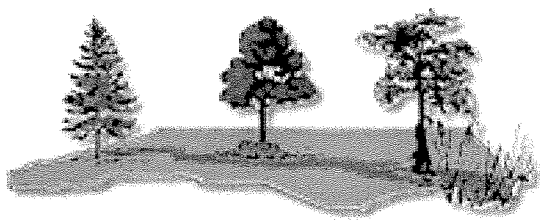
Smith and Austin Creeks Stream Mitigation Plan Wake Forest, North Carolina

North Carolina Department of Environment and Natural Resources
Wetlands Restoration Program



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March 2003

Smith and Austin Creeks
Stream Mitigation Plan
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Prepared For:

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Mitigation Plan Prepared By Buck Engineering PC

William A. Harman, P.G.
Project Manager

William M. Pedersen
Project Engineer

Executive Summary

In 2002, the North Carolina Wetlands Restoration Program (WRP) restored approximately 11,000 feet of Smith and Austin Creeks in Wake Forest, North Carolina. The project reaches are tributaries to the Neuse River. Construction began on May 13, 2002 and was completed on August 14, 2002. Due to three large storms causing bankfull events (one was between a 25 and 50-year rain event) within three months of construction, repair work was done from January 14 through January 23, 2003.

The existing stream channels had low sinuosity and varying levels of incision due to historic channelization and agricultural mismanagement. The stream restoration design was based on natural channel design principals and considered differences in drainage area, adjacent land uses, upstream impoundments, and future development potential. The design addressed the channel dimension, pattern, and profile based on reference reach parameters and hydraulic geometry relationships. When considering design alternatives, every effort was made to create a stable meandering channel with bankfull stage located at the existing floodplain elevation. Where valley or development restrictions did not allow for new channel pattern to be established, the existing incised channels were enhanced by excavating new floodplain benches and installing structures to improve bed features and control channel grade.

The project included creation of just over 700 ft of additional channel length. A summary of existing and restored reach lengths with restoration design approaches is provided in the table below. These lengths do not include the box culverts between Reaches AR1 and AR2 on Austin Creek which are 92 feet long.

Reach	Existing Length (ft)	Restored Length (ft)	Restoration Approach
SR1a	906	906	Change dimension and profile. Priority 3 restoration of incised channel.
SR1b	982	1,080	Change dimension, pattern, and profile. Priority 2 restoration of incised channel.
SR2	2,298	2,618	Change dimension, pattern, and profile. priority 1 restoration.
SR3	794	794	Stabilize eroding streambanks. Priority 4 Restoration.
AR1	2,581	2,581	Change dimension and profile. Priority 3 restoration of incised channel.
AR2	526	526	Change dimension and profile. Priority 3 restoration of incised channel.
AR3	2,189	2,480	Change dimension, pattern, and profile. Priority 1 restoration of an incised channel.
Total	**10,276**	**10,985**	

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1 Introduction

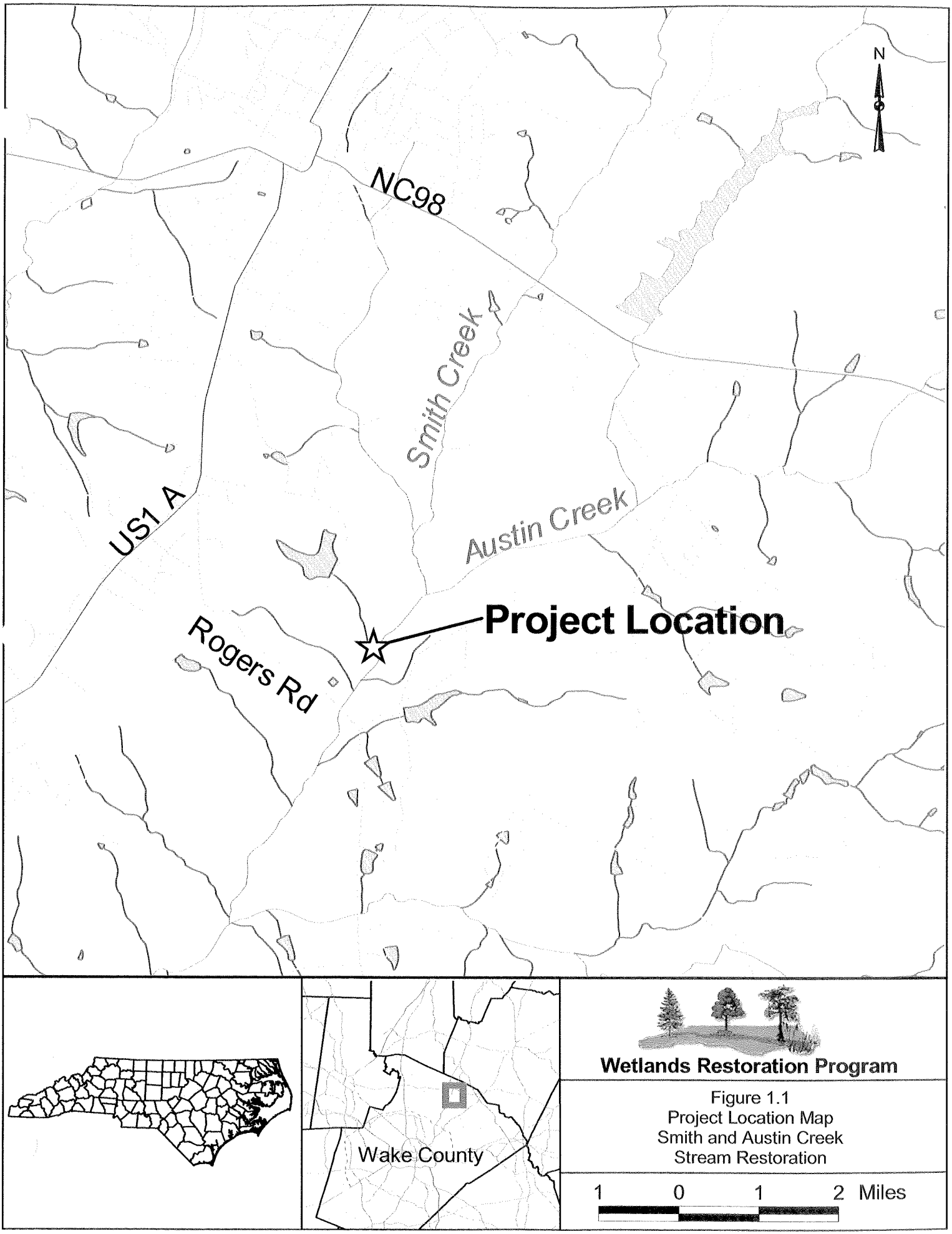
1.1 Project Goals

The objectives of the Smith and Austin Creeks stream restoration project are to:

1. Restore unstable stream channels to natural stable forms by modifying dimension, pattern, and profile based on reference reach parameters;
2. Improve floodplain functionality by matching bankfull stage with floodplain elevation;
3. Establish native floodplain vegetation through a forested riparian buffer;
4. Improve the natural aesthetics of the stream corridor; and
5. Obtain mitigation credits for other unavoidable impacts to streams within the same Hydrologic Unit Code (HUC).

1.2 Project Location

The project streams are located near the town of Wake Forest in Wake County, North Carolina (Figure 1.1). These streams are tributaries to the Neuse River (USGS HUC 03020201).


N
NC98
Smith Creek
US1 A
Austin Creek
Project Location
Rogers Rd
Wake County
Wetlands Restoration Program
Figure 1.1
Project Location Map
Smith and Austin Creek
Stream Restoration
1 0 1 2 Miles

2 Summary

2.1 Project Description and Watershed

The overall drainage area for the project watershed is 12.5 square miles. The project is divided into six reaches based on stream classification, reach drainage area, construction sequence, and confluence with tributaries (Figure 2.1 and the plan view sheets). The project reach lengths and their respective drainage areas are listed in Table 2.1.

Table 2.1 Project Reaches with Existing Lengths and Drainage Areas.

Reach Name and Location	Existing Length (ft)	Drainage Area (mi^2)
SR1 – Smith Creek from Property Boundary to Ford Crossing	1,888	3.3
SR2 – Smith Creek from Ford Crossing to Confluence with Austin Creek	2,298	3.6
SR3 – Smith Creek from Confluence to Forestville Road	794	12.5
AR1 – Austin Creek from Property Boundary to Box Culverts	2,581	8.4
AR2 – Austin Creek from Box Culverts to Bedrock Knickpoint	526	8.5
AR3 – Austin Creek from Bedrock Knickpoint to Confluence with Smith Creek	2,189	8.8
Total	**10,276**	

Historic agricultural land uses dramatically altered Smith and Austin Creeks on the project site. Past channelization resulted in low-sinuosity stream channels that were incised in many sections. Streambanks and bed features were unstable throughout the project site due to high shear stress and poor riparian vegetation. The location of the confluence of the two streams has changed as evidenced by old USGS topographic and USDA soil survey maps showing Austin Creek flowing into Smith Creek approximately 2,500 ft upstream of the current confluence. A large flood in the early 1990s caused an avulsion to occur and re-routed Austin Creek to its current downstream confluence with Smith Creek. A previous landowner completed the avulsion by excavating the current Austin Creek channel at the edge of the valley.

Currently, the land area between Smith and Austin Creeks immediately upstream of their confluence is being developed for a public park. The land uses farther upstream on the project site include a golf course and residential development. For all six reaches, a conservation easement of 15 to 100 ft from streambank was secured with no development planned within the stream corridor.

For a complete description of the existing conditions prior to construction, see the Smith and Austin Creeks Stream Mitigation Plan and Design prepared by Buck Engineering in June 2001.

2.2 Methodologies Used

Buck Engineering used natural channel design principles and considered differences in drainage area, adjacent land uses, upstream impoundments, and future development potential to redesign the stream to the highest level of restoration within the given constraints. The design addressed the channel dimension, pattern, and profile based on reference reach parameters and hydraulic geometry relationships. When considering design alternatives, every effort was made to create a stable meandering channel with bankfull stage located at the existing floodplain elevation. Where valley or development restrictions did not allow for new channel pattern to be established, the existing incised channels were enhanced by excavating new floodplain benches at the bankfull stage and installing structures to improve bed features and control channel grade.

This process included extensive planning beginning with the existing condition survey. Field data collected included: longitudinal profile and cross sections, bed material analysis, valley morphology, stream classification, channel stability assessment, channel evolution, riparian conditions, water quality impacts, and photographs. Other data analyzed included watershed analysis and land use survey (historical and present). The second step in the planning process was an analysis of stream potential and restoration alternatives (priority levels of restoration, urban considerations, and built-out scenarios). We conducted the design procedures concurrently with planning. These included reference reach analysis, verification of bankfull using the rural and urban Piedmont regional curves, restored channel morphology design (channel dimension, pattern, and profile), sediment transport analysis, structure design and placement, streambank stabilization/bioengineering, design of an erosion and sediment control plan, flood impact analysis, and completion of design plans. Finally, Buck Engineering conducted construction management including field layout, construction supervision, preparation of the as-built survey, and collection of photographs.

2.3 Plan View

See separate set of plan sheets included.

2.4 Points of Contact

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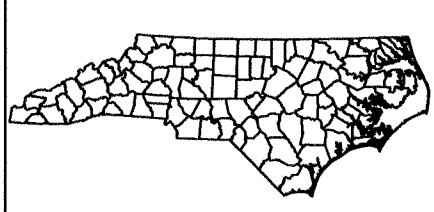

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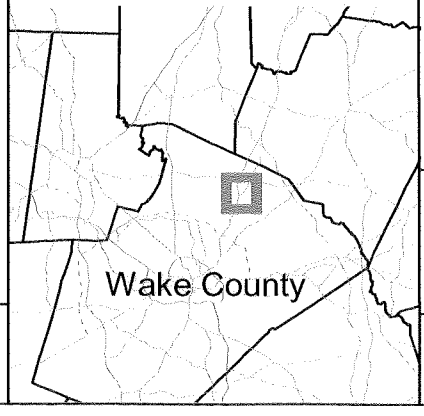

Wetlands Restoration Program

Figure 2.1
Watershed Map
Smith and Austin Creek
Stream Restoration

1 0 1 2 Miles

3 Success Criteria

Environmental components monitored in this project are those that allow an evaluation of channel stability and riparian survivability. Specifically, the success of channel modification, erosion control, seeding, and woody vegetation plantings will be evaluated. This will be accomplished through the following activities for 5 years after the project is built.

3.1 Dimension

Permanent cross-sections were established with approximately two riffles and two pools per reach, for a total of 23. Each cross-section is marked on both banks with permanent pins set in concrete to establish the exact transect used. A common benchmark is used for cross-sections to facilitate easy comparison of year-to-year data. The annual cross-section survey includes points measured at all breaks in slope, including top of bank, bankfull, and thalweg. Riffle cross-sections will be classified using the Rosgen stream classification system.

Success Criteria: There should be little or no change in as-built cross-sections. If changes do take place they should be evaluated to determine if they represent a movement toward a more unstable condition (down-cutting, erosion) or are minor changes that represent an increase in stability (settling, increase in vegetative density, deposition along the banks, decrease in width/depth ratio, decrease in cross sectional area).

3.2 Pattern and Profile

A longitudinal profile was completed after construction and will proceed every two years for a total of five years (for a total of 4 times). Measurements include thalweg, water surface, bankfull, and top of low bank. Each measurement is taken at the head of facets, e.g. riffle, run, pool, and glide, and the maximum pool depth. The survey is tied to a permanent benchmark. The survey is also used to calculate sinuosity.

Success Criteria: The as-built longitudinal profiles should show that the bedform features are remaining stable, e.g., they are not aggrading or degrading over the 5-year period. Short term aggradation/degradation may occur depending on the peak annual discharge. The gravel bed 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 "E" and "C" type channels. The pattern should not change and there should be no change in sinuosity. The pool/riffle sequence should also remain constant.

3.3 Bed Material Analysis

We did not complete a bed material analysis since this is a sand/small gravel stream. We do not expect significant coarsening over time.

3.4 Photo Reference Sites

Photographs used to evaluate restored sites will be made with a 35-mm camera using slide film or a digital camera. Reference sites were photographed before construction and will be taken once a year for at least 5 years following construction. After construction, reference sites were marked with wooden stakes.

Longitudinal reference photos: Photographs will be taken looking downstream at delineated locations. Reference photo locations were marked and described for future reference. Points are close enough together to provide an overall view of the reach. The angle of the shot depended on what angle provided the best view and was noted for future shots. When modifications of stream position have to be made due to obstructions or other reasons, the position will be noted along with any landmarks and the same position used in the future.

Lateral reference photos: Reference photo transects will be taken at each permanent cross-section. Photographs will show both banks at each cross-section. The survey tape will be centered in the photographs of the bank. The water line will be located in the lower edge of the frame and as much of the bank as possible included in each photo. Photographers should make an effort to consistently maintain the same area in each photo over time. These locations were also marked with wooden stakes.

Success Criteria: Photographs will be used to qualitatively evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation and effectiveness of erosion control measures. Longitudinal photos should indicate the absences of developing bars within the channel or an excessive increase in channel depth. Lateral photos should not indicate excessive erosion or continuing degradation of the bank over time. A series of photos over time should indicate successional maturation of riparian vegetation. Vegetative succession should include initial herbaceous growth, followed by increasing densities of woody vegetation and then ultimately a mature overstory with herbaceous understory.

3.5 Vegetation Survival Plots

The riparian restoration design was provided by Soil and Environmental Consultants, Inc. of Raleigh, North Carolina. Survival of planted vegetation will be evaluated using survival plots and counts.

Survival of live stakes will be evaluated using two plots that have over 100 live stakes in each plot. Evaluations of live stake survival will continue for at least 5 years. When

stakes do not survive a determination will be made as to the need for replacement; in general if greater than 25% die, replacement will be done.

Survival of rooted vegetation will be evaluated using three plots and will continue for at least 5 years to determine survival. The plots are 25 ft by 100 ft. All stems were flagged and counted. When rooted vegetation does not survive, a determination will be made as to the need for replacement; in general, if greater than 25% die, replacement will be done.

Success Criteria: The interim measure of vegetative success will be the survival of at least 320 3-year old planted trees per acre at the end of year three of the monitoring period. The final vegetative success criteria will be the survival of 260 5-year old planted trees per acre at the end of year five of the monitoring period. In addition, for the five year monitoring period, the presence of volunteer facultative softwood species such as red maple, sweet gum, and loblolly pine will be limited to less than 10% each of the total number of trees utilized to determine success. These trees may contribute more than 10% of the total trees on the site, but they will not constitute more than 10% each of the 260 trees per acre.

3.6 Benthic Macroinvertebrate Monitoring

Benthic macroinvertebrate monitoring will be conducted by the NC Division of Water Quality.

4 Monitoring Schedule and Methods

Monitoring will be conducted annually for five years. Buck Engineering conducted the as-built survey and will conduct the first year survey. Annual surveys will be conducted in September starting in 2003 and ending in 2007.

The cross sections will be surveyed each year using a tape and level between the permanent cross section pins. This will include a photo of each cross section taken from the upstream side looking downstream ensuring both banks are visible in the photograph.

The longitudinal survey will be done using a Total Station or level for the first year and then every two years for a total of four times (As-built is completed, then September of 2003, 2005, and 2007).

The photographs will be taken every year (Buck Engineering will use a digital camera for the first year). They include the cross sections listed above as well as longitudinal photographs taken from the photo locations listed on the plan view. These supplement the cross section photos to ensure the entire reach is covered.

Vegetation survival plots will be counted annually. The plots for both bare root plantings and live stakes are listed on the plan view. For success criteria, the 3-year period is through September 2005, and the 5-year period is through September 2007.

5 Mitigation

5.1 Mitigation Proposal

The following table lists the proposed mitigation available after completing the project.

Table 5.1 Proposed Mitigation.

Reach	Restored Length (ft)	Category
SR1a	906	Enhancement
SR1b	1,080	Restoration
SR2	2,618	Restoration
SR3	794	Stabilization
AR1	2,581	Enhancement
AR2	526	Enhancement
AR3	2,480	Restoration
Total	**10,985**	

5.2 Design Summary

The stream restoration design for Smith and Austin Creeks was based on natural channel design principals. The design took into account differences in drainage area, adjacent land uses, upstream impoundments, and future development potential. Overall, the natural channel design addressed the dimension, pattern, and profile for both Smith and Austin Creeks. The design approach for each of the six project reaches is described in Sections 5.3 through 5.8. For all reaches, the streambanks, bankfull bench and terrace scarp were seeded with millet and covered with C 125 BN erosion control matting. Permanent seeding will take place during the winter.

5.3 Reach SR1

The natural channel design for Reach SR1 of Smith Creek was based on a Priority 2 and 3 restoration approach. A new floodplain was created at a lower elevation by excavating

a stable bankfull bench of varying width. The resulting bank height ratio is 1.0. Reach SR1 was broken into sub-reaches as SR1a and SR1b. The break between the sub-reaches is at station 8+75 and is shown on the plan view. Reach SR1a from station 0+00 to 8+75 was converted from a G5c channel to an E5 channel in its existing location. Bedform was improved through the use of instream structures. Reach SR1b from station 8+75 to 19+55 was an eroding incised E5 channel. In addition to changes in dimension and profile, the meander geometry was improved through this section to provide a more stable plan form. Root wads were used to stabilize the streambanks, improve bedform diversity, and improve aquatic habitat. Instream structures were used to provide grade control, protect streambanks, and enhance bedform.

5.4 Reach SR2

The existing straight channel in Smith Creek (SR2) was replaced by a new meandering channel with bankfull stage at the existing floodplain elevation. A stable meandering channel was cut in the existing well-vegetated floodplain. Woody transplants and sod mats were used to stabilize the streambanks along the new channel. Instream structures such as root wads and rock vanes were used to stabilized the streambanks and improve bedform diversity.

5.5 Reach SR3

Reach SR3 of Smith Creek downstream of the confluence of Smith and Austin Creeks was moderately stable and has a well-vegetated riparian buffer. No changes in dimension, pattern, or profile were proposed for this reach. However, short eroding sections were stabilized with root wads and instream structures.

5.6 Reach AR1

The natural channel design for Reach AR1 of Austin Creek was based on a Priority 3 restoration approach. Stream restoration was confined to within the 50-ft conservation easement on both sides of the existing stream channel. Since the left streambank is moderately stable with mature vegetation providing shade to the stream, a bankfull bench was not constructed on the left bank except for several short sections devoid of woody vegetation. On the right streambank, a 45-ft wide inner berm to bankfull bench was excavated and vegetated. The right bench was constructed below the built out bankfull since the floodplain is confined. This approach will allow deposition to occur on the bench. The natural bankfull dimension will develop over time.

Instream structures, including root wads, log vanes, single wing deflectors, and rock vanes were used to repair eroding streambanks and improve the channel profile (bedforms). Cross vanes were installed upstream and downstream of the golf cart bridge to prevent near bank scour at the bridge. A cross vane and rock vane were constructed upstream of the box culverts to decrease the width of the low flow channel. In addition, a

"W" weir was added just upstream of the box culverts to direct base flow primarily through the center left culvert, then the center right culvert.

5.7 Reach AR2

The natural channel design for Reach AR2 of Austin Creek was based on a Priority 3 restoration approach similar to Reach AR1. The section immediately downstream of the Forestville Road box culverts was overly wide. In addition, the box culverts are angled such that stream velocity vectors were pointed at the right streambank. A rock vane was added to redirect the velocity vectors away from the streambank. A rock cross vane was constructed downstream of the rock vane to prevent further widening of the channel. Additional instream structures were installed to improve the channel profile by improving bedform diversity. A 95-ft bankfull bench was installed along the right streambank. The existing culverts near Station 32+00 were removed.

5.8 Reach AR3

The existing straight channel of Austin Creek (AR3) was replaced by a new meandering channel with bankfull stage at the existing floodplain elevation. A stable meandering channel was cut in the existing well-vegetated floodplain. The bankfull dimension for this reach was constructed for the built-out condition since the floodplain was not confined. This results in a larger channel than the one shown in AR1. Woody transplants and sod mats were used to stabilize the streambanks along the new channel. Instream structures such as root wads and rock vanes were used to stabilized the streambanks and improve bedform diversity.

5.9 Riparian Restoration Design

The riparian restoration design was provided by Soil and Environmental Consultants, Inc. of Raleigh, North Carolina and is not a part of this report. A copy of the report can be obtained from the NC Wetlands Restoration Program.

5.10 Mitigation Credit

The mitigation credit proposal will be completed by the NC Wetlands Restoration Program. Buck Engineering has provided a plan view showing reaches and sub-reaches for their use.

6 Maintenance and Contingency Plans

As noted in the summary, the project was subject to three large storm events directly after construction without the benefit of vegetation beyond temporary seeding. 94% of the rock structures had no damage and are functioning as planned. In addition, 98% of the restored streambanks are stable and functioning properly. To address the problem areas, Buck Engineering conducted construction supervision at the site from January 14 through January 23, 2003. Work included repairing structures, emplacing new structures, and stabilizing streambanks (through shaping, rootwads, seeding, matting, and bioengineering). The plan view was updated to reflect all changes. A summary of key changes to instream structures by reach follows.

1. SR1a. Added two bankfull benches to connect the existing benches from stations 1+00 to 2+75 and from stations 6+00 to 7+00. The cross vane at station 5+45 was dismantled and two rock vanes were added off the right bank in that meander bend. Finally, a rock vane was added off the left bank at station 6+75.
2. SR1b. Added two rock vanes at stations 9+00 and 15+75.
3. SR3. Removed the cross vane at station 45+80 and replaced it with two rock vanes off the right bank. In addition, provided toe protection for both banks from stations 52+40 to 53+00.
4. AR1. Added a rock vane off the right bank at station 24+75.
5. AR2. Stabilized the right bank vicinity the parking lot runoff at station 29+55 with rootwads, bioengineering, and additional grading.

Buck Engineering will look for maintenance concerns during monitoring the first year. After that time, the company conducting monitoring will report concerns to the NCWRP Project Manager.

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Smith and Austin Creeks
Cross Section Summary

Smith Creek

SR1

Cross Section 1 – Riffle	Photo Point 35
Cross Section 2 – Riffle	Photo Point 47
Cross Section 3 – Riffle	Photo Point 48
Cross Section 4 – Pool	Photo Point 49
Cross Section 5 – Pool	Photo Point 55

SR2

Cross Section 1 – Riffle	Photo Point 61
Cross Section 2 – Pool	Photo Point 62
Cross Section 3 – Pool	Photo Point 67
Cross Section 4 – Riffle	Photo Point 68
Cross Section 5 – Riffle	Photo Point 73

Austin Creek

AR1

Cross Section 1 – Rifle	Photo Point 1
Cross Section 2 – Riffle	Photo Point 4
Cross Section 3 – Riffle	Photo Point 10
Cross Section 4 – Pool	Photo Point 12

AR2

Cross Section 1 – Riffle	Photo Point 16
Cross Section 2 – Pool	Photo Point 17
Cross Section 3 – Riffle	Photo Point 19

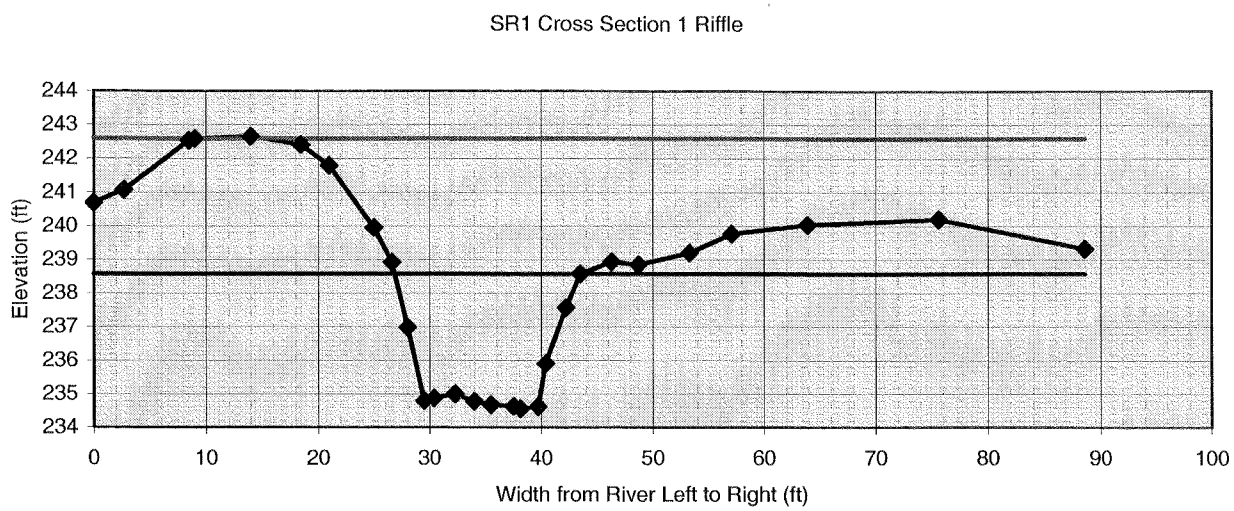
AR3

Cross Section 1 – Pool	Photo Point 22
Cross Section 2 – Riffle	Photo Point 23
Cross Section 3 – Pool	Photo Points 25 and 26
Cross Section 4 – Riffle	Photo Point 27
Cross Section 5 – Riffle	Photo Point 30
Cross Section 6 – Pool	Photo Point 31

Notes:

1. All cross sections are marked on each bank by permanent pins set in concrete.
2. All pins are shown on the plan views (with North Carolina State plane and elevation coordinates) and are marked with wooden stakes with orange flagging tape.
3. Photo point locations are shown on the plan views and are marked with wooden stakes with orange flagging tape.

Cross Section



section:	SR1 Cross Section 1
	Riffle
stream:	
location:	42' Upstream of Project Start
description:	No work was performed in the area of this cross section
height of instrument (ft):	248.32

notes	omit pt.	distance (ft)	FS (ft)	elevation
	# ☐ #	0	7.63	240.69
	# ☐ #	2.7	7.25	241.07
	# ☐ #	8.5	5.78	242.54
LPIN	# ☑ #	9	5.73	242.59
	# ☐ #	14	5.66	242.66
LTOB	# ☐ #	18.5	5.91	242.41
	# ☐ #	21	6.53	241.79
	# ☐ #	25	8.37	239.95
LBKF	# ☐ #	26.6	9.4	238.92
	# ☐ #	28	11.34	236.98
LCH	# ☐ #	29.5	13.52	234.8
	# ☐ #	30.4	13.45	234.87
	# ☐ #	32.3	13.32	235
	# ☐ #	34	13.54	234.78
WS	# ☐ #	35.5	13.64	234.68
	# ☐ #	37.5	13.69	234.63
TW	# ☐ #	38.1	13.76	234.56
RCH	# ☐ #	39.7	13.7	234.62
	# ☐ #	40.4	12.41	235.91
	# ☐ #	42.2	10.75	237.57
RTOBRBK	# ☐ #	43.5	9.74	238.58
	# ☐ #	46.3	9.39	238.93
RPIN	# ☑ #	48.7	9.47	238.85
	# ☐ #	53.3	9.12	239.2
	# ☐ #	57.1	8.55	239.77
	# ☐ #	63.9	8.28	240.04
	# ☐ #	75.6	8.12	240.2
	# ☐ #	88.6	9	239.32

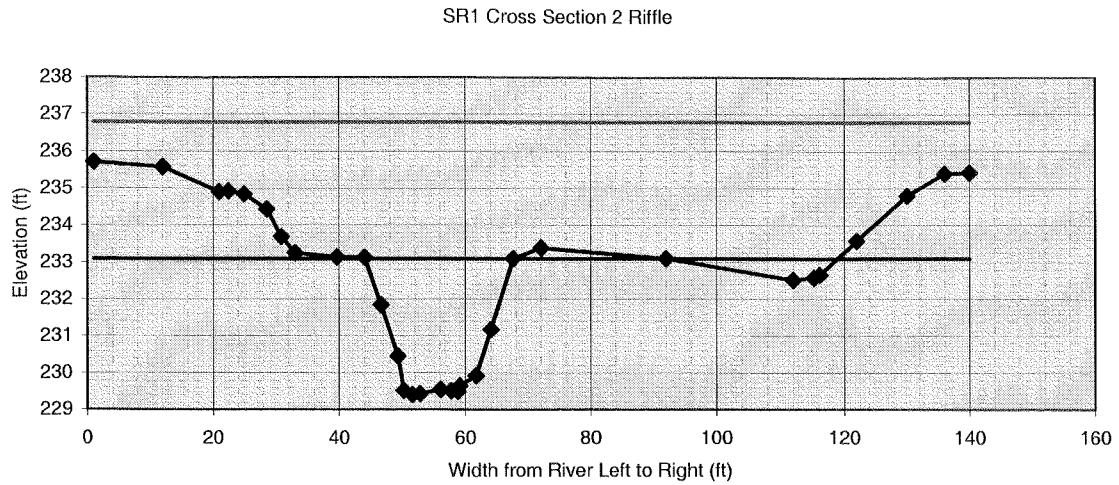
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
9.74	9.74	300.0		
238.58	238.58			

dimensions			
50.2	x-section area	3.0	d mean
16.7	width	20.4	wet P
4.0	d max	2.5	hyd radi
4.0	bank ht	5.5	w/d ratio
300.0	W flood prone area	18.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	SR1 Cross Section 2
	Riffle
stream:	
location:	STA 9+35
description:	
height of instrument (ft):	240.35

notes	omit pt.	distance (ft)	FS (ft)	elevation
	# ☐ #	1	4.64	235.71
	# ☐ #	12	4.78	235.57
	# ☐ #	21	5.45	234.9
LPIN	# ☑ #	22.5	5.43	234.92
LTT	# ☐ #	25	5.51	234.84
	# ☐ #	28.6	5.92	234.43
	# ☐ #	30.9	6.66	233.69
BB	# ☐ #	33.1	7.1	233.25
	# ☐ #	39.7	7.21	233.14
	# ☐ #	44	7.22	233.13
	# ☐ #	46.6	8.51	231.84
	# ☐ #	49.3	9.9	230.45
LCH	# ☐ #	50.2	10.83	229.52
TW	# ☐ #	51.5	10.95	229.4
	# ☐ #	52.8	10.92	229.43
	# ☐ #	56.1	10.81	229.54
	# ☐ #	57.7	10.84	229.51
	# ☐ #	58.8	10.86	229.49
WS	# ☐ #	59.1	10.7	229.65
RCH	# ☐ #	61.7	10.43	229.92
	# ☐ #	64	9.18	231.17
RTOBRBK	# ☐ #	67.6	7.26	233.09
	# ☐ #	72.1	6.97	233.38
	# ☑ #	92	7.26	233.09
	# ☑ #	112	7.83	232.52
RPIN	# ☑ #	115.3	7.77	232.58
BB	# ☑ #	116.2	7.69	232.66
	# ☐ #	122	6.78	233.57
TT	# ☐ #	130	5.55	234.8
	# ☐ #	136	4.96	235.39
	# ☐ #	140	4.93	235.42

☐

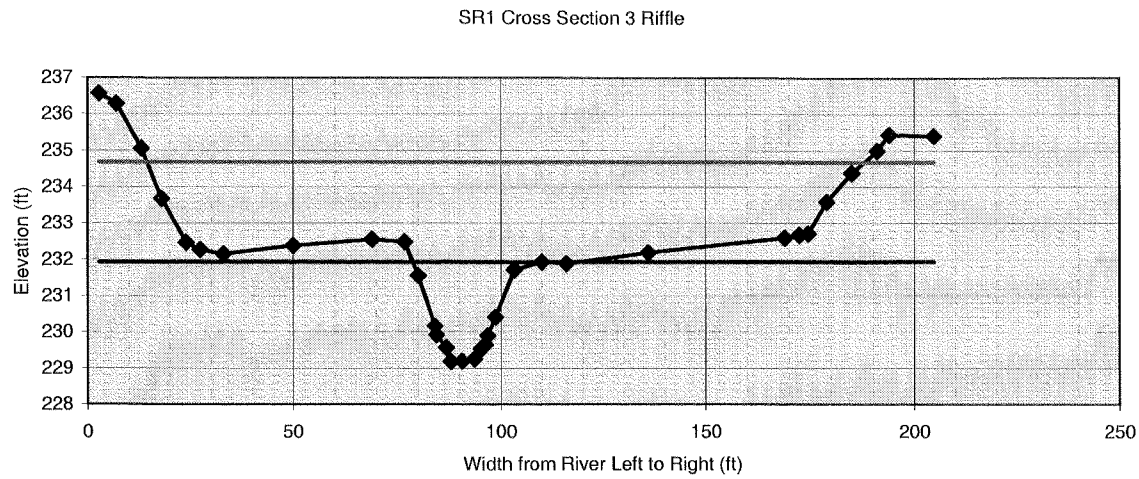
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
7.26	7.26			
233.09	233.09			

dimensions			
59.6	x-section area	2.5	d mean
23.5	width	25.4	wet P
3.7	d max	2.3	hyd radi
3.7	bank ht	9.3	w/d ratio
0.0	W flood prone area	0.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	SR1 Cross Section 3
	Riffle
stream:	
location:	STA 11+30
description:	
height of instrument (ft):	242.63

notes	omit pt.	distance (ft)	FS (ft)	elevation
	# ☐ #	2.8	6.07	236.56
TT	# ☐ #	7	6.34	236.29
	# ☐ #	13	7.58	235.05
	# ☐ #	18	8.96	233.67
BB	# ☐ #	24	10.16	232.47
LPIN	# ☑ #	27.4	10.37	232.26
	# ☐ #	33	10.48	232.15
	# ☐ #	50	10.25	232.38
	# ☐ #	69	10.08	232.55
LTOB	# ☐ #	76.7	10.14	232.49
	# ☐ #	80	11.08	231.55
	# ☐ #	84	12.47	230.16
LCH	# ☐ #	84.4	12.72	229.91
WS	# ☐ #	86.8	13.06	229.57
	# ☐ #	88	13.45	229.18
TW	# ☐ #	90.6	13.44	229.19
	# ☐ #	93.6	13.38	229.25
	# ☐ #	95.2	13.1	229.53
RCH	# ☐ #	96.2	12.98	229.65
	# ☐ #	96.8	12.73	229.9
	# ☐ #	98.7	12.23	230.4
	# ☐ #	103.3	10.92	231.71
RTOB/BKF	# ☐ #	110	10.7	231.93
	# ☑ #	116	10.75	231.88
	# ☐ #	136	10.45	232.18
	# ☐ #	169	10.04	232.59
RPIN	# ☑ #	172.5	9.96	232.67
BB	# ☐ #	174.5	9.92	232.71
	# ☐ #	179	9.05	233.58
	# ☐ #	185	8.25	234.38
	# ☐ #	191	7.64	234.99
TT	# ☐ #	194	7.2	235.43
	# ☐ #	204.8	7.23	235.4

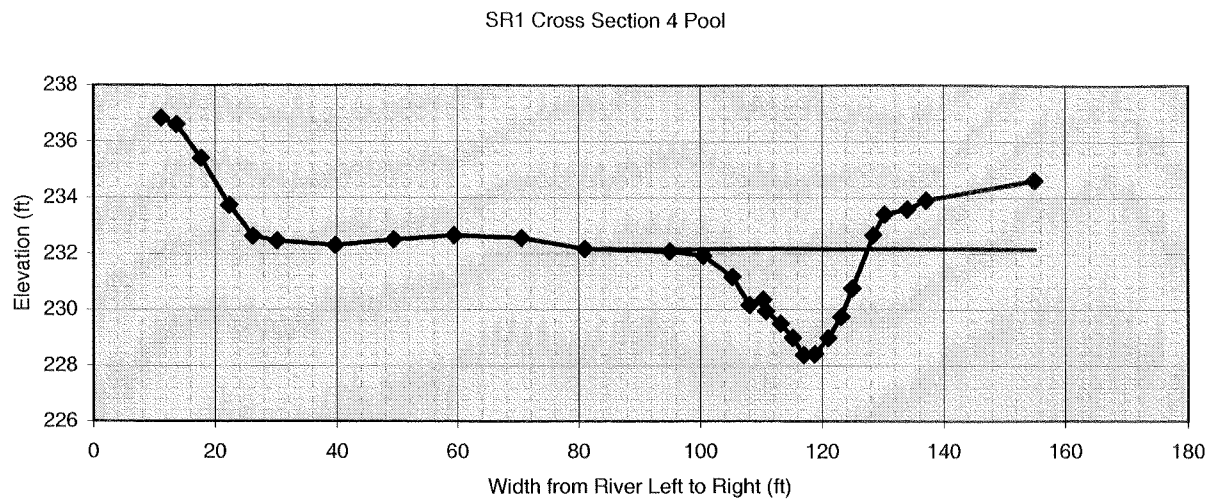
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
10.7	10.7			
231.93	231.93			

dimensions			
44.7	x-section area	1.4	d mean
31.3	width	32.1	wet P
2.8	d max	1.4	hyd radi
2.8	bank ht	21.9	w/d ratio
0.0	W flood prone area	0.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	SR1 Cross Section 4
	Pool
stream:	
location:	STA 12+00
description:	
height of instrument (ft):	242.66

notes	omit pt.	distance (ft)	FS (ft)	elevation
	# ☑ #	11.2	5.83	236.83
TT	# ☑ #	13.7	6.05	236.61
	# ☑ #	17.7	7.25	235.41
	# ☑ #	22.3	8.93	233.73
BB	# ☑ #	26.2	10.03	232.63
LPIN	# ☑ #	30.2	10.21	232.45
	# ☑ #	39.7	10.35	232.31
	# ☑ #	49.4	10.16	232.5
	# ☑ #	59.4	10.01	232.65
	# ☑ #	70.5	10.1	232.56
	# ☐ #	81	10.49	232.17
	# ☐ #	95	10.57	232.09
LBKFLTOE	# ☐ #	100.5	10.74	231.92
	# ☐ #	105.3	11.49	231.17
	# ☐ #	108.1	12.5	230.16
	# ☐ #	110.3	12.31	230.35
LCH	# ☐ #	110.8	12.72	229.94
WS	# ☐ #	113.2	13.17	229.49
	# ☐ #	115.2	13.68	228.98
TW	# ☐ #	117	14.29	228.37
	# ☐ #	118.8	14.25	228.41
	# ☐ #	121	13.67	228.99
RCH	# ☐ #	123.2	12.91	229.75
	# ☐ #	125	11.9	230.76
	# ☐ #	128.4	10	232.66
RTOB	# ☐ #	130.3	9.26	233.4
	# ☐ #	134	9.09	233.57
RPIN	# ☑ #	137.1	8.76	233.9
	# ☐ #	155	8.04	234.62

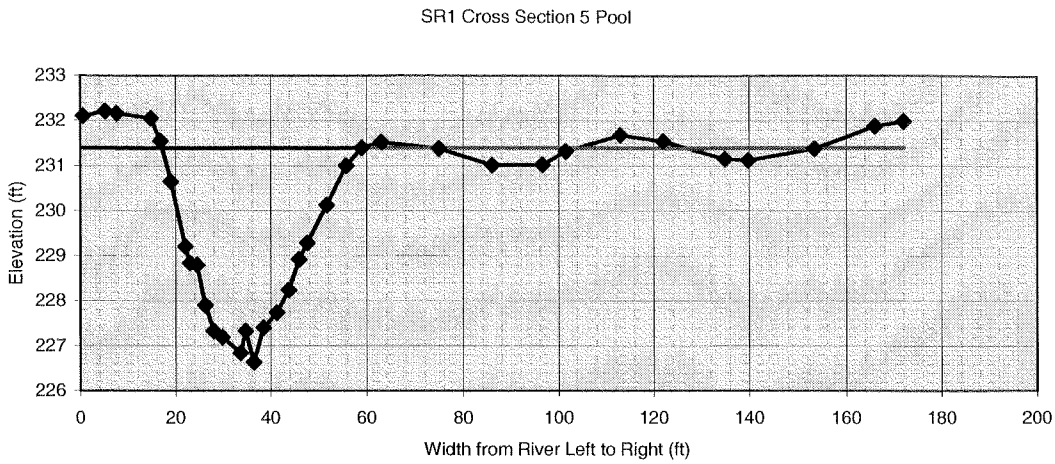
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
10.49	10.49	~~300.0~~		
232.17	232.17			

dimensions			
57.8	x-section area	1.2	d mean
46.5	width	48.0	wet P
3.8	d max	1.2	hyd radi
3.8	bank ht	~~37.5~~	w/d ratio
~~300.0~~	W flood prone area	~~6.4~~	ent ratio

hydraulics	
~~0.0~~	velocity (ft/sec)
~~0.0~~	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
~~0.00~~	Froude number
~~0.0~~	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
	measured D84 (mm)		
~~0.0~~	relative roughness	~~0.0~~	fric. factor
~~0.000~~	Manning's n from channel material		

Cross Section



section:	SR1 Cross Section 5
	Pool
stream:	
location:	STA 16+90
description:	
height of instrument (ft):	238.17

notes	omit pt.	distance (ft)	FS (ft)	elevation
	# ☐ #	0.6	6.07	232.1
	# ☐ #	5.2	5.96	232.21
LPIN	# ☑ #	7.6	6.01	232.16
LTOB	# ☐ #	14.8	6.12	232.05
	# ☐ #	16.8	6.62	231.55
	# ☐ #	19	7.52	230.65
	# ☐ #	22	8.96	229.21
LCH	# ☐ #	23	9.33	228.84
WS	# ☐ #	24.5	9.37	228.8
	# ☐ #	26.2	10.27	227.9
	# ☐ #	27.9	10.84	227.33
	# ☐ #	29.8	10.98	227.19
TW	# ☐ #	33.7	11.33	226.84
	# ☐ #	34.7	10.84	227.33
	# ☐ #	36.4	11.54	226.63
	# ☐ #	38.4	10.77	227.4
	# ☐ #	41.3	10.43	227.74
RCH	# ☐ #	43.8	9.93	228.24
	# ☐ #	45.9	9.25	228.92
	# ☐ #	47.6	8.88	229.29
	# ☐ #	51.7	8.04	230.13
	# ☐ #	55.8	7.17	231
RTOBRBK	# ☐ #	59	6.78	231.39
	# ☑ #	63	6.65	231.52
	# ☑ #	75	6.79	231.38
	# ☑ #	86	7.16	231.01
	# ☑ #	96.6	7.15	231.02
	# ☑ #	101.5	6.86	231.31
	# ☑ #	113	6.49	231.68
	# ☑ #	122	6.63	231.54
	# ☑ #	135	7.02	231.15
RPIN	# ☑ #	139.8	7.05	231.12
	# ☑ #	153.5	6.79	231.38
	# ☑ #	166	6.3	231.87
	# ☑ #	172	6.19	231.98

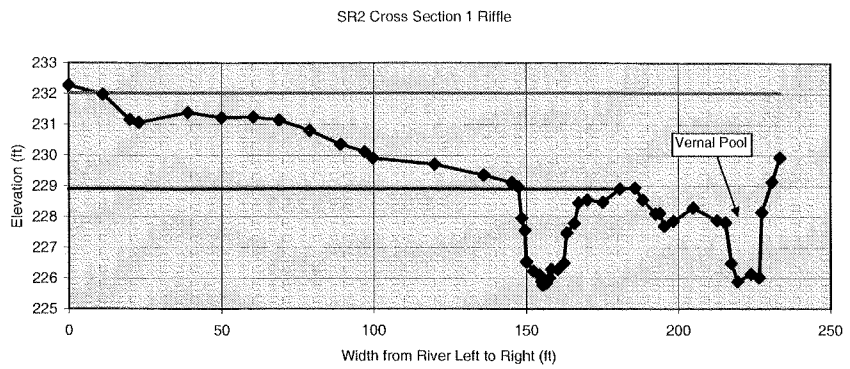
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
6.78	6.78			
231.39	231.39			

dimensions			
108.6	x-section area	2.6	d mean
41.8	width	43.5	wet P
4.8	d max	2.5	hyd radi
4.8	bank ht	~~16.1~~	w/d ratio
~~0.0~~	W flood prone area	~~0.0~~	ent ratio

hydraulics	
~~0.0~~	velocity (ft/sec)
~~0.0~~	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
~~0.00~~	Froude number
~~0.0~~	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
	measured D84 (mm)		
~~0.0~~	relative roughness	~~0.0~~	fric. factor
~~0.000~~	Manning's n from channel material		

Cross Section



section:	SR2 Cross Section 1
	Riffle
stream:	
location:	STA 24+30
description:	
height of instrument (ft):	236.88

notes	omit pt.	distance (ft)	FS (ft)	elevation
	# ☐ #	0	4.61	232.27
	# ☐ #	11	4.9	231.98
	# ☐ #	20	5.72	231.16
	# ☐ #	22.8	5.82	231.06
	# ☐ #	39	5.49	231.39
	# ☐ #	50	5.66	231.22
	# ☐ #	60.4	5.64	231.24
	# ☐ #	69	5.73	231.15
	# ☐ #	79	6.08	230.8
	# ☐ #	89	6.52	230.36
	# ☐ #	97	6.76	230.12
LPIN	# ☑ #	99.8	6.97	229.91
	# ☐ #	120	7.17	229.71
	# ☐ #	136	7.52	229.36
LTOB	# ☐ #	145.2	7.76	229.12
	# ☐ #	147.4	7.91	228.97
	# ☐ #	148.4	8.92	227.96
	# ☐ #	149.6	9.32	227.56
LCH	# ☐ #	150	10.34	226.54
	# ☐ #	152.2	10.65	226.23
	# ☐ #	154.1	10.76	226.12
	# ☐ #	155	10.97	225.91
TW	# ☐ #	155.4	11.1	225.78
	# ☐ #	156.6	11.04	225.84
	# ☐ #	157.6	10.87	226.01
	# ☐ #	158.2	10.59	226.29
	# ☐ #	160.3	10.59	226.29
	# ☐ #	162.9	10.38	226.5
	# ☐ #	169.3	9.41	227.47
	# ☐ #	165.8	9.09	227.79
	# ☐ #	167.2	8.43	228.45
	# ☐ #	170	8.33	228.55
	# ☐ #	175.1	8.41	228.47
RTOB	# ☐ #	180.7	7.98	228.9
RPIN	# ☑ #	185.7	7.94	228.94
	# ☑ #	188.3	8.33	228.55
	# ☑ #	192.5	8.77	228.11
	# ☑ #	193.5	8.76	228.12
	# ☑ #	195.3	9.17	227.71
	# ☑ #	198.5	9.02	227.86
	# ☑ #	204.8	8.59	228.29
	# ☑ #	212.8	9	227.88
	# ☑ #	215.6	9.07	227.81
	# ☑ #	217.4	10.4	226.48
	# ☑ #	219.5	10.99	225.89
	# ☑ #	224	10.74	226.14
	# ☑ #	226.7	10.86	226.02
	# ☑ #	227.5	8.73	228.15
	# ☑ #	230.9	7.74	229.14
	# ☑ #	233.5	6.95	229.93
	☐			

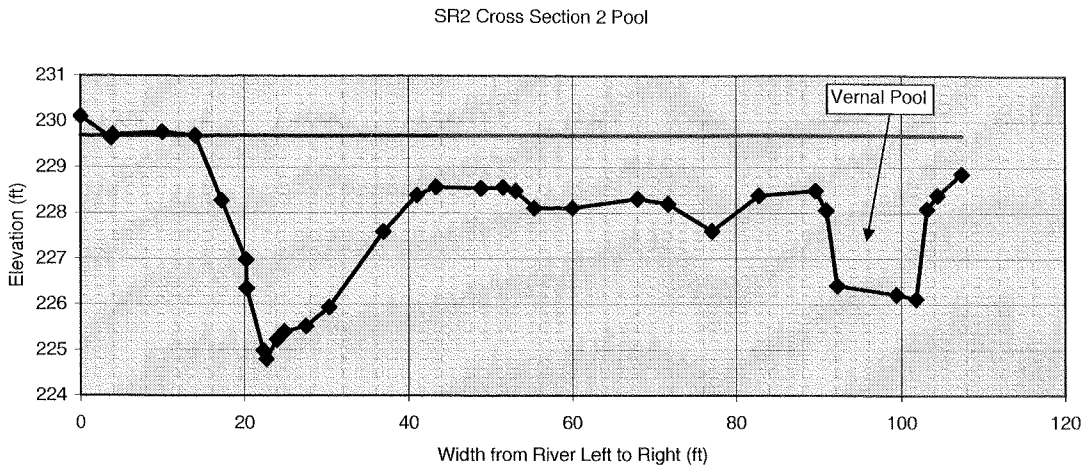
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
7.98	7.98	300.0		
228.9	228.9			

dimensions			
46.5	x-section area	1.4	d mean
33.2	width	35.1	wet P
3.1	d max	1.3	hyd radi
3.1	bank ht	23.8	w/d ratio
300.0	W flood prone area	9.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	SR2 Cross Section 2
stream:	Pool
location:	STA 24+87
description:	
height of instrument (ft):	236.21

notes	omit pt.	distance (ft)	FS (ft)	elevation
	# ☐ #	0	6.1	230.11
	# ☐ #	3.7	6.57	229.64
LPIN	# ☑ #	3.95	6.5	229.71
	# ☐ #	10	6.44	229.77
LTOB	# ☐ #	14	6.52	229.69
	# ☐ #	17.2	7.94	228.27
	# ☐ #	20.2	9.23	226.98
	# ☐ #	20.3	9.86	226.35
LCH	# ☐ #	22.3	11.23	224.98
TW	# ☐ #	22.7	11.41	224.8
	# ☐ #	24	10.99	225.22
	# ☐ #	24.9	10.81	225.4
	# ☐ #	27.5	10.69	225.52
RCH	# ☐ #	30.3	10.27	225.94
	# ☐ #	36.9	8.62	227.59
	# ☐ #	41	7.82	228.39
RTOB	# ☐ #	43.4	7.64	228.57
	# ☑ #	48.8	7.67	228.54
RPIN	# ☑ #	51.5	7.65	228.56
	# ☑ #	53	7.73	228.48
	# ☑ #	55.3	8.1	228.11
	# ☑ #	60	8.1	228.11
	# ☑ #	68	7.9	228.31
	# ☑ #	71.7	8.01	228.2
	# ☑ #	77.1	8.61	227.6
	# ☑ #	82.8	7.83	228.38
	# ☑ #	89.6	7.72	228.49
	# ☑ #	90.9	8.15	228.06
	# ☑ #	92.2	9.8	226.41
	# ☑ #	99.4	10	226.21
	# ☑ #	101.8	10.09	226.12
	# ☑ #	103.1	8.12	228.09
	# ☑ #	104.4	7.82	228.39
	# ☑ #	107.4	7.35	228.86

☐

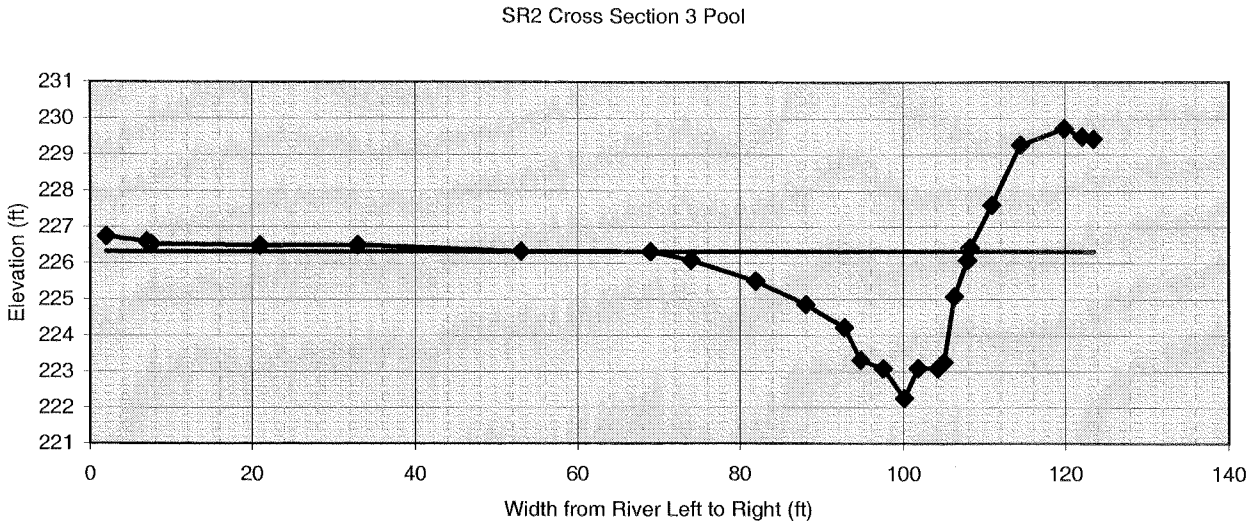
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
6.52	6.52			
229.69	229.69			

dimensions			
80.0	x-section area	2.7	d mean
29.8	width	31.8	wet P
4.9	d max	2.5	hyd radi
4.9	bank ht	~~11.1~~	w/d ratio
~~0.0~~	W flood prone area	~~0.0~~	ent ratio

hydraulics	
~~0.0~~	velocity (ft/sec)
~~0.0~~	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
~~0.00~~	Froude number
~~0.0~~	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
	measured D84 (mm)		
~~0.0~~	relative roughness	~~0.0~~	fric. factor
~~0.000~~	Manning's n from channel material		

Cross Section



section:	SR2 Cross Section 3
	Pool
stream:	
location:	STA 31+25
description:	
height of instrument (ft):	232.31

notes	omit pt.	distance (ft)	FS (ft)	elevation
	# ☐ #	2	5.57	226.74
	# ☐ #	7	5.71	226.6
LPIN	# ☑ #	7.6	5.78	226.53
	# ☐ #	21	5.82	226.49
	# ☐ #	33	5.81	226.5
	# ☐ #	53	5.98	226.33
LTOB/BKF	# ☐ #	69	5.99	226.32
	# ☐ #	74	6.23	226.08
	# ☐ #	81.9	6.81	225.5
	# ☐ #	88	7.45	224.86
	# ☐ #	92.7	8.1	224.21
LCH	# ☐ #	94.7	9	223.31
	# ☐ #	97.5	9.23	223.08
TW	# ☐ #	100.1	10.05	222.26
	# ☐ #	101.8	9.22	223.09
RCH	# ☐ #	104.2	9.22	223.09
	# ☐ #	105	9.05	223.26
	# ☐ #	106.3	7.23	225.08
	# ☐ #	107.9	6.23	226.08
	# ☐ #	108.2	5.88	226.43
	# ☐ #	110.9	4.7	227.61
RTOB	# ☐ #	114.5	3.05	229.26
	# ☐ #	119.9	2.6	229.71
	# ☐ #	122.1	2.82	229.49
RPIN	# ☑ #	123.5	2.88	229.43

☐

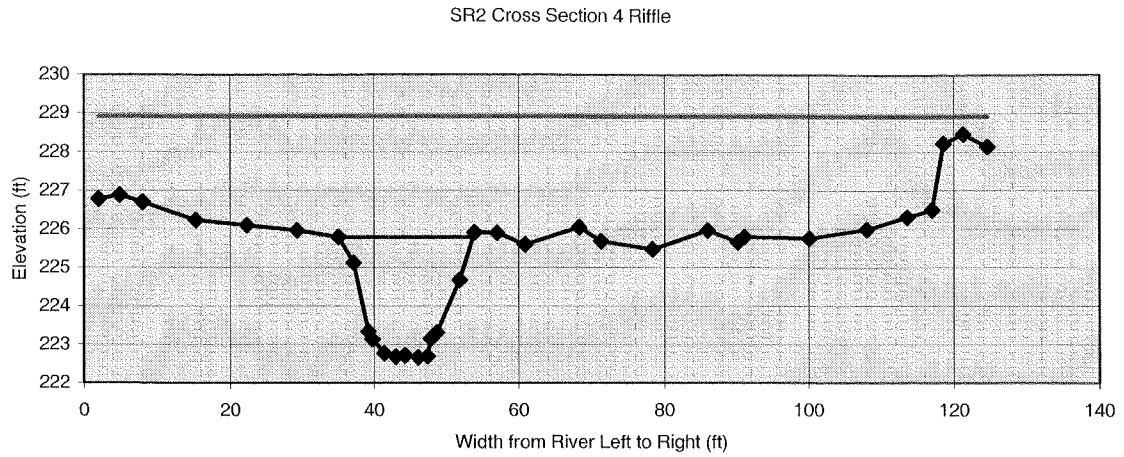
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
5.99	5.99			
226.32	226.32			

dimensions			
64.0	x-section area	1.6	d mean
39.1	width	41.1	wet P
4.1	d max	1.6	hyd radi
4.1	bank ht	~~23.9~~	w/d ratio
~~0.0~~	W flood prone area	~~0.0~~	ent ratio

hydraulics	
~~0.0~~	velocity (ft/sec)
~~0.0~~	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
~~0.00~~	Froude number
~~0.0~~	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
	measured D84 (mm)		
~~0.0~~	relative roughness	~~0.0~~	fric. factor
~~0.000~~	Manning's n from channel material		

Cross Section



section:	SR2 Cross Section 4
	Riffle
stream:	
location:	STA 32+45
description:	
height of instrument (ft):	232.52

notes	omit pt.	distance (ft)	FS (ft)	elevation
	# ☑ #	2	5.74	226.78
LPIN	# ☑ #	4.9	5.64	226.88
	# ☑ #	8	5.82	226.7
	# ☑ #	15.3	6.29	226.23
	# ☑ #	22.3	6.43	226.09
	# ☑ #	29.3	6.56	225.96
LTOB/BKF	# ☐ #	35	6.73	225.79
	# ☐ #	37.1	7.4	225.12
LCH	# ☐ #	39.2	9.19	223.33
	# ☐ #	39.7	9.39	223.13
	# ☐ #	41.4	9.76	222.76
	# ☐ #	43	9.84	222.68
	# ☐ #	44.3	9.81	222.71
TW	# ☐ #	46.1	9.86	222.66
RCH	# ☐ #	47.4	9.83	222.69
	# ☐ #	47.8	9.38	223.14
	# ☐ #	48.7	9.21	223.31
	# ☐ #	51.9	7.85	224.67
RTOB	# ☐ #	53.9	6.61	225.91
	# ☑ #	57	6.62	225.9
	# ☑ #	60.8	6.92	225.6
	# ☑ #	68.3	6.48	226.04
	# ☑ #	71.3	6.84	225.68
	# ☑ #	78.4	7.05	225.47
	# ☑ #	86	6.55	225.97
	# ☑ #	90.2	6.86	225.66
RPIN	# ☑ #	91.1	6.73	225.79
	# ☑ #	100.1	6.76	225.76
	# ☑ #	108	6.53	225.99
	# ☑ #	113.6	6.22	226.3
	# ☑ #	117	6.03	226.49
	# ☑ #	118.6	4.31	228.21
	# ☑ #	121.3	4.06	228.46
	# ☑ #	124.6	4.39	228.13

☐

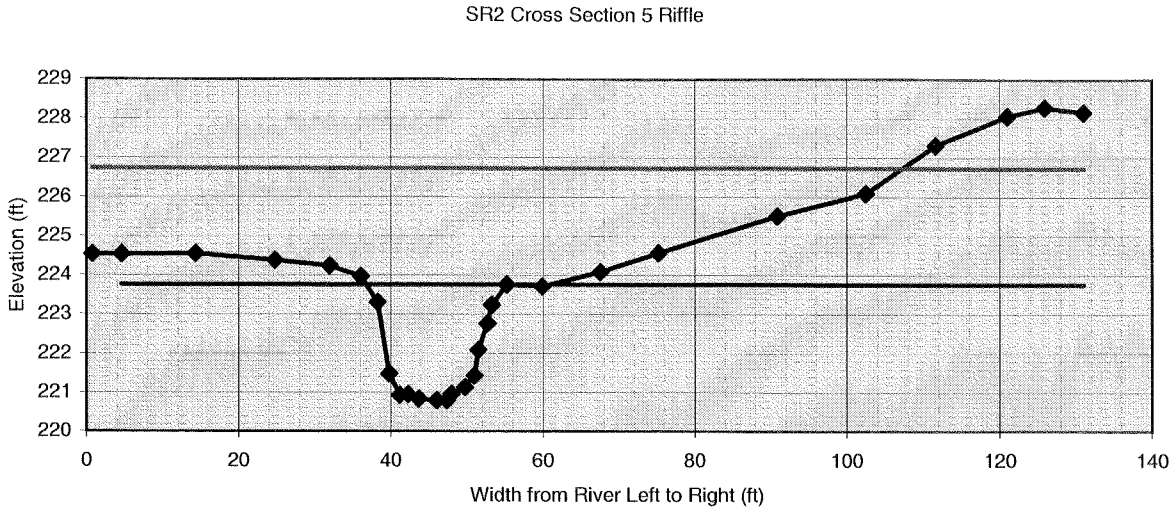
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
6.73	6.73			
225.79	225.79			

dimensions			
38.9	x-section area	2.1	d mean
18.7	width	20.4	wet P
3.1	d max	1.9	hyd radi
3.1	bank ht	9.0	w/d ratio
0.0	W flood prone area	0.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	SR2 Cross Section 5
	Riffle
stream:	
location:	STA 39+20
description:	
height of instrument (ft):	230.88

notes	omit pt.	distance (ft)	FS (ft)	elevation
LPIN	# ☑ #	0.8	6.34	224.54
	# ☐ #	4.6	6.34	224.54
	# ☐ #	14.3	6.33	224.55
	# ☐ #	24.8	6.5	224.38
	# ☐ #	32	6.64	224.24
LTOB	# ☐ #	36.1	6.91	223.97
	# ☐ #	38.3	7.57	223.31
	# ☐ #	39.8	9.4	221.48
LCH	# ☐ #	41.2	9.95	220.93
	# ☐ #	42.3	9.93	220.95
	# ☐ #	43.7	10.05	220.83
TW	# ☐ #	46.1	10.09	220.79
	# ☐ #	47.4	10.09	220.79
	# ☐ #	48	9.92	220.96
RCH	# ☐ #	49.8	9.75	221.13
	# ☐ #	51	9.45	221.43
	# ☐ #	51.5	8.79	222.09
	# ☐ #	52.7	8.12	222.76
	# ☐ #	53.3	7.64	223.24
RTOB	# ☐ #	55.2	7.12	223.76
	# ☑ #	59.9	7.17	223.71
	# ☐ #	67.5	6.8	224.08
	# ☐ #	75.2	6.31	224.57
	# ☐ #	90.9	5.37	225.51
	# ☐ #	102.5	4.79	226.09
	# ☐ #	111.6	3.56	227.32
	# ☐ #	121	2.81	228.07
RPIN	# ☑ #	125.9	2.59	228.29
	# ☐ #	131	2.71	228.17

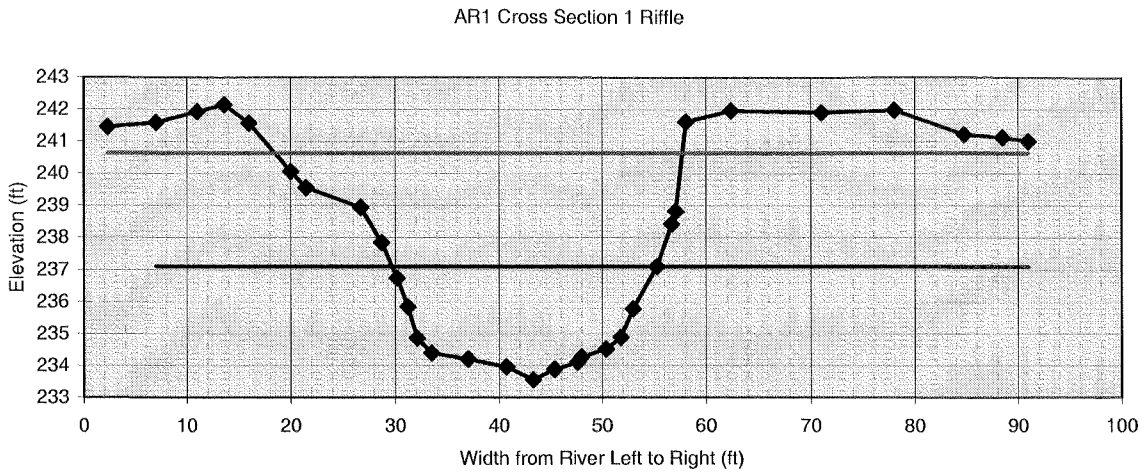
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
7.12	7.12			
223.76	223.76			

dimensions			
37.2	x-section area	2.0	d mean
18.4	width	20.3	wet P
3.0	d max	1.8	hyd radi
3.0	bank ht	9.1	w/d ratio
0.0	W flood prone area	0.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	AR1 Cross Section 1
	Riffle
stream:	
location:	45' Upstream of Project Start
description:	
height of instrument (ft):	246.76

notes	omit pt.	distance (ft)	FS (ft)	elevation
LPIN	# ☑ #	2.3	5.3	241.46
	# ☐ #	7	5.17	241.59
	# ☐ #	11	4.83	241.93
	# ☐ #	13.6	4.61	242.15
	# ☐ #	16	5.18	241.58
	# ☐ #	20	6.7	240.06
	# ☐ #	21.5	7.2	239.56
LTOB	# ☐ #	26.7	7.82	238.94
LBKF	# ☐ #	28.7	8.92	237.84
	# ☐ #	30.2	10.03	236.73
	# ☐ #	31.2	10.92	235.84
	# ☐ #	32.1	11.9	234.86
LCH	# ☐ #	33.5	12.37	234.39
	# ☐ #	37	12.56	234.2
	# ☐ #	40.7	12.8	233.96
TW	# ☐ #	43.3	13.2	233.56
	# ☐ #	45.4	12.88	233.88
	# ☐ #	47.6	12.66	234.1
	# ☐ #	48	12.5	234.26
RCH	# ☐ #	50.4	12.25	234.51
	# ☐ #	51.8	11.87	234.89
	# ☐ #	53	10.98	235.78
RBKF	# ☐ #	55.3	9.66	237.1
	# ☐ #	56.7	8.33	238.43
	# ☐ #	57.1	7.94	238.82
RTOB	# ☐ #	58.1	5.14	241.62
	# ☐ #	62.4	4.8	241.96
	# ☐ #	71	4.85	241.91
	# ☐ #	78	4.79	241.97
	# ☐ #	84.8	5.55	241.21
RPIN	# ☑ #	88.5	5.64	241.12
	# ☐ #	91	5.75	241.01

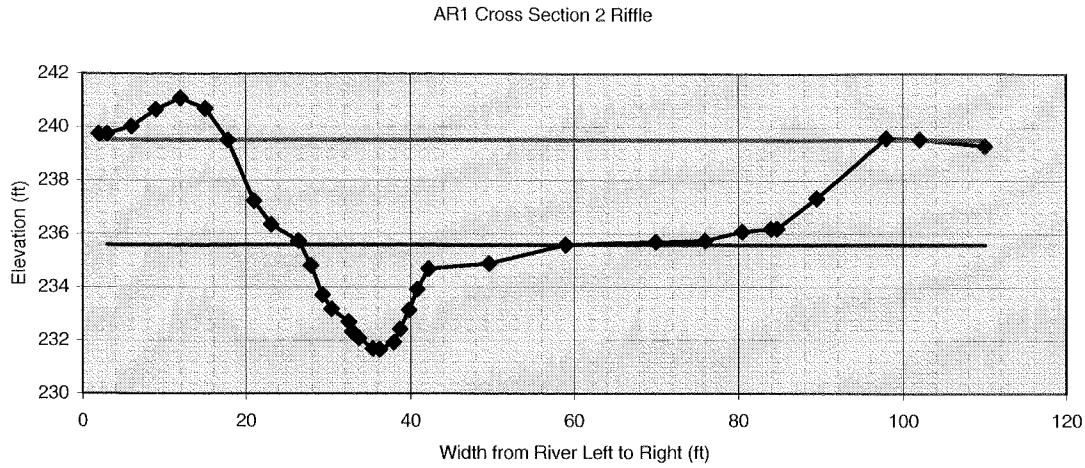
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
9.66	7.82			
237.1	238.94			

dimensions			
64.2	x-section area	2.5	d mean
25.6	width	27.4	wet P
3.5	d max	2.3	hyd radi
5.4	bank ht	10.2	w/d ratio
0.0	W flood prone area	0.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	AR1 Cross Section 2
	Riffle
stream:	
location:	STA 4+42
description:	
height of instrument (ft):	244.78

notes	omit pt.	distance (ft)	FS (ft)	elevation
LPIN	# ☑ #	2	5.04	239.74
	# ☐ #	3	5.04	239.74
	# ☐ #	6	4.75	240.03
	# ☐ #	9	4.13	240.65
	# ☐ #	12	3.7	241.08
LTT	# ☐ #	15	4.09	240.69
	# ☐ #	17.8	5.27	239.51
	# ☐ #	21	7.54	237.24
	# ☐ #	23.1	8.43	236.35
LBKFLTOE	# ☐ #	26.4	9.05	235.73
	# ☐ #	27.9	9.97	234.81
	# ☐ #	29.3	11.07	233.71
	# ☐ #	30.4	11.61	233.17
	# ☐ #	32.5	12.09	232.69
LCH	# ☐ #	32.9	12.47	232.31
	# ☐ #	33.7	12.7	232.08
	# ☐ #	35.4	13.09	231.69
TW	# ☐ #	36.2	13.12	231.66
	# ☐ #	37.9	12.85	231.93
RCH	# ☐ #	38.7	12.35	232.43
	# ☐ #	39.8	11.64	233.14
	# ☐ #	40.8	10.86	233.92
RBKFRTO	# ☐ #	42.2	10.09	234.69
	# ☐ #	49.6	9.89	234.89
	# ☐ #	59	9.19	235.59
	# ☐ #	70	9.08	235.7
	# ☐ #	76	9.03	235.75
	# ☐ #	80.5	8.7	236.08
RPIN	# ☑ #	84	8.6	236.18
RBB	# ☐ #	84.7	8.58	236.2
	# ☐ #	89.5	7.45	237.33
RTT	# ☐ #	97.9	5.2	239.58
	# ☐ #	102	5.25	239.53
	# ☐ #	110	5.49	239.29

FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
9.19	10.09			
235.59	234.69			

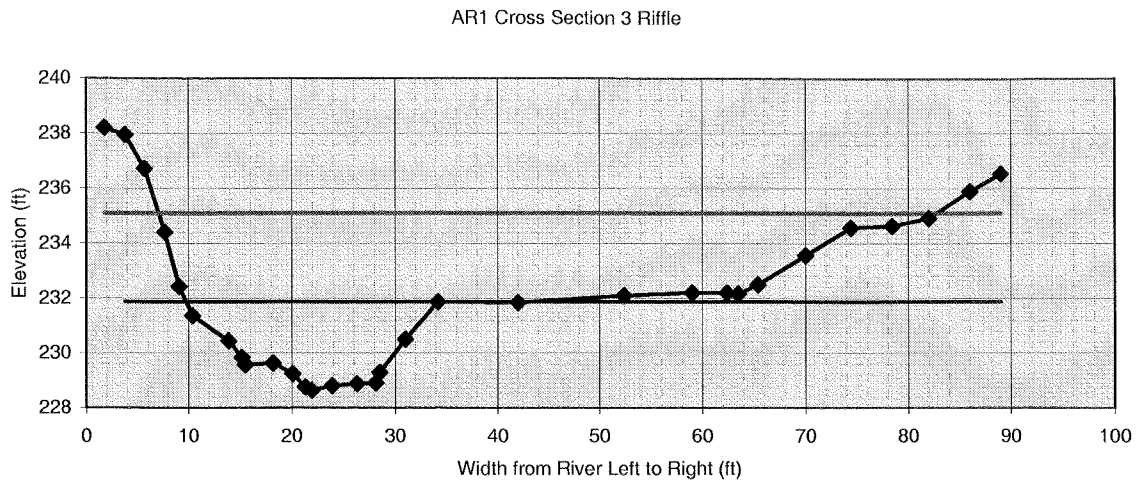
dimensions			
49.0	x-section area	1.5	d mean
32.4	width	34.2	wet P
3.9	d max	1.4	hyd radi
3.0	bank ht	21.4	w/d ratio
0.0	W flood prone area	0.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

☐

Cross Section



section:	AR1 Cross Section 3
	Riffle
stream:	
location:	STA 13+95
description:	
height of instrument (ft):	242.39

notes	omit pt.	distance (ft)	FS (ft)	elevation
LPIN	# ☑ #	1.8	4.19	238.2
LTOB	# ☐ #	3.8	4.45	237.94
	# ☐ #	5.7	5.67	236.72
	# ☐ #	7.7	7.99	234.4
	# ☐ #	9.1	9.97	232.42
LIB	# ☐ #	10.4	11.02	231.37
	# ☐ #	13.9	11.96	230.43
	# ☐ #	15.2	12.55	229.84
	# ☐ #	15.5	12.82	229.57
	# ☐ #	18.2	12.77	229.62
LCH	# ☐ #	20.1	13.16	229.23
	# ☐ #	21.3	13.64	228.75
TW	# ☐ #	21.9	13.75	228.64
	# ☐ #	23.9	13.59	228.8
	# ☐ #	26.3	13.52	228.87
RCH	# ☐ #	28.1	13.48	228.91
	# ☐ #	28.5	13.11	229.28
	# ☐ #	31	11.9	230.49
RBKFRTO	# ☐ #	34.2	10.52	231.87
	# ☑ #	42	10.56	231.83
	# ☐ #	52.4	10.29	232.1
	# ☐ #	59	10.19	232.2
RPIN	# ☑ #	62.4	10.2	232.19
RBB	# ☐ #	63.5	10.24	232.15
	# ☐ #	65.4	9.91	232.48
	# ☐ #	70	8.84	233.55
RTT	# ☐ #	74.4	7.83	234.56
	# ☐ #	78.4	7.76	234.63
	# ☐ #	82	7.47	234.92
	# ☐ #	86	6.5	235.89
	# ☐ #	89	5.86	236.53

☐

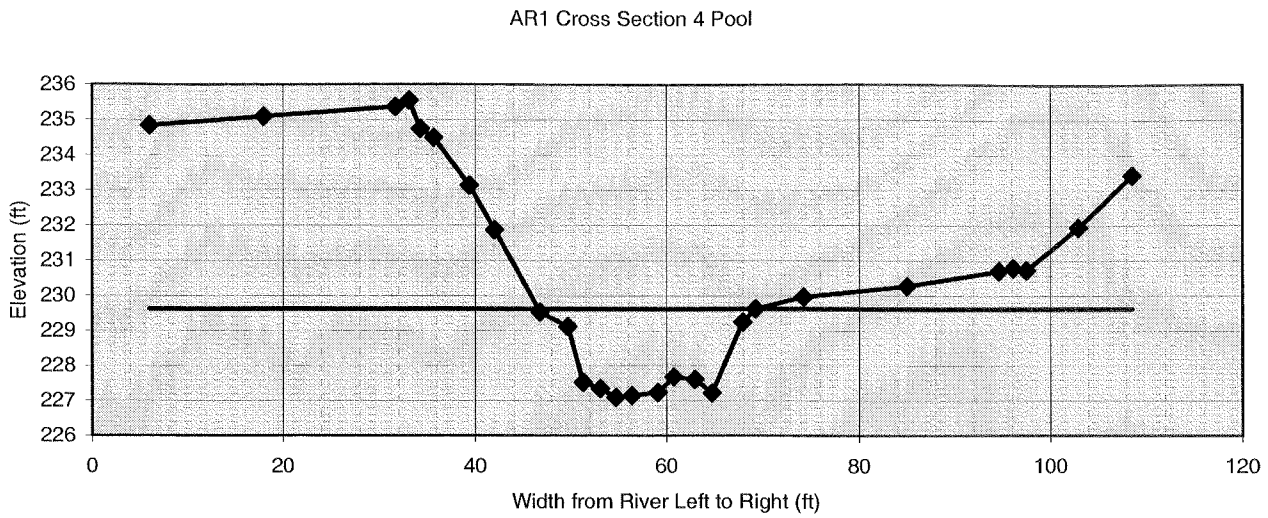
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
10.52	10.52			
231.87	231.87			

dimensions			
49.8	x-section area	2.0	d mean
24.4	width	25.8	wet P
3.2	d max	1.9	hyd radi
3.2	bank ht	12.0	w/d ratio
0.0	W flood prone area	0.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	AR1 Cross Section 4
stream:	Pool
location:	STA 20+90
description:	
height of instrument (ft):	239.35

notes	omit pt.	distance (ft)	FS (ft)	elevation
	# #	6	4.51	234.84
	# #	18	4.25	235.1
LPIN	# #	31.7	3.98	235.37
TT/LTOB	# #	33.1	3.8	235.55
	# #	34.3	4.61	234.74
	# #	35.7	4.86	234.49
	# #	39.4	6.22	233.13
	# #	42	7.48	231.87
BIB	# #	46.8	9.82	229.53
IB	# #	49.7	10.23	229.12
LCH	# #	51.3	11.82	227.53
	# #	53.1	12	227.35
TW	# #	54.7	12.26	227.09
	# #	56.4	12.2	227.15
	# #	59.1	12.11	227.24
	# #	60.8	11.67	227.68
	# #	63	11.74	227.61
RCH	# #	64.8	12.13	227.22
ROOTWAI	# #	68	10.11	229.24
RTOB/BKF	# #	69.3	9.73	229.62
	# #	74.3	9.39	229.96
	# #	85	9.08	230.27
	# #	94.6	8.64	230.71
RPIN	# #	96.1	8.56	230.79
BB	# #	97.5	8.62	230.73
	# #	103	7.4	231.95
TT	# #	108.6	5.92	233.43

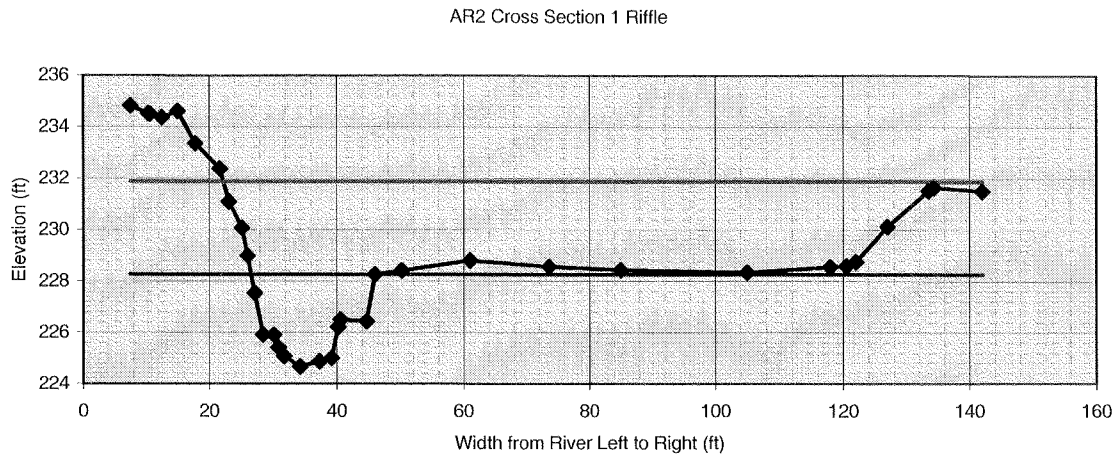
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
9.73	9.73			
229.62	229.62			

dimensions			
38.2	x-section area	1.7	d mean
22.7	width	24.2	wet P
2.5	d max	1.6	hyd radi
2.5	bank ht	~~13.5~~	w/d ratio
~~0.0~~	W flood prone area	~~0.0~~	ent ratio

hydraulics	
~~0.0~~	velocity (ft/sec)
~~0.0~~	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
~~0.00~~	Froude number
~~0.0~~	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
	measured D84 (mm)		
~~0.0~~	relative roughness	~~0.0~~	fric. factor
~~0.000~~	Manning's n from channel material		

Cross Section



section:	AR2 Cross Section 1
	Riffle
stream:	
location:	STA 27+90
description:	
height of instrument (ft):	238.82

notes	omit pt.	distance (ft)	FS (ft)	elevation
	# ☐ #	7.5	4	234.82
	# ☐ #	10.3	4.3	234.52
LPIN	# ☑ #	10.6	4.32	234.5
	# ☐ #	12.5	4.45	234.37
	# ☐ #	15	4.21	234.61
	# ☐ #	17.8	5.46	233.36
LTOB	# ☐ #	21.7	6.44	232.38
	# ☐ #	23.1	7.73	231.09
	# ☐ #	25.2	8.74	230.08
LBKF	# ☐ #	26.1	9.82	229
	# ☐ #	27.2	11.28	227.54
	# ☐ #	28.5	12.91	225.91
LCH	# ☐ #	30.2	12.92	225.9
	# ☐ #	30.9	13.41	225.41
	# ☐ #	31.8	13.75	225.07
	# ☐ #	34.3	14.15	224.67
TW	# ☐ #	37.3	13.95	224.87
RCH	# ☐ #	39.2	13.81	225.01
	# ☐ #	40.2	12.61	226.21
	# ☐ #	40.6	12.32	226.5
	# ☐ #	44.7	12.38	226.44
RBKFRTOI	# ☐ #	46	10.55	228.27
	# ☐ #	50.2	10.4	228.42
	# ☐ #	61	10.01	228.81
	# ☐ #	73.6	10.26	228.56
	# ☐ #	85	10.38	228.44
	# ☐ #	105	10.48	228.34
	# ☐ #	118	10.27	228.55
RPIN	# ☑ #	120.5	10.23	228.59
	# ☐ #	122	10.06	228.76
	# ☐ #	127	8.7	230.12
	# ☐ #	133.5	7.3	231.52
RTT	# ☐ #	134.3	7.17	231.65
	# ☐ #	142	7.31	231.51

☐

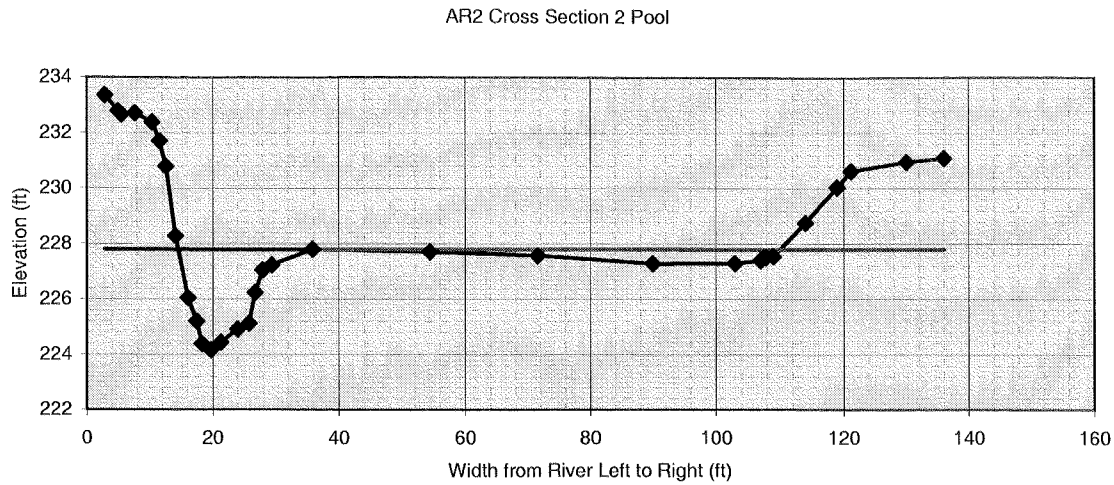
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
10.55	10.55			
228.27	228.27			

dimensions			
48.1	x-section area	2.5	d mean
19.4	width	22.4	wet P
3.6	d max	2.2	hyd radi
3.6	bank ht	7.8	w/d ratio
0.0	W flood prone area	0.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	AR2 Cross Section 2
	Pool
stream:	
location:	STA 28+35
description:	
height of instrument (ft):	238.70

notes	omit pt.	distance (ft)	FS (ft)	elevation
	# ☐ #	2.9	5.35	233.35
	# ☐ #	5	5.92	232.78
LPIN	# ☑ #	5.5	6.04	232.66
	# ☐ #	7.6	6	232.7
	# ☐ #	10.4	6.32	232.38
LTOB	# ☐ #	11.6	7	231.7
	# ☐ #	12.6	7.92	230.78
LBKF	# ☐ #	14.1	10.43	228.27
	# ☐ #	16.1	12.65	226.05
	# ☐ #	17.5	13.5	225.2
LCH	# ☐ #	18.3	14.32	224.38
	# ☐ #	19.7	14.54	224.16
	# ☐ #	21.3	14.26	224.44
	# ☐ #	24	13.8	224.9
	# ☐ #	25.8	13.58	225.12
	# ☐ #	26.8	12.47	226.23
RBKFRTO	# ☐ #	28	11.65	227.05
	# ☐ #	29.4	11.46	227.24
	# ☐ #	35.8	10.9	227.8
	# ☑ #	54.4	11	227.7
	# ☑ #	71.6	11.13	227.57
	# ☑ #	90	11.42	227.28
	# ☑ #	103	11.4	227.3
	# ☑ #	107	11.3	227.4
RPIN	# ☑ #	107.8	11.18	227.52
	# ☑ #	109	11.15	227.55
	# ☑ #	114	9.94	228.76
	# ☑ #	119	8.66	230.04
	# ☑ #	121.2	8.08	230.62
	# ☑ #	130	7.76	230.94
	# ☑ #	136	7.62	231.08

☐

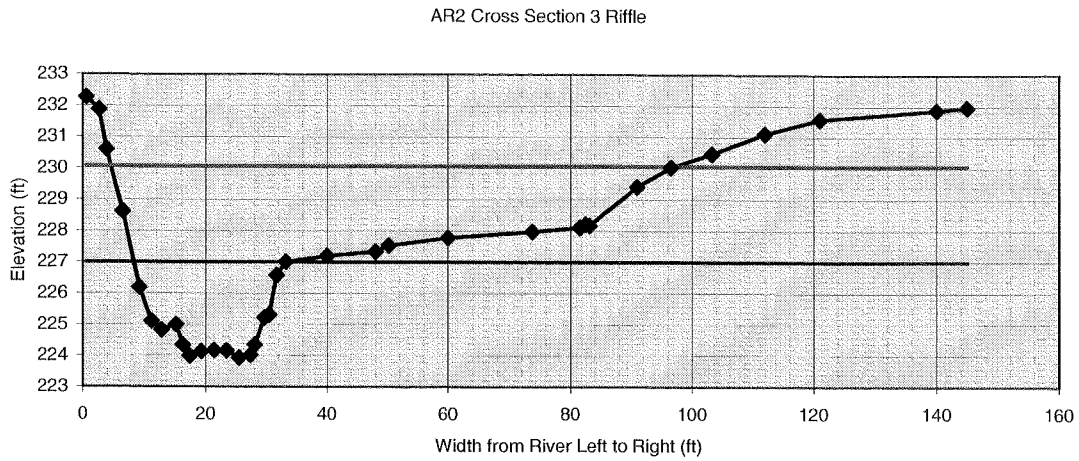
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
10.9	11.65			
227.8	227.05			

dimensions			
37.1	x-section area	1.7	d mean
21.3	width	23.5	wet P
3.6	d max	1.6	hyd radi
2.9	bank ht	~~12.2~~	w/d ratio
~~0.0~~	W flood prone area	~~0.0~~	ent ratio

hydraulics	
~~0.0~~	velocity (ft/sec)
~~0.0~~	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
~~0.00~~	Froude number
~~0.0~~	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
	measured D84 (mm)		
~~0.0~~	relative roughness	~~0.0~~	fric. factor
~~0.000~~	Manning's n from channel material		

Cross Section



section:	AR2 Cross Section 3
	Riffle
stream:	
location:	STA 30+45
description:	
height of instrument (ft):	236.32

notes	omit pt.	distance (ft)	FS (ft)	elevation
LTT/LPIN	# ☐ #	0.6	4.05	232.27
	# ☐ #	2.7	4.45	231.87
	# ☐ #	3.9	5.72	230.6
	# ☐ #	6.5	7.7	228.62
	# ☐ #	9.2	10.13	226.19
LIB	# ☐ #	11.2	11.21	225.11
	# ☐ #	12.8	11.5	224.82
	# ☐ #	15.2	11.32	225
LCH	# ☐ #	16.3	11.98	224.34
	# ☐ #	17.4	12.33	223.99
	# ☐ #	19.3	12.18	224.14
	# ☐ #	21.4	12.15	224.17
	# ☐ #	23.4	12.16	224.16
TW	# ☐ #	25.5	12.39	223.93
	# ☐ #	27.4	12.31	224.01
RCH	# ☐ #	28.1	11.98	224.34
	# ☐ #	29.7	11.11	225.21
	# ☐ #	30.5	11.01	225.31
	# ☐ #	31.7	9.74	226.58
RBKFRTO	# ☐ #	33.2	9.32	227
	# ☐ #	40	9.12	227.2
	# ☐ #	48	8.99	227.33
	# ☐ #	50.2	8.79	227.53
	# ☐ #	60	8.54	227.78
	# ☐ #	73.7	8.35	227.97
	# ☐ #	81.5	8.21	228.11
RPIN	# ☑ #	82.4	8.11	228.21
RBB	# ☐ #	83.1	8.15	228.17
	# ☐ #	91	6.91	229.41
	# ☐ #	96.5	6.29	230.03
RTT	# ☐ #	103.3	5.85	230.47
	# ☐ #	112	5.21	231.11
	# ☐ #	121	4.75	231.57
	# ☐ #	140	4.45	231.87
	# ☐ #	145	4.36	231.96

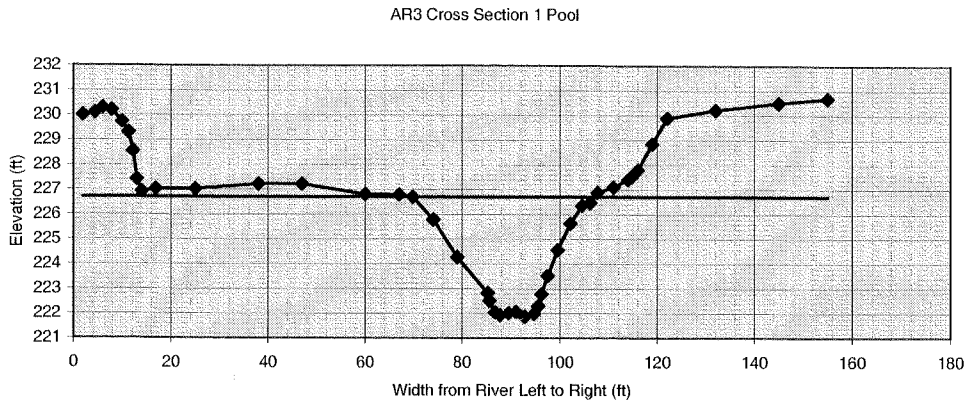
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
9.32	9.32			
227	227			

dimensions			
54.7	x-section area	2.2	d mean
24.9	width	26.7	wet P
3.1	d max	2.1	hyd radi
3.1	bank ht	11.3	w/d ratio
0.0	W flood prone area	0.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	AR3 Cross Section 1
	Pool
stream:	
location:	STA 34+55
description:	
height of instrument (ft):	236.64

notes	omit pt.	distance (ft)	FS (ft)	elevation
	# ☐ #	2	6.64	229.9986
	# ☐ #	4.4	6.54	230.0986
	# ☐ #	6	6.35	230.2886
LTT	# ☐ #	7.9	6.44	230.1986
	# ☐ #	10	6.91	229.7286
	# ☐ #	11.3	7.33	229.3086
	# ☐ #	12.2	8.09	228.5486
	# ☐ #	13	9.22	227.4186
LBB	# ☐ #	14	9.71	226.9286
LPIN	# ☑ #	16.9	9.61	227.0286
	# ☐ #	25	9.61	227.0286
	# ☐ #	38	9.42	227.2186
	# ☐ #	47	9.42	227.2186
	# ☐ #	60	9.83	226.8086
	# ☐ #	67	9.85	226.7886
LBKFLTOE	# ☐ #	69.8	9.93	226.7086
	# ☐ #	74	10.85	225.7886
	# ☐ #	79	12.36	224.2786
	# ☐ #	85.2	13.81	222.8286
	# ☐ #	85.6	14.12	222.5186
LCH	# ☐ #	86.7	14.6	222.0386
	# ☐ #	87.7	14.7	221.9386
	# ☐ #	89.5	14.62	222.0186
	# ☐ #	91	14.57	222.0686
TW	# ☐ #	92.7	14.76	221.8786
	# ☐ #	94.6	14.65	221.9886
RCH	# ☐ #	95.5	14.33	222.3086
WS	# ☐ #	96.2	13.85	222.7886
	# ☐ #	97.4	13.12	223.5186
	# ☐ #	99.5	12.07	224.5686
	# ☐ #	102.1	11.01	225.6286
	# ☐ #	104.5	10.27	226.3686
	# ☐ #	106.2	10.17	226.4686
RBKFRTOE	# ☐ #	107.7	9.76	226.8786
	# ☐ #	111	9.54	227.0986
RPIN	# ☑ #	113.9	9.25	227.3886
RBB	# ☐ #	114.6	9.14	227.4986
	# ☐ #	116	8.85	227.7886
	# ☐ #	119	7.8	228.8386
	# ☐ #	122	6.75	229.8886
	# ☐ #	132	6.42	230.2186
	# ☐ #	145	6.14	230.4986
	# ☐ #	155	5.95	230.6886

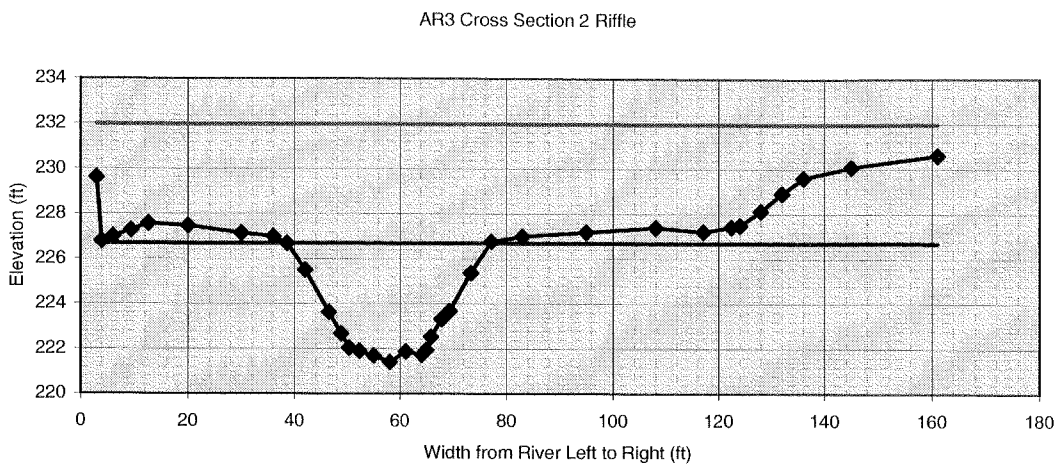
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
9.93	9.93			
226.7086	226.7086			

dimensions			
97.1	x-section area	2.6	d mean
37.3	width	39.0	wet P
4.8	d max	2.5	hyd radi
4.8	bank ht	14.3	w/d ratio
0.0	W flood prone area	0.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	AR3 Cross Section 2
	Riffle
stream:	
location:	STA 35+15
description:	
height of instrument (ft):	236.64

notes	omit pt.	distance (ft)	FS (ft)	elevation
LTT	# ☐ #	3	7.04	229.6
LBB	# ☐ #	4	9.85	226.79
	# ☐ #	6	9.65	226.99
	# ☐ #	9.4	9.37	227.27
LPIN	# ☑ #	12.6	9.07	227.57
	# ☐ #	20	9.17	227.47
	# ☐ #	30	9.5	227.14
	# ☐ #	36	9.65	226.99
LBKFLTOE	# ☐ #	38.6	9.95	226.69
	# ☐ #	42	11.14	225.5
	# ☐ #	46.5	13.02	223.62
LCH/WS	# ☐ #	48.9	13.97	222.67
	# ☐ #	50.4	14.6	222.04
	# ☐ #	52.3	14.75	221.89
	# ☐ #	55	14.94	221.7
TW	# ☐ #	58.1	15.23	221.41
	# ☐ #	61.1	14.78	221.86
	# ☐ #	64.2	14.92	221.72
RCH	# ☐ #	65.1	14.7	221.94
	# ☐ #	66	14.11	222.53
	# ☐ #	68	13.33	223.31
	# ☐ #	69.4	12.96	223.68
	# ☐ #	73.4	11.27	225.37
RBKFRTO	# ☐ #	77.2	9.88	226.76
	# ☐ #	83	9.65	226.99
	# ☐ #	95	9.46	227.18
	# ☐ #	108	9.24	227.4
	# ☐ #	117	9.43	227.21
RPIN	# ☑ #	122.4	9.22	227.42
RBB	# ☐ #	124	9.15	227.49
	# ☐ #	128	8.51	228.13
	# ☐ #	132	7.72	228.92
RTT	# ☐ #	136	7.03	229.61
	# ☐ #	145	6.56	230.08
	# ☐ #	161	6.05	230.59
	☐			

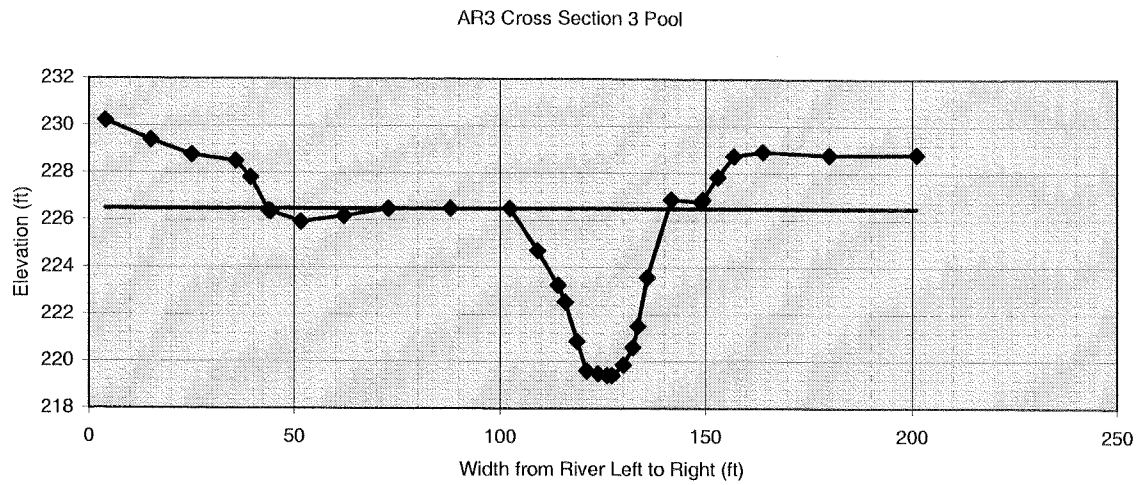
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
9.95	9.95			
226.69	226.69			

dimensions			
126.5	x-section area	3.3	d mean
38.4	width	40.3	wet P
5.3	d max	3.1	hyd radi
5.3	bank ht	11.7	w/d ratio
0.0	W flood prone area	0.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	AR3 Cross Section 3
	Pool
stream:	
location:	STA 38+15
description:	
height of instrument (ft):	234.45

notes	omit pt.	distance (ft)	FS (ft)	elevation
	# ☐ #	4	4.23	230.2165
	# ☐ #	15	5.05	229.3965
	# ☐ #	25	5.67	228.7765
LTT	# ☐ #	35.7	5.94	228.5065
	# ☐ #	39.3	6.63	227.8165
LBB	# ☑ #	43.7	8.05	226.3965
LPIN	# ☑ #	44.2	8.07	226.3765
	# ☑ #	51.6	8.51	225.9365
	# ☑ #	62	8.26	226.1865
	# ☑ #	72.9	7.97	226.4765
	# ☑ #	88	7.95	226.4965
LBKFLTOE	# ☐ #	102.3	7.95	226.4965
	# ☐ #	109	9.74	224.7065
	# ☐ #	114	11.2	223.2465
WS	# ☐ #	115.8	11.92	222.5265
LCH	# ☐ #	118.7	13.59	220.8565
	# ☐ #	121	14.85	219.5965
	# ☐ #	123.8	14.97	219.4765
	# ☐ #	126	15.04	219.4065
TW	# ☐ #	127.2	15.05	219.3965
	# ☐ #	130	14.6	219.8465
RCH	# ☐ #	132.3	13.85	220.5965
	# ☐ #	133.6	12.95	221.4965
	# ☐ #	135.8	10.87	223.5765
RBKFRTO	# ☐ #	141.7	7.57	226.8765
RPIN	# ☑ #	148.9	7.67	226.7765
RBB	# ☐ #	149.4	7.57	226.8765
	# ☐ #	153	6.61	227.8365
RTT	# ☐ #	156.9	5.72	228.7265
	# ☐ #	164	5.54	228.9065
	# ☐ #	180	5.67	228.7765
	# ☐ #	201	5.64	228.8065

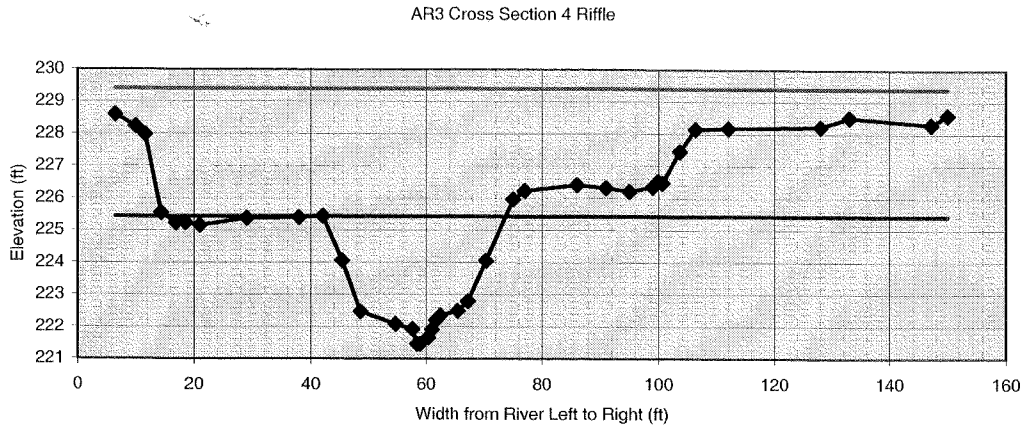
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
7.95	7.95			
226.4965	226.4965			

dimensions			
154.1	x-section area	4.0	d mean
38.7	width	42.1	wet P
7.1	d max	3.7	hyd radi
7.1	bank ht	~~9.7~~	w/d ratio
~~0.0~~	W flood prone area	~~0.0~~	ent ratio

hydraulics	
~~0.0~~	velocity (ft/sec)
~~0.0~~	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
~~0.00~~	Froude number
~~0.0~~	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
	measured D84 (mm)		
~~0.0~~	relative roughness	~~0.0~~	fric. factor
~~0.000~~	Manning's n from channel material		

Cross Section



section:	AR3 Cross Section 4 Riffle
stream:	
location:	STA 41+00
description:	
height of instrument (ft):	233.31

notes	omit pt.	distance (ft)	FS (ft)	elevation
	# ☐ #	6.5	4.72	228.59
	# ☐ #	10	5.08	228.23
LTT	# ☐ #	11.6	5.33	227.98
LBB	# ☐ #	14.4	7.76	225.55
	# ☑ #	16.9	8.09	225.22
LPIN	# ☑ #	18.5	8.08	225.23
	# ☑ #	21	8.16	225.15
	# ☑ #	29	7.94	225.37
	# ☑ #	38	7.92	225.39
LBKFLTOE	# ☐ #	42.1	7.88	225.43
	# ☐ #	45.4	9.25	224.06
LCH	# ☐ #	48.6	10.84	222.47
	# ☐ #	54.7	11.23	222.08
	# ☐ #	57.6	11.39	221.92
	# ☐ #	58.4	11.86	221.45
TW	# ☐ #	58.9	11.86	221.45
	# ☐ #	60.3	11.66	221.65
	# ☐ #	61	11.41	221.9
	# ☐ #	61.7	11.11	222.2
	# ☐ #	62.5	10.96	222.35
	# ☐ #	65.5	10.82	222.49
RCH	# ☐ #	67.3	10.52	222.79
	# ☐ #	70.4	9.25	224.06
RBKFRTO	# ☐ #	75	7.34	225.97
	# ☐ #	77	7.08	226.23
	# ☐ #	86	6.9	226.41
	# ☐ #	91	6.99	226.32
	# ☐ #	95	7.1	226.21
	# ☐ #	99	6.96	226.35
RPIN	# ☑ #	99.9	6.79	226.52
RBB	# ☐ #	100.6	6.84	226.47
	# ☐ #	103.6	5.85	227.46
	# ☐ #	106.3	5.16	228.15
	# ☐ #	112	5.13	228.18
	# ☐ #	128	5.09	228.22
	# ☐ #	133	4.8	228.51
	# ☐ #	147.2	5.01	228.3
	# ☐ #	150	4.72	228.59

☐

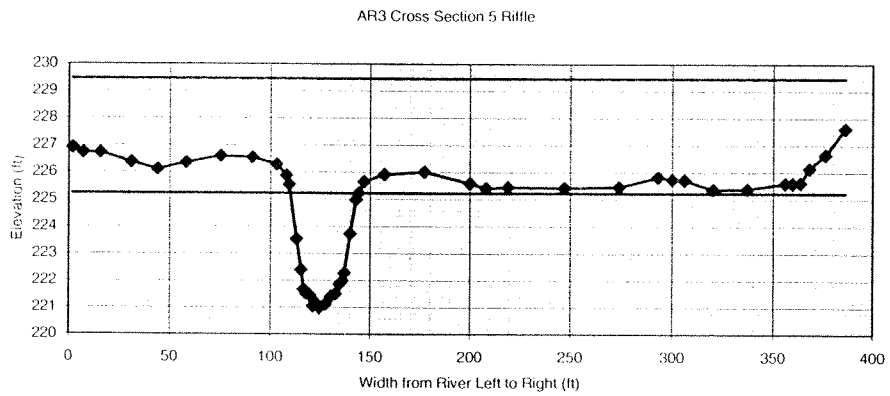
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
7.88	7.88			
225.43	225.43			

dimensions			
78.8	x-section area	2.5	d mean
31.6	width	33.1	wet P
4.0	d max	2.4	hyd radi
4.0	bank ht	12.7	w/d ratio
0.0	W flood prone area	0.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	AR3 Cross Section 5
	Riffle
stream:	
location:	STA 46+40
description:	
height of instrument (ft):	230.64

notes	omit pt.	distance (ft)	FS (ft)	elevation
	# ☐ #	2	3.73	226.91
	# ☐ #	7	3.91	226.73
LPIN	# ☑ #	15.8	3.91	226.73
	# ☐ #	31	4.25	226.38
	# ☐ #	44	4.53	226.11
	# ☐ #	58	4.29	226.35
	# ☐ #	75	4.05	226.59
	# ☐ #	91	4.09	226.55
	# ☐ #	103	4.35	226.29
LBKFLTOE	# ☐ #	107.9	4.76	225.88
	# ☐ #	109.3	5.09	225.55
	# ☐ #	113	7.1	223.54
	# ☐ #	115.3	8.25	222.39
LCH	# ☐ #	116.5	8.97	221.67
	# ☐ #	117.7	9.11	221.53
	# ☐ #	119.7	9.19	221.45
	# ☐ #	121.3	9.59	221.05
	# ☐ #	122.4	9.45	221.19
TW	# ☐ #	124.5	9.65	220.99
	# ☐ #	127.5	9.52	221.12
	# ☐ #	130.3	9.23	221.41
	# ☐ #	132.7	9.13	221.51
	# ☐ #	134.7	8.78	221.86
RCH	# ☐ #	136.2	8.66	221.98
	# ☐ #	137.1	8.37	222.27
	# ☐ #	140	6.91	223.73
	# ☐ #	143	5.66	224.98
RBKFRTO	# ☐ #	144.2	5.41	225.23
	# ☐ #	147	4.98	225.66
	# ☐ #	157	4.72	225.92
	# ☐ #	177	4.62	226.02
	# ☐ #	200	5.05	225.59
	# ☐ #	208	5.22	225.42
	# ☐ #	219	5.19	225.45
	# ☐ #	247	5.21	225.43
	# ☐ #	274	5.18	225.46
	# ☐ #	293	4.82	225.82
	# ☐ #	300	4.9	225.74
	# ☐ #	308	4.93	225.71
	# ☐ #	320	5.28	225.38
	# ☐ #	337	5.25	225.39
	# ☐ #	355	5.04	225.6
RPIN	# ☑ #	359.8	5.04	225.6
RBB	# ☐ #	369.5	5.02	225.62
	# ☐ #	388	4.49	226.15
	# ☐ #	376	3.99	226.65
	# ☐ #	386	3.02	227.62

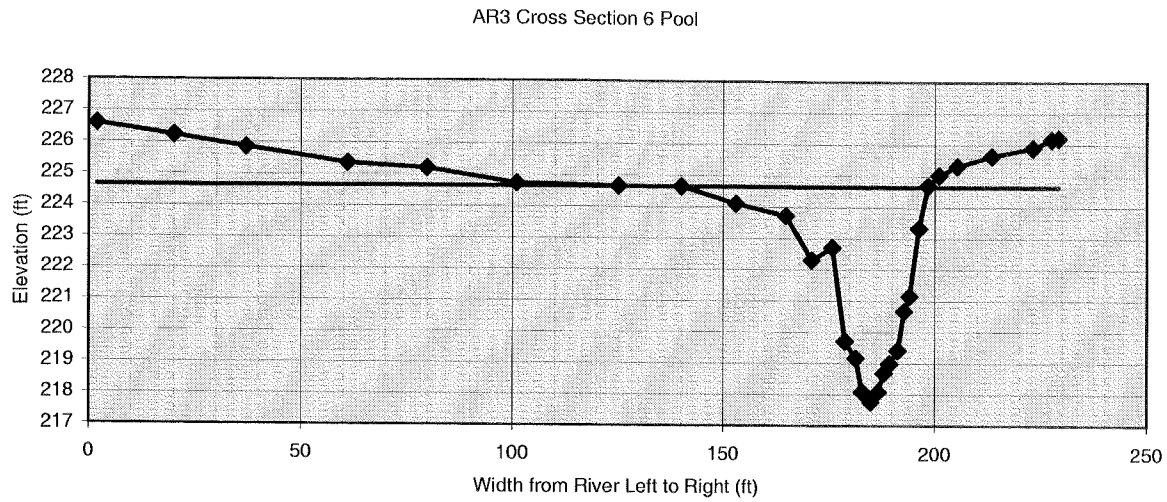
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
5.41	5.41			
225.23	225.23			

dimensions			
99.9	x-section area	2.9	d mean
34.3	width	36.0	wet P
4.2	d max	2.8	hyd radi
4.2	bank ht	11.8	w/d ratio
0.0	W flood prone area	0.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
	measured D84 (mm)		
0.0	relative roughness	0.0	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	AR3 Cross Section 6
stream:	Pool
location:	
description:	STA 48+20
height of instrument (ft):	230.64

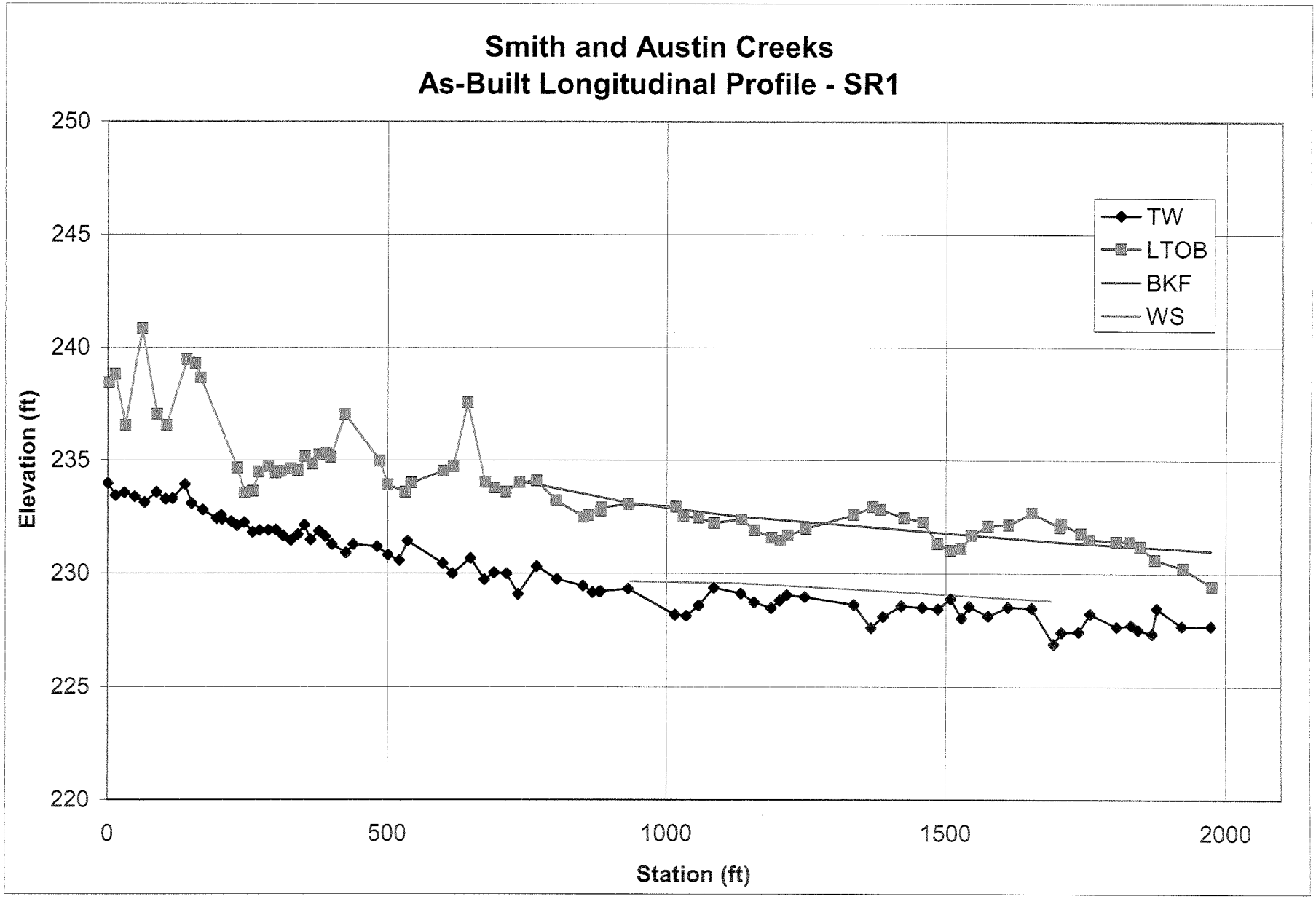
notes	omit pt.	distance (ft)	FS (ft)	elevation
	# ☐ #	2	4.05	226.59
	# ☐ #	20	4.41	226.23
	# ☐ #	37	4.79	225.85
	# ☐ #	61	5.29	225.35
LPIN	# ☑ #	79.9	5.45	225.19
	# ☐ #	101	5.91	224.73
	# ☑ #	125	5.99	224.65
LBKFLTOE	# ☐ #	140	5.99	224.65
	# ☐ #	153	6.54	224.1
	# ☐ #	165	6.92	223.72
	# ☐ #	171	8.34	222.3
	# ☐ #	176	7.93	222.71
LCH	# ☐ #	178.9	10.93	219.71
	# ☐ #	181.4	11.47	219.17
	# ☐ #	182.9	12.55	218.09
TW	# ☐ #	185	12.88	217.76
	# ☐ #	186.7	12.56	218.08
	# ☐ #	188.1	11.95	218.69
	# ☐ #	189.4	11.65	218.99
RCH	# ☐ #	191.3	11.23	219.41
	# ☐ #	192.8	9.97	220.67
	# ☐ #	194.1	9.48	221.16
	# ☐ #	196.3	7.31	223.33
RBKFRTO	# ☐ #	198.4	5.95	224.69
	# ☐ #	201	5.61	225.03
	# ☐ #	205.3	5.32	225.32
	# ☐ #	213.3	5	225.64
	# ☐ #	223	4.74	225.9
RPIN	# ☑ #	227.4	4.48	226.16
RBB	# ☐ #	229	4.44	226.2

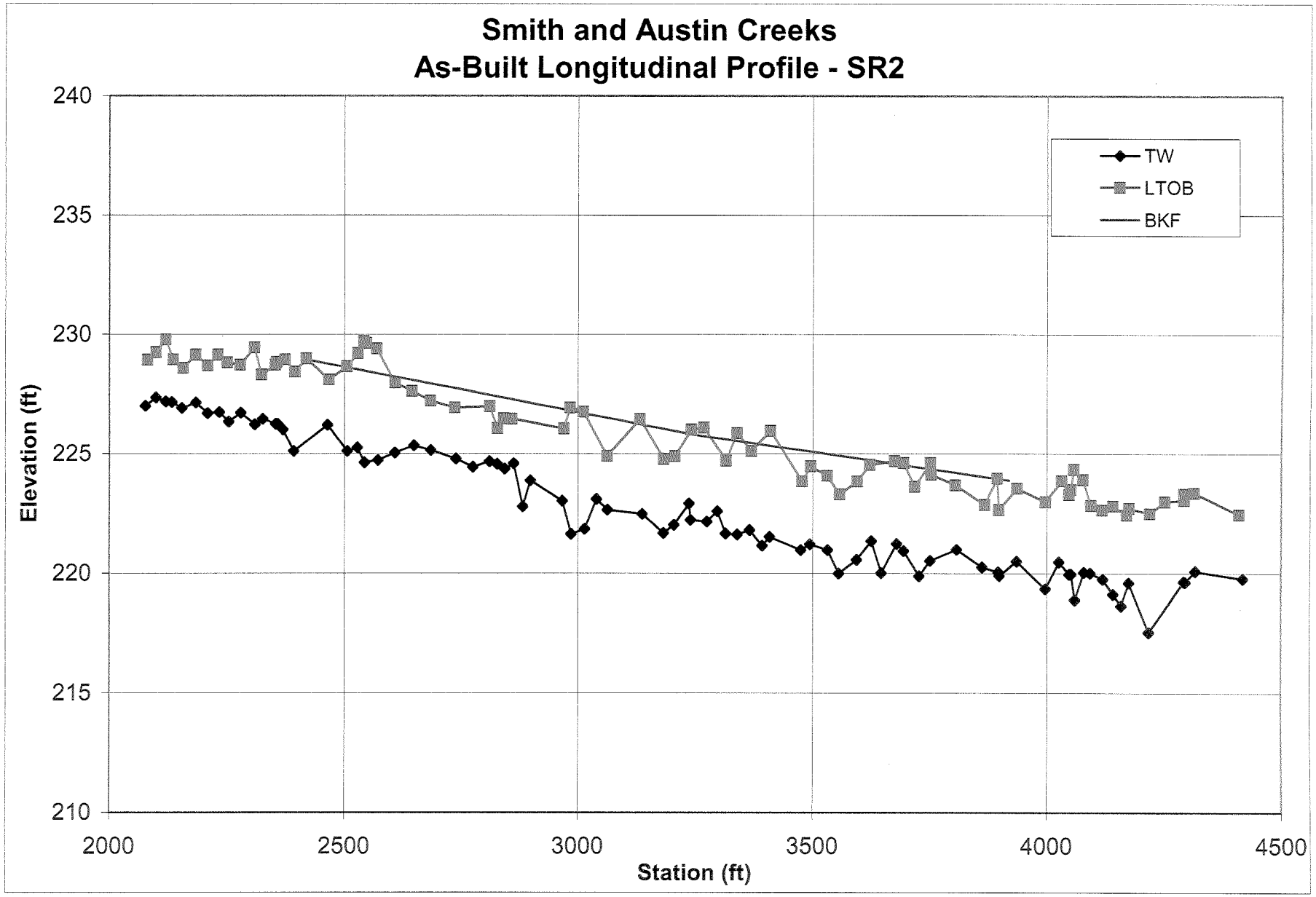
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
5.99	6.92			
224.65	223.72			

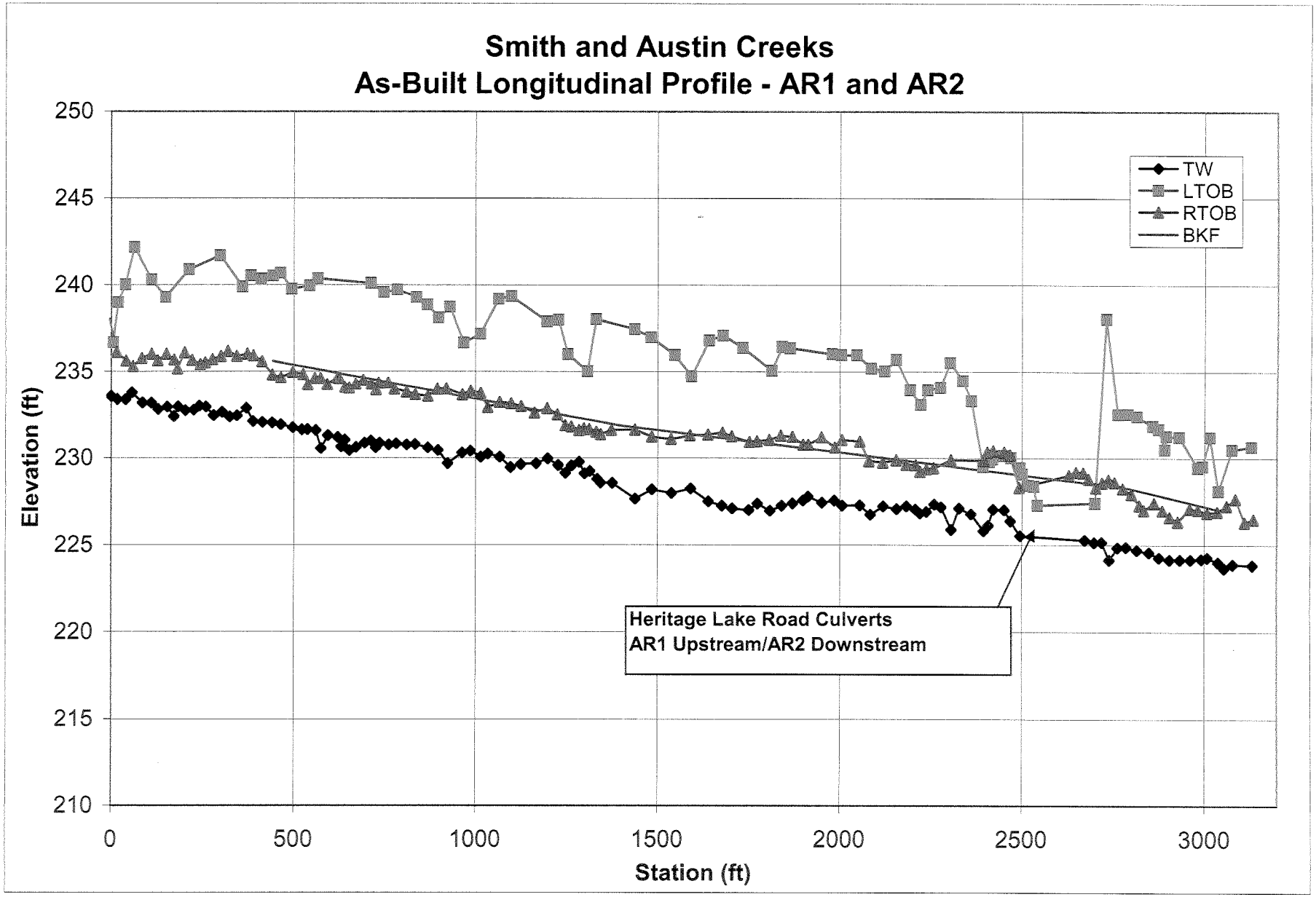
dimensions			
135.7	x-section area	2.3	d mean
58.3	width	62.3	wet P
6.9	d max	2.2	hyd radi
6.0	bank ht	~~25.1~~	w/d ratio
~~0.0~~	W flood prone area	~~0.0~~	ent ratio

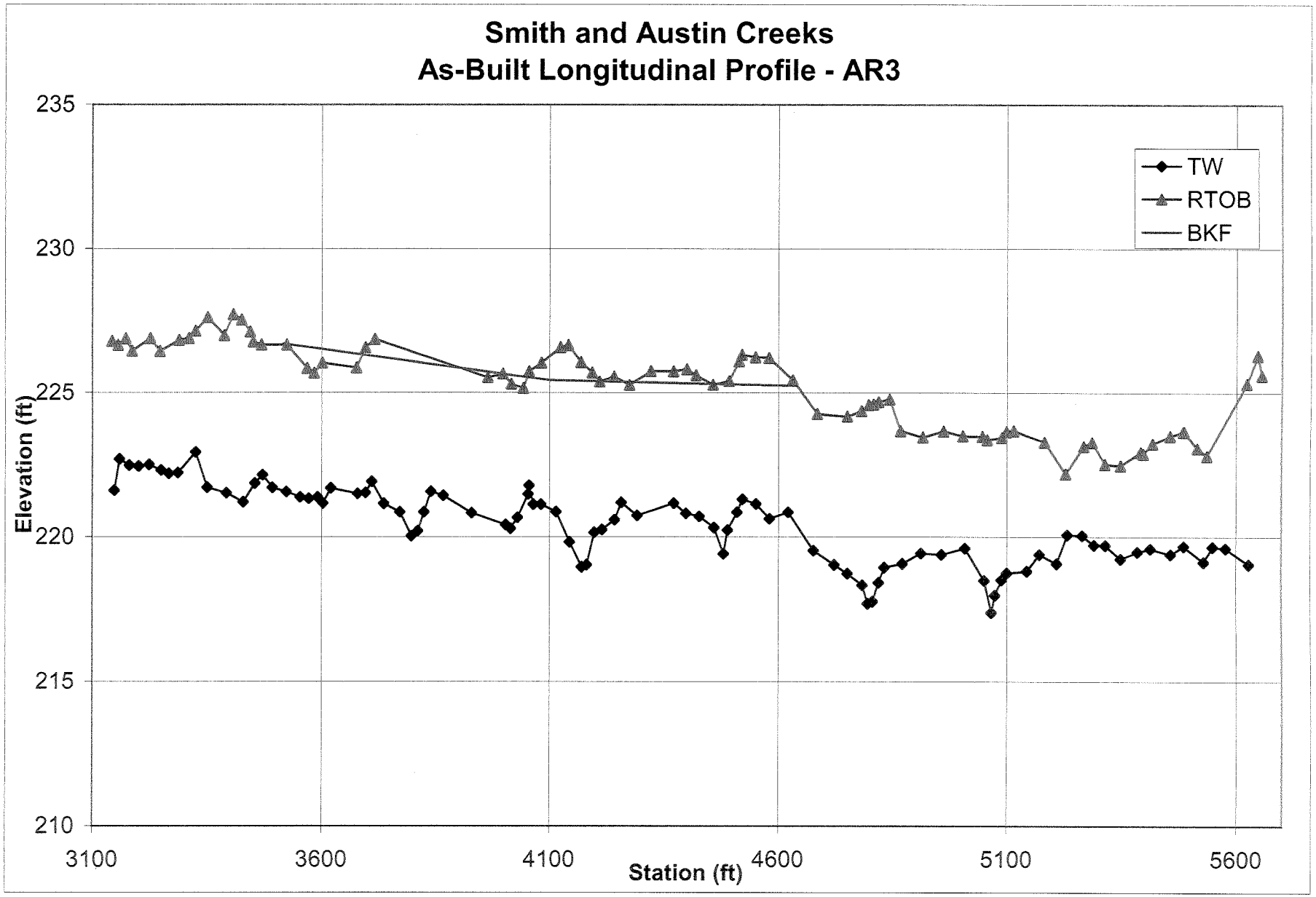
hydraulics	
~~0.0~~	velocity (ft/sec)
~~0.0~~	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
~~0.00~~	Froude number
~~0.0~~	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
	measured D84 (mm)		
~~0.0~~	relative roughness	~~0.0~~	fric. factor
~~0.000~~	Manning's n from channel material		


Smith and Austin Creeks
As-Built Longitudinal Profile - SR1
250
245
240
235
230
225
220
Elevation (ft)
0
500
1000
1500
2000
Station (ft)
TW
LTOB
BKF
WS


Smith and Austin Creeks
As-Built Longitudinal Profile - SR2
240
235
230
225
220
215
210
Elevation (ft)
2000
2500
3000
3500
4000
4500
Station (ft)
TW
LTOB
BKF


Smith and Austin Creeks
As-Built Longitudinal Profile - AR1 and AR2
250
245
240
235
230
225
220
215
210
Elevation (ft)
0
500
1000
1500
2000
2500
3000
Station (ft)
TW
LTOB
RTOB
BKF
Heritage Lake Road Culverts
AR1 Upstream/AR2 Downstream


Smith and Austin Creeks
As-Built Longitudinal Profile - AR3
235
230
225
220
215
210
Elevation (ft)
3100
3600
4100
4600
5100
5600
Station (ft)
TW
RTOB
BKF

Smith and Austin Creeks
Photo Log

Smith Creek

SR1 – Photos 35-57

SR2 – Photos 58-78

SR3 – Photos 79- 83

Austin Creek

AR1 – Photos 1-14

AR2 – Photos 15-19

AR3 – Photos 20-34

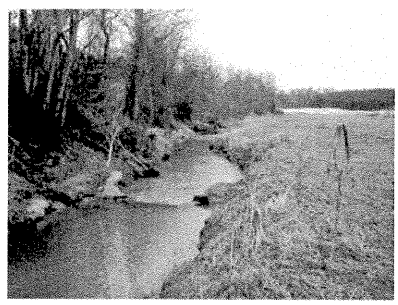
Notes:
1. Photo point locations are shown on the plan views in the actual location the picture was taken.
2. All photos are oriented downstream.
3. All points are marked with a wooden stake and orange flagging tape. For channel points, the stake is set up on the most accessible bank at that same station.
4. Photo locations include longitudinal photos, cross sections, and vegetation plots.
5. There is no photo location 18.

PHOTO LOG

Smith & Austin Mitigation Plan

APP1 - AR1 XSEC 1 (Riffle)

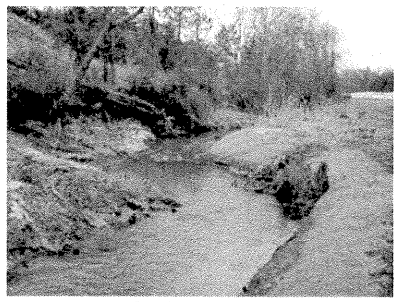
APP2 - AR1 Project Start



APP3 - AR1 STA 3+34

APP4 - AR1 XSEC 2 (Riffle)

APP5 - AR1 Vegetation Plot

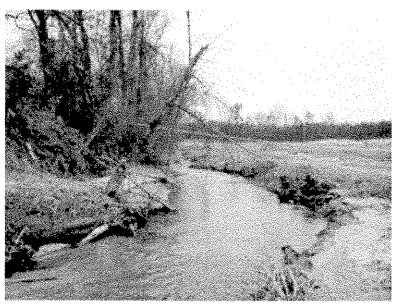


APP6 - AR1 STA 5+92

APP7 - AR1 STA 7+21

APP8 - AR1 STA 9+13

APP9 - AR1 STA 11+42

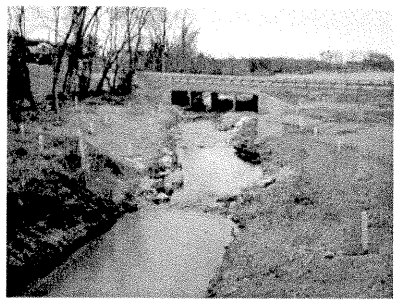


APP10 - AR1 XSEC 3 (Riffle)

APP11 - AR1 STA 18+55

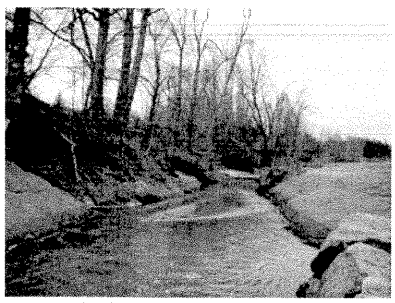
APP12 - AR1 XSEC 4 (Pool)

APP13 - AR1 STA 22+51



APP14 - AR1 STA 23+19 from

APP15 - AR2 Project Start f



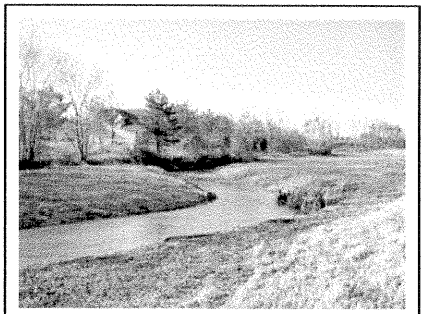
APP16 - AR2 XSEC 1 (Riffle)

APP17 - AR2 XSEC 2 (Pool)

APP19 - AR2 XSEC 3 (Riffle)

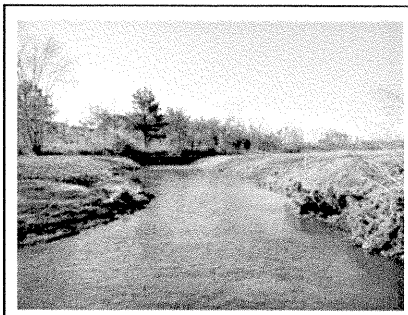
APP20 - AR3 Begin Reach - B

APP21 - AR3 STA 32+60

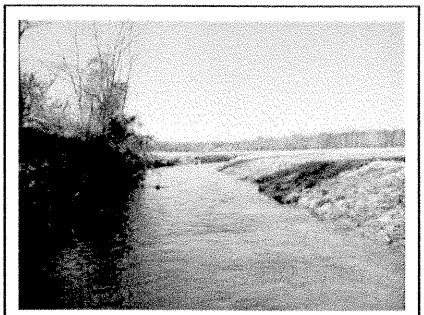


APP22 - AR3 XSEC 1 (Pool)

APP22A - AR3 Live Stake Plo

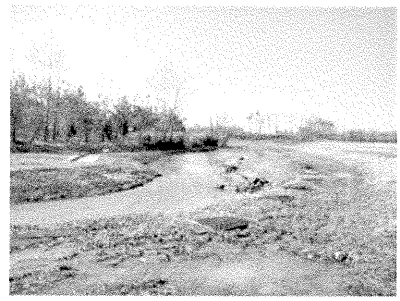


APP23 - AR3 XSEC 2 (Riffle)



APP24 - AR3 STA 36+00

APP25 - AR3 XSEC 3 (Pool)



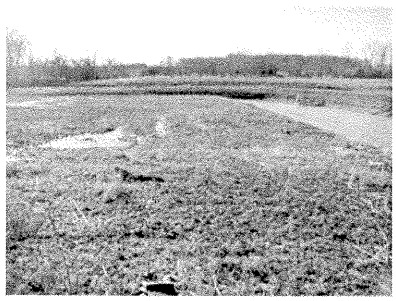
APP26 - AR3 XSEC 3 (Pool)

APP27 - AR3 XSEC 4 (Riffle)

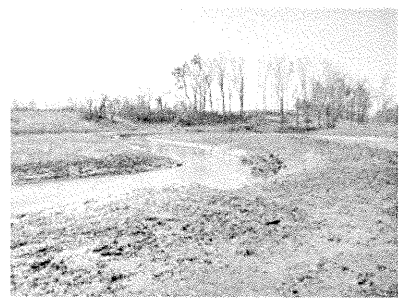
APP28 - AR3 STA 41+80

APP29 - AR3 STA 44+00

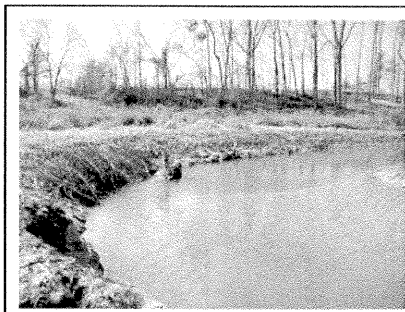
APP30 - AR3 XSEC 5 (Riffle)



APP30A - AR3 Vegetation Plo



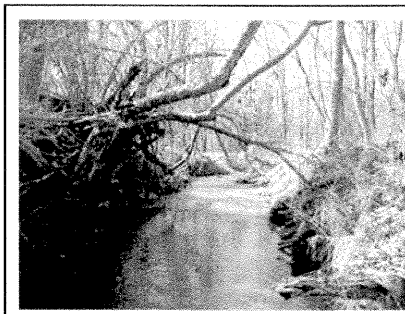
APP31 - AR3 XSEC 6 (Pool)



APP32 - AR3 STA 50+40

APP33 - AR3 STA 50+75

APP34 - AR3 STA 54+20



SPP35 - SR1 XSEC 1 (Riffle)

SPP36 - SR1 STA 0+00

SPP37 - SR1 STA 0+50

SPP38 - SR1 STA 1+25

SPP39 - SR1 STA 2+00

SPP40 - SR1 STA 2+55

SPP41 - SR1 STA 3+25 at Tri

SPP42 - SR1 STA 3+90

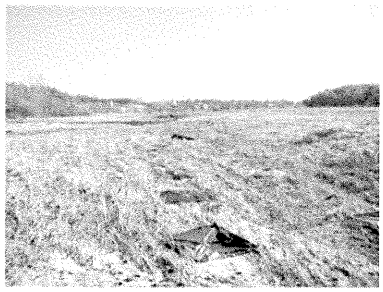
SPP43 - SR1 STA 4+90

SPP44 - SR1 STA 5+25

SPP45 - SR1 STA 6+50

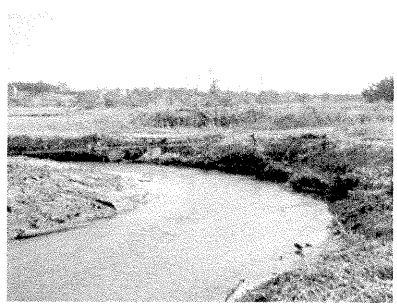
SPP46 - SR1 STA 7+25

SPP47 - SR1 XSEC 2 (Riffle)



SPP47A - SR1 Vegetation Plo

SPP48 - SR1 XSEC 3 (Riffle)

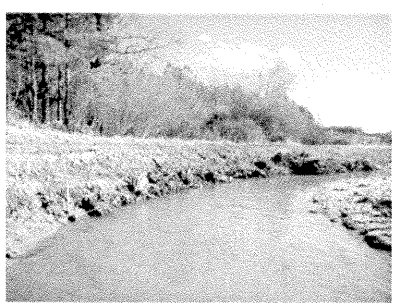


SPP49 - SR1 XSEC 4 (Pool)

SPP50 - SR1 STA 12+10

SPP51 - SR1 STA 13+35

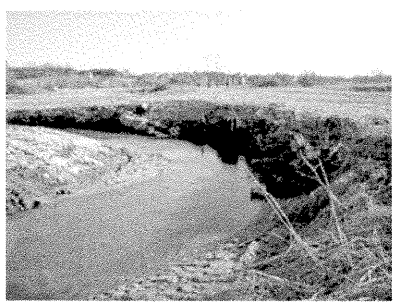
SPP51A - SR1 Live Stake Plo



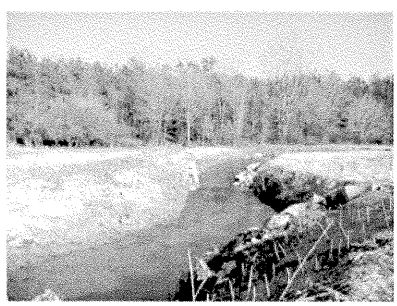
SPP51B - SR1 Live Stake Plo

SPP51C - SR1 Live Stake Plo

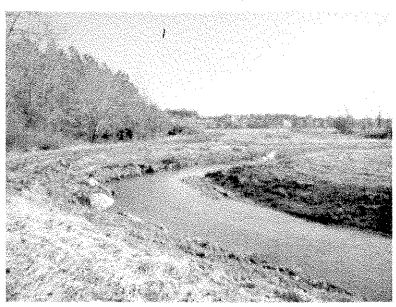
SPP52 - SR1 STA 14+10



SPP53 - SR1 STA 15+00



SPP54 - SR1 STA 15+35



SPP55 - SR1 XSEC 5 (Pool)

SPP56 - SR1 STA 17+05

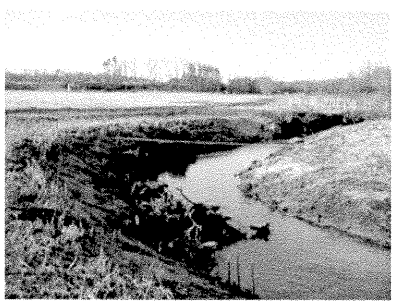
SPP57 - SR1 STA 18+40

SPP58 - SR2 STA 20+60

SPP59 - SR2 STA 21+95

SPP60 - SR2 STA 22+75

SPP61 - SR2 XSEC 1 (Riffle)



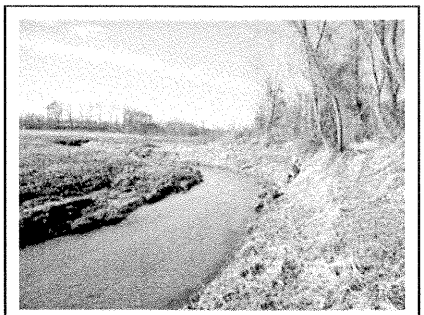
SPP62 - SR2 XSEC 2 (Pool)

SPP63 - SR2 STA 25+05

SPP64 - SR2 STA 26+55

SPP65 - SR2 STA 27+75

SPP66 - SR2 STA 29+00



SPP67 - SR2 XSEC 3 (Pool)

SPP68 - SR2 XSEC 4 (Riffle)

SPP69 - SR2 STA 32+75

SPP70 - SR2 STA 34+50

SPP71 - SR2 STA 35+10

SPP72 - SR2 STA 36+50

SPP73 - SR2 XSEC 5 (Riffle)

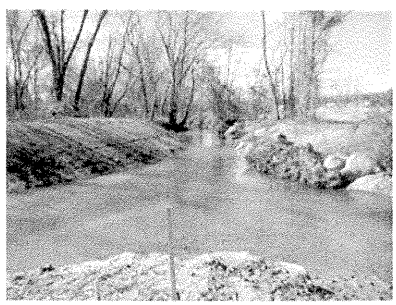
SPP74 - SR2 STA 39+90

SPP75 - SR2 STA 41+00

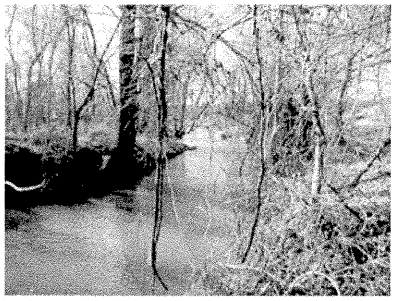
SPP76 - SR2 STA 42+00

SPP77 - SR2 STA 42+55

SPP78 - SR2 STA 44+00



SPP79 - SR2-AR3 Confluence



SPP80 - SR2 STA 47+90

SPP81 - SR2 STA 50+00

SPP82 - SR2 STA 51+50

SPP83 - SR2 STA 52+00 –
Project End

Smith and Austin Creeks
Vegetation Survival Plots

Live Stakes

Reach	Photo Point (#)	Planted (stakes)	Year 1 (stakes)	Year 2 (stakes)	Year 3 (stakes)	Year (stakes)	Year 5 (stakes)
SR1	51A, B, C	145					
AR3	22A	128					

Bare Root Plantings

Reach	Photo Point (#)	Planted (stems)	Year 1 (stems)	Year 2 (stems)	Year 3 (stems)	Year 4 (stems)	Year 5 (stems)
SR1	47A	47					
AR1	5	60					
AR3	30A	46					

Notes:

1. All plots are shown on the plan views. All plot corners are marked with wooden stakes with orange flagging tape.
2. Each counted stem or live stake is marked with pink flagging tape.
3. Photo point locations are shown on the plan views and marked with wooden stakes with orange flagging tape.
4. Use successive columns for survivability from year to year.