

ELK SHOALS STREAM RESTORATION SITE

ANNUAL MONITORING REPORT FOR 2008 (YEAR 4)

CONTRACT NUMBER AW.03003-B



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ANNUAL REPORT FOR 2008 (YEAR 4)

Elk Shoals Stream Restoration Site

1.0 SUMMARY

This Year 4 Annual Report describes the monitoring activities during the 2008 growing season on the Elk Shoals Stream Restoration Site (Site). Construction of the Site, including planting of trees, was completed in April 2005. The 2008 data represent results from the fourth year of stream and vegetation monitoring.

The design for the Elk Shoals project involved the restoration of channel dimension, pattern, and profile on Elk Shoals Creek and two of its unnamed tributaries (UTs). After construction was complete, 5,376 linear feet (LF) of stream had been restored on the Site.

This Annual Report presents the data from 3 vegetation monitoring stations, 21 photo point stations, 1 crest gauge and 10 cross-sections. The cross-sections are of Elk Shoals Creek and two UTs, as described in the approved Restoration Plan for the Site. Photos were taken of cross-sections and at in-stream structures. The longitudinal stream profile was not required during Year 4 of monitoring.

Survival success of woody vegetation is being monitored at 3 vegetation monitoring plots, each 0.057 acre in size, placed randomly at the Site. Survivability of trees in each vegetation plot is used to estimate the average survivability of all trees planted across the Site. The vegetation monitoring for Year 4 indicated a range of average survivability between 596 to 403 stems per acre. This Annual Report details the tree survival data obtained from all onsite vegetation monitoring plots and provides the average stems per acre of woody vegetation established throughout the Site during the 2008 growing season.

Part of the monitoring effort for this project includes observation of the project's response to local climatic conditions. Weather data from the Statesville Weather Station (UCAN: 14362, COOP: 318292) were used to document precipitation. Historical average rainfall totals were compared to the 2008 observed rainfall totals. For 2008, rainfall between the months of April and September was 28.19 inches recorded at the weather station compared to the long-term average of 23.80 inches for the same period of time, indicating that the conditions during the 2008 growing season were substantially wetter than the long-term average.

The on-site crest gauge documented the occurrence of at least one bankfull flow event during the Year 4 monitoring period. Year 4 cross-section monitoring data for stream stability were collected during August 2008. The riffle and pool cross-sections show that there has been very little adjustment to stream dimension since construction. Cross-sections 2, 3, 9 and 10 have remained very stable since as-built conditions. These cross-sections have continued to exhibit stability through Year 4. Cross-sections 1, 7 and 8 have exhibited moderate stability since as-built conditions. Cross-sections 5 and 6 have been deepening slightly every year since as-built conditions. The pool in cross-section 4 has also deepened since as-built conditions.

Visual observations of all structures for the Year 4 monitoring season revealed that the cross vane at station 49+50 exhibited minor piping occurring on the left bank. A visual observation of the ephemeral pool sequence located just upstream of Old Concord Church Road has experienced erosion on the left bank. An area of scour upstream of the ephemeral pool sequence was also observed during Year 4 of monitoring.

Approximately one acre of kudzu (*Pueraria montana*) was treated at the Site during Year 4 of monitoring. This was a follow-up to treatment of these areas in 2007, plus an expansion of the upstream area. Four beaver dams on Elk Shoals Creek were also observed and removed during the Year 4 monitoring period.

Table 1. Background Information.

Project Name	Elk Shoals Stream Restoration Site
Primary Contractor	Restoration Systems, LLC 1001 Haynes Street, Suite 203, Raleigh, NC 27604 (919) 755-9490
Designer	Michael Baker Engineering, Inc. 8000 Regency Parkway, Suite 200, Cary, NC, 27518 (919) 463-5488
Construction Contractor	River Works, Inc. 8000 Regency Parkway, Suite 200, Cary, NC, 27518 (919) 459-9001
Project County	Alexander County
Directions to Project Site	From Raleigh, follow I-40 west to exit 144 (Old Mountain Rd.). Head north on Old Mountain Rd to Old Concord Church Rd. Turn left on Old Concord Church Rd., Site entrance is on the right after crossing Elk Shoals Creek.
Drainage Area	Elk Shoals Creek = 4.6 square miles UT1 = 0.38 square miles UT2 = 0.5 square miles
USGS Cataloging Unit	03050101
NCDWQ Sub-basin	03-08-32
Project Length	5,376 LF (Restoration)
Restoration Approach	Restore and enhance channel dimension, pattern and profile to three separate stream reaches (As-built restoration length = 5,376 LF)
Date of Completion	April 2005
Monitoring Dates	Yearly through 5 growing seasons

2.0 INTRODUCTION

2.1 Project Description

The Site is located near the town of Stony Point in Alexander County within the Piedmont physiographic province of North Carolina (Figure 1). The Site lies in US Geological Survey (USGS) Cataloging Unit 03050101 and North Carolina Division of Water Quality (NCDWQ) sub-basin 03-08-32 of the Catawba River Basin. Environmental components monitored in this project are those that allow an evaluation of channel stability and survivability of riparian vegetation. The design for the restored streams involved the construction of stable meandering channels for the purpose of improving water quality and wildlife habitat.

The stream systems that historically flowed through the Site were degraded by past land management practices including land clearing, straightening and ditching of streams, row crop production (corn and soybeans), and livestock production. The streams on the Site were channelized, and riparian vegetation was cleared in most locations to increase arable acreage and improve drainage for agricultural purposes. Stream and riparian functions on the Site had been severely impacted as a result of agricultural conversion.

The project involved the restoration of 5,376 LF of channelized stream on Elk Shoals Creek and 2 UTs. Table 2 shows the as-built lengths and restoration type per reach. The as-built plans presented in Figure 2 illustrate the construction and planting that were completed for this project in April 2005.

Table 2. Summary of As-built Lengths and Restoration Approaches.

Reach Name	As-built Length (LF)	Restoration Approach
Elk Shoals Creek	563	Enhancement Level I
Elk Shoals Creek	3,531	Restoration
UT1	613	Restoration
UT2	669	Restoration
Total	5,376	

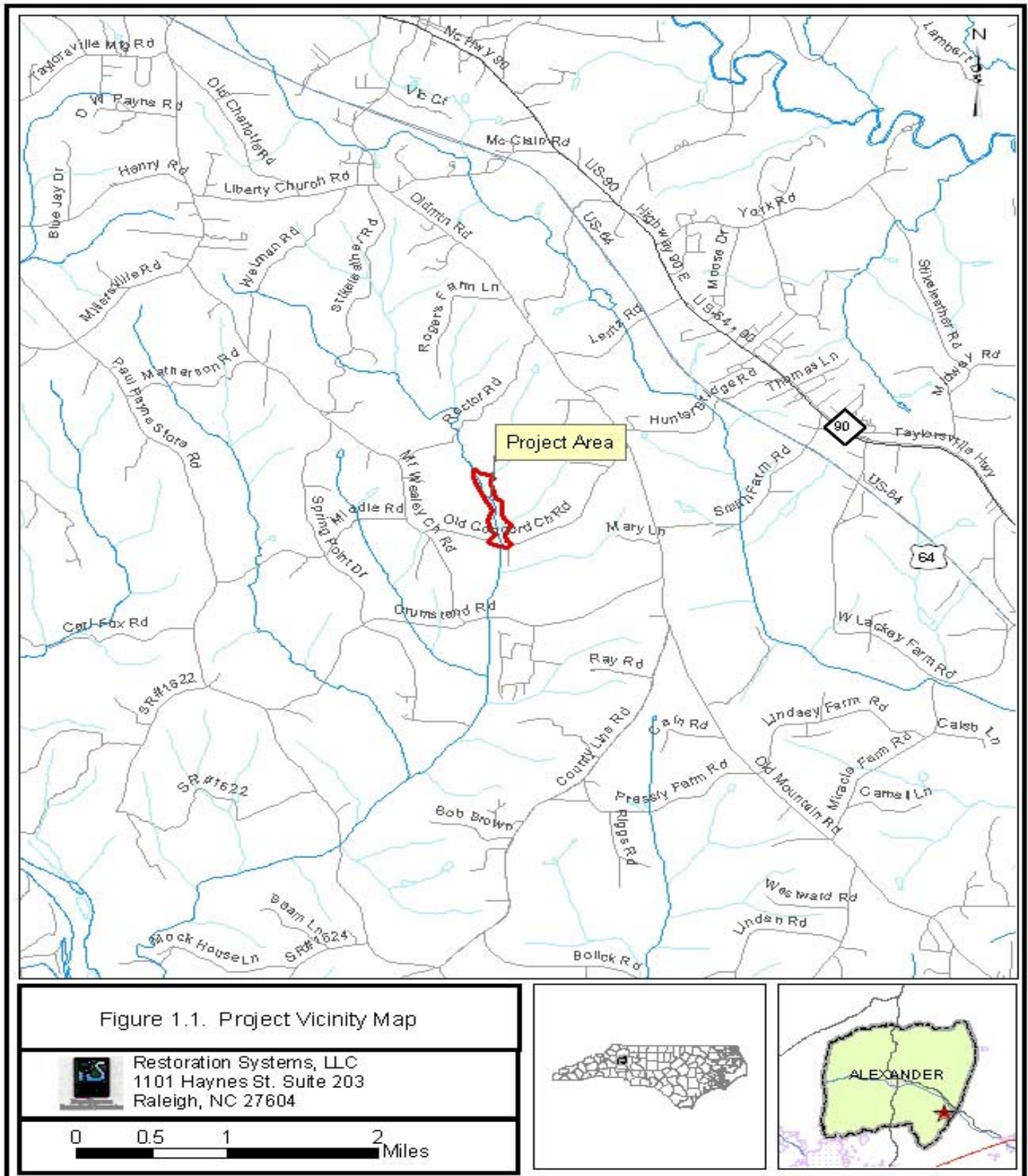
2.2 Purpose

Monitoring of the Elk Shoals Site is required to demonstrate successful stream restoration based on the criteria described in the approved Restoration Plan for this Site. Vegetation and stream stability monitoring are conducted on an annual basis. Success criteria for this site must be met for five consecutive years. This Annual Report details the results of the monitoring efforts performed during 2008 (Year 4) at the Elk Shoals Site.

2.3 Project History

October 2004	Approved Mitigation Plan
April 2005	Construction Completed
April 2005	Planting Completed
December 2005	1st Annual Monitoring Report
March 2006	Supplemental Planting
June 2006	Channel Repair Work
December 2006	2nd Annual Monitoring Report
November 2007	3rd Annual Monitoring Report
November 2008	4th Annual Monitoring Report
December 2009 (scheduled)	5th Annual Monitoring Report

Figure 1. Location of Elk Shoals Stream Restoration Site.



ELK SHOALS

PROJECT: 0173R

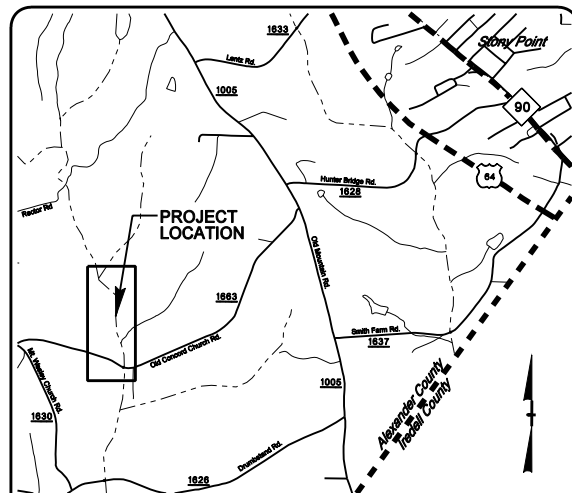
SINK PROPERTY STREAM RESTORATION SITE
ELK SHOALS CREEK

ALEXANDER COUNTY

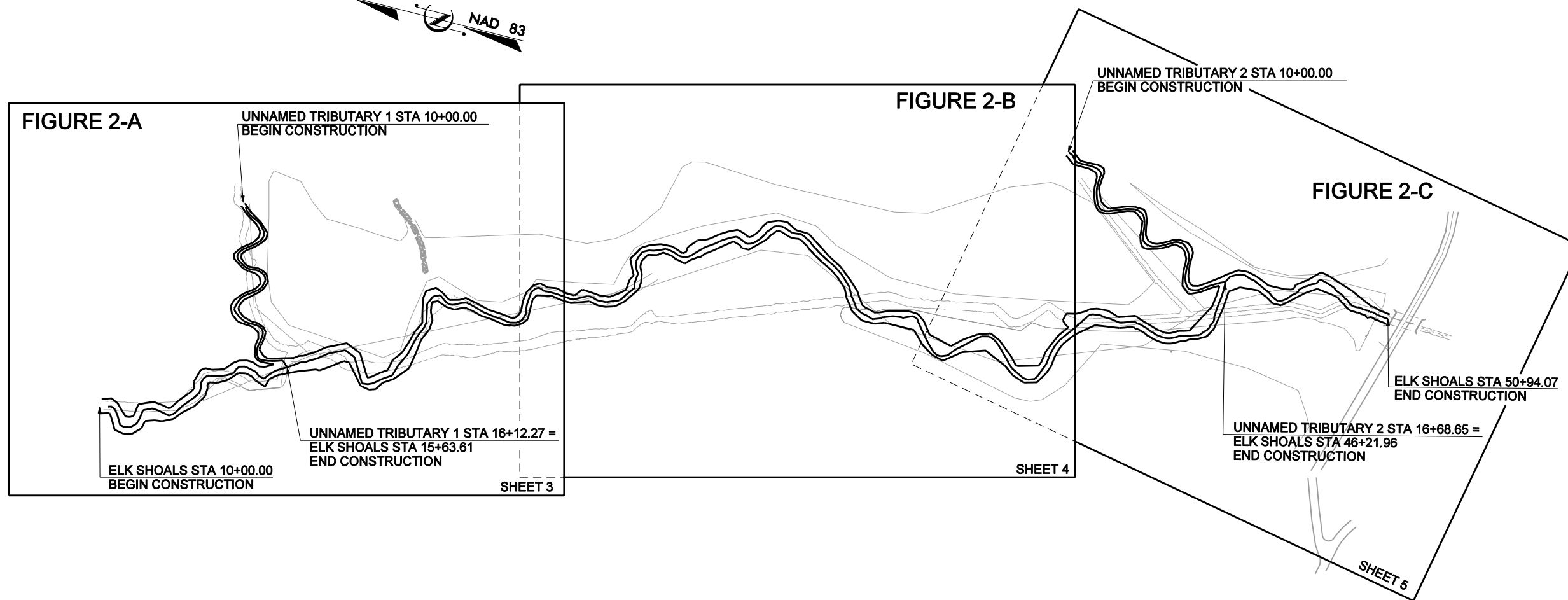
LOCATION: OFF SR 1663 OLD CONCORD CHURCH ROAD

FIGURE 2
TYPE OF WORK: AS-BUILT

STATE	BUCK PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
NC	173	1	8
NO.	DATE	CHECKED BY	APPROVED BY
1	4/27	HW	WH



VICINITY MAP



GRAPHIC SCALES



PROJECT SUMMARY

	ELK SHOALS	UT1	UT2	TOTAL	
DESIGN STREAM TYPE	= C4	C4	C4		
DRAINAGE AREA	= 4.6	0.38	0.5		SQ. MI.
AS-BUILT REACH LENGTH	= 4094	613	669	5376	- FEET
EXISTING REACH LENGTH	= 3342	412	493	4247	- FEET

PREPARED FOR THE OFFICE OF:
RESTORATION SYSTEMS, LLC



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APRIL, 2005
CONSTRUCTION COMPLETE:

C. HEATH WADSWORTH, P.E.
PROJECT ENGINEER

PROJECT ENGINEER

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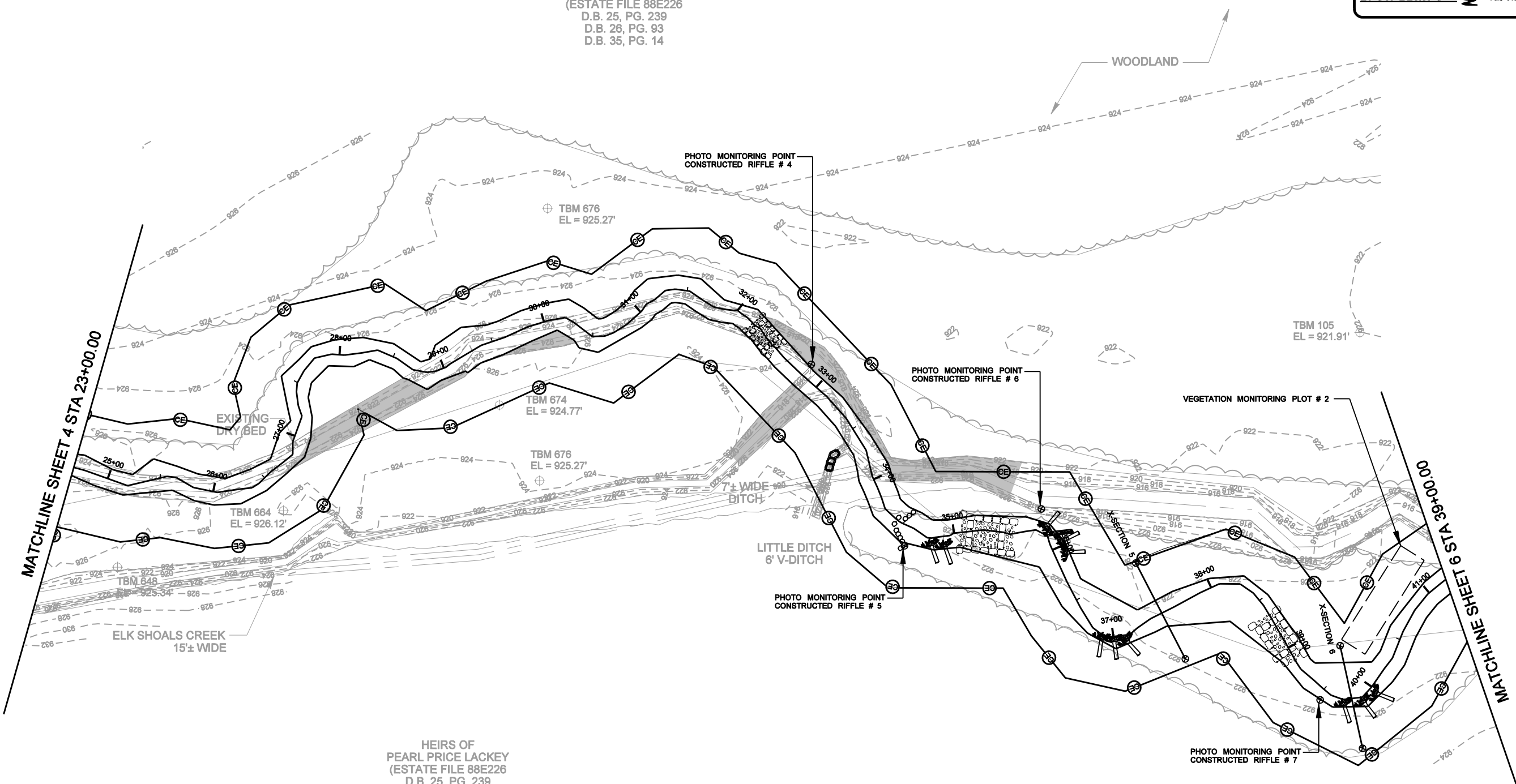
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PROJECT ENGINEER	
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FIGURE 2-B

HEIRS OF
PEARL PRICE LACKEY
(ESTATE FILE 88E226
D.B. 25, PG. 239
D.B. 26, PG. 93
D.B. 35, PG. 14

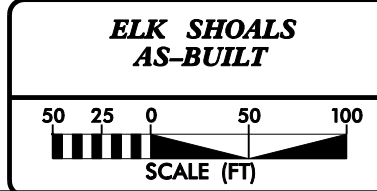


MATCHLINE SHEET 4 STA 23+00.00

MATCHLINE SHEET 9 STA 39+00.00

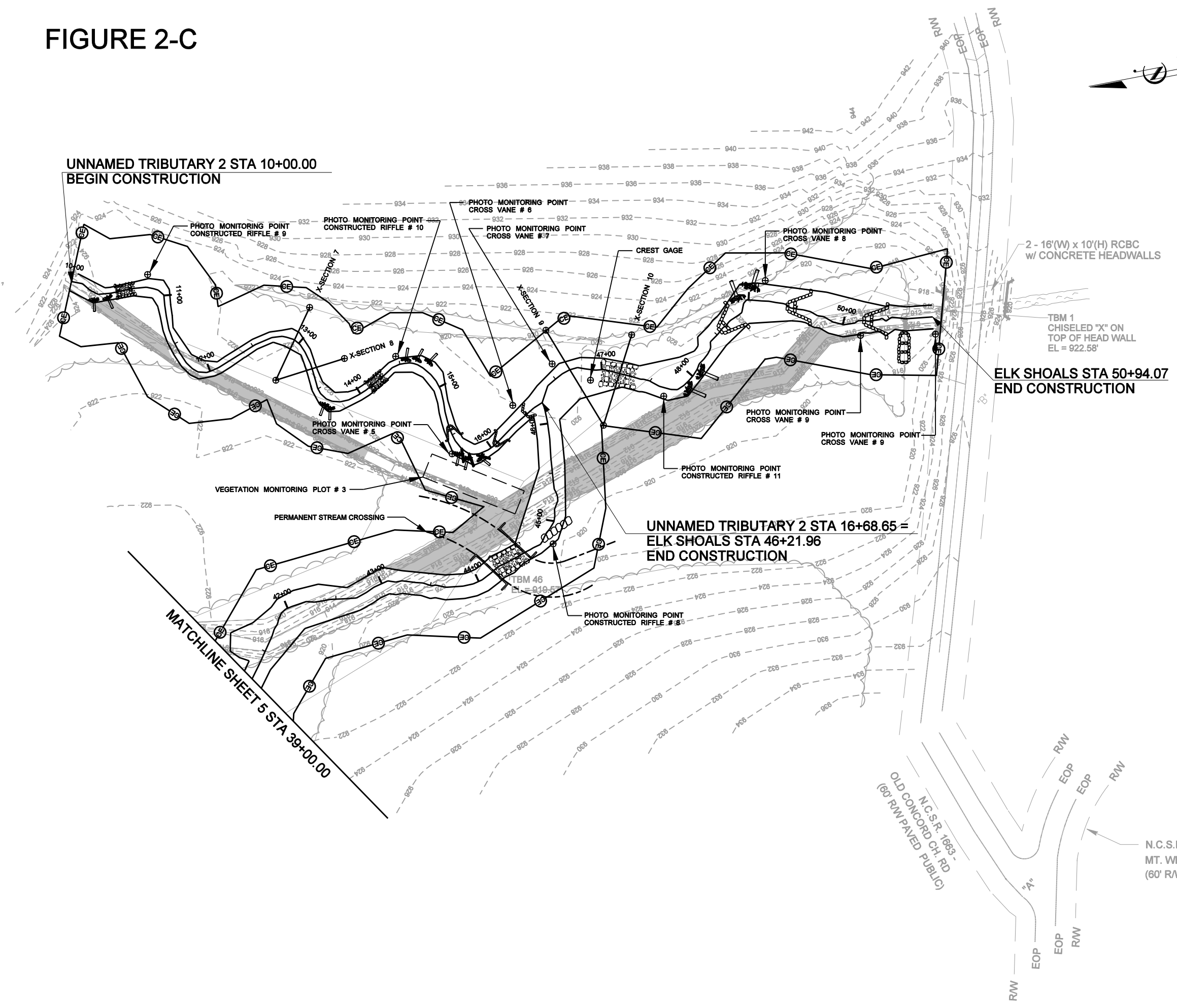
HEIRS OF
PEARL PRICE LACKEY
(ESTATE FILE 88E226
D.B. 25, PG. 239
D.B. 26, PG. 93
D.B. 35, PG. 14

NOTE:
SHADED CHANNEL SECTIONS INDICATE
AREAS THAT WERE FILLED.



2/26/03
I:\312006\173\Design\Plans\0173_PS_psh_AB_04.dgn

FIGURE 2-C



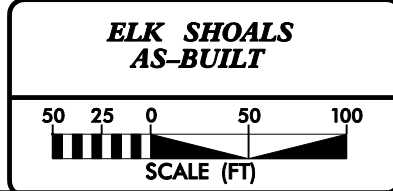
2 - 16'(W) x 10'(H) RCBC
w/ CONCRETE HEADWALLS

TBM 1
CHISELED "X" ON
TOP OF HEAD WALL
EL = 922.58'

UNNAMED TRIBUTARY 2 STA 16+68.65 =
ELK SHOALS STA 46+21.96
END CONSTRUCTION

NOTE:
SHADED CHANNEL SECTIONS INDICATE
AREAS THAT WERE FILLED.

N.C.S.R. 1630 -
MT. WESLEY CH. RD.
(60' RW PAVED PUBLIC)



2/26/03

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3.0 STREAM MONITORING

3.1 Description of Stream Monitoring

To document the stated success criteria, the following monitoring program was instituted following construction completion on the Elk Shoals Creek Restoration Site:

Bankfull Events: A crest gauge was installed on the Site to document bankfull events. The gauge is checked during yearly site visits, and records the highest out-of-bank flow event that occurs during the year. The gauge is located at stream station 47+00, near permanent cross-section 10 (see Figure 2-C).

Cross-Sections: As per the design criteria, 2 permanent cross-sections were installed per 2,000 LF of stream restoration work, with 1 of the locations being a riffle cross-section and 1 location being a pool cross-section. A total of 10 permanent cross-sections were established on the Site, 6 on Elk Shoals Creek, 2 on UT1, and 2 on UT2. Each cross-section was marked on both banks with permanent pins to establish the exact transect used. Permanent cross-section pins were surveyed and located relative to a common benchmark to facilitate easy comparison of year-to-year data. The annual cross-section surveys include points measured at all breaks in slope, including top of bank, bankfull, inner berm, edge of water, and thalweg. Riffle cross-sections are classified using the Rosgen stream classification system.

Longitudinal Profiles: A complete longitudinal profile was surveyed following construction completion to record as-built conditions. For monitoring years 1, 3, and 5 the longitudinal profile will be surveyed for at least 1,000 LF of the restored channel on Elk Shoals Creek, which shall include a 500-foot reach of the restored channel near the upstream section of the project and another 500-foot reach measured downstream. Measurements will include thalweg, water surface, bankfull, and top of low bank. Each of these measurements will be taken at the head of each feature (e.g., riffle, pool, and glide). In addition, maximum pool depth will be recorded. All surveys will be tied to a single permanent benchmark.

Photo Reference Stations: Photographs are used to visually document restoration success. A total of 21 photo reference stations were established to document conditions at the constructed grade control structures across the Elk Shoals Creek Site, and additional photo stations were established at each of the 10 permanent cross-sections. The GPS coordinates of each photo station have been noted as additional references to ensure the same photo location is used throughout the monitoring period. Reference photos are taken at least once per year.

Each stream bank is photographed at each permanent cross-section photo station. For each stream bank photo, the photograph is framed so that the survey tape is centered in the photo (appears as a vertical line at the center of the photograph), keeping the channel water surface line horizontal and near the lower edge of the frame, to include as much of the photographed bank as possible in the photo. A photo log of structures and photographs taken at the permanent cross-sections at the Elk Shoals Creek Site is included in Appendix A of this report.

3.2 Stream Restoration Success Criteria

The approved Restoration Plan requires the following criteria be met to achieve stream restoration success:

- *Bankfull Events*: Two bankfull flow events must be documented within the five-year monitoring period. The two bankfull events must occur in separate years.
- *Cross-Sections*: There should be little change in the as-built cross-sections. If cross-section changes are observed, they should be minor changes representing an increase in stability (e.g., settling, vegetative changes, deposition along the banks, or decrease in width/depth ratio). Cross-sections shall be classified using the Rosgen stream classification method and all monitored cross-sections should fall within the quantitative parameters defined for “C4/E4” type channels.
- *Longitudinal Profiles*: The longitudinal profiles should show that the bedform features are remaining stable (not aggrading or degrading). The pools should remain deep with flat water surface slopes and the riffles should remain steeper and shallower than the pools. Bedforms observed should be consistent with those observed in “C” or “E” type channels.
- *Photo Reference Stations*: Photographs will be used to subjectively evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation and effectiveness of erosion control measures. Photos should indicate the absence of developing bars within the channel, no excessive bank erosion or increase in channel depth over time, and maturation of riparian vegetation.

3.3 Results of Stream Monitoring

The on-site crest gauge documented the occurrence of at least one bankfull flow event during the Year 4 monitoring period. An inspection of site conditions during the October site visit revealed visual evidence of out-of-bank flow, such as debris and wrack lines, confirming the crest gauge reading. The largest onsite stream flow documented by the crest gauge during Year 4 of monitoring was in October, and was greater than 3.0 feet above the bankfull stage. Photos of the October bankfull evidence are located in Appendix A.

Year 4 cross-section monitoring data for stream stability were collected during August 2008 and compared to baseline stream data collected in May 2005 (as-built conditions), Year 1 data collected in November 2005, Year 2 data collected in September 2006 and Year 3 data collected in August 2007. The ten, permanent cross-sections along the restored channels (five located across riffles and five located across pools) were re-surveyed to document stream dimension at the end of monitoring Year 4. Data from each permanent cross-section are included in Appendix B of this report. The longitudinal profile survey was not required during Year 4 of monitoring.

The riffle and pool cross-sections show that there has been very little adjustment to stream dimension since construction. Cross-sections 1, 4, 6, 7, and 9 are located in pools found at the apex of meander bends. Cross-sections 2, 3, 5, 8 and 10 are located in riffles before and after pools.

Cross-sections 2, 3, 9 and 10 have remained very stable since as-built conditions. These cross-sections have continued to exhibit stability through Year 4. Cross-sections 1, 7 and 8 have exhibited moderate stability since as-built conditions.

Cross-sections 5 and 6 have been deepening slightly every year since as-built conditions. The pool in cross-section 4 has also been deepening since as-built conditions, with the exception of Year 4. During Year 4 of monitoring, the cross-section 4 thalweg was found to be at approximately the same elevation as as-built conditions.

Survey data from all pool cross-sections indicate the continued development of point bar features on the inside bank of the meander bends. All monitored cross-sections fell within the quantitative parameters defined for “C” or “E” type channels.

Four beaver dams were noted in the restored channel during this monitoring year and have since been removed. The beaver dams did not affect the overall monitoring results for Year 4.

Flow through a meander bend possesses higher conveyance velocity along the outer bank of the bend, and lower flow velocity along the bend’s inner bank. As flow velocity decreases, sediment transport capacity also declines, causing transported sediment to fall out and settle on the bottom as it slows down. Point bar formation along the inside of a meander bend indicates flow velocity vectors occurring as designed, and is therefore expected.

In-stream structures installed within the restored stream included constructed riffles, rock cross vanes, rock j-hooks and vanes, log bank toe protection, and root wads. A constructed riffle and three rock cross vanes were installed on the lower end of the project to step down the elevation of the restored stream bed to match the existing channel invert at the outlet of the project. Two cross vanes were repaired in June 2006 after minor piping or head cuts were noted upstream.

Visual observations of all structures during Year 4 of monitoring revealed that the cross vane at station 49+50 exhibited minor piping occurring on the left bank. A visual observation of the ephemeral step pool sequence located just upstream of Old Concord Church Road along the N.C. Department of Transportation (DOT) right-of-way has experienced erosion on the left bank. Scour upstream of the step pool sequence was also observed during Year 4 of monitoring. These two areas will be closely monitored during Year 5 of monitoring. If necessary, repairs may be performed using hand and/or power equipment. All other structures on the Site are performing as designed.

Rock vanes and J-hooks placed in meander pool areas have provided scour to keep pools deep and provide cover for fish. Cross vanes placed in riffle areas have maintained riffle elevations and provided a downstream scour hole that provides habitat. Root wads and brush layers placed on the outside of meander bends have provided bank stability and in-stream cover for fish and other aquatic organisms.

Photographs of the channel were taken during the Year 4 monitoring season to document the evolution of the restored stream geometry (see Appendix A and B).

4.0 VEGETATION MONITORING

4.1 Description of Vegetation Monitoring

At the completion of construction activities, stream margins and riparian areas of the Site were planted with bare root trees, live stakes, and a permanent herbaceous seed mixture. The woody vegetation was planted randomly six to eight feet apart from the top of the stream banks to the outer edge of the project's re-vegetation limits at a density of 680 stems per acre. The tree species planted at the Site are shown in Table 3. The seed mix of herbaceous species applied to the project's riparian area included Soft rush (*Juncus effusus*), Joe-pie-weed (*Eupatorium maculatum*), Wool grass (*Scirpus cyperinus*), Fringe sedge (*Carex crinata*), River Oats (*Uniola latifolia*), and Cardinal flower (*Lobelia cardinalis*). This seed mixture was broadcast on the Site at a rate of 21 pounds per acre. All planting was completed in April 2005.

Table 3. Tree Species Planted in the Elk Shoals Restoration Area.

ID	Scientific Name	Common Name	FAC Status
1	<i>Platanus occidentalis</i>	Sycamore	FACW-
2	<i>Quercus phellos</i>	Willow Oak	FACW-
3	<i>Quercus rubra</i>	Northern Red Oak	FACU
4	<i>Quercus alba</i>	White Oak	FACU
5	<i>Betula nigra</i>	River Birch	FACW
6	<i>Diospyros virginiana</i>	Persimmon	FAC
7	<i>Hamamelis virginiana</i>	Witch Hazel	FACU
8	<i>Fraxinus pennsylvanica</i>	Green Ash	FACW
9	<i>Liriodendron tulipifera</i>	Tulip Poplar	FAC
10	<i>Quercus falcata</i>	Southern Red Oak	FACU-
*11	<i>Quercus michauxii</i>	Swamp Chestnut	FACW
*12	<i>Quercus virginiana</i>	Live Oak	FACU
*13	<i>Quercus shumardii</i>	Shumard Oak	FAC

*September 2006 after supplemental planting conducted by River Works, Inc *

At the time of planting, three vegetation plots, labeled M1, M2, and M3, were delineated on-site to monitor survival of the planted woody vegetation. Each vegetation plot is 0.057 acre in size or 25 feet x 100 feet dimensionally. Plot delineation involved using metal fence posts at each of the four corners to clearly and permanently establish the area that was to be sampled. Then ropes were hung connecting all four corners to help in determining if trees close to the plot boundary were inside or outside of the plot. Trees on the boundary and trees just outside of the boundary that appear to have greater than 50 percent of their canopy inside the boundary were counted inside the plot. All of the planted stems inside the plot were flagged to distinguish them from any colonizing individuals and to facilitate locating them in the future.

4.2 Vegetation Success Criteria

To determine vegetation success criteria objectively, specific goals for woody vegetation density have been defined. Data from vegetation monitoring plots should display a surviving tree density of at least 320, 3-year-old trees per acre at the end of Year 3 monitoring, and a surviving tree density of at least 260, 5-year-old trees per acre at the end of the 5-year monitoring period. Although the selected native canopy species planted throughout the Site are the target woody vegetation cover, up to 20 percent of the Site’s established woody vegetation at the end of the monitoring period may be comprised of volunteer species.

4.3 Results of Vegetative Monitoring

Table 4 presents stem counts of surviving individuals found at each of the monitoring stations at the end of Year 4. Each planted tree species is identified across the top row, and each plot is identified down the left column. The numbers on the top row correlate to the ID column of Table 3. Trees within each monitoring plot are flagged regularly to prevent the occurrence of unmarked trees due to flag degradation. It is important for trees within the monitoring plots to remain marked to ensure they are all accounted for during the annual stem counts and calculation of tree survivability. Volunteer individuals found within the plots are also flagged during this process. Flags are used to tag trees because they do not interfere with the growth of the tree.

Table 4. 2008 Vegetation Monitoring Plot Species Composition.

Plot	Tree Species ID Number													Total	Stems/acre
	1	2	3	4	5	6	7	8	9	10	*11	*12	*13		
M1	8	3						18	1					30	526
M2	3	2						19	2		2	2	4	34	596
M3	5	1	4					9		2	1		1	23	403

*September 2006 after supplemental planting conducted by River Works, Inc *

4.4 Vegetation Observations

All of the herbaceous species seeded throughout the Site after construction (see Section 4.1 of this report) were found on-site at the end of the Year 4 monitoring period. In addition, Switch grass (*Panicum virgatum*) and Deer tongue (*Panicum clandestinum*) were observed throughout the Site. Microstegium (*Microstegium vimineum*), a non-native plant, was also noted within the riparian area. A few small privet plants and blackberry (*rubus spp.*) were noted on vegetation plot 1 M1. These species were not planted on the Site and are considered to be volunteer species.

During Year 4 of monitoring, Kudzu (*Pueraria montana.*) was noted on the Site within the conservation easement at Old Concord Church Road and between stations 42+00 and 44+00.

4.5 Vegetative Conclusions

The survival success of woody vegetation at each vegetation monitoring plot was notably low at the end of 2005. This low survival rate of planted trees was attributed to late planting (April 2005) combined with drier than average conditions throughout the growing season.

That initial low survival success of woody vegetation suggested the Site may not meet the minimum success criteria established as goal for the end of Year 3 of the monitoring period. To increase the density of successfully established trees at the Site, supplemental planting of woody vegetation took place during March 2006. The entire Site was planted with 50 percent of the original plantings, or 2,200 additional trees. At the end of Year 4 monitoring, the density of the 3 vegetation plots ranged from 596 to 403 stems\acre, as shown in Table 4 and the site is considered to be on trajectory for success. Photographs of the vegetation plots are presented in Appendix B.

4.5.1 Climatic Data

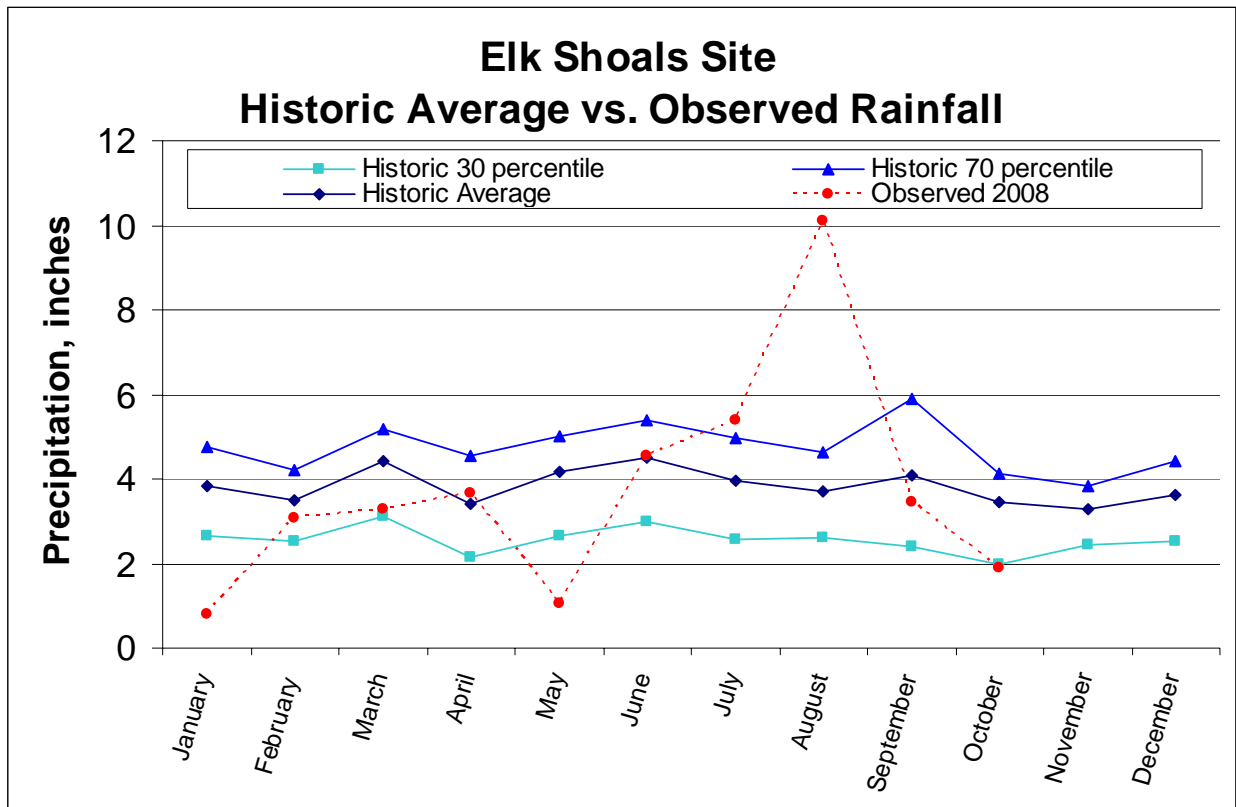
Table 5 and Figure 3 show a comparison of the 2008 monthly rainfall to historical precipitation (WETS table for Iredell County, collected between 1971 and 2000) for the project area. Historic climate information for Alexander County was not readily available; therefore, data from Iredell County were used due to its proximity to the Site. Weather data from the Statesville Weather Station (UCAN: 14362, COOP: 318292) were used to document precipitation for the monitoring year. Historical average rainfall totals were compared to the 2008 observed rainfall totals. For 2008, total rainfall observed at the weather station between the months of April and September was 28.19 inches, compared to the long-term average of 23.80 inches for the same period. Monthly precipitation values for 2008 were mostly average to below average, with the exceptions of July and August that experienced higher than normal rainfall due to tropical systems. This demonstrates that the climatic conditions observed during the 2008 growing season were substantially wetter than the long-term average.

Table 5. Comparison of Historic Average Rainfall to 2008 Observed Rainfall (Inches).

Month	Average	30%	70%	Observed Precipitation, P (in)	
				Month	P
January	3.83	2.65	4.74	January 2008	0.82
February	3.48	2.53	4.22	February 2008	3.06
March	4.4	3.13	5.19	March 2008	3.3
April	3.42	2.13	4.53	April 2008	3.65
May	4.15	2.67	5.00	May 2008	1.05
June	4.49	2.99	5.39	June 2008	4.55
July	3.95	2.57	4.95	July 2008	5.37
August	3.72	2.59	4.65	August 2008	10.12
September	4.07	2.41	5.88	September 2008	3.45
October	3.45	1.99	4.13	October 2008	1.90
November	3.3	2.45	3.84	November 2008	*
December	3.64	2.51	4.41	December 2008	*

Notes:
 * Data not available for Statesville Weather Station before submittal date of this report

Figure 3. Comparison of Historic Average Rainfall to 2008 Observed Rainfall



5.0 PROJECT MAINTENANCE

5.1 Kudzu Control

On September 19, 2008, approximately one acre of kudzu (*Pueraria montana*.) was treated at the Site. This was a follow-up to treatment of the areas made in 2007, plus an expansion of the upstream area. One area treated was near Station 50+25 and the other was between Stations 42+00 and 44+00. Treatment was made with Milestone VM herbicide at a rate of 7 oz. per acre. Follow-up surveys will be conducted during Year 5 and re-treatment carried out if necessary.

5.2 Beaver Dam Removal

Four beaver dams on Elk Shoals Creek were observed during the 2008 monitoring activities. The dams were located at the following locations: one upstream of station 20+00, two upstream of station 42+00 and one upstream of station 47+00. All dams were removed by using hand equipment. During monitoring Year 4, eight beavers were removed from the Site by trapping. Follow-up surveys during monitoring Year 5 will be conducted to determine if additional control activities are necessary.

6.0 OVERALL CONCLUSIONS AND RECOMMENDATIONS

Stream Monitoring. The total length of stream channel restored on the Site was 5,376 LF. This entire length was inspected during Year 4 of the monitoring period to assess stream performance.

Visual observations of all structures for the Year 4 monitoring season revealed that the cross vane at station 49+50 exhibited minor piping occurring on the left and right bank. A visual observation of the ephemeral step pool sequence located along the Old Concord Church Road DOT right-of-way has experienced erosion on the left bank. Scour upstream of the step pool sequence was also observed during Year 4 of monitoring. These two areas will be closely monitored during Year 5 of monitoring. If future monitoring proves that a move toward unstable conditions is developing in these areas, repairs may be performed using hand equipment. All other structures along the restored channel are stable and functioning as designed.

Vegetation Monitoring. During Year 4, vegetation monitoring indicated a range of average survivability between 403 and 596 stems per acre. The above average rainfall during the Year 4 growing season has increased the survivability of the vegetation plots. Seeded herbaceous vegetation has thrived onsite, providing adequate ground cover during the 2008 growing season. Kudzu on the Site will be monitored throughout Year 5 growing season.

APPENDIX A

PHOTO LOG



Constructed Riffle 1



Constructed Riffle 2



Constructed Riffle 3



Constructed Riffle 4



Constructed Riffle 5



Constructed Riffle 6



Constructed Riffle 7



Constructed Riffle 8



Constructed Riffle 9



Constructed Riffle 10



Constructed Riffle 11



Cross Vane 1



Cross Vane 2



Cross Vane 3



Cross Vane 4



Cross Vane 5



Cross Vane 6



Cross Vane 7



Cross Vane 8



Cross Vane 9



Cross Vane 10



Vegetation Plot M1



Vegetation Plot M2



Vegetation Plot M3



Bankfull evidence – Vegetation wrack line with direction of flow



Bankfull evidence – small debris in area of



Crest gauge - reading of more than 4.0 feet

APPENDIX B
STREAM MONITORING DATA

Permanent Cross-section #3
(Year 4 Data - collected August 2008)

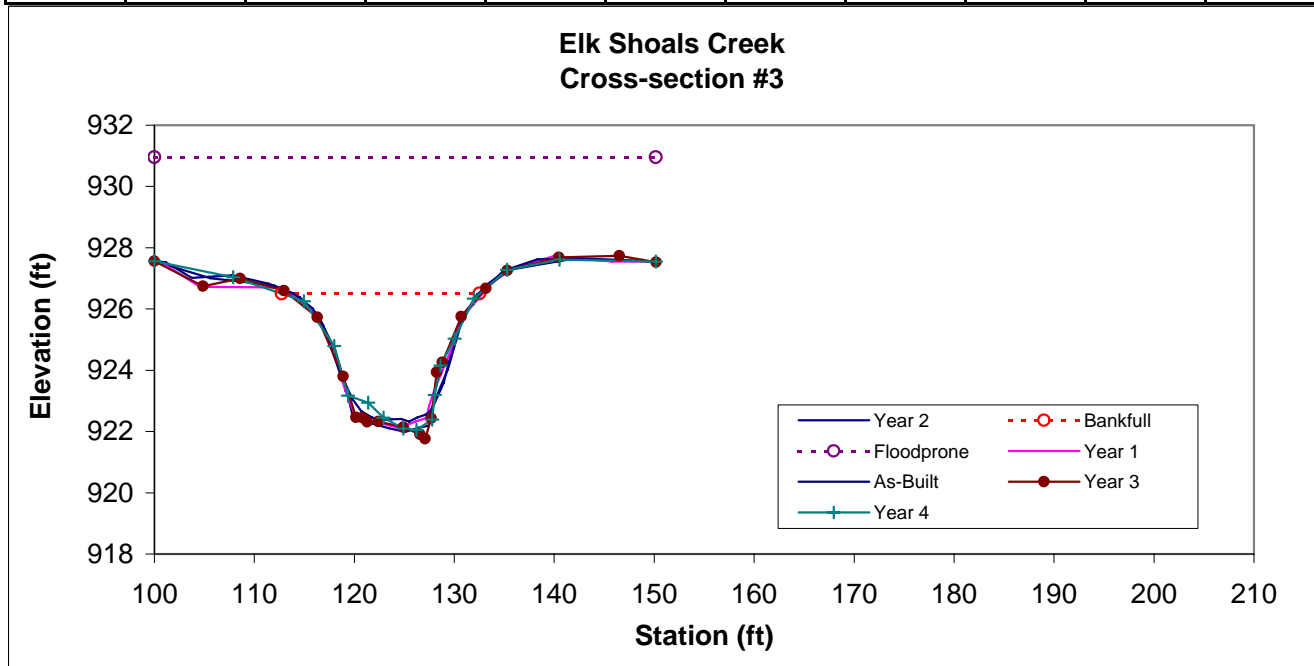


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	47.3	19.79	2.39	4.45	8.27	0.9	2.5	926.5	926.26



Permanent Cross-section #5
(Year 4 Data - collected August 2008)

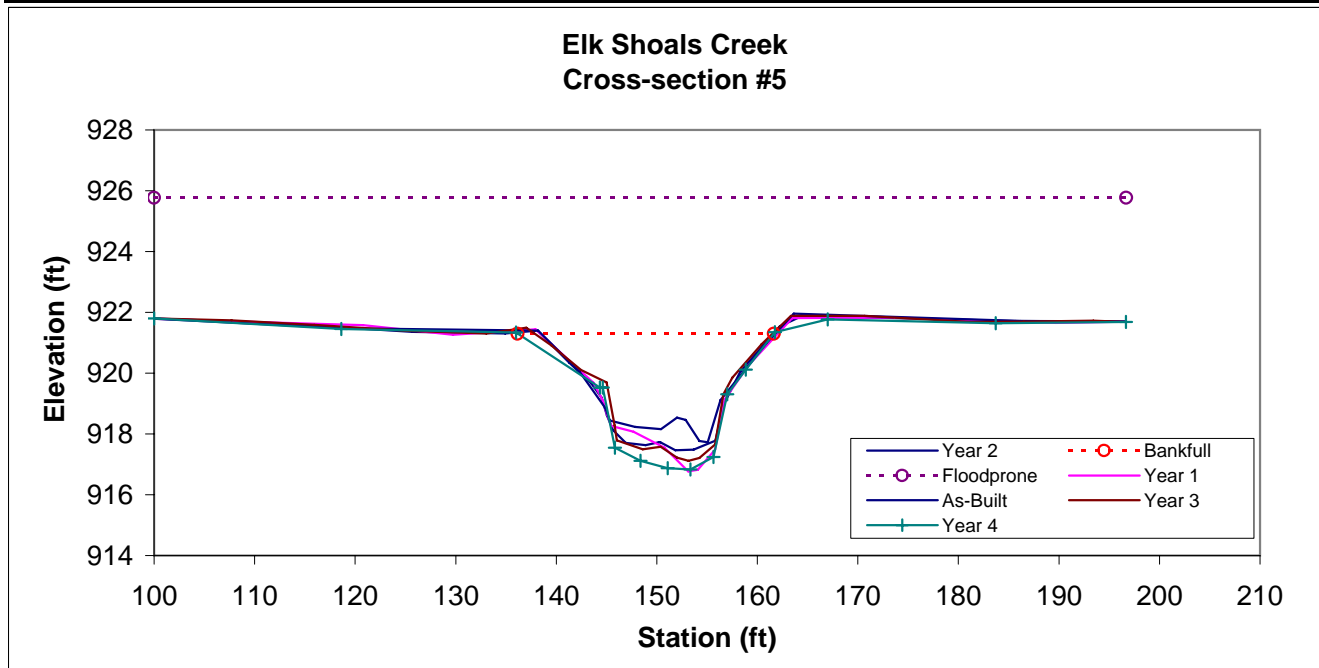


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	61.3	25.48	2.41	4.47	10.58	1	3.8	921.3	921.33



Permanent Cross-section #6
(Year 4 Data - collected August 2008)

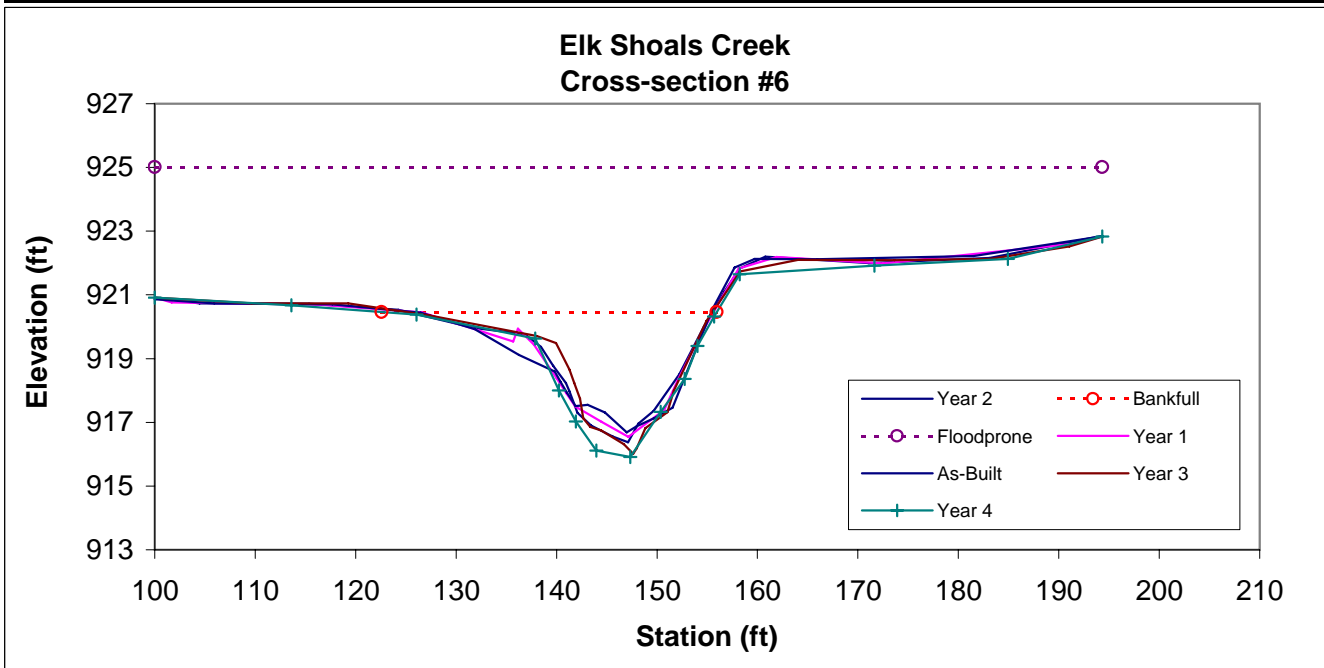


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		58.2	33.36	1.75	4.55	19.11	1	2.8	920.46	920.38



UT2 Permanent Cross-section #7

(Year 4 Data - collected August 2008)

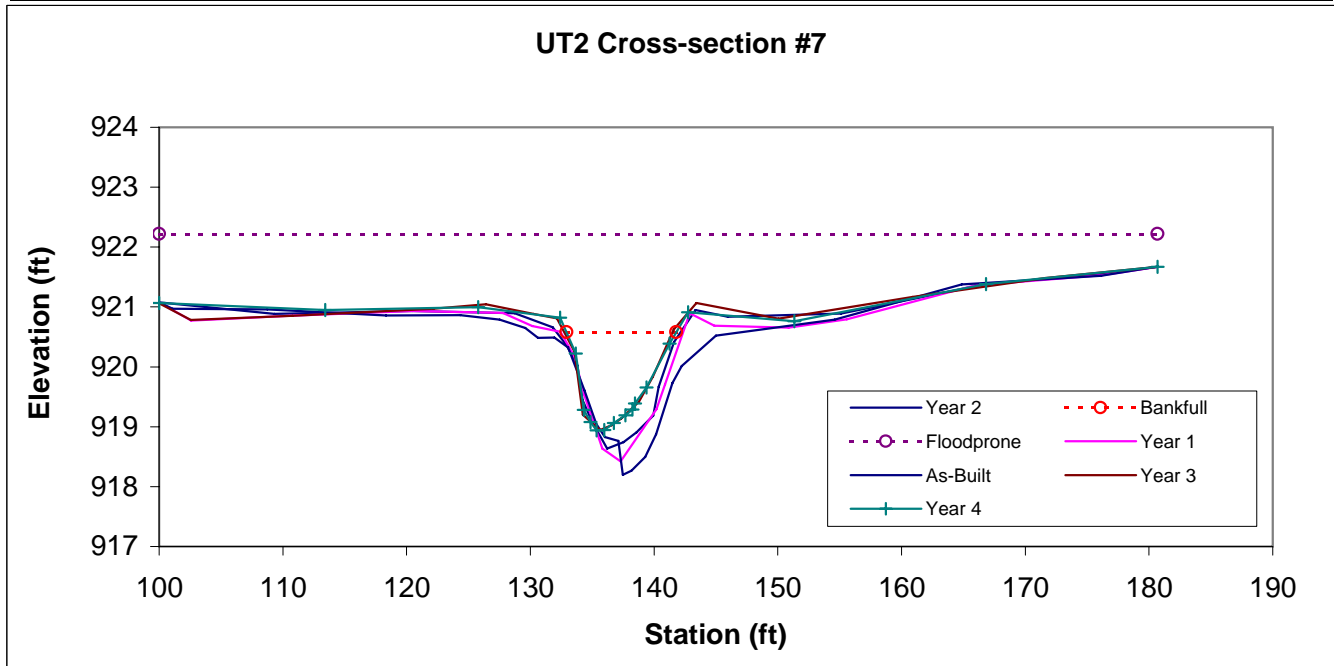


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		9	8.74	1.03	1.64	8.52	1.1	9.2	920.58	920.81



Permanent Cross-section #9
(Year 4 Data - collected August 2008)

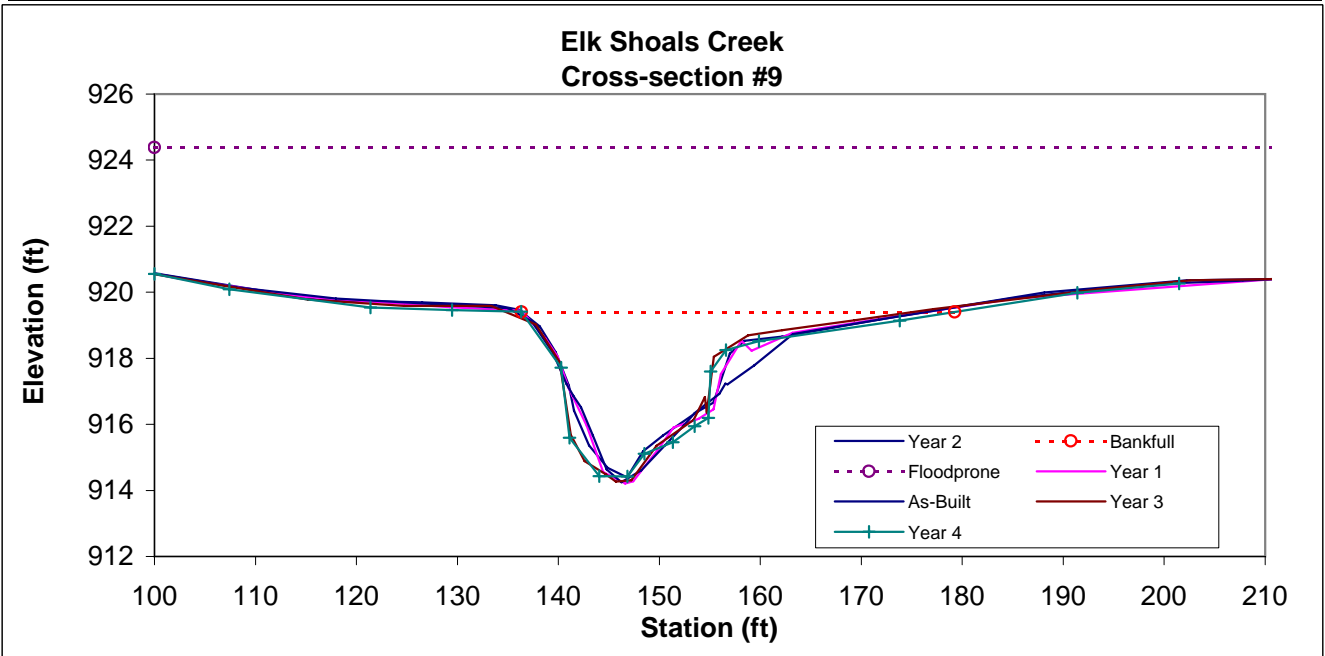


Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		79	42.9	1.84	4.98	23.3	0.8	2.6	919.4	918.52



Permanent Cross-section #10
 (Year 4 Data - collected August 2008)



Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	Cc	40	29.72	1.34	2.9	22.09	0.8	2.5	919.11	918.61

