

AERIAL ASSESSMENT OF KINKAID CREEK AND LITTLE KINKAID CREEK JACKSON COUNTY, IL

November, 2004

Prepared by Wayne Kinney for Illinois Department of Agriculture

The Illinois Environmental Protection Agency has listed one segment of Kinkaid Lake as impaired based on 1998 303(d) list data in the Big Muddy River Watershed. Kinkaid Lake is a 2350 acre lake located on Kinkaid Creek in eastern Jackson County. The Crissenberry Dam formed the impoundment in 1972. The dam, owned by IDNR, is 980 feet long and 96 feet tall storing a maximum of 153,000 acre-feet, although the normal stage volume is 78,500 acre-feet. The lake is used for both recreation and water supply. The drainage area is approximately 62 square miles and is fed by Kinkaid, Little Kinkaid, Spring and Johnson Creeks. (1)

The Executive Summary for the Big Muddy River Watershed TMDL (Final Draft) lists pH and Mercury as the TMDL impairments for concern with the major sources as “nonpoint from agriculture”. “Although Kinkaid Lake is not listed for phosphorus, sample concentrations do exceed the endpoint of 0.05 mg/L for total phosphorus in the mostly upstream pool. This TMDL is based on the assumption that trends in Kinkaid Lake will follow those observed in literature where the control of phosphorus results in acceptable pH values. The remainder of the section focuses on reductions in phosphorus to control pH.” (2)

“Phosphorus loads in the Kinkaid Lake Watershed originate from external sources, such as croplands. The annual averages of data collected during sampling of Kinkaid Lake indicate that only the upstream portion of Kinkaid Lake is impaired for phosphorus (detailed in Section 7). Land use for the entire watershed illustrates that 70 percent of the agricultural practices occur in the portion of the watershed upstream of Kinkaid Lake, which supports the data. Hence, implementation measures focus on the watershed area located upstream of Kinkaid Lake (subbasin 1 in Figure 7-5). However, the TMDL endpoints and load reductions apply to the entire Kinkaid Lake Watershed.”

“From modeling estimates, external loads from nonpoint source runoff from agricultural crops potentially account for 56 percent of the loading to Kinkaid Lake, and forest land, both deciduous and coniferous, accounts for approximately 15 percent of the nonpoint source phosphorus delivered to the lake. Grassland and pastureland account for approximately 16 percent of the modeled load, and the remaining 14 percent are contributed to by atmospheric and groundwater loads. To achieve the 41 percent reduction for the load allocations established in Section 8 (Table 8-4), management measures must address nonpoint source loading through the installation of sediment and surface runoff controls. Phosphorus sorbs readily to soil particles and controlling sediment load in the reservoir helps control phosphorus loadings.” (3)

The success of controlling pH levels in Kinkaid Lake has been linked to the control of nonpoint source phosphorus loads, and primarily the loading from subbasin one, which is fed by Kinkaid Creek and Little Kinkaid Creek. Therefore this assessment of Kinkaid Creek and Little Kinkaid Creek will address the condition of the streams themselves, the conveyance of water and sediment from the watershed and potential contributions of sediment from within the stream to control the sediment phosphorus loadings.

Assessment Procedure

Low-level geo-referenced video was taken of Kinkaid Creek and Little Kinkaid Creek in April 2004. Video taping was completed by Fostaire Helicopters, Sauget, Illinois, using a camera mounted beneath the helicopter to record data from just above tree top level in DVD format for further evaluation and assessment. Video began on both streams at the upper end of Kinkaid Lake and proceeded up the main channel until the stream size and vegetative cover prevented capture of useful video images. Regardless of the stream size or vegetation, aerial video of tributaries was not part of the project.

After videotaping the streams, 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 used to identify and locate the points where ground investigations were needed to verify aerial assessment assumptions and gather additional data.

The ground investigation 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.

The DVD has been divided into “chapters” of approximately five minutes of video 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, it will also provide an assessment and treatment recommendations for each chapter. The chapter divisions are clearly arbitrary and do not reflect “change points” in the stream characteristics or treatment recommendations. Conclusions and recommendations are presented for stream segments that are intended to assist in reaching the goal of reducing the phosphorus loads to Kinkaid Lake. The report will begin with a broader, more general assessment of the entire study reach.

General Observations from Assessment

Both Kinkaid Creek and Little Kinkaid Creek have much steeper gradients in the upper 25 to 40% of the watershed. In Kinkaid Creek the change in valley slope increases 290% approximately 6.75 miles (60% of total length) above Kinkaid Lake. Little Kinkaid Creek has a corresponding increase of 270% approximately 5.2 miles (75% of total length) above Kinkaid Lake. (See Fig.1 and Fig. 2)

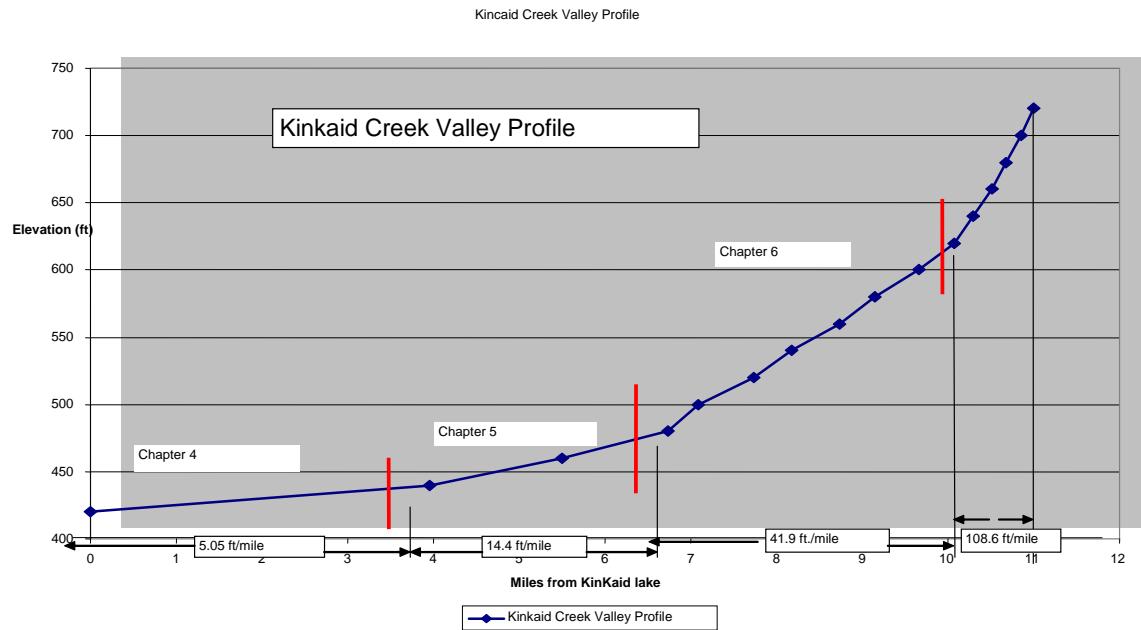


Figure 1

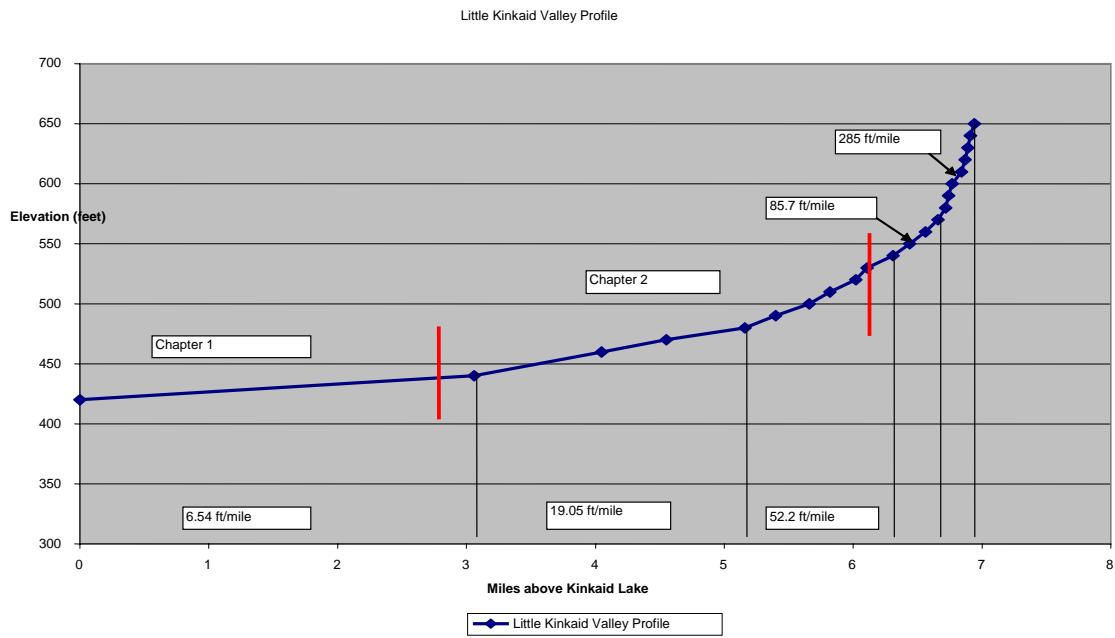


Figure 2

The slope data is calculated from USGS topo maps instead of actual survey data. Although they accurately represent a significant change, points are at best approximations as the contour intervals are 10 and 20 feet a part. Given the significant change in valley slope, it should be expected that velocities and the sediment carrying capacity of both Kinkaid and Little Kinkaid Creeks would be reduced significantly at these points.

It could be expected there would be indications of increased deposition at these points as the stream loses sediment transport capacity. The occurrence of deposition identified from the aerial video corresponds very well with this assumption for both streams. There are no depositional areas identified in the reaches that have valley slopes near 42 and 52 ft./mi. respectively. (Fig. 3)

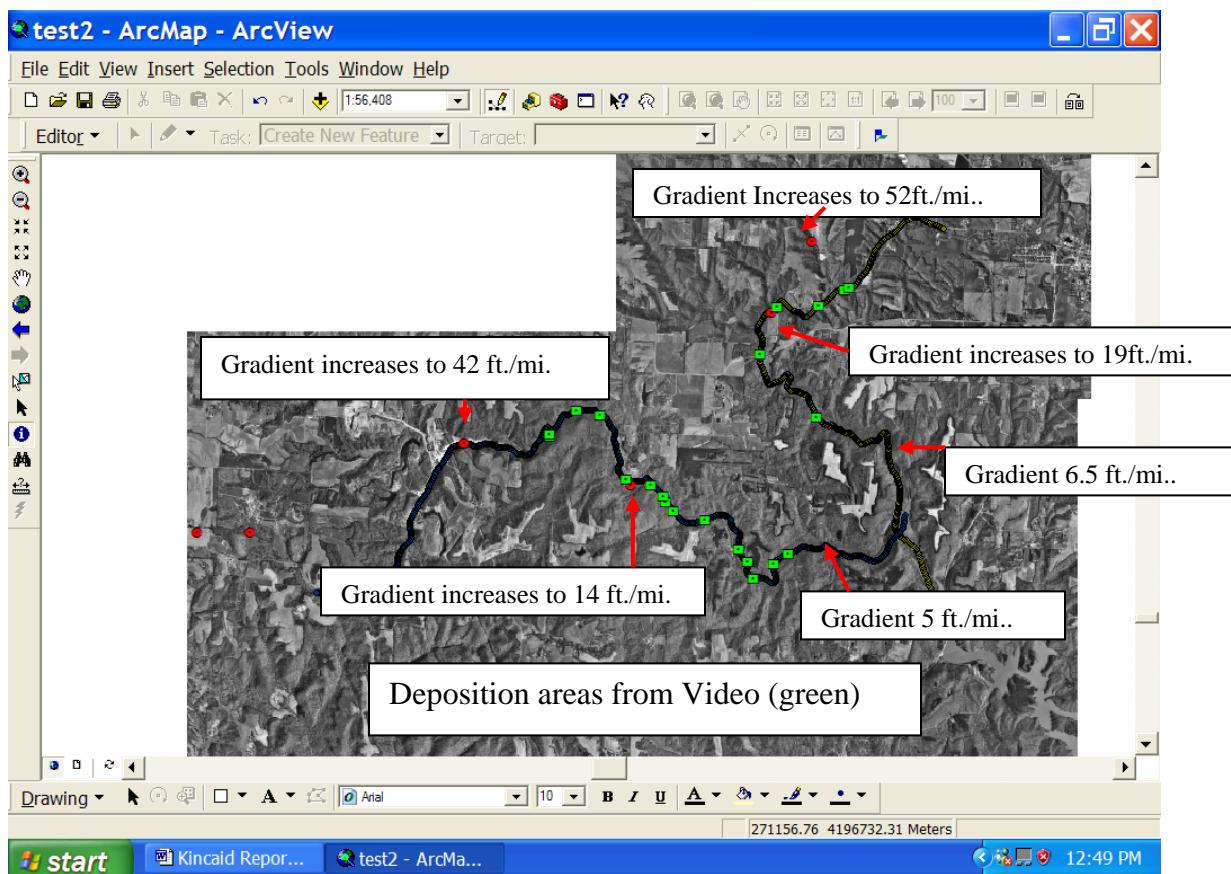


Figure 3

Comparison of features for the points identified from the DVD indicates that many breakpoints are found to be associated with the deposition areas, suggesting that these may be accumulations of heavy sediment rather than degradational features. (Fig. 4) Subsequent ground truthing has confirmed this assumption.

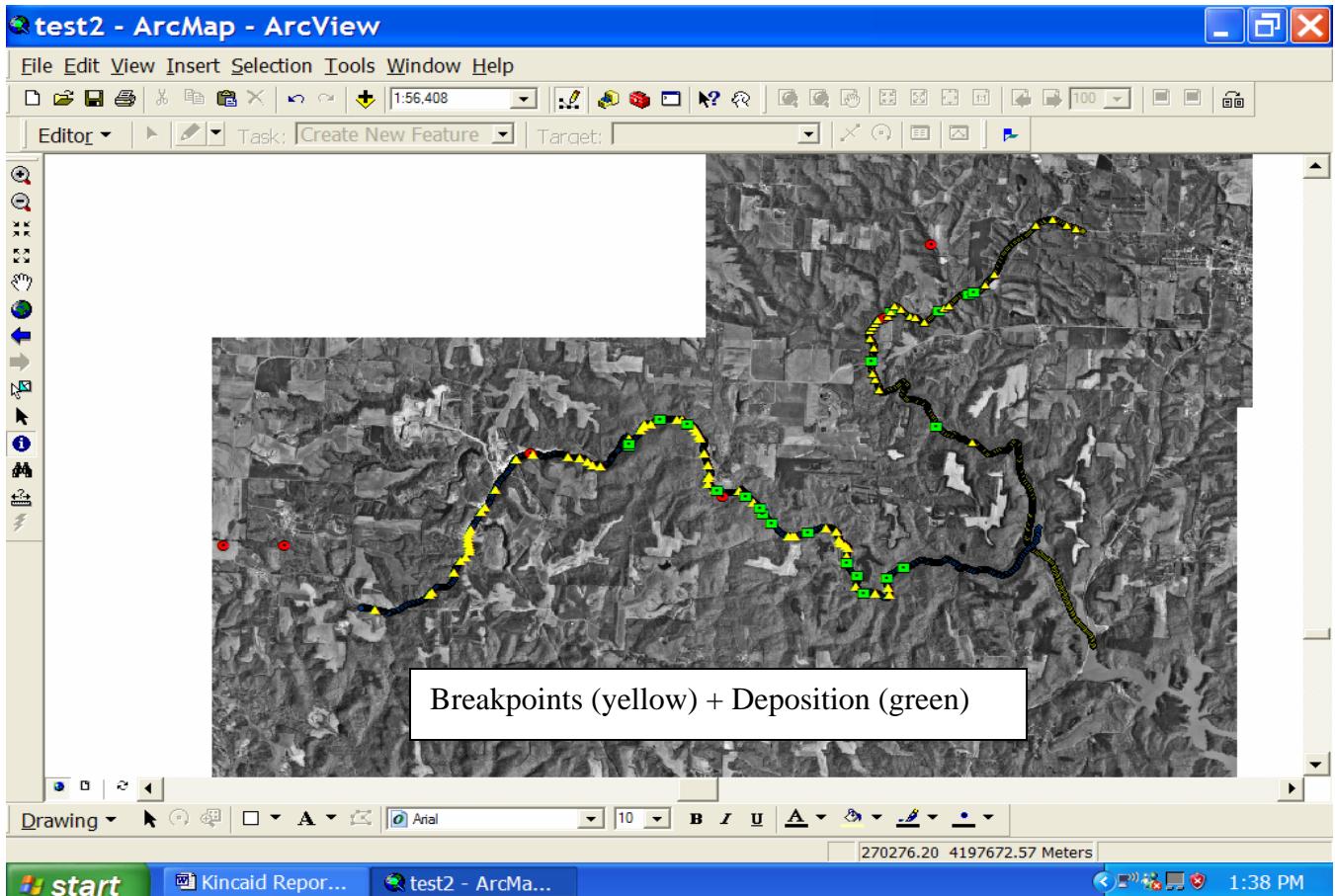


Figure 4

Figure 5 shows the erosion sites identified from the DVD are distributed along most of the length of Kinkaid and Little Kinkaid Creeks with little correlation to valley slope or where the deposition is occurring. In fact, the erosion points are more frequent in the depositional areas than in the areas upstream.

There clearly seems to be a different erosion process working in the upper reaches of these streams than in the lower gradient reaches nearer to Kinkaid Lake. Assessment of the DVD and the data collected during the ground investigation confirms that erosion in the upper reaches is driven by high velocities and generally confined flow resulting in very high transport capacity.

However, the lower reaches are driven by the bedload transported from the upper reaches being deposited within the channel in the lower gradient sections. By hydraulic sorting, the larger bedload materials are deposited first followed by progressively smaller size bedload, as the streams continue to lose gradient as they approach Kinkaid Lake. The finer materials (silts and clays) having the highest rate of affinity to carry phosphorus are presumed to be carried all the way to Kinkaid Lake.

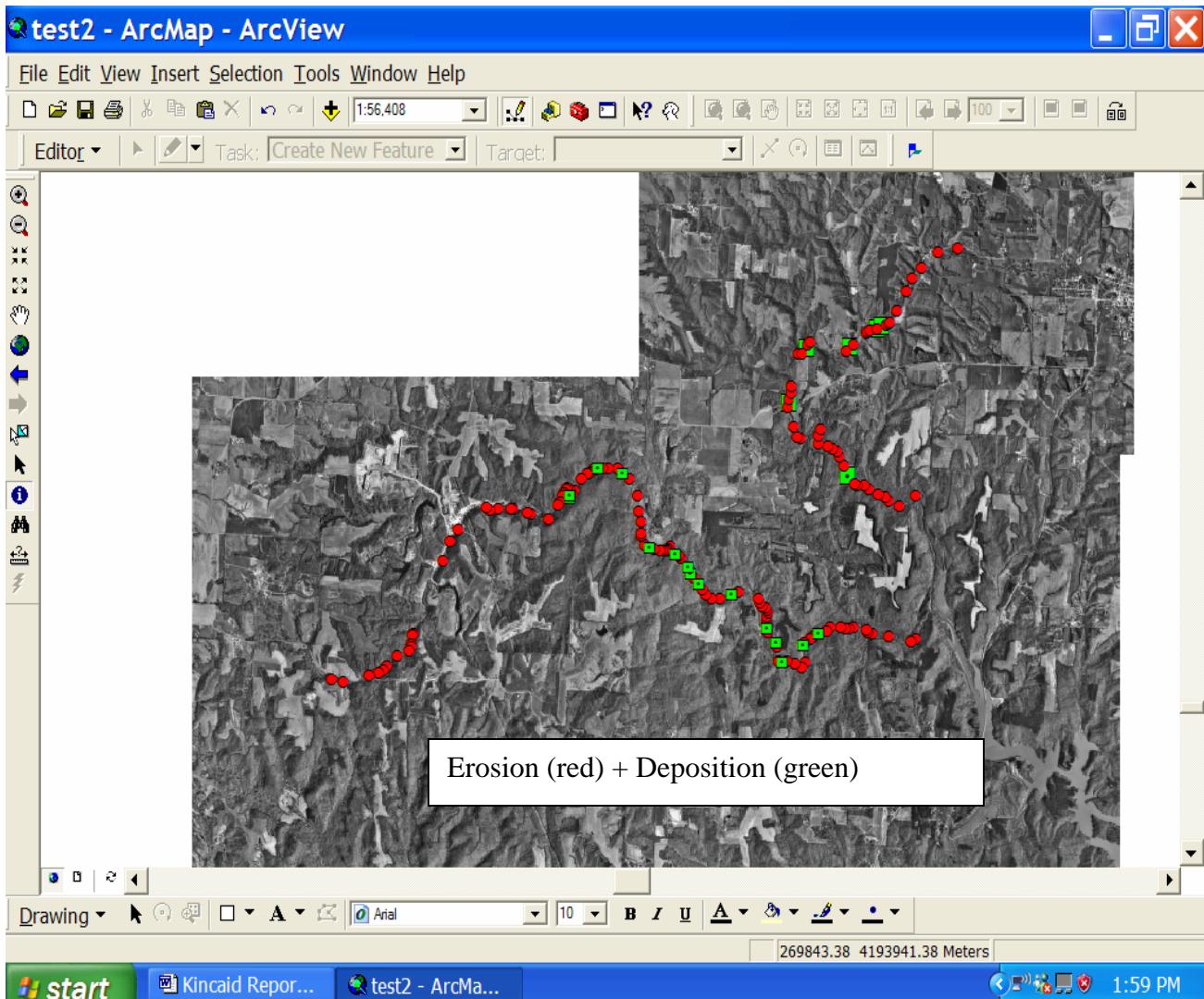


Figure 5

Adding to the problem of phosphorus carrying sediments is evidence that as the streams deposit heavier bedload within the channel, they pick-up finer material from the banks in the form of bank erosion in order to maintain the cross sectional area required for the channel forming discharge. The process of coarser material being exchanged for finer material causes the erosion points identified in association with the areas of deposition.

The finer material eroded from the streambanks also will contain higher levels of phosphorus and may represent a source not adequately accounted for by the model used in the TMDL study. The model is based on erosion levels computed by the Universal Soil Loss Equation (which measures only sheet and rill erosion) and then by applying a sediment delivery ratio to compute expected sediment yield.

Streambank Erosion Rates

The DVD shows obvious areas of streambank erosion that are contributing fine sediments, identified as a major source of phosphorus in Kinkaid Lake. Unfortunately, the DVD's capture only one point in time and do not allow for any analysis of the rate or extent of total fine sediments added from the stream system itself. The Jackson County SWCD and NRCS staff conducted an inventory and evaluation of erosion and sedimentation for this watershed using the "RAP-M", the Rapid Assessment Point Method, developed by NRCS. The study indicated that 36% of the sediment originates from gullies and only 3% from streambanks in the Kinkaid Lake watershed.

The incision found on these streams has undoubtedly caused the tributaries to degrade. The degradation of the tributaries may well be the primary cause of the NRCS estimate that 36% of the sediment contribution is from "gullies". The aerial geo-referenced video did not generally extend to these upper reaches where NRCS has identified gully erosion, and therefore the problem of gully erosion has not been addressed in this report.

It should be noted, that NRCS nomenclature defines a channel as a "concentrated flow area greater than one foot in depth and two feet in width and NOT destroyed by tillage operations. Both gullies and streambanks are included within this definition, as both are definitely channels. However the distinction between the two is immaterial because the procedure for measurement is essentially the same". (4)

While the distinction between "gully" and "streambank" erosion is somewhat subjective, NRCS general guidance is "to separate these within a watershed to show differences or to isolate a particular serious sediment source, then inventory and calculate each separately, following the same procedure. Using quadrangle maps as historical reference, streams can sometimes be separated from gullies by using the solid blue lines". (5)

Data collected in the field (i.e., cross sections-Table 1, bankfull discharges) from Kinkaid Creek and Little Kinkaid Creek were used to complete the Streambank Inventory and Evaluation data form developed by NRCS. This procedure allows for comparison of observed field conditions with "regional curve" predictions of channel dimensions, USGS Flood-Peak discharge predictions from Water-Resources Investigations Report 87-4207, and bedload material movement with velocity required for transport.

The fact that there is no actual discharge data available for Kinkaid Creek or Little Kinkaid Creek makes this type of analysis somewhat subjective, however it does provide a good analytical tool. Appendix A at the end of this report contains the NRCS Streambank Inventory and Evaluation of each cross section.

Table 1. Cross Section Data from NRCS Streambank Inventory and Evaluation Procedures

Little Kinkaid	X-sec	Easting	Northing	ADA Sq. Mi.	Valley Slope ft./mi.le	Q2 CFS	Bankfull CFS	Width Bkf (ft)	Mean D Bkf (ft)		W/D	Velocity Ft./sec..	Bedload In.	CEM
									D Bkf (ft)	W/D				
Little Kinkaid	1	277086	4194279	9.04	23.5	1592	1090	61	4.86	12.6	3.7	3	5	
Little Kinkaid	2	276243	4195027	7.9	30.3	1617	975	62	4.46	13.9	3.5	4	5	
Little Kinkaid	3	276728	4195765	5.62	33.3	1293	895	63	2.94	21.4	4.8	bedrock	5	
Little Kinkaid	4	277145	4195961	5.55	33.3	1280	860	54	3.2	16.9	5	bedrock	5	
Little Kinkaid	5	277362	4196054	1.88	47.4	645	475	31	2.64	11.7	5.8	5	4	
Little Kinkaid	6	277795	4196638	1.17	64	512	400	22	3.25	6.77	5.6	4	3	
Kinkaid	1	276107	4192224	11.16	32.2	2188	1500	66	6.27	10.5	3.6	2	5	
Kinkaid	2	275834	4192956	10.22	32.2	2041	1250	62	5.62	11	3.6	3	5	
Kinkaid	3	274347	4193666	7.98	39.8	1859	1020	42	4.66	9.01	5.2	4	4	
Kinkaid	4	274317	4193947	5.74	39.8	1433	1005	37	4.99	7.41	5.4	4	5	
Kinkaid	5	273457	4194171	5.39	47.3	1481	930	34	5.03	6.76	5.4	3	4	
Kinkaid	6	272682	4193943	4.66	50	1356	800	49	3.36	14.6	4.9	bedrock	5	
Kinkaid	7	270849	4192063	0.74	70.8	375	282	23	2.22	10.4	5.5	bedrock	5	
Kinkaid	8	270682	4191991	0.62	75.3	336	191	33	1.3	25.4	4.5	bedrock	6	

The Clay Lick Creek near Makanda, Illinois in southern Jackson County was selected as the Reference Stream Gage due to similarity in size (1.94 sq. mi) and topography. In addition to the data collected for the NRCS Streambank I & E, data was collected to compare the Total Depth at top bank (Td) and the Maximum Depth (Md) at bankfull discharge. This comparison estimates the past incision and the degree of separation from the floodplain and therefore is a good indicator in incised streams of the total amount of channel adjustment needed before reaching a new state of quasi-equilibrium (CEM 6).

The comparison has an advantage over the Entrenchment Ratio used by NRCS since it estimates actual past incision where the floodplain is found at less than two times the Maximum Bankfull depth. This recognition is important as degradation and channel incision is a major problem long before it reaches the threshold for measurement under the Entrenchment Ratio calculation.

A stable stream will have a developed floodplain at the Maximum Bankfull depth and therefore would have a ratio of Td/Md of 1 or Td would be 100 percent of Md as another way of expressing the same value. Figure 6 and Figure 7 show the comparison of Td and Md for Kinkaid and Little Kinkaid Creeks.

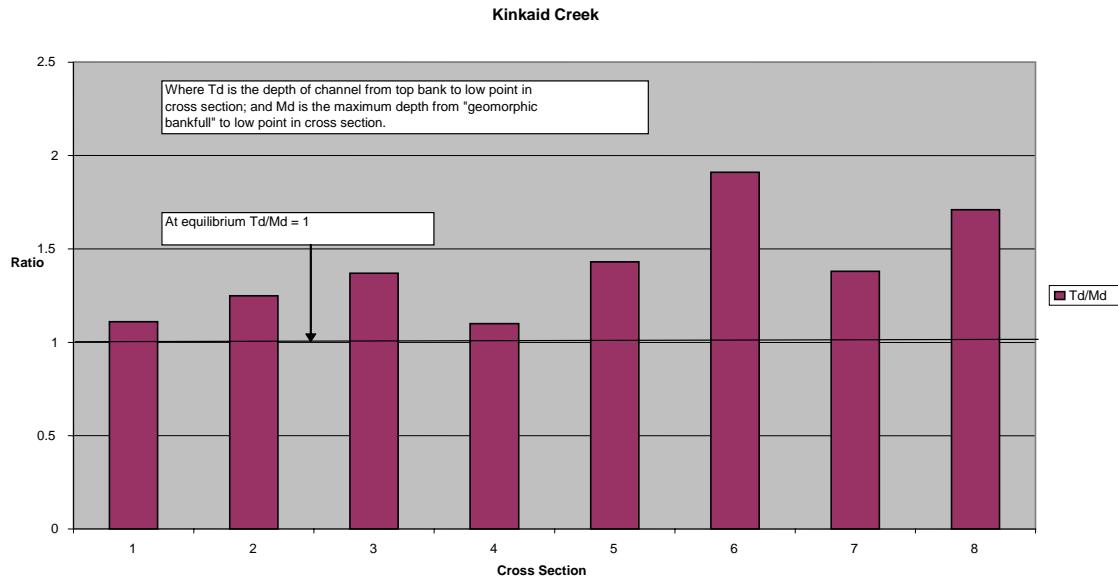


Figure 6

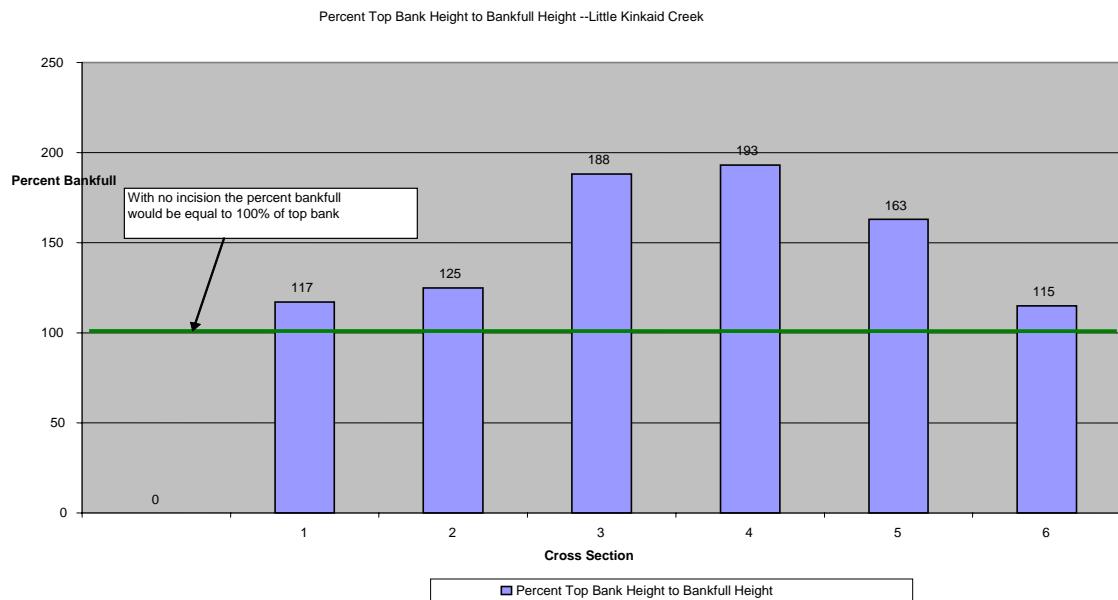


Figure 7

Conclusions

The following conclusions have been formulated from the cross section data collected in the field (Table1) and the aerial assessment.

1. Kinkaid and Little Kinkaid Creeks are flow driven in the upper reaches and bedload driven in the lower reaches near Kinkaid Lake.
2. Bedload transport capacity reduces with gradient and major deposition begins near the major valley slope breaks around elevation 480 on the USGS topo maps.
3. Channel degradation will be limited in upper reaches by the many places where the channel bed is on solid bedrock.
4. Past channel incision has resulted in channel depths ranging from 10% to 93% deeper than “bankfull flow”. (Fig. 6 and Fig. 7)
5. Channel incision has resulted in separation of the “bankfull discharge” from the floodplain in many locations. These locations have very high transport capacity and move bedload very efficiently.
6. Channel incision is less prominent after passing into the depositional zones and separation from floodplain is less severe.
7. Reconnecting the “bankfull discharge” with the floodplain would be very effective in reducing channel erosion and sediment load contributions coming from within the stream.
8. Reconnecting the bankfull discharge with the floodplain above elevation 480 would reduce the heavy bedload contributions and the total bedload transport would also reduce the problems associated with bedload deposition in the lower reaches (below elev. 480).

Field observations suggest that most of the heavy bedload within these streams is a direct contribution from the eroding streambanks. The heavy material is predominately old “lag” deposits from earlier channel migrations.

9. Perhaps the biggest benefit of reconnecting the bankfull discharge to the floodplain would be to promote deposition of finer materials on the floodplain and reduce sediment loading to Kinkaid Lake.

Treatment Recommendations

The DVD has been divided into “chapters” as shown in Figure 8. Each chapter consists of five minutes of video.

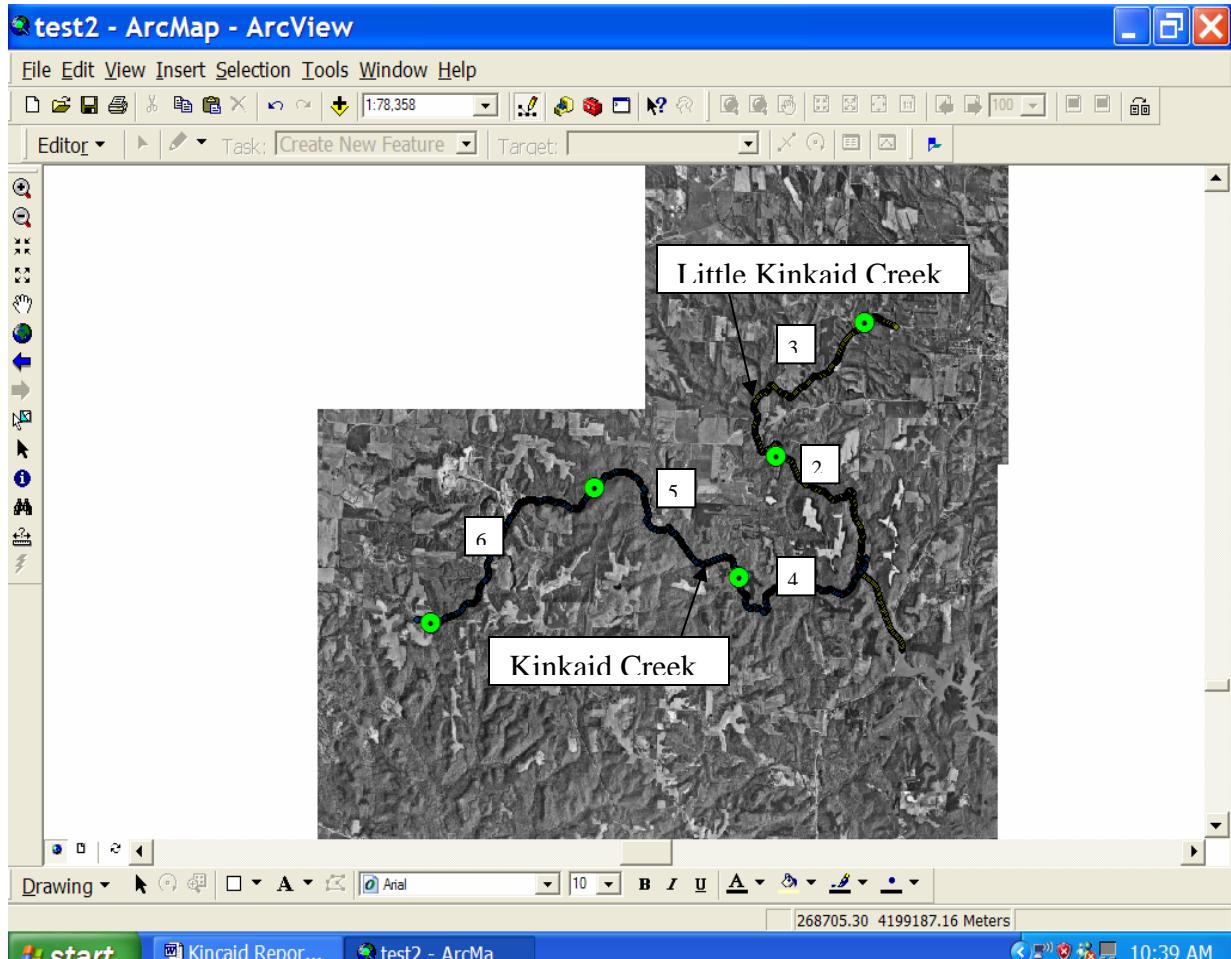


Figure 8: Chapter Divisions on DVD used for Recommendations

Treatment Recommendations for Chapter 2

This section of Little Kinkaid Creek is the outlet into Kinkaid Lake above Route 151. Sediments identified on the DVD from 5:00 to 8:00 minutes are fine sediments and are being transported by channel flows as bedload. From 7:41 minutes to the end of the chapter, there are 15 identified erosion sites and one deposition site. Bar development increases sharply around 8:00 minutes as does frequency of bank erosion sites. Cross section one is taken at 9:17 minutes and the velocity is estimated at 3.7 ft./sec.. with approximately 1.3 feet of incision. The bedload deposition with a D90 of three inches in diameter is driving the channel laterally causing the increased bank erosion.

1. No infra-structure was identified as threatened by the lateral migration. Treatment options for lateral migration are not recommended in this reach. Any reduction in sediment load achieved by stabilizing streambanks would need to be weighed against increases in sediment transport through treated reaches.
2. Reconnecting Little Kinkaid Creek with its floodplain at this point is recommended, provided it is done in conjunction with reducing the bedload reaching this segment. The use of Rock Riffle Grade Controls is the recommended treatment, but the design must insure that a stable “bankfull channel” can be maintained without excessive maintenance costs. The goal would be to pass finer sediments through the system and onto the floodplain for deposition, as well as reducing the large diameter bedload by stabilizing the streambanks within the newly created pools.
3. At six bankfull widths between riffles, this section of 3500 feet would require 10 to 12 riffles approximately two feet high at an estimated 300 tons of stone per structure. At \$30 per ton installed, the cost per structure would be \$9,000. Treatment cost for Chapter 2 would be \$90,000 to \$108,000.

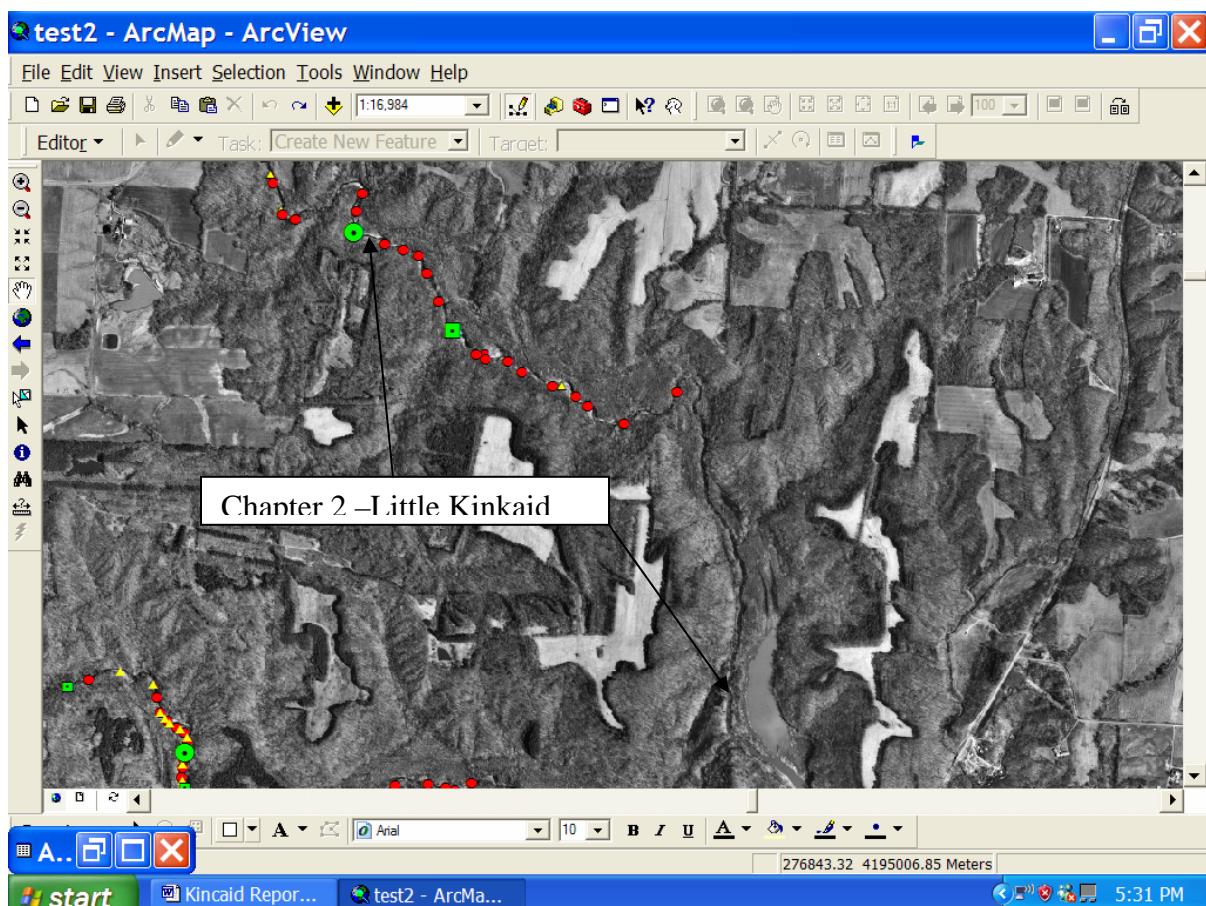


Figure 9: Location of Chapter 2 –Little Kinkaid Creek

Treatment Recommendations for Chapter 3

This segment is a continuation of Chapter 2 up to about 10:35 minutes on the DVD. At this point the channel enters a reach with bedrock bed control and some rock outcrop in the channel banks. The channel remains vertically stable through 14:18 minutes where the bedrock channel bed disappears through the remainder of the chapter. Valley slope in this section increases from 6.5 ft./mi. to 19 ft./mi. around 12:20 minutes.

The reach below 12:20 to 10:35 minutes appears to have been channelized and is a probable reason why bedload deposition does not appear as a problem until downstream of the channelized reach at 10:35 minutes. Cross sections two through six are in this chapter. There are velocity increases at each point upstream at 3.5 ft./sec.., 4.0 ft./sec.., 5.0 ft./sec.. and 5.8 ft./sec.. respectively at cross section two through five. This section appears to be transporting bedload effectively from cross section six downstream through cross section three before deposition becomes a significant problem.

The amount of past incision in this chapter steadily increases from the 1.3 feet found in Chapter 2 to 1.6 feet, 3.6 feet and 4.0 feet respectively at cross sections two through four. This incision probably means flows will be much deeper, with higher velocities and more tractive force within the channel before over bank flow occurs. Therefore, the stream is able to move the bedload through this chapter with minimal bar development and bank erosion is now more a function of velocity and tractive force than a result of bedload deposition (i.e., it is flow driven).

1. Continue with Rock Riffle installation through 10:35 minutes with an additional three to four riffles. With the estimated cost per riffle at \$9,000, the total cost amounts to \$27,000 to \$36,000. To be effective, the bedload now being deposited below 10:35 minutes needs to be addressed in the upper reaches to reduce volume and make Rock Riffle construction feasible.
2. In spite of past incision, the streambanks and channel bed are relatively stable above 10:35 minutes due to the abundance of natural stone. Some economic damage may occur as well if this section were reconnected to the floodplain as there are several crop fields and a county bridge in this chapter.

There are three sites where the lateral migration is threatening cropland. These sites at 11:12, 11:20, 11:49 minutes can be treated by use of Stone Toe Protection (STP) to protect adjacent improvements and stop the lateral migration. STP at these locations will have minimal effect on sediment transport, as very little deposition is occurring in this section, but will have an impact on the sediment contributions by controlling the lateral erosion. A total of 1000 feet of STP at 0.75 ton/ft. is needed. The estimated cost of installation is \$18,750 (750 ton @ \$25/ton).

3. Above 14:30 minutes there is some downcutting below a series of Rock Riffle Grade Control Structures installed under the IDOA Streambank Stabilization and Restoration Program in 1997. One additional structure and approximately 500 feet of STP are recommended to re-enforce this installation. The estimated stone requirements are 100 tons for the Rock Riffle and 300 tons for the STP. The cost is estimated at \$10,000 (400 ton @ \$25 ton).
4. The existing Rock Riffles in Chapter Three have been in place for seven years and have not filled with bedload. The performance of these riffles provide some evidence that Rock Riffles can be installed in the upper reaches to create a riffle-pool sequence and reduce sediment contributions downstream. The riffles seem to be maintaining depth and passing bedload very well from upstream sources. However, there has been some minor erosion between riffles and the addition of a small amount of STP would be a beneficial to maintain long-term stability.

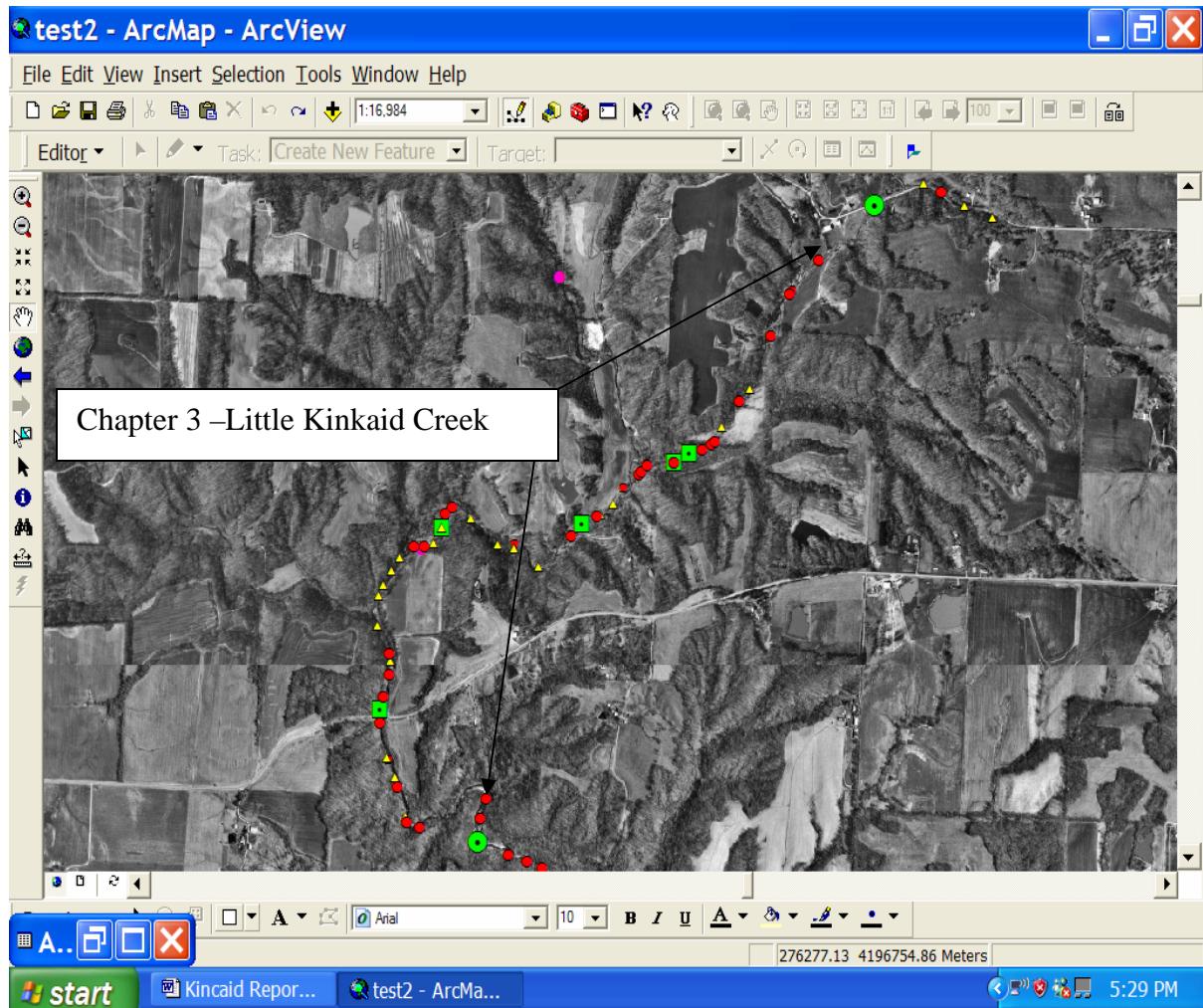


Figure 10: Location of Chapter 3–Little Kinkaid Creek

Treatment Recommendation for Chapter 4 (Little Kinkaid Creek)

Chapter 4 on the DVD contains about 40 seconds of video (15:00 to 15:40 minutes) at the upper end of Little Kinkaid Creek. This section is incised and runs parallel to a township road.

Install a series of eight to ten Rock Riffle Grade Control Structures on a 1200 feet segment. The riffle pool sequence created will dampen energy, reduce sediment contributions and help protect the road and two private drives. The total stone required is estimated at 1200 tons at a cost of \$36,000 (1200 @ \$30/ton).

(Kinkaid Creek)

This section of Kinkaid Creek is the outlet into Kinkaid Lake above Route 151. Sediments on the DVD from 15:50 to 17:17 minutes are fine sediments and are being transported by channel flows as bedload. From 16:18 minutes to the end of the chapter there are 30 identified erosion sites and five deposition sites. Bar development increases sharply around 17:17 minutes as does frequency of bank erosion sites. Cross section one is taken at 19:07 minutes and velocity is estimated at 3.6 ft./sec.. with approximately 0.9 feet of incision. The bedload deposition with a D90 of two inches in diameter is driving the channel laterally causing the increased bank erosion.

1. No infrastructure was identified as threatened by the lateral migration. The treatment options for lateral migration are not recommended in this reach. Any reduction in sediment load achieved by stabilizing streambanks would need to be weighed against increases in sediment transport through treated reaches.
2. Reconnecting Kinkaid Creek with its floodplain from 18:00 to 20:00 minutes is recommended, provided it is done in conjunction with reducing the bedload reaching this segment. The use of Rock Riffle Grade Control Structures is the recommended treatment, but the design must insure that a stable “bankfull channel” can be maintained without excessive maintenance costs. The goal would be to pass finer sediments through the system and onto the floodplain for deposition and reducing the large diameter bedload by stabilizing the streambanks within the newly created pools.
3. At six bankfull widths between riffles, this section of 4800 feet would require 10 to 12 riffles approximately two feet high at an estimated 350 tons of stone per structure. At \$30 per ton installed, the cost per structure would be \$10,500. Estimated treatment cost for Chapter 4 would be \$105,000 to \$126,000.

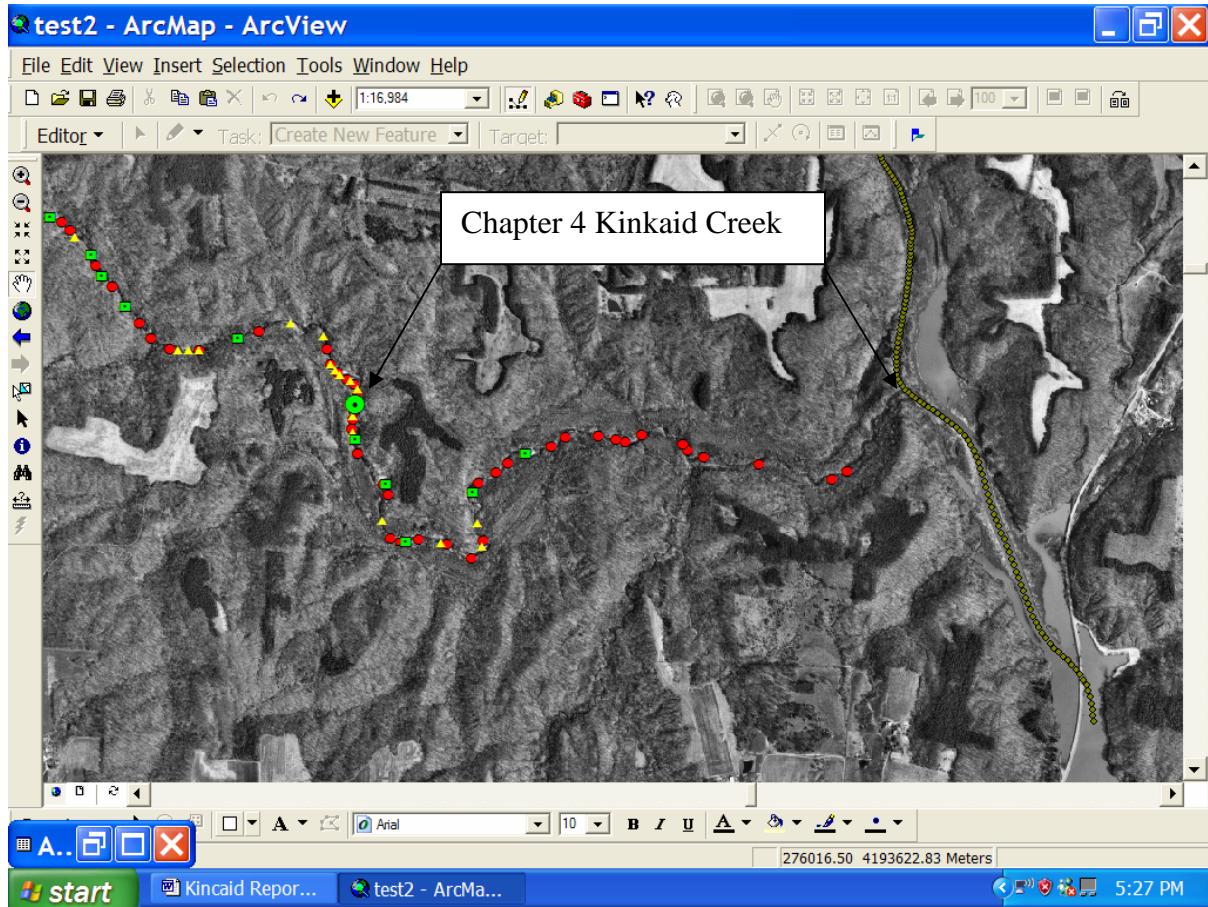


Figure 11: Location of Chapter 4 –Kinkaid Creek

Treatment Recommendations for Chapter 5

This chapter is a continuation of chapter 4 until approximately 20:28 minutes where the deposition and erosion decrease significantly. Cross Section two is in this chapter at 20:21 minutes where incision has increased to 2.1 feet from 0.9 feet and velocity has remained at 3.6 ft./sec.. Cross section three, four and five are also in this chapter and have increased velocities of 5.2 ft./sec., 5.4 ft./sec. and 5.4 ft./sec. respectively. Cross sections three and five have incision of 2.4 and 2.6 feet, while cross section four is only incised by 0.6 feet. This low incision rate for cross section four is probably due to two factors.

First, there is a concrete low water crossing downstream about 800 feet that is preventing downcutting from migrating upstream to cross section four. Second, the channel has been straightened in this reach and excavation and fill may have altered the true bank height. Below this concrete crossing around 22:15 minutes the valley slope increases from 5.0 ft./mi. downstream to 14.4 ft./mi. upstream. This chapter has 45 erosion sites identified along with 10 deposition points and 37 break points all scattered uniformly throughout the chapter with few specific areas of concentration.

1. Install Rock Riffle Grade Control Structures through the entire reach of 12,500 feet. Fifty Rock Riffles will be required to reconnect the channel to the floodplain. Each structure will require 400 ton of stone. At \$30/ton, the cost of each Rock Riffle is estimated to cost \$12,000. The estimated treatment cost for this chapter is \$600,000 ($50 \times \$12,000$).
2. There are two additional sites where lateral migration is affecting adjacent cropland. These sites can be treated with approximately 700 feet of STP in addition to the Rock Riffles. At \$25 per ton, the cost of this treatment will be \$17,500.

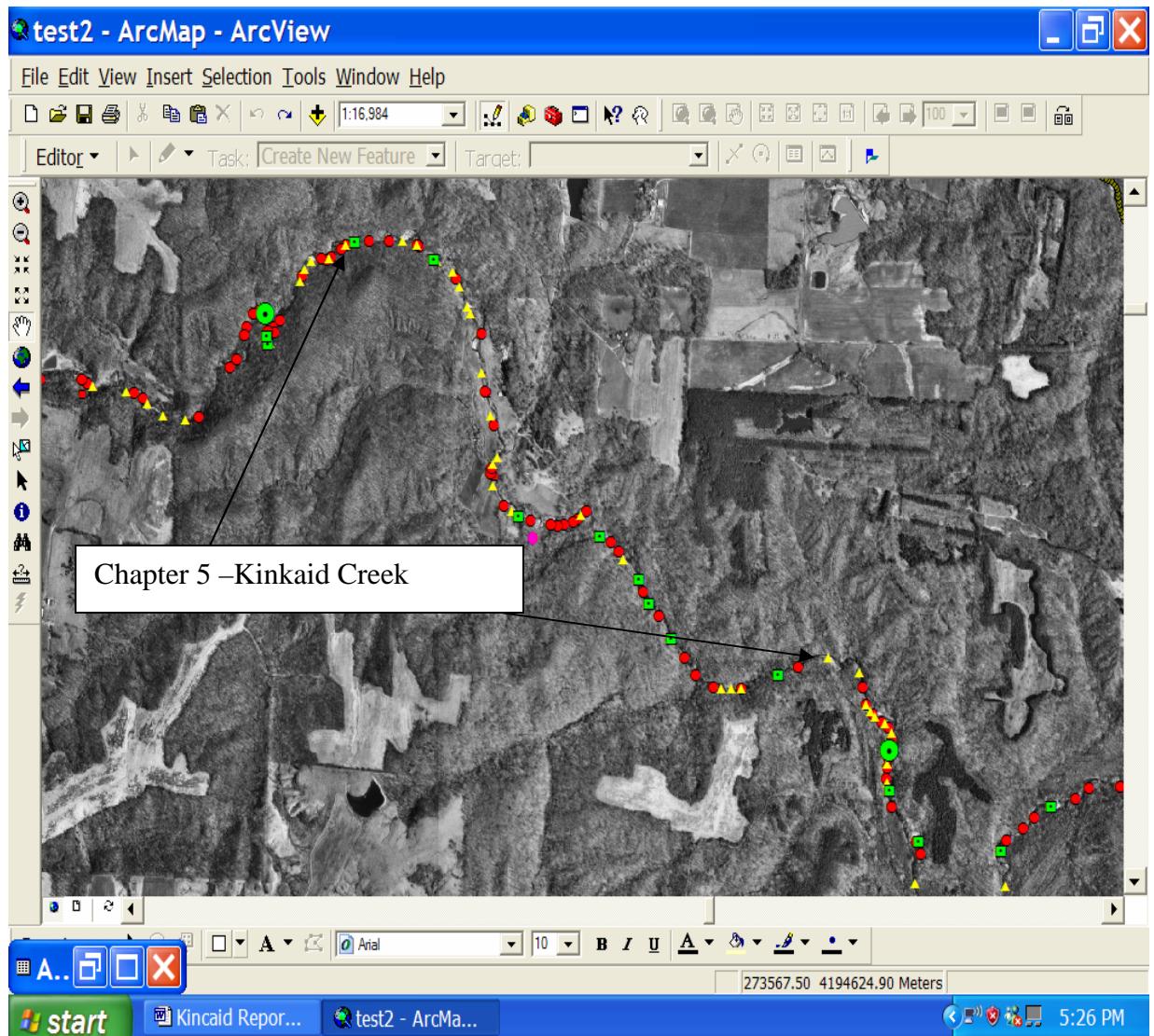


Figure 12: Location of Chapter 5 –Kinkaid Creek

Treatment Recommendations for Chapter 6

The incision in this chapter is controlled by bedrock throughout the entire length of stream. There are locations where there is no bedrock visible, but grade is still controlled by rock outcrops at multiple locations. In most locations, the channel is still incised and separated from the floodplain, but it has generally reached its limit in depth. The Kincaid Stone Company operates a limestone quarry along about a third of this chapter's length and reconnection to the floodplain could cause damage to the quarry's operation. There are 28 identified erosion points in this chapter and 24 break points, which are bedrock in the channel bed. Only six of the 28 erosion sites are along the quarry operation.

The lower end of this chapter at 25:30 minutes is where the channel begins to open up in valley width while above this point to 26:00 minutes (near the lower end of the quarry operation) the channel is very confined in a deeply incised rock-lined valley. From the beginning of the chapter, up through the quarry operation at 28:00 minutes there is very little opportunity for deposition and none was identified on the DVD.

The valley slope increases near the lower end of the quarry operation to 42 ft./mi. and remains relatively uniform upstream through the end of Chapter 6. Velocities remain at 5.0 to 5.5 ft./sec. at cross sections six through eight. It is very likely that a very high portion of the bedload entering the upper end of Chapter six is transported all the way through to Chapter 5 where the problems with deposition occur.

1. Above 28:00 minutes a series of Rock Riffle Grade Controls can be constructed to raise the water surface profile closer to the floodplain with the intent of reducing the fine sediment load being transported downstream by encouraging more rapid development of a new floodplain of sufficient width to slow velocities. While the incision has reached 4.6 feet at cross section six, the newly developing floodplain being formed is nearly 60 feet wide at an elevation of only 1.5 feet above bankfull.

Therefore, riffles approximately two feet high may raise the water surface enough to reduce velocities and encourage deposition. The area from 28:00 to 29:45 minutes would be applicable to this technique.

This reach is approximately 5200 feet long and would require about 25 riffles for treatment. Since the channel continues to get narrower the cost per riffle is estimated to be \$4,500 (150 tons at \$30 per ton). The total cost of treatment for this reach is estimated to be \$112,500.

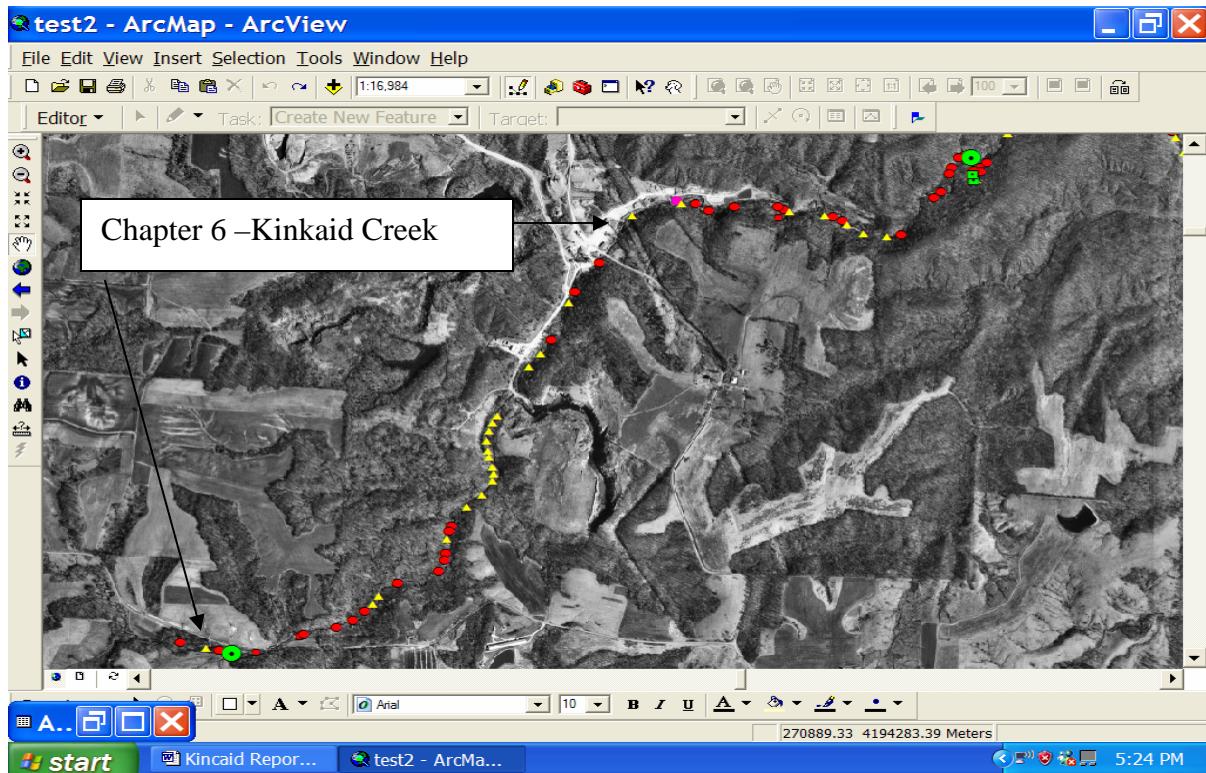


Figure 13: Location of Chapter 6 –Kinkaid Creek

Table 2 shows a summary of the recommended treatment costs for all chapters of Little Kinkaid and Kinkaid Creeks.

Estimated Cost to Implement Recommendations on Little Kinkaid and Kinkaid Creek				
	Chapter	Riffles	Stone Toe	Est. Cost
Lil_Kinkaid	2	12		\$108,000
	3	4		\$36,000
	3		1000 ft	\$18,750
	4	10		\$36,000
	4	12		\$126,000
	5	50		\$600,000
Kinkaid	5		700 ft.	\$17,500
	6	25		\$112,500
	Totals	113	1700 ft.	\$1,054,750

Table 2

Summary

Both Kinkaid and Little Kinkaid Creek have steep gradient, flow driven, incised upper reaches that transport bedload and sediment very efficiently until the stream gradient begins to flatten out around elevation 480. At this point, both streams begin to deposit heavier bedload material and become bedload driven with lateral erosion being the result of bedload accumulations in the channel. This hydraulic sorting of material results in the exchange of heavy bedload for the smaller alluvial material found in the streambanks. Finer material, silt and clay, are then carried downstream in the form of bedload “waves” and/or washload toward Kinkaid Lake. The proposed solution of reconnecting the incised channels to the floodplain is recommended because:

1. The major landuse in the floodplain is bottomland forest that will suffer no economic loss due to more frequent flooding.
2. There are no roads or homes within the floodplain that will cause economic or social objections to more frequent flooding.
3. Increased out of bank flow will result in less tractive force on the existing eroding banks by reducing effective bank height, which will result in reduced streambank erosion and lower sediment contributions to the stream.
4. Increased out of bank flow will create lower velocity flows occurring more frequently over the floodplain, resulting in more deposition of fine material in the floodplain and reduced fine material deposits in Kinkaid Lake.
5. As the finer material has higher affinity to phosphorus transport, the total phosphorus load delivered to the lake will be reduced lowering the ph level.

This report is not comprehensive enough to predict rates of reduction, provide specific construction detail or design plans for implementation. Additional information and analysis will be needed to determine the effectiveness of the proposed solution and/or development of an implementation plan. However, the report is intended to provide an approach that has the potential to reduce phosphorus levels, restore streams to near equilibrium and improve the aquatic habitat by establishing an improved riffle-pool habitat.

References:

- (1) IEPA, Total Maximum Daily Load Development for Big Muddy River #1 Watershed, January 2004: pg. 2-2
- (2) Ibid. Paragraph 2, sec. 8.2
- (3) Ibid. Paragraph 2 and 3, sec. 9.1
- (4) NRCS, Erosion and Sediment Inventory Procedures for Illinois, April 2001. P. 9
- (5) Ibid. Section i, page 10.

APPENDIX A**NRCS STREAMBANK INVENTORY AND EVALUATION FORMS FOR
CROSS SECTION ON KINKAID AND LITTLE KINKAID CREEKS,
JACKSON COUNTY, IL**