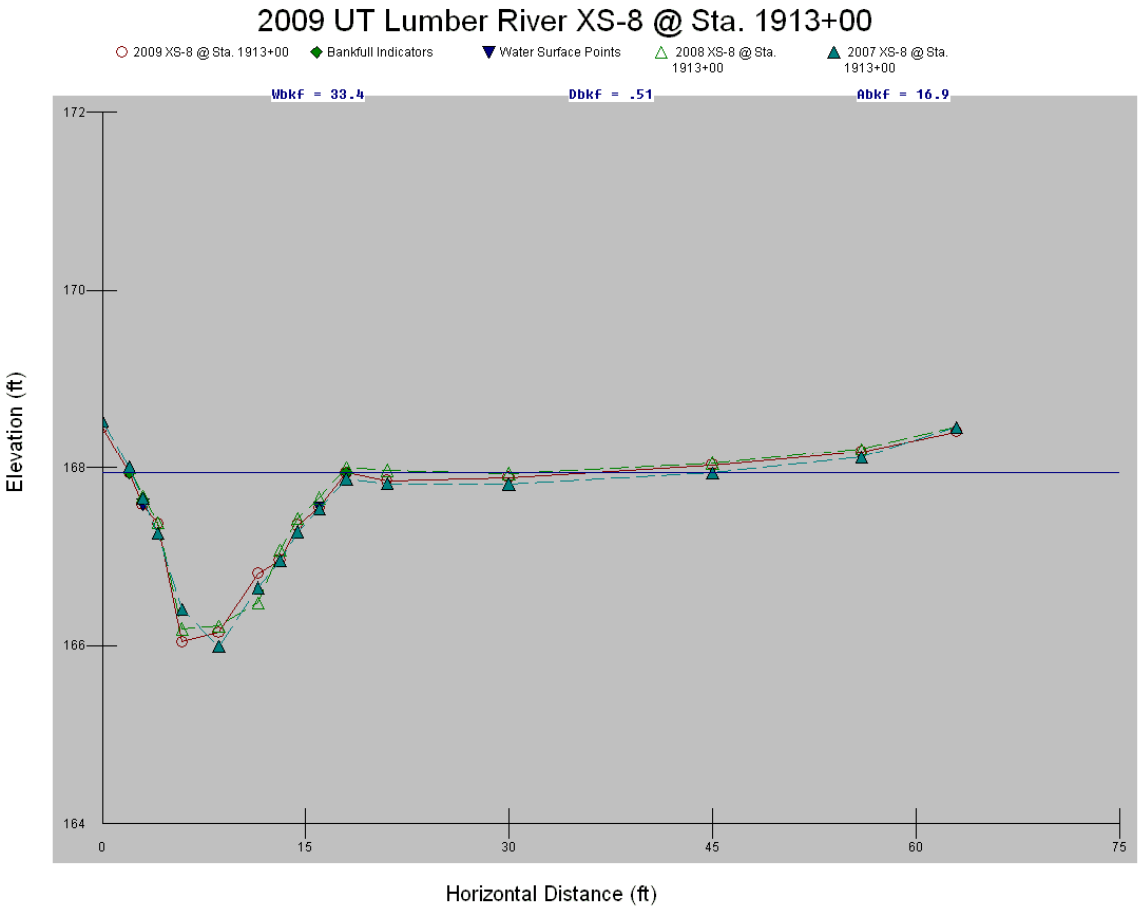


Cross-Section #6 (Pool) Abbreviated Morphological Summary*					
	2008	2009	2010	2011	2012
Bankfull Cross Sectional Area (ft^2)	22.71	19.06			
Maximum Bankfull Depth (ft)	2.15	1.99			
Bankfull Mean Depth (ft)	1.23	1.03			
Bankfull Width (ft)	18.50	18.50			

* 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.

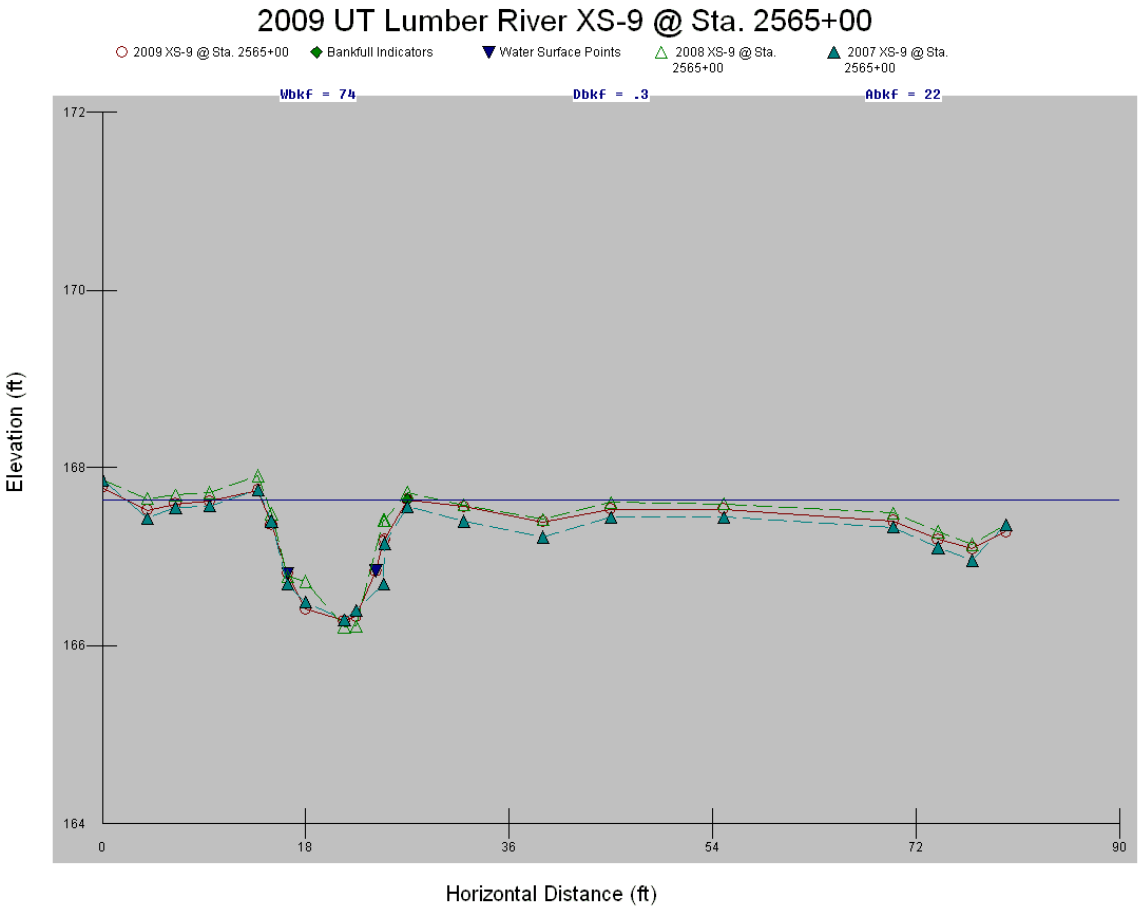


Cross-Section #7 (Riffle) Abbreviated Morphological Summary					
	2008	2009	2010	2011	2012
Bankfull Width (ft)	13.0	13.0			
Bankfull Mean Depth (ft)	0.8	0.79			
Width/Depth Ratio	16.25	16.46			
Bankfull Cross Sectional Area (ft^2)	10.4	10.26			
Maximum Bankfull Depth (ft)	1.28	1.30			
Width of the Floodprone Area (ft)	69	69			
Entrenchment Ratio	5.31	5.31			



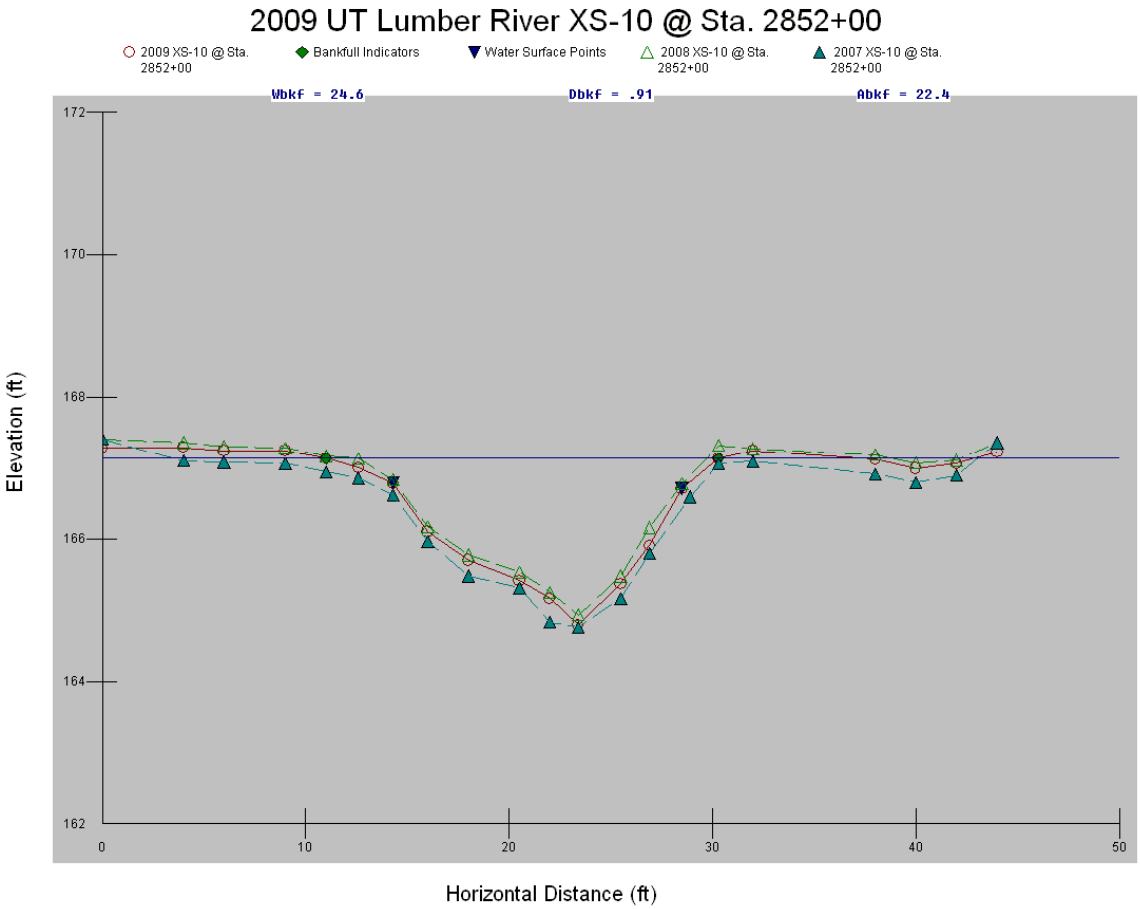
Cross-Section #8 (Pool) Abbreviated Morphological Summary*					
	2008	2009	2010	2011	2012
Bankfull Cross Sectional Area (ft^2)	16.5	16.01			
Maximum Bankfull Depth (ft)	1.81	1.90			
Bankfull Mean Depth (ft)	1.03	1.0			
Bankfull Width (ft)	16	16			

* 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.



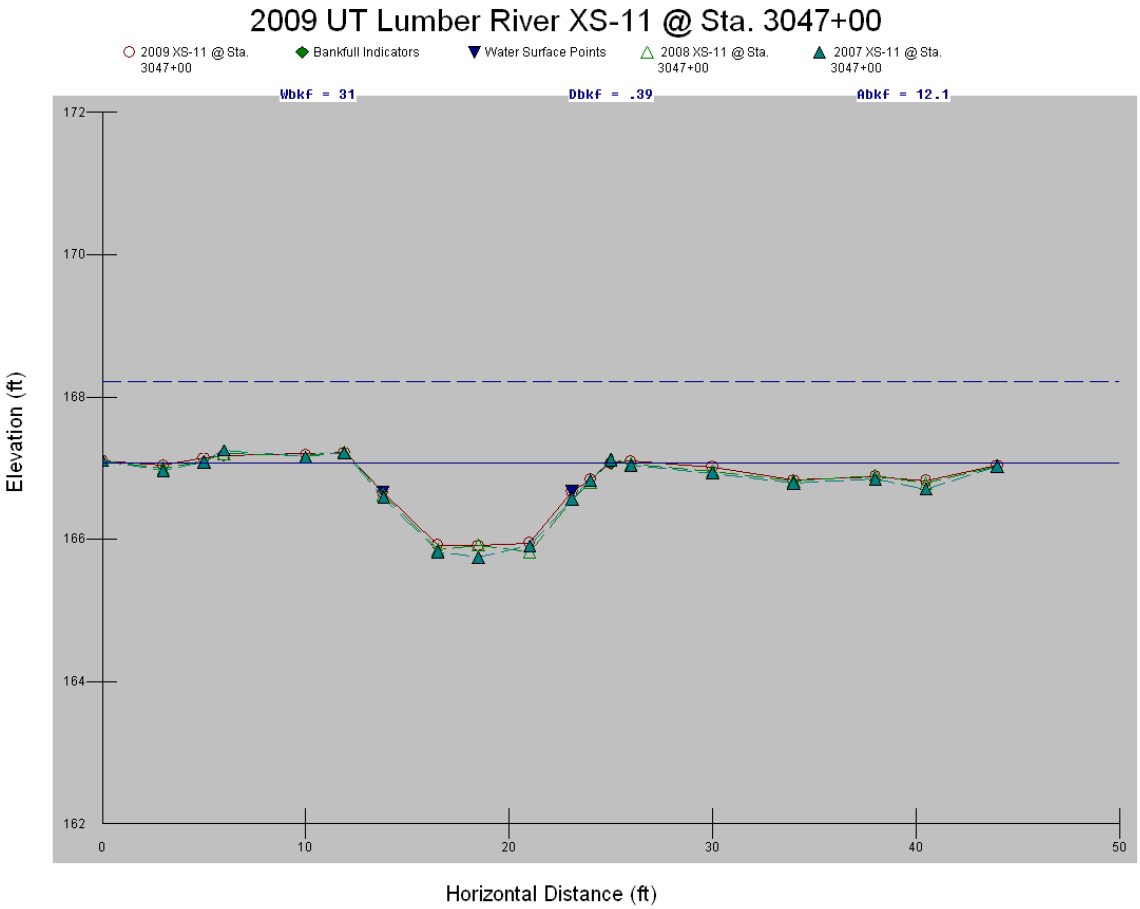
Cross-Section #9 (Pool) Abbreviated Morphological Summary*					
	2008	2009	2010	2011	2012
Bankfull Cross Sectional Area (ft^2)	10.89	11.15			
Maximum Bankfull Depth (ft)	1.51	1.36			
Bankfull Mean Depth (ft)	0.86	0.87			
Bankfull Width (ft)	12.61	12.88			

* 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.



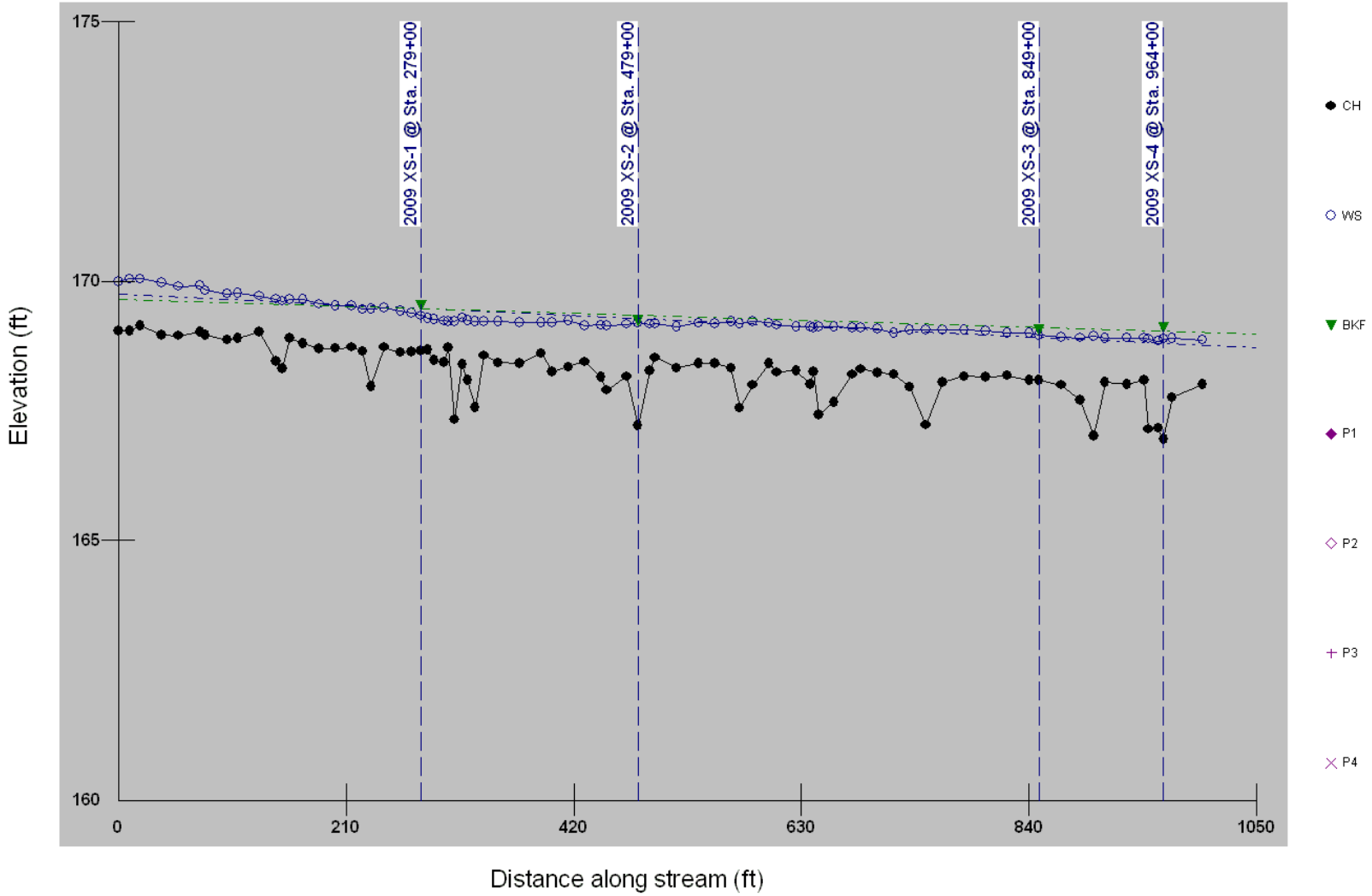
Cross-Section #10 (Pool) Abbreviated Morphological Summary*					
	2008	2009	2010	2011	2012
Bankfull Cross Sectional Area (ft^2)	23.31	21.96			
Maximum Bankfull Depth (ft)	2.37	2.34			
Bankfull Mean Depth (ft)	1.1	1.14			
Bankfull Width (ft)	21.23	19.3			

* 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.

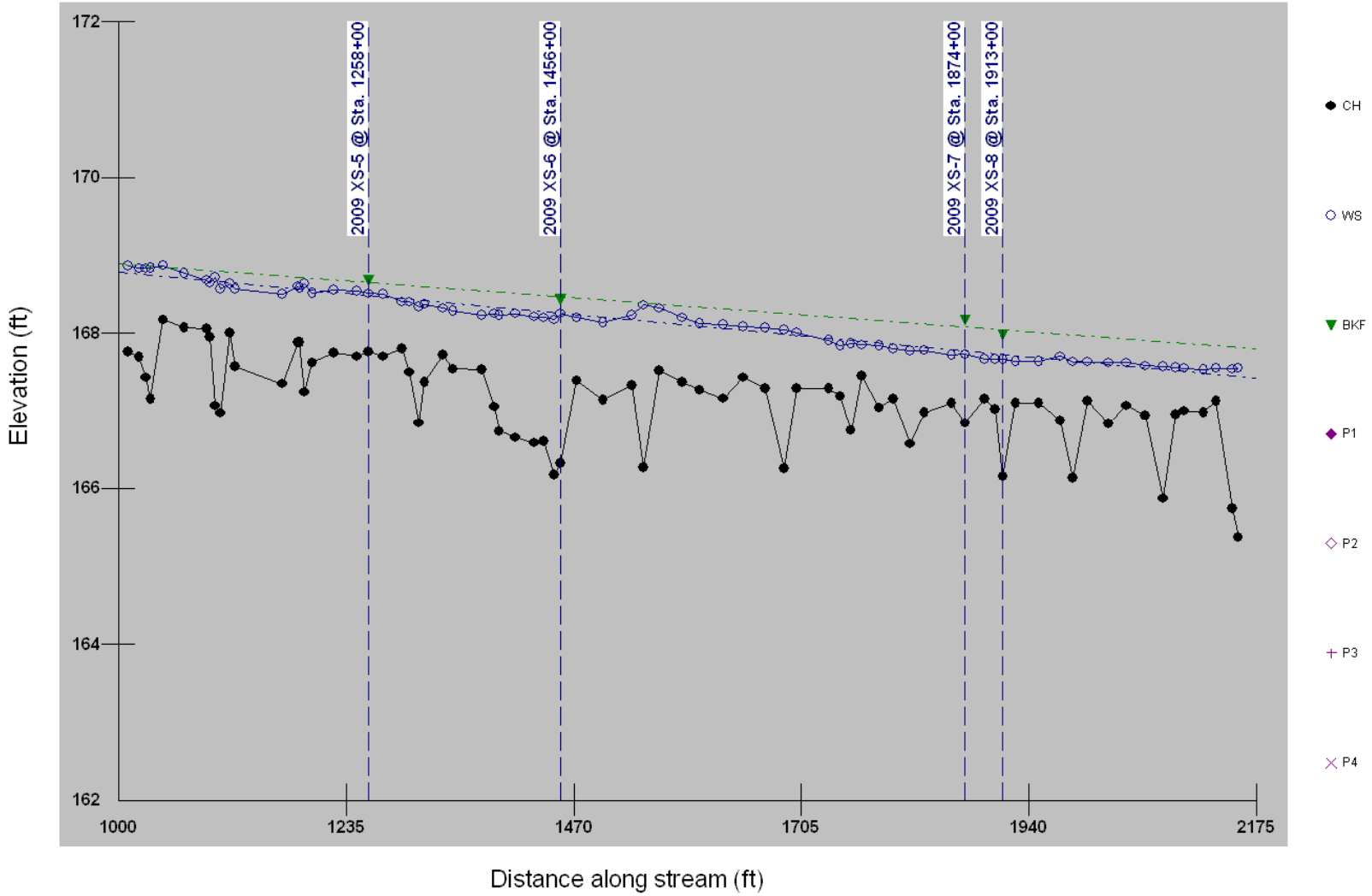


Cross-Section #11 (Riffle) Abbreviated Morphological Summary					
	2008	2009	2010	2011	2012
Bankfull Width (ft)	12.76	12.57			
Bankfull Mean Depth (ft)	0.86	0.76			
Width/Depth Ratio	14.84	16.54			
Bankfull Cross Sectional Area (ft^2)	10.93	9.54			
Maximum Bankfull Depth (ft)	1.3	1.16			
Width of the Floodprone Area (ft)	44	44			
Entrenchment Ratio	3.45	3.50			

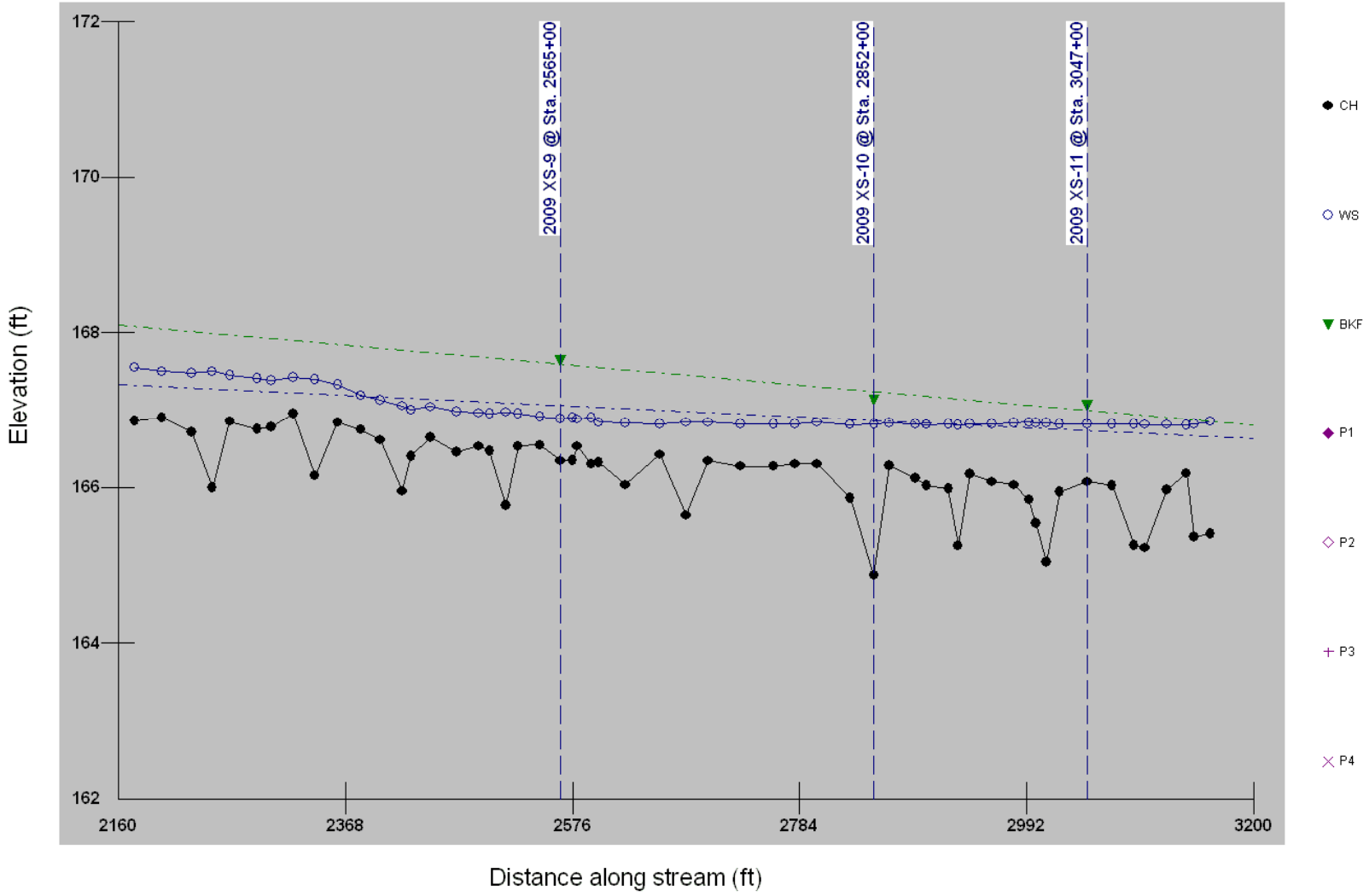
2009 UT Lumber River Longitudinal Profile Sta. 0+00 to Sta. 1000+00



2009 UT Lumber River Longitudinal Profile Sta. 1001+00 to Sta. 2156+00



2009 UT Lumber River Longitudinal Profile Sta. 2161+00 to Sta. 3160+00



APPENDIX B

SITE PHOTOGRAPHS, CROSS SECTION, VEGETATION

PLOT & PHOTO POINT LOCATIONS

UT to Lumber River

Photo Point #1 (Upstream)

Photo Point #1 (Downstream)

Photo Point #2 (Upstream)

Photo Point #2 (Downstream)

Photo Point #3 (Upstream)
November 2009

Photo Point #3 (Downstream)

UT to Lumber River

Photo Point #4 (Upstream)

Photo Point #4 (Downstream)

Photo Point #5 (Upstream)

Photo Point #5 (Downstream)

Photo Point #6 (Upstream)
November 2009

Photo Point #6 (Downstream)

UT to Lumber River

Photo Point #7 (Upstream)

Photo Point #7 (Downstream)

Photo Point #8 (Upstream)

Photo Point #8 (Downstream)

Photo Point #9 (Upstream)
November 2009

Photo Point #9 (Downstream)

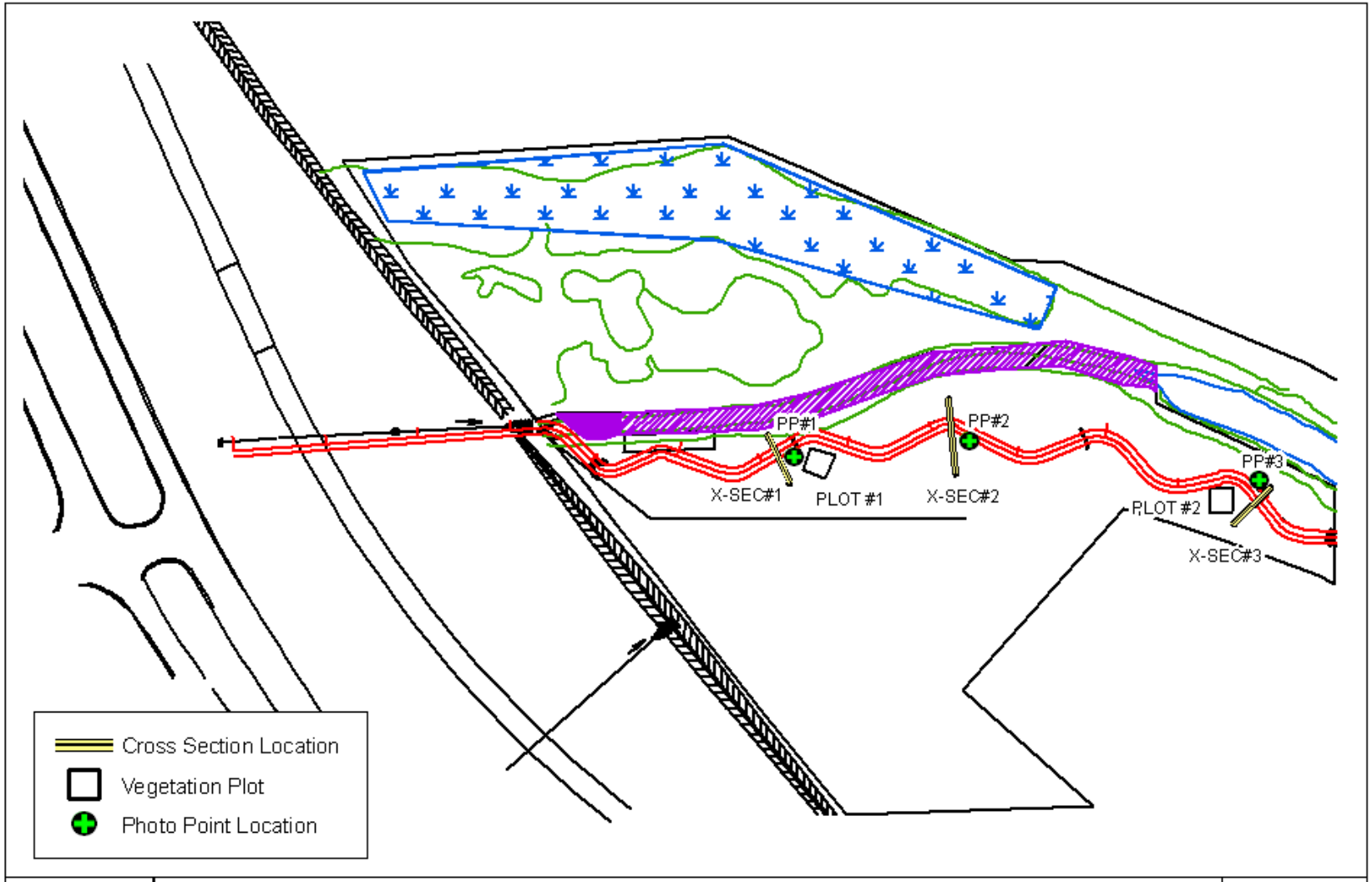
UT to Lumber River

Photo Point #10 (Upstream)

Photo Point #10 (Downstream)

Photo Point #11 (Upstream)
November 2009

Photo Point #11 (Downstream)



CROSS SECTION, VEGETATION PLOT AND PHOTO POINT LOCATIONS
R-0513 UT Lumber River Stream Restoration
Robeson County, North Carolina

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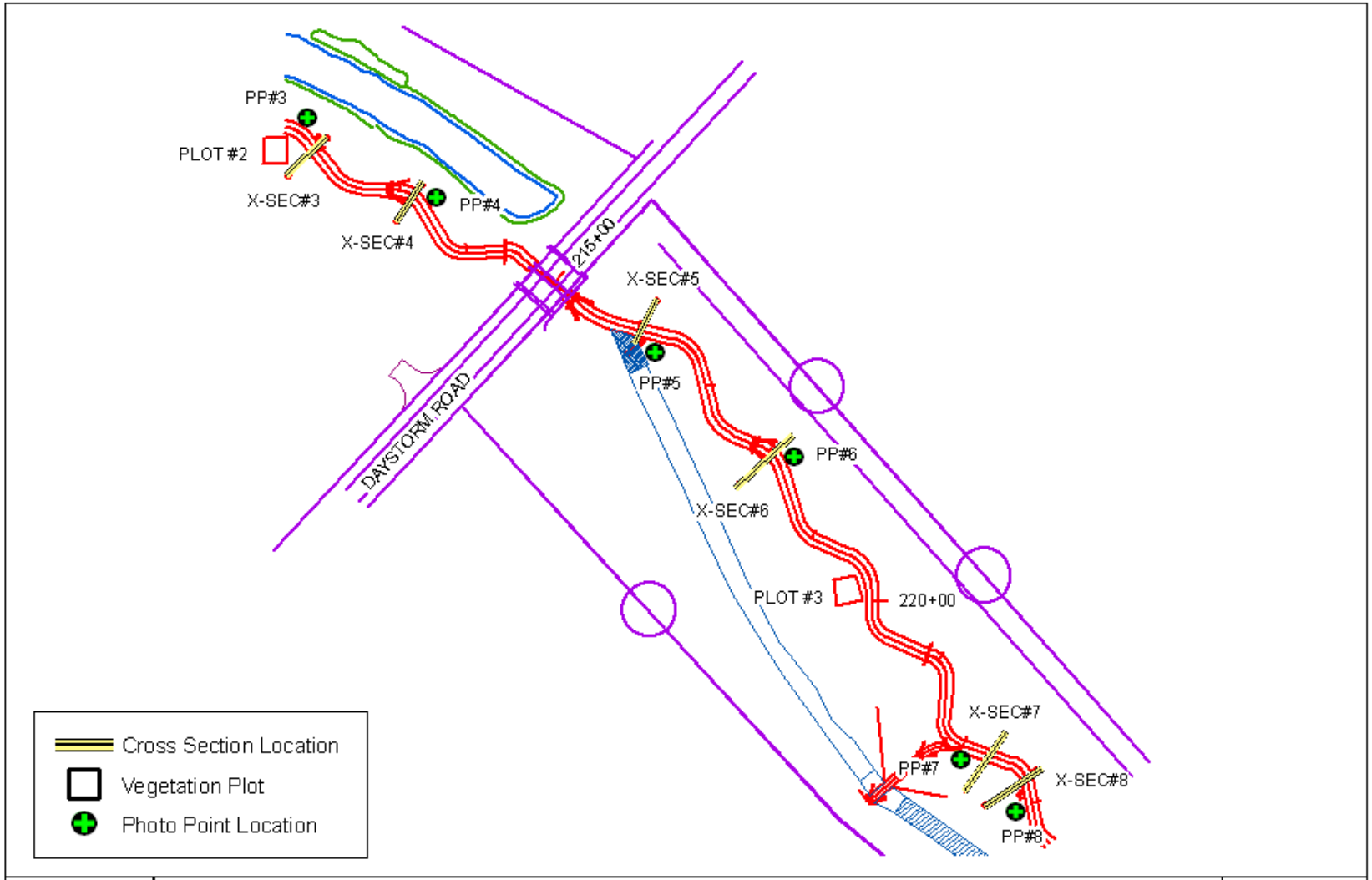

CROSS SECTION, VEGETATION PLOT AND PHOTO POINT LOCATIONS
R-0513 UT Lumber River Stream Restoration
Robeson County, North Carolina

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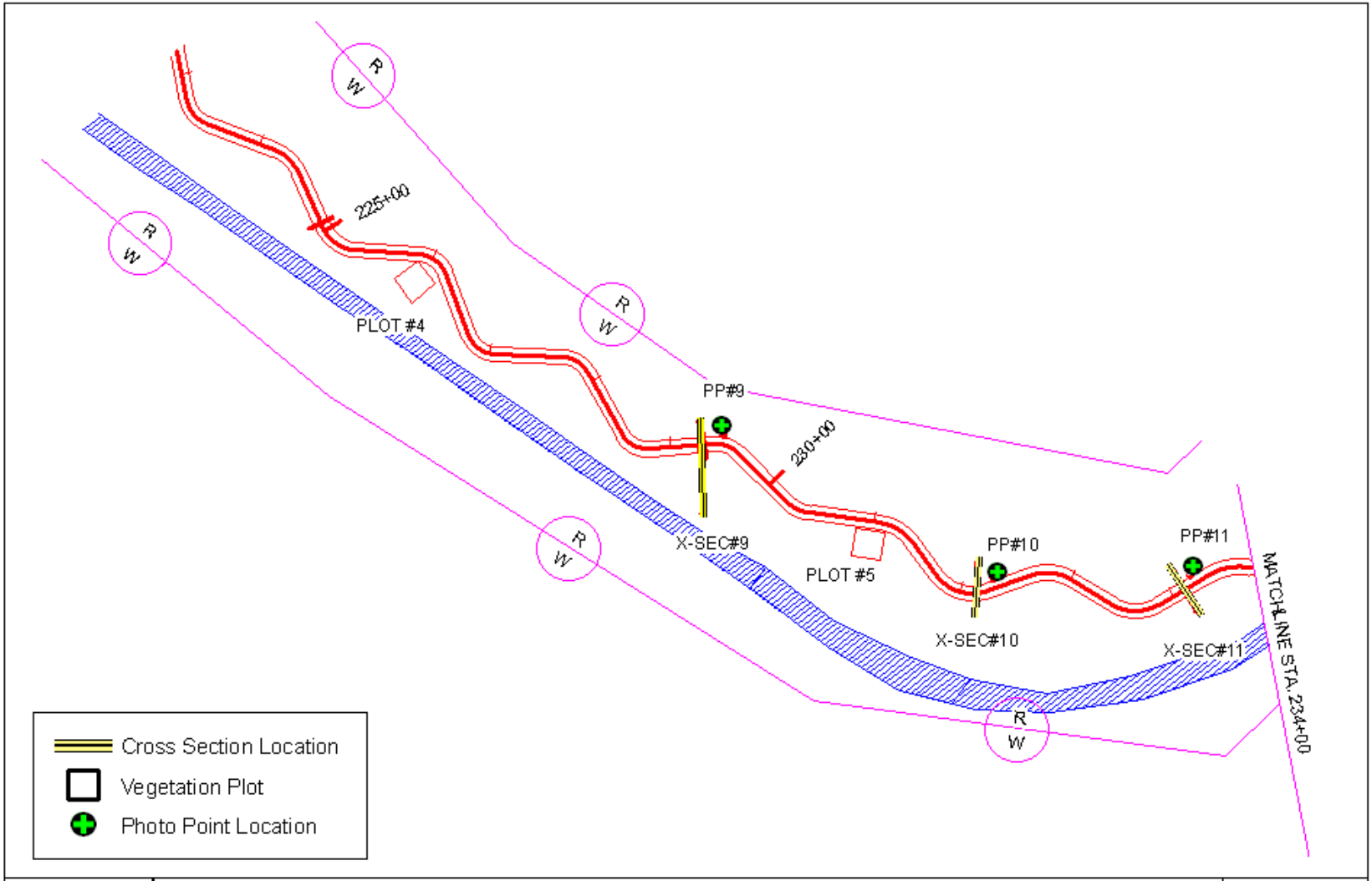

CROSS SECTION, VEGETATION PLOT AND PHOTO POINT LOCATIONS
R-0513 UT Lumber River Stream Restoration
Robeson County, North Carolina

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