TECHNICAL
REPORT
M27

FINAL REPORT—SEPTEMBER 2003

US Army Corps of Engineers
St. Louis District

HEADCUTTING INVESTIGATION UPSTREAM OF THE KASKASKIA RIVER NAVIGATION PROJECT, ILLINOIS

David C. Gordon, P.E.
Robert D. Davinroy, P.E.

U.S. ARMY CORPS OF ENGINEERS
ST. LOUIS DISTRICT
HYDROLOGIC AND HYDRAULICS BRANCH
APPLIED RIVER ENGINEERING CENTER
1222 SPRUCE STREET
ST. LOUIS, MISSOURI 63103

Sponsored by and Prepared for:
U.S. ARMY CORPS OF ENGINEERS

APPLIED RIVER ENGINEERING CENTER

Technical Report M27

Headcutting Investigation Upstream of the Kaskaskia River Navigation Project, Illinois

U.S. Army Corps of Engineers - St. Louis District
1222 Spruce Street
St. Louis, Missouri 63103

September 2003

TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

Completed in 1972, the 36-mile long Kaskaskia River Navigation Channel shortened and widened the Kaskaskia River between Fayetteville, Illinois and the confluence with the Mississippi River (See Figure 1, Vicinity and Project Map). Immediately after the excavation of the channel was completed, the upper 6 miles of the Project experienced excessive siltation due to caving banks upstream. The Project had caused a destructive headcut that initiated near Fayetteville and moved upstream. The headcut resulted in the widening and deepening of the natural channel upstream of the Project causing loss of private property and damage to the bottomland forest and aquatic habitat along the Kaskaskia River. The excess sand and silt generated from the caving banklines and degraded riverbed deposited in the upstream portion of the newly constructed navigation channel. The Corps St. Louis District prepared a GDM for the addition of a grade control structure, which would prevent an additional headcut from forming when the channel was re-dredged. This structure served this intended purpose but was unable to arrest the headcuts that had already moved upstream.

The most severe bank caving and sediment accumulation probably occurred within a few years after completion of the canal excavation. However, the headcutting is ongoing and continues to cause additional damage as it migrates upstream through Illinois's largest continuous tract of bottomland forest. The excess sediment and absence of maintenance dredging has caused the upstream portion of the navigation canal to once again silt in resulting in the reach being unsuitable for commercial navigation.

This report will describe the bank erosion and channel degradation problems along the Kaskaskia River. It will show how these problems were induced by the Kaskaskia River Navigation Project. The report will discuss the cause of the problem and illustrate the impacts and resultant damages. Forecast of additional damages that may occur if the problem is not resolved will also be illustrated. A description of the additional data that will be needed to specifically identify problem areas will be discussed. This data will enable the Corps to design the proper remedial measures with a view toward identifying the least cost measure(s) that will prevent additional deterioration of the river, loss of property, infrastructure, and habitat as well as remediate the extensive damage that has already occurred. A few preliminary design alternatives will also be discussed. Costs associated with these designs were not pursued in this study.

BACKGROUND

Kaskaskia River

The watershed of the Kaskaskia River (Figure 2) covers 5,790 square miles, which makes it the second largest in the State of Illinois. It extends from the center of Champaign County (in east-central Illinois) in a southwesterly direction to the Mississippi River near the City of Chester (in south-west Illinois). The length of the watershed is about 175 miles and its average width about 33 miles, with a maximum width of 55 miles. The Kaskaskia River flows through the approximate center of the watershed and has a sinuous channel with a slight fall and low banks. The distance of the river by channel is over 300 miles, while the total fall is about 390 feet.

The natural flow regime of the Kaskaskia River has been altered extensively by three major Corps of Engineer's projects. Two of these projects are flood control reservoirs that were completed in the late 1960's and early 1970's. The 26,000-acre Carlyle Lake Project was completed in April of 1967. The dam on the Kaskaskia River at Carlyle is 107 miles from the mouth and creates the largest man-made lake in Illinois. In 1970 an upper section of the Kaskaskia was dammed to create the 11,200-acre Lake Shelbyville. The third completed project was the Kaskaskia River Navigation Project.

Navigation Project

The original single purpose commercial navigation project was authorized by Congress in the River and Harbors Act of 23 October 1962, Senate Document No. 44, 87th Congress, P.L. 87-874, Second Session. The Project consists of approximately 36 miles of waterway, a lock and dam, and a grade control structure. The navigation channel extends from the grade control structure at Fayetteville, Illinois to the Lock and Dam near the confluence with the Mississippi River. A minimum channel depth of 9 feet is authorized to facilitate navigation. The width of the channel is approximately 225 feet wide, which allows for the passing of two tows, two barges abreast.

The first construction contract of the navigation channel was awarded in June 1966. To achieve construction of the Project, the project sponsor, the state of Illinois, relocated numerous power, telephone and gas pipelines. Federal relocations included two highway and three railroad bridges. The final excavation of the navigation channel from River Miles (RM) 29.5 to 36.2 was completed November 1972. The grade control structure was added to the Project later and was completed in 1982.

The Lock and Dam (Figure 3), completed in 1974, consists of a single lock, 600 feet long by 84 feet wide. A 130 foot long gated spillway with two 60-foot-wide control gates is utilized to regulate a maximum regulated navigation pool of 368.0 NGVD. (A pool deviation of +0.8 feet has been in use since May of 1988 to address shallow water conditions in the mouths of the numerous remnant channels).

In addition to the Corps facilities, the Illinois Department of Transportation (IDOT) purchased approximately 20,000 acres adjacent to the Kaskaskia River as part of the Navigation Project. The Kaskaskia River State Fish and Wildlife Area (KRFWA), is one of the largest, state-owned and managed sites in Illinois. Located 35 miles southeast of St. Louis, Missouri, the area comprises more than 20,000 acres of lands and waters and extends along the Kaskaskia River Navigation Project in St. Clair, Monroe, and Randolph Counties. The KRFWA includes an extensive mixed bottomland forest comprised of pecan, soft maple, bur oak, pin oak, shellbark hickory, willow. Many cultivated and fallow fields, native grass patches, brushy areas, and other "open" areas are interspersed with the stands of mature bottomland timber. Due to this great diversity of habitats, there exist good wildlife populations on the site.

The Water Resources Development Act (WRDA) of 1996, Section 321, Kaskaskia River, Illinois modified the original Navigation Project authorization to include fish and wildlife habitat restoration as Project purposes. Due to the Project's recreational importance the addition of recreation as an authorized purpose for the Navigation Project was mandated by the WRDA of 2000.

The Corps of Engineers, St. Louis District, has responsibility for the operation and maintenance of the lock and dam, grade control structure, navigational channel, fish and wildlife, and habitat maintenance within the Corps administered lands. The Kaskaskia Regional Port Authority (KRPA), a quasi-public state entity, and the Illinois Department of Natural Resources (IDNR) have the responsibility to provide necessary lands for dredge disposal and to maintain the disposal sites.

Initial Project Effects

Prior to channelization, the Kaskaskia River within the Project limits encompassed a length of approximately 52 river miles and an average channel width of approximately 125 feet. The Project converted the pattern of the river channel from highly sinuous to a straightened channel with only a few long bends. The excavation of the channel to authorized Project dimensions shortened the distance from Fayetteville to the river mouth by approximately 16 miles (from RM 52 to RM 36) and cut off 26 river bends leaving remnant channel segments. Removing this river length steepened the slope of the river by 80%, from 0.25 to 0.45 feet per mile. The average channel width was expanded by 80% to approximately 225 feet and the natural channel bottom was deepened an additional 5 to 10 feet.

The channelization of the Kaskaskia River immediately resulted in a major change in the natural river regime upstream of the Project. The increased slope and additional channel width initiated a headcut that began at the upstream end of the navigation channel near Fayetteville, Illinois. This headcut quickly traversed upstream through the natural, undisturbed Kaskaskia River channel. The headcutting degraded the riverbed and widened the banklines upstream of Fayetteville (Figure 4). The excessive material produced from this erosion was then deposited in the navigation channel between

Fayetteville and New Athens. Between 1972 and 1981, approximately 2.5 million cubic yards (cy) of material had been deposited in the upper 6 miles of the canal thereby reducing depths and closing this portion of the channel to navigation.

It was feared that removing this material from the navigation channel would initiate a second headcut upstream of Fayetteville. It was concluded that after the initial headcut traversed through the area, the river was attempting to reestablish an equilibrium condition just upstream and downstream of Fayetteville. Engineers worried that disturbing this reach with another dredge cut could initiate another headcutting episode that would fill in the nine-foot navigation channel again.

Remedial Measures

To prevent the occurrence of additional damage from a secondary headcut, the St. Louis District initiated an engineering study in the mid-1970s. A one-dimensional, numerical model study (HEC6) of the Kaskaskia River was conducted. Output from the model indicated that placement of a grade control structure, located at the upper end of the navigation channel near Fayetteville, would prevent the formation of a second headcut. It was shown that this would significantly reduce deposition within the navigation channel after the upper reach was re-dredged.

A physical model of the proposed grade control structure was also conducted at the Waterways Experiment Station (WES) to study localized physical effects, including velocities and flow patterns. Results of this study were documented in Technical Report HL-80-20, entitled *"Kaskaskia River Grade-Control Structure and Navigation Channel, Fayetteville, Illinois, Hydraulic Model Investigation"*, U.S. Army Engineer Waterways Experiment Station, December 1980. The two studies concluded that a structure was needed before the deposited material was dredged and the navigation channel reopened. This structure would maintain the upstream water surface profile so as not to disturb the state of dynamic equilibrium that had developed immediately upstream of Fayetteville.

The St. Louis District began a project in 1981 to construct the grade control structure at the head of the navigation channel and about 700 feet downstream from the U.S. Highway 460 Bridge at Fayetteville, in St. Clair County, Illinois. The structure was completed at 100 percent federal cost at RM 35.9 in 1982 (Figure 5). The purpose of the grade control structure was only to prevent the generation a secondary headcut upstream of the navigation channel so the Project would function as initially intended. The structure was not intended to arrest the original headcut that had traveled upstream and off of Project lands.

In 1983, General Design Memorandum (GDM) No. 2 was prepared by the St. Louis District as a supplement to the original Kaskaskia River Navigation Project GDM No. 1 (prepared in 1964). The Navigation Project work was conducted under the authority of the Senate Document No. 44, "all generally in accordance with the plan of the District Engineer, and with such modifications thereof as in the discretion of the Chief of

Engineers may be advisable". The channel was then re-dredged from RM 28.6 to 36.0 between 1983 and 1985. With the grade control structure constructed and the last portion of the channel excavated to the approved FDM and GDM design, the Project was considered complete.

Post-Project Developments

In the early 1990s, the St. Louis District decided to defer maintenance dredging within the upper 7 miles of the navigation channel (between Fayetteville and New Athens) to avoid O&M costs until the channel was needed for navigation. The decision was made based upon the fact that no facilities had been constructed within this particular reach and navigation had been non-existent since completion of the Project. As a result, MVS avoided upwards of 5 million dollars in dredging costs over 18 years.

In 1999, as a result of public and agency concerns about additional bank erosion and continued headcutting upstream of the Project, the St. Louis District conducted an erosion and sedimentation study of the Kaskaskia River, between Carlyle Lake, Illinois and New Athens, Illinois. The study was initiated as a cooperative effort between the St. Louis District, the Original Kaskaskia Area Wilderness, Inc. (OKAW), and the IDNR. The OKAW group was formed to develop, enhance and protect the ecological and social values of the natural resources within the Kaskaskia River corridor below Carlyle Lake downstream to Fayetteville, Illinois. This organization was instrumental in establishing a "Cost Sharing Agreement for Planning Assistance" between the Corps and the State of Illinois, which was signed on 18 December 1998.

Funds were issued from the IDNR on 19 January 1999. The study, conducted between June 1999 and October 1999, was a multi-agency and public effort that included U.S. Department of Agriculture (USDA), Natural Resource Conservation Service (NRCS), WES, St. Louis District, IDNR and OKAW members. The results of this study are documented in Technical Report M13 (TRM13) entitled *"Bank Erosion Study of the Kaskaskia River, Carlyle Lake to New Athens, Illinois,"* USACE, St. Louis District, February 2000.

As a result of this study, on 30 May 2000, a memorandum was submitted to the Commander of the Mississippi Valley Division (MVD). The subject was "Reconnaissance Report, Correction of Design Deficiency: Grade Control Structure, Carlyle Lake/Kaskaskia Navigation Project." In this document it was "recommended that approval be granted to initiate a design deficiency report with a view toward identifying the least cost measure, in an environmentally friendly manner to sustain the authorized Project purposes." Much of the text from that original memorandum is included in this document for information purposes.

On 22 June 2000, MVD granted approval to initiate a design deficiency report. The memorandum stated, "We have reviewed the subject memorandum and concur with the District Commander's recommendation to initiate a design deficiency report. The purpose of the report will be to further analyze the headcutting and bank erosion, which is occurring on the Kaskaskia River, and develop a plan to address the problem."

Future Project Developments

Due to the absence of commercial facilities and the lack of navigation traffic, depths in this 7-mile reach between New Athens and Fayetteville have not been maintained. However, on 25 April 2000 in Red Bud, Illinois, the KRPA presented to the St. Louis District their proposal for the development of a grain elevator at Fayetteville, Illinois. The grain elevator will service the Southwest Illinois agricultural market. At present, the agricultural commodities are hauled by truck to markets in St. Louis and Evansville, Indiana. The KRPA had originally intended to have the agricultural elevator operational in the year 2002. It will handle 20-25 million bushels of agricultural products for 7 Farm Service Cooperatives in a 5-county area. The KRPA and Farm Service estimate 10-12 cents/bushel higher prices to the farmers by using a river terminal for farmers than the inland elevator prices for shipping agricultural commodities to market. Other bulk materials commodities such as jibson, sand, and fertilizers will also be handled at the new port facilities. Support for the Fayetteville elevator is high due to the market advantage.

During the week of 04 March 2001, Corps representatives met with the IDNR staff and KRPA General Manager George Andres at the Carlyle Lake Project to discuss the New Athens to Fayetteville Kaskaskia Dredging Project. Channel maintenance of the nine-foot navigation channel from New Athens to Fayetteville will be necessary when the facility is completed. Since depths in the navigation channel have not been maintained, the reach has accumulated nearly 1.8 million cubic yards of material (calculated from the 1999 hydrographic survey, Figure 6). In order to make this reach of river usable for commercial navigation, the reach must be re-dredged. The IDNR and the KRPA have developed an acceptable dredge spoil disposal plan for the Project. The Section 404 Public Notice was prepared in December 2001, which resulted in numerous letters of support for the Project. Although funding is not currently available for the Project, the Corps, IDNR and the KRPA prepared for the dredging season.

PROJECT PERFORMANCE INVESTIGATION

Original Project Design

As with most channelization projects of the time, the original design of the Navigation Project did not address the morphologic changes that were expected to occur in the natural upstream river reaches outside of Project boundaries. Design Memorandum No. 1, Hydrology and Hydraulic Analyses, 1963, did not discuss the potential for headcutting, channel degradation, or channel widening. The only statement in this document that referred to sedimentation follows: “The small amount of anticipated channel dredging to remove the deposited sediment has been included in the maintenance costs.” The “deposited sediment” refers to the natural rate of sediment transport that would be expected to deposit within the entire navigation channel. The document did not discuss an increased sedimentation rate that would be expected to occur due to headcutting. It also did not discuss the obvious effects channel straightening or widening would have on the natural river regime. It also did not anticipate that most of the sedimentation, either natural or headcut induced, would be deposited in the upper 7 miles of the navigation channel, between Fayetteville and New Athens.

Design of Grade Control Structure

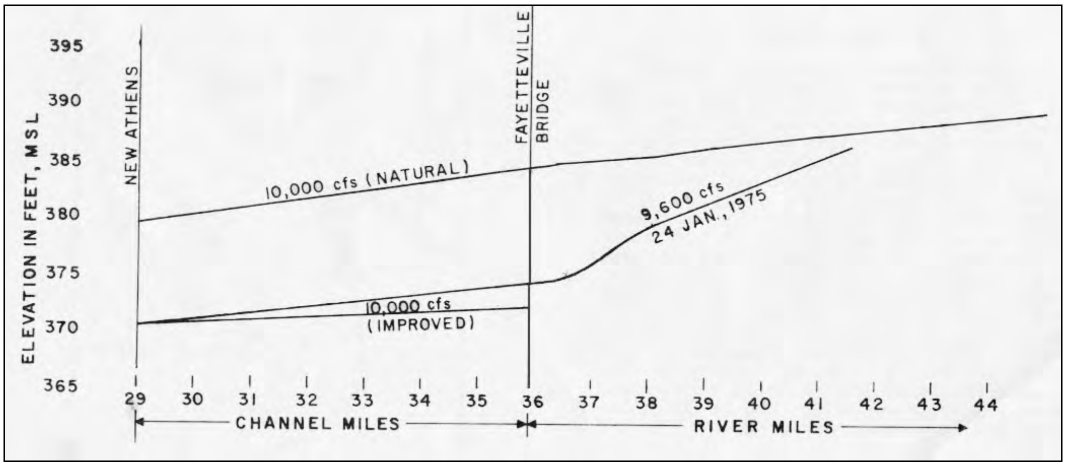
The grade control structure was added to the Project after the channel was constructed but before the Project was complete. The grade control was designed to prevent additional headcut formation and channel degradation as a result of re-dredging the navigation channel downstream of Fayetteville. The location at Fayetteville was chosen because this area was at the upstream boundary limits of the Navigation Project. The river upstream of Fayetteville had begun to reestablish a morphological equilibrium after the channel was degraded and widened by the initial headcut that had damaged the area shortly after the Project was completed in 1972. This protection was needed before the accumulated sediment could be safely redredged from the navigation channel. It was feared that without the grade control structure an additional headcut would again increase depositional rates in the navigation channel and cause additional dredging.

Denzel and Strauser, in a Technical Paper from the 1982 International Symposium on Urban Hydrology, Hydraulics and Sediment Control, stated the following:

> *“A grade control structure is required so that upstream headcutting and downstream sedimentation is minimized It is concluded that a structure is needed in order to maintain the upstream water surface profile so as not to disturb the state of dynamic equilibrium which presently exists in the channel, both upstream and downstream of Fayetteville.”*

> *“The grade control structure is needed to provide vertical control which will permit redredging of the upper portion of the navigation canal and maintain existing water surface without "headcutting" and upstream bank erosion and*

aggradation of the downstream channel bottom. An examination of the Kaskaskia River discharge profile between New Athens and 10 miles above the Fayetteville Bridge reveals a significant shift downward of about 12.5 feet due to construction of the navigation canal. The profile for 10,000 cfs was chosen because it represents bank full flow. A 9,600 cfs profile was observed on 24 January 1975. A comparison of before and after conditions shows a dramatic change in the profile.



An upward shift is apparent below the Fayetteville Bridge and a downward shift can be observed above Fayetteville. This aggradation below Fayetteville has been accompanied by bank caving and river widening above Fayetteville. A review of aerial photos taken before and after canal construction shows significant river widening and bank caving above Fayetteville. Between 1968 and 1970, no major changes in bankline stability were observed. Between 1970 and 1974, several areas of significant bank caving and river widening were easily observed. About 17 acres were eroded between 1972 and 1974. Between 1974 and 1976, additional caving was noted; however, it appears that a temporary state of equilibrium has been achieved. It is believed that the river has temporarily adjusted to the new imposed conditions. Any further dredging activity in the upper reach of the canal before the grade control structure is complete could initiate additional bank erosion and river widening above Fayetteville and result in additional deposition below Fayetteville."

The Environmental Impact Statement (EIS) of the Proposed Grade Control Structure (1980) stated:

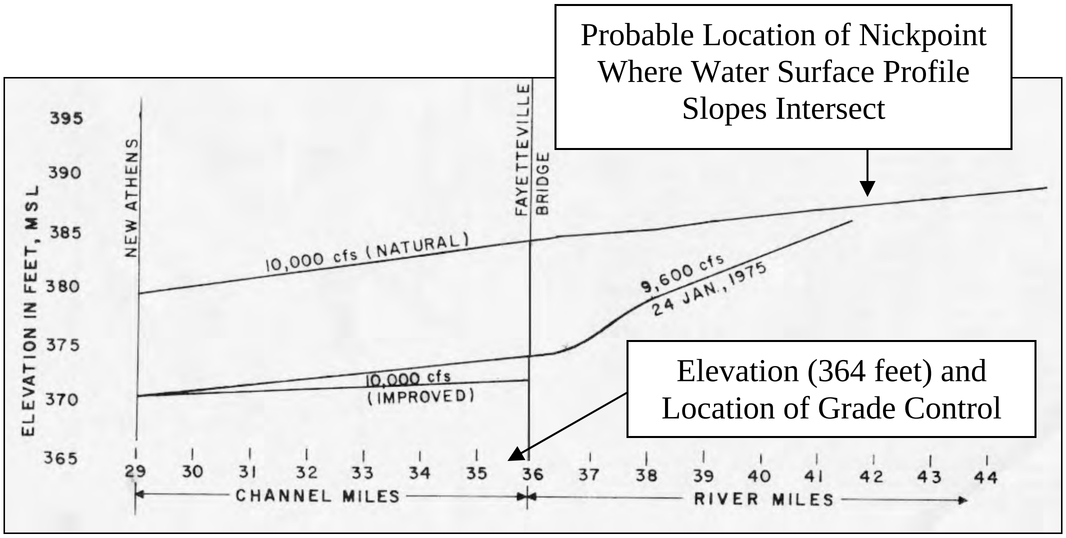
"The most severe bank caving and sediment accumulation occurred within a few years after completion of the channel excavation (1972 – 1974). The sediment, which has accumulated in the canal, has acted as a "natural" grade-control structure to stabilize the river upstream from Fayetteville, Illinois. The river in the upper six miles of the navigation channel also appears to have reached a relatively stable condition, but is not suitable for navigation."

"The purpose of the grade control structure is to maintain the present channel characteristics of the unchannelized reach of the Kaskaskia river upstream of the navigation channel, and thereby, reduce further upstream degradation, which otherwise would be caused by redredging the navigation channel between Fayetteville and New Athens."

"The (grade control structure's invert) elevation of 364 feet m.s.l. was chosen because the elevation approximates the invert of the present channel in the vicinity of the grade control structure and provides a minimum four feet water for small boat traffic. <u>The grade control will have very little effect either on the upstream river bottom profile or on the water surface profile. The basic concept of the design is to maintain the upstream water surface profiles as close as possible to the present conditions, after the navigation channel dredging occurs.</u> In other words, the grade control structure is to substitute for the mass of sediment now accumulated in the upper reach of the navigation channel to reproduce the present upstream water surface profiles when that mass of sediment is removed. The structure is not and will not be a sedimentation trap; normal sediment will continue to be transported downstream and deposited in the navigation channel. Normal bank caving upstream will continue. However, the grade control structure should substantially reduce the recurrence of the severe bed degradation-aggradation when the navigation channel to Fayetteville is redredged."

The previous statements reinforce that the grade control's sole purpose was to hold the bed and water surface profiles in the present condition after the navigation channel was redredged. That present condition represented a continually degrading channel upstream of Fayetteville and a downstream aggrading channel that had found dynamic equilibrium in the vicinity of Fayetteville. However, this dynamic equilibrium did not exist further upstream where the headcut was continuing to migrate upstream. The design of the grade control at this location and elevation could only affect the channel profile locally over a relatively short distance upstream. Additional grade control would have been required upstream to arrest the active headcut. However, the grade control was successful in preventing a second headcut from damaging the dynamic equilibrium at Fayetteville after the navigation channel was redredged.

Using the water surface profile figure from Denzel and Strauser, the approximate location of the original nickpoint was determined. This explained why the placement and elevation of the grade control structure would not have been able to arrest the upstream migration of the headcut. The captions on the figure indicate that the grade control could not possibly have corrected the difference in water surface profile slopes that was occurring approximately 6 miles upstream of its location.



These statements continue to support the fact that the grade control structure was not designed to arrest the headcut migration that initially passed through this area. The structure was intended to prevent a second headcut from developing after the channel was re-dredged which would once again alter the water surface profile. It was designed to maintain the equilibrium and channel gradient near Fayetteville that had been established after the downstream channel was redredged. This deposited material had acted as a natural grade control as the river began to reestablish its grade and morphology after the initial headcut damaged the reach.

Extensive damage occurred over great lengths in the natural river channel in the ten years between channelization and the construction of the grade control. The location of the grade control structure could not have been expected to reestablish the natural gradient, arrest the initial headcut migration, and control channel upstream degradation. This would be especially true if the headcut had indeed migrated to a location 6 to 11 miles upstream of Fayetteville in 1978, as suspected. The effects of continued channel degradation, widening, and headcutting upstream were not considered in the design of the grade control for the reaches several miles upstream of Fayetteville. A second headcut was not evident after redredging therefore the grade control performed as designed.

Post-Project Problems

After the grade control structure was constructed at Fayetteville, the initial headcut continued to migrate unimpeded upstream and caused irreparable damage to the river morphology and environment. The original design of the navigation channel failed to consider channel widening and profile degradation that would be expected to occur after the length of the river was reduced by 31% and widened by 80%. The initial design of the navigation project should have included a grade control structure or headcut abatement structure at the end of the navigation channel near Fayetteville, prior to channel excavation. Properly designed, this structure would have been able to prevent the development of a headcut and would have protected the upstream unchannelized, natural reaches from degradation and widening.

The grade control structure performed as designed. It prevented a second headcut from developing after the channel was redredged. The structure was not intended to address the ongoing damage that was occurring as a result of the initial headcut located several miles upstream. At the time of the study it may have not been realized just how far the headcut had migrated upstream. The limits of the HEC model may not have extended upstream the distance needed to accurately model the water surface profiles affected by headcutting.

The delays involved with studying, modeling, and constructing a design solution probably compounded the problem. The HEC model was initiated in the mid-1970's while the WES model was completed in the late 1970's. By the time the grade control was constructed in 1982, it was highly probable that the results from the HEC model were invalid for the upstream reaches. Due to the continued upstream migration of the headcut, its location as modeled during the HEC study had most likely shifted by the time the grade control was constructed in 1982. The observed water surface profile in 1975 was probably similar in 1982 at Fayetteville but the migration of the headcut probably made it considerably different further upstream.

Project Induced Damages

The damages induced by the headcutting have resulted in significant economic loss to the government through increased dredging, loss of private property, and unquantifiable ecosystem degradation to the riverine environment and bottomland hardwood forest.

The increased erosion induced by the headcut has introduced additional sediment load into the system. This increased load is responsible for the high rate of deposition in the navigation channel, which requires more frequent dredging. The majority of this material has deposited in the navigation channel just downstream of Fayetteville.

This channel degradation has resulted in considerable damage to the environment through a significant portion of the largest continuous tract of bottomland hardwood forest remaining in Illinois. Based on preliminary figures the headcut has destroyed close to 200 acres of valuable bottomland forest, most of which is privately owned. The Kaskaskia watershed between Carlyle Lake and the start of the Navigation Project has 18 tracts of forest that are greater than 1,000 acres and of those 18, eight are greater than 2,000 acres. These large unbroken tracts of forest are extremely important to the state's neotropical migrant bird population. Approximately 90% of the state's avian species that are on the state's threatened and endangered species list occur in these areas.

The environmental cost of the headcutting to terrestrial habitats up to this point has not been given a quantifiable value such as "habitat units". It can be assumed that if left uncorrected, the headcut will continue to degrade the channel and erode habitat along the Kaskaskia River and its tributaries. At this point, the majority of the habitat loss has occurred along an 18-mile stretch of the Kaskaskia with 43 miles additional miles left until it reaches Carlyle Dam.

The headcutting will also lower the water table along the Kaskaskia River and its tributaries, which will eventually change the tree species composition by allowing more water-intolerant upland species to survive. This will have a negative impact to bottomland species such as the cerulean warbler, which is currently a candidate species for the Federal threatened and endangered species list. Associated wetlands along the main stems will also become dryer and may loose some of their wetland functions and values. These wetlands currently provide valuable nesting sites for the area's amphibians.

The environmental cost of the headcutting to the aquatic habitat is hard to quantify due to the limited data that exists on the state of the habitat and fishery populations before and after the Project was completed. However, the following is from a letter dated October 29, 2001 from Randy W. Sauer, Stream Biologist, from IDNR in Carlyle, Illinois:

> *"Fisheries monitoring efforts in the Kaskaskia River have provided at least anecdotal evidence that habitat conditions improve in the unchannelized river as one progresses upstream from the head of the KRNP channel to the Carlyle dam. IDNR's recent fish sampling shows a longitudinal rise both in species richness (total number of fish species collected in an electrofishing sample) and catch-per-unit-effort (number of individual fish collected in an hour of shocking.)*
>
> *"These data were somewhat supported by 1999 monitoring efforts at two of the above stations. The Carlyle site yielded 21 species of fish with a CPUE of 350 fish/hr while the Venedy Station sample resulted in 19 species with only 168 fish/hr. The Fayetteville and Covington stations were not sampled in 1999.*
>
> *"Channel instability in the lowermost section of the "natural" (i.e. unchannelized) Kaskaskia River is likely detrimental to its fish community. Sediment load, much of it resulting from streambank erosion, is undoubtedly greater here than further upstream, particularly when one considers the sediment trapping efficiency of the Carlyle dam. The process of headcutting erodes bed materials which may destroy fish spawning sites. Like-wise, tributary streams with their mouths perched several feet above the river channel lose their value as seasonal spawning habitats as fish migration is made impossible under normal flow conditions.*
>
> *"Although moderate amounts of "large woody debris" (submerged logs, tree tops, root wads etc) in a river channel are usually beneficial as cover to stream fishes, the abundant fallen trees within the KRNP's Fayetteville-Venedy reach are of questionable habitat value. These mid-channel debris accumulations trap so much sediment that they are often sitting in a few inches of water and are therefore of little use to most fishes. As channels widen during the headcutting process there is often a compensatory "filling in" with bed and bank materials from further upstream, resulting in shallower mean depths in the affected reach. Coupled with the loss of riparian shading as bank side trees collapse into the channel, this could result in elevated water temperatures and lower dissolved oxygen levels*

during the stressful summer months. The filling in of deeper "holes" can eliminate thermal refugia for overwintering as well.

"Clearly, any restorative efforts that address the problem of headcutting caused by the KRNP should have positive implications for the Kaskaskia River's aquatic biota. By restoring the river channel's pre-project channel morphology, an increase in pool depth should result with habitat gains for centrarchids, catfish, and other pool dwelling species. Bed stability should benefit these fishes and others (minnows, suckers, percids), which rely on stable bottom substrates for spawning. A long term increase in the viability of bank side trees will, in time, afford the entire aquatic community with the shading, nutrient input, bank stability, and appropriate amount of woody debris typical of a healthy riparian zone.

"How this reduction in headcutting occurs is a geomorphic engineering consideration as well as a biological one. Recent innovations in grade control appear to benefit fisheries resources as well as hydrologic stability in several case studies. However, there is no single "cookbook" solution to headcutting; each application offers unique opportunities (and limitations) based on local fluvial dynamics, watershed characteristics, biological communities and socio-economic factors. This makes interdisciplinary review and input at all stages of project design and application a basic requirement of such projects."

HEADCUT MIGRATION ANALYSIS

In 1999, as part of the erosion and sedimentation study, river engineers and stream bank erosion specialists from the Corps, the USDA, and WES performed both aerial and "on the water" reconnaissance of the Kaskaskia River, from Carlyle Dam to New Athens, Illinois. An additional aerial reconnaissance was conducted in August of 2001. The river was studied and referenced by both bend location and the number of river miles upstream of Fayetteville (Figure 7). Bend 1 was located just downstream of Carlyle Lake. Bend 140 was located just upstream of Fayetteville. The bridge at Fayetteville was considered Mile 0 and Carlyle was at Mile 61. These river mile designations are independent of those used for referencing the navigation channel.

1999 Site Investigation

During the 1999 field investigations, engineers documented that major adverse impacts were continuing on the river as a result the original headcut induced by the Kaskaskia River Navigation Project. From observations of bank erosion and excessive debris in the channel, it was determined that the headcutting wave had continued to migrate upstream of the navigation channel at Fayetteville, Illinois to a possible nickpoint located approximately 14 miles above the Project, just above Bend 100 (Figure 8). Within this 14-mile reach, channel degradation, excessive bank erosion, channel widening, major deposition, abundant fallen trees, perched tributaries, and property damage were clearly evident within the channel (Figures 9 and 10). Bank erosion between Carlyle and the nickpoint was observed to be low to moderate and was mainly the result of localized tree removal along the riverbanks for agricultural purposes in selected areas. Although the exact location of the nickpoint could not be distinguished in the channel, a probable location was determined by observing increases in debris, bank height, and erosion. The channel width near the probable nickpoint was approximately 125 feet. The channel width in the first bend below the nickpoint (Bend 100) was approximately 175 feet, and the width in the second bend (Bend 101) was approximately 250 feet.

Probing of the riverbed was conducted in the thalweg at selected straight reach cross sections within the headcutting reach. The probing indicated that in most cases the bottom of the channel had scoured down to hard bottom clay. The general lack of sand in the thalweg further verified that channel degradation due to headcutting had occurred.

2001 Aerial Video Examination

An aerial reconnaissance video recorded from a helicopter in August 2001 verified the observations from the field recon that most of the erosional damage was located downstream of Bend 101. However, the video also showed that additional damage, although not as severe, was evident in the reaches above Bend 101. This damage was apparent up through Mile 34 and Bend 60. This area was just upstream of a channel cutoff formed naturally in the mid-1990s at Mile 31.5 and Bend 67 (Figure 11).

Upstream of this area, most damage was confined to the most predictable erosional areas, where vegetation had been cleared up to the bankline. Most of these unvegetated banklines were located upstream of the mouth of Crooked Creek at Mile 43 and Bend 39. However, the damages from these areas were not as significant as those damages seen within the headcut reach where vegetation was extremely dense.

In a short reach just upstream of Fayetteville, between Miles 0 and 3 or Bends 140 and 130, the channel appears to be naturally reestablishing its morphology and aggressively healing itself. Signs of this were evident in several areas where large sections of the undersized trees have clearly established new banklines and a new, lower elevation floodplain (Figure 12).

The most extensive, continued damage was apparent upstream of Mile 3 through Mile 18 and Bend 100. As mentioned previously, damages were also noticed in the reach between Miles 18 and 34, although not as severe and as widespread. Still photos from the video that display typical debris patterns and channel widening are shown in Figures 13 and 14.

Aerial Photography Bank Width Investigation

For this report, an analysis of bank width measurements was conducted using aerial photographs from 1962, 1978, 1988, and 1998. These photographs were the only comprehensive data set available to track the movement of the headcut through the widening of the riverbanks. The scale of the photographs (1 inch = 2,000 feet) provided enough accuracy in the measurements to establish an accepted level of confidence in the computed bank width averages, which enabled a determination of trends.

The graph in Figure 15 shows bank widths measured from aerial photographs at ½ mile increments from Fayetteville to Carlyle. The graph also shows a moving average trend line for each year. The year 1962 represented the baseline for bank widths because it was before the construction of the navigation channel. These bank widths were accepted as representative of the most natural channel width. By 1978, significant increases in bank widths indicated that the headcut had migrated approximately 11 miles upstream of Fayetteville. The headcut had migrated 10 miles further upstream by 1988 and was located approximately 30 miles above Fayetteville in 1998.

Figure 16 shows aerial photographs of the Kaskaskia River between 0 and 5 miles upstream of Fayetteville from 1962, 1978, 1984, and 1998. The photos clearly indicate significant increases in bank width upstream of the navigation channel. The bends located between Miles 0 and 2 in 1962 appear to have been overcome and straightened by the extensive widening of the riverbanks.

The following table shows average bank widths for 10-mile increments along the Kaskaskia River in 1962, 1978, 1988, and 1998.

Bank Width Average:	**1962**	**1978**	**1988**	**1998**
Miles 0 to 10	143	179	210	243
Miles 11 to 20	161	159	184	195
Miles 21 to 30	145	137	151	171
Miles 31 to 40	138	135	151	144
Miles 41 to 50	130	148	156	147
Miles 51 to 60	132	137	143	132
Total Bank Width Average	142	149	166	172

In 1962, the average bank width of the Kaskaskia River between Carlyle and Fayetteville (a distance of 61 river miles) was approximately 140 feet. In the first ten miles upstream of Fayetteville, which has been the most impacted reach, the average bank width increased from 143 feet in 1962 to 179 feet in 1978. Between Miles 11 and 20 the bank width averaged 161 feet in 1962, which was slightly greater than the overall average bank width. This unexplained increase is shown on the graph in Figure 15 where the 1962 moving average is greater than the average width in this reach. The average bank width in 1978 was 159 feet in this reach, which did not represent an increase. Upstream of this area, the average bank widths are close to the natural width of 140 feet in both 1962 and 1978.

In 1988, the photos showed that the average bank width had increased to 210 feet within the first 10 miles. Between Miles 11 and 20 the bank width also increased to 184 feet. Upstream of these areas the average bank widths in 1988 were just slightly higher than the natural bank widths. This could be attributed to the accuracy in the measurements, the scale of the photographs, and vegetation differences along the banklines.

In 1998, the average bank width had increased again within the first 10 miles to 243 feet. Between Miles 11 and 20 the average bank width was 195 feet and between Miles 21 and 30 the width was 171 feet. Upstream of these areas, the average bank widths in 1998 were close to the natural width of 140 feet.

To summarize, the average bank width in the 30 miles above Fayetteville had increased significantly. Between Miles 0 and 10, the bank width increased 100 feet or 70% (from 143 feet in 1962 to 243 feet in 1998). Between Miles 11 and 20, the bank width increased 34 feet or 21% (from 161 feet in 1962 to 195 feet in 1998). Between Miles 21 and 30, the bank width increased 26 feet or 18% (from 145 feet in 1962 to 171 feet in 1998). Between Miles 31 and 40, the average bank width did not increase significantly (from 138 feet in 1962 to 144 feet in 1998).

The table shows that in 1978, 1988, and 1998, the average bank widths in the unaffected reaches, (upstream of the reaches that have been determined as actively headcutting) had not changed significantly. However, in the headcutting reaches, the bank widths had increased dramatically. Previously it was shown that the headcut had moved approximately 10 miles upstream by the year 1978. Downstream of the headcut the average bank width of 179 feet was much wider than the upstream average bank width of

143 feet, which resembled the natural bank width. By 1988, the headcut was located near Mile 20. Downstream of the headcut, the average bank width of 197 feet was much wider than the upstream average bank width of 150 feet, which also resembled the natural bank width. In 1998, the headcut was located near Mile 30. Downstream of the headcut, the average bank width of 203 feet was much wider the upstream average bank width of 141 feet, which resembled the natural bank width.

The inaccuracies and uncertainties associated within this data set along with the differences in the observations from the reconnaissance missions suggest that a more detailed survey and analysis be conducted to completely determine the exact position of the headcut.

Carlyle Lake Project Effects

The previous investigations clearly illustrate that the water release operation from the Carlyle Lake Project has not affected the morphology of the Kaskaskia River. Average bank widths in the reaches just downstream of the Lake Project have not increased. Also not evident in these areas were excessive bank erosion or significant debris located in the channel. Bank widths began to increase in the areas 30 miles downstream of the Lake due to the headcut. Figure 17 is a schematic illustrating the relative flow contributions at Venedy Station (at the Highway 160 Bridge) from Shoal Creek, Crooked Creek, Little Crooked Creek, and reservoir releases from Carlyle Lake. The diagram demonstrates that high flows experienced on the Kaskaskia River at Venedy Station have not been a result of reservoir releases but rather natural flow contributions from the tributaries.

TRM13 concluded, *"Generally, dams act as sediment traps, storing incoming sediment and starving the river downstream of the dam. The channel then experiences degradation and associated bank erosion. In the case of the Kaskaskia River below Carlyle, this trend was not evident. The elimination of such a large percentage of the typical, yearly peak flow seems to have minimized the yearly sediment transport rate below the dam to such an extent that the downstream sediment budget has not been negatively effected."*

The sporadic areas of bank erosion and widening evident between Carlyle and the nickpoint are a direct result of localized land clearing and tree removal adjacent to the riverbanks. Even within these areas, bank erosion is not nearly as significant as it is along the heavily forested banklines within the headcut reach.

PREDICTED DAMAGES

If the headcutting problem is not remedied, it may lead to further upstream migration of the nickpoint, continued channel degradation and widening, increased sediment load into the river system, and excessive dredging of the navigation channel. It may also threaten the structural integrity of the highway bridges that cross the Kaskaskia River through this damaged reach. Continued channel widening and bank erosion may endanger the abutments of State Highway Bridge 166/170 as well as U.S. Interstate 64. Further channel degradation could affect the bridge piers of these structures as well.

The aerial photo bank width analysis shows that the headcut could be advancing upstream at a rate of about 1 mile per year. This rate has been constant since construction began. If left unimpeded, at this rate the initial headcut will reach the Crooked Creek confluence by 2010 and the Lake Carlyle Dam by 2030. The river morphology as well as the aquatic and terrestrial environments along these remaining 30 miles of river will be irreparably damaged. The headcut will also travel up the unaffected tributaries, namely Crooked Creek.

Channel widening will continue to damage private property including farmland and clubhouses. The loss of environmentally valuable forest from the banklines will continue with an additional 200 or more acres that could be lost. This will add to the exorbitant amount of debris that has already accumulated in the river from prior channel widening. Degradation and channel widening will also continue to occur up the tributaries that feed into the Kaskaskia River within the headcut reach. Additional bank erosion and habitat loss will occur in the reaches already damaged by the headcut. Although the headcut may have already moved through these areas, channel widening will continue until the river regains an equilibrium condition; a process that could take decades.

The sediment originated from not only from the natural sediment transport and bank erosion dynamics of the Kaskaskia River but also from the excess material generated by the headcut. Most of the sediment transported down the Kaskaskia River deposits in this area because the width of the river widens dramatically where the natural stream transitions into the navigation channel. This widened reach significantly reduces velocities to the point that most of the bed load that enters the reach is deposited here. Although dredging of this reach was suspended after the last re-dredge in 1985, the new facility that had been proposed at Fayetteville will require periodic maintenance dredging.

POSSIBLE REMEDIAL DESIGNS

The St. Louis District proposes pursuing a river engineering solution to the headcutting problem by studying alternative river engineering solutions in an environmentally and cost-effective manner. The investigation results will lead to a project that will prevent additional channel degradation and achieve environmental sustainability.

Proposed Investigations

The following is a list of additional data that will be required to identify the exact location of the headcut. Knowledge of this location is pertinent for the design of structures that will arrest the upstream migration of the headcut.

1. A physical survey of the Kaskaskia River within the headcutting reach. This includes a continuous channel profile, water surface profile, and intermittent cross sections.

2. Channel profiles and intermittent cross sections up selected tributaries.

3. Intermittent core samples of the channel thalweg to define depth of bed material above hard bottom surfaces.

4. Aerial photography for continued monitoring of bank widths.

Proposed Alternatives

Six basic alternatives have been identified. The first alternative is "do nothing." The other alternatives are additive to each other in the amount of protection provided by the designs to eliminate additional damages and sustain the river's current morphology and environment.

1. *Do Nothing:* This is most economical solution but also the most damaging to the private property and environment along the Kaskaskia River corridor and its tributaries. Damage may also be inflicted upon the numerous highway bridges that cross the river.

2. *Protect all Bridges Crossings with Rip Rap:* This solution would protect the Federal and State highway infrastructure from erosion due to further channel widening and deepening. It will not to reduce damages to private property or the environment.

3. *Alternative 2 + One Headcut Abatement Structure:* This design would stop the upstream migration of the headcut, protect the streambed and bankline above the nickpoint, and prevent additional damages from occurring at bridge abutments

and piers. However, it would not be capable of reducing the channel degradation and widening in the areas where the headcut has already passed. Channel degradation up the tributaries will continue to occur as well. Within these areas the banklines will continue to widen excessively and introduce unusually high amounts of sediment into the river system. Additional degradation of the streambed downstream of the headcut abatement structure may also continue and bridge structures may be threatened.

4. *Alternative 3 + One Headcut Abatement Structure on each tributary:* All the positive effects of Alternative 2 would be realized. Further degradation up the tributaries would be halted. However, these structures would not be capable of reducing the channel degradation and widening in the areas along the Kaskaskia River and its tributaries where the headcut has already passed. Within these areas the banklines will continue to widen excessively and introduce unusually high amounts of sediment into the river system. Additional degradation of the streambed downstream of the headcut abatement structures may also continue and bridge structures may be threatened.

5. *Alternative 4 + Numerous Intermediate Grade Control Structures on the Kaskaskia River:* This solution would not only provide the benefits discussed in Alternative 3 from the headcut abatement structures but would also prevent additional damage from occurring downstream of the nickpoint on the Kaskaskia River. The intermediate grade control structures would be beneficial for maintaining the current stream gradient, eliminating channel degradation and widening, decreasing the sediment load into the river system, and protecting bridge abutments and piers. However, further degradation downstream of the headcuts in the tributaries may continue to occur.

6. *Alternative 5 + Numerous Intermediate Grade Control Structures on the each tributary:* This alternative would provide the positive benefits mentioned in Alternative 4 as well as prevent additional bed degradation along the tributaries.

CONCLUSION

It has been shown that both the navigation channel and grade control structure are functioning as intended within the Project boundaries. However, the effects of channel straightening, widening and deepening are continuing to cause irreparable damage in the upstream reaches outside of the Navigation Project limits. During the time period when the Project was designed, hydraulic design standards for channel straightening projects did not consider sedimentation or river morphology. Today, the possibility of a headcut on this type of project would be considered immediately and upfront.

In the mid to late 1970's the Corps engineers recognized that there was a headcutting problem when the need for a grade control structure was investigated before the Project was closed out. The clear purpose of the grade control was to prevent a second headcut from forming when the channel was re-dredged. The Corps was unable to address the original headcut because it had traveled outside of the Project boundaries. The grade control as built functioned as intended and prevented a secondary headcut. Therefore, the Project is performing as intended, albeit with damage occurring outside of the Project boundaries.

The impacts of the damage could be increasing the sedimentation rate in the navigational channel. The headcut induced channel degradation and channel widening is contributing excess sediment into the river system. Although it is impossible to determine the origin of the sediment, a portion of the excess sediment from the headcut could be depositing in the navigation channel. Although sedimentation of this channel would still require maintenance without the headcutting, the excessive erosion induced by the channel widening and degradation could exacerbate the rate at which the sediment accumulates. Bank erosion introduces excessive fine material, such as clay, into the river system. This material compromises much of the material that needs to be removed from the navigation channel.

The authorized Project purposes of fish and wildlife and habitat restoration are also being degraded by the sedimentation resulting from the headcutting. The watershed upstream contains the largest contiguous block of bottomland hardwoods (7000 acres) in the state of Illinois and 46,600 total forested acres, making the area very significant to the neo-tropical songbirds. The headcutting is resulting in irreparable damage along the river through this 3-mile wide bottomland forest. The USFWS and IDNR are well aware of the headcutting damage that is occurring in the wilderness area and are anxiously awaiting remedial measures that will rehabilitate damaged areas as well as prevent additional damage from occurring in these environmentally sensitive areas.

The USFWS in 1992 proposed the area as a National Refuge due to its international importance to the Migratory Bird Treaty as a mid-migration habitat for waterfowl, breeding habitat for wood ducks, and breeding habitat for neo-tropical songbirds. The private landowners fought against the refuge designation and won. The OKAW group was formed as a not-for-profit organization to manage the resources in the private sector. The OKAW group is well informed, educated and active in sustaining these resources, and is proactive in working with state and federal agencies in performing its wilderness charter. The investigation in TRM13 documents the impacts to the OKAW members' land, which in turn, impacts the wilderness charter under which the group has organized.

Clearly the Kaskaskia Navigation Project has caused a problem that impacts navigation and the environment. At this time no authority, or funding has been identified to fix this problem.

PUBLICATIONS

The following are publications pertaining to the Kaskaskia River Navigation Project, which were either produced by the Corps of Engineers or under contract to the Corps.

1963, July – Kaskaskia River, Illinois, Navigation Improvement, Mouth to Fayetteville, Design Memorandum No. 1, Hydrology and Hydraulic Analysis

1964, April – Kaskaskia River, Illinois, Navigation Improvement, Mouth to Fayetteville, Design Memorandum No. 1A, Site Selection

1965, September
Kaskaskia River, Illinois, Navigation Improvement, Mouth to Fayetteville, Design Memorandum No. 3, State Highways

1966, October

- Kaskaskia River, Illinois, Navigation Project, Mouth to Fayetteville, Design Memorandum No. 4, Volume I, Lock and Dam
- Kaskaskia River, Illinois, Navigation Project, Mouth to Fayetteville, Design Memorandum No. 4, Volume III, Lock and Dam
- Kaskaskia River, Illinois, Navigation Project, Mouth to Fayetteville, Design Memorandum No. 4, Volume IV, Lock and Dam
- Kaskaskia River, Illinois, Navigation Project, Mouth to Fayetteville, Design Memorandum No. 4, Supplement No. 1 to Volume IV, Lock and Dam

1967, March – Kaskaskia River, Illinois, Navigation Project, Mouth to Fayetteville, Design Memorandum No. 3, State Highway 154, Revised Soil Test Report

1967, August – Kaskaskia River, Illinois, Navigation Project, Mouth to Fayetteville, Design Memorandum No. 3A, Relocation and Alterations – Gulf, Mobile, and Ohio Railroad

1967, December – Kaskaskia River, Illinois, Navigation Project, Mouth to Fayetteville, Design Memorandum No. 3B, Relocation and Alterations – Illinois Central Railroad

1968, September – Kaskaskia River, Illinois, Navigation Project, Mouth to Fayetteville, Design Memorandum No. 3C, Relocation and Alterations – Missouri-Pacific and Missouri-Illinois Railroads

1969 – Kaskaskia River Navigation Project, Illinois, Hydraulic Model Investigation, Technical Report H-69-1

1971, April – Dively Drainage and Levee District Kaskaskia River, Illinois, Local Flood Protection Project, Design Memorandum No. 1, General Design

1974 – The Earth Resources of the Kaskaskia Navigation Project Area

1978, March – Profile of the Habitats and Biological Communities of the Lower Kaskaskia River

1980, October – Environmental Impact Statement, Proposed Grade Control Structure, Canal Mile 36, Kaskaskia River, Illinois

1980, December – Kaskaskia River Grade-Control Structure and Navigation Channel, Fayetteville, Illinois, Hydraulic Model Investigation, Technical Report HL-80-20

1981, June – Kaskaskia River, Illinois, Navigation Project, Mouth to Fayetteville, St. Clair County, Illinois, Specifications for Grade Control Structure

1981, June – Vegetation Evaluation and Recommendations: Dredge Material Placement Areas and Adjacent Lands, Kaskaskia River Navigation Project, New Athens to Fayetteville; Biotic Consultants Inc.

1981, July – Sediment and Oxygen Demand and its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River

1982, July – Kaskaskia River Grade Control Structure (Technical Paper Presented at the 1982 International Symposium on Urban Hydrology, Hydraulics and Sediment Control) Charles W. Denzel, Chief, Hydraulic Design Section and Claude N. Strauser, Chief, Potamology Unit

1983, March – Summary of Findings: Kaskaskia River Sediment Investigation, Envirodyne Engineers Inc.

1989, June – Optimal Use of the Kaskaskia Navigation Canal; Management, Strategies, and Guidelines

1992, September – Kaskaskia River Basin, Illinois, Reconnaissance Report, 1st Draft

1999 – Kaskaskia River Area Assessment, Volume 2, Water Resources

1999 – Kaskaskia River Area Assessment, Volume 4, Social-Economic Profile, Environmental Quality, Archaeological Resources

2000 – Kaskaskia River Area Assessment, Volume 1, Geology

2000, February – Bank Erosion Study of the Kaskaskia River, Carlyle Lake to New Athens, Illinois; Technical Report M13

2001, October – Personal Correspondence from Randy Sauer, Stream Biologist, IDNR

Figure 1: Vicinity and Project Map

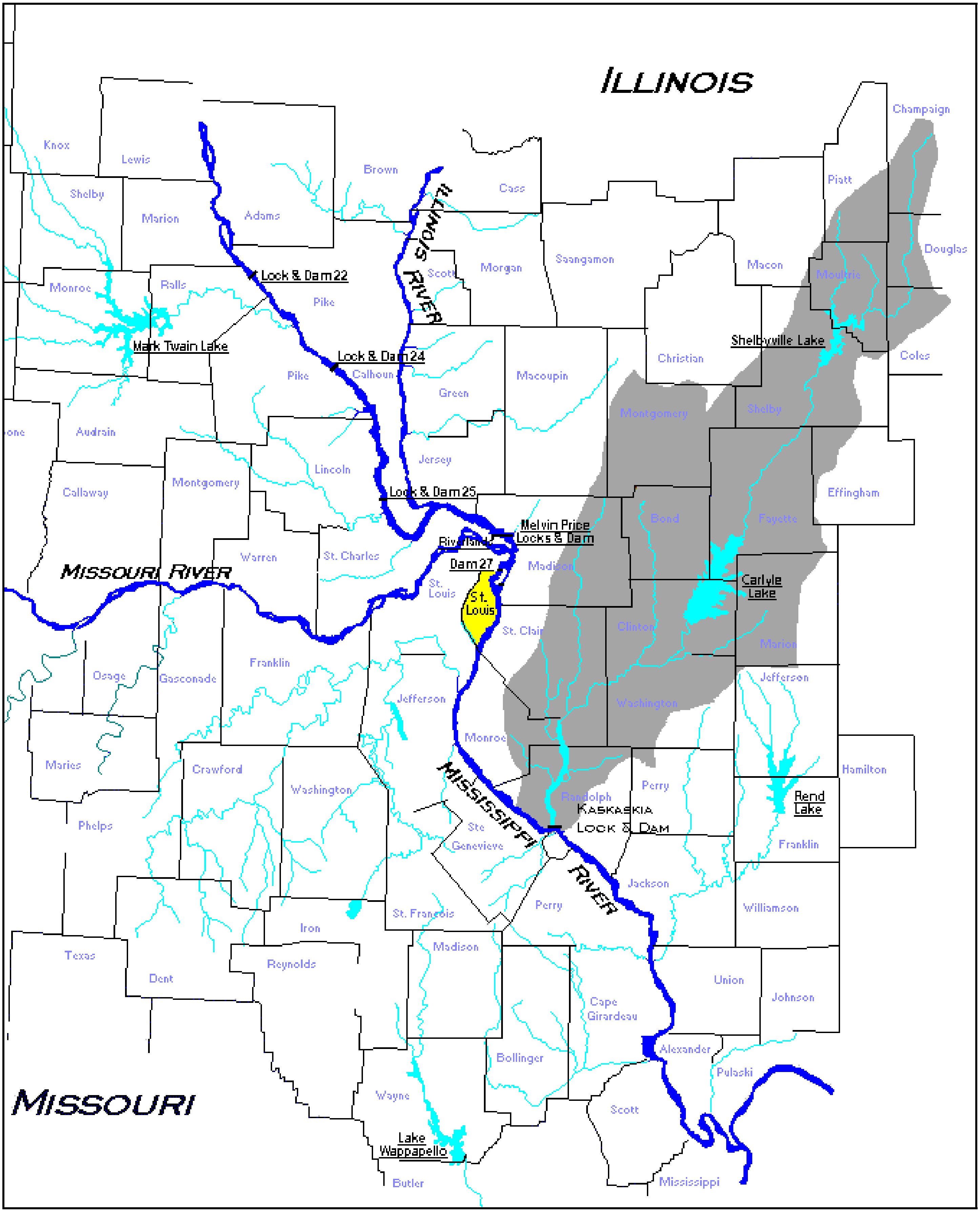
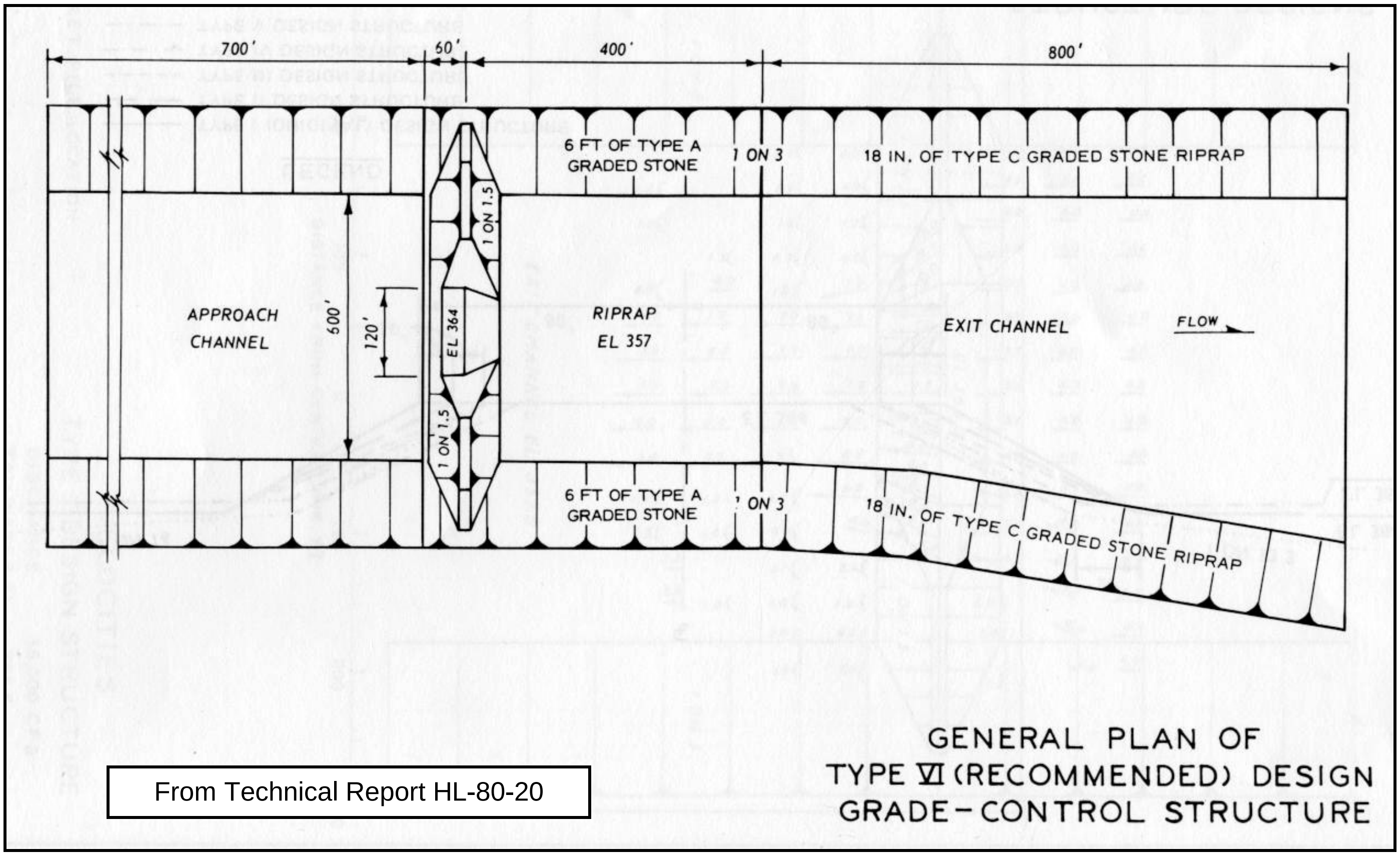


Figure 2: Kaskaskia River Watershed

Figure 3

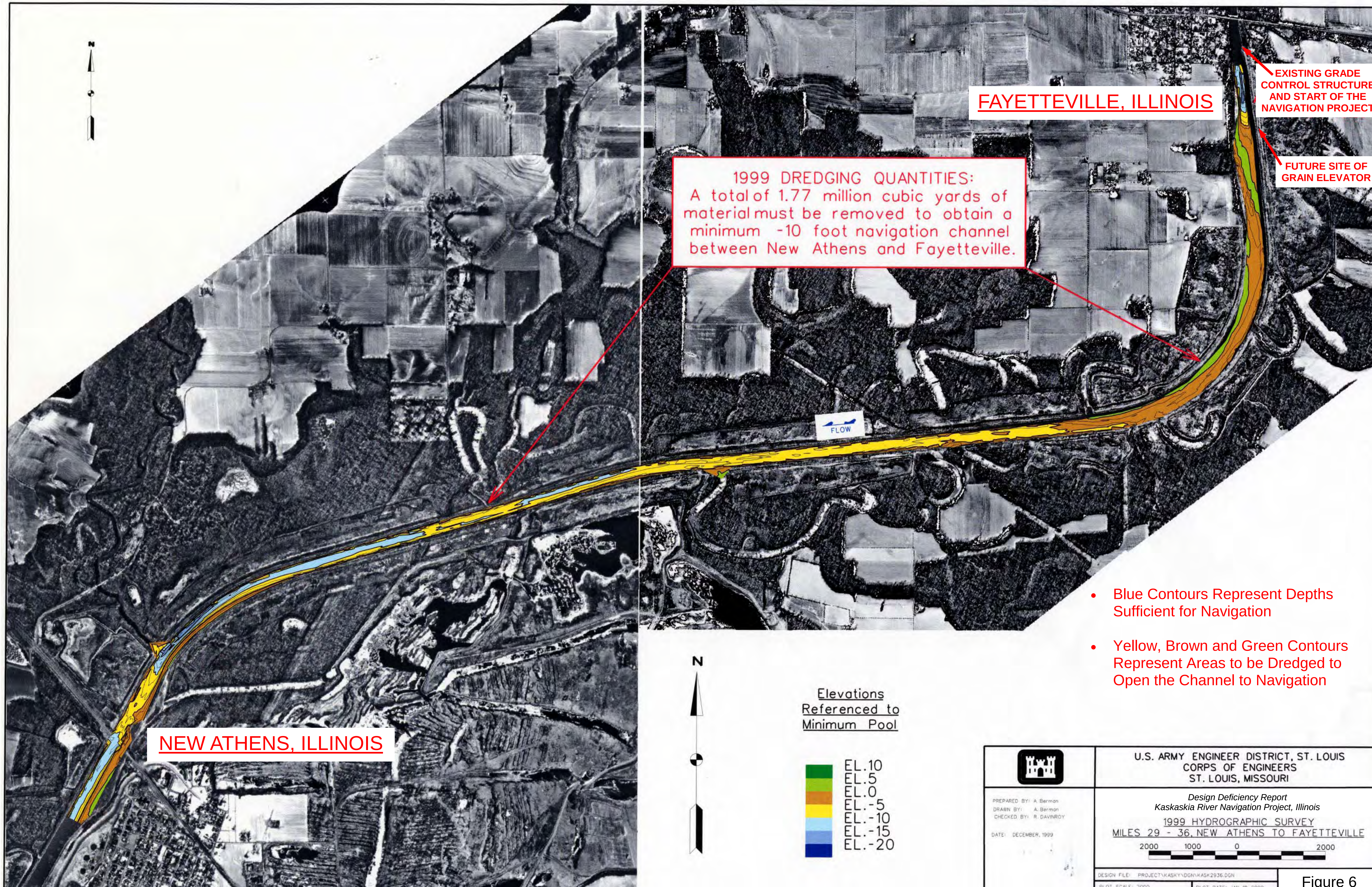
Damage Induced by Degradation of the "Natural" Kaskaskia River Channel Upstream of Fayetteville in the 1970's

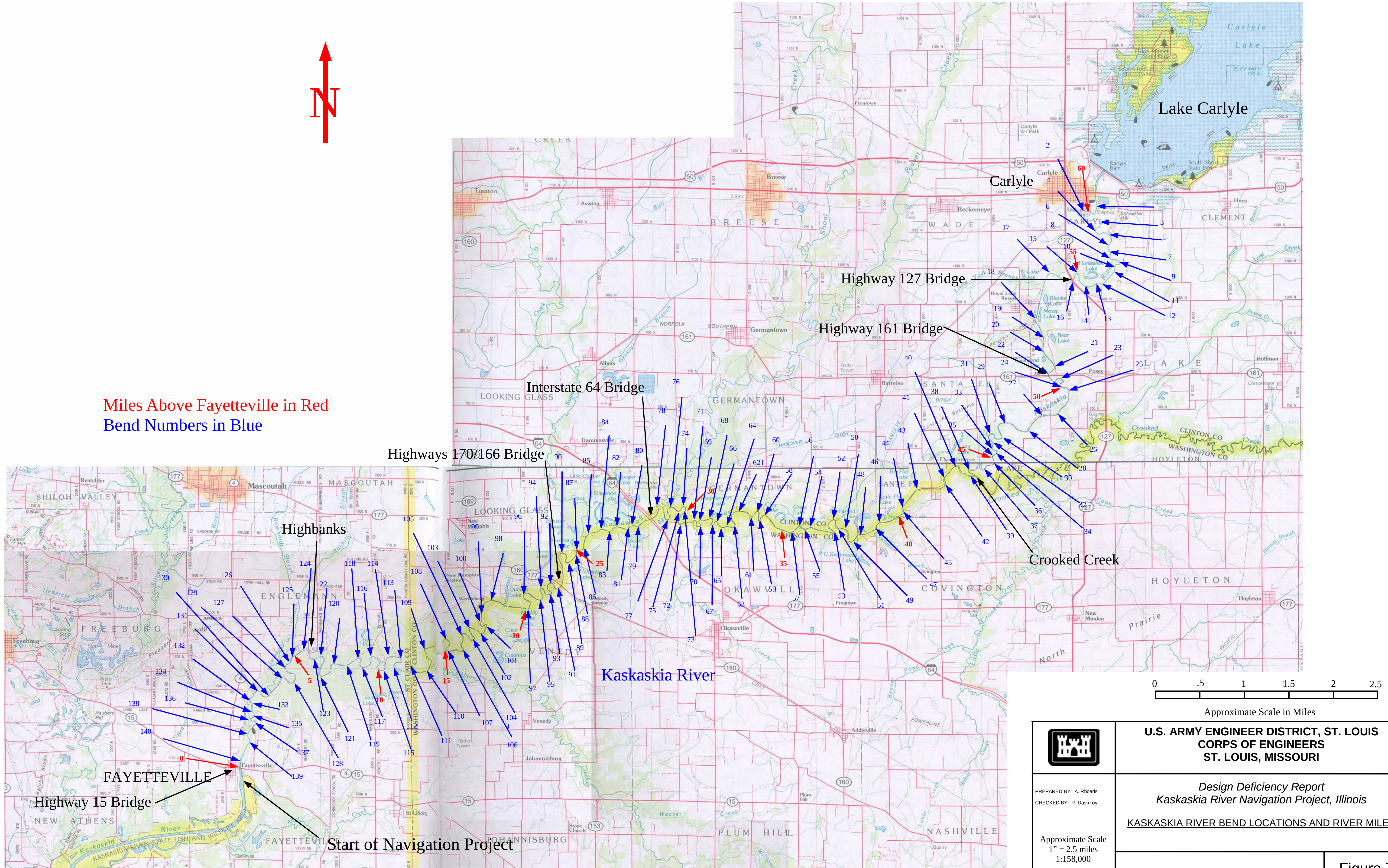
Figure 4


700'
60'
400'
800'
6 FT OF TYPE A
GRADED STONE
1 ON 3
18 IN. OF TYPE C GRADED STONE RIPRAP
1 ON 1.5
APPROACH
CHANNEL
600'
120'
EL 364
RIPRAP
EL 357
EXIT CHANNEL
FLOW
1 ON 1.5
6 FT OF TYPE A
GRADED STONE
1 ON 3
18 IN. OF TYPE C GRADED STONE RIPRAP
GENERAL PLAN OF
TYPE VI (RECOMMENDED) DESIGN
GRADE-CONTROL STRUCTURE
From Technical Report HL-80-20


FAYETTEVILLE
Grade Control
Structure

Figure 5


FAYETTEVILLE, ILLINOIS
EXISTING GRADE CONTROL STRUCTURE AND START OF THE NAVIGATION PROJECT
FUTURE SITE OF GRAIN ELEVATOR
1999 DREDGING QUANTITIES:
A total of 1.77 million cubic yards of material must be removed to obtain a minimum -10 foot navigation channel between New Athens and Fayetteville.
FLOW
NEW ATHENS, ILLINOIS
N
N
Elevations Referenced to Minimum Pool
EL.10
EL.5
EL.0
EL.-5
EL.-10
EL.-15
EL.-20
• Blue Contours Represent Depths Sufficient for Navigation
• Yellow, Brown and Green Contours Represent Areas to be Dredged to Open the Channel to Navigation
U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI
PREPARED BY: A. Berman
DRAWN BY: A. Berman
CHECKED BY: R. DAVINROY
DATE: DECEMBER, 1999
Design Deficiency Report
Kaskaskia River Navigation Project, Illinois
1999 HYDROGRAPHIC SURVEY
MILES 29 - 36, NEW ATHENS TO FAYETTEVILLE
2000 1000 0 2000
DESIGN FILE: PROJECT\KASKY\DGN\KASK2936.DGN
PLOT SCALE: 2000
PLOT DATE: JAN 18, 2000
Figure 6



U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

PREPARED BY: A. Rhoads
CHECKED BY: R. Davinroy

Approximate Scale
1" = 2.5 miles
1:158,000

Design Deficiency Report
Kaskaskia River Navigation Project, Illinois

KASKASKIA RIVER BEND LOCATIONS AND RIVER MILES

Figure 7

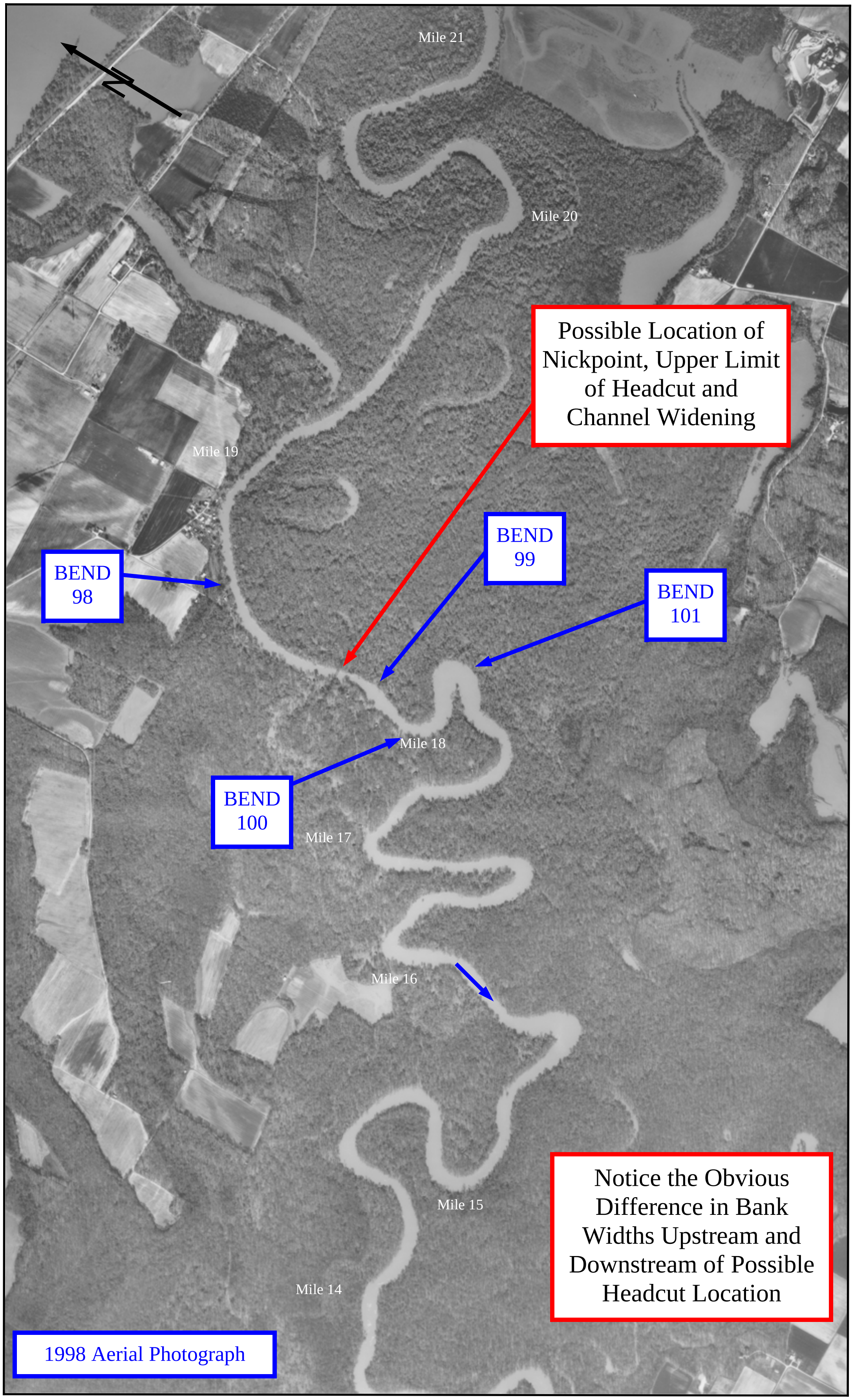
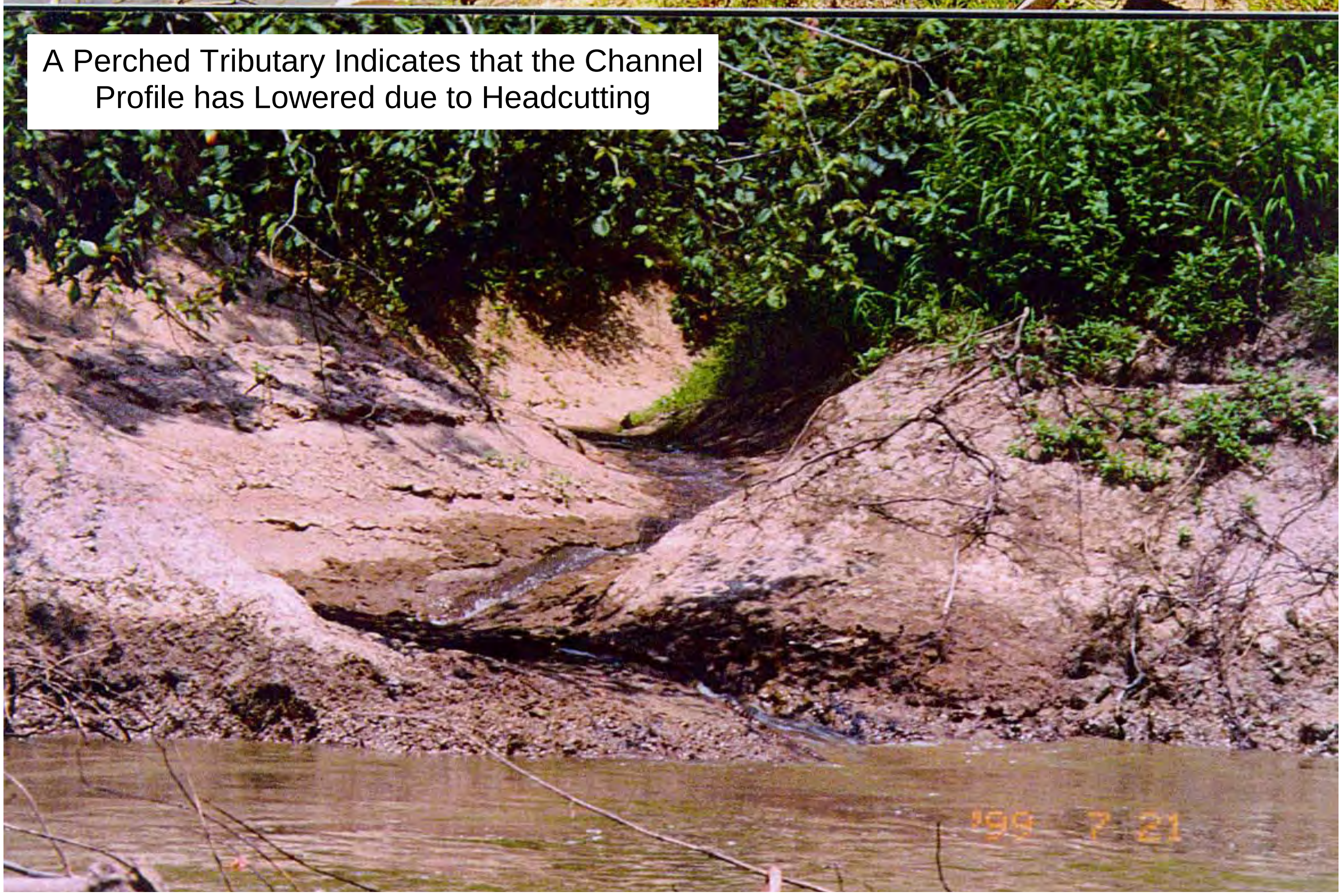


Figure 8: Possible Location of Nickpoint as Observed During the 1999 Field Reconnaissance

River Channel is Clogged with Vegetative Debris from Excessive Bankline Erosion



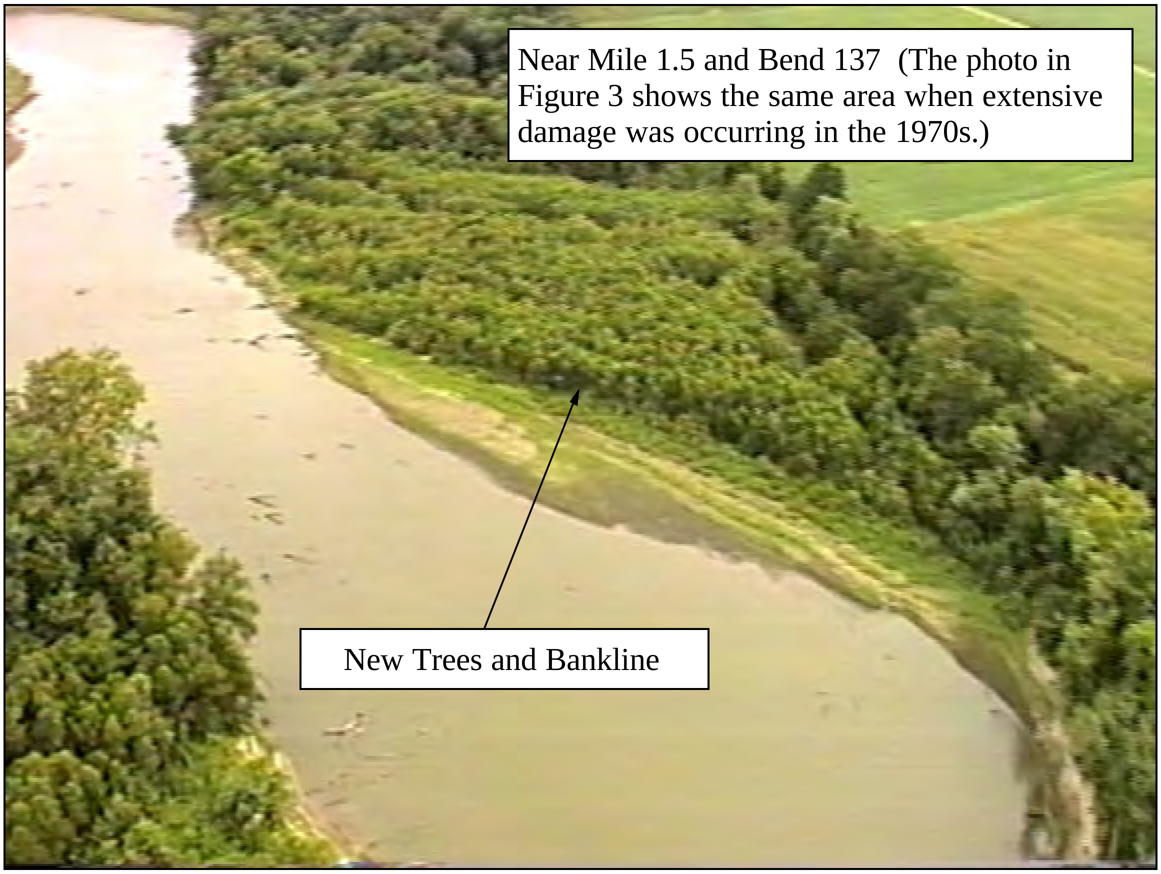
A Perched Tributary Indicates that the Channel Profile has Lowered due to Headcutting

Figure 9


The Channel Profile has Lowered due to Headcutting which has Induced Excessive Bankline Erosion
TRACKER
Excessive Bankline Erosion has Destroyed Private Property

Figure 10

Figure 11


Near Mile 1.5 and Bend 137 (The photo in Figure 3 shows the same area when extensive damage was occurring in the 1970s.)
New Trees and Bankline


Near Mile 2.0
New Trees and Banklines

Figure 12

Figure 13

Figure 14

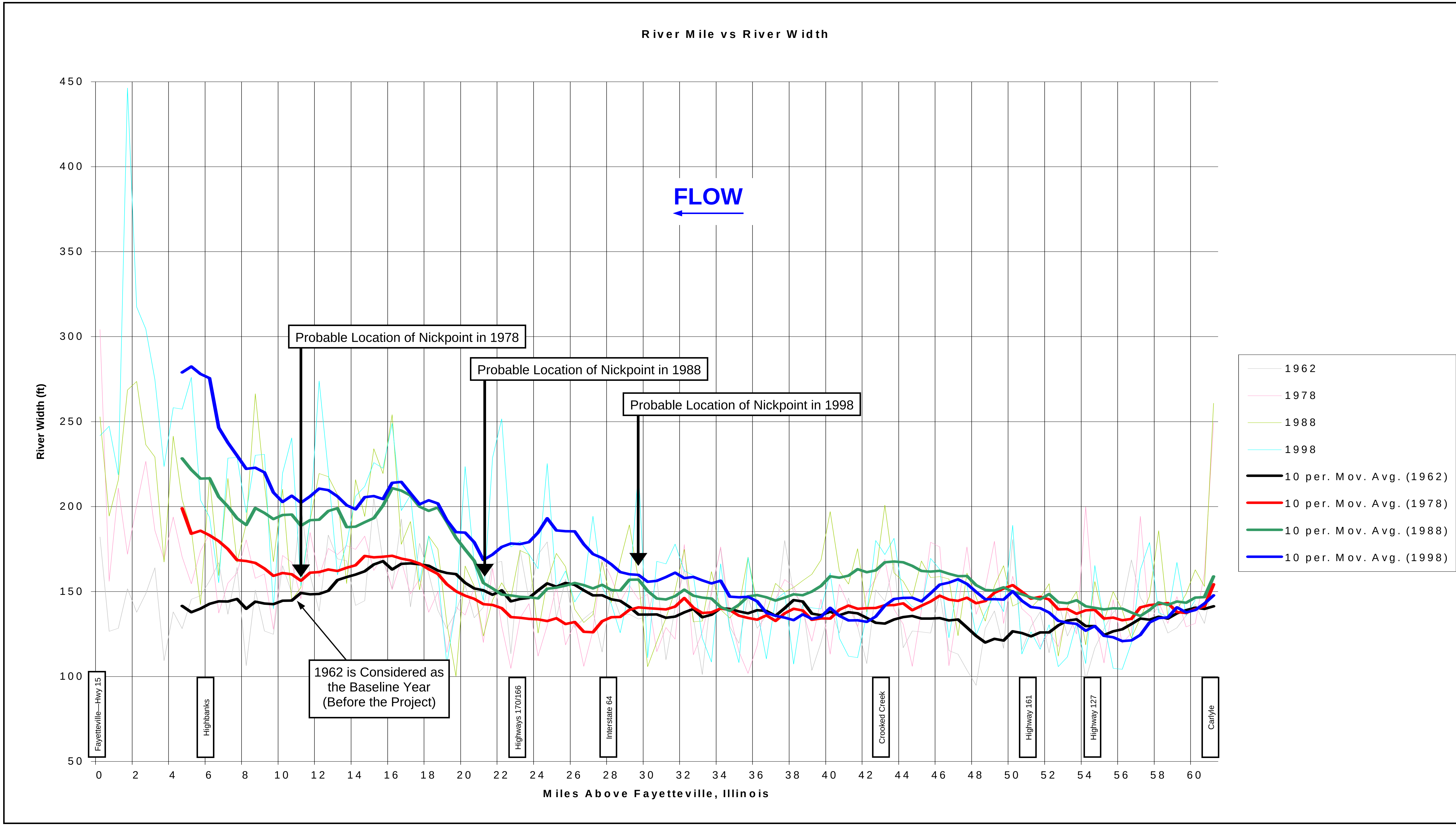


Figure 15: River Mile vs. Bank Width (1962, 1978, 1988, and 1998)

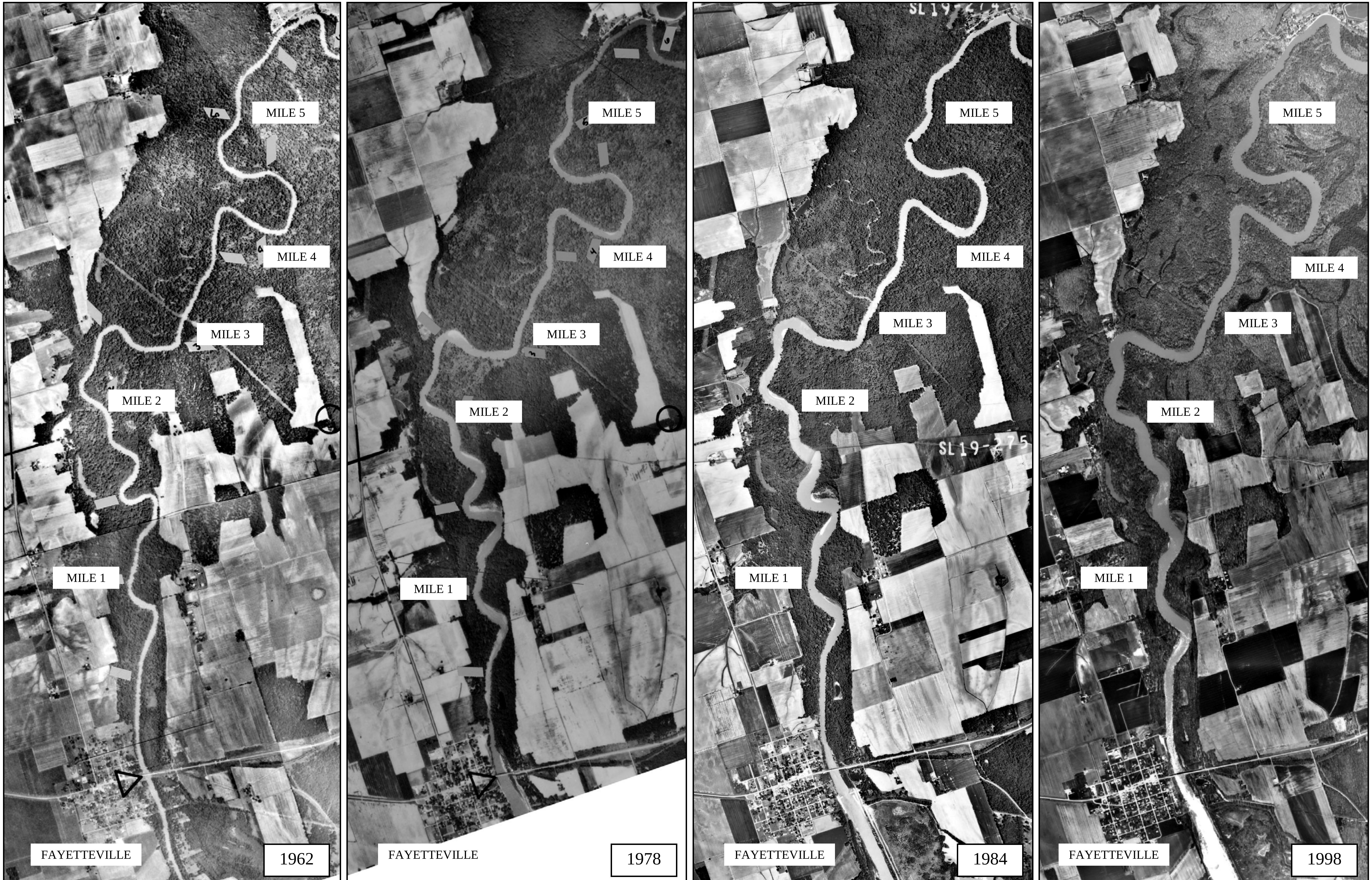


Figure 16: 1962, 1978, 1984, and 1998 Aerial Photographs of the Kaskaskia River, (0 to 5 miles above Fayetteville)

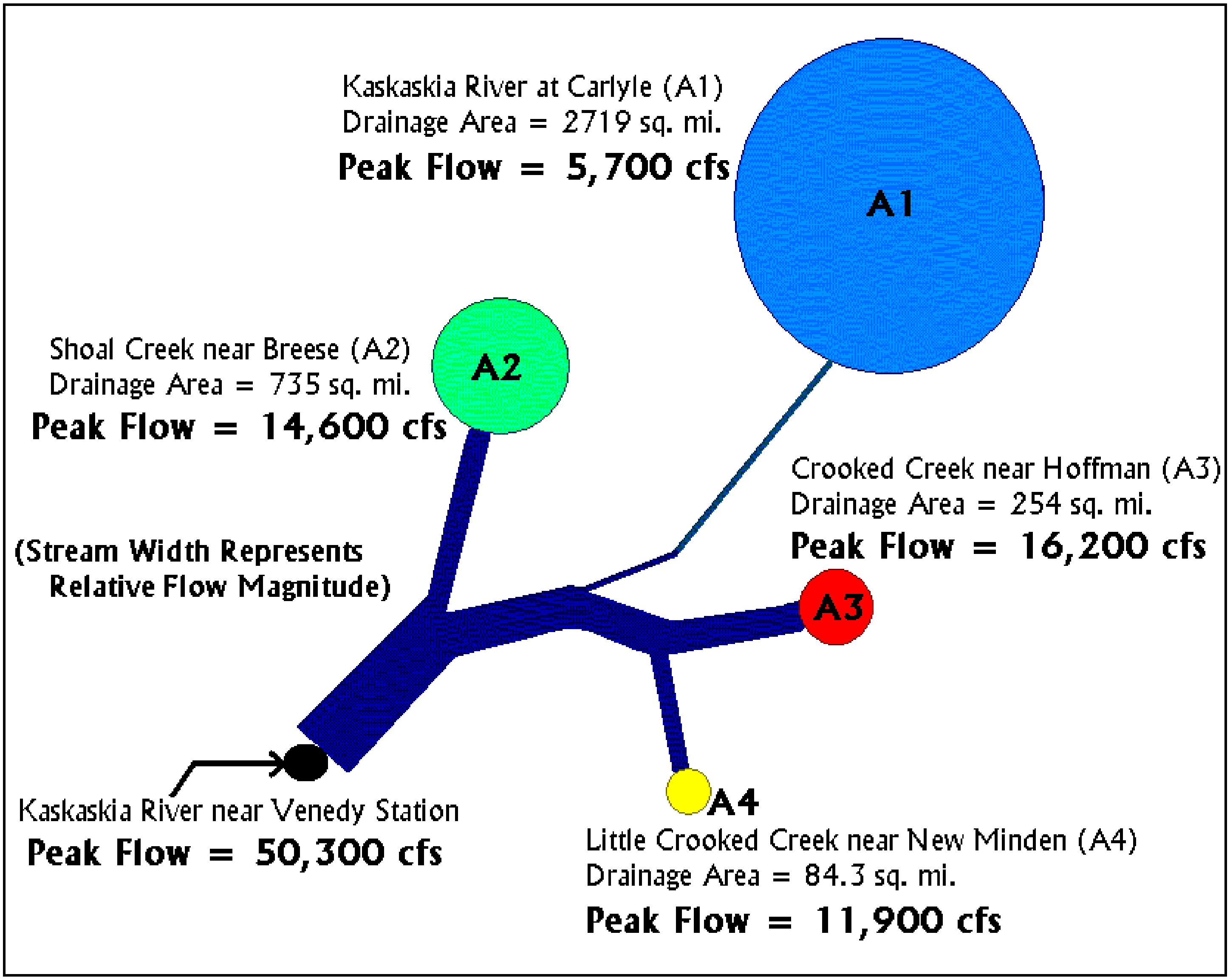


Figure 17: 1995 Flow Comparison, Kaskaskia River Basin