

YEAR 5 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

217 West Jones Street, Suite 3000A

Raleigh, North Carolina 27603

Construction Completed: April 2010

Morphology Data Collected: April 10, 2014

Vegetation Data Collected: August 12, 2014

Submitted: October 27, 2014

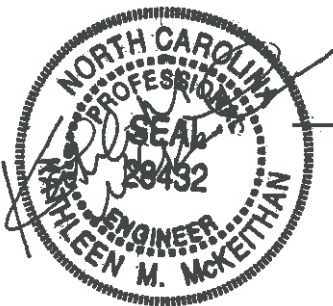
Prepared by:



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I HEREBY CERTIFY THAT THE DOCUMENTS CONTAINED HEREIN, UT TO THE LUMBER RIVER YEAR 5 MONITORING REPORT WERE PREPARED BY ME OR UNDER MY DIRECT SUPERVISION.

SIGNED SEALED, AND DATED THIS 27th DAY OF OCTOBER 2014.



Kathleen M. McKeithan, PE, CPESC, CPSWQ, CFM

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1.0 EXECUTIVE SUMMARY

The following report summarizes the vegetation establishment and stream stability for Year 5 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 fifth 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 2260 stems per acre. The species planted include river birch (*Betula nigra*), green ash (*Fraxinus pennsylvanica*), sycamore (*Platanus occidentalis*), black willow (*Salix nigra*), silky dogwood (*Corunus amomum*), water oak (*Quercus nigra*), willow oak (*Quercus phellos*), and button bush (*Cephalanthus occidentals*).

Areas previously noted to have sparse ground cover and minor erosion are forming moss and becoming increasingly stable. (See Current Condition Plan View (CCPV) map). Additionally, bare root plants along the side slopes are continuing to survive and provide further stability to the soil along the slopes. Remaining areas of minor erosion are not expected to be issues of concern

in the future as the vegetation continues to mature. Additional seeding or planting is not recommended.

Isolated areas of invasive/exotic plant species were observed; however, the invasive species do not seem to be out-competing the natural or planted vegetation and no corrective action is recommended at this time. Invasive/exotic vegetation is not expected to compromise the vegetative success of the site in the future.

Previous mowing occurring within the easement along Deep Branch Road underneath the power line appears to have ceased.



Figure 1.0 Evidence that mowing has ceased underneath power line

Beaver activity was observed in the channel near station 24+50, and a small beaver dam affected vegetation between stations 24+50 and 25+25. The beavers were removed in the spring of 2014 and woody vegetation is expected to regenerate in the absence of the beaver dam. Additional planting is not recommended at this time.



Figure 1.1 Vegetation affected by beaver compound

1.3 Stream Stability

The UT to the Lumber River appears to be stable and functioning as designed. Surveys do not show significant change to channel dimension, profile or pattern, and cross-sectional data confirms that the channel has experienced little change in dimension. Minor shifting of pools and sediment depositions are occurring; however, such changes in profile are expected in a dynamic, sand bed channel, and we expect excess sediment to be flushed out in future high flow storm events. Table 5, Visual Stream Morphology Stability Assessment, details 53 pools that are “stable, performing as intended”. The as-built profile depicted 63 pools. This would give a 84 percent rate of “stable, performing as intended” for Year 5 Monitoring, up from 75 percent for Year 4 Monitoring, 94 percent for Year 3 Monitoring, 92 percent for Year 2 Monitoring, and 76 percent for Year 1. These numbers are expected to continue to fluctuate in a sand bed system and it is our opinion that the channel is performing as it should.

The stream bed appears to have scoured between stations 42+00 through 44+00. It is unclear what caused this scour but based on field observations, there is no evidence of stream bank erosion or mass wasting in this area.

During Year 5 stream surveys a beaver dam was identified near station 24+50. This dam backed water up throughout the upper reach, leading to a water surface slope that is not indicative of normal circumstances. The dam was removed in the spring of 2014 and had no effect on the stability of the stream after Year 5 Monitoring.

The site has experienced several bankfull flows throughout the fifth year of monitoring. On-site crest gauges revealed that a bankfull event occurred at least twice during 2014. Rainfall exceeded one inch three separate times (January 12, February 13, and March 7) in the first quarter of 2014 and precipitation totaled 0.902 inches on April 19, 2014. Because bankfull events were not witnessed in person, dates can only be estimated based on rainfall data. 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 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 5 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 and Dan Mecklenburg's The Reference Reach Spreadsheet Version 4.3L 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 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 [May 15, 2011]. University of North Carolina Herbarium, North Carolina Botanical Garden, University of North Carolina, Chapel Hill, North Carolina.

4.0 APPENDICES

Appendix A. Background Tables

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.
Component Summations							
Restoration Level	Stream (LF)		Buffer (AC)				
Restoration	4,285		17.2				
Enhancement I							
Enhancement II	463		1.9				
Preservation	6,300		48.1				
Totals	11,022		67.2				

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

The as-built stationing on UT Lumber River 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.

Table 2. Project Activity and Reporting History

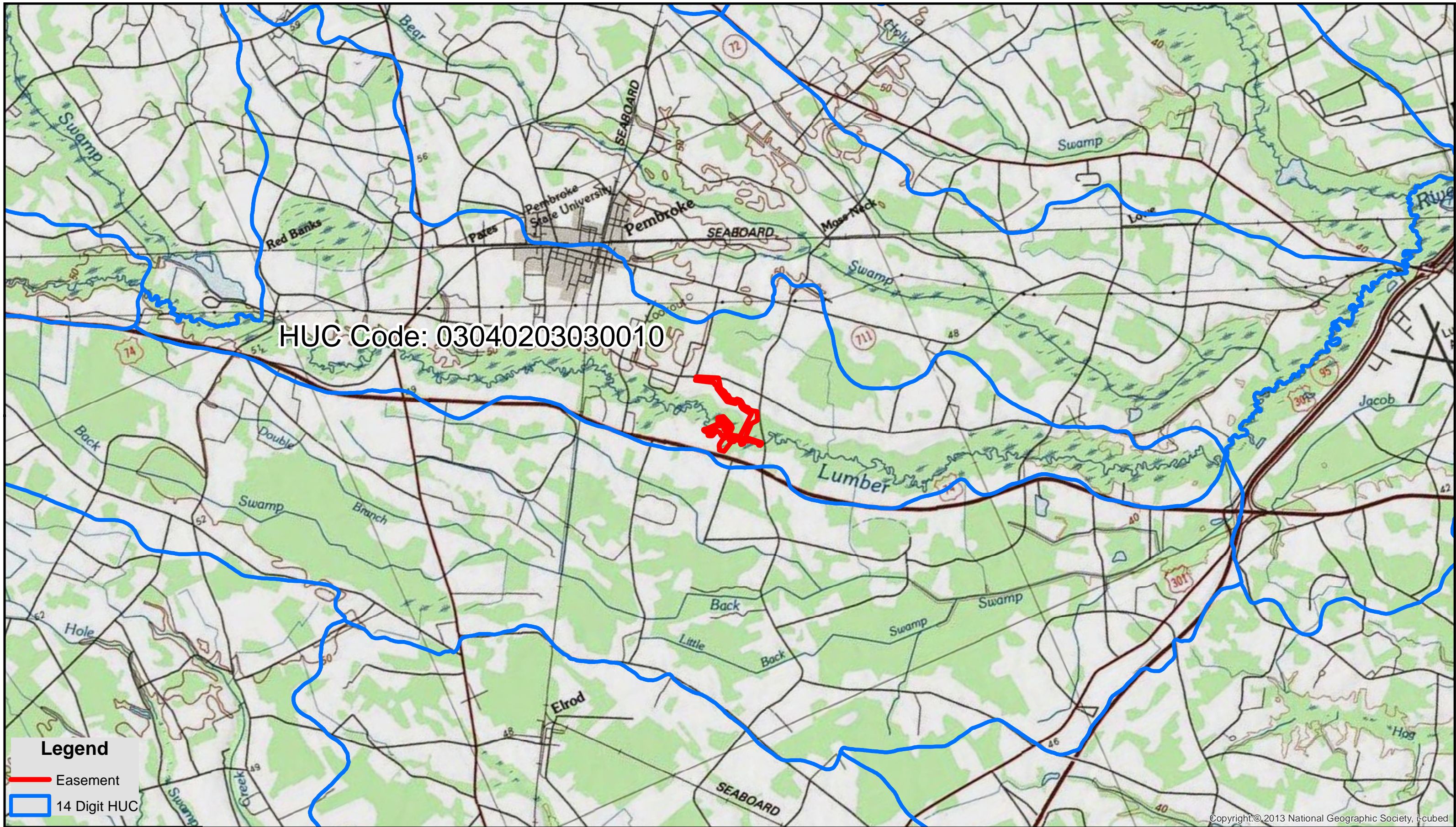
Activity or Report	Data Collection Complete	Completion or Delivery
Restoration Plan	September 2009	October 2009
Final Design – Construction Plans	October 2009	November 2009
Construction	January 18, 2010	April 9, 2010
Temporary S&E Mix Applied to Entire Project Area	January 18, 2010	April 9, 2010
Permanent 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	December 5, 2011
Year 3 Monitoring	September 28, 2012	December 11, 2012
Year 4 Monitoring	October 11, 2013	November 1, 2013
Year 5 Monitoring	August 12, 2014	October 27, 2014

Table 3. Project Contacts Table



Designer Primary project design POC	ICA Engineering, Inc. f/k/a Florence & Hutcheson, Inc. 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Kevin Williams (919) 851-6066
Construction Contractor Construction Contractor POC	Land Mechanics Design Lloyd Glover 126 Circle G Lane Willow Springs, NC 27592 (919) 639-6132
Planting Contractor Planting Contractor POC	Bruton Natural Systems Charlie Bruton PO Box 1197 Fremont, NC 27830 (919) 242-6555
Seeding Contractor 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
Monitoring Performers	ICA Engineering, Inc. f/k/a Florence & Hutcheson, Inc. 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Ben Furr (919) 851-6066
Stream Monitoring POC	ICA Engineering, Inc. f/k/a Florence & Hutcheson, Inc. 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Kevin Williams (919) 851-6066
Vegetation Monitoring POC	ICA Engineering, Inc. f/k/a Florence & Hutcheson, Inc. 5121 Kingdom Way, Suite 100 Raleigh, North Carolina 27607 Ben Furr (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	
Restoration Component Attributes		
	UT Lumber River	Lumber River
Drainage Area	0.42 sq mi (At End of Restoration Reach)	432 sq mi
Stream Order (USGS topo)	1 st	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



HUC Code: 03040203030010

- Legend**
-  Easement
 -  14 Digit HUC

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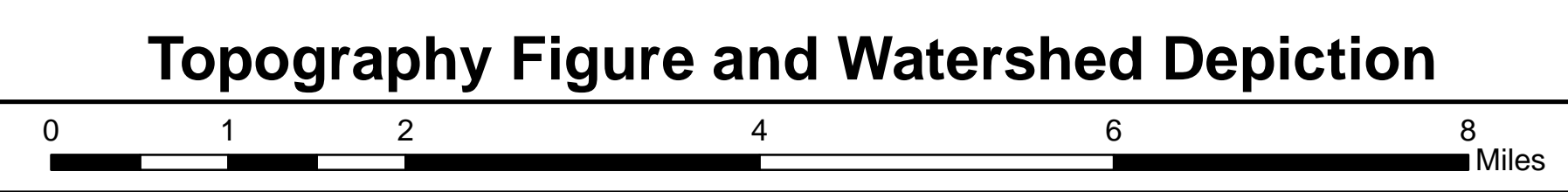
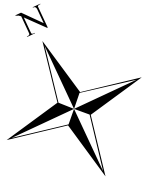
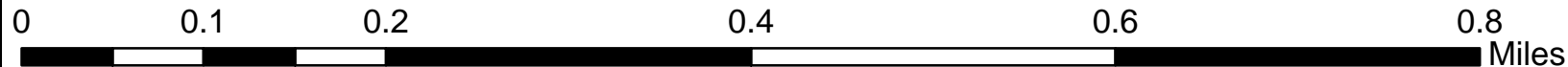
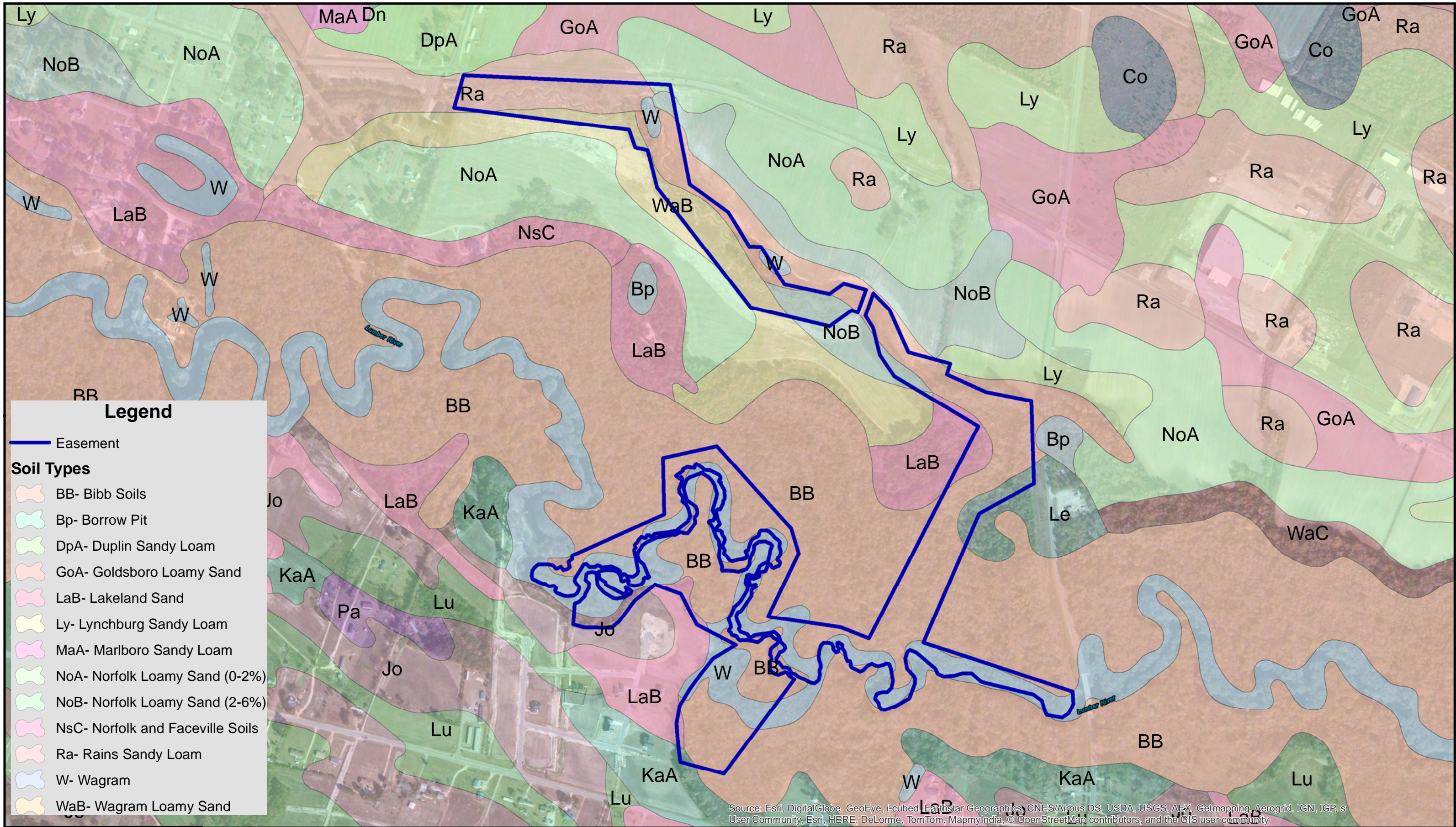
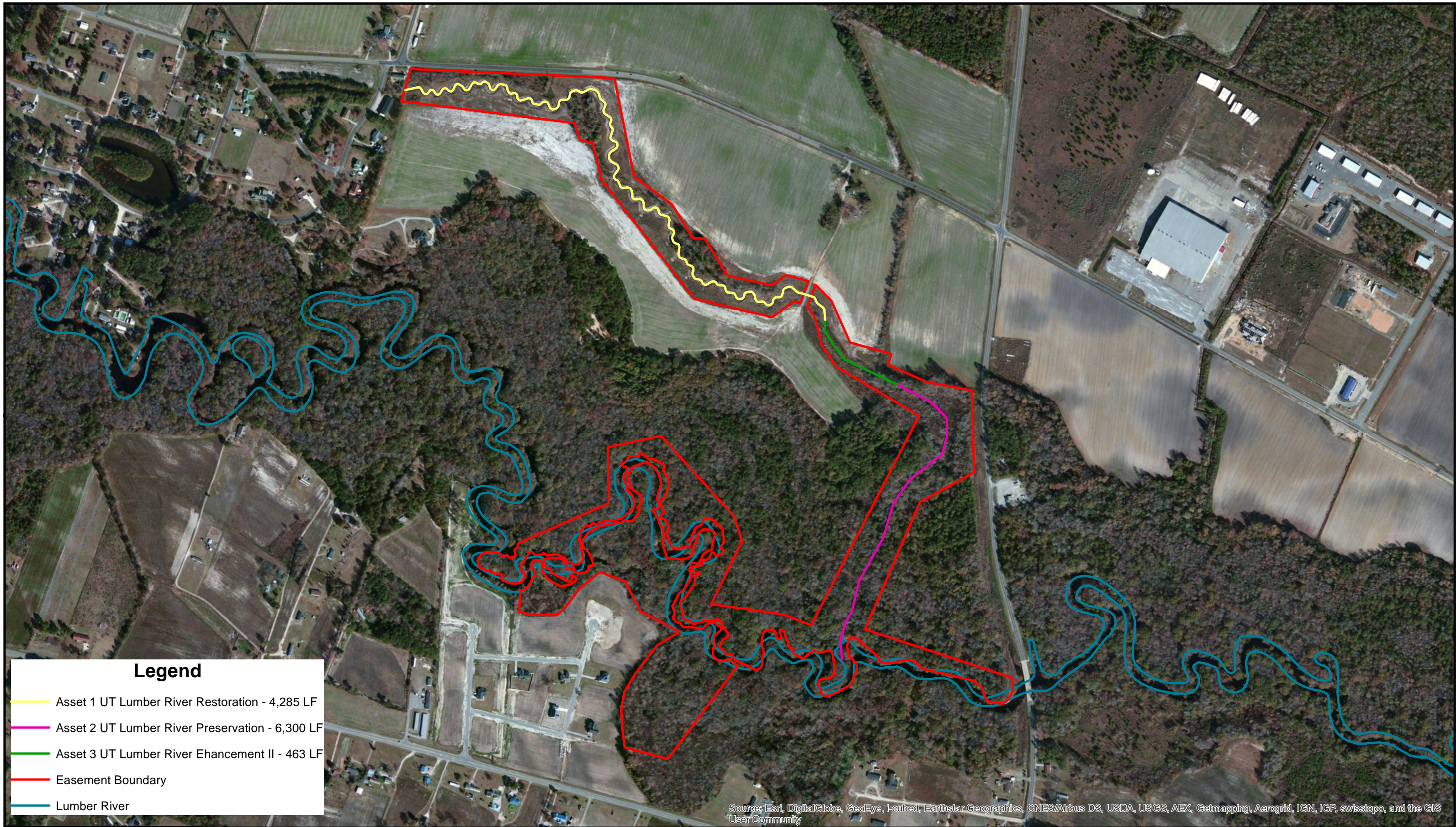


Figure 2.0



Soils Map

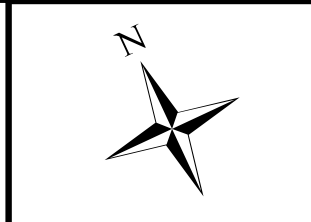
Figure 2.1



Legend

- Asset 1 UT Lumber River Restoration - 4,285 LF
- Asset 2 UT Lumber River Preservation - 6,300 LF
- Asset 3 UT Lumber River Enhancement II - 463 LF
- Easement Boundary
- Lumber River

Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



UT Lumber River Asset Map
Robeson County, North Carolina

0 0.1 0.2 0.4 0.6 0.8
Miles

**Figure
2.2**

Appendix B. Visual Assessment Data

Figures 3.0-3.8. Current Condition Plan View

9/29/2014
R:\stream\Proj\Monitoring CCPV\Year 5\LumberRiver-psh2\0_Monitoring_Y5_CCPV.dgn
E:\stream & Hydrology



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
- EXISTING WETLANDS

YEAR 5 CONDITIONS

IN-STREAM STRUCTURE CONDITION

- STABLE

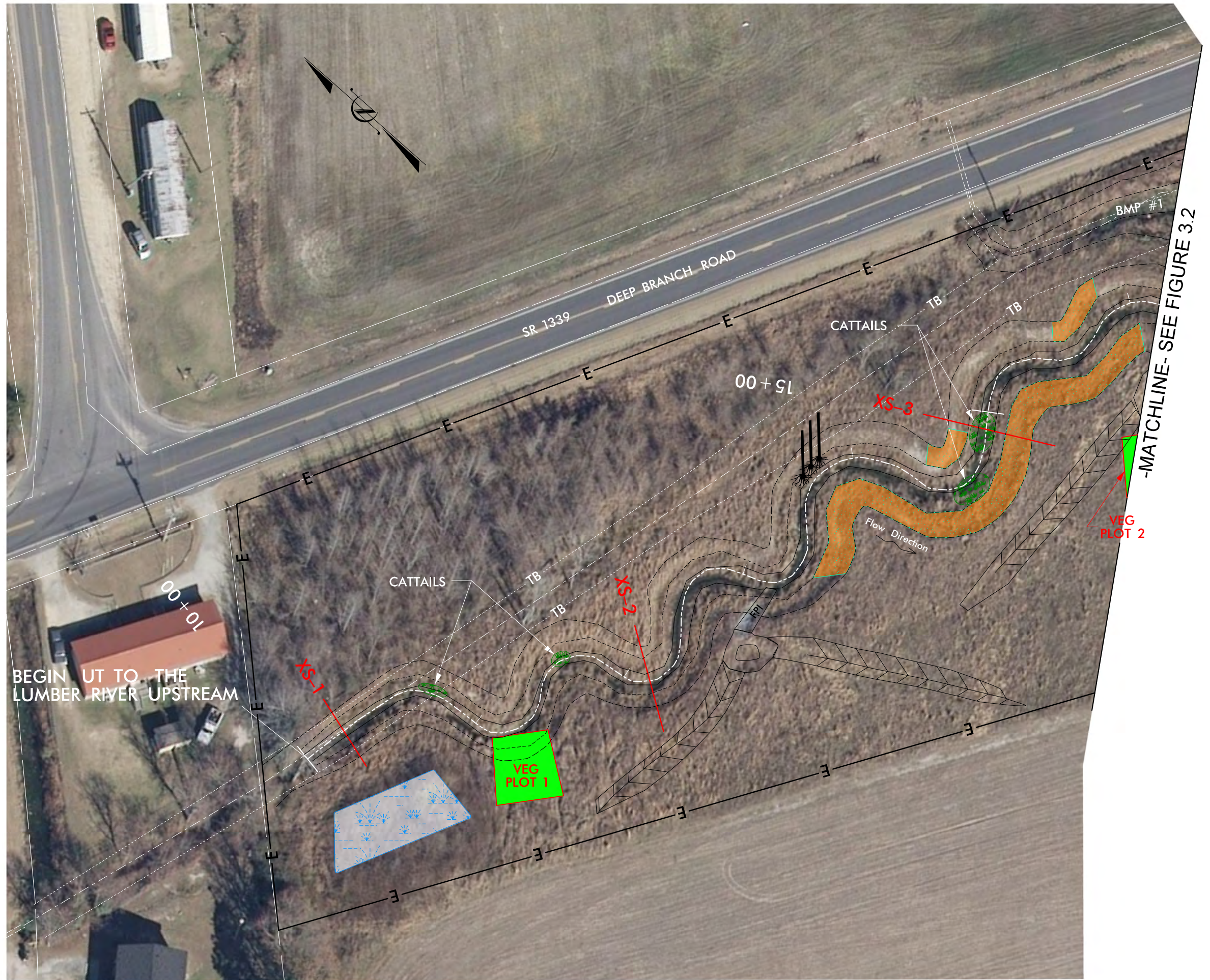
VEGETATION PROBLEM AREAS

- INVASIVE POPULATION
- THIN GRASS

VEGETATION PLOT CONDITIONS

- CRITERIA MET
- CRITERIA UNMET

CURRENT CONDITIONS PLAN VIEW (CCPV)



-MATCHLINE- SEE FIGURE 3.2

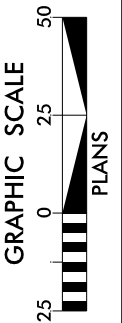
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UT TO THE LUMBER RIVER
STREAM RESTORATION PROJECT
ROBESON COUNTY, NORTH CAROLINA



DATE: 09-16-14

CCPV

Figure 3.1

CURRENT CONDITIONS PLAN VIEW (CCPV)



-MATCHLINE- SEE FIGURE 3.1

-MATCHLINE- SEE FIGURE 3.3

END UT TO THE LUMBER RIVER UPSTREAM
BEGIN UT TO THE LUMBER RIVER DOWNSTREAM

LEGEND

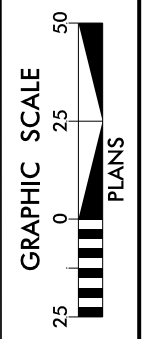
- | | | | |
|-----|------------------------|-----|------------------------------|
| --- | TOP OF TERRACE | --- | PRE-CONSTRUCTION TOP OF BANK |
| --- | THALWEG | --- | PRE-CONSTRUCTION THALWEG |
| --- | BANKFULL | --- | |
| --- | TOE OF TERRACE | --- | |
| --- | CROSS-SECTION LOCATION | --- | |
| E | EASEMENT BOUNDARY | --- | |
| --- | LOG SILL | --- | |
| --- | | --- | |
| --- | | --- | |
-
- | | |
|--------------------------------------|---------------------------|
| YEAR 5 CONDITIONS | |
| --- | BANK/BED CONDITION |
| --- | MINOR EROSION |
| IN-STREAM STRUCTURE CONDITION | |
| --- | STABLE |
| VEGETATION PROBLEM AREAS | |
| --- | INVASIVE POPULATION |
| --- | THIN GRASS |
| VEGETATION PLOT CONDITIONS | |
| --- | CRITERIA MET |
| --- | CRITERIA UNMET |

9/29/2014 8:15 AM C:\Users\j\Documents\Projects\Monitoring CCPV Year 5 Lumber-River-psh2.2-Monitoring_Y5_CCPV.dgn



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UT TO THE LUMBER RIVER
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ROBESON COUNTY, NORTH CAROLINA



DATE: 09-16-14

CCPV

Figure 3.2

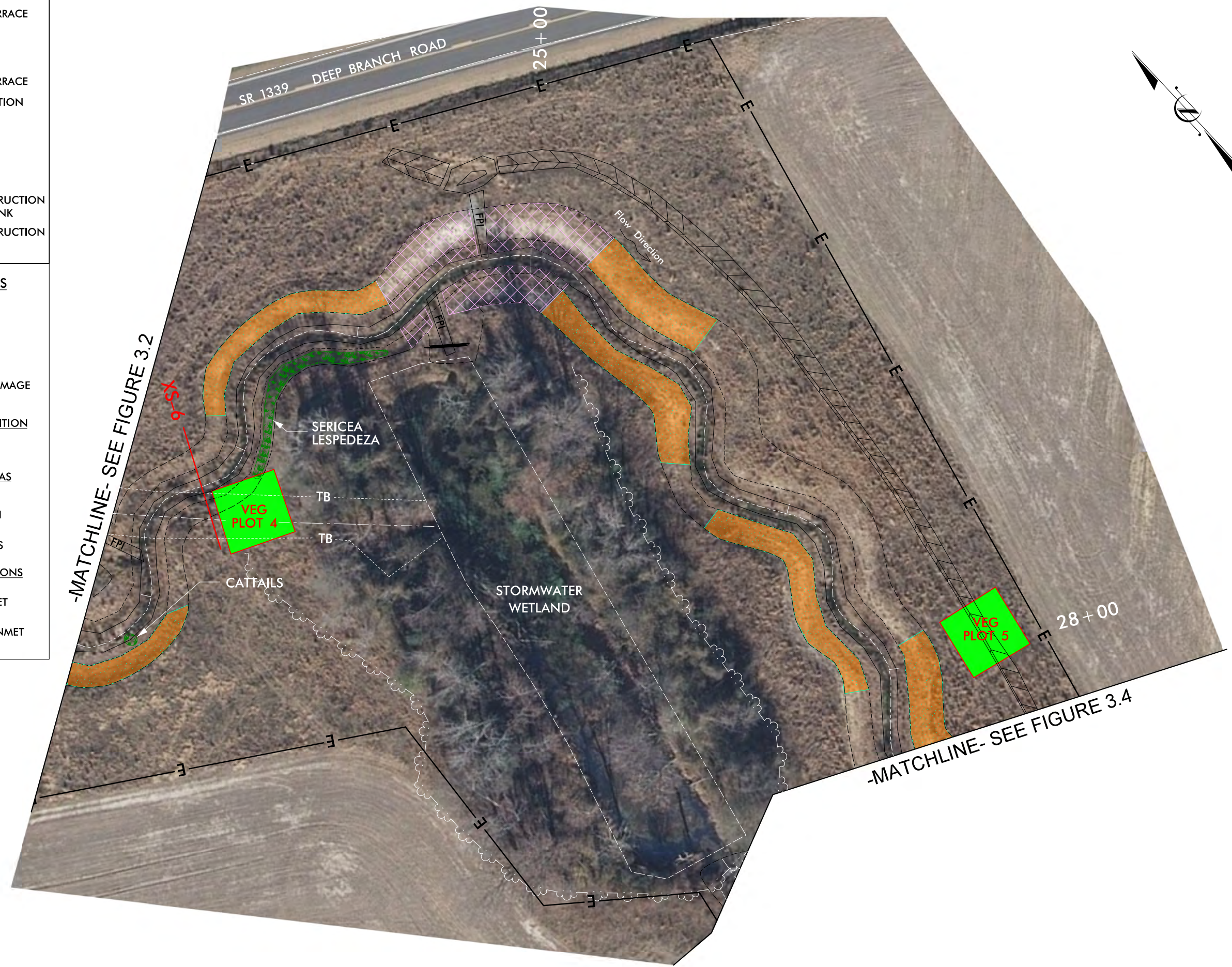
LEGEND

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

YEAR 5 CONDITIONS

- BANK/BED CONDITION**
 - MINOR EROSION
 - BEAVER DAMAGE
- IN-STREAM STRUCTURE CONDITION**
 - STABLE
- VEGETATION PROBLEM AREAS**
 - INVASIVE POPULATION
 - THIN GRASS
- VEGETATION PLOT CONDITIONS**
 - CRITERIA MET
 - CRITERIA UNMET

CURRENT CONDITIONS PLAN VIEW (CCPV)



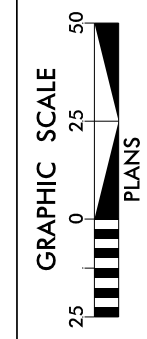
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UT TO THE LUMBER RIVER
STREAM RESTORATION PROJECT
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DATE: 09-16-14

CCPV

Figure 3.3

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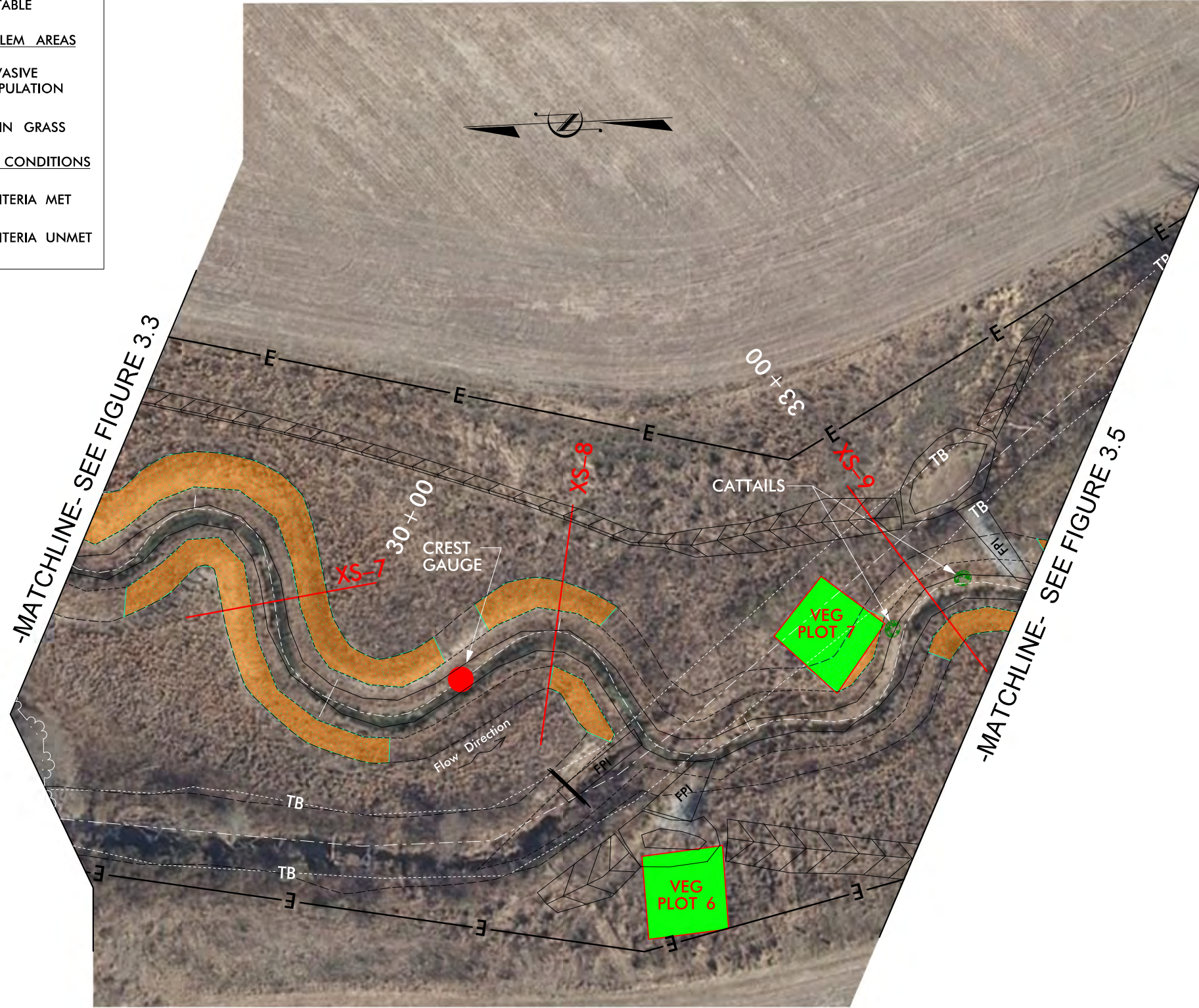
LEGEND

- 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

YEAR 5 CONDITIONS

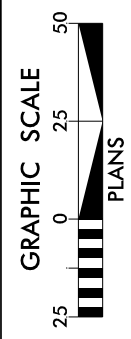
- IN-STREAM STRUCTURE CONDITION
- STABLE
- VEGETATION PROBLEM AREAS
- INVASIVE POPULATION
- THIN GRASS
- VEGETATION PLOT CONDITIONS
- CRITERIA MET
- CRITERIA UNMET

CURRENT CONDITIONS PLAN VIEW (CCPV)



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



DATE: 09-16-14

CCPV

Figure 3.4

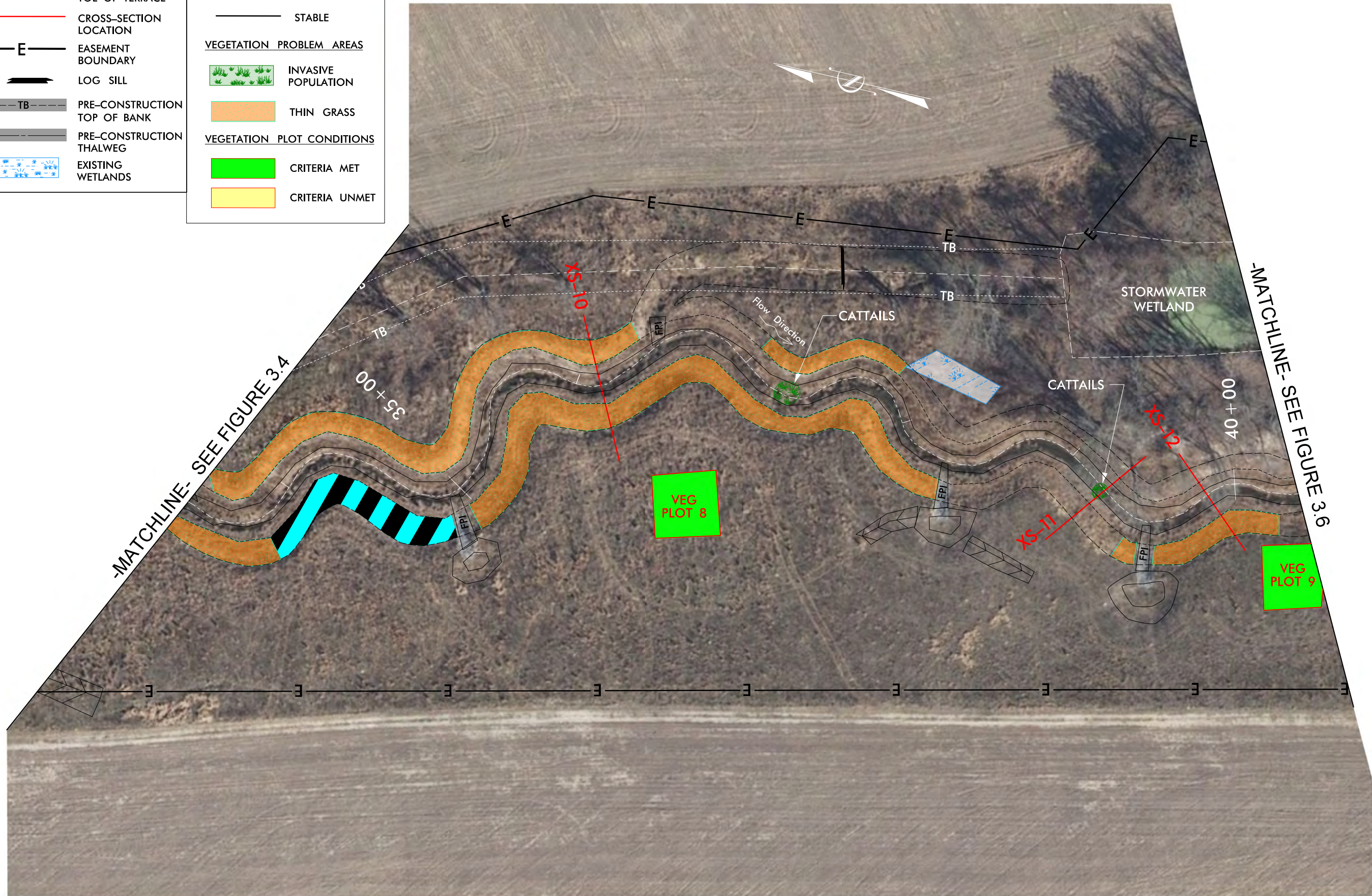
LEGEND

- 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
- EXISTING WETLANDS

YEAR 5 CONDITIONS

- BANKBED CONDITION**
- MINOR EROSION
- IN-STREAM STRUCTURE CONDITION**
- STABLE
- VEGETATION PROBLEM AREAS**
- INVASIVE POPULATION
- THIN GRASS
- VEGETATION PLOT CONDITIONS**
- CRITERIA MET
- CRITERIA UNMET

CURRENT CONDITIONS PLAN VIEW (CCPV)



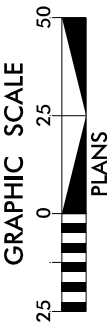
9/29/2014 9:29 AM C:\Projects\Monitoring CCPV Year 5\LumberRiver-psn2.5-Monitoring-Y5-CCPV.dgn



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STREAM RESTORATION PROJECT
ROBESON COUNTY, NORTH CAROLINA

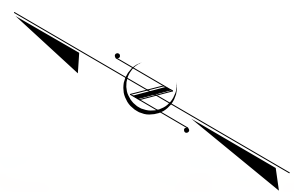


DATE: 09-16-14

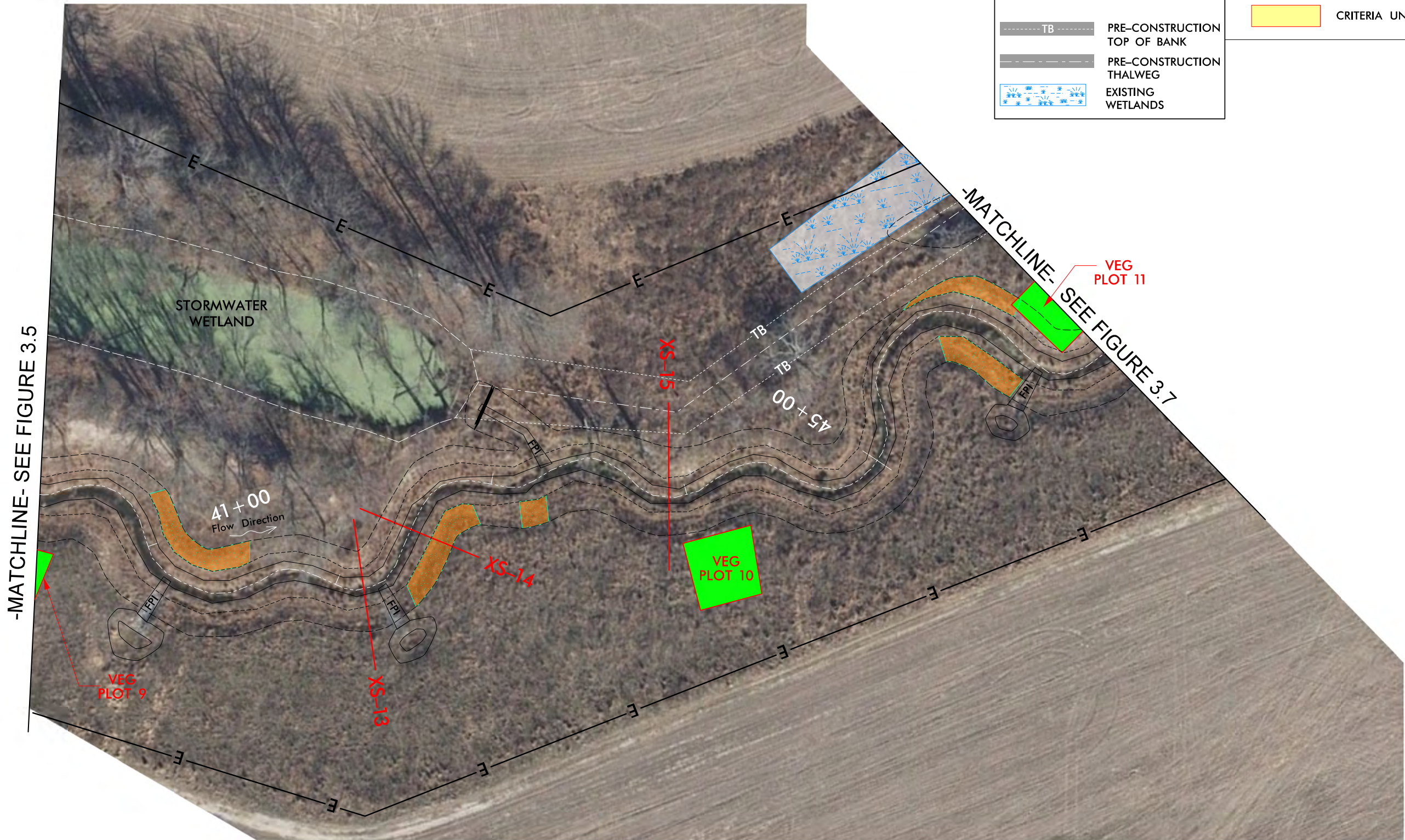
CCPV

Figure 3.5

CURRENT CONDITIONS PLAN VIEW (CCPV)



LEGEND		YEAR 5 CONDITIONS	
-----	TOP OF TERRACE	-----	IN-STREAM STRUCTURE CONDITION
-----	THALWEG	————	STABLE
————	BANKFULL		VEGETATION PROBLEM AREAS
-----	TOE OF TERRACE	■	THIN GRASS
—	CROSS-SECTION LOCATION	■	CRITERIA MET
—E—	EASEMENT BOUNDARY	■	CRITERIA UNMET
—	LOG SILL		
-----TB-----	PRE-CONSTRUCTION TOP OF BANK		
-----	PRE-CONSTRUCTION THALWEG		
■	EXISTING WETLANDS		

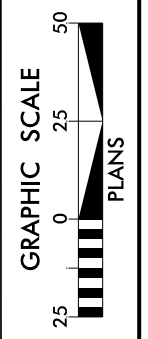


9/29/2014 R:\stream\Proj\Monitoring CCPV\Year 5\LumberRiver-psb2.6.Monitoring_Y5_CCPV.dgn



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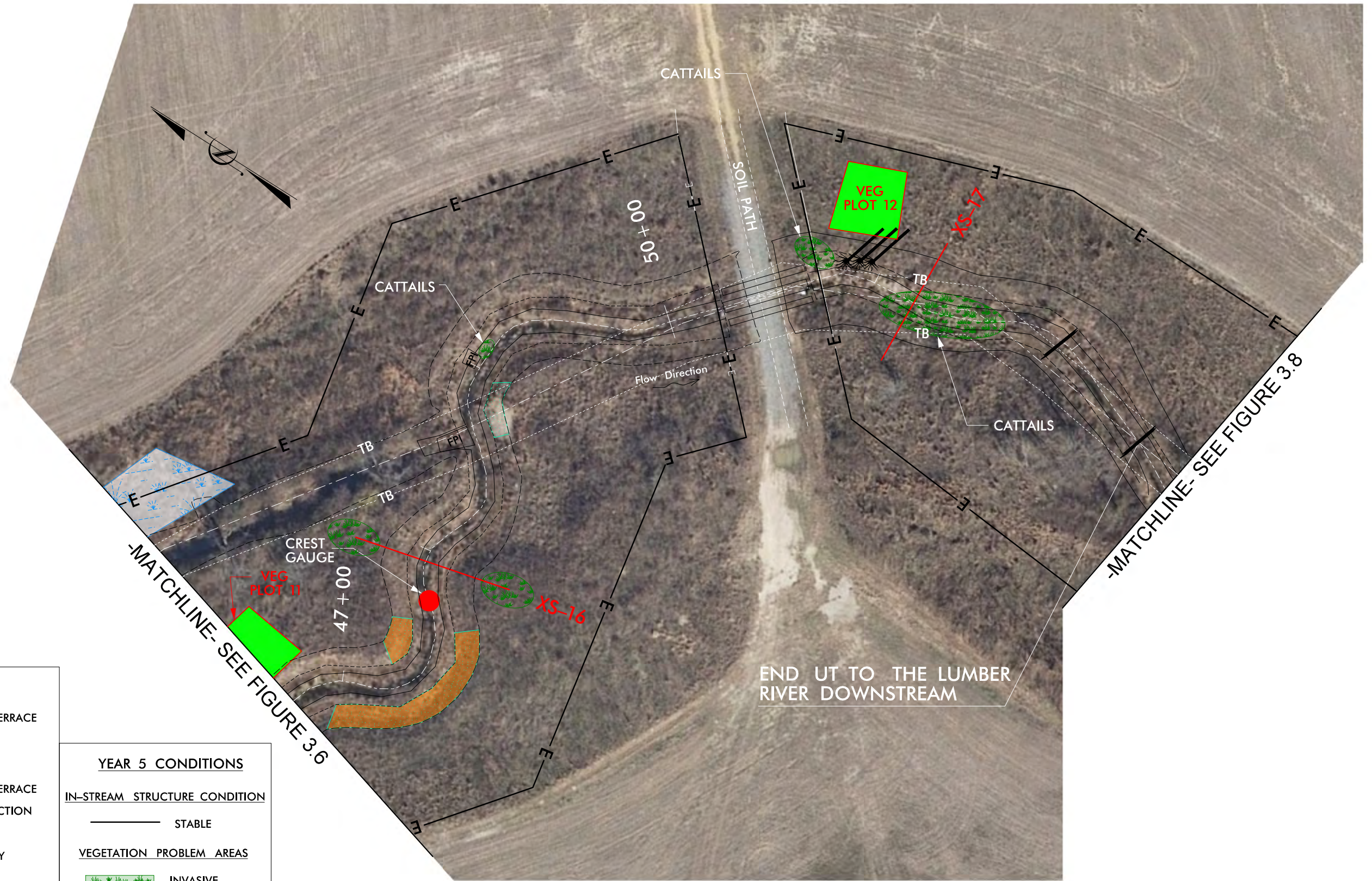


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Figure 3.6

CURRENT CONDITIONS PLAN VIEW (CCPV)



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
- EXISTING WETLANDS

YEAR 5 CONDITIONS

- IN-STREAM STRUCTURE CONDITION**
- STABLE
- VEGETATION PROBLEM AREAS**
- INVASIVE POPULATION
 - THIN GRASS
- VEGETATION PLOT CONDITIONS**
- CRITERIA MET
 - CRITERIA UNMET

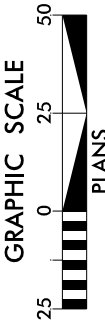
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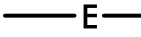





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Figure 3.7

LEGEND

-  EASEMENT BOUNDARY
-  LOG SILL
-  TB PRE-CONSTRUCTION TOP OF BANK
-  TB PRE-CONSTRUCTION THALWEG

YEAR 5 CONDITIONS

VEGETATION PLOT CONDITIONS

-  CRITERIA MET
-  CRITERIA UNMET

CURRENT CONDITIONS PLAN VIEW (CCPV)



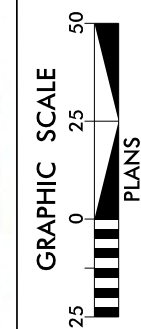
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UT TO THE LUMBER RIVER
STREAM RESTORATION PROJECT
ROBESON COUNTY, NORTH CAROLINA



DATE: 09-16-14

CCPV

Figure 3.8

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 (Riffle 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. Riffle Condition	1. <u>Texture/Substrate</u> - Riffle maintains coarser substrate	All	N/A			100%							
	3. Meander Pool Condition	1. <u>Depth</u> Sufficient	53	63										84%
		2. <u>Length</u> appropriate	53	63										84%
	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
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT 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				
Totals					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						
Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited ground cover (grass).	All bare or sparse areas were mapped.	See legend on CCPV (includes thin grass, no grass, and minor wash areas).	34	0.87	5.8
2. Low Stem Density Areas	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
3. Areas of Poor Growth Rates or Vigor	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						
Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	All populations were mapped	See legend on CCPV	14	0.06	0.4
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	None	N/A	N/A	N/A	N/A

Appendix C. Vegetation Plot Data

Figures 4.0-4.13. Vegetation Plot Photos and Pre-existing Condition Photos



4.0 Vegetation Plot 1



4.1 Vegetation Plot 2



4.2 Vegetation Plot 3



4.3 Vegetation Plot 4



4.4 Vegetation Plot 5



4.5 Vegetation Plot 6



4.6 Vegetation Plot 7



4.7 Vegetation Plot 8



4.8 Vegetation Plot 9



4.9 Vegetation Plot 10



4.10 Vegetation Plot 11



4.11 Vegetation Plot 12



4.12 Vegetation Plot 13



4.13 Vegetation Plot 14

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	20	809	Yes
2	Coastal Plain Small Stream Swamp	CPSSS	Upper	II	15	607	Yes
3	Coastal Plain Small Stream Swamp	CPSSS	Upper	II	12	486	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	15	607	Yes
7	Coastal Plain Small Stream Swamp	CPSSS	Lower	II	24	971	Yes
8	Coastal Plain Small Stream Swamp	CPSSS	Lower	II	21	850	Yes
9	Coastal Plain Small Stream Swamp	CPSSS	Lower	II	16	648	Yes
10	Coastal Plain Small Stream Swamp	CPSSS	Lower	II	14	567	Yes
11	Coastal Plain Small Stream Swamp	CPSSS	Lower	II	13	526	Yes
12	Coastal Plain Small Stream Swamp	CPSSS	Lower	II	18	728	Yes
13	Coastal Plain Small Stream Swamp	CPSSS	Lower	II	17	688	Yes
14	Coastal Plain Small Stream Swamp	CPSSS	Lower	II	15	607	Yes
Average Stems Per Acre						676	

Table 8. CVS Vegetation Metadata

Report Prepared By	Ryan Smith
Date Prepared	8/25/2014 16:06
database name	CVS_entry - 2013.mdb
database location	S:\Lumber_River\Docs\Monitoring
computer name	NC10493
file size	41660416
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT-----	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY-----	
Project Code	94068
project Name	UT to the Lumber River
Description	Stream Restoration, Enhancement and Preservation Site
River Basin	Lumber
length(ft)	4285
stream-to-edge width (ft)	75
area (sq m)	59707
Required Plots (calculated)	14

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

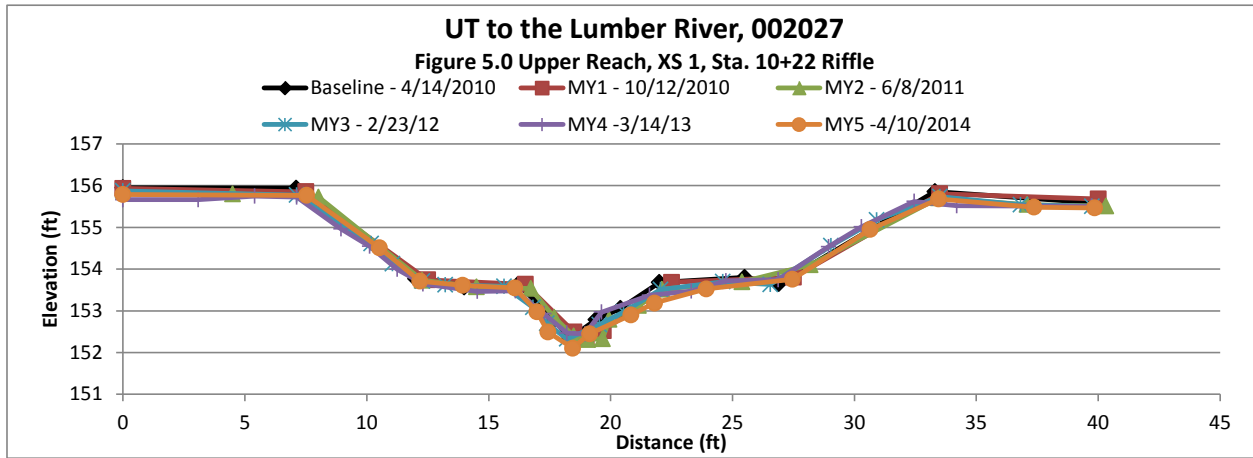
		Current Data (MY5 2014)														
Species	Common Name	Type	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6		Plot 7	
			P	T	P	T	P	T	P	T	P	T	P	T		
<i>Acer rubrum</i>	red maple	Tree						5		2						1
<i>Betula nigra</i>	river birch	Tree							1	1		2			2	2
<i>Diospyros virginiana</i>	common persimmon	Tree														2
<i>Fraxinus pennsylvanica</i>	green ash	Tree	4	5	3	3	1	1	3	3	3	4			3	3
<i>Nyssa biflora</i>	swamp tupelo	Tree	3	3			1	1	2	2	1	1	1	1	6	6
<i>Pinus taeda</i>	loblolly pine	Tree														
<i>Platanus occidentalis</i>	Amercian sycamore	Tree	1	1												
<i>Quercus laurifolia</i>	laurel oak	Tree	3	3	1	1	3	3	2	2	2	2	1	1	1	1
<i>Quercus lyrata</i>	overcup oak	Tree					1	1	3	3	1	1			4	4
<i>Quercus michauxii</i>	swamp chestnut oak	Tree	1	1	1	1			1	1	1	1				
<i>Quercus nigra</i>	water oak	Tree	2	2			3	3	2	2	4	4	4	4	2	2
<i>Quercus phellos</i>	willow oak	Tree	4	4	6	6	1	1	2	2	3	3	5	5	2	2
<i>Salix nigra</i>	black willow	Tree														
<i>Taxodium distichum</i>	bald cypress	Tree	2	2	1	1			1	1					4	4
<i>Liriodendron tulipifera</i>	tuliptree	Tree								4						
<i>Baccharis halimifolia</i>	eastern baccharis	Tree								1		1				
<i>Ulmus americana</i>	American elm	Tree			3	3	2	2	1	1	1	1	4	4		
Plot area (acres)			0.0247		0.0247		0.0247		0.0247		0.0247		0.0247		0.0247	
Species count			8	8	6	6	7	8	10	13	8	10	5	5	8	10
Stem Count			20	21	15	15	12	17	18	25	16	20	15	15	24	27
Stems per Acre			809	850	607	607	486	688	728	1012	648	809	607	607	971	1093

Table 9a Planted and Total Stem Counts Continued - Current Data (MY5 2014)																
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	P	T
<i>Acer rubrum</i>	red maple	Tree		3						1				3		
<i>Betula nigra</i>	river birch	Tree	1	1	1	1				1						
<i>Diospyros virginiana</i>	common persimmon	Tree														
<i>Fraxinus pennsylvanica</i>	green ash	Tree	3	4	4	4	2	2	3	4	4	4				1
<i>Liquidambar styraciflua</i>	sweet gum	Tree		1						1						
<i>Nyssa biflora</i>	swamp tupelo	Tree	2	2	1	1			1	3	4	4	4	4	4	4
<i>Pinus taeda</i>	loblolly pine	Tree														
<i>Platanus occidentalis</i>	Americian sycamore	Tree		1									1	2		2
<i>Quercus laurifolia</i>	laurel oak	Tree	4	4			4	4	2	2	3	3				
<i>Quercus lyrata</i>	overcup oak	Tree							2	2			7	8	7	8
<i>Quercus michauxii</i>	swamp chestnut oak	Tree	6	6	3	3	1	1			2	2				
<i>Quercus nigra</i>	water oak	Tree	4	4			1	1	1	2	1	1				
<i>Quercus phellos</i>	willow oak	Tree	1	1	5	5	3	3	1	1	3	3				
<i>Salix nigra</i>	black willow	Tree														
<i>Taxodium distichum</i>	bald cypress	Tree			1	1	1	1	3	3			5	6	4	4
<i>Baccharis halimifolia</i>	eastern baccharis	Tree										1		1		
<i>Sambucus nigra</i>	elderberry	Tree														1
<i>Ulmus americana</i>	American elm	Tree			1	2	2	2			1	1				
Plot area (acres)			0.0247		0.0247		0.0247		0.0247		0.0247		0.0247		0.0247	
Species count			7	10	7	7	7	7	7	10	7	8	4	6	3	6
Stem Count			21	27	16	17	14	14	13	20	18	19	17	24	15	20
Stems per Acre			850	1093	648	688	567	567	526	809	728	769	688	971	607	809

Species	Common Name	Type	Table 9b Annual Means										Notes:		
			MY5 (2014)		MY4 (2013)		MY3 (2012)		MY2 (2011)		MY1 (2010)			BL/AB (2010)	
			P	T	P	T	P	T	P	T	P	T		P	T
<i>Acer rubrum</i>	red maple	Tree		2.5		2.50		4.50		4.00				N/A	
<i>Baccharis halimifolia</i>	eastern baccharis	Shrub		1						1.00					
<i>Betula nigra</i>	river birch	Tree	1.25	1.33	1.25	1.33		1.00		1.67				N/A	
<i>Diospyros virginiana</i>	common persimmon	Tree		2		2.00				1.00				N/A	
<i>Fraxinus pennsylvanica</i>	green ash	Tree	3	3.16	3.00	3.17	2.55	2.55	2.64	2.64	3.31	3.31	3.69	N/A	
<i>Liquidambar styraciflua</i>	sweetgum	Tree		1				1.50							
<i>Nyssa biflora</i>	swamp tupelo	Tree	2.5	2.66	2.50	2.67	2.67	2.92	2.67	3.15	2.50	2.50	2.60	N/A	
<i>Pinus taeda</i>	loblolly pine	Tree													
<i>Platanus occidentalis</i>	American sycamore	Tree	1	1.5	1.00	1.50									
<i>Quercus</i>	oak	Tree								1.00					
<i>Quercus laurifolia</i>	laurel oak	Tree	2.36	2.36	2.36	2.36	2.18	2.18	2.30	2.50	4.43	4.43	3.67	N/A	
<i>Quercus lyrata</i>	overcup oak	Tree	3.57	3.85	3.57	3.86	4.14	4.14	4.29	4.86	2.22	2.22	1.89	N/A	
<i>Quercus michauxii</i>	swamp chestnut oak	Tree	2	2	2.00	2.00	2.22	2.22	2.22	2.22	2.73	2.73	2.82	N/A	
<i>Quercus nigra</i>	water oak	Tree	2.4	2.5	2.40	2.50	2.55	2.33	2.55	2.73	3.00	3.00	3.17	N/A	
<i>Quercus phellos</i>	willow oak	Tree	3	3	3.00	3.00	2.92	2.92	3.08	3.17	2.60	2.60	2.82	N/A	
<i>Salix nigra</i>	black willow	Tree													
<i>Sambucus canadensis</i>	common elderberry	Shrub		1				1.00							
<i>Taxodium distichum</i>	bald cypress	Tree	2.44	2.55	2.44	2.56	2.56	2.56	2.67	2.60	1.67	1.67	2.40	N/A	
<i>Ulmus americana</i>	American elm	Tree	1.875	2	1.88	2.00	1.88	1.88	1.75	1.78	0.00	0.00	0.00	N/A	
Plot area (acres)															
Species count			6.71	8.14	6.36	7.07	6.71	8.14	18.21	18.21	5.85	5.85			
Stem Count			16.71	20.07	16.36	17.86	16.71	20.07	16.90	19.57	18.57	18.57			
Stems per Acre			676	812	662	723	676	812	639	792	752	752			

Appendix D. Stream Survey Data

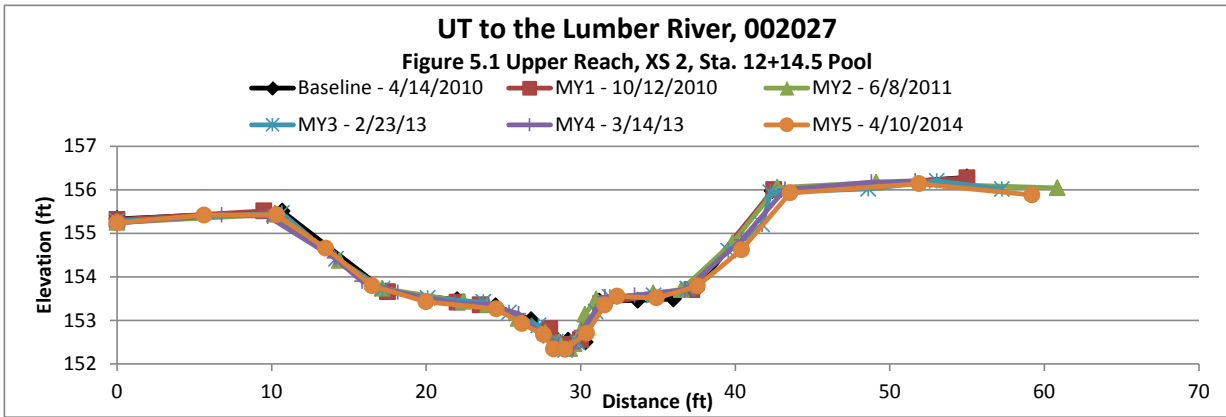
Figures 5.0-5.16. Cross Section Plots and Photos



STA	ELEV
0.00	155.79
7.53	155.77
10.52	154.51
12.18	153.71
13.93	153.61
16.07	153.55
16.98	152.98
17.43	152.49
18.44	152.10
19.14	152.45
20.83	152.90
21.80	153.19
23.92	153.53
27.46	153.76
30.65	154.95
33.46	155.68
37.37	155.49
39.85	155.46



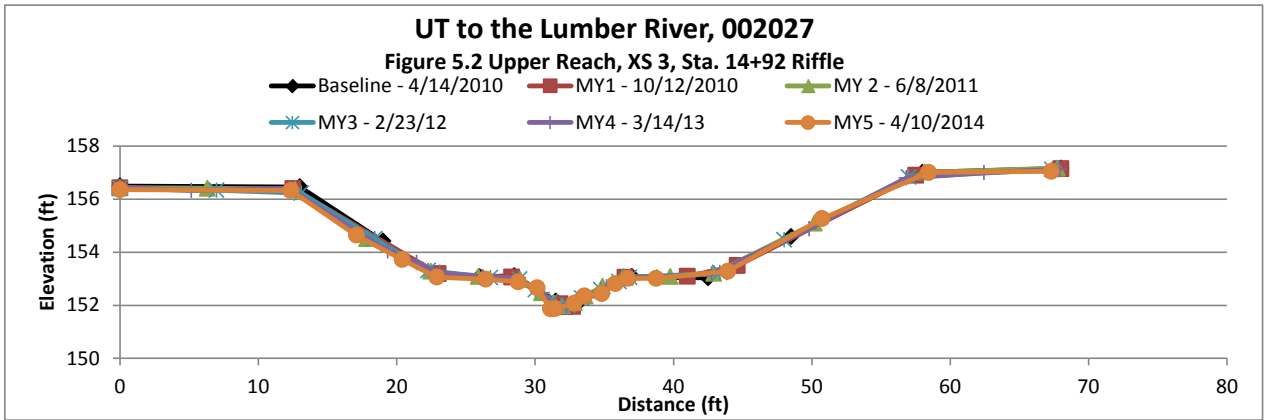
XS 1, Sta. 10+22, Looking Downstream



STA	ELEV
0.00	155.24
5.63	155.42
10.31	155.43
13.5	154.66
16.51	153.80
19.99	153.43
24.53	153.27
26.18	152.93
27.59	152.67
28.25	152.34
28.98	152.34
30.39	152.70
31.56	153.35
32.35	153.56
34.91	153.52
37.55	153.79
40.41	154.62
43.55	155.93
51.89	156.14
59.2	155.88



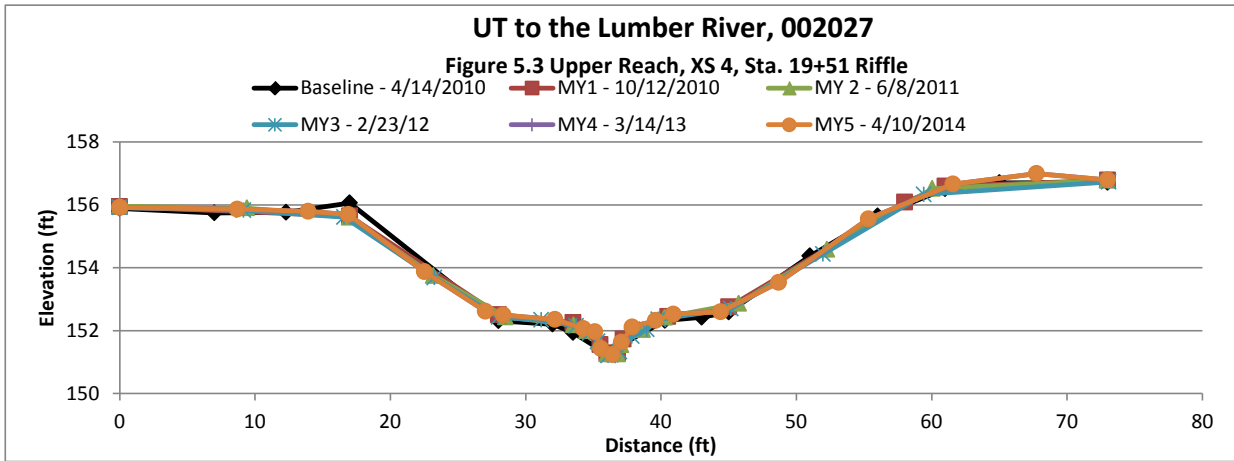
XS 2, Sta. 12+14.5, Looking Downstream



STA	ELEV
0	156.36
12.35	156.32
17.09	154.64
20.4	153.72
22.89	153.06
26.43	152.98
28.78	152.89
30.15	152.66
31.11	151.86
31.44	151.87
32.82	152.07
33.57	152.35
34.81	152.43
35.8	152.81
36.67	153.01
38.75	153.02
43.93	153.28
50.74	155.27
58.43	157.01
67.3	157.05



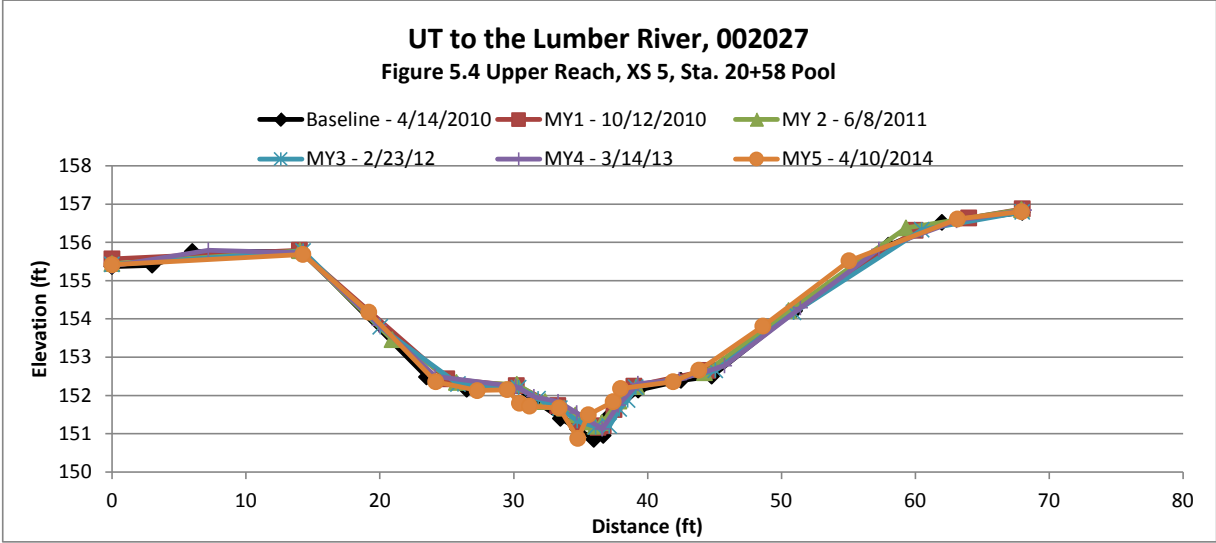
XS 3, Sta. 14+92, Looking Downstream



STA	ELEV
0.00	155.92
0.03	155.92
8.70	155.86
13.92	155.79
16.90	155.69
22.53	153.87
27.03	152.61
28.34	152.50
32.16	152.36
34.26	152.06
35.12	151.96
35.56	151.43
36.41	151.23
37.08	151.63
37.86	152.11
39.60	152.32
40.92	152.52
44.40	152.60
48.70	153.53
55.32	155.55
61.58	156.66
67.75	156.99
73.01	156.79



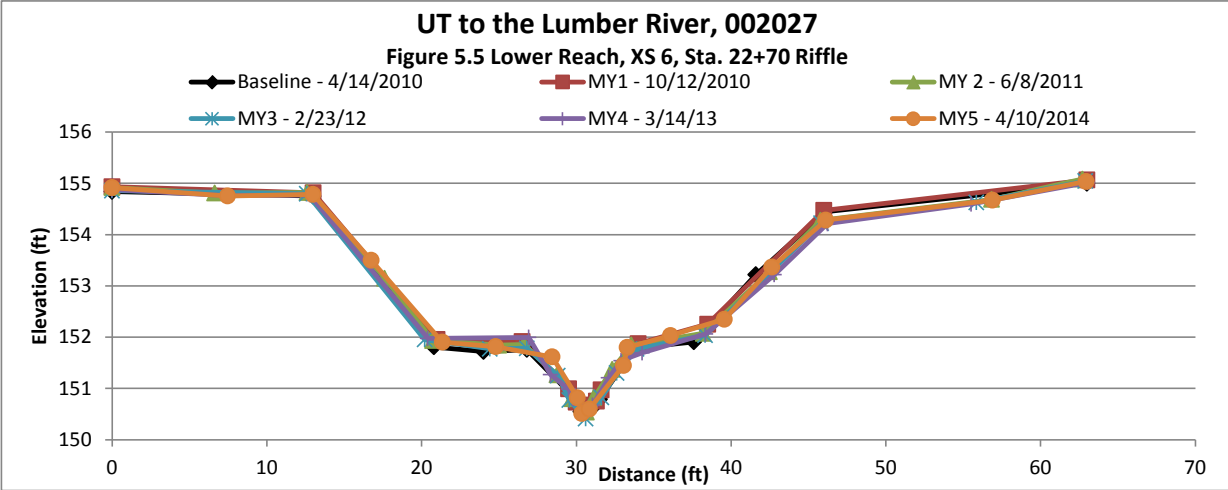
XS 4, Sta. 19+51, Looking Downstream



STA	ELEV
0.00	155.42
14.26	155.69
19.17	154.18
24.18	152.36
27.29	152.13
29.51	152.15
30.44	151.79
31.19	151.72
33.41	151.68
34.80	150.88
35.57	151.49
37.44	151.84
37.99	152.18
41.91	152.36
43.84	152.66
48.63	153.81
55.05	155.52
63.16	156.61
67.95	156.80



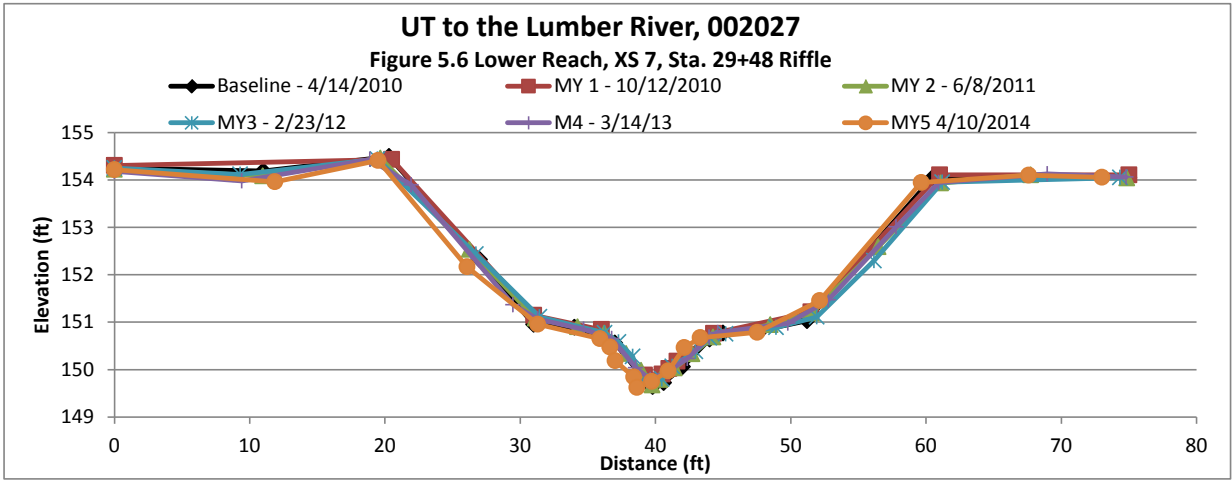
XS 5, Sta. 20+58, Looking Downstream



STA	ELEV
0.00	154.92
7.46	154.76
12.97	154.79
16.75	153.50
21.34	151.90
24.79	151.82
28.43	151.62
30.07	150.82
30.36	150.51
30.85	150.60
33.05	151.45
33.29	151.80
36.08	152.03
39.57	152.35
42.64	153.37
46.12	154.28
56.89	154.67
62.94	155.038



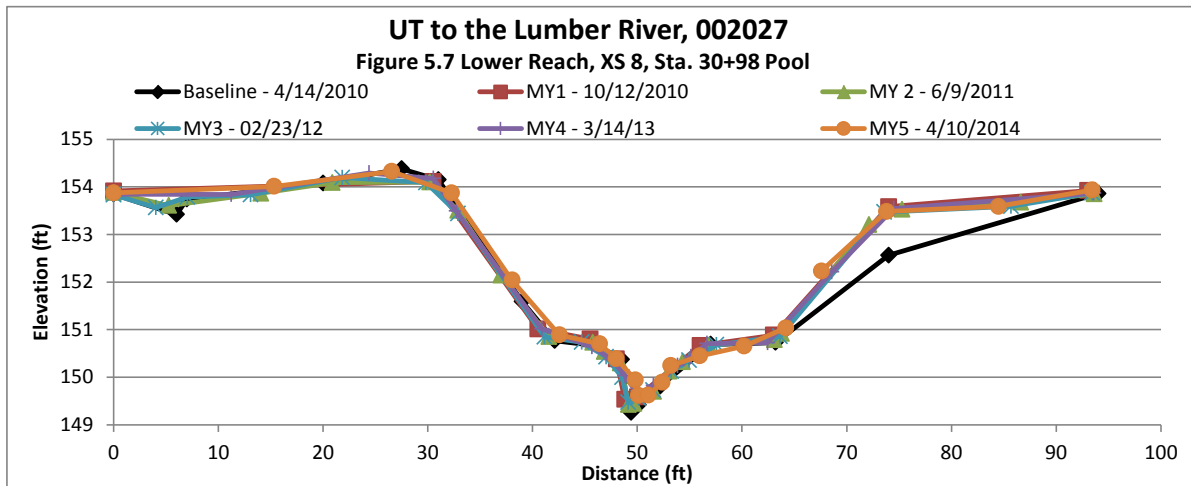
XS 6, Sta. 22+70, Looking Downstream



STA	ELEV
0.00	154.22
11.86	153.96
19.48	154.41
26.06	152.17
31.30	150.96
35.90	150.65
36.62	150.47
37.02	150.19
38.40	149.84
38.63	149.62
39.71	149.75
40.94	149.97
42.13	150.46
43.31	150.67
47.52	150.79
52.13	151.45
59.65	153.95
67.58	154.10
73.00	154.06



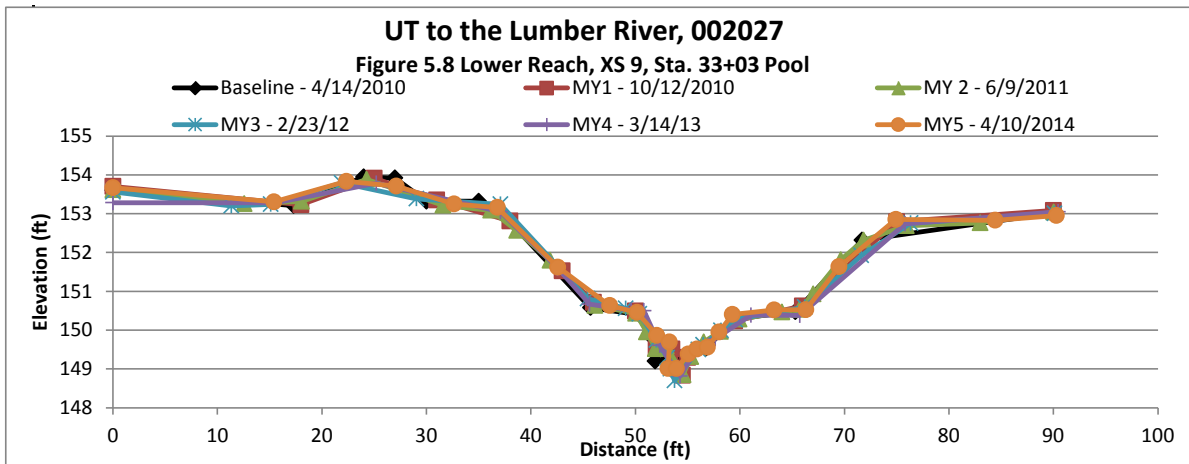
XS 7, Sta. 29+48, Looking Downstream



STA	ELEV
0.00	153.87
15.31	154.01
26.55	154.33
32.26	153.87
38.05	152.04
42.57	150.89
46.40	150.70
47.99	150.39
49.81	149.94
50.10	149.62
51.04	149.62
52.37	149.89
53.19	150.24
55.94	150.45
60.19	150.65
64.17	151.03



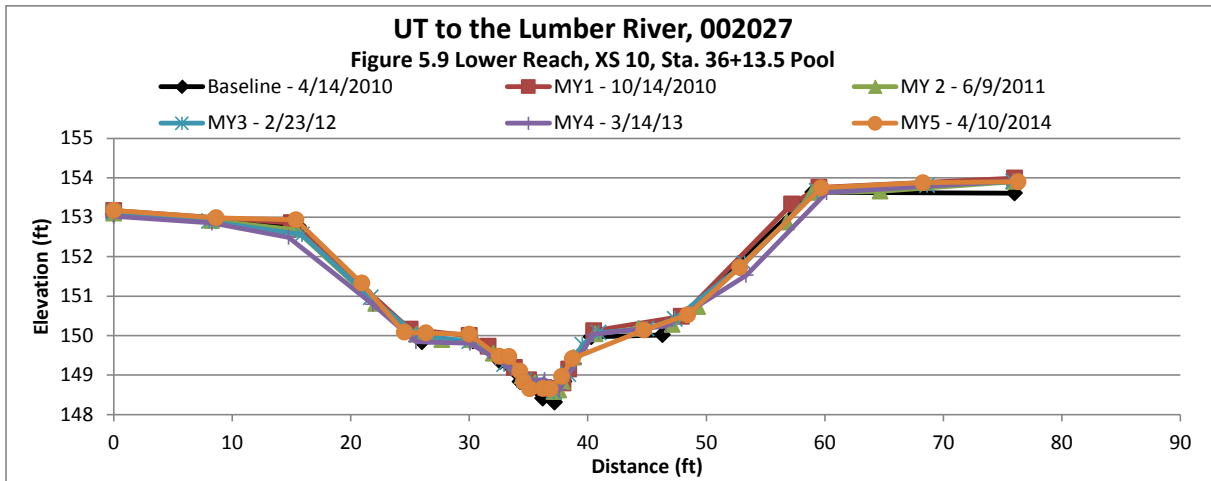
XS 8, Sta. 30+98, Looking Downstream



STA	ELEV
0.00	153.67
15.42	153.31
22.35	153.83
27.13	153.71
32.64	153.25
36.78	153.16
42.58	151.62
47.54	150.63
50.17	150.46
52.05	149.87
53.25	149.70
53.12	149.01
53.92	149.01
55.07	149.38
55.88	149.51
56.90	149.56
57.99	149.955
59.28	150.405
63.27	150.522
66.31	150.527
69.49	151.633
74.93	152.855
84.43	152.829
90.28	152.952



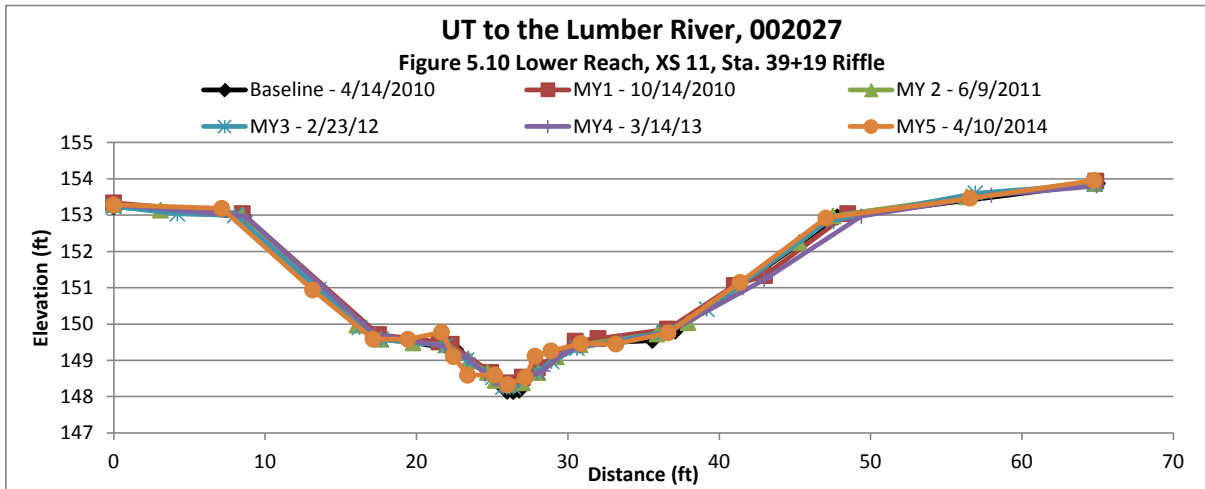
XS 9, Sta. 33+03, Looking Downstream



STA	ELEV
0.00	153.18
8.65	152.98
15.38	152.94
20.93	151.33
24.52	150.08
26.33	150.07
30.00	150.04
32.51	149.48
33.35	149.47
34.28	149.10
34.57	148.83
35.09	148.65
36.22	148.66
36.81	148.65
37.79	148.97
38.69	149.42
44.72	150.14
48.42	150.53
52.81	151.73
59.68	153.75
68.28	153.87
76.30	153.90



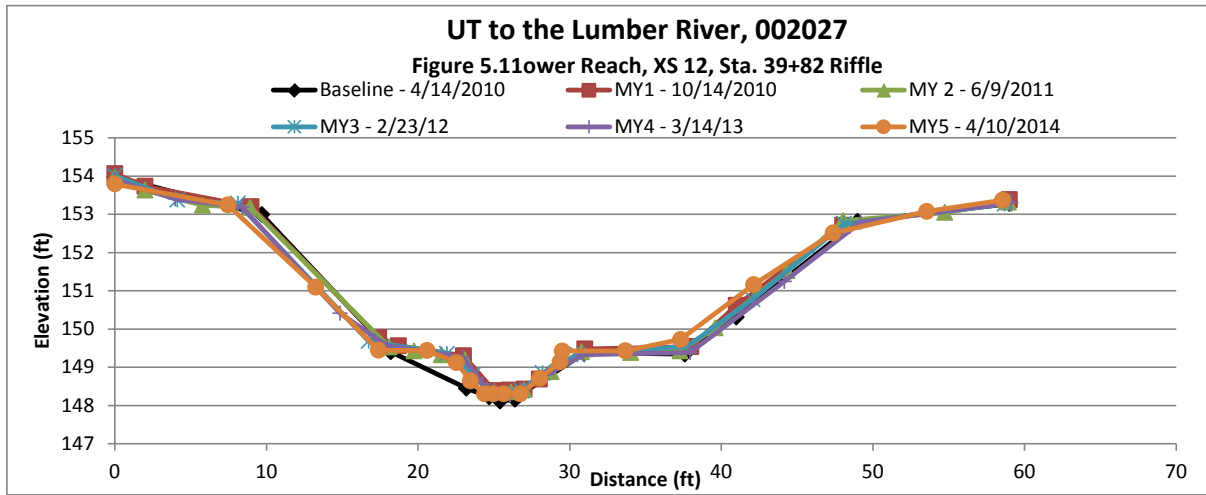
XS 10, Sta. 36+13.5, Looking Downstream



STA	ELEV
0.00	153.28
7.14	153.19
13.14	150.94
17.13	149.59
19.45	149.58
21.67	149.77
22.45	149.10
23.39	148.59
25.18	148.60
26.04	148.33
27.19	148.53
27.84	149.12
28.90	149.26
30.86	149.46
33.18	149.45
36.63	149.76
41.39	151.15
47.06	152.92
56.58	153.465
64.77	153.951



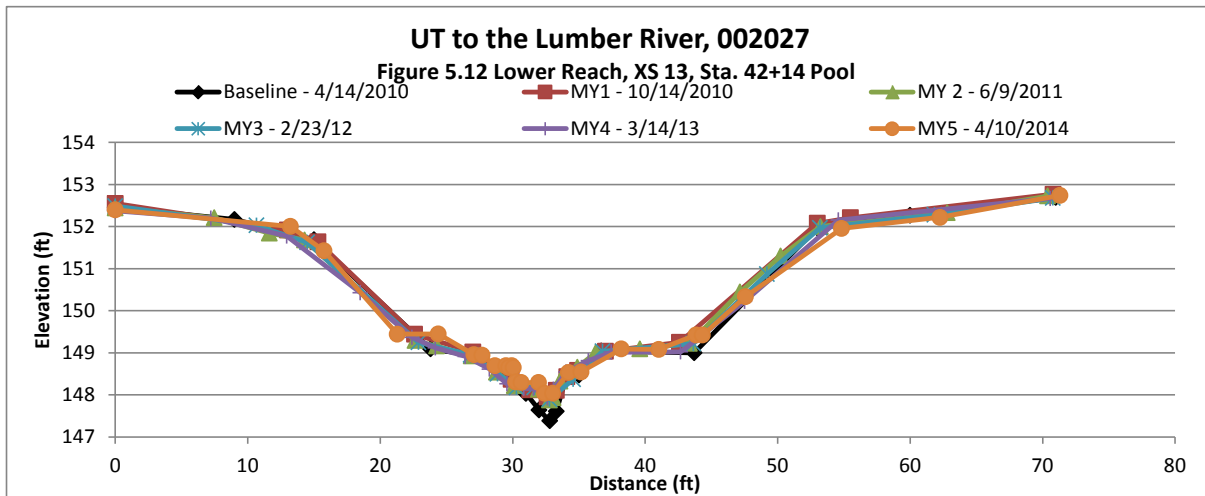
XS 11, Sta. 39+19, Looking Downstream



STA	ELEV
0.00	153.79
7.46	153.25
13.26	151.09
17.39	149.44
20.60	149.44
22.53	149.12
23.46	148.64
24.39	148.30
24.95	148.30
25.65	148.30
26.75	148.30
28.02	148.71
29.38	149.14
29.51	149.43
33.66	149.43
37.32	149.73
42.14	151.161
47.38	152.509
53.55	153.076
58.55	153.371



XS 12, Sta. 39+82, Looking Downstream



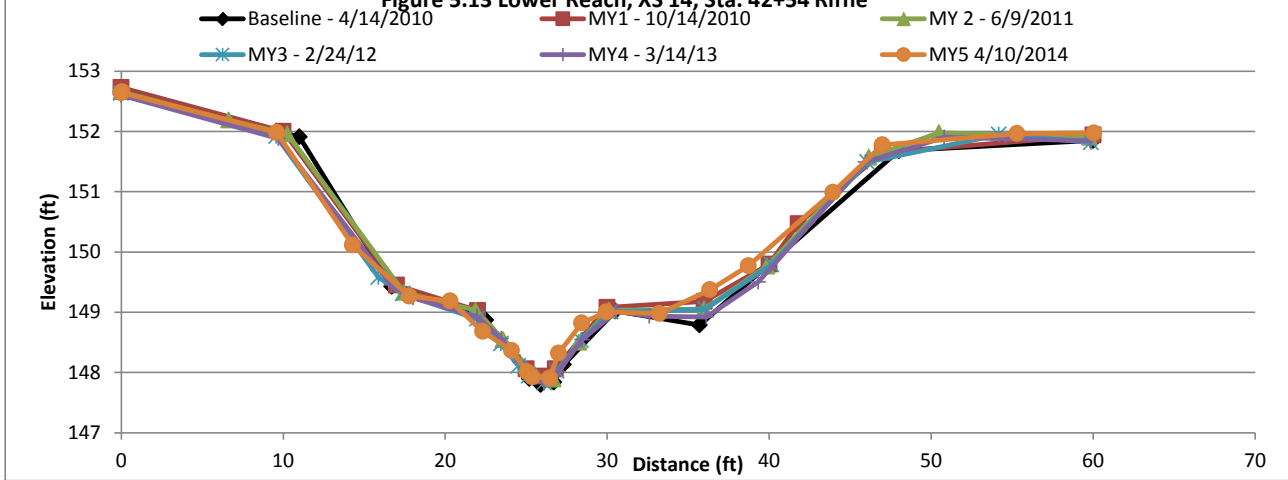
STA	ELEV
0.00	152.40
13.23	152.01
15.76	151.43
21.29	149.44
24.39	149.45
27.08	148.96
27.70	148.94
28.67	148.69
29.94	148.69
29.49	148.69
29.71	148.65
30.06	148.65
30.23	148.31
30.65	148.29
31.95	148.29
32.40	148.04
33.03	148.04
34.21	148.53
35.16	148.55
38.20	149.09
41.04	149.08
43.84	149.42
44.33	149.43
47.58	150.34
54.82	151.95
62.25	152.22
71.32	152.74



XS 13, Sta. 42+14, Looking Downstream

UT to the Lumber River, 002027

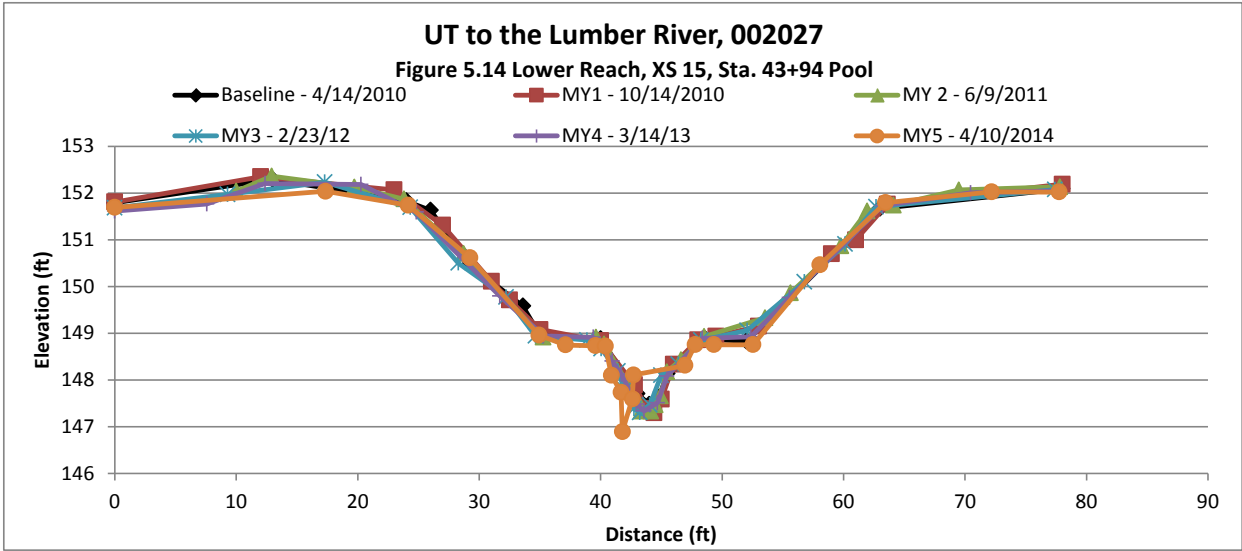
Figure 5.13 Lower Reach, XS 14, Sta. 42+54 Riffle



STA	ELEV	STA	ELEV
0.00	152.64	28.43	148.82
0.05	152.66	29.94	149.00
0.01	152.64	33.22	148.98
9.59	151.98	36.34	149.37
14.27	150.12	38.72	149.77
17.77	149.27	43.93	150.99
20.31	149.19	46.99	151.78
22.31	148.68	55.30	151.97
24.10	148.37	60.04	151.98
25.07	148.01		
25.38	147.92		
26.44	147.91		
27.00	148.32		



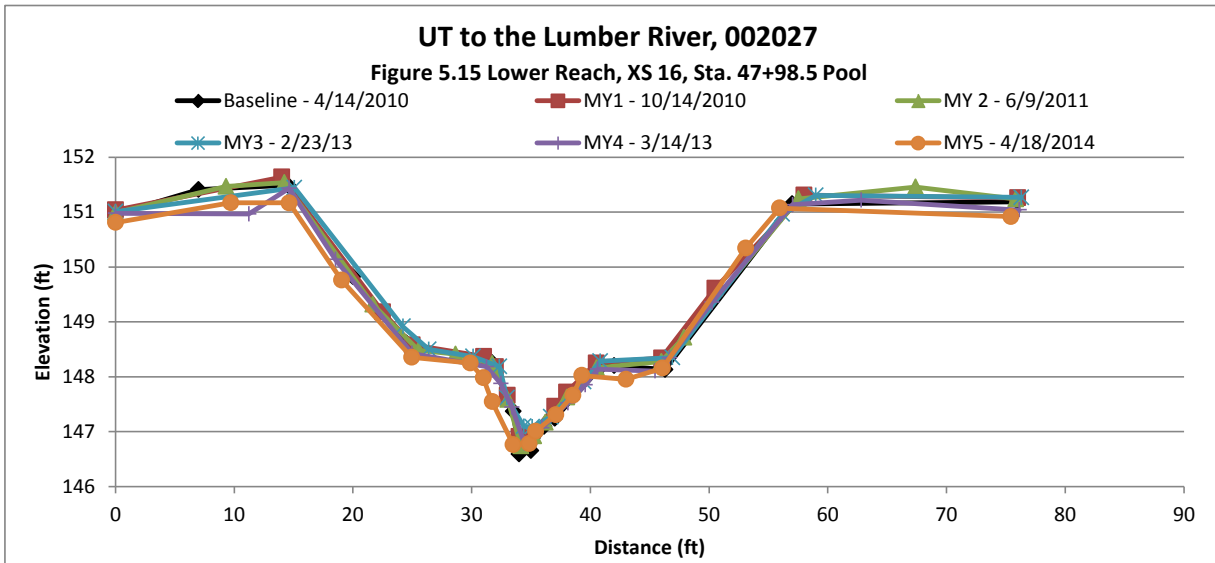
XS 14, Sta. 42+54, Looking Downstream



STA	ELEV
0.00	151.69
17.35	152.04
24.16	151.74
29.23	150.61
34.92	148.96
37.11	148.75
39.58	148.73
40.40	148.72
40.89	148.10
41.68	147.73
41.79	146.90
42.61	147.59
42.70	148.11
46.94	148.31
47.78	148.76
49.32	148.76
52.53	148.76
58.06	150.47
63.46	151.79
72.20	152.02
77.75	152.021



XS 15, Sta. 43+94, Looking Downstream

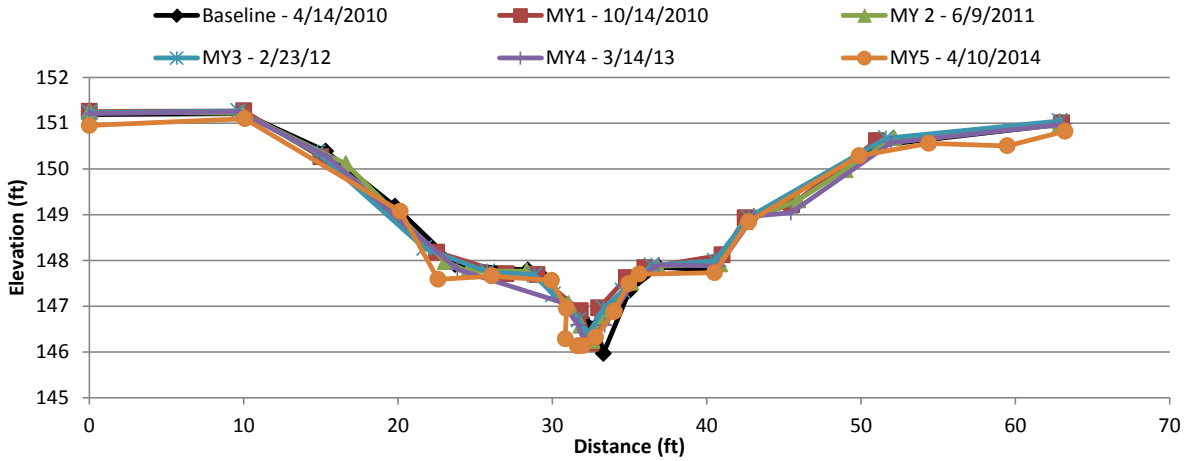


STA	ELEV
0.00	150.81
9.70	151.17
14.61	151.17
19.05	149.76
24.95	148.35
29.89	148.25
30.98	147.98
31.73	147.54
33.49	146.76
34.83	146.78
35.39	147.01
37.09	147.31
38.53	147.66
39.27	148.02
42.99	147.95
46.06	148.16
53.08	150.34
55.93	151.07
75.42	150.92



XS 16, Sta. 47+98.5, Looking Downstream

UT to the Lumber River, 002027
Figure 5.16 Lower Reach, XS 17, Sta. 51+26 Riffle



STA	ELEV
0.00	150.95
10.06	151.10
20.14	149.08
22.59	147.58
26.05	147.66
29.94	147.56
30.90	146.95
30.83	146.28
31.62	146.13
31.75	146.13
31.98	146.13
32.80	146.32
33.99	146.88
34.00	146.89
34.94	147.49
35.62	147.70
40.5	147.732
42.71	148.843
49.88	150.288
54.38	150.561
59.48	150.506
63.22	150.823



XS 17, Sta. 51+26, Looking Downstream

Figures 6.0-6.2. Longitudinal Profile Plots

Figure 6.0 UT to the Lumber River, 002027, Upper Reach Longitudinal Profile

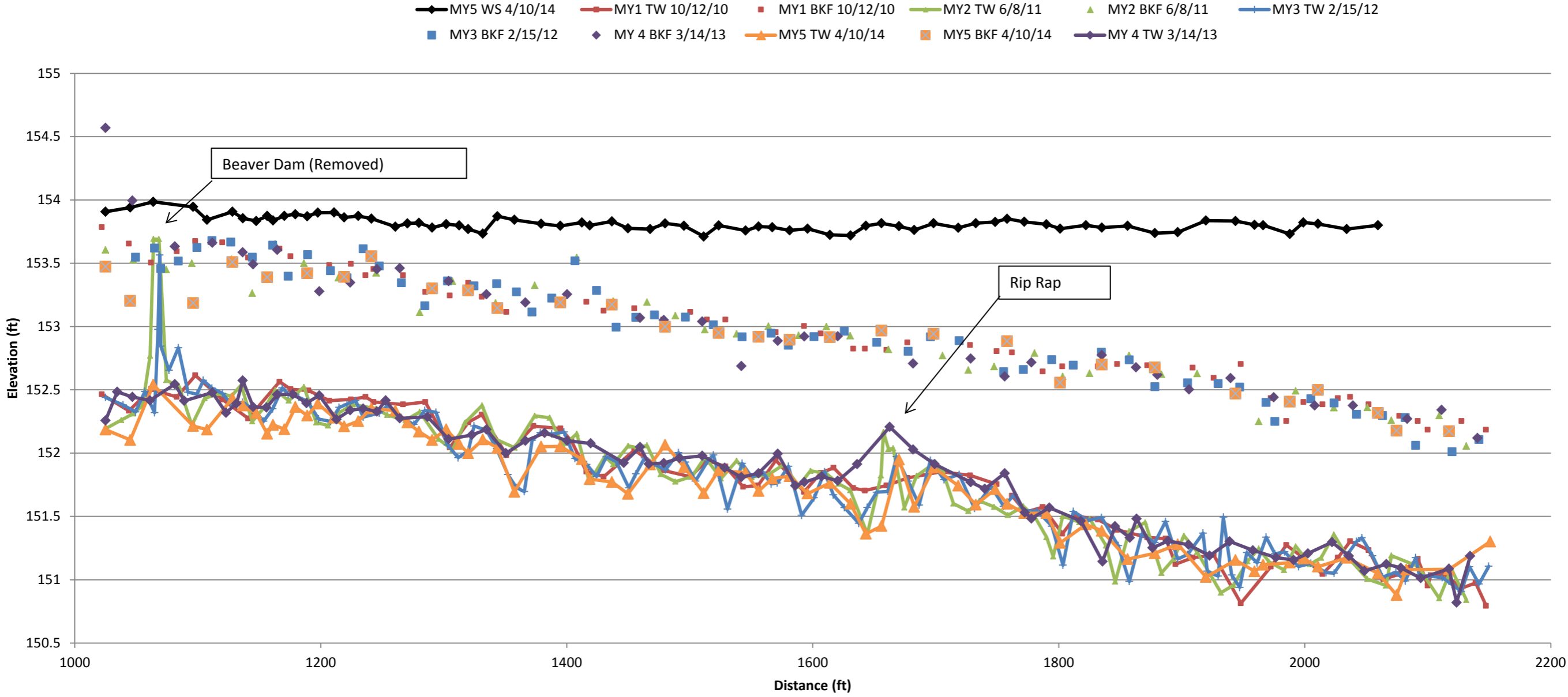


Figure 6.1 UT to the Lumber River, 002027, Lower Reach (1) Longitudinal Profile

- ◆ BL BKF 4/14/10
- ◆ MY1 TW 10/12/10
- ◆ MY1 BKF 10/12/10
- ◆ MY 2 TW 6/9/2011
- ◆ MY 2 BKF 6/9/2011
- ◆ MY3 TW 2/15/12
- ◆ MY 3 BK 2/15/12
- ◆ MY 4 TW 3/14/13
- ◆ MY 4 BKF 3/14/13
- ◆ MY5 TW 4/10/14
- ◆ MY5 BKF 4/10/14
- ◆ MY 5 WS 4/10/14

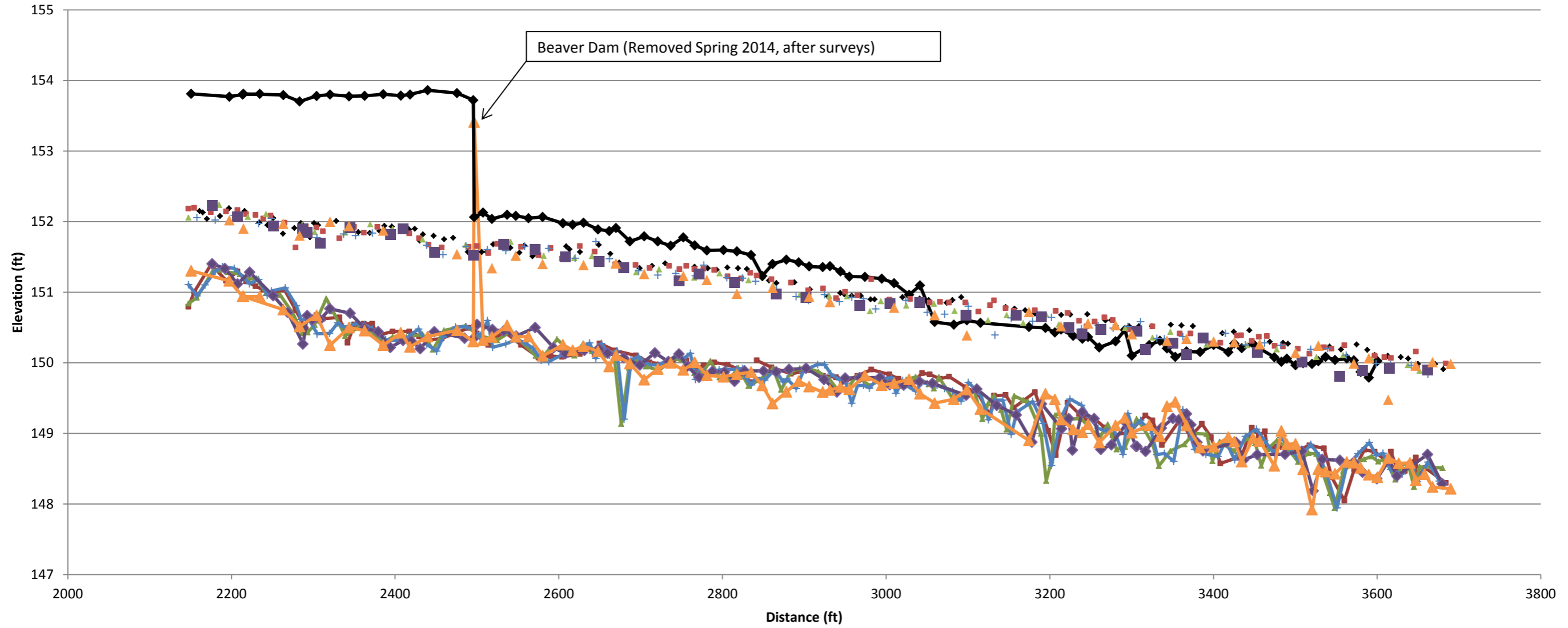


Figure 6.2 UT to the Lumber River, 002027, Lower Reach (2) Longitudinal Profile

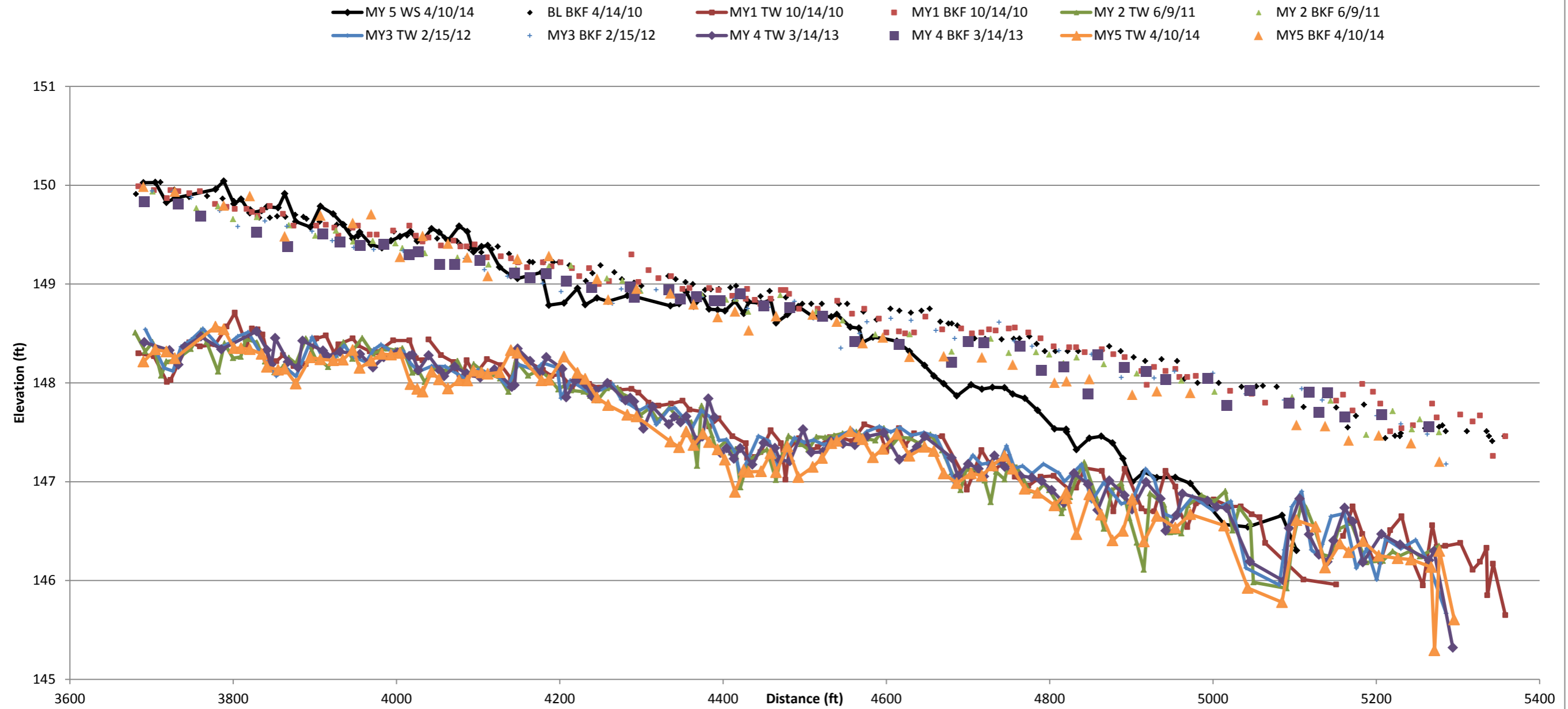


Table 10. Baseline Stream Data Summary
 UT to the Lumber River Site, 002027
 UT to the Lumber River: 4,285 feet

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.		Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Dimension and Substrate - Riffle																						
Bankfull Width (ft)	6.41	10.33	8.03	Mean	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 ²)	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														
Profile																						
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		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
Pool Cross Sectional Area (ft ²)				NA		12.90			4.69			7.44			9.48		3.92	8.93	5.69	5.94	6.75	7.86
Pattern																						
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
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
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
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
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
Substrate, bed and transport parameters																						
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/dP/di ⁹⁰ (mm)				Detritus	0.30			0.30														
Reach Shear Stress (competency) lb/ft ²				0.148							0.055			0.060			0.073					
Max part size (mm) mobilized at bankfull				10.62 - 37.22							3.83 - 18.12			4.16 - 19.2			5.1 - 22.2					
Unit Stream Power (transport capacity) lbs/ft.s				0.100							0.059			0.070			0.075					
Additional Reach Parameters																						
Drainage Area (SM)				0.42	1.61			0.63														
Impervious cover estimate (%)				5.00	5.00			5.00														
Rosgen Classification				G-F/5	E5			E5			E5			E5			E5					
Bankfull Velocity (fps)	0.65	1.11	1.08	0.74							1.02			1.12			1.19					
Bankfull Discharge (cfs)	5.90	14.06	8.87	6.00													5.00					
Valley length (ft)				3428.00	200.00			115.40									920.00					
Channel Thalweg length (ft)				3428.00	264.00			150.00			1162.00			*3123.00			1162.00					
Sinuosity (ft)				1.00	1.32			1.30			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					
BF slope (ft/ft)				0.0023	0.0020			0.0028			0.0015			0.0014			0.0018					
Bankfull Floodplain Area (acres)				0.00							0.67			1.97			0.67					
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
Biological or Other				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 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
Dimension and substrate - Riffle only																		
Bankfull Width (ft)	5.67	7.31	8.47	5.88	7.11	9.32	5.59	6.11	7.01	5.47	6.66	7.65	7.37	7.69	8.11	7.75	6.49	7.31
Floodprone Width (ft)	21.23	23.39	27.54	21.21	23.38	27.49	20.20	22.38	26.03	19.92	22.36	26.05	18.60	23.48	27.38	18.6	22.31	27.26
Bankfull Mean Depth (ft)	0.46	0.58	0.64	0.46	0.56	0.69	0.43	0.54	0.65	0.43	0.52	0.59	0.39	0.45	0.55	0.46	0.52	0.57
Bankfull Max Depth (ft)	0.96	1.13	1.30	0.98	1.13	1.30	0.93	1.05	1.22	0.94	1.05	1.22	1.03	1.07	1.12	0.96	1.04	1.12
Bankfull Cross Sectional Area (ft ²)	3.56	4.19	5.45	2.84	3.94	4.89	2.46	3.25	3.68	2.36	3.49	4.08	2.97	3.47	4.48	3.56	3.88	4.19
Bankfull Width/Depth Ratio	9.00	13.05	16.93	8.52	13.26	17.92	8.60	11.72	13.33	11.64	12.93	14.43	14.75	17.54	19.44	9	13.37	20.02
Bankfull Entrenchment Ratio	2.75	3.25	3.74	2.95	3.35	3.61	3.61	3.66	3.72	2.90	3.39	3.86	2.52	3.04	3.38	2.75	3.02	3.24
Bankfull Bank Height Ratio	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Profile																		
Riffle Length (ft)	5.50	21.67	47.00	14.99	51.77	121.03	16.07	33.74	122.1	6.68	14.68	23.56	7.2	43.6	77.3	6.94	16.8	48.56
Riffle Slope (ft/ft)	0.000	0.002	0.013	0.0012	0.0031	0.0050	0.0007	0.0025	0.0051	0.0002	0.0046	0.0099	0.0000	0.0023	0.0062	0.0018	0.0025	0.005
Pool Length (ft)	11.00	27.50	48.00	11.78	43.97	68.55	17.14	35.85	58.91	10.33	22.76	45.95	9.50	32.90	91.10	14.87	34.06	62.44
Pool Max Depth (ft)	1.01	1.33	1.65	1.13	1.33	1.91	1.18	1.4	1.68	0.88	1.34	1.78	0.99	1.24	1.52	1.73	2.23	2.95
Pool Spacing (ft)	23.00	49.96	91.00	20.35	54.62	131.74	27.85	63.86	155.3	12.11	37.62	63.03	24.68	68.27	156.93	40.01	63.23	140.04
Pattern																		
Channel Beltwidth (ft)	15.5	31	46.5															
Radius of Curvature (ft)	15.5	19.4	23.3															
Re:Bankfull Width (ft/ft)	2	2.5	3															
Meander Wavelength (ft)	23.3	50.4	77.5															
Meander Width Ratio	3	6.5	10															
Additional Reach Parameters																		
Rosgen Classification	E5			E5			E5			E5			E5			E5		
Channel Thalweg length (ft)	1162			1113			1106			1120			1123			1151		
Sinuosity (ft)	1.25			1.21			1.20			1.22			1.22			1.23		
Water Surface Slope (Channel) (ft/ft)	0.0018			0.00163			0.00127			0.0015			0.0015			0.0009		
BF slope (ft/ft)	0.0018			0.00143			0.0014			0.0014			0.0015			0.0014		
³ Ri% / P%	44.1 / 55.9			44.8 / 55.2			44.6 / 55.4			43.1 / 56.9			49.9 / 50.1			42.5/57.5		
³ SC% / Sa% / G% / C% / B% / Be%																		
³ d16 / d35 / d50 / d84 / d95																		
² % 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
Dimension and substrate - Rifle only																		
Bankfull Width (ft)	6.95	8.07	8.97	6.18	7.61	8.93	6.92	7.79	8.87	6.83	8.12	9.08	7.86	8.73	10.77	6.92	8.1367	9.21
Floodprone Width (ft)	23.23	25.73	28.30	23.40	24.49	26.31	22.89	24.90	26.66	23.69	24.99	25.82	23.63	25.23	26.84	22.89	25.106	25.16
Bankfull Mean Depth (ft)	0.52	0.63	0.73	0.50	0.57	0.63	0.50	0.58	0.62	0.47	0.56	0.63	0.49	0.54	0.56	0.5	0.58	0.58
Bankfull Max Depth (ft)	1.00	1.30	1.83	0.88	1.12	1.50	0.85	1.16	1.53	1.01	1.15	1.37	0.97	1.12	1.49	0.85	1.26	1.42
Bankfull Cross Sectional Area (ft ²)	4.02	5.10	5.74	3.20	4.31	5.05	3.79	4.51	5.26	3.99	4.51	4.98	4.09	4.68	5.99	3.79	4.7	4.93
Bankfull Width/Depth Ratio	10.68	12.99	15.74	11.70	13.50	16.06	11.16	13.54	15.52	11.57	14.75	19.32	14.87	16.32	19.23	10.68	14.288	14.2875
Bankfull Entrenchment Ratio	2.77	3.20	3.44	2.74	3.27	4.26	2.80	3.22	3.55	2.73	3.11	3.47	2.49	2.92	3.25	2.77	3.34	3.34
Bankfull Bank Height Ratio	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Profile																		
Rifle Length (ft)	5.00	22.77	87.00	10.3	25.29	81.89	12.74	43.35	102.48	8.57	30.16	182.08	14.68	73.06	235.25	11.22	35.52	93.86
Rifle Slope (ft/ft)	0.000	0.002	0.011	0.0000	0.0029	0.0081	0.0005	0.0019	0.0039	0.0003	0.0070	0.0214	0.000797	0.0030	0.0090	0.0048	0.015	0.11
Pool Length (ft)	6.00	23.77	51.00	6.02	35.47	109.59	11.64	39.88	67.26	5.36	29.85	83.54	15.73	45.95	145.44	8.22	40.75	89.99
Pool Max Depth (ft)	1.16	1.55	2.10	1.41	1.70	2.19	1.27	1.64	2.37	1.12	1.60	2.27	0.88	1.43	2.10	0.19	0.49	1.41
Pool Spacing (ft)	16.00	22.77	87.00	16.61	47.70	104.41	17.78	52.02	131.75	12.85	54.95	214.21	22.86	102.80	280.29	17.77	50.34	208.19
Pattern																		
Channel Beltwidth (ft)	17.5	35	52.5															
Radius of Curvature (ft)	17.5	21.9	26.3															
Re:Bankfull Width (ft/ft)	2	2.5	3															
Meander Wavelength (ft)	26.3	56.9	87.5															
Meander Width Ratio	3	6.5	10															
Additional Reach Parameters																		
Rosgen Classification	E5			E5			E5			E5			E5			E5		
Channel Thalweg length (ft)	*3123			*3166			*3120			*3065			*3120			*3094		
Sinuosity (ft)	1.25			1.26			1.25			1.26			1.25			1.25		
Water Surface Slope (Channel) (ft/ft)	0.00154			0.00169			0.00159			0.00142			0.0018			0.0017		
BF slope (ft/ft)	0.00154			0.00149			0.00145			0.00144			0.0015			0.0017		
³ R% / P%	49.3 / 50.7			48.7 / 51.3			46.1 / 53.9			44.3 / 55.7			53.8 / 46.2			43.7/56.3		
³ SC% / Sa% / G% / C% / B% / Be%																		
³ d16 / d35 / d50 / d84 / d95																		
² % 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.

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

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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.						
8/2/2014	XS 16	48+13	2.25	146.9	149.15	148.4	0.75	7.0
4/10/2014	XS 8	30+90	1.6	149.5	151.1	150.8	0.3	7.1



Figures 7.0 & 7.1 2014 Crest Gauge Photos