UT to TAR RIVER (Louisburg)
FINAL MONITORING REPORT
YEAR 3
2008

EEP Project # 234
Franklin County, North Carolina

Submitted to:

NCDENR-EEP
1652 Mail Service Center
Raleigh, NC 27699

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EEP Project # 234
Franklin County, North Carolina

Original Design Firm:
Earth Tech
701 Corporate Center Drive, Suite 475
Raleigh, NC 27607

Submitted to:

Ecosystem Enhancement Program

NCDENR-EEP
1652 Mail Service Center
Raleigh, NC 27699

Monitoring Firm:

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Executive Summary

The Unnamed Tributary to Tar River Restoration Site is located within the Town of Louisburg, Franklin County, North Carolina. The site was constructed between January 2005 and June 2005. The following report provides the stream restoration monitoring information for Monitoring Year 3 after construction.

The Priority Level II restoration involved the conversion of 1,792 linear feet of impaired channel into 1,937 linear feet with improved pattern, dimension, and profile. Rock grade control vanes and rootwads were incorporated for aquatic habitat enhancement and bed and bank stability. A variable width riparian buffer was planted on either side of the stream with native vegetation in December 2005.

Current monitoring for the site consists of evaluating both stream morphology and riparian vegetation. The stream monitoring included a longitudinal survey, cross section surveys, problem area identification, and photo documentation. A plan view featuring bankfull, edge of water, and thalweg lines as well as problem area locations was developed from the longitudinal survey. The vegetation assessment included a tally of planted vegetation in permanent vegetation plots, vegetation-specific problem area identification (i.e. bare areas and invasive species), and photo documentation. A vegetation problem area plan view was developed from the problem area identification. All morphological data, vegetation plot, cross section surveys, the longitudinal profile, and the plan view features were compared between years to assess project performance.

The UT to Tar River project reach appears to have remained stable through Monitoring Year 3, with the exception of two severe bank erosion and several areas of aggradation/bar formation. These aggradation/bar formations areas were probably influenced by excess sediment coming from the bank erosion observed in the reach. The most severe section of erosion is located at the head of the reach, on the right bank, where the bank has experienced mass wasting just downstream of the culvert outlet. It is recommended that this section of channel be reviewed to determine if repair work is necessary. Otherwise, the stream pattern and profile remained consistent between the monitoring years. The overall dimension of the stream appears to have remained stable. The structures appear to be in good physical condition; however, several structures were cited with problems of placement angle and/or location that caused adjacent bank erosion.

Streamside vegetation exhibited a noticeable boost during Monitoring Year 3, as is evident in most photographs. There are two areas of bare floodplain along the project (Station 14+19 and Station 16+21) where the terrace above the floodplain on the right side is actively eroding. Japanese stilt grass (*Microstegium vimineum*) remains a problem along the downstream half of the project (see Table VI in Appendix A3). Although not considered to be a problem, it should be noted that cattails, sometimes considered invasive, were found at one location within the stream channel. The planted stem densities for all the Vegetation Plots (VP), except VP #1, #2, and #6, were below the Monitoring Year 5 goal of 260 stems/acre. However, it should be noted that there were several species for which 'volunteer' individuals were noted the vegetation plots. With the inclusion of these 'volunteers,' all of the vegetation plots probably would meet the Monitoring Year 5 stem density goal. Noted volunteer species include: *Baccharis halimifolia, Prunus serotina, Diospyros virginiana, Quercus spp., Cephalanthus occidentalis, Liriodendron tulipifera, Alnus serrulata, Pinus taeda, Liquidambar styraciflua,* and *Aronia arbutifolia*..

UNNAMED TRIBUTARY TO TAR RIVER STREAM RESTORATION
YEAR 3 MONITORING REPORT

CONDUCTED FOR:
NCDENR ECOSYSTEM ENHANCEMENT PROGRAM

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1.0 PROJECT BACKGROUND

1.1 Project Objectives

This UT Tar River Stream Restoration Project has the following goals and objectives:

- Provide a stable stream channel that neither aggrades nor degrades while maintaining its dimension, pattern, and profile with the capacity to transport its watershed's water and sediment load;
- Improve water quality and reduce further property loss by stabilizing eroding streambanks;
- Reconnect the stream to its floodplain and/or establish a new floodplain at a lower elevation;
- Improve aquatic habitat with the use of natural material stabilization structures such as root wads, cross-vanes, woody debris, and a riparian buffer;
- Provide aesthetic value, wildlife habitat, and bank stability through the creation of a riparian zone; and,
- Stabilize and enhance the tributary and small drainage that enters the site.

1.2 Project Structure, Restoration Type, and Approach

The UT Tar River project is a Priority II restoration involving converting the 1,792 linear foot impaired channel into a sinuous channel that meanders for a total of 1,937 linear feet. Rock grade control vanes and rootwads were incorporated for aquatic habitat enhancement and bed and bank stability. A variable width riparian buffer was planted on either side of the stream with native vegetation. Table I provides the project restoration components of the UT to Tar River stream restoration project.

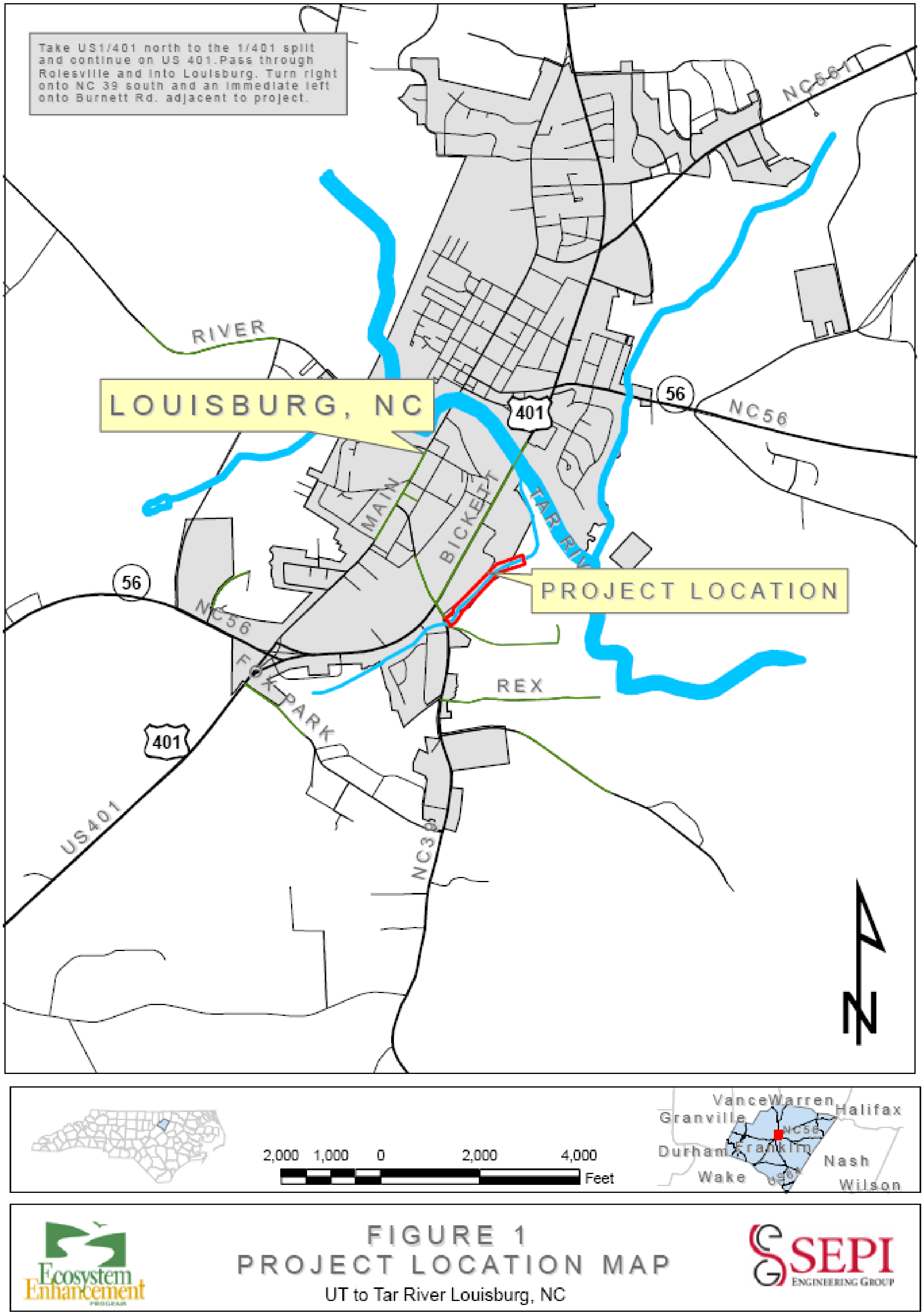
Table I. Project Restoration Components
UT Tar River Stream Mitigation Site/Project No. 234

Project Segment or Reach ID	Pre-Existing Footage	Type	Approach	As-Built Footage	As-Built Stationing	Monitoring Year 4 Stationing	Comments
Ut to Tar River	1,792	Restoration	P II	1,937.13	10+00 – 29+37.13	10+00 – 29+60.48	1:1 Ratio

1.3 Project Location and Setting

The UT Tar River project site is located in the town of Louisburg in Franklin County, North Carolina (Figure 1). Louisburg is located approximately 25 miles north of Raleigh along US 401. The project site begins at NC 39 and continues towards the northeast between Burnette Road and the Green Hill Country Club. To reach the site from Raleigh, take US 401 north to Louisburg. Turn right (south) at NC 39 and take the first left onto Burnette Road. The site is on the right running parallel with the road. The watershed area for this project is 0.61 square miles. The project is fully contained on publicly owned lands. UT Tar River flows from the southwest to the northeast. The project reach is bound on the west by NC 39, and a small drainage flows off of the country club property and into the conservation easement before entering the UT Tar River from the right bank.

Figure 1. UT to Tar River Vicinity Map



1.4 History and Background

A concern at the UT Tar River site prior to restoration was that the combined effects of urbanizing hydrology and lack of vegetative protection was putting Burnette Road at risk of undercutting from stream bank failure at the head of the project. Recent utility work by the town caused additional channel instability. Typical of many urban streams, the UT Tar River channel was an oversized gully. The town had placed riprap in the channel in some areas to prevent undercutting. Vegetation across the site was minimal due to channel degradation and other disturbances. Tables II, III, and IV provide the project history, contact information for the contractors on the project, and the project background/setting, respectively.

Table II. Project Activity and Reporting History
UT to Tar River/EEP Project No. 234

Activity or Report	Scheduled Completion	Data Collection Complete	Actual Completion Date
Restoration Plan	*	NA	June 2003
Final Design - 90%	*	NA	Unknown
Construction	*	NA	7/26/2005
Temporary S&E and Permanent seed mix applied	*	NA	Throughout Construction
Containerized, B&B, livestake planting	*	*	12/22/2005
Mitigation Plan / As-built (Year 0 Monitoring - baseline)	April 2006	April 2006	May 2006
Year 1 Monitoring	Fall 2006	January 2007	January 2007
Year 2 Monitoring	Fall 2007	September 2007	December 2007
Year 3 Monitoring	Fall 2008	October 2008	November 15, 2008
Year 4 Monitoring	Fall 2009		
Year 5 Monitoring	Fall 2010		

*Absent from both mitigation report (as-built) and Year 1 Monitoring Report.

Table III. Project Contact Table UT to Tar River/EEP Project No. 234	
Designer	Earth Tech 701 Corporate Center Drive Suite 475 Raleigh, NC 27607
Construction Contractor	McQueen Construction 619 Patrick Road Bahama, NC 27503
Planting Contractor	Carolina Environmental Contracting, Inc. P.O. Box 1905 Mount Airy, NC 27030
Seeding Contractor	Erosion Control Solutions 5508 Peakton Dr. Raleigh, NC 27614
2006 Monitoring Performers	Earth Tech 701 Corporation Center Drive, Suite 475 Raleigh, NC 27607
2007-2008 Monitoring Performer	SEPI Engineering Group 1025 Wade Avenue Raleigh, NC 27605 Phillip Todd (919) 789-9977
Stream Monitoring POC	Ira Poplar-Jeffers (919) 573-9914
Vegetation Monitoring POC	Phil Beach (919) 573-9936
Wetland Monitoring POC	N/A

Table IV. Project Background Table UT to Tar River /EEP Project No. 234	
Project County	Franklin County, NC
Drainage Area	0.61 square miles
Drainage impervious cover estimate (%)	> 30 %
Stream Order	1st order
Physiographic Region	Piedmont
Ecoregion	Northern Outer Piedmont
Rosgen Classification of As-Built	C
Cowardin Classification	NA
Dominant Soil Types	Chewacla and Wehadkee loam; Wedowee-Urbanland_Udorthents complex
Reference site ID	C5 UT Lake Lynn (Wake), C4 UT Hare Snipe Creek (Wake)
USGS HUC for Project	03020101
USGS HUC for References	03020201
NCDWQ Sub-basin for Project	03-03-01
NCDWQ Sub-basin for References	03-04-02
NCDWQ Classification for Project	Not Assigned
NCDWQ Classification for Reference	UT Lake Lynn: B-NSW; UT Hare Snipe Creek: C-NSW
Any portion of any project segment 303D listed?	No
Any portion of any project segment upstream of a 303D listed segment?	No
Reasons for 303D listing or stressor	N/A
% of project easement fenced	<5
% of project easement demarcated with bollards (if fencing absent)	0

2.0 PROJECT MONITORING METHODOLOGY

2.1 Vegetation Methodology

For this monitoring project, a total of nine (9) plots were studied. Plot sizes measure 10 meters by 10 meters (or equivalent to 100 square meters).depending on buffer width. The vegetation monitoring was not Carolina Vegetation Survey (CVS) monitoring protocols, but was based on the number of stems for the targeted species that were planted for the stream restoration project. The planted material in the plot (previously marked with flagging) was identified by species and a tally of each species was kept and recorded in a field book. Any stems for a given species in a given plot that were not flagged and were counted over and above the baseline total were considered volunteers.

2.2 Stream Methodology

The project monitoring for the stream channel included a longitudinal survey, cross-sectional surveys, problem area identification, and photo documentation. The specific methodology for each portion of the stream monitoring is described in detail below.

2.2.1 Longitudinal Profile

A longitudinal profile was surveyed with a Nikon DTM-520 Total Station, prism, and a TDS Recon Pocket PC. The heads of features (i.e. riffles, runs, pools, and glides) were surveyed, as well as the point of maximum depth of each pool, boundaries of problem areas, and any other significant slope-breaks or points of interest. At the head of each feature and at the maximum pool depth, thalweg, water surface, edge of water, left and right bankfull, and left and right top of bank (if different than bankfull) were surveyed. All profile measurements were extracted from this survey, including channel and valley length and length of each feature, water surface slope for each reach and feature, bankfull slope for the reach, and pool spacing. This survey also was used to draw plan view figures with Microstation v8 (Bentley Systems, Inc., Exton, PA). Stationing was calculated along the thalweg. All pattern measurements (i.e., meander length, radius of curvature, belt width, meander width ratio, and sinuosity) were extracted from the plan view.

2.2.2 Permanent Cross Sections

Five permanent cross sections (three riffles, one pool, and one run) were surveyed. The beginning and end of each permanent cross section were originally marked with a wooden stake and conduit. Cross sections were installed perpendicular to the stream flow. Each cross section survey noted all changes in slopes, tops of both banks (if different from bankfull), left and right bankfull, edges of water, thalweg and water surface. Before each cross section was surveyed, bankfull level was identified, and a quick bankfull area was calculated by measuring a bankfull depth at 1-foot intervals between the left and right bankfull locations and adding the area of each interval block across the channel. This rough area was then compared to the North Carolina Rural Piedmont Regional Curve-calculated bankfull area to ensure that bankfull was accurately located prior to the survey. The cross sections were then plotted and Monitoring Year 3 monitoring data was overlain on data from all previous monitoring years. All dimension measurements (i.e., bankfull width, floodprone width, bankfull mean depth, cross sectional area, width-to-depth ratio, entrenchment ratio, bank height ratio, wetted perimeter, and hydraulic radius) were extracted from these plots and compared to all previous monitoring data.

2.2.3 Pebble Counts

Based on the fact that UT Billys is a sandbed stream, it was determined that pebble counts were unnecessary as they would fail to detect increases in fine sediments. Therefore, pebble counts were not performed for Monitoring Year 3.

2.3 Photo Documentation

Permanent photo points were established during Monitoring Year 1. Two photographs (facing upstream and facing downstream) were taken at each photo point with a digital camera. A set of three photographs were taken at each cross-section (facing upstream, facing downstream, and facing the channel). A representative photograph of each vegetation plot was taken at the designated corner of the vegetation plot and in the same direction as the Monitoring Year 1 photograph. Photos were also taken of all significant stream and vegetation problem areas.

3.0 PROJECT CONDITIONS AND MONITORING RESULTS

3.1 Vegetation Assessment

3.1.1 Soils Data

Preliminary Soil Data UT to Tar River/ EEP Project No. 234					
Series	**Max Depth (in.)**	**% Clay on Surface**	**K**	**T**	**OM%**
Chewacla and Wehadkee Loam	62	6-35	0.28-0.32	5	1-5
Wedowee Sandy Loam	62	5-45	0.24-0.28	4	0.5-3
Wedowee-Urbanland-Udorthents Complex	62	5-20	0.24-0.28	4	0.5-3

3.1.2 Vegetative Problem Area Plan View

Streamside vegetation exhibited a noticeable boost at the UT Tar River site in Monitoring Year 3, as is evident in most photographs. There are two areas of bare floodplain along the project (Station 14+19 and Station 16+21) where the terrace above the floodplain on the right side is actively eroding. Japanese stilt grass (*Microstegium vimineum*) remains a problem along the downstream half of the project (see Table VI in Appendix A3). In addition, although not considered to be a problem, it should be noted that cattails, sometimes considered to be invasive, were found at one location within the stream channel (Station 18+82).

3.1.3 Stem Counts

The planted stem densities for all the Vegetation Plots (VP), except VP #1, #2, and #6, were below the Monitoring Year 5 goal of 260 stems/acre. However, it should be noted that there were several species for which several-to-many additional stems were counted within a given plot relative to previous monitoring years. These were not counted as 'planted' even if they appeared to be. We assumed that all of these stems were 'volunteers.' With the inclusion of these ‘volunteer’ species, all of the vegetation plots would probably meet the Monitoring Year 5 stem density goal. Volunteer species found within vegetation plots at UT Tar River included the following: *Baccharis halimifolia, Prunus serotina, Diospyros virginiana, Quercus spp., Cephalanthus occidentalis, Liriodendron tulipifera, Alnus serrulata, Pinus taeda, Liquidambar styraciflua,* and *Aronia arbutifolia. Liquidambar styraciflua* were too numerous to count in several of the plots.

3.2 Stream Assessment

Considering the 5 year timeframe of standard mitigation monitoring, restored streams should demonstrate morphologic stability in order to be considered successful. Stability does not equate to an absence of change, but rather to sustainable rates of change or stable patterns of variation. Restored streams often demonstrate some level of initial adjustment in the several months that follow construction and some change/variation subsequent to that is to also be expected. However, the observed change should not indicate a high rate or be unidirectional over time such that a robust trend is evident. If some trend is evident, it should be very modest or indicate migration to another stable form. Examples of the latter include depositional processes resulting in the development of constructive features on the banks and floodplain, such as an inner berm, slight channel narrowing, modest natural levees, and general floodplain deposition. Annual variation is to be expected, but over time this should demonstrate maintenance around some acceptable central tendency while also demonstrating consistency or a reduction in the amplitude of variation. Lastly, all of this must be evaluated in the context of hydrologic events to which the system is exposed over the monitoring period.

For channel dimension, cross-sectional overlays and key parameters such as cross-sectional area and the channel’s width to depth ratio should demonstrate modest overall change and patterns of variation that are in keeping with above. For the channels’ profile, the reach under assessment should not demonstrate any consistent trends in thalweg aggradation or degradation over any significant continuous portion of its length. Over the monitoring period, the profile should also demonstrate the maintenance or development of bedform (facets) more in keeping with reference level diversity and distributions for the stream type in question. It should also provide a meaningful contrast in terms of bedform diversity against the pre-existing condition. Bedform distributions, riffle/pool lengths and slopes will vary, but should do so with maintenance around design/As-built distributions. This requires that the majority of pools are maintained at greater depths with lower water surface slopes and riffles are shallow with greater water surface slopes. Substrate measurements should indicate the progression towards, or the maintenance of, the known distributions from the design phase.

In addition to these geomorphic criteria, a minimum of two bankfull events must be documented during separate monitoring years within the five year monitoring period for the monitoring to be considered complete. Table VIII documents all bankfull events recorded since the start of Monitoring Year 1.

Table V. Verification of Bankfull Events			
Date of Data Collection	**Date of Occurrence**	**Method**	**Photo # (if available)**
1/3/2007	unknown date in 2006	Photographic – Near Bankfull; wrack lines observeved.	See Monitoring Year 1 Report
6/4/2007	6/3/2007	Result of 1.5' rainfall event; wrack lines observed	None
10/1/2008	6/30/2008	According to NCDC Station Coop ID 315123 - Louisburg NC, 2 inches of precipitation fell over this 24 hour period. It was assumed, but not verified, that this rainfall produced a bankfull event.	None
10/1/2008	9/6/2008	According to NCDC Station Coop ID 315123 - Louisburg NC, 3.27 inches of precipitation fell over this 24 hour period. It was assumed, but not verified, that this rainfall produced a bankfull event.	None

3.2.1 Longitudinal Profile and Plan View

All profile and pattern parameters remained consistent with previous monitoring years. There are no significant trends to report.

3.2.2 Permanent Cross Sections

Cross section annual overlays show no changes in streambed elevations between monitoring years that would be considered abnormal, given that UT Tar River is a sandbed stream. There is was some sand deposition on the banks along the channel that is most evident in cross sections #1 and #2 (i.e. slight narrowing of bankfull width at these cross sections, and apparent rise in floodplain elevations just past bankfull, compared to Monitoring Year 2 elevations). However, this is not a concern considering there were multiple bankfull flows in 2008 and the floodplain is where the stream should be depositing excess sediments during high flows.

3.2.3 Pebble Counts

Based on the fact that UT Billys is a sandbed stream, it was determined that pebble counts were unnecessary as they would fail to detect increases in fine sediments. Therefore, pebble counts were not performed for Monitoring Year 3.

3.2.4 Stream Problem Areas

The most severe problem to report is the continued mass wasting of the left bank at the upstream end of the reach and the resultant aggradation/bar formation within the outlet pool associated with the culvert at the head of the reach. This erosion probably contributes to much of the aggradation/bar deposition of excess fine sediments downstream (see Table X in Appendix B3 and Problem Area Plan Views in Appendix C). There are several additional areas of bank erosion and deposition of excess sediments in the stream channel (i.e. aggradation/bar formation) heading downstream (e.g. severe erosion of left bank at Station 24+00 and aggradation/bar formation at Station 24+00). Although the bank condition was rated higher than in Monitoring Year 2 (i.e. 88% in Monitoring Year 2 compared to 97% in Monitoring Year 3) due to the healing over of several bank erosion areas, there still are several erosion areas to watch. Repair assessment may be warranted for these areas. The first is at the start of the reach as mentioned above where the culvert appears to be "shotgunning" high flows into the bank resulting in mass slumping of the bank and deposition of bank materials in the adjacent pool and downstream. The second area of severe erosion is located on the left bank at from Station 24+00 to 24+25. This area is located just downstream of the confluence of a ditch drainage that enters on stream left (see plan view in Appendix C). This drainage probably is very “flashy” during stormflow events since it drains a shopping center and other urban areas with high percentages of impervious surfaces. It is probable that the combination of these “flashy” flows, along with the lack of protective measures at this confluence, has caused the increased rate of bank erosion in this section of the project reach. These erosional areas have probably contributed most of the sediment to the aggradation areas found in the reach, although some of the sediment could have been entrained from upstream of the reach.

All problems associated with in-stream structures included situations where the structure was placed at the improper location or angle, or the structure was providing inadequate protection to an eroding bank. These structures were solely listed because their placement location or angle could be the cause of another adjacent problem. For example, if bank erosion is occurring at a specific location just downstream of a structure and this erosion could have been prevented if the structure had been placed further downstream, the structure was listed as a problem. Another example would be that if a structure is located along a straight section and is forming a pool where a riffle should be, the structure was listed. No serious structural integrity problems were found for any of the structures.

Table VII. Categorical Stream Feature Visual Stability Assessment						
UT to Tar River/ EEP Project No. 234						
Feature	**Initial**	**MY-01***	**MY-02**	**MY-03**	**MY-04**	**MY-05**
A. Riffles	100%	10%	72%	78%		
B. Pools	100%	30%	81%	64%		
C. Thalweg	100%	60%	100%	96%		
D. Meanders	100%	100%	77%	93%		
E. Bed General	100%	20%	88%	95%		
F. Bank Condition	100%	UNK	88%	97%		
G. Vanes / J Hooks etc.	100%	60%	90%	94%		
H. Wads and Boulders	100%	70%	97%	100%		

*There are several discrepances between table B2 and Table XI from the Monitoring Year 1 report. This might explain the discrepancies between Monitoring Year 1 and Monitoring Years 2 and 3 stability percentages in this table.

3.3 Photo Documentation

Photos taken of the vegetation problem areas are found in Appendix A1 and photos of the vegetation plots are in Appendix A2. Stream problem area photographs are provided in Appendix B1. The photographs taken at the marked photo point locations and at the cross-sections are provided in Appendix B2.

4.0 RECOMMENDATIONS AND CONCLUSIONS

The UT to Tar River project reach appears to have remained stable through Monitoring Year 3, with the exception of two severe bank erosion and several areas of sand/gravel bar formation that were probably influenced by the bank erosion observed in the reach. The most severe section of erosion is located at the head of the reach, on the right bank, where the bank has experienced mass wasting just downstream of the culvert outlet. This area may warrant repair assessment. Otherwise, the stream pattern and profile remained consistent between the monitoring years. The overall dimension of the stream appears to have remained stable. The structures appear to be in good physical condition; however, several structures were cited with problems of placement angle and/or location that caused adjacent bank erosion.

Streamside vegetation exhibited a noticeable boost during Monitoring Year 3, as is evident in most photographs. There are two areas of bare floodplain along the project (Station 14+19 and Station 16+21) where the terrace above the floodplain on the right side is actively eroding. Japanese stilt grass (*Microstegium vimineum*) remains a problem along the downstream half of the project (see Table VI in Appendix A3). In addition, cattails were found at one location within the stream channel (Station 18+82). The planted stem densities for all the Vegetation Plots (VP), except VP #1, #2, and #6 were below the Monitoring Year 5 goal of 260 stems/acre. However, it should be noted that there were several species for which 'volunteer' individuals were noted for in at least one vegetation plot. With the inclusion of these 'volunteers,' all of the vegetation plots probably would meet the Monitoring Year 5 stem density goal. Noted volunteer species include: *Baccharis halimifolia, Prunus serotina, Diospyros virginiana, Quercus spp., Cephalanthus occidentalis, Liriodendron tulipifera, Alnus serrulata, Pinus taeda, Liquidambar styraciflua,* and *Aronia arbutifolia.*

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APPENDIX A1

VEGETATION DATA TABLES

Table A1. Stem counts for each species arranged by plot for UT Tar River

Species	Plots									Initial Totals	Year 1 Totals	Year 2 Totals	Year 3 Totals	Survival %
	1	2	3	4	5	6	7	8	9					
Shrubs														
Myrica cerifera						1				5	2	2	1	20.0%
Alnus serrulata									1	3	3	1	1	33.3%
Sambucus canadensis										2	1	0	0	0.0%
Clematis virginiana										4	0	0	0	0.0%
Viburnum nudum									2	5	1	2	2	40.0%
Trees														
Fraxinus pennsylvanica	3	1			1	2	1		0	7	8	8	8	100.0%
Betula nigra	1	4				1				17	11	8	6	35.3%
Quercus phellos	2	2		1						8	4	5	5	62.5%
Quercus pagoda		1	1	1		2				10	6	5	5	50.0%
Quercus nigra	1									8	6	1	1	12.5%
Nyssa sylvatica										13	5	0	0	0.0%
Platanus occidentalis		3				1			1	9	9	5	5	55.6%
Celtis laevigata	2				1				1	10	1	4	4	40.0%
Total per plot	9	11	1	2	2	7	1	0	5	101	57	41		40.6%
Stems per acre	360	440	40	80	80	280	40	0	200	466	263	189		

**Volunteers of the following species, not initially recorded as planted, were counted: Baccharis halimifolia, Prunus serotina, Diospyros virginiana, Quercus spp., Cephalanthus occidentalis, Liriodendron tulipifera, Alnus serrulata, Pinus taeda, Liquidambar styraciflua, and Aronia arbutifolia.*

**Fraxinus pennsylvanica and Liquidambar styraciflua were too numerous to count where new volunteers were noted.*

Table VI. Vegetative Problem Areas (UT Tar River)			
Feature/Issue	**Station # / Range**	**Probable Cause**	**Photo #**
Bare Floodplain (Right Bank)	14+19 to 14+26	Lack of vegetative cover; weak soil characteristics on terrace.	
Bare Floodplain (Right Bank)	16+21 to 16+50	Lack of vegetative cover; weak soil characteristics on terrace.	1
Microstegium virmenium (Left Bank)	24+55 to 26+40	Invasive vegetative opportunism	2
Microstegium virmenium (Right Bank)	24+35 to 27+16	Invasive vegetative opportunism	
Microstegium virmenium (Left Bank)	26+80 to 29+51	Invasive vegetative opportunism	
Microstegium virmenium (Right Bank)	27+12 to 29+51	Invasive vegetative opportunism	

APPENDIX A2

PHOTOLOG VEGETATION PROBLEM AREAS

APPENDIX A2
PHOTOLOG - UT to Tar River

PROBLEM AREAS (Vegetation)

Photo 1: Representative bare floodplain (Station No. 16+00; view downstream; 2-20-2008)

Photo 2. Representative Japanese grass (*Microstegium virmineum*) growth; present below *Andropogon virginicus* (grass) at top of photo (Station No.17+80; view of left bank; 2-20-2008)

APPENDIX A3

PHOTOLOG VEGETATION PLOTS

APPENDIX A3
PHOTOLOG - UT to TAR RIVER

VEGETATION PLOTS


Photo 1: Vegetation Plot 1 (9-08-2008).


Photo 2: Vegetation Plot 2 (9-08-2008).


Photo 3: Vegetation Plot 3 (9-8-2008).


Photo 4: Vegetation Plot 4 (9-08-2008).


Photo 5: Vegetation Plot 5 (9-08-2008).


Photo 6: Vegetation Plot 6 (9-08-2008).


Photo 7: Vegetation Plot 7 (10-15-2008).


Photo 8: Vegetation Plot 8 (10-15-2008).


Photo 9: Vegetation Plot 9 (9-08-2008).

APPENDIX B1

PHOTOLOG STREAM PROBLEM AREAS

APPENDIX B1
PHOTOLOG - UT to Tar River

PROBLEM AREAS (Stream)

Photo 1: Representative fine sediment aggradation and bar formation problem area (Station No. 10+08; view upstream 2-20-2008).

Photo 2: New side bar formation problem area (Station No. 17+80; view of left bank; 2-20-2008).

Photo 3: Severe bank failure, aggradation, and bar formation just downstream of culvert at head of restoration reach on (Station No. 10+05; view of left bank facing upstream; 2-20-2008).

Photo 4: New central bar formation problem area (Station No. 18+65; view upstream; 2-20-2008).

Photo 5: Aggradation and bar formation problem area (Station No. 14+33; view downstream; 2-20-2008).

APPENDIX B2

PHOTOLOG OF CROSS-SECTIONS AND PHOTO POINTS

APPENDIX B2
PHOTOLOG - UT Tar River

Cross Sections/Photo Points


Cross-Section 1: View Upstream (9-23-2008).


Cross-Section 2: View Upstream (9-23-2008).


Cross-Section 1: View Downstream (9-23-2008).


Cross-Section 2: View Downstream (9-23-2008).


Cross-Section 1: Facing Stream (9-23-2008).


Cross-Section 2: Facing Stream (9-23-2008).


Cross-Section 3: View Upstream (9-23-2008).


Cross-Section 3: View Downstream (9-23-2008).


Cross-Section 3: Facing Stream (9-23-2008).


Cross-Section 4: View Upstream (10-16-2008).


Cross-Section 4: View Downstream (10-16-2008).


Cross-Section 4: Facing Stream (10-16-2008).


Cross-Section 5: View Upstream (10-16-2008).


Cross-Section 5: View Downstream (10-16-2008).


Cross-Section 5: Facing Stream (10-16-2008).


Photo Point 1: View Downstream (9-23-2008).


Photo Point 2: View Upstream (9-23-2008).


Photo Point 2: View Downstream (9-23-2008).

Photo Point 3: View Upstream (9-23-2008).

Photo Point 3: View Downstream (9-23-2008).

Photo Point 4: View Upstream (9-23-2008).

Photo Point 4: View Downstream (9-23-2008).

Photo Point 5: View Upstream (9-23-2008).

Photo Point 5: View Downstream (9-23-2008).


Photo Point 6: View Upstream (9-23-2008).


Photo Point 6: View Downstream (9-23-2008).


Photo Point 7: View Upstream (9-23-2008).


Photo Point 7: View Downstream (9-23-2008).


Photo Point 8: View Upstream (9-23-2008).


Photo Point 8: View Downstream (9-23-2008).


Photo Point 9: View Upstream (9-23-2008).


Photo Point 9: View Downstream (9-23-2008).


Photo Point 10: View Upstream (9-23-2008).


Photo Point 10: View Downstream (9-23-2008).


Photo Point 11: View Upstream (10-16-2008).


Photo Point 11: View Downstream (10-16-2008).


Photo Point 12: View Upstream (10-16-2008).


Photo Point 12: View Downstream (10-16-2008).


Photo Point 13: View Upstream (10-16-2008).


Photo Point 13: View Downstream (10-16-2008).


Photo Point 14: View Upstream (10-16-2008).


Photo Point 14: View Downstream (10-16-2008).

APPENDIX B3

STREAM DATA TABLES

Table VIII. Baseline Morphologyand Hydraulic Summary
UT Tar River/EEP Number 234

Parameter	USGS Gage Data			Regional Curve Interval			Pre-Existing Condition			Project Reference Stream			Design (SR#1)			As-built (SR#1)		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Dimension																		
BF Width (ft)				5.5	21.0	11.30	10.20	13.80		10.00	19.10				18.00	17.60	25.20	20.50
Floodprone Width (ft)																		
BFCross Sectional Area (ft)				6.2	28.0	15.30	20.80	28.10		5.50	23.40				24.50	19.80	35.10	23.30
BF Mean Depth (ft)				0.8	2.1	1.40			2.00	0.55	1.22				1.38	1.00	1.40	1.25
Max Depth (ft)							2.80	3.30		1.00	2.26				2.20	2.00	2.70	2.35
Width/Depth Ratio							5.00	6.80		10.30	20.60				13.20	13.00	20.20	18.70
Entrenchment Ratio							3.90	4.00		1.90	6.60				2.20	2.40	5.00	3.40
Wetted Perimeter (ft)																20.30	28.00	22.60
Hydraulic radius (ft)																0.90	1.30	1.08
Pattern																		
Channel Beltwidth (ft)							8.00	30.00		17.00	41.00		23.00	58.00		29.00	66.00	43.00
Radius of Curvature (ft)							10.00	60.00		12.00	81.00		36.00	72.00		28.00	58.00	34.50
Meander Wavelenght (ft)							265.00	470.00		42.00	59.00		59.00	84.00		80.00	165.00	121.00
Meander Width Ratio							0.70	2.50		1.30	3.20		1.30	3.20		1.64	2.61	2.20
Profile																		
Riffle length (ft)							14.00	316.00	83.00							1.50	51.70	13.10
Riffle slope (ft/ft)							0.002	0.017	0.012	0.009	0.075		0.009	0.033		0.000	0.040	0.010
Pool length (ft)							10.00	102.00	42.00							3.30	20.70	9.80
Pool spacing (ft)							33.00	379.00	226.00	32.00	75.00		32.00	75.00		13.60	158.30	57.93
Substrate																		
d50 (mm)							0.50	1.00		0.25	0.50					0.06	0.25	
d84 (mm)							5.70	8.00		11.30	16.00					0.25	0.50	
Additional Reach Parameters																		
Valley Length (ft)									1662.00									1662.00
Channel Length (ft)									1792.00									1937.00
Sinuosity									1.07	1.25	1.70				1.25			1.17
Water Surface Slope (ft/ft)									0.01	0.01	0.02				0.00			0.01
BF slope (ft/ft)									0.01									0.01
Rosgen Classification									E5	C4	C5				C5			
*Habitat Index																		
*Macrobenthos																		

Table IX. Morphology and Hydraulic Monitoring Summary
UT Tar River
Segment/Reach: 1

Parameter	Cross Section 1 Pool						Cross Section 2 Riffle						Cross Section 3 Riffle						Cross Section 4 Riffle						Cross Section 5 Pool					
Dimension	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5	MY0	MY1	MY2	MY3	MY4	MY5
BF Width (ft)	22.9	13.0	14.8	12.5			25.2	31.3	26.6	19.3			17.6	17.7	14.9	19.3			21.0	11.5	14.2	14.1			20.0	15.7	16.2	13.9		
Floodporne Width (ft)	N/A	77.6	N/A	N/A			91.0	83.1	87.0	77.5			100+	128.1	103+	106.5+			90.0	85.9	85+	85+			>100	112.8	110+	N/A		
BFCross Sectional Area (ft)	21.7	11.8	16.0	11.2			35.1	23.9	23.7	13.6			23.7	20.5	18.7	16.9			22.9	10.9	15.6	15.7			19.8	10.8	13.2	13.3		
BF Mean Depth (ft)	0.90	0.90	1.10	0.90			1.40	0.76	0.89	0.71			1.40	1.16	1.26	0.88			1.10	0.95	1.10	1.12			1.00	0.69	0.81	0.96		
Width/Depth Ratio	N/A	14.4	13.7	N/A			18.0	41.2	30.0	27.3			13.0	15.2	11.8	22.0			19.3	12.1	12.9	12.6			20.2	22.7	20.0	N/A		
Entrenchment Ratio	N/A	6.0	N/A	N/A			3.6	2.7	3.3	4.0			5.6	7.3	7.0+	5.5+			4.3	7.5	6.0+	6.0+			5.0	7.2	6.8+	N/A		
Bank Height Ratio	N/A	N/A	1.1	N/A			N/A	N/A	1.3	1.1			N/A	N/A	1.0	1.0			N/A	N/A	1.2	1.1			N/A	N/A	1.1	N/A		
Wetted Perimeter (ft)	N/A	13.7	16.3	13.9			28.0	33.2	27.9	18.8			20.3	19.0	16.2	20.6			23.2	12.2	15.1	15.4			22.0	16.7	17.2	15.5		
Hydraulic radious (ft)	N/A	0.86	0.98	0.81			1.30	0.72	0.84	1.03			1.17	1.08	1.16	0.93			1.00	0.90	1.00	0.91			0.90	0.64	0.77	0.86		
Substrate																														
d50 (mm)	.125-.25	1.13	1.3	NA			.125-.25	1.05	2.9	NA			.125-.25	0.36	2.0	NA			.125-.25	0.33	0.7	NA			.062-.12	0.44	4.3	NA		
d84 (mm)	.25-.5	8.41	5.4	NA			.25-.5	6.27	7.9	NA			.25-.5	3.33	7.0	NA			.25-.5	1.46	3.7	NA			.25-.5	0.96	15.0	NA		

Parameter	MY0			MY1			MY2			MY3			MY4			MY5		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	29	66	43	8.9	46.2	26.9	26.4	64.9	43.2	22.6	58.0	39.6						
Radius of Curvature (ft)	28	58	35	13.5	68.9	29.7	20.3	50.6	34.6	24.7	57.3	37.6						
Meander Wavelenght (ft)	80	165	121	77.2	160.9	121.0	77.5	156.3	117.8	81.7	160.8	117.1						
Meander Width Ratio	1.64	2.61	2.20				1.40	3.45	2.30	1.60	4.11	2.81						
Profile																		
Riffle length (ft)	1.5	51.7	13.1	21.1	60.0	33.0	2.0	57.4	15.4	1.6	71.4	16.7						
Riffle slope (ft/ft)	0.000	0.040	0.010	0.005	0.043	0.010	0.000	0.050	0.013	0.000	0.100	0.017						
Pool length (ft)	3.3	20.7	9.8	7.3	90.1	25.7	7.0	100.8	19.4	6.4	117.8	38.9						
Pool spacing (ft)	13.6	158.3	57.9	6.0	69.0	30.8	10.8	146.9	45.7	22.4	136.8	65.1						

Additional Reach Parameters	MY0	MY1	MY2	MY3	MY4	MY5
Valley Length (ft)	1662	1662	1654	1656		
Channel Length (ft)	1937	1937	1960	1952		
Sinuosity	1.2	1.2	1.2	1.2		
Water Surface Slope (ft/ft)	0.01	0.01	0.0059	0.0063		
BF slope (ft/ft)	0.01	0.01	0.0059	0.0061		
Rosgen Classification	C5	C5	C5	C5		
*Habitat Index	NA	NA	NA	NA		
*Macrobenthos	NA	NA	NA	NA		

Table B1. Stream Problem Areas

UT Tar

Feature Issue	Station numbers	Suspected Cause	Photo number
Bank Erosion (left bank, severe)	10+08.00 10+35.75	Back eddy from culvert and/or unstable soil charactheristics and lack of vegetation.	1, 3
Aggradation/Bar Formation	10+08.00 10+22.45	Excess fine sediment deposit from adjacent severe bank erosion and/or other upstream sources.	3
Bank Erosion (right bank)	10+27.66 10+38.81	Probably caused by high shear stress along the unprotected bank due to increased flow velocities leaving the culvert during peak flows.	
Aggradation	14+33.00 14+72.04	Excess fine sediment deposit from upstream severe bank erosion and/or other upstream sources.	5
Rock Sill	16+67.28	Placed too far upstream of the start of the meander to adequately protect the outside of the meander, forming pool in straight section.	
Aggradation	17+15.04 17+31.17	Small central bar; probably deposition resulting from upstream bank erosion and/or other upstream sources.	
Bar Formation (Left)	17+81.11 17+88.25	Inadequate bank protection, possibly due to misplacement of bank protection measures, and or lack of vegetation/soil instability.	2
Aggradation	18+12.97 18+19.74	Excess fine sediment deposits from adjacent/upstream bank erosion and/or other upstream sources.	
Aggradation/Central Bar Formation	18+59.14 18+65.73	Excess fine sediment deposit from upstream bank erosion and/or other upstream sources.	4
Aggradation	18+65.18 18+82.68	Channel possibly over-sinuous or bankfull dimensions incorrect.	4
Aggradation	18+92.07 19+14.43	Excess fine sediment deposits from adjacent/upstream bank erosion and/or other upstream sources.	
Central Bar Formation	21+88.96 22+01.96	Lack of bank protection between rootwad and rock structure.	
Bar Formation (Left)	22+82.62 22+87.61	Matting undercutting due to lack of bank protection early in meander and lack of vegetation.	
Bank Erosion (left bank)	23+60.83 23+68.09	Lack of bank protection along outside of meander bend. Structure directly upstream should be a cross vane.	
Rock Sill	23+95.66	Inadequate structure to protect banks directly downstream from increased discharge from tributary. Should be cross vane.	
Bank Erosion (left bank, severe)	24+00.07 24+25.64	Back eddy downstream of rock structure and/or lack of protective vegetation/soil stability characteristics.	
Bank Erosion (right bank)	23+95.44 24+16.53	Back eddy downstream of rock structure and/or lack of protective vegetation/soil stability characteristics.	
Aggradation/Bar Formation	24+02.63 24+21.20	Excess fine sediment deposits from adjacent/upstream bank erosion and/or other upstream sources.	
Bank Erosion (right bank)	24+82.02 24+98.36	Lack of bank protection.	
Rock Sill	25+47.91	Angle/placement possibly causing severe bank erosion directly upstream.	
Rock Sill	25+89.92	Stucture forming a pool along a straight section where a riffle should be located.	
Aggradation	26+74.94 26+88.13	Excess fine sediment deposits from adjacent/upstream bank erosion and/or other upstream sources.	
Rock Sill	28+00.79	Should have been placed @ start of meander, would possibly perform better as a crossvane.	
Aggradation/Side Bar Formation	28+08.96 28+33.74	Excess fine sediment deposits from adjacent/upstream bank erosion and/or other upstream sources.	

Table B2. Visual Morphological Stability Assessment

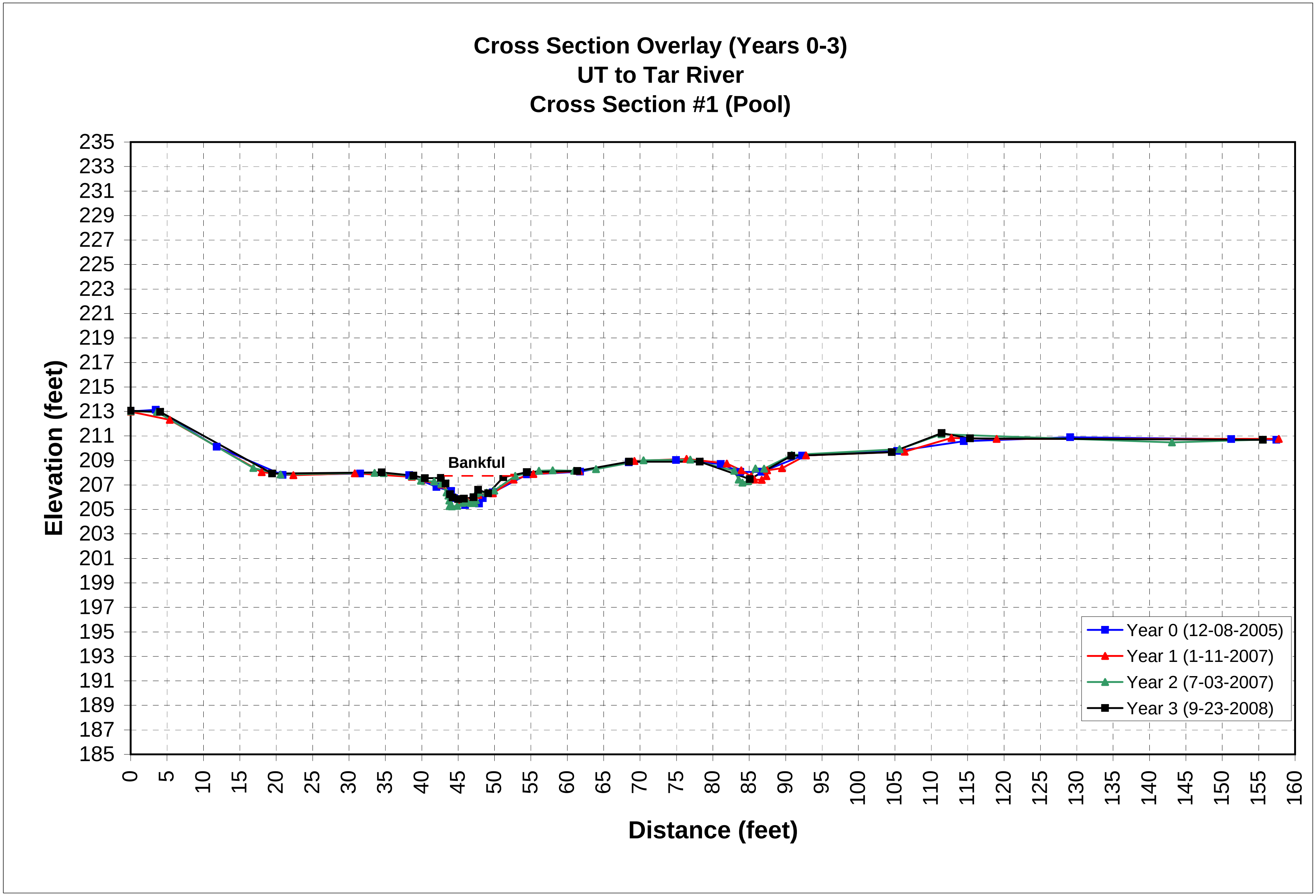
UT Tar River

Segment/Reach: UT Tar River (1,960 feet)

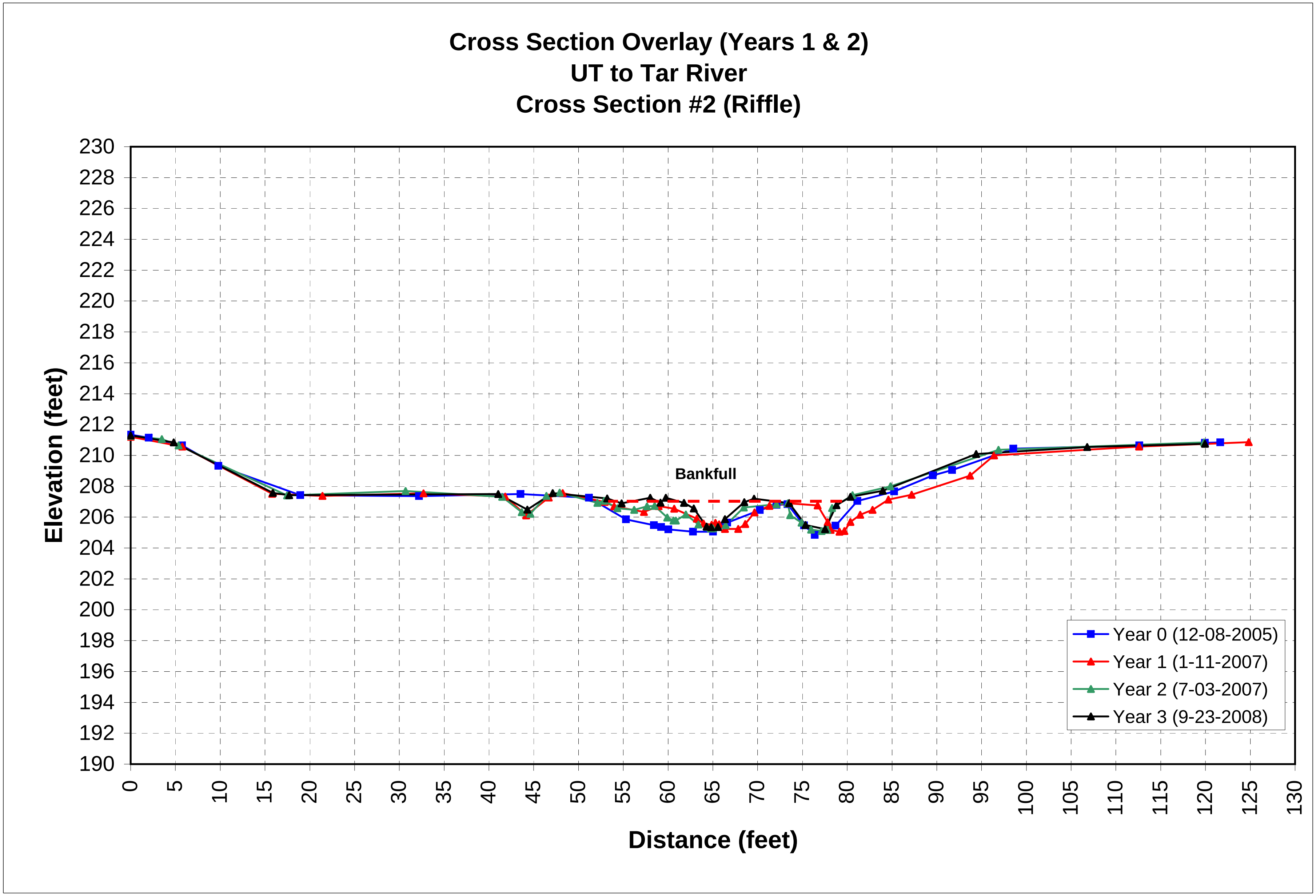
Feature Category	Metric (per As-built and reference baselines)	(#Stable) Number Performing as Intended	Total Number per As-built*	Total Number / feet in unstable state	% Performing in Stable Condition	Feature Performance Mean or Total
A. Riffles	1. Present	15	18	NA	83%	
	2. Armor stable	15	18	NA	83%	
	3. Facet grade appears stable	15	18	NA	83%	
	4. Minimal evidence of embedding/fining	13	18	NA	72%	
	5. Length appropriate	12	18	NA	67%	**78%**
B. Pools	1. Present	27	32	NA	84%	
	2. Sufficiently deep	27	32	NA	84%	
	3. Length appropriate	7	32	NA	22%	**64%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering	13	13	NA	100%	
	2. Downstream of meander (glide/inflection) centering	13	14	NA	93%	**96%**
D. Meanders	1. Outer bend in state of limited/controlled erosion	24	26	NA	92%	
	2. Of those eroding, # w/concomitant point bar formation	2	2	NA	100%	
	3. Apparent Rc within specifications	21	26	NA	81%	
	4. Sufficient floodplain access and relief	26	26	NA	100%	**93%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	NA	NA	14/211.8	89%	
	2. Channel bed degradation - areas of increasing down cutting or head cutting	NA	NA	0/0	100%	**95%**
F. Bank Condition	1. Actively eroding, wasting, or slumping bank	NA	NA	6/109.2	97%	**97%**
G. Vanes / J Hooks etc.	1. Free of back or arm scour	23	24	NA	96%	
	2. Height appropriate	24	24	NA	100%	
	3. Angle and geometry appear appropriate	19	24	NA	79%	
	4. Free of piping or other structural failures	24	24	NA	100%	**94%**
H. Wads and Boulders	1. Free of scour	57	57	NA	100%	
	2. Footing stable	57	57	NA	100%	**100%**

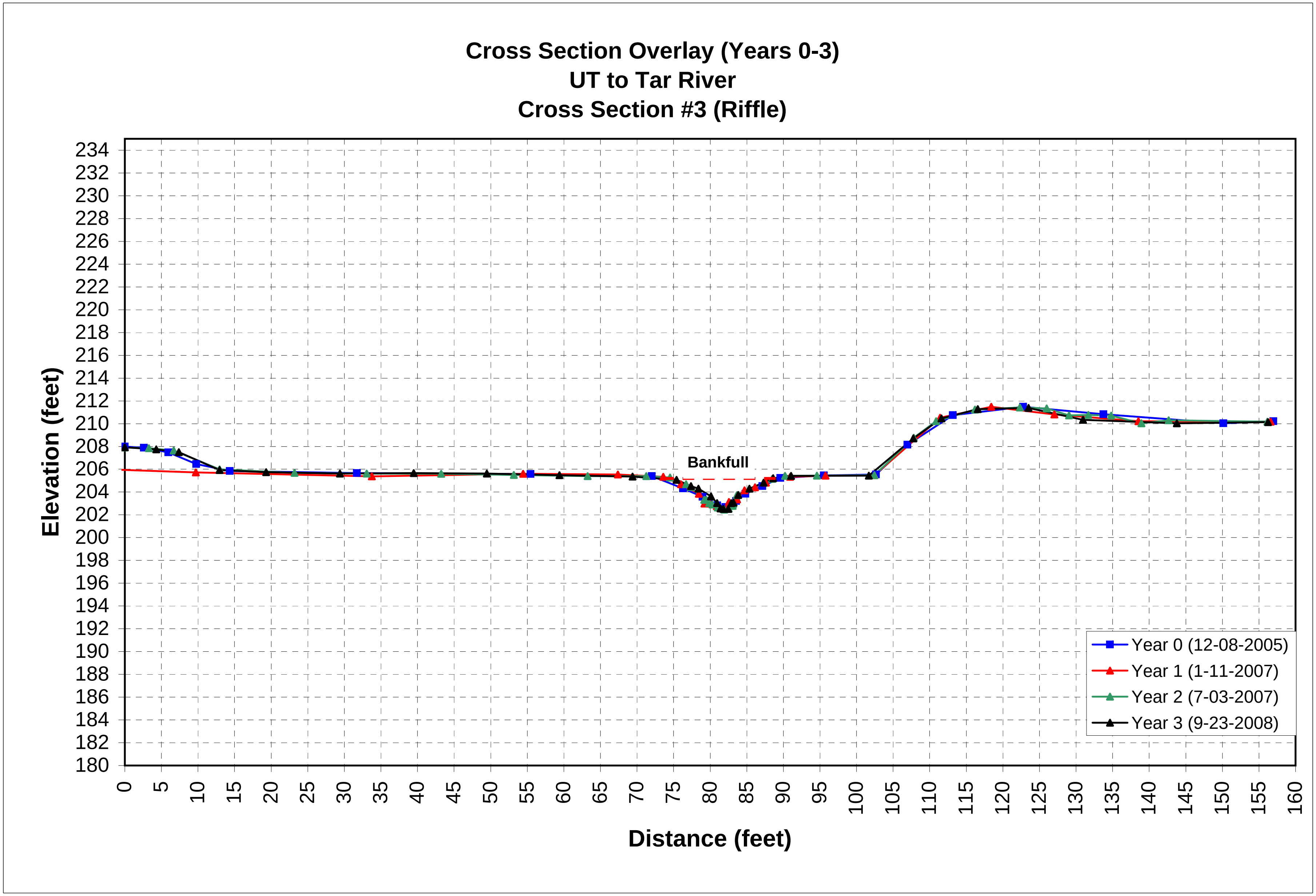
APPENDIX B4

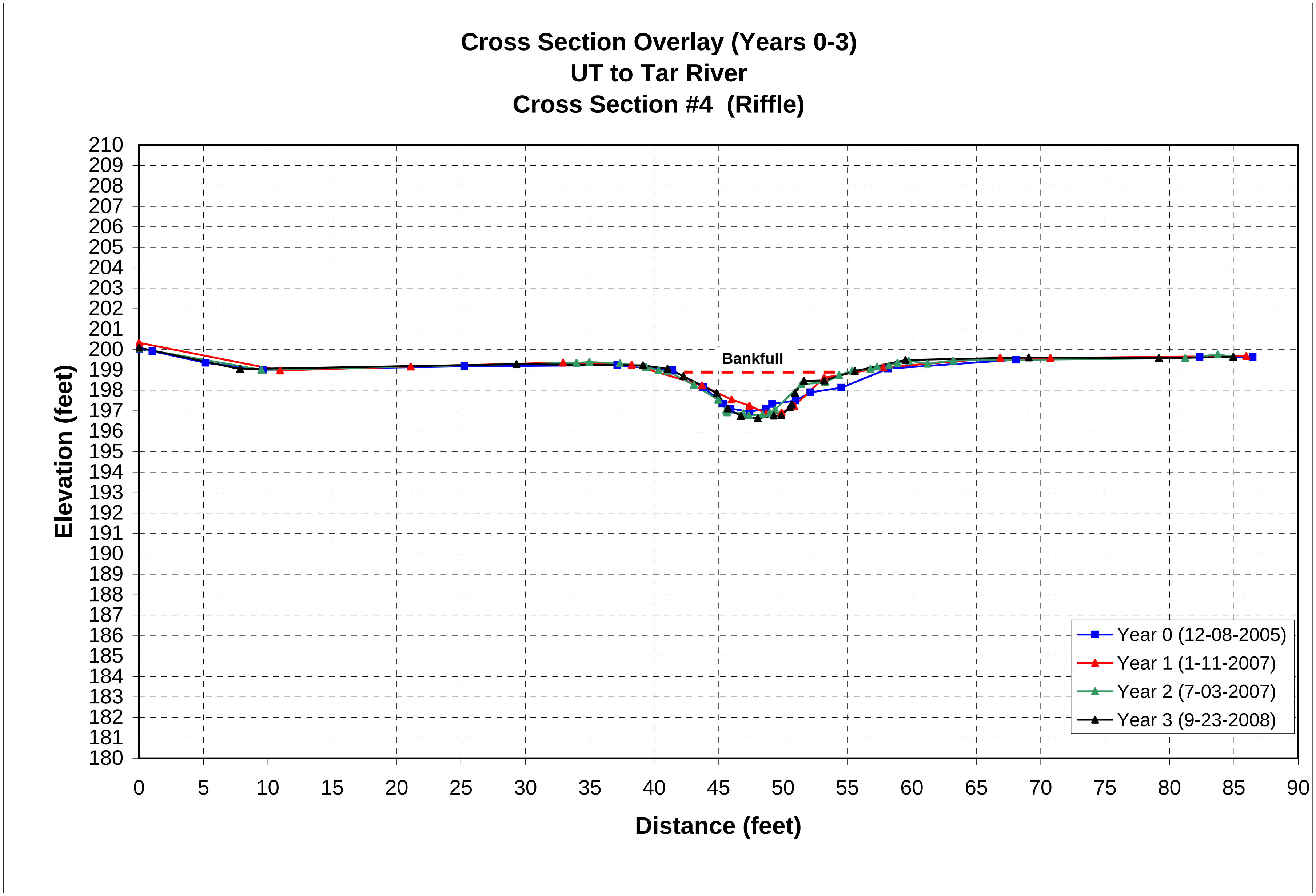
STREAM CROSS-SECTIONS



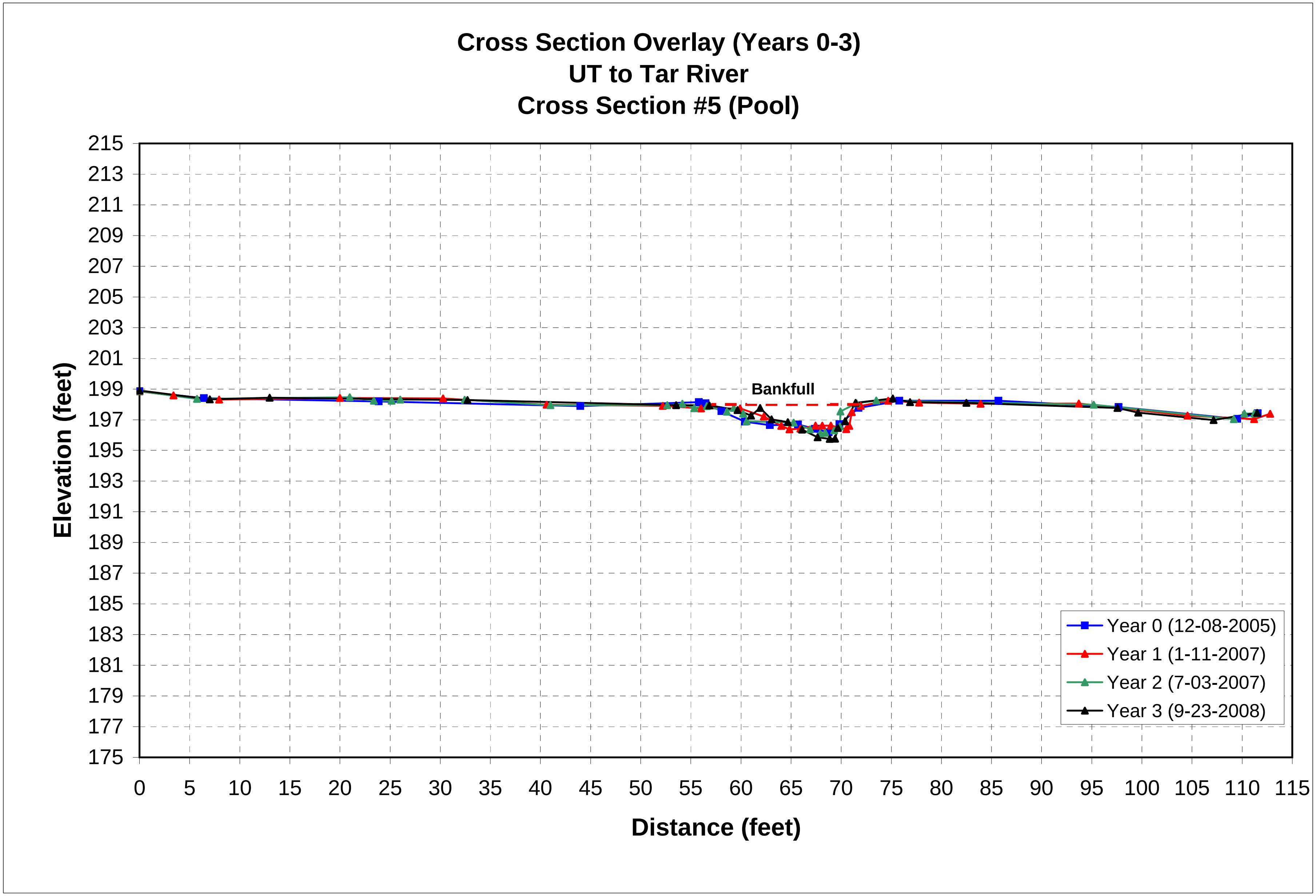
Cross Section Overlay (Years 0-3)
UT to Tar River
Cross Section #1 (Pool)
Elevation (feet)
235
233
231
229
227
225
223
221
219
217
215
213
211
209
207
205
203
201
199
197
195
193
191
189
187
185
Bankful
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160
Distance (feet)
Year 0 (12-08-2005)
Year 1 (1-11-2007)
Year 2 (7-03-2007)
Year 3 (9-23-2008)


Cross Section Overlay (Years 1 & 2)
UT to Tar River
Cross Section #2 (Riffle)
Elevation (feet)
Distance (feet)
Bankfull
Year 0 (12-08-2005)
Year 1 (1-11-2007)
Year 2 (7-03-2007)
Year 3 (9-23-2008)


Cross Section Overlay (Years 0-3)
UT to Tar River
Cross Section #3 (Riffle)
Elevation (feet)
Distance (feet)
Bankfull
Year 0 (12-08-2005)
Year 1 (1-11-2007)
Year 2 (7-03-2007)
Year 3 (9-23-2008)



Cross Section Overlay (Years 0-3)
UT to Tar River
Cross Section #4 (Riffle)
Elevation (feet)
210
209
208
207
206
205
204
203
202
201
200
199
198
197
196
195
194
193
192
191
190
189
188
187
186
185
184
183
182
181
180
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
Distance (feet)
Bankfull
Year 0 (12-08-2005)
Year 1 (1-11-2007)
Year 2 (7-03-2007)
Year 3 (9-23-2008)


Cross Section Overlay (Years 0-3)
UT to Tar River
Cross Section #5 (Pool)
Elevation (feet)
Distance (feet)
Bankfull
Year 0 (12-08-2005)
Year 1 (1-11-2007)
Year 2 (7-03-2007)
Year 3 (9-23-2008)

Appendix B4

Field Crew:	IPJ and PDB
Stream Reach:	UT to Tar River
Drainage Area:	0.61
Date:	Sep-08
Monitoring Year	3

STATION (Feet)	ELEVATION (Feet)	NOTES
0.00	213.06	
4.07	212.97	
19.45	207.93	
34.52	208.03	
38.85	207.76	
40.42	207.55	
42.64	207.56	
43.27	207.10	
43.90	206.25	
44.25	205.97	
45.01	205.84	
45.81	205.88	
47.12	205.99	
47.77	206.60	
49.14	206.32	
51.21	207.63	
54.44	208.05	
61.39	208.14	
68.47	208.89	
78.20	208.91	
85.07	207.47	
90.78	209.38	
104.59	209.67	
111.45	211.24	
115.35	210.79	
155.58	210.68	

Bankfull/Top of Bank Hydraulic Geometry

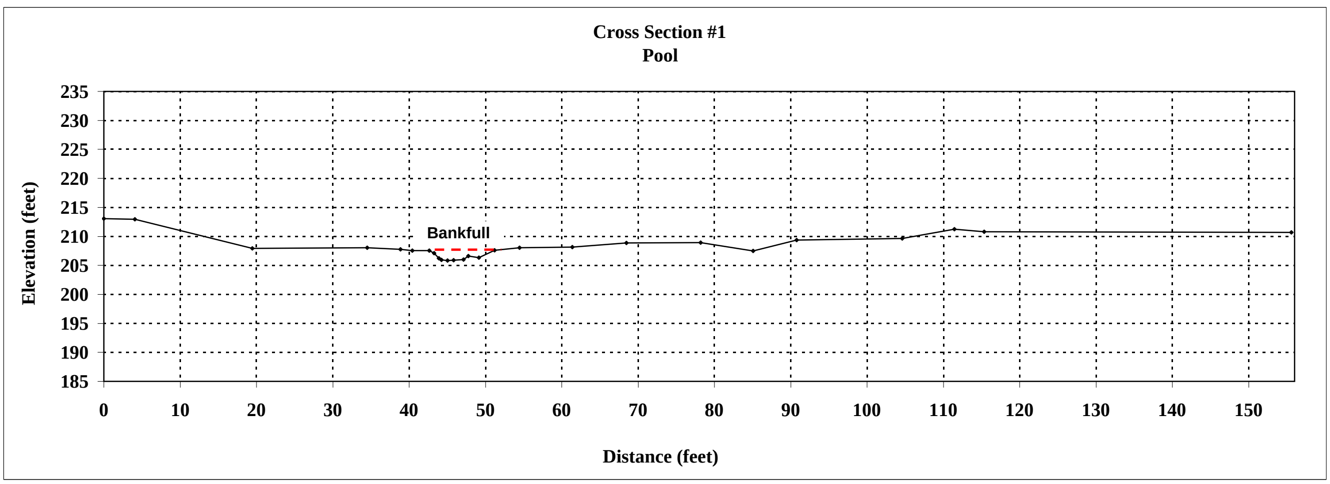
	Width (Feet)	Depth (Feet)	Perimeter (Feet)	Area (Sq. Ft.)
	0.0	0.0	0.00	0.0
	1.1	0.2	1.13	0.1
	2.2	0.1	2.22	0.3
	0.6	0.6	0.78	0.2
	0.6	1.5	1.06	0.7
	0.4	1.7	0.44	0.6
	0.8	1.9	0.77	1.4
	0.8	1.8	0.80	1.5
	1.3	1.7	1.32	2.3
	0.7	1.1	0.89	0.9
	1.4	1.4	1.40	1.7
	2.1	0.1	2.45	1.5
	0.6	0.0	0.60	0.0
TOTALS	12.5		13.9	11.2

SUMMARY DATA

A(BKF)	11.22
W(BKF)	12.50
Max d	1.87
Mean d	0.90
Wet. P	13.86
Hyd. R	0.81

Bankfull datum* = 207.71

*Datum reset during Monitoring Year 2.



Field Crew:	IPJ and PDB
Stream Reach:	UT to Tar River
Drainage Area:	0.61
Date:	Sep-08
Monitoring Year	3

STATION (Feet)	ELEVATION (Feet)	NOTES
0.00	211.29	
4.82	210.84	
15.88	207.57	
17.69	207.43	
41.05	207.50	
44.29	206.48	
47.11	207.56	
53.19	207.22	
54.82	206.89	
58.00	207.26	
59.16	206.95	
59.76	207.25	
61.77	206.93	
62.88	206.56	
64.31	205.39	
64.82	205.34	
65.57	205.35	
66.35	205.88	
68.51	206.97	
68.90	207.06	calc
69.59	207.19	
71.60	207.06	calc
73.53	206.92	
75.35	205.50	
77.52	205.22	
78.81	206.78	
80.35	207.31	
83.97	207.70	
94.39	210.10	
106.80	210.55	
119.93	210.76	

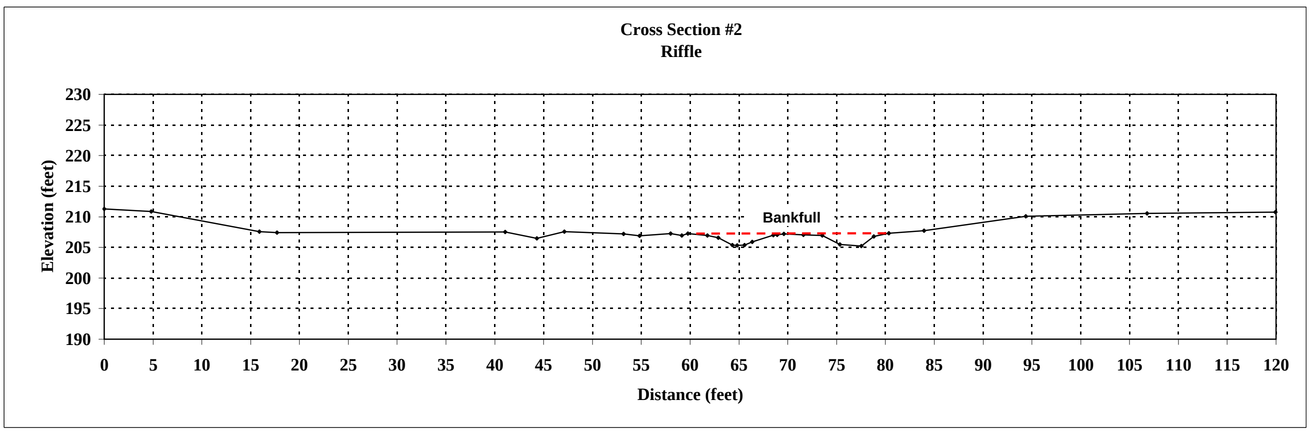
Bankfull Hydraulic Geometry

	Width (Feet)	Depth (Feet)	Perimeter (Feet)	Area (Sq. Ft.)
	0.0	0.0	0.00	0.0
	0.7	0.1	0.68	0.0
	1.1	0.5	1.17	0.3
	1.4	1.7	1.85	1.6
	0.5	1.7	0.51	0.9
	0.8	1.7	0.75	1.3
	0.8	1.2	0.94	1.1
	2.2	0.1	2.42	1.4
	0.4	0.0	0.40	0.0
	0.7	0.0	0.00	0.0
	2.0	0.0	0.00	0.0
	1.9	0.1	1.94	0.1
	1.8	1.6	2.31	1.6
	2.2	1.8	2.19	3.7
	1.3	0.3	2.02	1.4
	1.5	0.0	1.57	0.2
TOTALS	19.3		18.7	13.6

SUMMARY DATA (BANKFULL)

A(BKF)	13.59	W(FPA)	77.5
W(BKF)	19.25	WP	18.75
Max d	1.84	Hydraulic Radius	1.03
Mean d	0.71	Wetted Perimeter= WP	
W/D	27.27	Area= A	
Bank Height	2.03	Width= W	
Entrenchment	4.0	Depth= D	
Stream Type	C	Bankfull= BKF	
Area from Rural Regional Curve			15.8

Bankfull datum* = **207.06**
*Datum reset during Monitoring Year 2.



Field Crew:	IPJ and PDB
Stream Reach:	UT to Tar River
Drainage Area:	0.61
Date:	Sep-08
Monitoring Year	3

STATION (Feet)	HI (Feet)	NOTES
0.00	207.92	
4.28	207.74	
7.38	207.49	
12.95	205.93	
19.32	205.75	
29.39	205.62	
39.47	205.66	
49.47	205.62	
59.41	205.48	
69.39	205.36	
75.40	205.07	
77.36	204.51	
78.39	204.30	
80.12	203.61	
80.94	203.04	
81.42	202.56	
81.81	202.52	
82.46	202.52	
82.88	203.03	
83.20	203.08	
83.82	203.75	
85.36	204.30	
87.30	204.83	
88.60	205.22	
91.05	205.42	
101.67	205.44	
107.76	208.71	
111.62	210.46	
116.57	211.28	
123.50	211.37	
130.96	210.34	
143.77	210.03	
156.24	210.14	

Bankfull Hydraulic Geometry

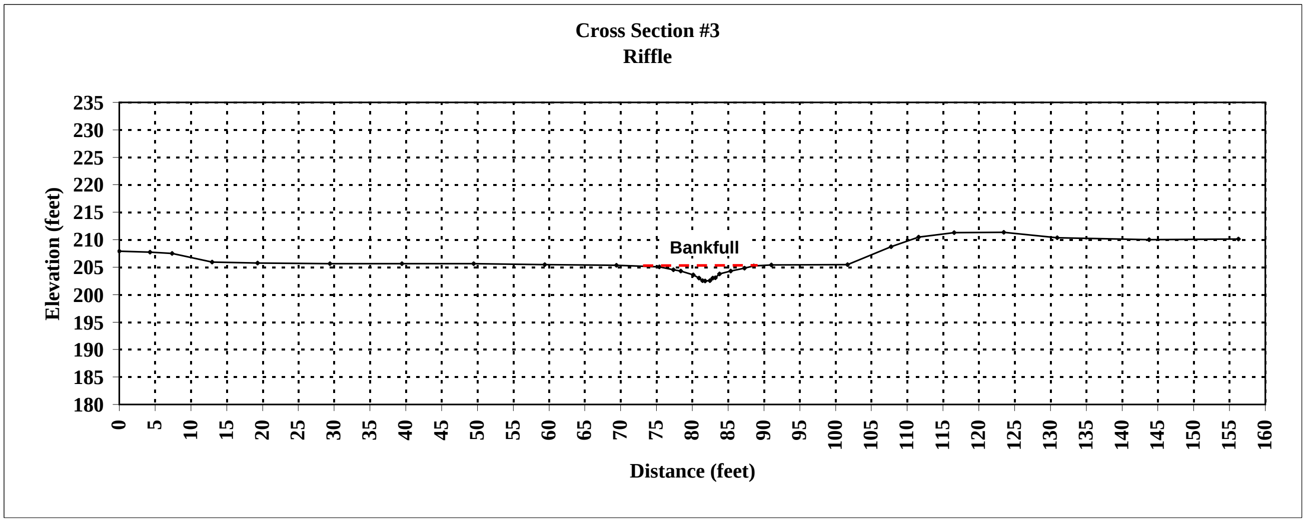
	Width (Feet)	Depth (Feet)	Perimeter (Feet)	Area (Sq. Ft.)
	0.0	0.0	0.00	0.0
	4.2	0.2	4.21	0.4
	2.0	0.8	2.04	1.0
	1.0	1.0	1.05	0.9
	1.7	1.7	1.86	2.3
	0.8	2.2	1.00	1.6
	0.5	2.7	0.67	1.2
	0.4	2.8	0.39	1.1
	0.6	2.8	0.65	1.8
	0.4	2.3	0.66	1.1
	0.3	2.2	0.32	0.7
	0.6	1.5	0.91	1.2
	1.5	1.0	1.64	1.9
	1.9	0.4	2.01	1.4
	1.3	0.1	1.36	0.3
	1.8	0.0	1.85	0.1
TOTALS	19.3		20.6	16.9

SUMMARY DATA (BANKFULL)

A(BKF)	16.87	W(FPA)	106.5+
W(BKF)	19.25	WP	20.62
Max d	2.76	Hydraulic Radius	0.93
Mean d	0.88	Wetted Perimeter= WP	
W/D	21.96	Area= A	
Bank Height	2.84	Width= W	
Entrenchment	5.5+	Depth= D	
Stream Type	C	Bankfull= BKF	
Area from Rural Regional Curve			15.8

Bankfull datum* = **205.28**

*Datum reset during Monitoring Year 2.



Field Crew:	IPJ and PDB
Stream Reach:	UT to Tar River
Drainage Area:	0.61
Date:	Sep-08
Monitoring Year	3

STATION (Feet)	ELEVATION (Feet)	NOTES
0.00	200.09	
7.85	199.04	
29.30	199.28	
39.13	199.22	
41.03	199.05	
42.26	198.70	
44.83	197.87	
45.70	197.12	
46.73	196.74	
48.03	196.63	
49.29	196.77	
49.87	196.78	
50.52	197.16	
50.68	197.32	
50.93	197.88	
51.61	198.47	
53.18	198.48	
55.57	198.94	
59.50	199.48	
69.08	199.61	
79.17	199.58	
84.95	199.63	

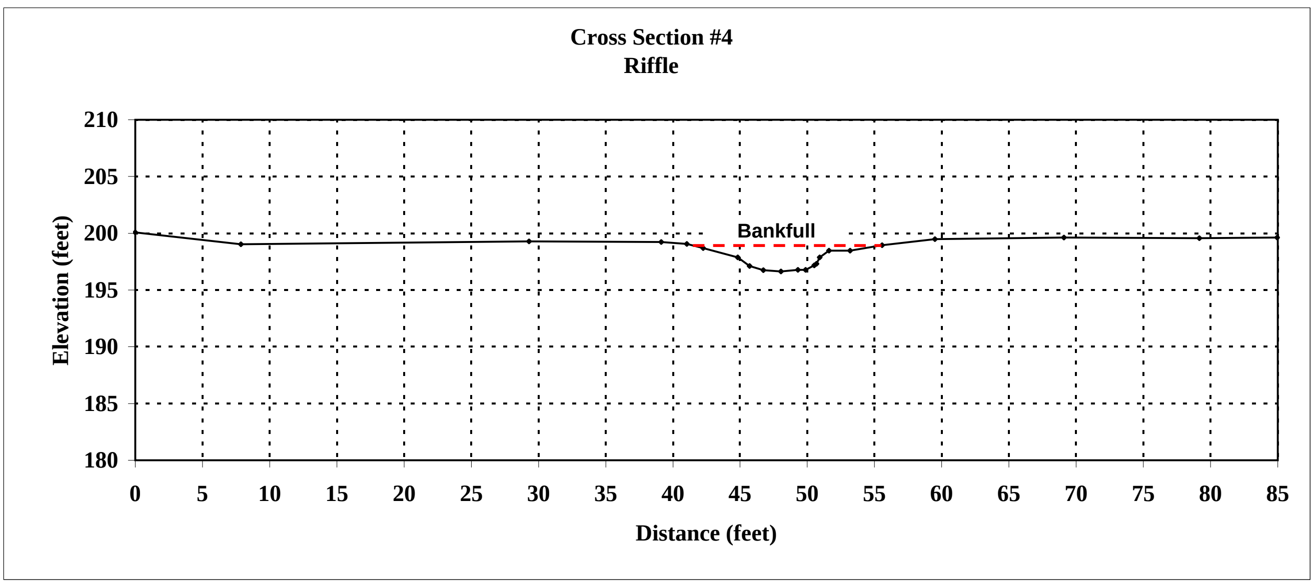
Bankfull Hydraulic Geometry

	Width (Feet)	Depth (Feet)	Perimeter (Feet)	Area (Sq. Ft.)
	0.0	0.0	0.00	0.0
	0.9	0.2	0.89	0.1
	2.6	1.1	2.70	1.7
	0.9	1.8	1.15	1.2
	1.0	2.2	1.10	2.1
	1.3	2.3	1.31	2.9
	1.3	2.2	1.27	2.8
	0.6	2.2	0.58	1.3
	0.7	1.8	0.75	1.3
	0.2	1.6	0.22	0.3
	0.3	1.0	0.62	0.3
	0.7	0.5	0.90	0.5
	1.6	0.5	1.57	0.7
	2.3	0.0	2.31	0.5
TOTALS	14.1		15.4	15.7

SUMMARY DATA (BANKFULL)

A(BKF)	15.67	W(FPA)	85+
W(BKF)	14.05	WP	15.36
Max d	2.30	'draulic Rad	0.91
Mean d	1.12	Perimeter=	WP
W/D	12.59	Area=	A
Bank Height	2.59	Width=	W
Entrenchment	6.0+	Depth=	D
Stream Type	C	Bankfull=	BKF
Area from Rural Regional Curve			15.8

Bankfull datum* = 198.93
*Datum reset during Monitoring Year 2



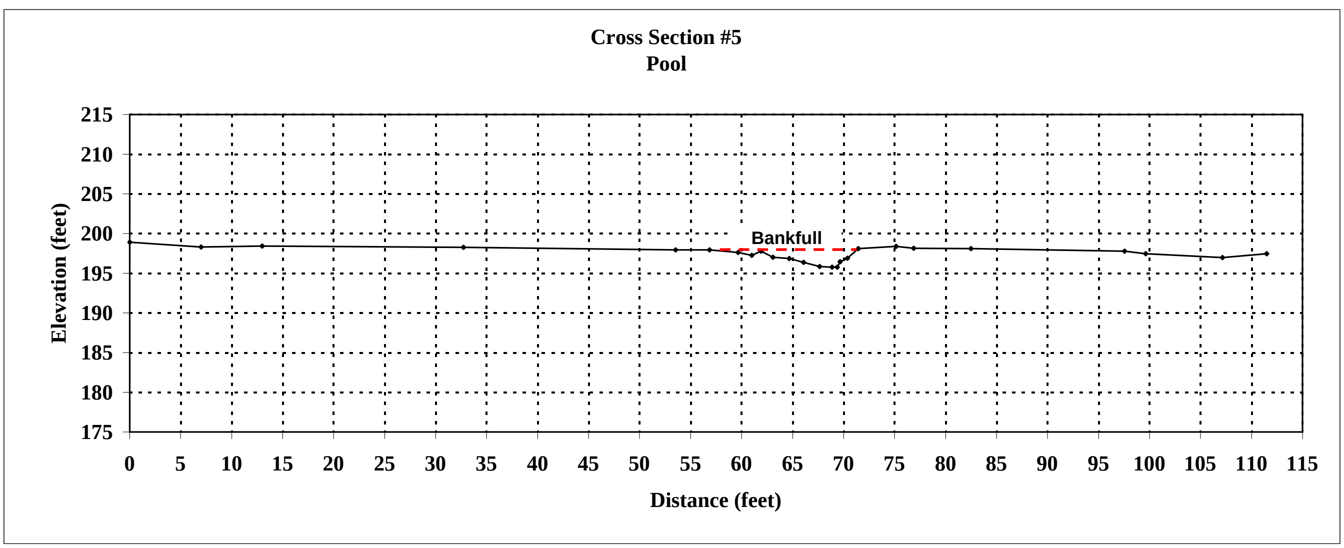
Field Crew:	IPJ and PDB
Stream Reach:	UT to Tar River
Drainage Area:	0.61
Date:	Sep-08
Monitoring Year	3

STATION (Feet)	ELEVATION (Feet)	NOTES
0.00	198.90	
7.01	198.32	
12.99	198.44	
32.73	198.28	
53.53	197.95	
56.85	197.93	
59.66	197.63	
61.01	197.27	
61.92	197.77	
63.06	197.02	
64.68	196.84	
66.09	196.36	
67.64	195.86	
68.86	195.75	
69.39	195.77	
69.66	196.46	
70.39	196.90	
71.44	198.10	
75.14	198.39	
76.87	198.15	
82.48	198.10	
97.55	197.77	
99.62	197.46	
107.14	196.97	
111.50	197.45	

	Bankfull/Top of Bank Hydraulic Geometry			
	Width (Feet)	Depth (Feet)	Perimeter (Feet)	Area (Sq. Ft.)
	0.0	0.0	0.00	0.0
	2.3	0.3	2.27	0.3
	1.4	0.6	1.40	0.6
	0.9	0.1	1.04	0.3
	1.1	0.9	1.37	0.6
	1.6	1.0	1.63	1.5
	1.4	1.5	1.49	1.8
	1.6	2.0	1.63	2.7
	1.2	2.1	1.22	2.5
	0.5	2.1	0.53	1.1
	0.3	1.4	0.74	0.5
	0.7	1.0	0.85	0.9
	0.9	0.0	1.31	0.4
TOTALS	13.9		15.5	13.3

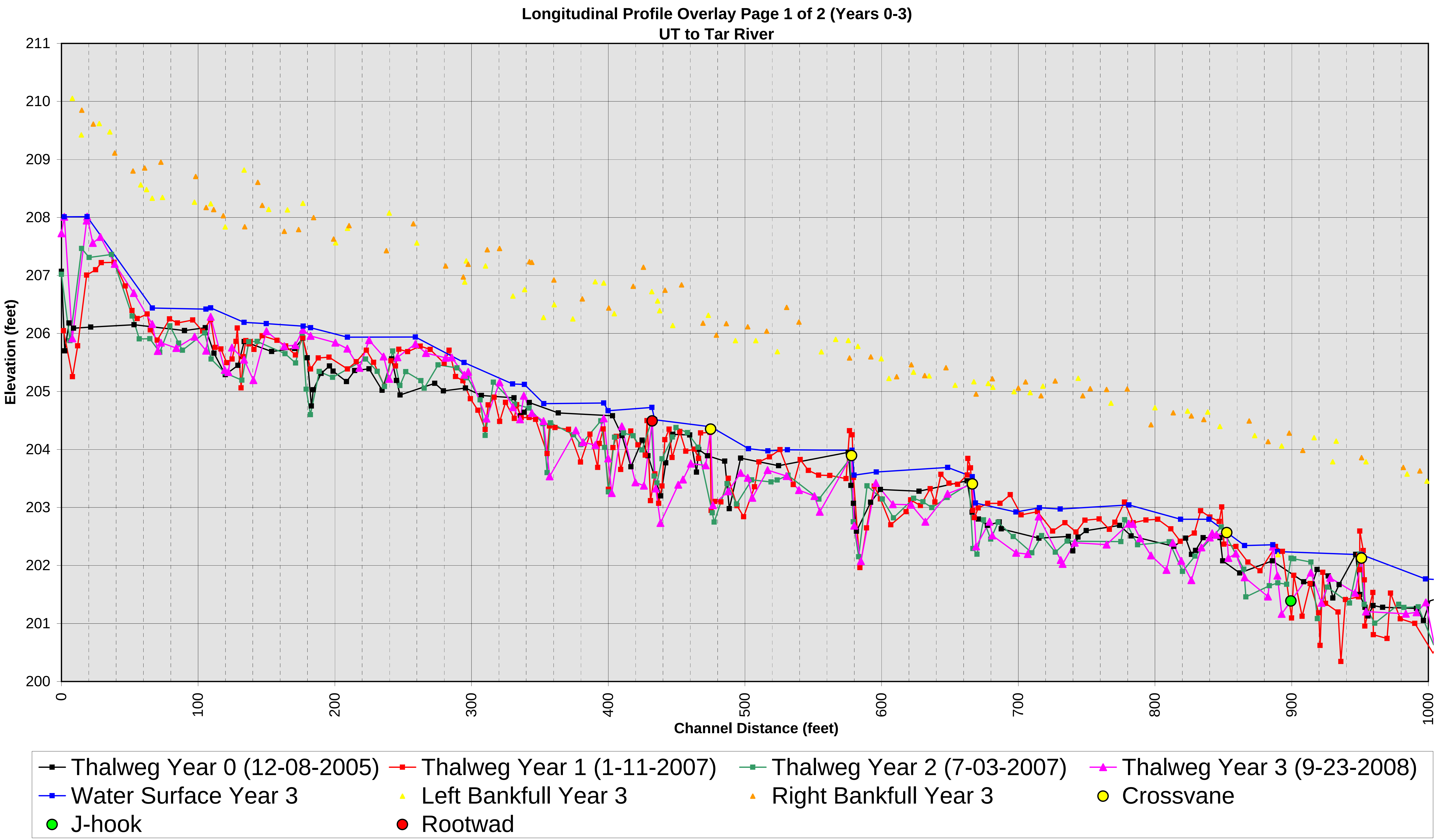
SUMMARY DATA	
A(BKF)	13.28
W(BKF)	13.85
Max d	2.13
Mean d	0.96
Wet. P	15.48
Hyd. R	0.86

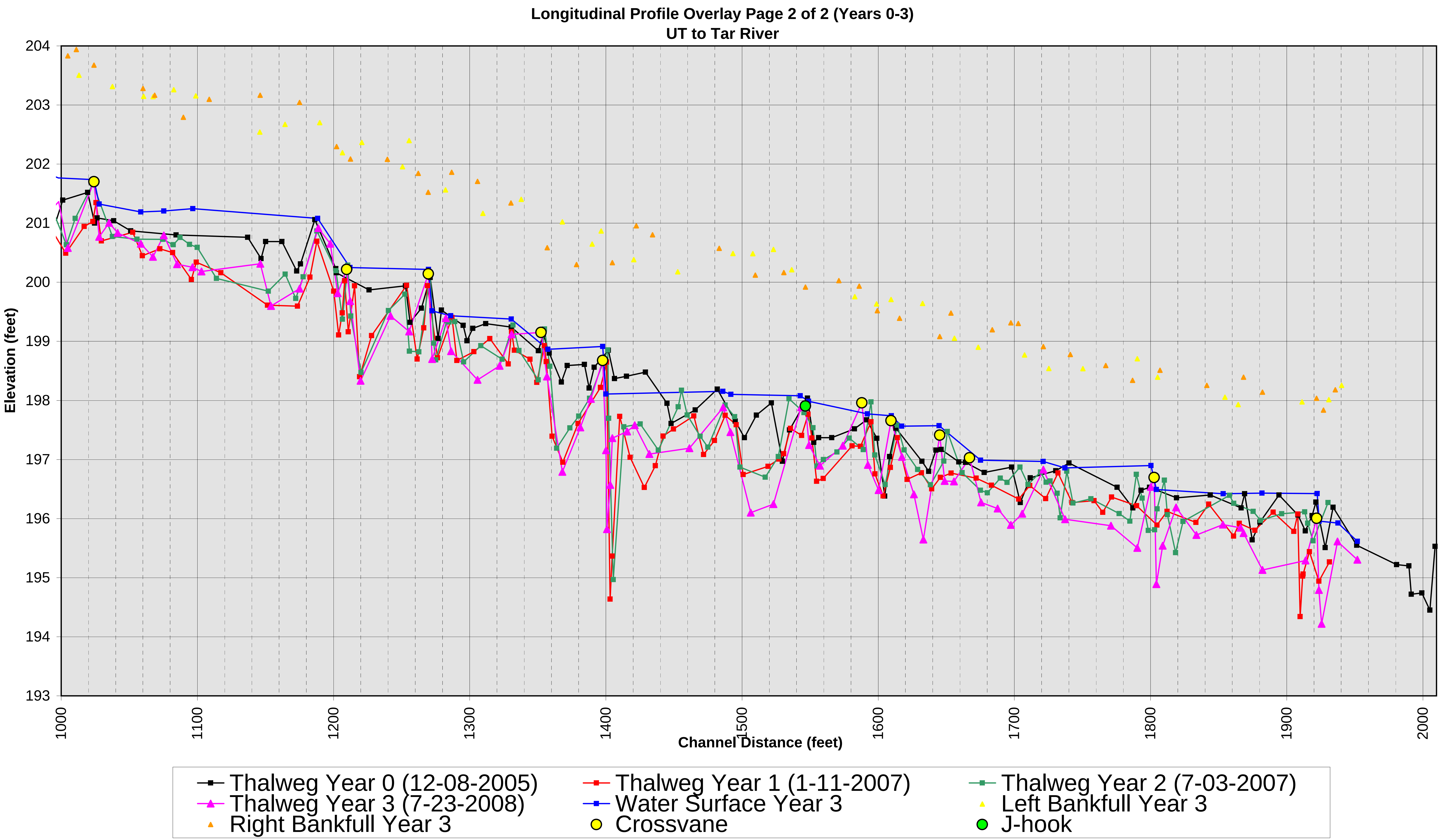
Bankfull datum* = 197.88
*Datum reset during Monitoring Year 2.



APPENDIX B5

STREAM LONGITUDINAL PROFILE


Longitudinal Profile Overlay Page 1 of 2 (Years 0-3)
UT to Tar River
Elevation (feet)
Channel Distance (feet)
211
210
209
208
207
206
205
204
203
202
201
200
0
100
200
300
400
500
600
700
800
900
1000
Thalweg Year 0 (12-08-2005)
Thalweg Year 1 (1-11-2007)
Thalweg Year 2 (7-03-2007)
Thalweg Year 3 (9-23-2008)
Water Surface Year 3
Left Bankfull Year 3
Right Bankfull Year 3
Crossvane
J-hook
Rootwad



Longitudinal Profile Overlay Page 2 of 2 (Years 0-3)
UT to Tar River
Elevation (feet)
Channel Distance (feet)
204
203
202
201
200
199
198
197
196
195
194
193
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
Thalweg Year 0 (12-08-2005)
Thalweg Year 1 (1-11-2007)
Thalweg Year 2 (7-03-2007)
Thalweg Year 3 (7-23-2008)
Water Surface Year 3
Left Bankfull Year 3
Right Bankfull Year 3
Crossvane
J-hook

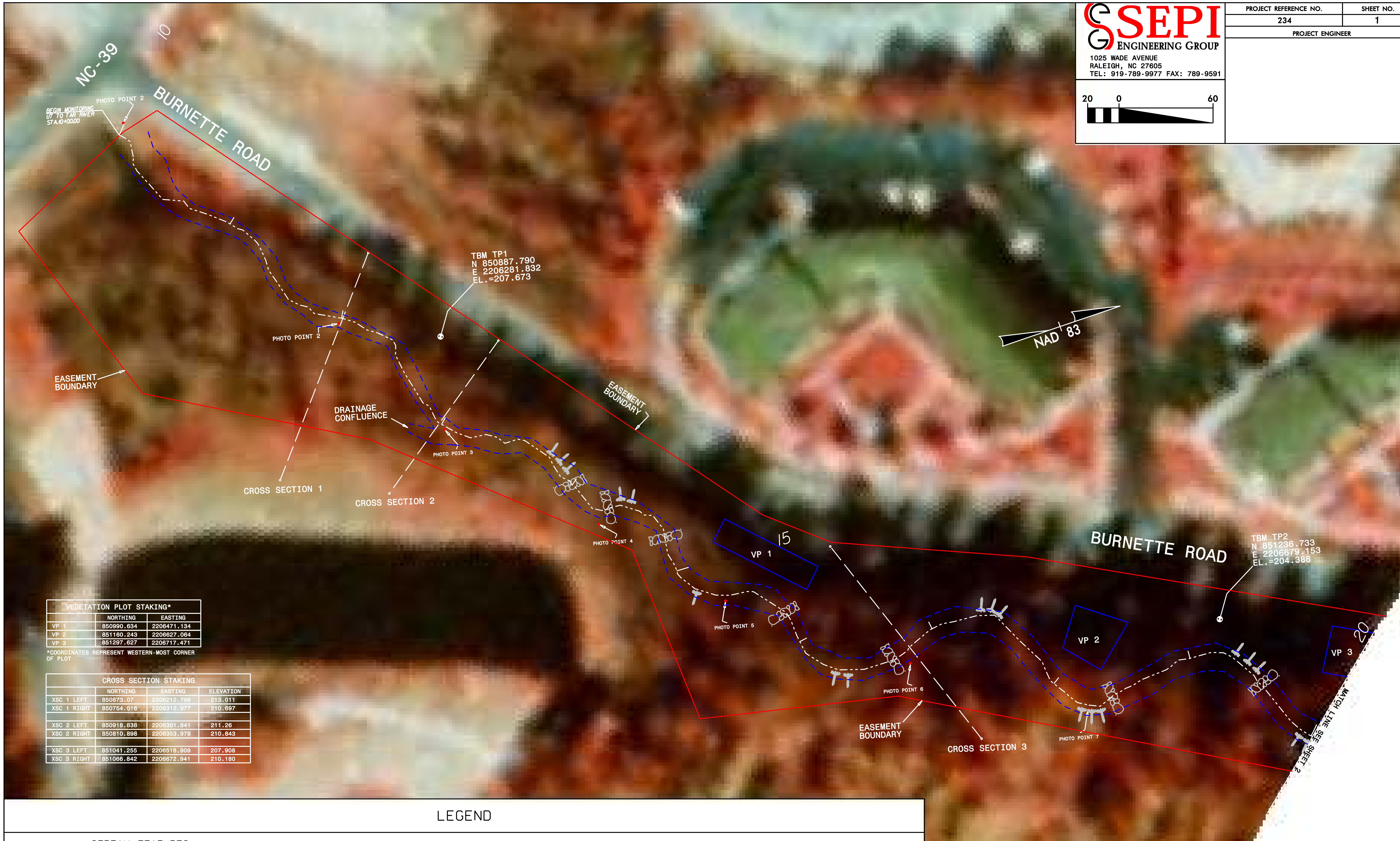
APPENDIX B6

STREAM PEBBLE COUNTS

At the request of EEP, pebble counts were not performed for UT Tar River during Monitoring Year 3 because this is a sandbed stream.

APPENDIX C

PLAN VIEW SHEETS



VEGETATION PLOT STAKING*		
	NORTHING	EASTING
VP 1	850990.634	2206471.134
VP 2	851160.243	2206627.064
VP 3	851297.627	2206717.471

*COORDINATES REPRESENT WESTERN-MOST CORNER OF PLOT

CROSS SECTION STAKING			
	NORTHING	EASTING	ELEVATION
XSC 1 LEFT	850873.07	2206212.798	213.011
XSC 1 RIGHT	850754.016	2206312.977	210.697
XSC 2 LEFT	850918.838	2206301.841	211.26
XSC 2 RIGHT	850810.898	2206353.978	210.843
XSC 3 LEFT	851041.255	2206518.909	207.908
XSC 3 RIGHT	851066.842	2206672.941	210.180

SEPI ENGINEERING GROUP
1025 WADE AVENUE
RALEIGH, NC 27605
TEL: 919-789-9977 FAX: 789-9591

PROJECT REFERENCE NO.	SHEET NO.
234	1
PROJECT ENGINEER	

20 0 60

LEGEND

STREAM FEATURES

- THALWEG 2008
- BANKFULL 2008

PROJECT ELEMENTS

- CONTROL POINT/BENCHMARK (TBM)
- VEGETATION PLOT
- CROSS-SECTIONS
- PHOTO POINT
- EASEMENT BOUNDARY

STRUCTURE TYPES

- ROCK VANE
- ROOTWAD

Ecosystem Enhancement PROGRAM

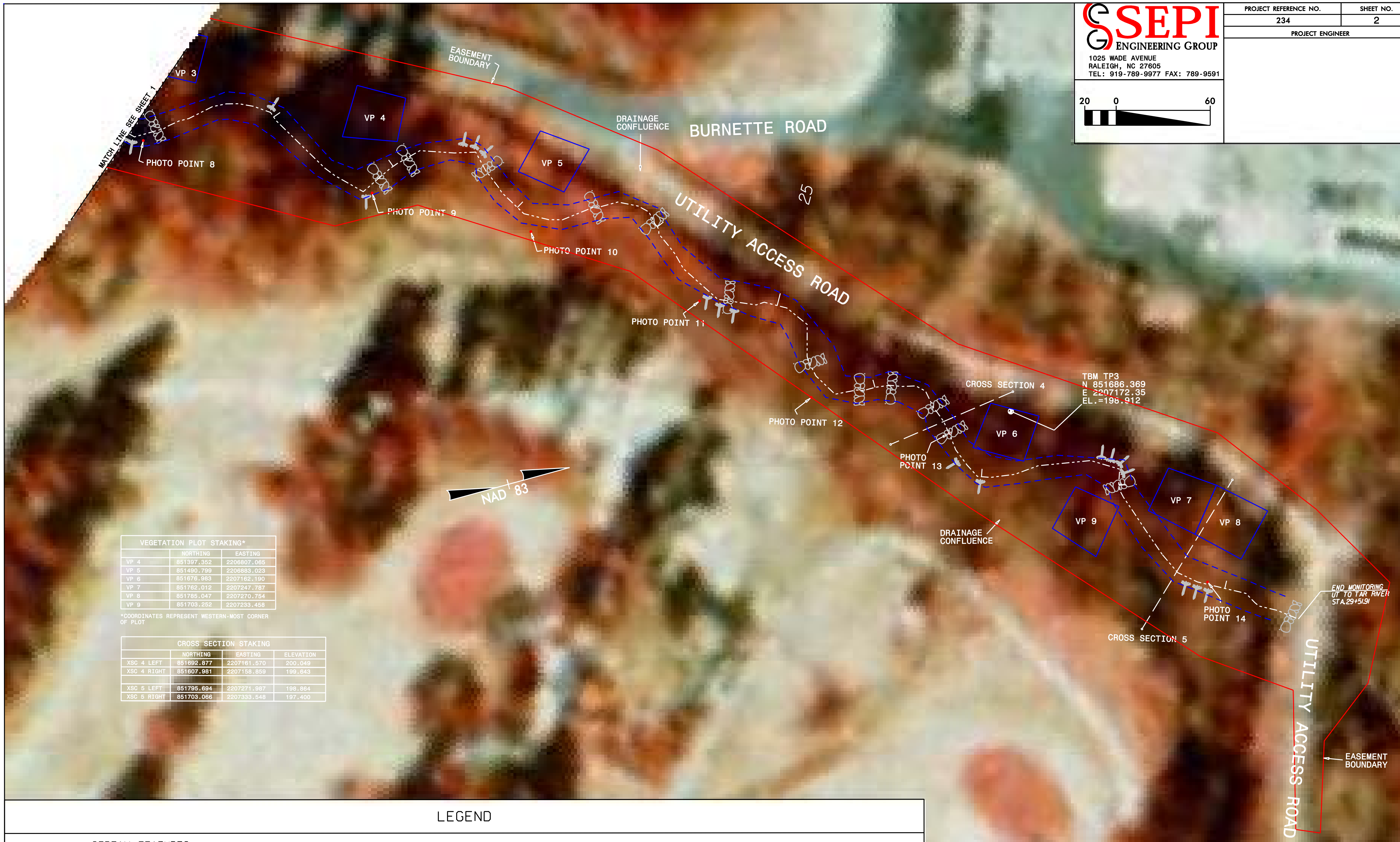
LOCATION:

UT TO TAR RIVER
MONITORING PLAN VIEW
MONITORING YEAR 3

PROJ #: 234	COUNTY: FRANKLIN
PREPARED BY: IPJ	
CHECKED BY: PDB	DATE: 2/4/09

SEPI ENGINEERING GROUP
1025 WADE AVENUE
RALEIGH, NC 27605
TEL: 919-789-9977 FAX: 789-9591

PROJECT REFERENCE NO.	SHEET NO.
234	2
PROJECT ENGINEER	



VEGETATION PLOT STAKING*		
	NORTHING	EASTING
VP 4	851397.352	2206807.065
VP 5	851490.799	2206883.023
VP 6	851676.983	2207162.190
VP 7	851762.012	2207247.787
VP 8	851785.047	2207270.754
VP 9	851703.252	2207233.458

*COORDINATES REPRESENT WESTERN-MOST CORNER OF PLOT

CROSS SECTION STAKING			
	NORTHING	EASTING	ELEVATION
XSC 4 LEFT	851692.877	2207161.570	200.049
XSC 4 RIGHT	851607.981	2207158.859	199.643
XSC 5 LEFT	851795.694	2207271.987	198.864
XSC 5 RIGHT	851703.066	2207333.548	197.400

LEGEND

STREAM FEATURES
- THALWEG 2008
- BANKFULL 2008

PROJECT ELEMENTS
- CONTROL POINT/BENCHMARK (TBM)
- VEGETATION PLOT
- CROSS-SECTIONS
- PHOTO POINT
- EASEMENT BOUNDARY

STRUCTURE TYPES
- ROCK VANE
- ROOTWAD

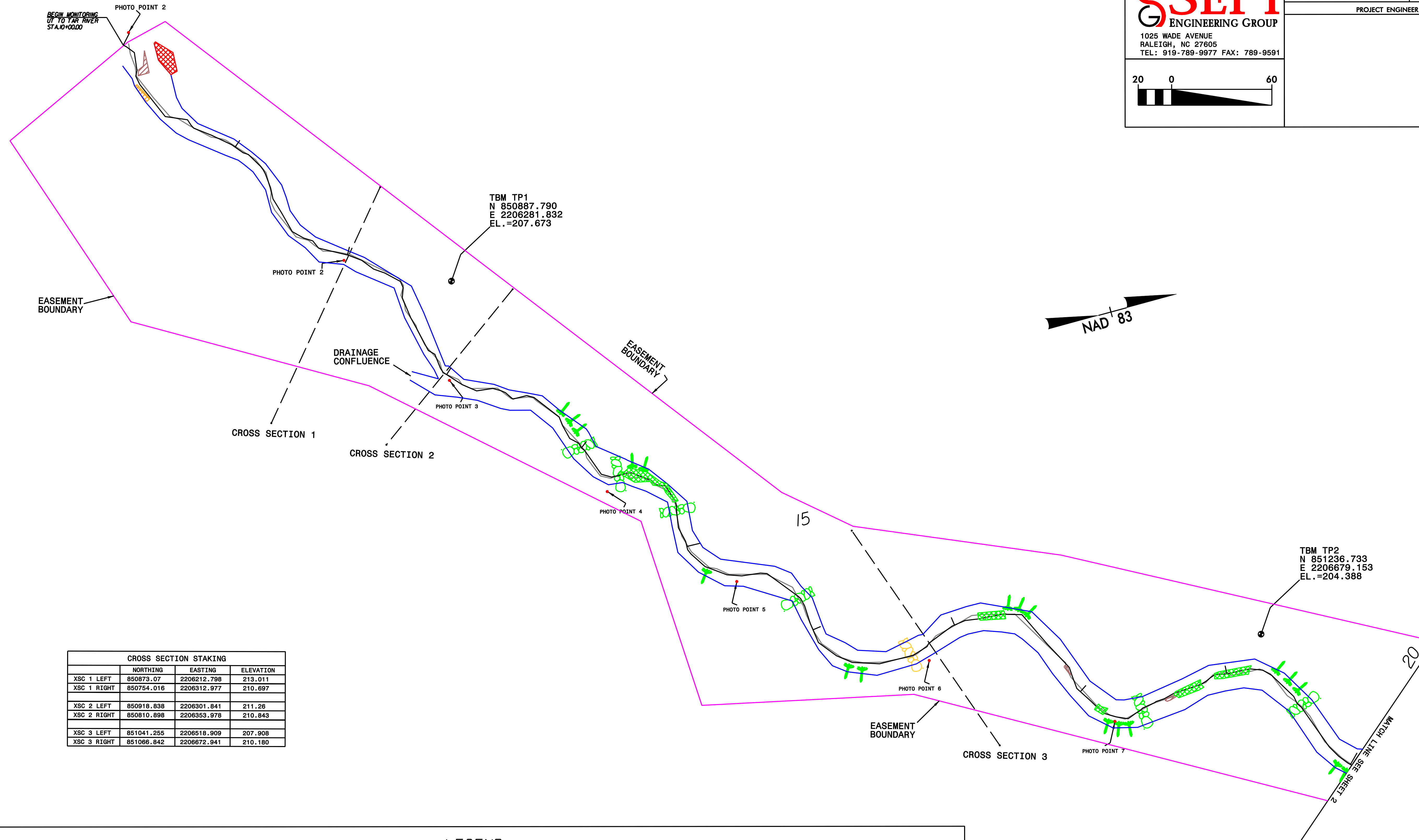
Ecosystem Enhancement PROGRAM

LOCATION:
UT TO TAR RIVER
MONITORING PLAN VIEW
MONITORING YEAR 3

PROJ #: 234	COUNTY: FRANKLIN
PREPARED BY: IPJ	
CHECKED BY: PDB	DATE: 2/4/09

SEPI
ENGINEERING GROUP
1025 WADE AVENUE
RALEIGH, NC 27605
TEL: 919-789-9977 FAX: 789-9591

PROJECT REFERENCE NO.	SHEET NO.
234	1
PROJECT ENGINEER	



CROSS SECTION STAKING			
	NORTHING	EASTING	ELEVATION
XSC 1 LEFT	850873.07	2206212.798	213.011
XSC 1 RIGHT	850754.016	2206312.977	210.697
XSC 2 LEFT	850918.838	2206301.841	211.26
XSC 2 RIGHT	850810.898	2206353.978	210.843
XSC 3 LEFT	851041.255	2206518.909	207.908
XSC 3 RIGHT	851066.842	2206672.941	210.180

LEGEND

THALWEG 2007
THALWEG 2008
BANKFULL 2008
CROSS-SECTIONS

BANK EROSION
SEVERE BANK EROSION
UNDERCUT BANKS
AGGRADATION
BAR FORMATION

STRUCTURE TYPES

ROCK STRUCTURE

ROOTWAD

COLOR CODE FOR STRUCTURES

GOOD STRUCTURE (ACTUAL LOCATION)

STRUCTURE WITH POTENTIAL PROBLEM (ACTUAL LOCATION)

FAILING STRUCTURE (ACTUAL LOCATION)

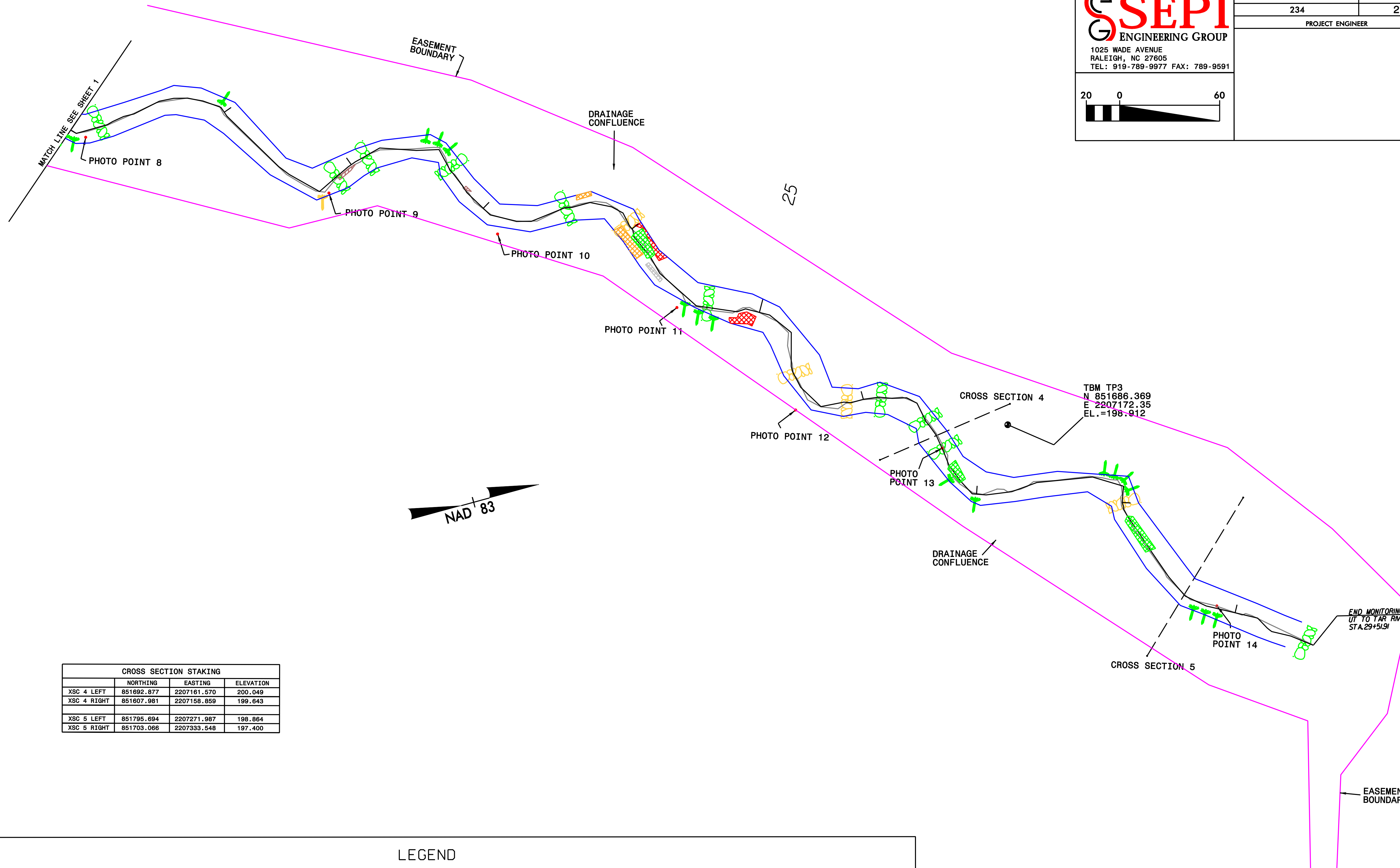
Ecosystem Enhancement PROGRAM

LOCATION:
UT TO TAR RIVER
CURRENT CONDITIONS PLAN VIEW
STREAM MONITORING - YEAR 3

PROJ #: 234	COUNTY: FRANKLIN
PREPARED BY: IPJ	
CHECKED BY: PDB	DATE: 2/10/09

SEPI ENGINEERING GROUP
1025 WADE AVENUE
RALEIGH, NC 27605
TEL: 919-789-9977 FAX: 789-9591

PROJECT REFERENCE NO.	SHEET NO.
234	2
PROJECT ENGINEER	



CROSS SECTION STAKING			
	NORTHING	EASTING	ELEVATION
XSC 4 LEFT	851692.877	2207161.570	200.049
XSC 4 RIGHT	851607.981	2207158.859	199.643
XSC 5 LEFT	851795.694	2207271.987	198.864
XSC 5 RIGHT	851703.066	2207333.548	197.400

LEGEND

THALWEG 2007
THALWEG 2008
BANKFULL 2008
CROSS-SECTIONS

BANK EROSION
SEVERE BANK EROSION
UNDERCUT BANKS
AGGRADATION
BAR FORMATION

STRUCTURE TYPES
ROCK STRUCTURE
ROOTWAD

COLOR CODE FOR STRUCTURES
GOOD STRUCTURE (ACTUAL LOCATION)
STRUCTURE WITH POTENTIAL PROBLEM (ACTUAL LOCATION)
FAILING STRUCTURE (ACTUAL LOCATION)

Ecosystem Enhancement PROGRAM

LOCATION:
UT TO TAR RIVER
CURRENT CONDITIONS PLAN VIEW
STREAM MONITORING - YEAR 3

PROJ #: 234	COUNTY: FRANKLIN
PREPARED BY: IPJ	
CHECKED BY: PDB	DATE: 2/10/09

SEPI ENGINEERING GROUP
1025 WADE AVENUE
RALEIGH, NC 27605
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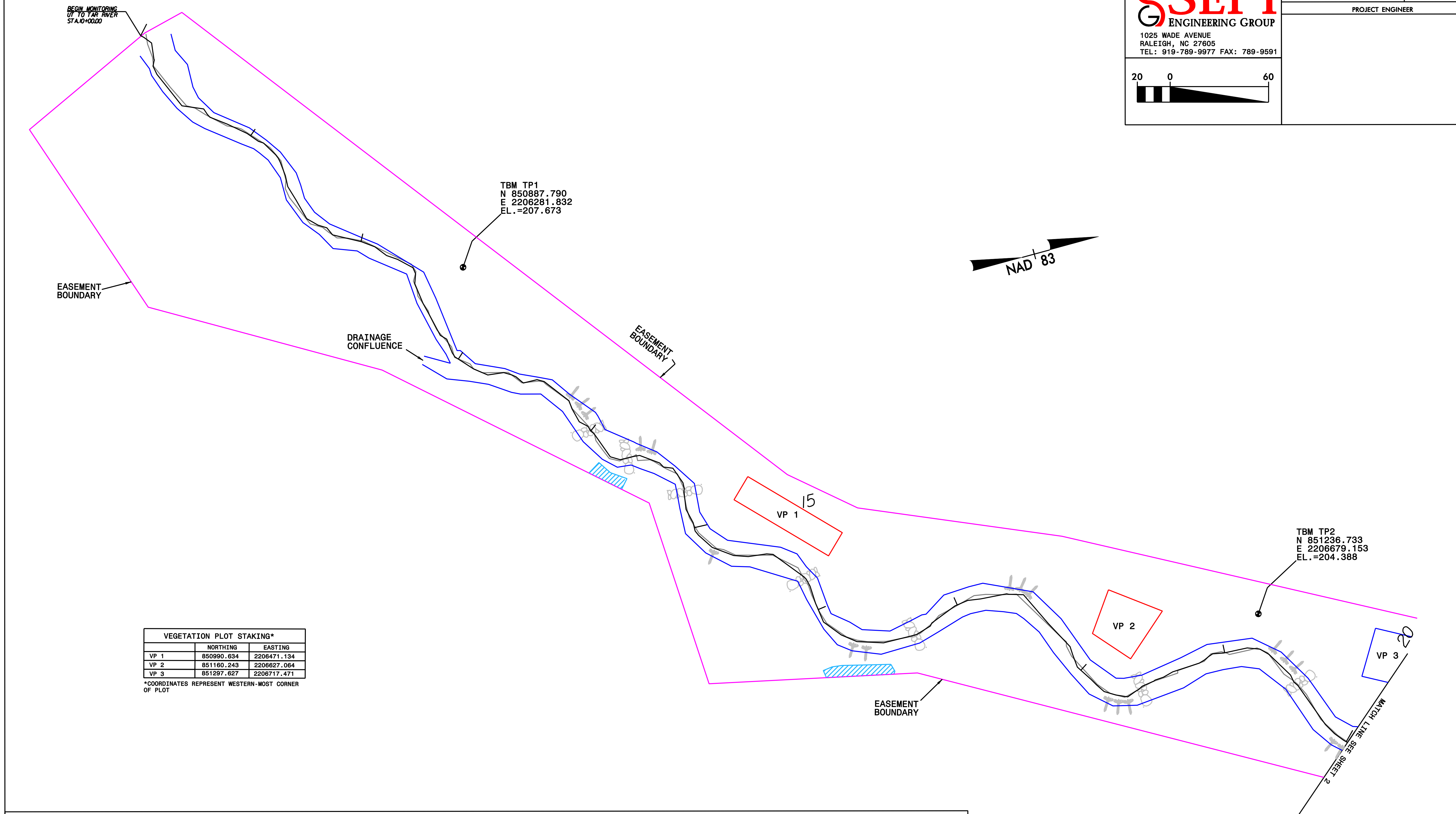
PROJECT REFERENCE NO.	SHEET NO.
234	1

PROJECT ENGINEER



VEGETATION PLOT STAKING*		
	NORTHING	EASTING
VP 1	850990.634	2206471.134
VP 2	851160.243	2206627.064
VP 3	851297.627	2206717.471

*COORDINATES REPRESENT WESTERN-MOST CORNER OF PLOT

LEGEND

THALWEG 2008

BANKFULL 2008

VEGETATION PLOT

VEGETATION PLOT NOT MEETING SUCCESS REQUIREMENTS

BARE FLOODPLAIN

MICROSTEGIUM VIRMINEUM PRESENT

STRUCTURE TYPES

ROCK STRUCTURE

ROOTWAD

Ecosystem Enhancement PROGRAM

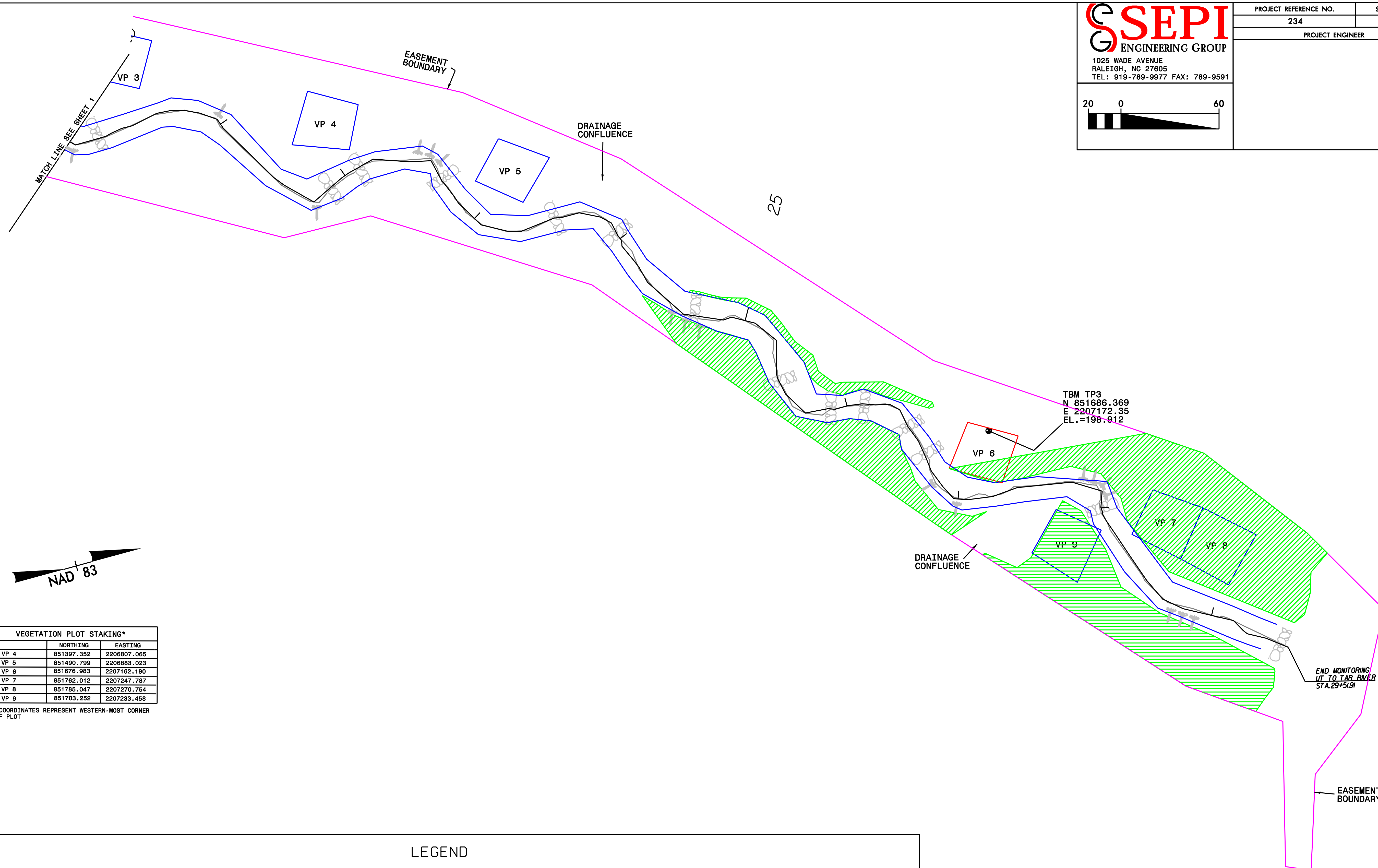
LOCATION: UT TO TAR RIVER
CURRENT CONDITIONS PLAN VIEW
VEGETATION ASSESSMENT - YEAR 3

PROJ #: 234	COUNTY: FRANKLIN
PREPARED BY: IPJ	
CHECKED BY: PDB	DATE: 2/10/09

SEPI ENGINEERING GROUP
1025 WADE AVENUE
RALEIGH, NC 27605
TEL: 919-789-9977 FAX: 789-9591

PROJECT REFERENCE NO.	SHEET NO.
234	2

PROJECT ENGINEER



VEGETATION PLOT STAKING*		
	NORTHING	EASTING
VP 4	851397.352	2206807.065
VP 5	851490.799	2206883.023
VP 6	851676.983	2207162.190
VP 7	851762.012	2207247.787
VP 8	851785.047	2207270.754
VP 9	851703.252	2207233.458

*COORDINATES REPRESENT WESTERN-MOST CORNER OF PLOT

LEGEND

THALWEG 2008

BANKFULL 2008

VEGETATION PLOT

VEGETATION PLOT NOT MEETING SUCCESS REQUIREMENTS

BARE FLOODPLAIN

MICROSTEGIUM VIRMINEUM PRESENT

STRUCTURE TYPES

ROCK STRUCTURE

ROOTWAD

Ecosystem Enhancement PROGRAM

LOCATION: UT TO TAR RIVER
CURRENT CONDITIONS PLAN VIEW
VEGETATION ASSESSMENT - YEAR 3

PROJ #: 234	COUNTY: FRANKLIN
PREPARED BY: IPJ	
CHECKED BY: PDB	DATE: 2/10/09