

Zacks Fork Creek Stream Restoration Monitoring Report

Monitoring Year: 2009
Measurement Year: 4
As-Built Date: 2005
NCEEP Project #: AW03003A

Submitted on December 8, 2009



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Zacks Fork Creek Year 4 (2009) Monitoring Report

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I. Executive Summary

The monitoring assessment of this stream restoration project for Year 4 indicates that hydrology is functioning within design specifications and continued vigorous vegetative growth in the riparian corridor is occurring. Dimension, pattern and profile data remain within the designed parameters Rosgen stream type. Other than beaver activity there are no naturally occurring vegetative issues; one vegetation sampling plot was partially graded at some point in the past year.

In March 2009 field work occurred to address review comments received from NCEEP related to the Year 3 Monitoring Report (REF. S&N Remediation Plan dated March 3, 2009, to NCEEP previously submitted). All areas of concern, as listed in the referenced Remediation Plan, were addressed. The Year 4 site evaluation indicates that re-vegetation and bank stabilization efforts were successful.

II. Project Background

The project site is located in Caldwell County to the north of Lenoir on Zacks Fork Road, adjacent to a municipal soccer field complex (Figure 1). The surrounding land use includes residential developments within the watershed to the north and east of the site that have likely altered the hydrologic regimen, resulting in higher peak events as evidenced by down-cutting and bank erosion. The stream restoration encompasses approximately 3,900 linear feet of a reach that had become incised and degraded. Through a combination of natural channel design, grade-control structures and excavation of a bankfull bench this project seeks to address deficiencies in the stream dimension, pattern and profile as well improve both in-stream and riparian habitat. Restoration was undertaken in 2004-5; a more complete description of the project background and design is given in “Geomorphologic Assessment & Stream Restoration Preliminary Design Report” prepared by FMSM Engineers and “Mitigation Report for Zack’s Fork Creek Stream Restoration” prepared by Spaulding & Norris, as revised in February 14, 2008. The as-built plan view of the project area is given in Figure 2; more detailed maps are also available in the “Mitigation Report”.

Figure 1



Table 1. Project Mitigation Structure	
Project Segment or Reach ID	Linear Footage or Acreage
Reach I	3,900 lf

Table 2: Project Background	
Project County	Caldwell
Drainage Area	12.3 square miles
Rosgen Classification of As-Built	C
Dominant Soil Types	Chewacla
Reference Site ID	-
USGS HUC for Project and Reference	-
NCDWQ Sub-Basin for Project and Reference	03050101-027
NCDWQ Classification for Project and Reference	-
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor	-
% of project easement fenced	0

Table 3. Project Contacts	Firm Address, Phone, Contact
<u>Project Manager</u> Spaulding & Norris, PA Attn: Stephanie L. Norris, PE	972 Trinity Road Raleigh, NC (919) 854-7990
<u>Designer</u> FMSM Engineers Attn: George Athanasakes, PE	1901 Nelson Miller Parkway Louisville, KY 40223 (502) 212-5000
<u>Construction Contractor</u> Environmental Services, Inc. Attn: Steve Jones	1980-A Parker Court Stone Mountain, GA 30087 Phone: 770-736-9101
<u>Planting Contractor</u> Coastal Plain Conservation Nursery Attn: Ellen Colodney	3067 Connors Drive Edenton, NC 27932 (252) 482-5707
<u>Seeding Contractor</u> Environmental Services, Inc. Attn: Steve Jones	1980-A Parker Court Stone Mountain, GA 30087 Phone: 770-736-9101
<u>Vegetation Monitoring</u> Environmental Services, Inc. Attn: Charles Johnston	524 S. New Hope Road Raleigh, NC 27610 (919) 212-1760
<u>Stream Monitoring</u> Environmental Services, Inc. Attn: Steve Jones	1980-A Parker Court Stone Mountain, GA 30087 Phone: 770-736-9101

III. Project Condition and Monitoring Results

A. Vegetation Assessment, Monitoring Year 4 (2009)

As specified by the guidelines in *Content, Format and Data Requirements for EEP Monitoring Reports*, upon completion of stream construction eleven (11) vegetation sampling plots (10m x 10m) were staked at intervals in the riparian zone of the project reach. Planting was done on a per-acre scale using a combination of live stakes, containerized plants and seeding. Baseline counts for the individual sampling plots were not assessed or recorded at the time of planting. In Year 1, 2 and 3 the vegetative assessments were performed on 12 Dec 2006, 21 Nov 2007, and 6 Nov 2008 respectively. This year (Year-4) the vegetative assessment was done earlier (12 Sept 2009) than in previous years; this shift to the end of the growing season aided assessment as vegetation was still in leaf. Chewacla loam is the only mapped soil series within the floodplain of the project, so no direct on-site soil sampling is performed as part of the yearly monitoring process. The spatial location of the vegetation sampling plots is given in Figure 3; note that plots have been numbered in this report to concur w/ prior monitoring reports with Plot #1 being the furthest upstream. Representative photographs of all plots are contained in Appendix D.

In response to EEP comments in the Year-3 review, additional trees (4th-yr class; *B. nigra*, *P. occidentalis*, *L. tulipifera*, *A. serrulata*) were planted in Plots #6 and #8 in March 2009 and both plots now have woody stem counts in excess of the 320 stems/acre requirement (Table 5 below). Also per EEP comments, the corners of all plots as well as the endpoints for each stream cross-section were relocated using sub-meter GPS and were re-flagged and/or re-staked.

The Year-4 vegetation plot data (Table 5 and Appendix A) reflects a continued upward trend throughout the restoration's reach. The 4th-year counts equal or exceed the prior 3-yr mean in 9 of the 11 plots with a mean 184% increase. There has also been considerable natural recruitment in many plots, most notably of river birch, silky willow, and sycamore. (Note: Stem counts were limited to specimens >4' high, in an attempt to reflect only originally or subsequently transplanted trees.) Silky willow (*Salix sericea*) continues to dominate the plots abutting the stream bank (e.g. VP#1, 7, 11) while those plots higher in the floodplain have a more even species distribution (e.g. VP#2, 10). Herbaceous ground cover in all plots (other than VP# 4, see below) is at or near 100%.

Two vegetative problem areas were identified in the Year 4 assessment (Table 4). There is one area of extreme beaver herbivory where virtually all the trees, primarily willows, have been gnawed off at 1'-2' above the ground. This is likely a scenario which will recur unless the beavers are removed or eliminated; however, it is also likely that this area will revegetate naturally from sprouting of the gnawed stumps and/or natural seed recruitment from the surrounding upper canopy. The other area is Vegetation Plot #4 which has been partially re-graded by heavy equipment, apparently to improve drainage or stormwater flow near the bridge and walking trail. This grading extends to within 10' of the stream bank; however the remaining riparian vegetation is vigorous and appears at this point to be sufficient to maintain bank integrity. S&N contacted the City Public Works Staff to discuss their activities and re-vegetation of the area. This is the second time at which the City Staff has encroached into the project area and S&N has discussed this with them. The City has indicated that they may be willing re-vegetate as recommended using appropriate year-class specimen.

Though not a condition of the monitoring agreement, at EEP's request following the Year 3 onsite inspection, an effort was undertaken to address the proliferation of wild rose (*Rosa multiflora*) within the riparian zone. In June 2008, selective spot-spraying as done using a glyphosphate-based herbicide. Evaluation in November 2008 showed this treatment to be partially effective as evidenced by leaf/stem kill of treated plants. It was apparent, however, that the *R. multiflora* infestation is not limited to the restoration corridor and that re-colonization from mature plants in adjacent areas and any existing *in situ* seed bank was likely. Our Year-4 evaluation show this to have largely occurred, as wild rose is still prevalent, though not dominant, within the riparian zone and repeated spraying will likely be necessary to achieve an successful and ongoing suppression.

Feature/Issue	Station#	Probable Cause	Photo #
Herbivory	26+00	Beaver activity	VP2
Grading	18+00	Vegetation Plot 4 partially graded	VP1

Species	Plot #	1	2	3	4*	5	6	7	8	9	10	11
<i>Alnus serrulata</i> (common alder)		2	2	2	1	5	2	3	4	7	6	3
<i>Betula nigra</i> (river birch)		-	3	4	2	-	5	1	7	6	4	5
<i>Cornus amomun</i> (silky dogwood)		-	2	-	-	-	-	-	2	2	-	-
<i>Ilex opaca</i> (American holly)		-	-	-	-	-	-	-	-	-	-	-
<i>Lindera benzoin</i> (spicebush)		-	1	-	-	-	2	-	-	-	-	-
<i>Liriodendron tulipifera</i> (tulip poplar)		1	1	1	-	-	2	-	1	8	8	6
<i>Platanus occidentalis</i> (sycamore)		1	7	12	-	19	1	1	-	1	3	11
<i>Salix sericea</i> (silky willow)		25	-	18	25	-	-	20	-	5	-	8
<i>Sambucus canadensis</i> (elderberry)		-	-	-	-	-	-	1	-	-	-	-
Stems / Plot		29	16	37	28	24	12	26	14	29	21	33
Stems / Acre		1175	648	1499	1134	972	486	1053	567	1175	851	1337
Est. % Ground Cover		100	100	100	50	100	95	100	100	100	100	100

B. Stream Assessment, Monitoring Year 4 (2009)

This stream restoration encompasses approximately 3,900 feet in stream length and incorporates numerous natural-channel design structures including rock crossvanes, rock J-hooks, log vanes, root wads and other bank stabilizations. As in prior monitoring years, this Year-4 assessment collected hydraulic performance parameters which include a complete longitudinal profile, ten cross-sectional profiles, riffle pebble counts, and a visual stability assessment. The locations of grade-control structures, stream cross-sections, vegetative plots and photo stations are shown in Figure 3. Please refer also to Appendix B containing the longitudinal and cross-sectional profiles and Appendix C for representative photographs arranged sequentially moving downstream.

The overall hydrology of the restoration project appears to be functioning within design specifications. There is strong establishment of stable riffle-pool sequences, maintenance of thalweg alignment, strong sediment sorting, well-vegetated banks, formation of point bars, and integrity of grade-control structures. There are vegetated bankfull benches in multiple locations and pools appear to be clearing out sediment adequately.

This year's evaluation records no problems with any grade-control structures. There are five other areas with minor issues (Table 6 and Figure 4). Two mid-channel bars have formed; both bars as well as the adjacent banks are fully vegetated and appear stable at this time. There is a beaver dam which spans one crossvane and is causing the water level to be raised for several hundred feet upstream. A minor bank slump (approximately 15 LF) is largely re-vegetated and appears to have a stable geometry. Lastly, there is an area of bank scour (approximately 50 LF) on the outer (right) bank of one mid-reach meander. Representative photographs are given in Appendix E. Of note, the rock crossvane near the downstream end of the project which had shown backcutting and piping through the vane arms was repaired in March 2009 by repositioning of rock and placement of erosion control matting. This year's evaluation shows this structure to be stable and functioning properly.

Cross-sectional morphology, and sediment sorting date, and reach morphology are given in Tables 7 and 8. All profiles are suitably congruent with those collected in Year-3. Cross-section #5 shows a slightly shallower pool, possibly reflecting increased scour efficacy and thereby deepening of the plunge pool immediately upstream with corresponding extension upstream of the glide portion of this pool. Cross-section #9 crosses the stream where one mid-stream bar has formed and the profile reflects the migration of sediment from bankside to bar. The visual stability assessment for all feature categories (Tables 9 and 10) are at or above the previous years.

A 4' crest gauge was installed in the streambed near Cross-section # 9 in March, 2009. This was subsequently read during the plant survey in September 2009 and found to have been overtopped. Data from the NC Climate office shows that the nearest monitoring station (Yadkin River at Patterson, NC) recorded peaks on May 16th in streamflow (800 cubic ft per second) and gage height (4.2 ft, where the mean is <1.5 ft); it is likely that this rainfall caused the bankful event.

The Year-3 EEP comments expressed concern over two Bank Erosion Hazard Index (BEHI) and Near-Bank Stress values in the lower reach. The bank stabilization areas identified in the previously referenced Remediation Plan were addressed with the March 2009 field work. In accordance with the monitoring schedule these indices will be re-evaluated in Year-5; if corrective action is indicated it will undertaken at that time.

Feature Issue	Station #	Suspected Cause	SP #	Photo #
Bar Formation	15+50	Mid-stream bar	1	SP1
	25+25	Mid-stream bar	2	SP2
Flow Occlusion	26+50	Beaver dam	3	SP3
Bank Slump	43+25	Water velocity	4	SP4
Bank Scour	44+50	Water velocity	5	SP5

	Cross-Section	1 - pool	2 - riffle	3 -pool	4 -riffle	5 - pool
DIMENSION	BF Width (ft)	52.72	32.85	39.84	32.91	50.87
	Floodprone Width (ft)	135.17	100.82	115.1	130.28	104.99
	BF Cross-sectional area (sq.ft)	148.65	95.97	130.21	71.42	217.86
	BF Mean Depth (ft)	2.82	2.92	3.27	2.17	4.28
	BF Max Depth (ft)	6.01	5.46	5.79	3.55	10.21
	Width/Depth Ratio	18.7	11.25	12.18	15.17	11.89
	Entrenchment Ratio	2.56	3.07	2.89	3.96	2.06
	Wetted Perimeter (ft)	57.86	39.04	43.24	34.2	58.79
	Hydraulic Radius (ft)	2.57	2.46	3.01	2.09	3.71
SUBSTRATE	D50 (mm)	-	64.0	-	69.7	-
	D84 (mm)	-	149	-	157	-
	Cross-Section	6 - pool	7 - riffle	8 -pool	9 -riffle	10 - pool
DIMENSION	BF Width (ft)	39.8	27.1	34.54	65.36	34.07
	Floodprone Width (ft)	77.44	53.89	141.62	176.0	199.44
	BF Cross-sectional area (sq.ft)	104.0	40.6	75.88	131.95	106.65
	BF Mean Depth (ft)	2.61	1.5	2.2	2.02	3.13
	BF Max Depth (ft)	6.03	2.4	5.3	3.88	4.71
	Width/Depth Ratio	15.25	18.07	15.7	32.36	10.88
	Entrenchment Ratio	1.95	1.99	4.1	2.69	5.85
	Wetted Perimeter (ft)	43.41	28.67	37.57	67.64	36.44
	Hydraulic Radius (ft)	2.4	1.42	2.02	1.95	2.93
SUBSTRATE	D50 (mm)	-	117.2	-	69.7	-
	D84 (mm)	-	178	-	128	-

		Min	Max	Med
PATTERN	Channel Beltwidth (ft)	70	150	110
	Radius of Curvature (ft)	-	-	-
	Meander Wavelength (ft)	180	300	240
	Meander Width Ratio	6.9	11.5	9.2
PROFILE	Riffle Length (ft)	68.4	120.4	93.2
	Riffle Slope (ft/ft)	.001	.009	.004
	Pool Length (ft)	56.7	275.1	111.8
	Pool Spacing (ft)	45.7	346.5	154.3

Feature Category	Metric	# Stable	# per As-built	LF of unstable state	% Stable	Feature Mean %
A. Riffles	1. Present?	22	22	-	100	
	2. Armor stable?	22	22	-	100	
	3. Facet grade appears stable?	22	22	-	100	
	4. Minimal evidence of embedding/fining?	22	22	-	100	
	5. Length appropriate?	22	22	-	100	100%
B. Pools	1. Present?	28	28	-	100	
	2. Sufficiently deep (maxD:mean bkfl >1.6?)	28	28	-	100	
	3. Length appropriate?	100	100	-	100	100%
C. Thalweg	1. Upstream of meander bend centering?	17	17	-	100	
	2. Downstream of meander centering?	15	17	90'	88	94%
D. Meanders	1. Outer bend in state of limited/controlled erosion?	10	11	40'	91	
	2. If eroding, # with concomitant bar formation?	2	2	35'	80	
	3. Apparent Rc within specifications?	11	11	-	100	
	4. Sufficient floodplain access and relief?	11	11	-	100	93%

E. Bed	1. General channel bed aggradation areas?	22	22	-	100	
	2. Channel bed degradations (downcuts/headcuts)?	0	0	-	100	100%
F. Vanes	1. Free of back or arm scour?	27	28	25'	96	
	2. Height appropriate?	27	28	-	96	
	3. Angle and geometry appear appropriate	27	28	-	96	
	4. Free of piping or other structural failures?	267	28	-	100	97%
G. Wads/Boulders	1. Free of scour?	7	8	15'	88	
	2. Footing stable?	8	8	0	100	94%

Table 10. Categorical Stream Feature Visual Stability Assessment						
Feature	Initial	MY-01	MY-02	MY-03	MY-04	MY-05
A. Riffles	NA	98%	98%	99%	100%	
B. Pools	NA	100%	100%	100%	100%	
C. Thalweg	NA	85%	88%	88%	94%	
D. Meanders	NA	93%	93%	93%	93%	
E. Bed General	NA	96%	96%	100%	100%	
F. Structures	NA	98%	98%	94%	97%	
G. Wads/Boulders	NA	88%	88%	88%	94%	

VI. Methodology and References

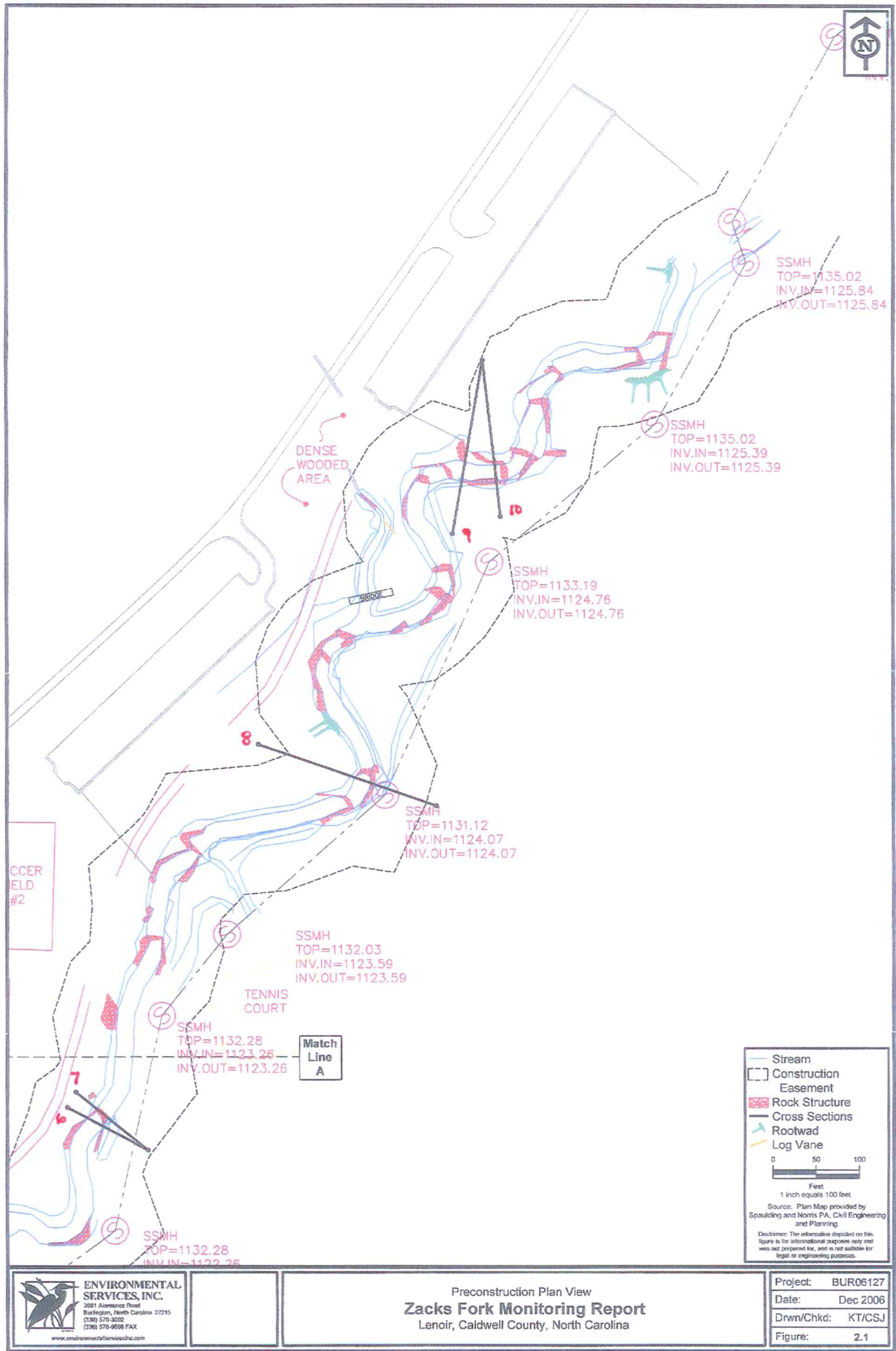
Field work was performed using usual and customary methods based on U.S. Army Corps of Engineers and N.C. Division of Water Quality guidelines. Data analysis was done using Microsoft Excel and other non-proprietary software.

References include but are not limited to:

USACOE. (2003) *Stream Mitigation Guidelines*. .

NCDWQ (2005) *Content, Format and Date Requirements for EEP Monitoring Reports*

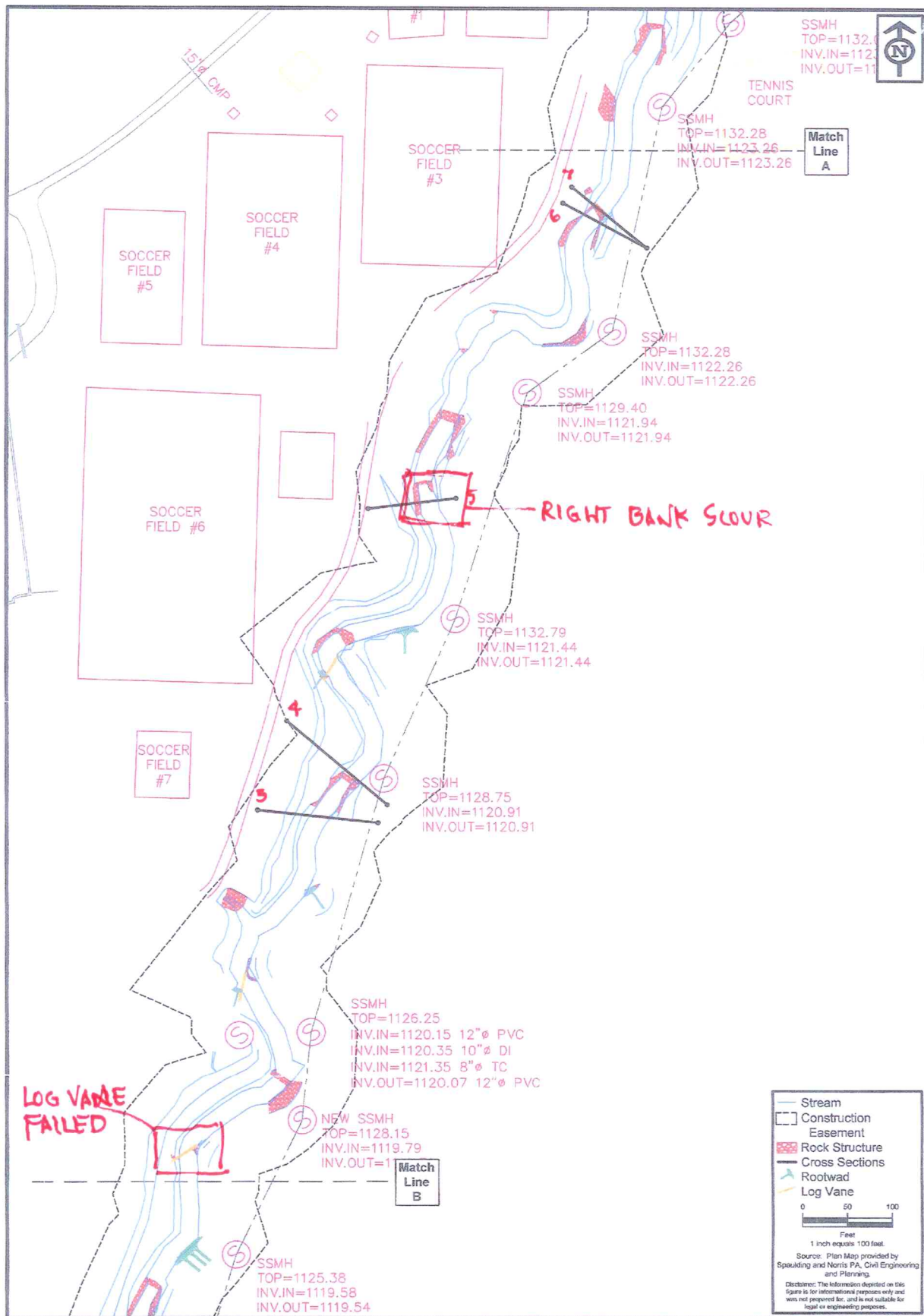
D.L. Rosgen. *Applied River Morphology*. (1996) Wildland Hydrology, Pagosa Springs CO.



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Preconstruction Plan View
Zacks Fork Monitoring Report
 Lenoir, Caldwell County, North Carolina

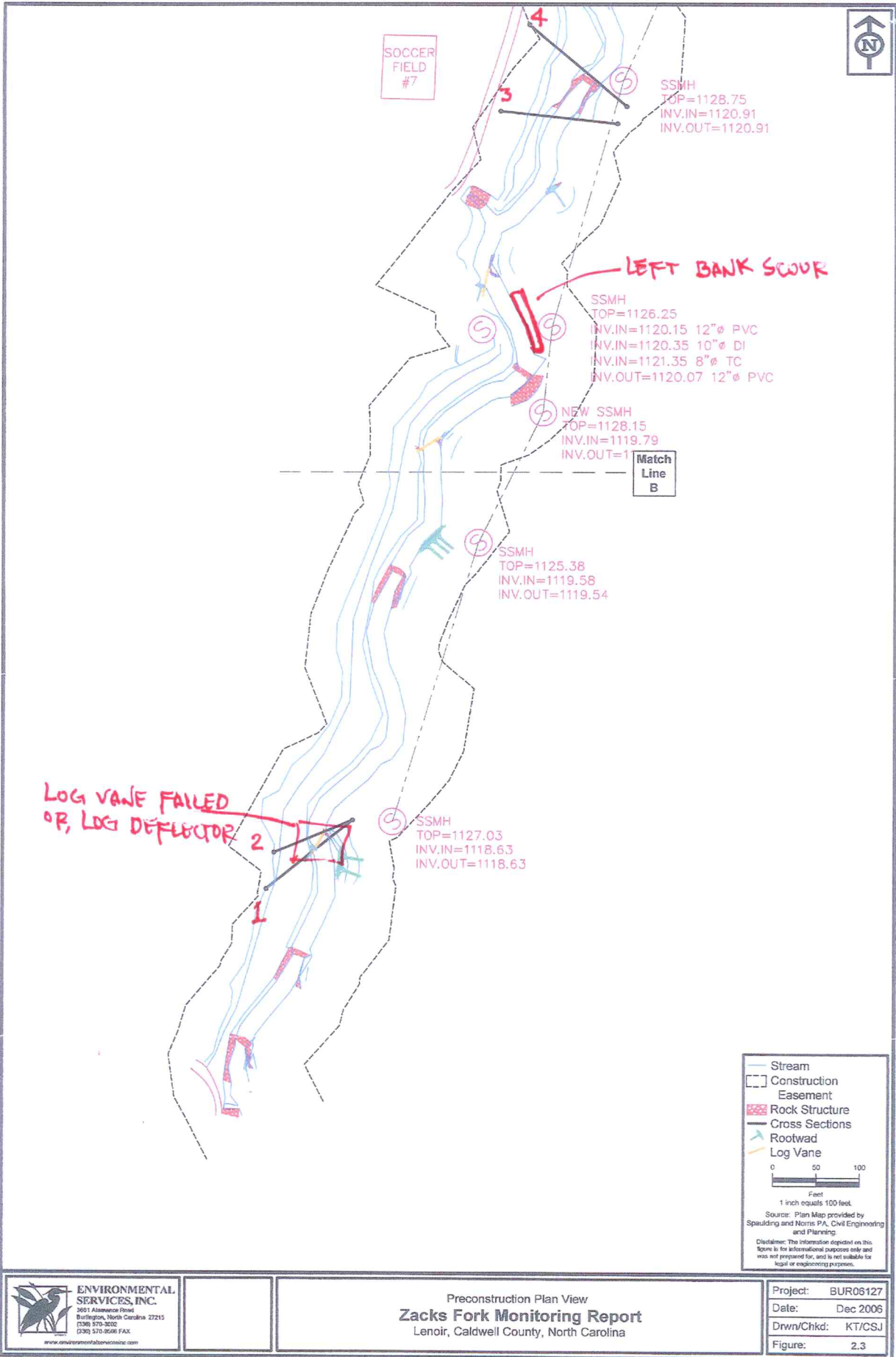
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 Date: Dec 2006
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 Figure: 2.1



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Preconstruction Plan View
Zacks Fork Monitoring Report
 Lenoir, Caldwell County, North Carolina

Project: BUR06127
 Date: Dec 2006
 Drwn/Chkd: KT/CSJ
 Figure: 2.2



SOCCER FIELD #7

SSMH
TOP=1128.75
INV.IN=1120.91
INV.OUT=1120.91

LEFT BANK SCOUR

SSMH
TOP=1126.25
INV.IN=1120.15 12"Ø PVC
INV.IN=1120.35 10"Ø DI
INV.IN=1121.35 8"Ø TC
INV.OUT=1120.07 12"Ø PVC

NEW SSMH
TOP=1128.15
INV.IN=1119.79
INV.OUT=1119.79

Match Line B

SSMH
TOP=1125.38
INV.IN=1119.58
INV.OUT=1119.54

SSMH
TOP=1127.03
INV.IN=1118.63
INV.OUT=1118.63

LOG VANE FAILED OR, LOG DEFLECTOR

— Stream
 [] Construction Easement
 [] Rock Structure
 — Cross Sections
 — Rootwad
 — Log Vane

0 50 100
Feet
1 inch equals 100 feet

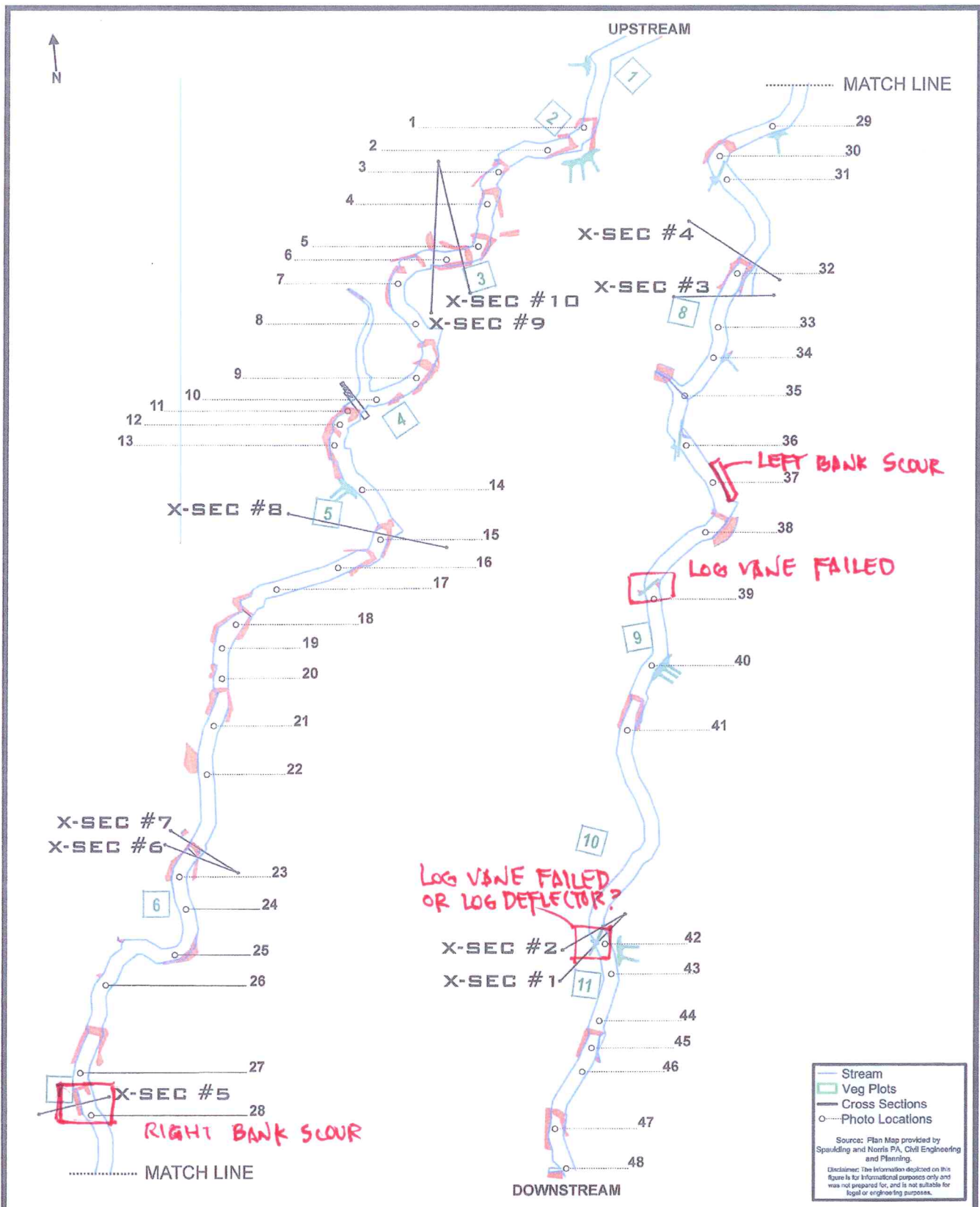
Source: Plan Map provided by Spaulding and Norris PA, Civil Engineering and Planning

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Preconstruction Plan View
Zacks Fork Monitoring Report
 Lenoir, Caldwell County, North Carolina

Project:	BUR06127
Date:	Dec 2006
Drawn/Chkd:	KT/CSJ
Figure:	2.3

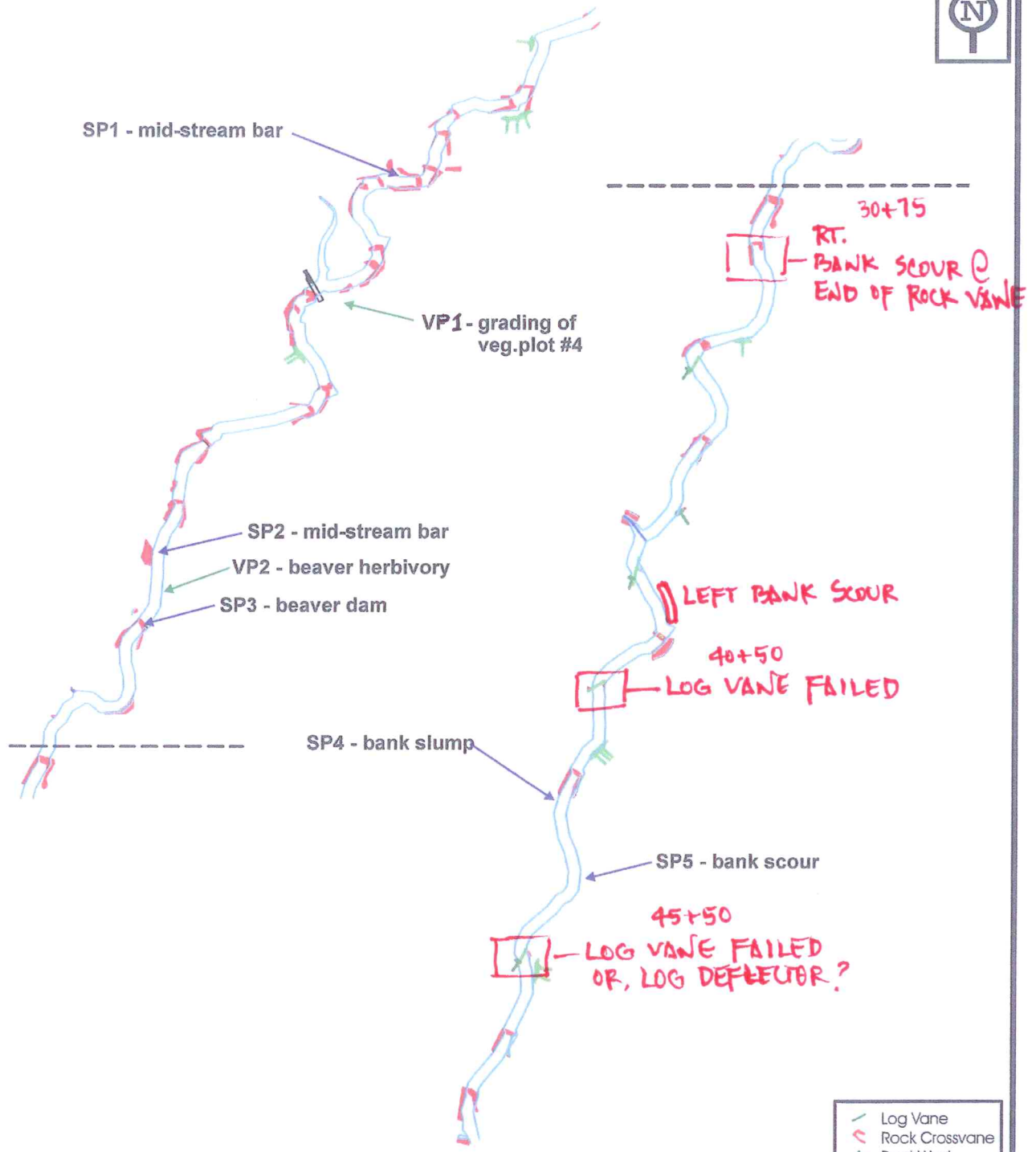


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Structures, Cross-Sections,
 Vegetative Plots, Photo Locations

Zack's Fork, Year 4 Monitoring Report
 Lenoir, Caldwell County, North Carolina

Project:	BUR06127
Date:	Oct 2009
Drwn/Chkd:	csj/csj
Figure:	3



✓ Log Vane
 < Rock Crossvane
 ⊕ Root Wad

Source: Plan Map provided by Spaulding and Norris PA, Civil Engineering and Planning.
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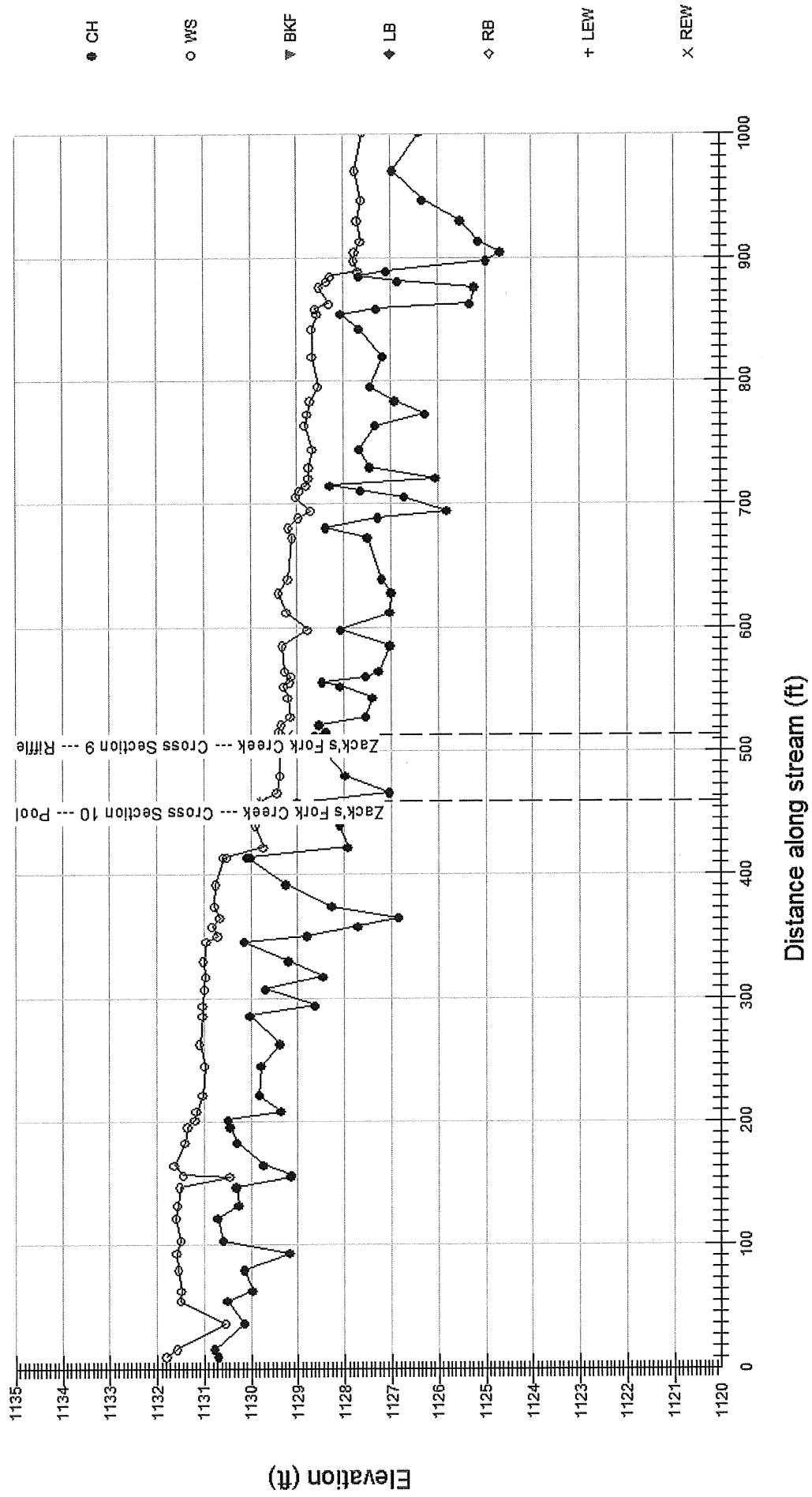
Stream Problem Areas
Zack's Fork, Year 4 Monitoring Report
 Lenoir, Caldwell County, North Carolina

Project:	BUR06127
Date:	Nov 2009
Drwn/Chkd:	csj/csj
Figure:	4

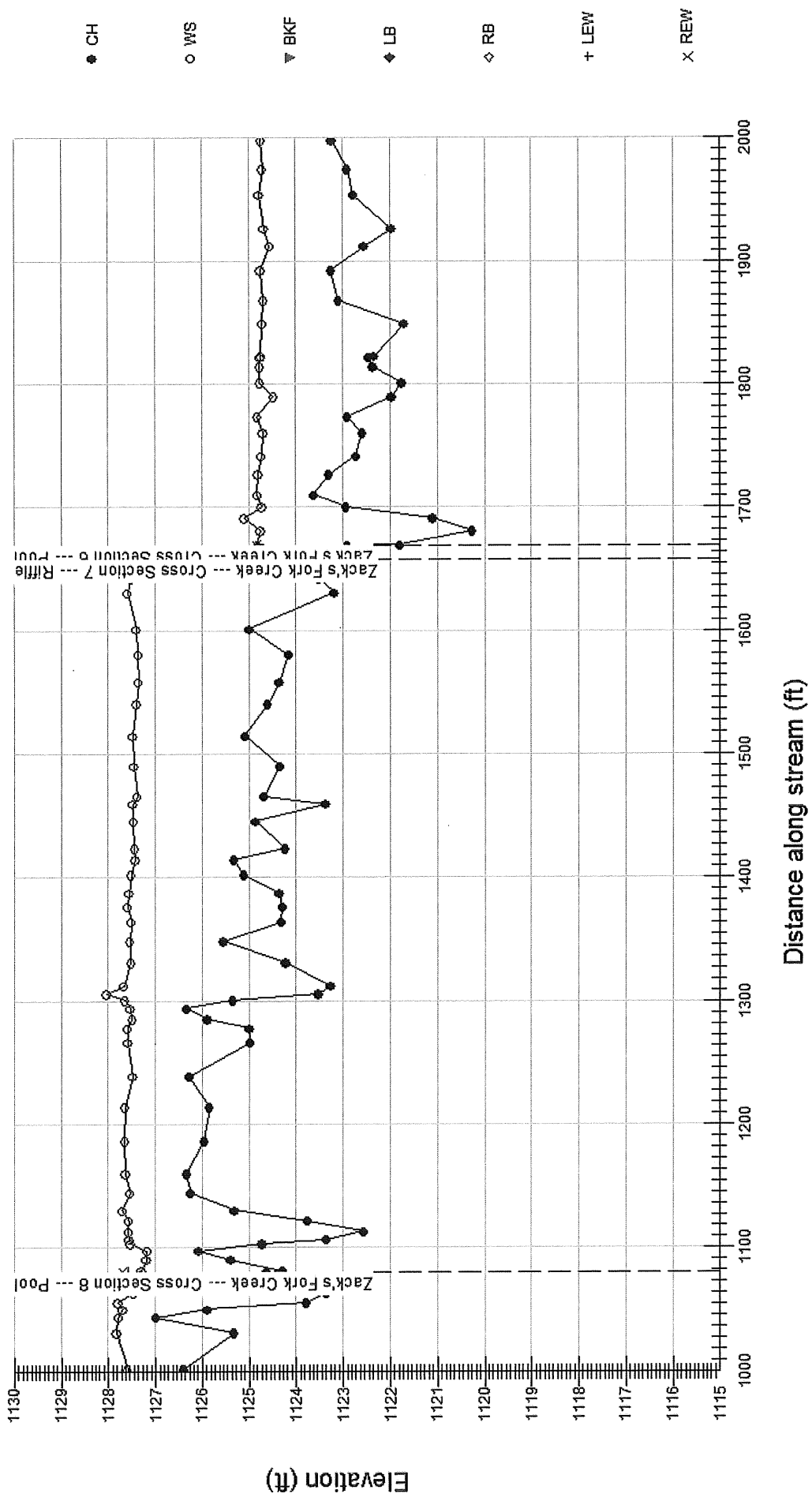
Appendix B

Longitudinal and Cross-sectional Profiles and Data

Zack's Fork Long Profile --- 2009



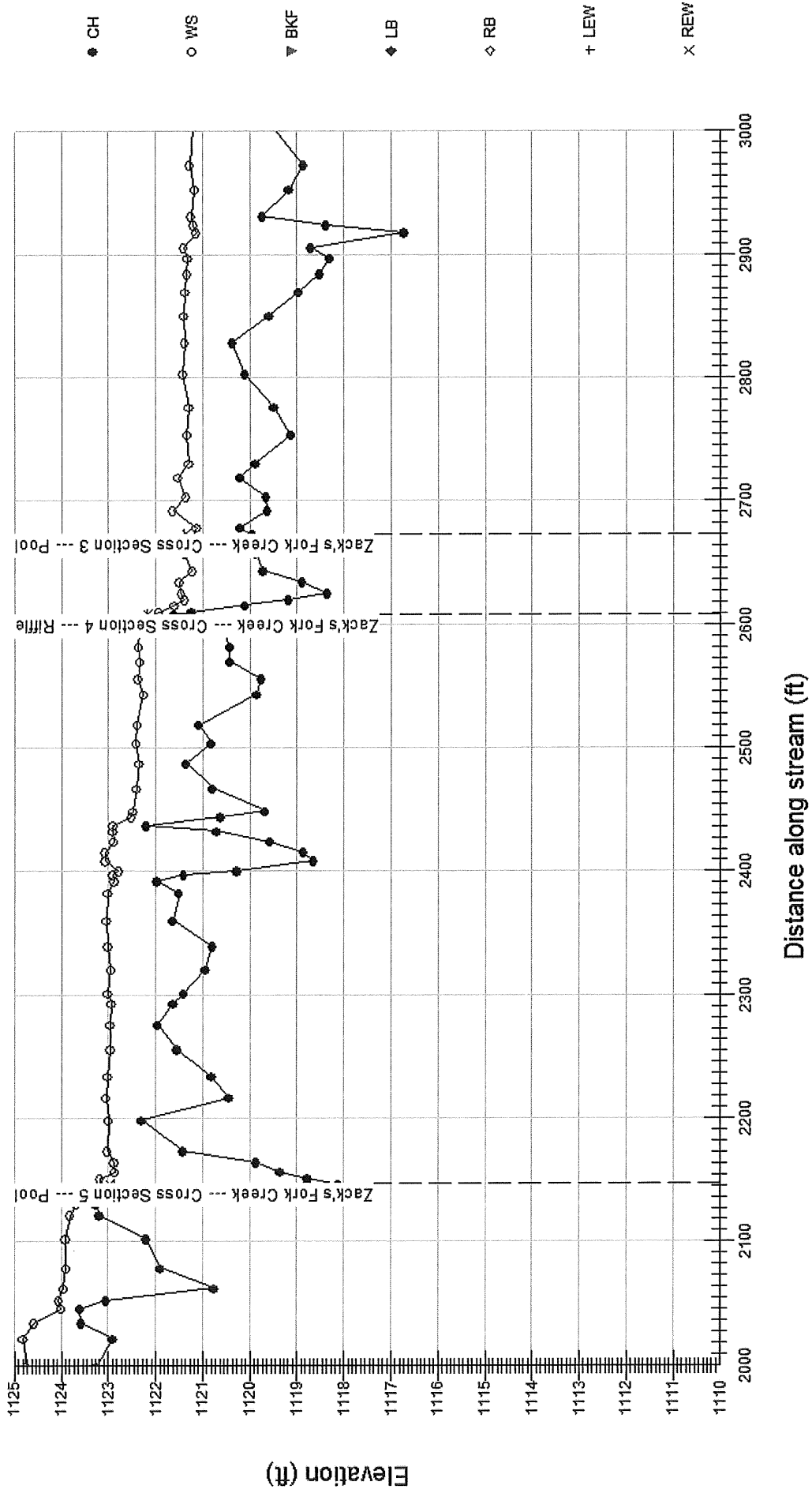
Zack's Fork Long Profile --- 2009



Zack's Fork Creek --- Cross Section 7 --- Riffle
 Zack's Fork Creek --- Cross Section 8 --- Pool
 Zack's Fork Creek --- Cross Section 9 --- Funnel

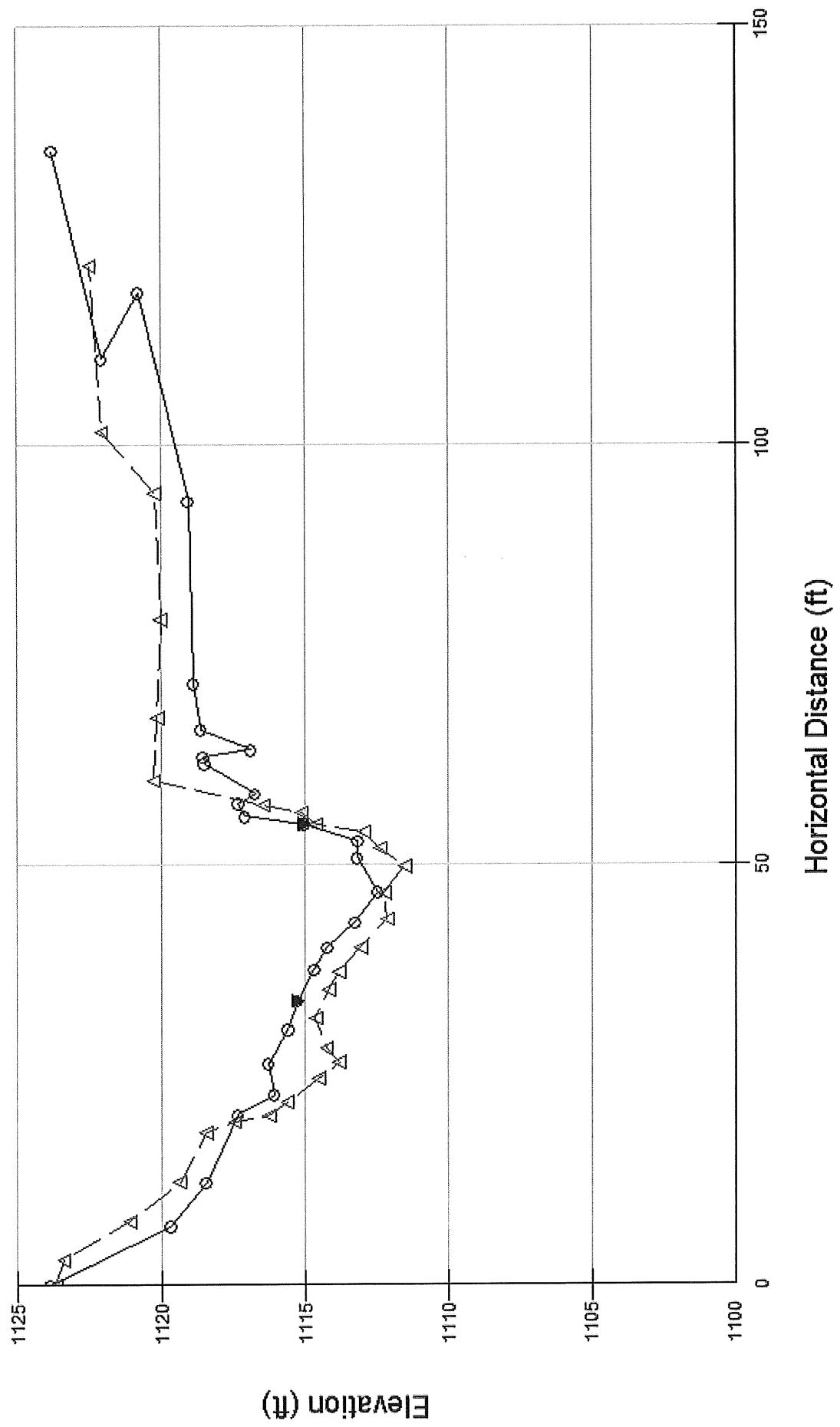
- CH
- WS
- ▼ BKF
- ◆ LB
- ◇ RB
- + LEW
- x REW

Zack's Fork Long Profile --- 2009



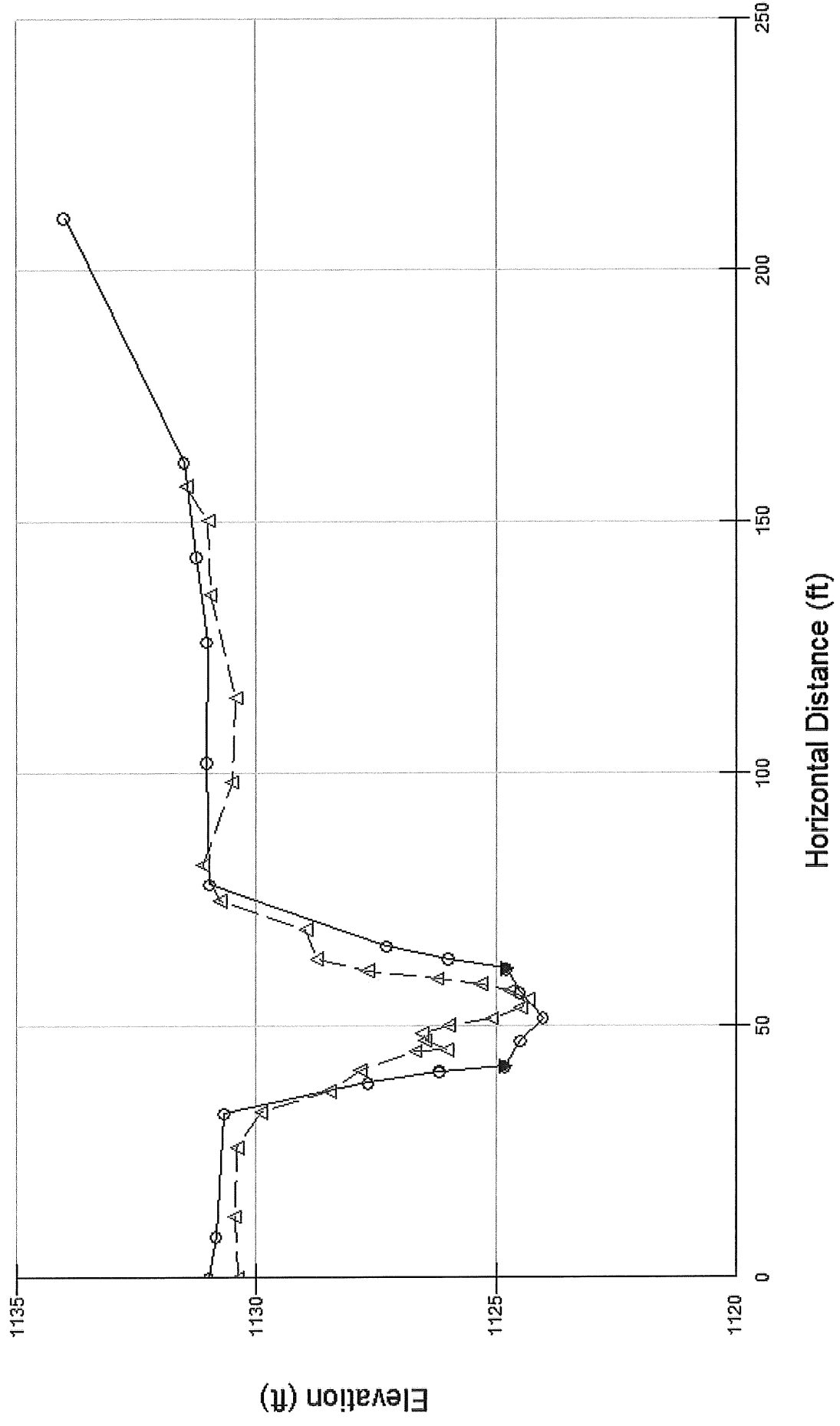
Zack's Fork Creek --- Cross Section 1 --- Pool

◊ Zack's Fork Creek --- Cross Section 1 --- Pool
 ◆ Bankfull Indicators
 ▼ Water Surface Points
 △ Zack's Fork Creek --- Cross Section 1 --- 2008



Zack's Fork Creek --- Cross Section 10 --- Pool

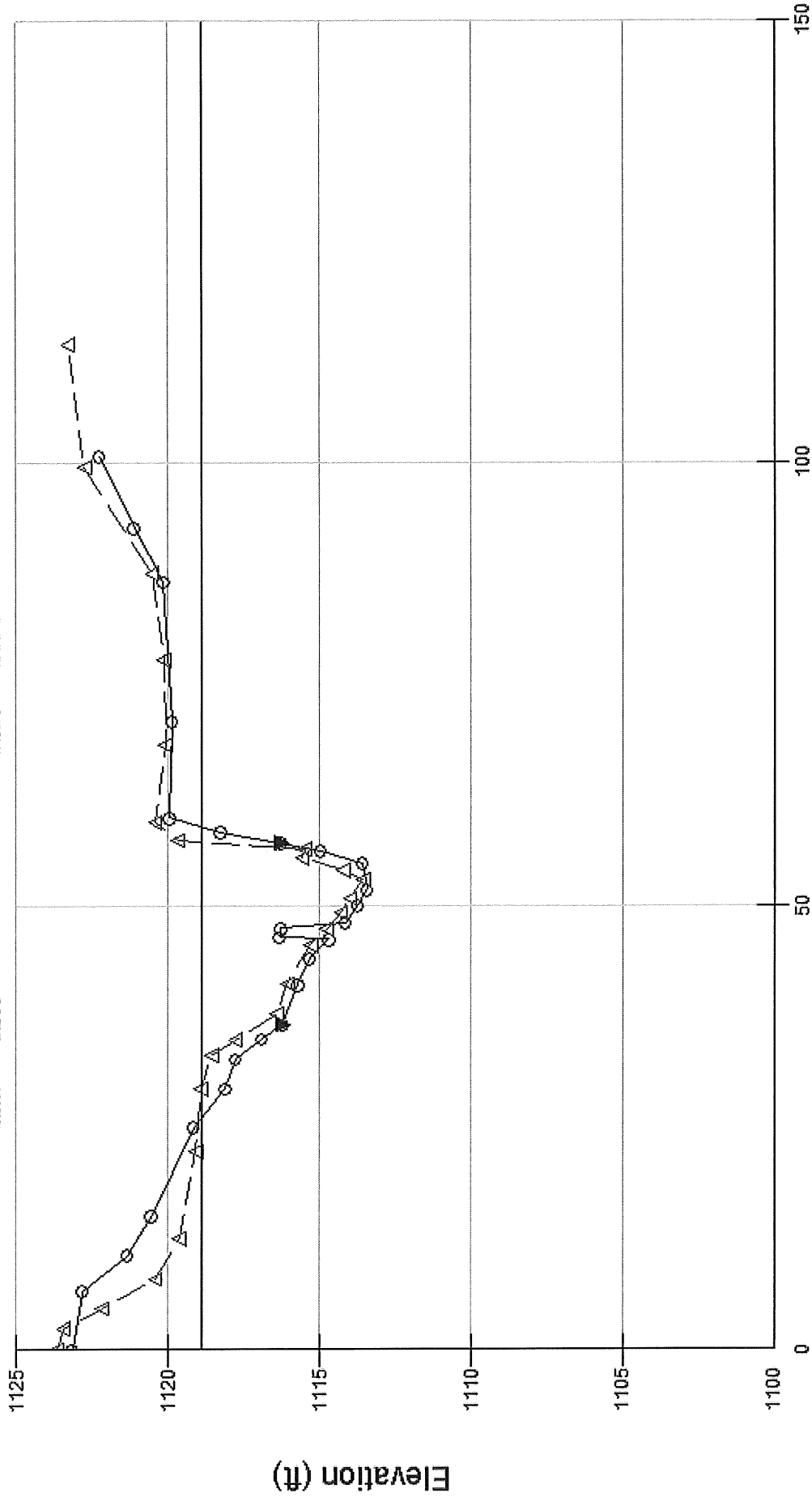
- Zack's Fork Creek --- Cross Section 10 --- Pool
- ◆ Bankfull Indicators
- ▼ Water Surface Points
- △ Zack's Fork Creek --- Cross Section 10 --- 2008



Zack's Fork Creek --- Cross Section 2 --- Riffle

◊ Zack's Fork Creek --- Cross Section 2 --- Riffle ◆ Bankfull Indicators ▼ Water Surface Points △ Zack's Fork Creek --- Cross Section 2 --- 2008

Wbkf = 32.9 Dbkf = 2.92 Abkf = 96

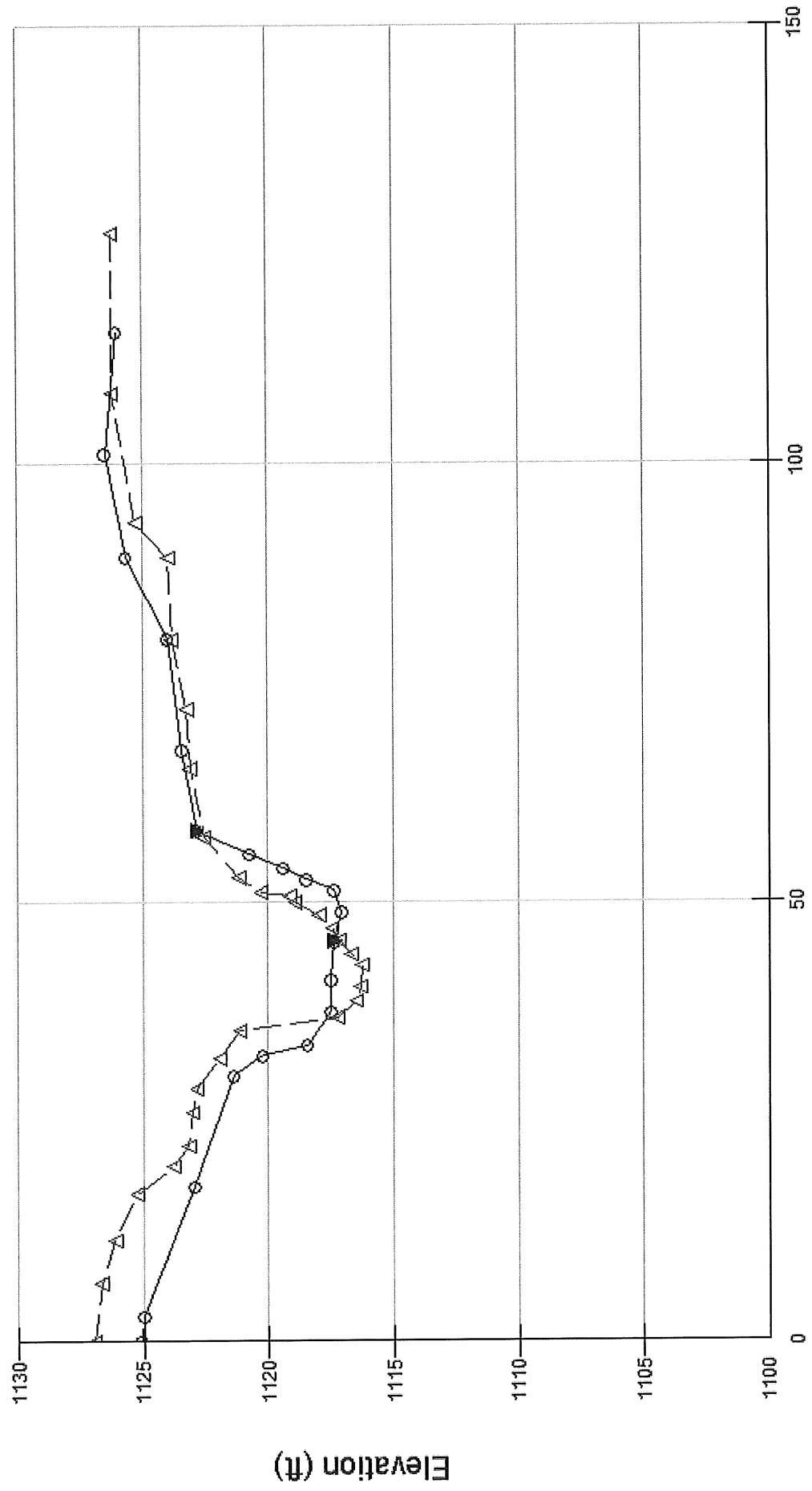


Horizontal Distance (ft)

Elevation (ft)

Zack's Fork Creek --- Cross Section 3 --- Pool

○ Zack's Fork Creek --- Cross Section 3 --- Pool
 ◆ Bankfull Indicators
 ▼ Water Surface Points
 △ Zack's Fork Creek --- Cross Section 3 --- 2008

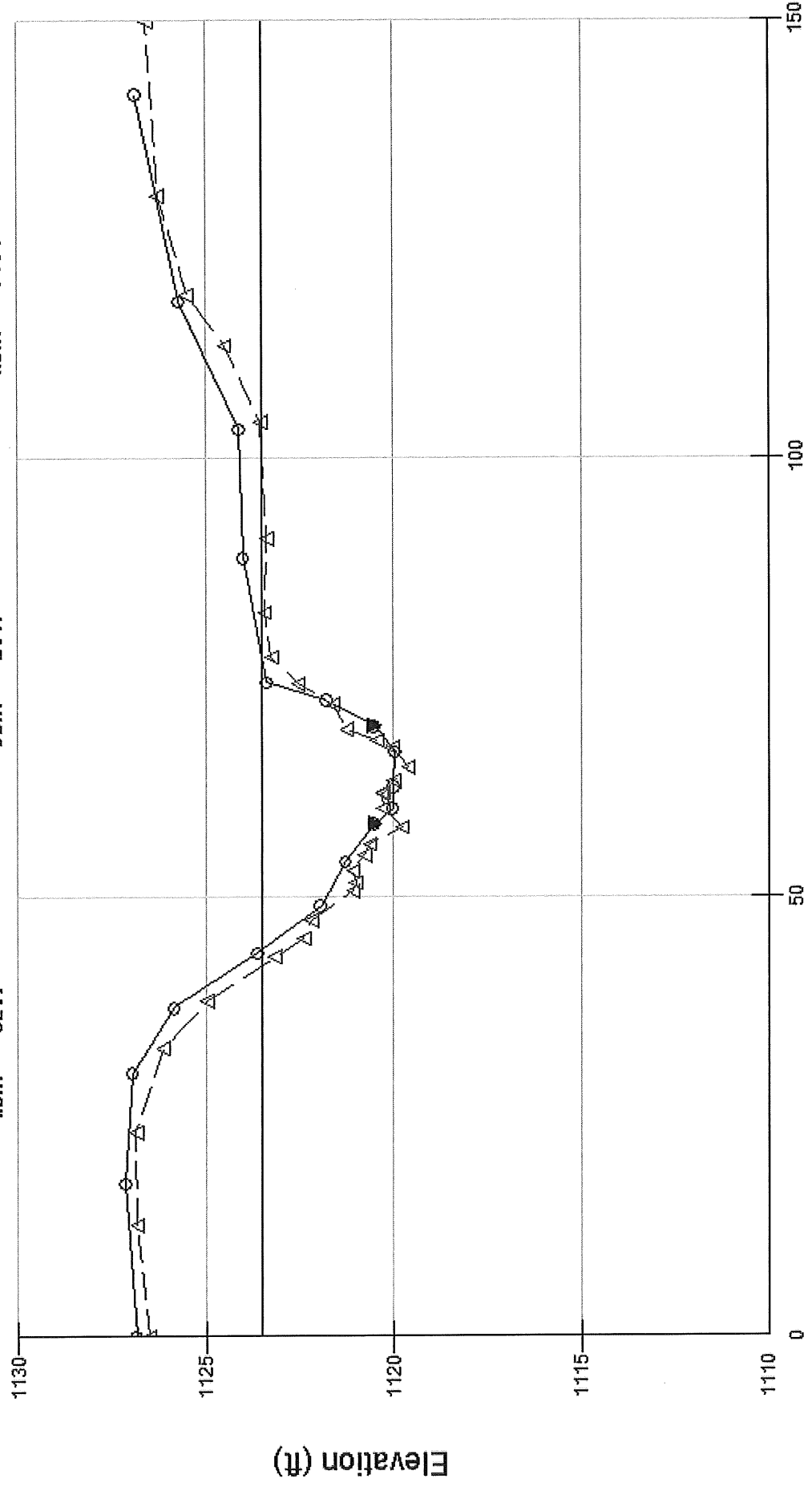


Horizontal Distance (ft)

Zack's Fork Creek --- Cross Section 4 --- Riffle

○ Zack's Fork Creek --- Cross Section 4 --- Riffle
 ◆ Bankfull Indicators
 ▼ Water Surface Points
 △ Zack's Fork Creek --- Cross Section 4 --- 2008

Wbkf = 32.9 Dbkf = 2.17 Abkf = 71.4

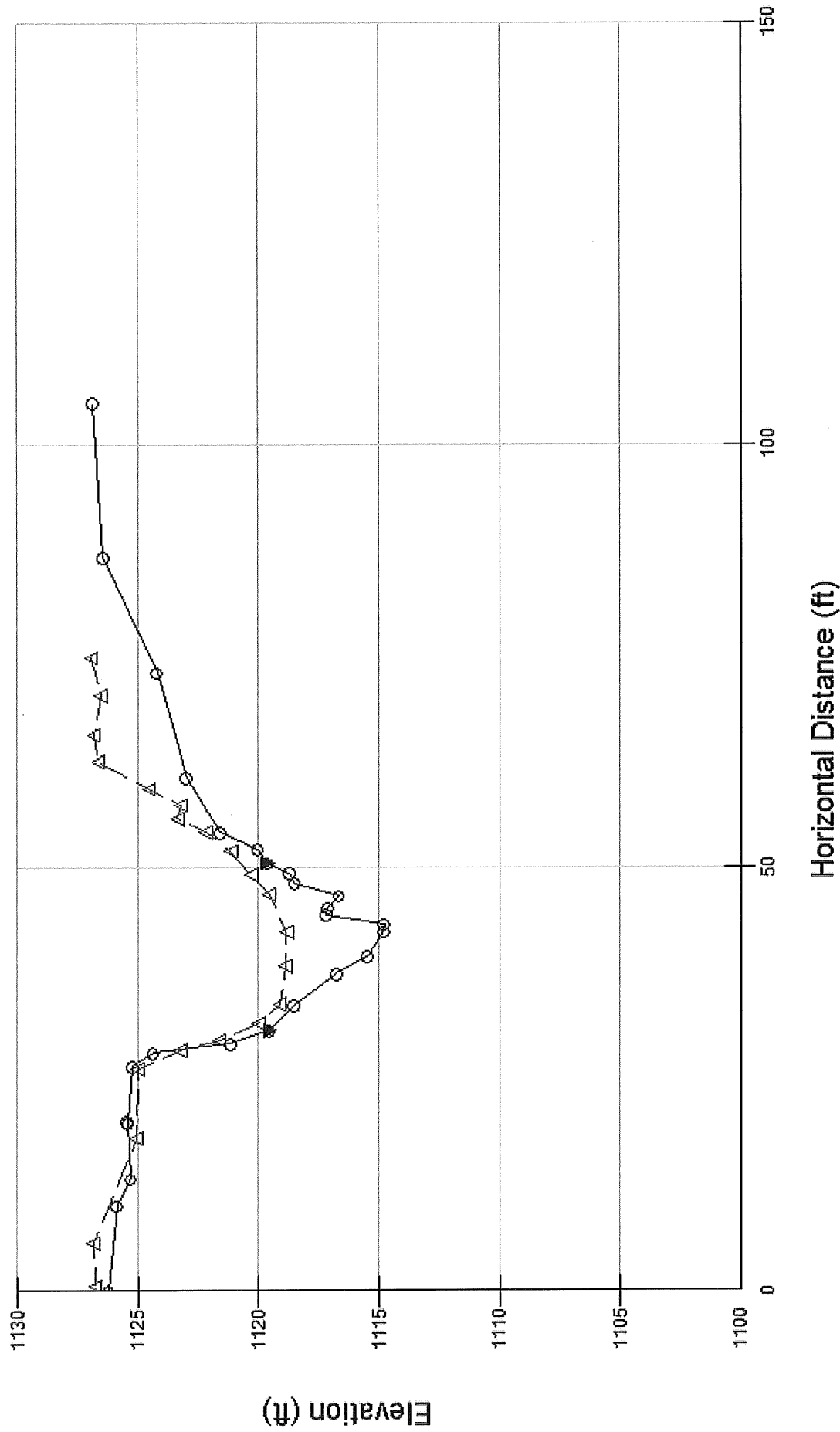


Horizontal Distance (ft)

Elevation (ft)

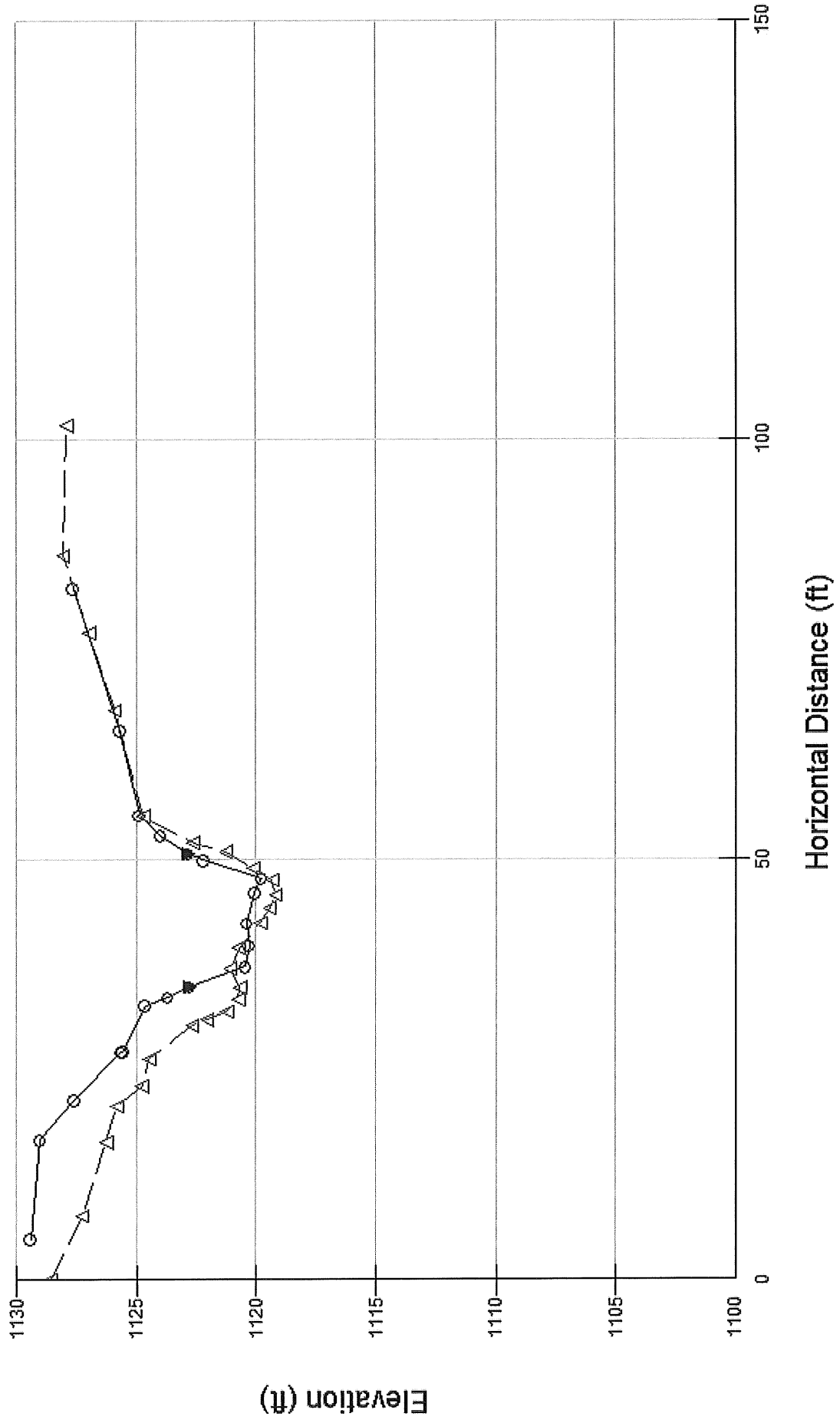
Zack's Fork Creek --- Cross Section 5 --- Pool

○ Zack's Fork Creek --- Cross Section 5 --- Pool ▼ Water Surface Points
 ◆ Bankfull Indicators △ Zack's Fork Creek --- Cross Section 5 --- 2008



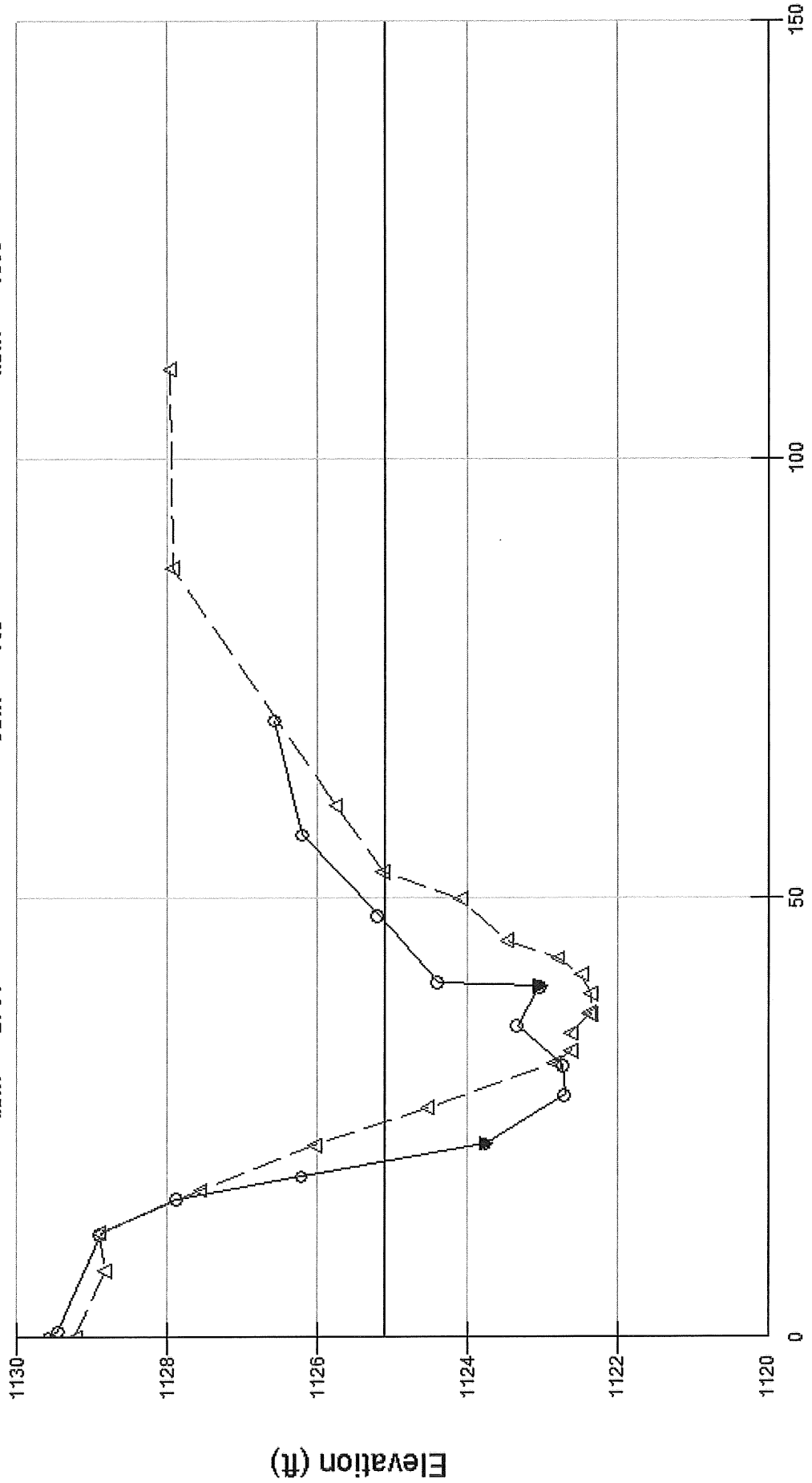
Zack's Fork Creek --- Cross Section 6 --- Pool

- Zack's Fork Creek --- Cross Section 6 --- Pool
- ◆ Bankfull Indicators
- ▼ Water Surface Points
- △ Zack's Fork Creek --- Cross Section 6 --- 2008



Zack's Fork Creek --- Cross Section 7 --- Pool

◊ Zack's Fork Creek --- Cross Section 7 --- Rifle ◆ Bankfull Indicators ▼ Water Surface Points △ Zack's Fork Creek --- Cross Section 7 --- 2008 **Abkf = 40.6**
Wbkf = 27.1 **Dbkf = 1.5**

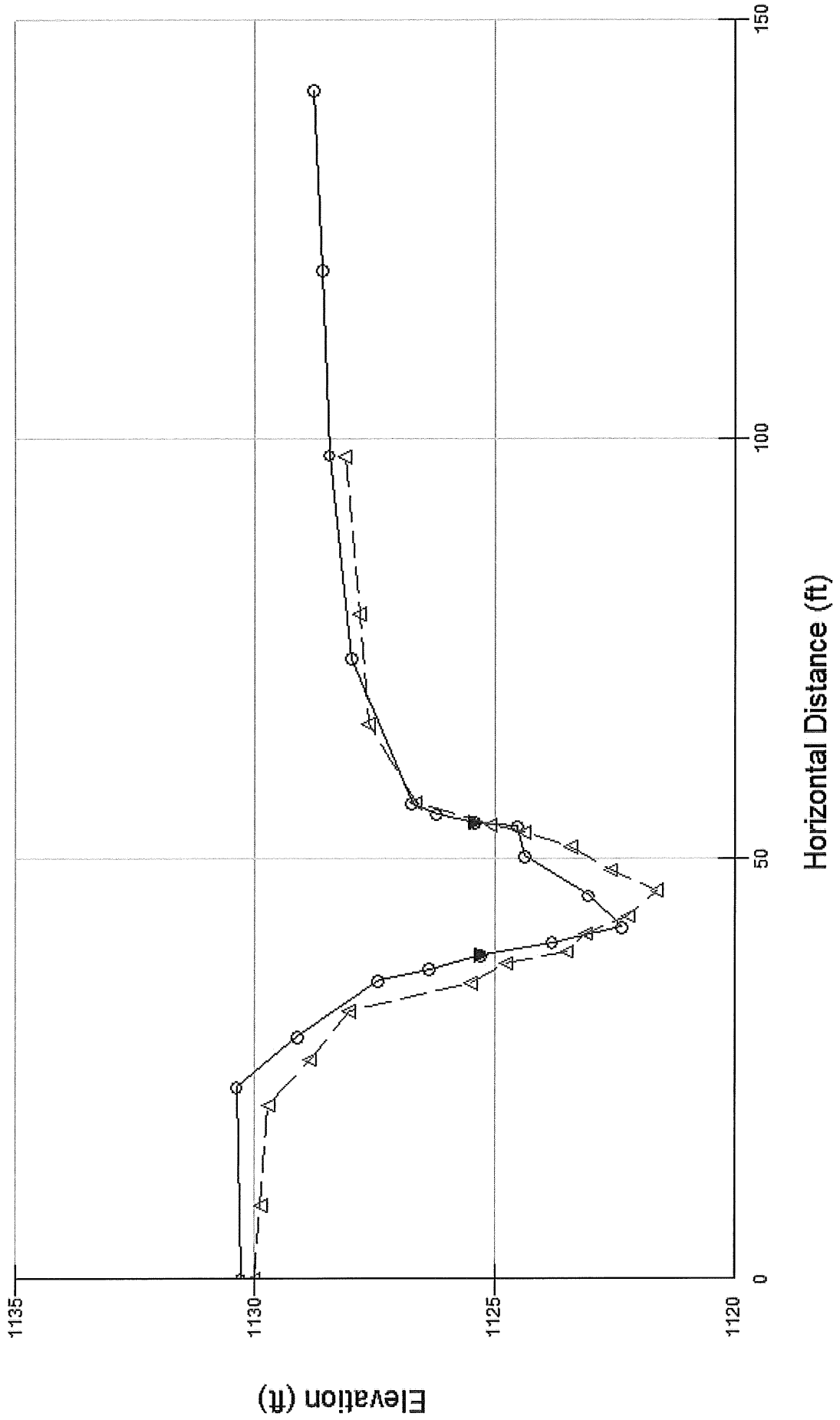


Horizontal Distance (ft)

Elevation (ft)

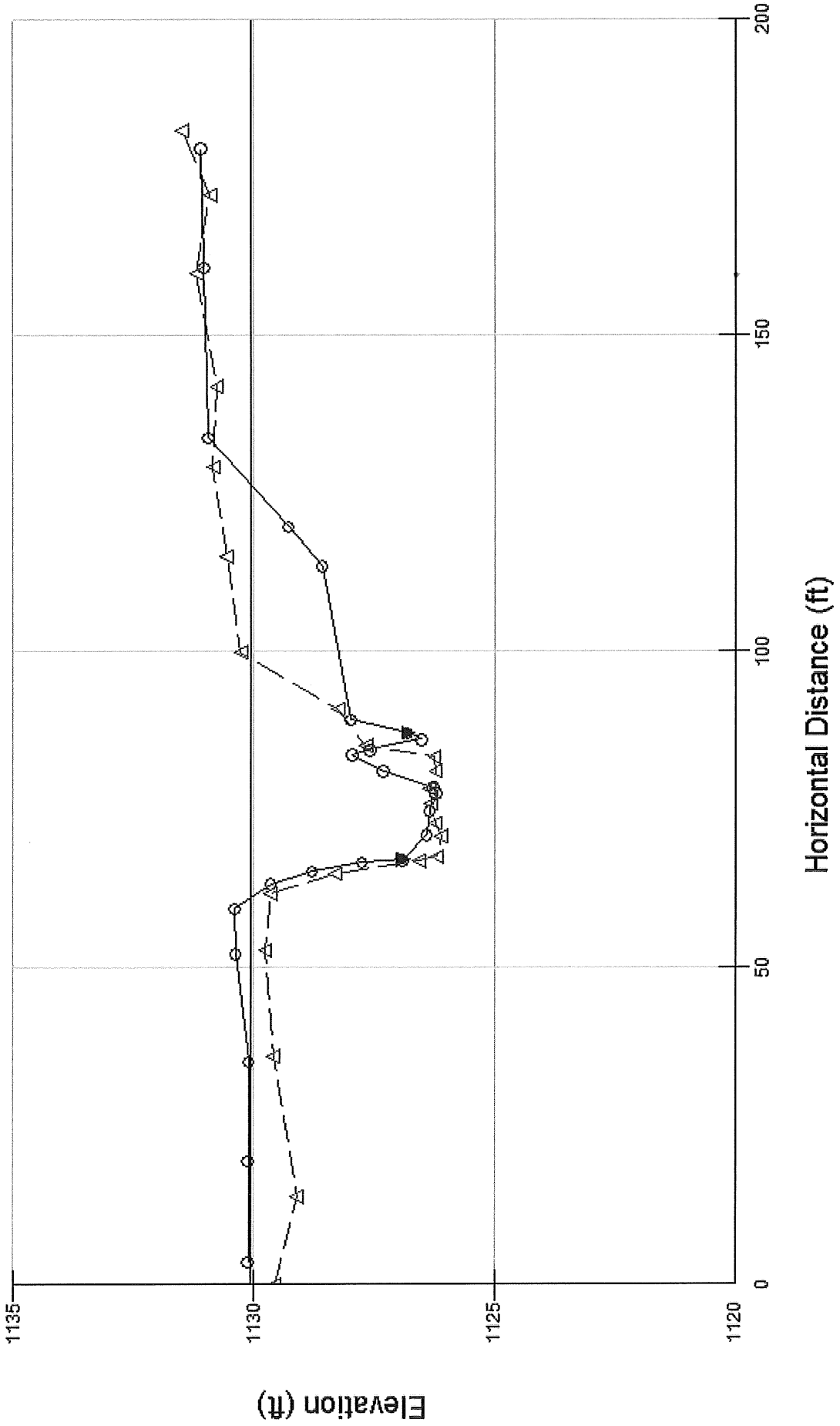
Zack's Fork Creek --- Cross Section 8 --- Pool

○ Zack's Fork Creek --- Cross Section 8 --- Pool
 ◆ Bankfull Indicators
 ▼ Water Surface Points
 △ Zack's Fork Creek --- Cross Section 8 --- 2008



Zack's Fork Creek --- Cross Section 9 --- Riffle

- Zack's Fork Creek --- Cross Section 9 --- Riffle
 - ◆ Bankfull Indicators
 - ▼ Water Surface Points
 - △ Zack's Fork Creek --- Cross Section 9 --- 2008
- Wbkf = 65.4** **Dbkf = 2.02** **Abkf = 132**



Appendix C

Representative Photographic Sequence



Photo Station 1

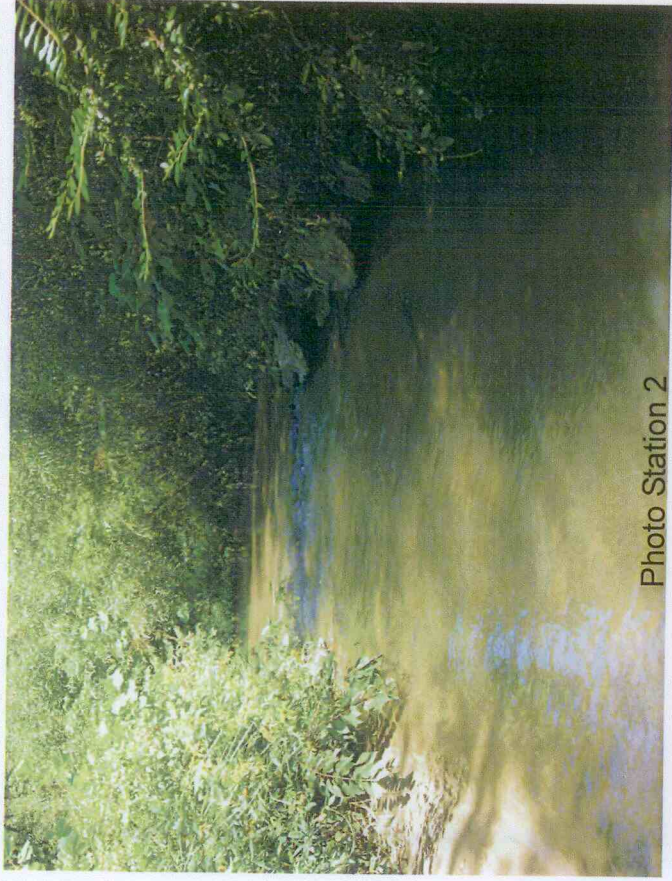


Photo Station 2



Photo Station 3

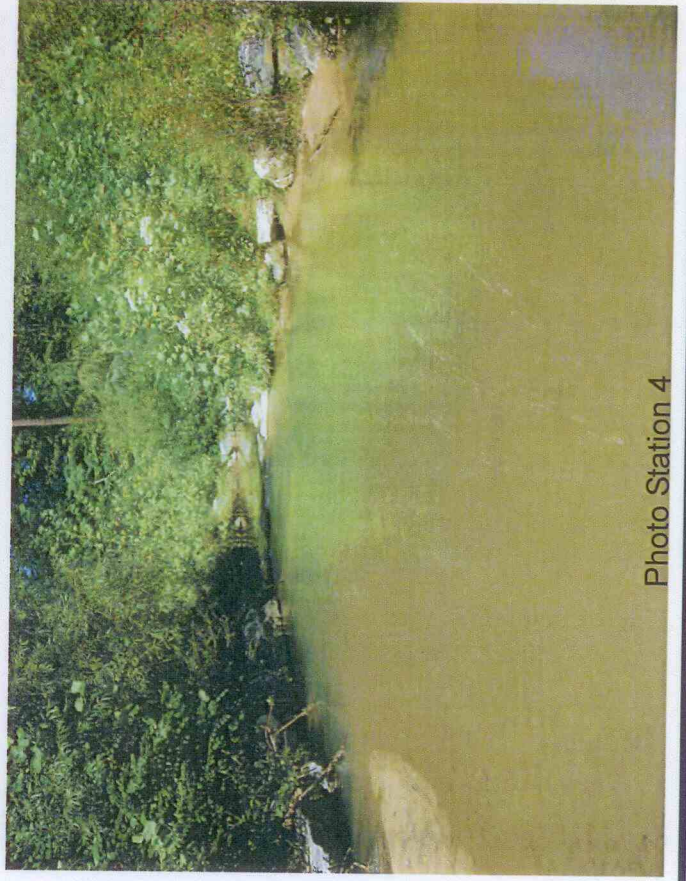


Photo Station 4

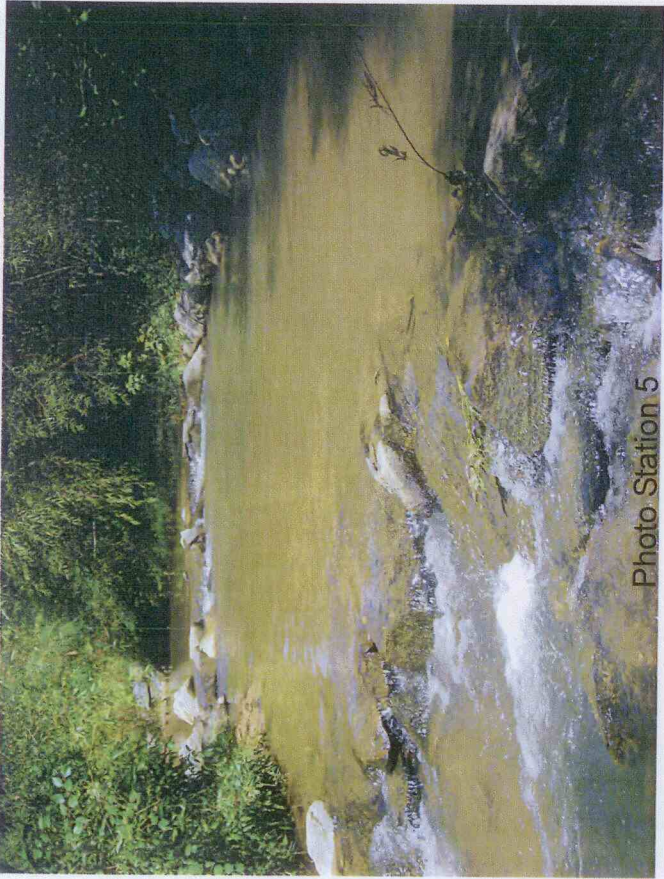


Photo Station 5

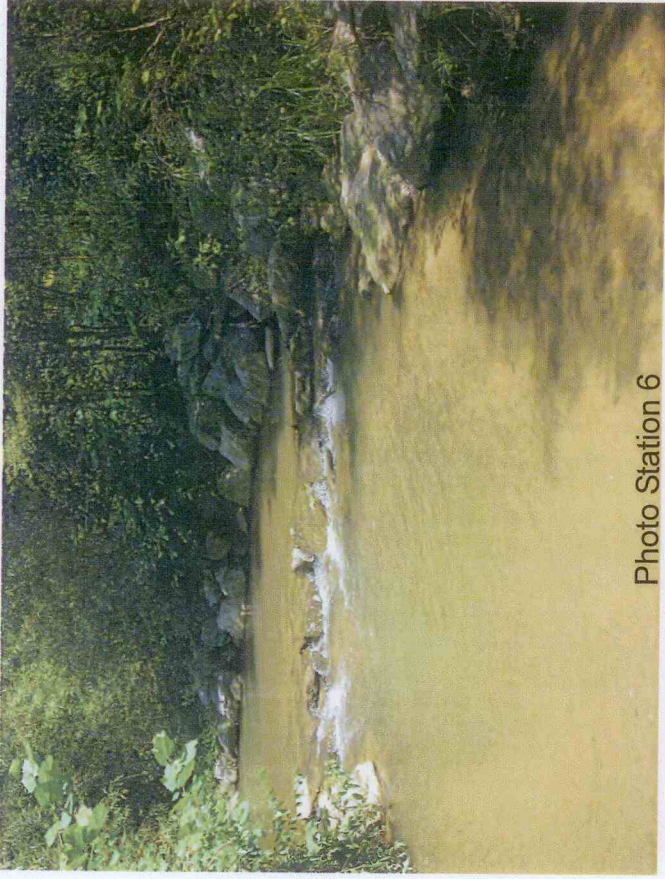


Photo Station 6

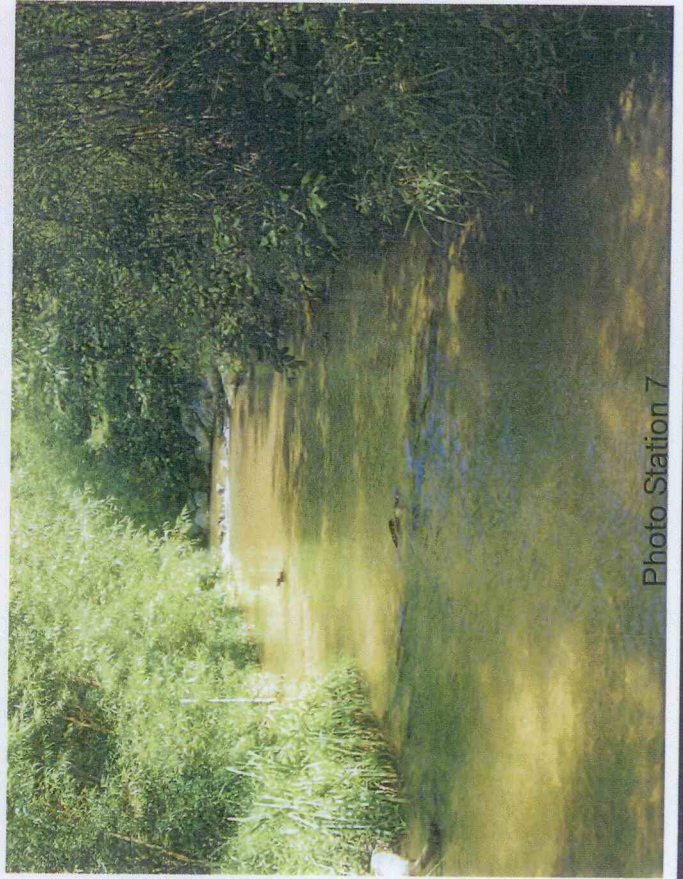


Photo Station 7

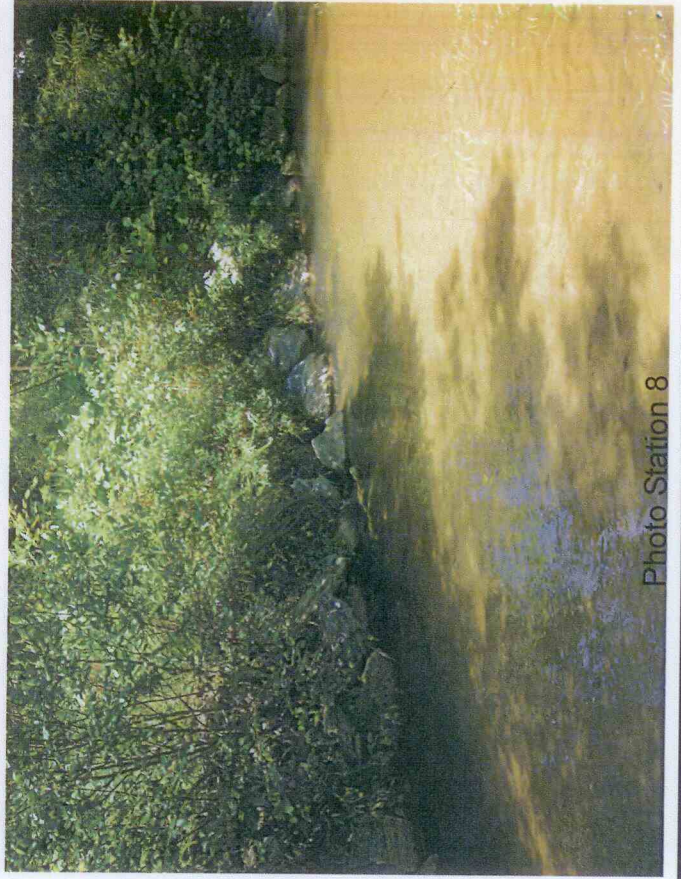


Photo Station 8

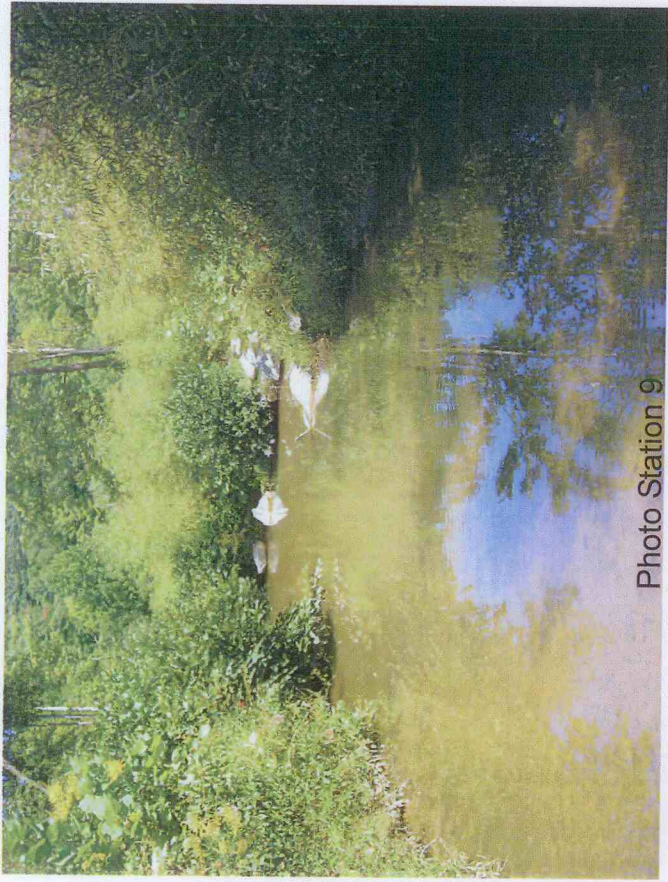


Photo Station 9

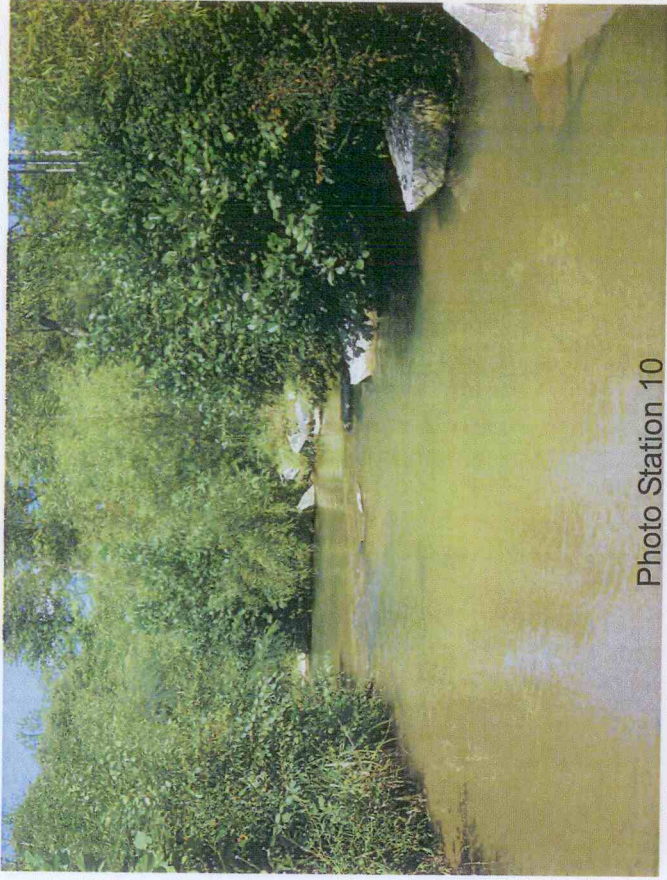


Photo Station 10

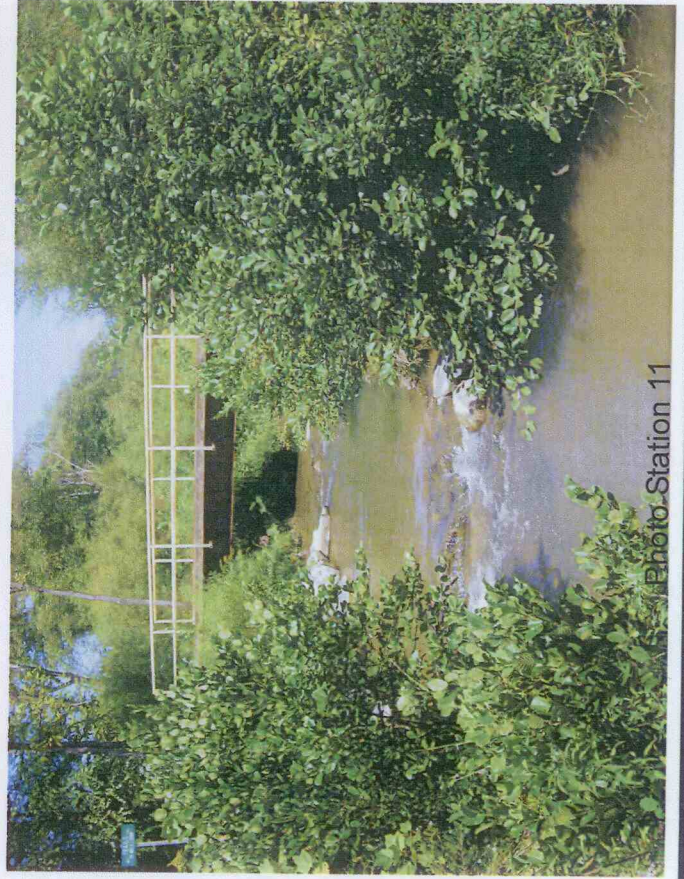


Photo Station 11



Photo Station 12



Photo Station 13



Photo Station 14

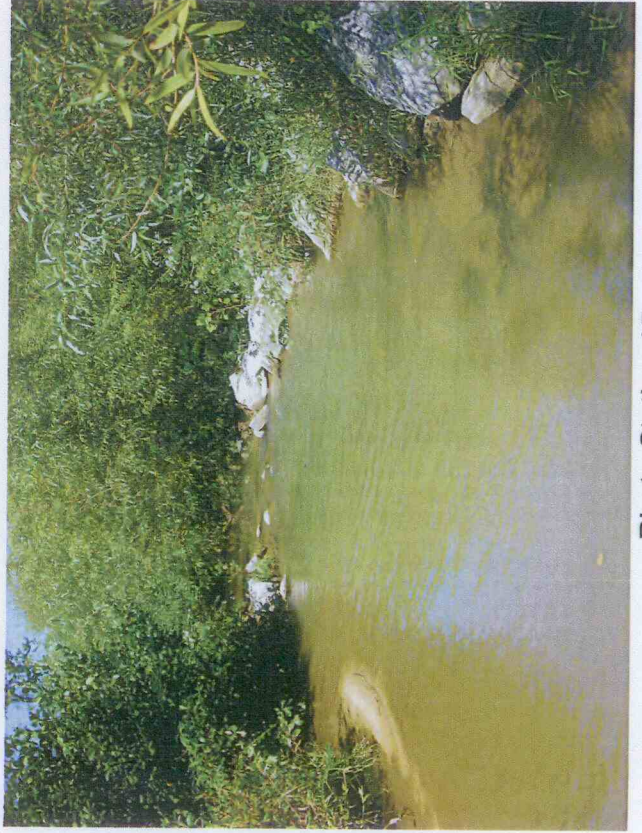


Photo Station 15

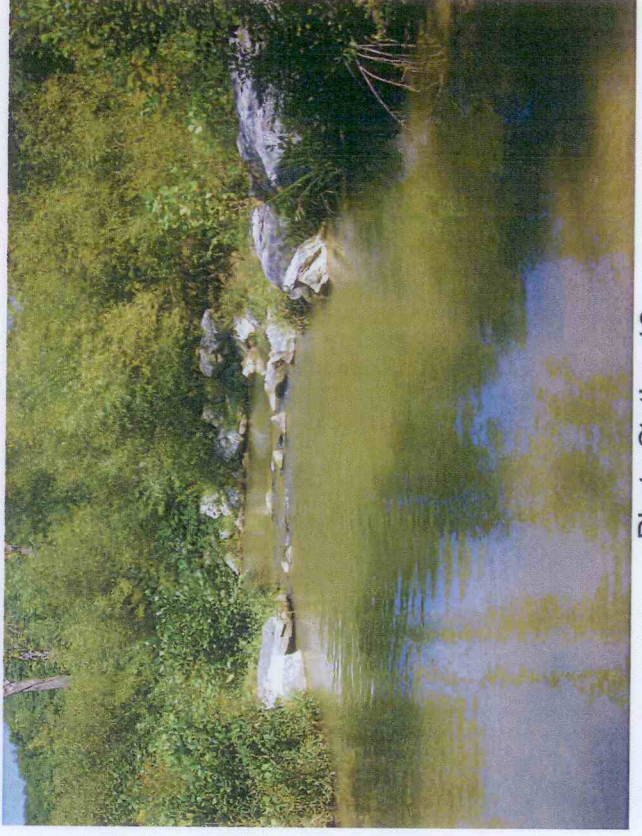


Photo Station 16

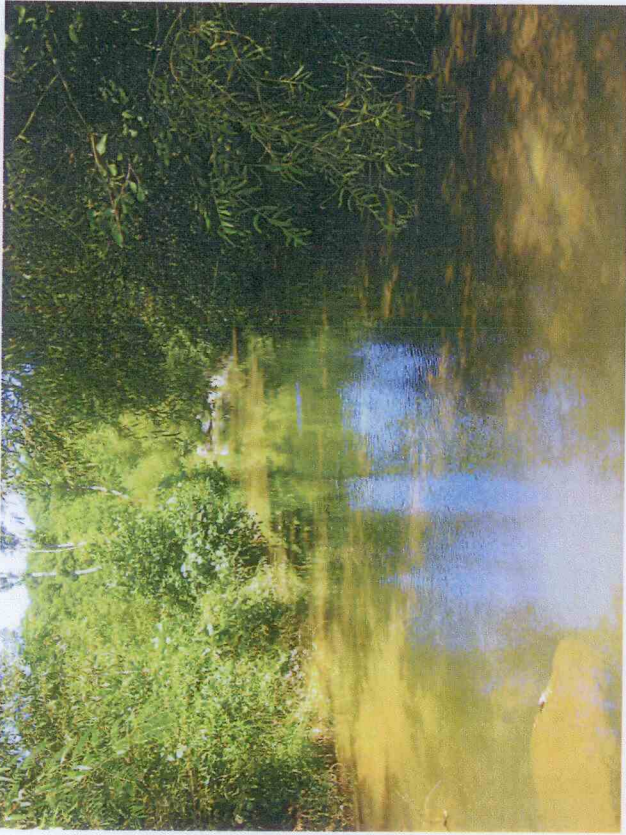


Photo Station 17

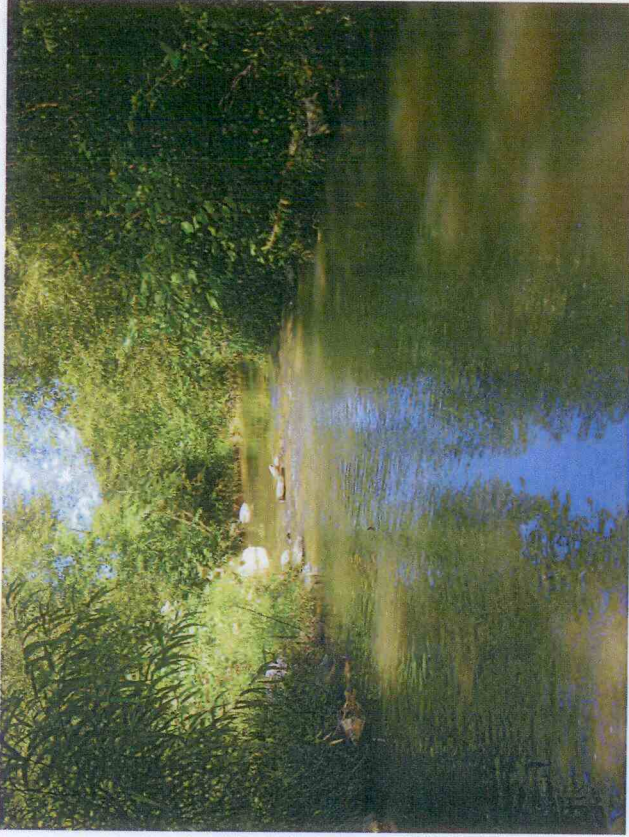


Photo Station 18



Photo Station 19

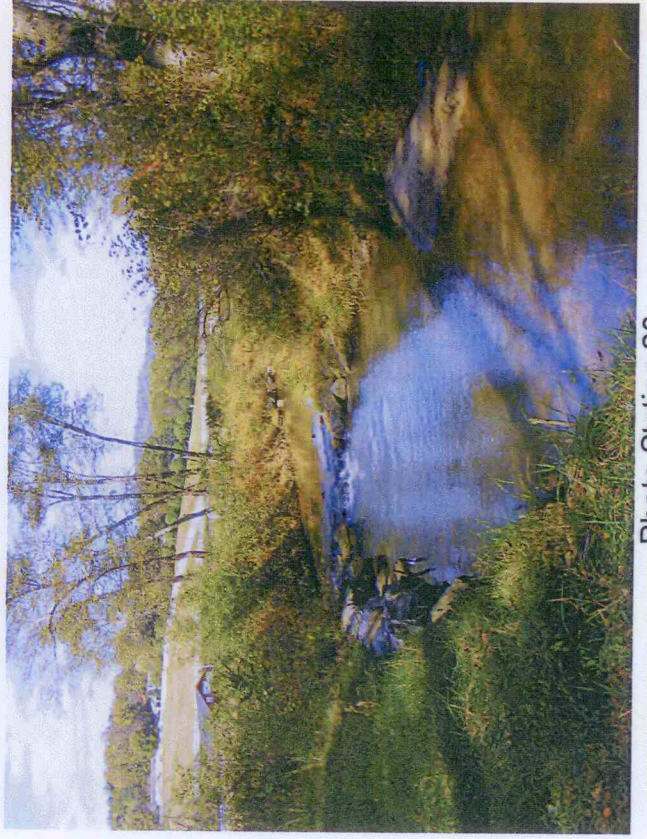


Photo Station 20



Photo Station 21



Photo Station 23



Photo Station 22

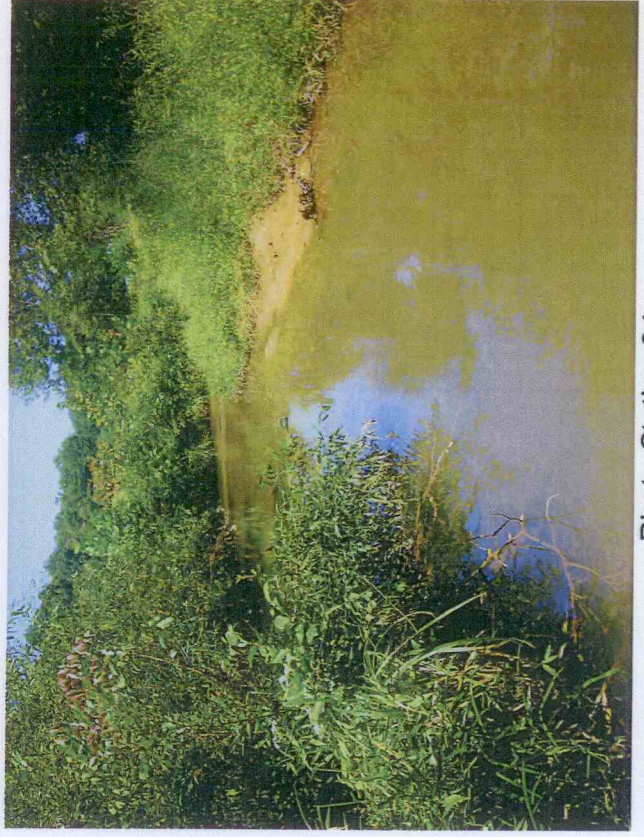


Photo Station 24



Photo Station 25

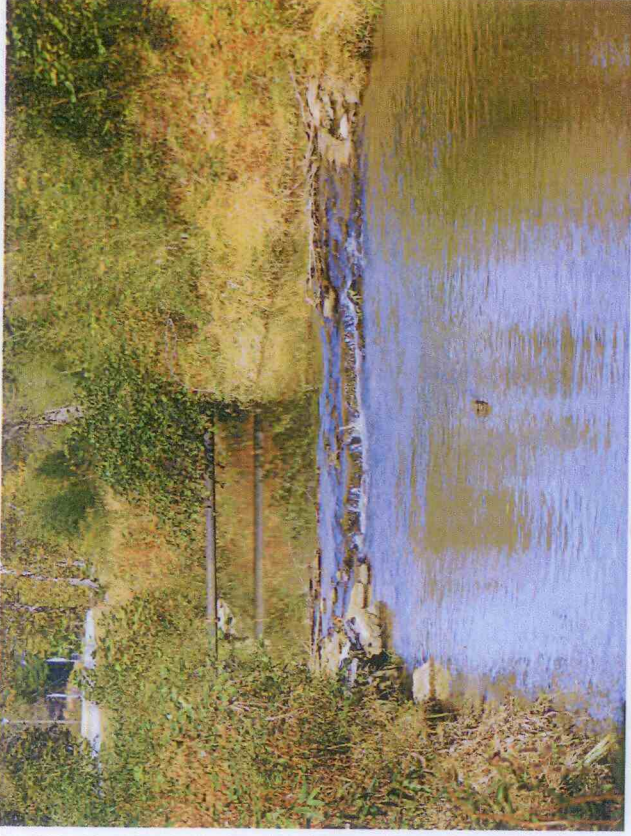


Photo Station 26

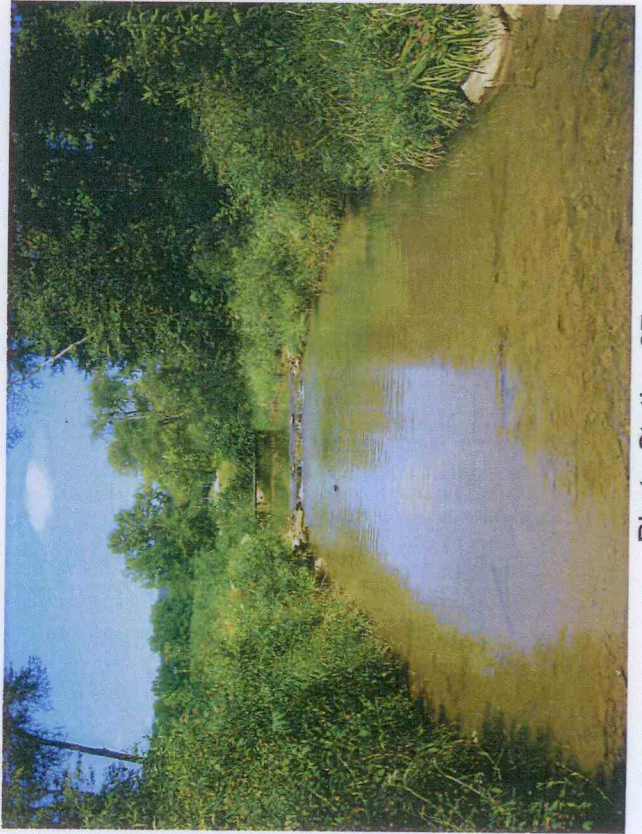


Photo Station 27

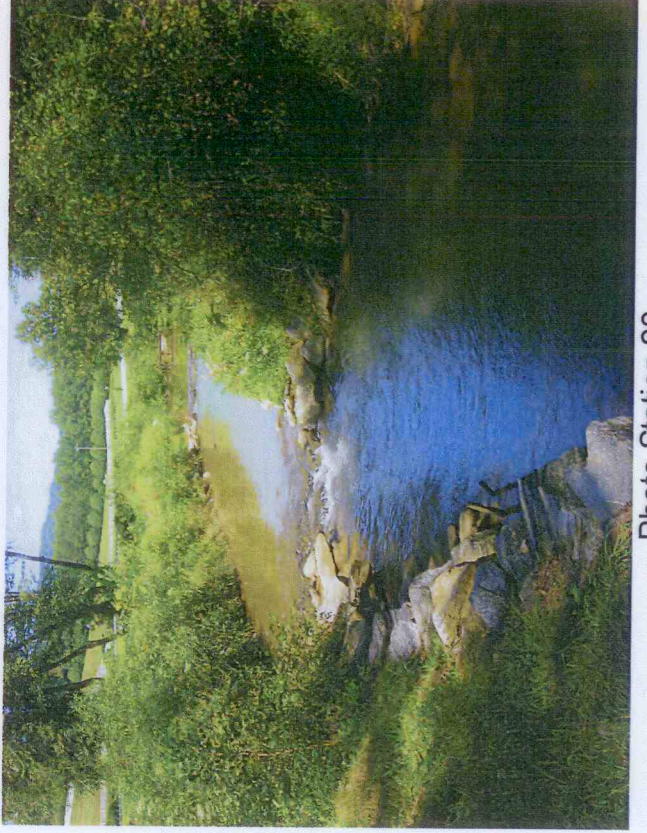


Photo Station 28



Photo Station 29



Photo Station 30

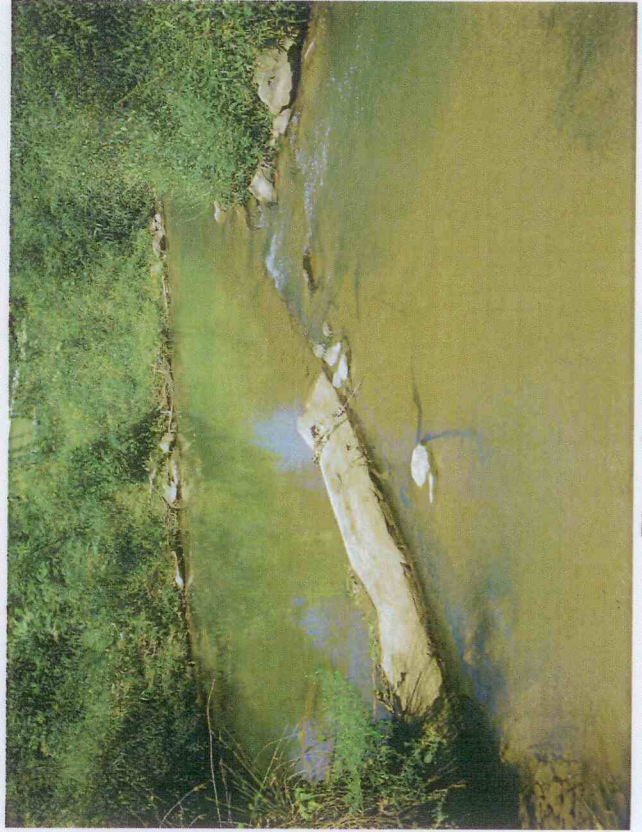


Photo Station 31

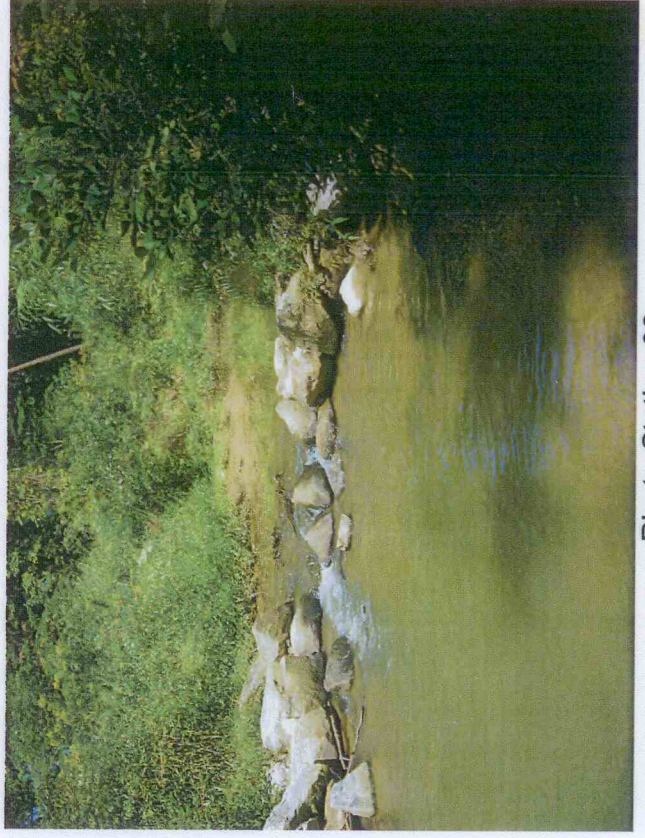


Photo Station 32

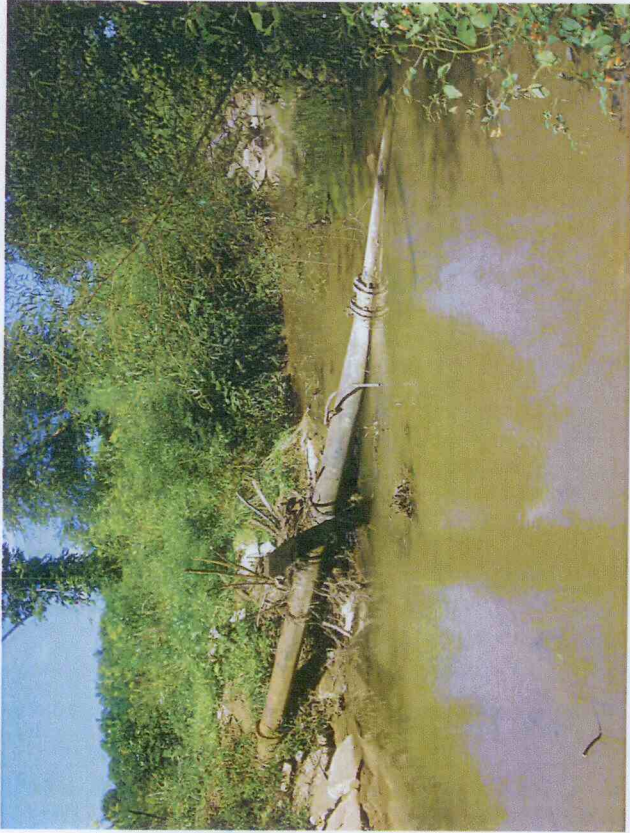


Photo Station 33



Photo Station 34

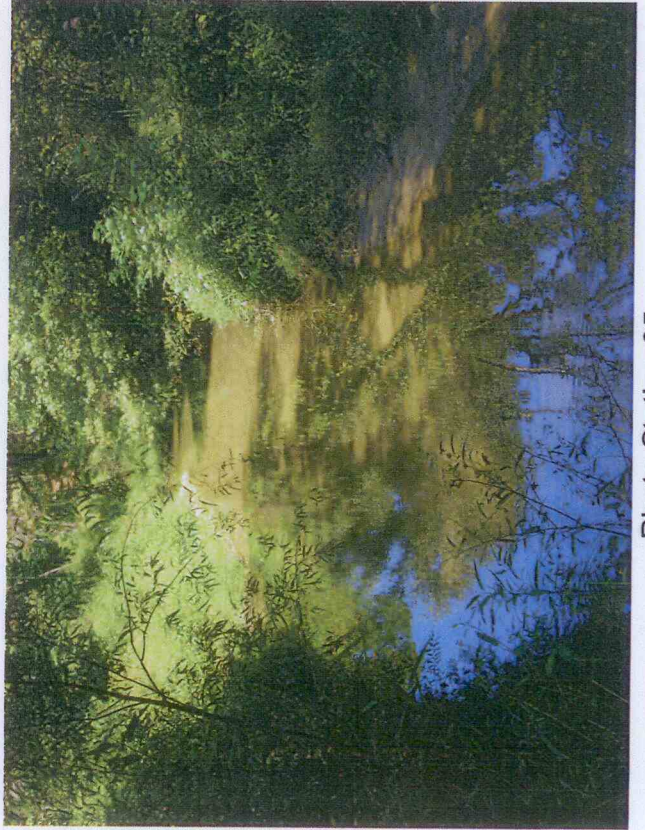


Photo Station 35

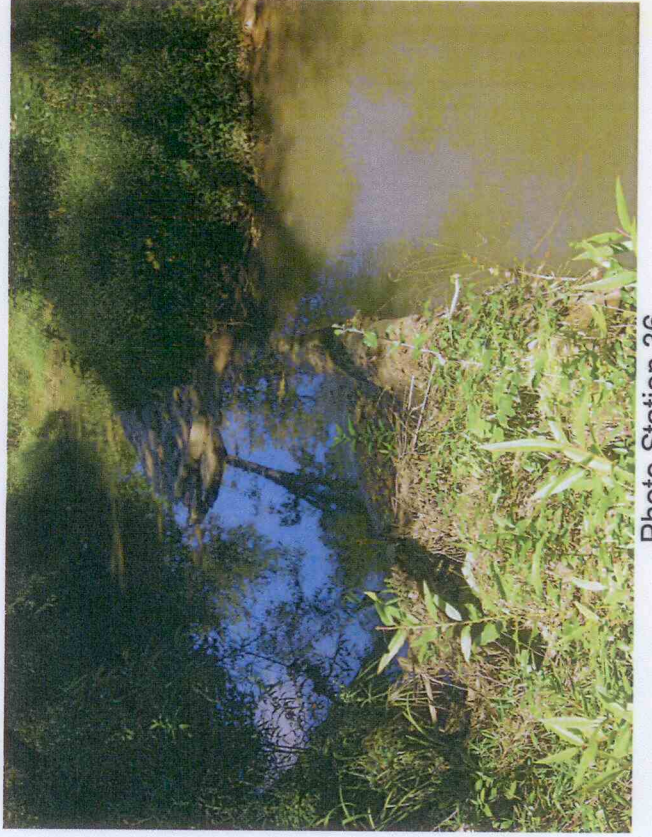


Photo Station 36

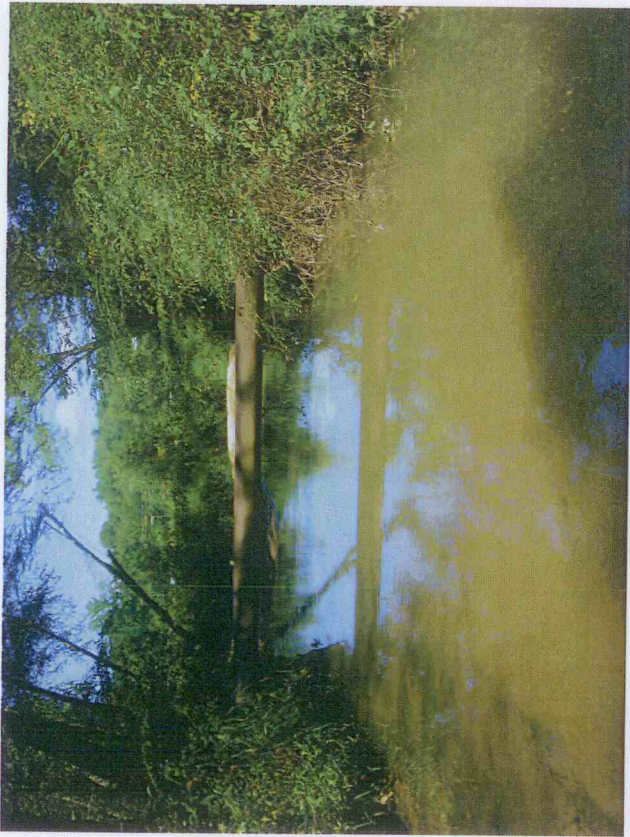


Photo Station 37

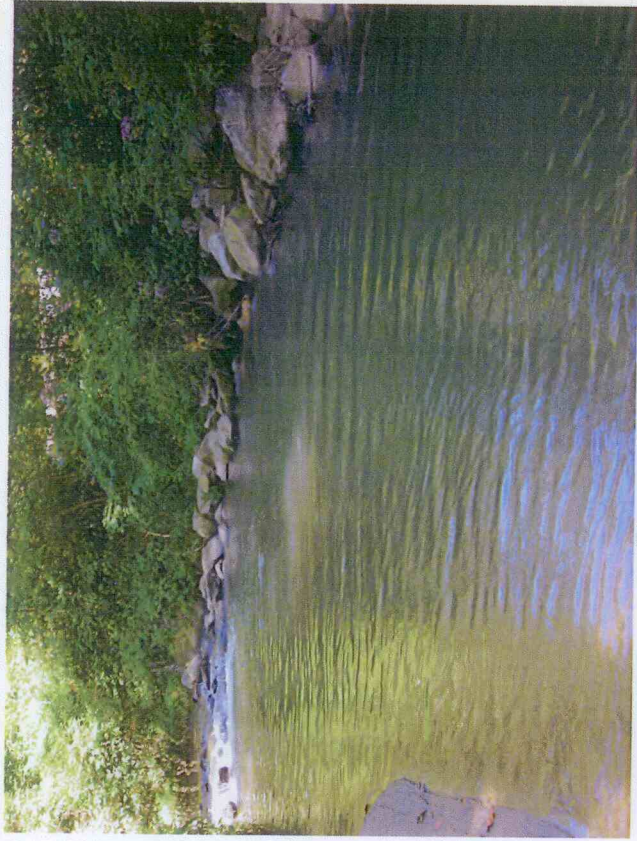


Photo Station 38

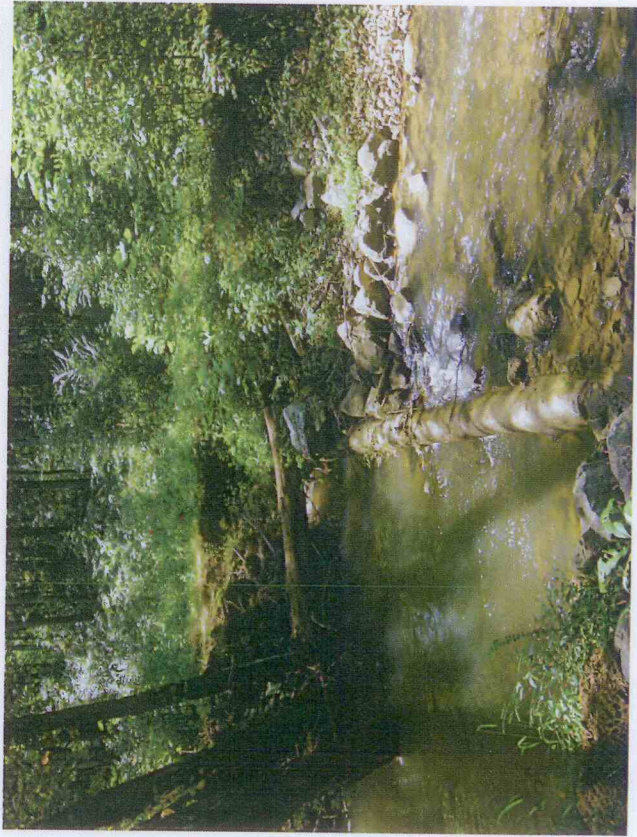


Photo Station 39



Photo Station 40

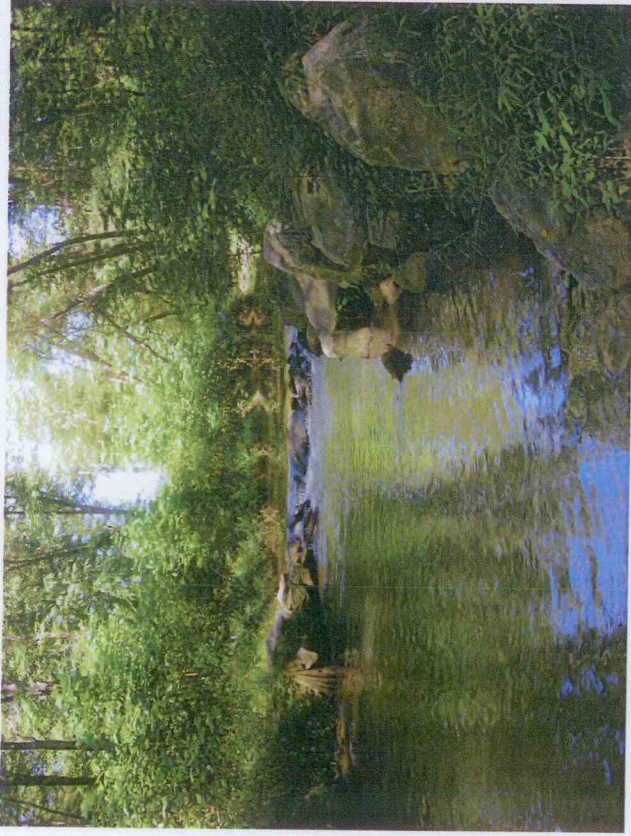


Photo Station 41



Photo Station 42



Photo Station 43



Photo Station 44

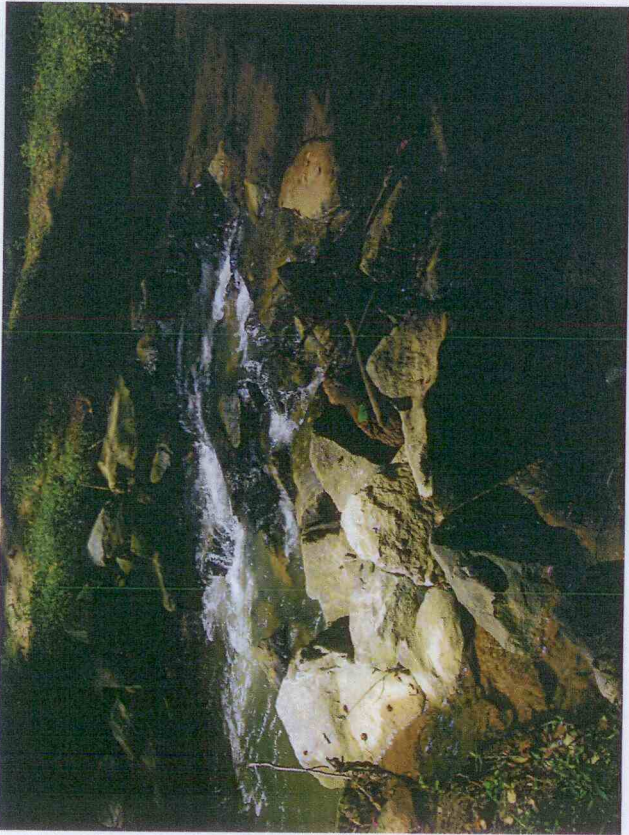


Photo Station 45



Photo Station 46

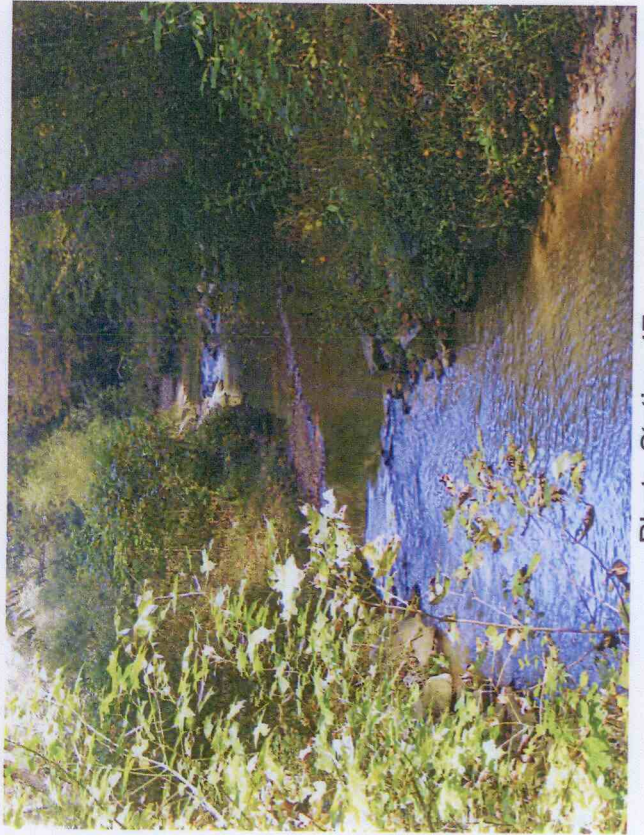


Photo Station 47



Photo Station 48

Appendix D

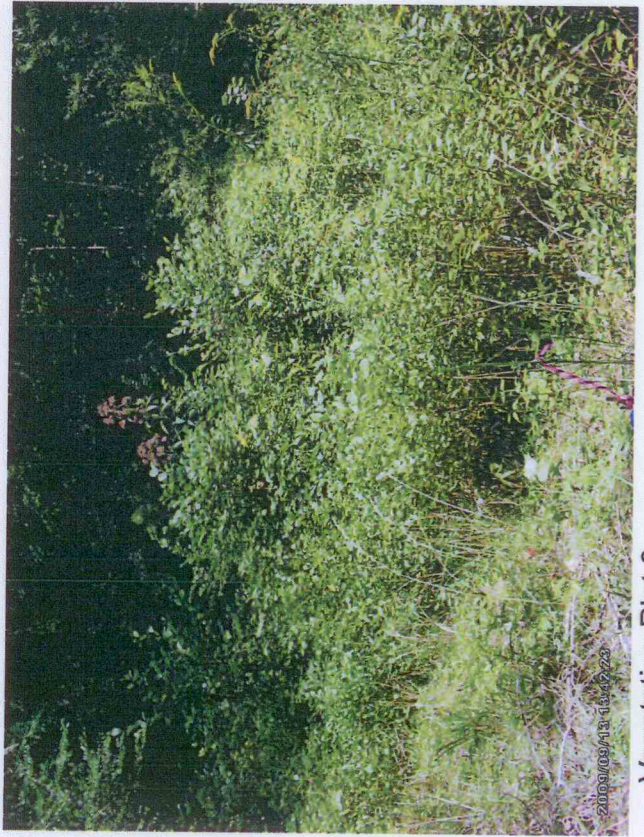
Vegetative Plots, Representative Photographs



Vegetative Plot 1



Vegetative Plot 2



Vegetative Plot 3



Vegetative Plot 4



Vegetative Plot 5



Vegetative Plot 6



Vegetative Plot 7



Vegetative Plot 8



Vegetative Plot 10



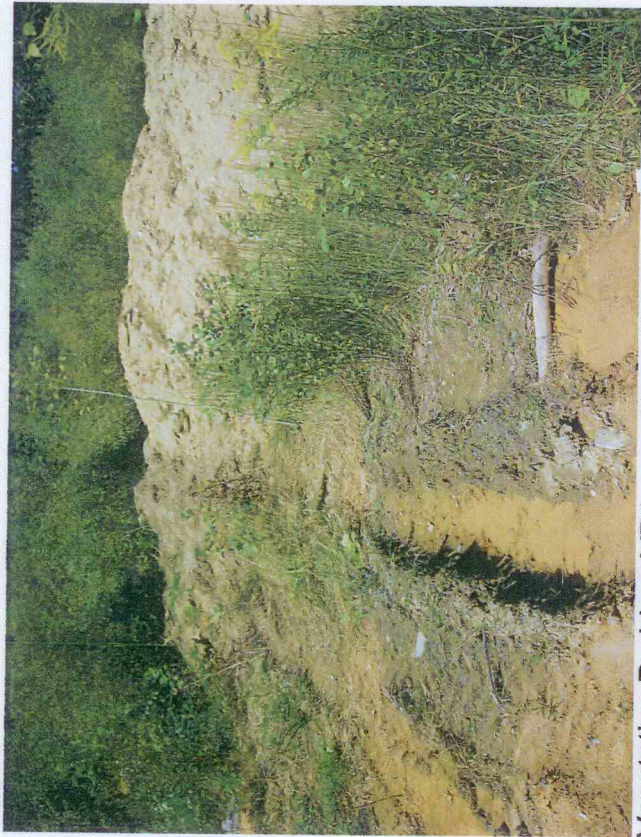
Vegetative Plot 9



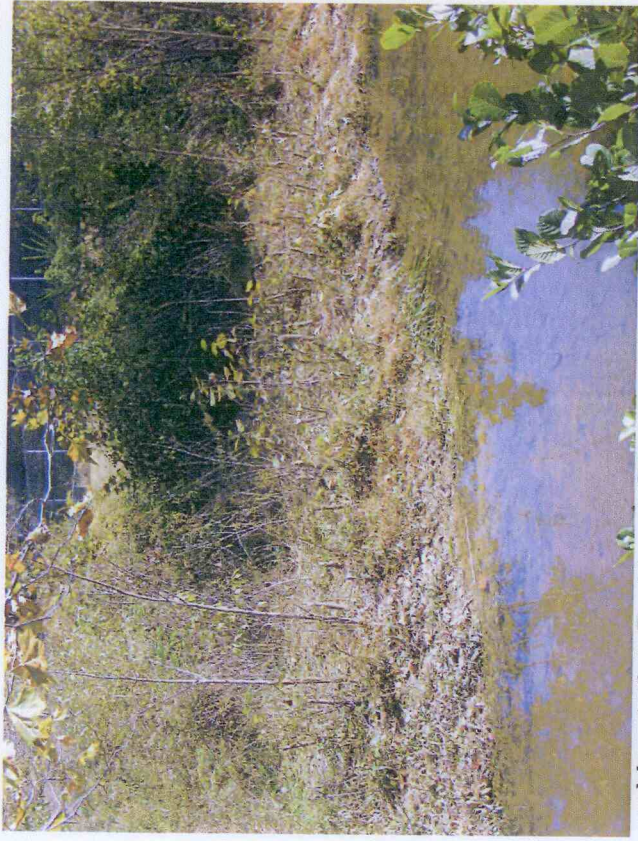
Vegetative Plot 11

Appendix E

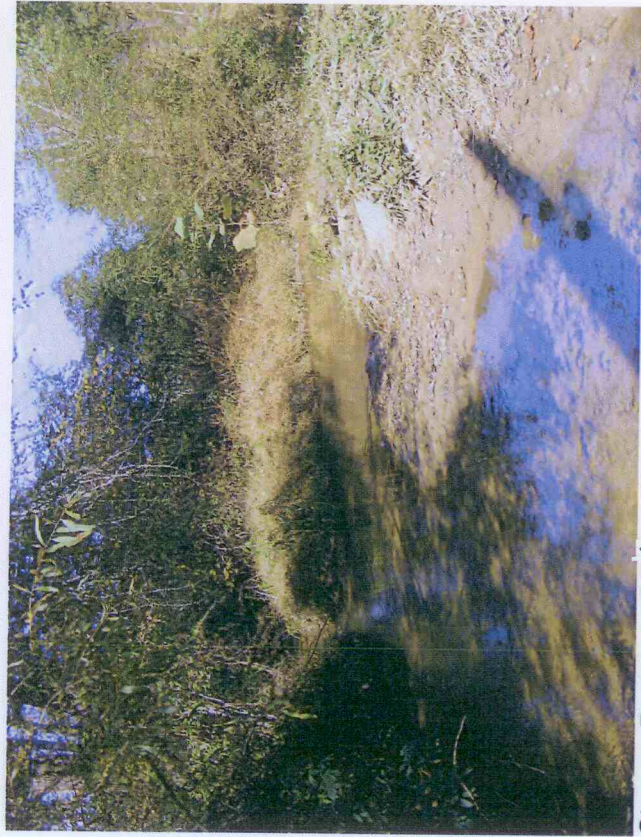
Problem Areas, Representative Photographs



Vegetative Problem VP1 - grading of VegPlot #4



Vegetative Problem VP2 - beaver herbivory



Stream Problem SP1 - mid-stream bar (in background)



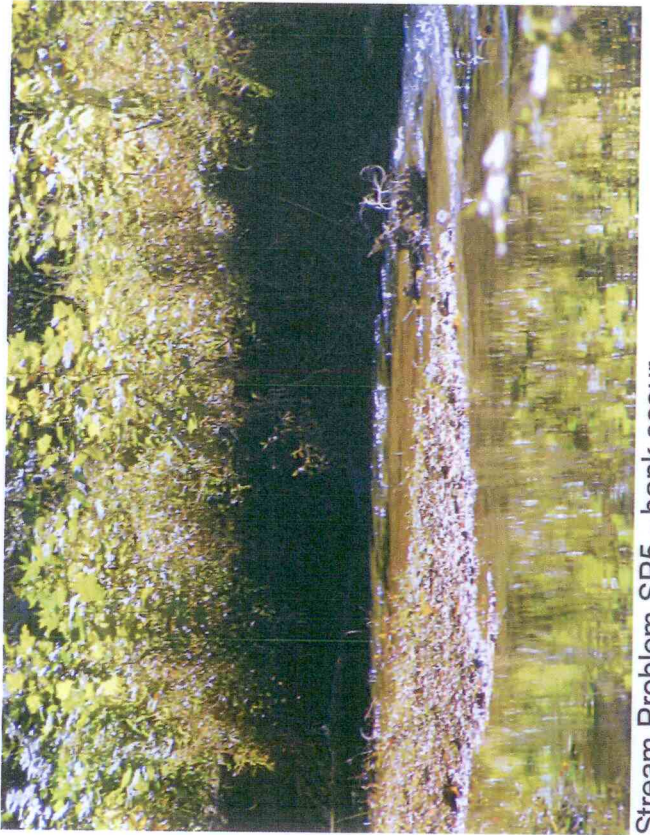
Stream Problem SP2 - mid-stream bar (partially submerged)



Stream Problem SP3 - beaver dam



Stream Problem SP4 - bank slump



Stream Problem SP5 - bank scour