AERIAL ASSESSMENT REPORT FOR SUGAR CREEK

EDGAR COUNTY

SEPTEMBER 2005

Prepared by Wayne Kinney for IL. Dept. of Agriculture

TetraTech, Inc. reported the status of TMDL development for Sugar Creek in a stage one report dated April, 2005. Both Paris Twin West Lake and Paris Twin East Lake are impaired by Total Phosphorus, Excessive Algal Growth and Total Suspended Solids (TSS). Segment BMC2 of 2.9 miles immediately below Paris Twin Lakes is impaired by Dissolved Oxygen, Sedimentation/Siltation and other unspecified nutrients. Segment BM02, which is the lower 12.9 miles to the Illinois-Indiana line, is impaired by Pathogens.

Assessment Procedure

Low level geo-referenced video was taken of Sugar 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 the Illinois-Indiana State Line. The mapping progressed upstream to Paris Twin Lakes continued for approximately 1 mile above the lakes. Aerial video of tributaries was not part of the project, regardless of the stream size or vegetation.

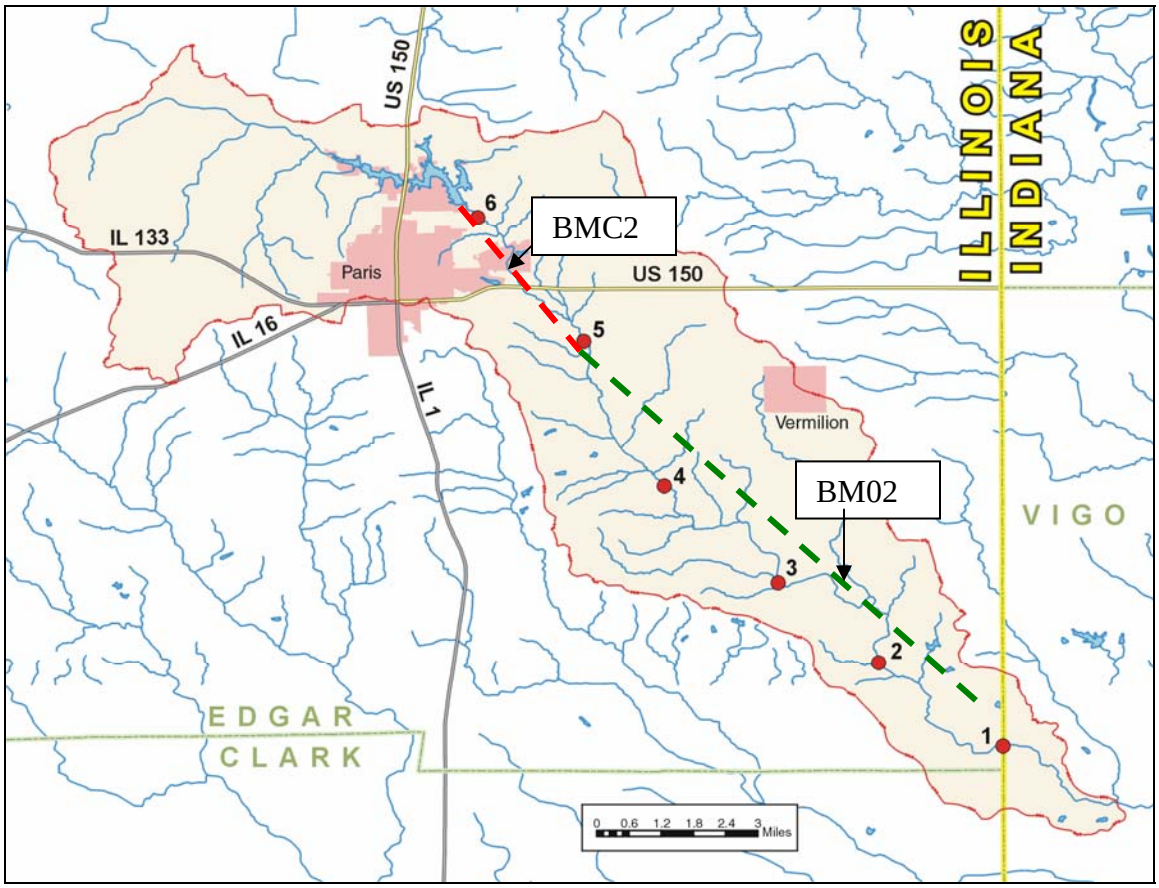


Fig. 1 Aerial Assessment Map of Sugar Creek

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.

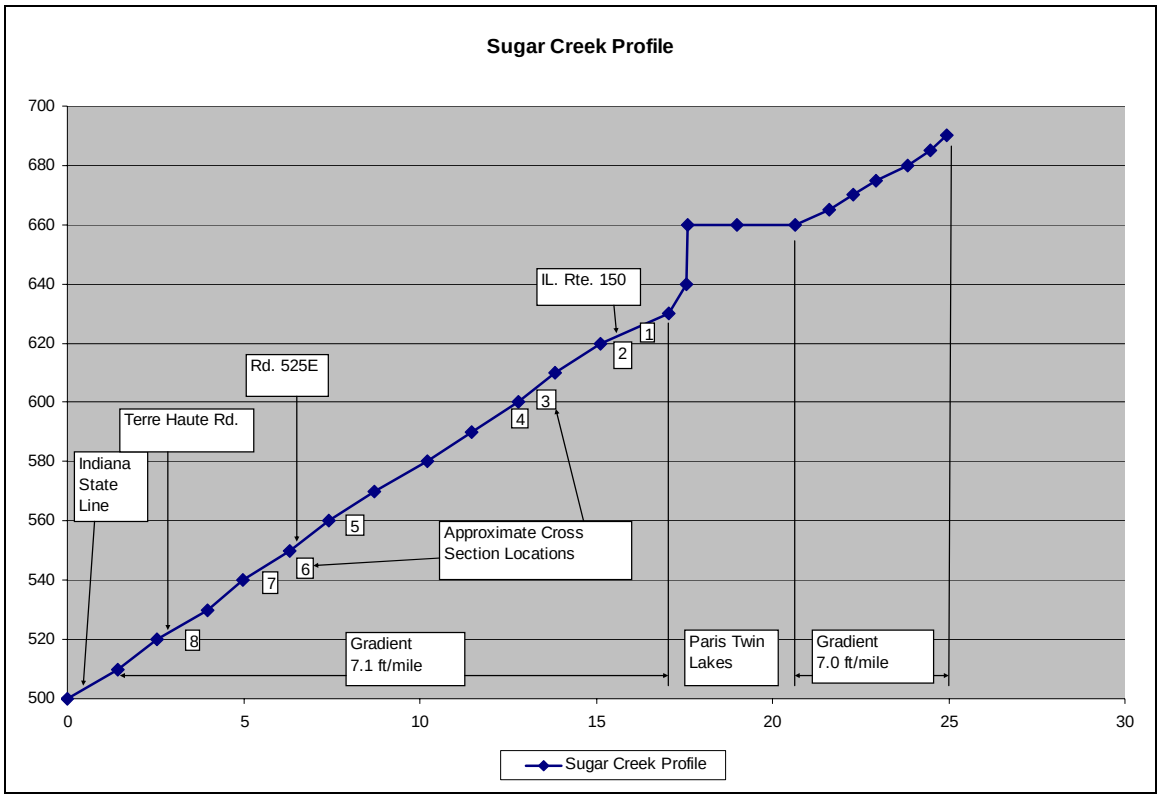


Figure 2 Channel Profile of Sugar Creek

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 Sugar Creek--Edgar County				
DVD Disc	DVD chapter	Beginning Time	Report Chapter	Cross Sections
1	2	5:00	1	8
1	3	10:00	2	6,7
1	4	15:00	3	5
1	5	20:00	4	3,4
1	6	25:00	5	1,2
1	7	30:00	6	

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”.

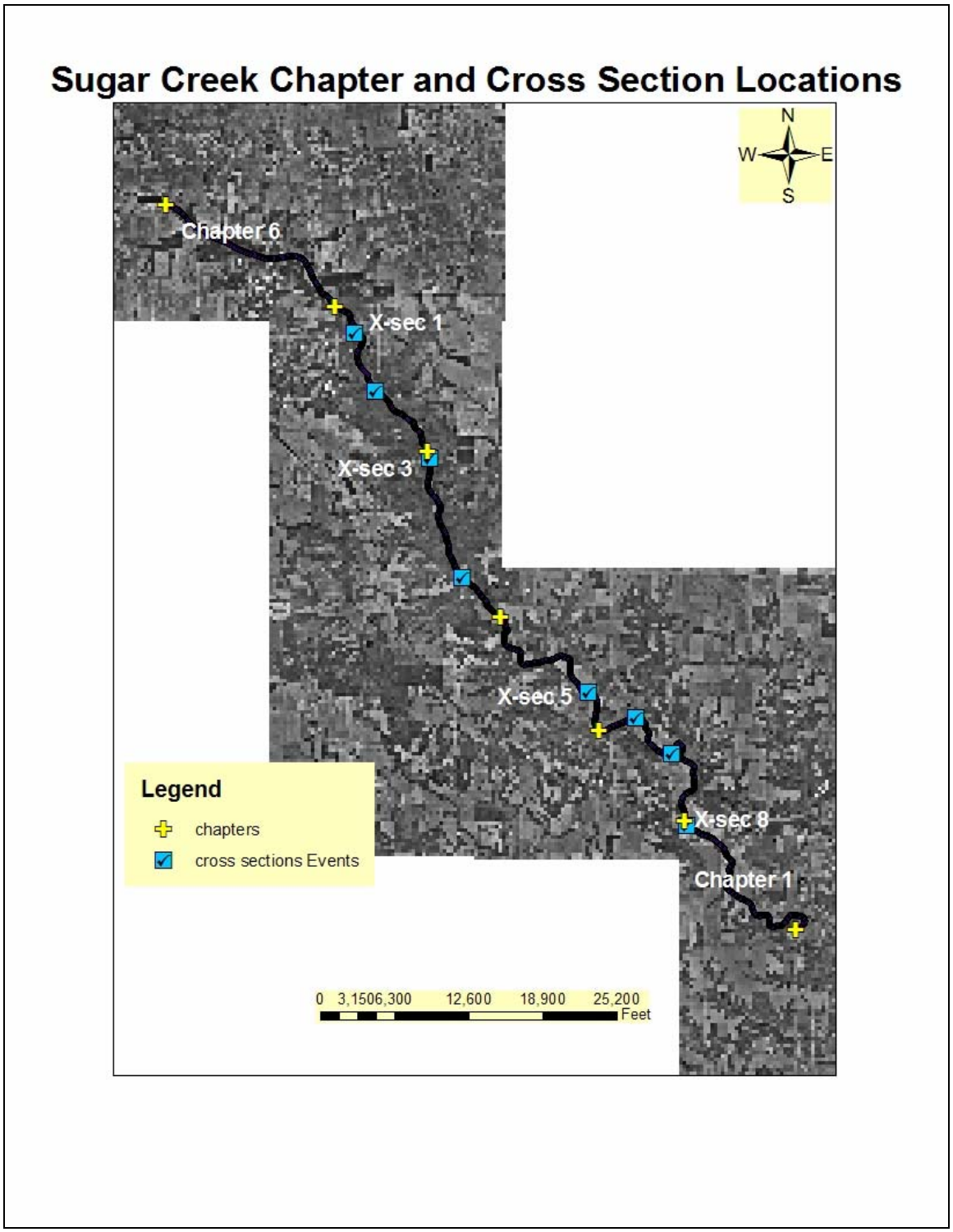


Fig. 4 Chapter Division and Cross Section locations

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								
SUGAR CREEK								
CHAPTER	ROCK OUTCROP	LOGJAM	GEOTECH FAILURE	DEPOSITION	BED CONTROL	BREAK POINT	EROSION	SEVERE EROSION
1	1	4	4	5	0	6	24	0
2	1	0	7	10	2	17	11	0
3	2	1	6	9	0	15	27	3
4	2	7	2	1	0	2	40	5
5	2	4	2	5	0	5	25	3
6	0	1	1	0	0	0	10	0
TOTALS	8	17	22	30	2	45	137	11

Table 1 Features by Chapter Identified with Aerial Assessment

Eight cross sections were taken at selected locations on Sugar 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. 11 thru 17. Exact locations as Eastings and Northings and more detail can be found in Appendix A.

Cross Section Data --Sugar Creek, Edgar County, IL														
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	442861	4385712	23	7.7	1311	985	55	4.76	11.6	3.8	2	4	42.83	0.75
2	443381	4384205	25.5	7.7	1423	1097	67	4.53	14.8	3.6	2	5	43.02	0.77
3	444806	4382467	31.5	6.9	1595	1050	50	5.28	9.47	4	3	5	33.33	0.66
4	445630	4379397	39.4	7.3	1956	1301	60	5.36	11.2	4	2	4	33.02	0.67
5	448902	4376418	46.2	7.2	2299	1341	62	5.33	11.6	4.1	4	4	29.03	0.58
6	450135	4375769	49.8	7.4	2368	1412	59	5.71	10.3	4.2	6	5	28.35	0.60
7	451081	4374826	50.6	7.6	2429	1510	64	5.58	11.5	4	1	5	29.84	0.62
8	451472	4372978	58.9	7.6	2739	1663	88	4.91	17.9	3.8	4	4	28.23	0.61

Table 2 Cross Section Summary

Fig. 5 Channel changes due to large sand deposits and lateral erosion (Chapter 1)

Fig. 6 Large point bar developing as lateral migration destroys riparian zone and encroaches on cropland

Fig. 7 Large cobble for stable riffles in Chapter 1 and 2

Fig. 8 Concrete ford with 3-4 ft. overfall on Road S625

General Observations

1. Flow data is not available for any streams in Edgar or Clark counties; therefore the 2 yr. discharge from Bluegrass Creek in Vermillion Co. at Potomic has been used as a guide. This stream has a similar valley slope and slightly smaller drainage area but is located approximately 50 miles away in a different hydrologic group and should not be relied on for flow determinations.
2. Sugar Creek appears to be a stream driven predominantly by bedload rather than by flow.
3. Large sandy unvegetated point bars are found on almost every bend in segment BM02 (chapters 1 thru 4) indicating severe lateral erosion. The streambank erosion is therefore suspected to be a major contributor of the sand bedload and wash load found in this segment.
4. Several large escarpments 40 to 50 ft. high may be contributing a disproportional amount of material to the stream.
5. Sugar creek has large sections of very wide shallow flow with an absence of deeper pools.
6. Large cobble bedload has formed stable riffles in many locations, they are most often found on the aerial assessment feature list as “breakpoints”. Therefore downcutting is not believed to be a significant problem. However, two concrete fords on public roads are maintained with 3 to 4 ft. overfalls downstream. It is uncertain if the overfalls are a result of downcutting below the fords, or if the fords have been elevated to create the overfalls.
7. Stream Barbs are recommended as the primary lateral bank treatment for erosion control in combination with limited amounts of Stone Toe Protection. No grade control is recommended for BM02.
8. Rock Riffle Grade Control structures may be used in BMC2 (chapter 5 and 6) as re-aeration structures to improve DO levels. Riffles will be limited in height to approximately 1.5 ft. to prevent increased flooding or backwater.
9. The aerial assessment extends only a short distance above Paris Twin Lake West, therefore this report does not adequately address the streambank contributions of Sugar Creek above the Paris Twin Lakes.

Fig. 9 Large escarpment in Chapter 3

Fig. 10 Downstream lateral migration resulting in unstable planform and eminent cutoffs

Recommendations—Chapter 1-4

This segment has very heavy bedload with large point bars, mid channel bars and some tortuous channel meanders as a result of downstream migration the meanders. Lateral migration and failing banks are contributing large sediment loads and mature trees are undermined and falling into channel resulting in formation of numerous logjams.

While this segment is impaired only by pathogens, it is a very unstable channel with long shallow sediment/sand waves that tend to drive flow into the eroding banks accelerating the lateral bank movement even more. The recommended treatment for these chapters is to address the lateral migration with a combination of Stream Barbs and Stone Toe Protection to reduce sediment entering the channel from streambank erosion and encourage redevelopment of natural riffles and pools as sediment loads come into balance with flow. The estimated quantities and cost are provided in Table 3.

`	TREATMENT --CHAPTERS 1 THRU 4				
	Lateral Bank Protection				
Chapter	Erosion Sites	Average Length(ft)	Total Length	Average Cost/foot	Total Cost
1	24	500	12000	$25.00	$300,000.00
2	11	400	4400	$25.00	$110,000.00
3	27	300	8100	$25.00	$202,500.00
4	40	300	12000	$25.00	$300,000.00
Total	102		36500		$912,500.00

Table 3 Treatment recommendations for Chapters 1 through 4

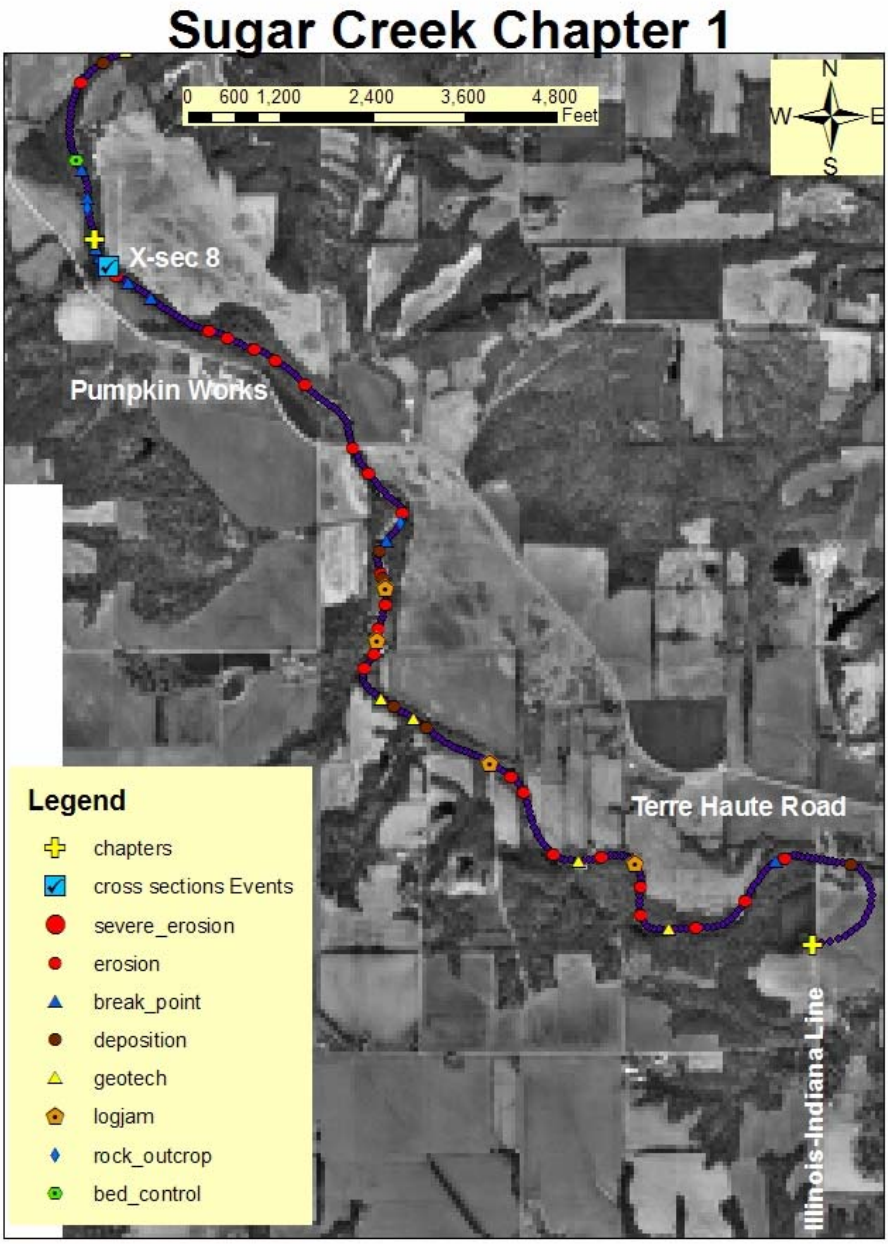


Fig. 11 Chapter 1

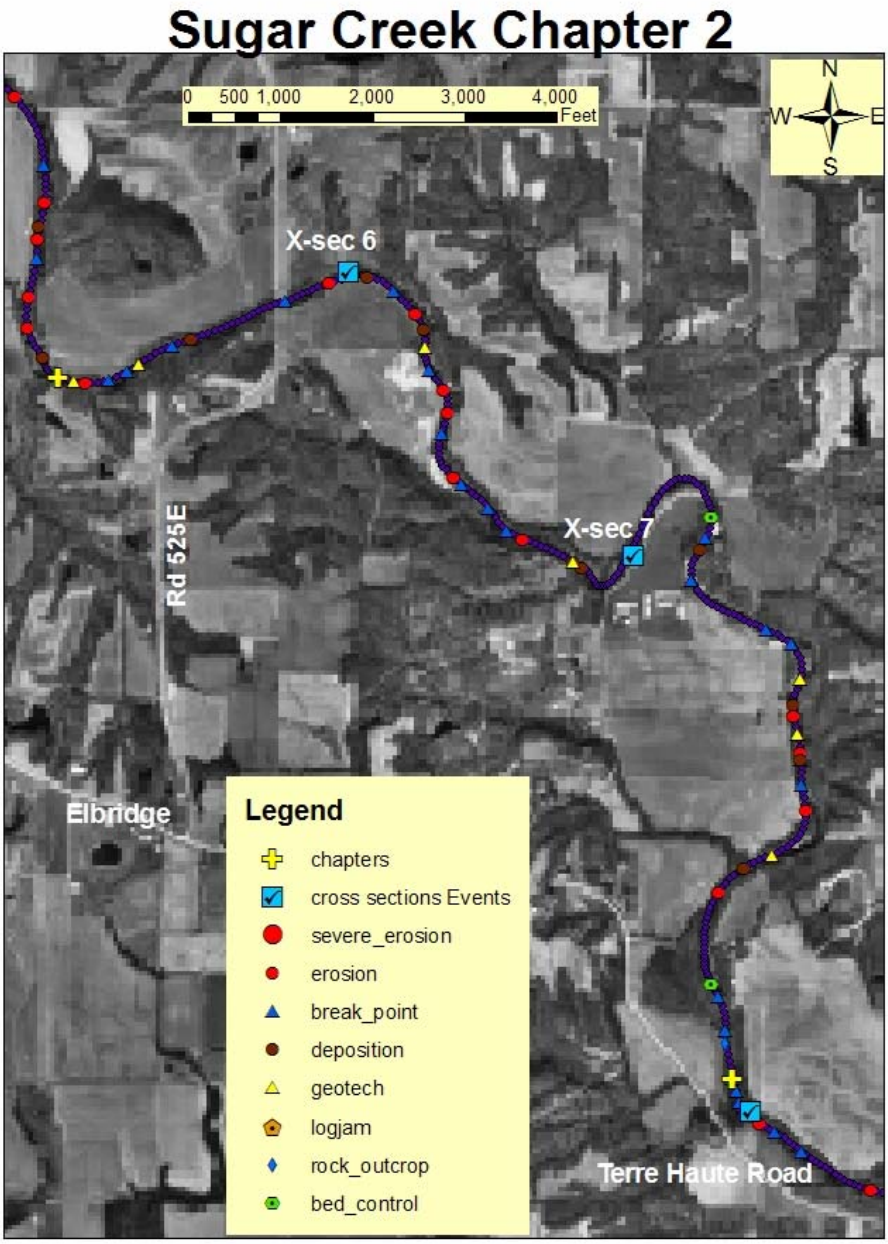


Fig. 12 Chapter 2

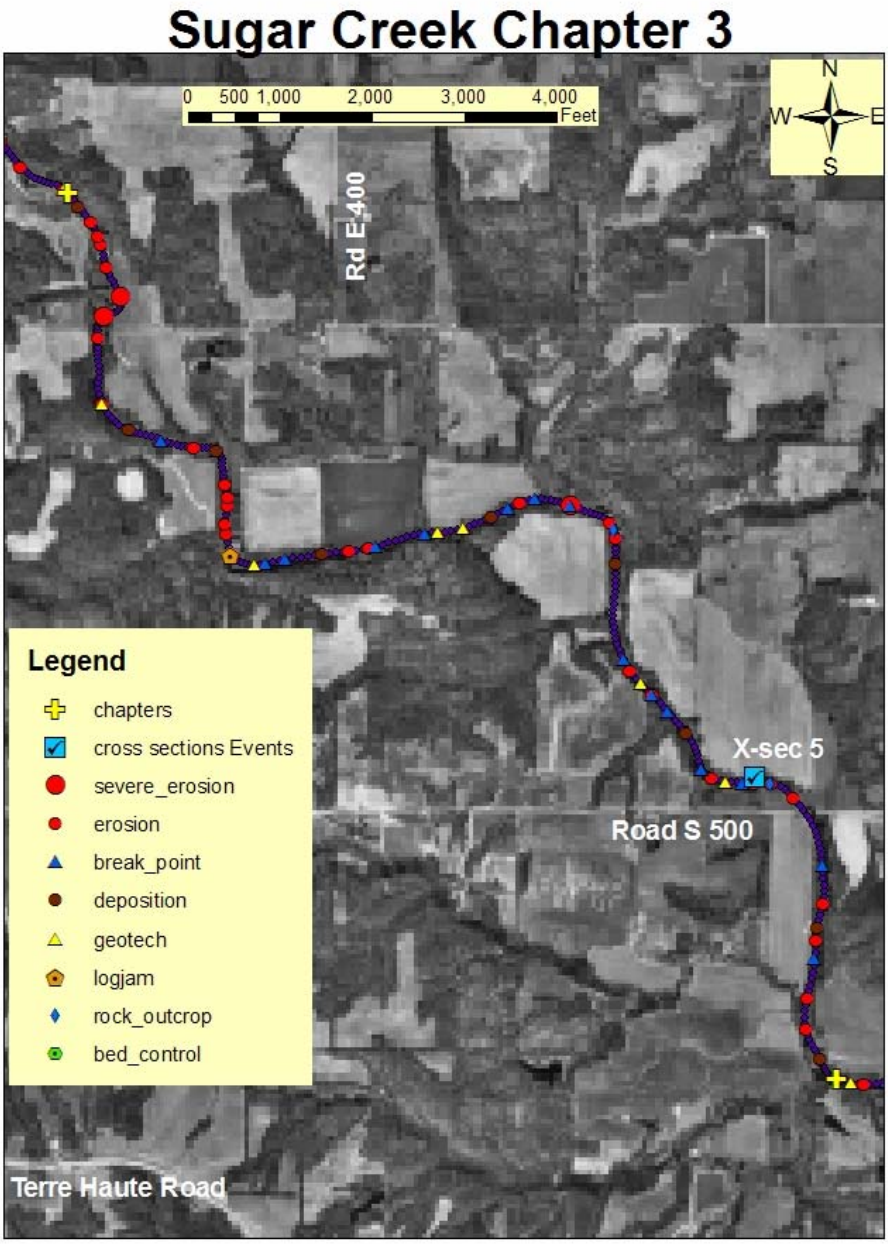


Fig. 13 Chapter 3

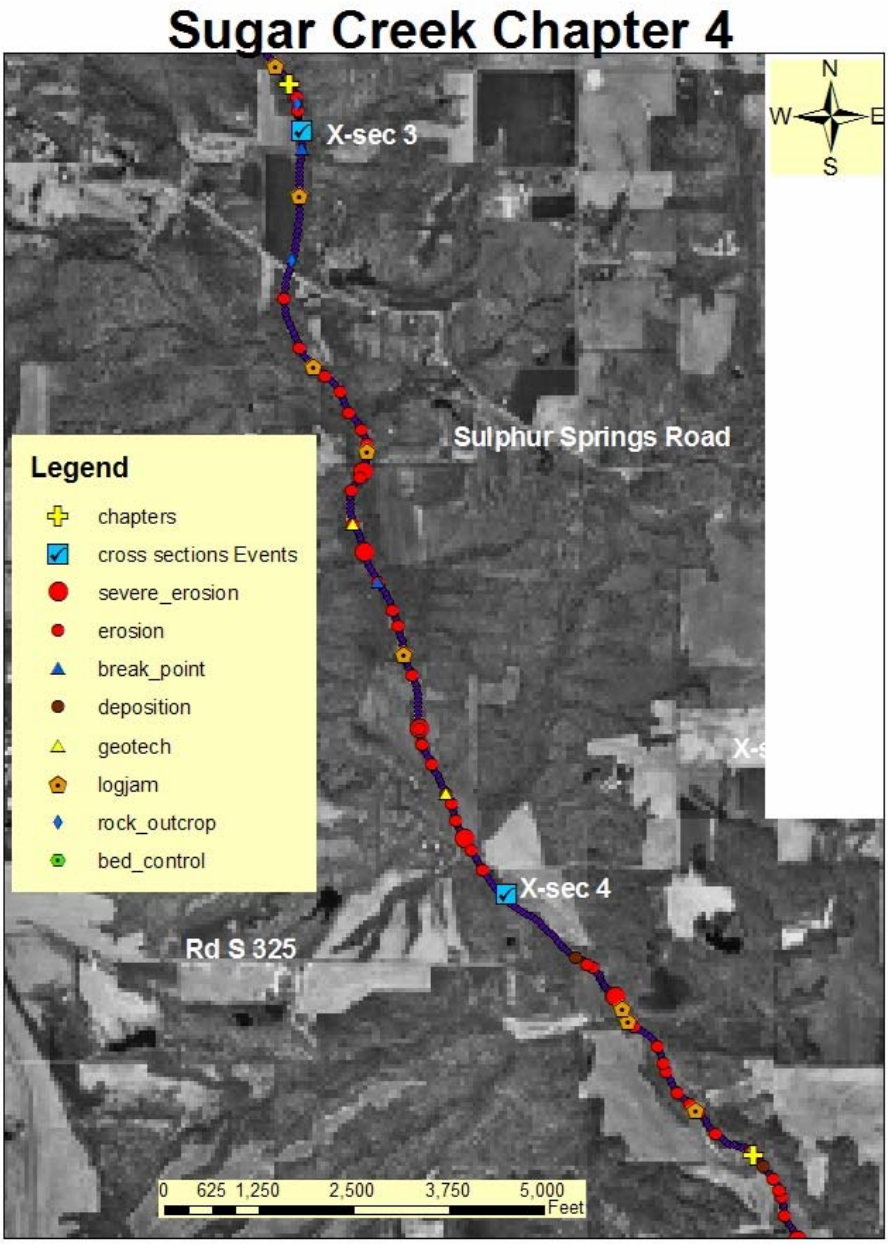


Fig. 14 Chapter 4

Fig. 15 Low water crossing on Rd. S625 with 3-4 ft. overfall (Chapter 2)

Recommendation—Chapter 5 and 6

This segment has significantly less erosion with less rapid lateral migration. Chapters 5 and 6 correspond to segment BMC2 which is impaired by low DO and sedimentation/siltation. Chapter 6 also includes the short section above Paris Twin West Lake to the point where Sugar Creek becomes a man-made drainage ditch.
The recommended treatment for this segment is to install Rock Riffle Grade Control Structures to increase turbulence and re-aeration to assist with the DO impairment. Additionally there will be a need for streambank stabilization treatment between riffles, although the recommendation is to begin installation with the Rock Riffles and monitor results before determining the need for bank stabilization. Table 4 includes all streambank treatment identified in the aerial assessment; however Rock Riffle can be expected to reduce this need significantly by creating a riffle-pool sequence to dissipate energy that now attacks the eroding banks. Table 4 presents the estimated quantities and cost of treatment for this segment.

TREATMENT --CHAPTERS 5 through 6					
Lateral Bank Treatment					
Chapter	Erosion Sites	Average Length(ft)	Total Length	Average Cost/foot	Total Cost
5	25	250	6250	$25.00	$156,250.00
6	10	250	2500	$25.00	$62,500.00
Total	**35**		**8750**		**$218,750.00**
Rock Riffle Grade Control					
	Rock Riffles	Average Tonnage	Ave. Cost Ton	Average Cost/Riffle	
5	46	250	$30.00	$7,500.00	$345,000.00
6	5	250	$30.00	$7,500.00	$37,500.00
Total	**51**				$382,500.00

Table 4 Treatment recommendations Chapters 5 and 6

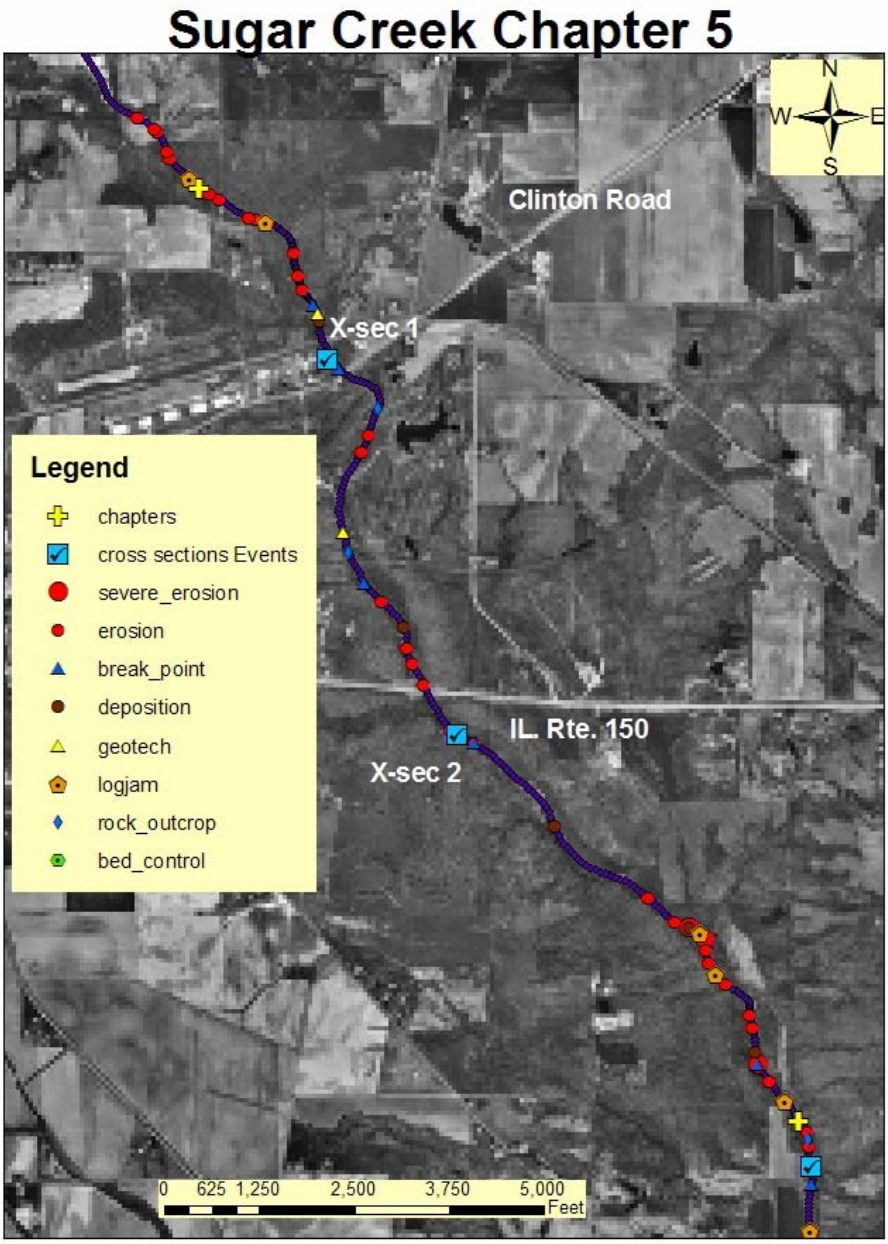


Fig. 16 Chapter 5

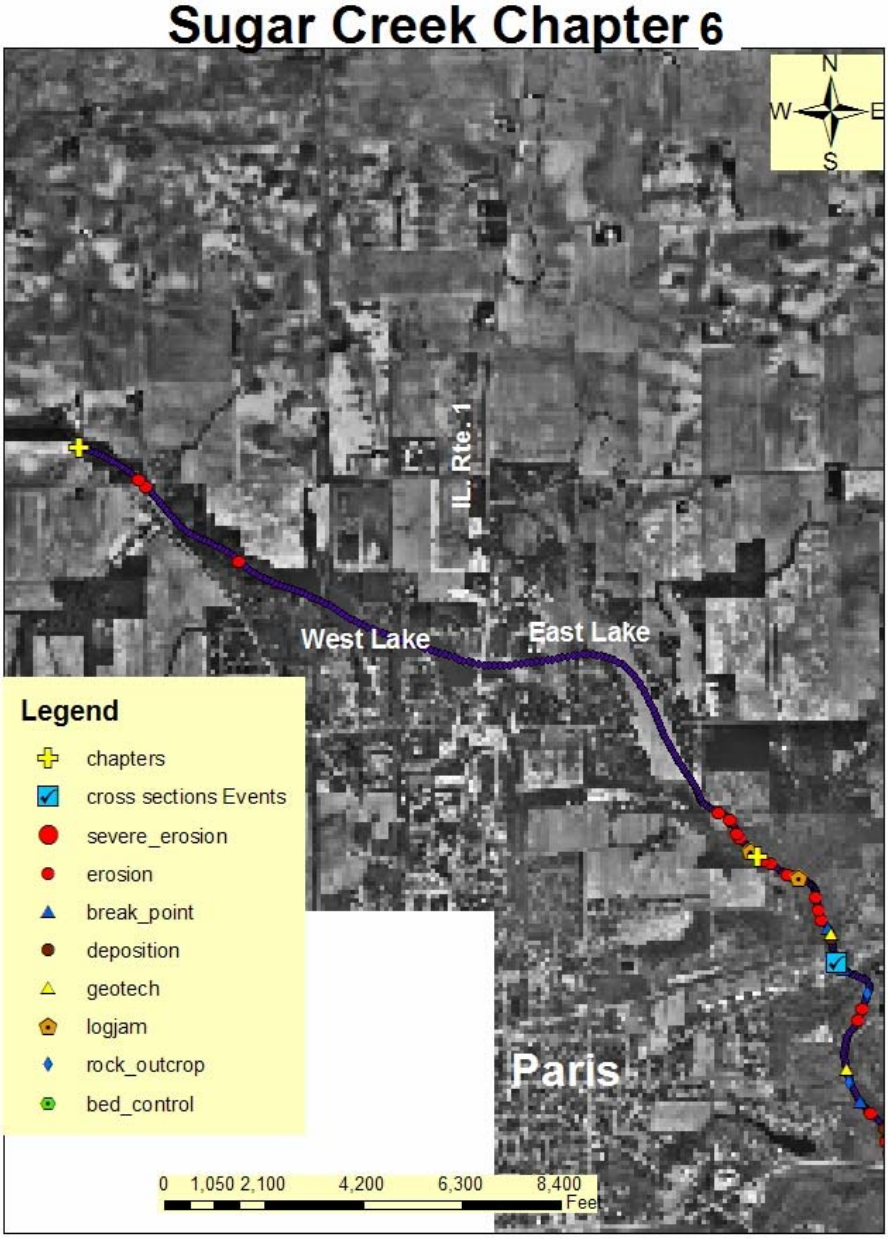


Fig. 17 Chapter 6

APPENDIX A

CROSS SECTION DATA

Stream Stabilization I & E Form

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

County Vermilion T. R. Sec.

Date 9/16/2005 By Wayne Kinney

Stream Name Sugar Creek UTM Coord. E442861 N4385712

Landowner Name X-sec 1

Drainage Area 23 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions Width 51 ft. Cross Sectional Area 189 sq. ft.

Depth 3.7 ft.

Reference Stream Gage:

Bluegrass Creek at Potomac Station No. 03336500 Gage Q_2 1850 cfs

Drainage Area 35 sq.mi Regression (1060 cfs

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

USGS Flood-Peak Discharge Predictions:

Valley Slope: 7.7 *ft./mi. (user-entered)* Regression Q_2 751 cfs

ft/mi (from worksheet) Rainfall 2.95 in *(2 yr, 24 hr)* Adjusted Q_2 1311 cfs

0.0015 *ft./ft.* Regional Factor 1.057 Typical Range for Bankfull Discharge:

520 to 1050 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 55 *ft.* Contour Interval feet

Mean Bankfull Depth 4.76 *ft.* Estimated Sinuosity

Width/Depth Ratio 11.55

Channel Slope: Bankfull Q from:

Max. Bankfull Depth 6.4 *ft.* Surveyed: 0.00132 *ft./ft.* Cross-Section 966 *cfs*

Width at twice max. depth 250 *ft.* Estimated: *ft./ft.* Basic field data 1003 *cfs*

(12.8 ft.) Selected Q 985 *cfs*

Entrenchment Ratio 4.55 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: 3.69 *ft./sec.*

GOAL: Develop confidence by matching Velocity from basic field data: 3.83 *ft./sec.*

velocities from different sources. Velocity from selected Q: 3.8 *ft./sec.*

Channel Evolution Stage IV Stream Type (Rosgen)

Notes

42.8 cfs/sq. mi.

Natural Open Channel Flow

Project:	X-sec 1	
Assisted by:	Wayne Kinney	
Date:	9/16/2005	
Channel Slope (***S***):	0.001320	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	6.9	*ft*

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

assuming uniform, steady flow

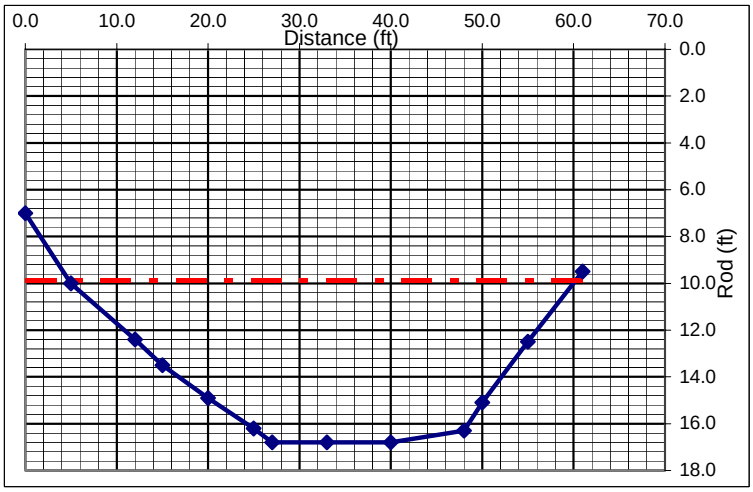
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	6.9 *ft*	7.3	
Channel Flow (***Q***):	965.8 *cfs*	1,086.8	
Channel Velocity:	3.7 *ft/sec*	3.8	
Cross-Sectional Area (***A***):	262.0 *sq.ft.*	284.4	
Hydraulic Radius (***R***):	4.5 *ft*	4.8	

Survey Data:

Rod *(ft)*	Distance *(ft)*
7.0	0.0
10.0	5.0
12.4	12.0
13.5	15.0
14.9	20.0
16.2	25.0
16.8	27.0
16.8	33.0
16.8	40.0
16.30	48
15.10	50
12.50	55
9.50	61



COMMENTS:

Stream Stabilization I & E Form

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

County Vermilion T. R. Sec.

Date 9/16/2005 By Wayne Kinney

Stream Name Sugar Creek UTM Coord. E443381 N4384205

Landowner Name X-sec 2

Drainage Area 25.5 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions Width 53 ft. Cross Sectional Area 202 sq. ft.

Depth 3.8 ft.

Reference Stream Gage:

Bluegrass Creek at Potomac Station No. 03336500 Gage Q_2 1850 cfs

Drainage Area 35 sq.mi Regression (1060 cfs

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

USGS Flood-Peak Discharge Predictions:

Valley Slope: 7.7 *ft./mi. (user-entered)* Regression Q_2 815 cfs

ft/mi (from worksheet) Rainfall 2.95 in *(2 yr, 24 hr)* Adjusted Q_2 1423 cfs

0.0015 *ft./ft.* Regional Factor 1.057 Typical Range for Bankfull Discharge:

560 to 1140 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 67 *ft.* Contour Interval feet

Mean Bankfull Depth 4.53 *ft.* Estimated Sinuosity

Width/Depth Ratio 14.79

Channel Slope: Bankfull Q from:

Max. Bankfull Depth 6.8 *ft.* Surveyed: 0.00132 *ft./ft.* Cross-Section 1069 *cfs*

Width at twice max. depth 300 *ft.* Estimated: *ft./ft.* Basic field data 1125 *cfs*

(13.6 ft.) Selected Q 1097 *cfs*

Entrenchment Ratio 4.48 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: 3.51 *ft./sec.*

GOAL: Develop confidence by matching Velocity from basic field data: 3.71 *ft./sec.*

velocities from different sources. Velocity from selected Q: 3.6 *ft./sec.*

Channel Evolution Stage V Stream Type (Rosgen)

Notes

43.0 cfs/sq.mi.

Natural Open Channel Flow

Project:	X-sec 2	
Assisted by:	Wayne Kinney	
Date:	9/16/2005	
Channel Slope (***S***):	0.001320	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	6.7	*ft*

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

assuming uniform, steady flow

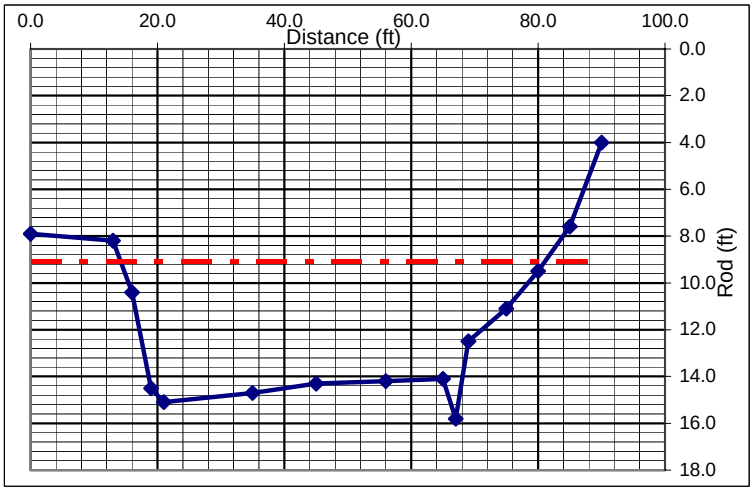
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	6.7 *ft*	7.9	7.6
Channel Flow (***Q***):	1,068.6 *cfs*	1,390.4	1,402.3
Channel Velocity:	3.5 *ft/sec*	3.6	3.8
Cross-Sectional Area (***A***):	304.1 *sq.ft.*	389.1	365.9
Hydraulic Radius (***R***):	4.2 *ft*	4.3	4.8

Survey Data:

Rod *(ft)*	Distance *(ft)*
7.9	0.0
8.2	13.0
10.4	16.0
14.5	19.0
15.1	21.0
14.7	35.0
14.3	45.0
14.2	56.0
14.1	65.0
15.80	67
12.50	69
11.10	75
9.50	80
7.60	85
4.00	90



COMMENTS:

Stream Stabilization I & E Form

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

County Vermilion T. R. Sec.

Date 9/16/2005 By Wayne Kinney

Stream Name Sugar Creek UTM Coord. E 444806 N4382467

Landowner Name Xsec 3

Drainage Area 31.5 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions Width 57 ft. Cross Sectional Area 233 sq. ft.

Depth 4.1 ft.

Reference Stream Gage:

Bluegrass Creek at Potomac Station No. 03336500 Gage Q_2 1850 cfs

Drainage Area 35 sq.mi Regression (1060 cfs

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

USGS Flood-Peak Discharge Predictions:

Valley Slope: 6.9 *ft./mi. (user-entered)* Regression Q_2 914 cfs

ft/mi (from worksheet) Rainfall 2.95 in *(2 yr, 24 hr)* Adjusted Q_2 1595 cfs

0.0013 *ft./ft.* Regional Factor 1.057 Typical Range for Bankfull Discharge:

630 to 1280 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 50 *ft.* Contour Interval feet

Mean Bankfull Depth 5.28 *ft.* Estimated Sinuosity

Width/Depth Ratio 9.47

Channel Slope: Bankfull Q from:

Max. Bankfull Depth 6.5 *ft.* Surveyed: 0.00132 *ft./ft.* Cross-Section 1015 *cfs*

Width at twice max. depth 1000 *ft.* Estimated: *ft./ft.* Basic field data 1084 *cfs*

(13.0 ft.) Selected Q 1050 *cfs*

Entrenchment Ratio 20.00 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} 3 *in.* Velocity required to move D_{90}: 3.6 *ft./sec.*

D_{50} *in.* Velocity from Cross-Section data: 3.84 *ft./sec.*

GOAL: Develop confidence by matching Velocity from basic field data: 4.11 *ft./sec.*

velocities from different sources. Velocity from selected Q: 4.0 *ft./sec.*

Channel Evolution Stage V Stream Type (Rosgen)

Notes

33.3 cfs/mi

Natural Open Channel Flow

Project:	Xsec 3	
Assisted by:	Wayne Kinney	
Date:	9/16/2005	
Channel Slope (***S***):	0.001320	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	6.4	*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:	6.4 *ft*	7.5	
Channel Flow (***Q***):	1,015.4 *cfs*	1,319.2	
Channel Velocity:	3.8 *ft/sec*	4.1	
Cross-Sectional Area (***A***):	264.1 *sq.ft.*	321.6	
Hydraulic Radius (***R***):	4.8 *ft*	5.3	

Survey Data:

Rod *(ft)*	Distance *(ft)*
9.9	0.0
14.9	3.0
16.6	5.0
17.1	6.0
17.4	10.0
17.0	20.0
16.9	25.0
17.2	35.0
17.5	40.0
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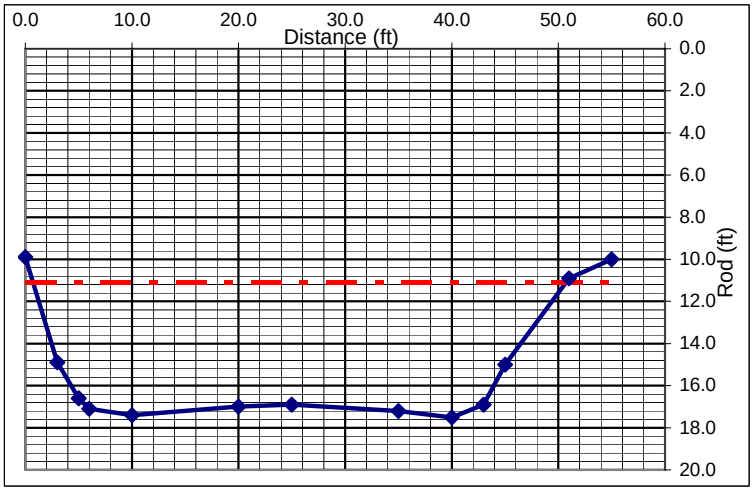
10.90	51
10.00	55



COMMENTS:

Stream Stabilization I & E Form

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

County Vermilion T. R. Sec.

Date 9/16/2005 By Wayne Kinney

Stream Name Sugar Creek UTM Coord. E445630 N4379397

Landowner Name Xsec 4

Drainage Area 39.4 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions Width 63 ft. Cross Sectional Area 272 sq. ft.

Depth 4.3 ft.

Reference Stream Gage:

Bluegrass Creek at Potomac Station No. 03336500 Gage Q_2 1850 cfs

Drainage Area 35 sq.mi Regression (1060 cfs

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

USGS Flood-Peak Discharge Predictions:

Valley Slope: 7.3 *ft./mi. (user-entered)* Regression Q_2 1120 cfs

ft/mi (from worksheet) Rainfall 2.95 in *(2 yr, 24 hr)* Adjusted Q_2 1956 cfs

0.0014 *ft./ft.* Regional Factor 1.057 Typical Range for Bankfull Discharge:

780 to 1570 cfs

Local Stream Morphology:

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

Manning's "n" 0.04

Basic Field Data:

Bankfull Width 60 *ft.*

Mean Bankfull Depth 5.36 *ft.*

Width/Depth Ratio 11.19

Max. Bankfull Depth 7.1 *ft.*

Width at twice max. depth 1000 *ft.*

(14.2 ft.)

Entrenchment Ratio 16.67

Stream Length *ft.*

Valley Length *ft.*

Contour Interval feet

Estimated Sinuosity

Channel Slope:

Surveyed: 0.00132 *ft./ft.*

Estimated: *ft./ft.*

Radius of Curvature (Rc) ft.

Rc/Bankfull width: 0.00

Bankfull Q from:

Cross-Section 1268 *cfs*

Basic field data 1334 *cfs*

Selected Q 1301 *cfs*

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: 3.94 *ft./sec.*

GOAL: Develop confidence by matching velocities from different sources.

Velocity from basic field data: 4.15 *ft./sec.*

Velocity from selected Q: 4.0 *ft./sec.*

Channel Evolution Stage IV Stream Type (Rosgen)

Notes

33.0 cfs/ sq. mi.

Natural Open Channel Flow

Project:	Xsec 4	
Assisted by:	Wayne Kinney	
Date:	9/16/2005	
Channel Slope (***S***):	0.001320	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	7.2	*ft*

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

assuming uniform, steady flow

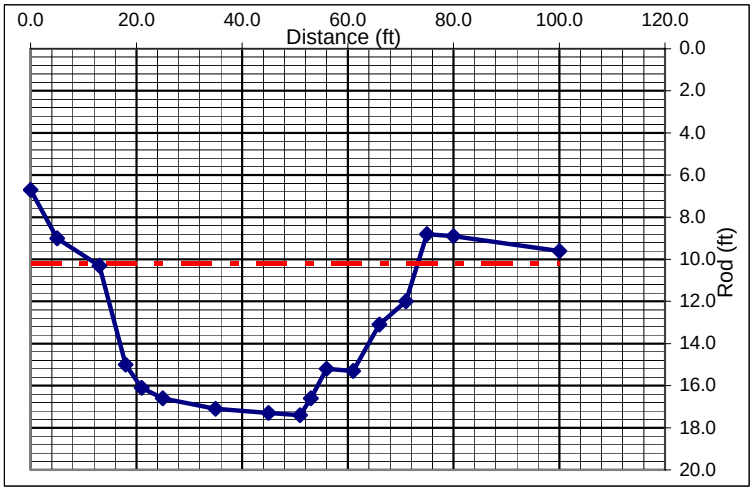
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	7.2 *ft*	8.6	
Channel Flow (***Q***):	1,267.8 *cfs*	1,439.0	
Channel Velocity:	3.9 *ft/sec*	3.4	
Cross-Sectional Area (***A***):	322.1 *sq.ft.*	427.0	
Hydraulic Radius (***R***):	5.0 *ft*	3.9	

Survey Data:

Rod *(ft)*	Distance *(ft)*
6.7	0.0
9.0	5.0
10.3	13.0
15.0	18.0
16.1	21.0
16.6	25.0
17.1	35.0
17.3	45.0
17.4	51.0
16.60	53
15.20	56
15.30	61
13.10	66
12.00	71
8.80	75
8.9	80
9.6	100



COMMENTS:

Stream Stabilization I & E Form

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

County Vermilion T. R. Sec.

Date 9/16/2005 By Wayne Kinney

Stream Name Sugar Creek UTM Coord. E448902 N4376418

Landowner Name xsec 5

Drainage Area 46.2 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions Width 66 ft. Cross Sectional Area 303 sq. ft.

Depth 4.5 ft.

Reference Stream Gage:

Bluegrass Creek at Potomac Station No. 03336500 Gage Q_2 1850 cfs

Drainage Area 35 sq.mi Regression (1060 cfs

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

USGS Flood-Peak Discharge Predictions:

Valley Slope: 7.9 *ft./mi. (user-entered)* Regression Q_2 1317 cfs

ft/mi (from worksheet) Rainfall 2.95 in *(2 yr, 24 hr)* Adjusted Q_2 2299 cfs

0.0015 *ft./ft.* Regional Factor 1.057 Typical Range for Bankfull Discharge:

910 to 1840 cfs

Local Stream Morphology:

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

Manning's "n" 0.04

Basic Field Data:

Bankfull Width 62 *ft.*

Mean Bankfull Depth 5.34 *ft.*

Width/Depth Ratio 11.61

Max. Bankfull Depth 7 *ft.*

Width at twice max. depth 1000 *ft.*

(14.0 ft.)

Entrenchment Ratio 16.13

Stream Length *ft.*

Valley Length *ft.*

Contour Interval feet

Estimated Sinuosity

Channel Slope:

Surveyed: 0.00132 *ft./ft.*

Estimated: *ft./ft.*

Radius of Curvature (Rc) ft.

Rc/Bankfull width: 0.00

Bankfull Q from:

Cross-Section 1312 *cfs*

Basic field data 1370 *cfs*

Selected Q 1341 *cfs*

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

Bedload: D_{90} 4 *in.* Velocity required to move D_{90}: 4.2 *ft./sec.*

D_{50} *in.* Velocity from Cross-Section data: 3.96 *ft./sec.*

GOAL: Develop confidence by matching velocities from different sources.

Velocity from basic field data: 4.14 *ft./sec.*

Velocity from selected Q: 4.1 *ft./sec.*

Channel Evolution Stage IV Stream Type (Rosgen)

Notes

29.0 cfs/sq. mi.

Natural Open Channel Flow

Project:	xsec 5	
Assisted by:	Wayne Kinney	
Date:	9/16/2005	
Channel Slope (***S***):	0.001320	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	6.8	*ft*

$$Q \; 0 \; \frac{1.486}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}}$$

assuming uniform, steady flow

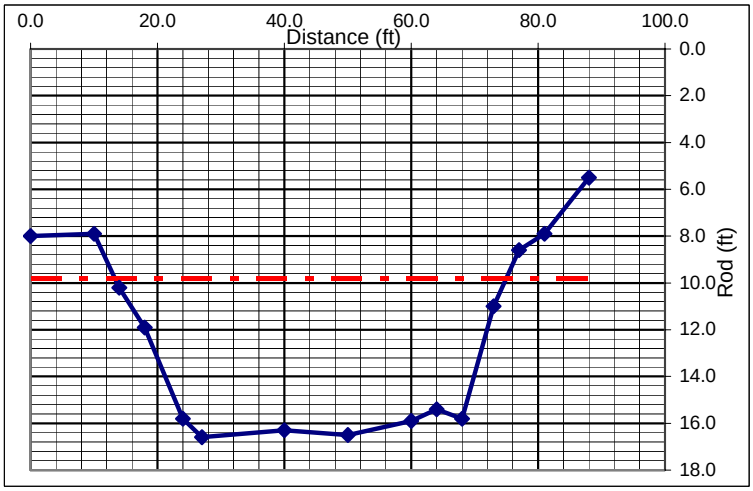
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	6.8 *ft*	8.7	
Channel Flow (***Q***):	1,311.6 *cfs*	1,870.5	
Channel Velocity:	4.0 *ft/sec*	4.1	
Cross-Sectional Area (***A***):	330.9 *sq.ft.*	455.8	
Hydraulic Radius (***R***):	5.0 *ft*	5.3	

Survey Data:

Rod *(ft)*	Distance *(ft)*
8.0	0.0
7.9	10.0
10.2	14.0
11.9	18.0
15.8	24.0
16.6	27.0
16.3	40.0
16.5	50.0
15.9	60.0
15.40	64
15.80	68
11.00	73
8.60	77
7.90	81
5.50	88



COMMENTS:

Stream Stabilization I & E Form

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

County Vermilion T. R. Sec.

Date 9/16/2005 By Wayne Kinney

Stream Name Sugar Creek UTM Coord. E450135 N4375769

Landowner Name xsec 6

Drainage Area 49.8 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions Width 68 ft. Cross Sectional Area 318 sq. ft.

Depth 4.6 ft.

Reference Stream Gage:

Bluegrass Creek at Potomac Station No. 03336500 Gage Q_2 1850 cfs

Drainage Area 35 sq.mi Regression (1060 cfs

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

USGS Flood-Peak Discharge Predictions:

Valley Slope: 7.4 *ft./mi. (user-entered)* Regression Q_2 1357 cfs

ft/mi (from worksheet) Rainfall 2.95 in *(2 yr, 24 hr)* Adjusted Q_2 2368 cfs

0.0014 *ft./ft.* Regional Factor 1.057 Typical Range for Bankfull Discharge:

940 to 1900 cfs

Local Stream Morphology:

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

Manning's "n" 0.04

Basic Field Data:

Bankfull Width 59 *ft.*

Mean Bankfull Depth 5.71 *ft.*

Width/Depth Ratio 10.33

Max. Bankfull Depth 7 *ft.*

Width at twice max. depth 800 *ft.*

(14.0 ft.)

Entrenchment Ratio 13.56

Stream Length *ft.*

Valley Length *ft.*

Contour Interval feet

Estimated Sinuosity

Channel Slope:

Surveyed: 0.00132 *ft./ft.*

Estimated: *ft./ft.*

Radius of Curvature (Rc) ft.

Rc/Bankfull width: 0.00

Bankfull Q from:

Cross-Section 1366 *cfs*

Basic field data 1457 *cfs*

Selected Q 1412 *cfs*

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

Bedload: D_{90} 6 *in.* Velocity required to move D_{90}: 5.1 *ft./sec.*

D_{50} *in.* Velocity from Cross-Section data: 4.05 *ft./sec.*

GOAL: Develop confidence by matching Velocity from basic field data: 4.33 *ft./sec.*

velocities from different sources. Velocity from selected Q: 4.2 *ft./sec.*

Channel Evolution Stage V Stream Type (Rosgen)

Notes

28.3 cfs/ sq. mi.

Natural Open Channel Flow

Project:	xsec 6	
Assisted by:	Wayne Kinney	
Date:	9/16/2005	
Channel Slope (***S***):	0.001320	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	7.1	*ft*

$$Q \; 8 \; \frac{1.486}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}}$$

assuming uniform, steady flow

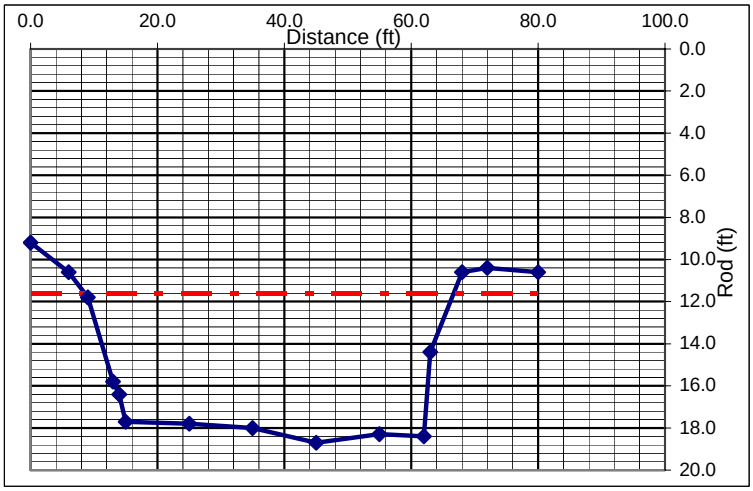
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	7.1 *ft*	8.3	
Channel Flow (***Q***):	1,365.6 *cfs*	1,604.2	
Channel Velocity:	4.1 *ft/sec*	3.9	
Cross-Sectional Area (***A***):	337.0 *sq.ft.*	410.9	
Hydraulic Radius (***R***):	5.2 *ft*	4.9	

Survey Data:

Rod *(ft)*	Distance *(ft)*
9.2	0.0
10.6	6.0
11.8	9.0
15.8	13.0
16.4	14.0
17.7	15.0
17.8	25.0
18.0	35.0
18.7	45.0
18.30	55
18.40	62
14.40	63
10.60	68
10.40	72
10.60	80



COMMENTS:

Stream Stabilization I & E Form

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

County Vermilion T. R. Sec.

Date 9/16/2005 By Wayne Kinney

Stream Name Sugar Creek UTM Coord. E451081 N4374826

Landowner Name xsec 7

Drainage Area 50.6 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions	Width	69 ft.	Cross Sectional Area	322 sq. ft.
	Depth	4.7 ft.		

Reference Stream Gage:

Bluegrass Creek at Potomac	Station No.	03336500	Gage Q_2	1850 cfs
	Drainage Area	35 sq.mi	Regression (	1060 cfs
Vermilion County, IL		**REFERENCE STREAM DATA ONLY**		

USGS Flood-Peak Discharge Predictions:

Valley Slope:	7.6	*ft./mi. (user-entered)*			Regression Q_2	1392 cfs
		ft/mi (from worksheet)	Rainfall	2.95 in *(2 yr, 24 hr)*	Adjusted Q_2	2429 cfs
	0.0014	*ft./ft.*	Regional Factor	1.057	Typical Range for Bankfull Discharge:	
					970 to 1950 cfs	

Local Stream Morphology:

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

Manning's "n" 0.04

Basic Field Data:					
Bankfull Width	68	*ft.*	Stream Length		*ft.*
Mean Bankfull Depth	5.58	*ft.*	Valley Length		*ft.*
Width/Depth Ratio	12.19		Contour Interval		feet
			Estimated Sinuosity		
Max. Bankfull Depth	6.7	*ft.*	*Channel Slope:* Surveyed:	0.00132 *ft./ft.*	Bankfull Q from: Cross-Section 1403 *cfs*
Width at twice max. depth	1200	*ft.*	Estimated:	*ft./ft.*	Basic field data 1616 *cfs*
(13.4 ft.)					Selected Q 1510 *cfs*
Entrenchment Ratio	17.65		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:	3.93	*ft./sec.*
GOAL: Develop confidence by matching			Velocity from basic field data:	4.26	*ft./sec.*
velocities from different sources.			Velocity from selected Q:	4.0	*ft./sec.*

Channel Evolution Stage V Stream Type (Rosgen)

Notes

29.8 cfs/ sq. mi.

Natural Open Channel Flow

Project:	xsec 7	
Assisted by:	Wayne Kinney	
Date:	9/16/2005	
Channel Slope (***S***):	0.001320	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	6.2	*ft*

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

assuming uniform, steady flow

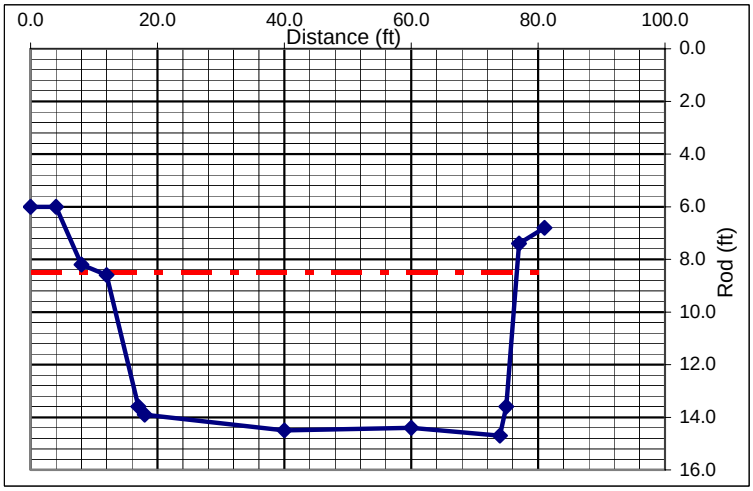
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	6.2 *ft*	7.9	
Channel Flow (***Q***):	1,403.0 *cfs*	2,063.2	
Channel Velocity:	3.9 *ft/sec*	4.3	
Cross-Sectional Area (***A***):	357.2 *sq.ft.*	476.9	
Hydraulic Radius (***R***):	5.0 *ft*	5.7	

Survey Data:

Rod *(ft)*	Distance *(ft)*
6.0	0.0
6.0	4.0
8.2	8.0
8.6	12.0
13.6	17.0
13.9	18.0
14.5	40.0
14.4	60.0
14.7	74.0
13.60	75
7.40	77
6.80	81



COMMENTS:

Stream Stabilization I & E Form

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

County Vermilion T. R. Sec.

Date 9/16/2005 By Wayne Kinney

Stream Name Sugar Creek UTM Coord. E451472 N4372978

Landowner Name xsec 8

Drainage Area 58.9 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions	Width	73 ft.	Cross Sectional Area	357 sq. ft.
	Depth	4.9 ft.		

Reference Stream Gage:

Bluegrass Creek at Potomac	Station No.	03336500	Gage Q_2 1850 cfs
	Drainage Area	35 sq.mi	Regression (1060 cfs
Vermilion County, IL		**REFERENCE STREAM DATA ONLY**	

USGS Flood-Peak Discharge Predictions:

Valley Slope:	7.6	*ft./mi. (user-entered)*			Regression Q_2 1569 cfs
		ft/mi (from worksheet)	Rainfall	2.95 in *(2 yr, 24 hr)*	Adjusted Q_2 2739 cfs
	0.0014	*ft./ft.*	Regional Factor	1.057	Typical Range for Bankfull Discharge: 1090 to 2200 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	88	*ft.*	Contour Interval		feet
Mean Bankfull Depth	4.91	*ft.*	Estimated Sinuosity		
Width/Depth Ratio	17.92				
			Channel Slope:		Bankfull Q from:
Max. Bankfull Depth	5.7	*ft.*	Surveyed:	0.00132 *ft./ft.*	Cross-Section 1637 *cfs*
Width at twice max. depth	1200	*ft.*	Estimated:	*ft./ft.*	Basic field data 1690 *cfs*
(11.4 ft.)					Selected Q 1663 *cfs*
Entrenchment Ratio	13.64		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}	4 *in.*	Velocity required to move D_{90}:	4.2 *ft./sec.*
	D_{50}	*in.*	Velocity from Cross-Section data:	3.79 *ft./sec.*
GOAL: Develop confidence by matching			Velocity from basic field data:	3.91 *ft./sec.*
velocities from different sources.			Velocity from selected Q:	3.8 *ft./sec.*

Channel Evolution Stage IV Stream Type (Rosgen)

Notes

28.2 cfs/sq. mi.

Natural Open Channel Flow

Project:	xsec 8	
Assisted by:	Wayne Kinney	
Date:	9/16/2005	
Channel Slope (***S***):	0.001320	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	5.7	*ft*

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

assuming uniform, steady flow

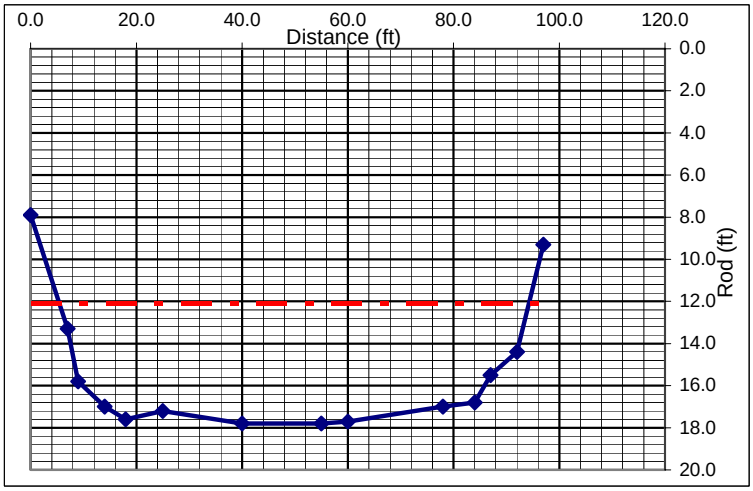
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	5.7 *ft*	8.5	
Channel Flow (***Q***):	1,636.7 *cfs*	3,362.9	
Channel Velocity:	3.8 *ft/sec*	4.9	
Cross-Sectional Area (***A***):	432.3 *sq.ft.*	689.9	
Hydraulic Radius (***R***):	4.7 *ft*	6.9	

Survey Data:

Rod *(ft)*	Distance *(ft)*
7.9	0.0
13.3	7.0
15.8	9.0
17.0	14.0
17.6	18.0
17.2	25.0
17.8	40.0
17.8	55.0
17.7	60.0
17.00	78
16.80	84
15.50	87
14.40	92
9.30	97



COMMENTS: