REEDY BRANCH
2007 FINAL MONTORING REPORT
YEAR 3 OF 5
2007

EEP Project # 301
Alamance County, North Carolina

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Executive Summary

Reedy Branch is a typical stream within this and surrounding watersheds, exhibiting instability and degradation in response to current and historical land use practices. Reedy Branch is a tributary of Cane Creek in the Cape Fear River Basin. The project site is located off of Quakenbush Road near Snow Camp, NC. Cattle pasture and chicken production make up the farm surrounding the restoration site. The restored stream is enclosed in a moderately dense wooded area and contains large bedrock outcrops as well other sporadic occurrences of bedrock throughout the reach. The site is located in the Carolina Slate Belt, known for shallow soils and high run-off during storm events resulting in very "flashy" flows and streams that tend to dry out during the summer as was confirmed during Monitoring Year 3. The main goal of this restoration project was to improve water quality in the Cape Fear River basin. Overall, Reedy Branch covers approximately 3,155 linear feet of stream. The reach is moderately to highly sinuous. The construction phase of the project included the improvement of bank stability and in-stream feature morphology while saving as much native forest vegetation as possible and preserving or enhancing several small wetlands located adjacent to the channel.

Current monitoring for the site consists of evaluating both stream morphology and riparian vegetation. The stream monitoring included a longitudinal survey, cross section surveys, pebble counts, 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 and pebble counts, cross section surveys, the longitudinal profile, and the plan view features were compared between monitoring years to assess project performance.

The overall pattern, dimension, and profile apparently have remained stable through Monitoring Year 3. The channel bed substrate size distributions have remained fairly consistent through Monitoring Year 3, with a coarsening effect observed at the most downstream riffle cross section.

There were several problem areas noted along the reach. These areas included some bank erosion, aggradation, and several problems with arm scour, piping, or placement location/angle at crossvanes. Several of these crossvanes were rated severe. There were also several rootwads noted to be placed too high on the bank. Some of the aggradation areas were noted to be associated with pickerelweed growth. No bank erosion areas were considered severe, however many areas were located on the outside of meander bends, reducing the overall meander performance rating to 66%.

At the end of Monitoring Year 3, it may be concluded that bare root tree growth may be inhibited in some areas by the heavy prevalence of Japanese stilt grass (e.g. Vegetation Plots #7 and 8) with areas of concern at Vegetation Plots #9 and 10. These stem densities represent the 'identified planted material' as the inclusion of 'volunteer' species would result in an increase in the stem densities for these plots. Overall the average seedling density across the entire project is well above the Monitoring Year 5 goal of 260 stems per acre.

REEDY BRANCH STREAM RESTORATION
YEAR 3 MONITORING REPORT

CONDUCTED FOR:
NCDENR ECOSYSTEM ENHANCEMENT PROGRAM

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1.0 PROJECT BACKGROUND

1.1 Project Objectives

Reedy Branch is a typical stream within this and surrounding watersheds, exhibiting instability and degradation in response to current and historical land use practices. The main goal of this restoration project was to improve water quality in the Cape Fear River basin. The specific objectives of this project were to:

1. Improve water quality by reducing the sediment load generated by eroding banks and by restoring a riparian buffer;
2. Reestablish stable channel dimension, pattern, and profile;
3. Restore a functioning floodplain;
4. Enhance aquatic and terrestrial habitats in the stream corridor;
5. Assist the landowner to dedicate the entire floodplain as a wildlife area; and,
6. Provide at least one stable cattle crossing across the main channel.

1.2 Project Structure, Restoration Type, and Approach

Overall, Reedy Branch covers approximately 3,155 linear feet of stream. The reach is moderately to highly sinuous as it meanders through a valley length of approximately 2,550 feet. The construction phase of the project included the improvement of bank stability and in-stream feature morphology while saving as much native forest vegetation as possible and preserving or enhancing several small wetlands located adjacent to the channel. In some areas, minor changes to the proposed pattern were made to save large trees or avoid bedrock. The restoration involved construction of a smaller dimension and restoring a stable pattern. Crossvanes, single-arm weirs and existing bedrock all were used to control grade at the tops of riffles. Root wads were used to protect the outside of meander bends. To reduce bank height ratio, vertical banks were laid back to create a bankfull bench and establish a stable growing surface. The pattern of the creek also was adjusted to eliminated some overly-sharp meanders in the existing channel. The narrow confines of the valley required that the new channel cross the existing channel at several locations. These crossing points required clay channel plugs to prevent water from seeping into the old channel. After completion of the restoration, the cattle were fenced out of the entire floodplain. The floodplain was then placed under a conservation easement by the landowner. Since the creek bisects the Kiser farm, two cattle crossings were constructed across the restoration.

Table I. Project Mitigation Structure and Objectives Table

Reedy Branch/EEP Project Number 301				
Project Segment or Reach ID	**Mitigation Type**	**Approach**	**Linear Footage or Acreage Stationing**	**Comment**
Reedy Branch	Restoration	PII	3,155 linear feet	New channel construction.

Note: "P" in the Approach column refers to Priority Level.

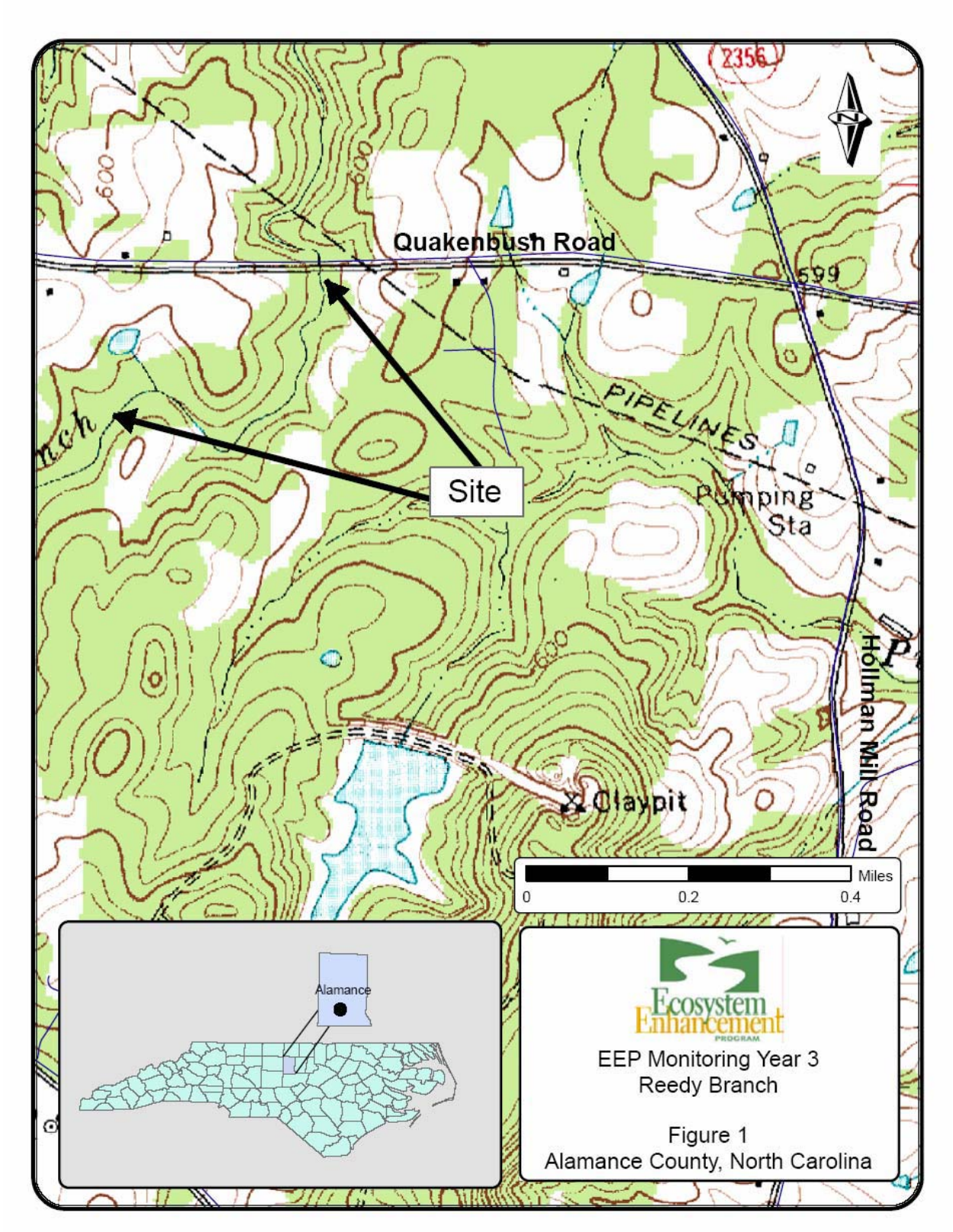
1.3 Project Location and Setting

This project is near Snow Camp, North Carolina in south-central Alamance County. To reach the site from Raleigh, go west on US 64 to Siler City. In Siler City, go north on Martin Luther King Boulevard; the North Carolina Atlas and Gazetteer (DeLorme 1997) labels the road as Snow Camp Road. Continue north toward the community of Snow Camp (approximately 12 miles). Before entering Snow Camp, take

a right on SR 2358 (Workman Rd). Continue on Workman Road approximately 1 mile then take a right on Quakenbush Road. Continue on Quakenbush Road for approximately 1½ miles to a small road crossing over Reedy Branch. The road crossing is at the downstream end of the project. Reedy Branch extends upstream (south) of Quakenbush Road. Figure 1 shows the location of Reedy Branch.

Reedy Branch is a tributary of Cane Creek in the Cape Fear River Basin. The Reedy Branch watershed above the restoration reach drains about 1.6 square miles. The creek starts about one-half mile south of the Alamance and Chatham County line and flows generally North to its confluence with Cane Creek, about 1.6 miles east of Snow Camp, NC. The watershed consists primarily of woodland and farmland. The agriculture in the watershed mainly consists of row crops and cattle grazing.

The project is located entirely on property owned by Sam and Deborah Kiser. Cattle pasture and chicken production make up the Kiser Farm surrounding the restoration site. There are four modern chicken houses within sight of the restoration reach with a population of about 500,000 birds. Some of the chicken litter is land applied to the pastures surrounding the restoration site, while some is trucked to nearby farms. The restored stream is enclosed in a moderately dense wooded area and contains large bedrock outcrops as well other sporadic occurrences of bedrock throughout the reach. The site is located in the Carolina Slate Belt, known for shallow soils and high run-off during storm events resulting in very "flashy" flows. The creeks in this region often dry up during the hot summer months. The Monitoring Year 1 performers reported that Reedy Branch had been essentially dry with only standing pools for the entire three years of drought that preceded the restoration. This trend was verified this summer during the most severe drought on North Carolina record, when the flow went subsurface along the entire project reach, with only a couple of standing pools.


2356
Quakenbush Road
599
600
PIPELINES
Site
Pumping Sta
Hollman Mill Road
Claypit
Miles
0
0.2
0.4
Alamance
Ecosystem Enhancement PROGRAM
EEP Monitoring Year 3
Reedy Branch
Figure 1
Alamance County, North Carolina

1.4 History and Background

Historically, cattle had access to all parts of the stream. This resulted in various negative impacts to the stream. The stream had steep banks with frequent erosion, completely trampled aquatic habitat, a heavily browsed riparian zone, several areas of pattern instability, and frequent debris jams.

Since completion of this project and fencing in of the floodplain and riparian buffer, cattle have been excluded from the stream the entire valley

Table II. Project Activity and Reporting History

Reedy Branch/EEP Project Number 301

Activity or Report	Scheduled Completion	Data Collection Complete	Actual Completion or Delivery
Restoration Plan			*
Final Design - 90%			*
Construction			November 1, 2003
Temporary S&E mix applied to entire project area			November 1, 2003
Permanent seed mix applied to entire project area			December 1, 2003
Vegetative Planting			January 1, 2003
Mitigation Plan/ As-built (Year 0 Monitoring - baseline)		February 2005	August 1, 2005
Repair Work			Fall 2004
Repair Work			May 1, 2005
Year 1 monitoring		May 2005	August 2005
Year 2 monitoring	December 2007	June 2006	December 2006
Year 3 monitoring	December 2007	November 2007	December 2007
Year 4 monitoring	December 2008		
Year 5 monitoring	December 2009		
Year 5+ monitoring			

"*" Information being acquired and provided by EEP and will be included in the 2008 monitoring report for the site

Table III. Project Contract Table	
Reedy Branch/EEP Project Number 301	
Designer Mark Taylor	EcoLogic 218-4 Swing Road Greensboro, NC 27409 336-335-1108
Construction Contractor	Phillips and Jordan, Inc. 8245 Chapel Hill Road Cary, NC 27513 919-388-4222
Planting Contractor	*
Seeding Contractor	*
2006 & 2007 Monitoring Performers Phillip Todd	SEPI Engineering Group 1025 Wade Avenue Raleigh, NC 27605 919-789-9977
Stream Monitoring POC	Ira Poplar-Jeffers
Vegetation Monitoring POC	Phil Beach
Wetland Monitoring POC	NA

* Information being acquired and provided by EEP and will be included in the 2008 monitoring report for the site.

Table IV. Project Background Table	
Reedy Branch/EEP Project Number 301	
Project County	Alamance
Drainage Area	1.6 square miles
Drainage impervious cover estimate (%)	10%
Stream Order	Second
Physiographic Region	Piedmont
Ecoregion	Carolina Slate Belt
Rosgen Classification of As-built	C5
Cowardin Classification	N/A
Dominant soil types	Herndon
Reference site ID	Unknown
USGS HUC for Project and Reference	03030002 Haw River
NCDWQ Sub-basin for Project and Reference	03-06-04
NCDWQ classification for Project and Reference	*
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	100%
% of project easement demarcated with bollards (if fencing absent)	N/A

* Information being acquired and provided by EEP and will be included in the 2008 monitoring report for the site.

2.0 PROJECT MONITORING METHODOLOGY

2.1 Vegetation Methodology

The following methodology was used for the stem count. The configuration of the vegetation plots was marked out with tape to measure 10 meters by 10 meters (or equivalent to 100 square meters) depending on buffer width. The planted material in the plot was marked with flagging. The targeted vegetation was then identified by species, and a tally of each species was kept and recorded in a field book.

2.2 Stream Methodology

The project monitoring for the stream channel included a longitudinal survey, cross-sectional surveys, pebble counts, problem area identification, and photo documentation. These measurements were taken at each reach. The stationing was based on thalweg. The methodology for each portion of the stream monitoring is described in detail below.

2.2.1 Longitudinal Profile and Plan View

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, the 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 calculated from this survey, including channel and valley length and length of each feature, water surface slope for the reach and each pool and riffle, bankfull slope, and pool spacing. This survey also was used to draw plan view figures with Microstation v8 (Bentley Systems, Inc., Exton, PA), and all pattern measurements (i.e. meander length, radius of curvature, belt width, meander width ratio, and sinuosity) were measured from the plan view. Stationing was calculated along the thalweg.

2.2.2 Permanent Cross Sections

Six permanent cross sections (four riffles and two pools) were surveyed. The beginning and end of each permanent cross section were originally marked with a wooden stake and metal conduit. Cross sections were installed perpendicular to the stream flow. Each survey noted all changes in slope, tops of both banks, 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 Monitoring Year 1 and 2 data for comparison. 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 calculated from these plots and compared to the Monitoring Year 1 data.

2.2.3 Pebble Counts

A modified Wolman pebble count (Rosgen 1994), consisting of 50 samples, was conducted at each permanent cross section. The cumulative percentages were graphed, and the D50 and D84 particle sizes were calculated and compared to Monitoring Year 1 and 2 data.

2.3 Photo Documentation

Permanent photo points were established during Monitoring Year 1. A set of three photographs (facing upstream, facing downstream, and facing the channel) were taken at each photo point with a digital camera. Two photographs were taken at each cross-section (facing upstream and downstream). 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 2 photograph. An arrow was placed on the designated corner of each vegetation plot on the plan view sheets to document the corner and direction of each photograph. Photos were also taken of all significant stream and vegetation problem areas.

3.0 PROJECT CONDITION AND MONITORING RESULTS

3.1 Vegetation Assessment

3.1.1 Soils Data

Table V. Preliminary Soil Data

Series	Max Depth (in.)	% Clay on Surface	K	T	OM %
Herndon (HdB2)	68	5.0 - 27.0	0.48	*	0.5 - 1.0
Herndon (HeC3)	68	27.0 - 35.0	0.35	*	0.0 - 0.5
Herndon (HdC2)	68	5.0 - 27.0	0.48	*	0.5 - 1.0
Mixed alluvial (Mc)	<<<< High variability of data >>>>				

* This information was not available from the Natural Resources Conservation Service (NRCS).

3.1.2 Vegetative Problem Area Plan View

There is good herbaceous vegetation growth along all of the monitored stream reach. Japanese stilt grass (*Microstegium vimineum*) has established along the entire stream reach with limited areas where it does not dominate. The vegetation problem area plan view sheets (Appendix C) show the location of the vegetation plots and areas not dominated by Japanese grass.

Table VI. Vegetative Problem Areas

Feature/Issue	Station # / Range	Probable Cause	Photo #
Invasive/Exotic Populations	entire stream reach	Japanese stilt grass (*Microstegium vimineum*); likely remnant from pre-construction	1

3.1.3 Stem Counts

Overall, the project has decent stem densities, especially with the inclusion of 'volunteer' species noted in the plot count table of Appendix A. The stem density goal at Monitoring Year 5 is 260 trees/acre. Vegetation Plot #6 is at 280 trees/acre at Monitoring Year 3 for 'identified planted material' with four other plots having stem densities below 260 stems/acre at Monitoring Year 5. These vegetation plots are #7, 8, 9 and 10. With the inclusion of 'volunteer' species noted in the plot count table of Appendix A, the

stems/acre density would not be so 'low'. The vegetative plots are shown on the vegetation problem area plan view in Appendix C.

It should be noted that there were several species for which several-to-many additional stems were counted within a given plot relative to the Monitoring Year 2 count. These additional stems were assumed to be volunteers and were not included in the survival calculations. The species were *Carpinus caroliniana* (VP #1, 3 through 5, 11, and 12), *Platanus occidentalis* (VP #5 and 10), *Quercus alba* (VP #2 and 3), *Quercus phellos* (VP #3 and 5), and Ulmus alata (VP #4). In addition, the following species were found in plots but were assumed to be volunteers because they were apparently not found during Monitoring Year 2: *Liquidambar styraciflua* (all plots), *Fagus grandifolia* (Plot 2), *Salix nigra* (Plot 2), *Quercus phellos* (Plot 2), *Quercus nigra* (Plot 3), *Myrica cerifera* (Plots 4, 5, 6, 7, 8, and 9), *Pinus taeda* (Plots 6, 7, 9, 10, and 12), *Rhus copallina* (Plot 7), *Quercus alba* (Plot 7), *Ulmus alata* (Plot 8), *Liriodendron tulipifera* (Plot 10), *and Acer saccharum* (Plot 3).

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 VIII. Verification of Bankfull Events - Reedy Branch			
Date of Data Collection	**Date of Occurrence**	**Method**	**Photo # (if available)**
2005	2005	Several bankfull events resulting from hurricanes noted in Monitoring Year 1 report.	
8/8/2006	Unknown	Crest Stage Gauge measurement of approximately 2" on stick (bottom of stick at bkf)	
1/11/2007	Unknown	Crest Stage Gauge measurement of approximately 6" on stick (bottom of stick at bkf)	
6/4/2007	6/3/2007 – 6/4/2007	According to NOAA National Weather Service daily climate data, approximately 1.45" of precipitation fell over the listed two day period. 1" of this fell on 6/3. An additional 0.4" fell on 6/5/2007. It was assumed, but not confirmed, that this event resulted in a bankfull flow.	No Photo.
7/16/2007	7/12 & 7/13/2007	Phone conversation with landowner (Mr. Sam Kiser).	

3.2.1 Longitudinal Profile and Plan View

The overall water surface slope has remained consistent since Monitoring Year 1. Riffle length, riffle slope, pool length, and pool spacing have all remained consistent since Monitoring Year 1 with some slight variation observed between Monitoring Years that can probably be attributed to slight differences in survey calls (i.e. human error) during the longitudinal survey. The Monitoring Year 3 thalweg profile appears consistent with Monitoring Year 2 with a some small areas of apparent downcutting or aggradation. However, it appears that several more points were taken during the Monitoring Year 3 survey. This result can probably account for most of the differences observed in the longitudinal profile overlay. In addition, all pattern parameters remain consistent indicating that the stream pattern remained stable since Monitoring Year 2. The plan view overlay remain consistent between monitoring years. The longitudinal profile is found in Appendix and problem area plan views are shown in Appendix C.

3.2.2 Permanent Cross Sections

From a review of the cross-sectional survey data between Monitoring Years 1, 2, and 3, it can be concluded that channel dimension has not changed significantly at any cross section. No cross sections were closely associated with any stream problem area. The channel dimension of the project has essentially remained stable since Monitoring Year 1.

3.2.3 Pebble Counts

The pebble size class distribution plots show that the stream bed substrate has remained consistent at all cross sections since Monitoring Year 1 with the exception of the substrate at cross section #5. This cross section appears to have experienced a slight fining since Monitoring Year 1. However, this fining is not of any major concern because cross section #5 is located over a pool (i.e., depositional) feature. In contrast, one of the riffle pebble counts at the bottom end of the reach (cross section #6) displayed a coarsening of bed material, a result consistent with the reduction of fine sediment inputs (an objective of this restoration project).

One trend noticed in the distribution plots for the pebble counts of cross section #1 and cross section #5 was that the bed material apparently experienced an influx of finer sediments in Monitoring Year 2 and a coarsening back to near Monitoring Year 1 conditions in Monitoring Year 3. This observation may be accounted for by human error during Monitoring Year 2 counts, or there could have been a storm event that deposited fine sediments during Monitoring Year 2, and those sediments were subsequently flushed downstream during Monitoring Year 3.

3.2.4 Stream Problem Areas

Various areas of aggradation and bank erosion were noted during the problem area inspection. None of these areas were considered of severe status, and erosion and aggradation were limited to a total length of 223 and 293 feet, respectively. However, many erosion areas were located on the outside of meanders, reducing the meander performance rating to 66% (Table XI). It should also be noted that several of the aggradation areas were observed to have pickerelweed (*Pontederia cordata*) growing in the channel.

There were several problems with in-stream structures. Several crossvanes had significant structural problems or were apparently placed incorrectly to adequately dissipate sheer stress on the bank, resulting in nearby bank erosion. The most severe of these areas were at a crossvane (Station 29+88) where the bulk of the stream flow was piping around the left side, and a crossvane 9 (Station 33+08) that has experienced significant back arm scour along the right side. Several rocks of this structure (i.e., crossvane at Station 33+08) have shifted, leaving exposed matting and piping under and around several parts of the structure. In addition, there are several rootwads (e.g., Station 26+55) that appear to have been installed too high on the bank, and several debris jams (e.g., Station 34+73) were noted along the reach that may be of some concern.

The list of stream problem areas is located in Appendix B. The problem area plan view sheets are located in Appendix C.

Table XI. Categorical Stream Feature Visual Stability Assessment

Reedy Branch (EEP Project No. 301)

Feature	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
A. Riffles	Unknown	Unknown	66%	71%		
B. Pools			85%	85%		
C. Thalweg			88%	93%		
D. Meanders			61%	66%		
E. Bed General			96%	95%		
F. Bank Condition			95%	96%		
G. Vanes / J Hooks etc.			74%	91%		
H. Wads and Boulders			80%	90%		

3.3 Photo Documentation

Photos taken of the vegetation problem areas and photos of the vegetation plots are in Appendix A. Stream problem area photographs are provided in Appendix B. The photographs taken at the marked photo point locations and at the cross-sections are provided in Appendix B.

4.0 RECOMMENDATIONS AND CONCLUSIONS

The overall pattern, dimension, and profile apparently have remained stable through Monitoring Year 3. The channel bed substrate size distributions have remained fairly consistent through Monitoring Year 3, with a coarsening effect observed at the most downstream riffle cross section.

There were several problem areas noted along the reach. These areas included some bank erosion, aggradation, and several problems with arm scour, piping, or placement location/angle at crossvanes. Several of these crossvanes were rated severe. There were also several rootwads noted to be placed too high on the bank. Some of the aggradation areas were noted to be associated with pickerelweed growth.

No bank erosion areas were considered severe, however many areas were located on the outside of meander bends, reducing the overall meander performance rating to 66%.

At the end of Monitoring Year 3, it may be concluded that bare root tree growth may be inhibited in some areas by the heavy prevalence of Japanese stilt grass (e.g. Vegetation Plots #7 and 8) with areas of concern at Vegetation Plots #9 and 10. These stem densities represent the 'identified planted material' as the inclusion of 'volunteer' species would result in an increase in the stem densities for these plots. Overall the average seedling density across the entire project is well above the Monitoring Year 5 goal of 260 stems per acre.

REFERENCES

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Appendix A1

Photolog - Vegetation Problem Areas

APPENDIX A1
PHOTOLOG – REEDY BRANCH

PROBLEM AREAS (Vegetation)

Photo 1. Representative Japanese grass (*Microstegium viminium*) infestation (Vegetation Plot 9). Japanese grass is growing in the lower right-hand quadrant of the picture. Note how other vegetation has been suppressed where the Japanese grass has taken over.

Appendix A2

Photolog - Vegetation Plots

APPENDIX A2
PHOTOLOG REEDY BRANCH

VEGETATION PLOTS


Photo 1: Vegetation Plot 1.


Photo 2: Vegetation Plot 2.


Photo 3: Vegetation Plot 3.


Photo 4: Vegetation Plot 4.


Photo 5: Vegetation Plot 5.


Photo 6: Vegetation Plot 6.


Photo 7: Vegetation Plot 7.


Photo 8: Vegetation Plot 8.


Photo 9: Vegetation Plot 9.


Photo 10: Vegetation Plot 10.


Photo 11: Vegetation Plot 11.


Photo 12: Vegetation Plot 12.

Appendix A3

Vegetation Data Tables

Table VII. Stem counts for each species arranged by plot for Reedy Branch															
Species	**Plots**												**Year 2 Totals**	**Year 3 Totals**	**Survival %**
	1	2	3	4	5	6	7	8	9	10	11	12			
Shrubs															
Cornus ammomum	1												1 (LS 1)	1 (LS 1)	100%
Trees															
Betula nigra													2	0	0%
Carpinus caroliniana	30	8	18	6	6	3	1	2	1	1	1	3	84	80	95%
Carya tomentosa		2											5	2	40%
Diospyros virginiana											1		4	1	25%
Juglans nigra					2				1				7	3	43%
Platanus occidentalis	1		3	2	4	3	2	1	12	5	3	5	46	41	89%
Salix nigra		1	2								1		21 (LS 2)	4	17%
Sambucus canandensis													1	0	0%
Quercus alba		6	2										9	8	89%
Quercus michauxii		1		1			2		2			2	10	8	80%
Quercus phellos			10	1	1								13	12	92%
Quercus sp.						1							1	1	100%
Rhus copallina													1	0	0%
Ulmus alata				1									1	1	100%
Total including live stake	32	18	35	11	13	7	5	3	16	6	6	10	278	162	58%
Stems per acre	1280	720	1400	440	520	280	200	120	640	240	240	400	927	540	
Total excluding live stake	31	18	35	11	13	7	5	3	16	6	6	10	275	161	59%
Stems per acre	1240	720	1400	440	520	280	200	120	640	240	240	400	917	537	

Appendix B1

Photolog – Stream Problem Areas

APPENDIX B1
PHOTOLOG Reedy Creek

PROBLEM AREAS

Photo 1: Representative grass aggradation problem area (Station 30+11 along plan view).

Photo 2: Representative grass and pickerelweed aggradation problem area (Station 26+98 along plan view).

Photo 3: Representative bank erosion problem area (Station 35+98 along plan view).

Photo 4: Representative undercut problem area (Station 30+82 along plan view).

Photo 5: Representative problem crossvane (Station 29+88 along plan view).

Photo 6: Representative problem rootwad (Station 11+62 along plan view).

Photo 7: Representative debris jam (Station 34+73 along plan view).

Photo 8: Representative debris jam (35+88 along plan view), scour caused by debris jam (Station 35+98), and resultant aggradation from scour-associated sediment deposition (Station 35+98).

Appendix B2

Photolog – Cross-Sections & Photo Points

APPENDIX B2
PHOTOLOG – REEDY BRANCH

CROSS-SECTIONS & PHOTOPOINTS


Cross-Section 1: Looking Downstream


Cross-Section 1: Looking Upstream


Cross-Section 2: Looking Downstream


Cross-Section 2: Looking Upstream


Cross-Section 3: Looking Downstream


Cross-Section 3: Looking Upstream

Cross-Section 4: Looking Downstream

Cross-Section 4: Looking Upstream

No photograph available.

Cross-Section 5: Looking Downstream

No photograph available.

Cross-Section 5: Looking Upstream

Cross-Section 6: Looking Downstream

Cross-Section 6: Looking Upstream


Photo point 1


Photo point 2


Photo point 3


Photo point 4


Photo point 5


Photo point 6


Photo point 7


Photo point 8


Photo point 9


Photo point 10


Photo point 11


Photo point 12


Photo point 13


Photo point 14


Photo point 15


Photo point 16


Photo point 17


Photo point 18


Photo point 19


Photo point 20


Photo point 21


Photo point 22


Photo point 23


Photo point 24


Photo point 25


Photo point 26


Photo point 27


Photo point 28


Photo point 29


Photo point 30


Photo point 31


Photo point 32


Photo point 33


Photo point 34


Photo point 35


Photo point 36

Photo point 37

Appendix B3

Stream Data Tables

Table B2. Visual Morphological Stability Assessment Reedy Branch						
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	21	21	NA	100%	
	2. Armor stable	13	21	NA	62%	
	3. Facet grade appears stable	13	21	NA	62%	
	4. Minimal evidence of embedding/fining	13	21	NA	62%	
	5. Length appropriate	15	21	NA	71%	**71%**
B. Pools	1. Present	24	24	NA	100%	
	2. Sufficiently deep	24	24	NA	100%	
	3. Length appropriate	13	24	NA	54%	**85%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering	14	14	NA	100%	
	2. Downstream of meander (glide/inflection) centering	12	14	NA	86%	**93%**
D. Meanders	1. Outer bend in state of limited/controlled erosion	20	29	NA	69%	
	2. Of those eroding, # w/concomitant point bar formation	0	9	NA	0%	
	3. Apparent Rc within specifications*	28	29	NA	97%	
	4. Sufficient floodplain access and relief	29	29	NA	100%	**66%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	NA	NA	15/293	91%	
	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	14/223	96%	**96%**
G. Vanes / J Hooks	1. Free of back or arm scour	21	23	NA	91%	
	2. Height appropriate	23	23	NA	100%	
	3. Angle and geometry appear appropriate	20	23	NA	87%	
	4. Free of piping or other structural failures	20	23	NA	87%	**91%**
H. Wads and Boulders	1. Free of scour	28	30	NA	93%	
	2. Footing stable	26	30	NA	87%	**90%**

*The range of Rc values from the as-built did not make sense for the project. So the range from Monitoring Year 2 was used for comparison.

Table XII Baseline Morphology and Hydraulic Summary

Reedy Branch (EEP Project No. 301)

Parameter	USGS Gage Data			Regional Curve Interval			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)																18.9	26.1	18.9
Floodprone Width (ft)																80	100	90
BF Cross Sectional Area (ft)																21.9	23.2	21.9
BF Mean Depth (ft)																0.9	1.2	1.16
Max Depth (ft)																2.1	2.7	2.7
Width/Depth Ratio																16.3	29.3	16.3
Entrenchment Ratio																3.1	5.3	4.8
Bank Heigh Ratio																n/a	n/a	n/a
Wetted Perimeter (ft)																19.9	46.5	31.1
Hydraulic Radius (ft)																0.9	1.4	1.1
Pattern																		
Channel Belthwidth (ft)																37	170	81
Radius of Curvature (ft)																10.9	24	17.1
Meander Wavelength (ft)																60	280	128
Meader Width Ratio																2	9	4.3
Profile																		
Riffle Length																7	35	16
Riffle Slope (ft/ft)																0.0011	0.0410	0.0100
Pool Length (ft)																16	41	29
Pool Spacing (ft)																29	150	59
Substrate																		
d50 (mm)																n/a	n/a	0.8
d84 (mm)																n/a	n/a	6.5
Additional Reach Parameters																		
Valley Length (ft)																n/a	n/a	2990
Channel Length (ft)																n/a	n/a	3090
Sinuosity																n/a	n/a	1.35
Water Surface Slope (ft/ft)																n/a	n/a	0.0033
BF Slope (ft/ft)																n/a	n/a	0.0031
Rosgen Classification																n/a	n/a	C5
*Habitat Index																n/a	n/a	n/a
*Macrobenthos																n/a	n/a	n/a

Table XIII. Morphology and Hydraulic Monitoring Summary

Reedy Branch

Segment/Reach: Reedy Branch (EEP Project No. 301)

Parameter	Cross Section 1 Riffle						Cross Section 2 Pool						Cross Section 3 Riffle						Cross Section 4 Riffle						Cross Section 5 Pool						Cross Section 6 Riffle					
Dimension	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
BF Width (ft)	26.1	21.9	22.8					24.4	23.0					16.6	16.2				18.9	20.8	18.8				44.8	17.9	17.5					22.4	20.9			
Floodporne Width (ft)	80	88+	88+					NA	NA					59+	59+				100	85+	85+				NA	NA	NA					46+	46+			
BFCross Sectional Area (ft)	23.2	24.7	23.2					44.5	40.3					18.5	18.0				21.9	25.4	25.0				63	37.8	38.4					31.2	27.9			
BF Mean Depth (ft)	0.9	1.1	1.0					1.8	1.7					1.1	1.1				1.2	1.2	1.3				1.4	2.1	2.2					1.4	1.3			
Width/Depth Ratio	29.3	19.5	22.5					NA	NA					14.8	14.6				16.3	17	14.1				NA	NA	NA					16.1	15.7			
Entrenchment Ratio	3.1	4.0+	3.9+					NA	NA					3.6+	3.6+				5.3	4.0+	4.5+				NA	NA	NA					2.1+	2.2+			
Bank Height Ratio	1.0	1.0	1.0					NA	NA					1.0	1.0				1.0	1.0	1.0				NA	NA	NA					1.0	1.1			
Wetted Perimeter (ft)	27.0	24.3	23.9					26.5	24.5					23.7	17.3				19.9	38.3	20.0				46.5	21.3	20.1					25.5	22.2			
Hydraulic radius (ft)	0.9	1.1	1.0					1.7	1.6					0.8	1.0				1.1	0.7	1.3				1.4	1.8	1.9					1.2	1.3			
Substrate																																				
d50 (mm)	1	0.11	1.2					0.1	0.2					0.085	0.08				1.7	0.12	0.06				0.4	0.06	1.6					0.2	1.7			
d84 (mm)	17	6.5	20					0.35	0.95					0.22	0.12				11	0.9	1.95				9	1.8	1.1					32	27			

Parameter	MY-01 (2005)			MY-02 (2006)			MY-03 (2007)			MY-04 (2008)			MY-05 (2005)			MY+ (2009)		
Pattern	Min	Max	Med	Min	Max	Med*	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	37.0	170.0	80.9	13.7	165.2	44.3	25.6	173.8	48.4									
Radius of Curvature (ft)	10.9	24.0	17.1	18.4	106.0	40.3	17.6	122.8	39.9									
Meander Wavelenght (ft)	60.0	280.0	128.0	80.5	273.0	156.0	75.2	299.2	143.8									
Meander Width Ratio	2.0	9.0	4.3	0.6	7.5	2.0	1.2	8.1	2.3									
Profile																		
Riffle length (ft)	8	38	17	2.6	93.5	11.6	2.8	97.6	21.2									
Riffle slope (ft/ft)	0.0011	0.05	0.015	0.000	0.054	0.025	0.000	0.053	0.014									
Pool length (ft)	16	40	29	3.9	155.3	44.4	9.8	139.1	36.7									
Pool spacing (ft)	27	152	59	9.1	744.9	64.7	15.4	195.7	64.9									
Additional Reach Parameters																		
Valley Length (ft)	2290			2550			2390											
Channel Length (ft)	3090			3096			3130											
Sinuosity	1.35			1.21			1.31											
Water Surface Slope (ft/ft)	0.0036			0.0036			0.0036											
BF slope (ft/ft)	0.0051			0.0033			0.0032											
Rosgen Classification	C5			C5			C5											
Habitat Index	NA			NA			NA											
Macrobenthos	NA			NA			NA											

*Values reported as means in the Monitoring Year 2 report. These have been changed to reflect the median values in the Monitoring Year 3 report.

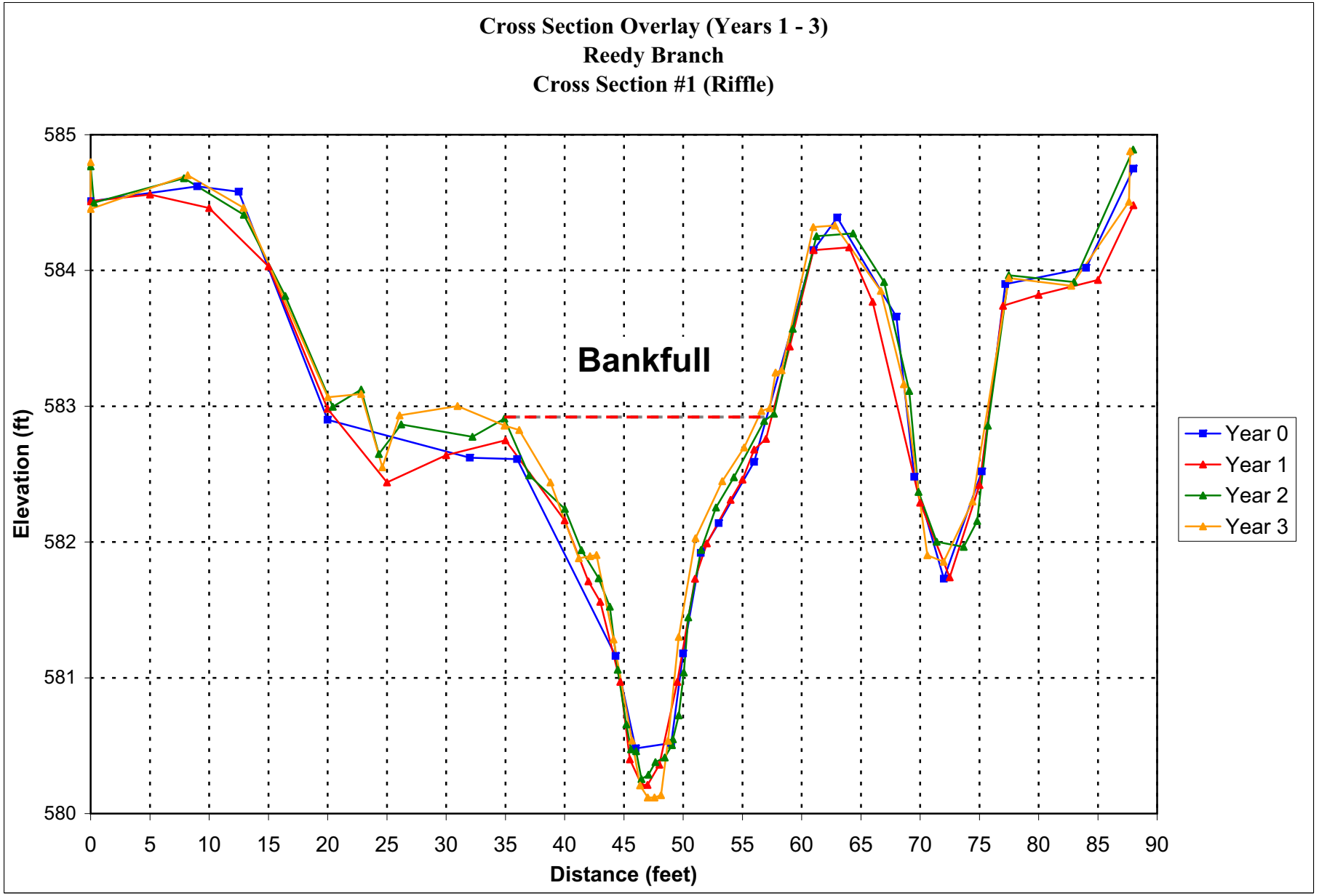
Table X. Stream Problem Areas

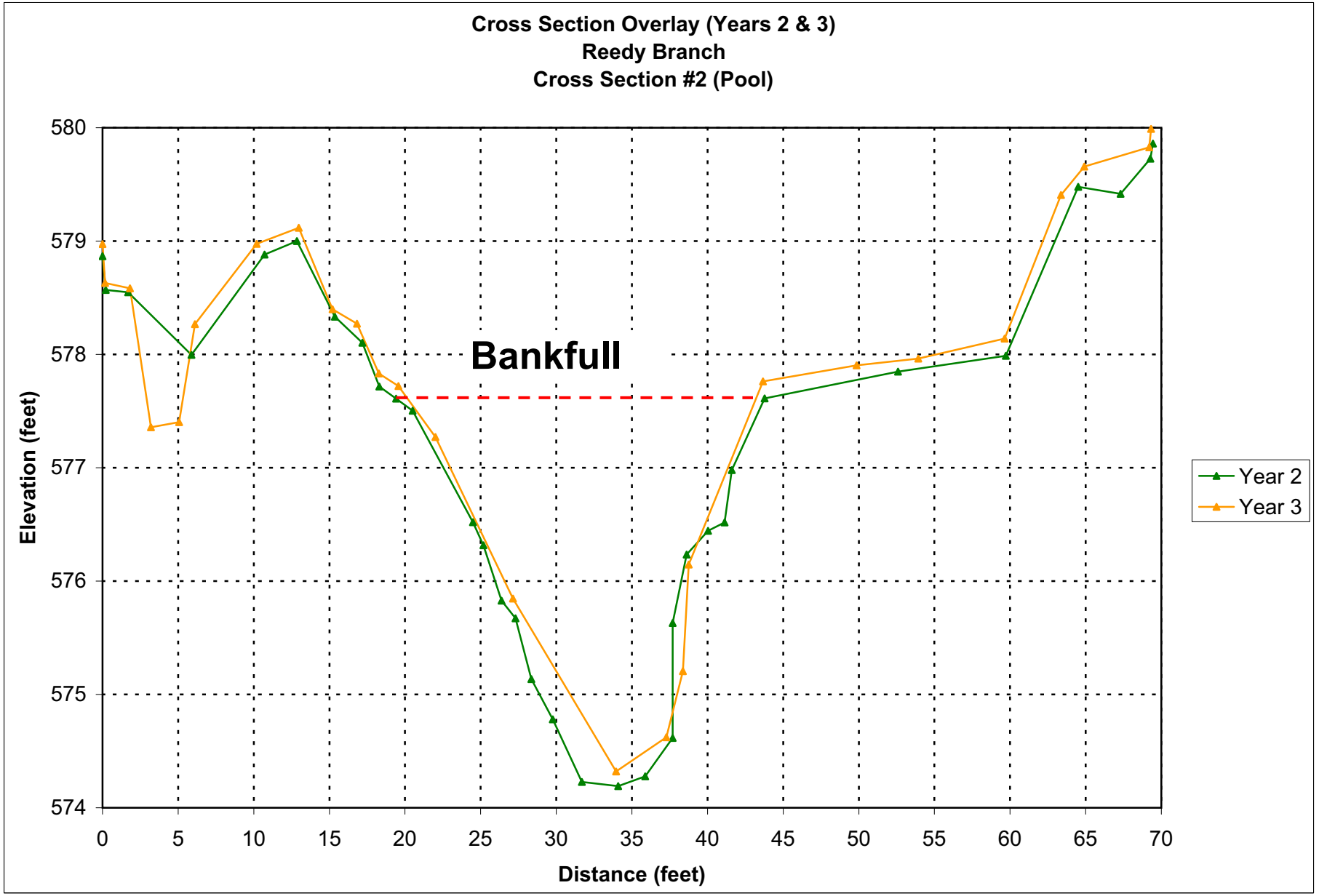
Reedy Branch (EEP Project #301)

Feature Issue	Station numbers	Suspected Cause	Photo number
Aggradation (grass)	10+36 10+59	Channel built too wide; narrowing to a stable dimension.	
Crossvane	10+86	Minor piping around structure.	
Rootwad	11+62	Possibly placed too high.	6
Aggradation (pickerelweed)	13+66 13+78	Pickerelweed observed in channel; associated with sediment aggradation.	
Aggradation (grass)	18+50 18+72	Channel built too wide; narrowing to a stable dimension.	
Bank Erosion (left)	19+57 19+71	Almost completely healed; large tree anchoring bank.	
Aggradation (grass)	19+97 20+40	Channel built too wide; narrowing to a stable dimension. Grass spanning channel.	
Bank Erosion (left)	20+73 20+90	Inadequate bank protection; soil stability characteristics.	
Bank Erosion (right)	20+73 20+83	Inadequate bank protection; soil stability characteristics.	
Rootwad	20+93	Angle or placement location is possible cause of erosion of both banks just upstream.	
Bank Erosion (right)	21+50 21+83	High flow have washed the outside of the meander bend leaving exposed matting and spots of bare soil.	
Aggradation (grass)	22+23 22+39	Channel built too wide; narrowing to a stable dimension.	
Aggradation (grass & cattail)	22+94 23+02	Channel built too wide; narrowing to a stable dimension. Cattails observed growing in channel in addition to grass.	
Bank Erosion (right)	23+55 23+74	Lack of rooted protection or soil stability characteristics. Matting is exposed and somewhat undercut.	
Debris Jam	23+97	Debris caught by barbed wire fence on downstream end of the cattle crossing. This has caused some damage to the fencing.	
Bank Erosion (left)	24+44 24+50	Bank just upstream of rock vane has inadequate protection during high flows and has been stripped of most vegetation.	
Rock Vane	24+47	Placed too far along the meander to protect the eroding bank on the upstream end of this structure.	
Rootwads (2 count)	24+75 24+80	Possibly placed too high.	
Aggradation (grass)	25+03 25+24	Channel built too wide; narrowing to a stable dimension.	
Undercut Bank (right)	25+34 25+66	Evidence of past erosion/undercutting; but healing over well with grass cover.	
Aggradation (grass)	26+12 26+24	Channel built too wide; narrowing to a stable dimension.	
Bank Erosion (left)	26+37 26+48	Bank protected well by large tree, but roots of tree apparently have been scoured/undercut during high flows.	
Rootwad	26+55	Possibly placed too high or too far downstream to protect eroding bank.	
Aggradation (grass/ pickerelweed)	26+98 27+44	Fine sediment aggradation observed with pickerelweed and grass spanning channel.	2
Aggradation (pickerelweed)	27+59 27+66	Fine sediment aggradation observed with pickerelweed spanning channel.	
Aggradation (pickerelweed)	27+96 28+01	Fine sediment aggradation observed with pickerelweed spanning channel.	
Debris Jam	28+51	Tree (DBH approximately 20") fell into channel to cause jam.	
Bank Erosion (right)	29+21 29+32	Inadequate bank protection on outside of meander at high flows.	
Bank Erosion (left)	29+72 29+86	Lack of vegetation; some bare soil present but healing over.	
Crossvane (severe)	29+88	The bulk of the flow is piping around/under the large rock on the left side of the structure.	5
Aggradation (grass)	30+11 30+28	Channel built too wide; narrowing to a stable dimension. Grass spanning channel.	1
Undercut Bank (right)	30+82 30+97	Back eddy from tree anchored in the bank, soil stability.	4
Undercut Bank (left)	30+84 30+98	Soil stability or lack of protective vegetation.	
Crossvane	33+08	Significatnt back arm scour on right side of structure. Some rocks appear to have come loose, leaving exposed matting.	
Debris Jam	34+73	Tree (DBH approximately 25") fell into channel to cause jam.	7
Debris Jam	35+88	Tree in channel and vines remaining attached to cause jam.	8
Bank Erosion (left)	35+98 36+09	Piping around debris jam caused bank scour on outside of meander.	8
Aggradation (grass)	35+98 36+15	Resultant sediment deposition from adjacent bank erosion.	8
Aggradation (cattails/ pickerelweed)	37+53 37+75	Fine sediment aggradation observed with pickerelweed in channel.	
Aggradation (grass/ pickerelweed)	38+81 39+03	Fine sediment aggradation observed with grass and pickerelweed in channel.	
Crossvane	39+75	Angle or placement location is possible cause of erosion of both banks just downstream.	
Bank Erosion (right)	40+07 40+30	Minor scour; healing over.	
Bank Erosion (left)	40+11 40+28	Minor scour; healing over.	
Bank Erosion (left)	40+97 41+20	Past bank sloughing. Appears to be good vegetative protection. Perhaps the erosion was a post-construction adjustment now healing over.	
Bank Erosion (right)	41+04 41+18	Past bank sloughing. Appears to be good vegetative protection. Perhaps the erosion was a post-construction adjustment now healing over.	

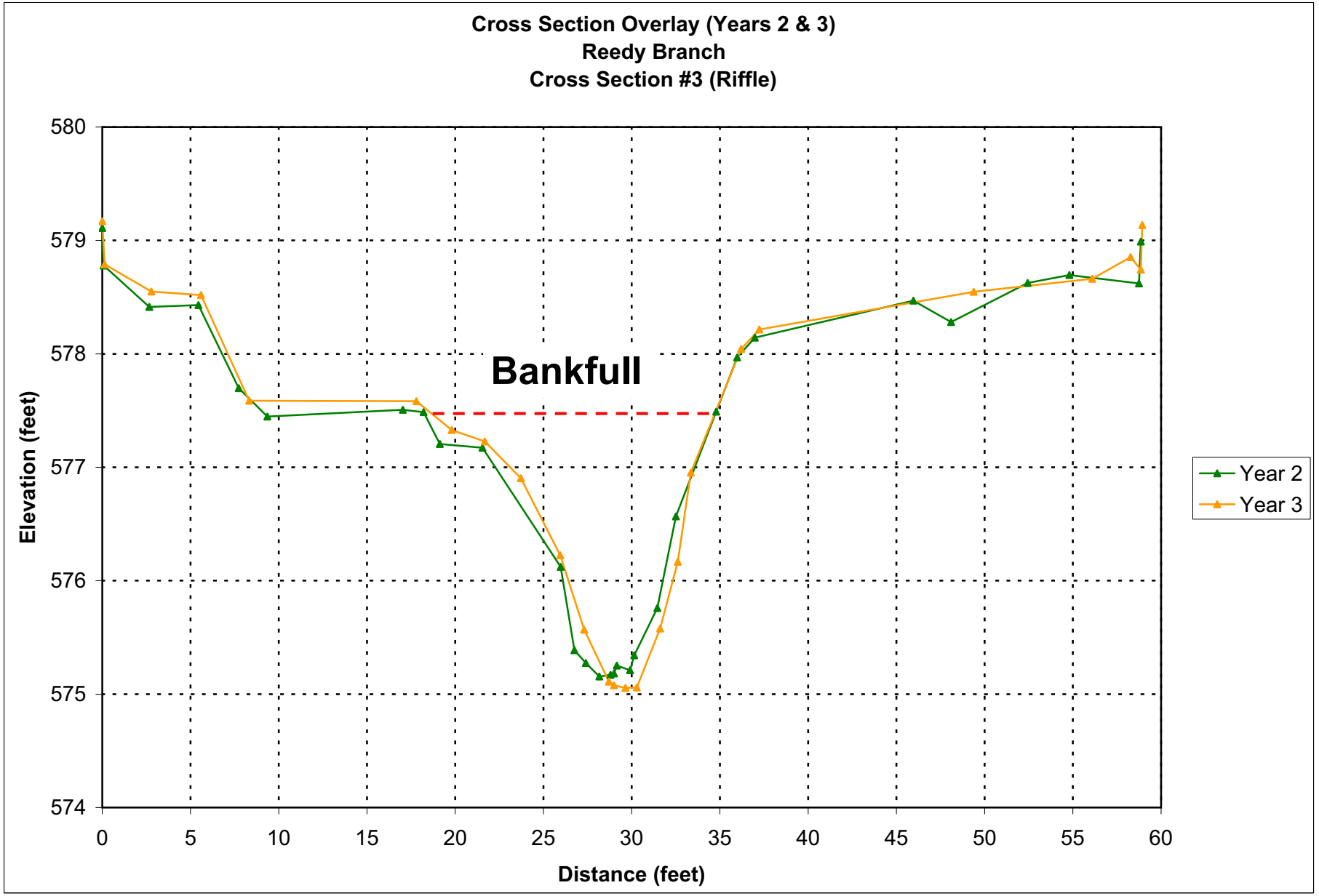
Appendix B4

Stream Cross-Sections

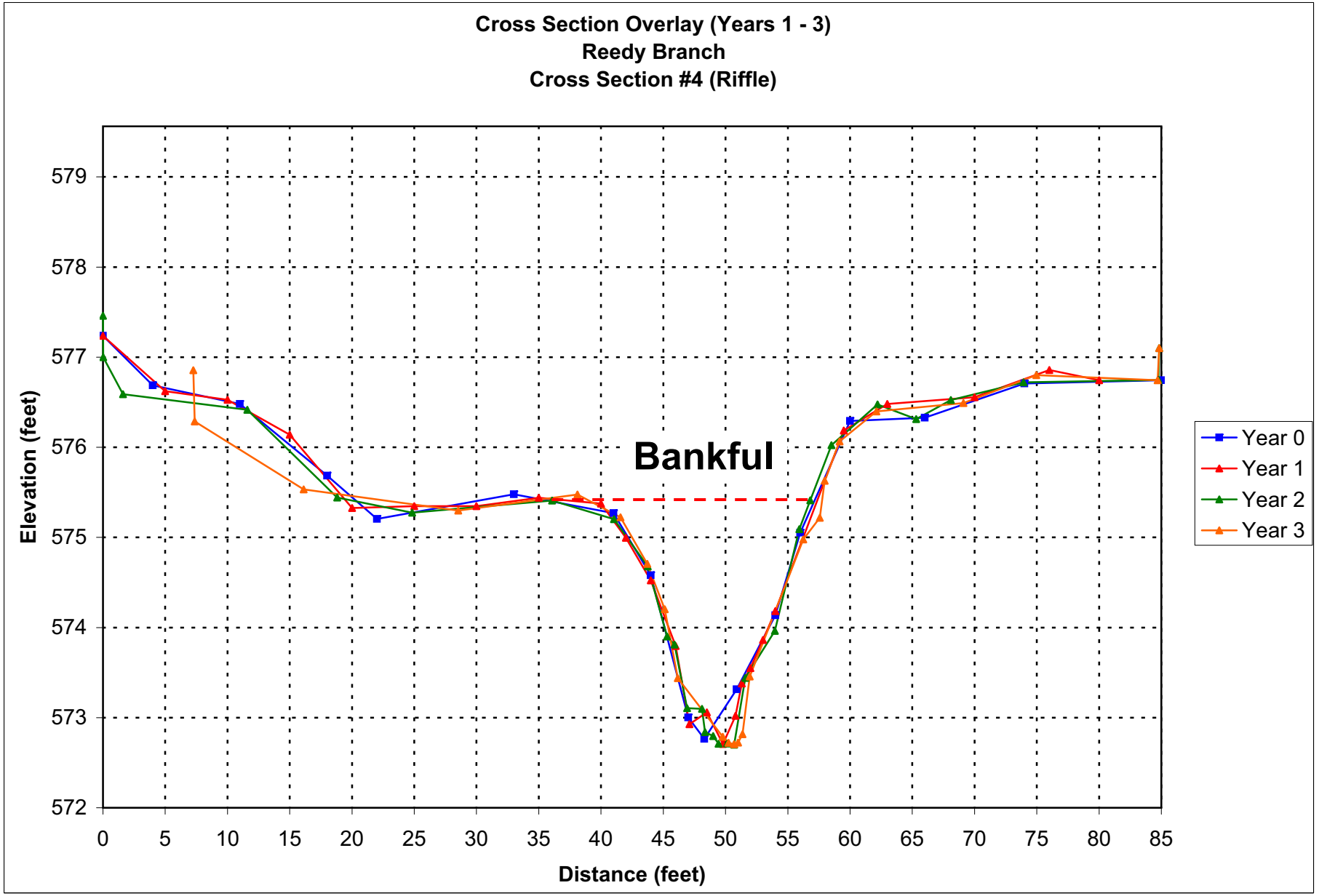

Cross Section Overlay (Years 1 - 3)
Reedy Branch
Cross Section #1 (Riffle)
Bankfull
Elevation (ft)
585
584
583
582
581
580
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
Distance (feet)
Year 0
Year 1
Year 2
Year 3

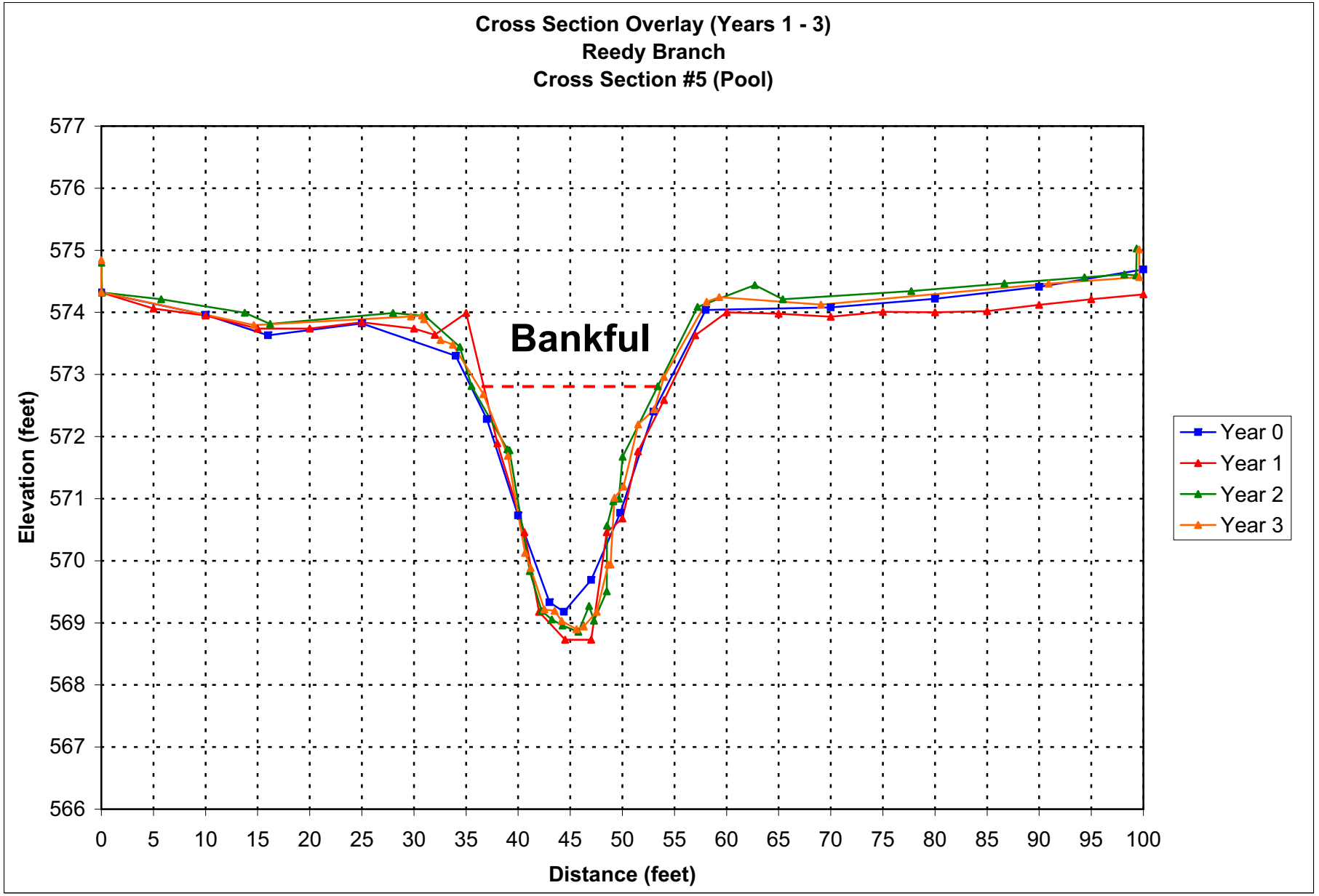


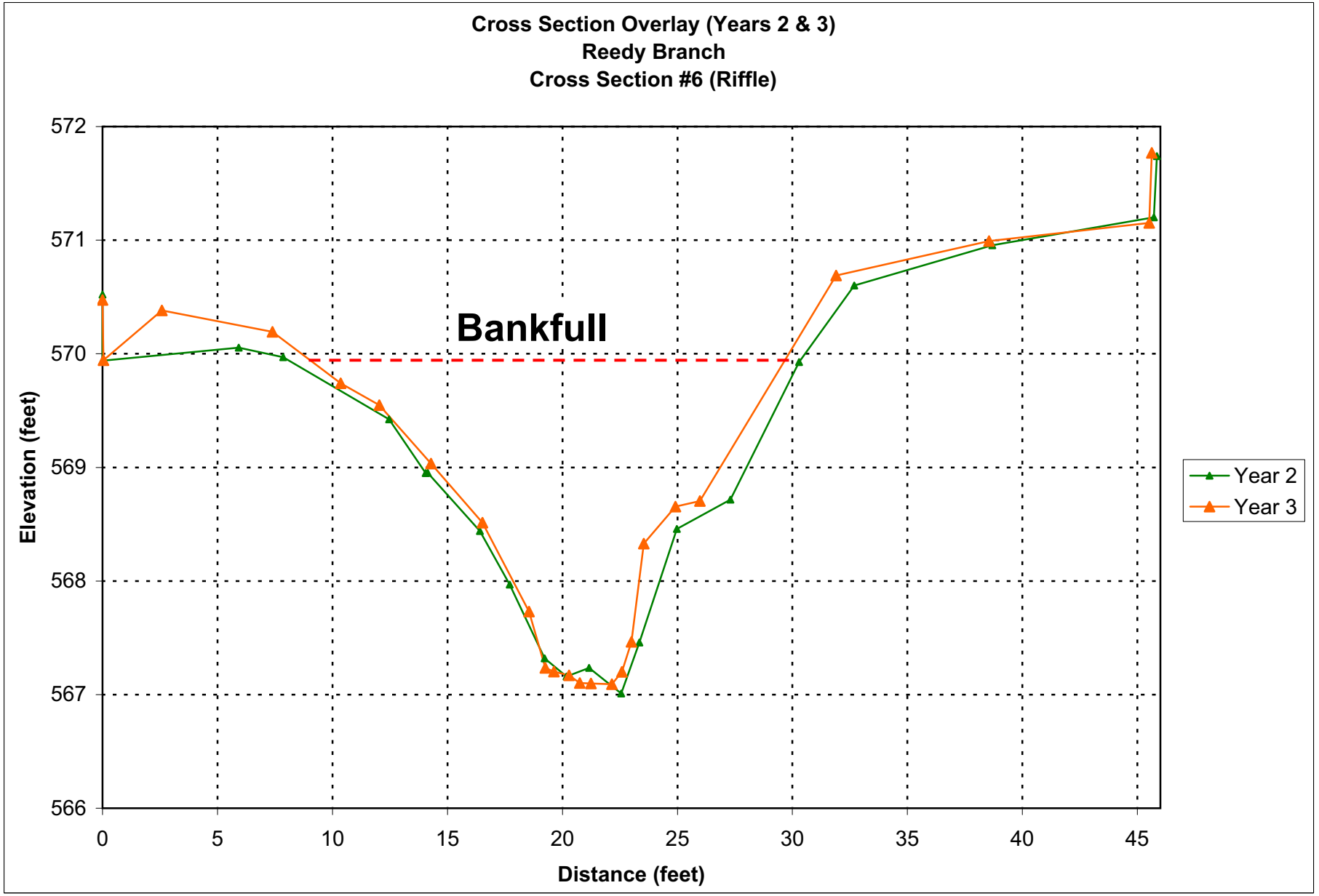
*Year 1 data was not collected.



*Year 1 data was not collected.


Cross Section Overlay (Years 1 - 3)
Reedy Branch
Cross Section #4 (Riffle)
Bankful
Elevation (feet)
Distance (feet)
579
578
577
576
575
574
573
572
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
Year 0
Year 1
Year 2
Year 3


Cross Section Overlay (Years 1 - 3)
Reedy Branch
Cross Section #5 (Pool)
Bankful
Elevation (feet)
Distance (feet)
577
576
575
574
573
572
571
570
569
568
567
566
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
Year 0
Year 1
Year 2
Year 3



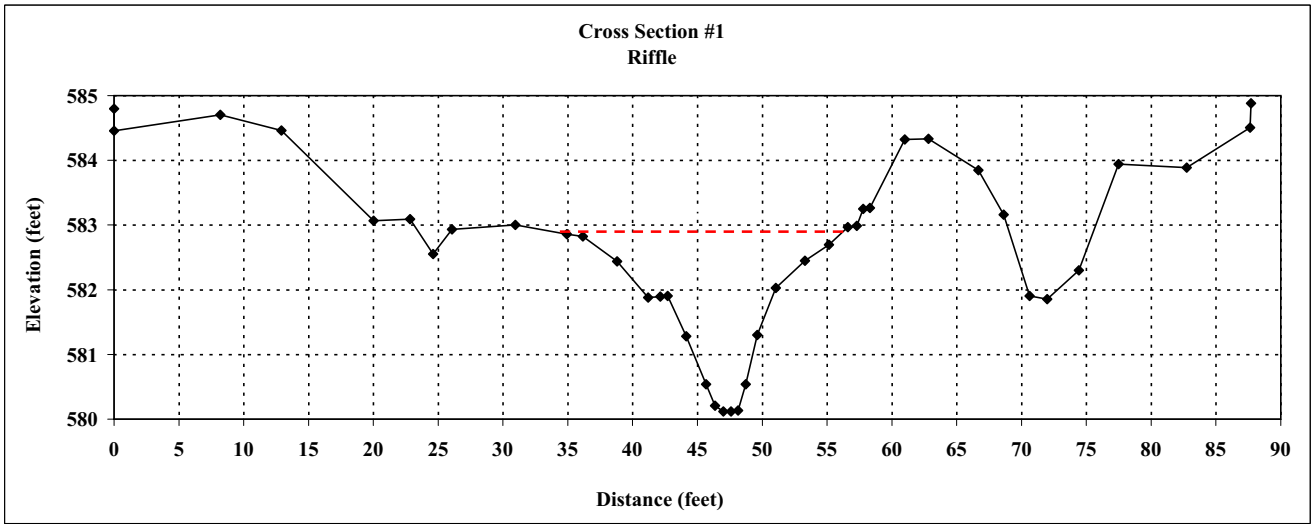
*Year 1 data was not collected.

Field Crew:	IPJ and PDB
Stream Reach:	Reedy Branch
Drainage Area:	1.6 mi^2
Date:	Jun-07
Monitoring Year	3

STATION (Feet)	ELEVATION (Feet)	NOTES
0.00	584.80	
0.00	584.45	
8.19	584.70	
12.90	584.46	
20.03	583.07	
22.82	583.09	
24.61	582.55	
26.07	582.93	
30.96	583.00	
34.94	582.86	BKF = 582.91
36.16	582.83	
38.80	582.44	
41.20	581.88	
42.13	581.90	
42.70	581.90	
44.13	581.28	
45.67	580.54	LEW
46.36	580.21	L Bank Toe
47.01	580.12	Thalweg
47.59	580.12	
48.12	580.14	R Bank Toe
48.73	580.54	REW
49.62	581.30	
51.04	582.03	
53.30	582.45	
55.16	582.70	
56.60	582.97	
57.30	582.99	
57.79	583.25	
58.30	583.27	
60.98	584.32	
62.81	584.33	
66.68	583.85	
68.63	583.16	
70.62	581.90	
71.99	581.85	
74.43	582.30	
77.49	583.94	
82.75	583.89	
87.63	584.51	
87.72	584.88	

Bankfull/Top of Bank Hydraulic Geometry		
Width (Feet)	**Depth (Feet)**	**Area (Sq. Ft.)**
0.0	0.0	0.0
1.4	0.1	0.0
1.2	0.1	0.1
2.6	0.5	0.7
2.4	1.0	1.8
0.9	1.0	1.0
0.6	1.0	0.6
1.4	1.6	1.9
1.5	2.4	3.1
0.7	2.7	1.7
0.7	2.8	1.8
0.6	2.8	1.6
0.5	2.8	1.5
0.6	2.4	1.6
0.9	1.6	1.8
1.4	0.9	1.8
2.3	0.5	1.5
1.9	0.2	0.6
1.1	0.0	0.1
TOTALS 22.8		23.2

SUMMARY DATA	
A(BKF)	23.2
W(BKF)	22.8
Max d	2.8
Mean d	1.0



Field Crew:	IPJ and PDB
Stream Reach:	Reedy Branch
Drainage Area:	1.6 mi^2
Date:	Nov-07
Monitoring Year	3

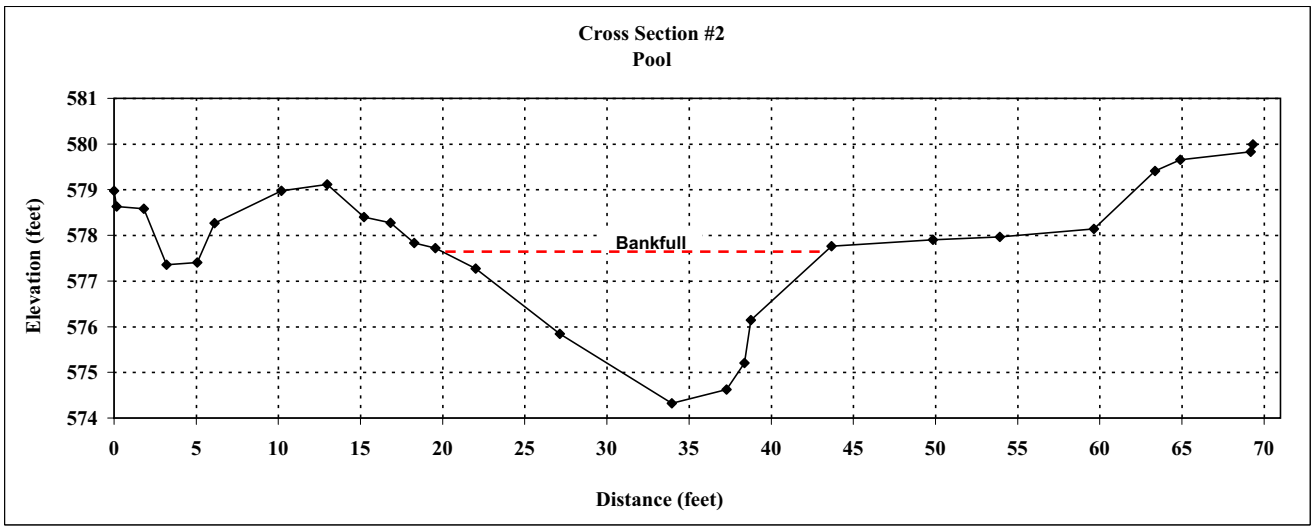
STATION (Feet)	ELEVATION (Feet)	NOTES
0.00	578.97	
0.16	578.63	
1.81	578.58	
3.20	577.36	
5.06	577.40	
6.11	578.27	
10.19	578.98	
12.97	579.12	
15.21	578.40	
16.82	578.27	
18.27	577.83	
19.56	577.72	BKF = 577.61
22.01	577.27	
27.13	575.85	
33.96	574.32	Thalweg
37.28	574.62	R Bank Toe
38.37	575.21	REW
38.76	576.15	
43.67	577.76	
49.86	577.90	
53.93	577.96	
59.64	578.14	
63.37	579.41	
64.91	579.66	
69.20	579.83	
69.33	579.99	

Bankfull/Top of Bank Hydraulic Geometry

	Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
	0.0	0.0	0.0
	1.9	0.3	0.3
	5.1	1.8	5.4
	6.8	3.3	17.2
	3.3	3.0	10.4
	1.1	2.4	2.9
	0.4	1.5	0.8
	4.4	0.0	3.2
TOTALS	23.0		40.3

SUMMARY DATA

A(BKF)	40.3
W(BKF)	23.0
Max d	3.3
Mean d	1.7



Field Crew:	IPJ and PDB
Stream Reach:	Reedy Branch
Drainage Area:	1.6 mi^2
Date:	Nov-07
Monitoring Year	3

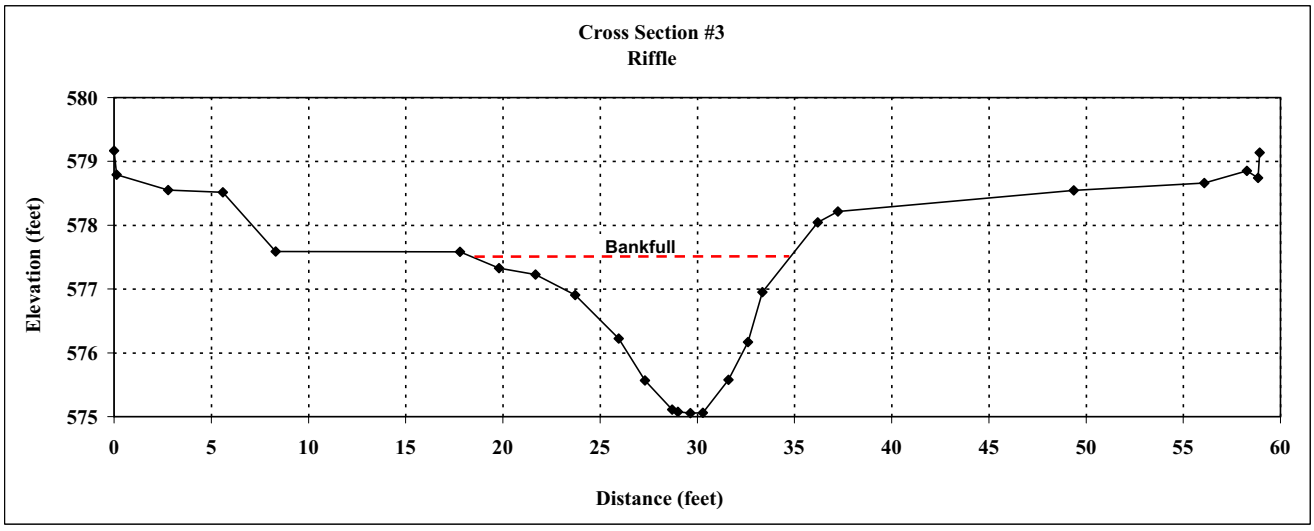
STATION (Feet)	ELEVATION (Feet)	NOTES
0.00	579.17	
0.14	578.79	
2.78	578.55	
5.60	578.52	
8.32	577.59	
17.80	577.58	BKF = 577.49
19.80	577.33	
21.68	577.23	
23.72	576.90	
25.95	576.23	
27.30	575.57	
28.71	575.11	L Bank Toe
29.00	575.08	Thalweg
29.64	575.05	
30.29	575.06	R Bank Toe
31.61	575.58	
32.61	576.17	
33.35	576.95	
36.20	578.04	
37.23	578.21	R Top of Bank
49.37	578.55	
56.09	578.66	
58.27	578.85	
58.85	578.74	
58.94	579.14	

Bankfull/Top of Bank Hydraulic Geometry

	Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
	0.0	0.0	0.0
	1.2	0.2	0.1
	1.9	0.3	0.4
	2.0	0.6	0.9
	2.2	1.3	2.1
	1.4	1.9	2.2
	1.4	2.4	3.0
	0.3	2.4	0.7
	0.6	2.4	1.6
	0.6	2.4	1.6
	1.3	1.9	2.9
	1.0	1.3	1.6
	0.7	0.5	0.7
	1.4	0.0	0.4
TOTALS	16.2		18.0

SUMMARY DATA

A(BKF)	18.0
W(BKF)	16.2
Max d	2.4
Mean d	1.1



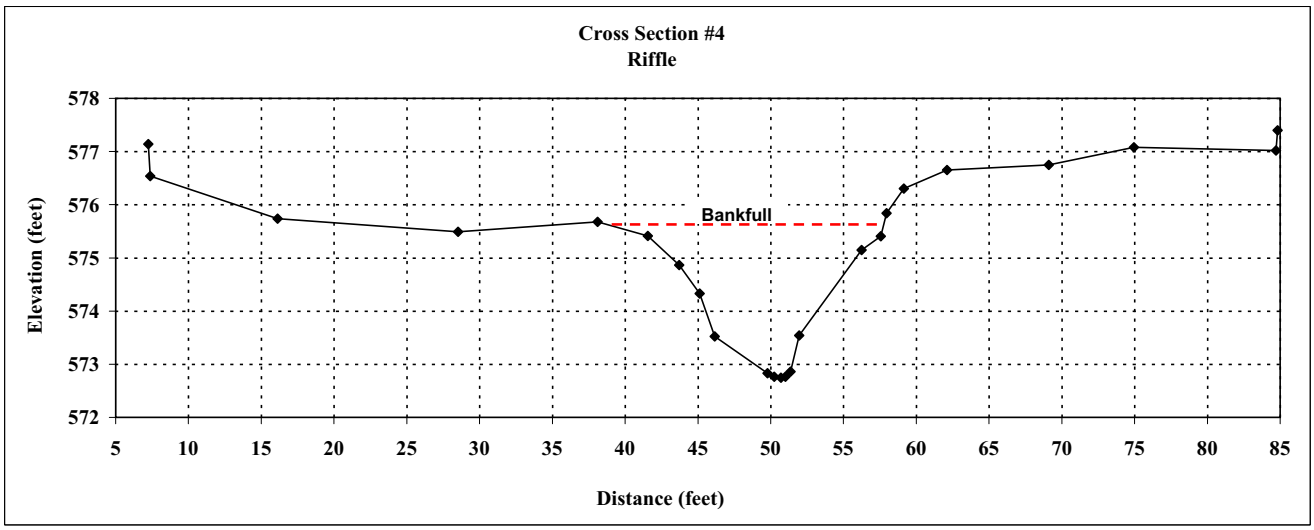
Field Crew:	IPJ and PDB
Stream Reach:	Reedy Branch
Drainage Area:	1.6 mi^2
Date:	Nov-07
Monitoring Year	3

STATION (Feet)	ELEVATION* (Feet)	NOTES
7.25	577.14	
7.37	576.53	
16.12	575.74	
28.53	575.49	
38.11	575.68	BKF = 575.61
41.57	575.41	
43.71	574.86	
45.12	574.33	
46.16	573.52	
49.78	572.83	LEW
50.25	572.76	
50.70	572.75	Thalweg
51.02	572.77	
51.36	572.86	REW
51.95	573.54	
56.25	575.15	
57.56	575.41	
57.96	575.84	
59.15	576.30	
62.12	576.65	R Top of Bank
69.11	576.75	
74.96	577.08	
84.71	577.02	
84.83	577.40	

***Elevations for Year 3 adjusted by -1.03 ft for comparison with Monitoring Year 0 elevations.**

Bankfull/Top of Bank Hydraulic Geometry		
Width (Feet)	**Depth (Feet)**	**Area (Sq. Ft.)**
0.0	0.0	0.0
2.5	0.2	0.2
2.1	0.7	1.0
1.4	1.3	1.4
1.0	2.1	1.8
3.6	2.8	8.8
0.5	2.8	1.3
0.4	2.9	1.3
0.3	2.8	0.9
0.3	2.7	1.0
0.6	2.1	1.4
4.3	0.5	5.4
1.3	0.2	0.4
0.3	0.0	0.0
TOTALS 18.8		25.0

SUMMARY DATA	
A(BKF)	25.0
W(BKF)	18.8
Max d	2.9
Mean d	1.3



Field Crew:	IPJ and PDB
Stream Reach:	Reedy Branch
Drainage Area:	1.6 mi^2
Date:	Nov-07
Monitoring Year	3

STATION (Feet)	ELEVATION* (Feet)	NOTES
0.00	574.84	
0.00	574.32	
14.62	573.80	
29.71	573.94	
30.77	573.95	
30.97	573.89	L Top of Bank
32.54	573.56	
33.73	573.48	BKF = 572.81
36.66	572.68	
39.01	571.69	
40.66	570.13	L Bank Toe
41.20	569.88	LEW
42.53	569.22	
43.50	569.19	
44.16	569.03	
45.60	568.90	
46.30	568.94	Thalweg
47.54	569.18	
48.63	569.94	REW
48.87	569.94	R Bank Toe
49.24	571.01	
50.11	571.20	
51.52	572.20	
53.06	572.44	
53.99	572.96	
58.09	574.17	
59.29	574.25	R Top of Bank
69.07	574.13	
90.91	574.46	
99.59	574.57	
99.59	575.01	

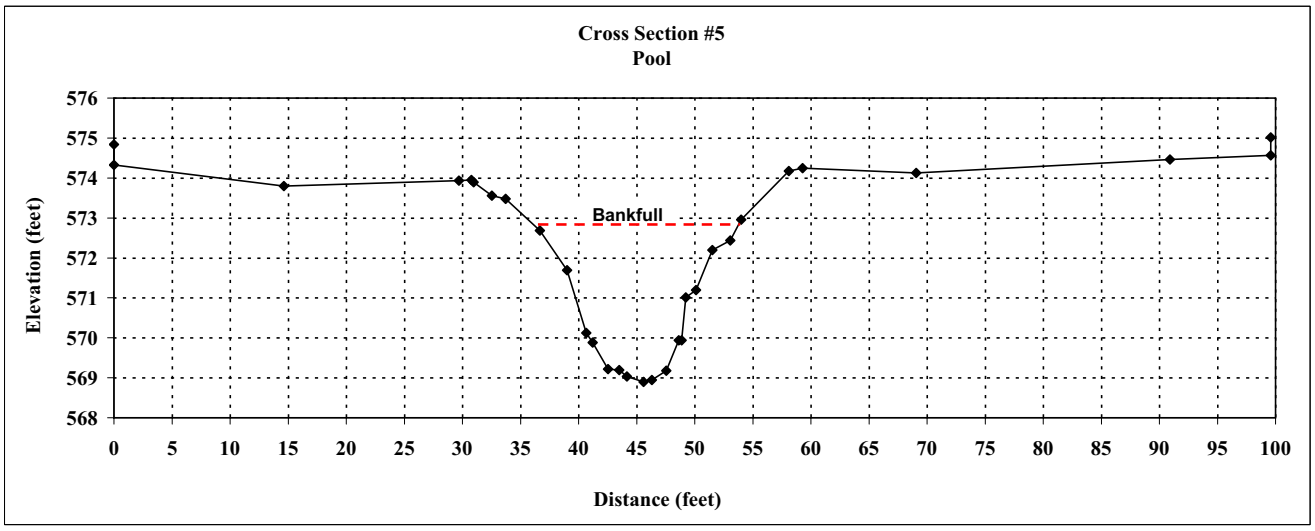
***Year 3 elevations adjusted -1.03 ft for comparison with Year 0 elevations.**

Bankfull/Top of Bank Hydraulic Geometry

	Width (Feet)	Depth (Feet)	Area (Sq. Ft.)
	0.0	0.0	0.0
	0.5	0.1	0.0
	2.3	1.1	1.5
	1.7	2.7	3.1
	0.5	2.9	1.5
	1.3	3.6	4.3
	1.0	3.6	3.5
	0.7	3.8	2.4
	1.4	3.9	5.5
	0.7	3.9	2.7
	1.2	3.6	4.7
	1.1	2.9	3.5
	0.2	2.9	0.7
	0.4	1.8	0.9
	0.9	1.6	1.5
	1.4	0.6	1.6
	1.5	0.4	0.8
	0.7	0.0	0.1
TOTALS	17.5		38.4

SUMMARY DATA

A(BKF)	38.4
W(BKF)	17.5
Max d	3.9
Mean d	2.2



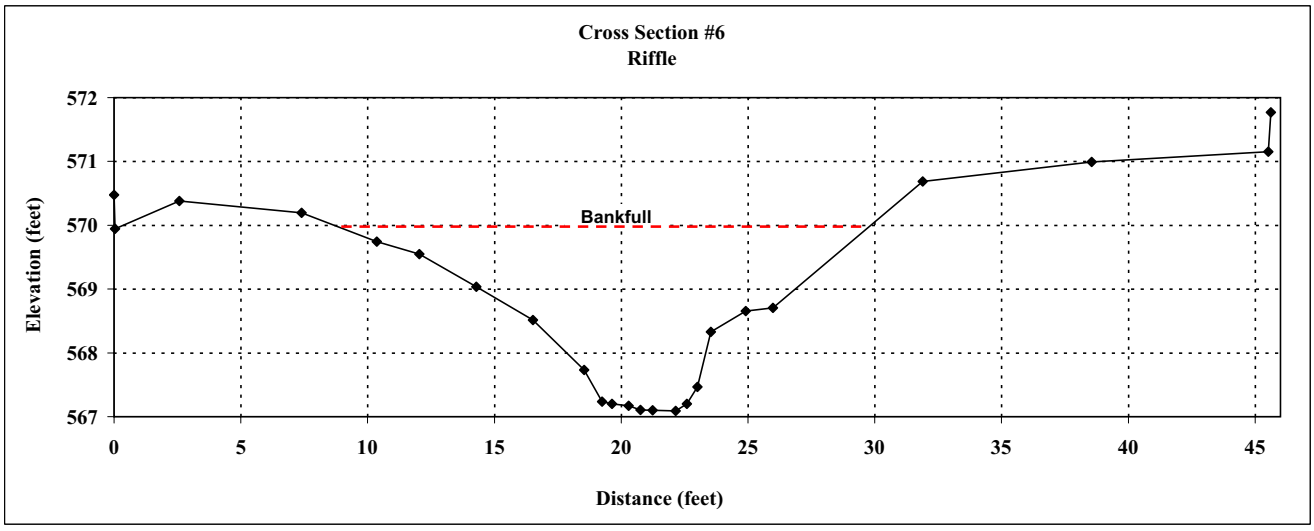
Field Crew:	IPJ and PDB
Stream Reach:	Reedy Branch
Drainage Area:	1.6 mi^2
Date:	Nov-07
Monitoring Year	3

STATION (Feet)	ELEVATION* (Feet)	NOTES
0.00	570.47	
0.04	569.94	
2.58	570.38	
7.39	570.19	BKF = 569.97
10.36	569.74	
12.04	569.55	
14.28	569.03	
16.52	568.51	
18.55	567.73	
19.25	567.24	L Bank Toe
19.63	567.20	LEW
20.29	567.17	
20.76	567.10	
21.24	567.10	Thalweg
22.15	567.09	
22.59	567.20	REW
23.01	567.46	
23.54	568.33	
24.92	568.66	
25.98	568.70	
31.90	570.69	R Top of Bank
38.55	570.99	
45.52	571.15	
45.62	571.77	

***Year 3 elevations adjusted -3.39 ft for comparison with Year 2 elevations.**

Bankfull/Top of Bank Hydraulic Geometry		
Width (Feet)	**Depth (Feet)**	**Area (Sq. Ft.)**
0.0	0.0	0.0
1.5	0.2	0.2
1.7	0.4	0.5
2.2	0.9	1.5
2.2	1.5	2.7
2.0	2.2	3.7
0.7	2.7	1.8
0.4	2.8	1.1
0.7	2.8	1.8
0.5	2.9	1.3
0.5	2.9	1.4
0.9	2.9	2.6
0.4	2.8	1.2
0.4	2.5	1.1
0.5	1.6	1.1
1.4	1.3	2.0
1.1	1.3	1.4
3.8	0.0	2.4
TOTALS 20.9		27.9

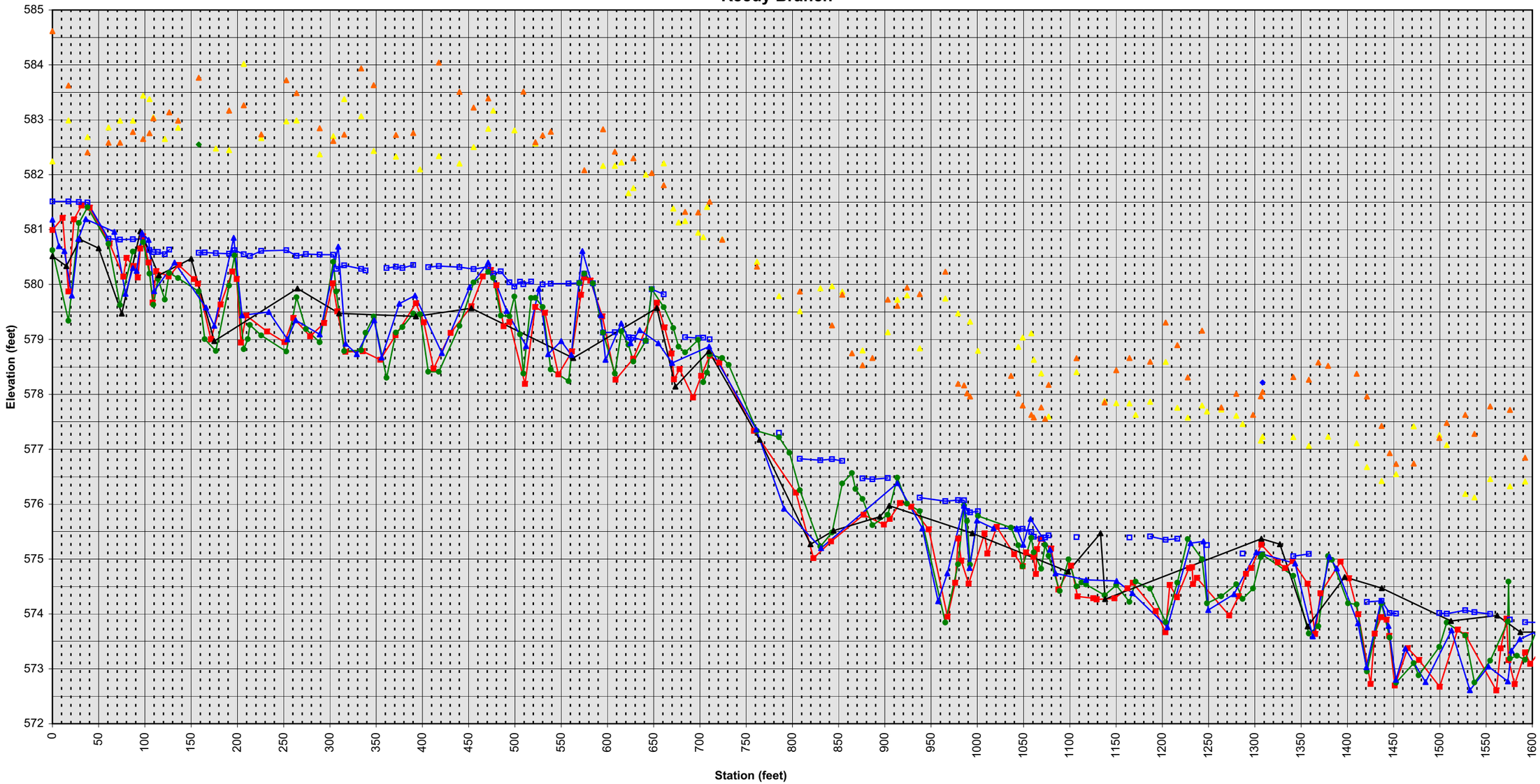
SUMMARY DATA	
A(BKF)	27.9
W(BKF)	20.9
Max d	2.9
Mean d	1.3



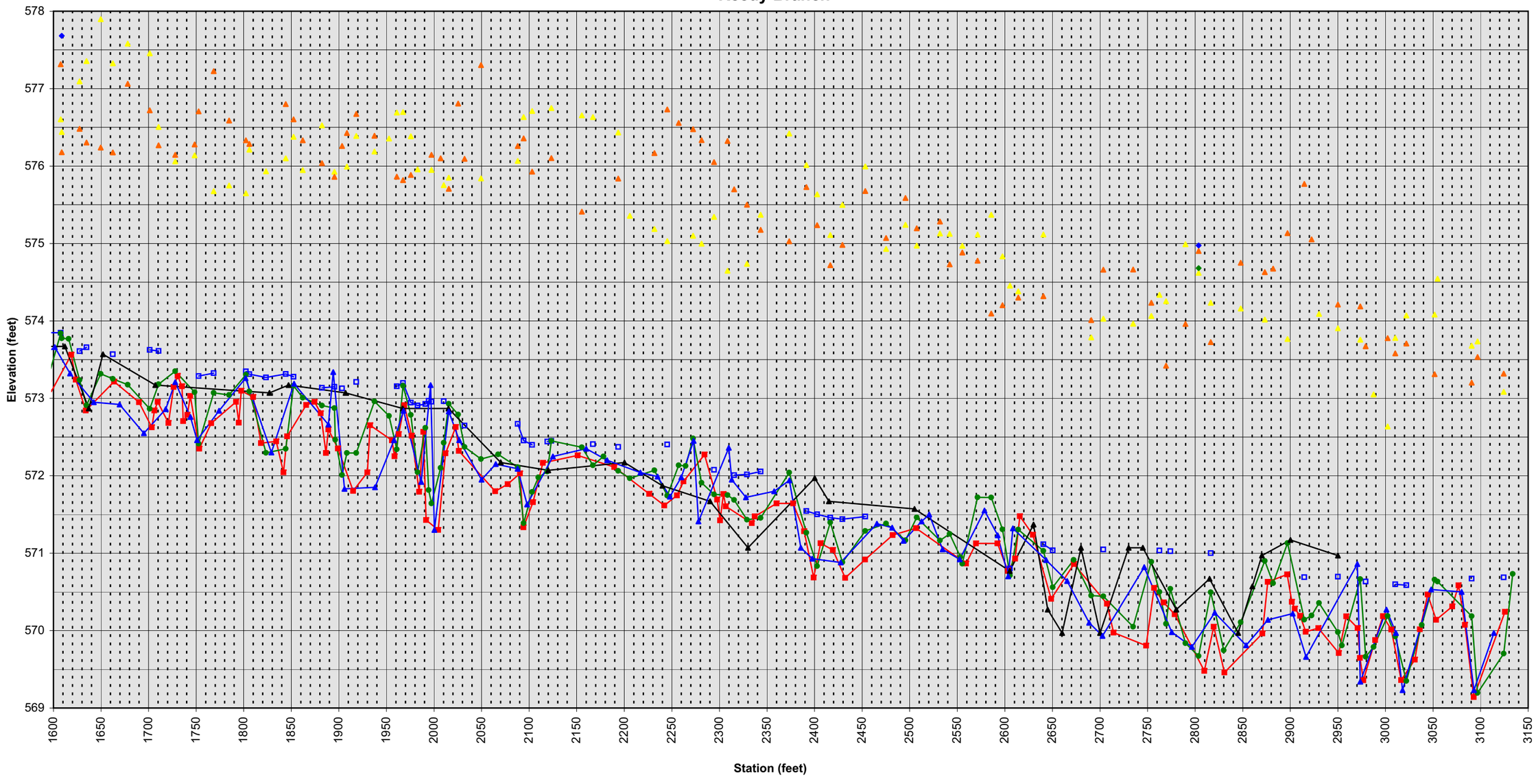
Appendix B5

Stream Longitudinal Profile

Longitudinal Profile Overlay (Years 1 - 3) Page 1 of 2
Reedy Branch



Longitudinal Profile Overlay (Years 1 - 3) Page 2 of 2
Reedy Branch



Appendix B6

Stream Pebble Counts

Reedy Branch
Stream Monitoring
Year 2: 2006
Alamance County, NC

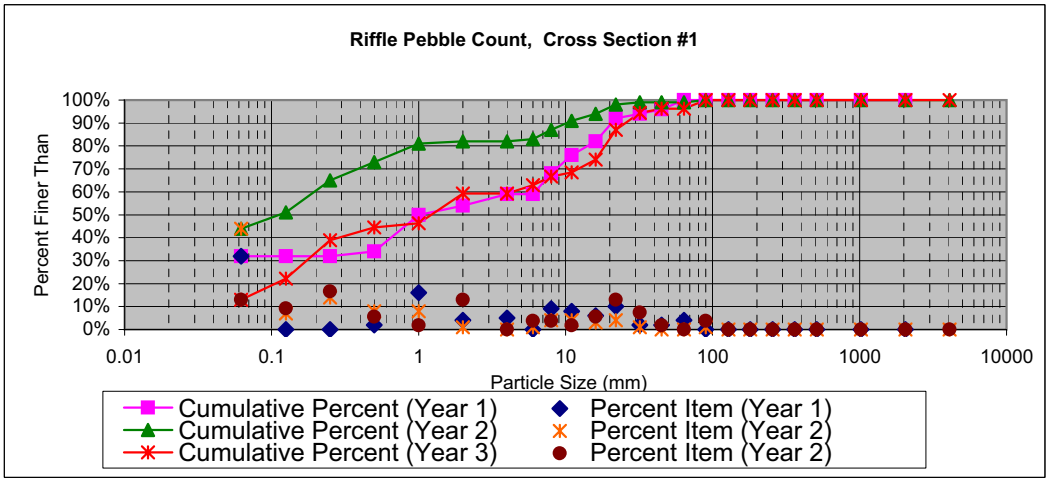
PEBBLE COUNT

Site: Reedy Branch

Party: IPJ and PDB

Date: 10/23/2007

Inches	Particle	Millimeters		Cross-Section 1 (Riffle)	TOT#	ITEM %	% CUM
	Silt/Clay	< 0.062	S/C	7	7	13%	13%
	Very Fine	.062-.125	SAND	5	5	9%	22%
	Fine	.125-.25	SAND	9	9	17%	39%
	Medium	.25-.50	SAND	3	3	6%	44%
	Coarse	.50-1.0	SAND	1	1	2%	46%
.04-.08	Very Coarse	1.0-2	SAND	7	7	13%	59%
.08-.16	Very Fine	2.0-4.0	GRAVEL		0	0%	59%
.16-.22	Fine	4-5.7	GRAVEL	2	2	4%	63%
.22-.31	Fine	5.7-8	GRAVEL	2	2	4%	67%
.31-.44	Medium	8-11.3	GRAVEL	1	1	2%	69%
.44-.63	Medium	11.3-16	GRAVEL	3	3	6%	74%
.63-.89	Coarse	16-22.6	GRAVEL	7	7	13%	87%
.89-1.26	Coarse	22.6-32	GRAVEL	4	4	7%	94%
1.26-1.77	Very Coarse	32-45	GRAVEL	1	1	2%	96%
1.77-2.5	Very Coarse	45-64	GRAVEL		0	0%	96%
2.5-3.5	Small	64-90	COBBLE	2	2	4%	100%
3.5-5.0	Small	90-128	COBBLE		0	0%	100%
5.0-7.1	Large	128-180	COBBLE		0	0%	100%
7.1-10.1	Large	180-256	COBBLE		0	0%	100%
10.1-14.3	Small	256-362	BOULDER		0	0%	100%
14.3-20	Small	362-512	BOULDER		0	0%	100%
20-40	Medium	512-1024	BOULDER		0	0%	100%
40-80	Large	1024-2048	BOULDER		0	0%	100%
	Bedrock		**BDRK**		0	0%	100%
					54	**100%**	**100%**



Reedy Branch
Stream Monitoring
Year 2: 2006
Alamance County, NC

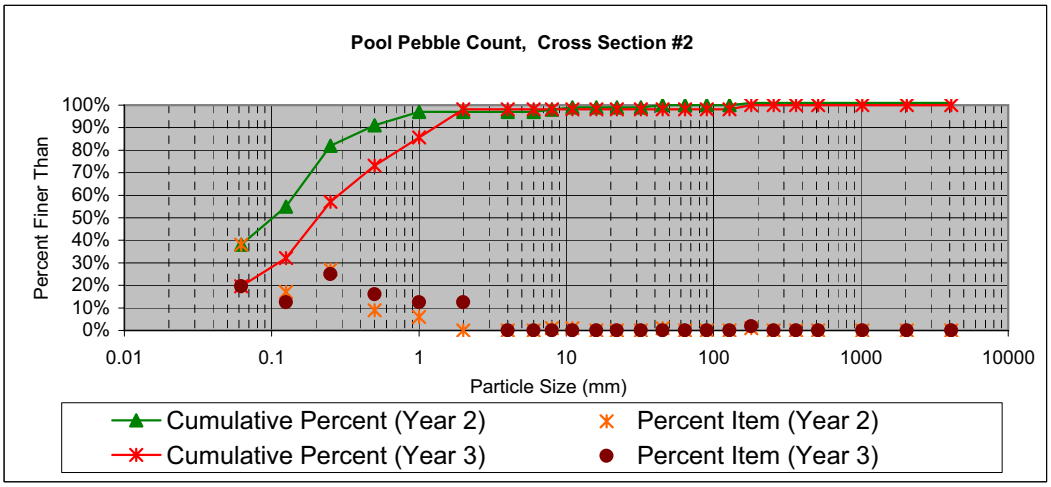
PEBBLE COUNT

Site: Reedy Branch

Party: IPJ and PDB

Date: 10/23/2007

Inches	Particle	Millimeters		Cross-Section 2 (Pool)	TOT#	ITEM %	% CUM
	Silt/Clay	< 0.062	**S/C**	11	11	20%	20%
	Very Fine	.062-.125	SAND	7	7	13%	32%
	Fine	.125-.25	SAND	14	14	25%	57%
	Medium	.25-.50	SAND	9	9	16%	73%
	Coarse	.50-1.0	SAND	7	7	13%	86%
.04-.08	Very Coarse	1.0-2	SAND	7	7	13%	98%
.08-.16	Very Fine	2.0-4.0	GRAVEL		0	0%	98%
.16-.22	Fine	4-5.7	GRAVEL		0	0%	98%
.22-.31	Fine	5.7-8	GRAVEL		0	0%	98%
.31-.44	Medium	8-11.3	GRAVEL		0	0%	98%
.44-.63	Medium	11.3-16	GRAVEL		0	0%	98%
.63-.89	Coarse	16-22.6	GRAVEL		0	0%	98%
.89-1.26	Coarse	22.6-32	GRAVEL		0	0%	98%
1.26-1.77	Very Coarse	32-45	GRAVEL		0	0%	98%
1.77-2.5	Very Coarse	45-64	GRAVEL		0	0%	98%
2.5-3.5	Small	64-90	COBBLE		0	0%	98%
3.5-5.0	Small	90-128	COBBLE		0	0%	98%
5.0-7.1	Large	128-180	COBBLE	1	1	2%	100%
7.1-10.1	Large	180-256	COBBLE		0	0%	100%
10.1-14.3	Small	256-362	BOULDER		0	0%	100%
14.3-20	Small	362-512	BOULDER		0	0%	100%
20-40	Medium	512-1024	BOULDER		0	0%	100%
40-80	Large	1024-2048	BOULDER		0	0%	100%
	Bedrock		**BDRK**		0	0%	100%
					56	**100%**	**100%**



Reedy Branch
Stream Monitoring
Year 2: 2006
Alamance County, NC

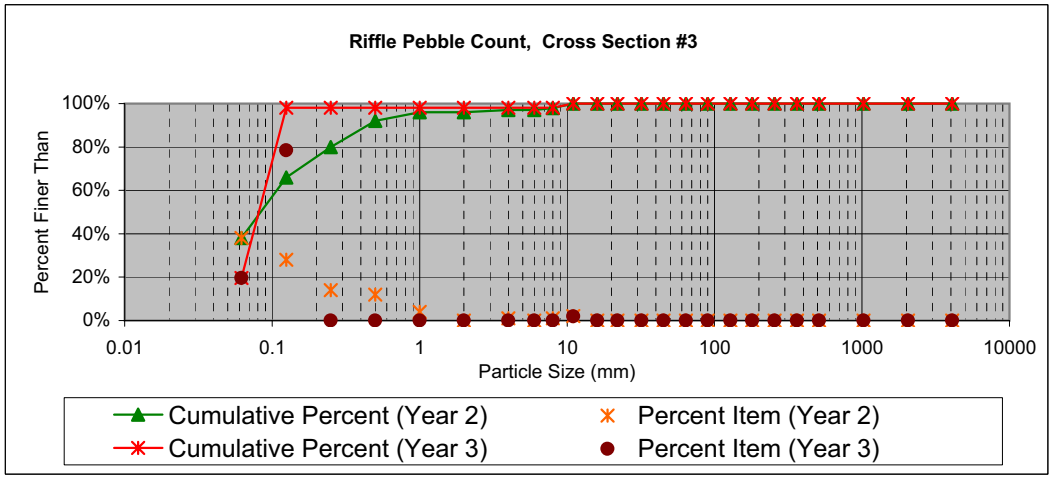
PEBBLE COUNT

Site: Reedy Branch

Party: IPJ and PDB

Date: 10/23/2007

Inches	Particle	Millimeters		Cross-Section 3 (Riffle)	TOT#	ITEM %	% CUM
	Silt/Clay	< 0.062	**S/C**	10	10	20%	20%
	Very Fine	.062-.125	SAND	40	40	78%	98%
	Fine	.125-.25			0	0%	98%
	Medium	.25-.50			0	0%	98%
	Coarse	.50-1.0			0	0%	98%
.04-.08	Very Coarse	1.0-2			0	0%	98%
.08-.16	Very Fine	2.0-4.0	GRAVEL		0	0%	98%
.16-.22	Fine	4-5.7			0	0%	98%
.22-.31	Fine	5.7-8			0	0%	98%
.31-.44	Medium	8-11.3		1	1	2%	100%
.44-.63	Medium	11.3-16			0	0%	100%
.63-.89	Coarse	16-22.6			0	0%	100%
.89-1.26	Coarse	22.6-32			0	0%	100%
1.26-1.77	Very Coarse	32-45			0	0%	100%
1.77-2.5	Very Coarse	45-64			0	0%	100%
2.5-3.5	Small	64-90	COBBLE		0	0%	100%
3.5-5.0	Small	90-128			0	0%	100%
5.0-7.1	Large	128-180			0	0%	100%
7.1-10.1	Large	180-256			0	0%	100%
10.1-14.3	Small	256-362	BOULDER		0	0%	100%
14.3-20	Small	362-512			0	0%	100%
20-40	Medium	512-1024			0	0%	100%
40-80	Large	1024-2048			0	0%	100%
	Bedrock		**BDRK**		0	0%	100%
					51	**100%**	**100%**



Reedy Branch
Stream Monitoring
Year 2: 2006
Alamance County, NC

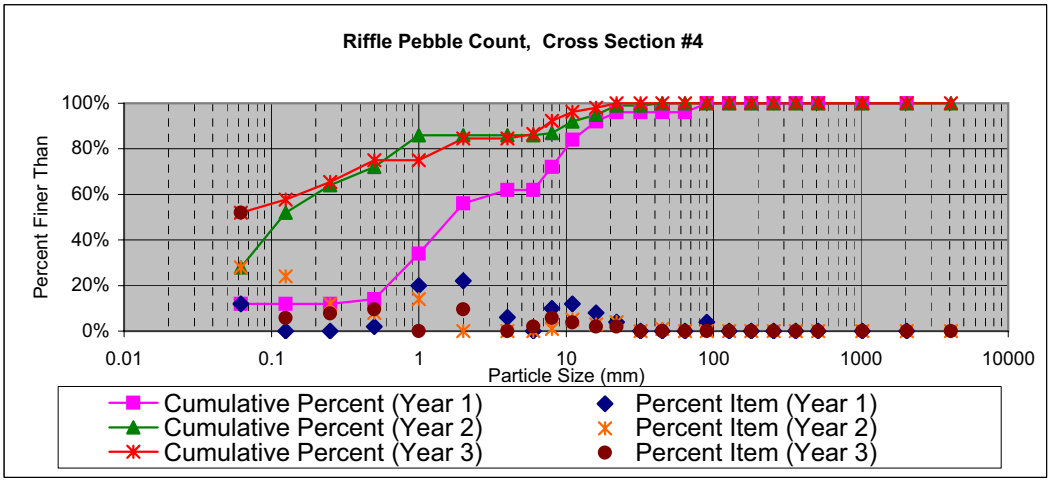
PEBBLE COUNT

Site: Reedy Branch

Party: IPJ and PDB

Date: 10/23/2007

Inches	Particle	Millimeters		Cross-Section 4 (Riffle)	TOT#	ITEM %	% CUM
	Silt/Clay	< 0.062	**S/C**	27	27	52%	52%
	Very Fine	.062-.125	SAND	3	3	6%	58%
	Fine	.125-.25	SAND	4	4	8%	65%
	Medium	.25-.50	SAND	5	5	10%	75%
	Coarse	.50-1.0	SAND		0	0%	75%
.04-.08	Very Coarse	1.0-2	SAND	5	5	10%	85%
.08-.16	Very Fine	2.0-4.0	GRAVEL		0	0%	85%
.16-.22	Fine	4-5.7	GRAVEL	1	1	2%	87%
.22-.31	Fine	5.7-8	GRAVEL	3	3	6%	92%
.31-.44	Medium	8-11.3	GRAVEL	2	2	4%	96%
.44-.63	Medium	11.3-16	GRAVEL	1	1	2%	98%
.63-.89	Coarse	16-22.6	GRAVEL	1	1	2%	100%
.89-1.26	Coarse	22.6-32	GRAVEL		0	0%	100%
1.26-1.77	Very Coarse	32-45	GRAVEL		0	0%	100%
1.77-2.5	Very Coarse	45-64	GRAVEL		0	0%	100%
2.5-3.5	Small	64-90	COBBLE		0	0%	100%
3.5-5.0	Small	90-128	COBBLE		0	0%	100%
5.0-7.1	Large	128-180	COBBLE		0	0%	100%
7.1-10.1	Large	180-256	COBBLE		0	0%	100%
10.1-14.3	Small	256-362	BOULDER		0	0%	100%
14.3-20	Small	362-512	BOULDER		0	0%	100%
20-40	Medium	512-1024	BOULDER		0	0%	100%
40-80	Large	1024-2048	BOULDER		0	0%	100%
	Bedrock		**BDRK**		0	0%	100%
					52	**100%**	**100%**



Reedy Branch
Stream Monitoring
Year 2: 2006
Alamance County, NC

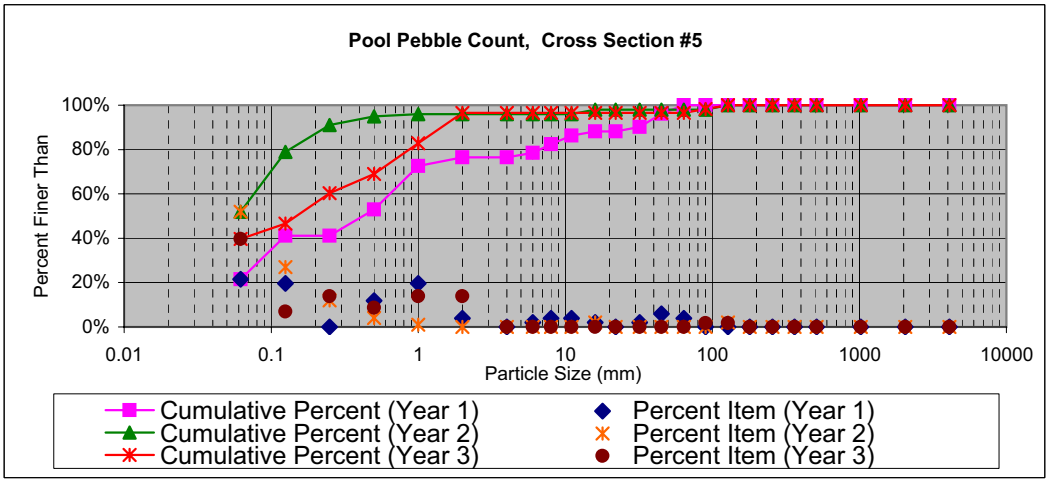
PEBBLE COUNT

Site: Reedy Branch

Party: IPJ and PDB

Date: 10/23/2007

Inches	Particle	Millimeters		Cross-Section 5 (Pool)	TOT#	ITEM %	% CUM
	Silt/Clay	< 0.062	S/C	23	23	40%	40%
	Very Fine	.062-.125	SAND	4	4	7%	47%
	Fine	.125-.25	SAND	8	8	14%	60%
	Medium	.25-.50	SAND	5	5	9%	69%
	Coarse	.50-1.0	SAND	8	8	14%	83%
.04-.08	Very Coarse	1.0-2	SAND	8	8	14%	97%
.08-.16	Very Fine	2.0-4.0	GRAVEL		0	0%	97%
.16-.22	Fine	4-5.7	GRAVEL		0	0%	97%
.22-.31	Fine	5.7-8	GRAVEL		0	0%	97%
.31-.44	Medium	8-11.3	GRAVEL		0	0%	97%
.44-.63	Medium	11.3-16	GRAVEL		0	0%	97%
.63-.89	Coarse	16-22.6	GRAVEL		0	0%	97%
.89-1.26	Coarse	22.6-32	GRAVEL		0	0%	97%
1.26-1.77	Very Coarse	32-45	GRAVEL		0	0%	97%
1.77-2.5	Very Coarse	45-64	GRAVEL		0	0%	97%
2.5-3.5	Small	64-90	COBBLE	1	1	2%	98%
3.5-5.0	Small	90-128	COBBLE	1	1	2%	100%
5.0-7.1	Large	128-180	COBBLE		0	0%	100%
7.1-10.1	Large	180-256	COBBLE		0	0%	100%
10.1-14.3	Small	256-362	BOULDER		0	0%	100%
14.3-20	Small	362-512	BOULDER		0	0%	100%
20-40	Medium	512-1024	BOULDER		0	0%	100%
40-80	Large	1024-2048	BOULDER		0	0%	100%
	Bedrock		BDRK		0	0%	100%
					58	**100%**	**100%**



Reedy Branch
Stream Monitoring
Year 2: 2006
Alamance County, NC

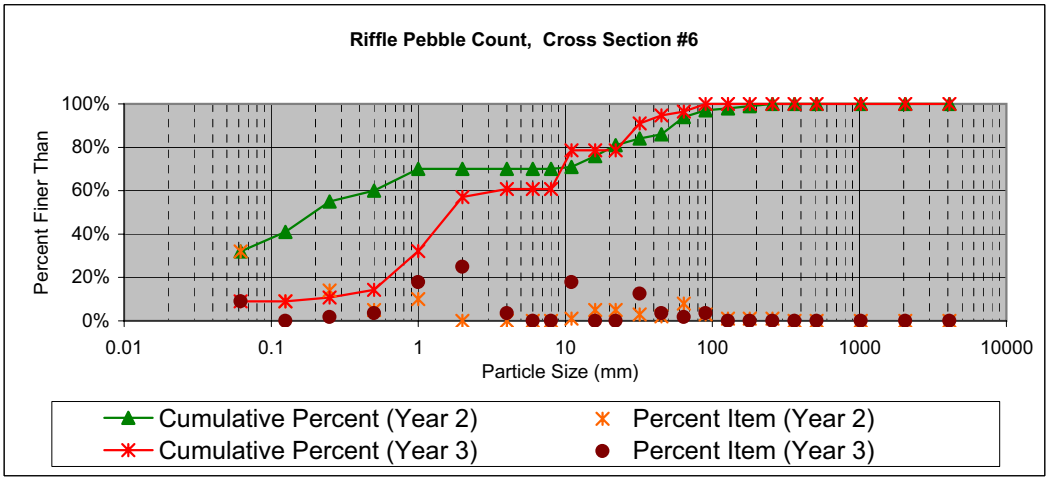
PEBBLE COUNT

Site: Reedy Branch

Party: IPJ and PDB

Date: 11/11/2007

Inches	Particle	Millimeters		Cross-Section 6 (Riffle)	TOT#	ITEM %	% CUM
	Silt/Clay	< 0.062	**S/C**	5	5	9%	9%
	Very Fine	.062-.125	SAND		0	0%	9%
	Fine	.125-.25	SAND	1	1	2%	11%
	Medium	.25-.50	SAND	2	2	4%	14%
	Coarse	.50-1.0	SAND	10	10	18%	32%
.04-.08	Very Coarse	1.0-2	SAND	14	14	25%	57%
.08-.16	Very Fine	2.0-4.0	GRAVEL	2	2	4%	61%
.16-.22	Fine	4-5.7	GRAVEL		0	0%	61%
.22-.31	Fine	5.7-8	GRAVEL		0	0%	61%
.31-.44	Medium	8-11.3	GRAVEL	10	10	18%	79%
.44-.63	Medium	11.3-16	GRAVEL		0	0%	79%
.63-.89	Coarse	16-22.6	GRAVEL		0	0%	79%
.89-1.26	Coarse	22.6-32	GRAVEL	7	7	13%	91%
1.26-1.77	Very Coarse	32-45	GRAVEL	2	2	4%	95%
1.77-2.5	Very Coarse	45-64	GRAVEL	1	1	2%	96%
2.5-3.5	Small	64-90	COBBLE	2	2	4%	100%
3.5-5.0	Small	90-128	COBBLE		0	0%	100%
5.0-7.1	Large	128-180	COBBLE		0	0%	100%
7.1-10.1	Large	180-256	COBBLE		0	0%	100%
10.1-14.3	Small	256-362	BOULDER		0	0%	100%
14.3-20	Small	362-512	BOULDER		0	0%	100%
20-40	Medium	512-1024	BOULDER		0	0%	100%
40-80	Large	1024-2048	BOULDER		0	0%	100%
	Bedrock		**BDRK**		0	0%	100%
					56	**100%**	**100%**



Appendix C

Plan View Sheets

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

PROJECT REFERENCE NO.	SHEET NO.
301	1
PROJECT ENGINEER	

10 0 20
SCALE

NAD 83

BEGIN MONITORING
REEDY BRANCH
STA.10+00.00

CROSS SECTION 1

VEGETATION PLOT #1
VEGETATION PLOT #2
VEGETATION PLOT #3
VEGETATION PLOT #4

CATTLE CROSSING

MATCH LINE SEE SHEET 2

CROSS SECTION STAKING			
	NORTHING	EASTING	ELEVATION
XSC 1 LEFT	771025.3443	1879852.4770	584.7667
XSC 1 RIGHT	770943.7261	1879884.3740	584.8904

LEGEND

- THALWEG 2006
- BANKFULL 2006
- THALWEG 2007
- EDGE OF WATER 2007
- BANKFULL 2007
- TOP OF BANK 2007
- CROSS-SECTIONS
- PHOTO POINT

- BANK EROSION
- SEVERE BANK EROSION
- AGGRADATION (GRASSES)
- AGGRADATON (PICKERELWEED)
- UNDERCUT BANKS

STRUCTURE TYPES

ROCK CROSS VANE
J-HOOK VANE
ROCK VANE
ROOTWAD
BEDROCK

COLOR CODE FOR STRUCTURES

- GOOD STRUCTURE
- STRUCTURE WITH POTENTIAL PROBLEM
- FAILING STRUCTURE

Ecosystem Enhancement PROGRAM

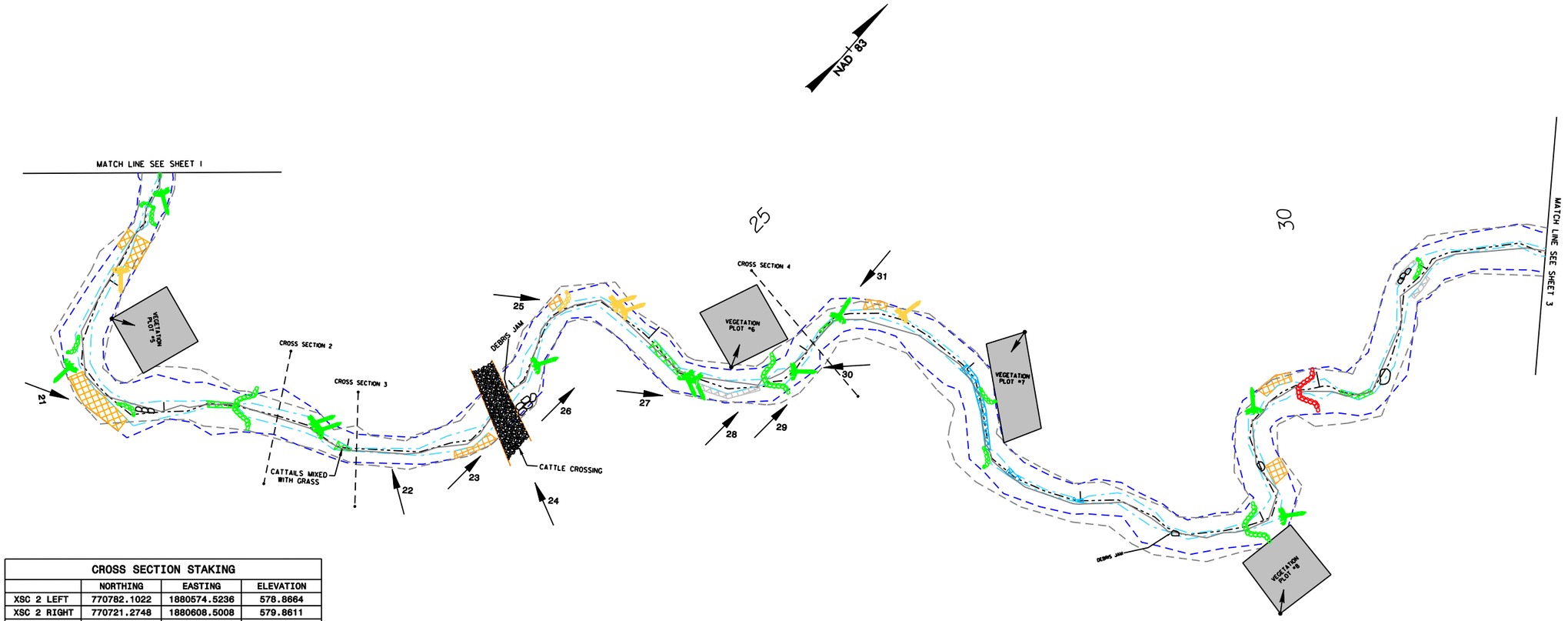
LOCATION:
REEDY BRANCH
STREAM MONITORING - YEAR 3

PROJ #:	COUNTY:
301	ALAMANCE
PREPARED BY: IPJ	
CHECKED BY: PDB	DATE: 3/26/07

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

PROJECT REFERENCE NO.	SHEET NO.
301	2
PROJECT ENGINEER	

10 0 20
SCALE



CROSS SECTION STAKING			
	NORTHING	EASTING	ELEVATION
XSC 2 LEFT	770782.1022	1880574.5236	578.8664
XSC 2 RIGHT	770721.2748	1880608.5008	579.8611
XSC 3 LEFT	770788.7579	1880614.5106	579.1104
XSC 3 RIGHT	770743.0304	1880651.6428	578.9910
XSC 4 LEFT	770968.3605	1880727.1468	575.6349
XSC 4 RIGHT	770955.0930	1880810.9364	575.2575

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301	3
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10 0 20
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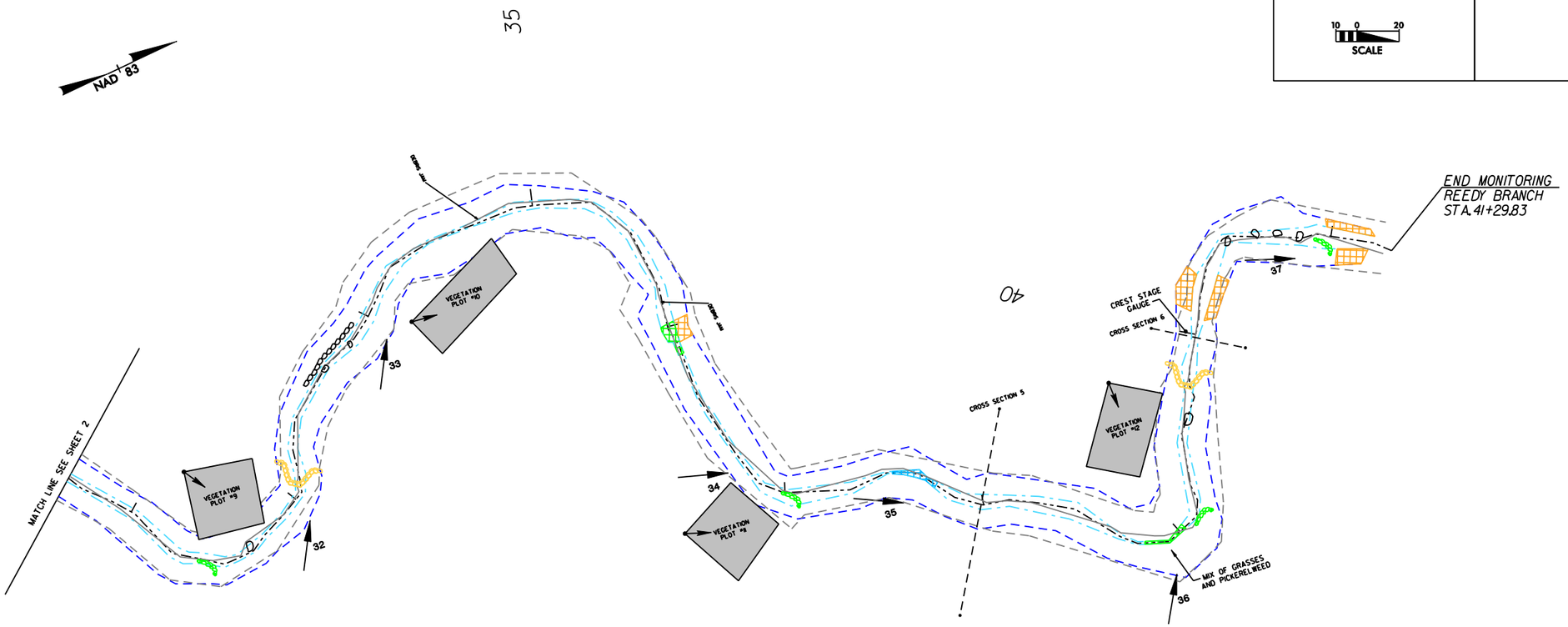

CROSS SECTION STAKING			
	NORTHING	EASTING	ELEVATION
XSC 5 LEFT	771655.7440	1881190.6814	572.4095
XSC 5 RIGHT	771596.7893	1881270.3239	572.6393
XSC 6 LEFT	771737.2562	1881187.0696	570.5211
XSC 6 RIGHT	771773.7453	1881214.5737	571.7398

LEGEND

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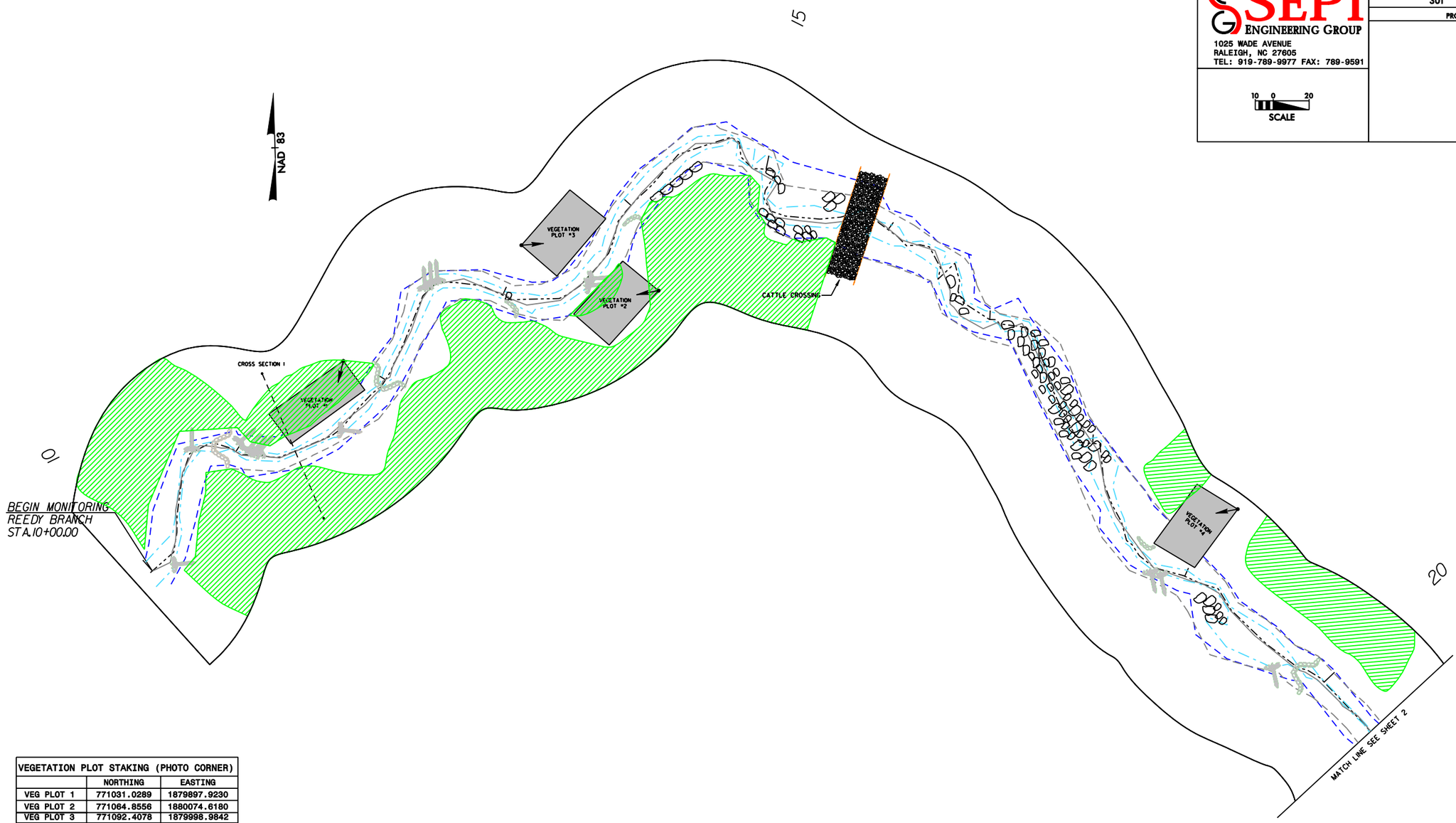

VEGETATION PLOT STAKING (PHOTO CORNER)		
	NORTHING	EASTING
VEG PLOT 1	771031.0289	1879897.9230
VEG PLOT 2	771064.8556	1880074.6180
VEG PLOT 3	771092.4078	1879998.9842
VEG PLOT 4	770933.5667	1880393.4111

•NOTE: INVASIVE/EXOTIC (MICROSTEGIUM) IS PRESENT IN ALL AREAS WITHIN PLANTING BUFFER EXCEPT AS NOTED TO BE FREE FROM INVASIVE/EXOTIC SPECIES

LEGEND

- THALWEG 2006
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- BANKFULL 2007
- TOP OF BANK 2007
- CROSS-SECTIONS

STRUCTURE TYPES

ROCK CROSS VANE, J-HOOK VANE, ROCK VANE, ROOTWAD, BEDROCK

AREA FREE OF INVASIVE/EXOTIC SPECIES

Ecosystem Enhancement PROGRAM

LOCATION:
REEDY BRANCH
VEGETATION ASSESSMENT - YEAR 3

PROJ #:	COUNTY:
301	ALAMANCE
MONITORED BY: IPJ	
CHECKED BY: PDB	DATE: 4/26/07

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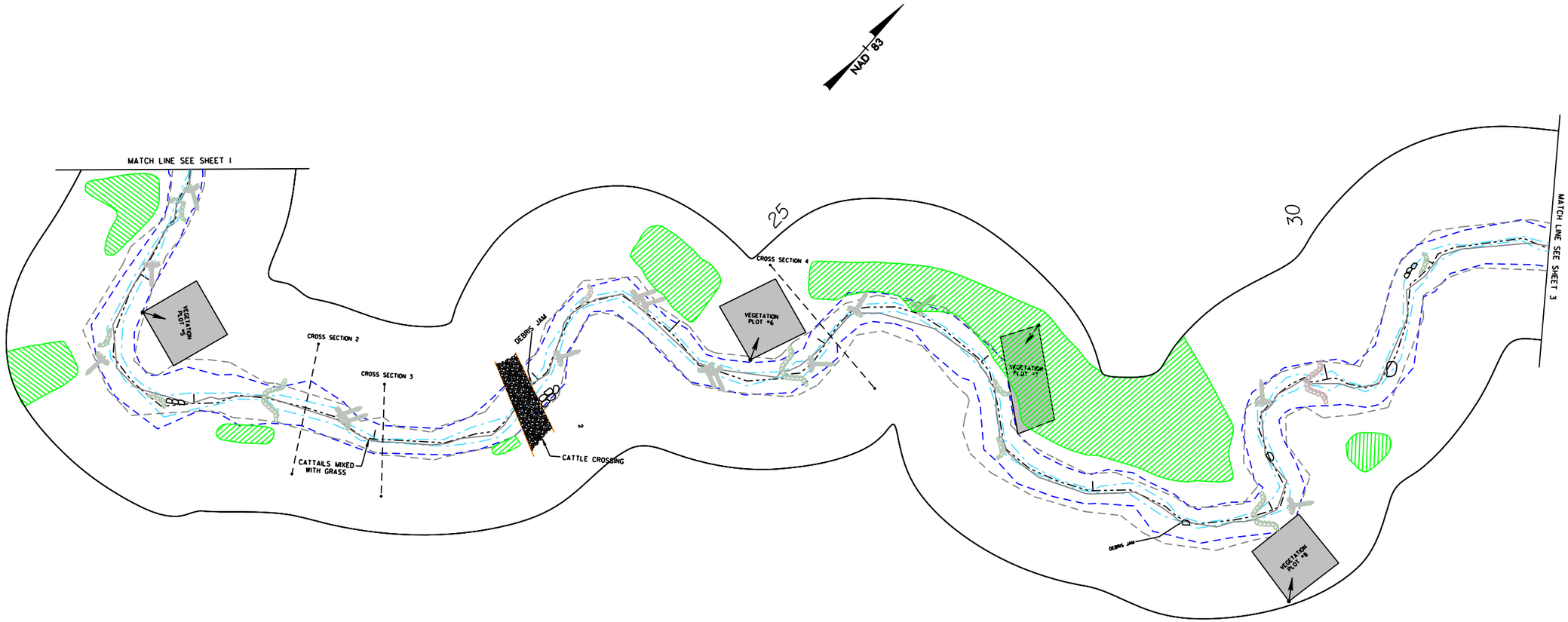
PROJECT REFERENCE NO.	SHEET NO.
301	2
PROJECT ENGINEER	

10 0 20
SCALE



VEGETATION PLOT STAKING (PHOTO CORNER)		
	NORTHING	EASTING
VEG PLOT 5	770734.5241	1880493.7336
VEG PLOT 6	770923.8296	1880751.6924
VEG PLOT 7	771036.2431	1880854.3849
VEG PLOT 8	771012.3764	1881048.6540

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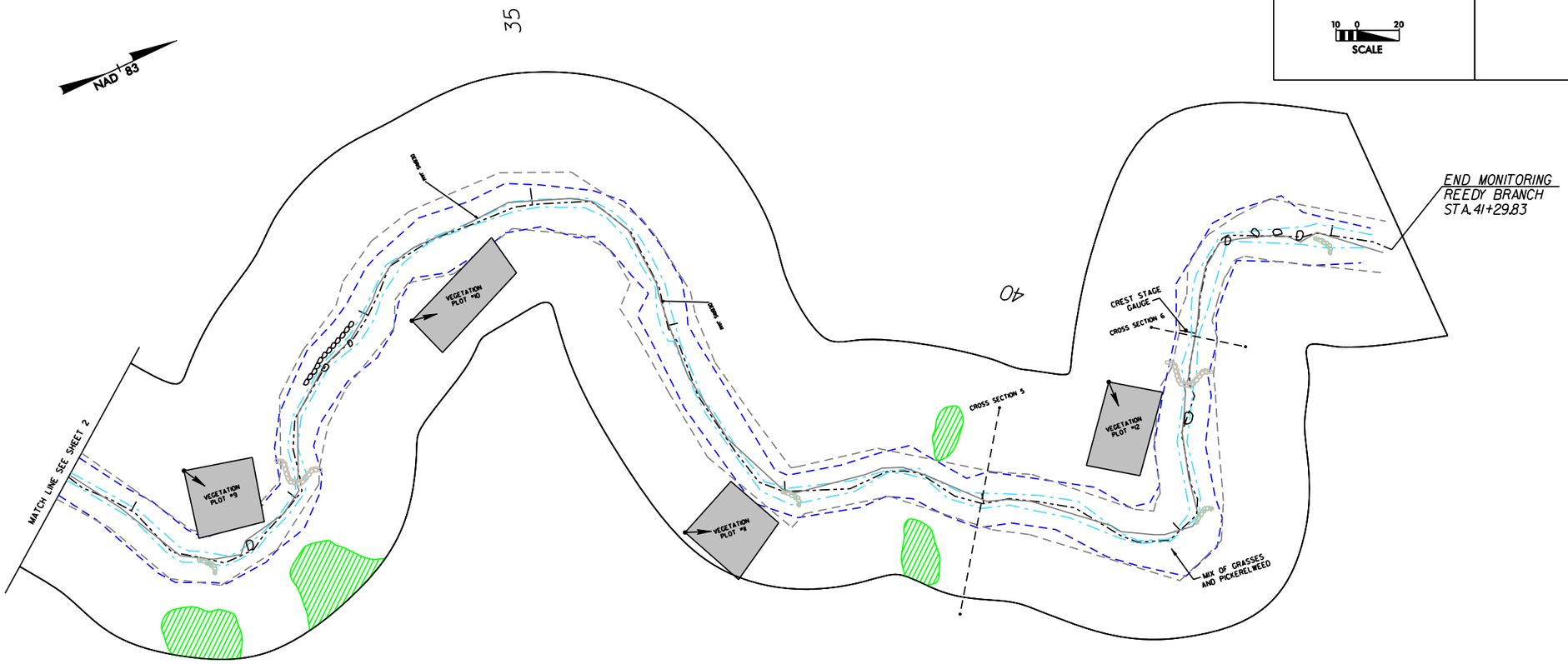

VEG PLOT STAKING (PHOTO CORNER)		
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