

**UT ROCKY RIVER STREAM RESTORATION – NCEEP Project #402**  
2009 FINAL MONITORING REPORT – YEAR 3

CONDUCTED FOR THE NORTH CAROLINA DEPARTMENT OF ENVIRONMENT  
AND NATURAL RESOURCES



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Environment and Natural Resources  
Ecosystem Enhancement Program  
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Raleigh, NC 27699-1652

**UT ROCKY RIVER STREAM RESTORATION – NCEEP Project #402  
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## 1.0 Executive Summary

As outlined in the 2007 Mitigation Plan (Ward Consulting 2007), the goals of the UT Rocky River Stream Restoration Project are to:

- Improve water quality and reduce erosion through restricting cattle access and improved riparian buffers;
- Improve aquatic habitat using natural material stabilization structures; and
- Provide aesthetic value, wildlife habitat, and bank stability through restoration/enhancement of the riparian zone.

The objectives for this restoration are to:

- Exclude cattle from Reach 1;
- Enhance approximately 150 feet of Reach 1 and stabilize an additional 955 feet of the same reach;
- Reconnect Reach 2 to its floodplain;
- Provide a stable channel for both reaches in terms of pattern, profile, and dimension; and
- Provide a conservation easement and enhance/restore portions of the buffer for both reaches.

The average live planted woody stem density (499 live stems per acre) has exceeded the vegetation success criteria (320 live stems per acre) by 55 percent. Invasive exotics are present in both reaches, but do not appear to be undermining planted stem success at this time. The site was assessed as part of a more comprehensive invasive exotic vegetation survey of restoration sites and may be treated in 2010 if conditions warrant.

Overall, the restoration project appears to have met morphological goals. The enhanced sections of Reach 1 are stable. Flowing water was present in the Reach 2 channel during the initial assessment conducted in 2009, but there was no flow during the October and November 2009 site visits. As can be seen in the cross-section and stream problem area photos, terrestrial grass is well established in the channel throughout Reach 2. Sub-normal precipitation in 2009 may partially explain the absence of water in Reach 2; however, the previous monitoring reports indicate that no flowing water was present in Reach 2 during the fall assessment in 2007 (MY 1) and 2008 (MY 2) (Ward Consulting 2008; RJG&A 2009). Vegetation growing in the channel made accurate assessment of the channel morphology more difficult, but overall the channel appears to be stable. The areas of scour and incision noted in the past have stabilized; aggradation associated with the downstream-most cross-vane is still present.

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 mitigation and 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**

Monitoring methodologies follow the current EEP-provided templates and guidelines (Lee *et al* 2006). Photographs were taken digitally. A Trimble Geo XT handheld mapping-grade unit was used to collect cross section, vegetation corner, photopoint, and problem area locations. All problem areas identified on the spring 2009 versions of the CCPV were re-evaluated.

### **2.1 Stream Methodology**

Methods employed were a combination of those specified in the Mitigation Plan, the First Annual Monitoring Report, and standard regulatory guidance and procedures documents. Stream monitoring data was collected using the techniques described in US ACE Stream Mitigation Guidelines, US Forest Service's Stream Channel Reference Sites, and Applied River morphology (USACE, 2003; Harrelson et al., 1994; Rosgen, 1996). A Topcon Total Station and Nikon automatic level were used for collecting all geomorphic data. Photographs facing upstream were taken at each cross section.

### **2.2 Vegetation Methodology**

A total of six representative vegetation survey plots were selected and installed in the Reaches 1 and 2 by Ward Engineering in 2007. All plots measure 100 square meters in area and are five meters by 20 meters. Pursuant to the guidelines, the four corners of each plot (e.g. 0,0; 0,10; 10,0; and 10,10; or 0,0; 0,20; 5,0; and 5,20.) are marked with metal pipe.

Level 1 (planted woody stems) and Level 2 (volunteer woody stems) data collection was performed in all plots, pursuant to the most recent CVS/EEP protocol (Lee *et al* 2006). Within each plot, each planted woody stem location (x and y) was recorded, and height and live stem diameter were recorded for each stem location. All planted stems were identified with pink flagging. Vegetation was identified using Weakley (Weakley 2007). Photos were taken of each vegetation plot from the 0,0 corner.

### 3.0 References

- Harrelson, Cheryl, C. L. Rawlins, and John Potpondy. (1994). *Stream Channel Reference Sites: An Illustrated Guide to Field Technique*. USDA, Forest Service. General Technical Report RM-245.
- Lee, Michael T., Peet, Robert K., Roberts, Steven D., Wentworth, Thomas R. (2006). *CVS-EEP Protocol for Recording Vegetation Version 4.0*. Retrieved October 30, 2006, from: <http://www.nceep.net/business/monitoring/veg/datasheets.htm>.
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- USACOE (2003) *Stream Mitigation Guidelines*. USACOE, USEPA, NCWRC, NCDENR-DWQ
- Ward Consulting Engineering (2007). *UT to Rocky River (Smith Tract) Stream and Buffer Restoration, Enhancement, and Preservation, Chatham County, North Carolina Mitigation Report*. March 20, 2007.
- Ward Consulting Engineering (2008). *UT to Rocky River (Smith Tract) Stream and Buffer Restoration, Enhancement, and Preservation, Chatham County, North Carolina Final Monitoring Report*. February 15, 2008.
- Weakley, Alan (2007). *Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas*. Retrieved March 27, 2007 from: <http://www.herbarium.unc.edu/flora.htm>.

## **Appendix A. General Figures and Plan Views**

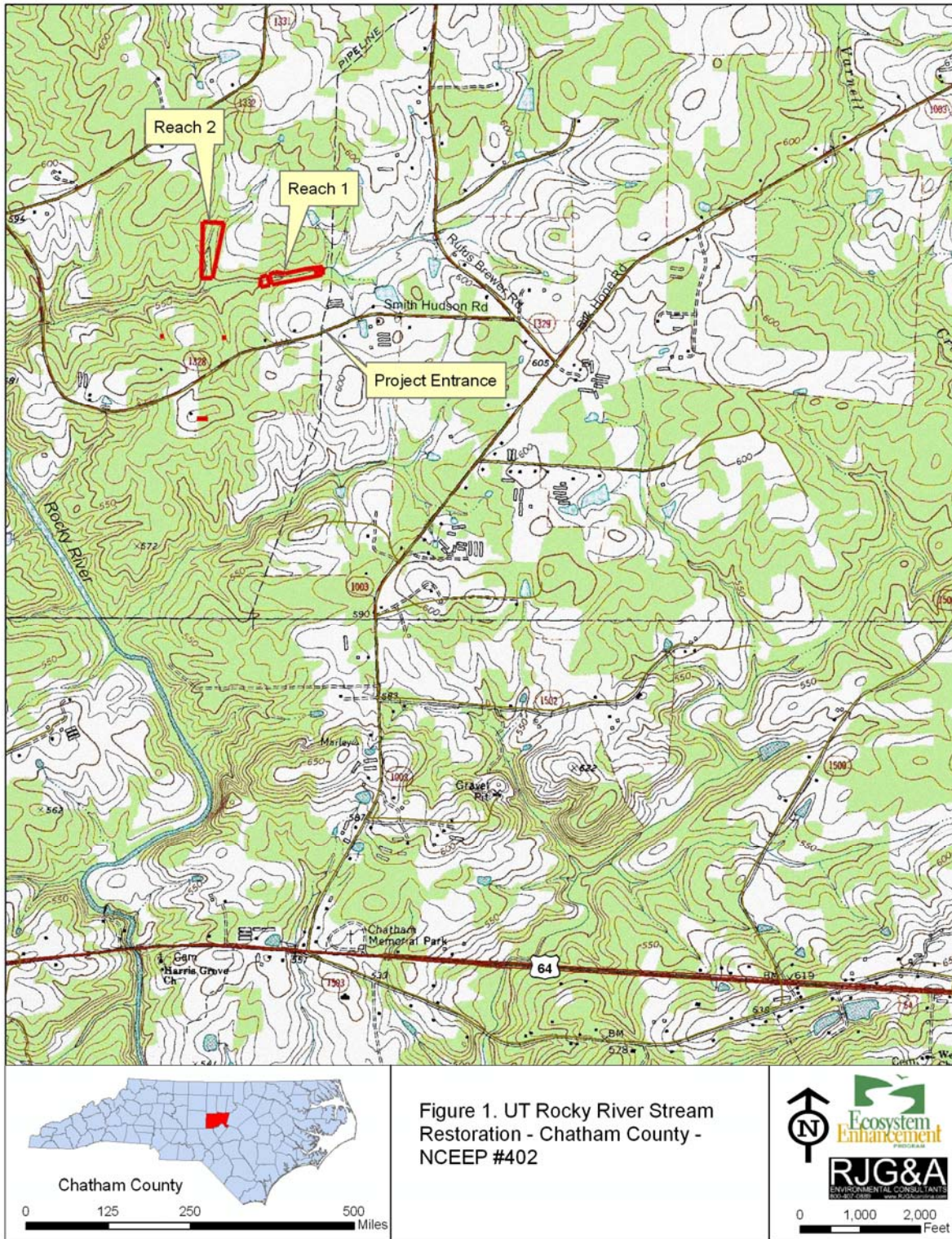
Figure 1. General Vicinity Map

Figure 2.0. CCPV – Reach 1

Figure 2.1. CCPV – Reach 2

# UT Rocky River Stream Restoration (EEP Project #402)

Appendix A. Figure 1. Vicinity Map.



**Figure 2.0. Current Conditions Plan View. Rocky River (Reach 1) - 2009 Chatham County, NC - EEP Project #402**

— Thalweg Monitoring Year 3 11/04/2009 # Photopoints


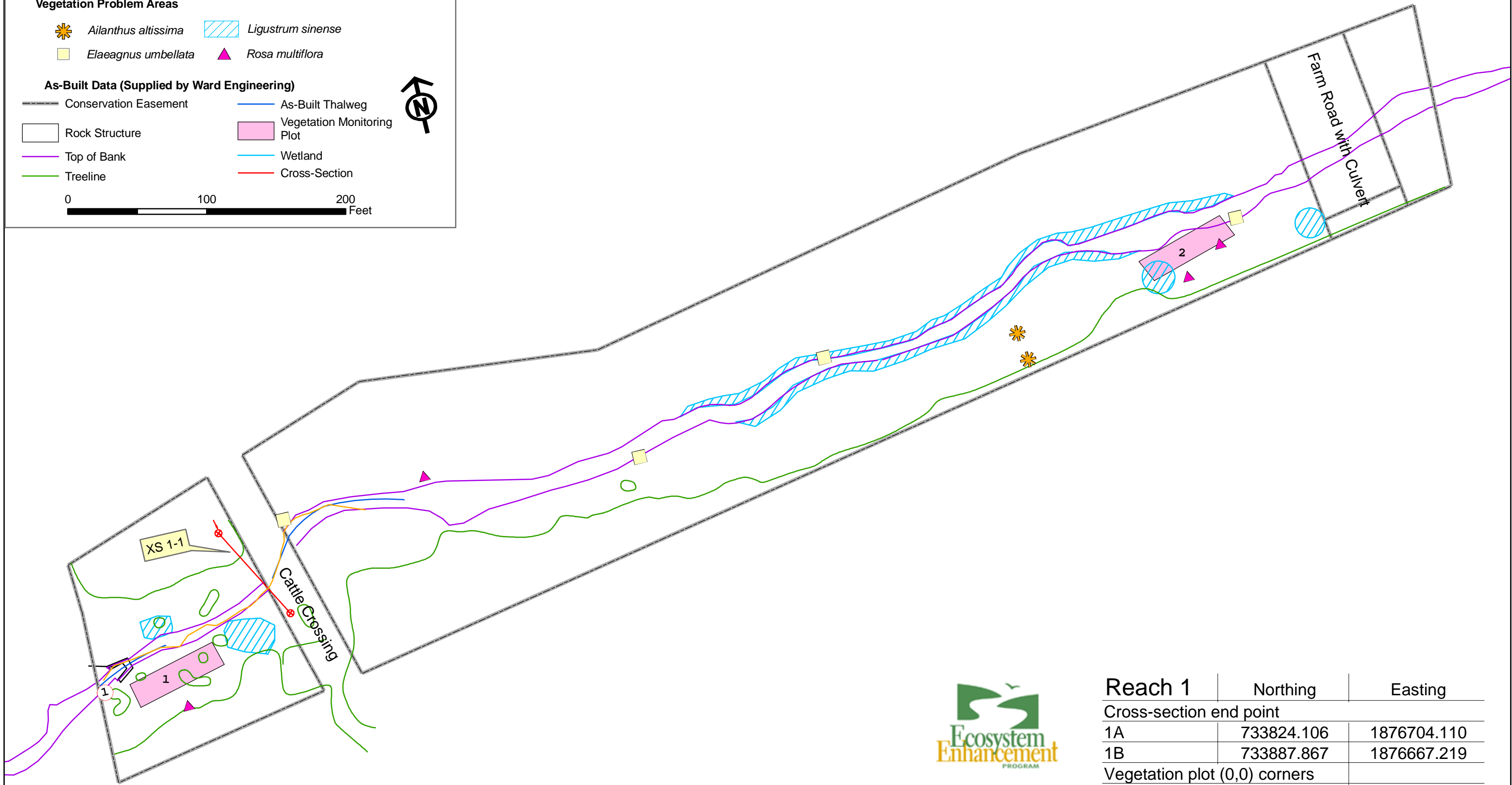
**Vegetation Problem Areas**

✱ *Ailanthus altissima*      *Ligustrum sinense*  
  *Elaeagnus umbellata*    ▲ *Rosa multiflora*

**As-Built Data (Supplied by Ward Engineering)**

Conservation Easement    — As-Built Thalweg  
 Rock Structure     Vegetation Monitoring Plot  
— Top of Bank    — Wetland  
— Treeline    — Cross-Section

0      100      200  
 Feet

Reach 1	Northing	Easting
Cross-section end point		
1A	733824.106	1876704.110
1B	733887.867	1876667.219
Vegetation plot (0,0) corners		
1	733921.773	1877367.424
2	733786.687	1876587.837



**Figure 2.1. Current Conditions Plan View. Rocky River (Reach 2) - 2009 Chatham County, NC - EEP Project #402**



Thalweg Monitoring Year 3  
11/5/2009 - 11/6/2009

Photopoints  
Crest Gauge

**Stream Problem Areas**

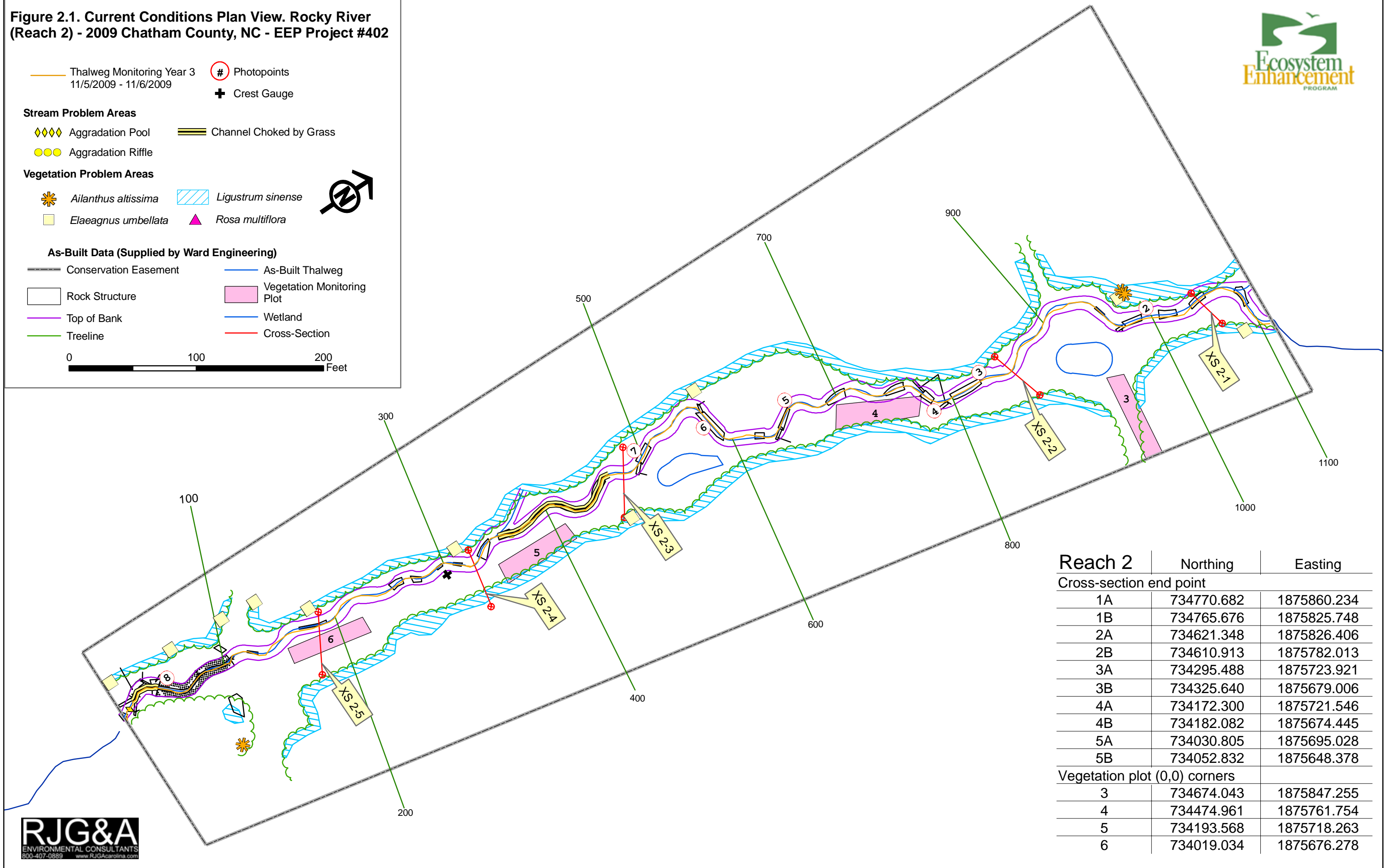
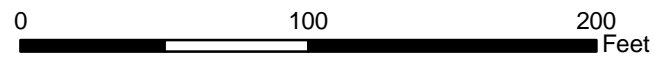
Aggradation Pool  
Aggradation Riffle  
Channel Choked by Grass

**Vegetation Problem Areas**

*Ailanthus altissima*  
*Elaeagnus umbellata*  
*Ligustrum sinense*  
*Rosa multiflora*

**As-Built Data (Supplied by Ward Engineering)**

Conservation Easement  
Rock Structure  
Top of Bank  
Treeline  
As-Built Thalweg  
Vegetation Monitoring Plot  
Wetland  
Cross-Section



Reach 2	Northing	Easting
Cross-section end point		
1A	734770.682	1875860.234
1B	734765.676	1875825.748
2A	734621.348	1875826.406
2B	734610.913	1875782.013
3A	734295.488	1875723.921
3B	734325.640	1875679.006
4A	734172.300	1875721.546
4B	734182.082	1875674.445
5A	734030.805	1875695.028
5B	734052.832	1875648.378
Vegetation plot (0,0) corners		
3	734674.043	1875847.255
4	734474.961	1875761.754
5	734193.568	1875718.263
6	734019.034	1875676.278

## **Appendix B. General Project Tables**

Table 1. Project Restoration Components

Table 2. Project Activity and Reporting History

Table 3. Project Contacts Table

Table 4. Project Attribute Table

## UT Rocky River Stream Restoration (EEP Project #402)

**Appendix B. Table 1. Project Restoration Components.**

Reach ID	Mitigation Type	Approach	Linear Feet	Stationing	Comment
Reach 1	EII	SS	887	00+00 – 08+87	Bank stabilization, fence out cattle
Reach 1	EI	P1	208	08+87 – 10+95	Relocation, improve cattle/equipment crossing, re-establish stream pattern and dimension
Reach 2	R	P1	1,111	-00+03 – 11+08	Reconnect to floodplain, adjust stream pattern, profile and dimension, install structures and vegetation

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

Activity or Report	Data Collection	Completion
Restoration Plan	2003	April 2005
Construction	NA	October 2006
Temporary S&E mix applied	NA	July 2006 (Reach 1); September 2006 (Reach 2)
Permanent seed mix applied	NA	July 2006 (Reach 1); September 2006 (Reach 2)
Containerized and B&B plantings	NA	December 2006
Mitigation Plan	NA	March 2007 (report date)
As-built	March 2005	December 2005 (report date)
Year 1 Monitoring		December 2007 (report date)
Vegetation	November 2007	
Geomorphological	November 2007	
Year 2 Monitoring		November 2008 (report date)
Vegetation	October 2008	
Geomorphological	October 2008	
Year 3 Monitoring		November 2009 (report date)
Vegetation	October 2009	
Geomorphological	November 2009	

## UT Rocky River Stream Restoration (EEP Project #402)

**Appendix B. Table 3. Project Contacts.**

Design:	Ward Consulting Engineers 8386 Six Forks Road, Suite 101 Raleigh, NC 27615-5088 Becky Ward (919) 870-0526
Construction Contractor:	McQueen Construction 619 Patrick Road Bahama, NC 27503 Harvey McQueen (919) 697-0614
Planting Contractor:	Southern Garden Inc. P.O. Box 808 Apex, NC 27502 (919) 362-1050
Seed Contractor:	McQueen Construction 619 Patrick Road Bahama, NC 27503 Harvey McQueen (919) 697-0614
Seed Mix Sources:	Evergreen Seed (919) 567-1333
Nursery Stock Suppliers:	Coastal Plain Conserv. Nursery, Inc. (Edenton, NC) Ellen Colodney (252) 482-5707 Cure Nursery (Pittsboro, NC) Bill and Jennifer Cure (919) 542-6186 Brook Run Nursery (Blackstone, VA) Howard Malinski (919) 422-8727
Monitoring Performers (2008 - 2009):	RJG&A 1221 Corporation Parkway, Suite 100 Raleigh, NC 27616 Mr. Sean Doig (919) 872-1174

## UT Rocky River Stream Restoration (EEP Project #402)

**Appendix B. Table 4. Project Attribute Table.**

County	Chatham
Drainage Area	Reach 1: 820 acres (1.28 square miles) Reach 2: 135 acres (0.21 square miles)
Drainage Impervious Cover Estimate (%)	Reach 1: 2% Reach 2: 1%
Stream Order	Reach 1: 2 Reach 2: 2
Physiographic Region	Piedmont
Ecoregion	45c Carolina Slate Belt
Rosgen Classification of As-built	Reach 1: C4/E4 Reach 2: C4
Dominant Soil Types	Reach 1: cid-Lignum Complex, Nanford-Baden Complex Reach 2: Riverview Silt Loam
Reference Site ID	North Prong Creek
USGS HUC for Project and Reference	03030003
NCDWQ Sub-basin for Project and Reference	03-06-12
NCDWQ Classification for Project and Reference	Reach 1: C Reach 2: C
Any portion of the project segment 303d listed?	No
Any portion of the project segment upstream of a 303d listed segment?	No
Reasons for 303d Listing or Stressor	NA
% of Project Easement Fenced	Reach 1: 13% Reach 2: 41%

## **Appendix C. Vegetation Assessment Data**

Table 5. Vegetation Plot Mitigation Success Summary Table

Vegetation Monitoring Plot Photos

Table 6. Vegetation Metadata

Table 7. Stem Count Total and Planted by Plot and Species

Vegetation Problem Area Photos (electronic submission only)

Vegetation Problem Areas Inventory Table (electronic submission only)

UT Rocky River Stream Restoration #402

Appendix C. 2009 Vegetation Monitoring Plot Photos



Plot 1 (10/29/09)



Plot 1 (10/16/08)



Plot 2 (10/29/09)



Plot 2 (11/11/08)

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Plot 3 (10/29/09)



Plot 3 (10/23/08)



Plot 4 (11/04/09)



Plot 4 (10/17/08)



**UT Rocky River Stream Restoration (EEP #402)**



**Plot 5 (11/04/09)**



**Plot 5 (10/23/08)**



**Plot 6 (10/29/09)**



**Plot 6 (10/23/08)**

## UT Rocky River Stream Restoration (EEP #402)

### Appendix C. Table 6. Vegetation Metadata Table.

Report Prepared By	sean doig
Date Prepared	11/9/2009 13:29
database name	UTRockyRiver.mdb
database location	C:\Documents and Settings\Owner\Desktop\EEP 2009
computer name	GATELAP
file size	42958848

### DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT-----

<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. 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>Proj, total stems</b>	
<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>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.

### PROJECT SUMMARY-----

<b>Project Code</b>	402
<b>project Name</b>	UT to Rocky River (Smith Tract)
<b>Description</b>	stream restoration, enhancement, and preservation
<b>River Basin</b>	Cape Fear
<b>length(ft)</b>	Reach 1: 1,095; Reach 2: 1,111
<b>stream-to-edge width (ft)</b>	Reach 1: 25'-64'; Reach 2: 1'-125'
<b>area (sq m)</b>	Reach 1: 3,830; Reach 2: 4,660
<b>Required Plots (calculated)</b>	6
<b>Sampled Plots</b>	6

UT Rocky River Stream Restoration (EEP #402)

Appendix C. Table 7. Planted and Total Stem Counts

Scientific Name	Common Name	Species Type	Current Plot Data (MY3 2009)																		Annual Means											
			Plot 1			Plot 2			Plot 3			Plot 4			Plot 5			Plot 6			MY3 (2009)			MY2 (2008)			MY1 (2007)			MY0 (2006)		
			P w/o LS	P-all	T	P w/o LS	P-all	T	P w/o LS	P-all	T	P w/o LS	P-all	T	P w/o LS	P-all	T	P w/o LS	P-all	T	P w/o LS	P-all	T	P w/o LS	P-all	T	P w/o LS	P-all	T			
<i>Acer rubrum</i>	red maple	Tree						5			13							3			21						74					
<i>Albizia julibrissin</i>	silktree	Shrub Tree																									2					
<i>Alnus serrulata</i>	hazel alder	Shrub Tree									1	1					3	3		4	4		4	4		7	7		9	9		
<i>Betula nigra</i>	river birch	Tree									4	4			5	5				9	9		9	9		11	110		12	12		
<i>Carpinus caroliniana</i>	American hornbeam	Shrub Tree																										6	6			
<i>Carya</i>	hickory	Tree			2						1											3										
<i>Carya alba</i>	mockernut hickory	Tree																									2					
<i>Carya cordiformis</i>	bitternut hickory	Tree															3	3		3	3		7	7		23	24		28	28		
<i>Carya glabra</i>	pignut hickory	Tree																									4					
<i>Carya ovata</i>	shagbark hickory	Tree									2											2										
<i>Celtis laevigata</i>	sugarberry	Shrub Tree	1	1			1	1				2	2							4	4		7	7		9	10		5	5		
<i>Cercis canadensis</i>	eastern redbud	Shrub Tree			6													1			7						8					
<i>Elaeagnus umbellata</i>	autumn olive	Shrub										1						3			4											
<i>Fraxinus pennsylvanica</i>	green ash	Tree	3	3			1	1				3	3			5	6		1	2		13	15		14	14		17	18			
<i>Gleditsia triacanthos</i>	honeylocust	Shrub Tree						1													1											
<i>Ilex opaca</i>	American holly	Shrub Tree									1										1						2					
<i>Ilex verticillata</i>	common winterberry	Shrub Tree									1	1						3	3		4	4		4	4		5	5		6	6	
<i>Juglans nigra</i>	black walnut	Tree																									4					
<i>Juniperus virginiana</i>	eastern redcedar	Tree			1			3														4										
<i>Ligustrum sinense</i>	Chinese privet	Shrub Tree						1				2										10					8					
<i>Lindera benzoin</i>	northern spicebush	Shrub Tree									1	1						2	2		3	3		5	5		6	6		8	8	
<i>Liquidambar styraciflua</i>	sweetgum	Tree			2						18		50			29						131					58					
<i>Liriodendron tulipifera</i>	tuliptree	Tree					1	1			1	11		1	10			1	2		3		4	27		2	2		8	30		
<i>Morus</i>	mulberry	Shrub Tree																									2					
<i>Nyssa sylvatica</i>	blackgum	Tree									1	1								1	2		2	2		6	6		6	6		
<i>Pinus taeda</i>	loblolly pine	Tree			1						2			2							5						13					
<i>Platanus occidentalis</i>	American sycamore	Tree													2	2		1	1		3	3		5	5		6	6		7	7	
<i>Prunus serotina</i>	black cherry	Shrub Tree										1									1											
<i>Quercus alba</i>	white oak	Tree									4	4									4	4		5	5		7	7		6	6	
<i>Quercus coccinea</i>	scarlet oak	Tree										1									1											
<i>Quercus pagoda</i>	cherrybark oak	Tree													2	2					2	2		4	4		8	8		8	8	
<i>Quercus phellos</i>	willow oak	Tree			1	1									3	3		1	1		5	5		5	5		9	9		10	10	
<i>Quercus rubra</i>	northern red oak	Tree																					2	2		4	5		5	5		
<i>Quercus velutina</i>	black oak	Tree										2	2								2	2										
<i>Rhus copallinum</i>	flameleaf sumac	Shrub Tree											1									1										
<i>Rosa multiflora</i>	multiflora rose	Shrub Vine						1														1										
<i>Sambucus canadensis</i>	Common Elderberry	Shrub Tree										1	1					5	5		6	6		5	5		5	5		7	7	
<i>Ulmus</i>	elm	Tree			5						8		5			5						23										
<i>Ulmus alata</i>	winged elm	Tree										1										1										
<i>Ulmus americana</i>	American elm	Tree										4	4			1	1		2	2		7	7		7	7		6	44		7	7
<i>Unknown</i>		unknown																				3										
<i>Viburnum nudum</i>	possumhaw	Shrub Tree																				1		2	2		2	2		2	2	
<b>Stem count</b>			0	5	22	0	3	13	0	6	56	0	20	103	0	19	55	0	21	72	0	74	321	0	89	89	0	139	479	0	163	163
<b>size (ares)</b>			1			1			1			1			1			1			6			6			6			6		
<b>size (ACRES)</b>			0.02			0.02			0.02			0.02			0.02			0.02			0.15			0.15			0.15			0.15		
<b>Species count</b>			0	3	9	0	3	9	0	3	12	0	10	18	0	7	9	0	9	17	0	16	35	0	17	17	0	17	28	0	18	18
<b>Stems per ACRE</b>			0	202	890	0	121	526	0	243	2266	0	809	4168	0	769	2226	0	850	2914	0	499	2165	0	600	600	0	938	3231	0	1099	1099

**UT Rocky River Stream Restoration (EEP #402)**

**Appendix C. Vegetation Problem Area Photos.**



**SP1 - *Rosa multiflora* growing near channel in Reach 1 (11/5/09)**



**SP2 - *Ligustrum sinense* growing along forest edge in Reach 2 (11/5/09)**



**SP3 - *Elaeagnus umbellata* at approximately station 470 in Reach 2 (11/5/09)**

**UT Rocky River Stream Restoration (EEP #402)**



**Plot 5 (11/04/09)**



**Plot 5 (10/23/08)**



**Plot 6 (10/29/09)**



**Plot 6 (10/23/08)**

**UT Rocky River Stream Restoration (EEP #402)**

**Appendix C. Table 5. Vegetation Plot Mitigation Success Summary Table.**

<b>Tract</b>	<b>Vegetation Plot ID</b>	<b>Vegetation Survival Threshold Met?</b>	<b>Tract Mean</b>
Reach 1	1	N	0%
	2	N	
Reach 2	3	N	75%
	4	Y	
	5	Y	
	6	Y	

UT Rocky River Stream Restoration (EEP #402)

Appendix C. Vegetation Problem Area Inventory Table.

Feature/Issue	Station	Suspected Cause	Photo #
<b>Reach 1</b>			
Exotic invasive species	Entire Reach	Intruding from forested buffer or off-site seed sources	VP1
<b>Reach 2</b>			
Exotic invasive species	Entire Reach	Intruding from forested buffer or off-site seed sources	VP2 & VP3

## **Appendix D. Stream Assessment Data**

Stream Station Photos

Table 8. Visual Morphological Stability Assessment

Table 9. Verification of Bankfull Events

Cross sections with Annual Overlays

Longitudinal Profiles with Annual Overlays

Pebble Count Plots with Annual Overlays

Baseline Stream Data Summary Table (electronic submission only)

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Stream Problem Areas Inventory Table (electronic submission only)



UT Rocky River Stream Restoration (EEP #402)

Appendix D. Stream Station Photos



**PP #1 - Reach 1 - (03/12/09)**



**PP #1 - Reach 1 - (05/14/08)**



**PP #2 - Reach 2 - (03/12/09)**



**PP #2 - Reach 2 - (05/14/08)**

**UT Rocky River Stream Restoration (EEP #402)**



**PP #3 - Reach 2 - (03/12/09)**



**PP #3 - Reach 2 - (05/14/08)**



**PP #4 - Reach 2 - (03/12/09)**



**PP #4 - Reach 2 - (05/14/08)**

**UT Rocky River Stream Restoration (EEP #402)**



**PP #5 - Reach 2 - (03/12/09)**



**PP #5 - Reach 2 - (05/14/08)**



**PP #6 - Reach 2 - (03/12/09)**



**PP #6 - Reach 2 - (05/14/08)**

**UT Rocky River Stream Restoration (EEP #402)**



**PP #7 - Reach 2 - (03/12/09)**



**PP #7 - Reach 2 - (05/14/08)**



**PP #8 - Reach 2 - (10/29/09)**



**PP #8 - Reach 2 - (05/14/08)**

## UT Rocky River Stream Restoration (EEP #402)

**Table 8. Visual Morphological Stability Assessment**  
**Reach 1: 1095 feet (reconstructed channel: sta. 8+87 to 10+95)**

Feature Category	Metric (per As-built and reference baselines)	(# Stable) Number Performing as Intended	Total number per As-built	Total Number / feet in unstable state	% Perform in Stable Condition	Feature perform Mean or Total
A. Riffles	1. Present?	3	4	NA	75	
	2. Armor stable (e.g.no displacement?)	3	4	NA	75	
	3. Facet grade appears stable?	3	4	NA	75	
	4. Minimal evidence of embedding/fining?	3	4	NA	75	
	5. Length appropriate?	2	4	NA	50	<b>70%</b>
B. Pools	1. Present? (e.g. not subject to severe aggrad. Or migrat.?)	3	3	NA	100	
	2. Sufficiently deep (Max. Pool D:Mean Bkf>1.6?)	3	3	NA	100	
	3. Length appropriate?	2	3	NA	67	<b>89%</b>
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	3	3	NA	100	
	2. Downstream of meander (glide/inflection) centering?	3	3	NA	100	<b>100%</b>
D. Meanders	1. Outer bend in state of limited/controlled erosion?	3	3	NA	100	
	2. Of those eroding, # w/concomitant point bar formation?	3	3	NA	100	
	3. apparent Rc within spec?	3	3	NA	100	
	4. Sufficient floodplain access and relief?	3	3	NA	100	<b>100%</b>
E. Bed General	1. General channel bed aggradation areas (bar formation)	NA	NA	NA	NA	
	2. Channel bed degradation-areas of increasing downcutting of head cutting?	NA	NA	NA	NA	<b>100%</b>
F. Bank	1. Actively eroding, wasting, or slumping bank	NA	NA	0/0	100	<b>100%</b>
F. Vanes	1. Free of back or arm scour?	1	1	NA	100	
	2. Height appropriate?	1	1	NA	100	
	3. Angle and geometry appear appropriate?	1	1	NA	100	
	4. Free of piping or other structural failures?	1	1	NA	100	<b>100%</b>
G. Wads/ Boulders	1. Free of scour?	NA	NA	NA	NA	
	2. Footing stable?	NA	NA	NA	NA	NA

UT Rocky River Stream Restoration (EEP #402)

**Table 8. Visual Morphological Stability Assessment  
Reach 2: 1111 feet**

Feature Category	Metric (per As-built and reference baselines)	(# Stable) Number Performing as Intended	Total number per As-built	Total Number / feet in unstable state	% Perform in Stable Condition	Feature perform Mean or Total
A. Riffles*+	1. Present?	29	41	NA	71	
	2. Armor stable (e.g.no displacement?)	29	41	NA	71	
	3. Facet grade appears stable?	29	41	NA	71	
	4. Minimal evidence of embedding/fining?	29	41	NA	71	
	5. Length appropriate?	25	41	NA	61	<b>69%</b>
B. Pools*+	1. Present? (e.g. not subject to severe aggrad. Or migrat.?)	28	42	NA	67	
	2. Sufficiently deep (Max. Pool D:Mean Bkf>1.6?)	20	42	NA	48	
	3. Length appropriate?	21	42	NA	50	<b>55%</b>
C. Thalweg*	1. Upstream of meander bend (run/inflection) centering?	41	41	NA	100	
	2. Downstream of meander (glide/inflection) centering?	41	41	NA	100	<b>100%</b>
D. Meanders*	1. Outer bend in state of limited/controlled erosion?	42	42	NA	100	
	2. Of those eroding, # w/concomitant point bar formation?	0	0	NA	100	
	3. apparent Rc within spec?	42	42	NA	100	
	4. Sufficient floodplain access and relief?	40	42	NA	95	<b>99%</b>
E. Bed General*	1. General channel bed aggradation areas (bar formation)	NA	NA	1/15	98	
	2. Channel bed degradation-areas of increasing downcutting or head cutting?	NA	NA	0/0	100	<b>99%</b>
F. Bank*	1. Actively eroding, wasting, or slumping bank	NA	NA	0/0	100	<b>100%</b>
F. Vanes*	1. Free of back or arm scour?	8	8	NA	100	
	2. Height appropriate?	8	8	NA	100	
	3. Angle and geometry appear appropriate?	8	8	NA	100	
	4. Free of piping or other structural failures?	8	8	NA	100	<b>100%</b>
G. Wads/Boulders*	1. Free of scour?	NA	NA	NA	NA	
	2. Footing stable?	NA	NA	NA	NA	NA

\* No water when survey conducted. Additionally, terrestrial grass obscuring much of channel, making accurate visual assessment difficult.

+Assessment of riffles and pools based principally on longitudinal profile.

**Appendix D. Table 9. Verification of Bankfull Events.**

<b>Date of Data Collection</b>	<b>Date of Occurrence</b>	<b>Method</b>	<b>Photo # (if available)</b>
15 November 2007	October 26, 2007	Crest gauge evaluation, evaluation of USGS rain gauge data	NA
14 April 2008	March 5, 2008, April 5, 2008	Crest gauge evaluation, presence of wrack and drift lines, evaluation of NC CRONOS data	NA
17 October 2008	August 27, 2008, September 6, 2008	Crest gauge evaluation, presence of wrack and drift lines, evaluation of NC CRONOS data	NA
12 March 2009	December 11-12, 2008, January 6, 2009, March 2, 2009	Crest gauge evaluation, presence of wrack and drift lines, evaluation of NC CRONOS data	NA
4 November 2009	None	Crest gauge evaluation and absence of wrack and drift lines indicates bankfull event has not occurred since assessment in March 2009	NA

UT Rocky River Stream Restoration (EEP #402)  
 Appendix D. Cross-Sections with Annual Overlays.

River Basin: Cape Fear  
 Watershed: UT Rocky River  
 XS ID: Reach 1, XS-1  
 Reach: 1  
 Date: 11/4/2009  
 Field Crew: C.H. and S.D.

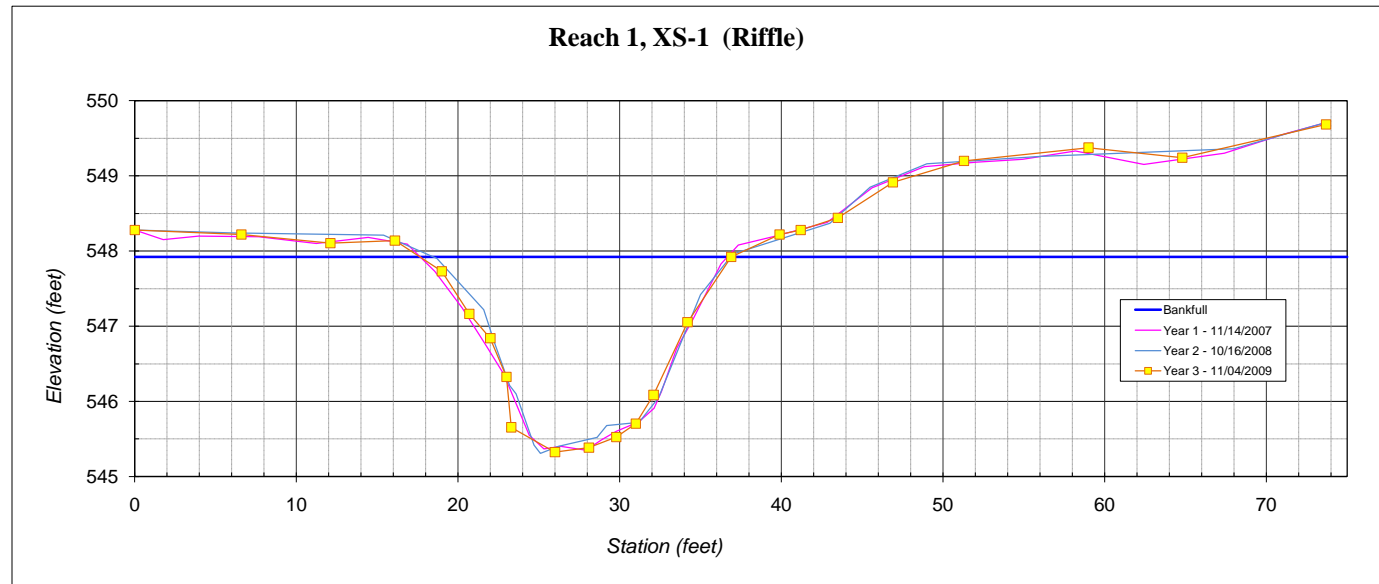
Station	Rod Ht.	Elevation
0.00	6.155	548.28
6.60	6.215	548.22
12.10	6.330	548.11
16.10	6.295	548.14
19.00	6.705	547.73
20.70	7.270	547.17
22.00	7.595	546.84
23.00	8.110	546.33
23.30	8.780	545.66
26.00	9.110	545.33
28.10	9.050	545.39
29.80	8.910	545.53
31.00	8.730	545.71
32.10	8.350	546.09
34.20	7.380	547.06
36.90	6.515	547.92
39.90	6.215	548.22
41.20	6.155	548.28
43.50	5.995	548.44
46.90	5.520	548.92
51.30	5.235	549.20
59.00	5.060	549.38
64.80	5.195	549.24
73.70	4.750	549.69

SUMMARY DATA  
 Floodprone Elevation (ft) 550.51  
 Bankfull Elevation (ft) 547.92  
 Floodprone Width (ft) 157.00  
 Bankfull Width (ft) 19.24  
 Entrenchment Ratio 8.16  
 Mean Depth (ft) 1.51  
 Maximum Depth (ft) 2.59  
 Width/Depth Ratio 12.73  
 Bankfull Area (sq ft) 29.1  
 Wetted Perimeter (ft) 20.40  
 Hydraulic Radius (ft) 1.43

Stream Type: C4



View of UT Rocky River, Reach 1, XS-1 looking upstream





UT Rocky River Stream Restoration (EEP #402)

River Basin: Cape Fear  
 Watershed: UT Rocky River  
 XS ID: Reach 2, XS-1  
 Reach: 2  
 Date: 11/4/2009  
 Field Crew: C.H. and S.D.

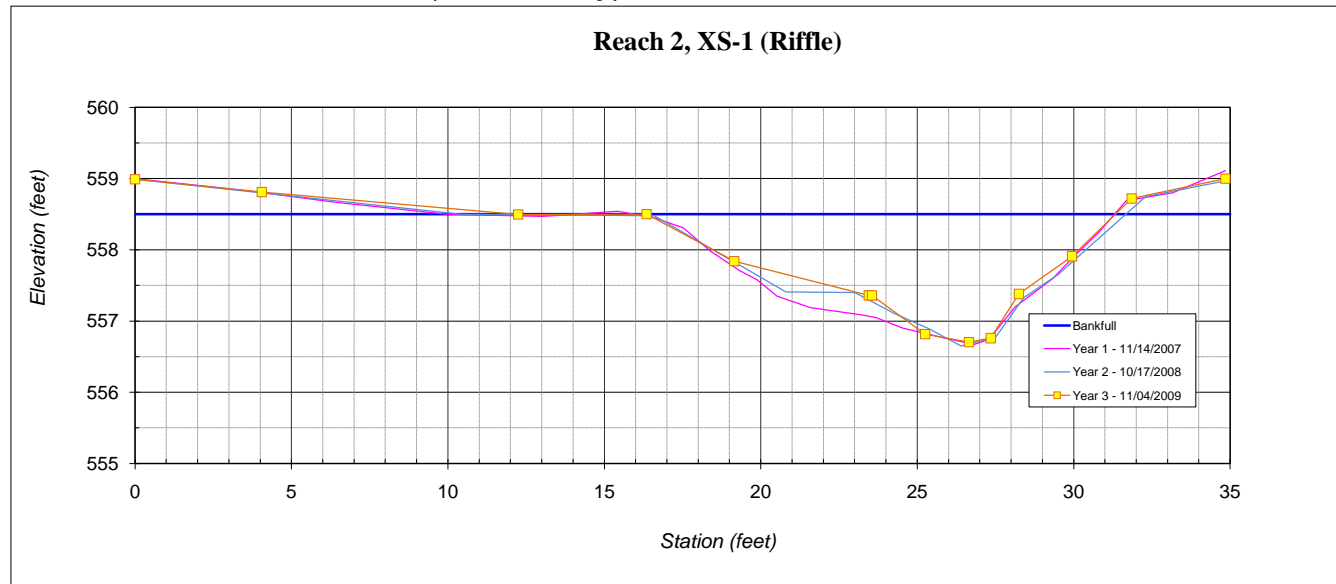
Station	Rod Ht.	Elevation
0	5.110	558.99
4.05	5.290	558.81
12.25	5.605	558.50
16.35	5.600	558.50
19.15	6.260	557.84
23.45	6.740	557.36
23.55	6.740	557.36
25.25	7.285	556.82
26.65	7.395	556.71
27.35	7.340	556.76
28.25	6.720	557.38
29.95	6.190	557.91
31.85	5.380	558.72
34.85	5.100	559.00

SUMMARY DATA  
 Floodprone Elevation (ft) 560.29  
 Bankfull Elevation (ft) 558.50  
 Floodprone Width (ft) 104.00  
 Bankfull Width (ft) 14.98  
 Entrenchment Ratio 6.94  
 Mean Depth (ft) 0.94  
 Maximum Depth (ft) 1.79  
 Width/Depth Ratio 15.90  
 Bankfull Area (sq ft) 14.12  
 Wetted Perimeter (ft) 15.57  
 Hydraulic Radius (ft) 0.91

Stream Type: C4



View of UT Rocky River, Reach 2, XS-1 looking upstream



UT Rocky River Stream Restoration (EEP #402)

River Basin: Cape Fear  
 Watershed: UT Rocky River  
 XS ID: Reach 2, XS-2  
 Reach: 2  
 Date: 11/4/2009  
 Field Crew: C.H. and S.D.

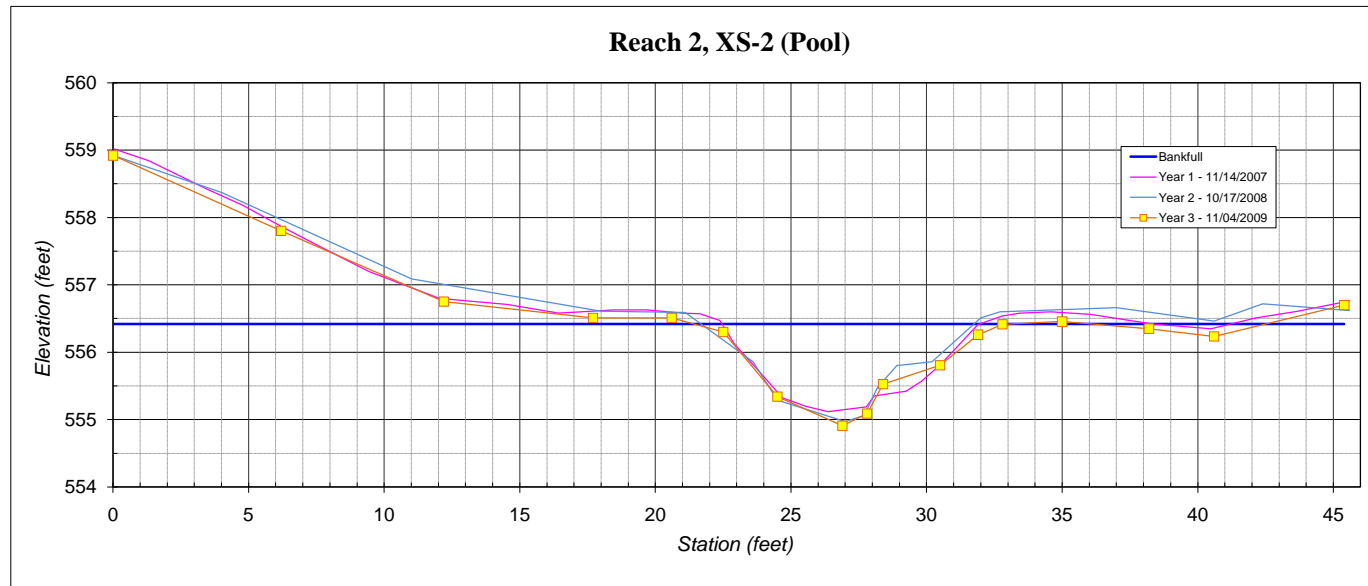
Station	Rod Ht.	Elevation
0.00	3.230	558.92
6.20	4.350	557.80
12.20	5.400	556.75
17.70	5.640	556.51
20.60	5.640	556.51
22.50	5.850	556.30
24.50	6.810	555.34
26.90	7.240	554.91
27.80	7.060	555.09
28.40	6.625	555.53
30.50	6.345	555.81
31.90	5.890	556.26
32.80	5.735	556.42
35.00	5.695	556.46
38.20	5.800	556.35
40.60	5.915	556.24
45.40	5.450	556.70

**SUMMARY DATA**  
 Floodprone Elevation (ft) 557.93  
 Bankfull Elevation (ft) 556.42  
 Floodprone Width (ft) 112.00  
 Bankfull Width (ft) 11.39  
 Entrenchment Ratio 9.84  
 Mean Depth (ft) 0.75  
 Maximum Depth (ft) 1.51  
 Width/Depth Ratio 15.25  
 Bankfull Area (sq ft) 8.50  
 Wetted Perimeter (ft) 11.91  
 Hydraulic Radius (ft) 0.71

Stream Type: C6



View of UT Rocky River, Reach 2, XS-2 looking upstream



UT Rocky River Stream Restoration (EEP #402)

River Basin: Cape Fear  
 Watershed: UT Rocky River  
 XS ID: Reach 2, XS-3  
 Reach: 2  
 Date: 11/4/2009  
 Field Crew: C.H. and S.D.

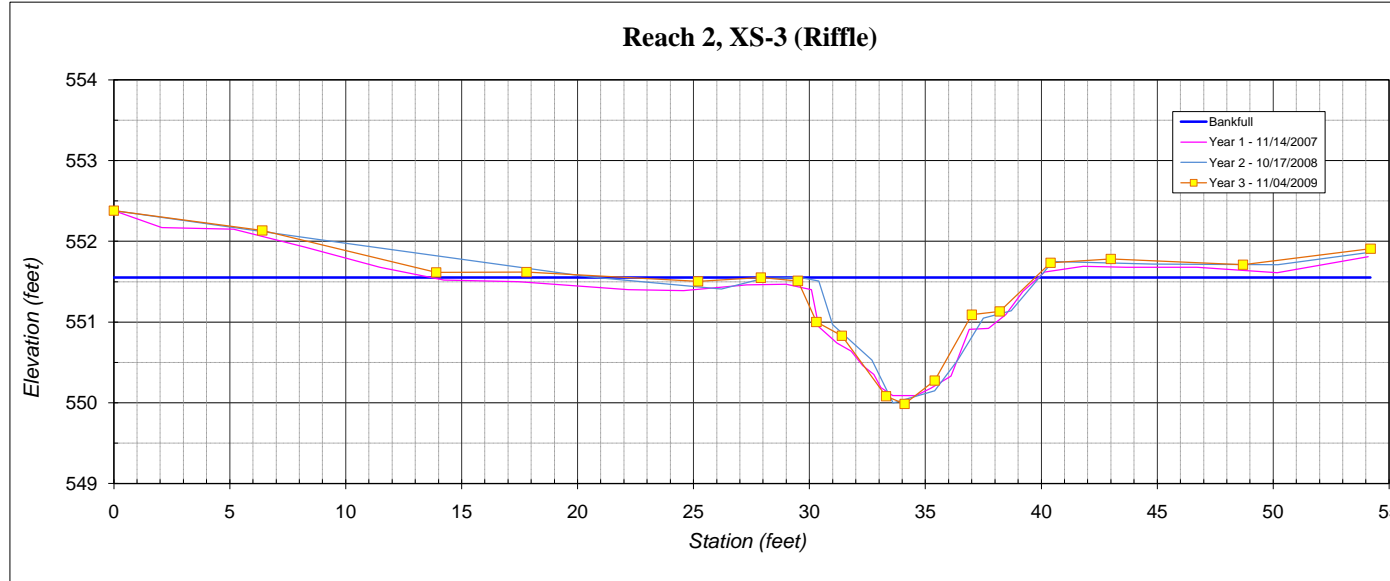
Station	Rod Ht.	Elevation
0.00	4.620	552.38
6.40	4.865	552.14
13.90	5.385	551.62
17.80	5.380	551.62
25.20	5.495	551.51
27.90	5.450	551.55
29.50	5.490	551.51
30.30	6.000	551.00
31.40	6.170	550.83
33.30	6.920	550.08
34.10	7.015	549.99
35.40	6.725	550.28
37.00	5.910	551.09
38.20	5.870	551.13
40.40	5.265	551.74
43.00	5.220	551.78
48.70	5.290	551.71
54.20	5.090	551.91

SUMMARY DATA	
Floodprone Elevation (ft)	553.11
Bankfull Elevation (ft)	551.55
Floodprone Width (ft)	200.00
Bankfull Width (ft)	11.81
Entrenchment Ratio	16.94
Mean Depth (ft)	0.70
Maximum Depth (ft)	1.56
Width/Depth Ratio	16.76
Bankfull Area (sq ft)	8.33
Wetted Perimeter (ft)	12.41
Hydraulic Radius (ft)	0.67

Stream Type: C5



View of UT Rocky River, Reach 2, XS-3 looking upstream



UT Rocky River Stream Restoration (EEP #402)

River Basin: Cape Fear  
 Watershed: UT Rocky River  
 XS ID: Reach 2, XS 4  
 Reach: 2  
 Date: 11/4/2009  
 Field Crew: C.H. and S.D.

Station	Rod Ht.	Elevation
0.00	4.950	549.84
9.80	5.120	549.67
17.80	5.205	549.59
24.20	5.120	549.67
26.10	5.060	549.73
29.50	6.635	548.16
30.30	6.805	547.99
32.30	6.630	548.16
33.20	5.940	548.85
34.00	5.850	548.94
35.90	5.460	549.33
37.90	4.930	549.86
42.70	5.055	549.74
47.80	5.050	549.74

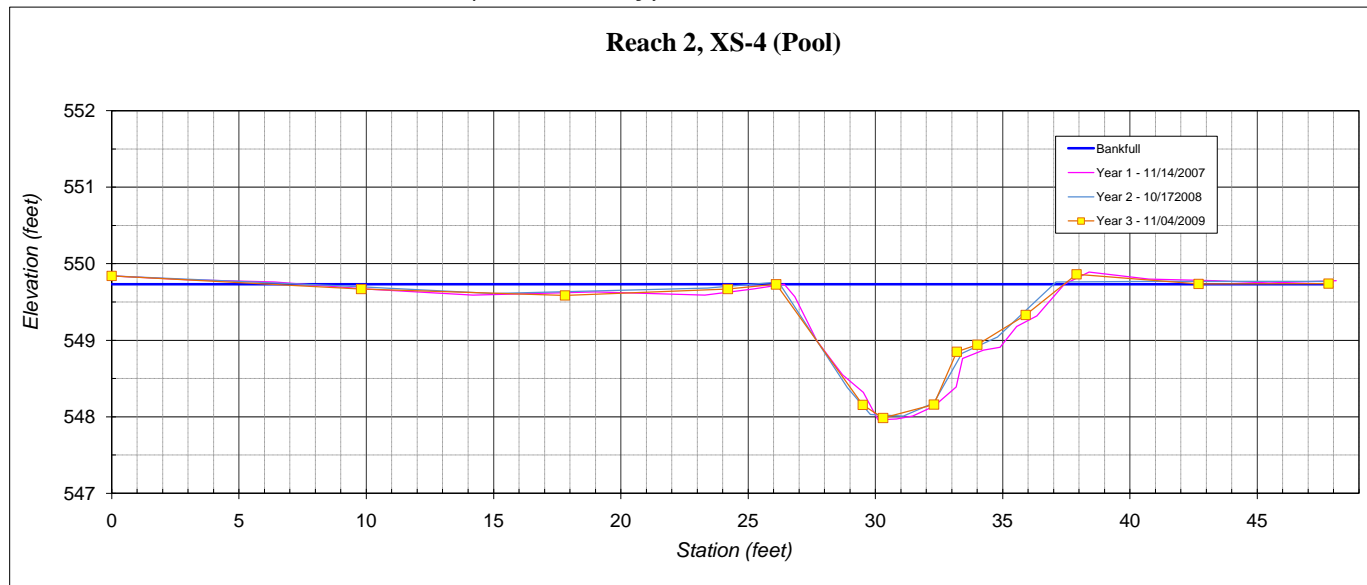
**SUMMARY DATA**

Floodprone Elevation (ft) 551.47  
 Bankfull Elevation (ft) 549.73  
 Floodprone Width (ft) 160.00  
 Bankfull Width (ft) 11.31  
 Entrenchment Ratio 14.15  
 Mean Depth (ft) 0.93  
 Maximum Depth (ft) 1.74  
 Width/Depth Ratio 12.17  
 Bankfull Area (sq ft) 10.51  
 Wetted Perimeter (ft) 12.01  
 Hydraulic Radius (ft) 0.87

Stream Type: C6



View of UT Rocky River, Reach 2, XS-4 looking upstream



UT Rocky River Stream Restoration (EEP #402)

River Basin: Cape Fear  
 Watershed: UT Rocky River  
 XS ID: Reach 2, XS-5  
 Reach: 2  
 Date: 11/4/2009  
 Field Crew: C.H. and S.D.

Station	Rod Ht.	Elevation
0.00	5.720	547.87
5.60	5.830	547.76
11.30	5.985	547.61
17.60	5.805	547.79
19.80	5.630	547.96
22.00	5.500	548.09
25.10	5.600	547.99
30.20	5.790	547.80
33.10	5.860	547.73
34.60	6.450	547.14
35.70	7.360	546.23
36.50	7.520	546.07
38.50	7.815	545.78
39.80	7.545	546.05
40.50	6.670	546.92
41.40	6.560	547.03
43.30	6.110	547.48
45.60	5.935	547.66
49.30	5.745	547.85
51.20	5.470	548.12

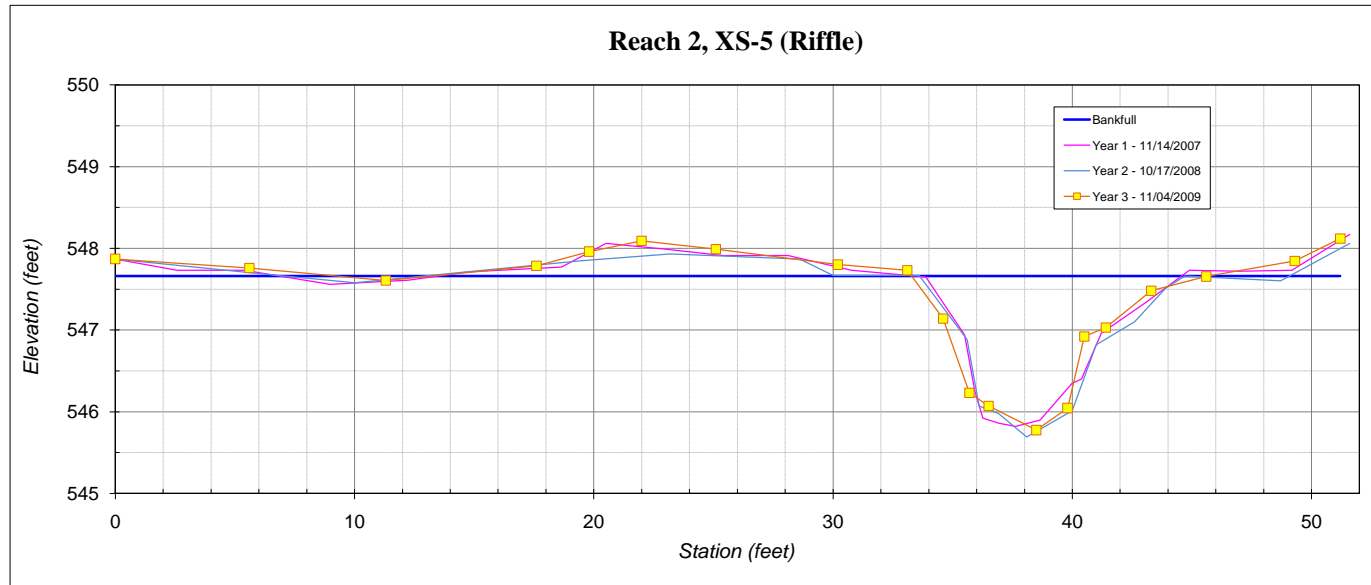
SUMMARY DATA

Floodprone Elevation (ft) 549.54  
 Bankfull Elevation (ft) 547.66  
 Floodprone Width (ft) 130.00  
 Bankfull Width (ft) 12.32  
 Entrenchment Ratio 10.55  
 Mean Depth (ft) 0.87  
 Maximum Depth (ft) 1.88  
 Width/Depth Ratio 14.09  
 Bankfull Area (sq ft) 10.78  
 Wetted Perimeter (ft) 13.30  
 Hydraulic Radius (ft) 0.81

Stream Type: C4

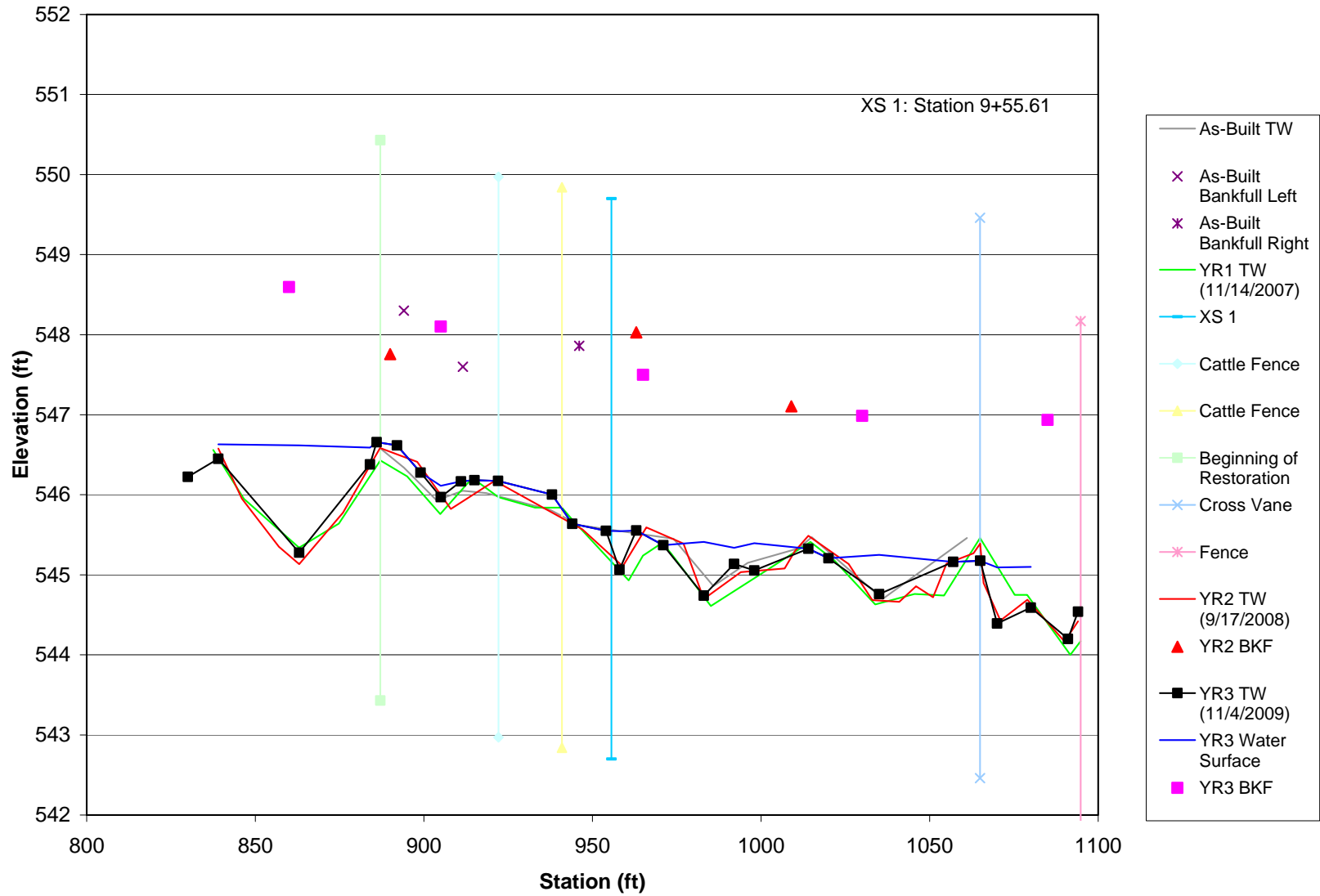


View of UT Rocky River, Reach 2, XS-5 looking upstream



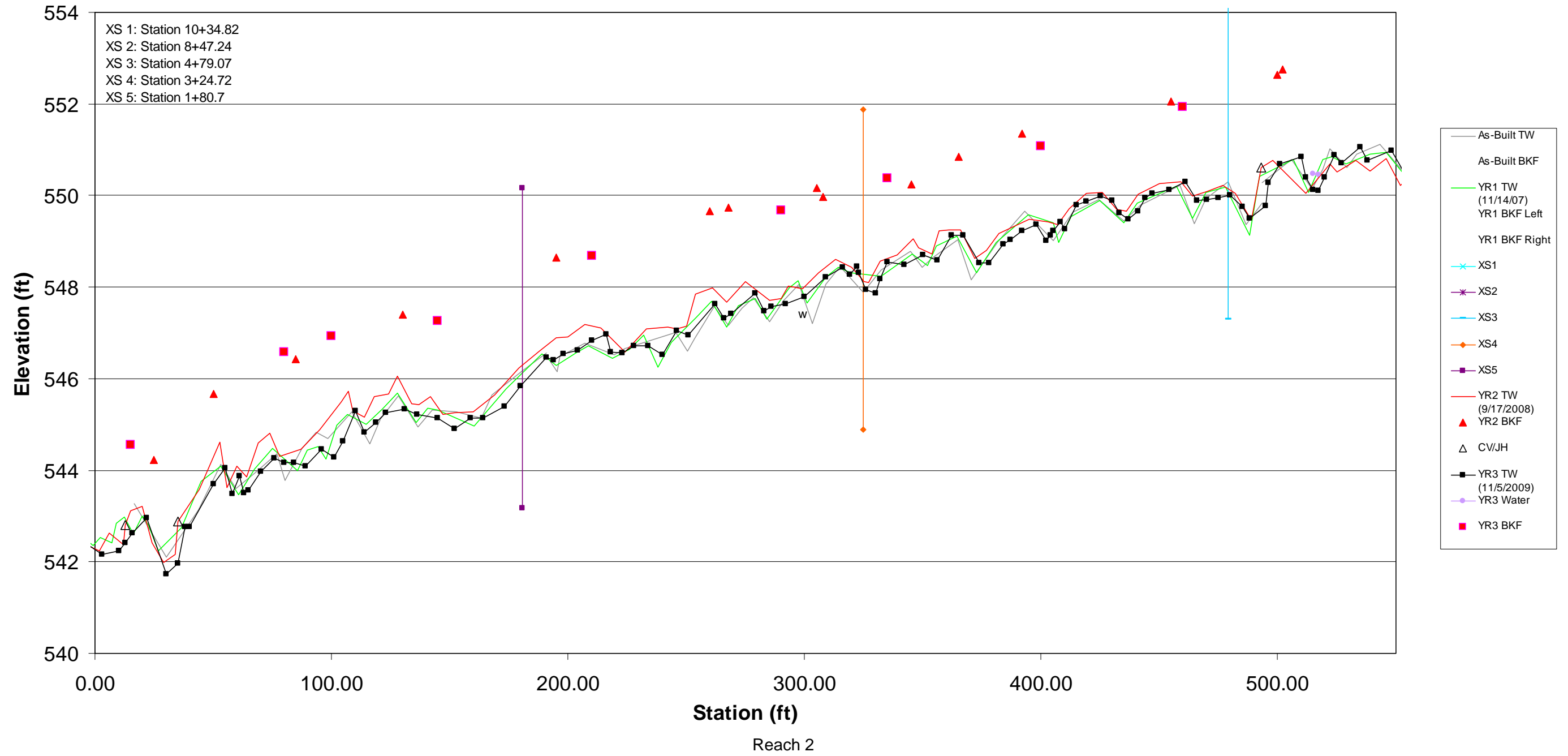
# UT Rocky River Stream Restoration (EEP Project #402)

## Appendix D. Longitudinal Profiles with Annual Overlays. Reach 1

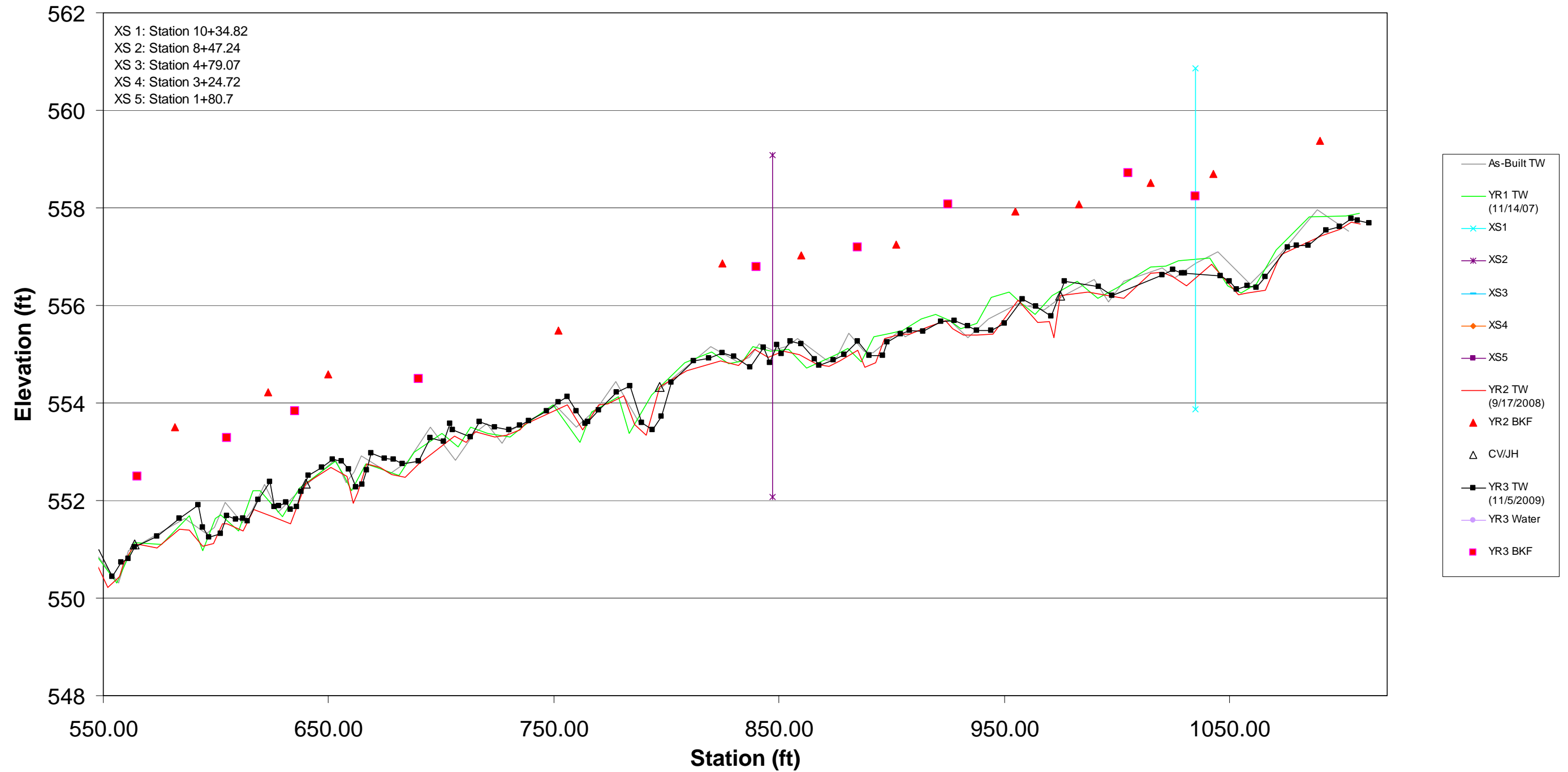


UT Rocky River Stream Restoration (EEP Project #402)

Appendix D. Longitudinal Profiles with Annual Overlays.



Appendix D. Longitudinal Profiles with Annual Overlays.  
Reach 1





UT Rocky River Stream Restoration (EEP #402)

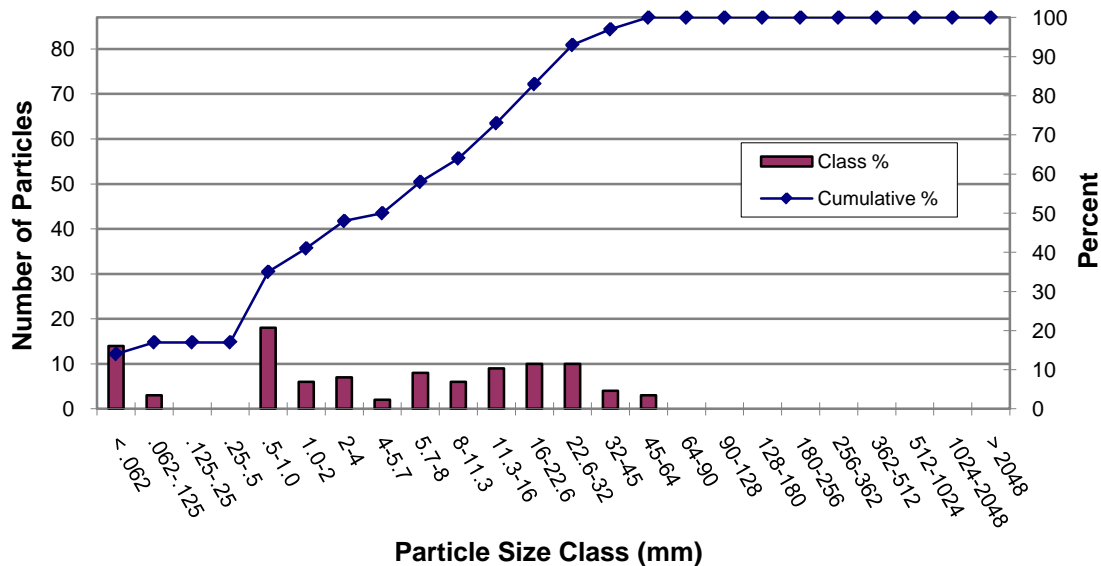
Appendix D. Pebble Count Plots

Reach One, Cross Section One  
Monitoring Year - 3 (11/3/09)

S/C	Particle	Size Range (mm)	Total #	Class %	Cumulative %
	Silt/Clay	< .062	14	14	14
Sand	Very Fine Sand	.062-.125	3	3	17
	Fine Sand	.125-.25		0	17
	Medium Sand	.25-.5		0	17
	Coarse Sand	.5-1.0	18	18	35
	Very Course Sand	1.0-2	6	6	41
Gravel	Very Fine Gravel	2-4	7	7	48
	Fine Gravel	4-5.7	2	2	50
	Fine Gravel	5.7-8	8	8	58
	Medium Gravel	8-11.3	6	6	64
	Medium Gravel	11.3-16	9	9	73
	Coarse Gravel	16-22.6	10	10	83
	Coarse Gravel	22.6-32	10	10	93
	Very Course Gravel	32-45	4	4	97
	Very Course Gravel	45-64	3	3	100
Cobble	Small Cobble	64-90		0	100
	Small Cobble	90-128		0	100
	Medium Cobble	128-180		0	100
	Large Cobble	180-256		0	100
Boulder	Small Boulders	256-362		0	100
	Small Boulders	362-512		0	100
	Medium Boulders	512-1024		0	100
	Large Boulders	1024-2048		0	100
	Bedrock	> 2048		0	100

d<sub>50</sub> = 5.7  
d<sub>84</sub> = 23.54

Total 100



UT Rocky River Stream Restoration (EEP #402)

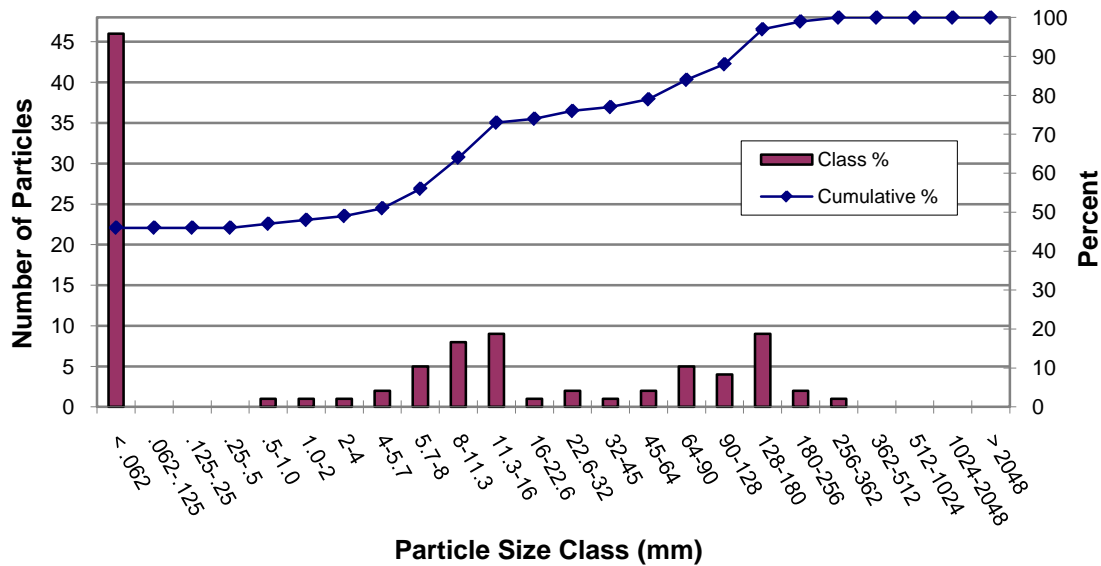
Appendix D. Pebble Count Plots

Reach Two, Cross Section One  
Monitoring Year - 3 (11/3/09)

S/C	Particle	Size Range (mm)	Total #	Class %	Cumulative %
	Silt/Clay	< .062	46	46	46
Sand	Very Fine Sand	.062-.125		0	46
	Fine Sand	.125-.25		0	46
	Medium Sand	.25-.5		0	46
	Coarse Sand	.5-1.0	1	1	47
	Very Course Sand	1.0-2	1	1	48
Gravel	Very Fine Gravel	2-4	1	1	49
	Fine Gravel	4-5.7	2	2	51
	Fine Gravel	5.7-8	5	5	56
	Medium Gravel	8-11.3	8	8	64
	Medium Gravel	11.3-16	9	9	73
	Coarse Gravel	16-22.6	1	1	74
	Coarse Gravel	22.6-32	2	2	76
	Very Course Gravel	32-45	1	1	77
	Very Course Gravel	45-64	2	2	79
Cobble	Small Cobble	64-90	5	5	84
	Small Cobble	90-128	4	4	88
	Medium Cobble	128-180	9	9	97
	Large Cobble	180-256	2	2	99
Boulder	Small Boulders	256-362	1	1	100
	Small Boulders	362-512		0	100
	Medium Boulders	512-1024		0	100
	Large Boulders	1024-2048		0	100
	Bedrock	> 2048		0	100

d<sub>50</sub> = 4.85  
d<sub>84</sub> = 90.0

Total 100



UT Rocky River Stream Restoration (EEP #402)

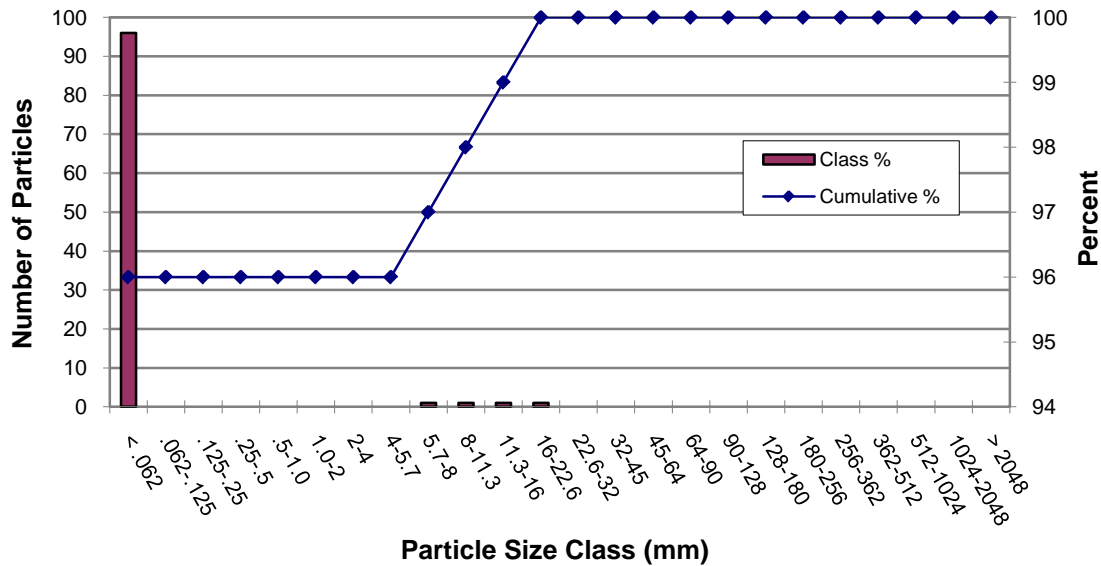
Appendix D. Pebble Count Plots

Reach Two, Cross Section Two  
Monitoring Year - 3 (11/3/09)

S/C	Particle	Size Range (mm)	Total #	Class %	Cumulative %
	Silt/Clay	< .062	96	96	96
Sand	Very Fine Sand	.062-.125		0	96
	Fine Sand	.125-.25		0	96
	Medium Sand	.25-.5		0	96
	Coarse Sand	.5-1.0		0	96
	Very Course Sand	1.0-2		0	96
Gravel	Very Fine Gravel	2-4		0	96
	Fine Gravel	4-5.7		0	96
	Fine Gravel	5.7-8	1	1	97
	Medium Gravel	8-11.3	1	1	98
	Medium Gravel	11.3-16	1	1	99
	Coarse Gravel	16-22.6	1	1	100
	Coarse Gravel	22.6-32		0	100
	Very Course Gravel	32-45		0	100
	Very Course Gravel	45-64		0	100
Cobble	Small Cobble	64-90		0	100
	Small Cobble	90-128		0	100
	Medium Cobble	128-180		0	100
	Large Cobble	180-256		0	100
Boulder	Small Boulders	256-362		0	100
	Small Boulders	362-512		0	100
	Medium Boulders	512-1024		0	100
	Large Boulders	1024-2048		0	100
	Bedrock	> 2048		0	100

d<sub>50</sub> = 0.03  
d<sub>84</sub> = 0.05

Total 100



UT Rocky River Stream Restoration (EEP #402)

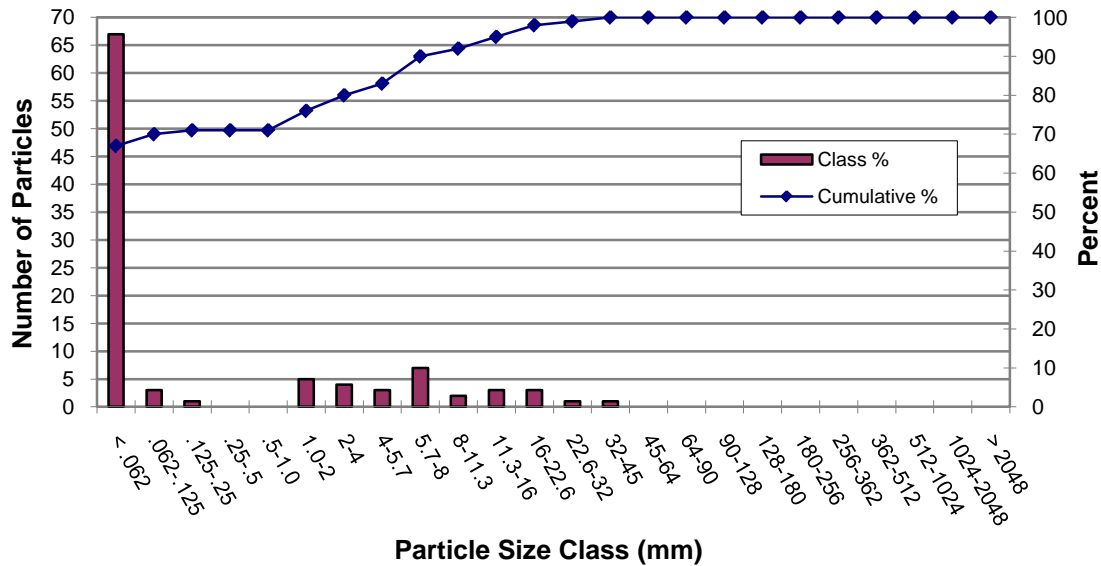
Appendix D. Pebble Count Plots

Reach Two, Cross Section Three  
Monitoring Year - 3 (11/3/09)

S/C	Particle	Size Range (mm)	Total #	Class %	Cumulative %
	Silt/Clay	< .062	67	67	67
Sand	Very Fine Sand	.062-.125	3	3	70
	Fine Sand	.125-.25	1	1	71
	Medium Sand	.25-.5		0	71
	Coarse Sand	.5-1.0		0	71
	Very Course Sand	1.0-2	5	5	76
Gravel	Very Fine Gravel	2-4	4	4	80
	Fine Gravel	4-5.7	3	3	83
	Fine Gravel	5.7-8	7	7	90
	Medium Gravel	8-11.3	2	2	92
	Medium Gravel	11.3-16	3	3	95
	Coarse Gravel	16-22.6	3	3	98
	Coarse Gravel	22.6-32	1	1	99
	Very Course Gravel	32-45	1	1	100
	Very Course Gravel	45-64		0	100
Cobble	Small Cobble	64-90		0	100
	Small Cobble	90-128		0	100
	Medium Cobble	128-180		0	100
	Large Cobble	180-256		0	100
Boulder	Small Boulders	256-362		0	100
	Small Boulders	362-512		0	100
	Medium Boulders	512-1024		0	100
	Large Boulders	1024-2048		0	100
	Bedrock	> 2048		0	100

d<sub>50</sub> = 0.05  
d<sub>84</sub> = 6.03

Total 100



UT Rocky River Stream Restoration (EEP #402)

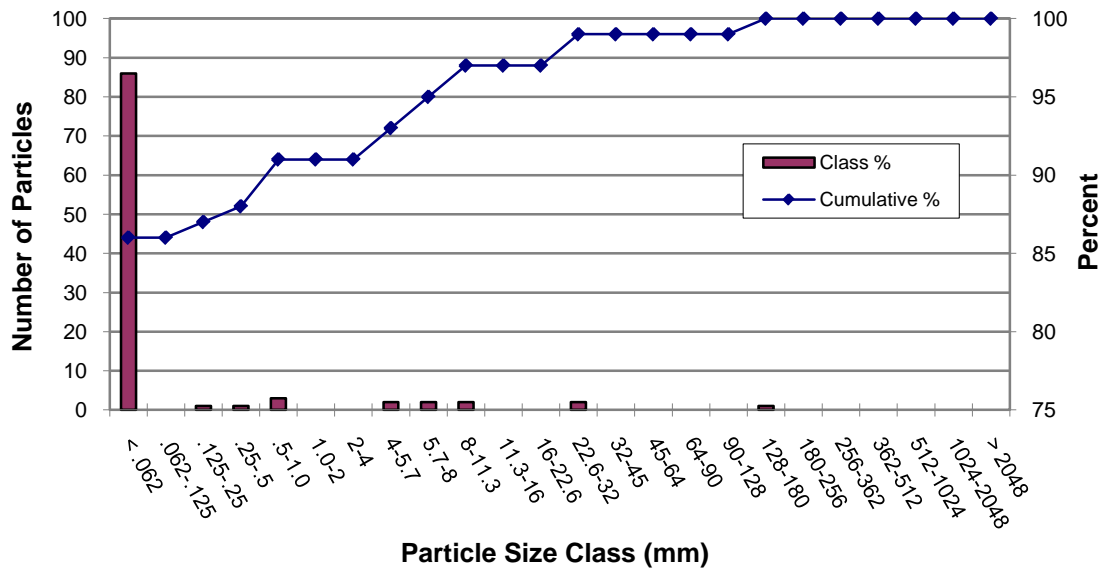
Appendix D. Pebble Count Plots

Reach Two, Cross Section Four  
Monitoring Year - 3 (11/3/09)

S/C	Particle	Size Range (mm)	Total #	Class %	Cumulative %
	Silt/Clay	< .062	86	86	86
Sand	Very Fine Sand	.062-.125		0	86
	Fine Sand	.125-.25	1	1	87
	Medium Sand	.25-.5	1	1	88
	Coarse Sand	.5-1.0	3	3	91
	Very Course Sand	1.0-2		0	91
Gravel	Very Fine Gravel	2-4		0	91
	Fine Gravel	4-5.7	2	2	93
	Fine Gravel	5.7-8	2	2	95
	Medium Gravel	8-11.3	2	2	97
	Medium Gravel	11.3-16		0	97
	Coarse Gravel	16-22.6		0	97
	Coarse Gravel	22.6-32	2	2	99
	Very Course Gravel	32-45		0	99
	Very Course Gravel	45-64		0	99
Cobble	Small Cobble	64-90		0	99
	Small Cobble	90-128		0	99
	Medium Cobble	128-180	1	1	100
	Large Cobble	180-256		0	100
Boulder	Small Boulders	256-362		0	100
	Small Boulders	362-512		0	100
	Medium Boulders	512-1024		0	100
	Large Boulders	1024-2048		0	100
	Bedrock	> 2048		0	100

d<sub>50</sub> = 0.04  
d<sub>84</sub> = 0.06

Total 100



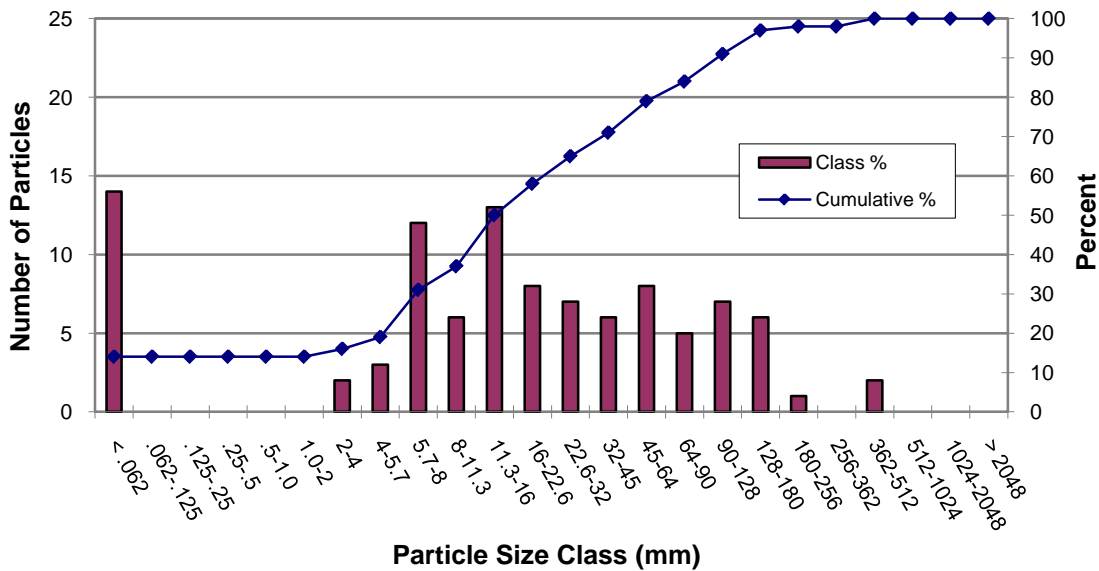
UT Rocky River Stream Restoration (EEP #402)

Appendix D. Pebble Count Plots

Reach Two, Cross Section Five  
Monitoring Year - 3 (11/3/09)

S/C	Particle	Size Range (mm)	Total #	Class %	Cumulative %
	Silt/Clay	< .062	14	14	14
Sand	Very Fine Sand	.062-.125		0	14
	Fine Sand	.125-.25		0	14
	Medium Sand	.25-.5		0	14
	Coarse Sand	.5-1.0		0	14
	Very Course Sand	1.0-2		0	14
Gravel	Very Fine Gravel	2-4	2	2	16
	Fine Gravel	4-5.7	3	3	19
	Fine Gravel	5.7-8	12	12	31
	Medium Gravel	8-11.3	6	6	37
	Medium Gravel	11.3-16	13	13	50
	Coarse Gravel	16-22.6	8	8	58
	Coarse Gravel	22.6-32	7	7	65
	Very Course Gravel	32-45	6	6	71
	Very Course Gravel	45-64	8	8	79
Cobble	Small Cobble	64-90	5	5	84
	Small Cobble	90-128	7	7	91
	Medium Cobble	128-180	6	6	97
	Large Cobble	180-256	1	1	98
Boulder	Small Boulders	256-362		0	98
	Small Boulders	362-512	2	2	100
	Medium Boulders	512-1024		0	100
	Large Boulders	1024-2048		0	100
	Bedrock	> 2048		0	100
Total			100		

d<sub>50</sub> = 15.0  
d<sub>84</sub> = 90.0



# UT Rocky River Stream Restoration (EEP #402)

**Appendix D. Baseline Stream Data Summary Table**  
**Reach 1: 1095 feet total, Enhancement I length 208 feet Station 8+87 to 10+95**

Parameter	USGS Gage Data			Regional Curve Data			Pre-Existing Condition (208')			Project Reference Stream			Design (208')			As-built (208')		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
<b>Dimension</b>																		
BF Width (ft)	NA			8.1	28	14	17	22.3	19.9	12.7	13.9	13.3	-	-	24	-	-	24
Floodprone width (ft)	NA			NA			95	196	153	27	45	35.3	125	155	140	125	155	140
BF Cross Sectional Area (sq. ft)	NA			13	50	25	31.4	36	34	11.03	11.95	11.59	38	53	38.4	-	-	34.4
BF Mean depth (ft)	NA			1.03	2.6	1.6	1.5	2.08	1.74	0.85	0.91	0.88	-	-	1.6	-	-	1.44
BF Max Depth (ft)	NA			NA			2.45	3	2.62	1.26	1.44	1.34	2.3	2.6	2.45	2.3	2.6	2.8
Width/Depth Ratio	NA			NA			8.17	14.87	11.75	14.5	16.35	15.15	-	-	15	-	-	16.6
Entrenchment Ratio	NA			NA			4.8	7	6	2.13	3.24	2.65	5.2	6.45	5.8	5.23	6.48	5.85
Bank Height Ratio	NA			NA			1	1.3	1.2	0.84	1.8	1.19	1	1.2	1.1	1	1.2	1.15
Wetted Perimeter (ft)	NA			NA			-			-			-	-	24.93	-	-	26
Hydraulic Radius (ft)	NA			NA			1.5	1.74	1.5	0.79	0.81	0.8	-	-	1.54	-	-	1.32
<b>Pattern</b>																		
Channel Beltwidth (ft)	NA			NA			40	80	60	15	32	21.7	40	70	50	40	70	50
Radius of Curvature (ft)	NA			NA			15	70	40	11.7	35.9	21.5	55	70	60	55	70	62
Meander Wavelength (ft)	NA			NA			65	160	112	35	57.5	45.8	100	110	105	100	110	105
Meander Width Ratio	NA			NA			2.35	3.58	3.01	1.13	2.41	1.63	1.6	2.9	2	1.67	2.93	2.1
<b>Profile</b>																		
Riffle length (ft)	NA			NA			8	45	24.5	5	24	15.92	10	60	30	7	53	24
Riffle slope (ft/ft)	NA			NA			0.003	0.036	0.015	0.0156	0.149	0.0257	0.033	0.037	0.034	0.012	0.032	0.03
Pool length (ft)	NA			NA			7	46	23	5	19	9.99	19	55	40	19	50	36
Pool spacing (ft)	NA			NA			26	57.5	43.7	22.8	64	40.3	27	60	52.6	24	60	45.8
<b>Substrate</b>																		
d50 (mm)	NA			NA			-	-	37	-	-	3	-	-	36	10		
d84 (mm)	NA			NA			-	-	79	-	-	31	-	-	74	33		
<b>Additional Reach Parameters</b>																		
Valley Length (ft)	NA			NA			-	-	185	-	-	312	-	-	185	-	-	185
Channel Length (ft)	NA			NA			-	-	222	-	-	397	-	-	208	-	-	208
Sinuosity	NA			NA			-	-	1.2	-	-	1.27	-	-	1.12	-	-	1.12
Water Surface Slope (ft/ft)	NA			NA			-	-	0.0088	-	-	0.0078	-	-	0.0103	-	-	0.0093
BF slope (ft/ft)	NA			NA			-	-	0.0103	-	-	0.0079	-	-	0.0105	-	-	0.0105
Rosgen Classification	NA			NA			-	-	C4/E4	-	-	C4	-	-	C4	-	-	C4

\*Data could not be collected for base line data directly after construction due to stream matting covering the substrate

# UT Rocky River Stream Restoration (EEP #402)

## Appendix D. Baseline Stream Data Summary Table

### Reach 2: 1111 feet

Parameter	USGS Gage Data			Regional Curve Data			Pre-Existing Condition			Project Reference Stream			Design			As-built		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Dimension																		
BF Width (ft)	NA			3.7	14	7.6	7.7	8.7	8.13	12.7	13.9	13.3	-	-	11	9.89	14.57	11.15
Floodprone width (ft)	NA			NA			11	12	11.33	27	45	35.3	100	200	144	104	200	141.2
BF Cross Sectional Area (sq. ft)	NA			3.4	15	7.5	6.03	7.04	6.7	11.03	11.95	11.59	8.2	9.2	8.2	8.04	14.87	9.86
BF Mean depth (ft)	NA			0.59	1.55	1.02	0.75	0.91	0.82	0.85	0.91	0.88	0.74	0.84	0.74	0.77	1.02	0.87
BF Max Depth (ft)	NA			NA			1.2	1.37	1.26	1.26	1.44	1.34	1.05	1.33	1.16	1.34	1.64	1.51
Width/Depth Ratio	NA			NA			8.42	10.94	10	14.5	16.35	15.15	13	16.35	15	11.16	14.28	12.75
Entrenchment Ratio	NA			NA			1.26	1.56	1.4	2.13	3.24	2.65	9.9	18	13	7.9	21.85	13.56
Bank Height Ratio	NA			NA			1.46	1.83	1.66	0.84	1.18	1.02	0.84	1.15	1.0	1.0	1.12	1.04
Wetted Perimeter (ft)	NA			NA			-			-			-			10.40	15.11	11.78
Hydraulic Radius (ft)	NA			NA			0.75	0.91	0.82	0.79	0.81	0.8	-			0.73	0.98	0.83
Pattern																		
Channel Beltwidth (ft)	NA			NA			13	35	20	15	32	21.7	12.5	26.5	18	14.3	35	21
Radius of Curvature (ft)	NA			NA			7.6	21.2	12.3	11.7	35.9	21.5	10	20	13.5	10	20	13.8
Meander Wavelength (ft)	NA			NA			35	85	57	35	57.5	45.8	24	65	38	24	65	37.1
Meander Width Ratio	NA			NA			1.6	4.3	2.46	1.13	2.41	1.63	1.13	2.41	1.63	1.3	2.7	1.98
Profile																		
Riffle length (ft)	NA			NA			4	117.5	22.78	5	24	15.92	4	26	9.5	3	26.3	9.48
Riffle slope (ft/ft)	NA			NA			0.005	0.0722	0.0305	0.0156	0.149	0.0257	0.02	0.083	0.035	0.012	0.064	0.033
Pool length (ft)	NA			NA			6	13	9.75	5	19	9.99	13	27	16.4	7.88	29.5	15.84
Pool spacing (ft)	NA			NA			14	139	40	22.8	64	40.3	17	51	27.5	12.3	63	28
Substrate																		
d50 (mm)	NA			NA			-	-	29	-	-	3	-	-	29	*		
d84 (mm)	NA			NA			-	-	110	-	-	31	-	-	110	*		
Additional Reach Parameters																		
Valley Length (ft)	NA			NA			-	-	950	-	-	312	-	-	950	-	-	950
Channel Length (ft)	NA			NA			-	-	1011	-	-	397	-	-	1165	-	-	1111
Sinuosity	NA			NA			-	-	1.06	-	-	1.27	-	-	1.23	-	-	1.20
Water Surface Slope (ft/ft)	NA			NA			-	-	0.0154	-	-	0.0078	0.0087	0.016	0.0126	-	-	-
BF slope (ft/ft)	NA			NA			-	-	0.0137	-	-	0.0079	0.0087	0.016	0.0126	0.009	0.02	0.009/0.014**
Rosgen Classification	NA			NA			-	-	G4	-	-	C4	-	-	C4	-	-	C4

\*Data could not be collected for base line data directly after construction due to stream matting covering the substrate; \*\*Upper portion of reach2/Lower portion of reach 2



# UT Rocky River Stream Restoration (EEP #402)

Appendix D. Morphology and Hydraulic Summary Table (Cross-Section and Reach Parameters)  
Reach 1: 1095 feet

Parameter	Cross Section 1 Riffle					
Dimension	MY1	MY2	MY3	MY4	MY5	MY+
BF Width (ft)	23.9	25.3	19.2			
Floodprone Width (ft)	158	157	157			
BF Cross Sectional Area (sq.ft)	34.7	33.9	29.1			
BF Mean Depth (ft)	1.45	1.34	1.51			
BF Max Depth (ft)	2.81	2.90	2.59			
Width/Depth Ratio	16.49	18.81	12.73			
Entrenchment Ratio	8.44	6.20	8.16			
Bank Height Ratio	1.32	1.31	1.08			
Wetted Perimeter (ft)	19.1	26.4	20.4			
Hydraulic Radius (ft)	1.46	1.29	1.43			
<b>Substrate</b>						
d50 (mm)	10.00	11.30	5.70			
d84 (mm)	33.00	59.25	23.54			

Parameter	MY-01 (2007)			MY-02 (2008)			MY-03 (2009)			MY-04 (2010)			MY-05 (2011)			MY-06 (2012)		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	27	58	39	26	46	42	31	44	43									
Radius of Curvature (ft)	21	65	39	27	70	32	30	60	36									
Meander Wavelength (ft)	63	104	84	95	173	120	105	160	116									
Meander Width Ratio	1.23	2.04	1.63	1.03	1.82	1.66	1.61	2.29	2.24									
<b>Profile</b>																		
Riffle length (ft)	4	18	7	8	26	14	6	70	8									
Riffle slope (ft/ft)	0.020	0.040	0.034	-0.020	0.030	0.010	-0.002	0.020	0.015									
Pool length (ft)	13	18	14	19	37	27	29	43	37									
Pool spacing (ft)	17	36	22	11	26	16	6	87	8									
<b>Additional Reach parameters</b>				**For the surveyed section only														
Valley Length (ft)	1060			245			245											
Channel Length (ft)	1139			266			268											
Sinuosity	1.07			1.08			1.09											
Water Surface Slope (ft/ft)	*			0.0130			0.0057											
BF Slope (ft/ft)	0.0093			0.0055			0.0074											
Rosgen Classification	C4			C4			C4											

\* No Data - Stream was dry at time of survey

# UT Rocky River Stream Restoration (EEP #402)

**Appendix D. Morphology and Hydraulic Summary Table (Cross-Section Parameters)**  
**Reach 2: 1111 feet**

Parameter	Cross Section 1 Riffle						Cross Section 2 Pool						Cross Section 3 Riffle					
	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
BF Width (ft)	13.2	15.0	15.0				9.9	13.2	11.4				9.2	10.3	11.8			
Floodprone Width (ft)	104	104	104				112	112	112				200	200	200			
BF Cross Sectional Area (sq.ft)	12.6	14.8	14.1				8.6	9.8	8.5				7.2	8.2	8.3			
BF Mean Depth (ft)	0.95	0.98	0.94				0.87	0.74	0.75				0.78	0.80	0.70			
BF Max Depth (ft)	1.59	1.83	1.79				1.35	1.63	1.51				1.30	1.55	1.56			
Width/Depth Ratio	13.81	15.28	15.90				11.45	17.70	15.25				11.72	12.94	16.76			
Entrenchment Ratio	4.78	6.90	6.94				11.27	8.50	9.84				21.85	19.40	16.94			
Bank Height Ratio	2.13	1.28	1.28				1.26	1.07	1.06				1.15	1.13	1.12			
Wetted Perimeter (ft)	13.7	15.6	15.6				10.5	13.8	11.9				9.7	11.0	12.4			
Hydraulic Radius (ft)	0.92	0.95	0.91				0.82	0.71	0.71				0.74	0.75	0.67			
<b>Substrate</b>																		
d50 (mm)	22.00	0.04	4.85				0.18	0.04	0.03				0.25	0.04	0.05			
d84 (mm)	110.00	90.00	90.00				11.00	1.67	0.05				11.00	0.06	6.03			

Parameter	Cross Section 4 Pool						Cross Section 5 Riffle					
	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
BF Width (ft)	11.0	10.9	11.3				10.6	13.1	12.3			
Floodprone Width (ft)	160	160	160				130	130	130			
BF Cross Sectional Area (sq.ft)	11.0	10.9	10.5				10.3	11.3	10.8			
BF Mean Depth (ft)	1.00	1.00	0.93				0.97	0.86	0.87			
BF Max Depth (ft)	1.77	1.75	1.74				1.83	1.98	1.88			
Width/Depth Ratio	10.95	10.91	12.17				10.96	15.18	14.09			
Entrenchment Ratio	14.55	14.68	14.15				12.22	9.90	10.55			
Bank Height Ratio	1.46	1.01	1.06				0.61	1.20	1.10			
Wetted Perimeter (ft)	11.8	11.6	12.0				11.6	8.8	13.3			
Hydraulic Radius (ft)	0.93	0.94	0.87				0.89	0.98	0.81			
<b>Substrate</b>												
d50 (mm)	0.20	0.04	0.04				0.23	39.80	15.00			
d84 (mm)	16.00	0.06	0.06				90.00	120.90	90.00			

## UT Rocky River Stream Restoration (EEP #402)

### Appendix D. Morphology and Hydraulic Summary Table (Reach Parameters)

#### Reach 2: 1111 feet

Parameter	MY-01 (2007)			MY-02 (2008)			MY-03 (2009)			MY-04 (2010)			MY-05 (2011)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
<b>Pattern</b>															
Channel Beltwidth (ft)	13	27	18	6	24	13	8	29	14						
Radius of Curvature (ft)	10	30	18	8	33	11	7	29	12						
Meander Wavelength (ft)	29	48	38	28	64	46	21	67	47						
Meander Width Ratio	1.13	2.41	1.63	0.48	1.92	1.04	0.65	2.34	1.13						
<b>Profile</b>															
Riffle length (ft)	3	26	10	4	45	13	5	43	11						
Riffle slope (ft/ft)	-0.020	0.060	0.030	-0.017	0.098	0.029	-0.012	0.086	0.026						
Pool length (ft)	7	29	14	8	31	16	13	30	17						
Pool spacing (ft)	12	47	26	0	89	22	0	93	13						
<b>Additional Reach parameters</b>															
Valley Length (ft)	950			950			950								
Channel Length (ft)	1200			1111			1112								
Sinuosity	1.26			1.17			1.17								
Water Surface Slope (ft/ft)	*			*			*								
BF Slope (ft/ft)	0.009 / 0.014**			0.014***			0.013***								
Rosgen Classification	C4			C4			C4								

\*No water in the channel at the time of the survey; \*\*Upper portion of reach2/Lower portion of reach 2; \*\*\* No information regarding location of break between "upper" and "lower" portions of Reach 2.

**UT Rocky River Stream Restoration (EEP #402)**

**Appendix D. Stream Problem Area Photos.**



**SP1 - Standing on aggradation mid-channel, just upstream of last cross vane (11/6/09)**



**SP2 - Terrestrial grass growing in channel, Reach 2 (10/29/09)**

**UT Rocky River Stream Restoration (EEP #402)**



**SP3 - Standing on riffle aggradation mid-channel at approximately Station 370 (11/5/09)**

UT Rocky River Stream Restoration (EEP #402)

Appendix D. Stream Problem Areas Inventory Table.

Feature/Issue	Station	Suspected Cause	Photo #
<b>Reach 1</b>			
No problem areas in fall 2009			
<b>Reach 2</b>			
Aggradation (Pool)	15-18	Above and below last structure, deposition due to previously existing pipe restriction	SP1
Channel Choked by Terrestrial Grass	13-40	Insufficient flow	SP2
Channel Choked by Terrestrial Grass	350-460	Insufficient flow	SP3
Aggradation (Riffle)	360-367	Insufficient flow	SP