

# ***YEAR 2 MONITORING REPORT***

## **UT TO THE LUMBER RIVER SITE**

Robeson County, North Carolina

Contract No. 002027, EEP IMS No. 94068



Submitted to:



### **NCDENR-Ecosystem Enhancement Program**

2728 Capital Boulevard, Suite 1H 103

Raleigh, North Carolina 27604

Construction Completed: April 2010

Morphology Data Collected: June 8-9, 2011

Vegetation Data Collected: October 10 and 13, 2011

Submitted: November 29, 2011

Prepared by:



**Florence & Hutcheson**

CONSULTING ENGINEERS

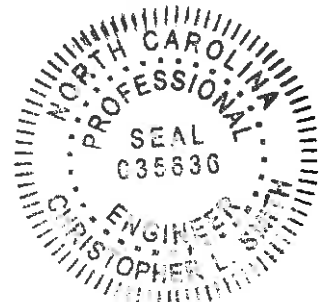
**Florence & Hutcheson, Inc.  
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I HEREBY CERTIFY THAT THE DOCUMENTS CONTAINED HEREIN, UT TO THE LUMBER RIVER YEAR 2 MONITORING REPORT WERE PREPARED BY ME OR UNDER MY DIRECT SUPERVISION.

SIGNED SEALED, AND DATED THIS 5<sup>TH</sup> DAY OF DECEMBER 2011.

Chris L. Smith, PE



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## 1.0 EXECUTIVE SUMMARY

The following report summarizes the vegetation establishment and stream stability for Year 2 monitoring for the UT to the Lumber River Site in Robeson County, North Carolina.

### 1.1 Goals and Objectives

The primary goals of the UT to the Lumber River stream restoration project focus on:

- Improving water quality
- Providing/enhancing flood attenuation
- Restoring/enhancing aquatic and riparian habitat function and connectivity with adjacent pristine habitats
- Assisting the State of North Carolina initiatives along the Lumber River for conservation, including assisting the EEP with meeting its goals of improving water quality and habitat as documented within the Lumber River/Bear Swamp Watershed Management Plan for the Targeted 03040203030010 14-digit Hydrologic Unit.

These goals will be achieved through the following objectives:

- Restore the UT to a stable, more natural sand bed channel.
- Excavate a floodplain and connect flood flows to existing ponds for attenuation.
- Enhance in stream habitat by creating an undulating bedform.
- Establish a vegetated riparian buffer for nutrient and sedimentation reduction.
- Create three stormwater BMPS on three existing ditches to reduce sedimentation and nutrients from contributing waters.
- Connect the Lumber River with a habitat corridor through the existing agricultural fields through a conservation easement, riparian plantings, and stream restoration.
- Preserve much of the Lumber River and its floodplain through a conservation easement to protect habitat and water quality benefits of a mature floodplain and riverine system.

### 1.2 Vegetation

After the second growing season, bare root and live stake plantings are meeting and exceeding success criteria goals. Each of the 14 vegetation plots met the success criteria of at least 320 stems per acre.

Repairs to bare ground and rill erosion areas documented in the Year 1 Monitoring Report were completed in December, 2010. Several areas along the terrace cut slopes (terrace side slopes) still have sparse ground cover. However, the erosion control matting, installed in December 2010, has prevented rill erosion along the majority of side slopes. It is anticipated that permanent grass germination will occur in the next growing season. Additional seeding is not recommended.

Four small clusters of cattail (*Typha latifolia*) were observed in the floodplain and are noted on the Current Condition Plan View (CCPV) map. Sericea lespedeza (*Lespedeza cuneata*) was also

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observed adjacent to Vegetation Plot 4 and is depicted on the CCPV. No corrective action is recommended at this time. Invasive/exotic vegetation is not currently compromising the vegetative success of the site.

### **1.3 Stream Stability**

The UT to the Lumber River appears to be stable and functioning as designed. There is no evidence of trends toward significant change in channel dimension, profile or pattern. Cross-sectional data indicates that the channel has experienced little change in dimension. The profile plots depict some shifting of pools throughout the reach. This is expected in sand bed channels, where the bed form is in constant flux and pools adjust their depths during most storm events. Sediment deposition in pools is common in sand systems and we fully expect these pools to scour and fill throughout the entire monitoring timeframe. The channel is expected to flush excess sediment out in future high flow events. Table 5, Visual Stream Morphology Stability Assessment, details 58 pools that are “stable, performing as intended”. The as-built profile depicted 63 pools. This would give a 92 percent rate of “stable, performing as intended” for Year 2 Monitoring, up from 76 percent for Year 1 Monitoring. It is our opinion that the channel is performing as it should. However, it is anticipated that pools will experience scour (deeper) after some storm events and will experience aggradation (shallower) after other storm events, which is a common and natural process in sand systems.

An overall visual assessment of the channel appears to confirm morphological data, in that there are no substantial areas of concern within the bankfull channel. A small beaver dam was observed near station 10+43, approximately 20 feet downstream of Cross-section 1. The beaver dam has not had a significant impact on the stability of the stream, but it will be removed prior to Year 3 Monitoring surveys. After the repair of a floodplain interceptor near station 16+65, some of the smaller rip-rap used during the repair washed into the channel and raised the bed elevation. The rap-rap has not resulted in stream degradation and it will be removed from the channel prior to Year 3 Monitoring surveys. The beaver dam and rip-rap are identified on Figure 5.1.

The site has experienced several bankfull flows throughout the first monitoring year. Crest gauges installed on-site were inspected on 9 June 2011 and 13 October 2011. The crest gauges revealed that a bankfull event occurred at least twice during 2011 (Table 13). Additional overbank evidence includes debris lines, and vegetation bent in the downstream direction. Evidence of bankfull events can be found in Appendix E.

### **1.4 Wetlands**

No wetland monitoring areas were established for this project report.

### **1.5 Note**

Summary information/data related to the occurrence of items such 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. Narrative background and supporting information

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formerly found in these reports can be found in the Baseline Monitoring Report (formerly Mitigation Plan) and in the Mitigation Plan (formerly the Restoration Plan) documents available on EEP's website. All raw data supporting the tables and figures in the appendices is available from EEP upon request.

## 2.0 METHODOLOGY

The Year 2 Monitoring survey was completed using a Total Station. Each cross section is marked with two rebar monuments at their beginning and ending points. The rebar has been located vertically and horizontally in NAD 83-State Plane. Surveying these monuments throughout the Site ensured proper orientation. The survey data was imported into MicroStation for verification. The longitudinal stationing was developed from total station data and compared with previous year's data to ensure consistent beginning and ending points. RIVERMorph was used to analyze the profile and cross section data. Tables and figures were created using Microsoft Excel.

The channel is entirely a sand bed system; therefore a pebble count was not conducted. It should be noted however, that the restored channel is dominated by sand, not detritus as was the case in pre-restoration conditions.

Vegetation monitoring was completed using CVS level II methods, for 14, 100 square meter vegetation plots (Lee et al. 2006). The taxonomic standard for vegetation used for this document was Flora of the Southern and Mid-Atlantic States (Weakley 2011).

## 3.0 REFERENCES

Lee, Michael T., R. K. Peet, S. D. Roberts, and T. R. Wentworth. 2006. CVS-EEP Protocol for Recording Vegetation, Version 4.0 (<http://cvs.bio.unc.edu/methods.htm>).

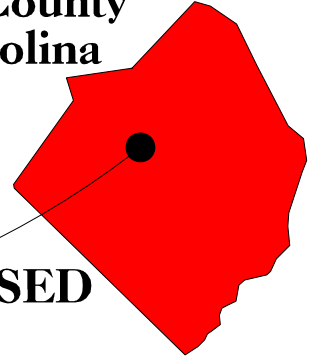
Weakley, Alan S. 2011. Flora of the Southern and Mid-Atlantic States (online). Available: [http://www.herbarium.unc.edu/FloraArchives/WeakleyFlora\\_2011-May-nav.pdf](http://www.herbarium.unc.edu/FloraArchives/WeakleyFlora_2011-May-nav.pdf) [May 15, 2011]. University of North Carolina Herbarium, North Carolina Botanical Garden, University of North Carolina, Chapel Hill, North Carolina.

APPENDICES

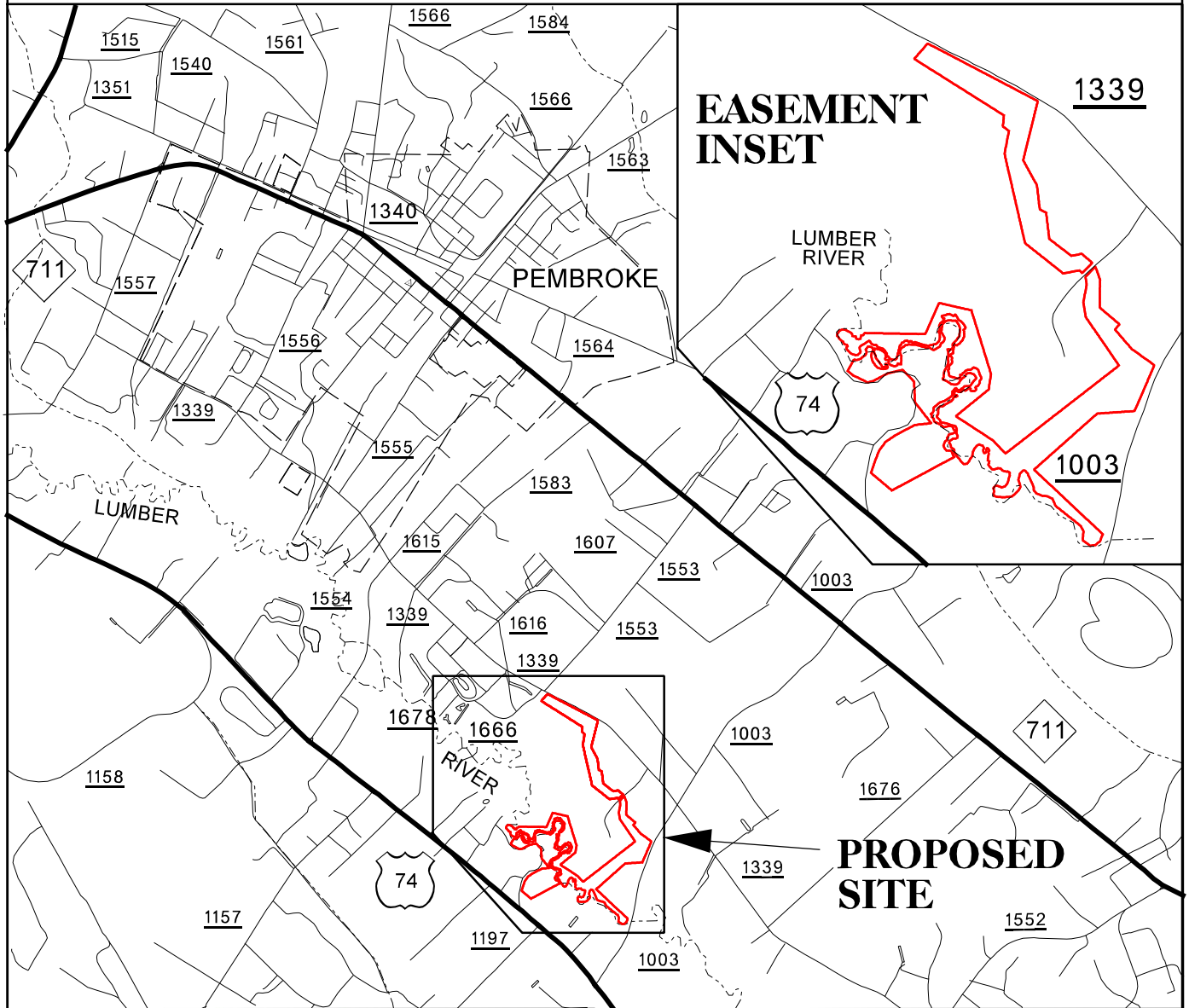
**Appendix A. Project Vicinity Map and Background Tables**

THE SUBJECT PROJECT SITE IS AN ENVIRONMENTAL RESTORATION SITE OF THE NCDENR ECOSYSTEM ENHANCEMENT PROGRAM (EEP) AND IS ENCOMPASSED BY A RECORDED CONSERVATION EASEMENT, BUT IS BORDERED BY LAND UNDER PRIVATE OWNERSHIP. ACCESSING THE SITE MAY REQUIRE TRAVERSING AREAS NEAR OR ALONG THE EASEMENT BOUNDARY AND THEREFORE ACCESS BY THE GENERAL PUBLIC IS NOT PERMITTED. ACCESS BY AUTHORIZED PERSONNEL OF STATE AND FEDERAL AGENCIES OR THEIR DESIGNEES /CONTRACTORS INVOLVED IN THE DEVELOPMENT, OVERSIGHT AND STEWARDSHIP OF THE RESTORATION SITE IS PERMITTED WITHIN THE TERMS AND TIMEFRAMES OF THEIR DEFINED ROLES. ANY INTENDED SITE VISITATION OR ACTIVITY BY ANY PERSON OUTSIDE OF THESE PREVIOUSLY SANCTIONED ROLES AND ACTIVITIES REQUIRES PRIOR COORDINATION WITH EEP.

## Robeson County North Carolina

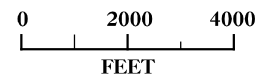


**PROPOSED  
SITE**



## Vicinity Map

UT to the Lumber River  
Stream Restoration Plan  
Robeson County, North Carolina



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Date: 08/26/10

Figure: 1



## Project Location and Directions

The UT to the Lumber River Stream Restoration Site (Site) is located approximately two (2) miles southeast of Pembroke in Robeson County, North Carolina (Figure 1). The properties included in this Site span east of State Road (SR) 1003 (Chicken Road) and south from SR 1339 (Deep Branch Road) to US 74 Highway along the Lumber River.

### Directions to the Site:

- From Interstate 40 take exit 328A (towards Fayetteville/Benson) onto Interstate 95 South
- From Interstate 95 take exit 17 (towards Pembroke) onto US-711/72. Remain on US 711 at US 711 and US 72 Split.
- Go approximately 7.4 miles west towards Pembroke after exiting I-95.
- Turn left onto SR 1003 (Chicken Road). Go for approximately 1.1 miles to the intersection of Chicken Road and SR 1339 (Deep Branch Road).
- Turn right onto Deep Branch Road. Go for approximately 0.2 miles and turn left onto dirt road that takes you through the Site to the UT.

*The subject project is an environmental restoration site of the NCDENR Ecosystem Enhancement Program (EEP) and is encompassed by a recorded conservation easement, but is bordered by land under private ownership. Accessing the site may require traversing areas near or along the easement boundary and therefore access by the general public is not permitted. Access by authorized personnel of state and federal agencies or their designees/contractors involved in the development, oversight and stewardship of the restoration site is permitted within the terms and timeframes of their defined roles. Any intended site visitation or activity by any person outside of these previously sanctioned roles and activities requires prior coordination with EEP.*

**Table 1. Project Components and Mitigation Credits**

Restoration Segment/ Reach ID	Existing LF/AC	Restoration Level	Approach	Restored LF/AC	Station Range	Buffer Acres	Comment
UT Lumber River	5,958	R	PII	4,285	10+00 – 53+57	17.2	Restore pattern, dimension, profile, and riparian buffer.
		E II	Plantings	463	10+00 – 14+63	1.9	Plant a native vegetated riparian buffer through agricultural fields.
		P	Easement	2,177	10+00 – 31+77	12.2	Place a permanent conservation easement over lands in preservation areas.
Lumber River	4,123	P	Easement	4,123	10+00 – 50+87	35.9	Place a permanent conservation easement over lands in preservation areas.
<b>Component Summations</b>							
Restoration Level	Stream (LF)			Buffer (AC)			
Restoration	4,285			17.2			
Enhancement I							
Enhancement II	463			1.9			
Preservation	6,300			48.75			
<b>Totals</b>	<b>11,022</b>			<b>67.85</b>			

<b>Mitigation Unit Summary</b>			
Stream	Restoration (SMU)	Enhancement (SMU)	Preservation (SMU)
UT	4,285.0	185.2	435.4
Lumber River			824.6
<b>Total (SMU)</b>	<b>5730.2</b>		

*The as-built stationing is 22 feet longer than the proposed channel design stationing (53+35 for design and 53+57 for as-built). The contractor stabilized an additional 22 feet of channel past the designed end point during construction to complete the tie in from the design channel to the existing channel. This area was shown in the as-built, but is not considered a major modification in the channel design. Future monitoring may end at station 53+35.*

**Table 2. Project Activity and Reporting History**

<b>Activity or Report</b>	<b>Data Collection Complete</b>	<b>Completion or Delivery</b>
Restoration Plan	September 2009	October 2009
Final Design – Construction Plans	October 2009	November 2009
Construction	January 18, 2010	April 9, 2010
Temporary S&E Mix Applied to Entire Project Area	January 18, 2010	April 9, 2010
Permanent Seed Mix Applied to Entire Project Area	January 18, 2010	April 9, 2010
Containerized and B&B plantings for Entire Project Area	April, 4 2010	April 7, 2010
Mitigation Plan/As-built (Year 0 Monitoring-Baseline)	April 13, 2010	April 22, 2010
Year 1 Monitoring	October 14, 2010	December 3, 2010
Year 2 Monitoring	October 13, 2011	November, 2011
Year 3 Monitoring		
Year 4 Monitoring		
Year 5 Monitoring		

**Table 3. Project Contacts Table**

<b>Designer</b>  Primary project design POC	Florence & Hutcheson, Inc. 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Kevin Williams (919) 851-6066
<b>Construction Contractor</b>  Construction Contractor POC	Land Mechanics Design Lloyd Glover 126 Circle G Lane Willow Springs, NC 27592 (919) 639-6132
<b>Planting Contractor</b>  Planting Contractor POC	Bruton Natural Systems Charlie Bruton PO Box 1197 Fremont, NC 27830 (919) 242-6555
<b>Seeding Contractor</b>  Seeding Contractor POC	Land Mechanics Design Lloyd Glover 126 Circle G Lane Willow Springs, NC 27592 (919) 639-6132
Seed Mix Sources	Green Resources – Triad Office
Nursery Stock Suppliers	ArborGen - South Carolina SuperTree Nursery Bruton Natural Systems
<b>Monitoring Performers</b>	Florence & Hutcheson, Inc. 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Ryan Smith (919) 851-6066
Stream Monitoring POC	Florence & Hutcheson, Inc. 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Ryan Smith (919) 851-6066
Vegetation Monitoring POC	Florence & Hutcheson, Inc. 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Ryan Smith (919) 851-6066

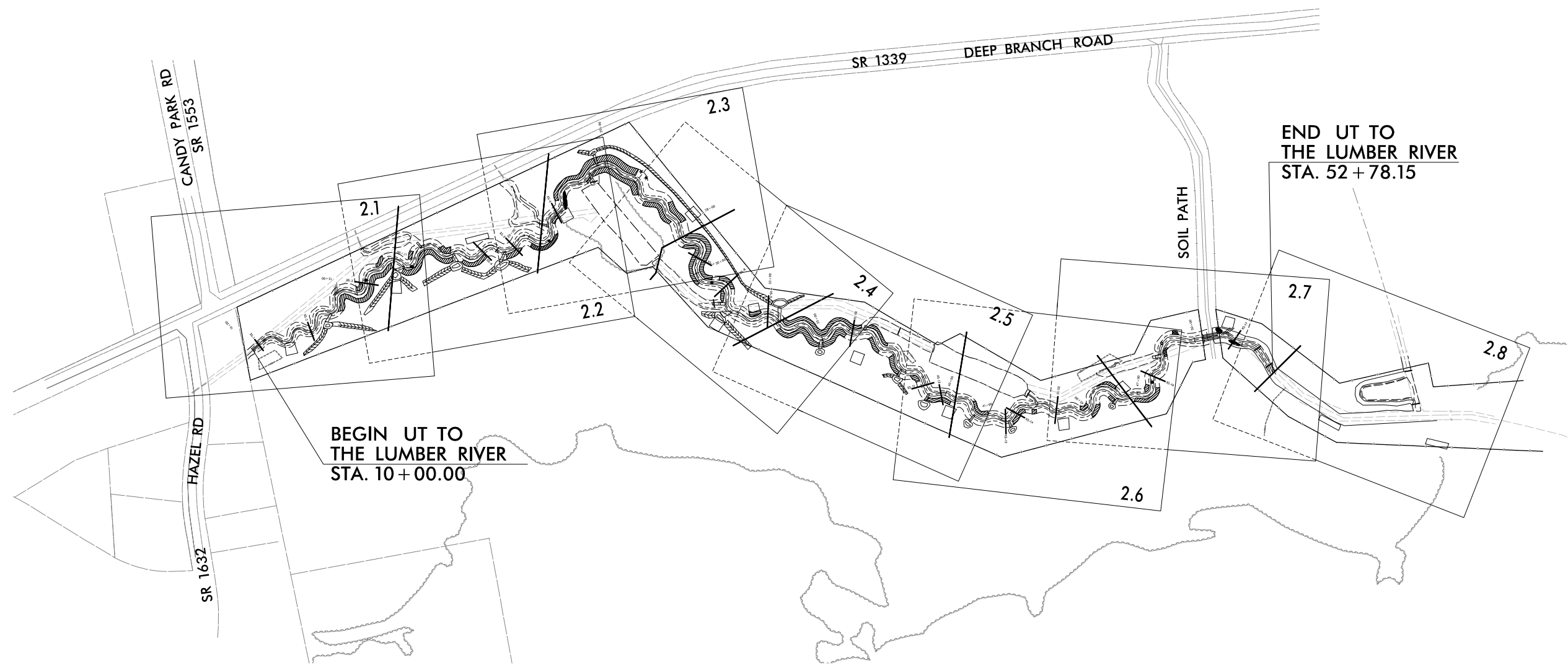
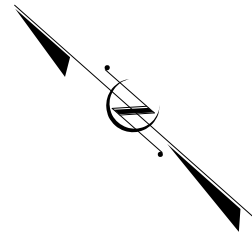
**Table 4. Project Attributes Table**

Project County	Robeson County, North Carolina	
Physiographic Region	Southeastern Plains	
Ecoregion	Southeastern Floodplains and Low Terraces	
Project River Basin	Lumber	
USGS HUC for Project (14 digit)	03040203030010	
NCDWQ Sub-basin for Project	03-07-51	
Within extent of EEP Watershed Plan?	Yes – Lumber River/Bear Swamp Watershed Management Plan 2006	
WRC Class (Warm, Cool, Cold)	Warm	
% of project easement fenced or demarcated	100% demarcated with signs/posts)	
Beaver activity observed during design phase?	Yes	
<b>Restoration Component Attributes</b>		
	<b>UT Lumber River</b>	<b>Lumber River</b>
Drainage Area	0.42 sq mi (At End of Restoration Reach)	432 sq mi
Stream Order (USGS topo)	1 <sup>st</sup>	Multiple Order
Restored Length (feet)	4,285	0.0
Perennial (P) or Intermittent (I)	P	P
Watershed Type	Primarily rural w/ some urban	Primarily Rural
Watershed impervious cover	~5%	~1%
NCDWQ AU/Index number	14-(7)	14-(7)
NCDWQ Classification	WS-IV, B, Sw, HQW	WS-IV, B, Sw, HQW
303d listed?	No	No
Upstream of a 303d listed	No	No
Reasons for 303d listed segment	N/A	N/A
Total acreage of easement	67.85 ac	
Total vegetated acreage of easement	52.5 ac	
Total planted restoration acreage	15.0 ac	
Rosgen Classification of preexisting	G5/F5	E5
Rosgen Classification of As-built	E5	N/A
Valley type	VIII	X
Valley slope	0.23%	0.07%
Cowardin classification	Coastal Plain Small Stream Swamp	Coastal Plain Small Stream Swamp
Trout waters designation	N/A	N/A
Species of concern, endangered etc.	In County: RCW, Michaux's Sumac	In County: RCW, Michaux's Sumac
Dominant Soil Series	Bibb/Rains	Bibb

## Appendix B. Visual Assessment Data

**Figures 2.0-2.8. Current Condition Plan View**

**CURRENT CONDITION PLAN VIEW (CCPV)  
OVERVIEW MAP**



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**UT TO THE LUMBER RIVER  
 STREAM RESTORATION PROJECT**  
 ROBESON COUNTY, NORTH CAROLINA

NOT TO SCALE

DATE: 10-25-11

CCPV  
OVERVIEW  
MAP

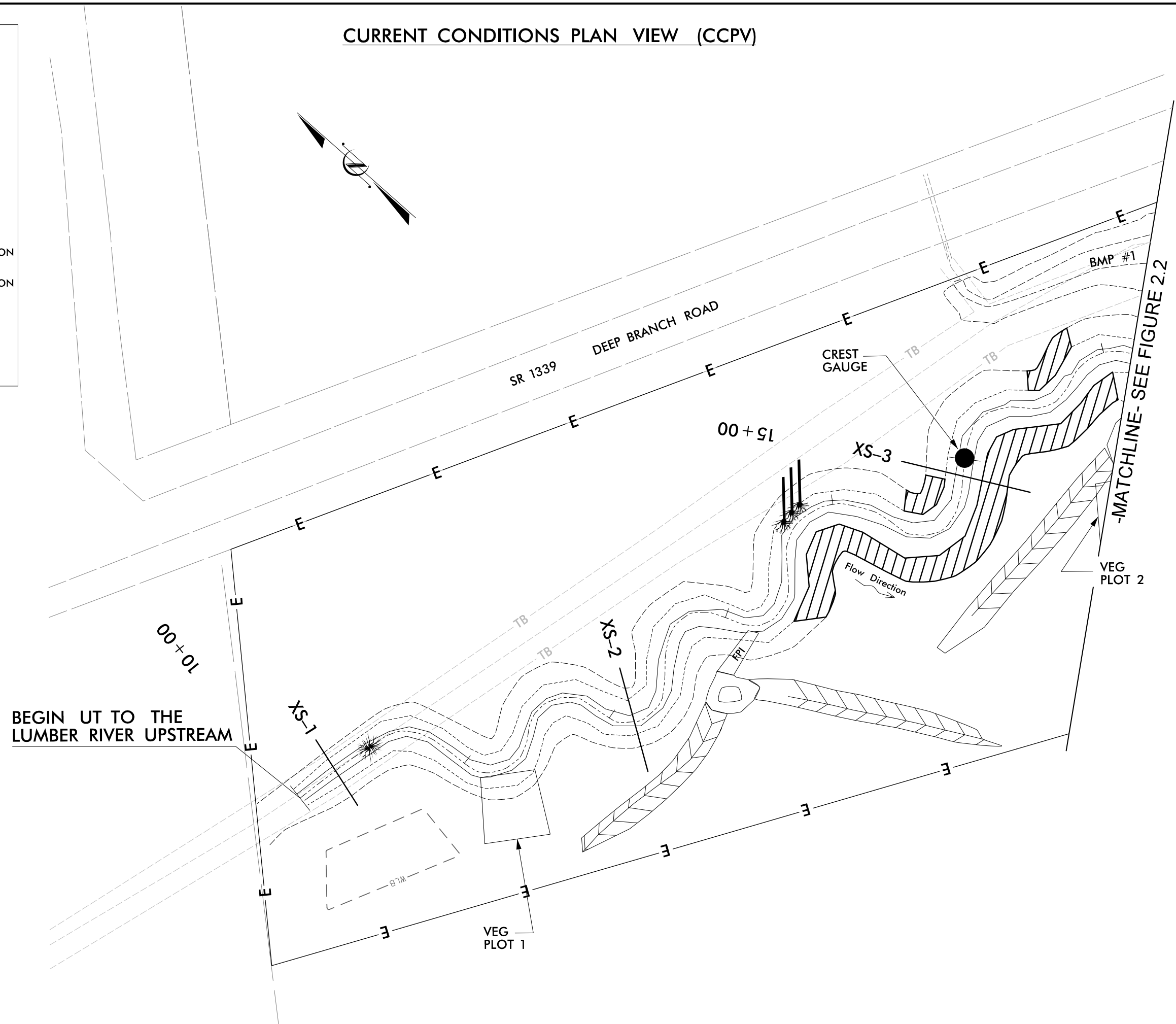
Figure  
2.0



**LEGEND**

- TOP OF TERRACE
- THALWEG
- BANKFULL
- TOE OF TERRACE
- CROSS-SECTION LOCATION
- E— EASEMENT BOUNDARY
- ✱ ROOTWAD
- TB --- PRE-CONSTRUCTION TOP OF BANK
- PRE-CONSTRUCTION THALWEG
- ▨ THIN GRASS
- ✱ BEAVER DAM

**CURRENT CONDITIONS PLAN VIEW (CCPV)**

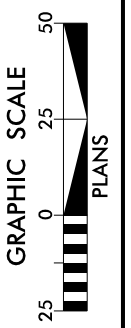


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UT TO THE LUMBER RIVER  
 STREAM RESTORATION PROJECT  
 ROBESON COUNTY, NORTH CAROLINA

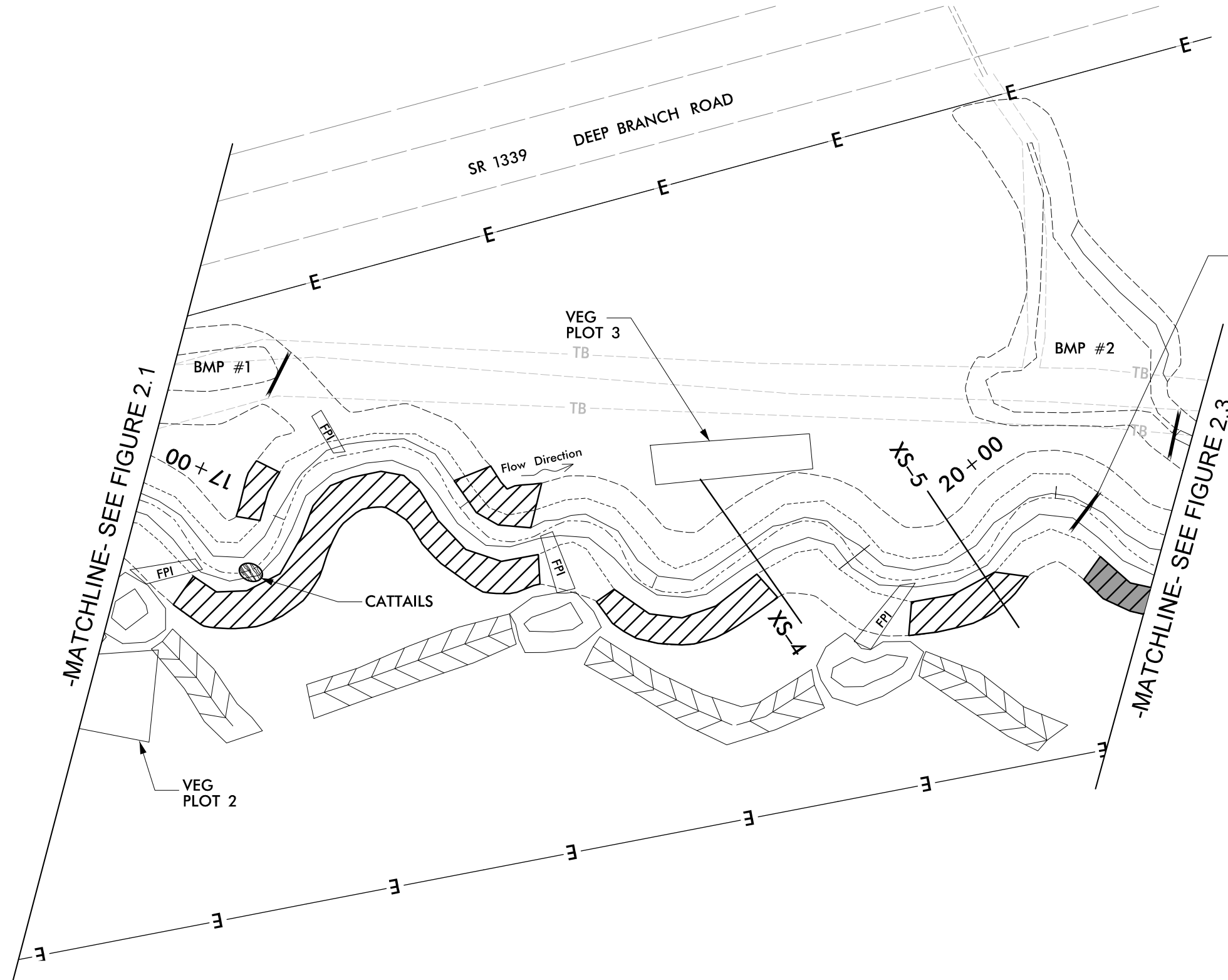
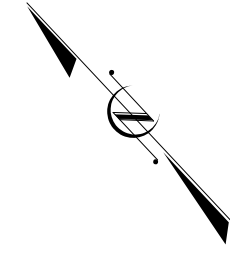


DATE: 10-25-11

CCPV

Figure 2.1

CURRENT CONDITIONS PLAN VIEW (CCPV)



END UT TO THE LUMBER RIVER UPSTREAM

BEGIN UT TO THE LUMBER RIVER DOWNSTREAM

-MATCHLINE- SEE FIGURE 2.1

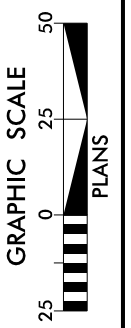
-MATCHLINE- SEE FIGURE 2.3

LEGEND	
	TOP OF TERRACE
	THALWEG
	BANKFULL
	TOE OF TERRACE
	CROSS-SECTION LOCATION
	EASEMENT BOUNDARY
	LOG SILL
	PRE-CONSTRUCTION TOP OF BANK
	PRE-CONSTRUCTION THALWEG
	THIN GRASS
	INVASIVE VEGETATION
	MINOR WASH



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UT TO THE LUMBER RIVER  
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 ROBESON COUNTY, NORTH CAROLINA



DATE: 10-25-11

CCPV

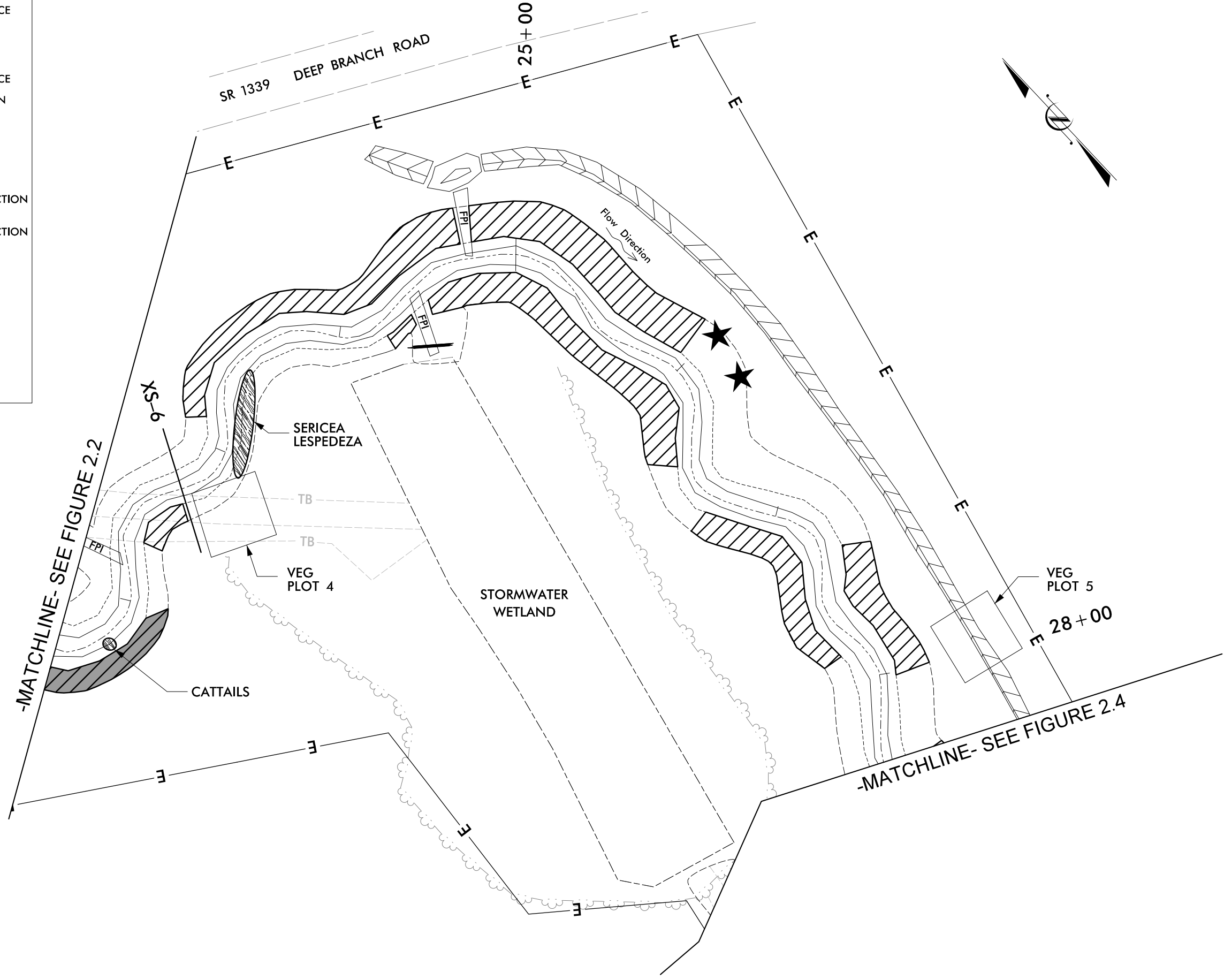
Figure 2.2

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 Florence & Hutcheson, Inc.

**LEGEND**

- TOP OF TERRACE
- THALWEG
- BANKFULL
- TOE OF TERRACE
- CROSS-SECTION LOCATION
- E — EASEMENT BOUNDARY
- LOG SILL
- TB --- PRE-CONSTRUCTION TOP OF BANK
- PRE-CONSTRUCTION THALWEG
- THIN GRASS
- INVASIVE VEGETATION
- MINOR WASH
- ★ GULLEY

**CURRENT CONDITIONS PLAN VIEW (CCPV)**

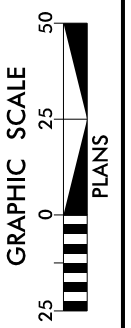


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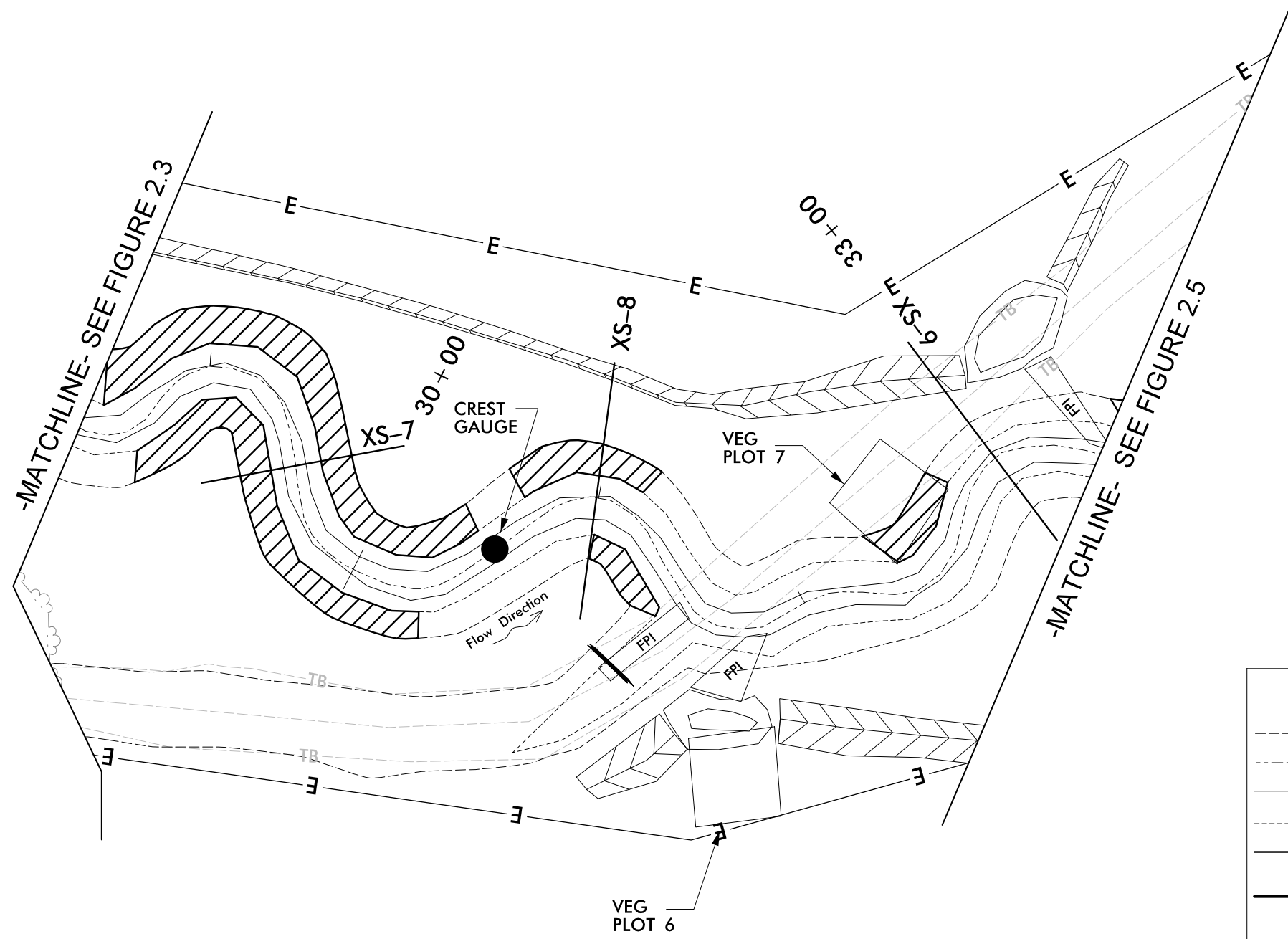


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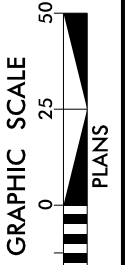
CCPV

Figure 2.3

# CURRENT CONDITIONS PLAN VIEW (CCPV)



LEGEND	
	TOP OF TERRACE
	THALWEG
	BANKFULL
	TOE OF TERRACE
	CROSS-SECTION LOCATION
	EASEMENT BOUNDARY
	LOG SILL
	PRE-CONSTRUCTION TOP OF BANK
	PRE-CONSTRUCTION THALWEG
	THIN GRASS



DATE: 10-25-11

CCPV

Figure 2.4

UT TO THE LUMBER RIVER  
STREAM RESTORATION PROJECT  
ROBESON COUNTY, NORTH CAROLINA

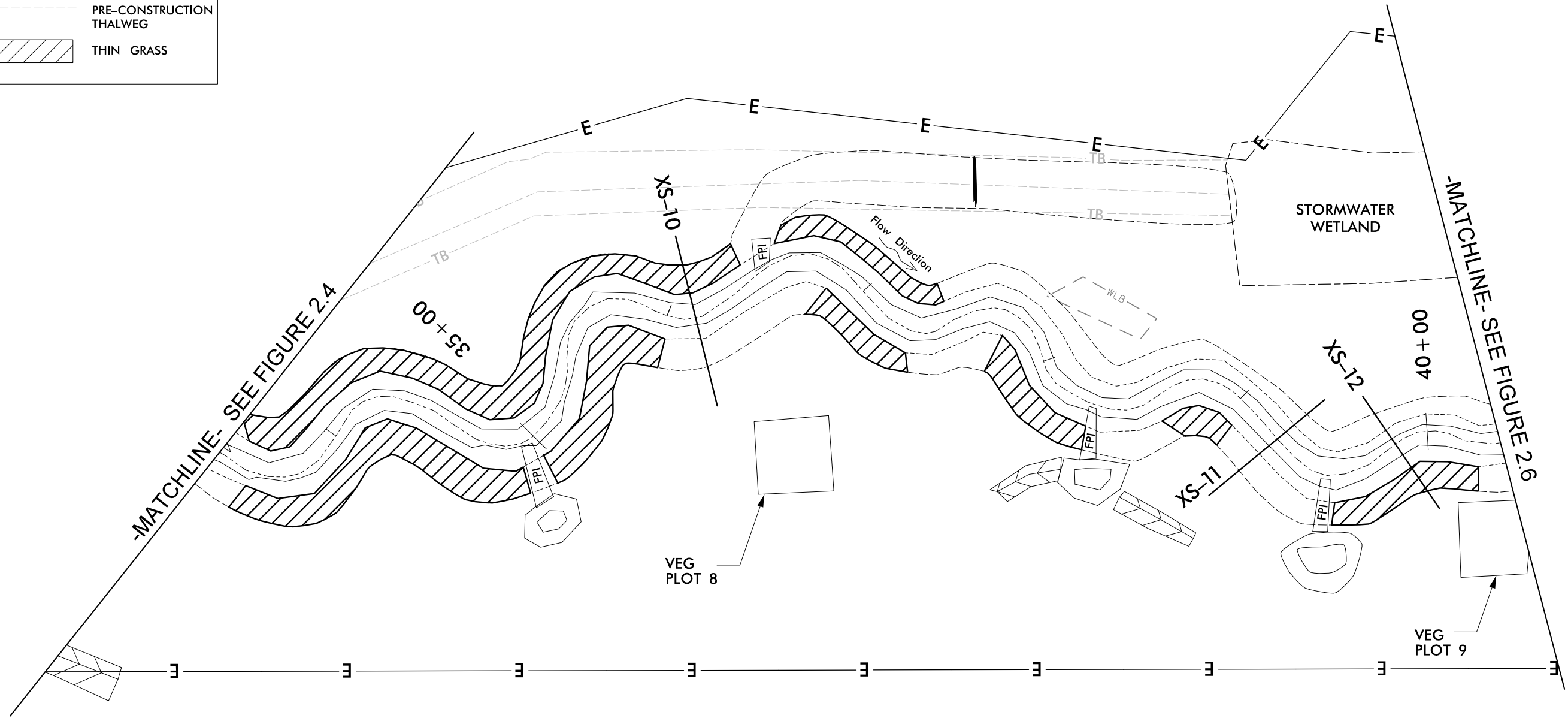
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**LEGEND**

- TOP OF TERRACE
- THALWEG
- BANKFULL
- TOE OF TERRACE
- CROSS-SECTION LOCATION
- E — EASEMENT BOUNDARY
- TB --- PRE-CONSTRUCTION TOP OF BANK
- PRE-CONSTRUCTION THALWEG
- ▨ THIN GRASS

**CURRENT CONDITIONS PLAN VIEW (CCPV)**

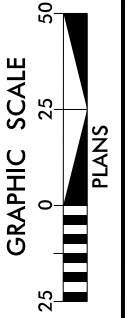


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UT TO THE LUMBER RIVER  
 STREAM RESTORATION PROJECT  
 ROBESON COUNTY, NORTH CAROLINA



DATE: 10-25-11

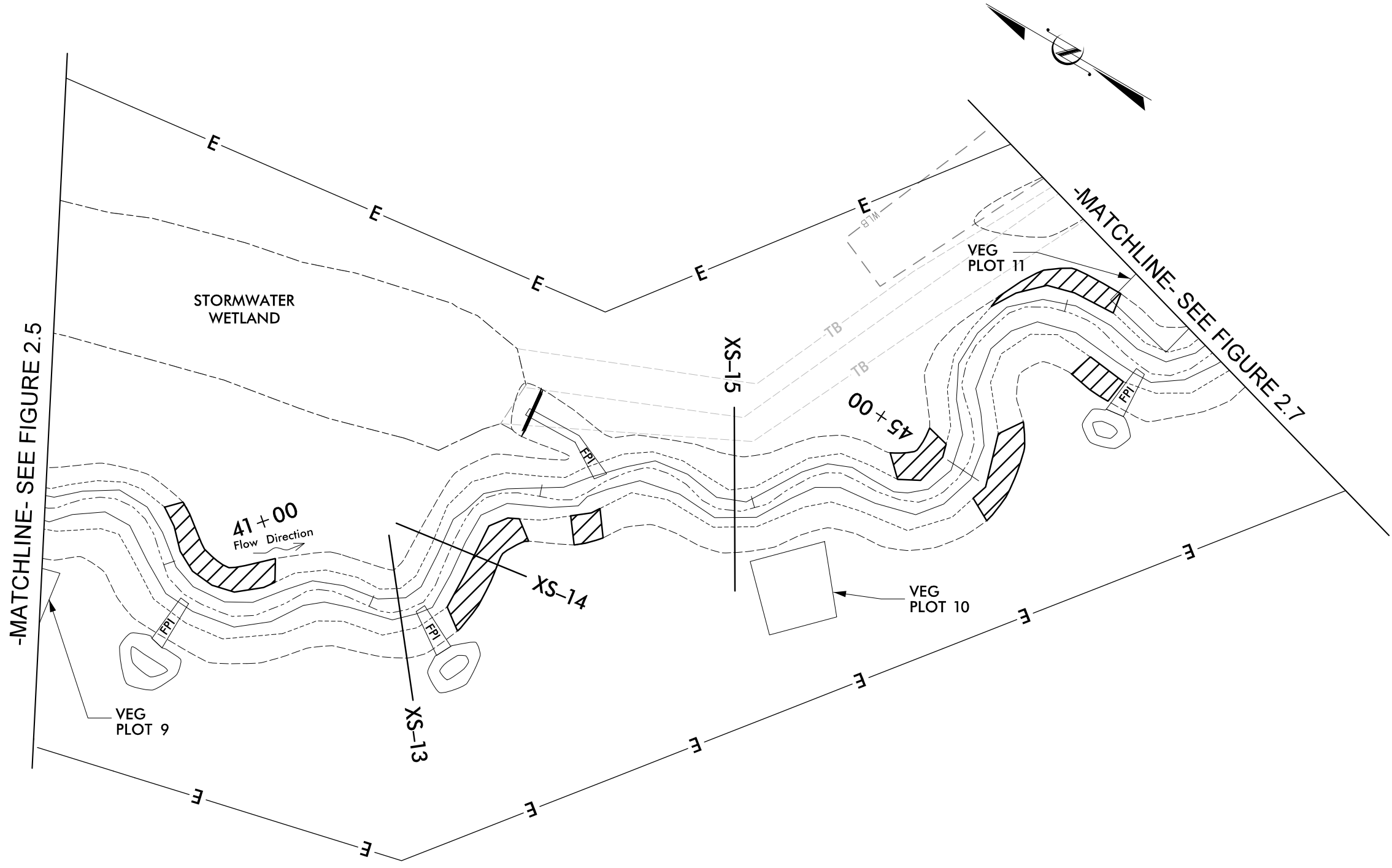
CCPV

Figure 2.5

**LEGEND**

- TOP OF TERRACE
- THALWEG
- BANKFULL
- TOE OF TERRACE
- CROSS-SECTION LOCATION
- E— EASEMENT BOUNDARY
- ▬ LOG SILL
- TB--- PRE-CONSTRUCTION TOP OF BANK
- TB--- PRE-CONSTRUCTION THALWEG
- ▨ THIN GRASS

**CURRENT CONDITIONS PLAN VIEW (CCPV)**

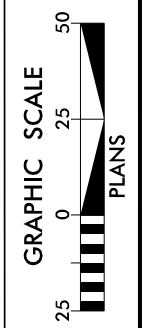


I:\1\2011  
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 Florence & Hutcheson, Inc.



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 STREAM RESTORATION PROJECT  
 ROBESON COUNTY, NORTH CAROLINA



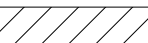





DATE: 10-25-11

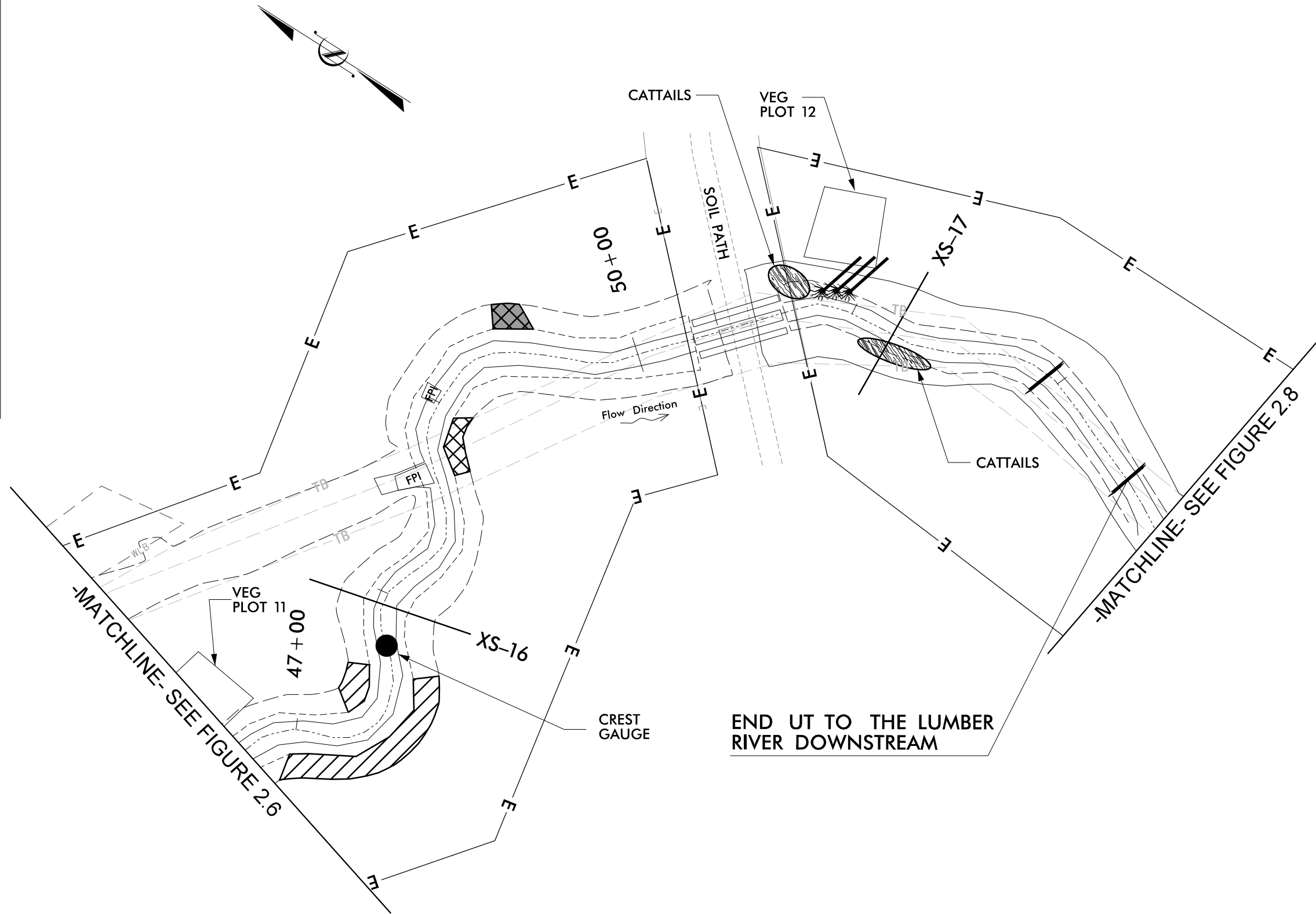
CCPV

Figure 2.6

# LEGEND

- TOP OF TERRACE
- THALWEG
- BANKFULL
- TOE OF TERRACE
- CROSS-SECTION LOCATION
- E** EASEMENT BOUNDARY
-  ROOTWAD
-  LOG SILL
- TB --- PRE-CONSTRUCTION TOP OF BANK
- PRE-CONSTRUCTION THALWEG
-  THIN GRASS
-  NO GRASS
-  INVASIVE VEGETATION
-  MEDIUM WASH

# CURRENT CONDITIONS PLAN VIEW (CCPV)

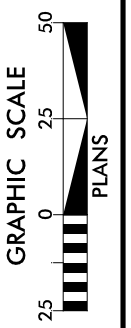


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UT TO THE LUMBER RIVER  
 STREAM RESTORATION PROJECT  
 ROBESON COUNTY, NORTH CAROLINA



DATE: 10-25-11

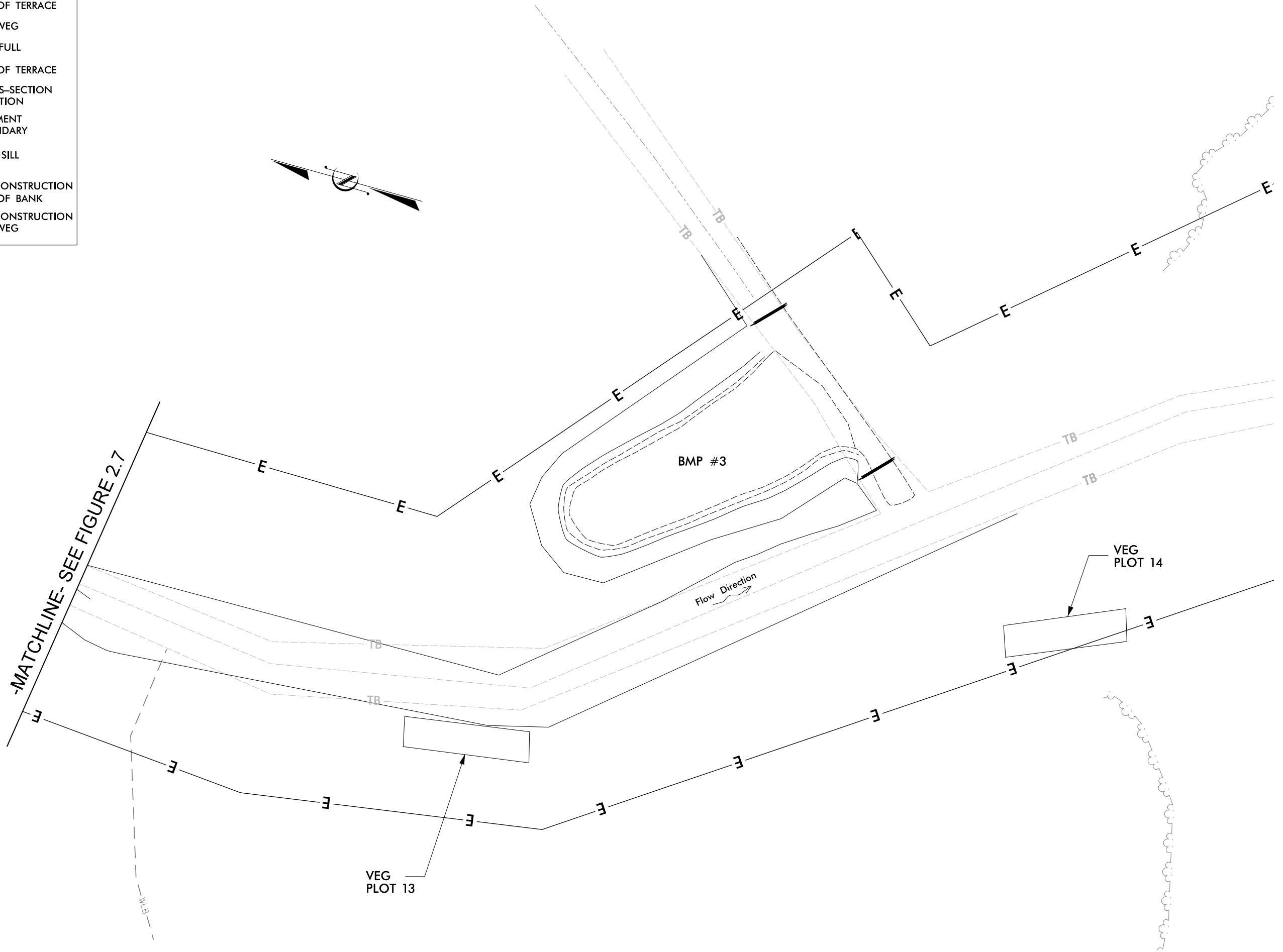
CCPV

Figure 2.7

**LEGEND**

- TOP OF TERRACE
- THALWEG
- BANKFULL
- TOE OF TERRACE
- CROSS-SECTION LOCATION
- E— EASEMENT BOUNDARY
- ▬ LOG SILL
- TB--- PRE-CONSTRUCTION TOP OF BANK
- PRE-CONSTRUCTION THALWEG

**CURRENT CONDITIONS PLAN VIEW (CCPV)**

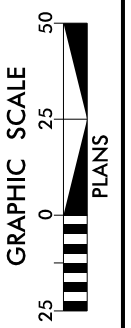


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UT TO THE LUMBER RIVER  
 STREAM RESTORATION PROJECT  
 ROBESON COUNTY, NORTH CAROLINA



DATE: 10-25-11

CCPV

Figure 2.8



**Table 5. Visual Stream Morphology Stability Assessment  
UT to the Lumber River Site, 002027  
UT to the Lumber River: 4,285 feet**

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Rifle and Run units)	1. <u>Aggradation</u> - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%			
		2. <u>Degradation</u> - Evidence of downcutting			0	0	100%			
	2. Rifle Condition	1. <u>Texture/Substrate</u> - Rifle maintains coarser substrate	All	N/A			100%			
	3. Meander Pool Condition	1. <u>Depth</u> Sufficient	58	63			92%			
		2. <u>Length</u> appropriate	58	63			92%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	All	N/A			100%			
2. Thalweg centering at downstream of meander (Glide)		All	N/A			100%				
2. Bank	1. Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	N/A	N/A	N/A
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does <u>NOT</u> include undercuts that are modest, appear sustainable and are providing habitat.			0	0	100%	N/A	N/A	N/A
	3. Mass Wasting	Bank slumping, calving, or collaps			0	0	100%	N/A	N/A	N/A
<b>Totals</b>					0	0	100%	N/A	N/A	N/A
3. Engineered Structures	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs	4	4			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	3	3			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	3	3			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does <u>not</u> exceed 15%. (See guidance for this table in EEP monitoring guidance document)	4	4			100%			
	4. Habitat	Pool forming structures maintaing ~ Max Pool Depth : Mean Bankfull Depth ratio > 1.6 Rootwads/logs providing some cover at base-flow.	4	4			100%			

**Table 6. Vegetation Condition Assessment**  
**UT to the Lumber River Site, 002027**  
**UT to the Lumber River: 4,285 feet**

**Planted Acreage = 15.0**

<b>Vegetation Category</b>	<b>Definitions</b>	<b>Mapping Threshold</b>	<b>CCPV Depiction</b>	<b>Number of Polygons</b>	<b>Combined Acreage</b>	<b>% of Planted Acreage</b>
<b>1. Bare Areas</b>	Very limited ground cover (grass).	All bare or sparse areas were mapped.	See legend on CCPV.	40	0.9	6
<b>2. Low Stem Density Areas</b>	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	None	N/A	N/A	N/A	N/A
<b>3. Areas of Poor Growth Rates or Vigor</b>	Areas with woody stems of a size class that are obviously small given the monitoring year.	None	N/A	N/A	N/A	N/A

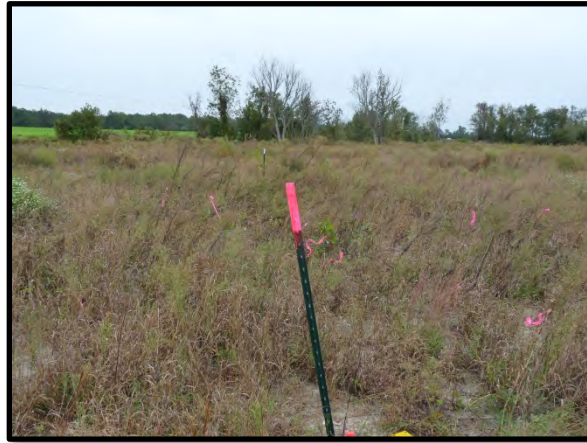
**Easement Acreage = 67.85**

<b>Vegetation Category</b>	<b>Definitions</b>	<b>Mapping Threshold</b>	<b>CCPV Depiction</b>	<b>Number of Polygons</b>	<b>Combined Acreage</b>	<b>% of Planted Acreage</b>
<b>4. Invasive Areas of Concern</b>	Areas or points (if too small to render as polygons at map scale).	All populations were mapped	See legend on CCPV	5	0.02	0.03
<b>5. Easement Encroachment Areas</b>	Areas or points (if too small to render as polygons at map scale).	None	N/A	N/A	N/A	N/A

**Figures 3.1-3.20. Vegetation Plot Photos and Problem Areas**



**3.1 Vegetation Plot 1**



**3.2 Vegetation Plot 2**



**3.3 Vegetation Plot 3**



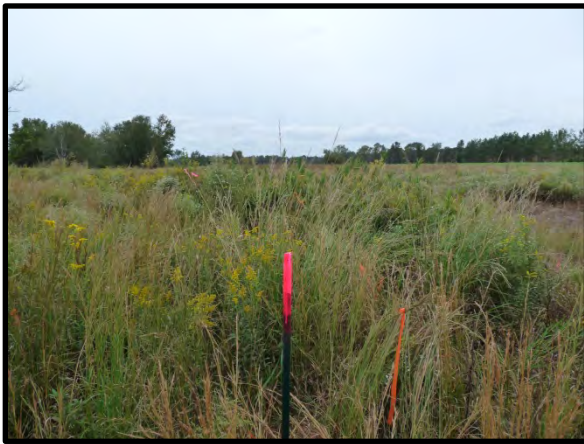
**3.4 Vegetation Plot 4**



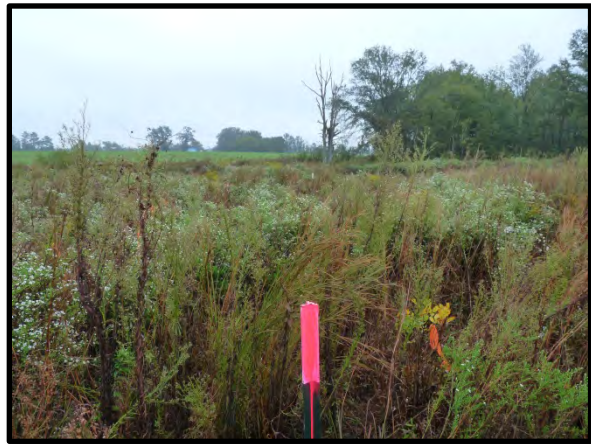
**3.5 Vegetation Plot 5**



**3.6 Vegetation Plot 6**



**3.7 Vegetation Plot 7**



**3.8 Vegetation Plot 8**



**3.9 Vegetation Plot 9**



**3.10 Vegetation Plot 10**



**3.11 Vegetation Plot 11**



**3.12 Vegetation Plot 12**



**3.13 Vegetation Plot 13**



**3.14 Vegetation Plot 14**



**3.15 Cluster of cattail adjacent to VP 12**



**3.16 Sericea lespedeza near VP 4**



**3.17 Sparse vegetation on terrace slope**



**3.18 Small gully on terrace slope**



**3.19 Sparse vegetation on terrace slope**



**3.20 Minor wash on terrace slope**

**Appendix C. Vegetation Plot Data**

**Table 7. Vegetation Plot Mitigation Success Summary**

UT to the Lumber River Site, 002027							
Plot ID	Community Type	Planting Zone ID	Reach ID	CVS Level	Planted Stems	Stems Per Acre	Survival Threshold Met?
1	Coastal Plain Small Stream Swamp	CPSSS	Upper	II	17	688	Yes
2	Coastal Plain Small Stream Swamp	CPSSS	Upper	II	15	607	Yes
3	Coastal Plain Small Stream Swamp	CPSSS	Upper	II	13	526	Yes
4	Coastal Plain Small Stream Swamp	CPSSS	Lower	II	18	728	Yes
5	Coastal Plain Small Stream Swamp	CPSSS	Lower	II	16	648	Yes
6	Coastal Plain Small Stream Swamp	CPSSS	Lower	II	16	648	Yes
7	Coastal Plain Small Stream Swamp	CPSSS	Lower	II	19	769	Yes
8	Coastal Plain Small Stream Swamp	CPSSS	Lower	II	20	809	Yes
9	Coastal Plain Small Stream Swamp	CPSSS	Lower	II	17	688	Yes
10	Coastal Plain Small Stream Swamp	CPSSS	Lower	II	16	648	Yes
11	Coastal Plain Small Stream Swamp	CPSSS	Lower	II	14	567	Yes
12	Coastal Plain Small Stream Swamp	CPSSS	Lower	II	18	728	Yes
13	Coastal Plain Small Stream Swamp	CPSSS	Lower	II	20	809	Yes
14	Coastal Plain Small Stream Swamp	CPSSS	Lower	II	18	728	Yes
<b>Average Stems Per Acre</b>						685	



**Table 8. CVS Vegetation Metadata**

<b>Report Prepared By</b>	Ryan Smith
<b>Date Prepared</b>	10/14/2011 14:02
<b>database name</b>	CVS_entry.mdb
<b>database location</b>	S:\Lumber_River\Docs\Monitoring
<b>computer name</b>	NC10465
<b>file size</b>	38801408
<b>DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT-----</b>	
<b>Metadata</b>	Description of database file, the report worksheets, and a summary of project(s) and project data.
<b>Proj, planted</b>	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
<b>Proj, total stems</b>	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
<b>Plots</b>	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
<b>Vigor</b>	Frequency distribution of vigor classes for stems for all plots.
<b>Vigor by Spp</b>	Frequency distribution of vigor classes listed by species.
<b>Damage</b>	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
<b>Damage by Spp</b>	Damage values tallied by type for each species.
<b>Damage by Plot</b>	Damage values tallied by type for each plot.
<b>Planted Stems by Plot and Spp</b>	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
<b>ALL Stems by Plot and spp</b>	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
<b>PROJECT SUMMARY-----</b>	
<b>Project Code</b>	94068
<b>project Name</b>	UT to the Lumber River
<b>Description</b>	Stream Restoration, Enhancement and Preservation Site
<b>River Basin</b>	Lumber
<b>length(ft)</b>	4285
<b>stream-to-edge width (ft)</b>	75
<b>area (sq m)</b>	59707
<b>Required Plots (calculated)</b>	14
<b>Sampled Plots</b>	14

**Table 9. Planted and Total Stem Counts (Specied by Plot with Annual Means)**

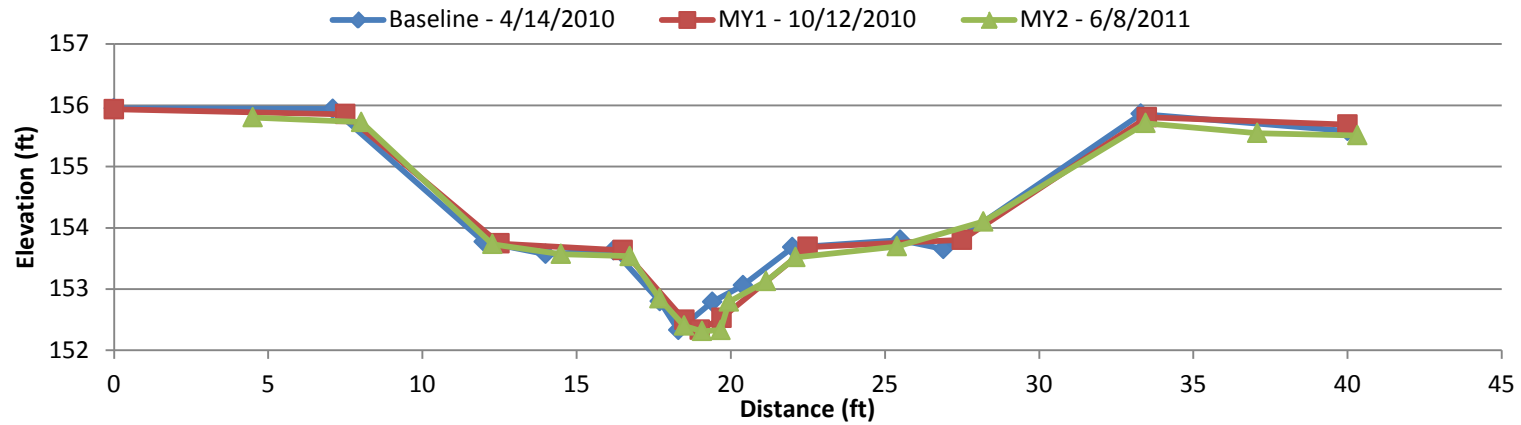
		Current Data (MY2 2011)														
Species	Common Name	Type	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6		Plot 7	
			P	T	P	T	P	T	P	T	P	T	P	T		
<i>Acer rubrum</i>	red maple	Tree														
<i>Baccharis halimifolia</i>	eastern baccharis	Shrub														
<i>Betula nigra</i>	river birch	Tree		1						1						3
<i>Diospyros virginiana</i>	common persimmon	Tree														1
<i>Fraxinus pennsylvanica</i>	green ash	Tree	3	3	3	3	1	1	2	2	3	3			2	2
<i>Nyssa biflora</i>	swamp tupelo	Tree	3	3		3	1	1	3	3	1	2	1	1	4	4
<i>Quercus</i>	oak	Tree		1												
<i>Quercus laurifolia</i>	laurel oak	Tree	2	3			3	3	2	2	2	1	1	1	1	1
<i>Quercus lyrata</i>	overcup oak	Tree							3	3	1				4	4
<i>Quercus michauxii</i>	swamp chestnut oak	Tree	1	1	1	1	1	1	2	2	1					
<i>Quercus nigra</i>	water oak	Tree	2	2			5	5	2	3	4	4	4	5	2	2
<i>Quercus phellos</i>	willow oak	Tree	4	4	7	7	1	1	2	3	3	6	6	6	2	2
<i>Taxodium distichum</i>	bald cypress	Tree	2	3	1	1		1	1	1					4	4
<i>Ulmus americana</i>	American elm	Tree			3	3	1	1	1	2	1	4	4	4		1
Plot area (acres)			0.0247		0.0247		0.0247		0.0247		0.0247		0.0247		0.0247	
Species count			7	9	5	6	7	8	9	10	8	6	5	5	7	10
Stem Count			17	21	15	18	13	14	18	22	16	20	16	17	19	24
Stems per Acre			688	850	607	728	526	567	728	890	648	809	648	688	769	971
		Current Data (MY2 2011)														
Species	Common Name	Type	Plot 8		Plot 9		Plot 10		Plot 11		Plot 12		Plot 13		Plot 14	
			P	T	P	T	P	T	P	T	P	T	P	T		
<i>Acer rubrum</i>	red maple	Tree												4		
<i>Baccharis halimifolia</i>	eastern baccharis	Shrub												1		
<i>Betula nigra</i>	river birch	Tree														
<i>Diospyros virginiana</i>	common persimmon	Tree														
<i>Fraxinus pennsylvanica</i>	green ash	Tree	3	3	4	4	2	2	2	2	4	4				
<i>Nyssa biflora</i>	swamp tupelo	Tree	2	2	1	2			3	3	4	4	5	7	4	6
<i>Quercus</i>	oak	Tree														
<i>Quercus laurifolia</i>	laurel oak	Tree	4	4			3	3	2	3	3	3				
<i>Quercus lyrata</i>	overcup oak	Tree					1	1	2	2			9	11	10	12
<i>Quercus michauxii</i>	swamp chestnut oak	Tree	6	6	5	5	1	1			2	2				
<i>Quercus nigra</i>	water oak	Tree	4	4	1	1	2	2	1	1	1	1				
<i>Quercus phellos</i>	willow oak	Tree	1	1	4	4	3	3	1	1	3	3				
<i>Taxodium distichum</i>	bald cypress	Tree			1	1	2	2	3	3			6	6	4	4
<i>Ulmus americana</i>	American elm	Tree			1	1	2	2			1	1				
Plot area (acres)			0.0247		0.0247		0.0247		0.0247		0.0247		0.0247		0.0247	
Species count			6	6	7	7	8	8	7	7	7	7	3	5	3	3
Stem Count			20	20	17	18	16	16	14	15	18	18	20	29	18	22
Stems per Acre			809	809	688	728	648	648	567	607	728	728	809	1174	728	890
Species	Common Name	Type	Annual Means						Notes:							
			MY2 (2011)		MY1 (2010)		BL/AB (2010)									
P	T	P	T	P	T	P	T	The planted stems in Plot 10 increased by two in 2011 because two stems that were counted as dead last year resprouted.								
<i>Acer rubrum</i>	red maple	Tree		4.00					N/A							
<i>Baccharis halimifolia</i>	eastern baccharis	Shrub		1.00					N/A							
<i>Betula nigra</i>	river birch	Tree		1.67					N/A							
<i>Diospyros virginiana</i>	common persimmon	Tree		1.00					N/A							
<i>Fraxinus pennsylvanica</i>	green ash	Tree	2.64	2.64	2.64	2.64	2.64		N/A							
<i>Nyssa biflora</i>	swamp tupelo	Tree	2.67	3.15	3.31	3.31	3.69		N/A							
<i>Quercus</i>	oak	Tree		1.00					N/A							
<i>Quercus laurifolia</i>	laurel oak	Tree	2.30	2.50	2.50	2.50	2.60		N/A							
<i>Quercus lyrata</i>	overcup oak	Tree	4.29	4.86	4.43	4.43	3.67		N/A							
<i>Quercus michauxii</i>	swamp chestnut oak	Tree	2.22	2.22	2.22	2.22	1.89		N/A							
<i>Quercus nigra</i>	water oak	Tree	2.55	2.73	2.73	2.73	2.82		N/A							
<i>Quercus phellos</i>	willow oak	Tree	3.08	3.17	3.00	3.00	3.17		N/A							
<i>Taxodium distichum</i>	bald cypress	Tree	2.67	2.60	2.60	2.60	2.82		N/A							
<i>Ulmus americana</i>	American elm	Tree	1.75	1.78	1.67	1.67	2.40		N/A							
Plot area (acres)																
Species count			6.36	6.93	6.57	6.57	6.86	N/A								
Stem Count			16.93	19.57	18.21	18.21	19.79	N/A								
Stems per Acre			685	792	737	737	801	N/A								

## Appendix D. Stream Survey Data

**Figures 4.1-4.17. Cross Section Plots and Photos**

### UT to the Lumber River, 002027

#### Upper Reach, XS 1, Sta. 10+22 Riffle



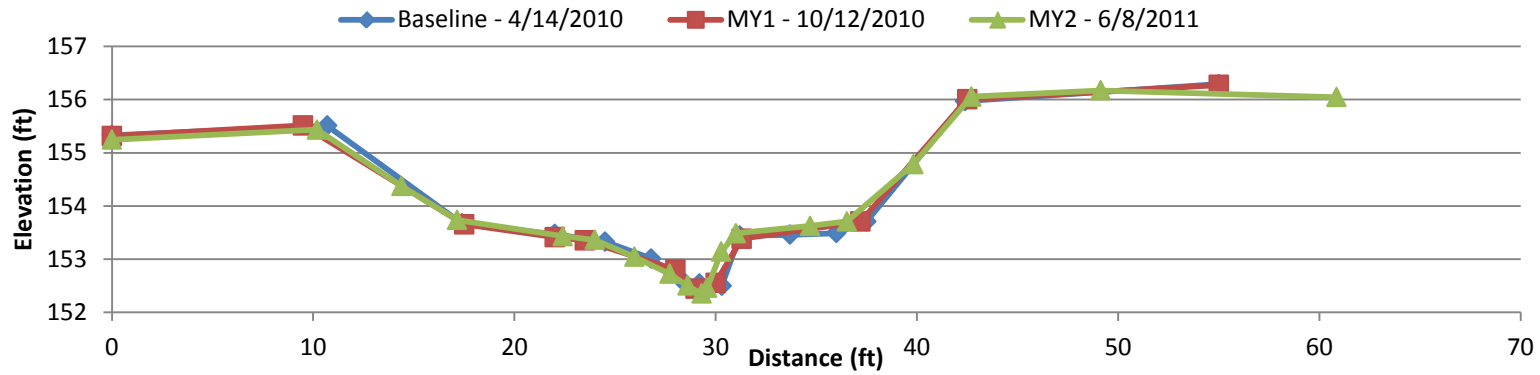
STA	ELEV
4.5	155.80
8.02	155.73
12.27	153.73
14.5	153.57
16.73	153.54
17.69	152.84
18.49	152.40
19.07	152.31
19.67	152.33
19.94	152.79
21.15	153.13
22.1	153.52
25.39	153.69
28.19	154.10
33.45	155.71
37.08	155.55
40.32	155.51



XS 1, Sta. 10+22, Looking Downstream

### UT to the Lumber River, 002027

Upper Reach, XS 2, Sta. 12+14.5 Pool



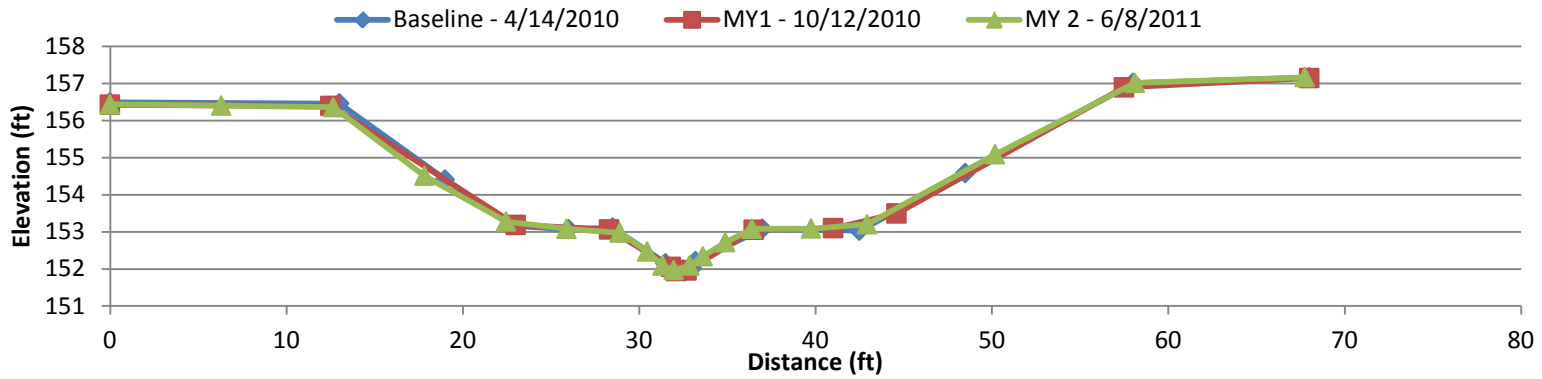
STA	ELEV
0	155.25
10.19	155.44
14.39	154.38
17.16	153.74
22.41	153.43
23.99	153.36
25.97	153.04
27.71	152.72
28.6	152.50
29.3	152.35
29.58	152.46
30.28	153.14
31.01	153.49
34.69	153.62
36.52	153.71
39.83	154.79
42.71	156.05
49.13	156.17
60.85	156.04



XS 2, Sta. 12+14.5, Looking Downstream

### UT to the Lumber River, 002027

#### Upper Reach, XS 3, Sta. 14+92 Riffle



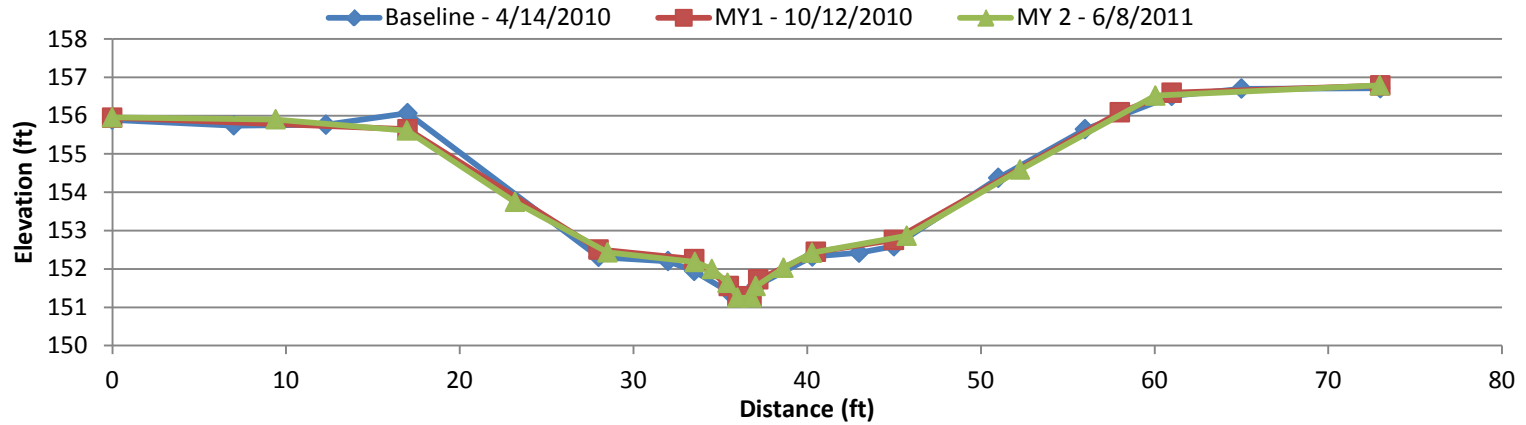
STA	ELEV
0	156.44
6.32	156.40
12.66	156.36
17.83	154.51
22.46	153.28
25.89	153.08
28.91	152.97
30.46	152.47
31.34	152.09
31.96	151.97
32.85	152.09
33.61	152.34
34.88	152.72
36.39	153.08
39.76	153.08
42.92	153.20
50.18	155.09
58.12	157.01
67.75	157.17



XS 3, Sta. 14+92, Looking Downstream

### UT to the Lumber River, 002027

#### Upper Reach, XS 4, Sta. 19+51 Riffle



STA	ELEV
0	155.95
9.41	155.90
16.97	155.60
23.19	153.75
28.51	152.43
33.55	152.18
34.52	152.00
35.42	151.64
36	151.25
36.8	151.25
37.05	151.55
38.65	152.03
40.28	152.42
45.74	152.86
52.26	154.59
60.05	156.52
72.96	156.79

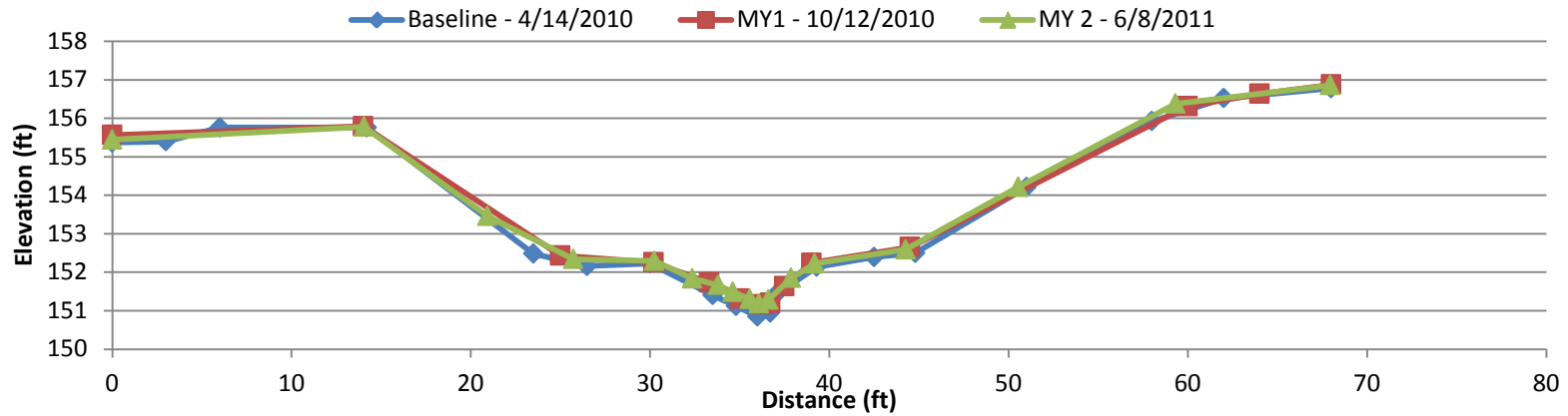


XS 4, Sta. 19+51, Looking Downstream



### UT to the Lumber River, 002027

#### Upper Reach, XS 5, Sta. 20+58 Pool



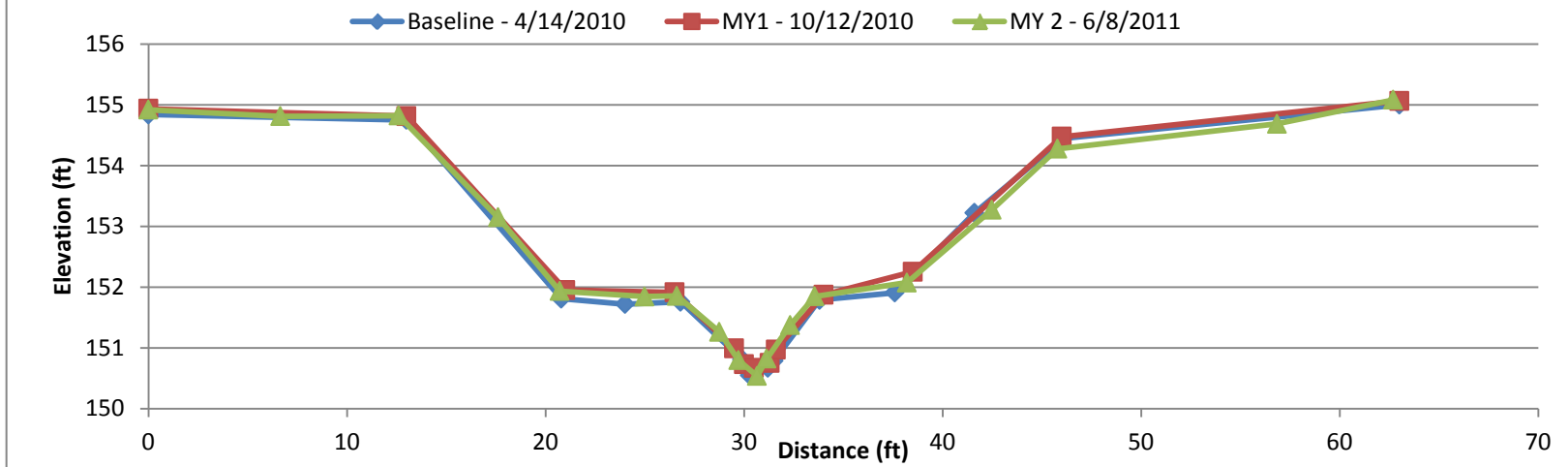
STA	ELEV
0	155.44
14.04	155.78
20.93	153.46
25.73	152.34
30.24	152.29
32.36	151.84
33.8	151.67
34.62	151.49
35.57	151.30
36.08	151.19
36.6	151.29
37.87	151.85
39.19	152.23
44.26	152.59
50.55	154.22
59.31	156.38
67.94	156.86



XS 5, Sta. 20+58, Looking Downstream

### UT to the Lumber River, 002027

#### Lower Reach, XS 6, Sta. 22+70 Riffle



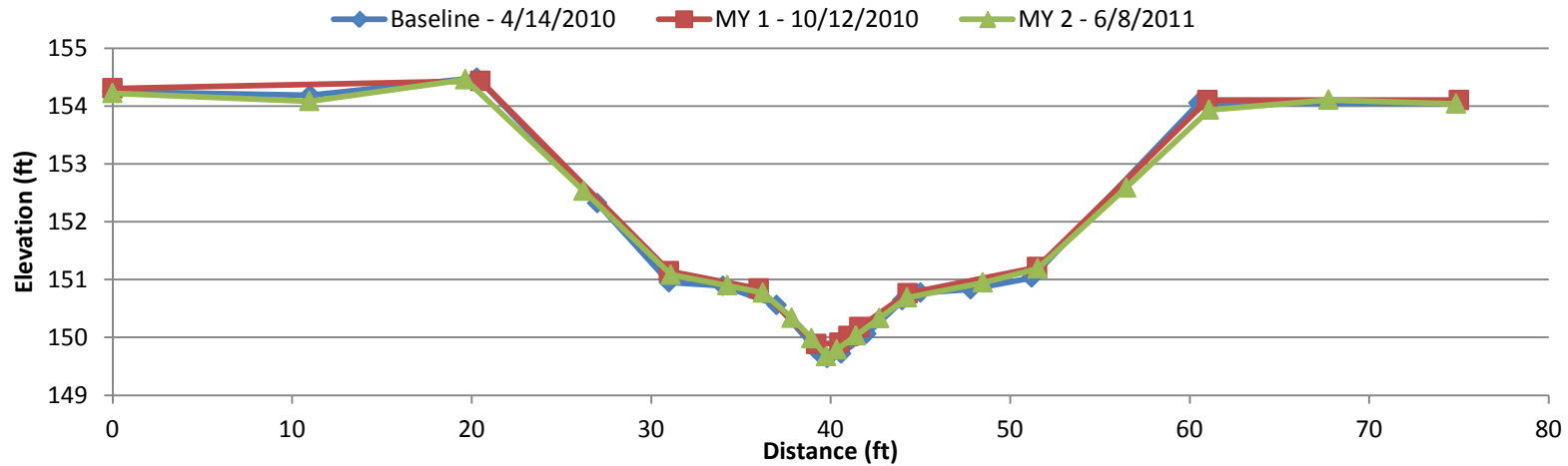
STA	ELEV	STA	ELEV
0	154.92	30.66	150.54
6.64	154.81	31.14	150.82
12.6	154.82	32.32	151.37
17.61	153.15	33.56	151.85
20.72	151.94	38.21	152.07
24.99	151.84	42.48	153.27
26.62	151.86	45.78	154.28
28.75	151.27	56.84	154.69
29.71	150.80	62.7	155.08



XS 6, Sta. 22+70, Looking Downstream

### UT to the Lumber River, 002027

#### Lower Reach, XS 7, Sta. 29+48 Riffle



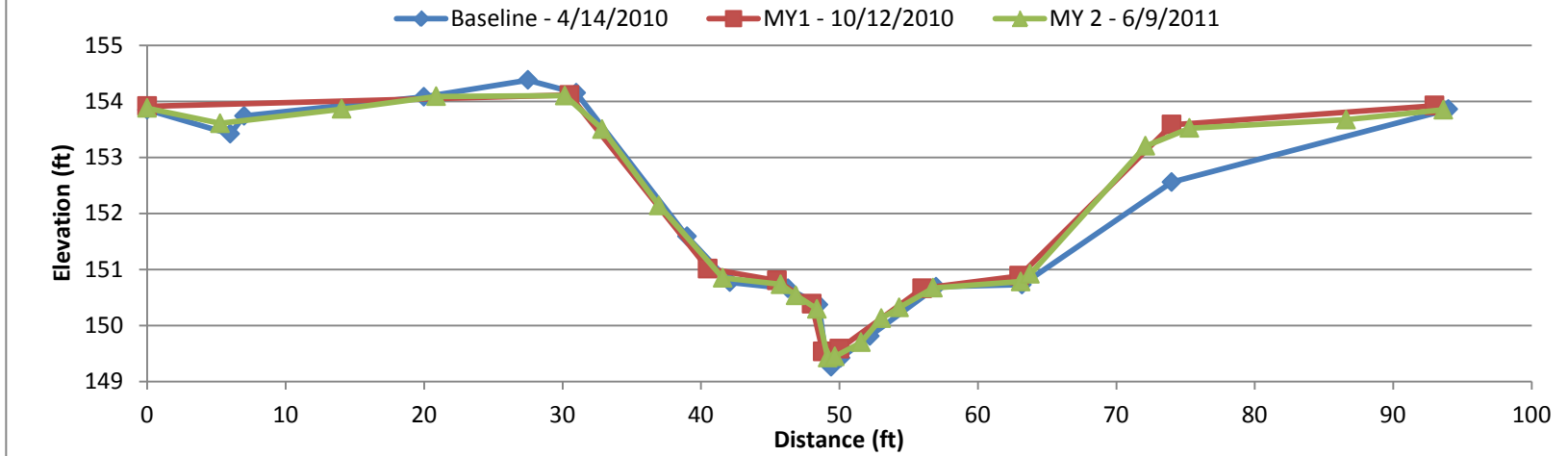
STA	ELEV	STA	ELEV
0	154.22	40.34	149.79
10.96	154.08	41.41	150.03
19.66	154.46	42.71	150.33
26.24	152.54	44.25	150.69
31.11	151.08	48.48	150.95
34.25	150.90	51.54	151.19
36.23	150.77	56.47	152.59
37.84	150.34	61.09	153.93
38.94	149.98	67.75	154.11
39.76	149.67	74.85	154.04



XS 7, Sta. 29+48, Looking Downstream

### UT to the Lumber River, 002027

#### Lower Reach, XS 8, Sta. 30+98 Pool



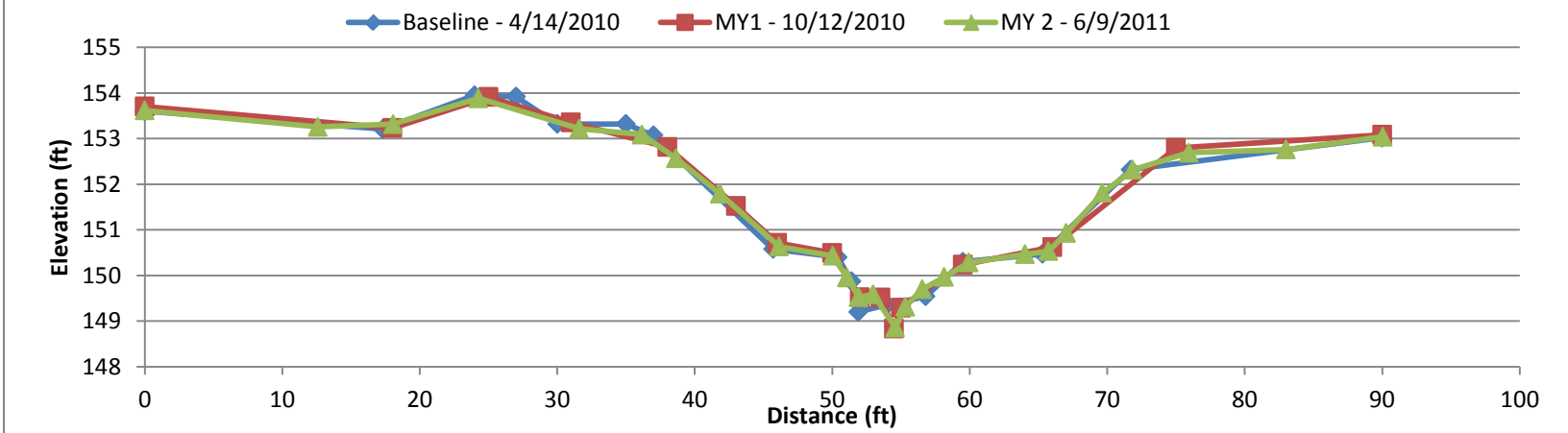
STA	ELEV	STA	ELEV
0	153.88	49.67	149.44
5.27	153.61	51.56	149.70
14.06	153.86	53.03	150.13
20.89	154.09	54.33	150.32
30.17	154.10	56.77	150.67
32.87	153.50	63.1	150.78
36.96	152.14	63.78	150.92
41.57	150.85	72.12	153.20
45.75	150.73	75.29	153.52
46.86	150.54	86.61	153.67
48.38	150.30	93.63	153.85
49.16	149.42		



XS 8, Sta. 30+98, Looking Downstream

### UT to the Lumber River, 002027

#### Lower Reach, XS 9, Sta. 33+03 Pool



STA	ELEV	STA	ELEV
0	153.62	54.58	148.85
12.58	153.26	55.32	149.32
18.06	153.32	56.54	149.70
24.27	153.88	58.14	149.97
31.6	153.22	59.93	150.28
36.16	153.09	64.02	150.47
38.64	152.57	65.72	150.53
41.83	151.80	67.02	150.93
46.13	150.63	69.66	151.81
50.04	150.43	71.85	152.32
51.07	149.95	75.93	152.69
51.93	149.52	83	152.76
52.98	149.58	90.04	153.04

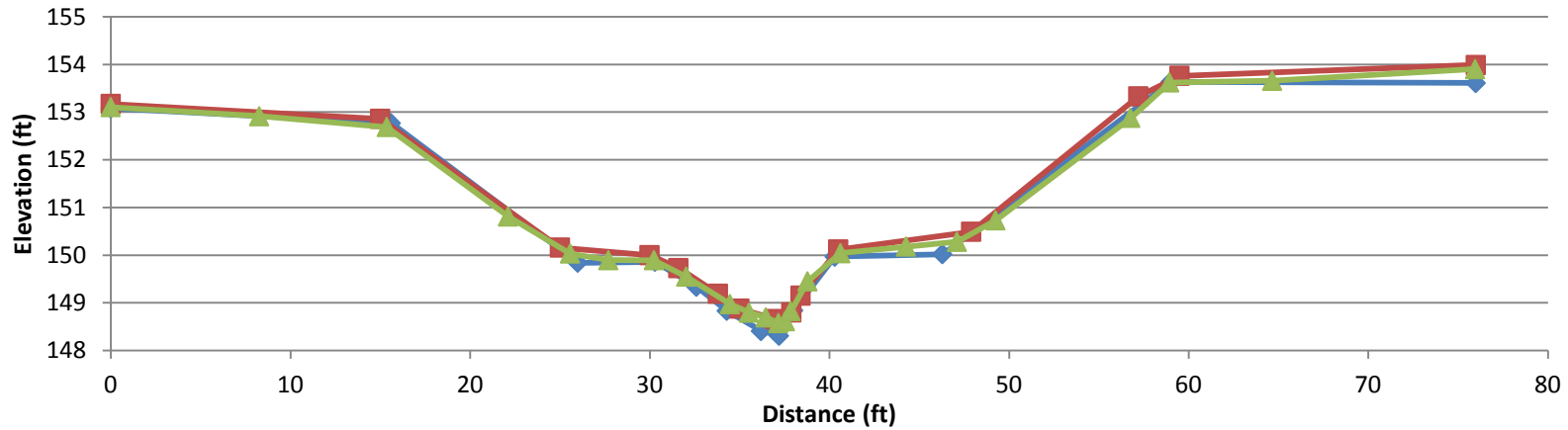


XS 9, Sta. 33+03, Looking Downstream

### UT to the Lumber River, 002027

Lower Reach, XS 10, Sta. 36+13.5 Pool

◆ Baseline - 4/14/2010    ■ MY1 - 10/14/2010    ▲ MY 2 - 6/9/2011



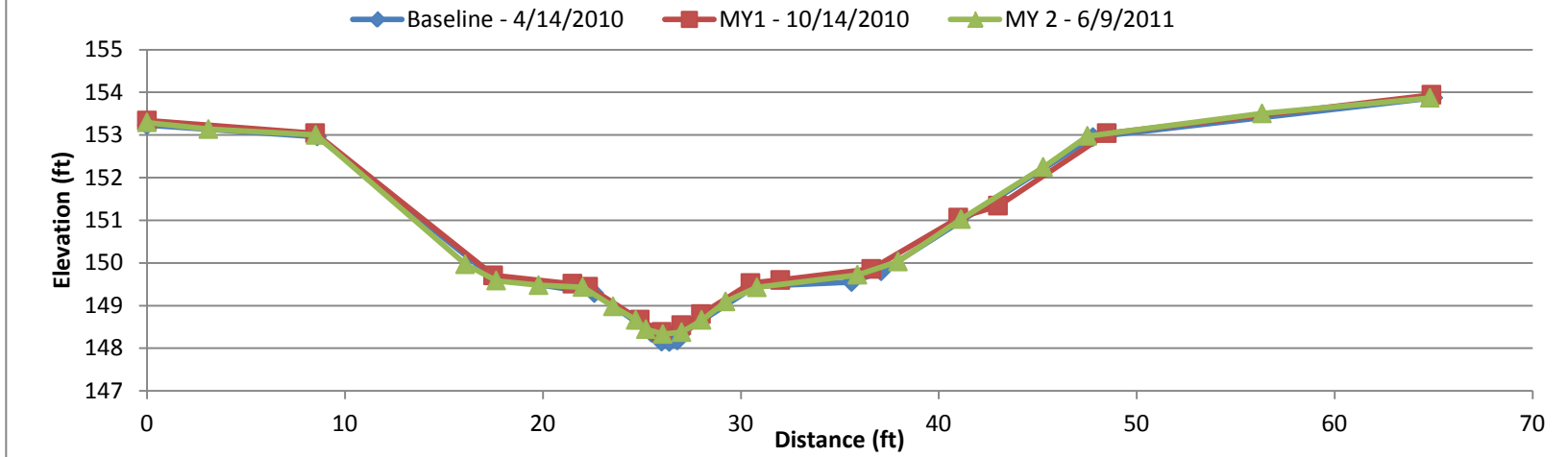
STA	ELEV	STA	ELEV
0	153.10	37.54	148.61
8.27	152.91	37.86	148.83
15.36	152.69	38.79	149.45
22.11	150.81	40.62	150.04
25.57	150.03	44.27	150.18
27.7	149.89	47.11	150.28
30.24	149.89	49.26	150.73
32.04	149.55	56.77	152.88
34.47	148.97	58.94	153.62
35.53	148.79	64.67	153.66
36.46	148.69	75.95	153.90
37.16	148.57		



XS 10, Sta. 36+13.5, Looking Downstream

### UT to the Lumber River, 002027

#### Lower Reach, XS 11, Sta. 39+19 Riffle



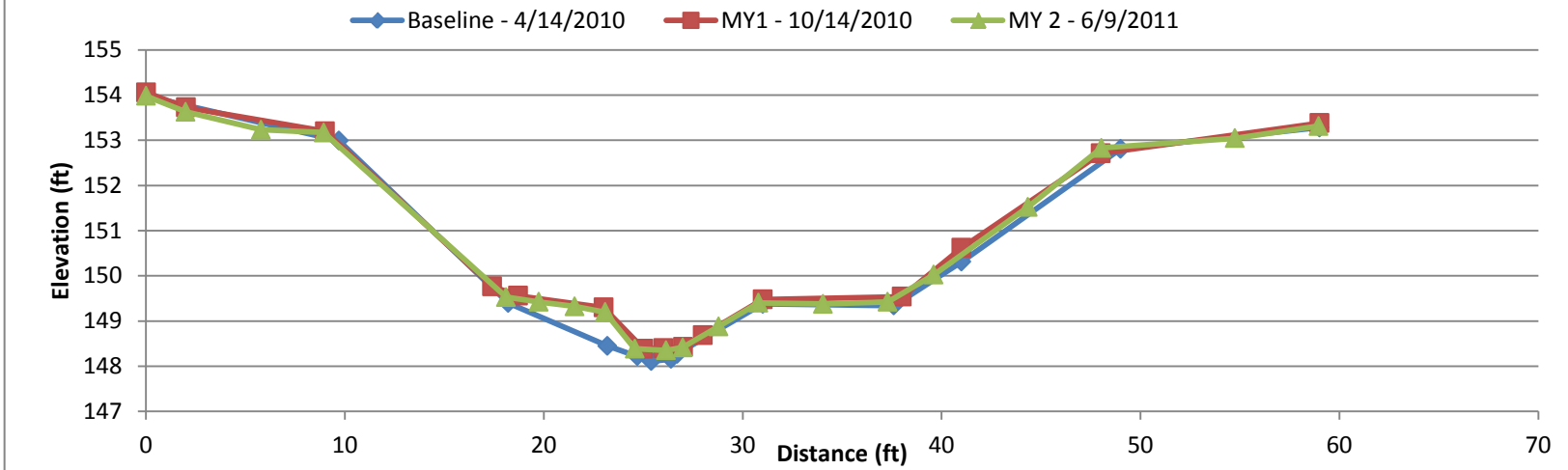
STA	ELEV	STA	ELEV
0	153.29	27.01	148.38
3.1	153.14	28.03	148.66
8.53	153.00	29.24	149.10
16.08	149.97	30.82	149.43
17.65	149.58	35.9	149.72
19.79	149.48	37.95	150.03
22.02	149.43	41.13	151.03
23.55	148.98	45.29	152.25
24.7	148.66	47.52	152.98
25.22	148.44	56.35	153.50
26.07	148.33	64.82	153.87



XS 11, Sta. 39+19, Looking Downstream

### UT to the Lumber River, 002027

#### Lower Reach, XS 12, Sta. 39+82 Riffle



STA	ELEV	STA	ELEV
0	153.98	26.98	148.41
1.99	153.63	28.79	148.88
5.78	153.23	30.79	149.40
8.93	153.17	34.04	149.38
18.1	149.53	37.29	149.42
19.75	149.42	39.6	150.03
21.54	149.32	44.33	151.52
23.08	149.20	48.04	152.83
24.57	148.39	54.75	153.05
26.14	148.35	58.96	153.32

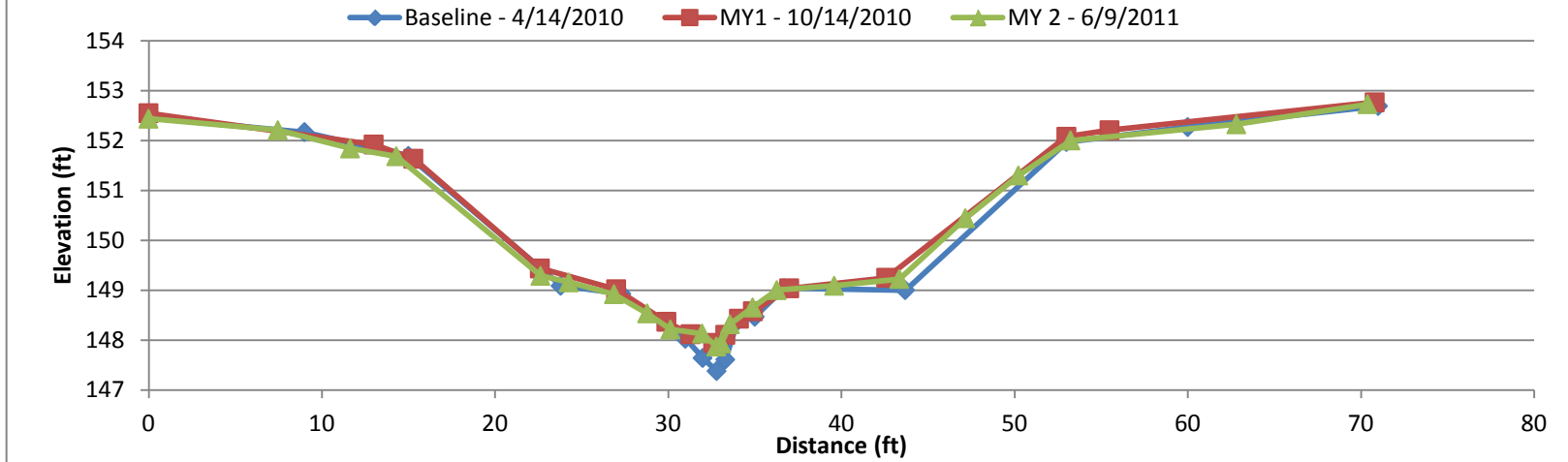


XS 12, Sta. 39+82, Looking Downstream



### UT to the Lumber River, 002027

#### Lower Reach, XS 13, Sta. 42+14 Pool



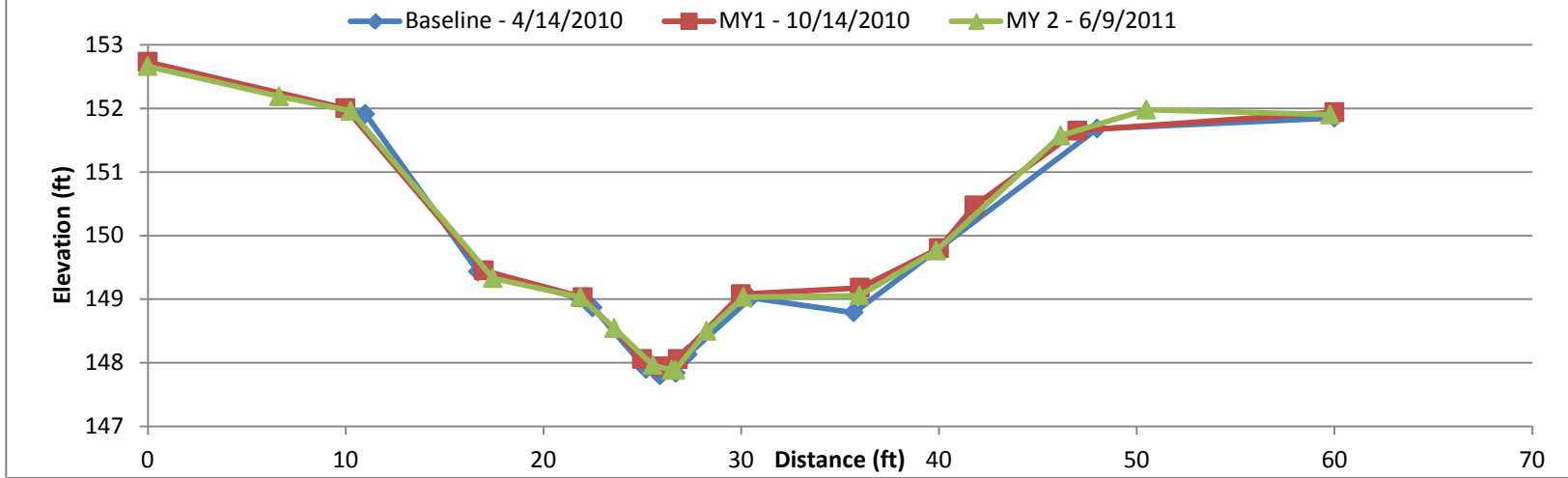
STA	ELEV	STA	ELEV
0	152.44	33.07	147.93
7.47	152.21	33.57	148.32
11.64	151.84	34.88	148.66
14.3	151.68	36.27	149.01
22.64	149.29	39.6	149.09
24.26	149.16	43.35	149.22
26.87	148.92	47.16	150.44
28.79	148.53	50.23	151.30
30.13	148.22	53.24	152.00
31.96	148.13	62.82	152.33
32.78	147.87	70.39	152.73



XS 13, Sta. 42+14, Looking Downstream

### UT to the Lumber River, 002027

#### Lower Reach, XS 14, Sta. 42+54 Riffle



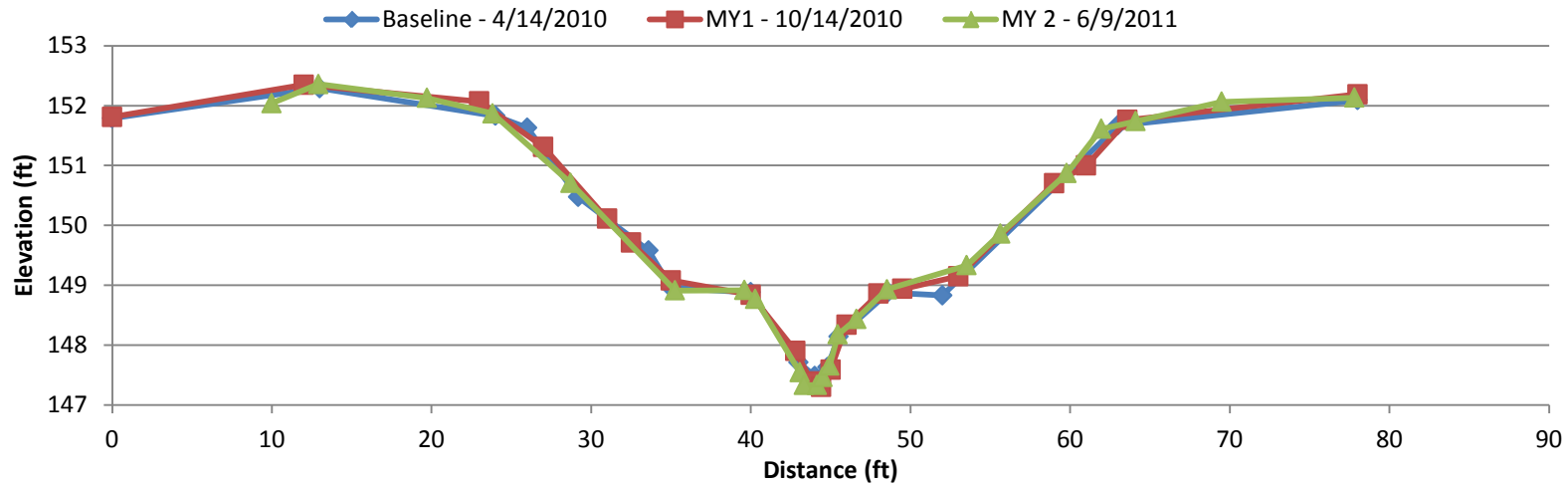
STA	ELEV	STA	ELEV
0	152.66	39.87	149.76
6.64	152.19	46.16	151.57
10.26	151.96	50.49	151.98
17.45	149.33	59.78	151.90
21.87	149.03		
23.58	148.55		
25.54	147.96		
26.49	147.89		
26.68	147.89		
28.26	148.50		
30.12	149.03		
35.99	149.06		



XS 14, Sta. 42+54, Looking Downstream

### UT to the Lumber River, 002027

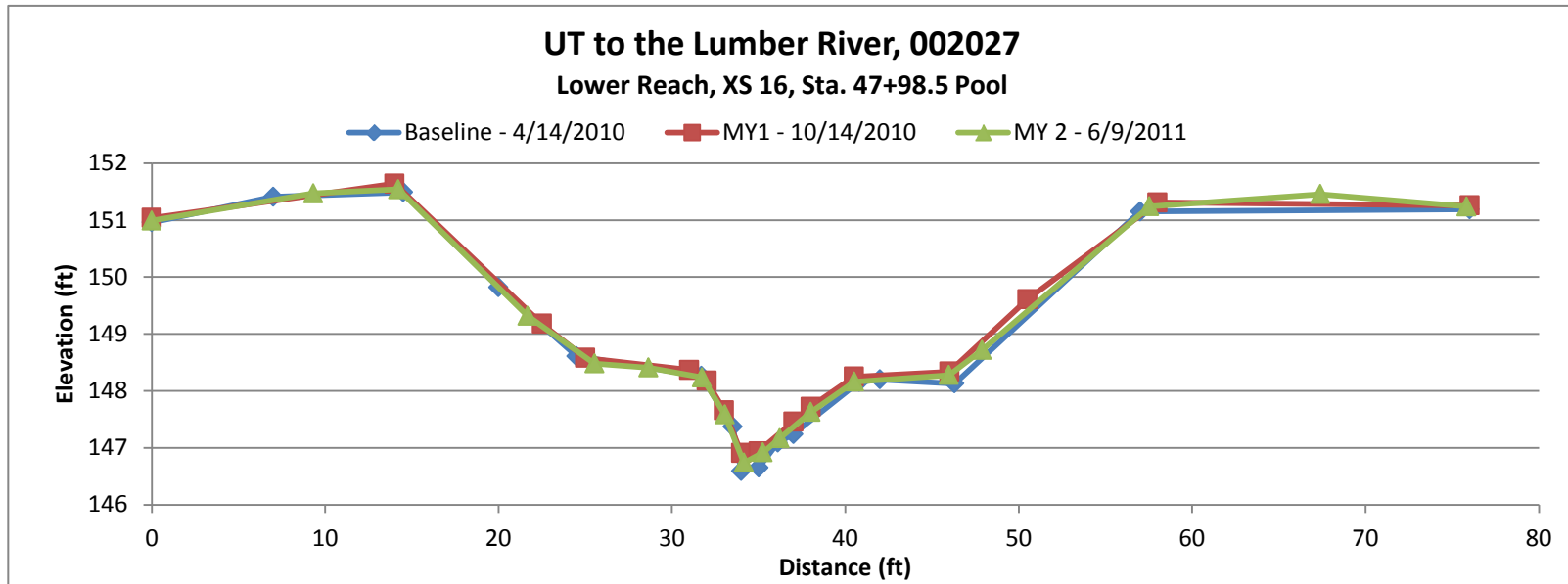
#### Lower Reach, XS 15, Sta. 43+94 Pool



STA	ELEV	STA	ELEV
10	152.04	44.93	147.66
12.92	152.36	45.45	148.18
19.72	152.13	46.62	148.43
23.82	151.87	48.53	148.93
28.72	150.70	53.53	149.33
35.26	148.91	55.63	149.86
39.61	148.92	59.79	150.87
40.29	148.77	61.95	151.61
43.07	147.54	64.11	151.74
43.34	147.33	69.49	152.06
44.14	147.33	77.8	152.13
44.5	147.47		



XS 15, Sta. 43+94, Looking Downstream



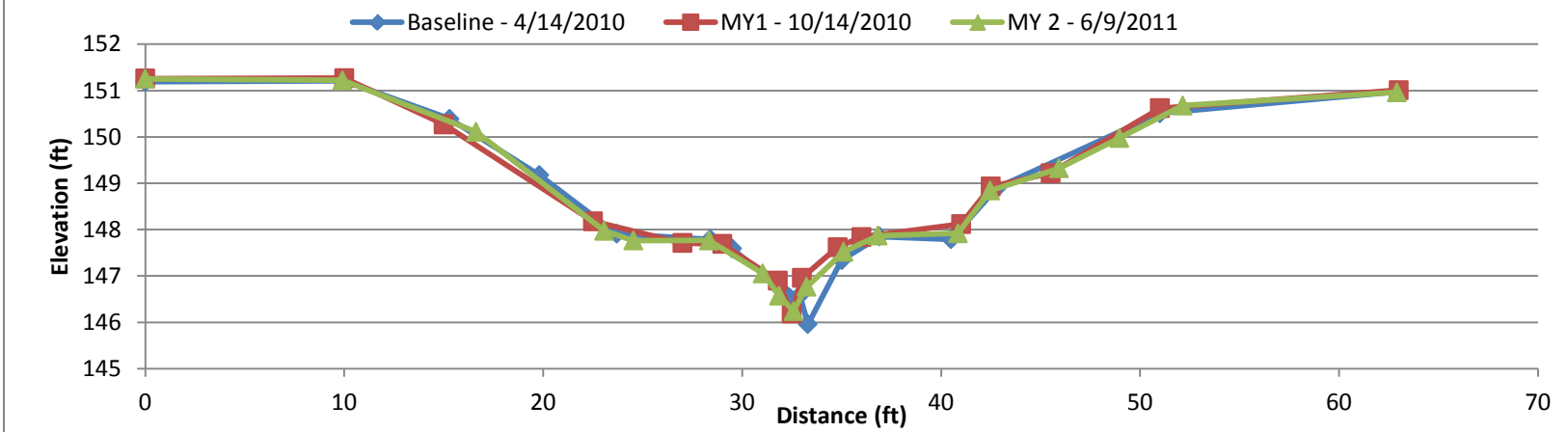
STA	ELEV	STA	ELEV
0	150.99	35.24	146.92
9.31	151.47	36.21	147.17
14.22	151.54	38.01	147.63
21.67	149.32	40.52	148.16
25.53	148.48	45.97	148.28
28.65	148.41	47.88	148.72
31.74	148.24	57.53	151.24
33.05	147.58	67.39	151.46
34.15	146.74	75.83	151.24



XS 16, Sta. 47+98.5, Looking Downstream

### UT to the Lumber River, 002027

#### Lower Reach, XS 17, Sta. 51+26 Riffle



STA	ELEV	STA	ELEV
0	151.25	33.24	146.77
9.91	151.22	35.1	147.52
16.62	150.11	36.82	147.87
23.07	147.97	40.85	147.92
24.53	147.76	42.47	148.84
28.33	147.77	45.92	149.32
31.04	147.06	48.97	149.98
31.86	146.58	52.14	150.68
32.58	146.24	62.9	150.96



XS 17, Sta. 51+26, Looking Downstream

**Figures 5.1-5.3. Longitudinal Profile Plots**

Figure 5.1 UT to the Lumber River, 002027, Upper Reach Longitudinal Profile



Figure 5.2 UT to the Lumber River, 002027, Lower Reach (1) Longitudinal Profile

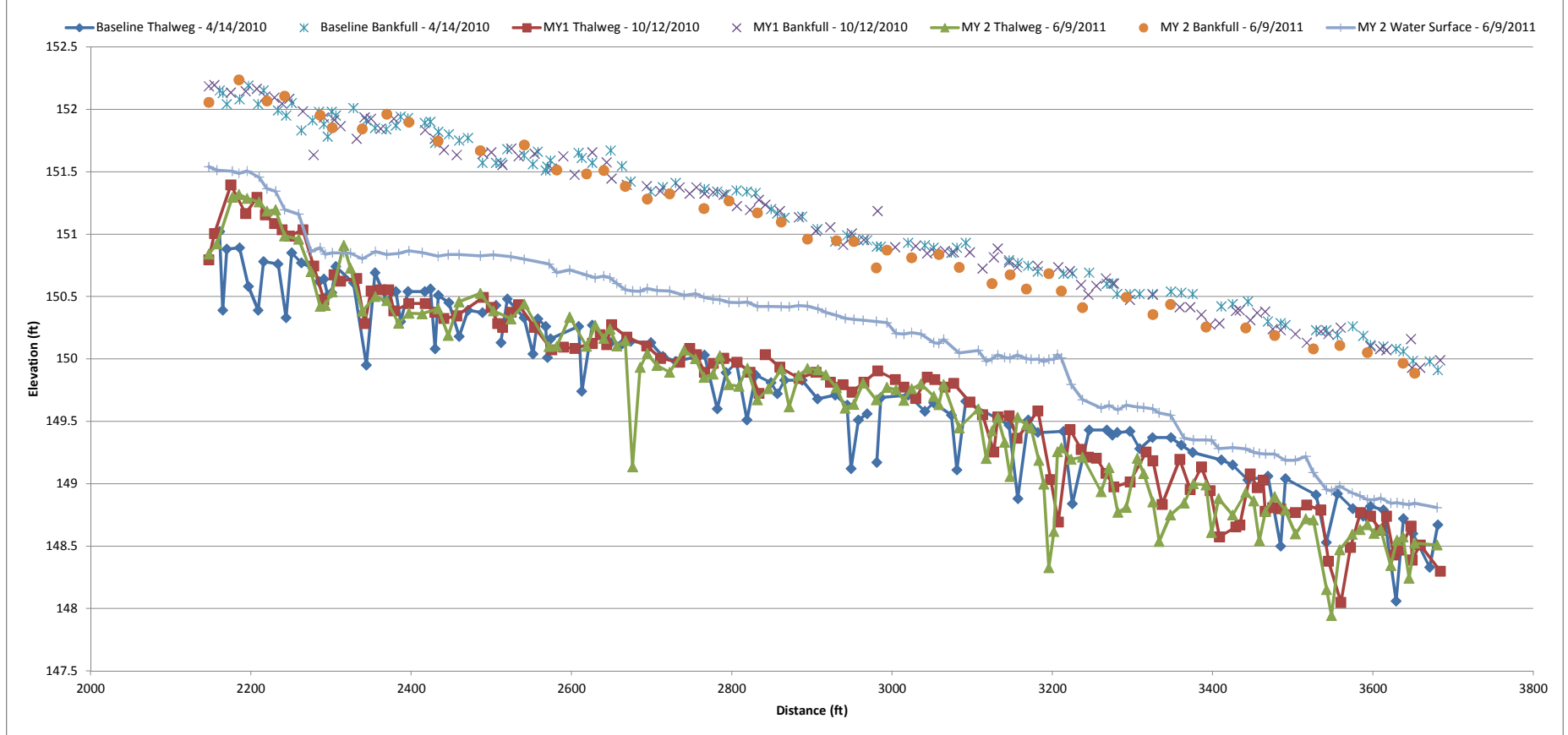
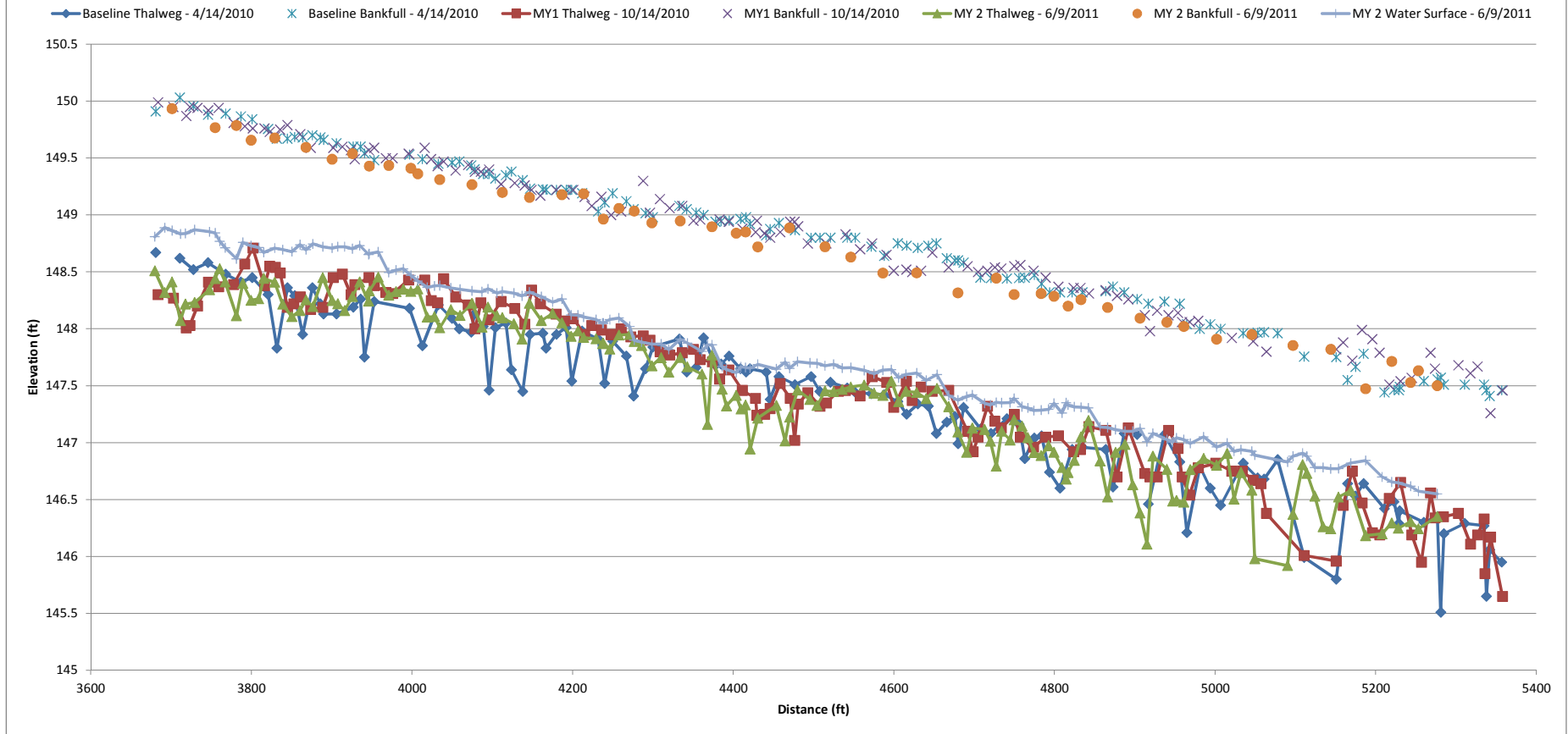




Figure 5.3 UT to the Lumber River, 002027, Lower Reach (2) Longitudinal Profile



**Table 10. Baseline Stream Data Summary**  
**UT to the Lumber River Site, 002027**  
**UT to the Lumber River: 4,285 feet**

Parameter	Regional Curve			Pre-Existing Condition			UT Ironhill Branch Reference Reach			UT to Lumber River Reference Reach			Design - Upstream			Design - Downstream			As-built/Baseline - Upstream			As-built/Baseline - Downstream				
	LL	UL	Eq.	Mean	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	
<b>Dimension and Substrate - Riffle</b>																										
Bankfull Width (ft)	6.41	10.33	8.03	8.70		10.30				9.50					7.80			8.80			5.67	7.31	8.47	6.95	8.07	8.97
Floodprone Width (ft)				13.30		290.00				100.00					25.00			27.00			21.23	23.39	27.54	23.23	25.73	28.30
Bankfull Mean Depth (ft)	0.76	1.45	0.99	0.94		0.95				0.85					0.74			0.83			0.46	0.58	0.64	0.52	0.63	0.73
Bankfull Max Depth (ft)				1.77		1.58				1.42					1.11			1.25			0.96	1.13	1.30	1.00	1.30	1.83
Bankfull Cross Sectional Area (ft <sup>2</sup> )	9.08	12.57	8.19	8.16		9.76				8.03					4.90			6.20			3.56	4.19	5.45	4.02	5.10	5.74
Width/Depth Ratio				9.20		10.80				11.20					10.50			10.50			9.00	13.05	16.93	10.68	12.99	15.74
Entrenchment Ratio				1.53		28.21				28.21					3.20			3.10			2.75	3.25	3.74	2.77	3.20	3.44
Bank Height Ratio				2.94		1.00				1.03					1.00			1.00			1.00	1.00	1.00	1.00	1.00	1.00
d50 (mm)				Detritus		0.30				0.30																
<b>Profile</b>																										
Riffle Length (ft)				NA	11.66	33.00	67.02	17.04	18.60	20.16	0.78	18.20	77.00	0.65	18.70	91.60	5.50	21.67	47.00	5	22.77	87				
Riffle Slope (ft/ft)				0.0000		0.0043				0.0013					0.0020			0.0019			0.0000	0.0023	0.0129	0	0.0024	0.0107
Pool Length (ft)				NA	20.74	28.03	42.51	11.69	17.63	21.13	8.50	35.00	42.00	5.90	35.00	39.00	11.00	27.50	48.00	6	23.77	51				
Pool Max depth (ft)				2.02	ream Da	1.78				1.50					1.48			1.67			1.01	1.33	1.65	1.16	1.55	2.1
Pool Spacing (ft)				115.00		37.20	71.50	105.75	26.18	40.12	54.06	15.50	31.00	46.50	21.00	37.20	53.40	23.00	49.96	91.00	16	22.77	87			
Pool Cross Sectional Area (ft <sup>2</sup> )				NA		12.90				4.69					7.44			9.48			3.92	8.93	5.69	5.94	6.75	7.86
<b>Pattern</b>																										
Channel Beltwidth (ft)				NA	30.00	44.50	59.00	16.00	17.50	19.00	15.50	31.00	46.50	17.50	35.00	52.50	15.50	31.00	46.50	17.50	35.00	52.50	17.50	35.00	52.50	
Radius of Curvature (ft)				NA	13.70	17.25	20.80	7.42	8.53	9.63	15.50	19.40	23.30	17.50	21.90	26.30	15.50	19.40	23.30	17.50	21.90	26.30	17.50	21.90	26.30	
Rc: Bankfull Width (ft/ft)				NA	1.33	1.68	2.02	0.78	0.90	1.02	2.00	2.50	3.00	2.00	2.50	3.00	2.00	2.50	3.00	2.00	2.50	3.00	2.00	2.50	3.00	
Meander Wavelength (ft)				NA	42.00	57.00	72.00	38.00	38.00	38.00	23.30	50.40	77.50	26.30	56.90	87.50	23.30	50.40	77.50	26.30	56.90	87.50	26.30	56.90	87.50	
Meander Width Ratio				NA	4.09	5.55	7.00	4.01	4.01	4.01	3.00	6.50	10.00	3.00	6.50	10.00	3.00	6.50	10.00	3.00	6.50	10.00	3.00	6.50	10.00	
<b>Substrate, bed and transport parameters</b>																										
Ri%/P%				NA		54.1 / 45.9				51.4 / 48.6											44.1 / 55.9			49.3 / 50.7		
SC%/Sa%/G%/C%/B%/Be%				Detritus		100% Sa				100% Sa																
d16/d35/d50/d84/d95/d <sup>p</sup> /di <sup>90</sup> (mm)				Detritus		0.30				0.30																
Reach Shear Stress (competency) lb/ft <sup>2</sup>				0.148											0.055			0.060			0.073			0.061		
Max part size (mm) mobilized at bankfull				10.62 - 37.22											3.83 - 18.12			4.16 - 19.2			5.1 - 22.2			4.2 - 19.3		
Unit Stream Power (transport capacity) lbs./ft.s				0.100											0.059			0.070			0.075			0.083		
<b>Additional Reach Parameters</b>																										
Drainage Area (SM)				0.42		1.61				0.63																
Impervious cover estimate (%)				5.00		5.00				5.00																
Rosgen Classification						E5				E5					E5			E5			E5			E5		
Bankfull Velocity (fps)	0.65	1.11	1.08	0.74											1.02			1.12			1.19			1.37		
Bankfull Discharge (cfs)	5.90	14.06	8.87	6.00																	5.00			7.00		
Valley length (ft)				3428.00		200.00				115.40											920.00			2508.00		
Channel Thalweg length (ft)				3428.00		264.00				150.00					1162.00			*3123.00			1162.00			*3123.00		
Sinuosity (ft)				1.00		1.32				1.30					1.25			1.25			1.25			1.25		
Water Surface Slope (Channel) (ft/ft)				0.0000 (Backwater Blockage)		0.0020				0.0028					0.0015			0.0014			0.0018			0.00154		
BF slope (ft/ft)				0.0023		0.0020				0.0028					0.0015			0.0014			0.0018			0.00154		
Bankfull Floodplain Area (acres)				0.00											0.67			1.97			0.67			1.97		
Proportion over wide (%)				50.00		0.00				0.00																
Entrenchment Class (ER Range)				1.53		28.21				10.55																
Incision Class (BHR Range)				2.94		1.00				1.06																
BEHI VL%/L%/M%/H%/VH%/E%				NA		100% VL				100% VL																
Channel Stability or Habitat Metric				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Biological or Other				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		

It should be noted that As-built conditions were completed at the end of construction. Many storm events had occurred between beginning of construction and end of construction that naturally modified constructed parameters.  
 \*50 foot easement crossing is taken out of the stationing to get 3,123 linear feet of construction.

Table 11. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters - Cross Section) - Upstream Reach Sections 1 -5; Downstream Reach Sections 6 - 17

UT to the Lumber River Site, 002027

UT to the Lumber River: 4,285 feet

Dimension and substrate	Cross Section 1 (Riffle)							Cross Section 2 (Pool)							Cross Section 3 (Riffle)							Cross Section 4 (Riffle)							Cross Section 5 (Pool)													
	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+							
<b>Based on fixed baseline bankfull elevation<sup>1</sup></b>																																										
Bankfull Width (ft)	5.67	5.88	5.59					8.66	7.75	8.22					8.47	9.32	7.01					7.79	6.13	5.73					8.92	8.74	9.25											
Floodprone Width (ft)	21.23	21.21	20.2					24.14	23.61	24.98					27.54	27.49	26.03					21.41	21.43	20.92					27.37	25.25	25.64											
Bankfull Mean Depth (ft)	0.63	0.69	0.65					0.45	0.43	0.44					0.64	0.52	0.53					0.46	0.46	0.43					0.64	0.55	0.51											
Bankfull Max Depth (ft)	1.3	1.3	1.22					0.94	0.91	1.07					1.12	1.12	1					0.96	0.98	0.93					1.29	1.08	1.07											
Bankfull Cross Sectional Area (ft <sup>2</sup> )	3.56	4.08	3.61					3.92	3.32	3.62					5.45	4.89	3.68					3.56	2.84	2.46					5.69	4.85	4.76											
Bankfull Width/Depth Ratio	9	8.52	8.6					19.24	18.02	18.68					13.23	17.92	13.23					16.93	13.33	13.33					13.94	15.89	18.14											
Bankfull Entrenchment Ratio	3.74	3.61	3.61					2.79	3.05	3.04					3.25	2.95	3.72					2.75	3.5	3.65					3.07	2.89	2.77											
Bankfull Bank Height Ratio	1	1	1					1	1	1					1	1	1					1	1	1					1	1	1											
Dimension and substrate	Cross Section 6 (Riffle)							Cross Section 7 (Riffle)							Cross Section 8 (Pool)							Cross Section 9 (Pool)							Cross Section 10 (Pool)													
<b>Based on fixed baseline bankfull elevation<sup>1</sup></b>																																										
Bankfull Width (ft)	6.95	7.37	6.92					7.73	8.03	7.76					11.85	9.67	9.77					8.91	8.96	9.56					9.78	10.24	9.9											
Floodprone Width (ft)	23.23	23.4	24.52					24.09	23.51	24.35					34.06	28.72	28.64					25.68	27.62	27.18					30.76	30.05	30.24											
Bankfull Mean Depth (ft)	0.63	0.63	0.62					0.52	0.5	0.5					0.56	0.55	0.53					0.69	0.6	0.61					0.8	0.73	0.68											
Bankfull Max Depth (ft)	1.22	1.2	1.31					1	0.88	1.02					1.43	1.13	1.18					1.1	1.4	1.43					1.55	1.34	1.32											
Bankfull Cross Sectional Area (ft <sup>2</sup> )	4.4	4.66	4.27					4.02	4.02	3.85					6.63	5.36	5.18					6.1	5.35	5.87					7.86	7.46	6.72											
Bankfull Width/Depth Ratio	11.03	11.7	11.16					14.87	16.06	15.52					21.16	17.58	18.43					12.91	14.93	15.67					12.22	14.03	14.56											
Bankfull Entrenchment Ratio	3.34	3.18	3.55					3.12	2.93	3.14					2.88	2.97	2.93					2.88	3.08	2.84					3.15	2.93	3.05											
Bankfull Bank Height Ratio	1	1	1					1	1	1					1	1	1					1	1	1					1	1	1											
Dimension and substrate	Cross Section 11 (Riffle)							Cross Section 12 (Riffle)							Cross Section 13 (Pool)							Cross Section 14 (Riffle)							Cross Section 15 (Pool)													
<b>Based on fixed baseline bankfull elevation<sup>1</sup></b>																																										
Bankfull Width (ft)	8.97	8.93	8.87					7.8	7.32	6.97					10.56	9.91	9.64					8.7	7.84	8.23					8.6	7.92	8.3											
Floodprone Width (ft)	24.87	24.47	24.85					26.85	23.54	22.89					30.02	25.24	25.92					27.03	25.7	26.14					27.48	27.66	27.78											
Bankfull Mean Depth (ft)	0.57	0.57	0.59					0.73	0.57	0.54					0.63	0.55	0.52					0.64	0.61	0.61					0.69	0.71	0.73											
Bankfull Max Depth (ft)	1.23	1.13	1.1					1.27	0.91	0.85					1.61	1.07	1.09					1.22	1.09	1.14					1.4	1.54	1.52											
Bankfull Cross Sectional Area (ft <sup>2</sup> )	5.15	5.05	5.26					5.7	4.15	3.79					6.68	5.45	4.99					5.59	4.78	5.01					5.94	5.6	6.07											
Bankfull Width/Depth Ratio	15.74	15.67	15.03					10.68	12.84	12.91					16.76	18.02	18.54					13.59	12.85	13.49					12.46	11.15	11.37											
Bankfull Entrenchment Ratio	2.77	2.74	2.8					3.44	3.22	3.29					2.84	2.55	2.69					3.11	3.28	3.18					3.19	3.49	3.35											
Bankfull Bank Height Ratio	1	1	1					1	1	1					1	1	1					1	1	1					1	1	1											
Dimension and substrate	Cross Section 16 (Pool)							Cross Section 17 (Riffle)																																		
<b>Based on fixed baseline bankfull elevation<sup>1</sup></b>																																										
Bankfull Width (ft)	9	8.87	8.62					8.28	6.18	8																																
Floodprone Width (ft)	32.36	29.35	30.41					28.3	26.31	26.66																																
Bankfull Mean Depth (ft)	0.81	0.68	0.7					0.69	0.52	0.61																																
Bankfull Max Depth (ft)	1.62	1.34	1.42					1.83	1.5	1.53																																
Bankfull Cross Sectional Area (ft <sup>2</sup> )	7.27	6.06	6.01					5.74	3.2	4.89																																
Bankfull Width/Depth Ratio	11.11	13.04	12.31					12	11.88	13.11																																
Bankfull Entrenchment Ratio	3.6	3.31	3.53					3.42	4.26	3.33																																
Bankfull Bank Height Ratio	1	1	1					1	1	1																																

<sup>1</sup> = Widths and depths for each resurvey will be based on the baseline bankfull datum regardless of dimensional/depositional development.

**Table 12. Monitoring Data - Stream Reach Data Summary**  
**UT to the Lumber River Site, 002027**  
**Reach 1 (Upper), UT to the Lumber River: 1,162 feet**

Parameter	Baseline			MY-1			MY-2			MY-3			MY-4			MY-5		
	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
<b>Dimension and substrate - Riffle only</b>																		
Bankfull Width (ft)	5.67	7.31	8.47	5.88	7.11	9.32	5.59	6.11	7.01									
Floodprone Width (ft)	21.23	23.39	27.54	21.21	23.38	27.49	20.20	22.38	26.03									
Bankfull Mean Depth (ft)	0.46	0.58	0.64	0.46	0.56	0.69	0.43	0.54	0.65									
Bankfull Max Depth (ft)	0.96	1.13	1.30	0.98	1.13	1.30	0.93	1.05	1.22									
Bankfull Cross Sectional Area (ft <sup>2</sup> )	3.56	4.19	5.45	2.84	3.94	4.89	2.46	3.25	3.68									
Bankfull Width/Depth Ratio	9.00	13.05	16.93	8.52	13.26	17.92	8.60	11.72	13.33									
Bankfull Entrenchment Ratio	2.75	3.25	3.74	2.95	3.35	3.61	3.61	3.66	3.72									
Bankfull Bank Height Ratio	1	1	1	1	1	1	1	1	1									
<b>Profile</b>																		
Riffle Length (ft)	5.50	21.67	47.00	14.99	51.77	121.03	16.07	33.74	122.1									
Riffle Slope (ft/ft)	0.000	0.002	0.013	0.0012	0.0031	0.0050	0.0007	0.0025	0.0051									
Pool Length (ft)	11.00	27.50	48.00	11.78	43.97	68.55	17.14	35.85	58.91									
Pool Max Depth (ft)	1.01	1.33	1.65	1.13	1.33	1.91	1.18	1.4	1.68									
Pool Spacing (ft)	23.00	49.96	91.00	20.35	54.62	131.74	27.85	63.86	155.3									
<b>Pattern</b>																		
Channel Beltwidth (ft)	15.5	31	46.5															
Radius of Curvature (ft)	15.5	19.4	23.3															
Rc:Bankfull Width (ft/ft)	2	2.5	3															
Meander Wavelength (ft)	23.3	50.4	77.5															
Meander Width Ratio	3	6.5	10															
<b>Additional Reach Parameters</b>																		
Rosgen Classification	E5			E5			E5											
Channel Thalweg length (ft)	1162			1113			1106											
Sinuosity (ft)	1.25			1.21			1.2											
Water Surface Slope (Channel) (ft/ft)	0.0018			0.00163			0.00127											
BF slope (ft/ft)	0.0018			0.00143			0.0014											
<sup>3</sup> Ri% / P%	44.1 / 55.9			44.8 / 55.2			44.6 / 55.4											
<sup>3</sup> SC% / Sa% / G% / C% / B% / Be%																		
<sup>3</sup> d16 / d35 / d50 / d84 / d95																		
<sup>2</sup> % of Reach with Eroding Banks																		
Channel Stability or Habitat Metric																		
Biological or Other																		

Shaded cells indicate that these will typically not be filled in.

1 = The distributions for these parameters can include information from both the cross-section surveys and the longitudinal profile.

2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table

3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave

4 = Of value/needed only if the n exceeds 3

**Table 12. Monitoring Data - Stream Reach Data Summary**  
**UT to the Lumber River Site, 002027**  
**Reach 2 (Lower), UT to the Lumber River: 3,123 feet**

Parameter	Baseline			MY-1			MY-2			MY-3			MY-4			MY-5		
	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
<b>Dimension and substrate - Riffle only</b>																		
Bankfull Width (ft)	6.95	8.07	8.97	6.18	7.61	8.93	6.92	7.79	8.87									
Floodprone Width (ft)	23.23	25.73	28.30	23.40	24.49	26.31	22.89	24.90	26.66									
Bankfull Mean Depth (ft)	0.52	0.63	0.73	0.50	0.57	0.63	0.50	0.58	0.62									
Bankfull Max Depth (ft)	1.00	1.30	1.83	0.88	1.12	1.50	0.85	1.16	1.53									
Bankfull Cross Sectional Area (ft <sup>2</sup> )	4.02	5.10	5.74	3.20	4.31	5.05	3.79	4.51	5.26									
Bankfull Width/Depth Ratio	10.68	12.99	15.74	11.70	13.50	16.06	11.16	13.54	15.52									
Bankfull Entrenchment Ratio	2.77	3.20	3.44	2.74	3.27	4.26	2.80	3.22	3.55									
Bankfull Bank Height Ratio	1	1	1	1	1	1	1	1	1									
<b>Profile</b>																		
Riffle Length (ft)	5.00	22.77	87.00	10.3	25.29	81.89	12.74	43.35	102.48									
Riffle Slope (ft/ft)	0.000	0.002	0.011	0.0000	0.0029	0.0081	0.0005	0.0019	0.0039									
Pool Length (ft)	6.00	23.77	51.00	6.02	35.47	109.59	11.64	39.88	67.26									
Pool Max Depth (ft)	1.16	1.55	2.10	1.41	1.70	2.19	1.27	1.64	2.37									
Pool Spacing (ft)	16.00	22.77	87.00	16.61	47.70	104.41	17.78	52.02	131.75									
<b>Pattern</b>																		
Channel Beltwidth (ft)	17.5	35	52.5															
Radius of Curvature (ft)	17.5	21.9	26.3															
Rc:Bankfull Width (ft/ft)	2	2.5	3															
Meander Wavelength (ft)	26.3	56.9	87.5															
Meander Width Ratio	3	6.5	10															
<b>Additional Reach Parameters</b>																		
Rosgen Classification	E5			E5			E5											
Channel Thalweg length (ft)	*3123			*3166			*3129											
Sinuosity (ft)	1.25			1.26			1.25											
Water Surface Slope (Channel) (ft/ft)	0.00154			0.00169			0.00159											
BF slope (ft/ft)	0.00154			0.00149			0.00145											
<sup>2</sup> Ri% / P%	49.3 / 50.7			48.7 / 51.3			46.1 / 53.9											
<sup>3</sup> SC% / Sa% / G% / C% / B% / Be%																		
<sup>3</sup> d16 / d35 / d50 / d84 / d95																		
<sup>2</sup> % of Reach with Eroding Banks																		
Channel Stability or Habitat Metric																		
Biological or Other																		

Shaded cells indicate that these will typically not be filled in.

\*50 foot easement crossing is taken out of the stationing to get channel thalweg length.

1 = The distributions for these parameters can include information from both the cross-section surveys and the longitudinal profile.

2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table

3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave

4 = Of value/needed only if the n exceeds 3

## Appendix E. Hydrologic Data

Table 13. Verification of Bankfull Events

Date	Crest Gauge Info		Gauge Reading (ft)	Gauge Elevation (ft)	Crest Elevation (ft)	Bankfull Elevation (ft)	Height above Bankfull (ft)	Photo
	Site	Sta.						
10/13/2011	XS 16	48+13	1.75	146.9	148.65	148.36	0.29	6.1
6/9/2011	XS 8	30+90	1.85	149.52	151.37	150.79	0.58	6.2



Figures 6.1 & 6.2 Crest Gauge Photos