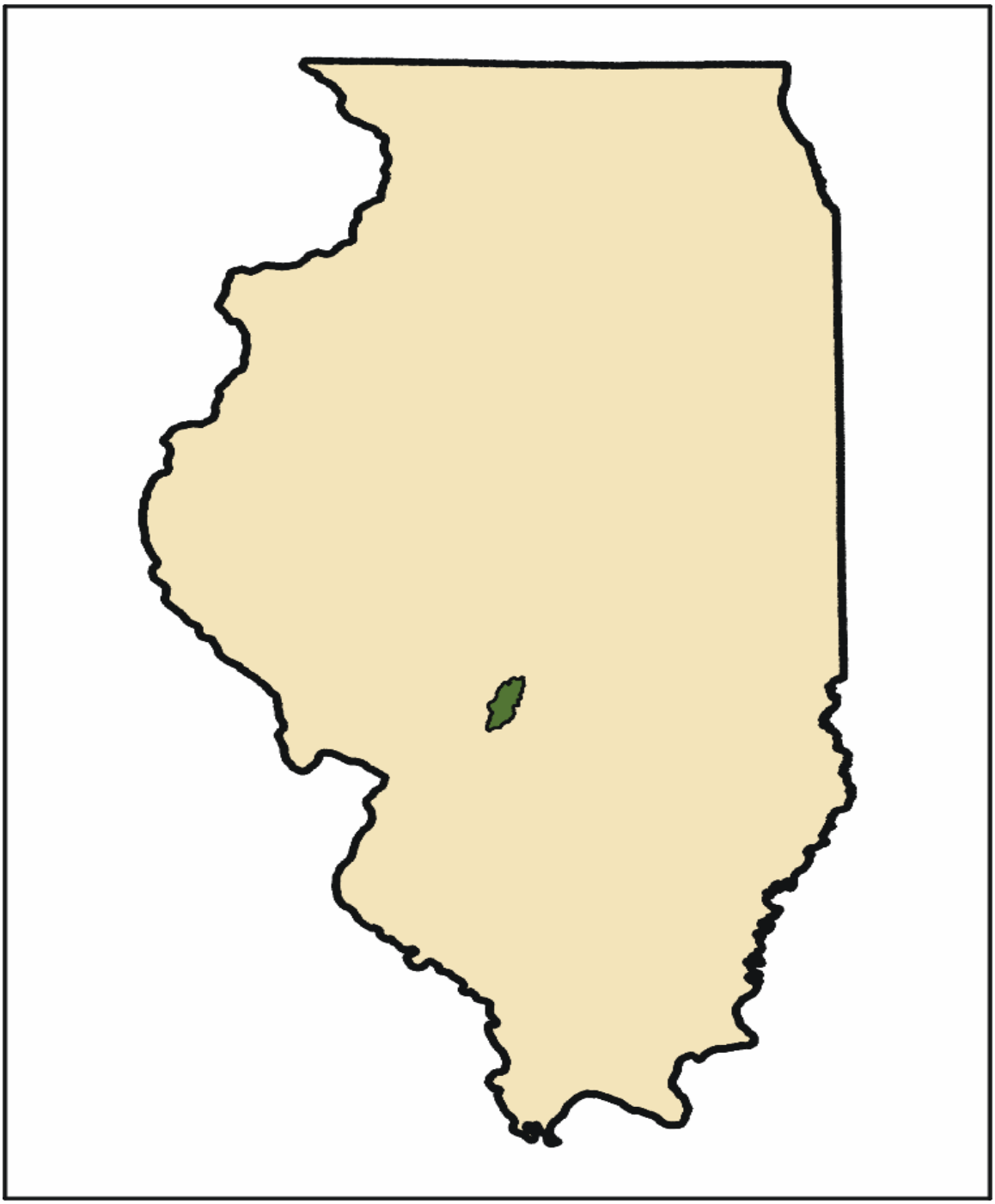


AERIAL ASSESSMENT FOR MIDDLE FORK SHOAL CREEK

MONTGOMERY COUNTY

SEPT. 2005

PREPARED BY WAYNE KINNEY FOR IL. DEPT. OF AGRICULTURE

Limno-Tech, Inc. has developed a draft TMDL plan for two lakes in this watershed, Lake Glenn Shoals and Old Hillsboro Lake. Lake Glenn Shoals is located on the mainstem of the Middle Fork of Shoal Creek and has been identified as having impairment from phosphorus, total suspended solids and excess algae growth. Old Hillsboro Lake is impaired by the same pollutants with an additional impairment from manganese. Middle Fork of Shoal Creek is not included as an impaired waterbody, but does feed Lake Glenn Shoals.

Assessment Procedure

Low level geo-referenced video was taken of the Middle Fork Shoal Creek in March, 2004. Video taping was completed by Fostaire Helicopters, Sauget, IL, using a camera mounted beneath a helicopter to record data from just above tree top level in DVD format for further evaluation and assessment. Video mapping began at Road 950 East (Red Bridge Road) just below the confluence of Miller Creek and the Middle Fork of Shoal. The mapping progressed upstream to just above Road 2100N in Montgomery Co. Aerial video of tributaries was not part of the project, regardless of the stream size or vegetation.

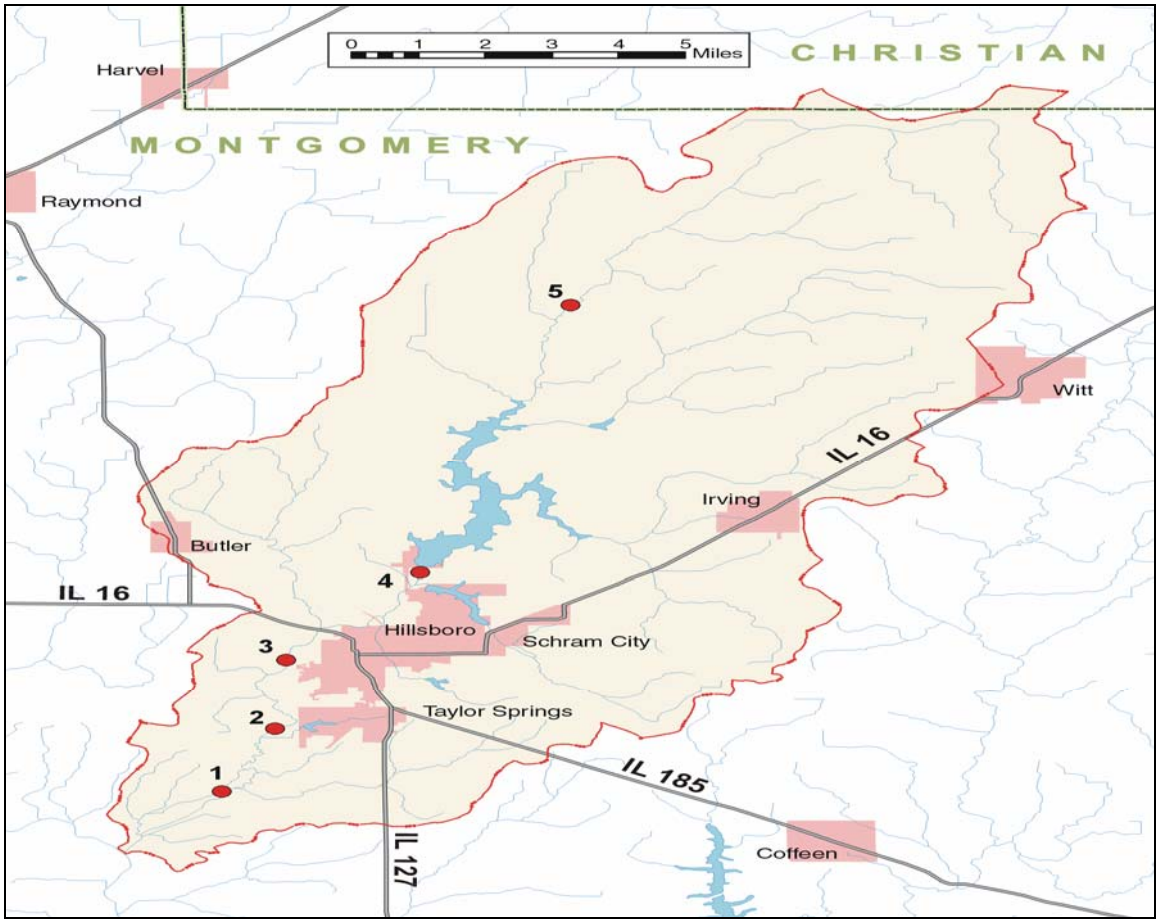


Fig. 1 Aerial Assessment Map of Middle Fork Shoal Creek

After videotaping the stream, the DVD tapes were processed by USGS to produce a geo-referenced DVD showing flight data and location. Next, USGS identified features from

the video and created shapefiles containing the GPS location, type of feature identified, and the time on the DVD to allow cross referencing. The shape-files along with the DVD were then used to identify and locate the points where ground investigations were needed to verify aerial assessment assumptions and gather additional data.

The ground investigations or "ground truthing" is intended to accomplish two primary functions. First, it provides those viewing videos the opportunity to verify the correct interpretation of the video. Second, the video allows the user to identify and gather field data at the most appropriate locations to more closely represent the entire study portion of the stream.

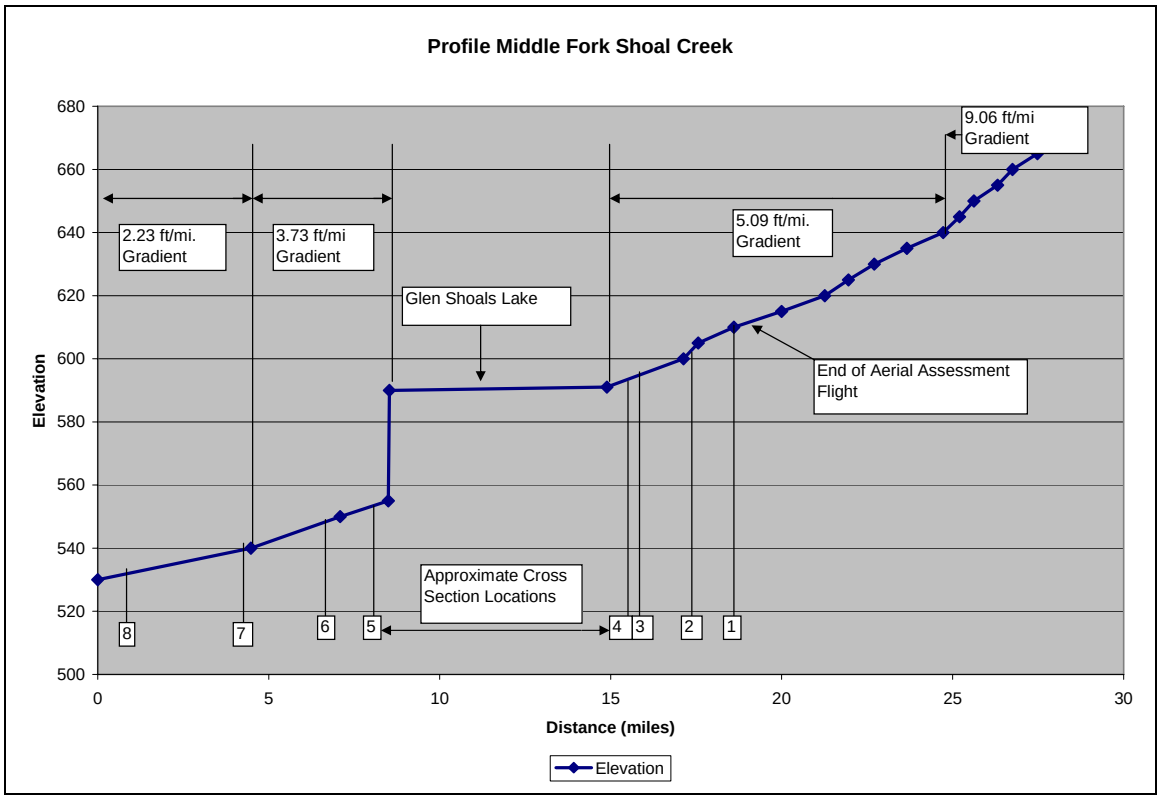


Figure 2 Channel Profile of Middle Fork Shoal Creek

Detailed elevation data is not available; therefore the channel slope is calculated from USGS topo maps by measuring the channel length between contour lines. The report refers to this as "valley profile" although a true valley profile would use a straight line distance down the floodplain rather than channel length. However, this method is used because it incorporates sinuosity into the calculation and allows the channel slope to be assume equal to "valley slope" in order to estimate channel capacity, velocity, etc., although there are short segments where the channel slope may differ significantly near roads, logjams, knickpoints, etc.

CHAPTERS ON DVD AND ASSESSMENT REPORT Middle Fork Shoal Creek--Montgomery Co.				
DVD Disc	DVD chapter	Beginning Time	Report Chapter	Cross Sections
1	2	5:00	1	8
1	3	10:00	2	7
1	4	15:00	3	5,6
1	5	20:00	4	3,4
1	6	25:00	5	1,2

Note: Flight path is from downstream to upstream

Fig. 3 DVD Chapters and Report Guide

The DVD has been divided into "chapters" of approximately five minutes of video (Fig. 3) to enhance the ability to navigate within the flight video and provide a simple way to identify and discuss different stream segments. Although the report will begin with a broader more general assessment of the entire study reach, it will also provide an assessment and treatment recommendations by chapter or group of chapters. The chapter divisions are clearly arbitrary and do not reflect "change points" in the stream characteristics or treatment recommendations. For clarity the conclusions and recommendations are presented for each stream "chapter".

The major factors indicating channel conditions identified from the aerial assessment have been totaled by DVD chapter in Table 1 below. This tabulation allows a general comparison of the relative dominance of features found in each chapter and provides a means of comparing stream characteristic between chapters. A discussion of the major differences will follow later in this report.

FEATURES IDENTIFIED BY CHAPTER Middle Fork Shoal Creek							
CHAPTER	LOGJAM	GEOTECH FAILURE	DEPOSITION	BED CONTROL	BREAK POINT	EROSION	SEVERE EROSION
1	8	8	3	0	0	33	0
2	2	8	4	0	0	36	2
3	1	3	3	1	0	40	0
4	4	0	4	0	1	28	0
5	4	1	1	1	0	22	0
Totals	19	20	15	2	1	159	2

Table 1 Features by Chapter Identified with Aerial Assessment

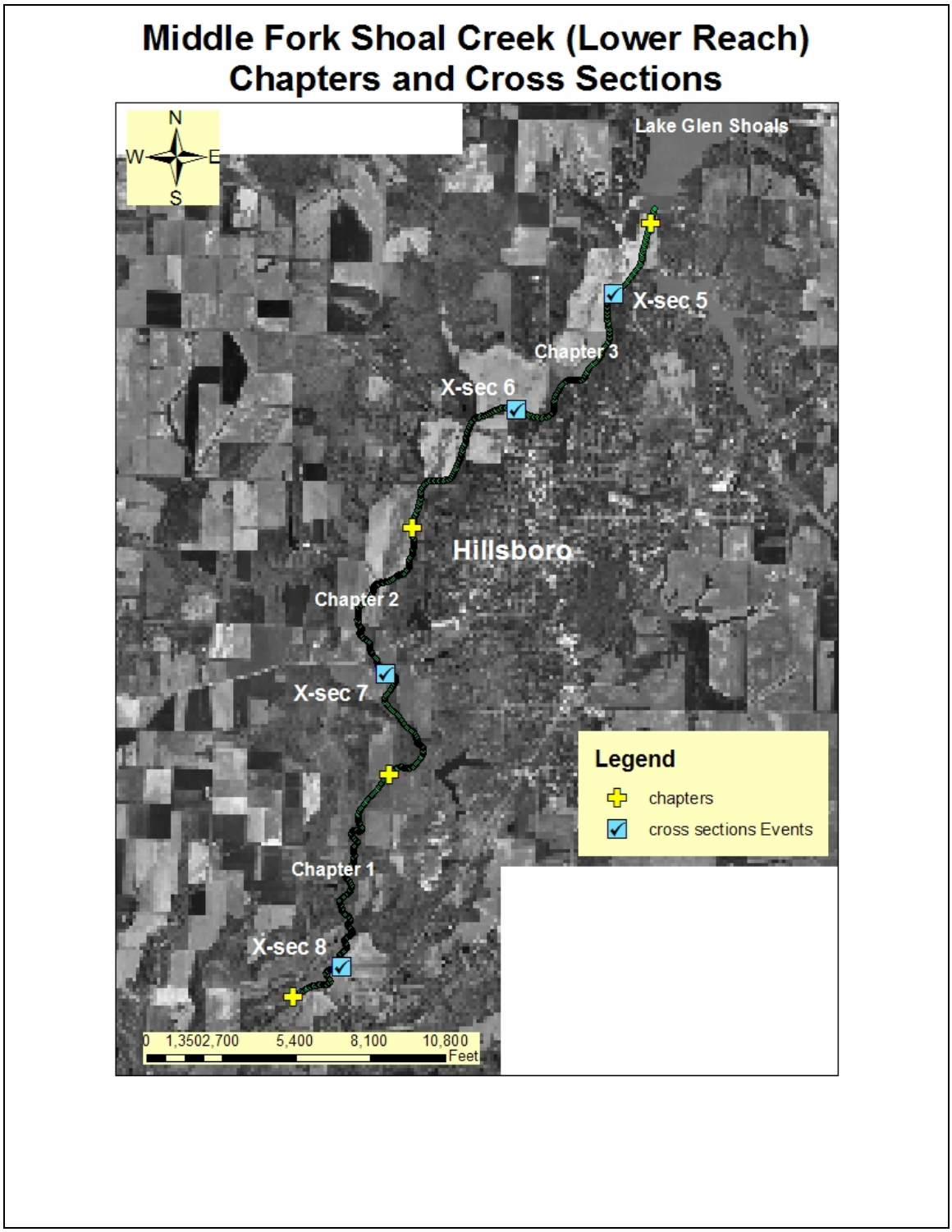


Fig. 4 Chapter Division and Cross Section locations (lower Middle Fork Shoal)

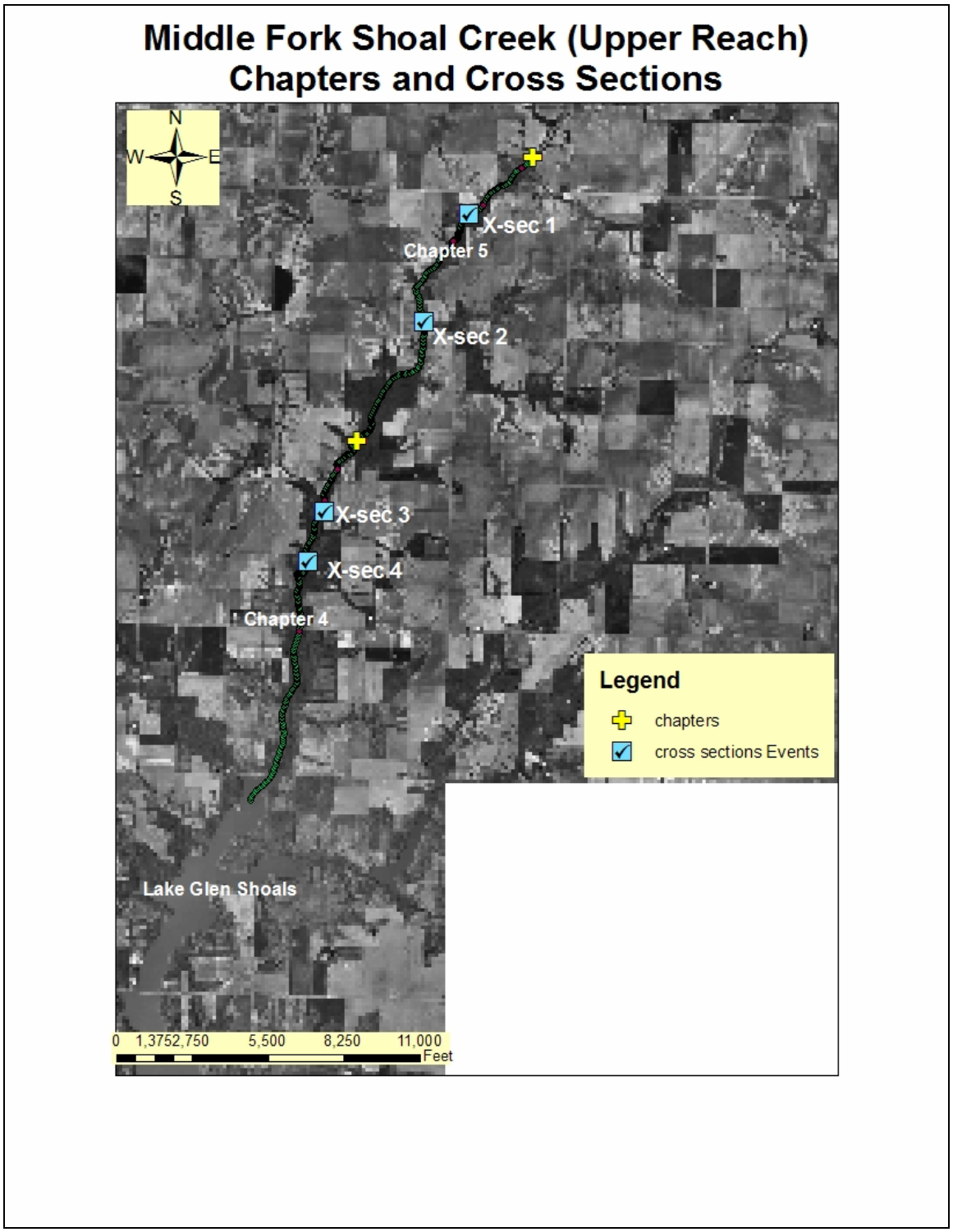


Fig. 5 Chapter Division and Cross Section locations (upper Middle Fork Shoal)

Eight cross sections were taken at selected locations on the Middle Fork of Shoal Creek after viewing the DVD's. The cross sections are located at "riffle" locations to best represent the channel characteristics and to allow for comparison of width, depth, x-sec.

area, etc. along the channel at similar geometric locations. The result of the hydraulic analysis at each site is presented in summary form in Table 2 and the approximate location of each cross section along the channel profile is found in Fig. 2. Aerial views of cross sections locations are shown in Figs. 17 thru 23. Exact locations as Eastings and Northings and more detail can be found in Appendix A.

Cross Section Data --Middle Fork Shoal Creek
Montgomery County, Illinois

X-sec	Easting	Northing	ADA Sq. Mi.	Valley Slope ft/mi.	Q2 cfs	Bank Full Q cfs	Width Ft.	Mean Depth Ft.	W/D Ratio	Vel. fps	Bedload Dia. Inches	CEM Simon	CFS/ sq. mi.	BKF Q/ Q2
1	290226	4353177	17.95	6.4	979	529	38	4.53	8.39	3.1	2	4	29.47	0.54
2	289725	4351989	18.33	5.8	949	537	34	4.91	6.92	3.2	1	4	29.3	0.57
3	288626	4349890	27.67	5.9	1325	792	40	5.64	7.09	3.5	1	5	28.62	0.60
4	288451	4349345	28.28	5.9	1348	714	43	5.07	8.48	3.3	1	5	25.64	0.53
5	285440	4339479	83.85	5.2	2993	1815	65	7.56	8.6	3.7	2	4	21.65	0.61
6	284365	4338197	88.75	5.2	3130	2098	64	8.45	7.57	3.9	1	4	23.64	0.67
7	282913	4335280	102.3	5.1	3468	1959	77	7.28	10.6	3.5	2	6	19.16	0.56
8	282435	4332047	105.8	5	3530	1282	57	8.19	6.96	2.7	1	3	12.11	0.36

Table 2 Cross Section Summary

USGS Gage#05593900 is located on the East Fork of Shoal Creek near Coffeen, IL. The drainage area at this location is 55.5 sq. miles. Given the similar size and location this gage has been used as a comparison for flow data as there is no data available for the Middle Fork. A plot of the probability for an Annual Maximum Peak Discharges from the East Fork has been produced from USGS data for the period 1981-2004. (Fig. 6) By applying a logarithmic trend line to the data the 2 yr. return interval annual maximum peak discharge is estimated at 2250 cfs or about 40.5 cfs/sq. mi. of drainage area. The 1.5 yr. return interval discharge is estimated at 1575 cfs or about 28.4 cfs/sq. mi. of drainage area.

These figures compare well with the field determined bankfull discharges ranging from 29.47 cfs/sq. mi. at cross section 1 down to 19.16 cfs/sq. mi. at cross section 7 which has a drainage area of 102.3 sq. miles or nearly twice that found at gage site on the East Fork of Shoal Creek. The discharge per sq. mi. of drainage can be expected to decrease as the watershed becomes larger, therefore it is reasonable to assume that the bankfull discharge for the Middle Fork of Shoal Creek is near or slightly below the 1.5 yr. return interval based on the East Fork data.

Cross Section 8 however has a significantly lower bankfull capacity and out of bank flow in this lower reach near Miller Creek and approx. 2.5 miles above the confluence with Shoal Creek will be much more frequent. Cross section 8 however is located in a definite “knickzone” where there is active degradation occurring which will result in a larger channel capacity as the channel degrades. The result will also be increased bank failures and logjams while the channel makes this adjustment.

While this aerial assessment did not include any segments downstream, there has been extensive channelization Shoal Creek and the downcutting found at Cross Section 8 may

be the result of degradation on Shoal Creek, caused by the channelization, progressing upstream to this reach of the Middle Fork.

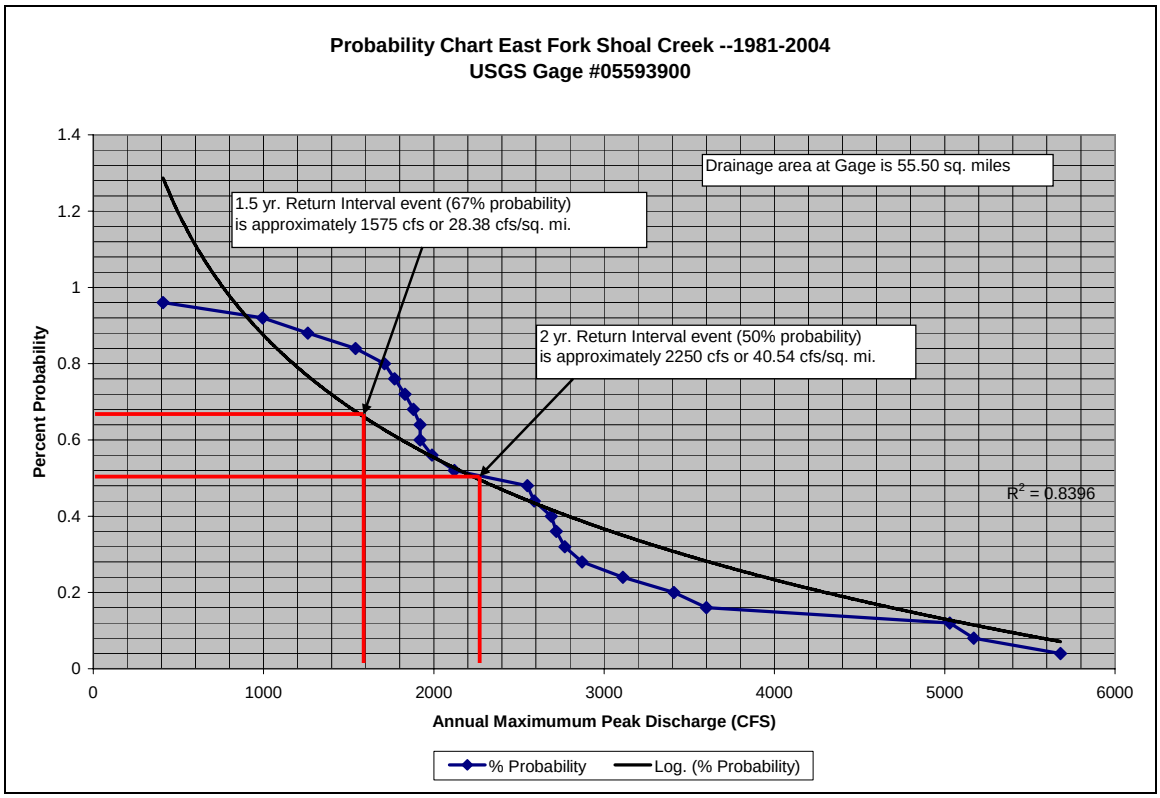


Fig. 6 Annual Maximum Peak Flow Probability Chart for East Fork Shoal Creek

General Observations

1. All cross sections taken on Middle Fork have at least a small floodplain area at or near the field determined "bankfull discharge".
2. "Bankfull discharge" appears to be near or slightly below the 1.5 yr. return interval storm using USGS gage 05593900 as a comparison.
3. The aerial assessment includes a reach above Lake Glen Shoals that potentially contribute to the impaired water and also a reach below Lake Glen Shoals where there is no identified impairment. The report will cover both reaches.
4. Cross sections 1-4 are above Lake Glen Shoals and 5-8 are below Lake Glen Shoals. The cross sections indicate degrading and/or widening of the channel at cross sections 1 and 2, Lake Glen Shoals backwater is preventing degradation at cross sections 3 and 4.
5. The principle spillway discharge on Lake Glen Shoals is rated at 2466cfs, according to NRCS design information, while the field determined bankfull discharge below the lake is only 1815 cfs. Therefore while the lake is a flood control structure and reduces peak floods, it has little or no effect on the "channel forming" discharge that determines the channel morphology downstream. The lake does however, extend the time the channel flows at capacity and the lake also

acts as a sediment trap that then releases “cleaner” and therefore more erosive flow.

6. The aerial assessment does not extend upstream much beyond Road 2100N due to the channel size. The aerial assessment ends where the channel is in CEM stage 4. It is likely that there is a stage 3 channel upstream that has not been assessed.
7. Cross section 8 is downcutting significantly and will advance upstream if left unattended.

Treatment Recommendations: Chapter 1

This chapter is degrading (CEM stage 3), possibly from degradation that has occurred downstream on Shoal Creek. There are 8 geotech failures in the lower portion of this chapter due to the degradation. The channel capacity in this reach is however, approximately 35% lower than that upstream in Chapter 2 where there is a CEM stage 6 channel. Therefore additional study is needed to determine if grade control is necessary, or if the channel is undersized and needs to be allowed to enlarge through degradation or mechanical means. No treatment recommendation can be made at this time pending further analysis.

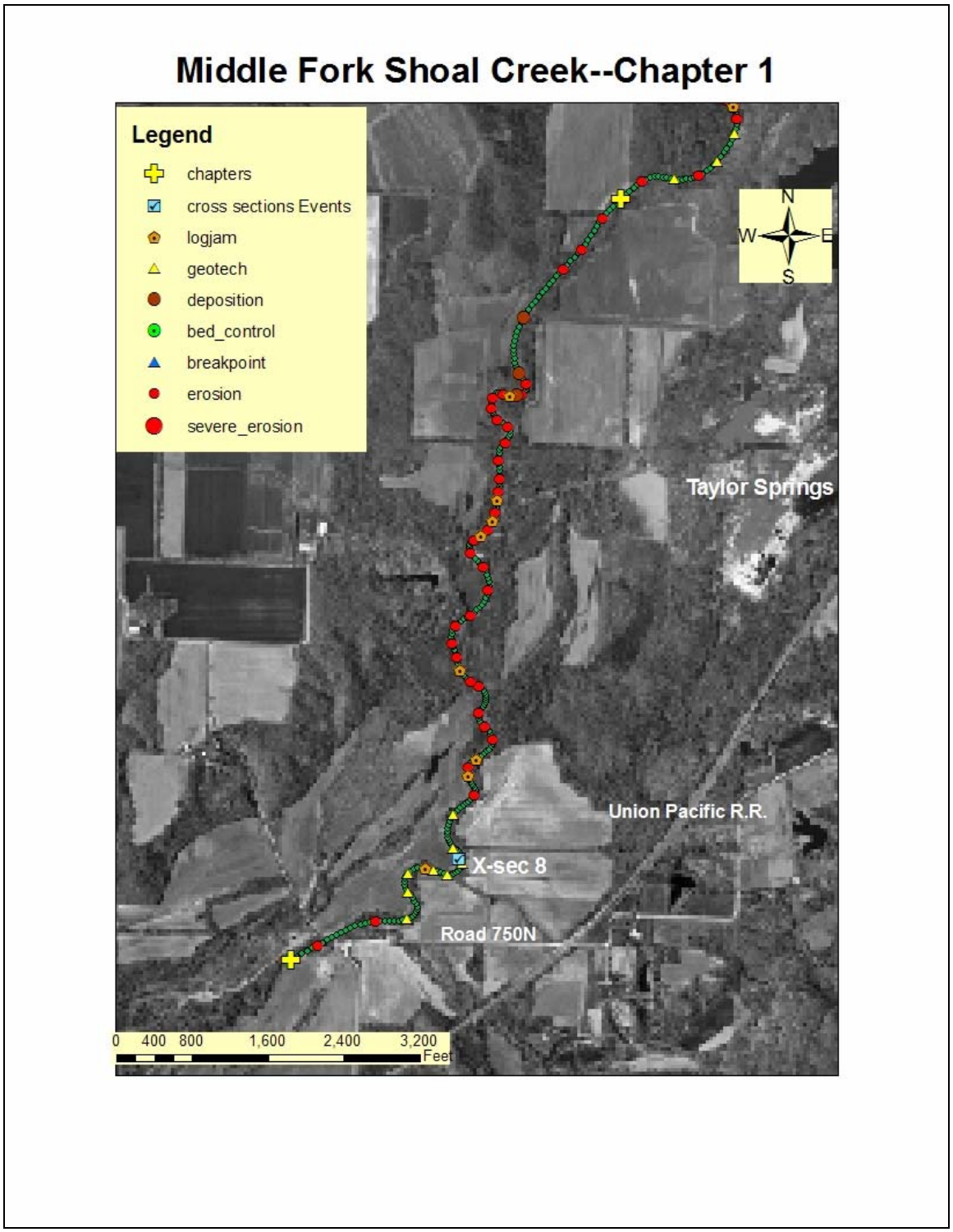


Fig. 7 Chapter1

Treatment Recommendations: Chapter 2 and 3

These chapters contain cross section 7 which is a CEM stage 6 channel and cross sections 5 and 6 which are CEM stage 4 channels. Although two cross sections are determined to be CEM stage 4 the channels are not incised with all cross sections being connected to a floodplain. Further the channels do not appear to be either degrading or aggrading in this reach. Rather the 76 erosion sites within this Chapter along with 11 geotech failures appear to be the result of lateral bank erosion and toe scour. This reach may in fact be reacting to the changes in flow regime as a result of the flood control function of Lake Glen Shoals. With the addition of flood storage within the lake there is a longer period of elevated flow within the channel that may be a significant factor in the lateral bank erosion.

The treatment recommendation for these chapters is to treat the lateral bank stability problems with Stone Toe Protection (STP) and/or Stream Barbs to control the toe scouring and subsequent bank failure. This treatment option has been used near cross section 5 in two separate locations. STP installed approximately 7 years ago can be viewed on the DVD at 18:58 and 19:13. (Fig. 8 and 9) Both installations appear to be working well.

The geotech failures in Middle Fork appear to be primarily due to oversteepening of the bank from toe scour, therefore these sites are included in the estimate for lateral bank protection. Geotech sites will need special attention to determine the presence or absence of any internal drainage problems that must be addressed.

The estimated treatment cost and quantities are presented below in Table 3.

`	TREATMENT --CHAPTERS 2 and 3				
	Lateral Bank Protection				
Chapter	Erosion Sites	Average Length(ft)	Total Length	Average Cost/foot	Total Cost
2	44	350	15400	$30.00	$462,000.00
3	43	350	15050	$30.00	$451,500.00
Total	87		30450		$913,500.00

Table 3. Treatment needs and cost for Chapters 2 and 3

Fig. 8 Stone Toe Protection installed around 1998 for lateral bank treatment. Note the stable banks and ponded water behind the STP in the apex of the bend.

Fig. 9 Stone Toe Protection installed around 1998 for toe protection.

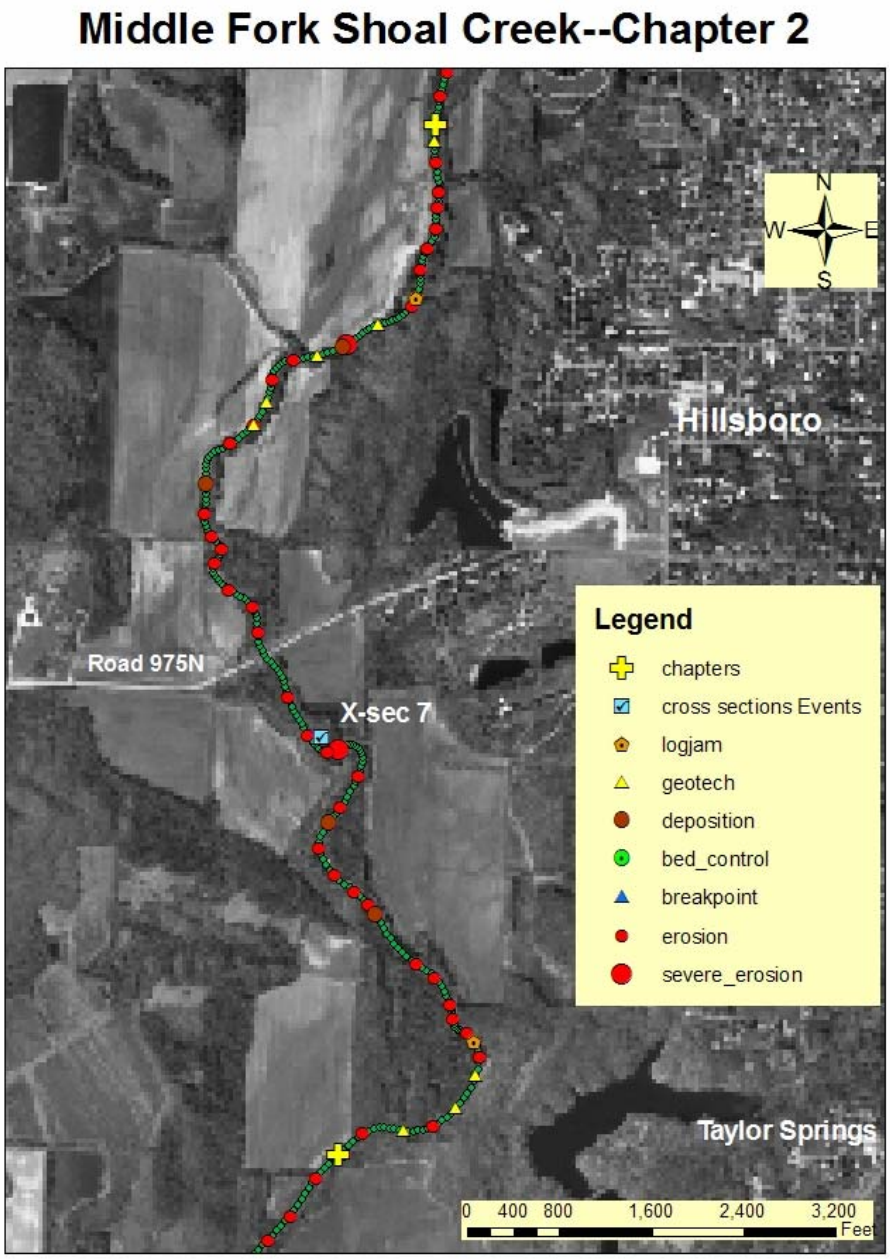


Fig. 10 Chapter2

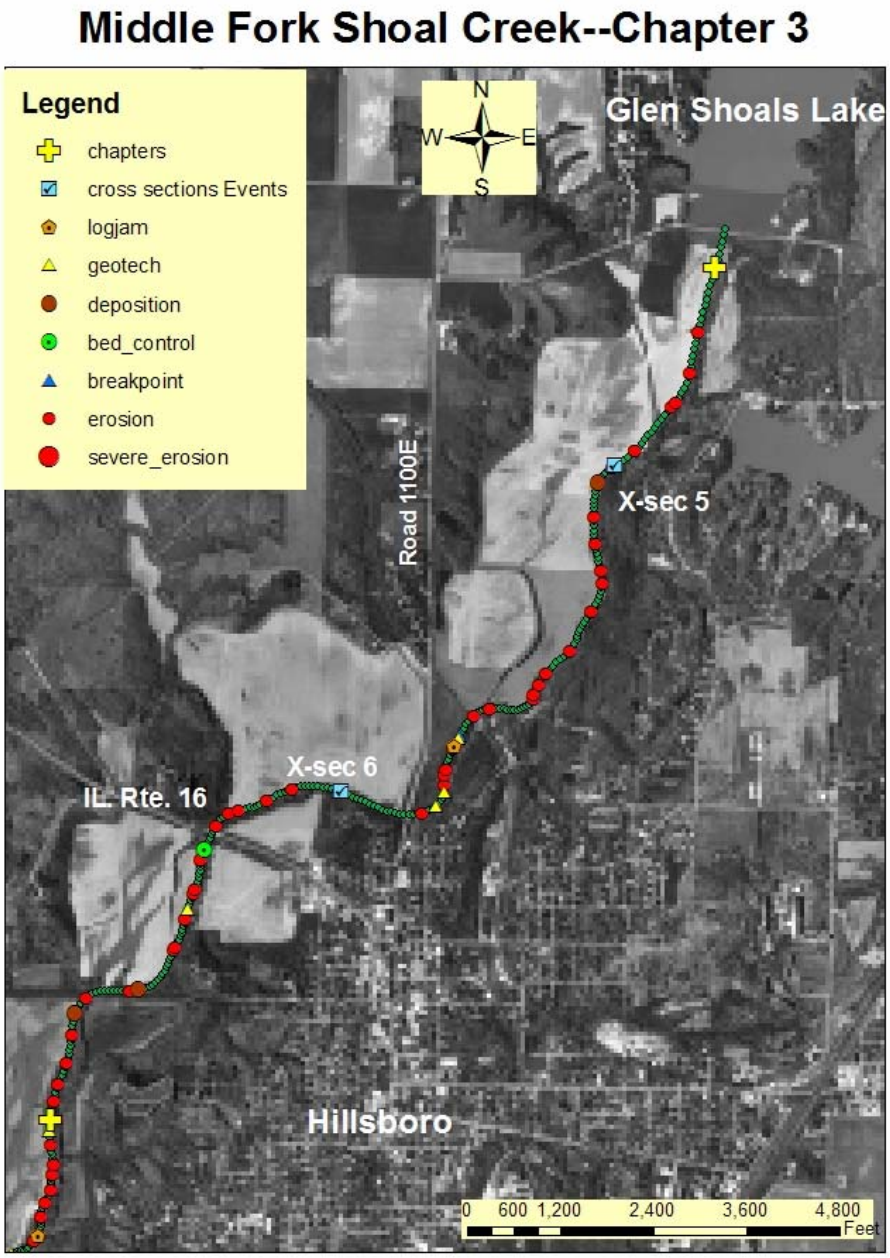


Fig. 11 Chapter3

Treatment Recommendations: Chapter 4

This chapter begins at the upper end of Lake Glen Shoals and continues upstream for 2.6 miles. This reach contains cross sections 3 and 4 which are determined to be CEM stage 5 with some aggradation due to the backwater effects of the lake. There are 28 erosion sites in this chapter and they are recommended to be treated with Stone Toe Protection. The channel is too narrow at 40 ft. to make use of Bendway Weirs or Stream Barbs an effective treatment. There is no need for grade control.
The treatment needs and estimated cost are provide below in Table 4.

`	TREATMENT --CHAPTER 4				
	Lateral Bank Protection				
Chapter	Erosion Sites	Average Length(ft)	Total Length	Average Cost/foot	Total Cost
4	28	200	5600	$25.00	$140,000.00
Total	28		5600		$140,000.00

Table 4. Treatment needs and cost for chapter 4.

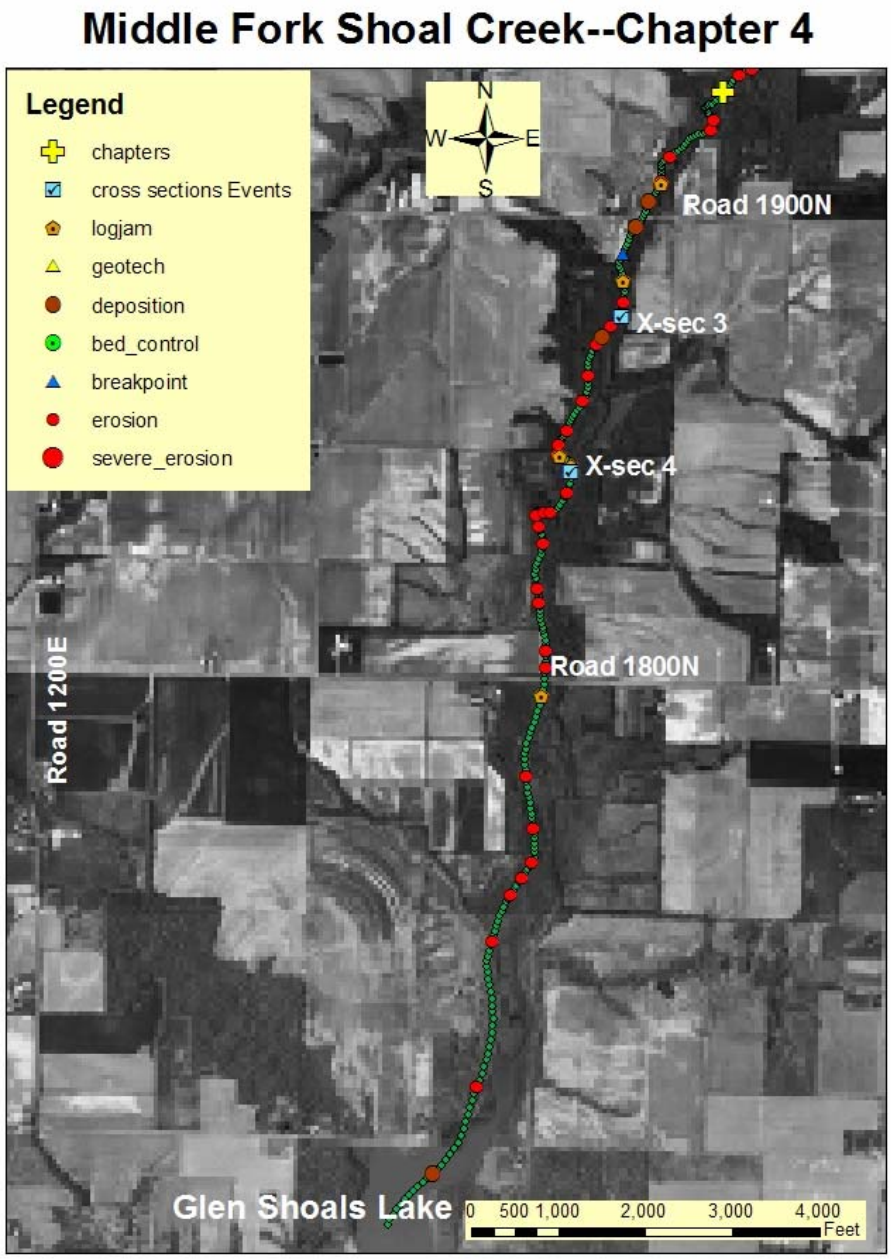


Fig. 12 Chapter 4

Treatment Recommendations: Chapter 5

This reach is the upper 2.5 miles of the aerial assessment. It contains cross sections 1 and 2 which are CEM stage 4 channels. There are 22 erosion sites identified in this chapter and 1 geotech failure. Unlike the stage 4 channels found below Lake Glen Shoals these locations appear to have active downcutting. Therefore the use of Rock Riffle Grade control plus lateral bank treatment is recommended in chapter 5. However the use of Rock Riffles will likely reduce the need for lateral bank treatment significantly below that shown in Table 5. Table 5 assumes no credit for lateral bank stability to the Rock Riffles as it is uncertain how significant the downcutting will be in this reach and existing bridges and culverts may be relied upon to control the degradations. If this option is pursued additional study of existing grade controls need to be completed.

`	TREATMENT --CHAPTER 4				
	Lateral Bank Protection				
Chapter	Erosion Sites	Average Length(ft)	Total Length	Average Cost/foot	Total Cost
5	23	200	4600	$25.00	$115,000.00
Total	23		4600		$115,000.00

	Rock Riffle Grade Control				
Chapter	Rock Riffles	Average Tonnage	Ave. Cost Ton	Average Cost/Riffle	Total Cost
5	54	120	$30.00	$3,600.00	$194,400.00

Table 5. Treatment needs and costs for Chapter 5

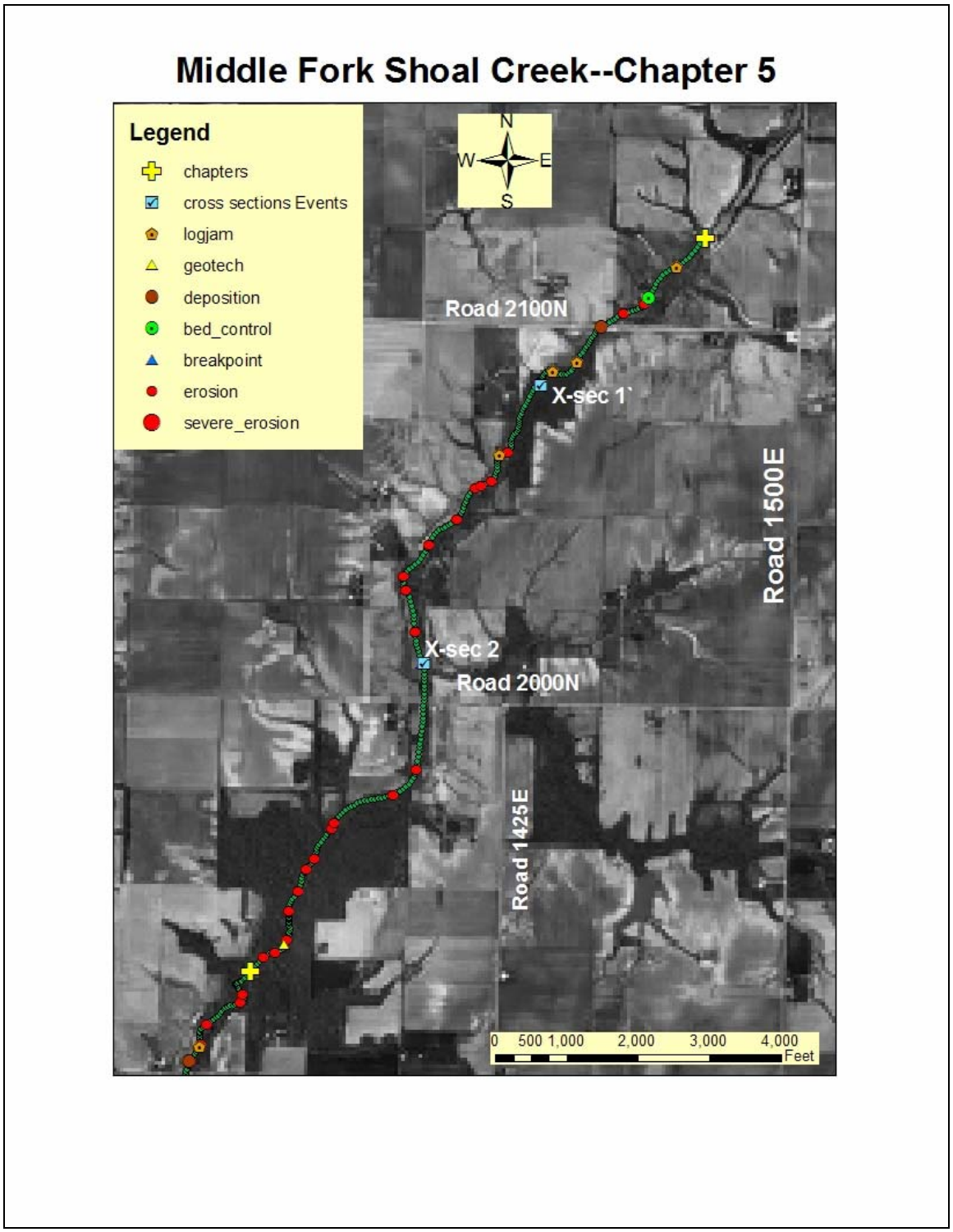


Fig. 13 Chapter 5

APPENDIX A

CROSS SECTION DATA

Stream Stabilization I & E Form

ILLINOIS NRCS - Version 2.05- modified 9/12/04 R.Book

County Montgomery T. R. Sec.

Date 9/26/2005 By Wayne Kinney

Stream Name Middle Fork Shoal Creek UTM Coord. E290226 N4353177

Landowner Name X-sec 1

Drainage Area 17.95 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions	Width	46 ft.	Cross Sectional Area	159 sq. ft.
	Depth	3.5 ft.		

Reference Stream Gage:

East Fork Shoal Creek near Coffeen	Station No.	05593900	Gage Q_2	2130 cfs
	Drainage Area	56 sq.mi	Regression (	1880 cfs
Montgomery County, IL		**REFERENCE STREAM DATA ONLY**		

USGS Flood-Peak Discharge Predictions:

Valley Slope:	6.4	*ft./mi. (user-entered)*			Regression Q_2	864 cfs
		ft/mi (from worksheet)	Rainfall	3.35 in *(2 yr, 24 hr)*	Adjusted Q_2	979 cfs
	0.0012	*ft./ft.*	Regional Factor	1.057	Typical Range for Bankfull Discharge:	
					390	to 790 cfs

Local Stream Morphology:

Channel Description: (c) Clean, winding, some pools and shoals

Manning's "n" 0.04

			Stream Length		*ft.*
Basic Field Data:			Valley Length		*ft.*
Bankfull Width	38	*ft.*	Contour Interval		feet
Mean Bankfull Depth	4.53	*ft.*	Estimated Sinuosity		
Width/Depth Ratio	8.39				
			Channel Slope:		Bankfull Q from:
Max. Bankfull Depth	6.8	*ft.*	Surveyed:	0.00096 *ft./ft.*	Cross-Section 514 *cfs*
Width at twice max. depth	400	*ft.*	Estimated:	*ft./ft.*	Basic field data 544 *cfs*
(13.6 ft.)					Selected Q 529 *cfs*
Entrenchment Ratio	10.53		Radius of Curvature (Rc)		ft.
			Rc/Bankfull width:	0.00	

Bankfull Velocity Check: *(typical Illinois streams will have average bankfull velocity between 3 and 5 ft/sec.)*

Bedload:	D_{90}	2 *in.*	Velocity required to move D_{90}:	2.9	*ft./sec.*
	D_{50}	*in.*	Velocity from Cross-Section data:	2.97	*ft./sec.*
GOAL: Develop confidence by matching			Velocity from basic field data:	3.16	*ft./sec.*
velocities from different sources.			Velocity from selected Q:	3.1	*ft./sec.*

Channel Evolution Stage IV Stream Type (Rosgen)

Notes

29.47 cfs/sq. mi.

Natural Open Channel Flow

Project:	X-sec 1	
Assisted by:	Wayne Kinney	
Date:	9/26/2005	
Channel Slope (***S***):	0.000960	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	6.8	*ft*

$$Q \Pi \frac{1.486}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}}$$

assuming uniform, steady flow

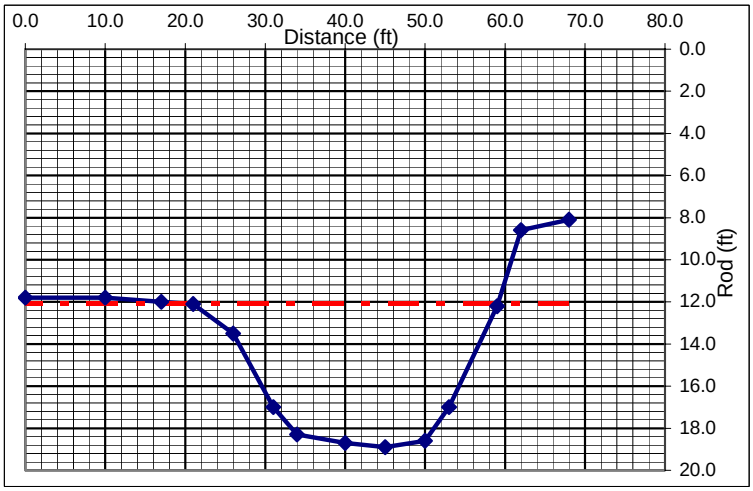
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	6.8 *ft*	7.1	
Channel Flow (***Q***):	514.0 *cfs*	440.9	
Channel Velocity:	3.0 *ft/sec*	2.4	
Cross-Sectional Area (***A***):	173.2 *sq.ft.*	186.3	
Hydraulic Radius (***R***):	4.1 *ft*	2.9	

Survey Data:

Rod *(ft)*	Distance *(ft)*
8.1	68.0
8.6	62.0
12.2	59.0
17.0	53.0
18.6	50.0
18.9	45.0
18.7	40.0
18.3	34.0
17.0	31.0
13.50	26
12.10	21
12.00	17
11.80	10
11.80	0



COMMENTS:

Stream Stabilization I & E Form

ILLINOIS NRCS - Version 2.05- modified 9/12/04 R.Book

County Montgomery T. R. Sec.

Date 9/26/2005 By Wayne Kinney

Stream Name Middle Fork Shoal Creek UTM Coord. E289725 N4351989

Landowner Name Xsec2

Drainage Area 18.33 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions	Width	46 ft.	Cross Sectional Area	162 sq. ft.
	Depth	3.5 ft.		

Reference Stream Gage:

East Fork Shoal Creek near Coffeen

Station No. 05593900 Gage Q_2 2130 cfs

Drainage Area 56 sq.mi Regression (1880 cfs

Montgomery County, IL **REFERENCE STREAM DATA ONLY**

USGS Flood-Peak Discharge Predictions:

Valley Slope:	5.8	*ft./mi. (user-entered)*			Regression Q_2	838 cfs
		ft/mi (from worksheet)	Rainfall	3.35 in *(2 yr, 24 hr)*	Adjusted Q_2	949 cfs
	0.0011	*ft./ft.*	Regional Factor	1.057	Typical Range for Bankfull Discharge:	
					370	to 760 cfs

Local Stream Morphology:

Channel Description: (c) Clean, winding, some pools and shoals

Manning's "n" 0.04

Basic Field Data:					
			Stream Length		*ft.*
			Valley Length		*ft.*
Bankfull Width	34	*ft.*	Contour Interval		feet
Mean Bankfull Depth	4.91	*ft.*	Estimated Sinuosity		
Width/Depth Ratio	6.92				

			Channel Slope:			Bankfull Q from:		
Max. Bankfull Depth	8.2	*ft.*	Surveyed:	0.00096	*ft./ft.*	Cross-Section	516	*cfs*
Width at twice max. depth		*ft.*	Estimated:		*ft./ft.*	Basic field data	557	*cfs*
(16.4 ft.)						Selected Q	537	*cfs*
Entrenchment Ratio	0.00		Radius of Curvature (Rc)		ft.			
			Rc/Bankfull width:	0.00				

Bankfull Velocity Check: *(typical Illinois streams will have average bankfull velocity between 3 and 5 ft/sec.)*

Bedload:	D_{90}	1 *in.*	Velocity required to move D_{90}:	2.1	*ft./sec.*
	D_{50}	*in.*	Velocity from Cross-Section data:	3.09	*ft./sec.*
GOAL: Develop confidence by matching			Velocity from basic field data:	3.34	*ft./sec.*
velocities from different sources.			Velocity from selected Q:	3.2	*ft./sec.*

Channel Evolution Stage IV Stream Type (Rosgen)

Notes

29.3 cfs/sq. mi.

Natural Open Channel Flow

Project:	Xsec2	
Assisted by:	Wayne Kinney	
Date:	9/26/2005	
Channel Slope (***S***):	0.000960	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	8.2	*ft*

$$Q \Pi \frac{1.486}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}}$$

assuming uniform, steady flow

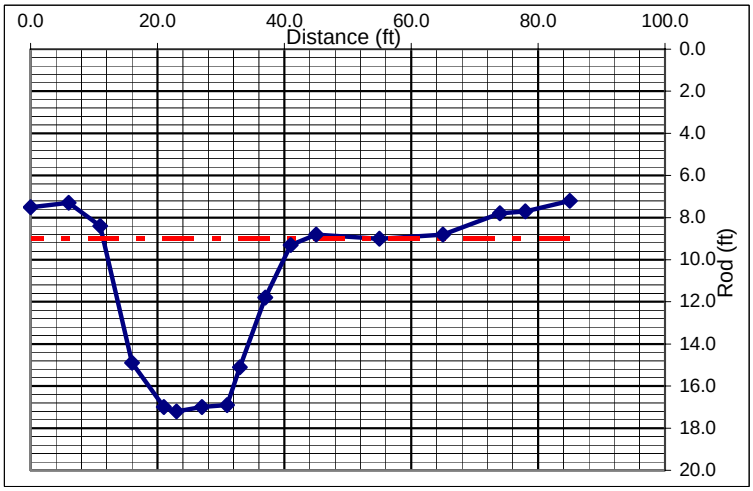
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	8.2 *ft*	9.9	
Channel Flow (***Q***):	516.2 *cfs*	651.9	
Channel Velocity:	3.1 *ft/sec*	2.4	
Cross-Sectional Area (***A***):	166.9 *sq.ft.*	271.7	
Hydraulic Radius (***R***):	4.4 *ft*	3.0	

Survey Data:

Rod *(ft)*	Distance *(ft)*
7.2	85.0
7.7	78.0
7.8	74.0
8.8	65.0
9.0	55.0
8.8	45.0
9.3	41.0
11.8	37.0
15.1	33.0
16.90	31
17.00	27
17.20	23
17.00	21
14.90	16
8.40	11
7.3	6
7.5	0



COMMENTS:

Stream Stabilization I & E Form

ILLINOIS NRCS - Version 2.05- modified 9/12/04 R.Book

County Montgomery T. R. Sec.

Date 9/26/2005 By Wayne Kinney

Stream Name Middle Fork Shoal Creek UTM Coord. E288626 N4349890

Landowner Name Xsec3

Drainage Area 27.67 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions	Width	54 ft.	Cross Sectional Area	214 sq. ft.
	Depth	3.9 ft.		

Reference Stream Gage:

East Fork Shoal Creek near Coffeen

Montgomery County, IL

Station No. 05593900 Gage Q_2 2130 cfs

Drainage Area 56 sq.mi Regression (1880 cfs

REFERENCE STREAM DATA ONLY

USGS Flood-Peak Discharge Predictions:

Valley Slope: 5.9 *ft./mi. (user-entered)* Regression Q_2 1169 cfs

ft/mi (from worksheet) Rainfall 3.35 in *(2 yr, 24 hr)* Adjusted Q_2 1325 cfs

0.0011 *ft./ft.* Regional Factor 1.057 Typical Range for Bankfull Discharge:

520 to 1060 cfs

Local Stream Morphology:

Channel Description: (c) Clean, winding, some pools and shoals

Manning's "n" 0.04

Basic Field Data:

Bankfull Width 40 *ft.*

Mean Bankfull Depth 5.64 *ft.*

Width/Depth Ratio 7.09

Max. Bankfull Depth 7.1 *ft.*

Width at twice max. depth 500 *ft.*

(14.2 ft.)

Entrenchment Ratio 12.50

Stream Length *ft.*

Valley Length *ft.*

Contour Interval feet

Estimated Sinuosity

Channel Slope:

Surveyed: 0.00096 *ft./ft.*

Estimated: *ft./ft.*

Radius of Curvature (Rc) ft.

Rc/Bankfull width: 0.00

Bankfull Q from:

Cross-Section 760 *cfs*

Basic field data 825 *cfs*

Selected Q 792 *cfs*

Bankfull Velocity Check: *(typical Illinois streams will have average bankfull velocity between 3 and 5 ft/sec.)*

Bedload: D_{90} 1 *in.*

D_{50} *in.*

GOAL: Develop confidence by matching velocities from different sources.

Velocity required to move D_{90}:	2.1	*ft./sec.*
Velocity from Cross-Section data:	3.36	*ft./sec.*
Velocity from basic field data:	3.66	*ft./sec.*
Velocity from selected Q:	3.5	*ft./sec.*

Channel Evolution Stage V Stream Type (Rosgen)

Notes

Natural Open Channel Flow

Project:	Xsec3	
Assisted by:	Wayne Kinney	
Date:	9/26/2005	
Channel Slope (***S***):	0.000960	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	7.1	*ft*

$$Q = \frac{1.486}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}}$$

assuming uniform, steady flow

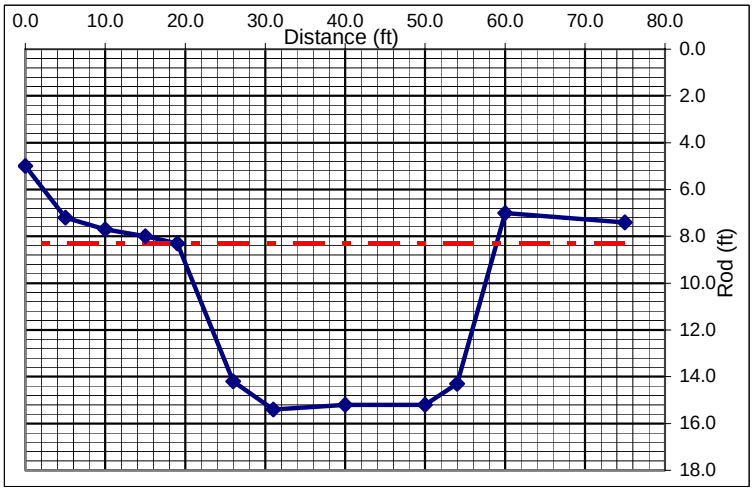
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	7.1 *ft*	8.4	
Channel Flow (***Q***):	759.6 *cfs*	824.0	
Channel Velocity:	3.4 *ft/sec*	2.8	
Cross-Sectional Area (***A***):	225.7 *sq.ft.*	292.5	
Hydraulic Radius (***R***):	5.0 *ft*	3.8	

Survey Data:

Rod *(ft)*	Distance *(ft)*
7.4	75.0
7.0	60.0
14.3	54.0
15.2	50.0
15.2	40.0
15.4	31.0
14.2	26.0
8.3	19.0
8.0	15.0
7.70	10
7.20	5
5.00	0



COMMENTS:

Stream Stabilization I & E Form

ILLINOIS NRCS - Version 2.05- modified 9/12/04 R.Book

County Montgomery T. R. Sec.

Date 9/26/2005 By Wayne Kinney

Stream Name Middle Fork Shoal Creek UTM Coord. E288451 N4349345

Landowner Name Xsec4

Drainage Area 28.28 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions	Width	55 ft.	Cross Sectional Area	217 sq. ft.
	Depth	3.9 ft.		

Reference Stream Gage:

East Fork Shoal Creek near Coffeen

Station No. 05593900 Gage Q_2 2130 cfs

Drainage Area 56 sq.mi Regression (1880 cfs

Montgomery County, IL **REFERENCE STREAM DATA ONLY**

USGS Flood-Peak Discharge Predictions:

Valley Slope: 5.9 *ft./mi. (user-entered)* Regression Q_2 1190 cfs

ft/mi (from worksheet) Rainfall 3.35 in *(2 yr, 24 hr)* Adjusted Q_2 1348 cfs

0.0011 *ft./ft.* Regional Factor 1.057 Typical Range for Bankfull Discharge:

530 to 1080 cfs

Local Stream Morphology:

Channel Description: (c) Clean, winding, some pools and shoals

Manning's "n" 0.04

Basic Field Data:

Bankfull Width	43	*ft.*	Stream Length		*ft.*
Mean Bankfull Depth	5.07	*ft.*	Valley Length		*ft.*
Width/Depth Ratio	8.48		Contour Interval		feet
			Estimated Sinuosity		
Max. Bankfull Depth	6.8	*ft.*	*Channel Slope:* Surveyed:	0.00096 *ft./ft.*	
Width at twice max. depth	1000	*ft.*	Estimated:	*ft./ft.*	
(13.6 ft.)					
Entrenchment Ratio	23.26		Radius of Curvature (Rc)		ft.
			Rc/Bankfull width:	0.00	

Bankfull Q from:

Cross-Section	685	*cfs*
Basic field data	743	*cfs*
Selected Q	714	*cfs*

Bankfull Velocity Check: *(typical Illinois streams will have average bankfull velocity between 3 and 5 ft/sec.)*

Bedload:					
D_{90}	1	*in.*	Velocity required to move D_{90}:	2.1	*ft./sec.*
D_{50}		*in.*	Velocity from Cross-Section data:	3.14	*ft./sec.*
GOAL: Develop confidence by matching			Velocity from basic field data:	3.41	*ft./sec.*
velocities from different sources.			Velocity from selected Q:	3.3	*ft./sec.*

Channel Evolution Stage V Stream Type (Rosgen)

Notes

25.24 cfs/sq. mi. --backwater effect from Glens Shoals may be a factor at this point only 2 ft.(+ or -) above normal pool

Natural Open Channel Flow

Project:	Xsec4	
Assisted by:	Wayne Kinney	
Date:	9/26/2005	
Channel Slope (***S***):	0.000960	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	6.9	*ft*

$$Q \left(\frac{1.486}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}} \right)$$

assuming uniform, steady flow

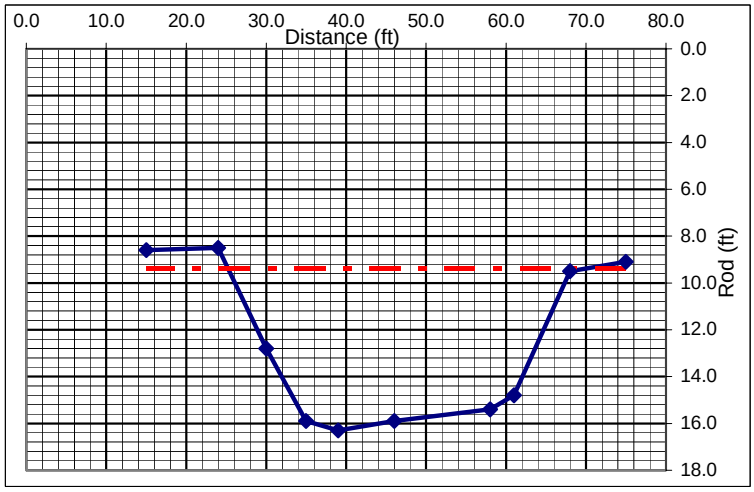
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	6.9 *ft*	7.2	
Channel Flow (***Q***):	684.6 *cfs*	705.4	
Channel Velocity:	3.1 *ft/sec*	3.0	
Cross-Sectional Area (***A***):	218.0 *sq.ft.*	232.2	
Hydraulic Radius (***R***):	4.5 *ft*	4.3	

Survey Data:

Rod *(ft)*	Distance *(ft)*
9.1	75.0
9.5	68.0
14.8	61.0
15.4	58.0
15.9	46.0
16.3	39.0
15.9	35.0
12.8	30.0
8.5	24.0
8.60	15



COMMENTS:

Stream Stabilization I & E Form

ILLINOIS NRCS - Version 2.05- modified 9/12/04 R.Book

County Montgomery T. R. Sec.

Date 9/26/2005 By Wayne Kinney

Stream Name Middle Fork Shoal Creek UTM Coord. E285440 N4339479

Landowner Name Xsec5

Drainage Area 83.85 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions	Width	84 ft.	Cross Sectional Area	453 sq. ft.
	Depth	5.4 ft.		

Reference Stream Gage:

East Fork Shoal Creek near Coffeen	Station No.	05593900	Gage Q_2	2130 cfs
	Drainage Area	56 sq.mi	Regression (	1880 cfs
Montgomery County, IL		**REFERENCE STREAM DATA ONLY**		

USGS Flood-Peak Discharge Predictions:

Valley Slope:	5.2	*ft./mi. (user-entered)*			Regression Q_2	2642 cfs
		ft/mi (from worksheet)	Rainfall	3.35 in *(2 yr, 24 hr)*	Adjusted Q_2	2993 cfs
	0.0010	*ft./ft.*	Regional Factor	1.057	Typical Range for Bankfull Discharge:	
					1190 to 2400 cfs	

Local Stream Morphology:

Channel Description: (c) Clean, winding, some pools and shoals

Manning's "n" 0.04

Basic Field Data:					
			Stream Length		*ft.*
			Valley Length		*ft.*
Bankfull Width	65	*ft.*	Contour Interval		feet
Mean Bankfull Depth	7.56	*ft.*	Estimated Sinuosity		
Width/Depth Ratio	8.60				
			Channel Slope:		Bankfull Q from:
Max. Bankfull Depth	10.2	*ft.*	Surveyed:	0.00071 *ft./ft.*	Cross-Section 1750 *cfs*
Width at twice max. depth	1200	*ft.*	Estimated:	*ft./ft.*	Basic field data 1880 *cfs*
(20.4 ft.)					Selected Q 1815 *cfs*
Entrenchment Ratio	18.46		Radius of Curvature (Rc)		ft.
			Rc/Bankfull width:	0.00	

Bankfull Velocity Check: *(typical Illinois streams will have average bankfull velocity between 3 and 5 ft/sec.)*

Bedload:	D_{90}	2 *in.*	Velocity required to move D_{90}:	2.9 *ft./sec.*
	D_{50}	*in.*	Velocity from Cross-Section data:	3.56 *ft./sec.*
GOAL: Develop confidence by matching			Velocity from basic field data:	3.83 *ft./sec.*
velocities from different sources.			Velocity from selected Q:	3.7 *ft./sec.*

Channel Evolution Stage IV Stream Type (Rosgen)

Notes

21.65 cfs/sq. mi.

Natural Open Channel Flow

Project:	Xsec5	
Assisted by:	Wayne Kinney	
Date:	9/26/2005	
Channel Slope (***S***):	0.000710	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	10.2	*ft*

$$Q \div \frac{1.486}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}}$$

assuming uniform, steady flow

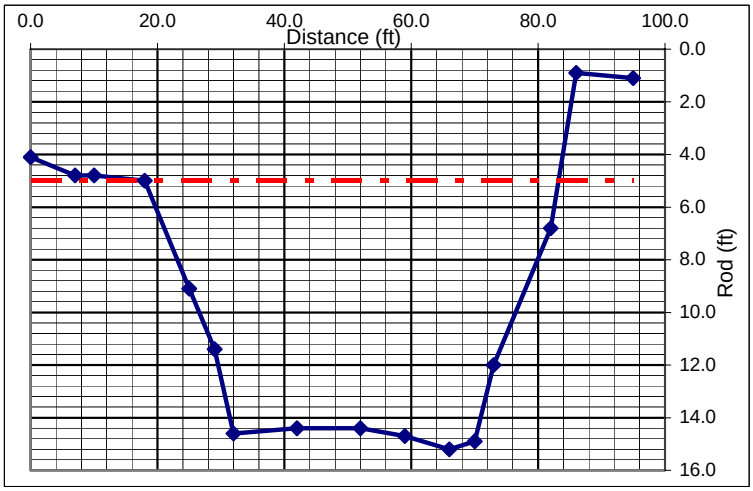
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	10.2 *ft*	11.1	
Channel Flow (***Q***):	1,750.2 *cfs*	1,867.0	
Channel Velocity:	3.6 *ft/sec*	3.3	
Cross-Sectional Area (***A***):	491.1 *sq.ft.*	561.0	
Hydraulic Radius (***R***):	6.8 *ft*	6.2	

Survey Data:

Rod *(ft)*	Distance *(ft)*
4.1	0.0
4.8	7.0
4.8	10.0
5.0	18.0
9.1	25.0
11.4	29.0
14.6	32.0
14.4	42.0
14.4	52.0
14.70	59
15.20	66
14.90	70
12.00	73
6.80	82
0.90	86
1.1	95



COMMENTS:
Principle spillway--Glen Shoals discharge =2466 cfs
or 29.4 cfs/sq. mi.

Stream Stabilization I & E Form

ILLINOIS NRCS - Version 2.05- modified 9/12/04 R.Book

County Montgomery T. R. Sec.

Date 9/26/2005 By Wayne Kinney

Stream Name Middle Fork Shoal Creek UTM Coord. E284365 N4338197

Landowner Name Xsec6

Drainage Area 88.75 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions	Width	86 ft.	Cross Sectional Area	471 sq. ft.
	Depth	5.5 ft.		

Reference Stream Gage:

East Fork Shoal Creek near Coffeen	Station No.	05593900	Gage Q_2	2130 cfs
	Drainage Area	56 sq.mi	Regression (	1880 cfs
Montgomery County, IL		**REFERENCE STREAM DATA ONLY**		

USGS Flood-Peak Discharge Predictions:

Valley Slope:	5.2	*ft./mi. (user-entered)*				Regression Q_2	2763 cfs
		ft/mi (from worksheet)	Rainfall	3.35 in	*(2 yr, 24 hr)*	Adjusted Q_2	3130 cfs
	0.0010	*ft./ft.*	Regional Factor	1.057		Typical Range for Bankfull Discharge:	
						1250 to 2510 cfs	

Local Stream Morphology:

Channel Description: (c) Clean, winding, some pools and shoals

Manning's "n" 0.04

Basic Field Data:					
			Stream Length		*ft.*
			Valley Length		*ft.*
Bankfull Width	64	*ft.*	Contour Interval		feet
Mean Bankfull Depth	8.45	*ft.*	Estimated Sinuosity		
Width/Depth Ratio	7.57				
			Channel Slope:		Bankfull Q from:
Max. Bankfull Depth	10.9	*ft.*	Surveyed:	0.00071 *ft./ft.*	Cross-Section 1968 *cfs*
Width at twice max. depth	1500	*ft.*	Estimated:	*ft./ft.*	Basic field data 2228 *cfs*
(21.8 ft.)					Selected Q 2098 *cfs*
Entrenchment Ratio	23.44		Radius of Curvature (Rc)		ft.
			Rc/Bankfull width:	0.00	

Bankfull Velocity Check: *(typical Illinois streams will have average bankfull velocity between 3 and 5 ft/sec.)*

Bedload:	D_{90}	1 *in.*	Velocity required to move D_{90}:	2.1 *ft./sec.*
	D_{50}	*in.*	Velocity from Cross-Section data:	3.64 *ft./sec.*
GOAL: Develop confidence by matching			Velocity from basic field data:	4.12 *ft./sec.*
velocities from different sources.			Velocity from selected Q:	3.9 *ft./sec.*

Channel Evolution Stage IV Stream Type (Rosgen)

Notes

24.33 cfs/sq. mi.

Natural Open Channel Flow

Project:	Xsec6	
Assisted by:	Wayne Kinney	
Date:	9/26/2005	
Channel Slope (***S***):	0.000710	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	10.9	*ft*

$$Q \blacklozenge \frac{1.486}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}}$$

assuming uniform, steady flow

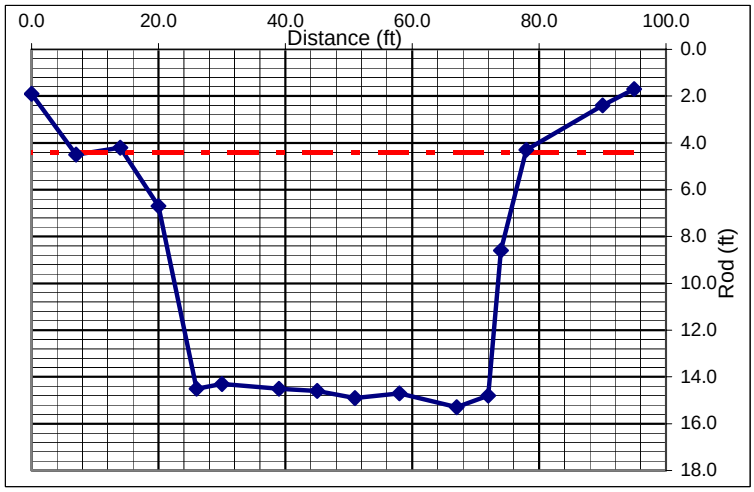
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	10.9 *ft*	13.4	
Channel Flow (***Q***):	1,968.2 *cfs*	2,724.5	
Channel Velocity:	3.6 *ft/sec*	3.7	
Cross-Sectional Area (***A***):	540.9 *sq.ft.*	745.3	
Hydraulic Radius (***R***):	7.0 *ft*	7.1	

Survey Data:

Rod *(ft)*	Distance *(ft)*
1.7	95.0
2.4	90.0
4.3	78.0
8.6	74.0
14.8	72.0
15.3	67.0
14.7	58.0
14.9	51.0
14.6	45.0
14.50	39
14.30	30
14.50	26
6.70	20
4.20	14
4.50	7
1.9	0



COMMENTS:

Stream Stabilization I & E Form

ILLINOIS NRCS - Version 2.05- modified 9/12/04 R.Book

County Montgomery T. R. Sec.

Date 9/26/2005 By Wayne Kinney

Stream Name Middle Fork Shoal Creek UTM Coord. E282913 N4335280

Landowner Name Xsec7

Drainage Area 102.25 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions	Width	91 ft.	Cross Sectional Area	518	sq. ft.
	Depth	5.7 ft.			

Reference Stream Gage:

East Fork Shoal Creek near Coffeen	Station No.	05593900	Gage Q_2	2130 cfs
	Drainage Area	56 sq.mi	Regression (	1880 cfs
Montgomery County, IL		**REFERENCE STREAM DATA ONLY**		

USGS Flood-Peak Discharge Predictions:

Valley Slope:	5.1	*ft./mi. (user-entered)*			Regression Q_2	3061 cfs
		ft/mi (from worksheet)	Rainfall	3.35 in *(2 yr, 24 hr)*	Adjusted Q_2	3468 cfs
	0.0010	*ft./ft.*	Regional Factor	1.057	Typical Range for Bankfull Discharge:	
					1380	to 2780 cfs

Local Stream Morphology:

Channel Description: (c) Clean, winding, some pools and shoals

Manning's "n" 0.04

			Stream Length		*ft.*
Basic Field Data:			Valley Length		*ft.*
Bankfull Width	77	*ft.*	Contour Interval		feet
Mean Bankfull Depth	7.28	*ft.*	Estimated Sinuosity		
Width/Depth Ratio	10.58				
			Channel Slope:		Bankfull Q from:
Max. Bankfull Depth	11.3	*ft.*	Surveyed:	0.00071 *ft./ft.*	Cross-Section 1827 *cfs*
Width at twice max. depth	1500	*ft.*	Estimated:	*ft./ft.*	Basic field data 2091 *cfs*
(22.6 ft.)					Selected Q 1959 *cfs*
Entrenchment Ratio	19.48		Radius of Curvature (Rc)		ft.
			Rc/Bankfull width:	0.00	

Bankfull Velocity Check: *(typical Illinois streams will have average bankfull velocity between 3 and 5 ft/sec.)*

Bedload:	D_{90}	2 *in.*	Velocity required to move D_{90}:	2.9	*ft./sec.*
	D_{50}	*in.*	Velocity from Cross-Section data:	3.26	*ft./sec.*
GOAL: Develop confidence by matching			Velocity from basic field data:	3.73	*ft./sec.*
velocities from different sources.			Velocity from selected Q:	3.5	*ft./sec.*

Channel Evolution Stage VI Stream Type (Rosgen)

Notes

19.16 cfs/sq. mi.

Natural Open Channel Flow

Project:	Xsec7	
Assisted by:	Wayne Kinney	
Date:	9/26/2005	
Channel Slope (***S***):	0.000710	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:		*ft*

$$Q \equiv \frac{1.486}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}}$$

assuming uniform, steady flow

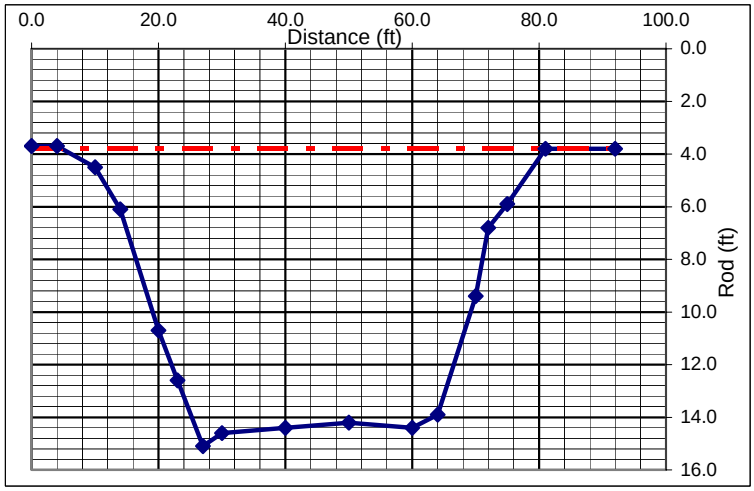
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	11.3 *ft*	11.3	
Channel Flow (***Q***):	1,826.7 *cfs*	1,826.7	
Channel Velocity:	3.3 *ft/sec*	3.3	
Cross-Sectional Area (***A***):	560.4 *sq.ft.*	560.4	
Hydraulic Radius (***R***):	6.0 *ft*	6.0	

Survey Data:

Rod *(ft)*	Distance *(ft)*
3.7	0.0
3.7	4.0
4.5	10.0
6.1	14.0
10.7	20.0
12.6	23.0
15.1	27.0
14.6	30.0
14.4	40.0
14.20	50
14.40	60
13.90	64
9.40	70
6.80	72
5.90	75
3.8	81
3.8	92



COMMENTS:

Stream Stabilization I & E Form

ILLINOIS NRCS - Version 2.05- modified 9/12/04 R.Book

County Montgomery T. R. Sec.

Date 9/26/2005 By Wayne Kinney

Stream Name Middle Fork Shoal Creek UTM Coord. E282435 N4332047

Landowner Name Xsec8

Drainage Area 105.83 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions	Width	92 ft.	Cross Sectional Area	531 sq. ft.
	Depth	5.8 ft.		

Reference Stream Gage:

East Fork Shoal Creek near Coffeen	Station No.	05593900	Gage Q_2	2130 cfs
	Drainage Area	56 sq.mi	Regression (	1880 cfs
Montgomery County, IL		**REFERENCE STREAM DATA ONLY**		

USGS Flood-Peak Discharge Predictions:

Valley Slope:	5.0	*ft./mi. (user-entered)*			Regression Q_2	3116 cfs
		ft/mi (from worksheet)	Rainfall	3.35 in *(2 yr, 24 hr)*	Adjusted Q_2	3530 cfs
	0.0009	*ft./ft.*	Regional Factor	1.057	Typical Range for Bankfull Discharge:	
					1410	to 2830 cfs

Local Stream Morphology:

Channel Description: (c) Clean, winding, some pools and shoals

Manning's "n" 0.04

			Stream Length		*ft.*
Basic Field Data:			Valley Length		*ft.*
Bankfull Width	57	*ft.*	Contour Interval		feet
Mean Bankfull Depth	8.19	*ft.*	Estimated Sinuosity		
Width/Depth Ratio	6.96				
			Channel Slope:		Bankfull Q from:
Max. Bankfull Depth	10.2	*ft.*	Surveyed:	0.00042 *ft./ft.*	Cross-Section 1116 *cfs*
Width at twice max. depth	2000	*ft.*	Estimated:	*ft./ft.*	Basic field data 1449 *cfs*
(20.4 ft.)					Selected Q 1282 *cfs*
Entrenchment Ratio	35.09		Radius of Curvature (Rc)		ft.
			Rc/Bankfull width:	0.00	

Bankfull Velocity Check: *(typical Illinois streams will have average bankfull velocity between 3 and 5 ft/sec.)*

Bedload:	D_{90}	1 *in.*	Velocity required to move D_{90}:	2.1	*ft./sec.*
	D_{50}	*in.*	Velocity from Cross-Section data:	2.39	*ft./sec.*
GOAL: Develop confidence by matching			Velocity from basic field data:	3.10	*ft./sec.*
velocities from different sources.			Velocity from selected Q:	2.7	*ft./sec.*

Channel Evolution Stage III Stream Type (Rosgen)

Notes

12.11 cfs/sq. mi.

Natural Open Channel Flow

Project:	Xsec8	
Assisted by:	Wayne Kinney	
Date:	9/26/2005	
Channel Slope (***S***):	0.000420	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:		*ft*

$$Q \approx \frac{1.486}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}}$$

assuming uniform, steady flow

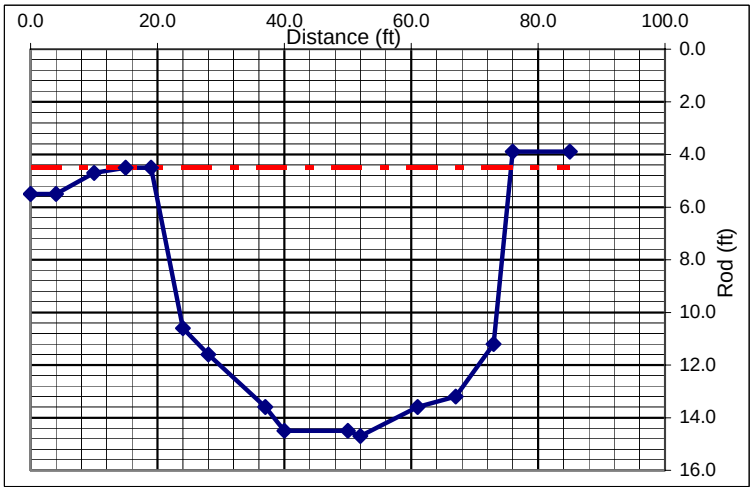
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	10.2 *ft*	10.2	
Channel Flow (***Q***):	1,115.8 *cfs*	1,115.8	
Channel Velocity:	2.4 *ft/sec*	2.4	
Cross-Sectional Area (***A***):	467.2 *sq.ft.*	467.2	
Hydraulic Radius (***R***):	5.6 *ft*	5.6	

Survey Data:

Rod *(ft)*	Distance *(ft)*
5.5	0.0
5.5	4.0
4.7	10.0
4.5	15.0
4.5	19.0
10.6	24.0
11.6	28.0
13.6	37.0
14.5	40.0
14.50	50
14.70	52
13.60	61
13.20	67
11.20	73
3.90	76
3.9	85



COMMENTS: