Approved: 2-10-98
Date

MINUTES OF THE SENATE COMMITTEE ON ENERGY AND NATURAL RESOURCES.

The meeting was called to order by Chairperson David Corbin at 8:08 a.m. on February 4, 1998 in Room 254-E of the Capitol.

All members were present except:

Committee staff present: Raney Gilliland, Legislative Research Department
Mary Ann Torrence, Revisor of Statutes
Lila McClaflin, Committee Secretary

Conferees appearing before the committee:
Lee Gerhard, Director, Kansas Geological Survey
Dr. James R. McCauley, Kansas Geological Survey

Others attending: See attached list

Chairperson David Corbin welcomed Lee Gerhard, Director, Kansas Geological Survey. Mr. Gerhard introduced his staff. He said Dr. James McCauley would give the briefing on the Kansas River Valley Sand Dredging Report. Mr. Gerhard said the report encompasses all of the information that they compiled to create the report on the natural resources of the river. The Kansas Geological Survey is housed at the University of Kansas.

Dr. James McCauley said he was a geologist at the Kansas Geological Survey. The title of his report is: "The Kansas River Corridor, its Geologic Setting, Land Use, Economic Geology, and Hydrology." It was edited by Lawrence L. Brady and the contributing authors, in addition to Dr. McCauley were David Grisafe, Gregory Ohlmacher, Herman Quinodoz, and Kenneth Nelson. The Kansas River Corridor runs from Junction City to Kansas City. The Kansas River is an important mineral resource, mainly sand and gravel, and that is the major topic of his report (Attachment 1).

Mr. Gerhard and Dr. McCauley responded to many questions. They explained how the dredging is done. They said the quality of water is monitored very close by the Corp of Engineers. They answered questions regarding pit dredging versus river dredging. They said the flood of 1993 caused significant changes to the river. They said a study was being conducted by Kansas State to make a comparison between the flood of 1951 and the flood of 1993. It was noted with all of the reservoirs and flood plains in place now the high water last much longer and more damage may be done to the river, riverbanks and surrounding land than was done in the past. However, there may be less potential for property damage and loss of life. Dr. McCauley thought that it might be interesting to do a study on what affect the reserviors and watersheds are having on the Kansas rivers and streams during times of high water.

The next meeting is scheduled for February 5, 1998.

The meeting adjourned at 8:59 a.m.

SENATE ENERGY & NATURAL RESOURCES COMMITTEE GUEST LIST

DATE: February 4, 1998

NAME	REPRESENTING
[illegible]	KGeol Survey
Bill Harrison	Kansas Geological Survey
Dave Grisafe	Kansas Geological Survey
JIM McCAULEY	KANSAS GEOLOGICAL SURVEY
Randy Allen	Kansas Association of Counties
Paul Liechti	Kansas Biological Survey
Lawrence G Brady	Kansas Geol. Survey
Wendy Harms	Kansas Aggregate Producers' Assn.
Dan Thalmann	Kansas Audubon Council
~~DALE HOLTHAUS~~	Western Resources
Hugh Archie	Meier's Ready Mix, Inc.
[illegible]	Ks Dept of Commerce & Hsng
Erika Unglaver	Self
Cathy Tucker-Vogel	KS Water Office
Mike Beam	KS LVSTK. ASSN.
Bill Bider	KDHE
Mary Jane Stattelman	KDA
Karla Ann Brown	KS Gov't Consult
Charles Benjamin	KNRC / KS Sierra Club

SENATE ENERGY & NATURAL RESOURCES COMMITTEE GUEST LIST

DATE: Feb. 4, 1998

NAME	REPRESENTING
Steve Adams	KDWP
Tom Stiles	KWO
Clint Riley	KDWP
Ed Moslan	City of Topeka

The Kansas River Corridor, its Geologic Setting, Land Use, Economic Geology, and Hydrology

James R. McCauley, Kansas Geological Survey

Senate Committee on Energy and Natural Resources

February 4, 1998

My name is Jim McCauley, and I am a geologist at the Kansas Geological Survey where I have worked for the last 21 years. The Kansas Geological Survey was established by the legislature at the University of Kansas in 1889 as a research and service organization with the expressed purpose of making, and I quote, "A complete geological survey of the state of Kansas, giving special attention to any and all natural products of economic importance." It is in fulfilling this mission that I am presenting this report to you today. The title of the report is: "The Kansas River Corridor, its geologic setting, land use, economic geology, and hydrology." It was edited by Lawrence L. Brady and the contributing authors, in addition to myself, are David Grisafe, Gregory Ohlmacher, Hernan Quinodoz, and Kenneth Nelson.

Attempts to eliminate or restrict the Kansas River as a source of economic minerals prompted this study of the river. The objective of this study is to provide a better understanding of the Kansas River as a geologic resource by discussing the physical and cultural geography of the river valley, the geologic setting, the river's hydraulics and sedimentary load and the economic minerals associated with the river, especially sand and gravel. The study focuses on a Kansas River corridor that we defined as that area within 6 miles of the river, from its source in Junction City to its mouth in Kansas City, an area of roughly 1,700 square miles.

The Kansas River is a major natural resource in northeast Kansas, in fact, it is many different resources. First of all, it is a transportation resource and is still classified as a navigable stream, although that is primarily a bureaucratic description rather than a practical one. Its river valley cuts through the Flint Hills and the Osage Cuestas and is to this day an important transportation corridor. The river is an important water resource, not only the river itself, but also its alluvial aquifer, which is the major aquifer in northeastern Kansas. The rich bottom lands of the river are an important agricultural resource. The Kansas River is the largest river in the state, and its riparian habitat represent an ecological resource. As one of three public water-ways in the state, the Kansas River is an important recreational resource. And since it is the source of industrial minerals, mainly sand and gravel, the Kansas River is an important mineral resource and this will be the major topic of my report today.

GEOGRAPHIC AND GEOLOGIC SETTING

The Kansas River officially begins in Junction City at the confluence of the Smoky Hill and Republican rivers. It flows 170 miles east to the Missouri River in Kansas City. The actual drainage area of the Kansas River extends 500 miles west from Kansas City onto the high plains in northeastern Colorado. The river drains an area of 60,000 square miles, an area larger than the state of Iowa. Major tributaries to the river include the Smoky Hill, the Saline, the Solomon, the Republican, and Big Blue Rivers, Soldier Creek, the Delaware River, Wakarusa

River, and Stranger Creek. All the large tributaries of the Kansas River are impounded by federal reservoirs and there are a total of 18 such reservoirs in the basin. The Kansas River itself is dammed at Lawrence by Bowersock Dam, a low hydro-electric dam.

The Kansas River flows near the southern limit of glacial advance into Kansas during the Pleistocene epic, a period of time known informally as the Ice Ages which occurred fairly recently in geologic time. The Kansas glacier entered Kansas several hundred thousand years ago and played a major role in the formation and location of the Kansas River. Since that time, the Kansas River has been cutting into the underlying bedrock which dates to the Pennsylvanian and Permian periods of geologic time, and is 270 to 300 million years old. This bedrock is predominately limestone and shale with a few sandstones and thin coals inter-bedded. This bedrock forms the bluffs and the uplands that border the Kansas River. Scattered throughout the uplands are glacial drift deposits that include clay, silt, sand, gravel and even boulders, especially the large pink boulders so common to northeastern Kansas. The Kansas River is a dynamic fluvial system that transports sediments, erodes existing soil and rock, and creates new sedimentary deposits. Sediment is transported in the river in two ways: as bedload, which includes that material such as sand and gravel that bounces or rolls along the river bed, and suspended load, which is much finer material that is held in suspension by the river and only reaches the bottom in areas of slack water in which the river is not moving.

The Kansas River has been altering its valley and channel throughout its history. During times of high flow such as when the glaciers are melting, a lot of water and a lot of sediment moved down the river and allowed it to erode a deep channel and to widen it by lateral erosion. Since that time it has repeatedly filled this valley with sediment. When it does this, the river is said to be aggrading and the process is called aggradation. At other times, it has eroded these sediments from its valley. When it does this the river is said to be degrading and the process is called degradation. When I use the term degradation, I am only referring to the down cutting action of the river on its river bed, I am not making value judgments concerning the water quality or the state of the environment.

Today, the Kansas River has formed a deep bedrock trench that is partially filled up with silt, sand and gravel, material collectively known as alluvium. In places, this alluvium is up to 95 feet thick. The upper surface of this alluvium is referred to as the flood plain. Away from the river are slightly elevated portions of the flood plain that are known as terraces. These represent flood plain deposits that formed when the river flowed at higher levels. In general, the Kansas River is said to be at equilibrium or to be slightly degrading. A study done in 1984 estimated that roughly 1.67 million tons of sediment per year passed the DeSoto gauging station. Such measurements are made with a high degree of uncertainty. The 18 federal reservoirs in the Kansas River basin do two things: they control floods and they trap sediment. By reducing the size of floods along the Kansas River these reservoirs reduce the maximum grain size that can be transported by the river. As a result, today, much of the gravel that is taken from this river cannot be replenished since it is only moved during very large floods.

The Kansas River valley is 138 miles long and has a gradient or slope of about two and a half feet per mile. The Kansas River takes a more tortuous course and is 170 miles long and has a gradient of about 2 feet per mile. The average width of the Kansas River flood plain is 2.6 miles. However, it is 3 miles or wider in numerous places above Eudora. The widest stretch of the flood plain is in the Wamego to Rossville area where it is equal to or slightly more than 4 miles in width. The narrowest stretch of the Kansas River is from Eudora to its mouth where it is less than a mile and a half in width and in some places less than a mile. From Junction City to Lawrence, the Kansas River seems to prefer the south side of its valley touching the south valley walls in numerous locations. Below Lawrence, the river shows no preference for either side of its valley and meanders from bluff to bluff. Also, in this stretch of the river from Eudora to Kansas City there are very few terraces.

POPULATION

The Kansas River touches on or passes through 10 counties along its course. Those are Riley, Geary, Pottawatomie, Wabaunsee, Shawnee, Douglas, Jefferson, Leavenworth, Johnson and Wyandotte. These 10 counties had a population of slightly less than one million in the 1990 census. This represents 40% of the state's two and a half million population. Eight of these 10 counties gained population between the 1980 and 1990 census years, and the net gain of these 10 counties equals 97% of the state's net gain in population between those two census years. The population density of the 10 county area is 182.3 people per square mile. This is 6 times as dense as the state as a whole, which has an average density of 30.3 people per square mile. Although there are roughly one million people in the Kansas River valley now, by the year 2025 it is projected that the population of these 10 counties will be 1.3 million, nearly 50% of the state's population at that time. Such growth demands new infrastructure and new construction, and one resource necessary for new construction is aggregates.

AGGREGATES

I need to define an aggregate. An aggregate is any hard inert material used for mixing with a cementing or bituminous material to form concrete, mortar, asphalt or similar product, or used alone as in railroad ballast, road covering or fill. Aggregates are not the most exciting material extracted from the earth. When sand was discovered in the Kansas River valley, it is unlikely this discovery was heralded with banner headlines in the local paper. Anything that you buy by the ton and deliver by the truckload is not considered a precious commodity unless it is no longer available. But it is the stuff of which civilization is built. This morning you no doubt left a home containing aggregates, traveled on streets, highways, and sidewalks containing aggregates, and today we are assembled in a building held together by mortar containing aggregates.

Although aggregates are inexpensive and in places an abundant natural resource, they are like most of the earth's resources and are not distributed in the uniform, fair or equitable manner. This inequitable distribution of the earth's resources is the reason there are disputes, lawsuits, wars and geologists. The two main types of aggregates used in Kansas are sand and gravel and crushed stone. Most of the crushed stone in Kansas is produced from the limestones that crop out from the Flint Hills eastward. In the Kansas River valley there are roughly 75 named limestone units. However, only a few of these meet the rigid specifications of the KDOT and other users of aggregates for purity and physical character for use in concrete construction. A recent article in the Kansas City Star dealt with the problem of crumbling concrete in the Kansas City area and laid the blame on the use of crushed limestone from eastern Kansas. Today, more sand and gravel is being substituted for crushed stone. The average mixture in highway concrete is 65% sand and gravel to 35% crushed limestone. KDOT estimates that a one mile concrete highway, two lanes wide and nine inches thick, uses 3,400 tons of sand and gravel at the cost of $12,350. In Kansas, the use of sand and gravel breaks down as follows: concrete aggregate - 50%, asphalt aggregate - 21%, fill sand - 14%, road base and covering - 11%, and other uses 4%. This includes treatment of icy roads, sand blasting and fiberglass production. Twenty-five percent of the sand and gravel produced in the Kansas River corridor is used by the Kansas Department of Transportation.

PRIMARY SOURCES OF SAND AND GRAVEL

The primary sources of sand and gravel in Kansas, and here I will refer to the state geologic map, are the Kansas River, and also the lower tributaries of the Kansas River such as the Republican, Big Blue and Smoky Hill, the Arkansas River, which is extensively mined in the Wichita area and other places, and the Missouri River, which has a drawback in that much of its sand contains lignite, a form of brown coal that causes dark spots in the concrete which can lead to cavities and make it susceptible to attack by the elements. The Neosho River is mined for cherty gravels that are found along its course.

Another source of sand and gravel is in western Kansas where Ogallala and younger deposits of sand and gravel are mined in dry pits generally located above the water table. The ultimate source of sand and gravel comes from two sources: the glacial drift, left behind by the glaciers in northeast Kansas, which was carried into the state from Canada and the north-central parts of the United States; the other source of sand and gravel in Kansas are the sand and gravel deposits of the high plains that were washed into Kansas from the west and the Rocky Mountains. Rivers that do not drain these two areas, the glaciated area, and the Ogallala type deposits of western Kansas, generally do not have economic deposits of sand and gravel in their river beds.

DREDGING

The Kansas River is a major source of sand and gravel in northeastern Kansas. Sand and gravel is produced by two dredging processes: river dredges and flood plain or pit dredges. I refer you to Figure 1.1, one of the colored maps of the Kansas River valley that we have given you. This map shows the river corridor, permits for dredging, exclusion zones to river dredging, river miles and some other pertinent information.

River dredges operate directly in the river. They mine the bed material of the river which is generally sand and small gravel. This material contains very little mud or clay, therefore there is very little waste. Nearly all the material taken from the river can be used as a commercial product. This results in some of the best quality, least expensive sand in the United States. U.S. prices for sand at the plant range from $3.00 to $15.00 a ton. In Kansas City, sand at the plant cost on average $3.60 per ton. In 1996, 2.4 million tons of sand and gravel were produced from the Kansas River. This represents 75% of the sand and gravel produced in the 10 county area along the Kansas River. Producers pay a $.15 per ton royalty on sand taken from the Kansas River and in 1996 this resulted in $360,000 paid in to the Kansas treasury.

Flood plain dredges or pit dredges operate on the flood plain of the river at some distance from the river and mine the alluvial fill of the river valley. Here I refer to the other colored map, Figure 2.1, which shows industrial mineral operations and cross section locations along the Kansas River corridor. On this map, river dredges are shown by the orange circles, and pit dredge locations are shown by the circles with the orange x's in them. In addition, limestone quarry sites for crushed limestone and building limestone are shown by blue circles and squares respectively. Also, shown on Figure 2.1 are red lines that cross the Kansas River. These are lines along which cross sections have been constructed in previous KGS reports. Three of these cross sections, A, B and C are shown in Figures 2.2, 2.3, and 2.4 on one of your other handouts. On these cross sections, the vertical scale has been expanded in relation to the horizontal scale to make the cross sections a little bit more readable. These cross sections show the typical sequence of materials encountered when one mines into the river flood plain. The uppermost part of the flood plain and much of the terrace deposits are composed of soil and also overbank deposits. These are generally fine materials such as clays and silts that were deposited at times of flood at some distance from the river channel itself. The soil and these fine materials represent overburden that must be removed and used as fill or possibly as topsoil. There is limited market for this material. The next material often encountered is fine sand. Much of that is also unusable, however, a small amount can be used and sold as masonry sand. The deeper layers on down to bedrock often contain large amounts of sand and gravel and this is the desired material. However, within this sand and gravel sequence there may be lenses of clay or silt material that again have very little market value. In general, the overburden must be removed down to the water table in order to float the dredge that will then dig up the sand and gravel.

It is worth noting in each of these three cross sections that the deepest point in the bedrock channel carved by the Kansas River, and the modern day location of the Kansas River are at a different location. The thickest sequence of alluvium shown on these cross sections is roughly 90 feet or so shown on the Topeka cross section, along the north side of the Kansas River valley.

PIT DREDGING VS. RIVER DREDGING

Some comparisons of pit dredges and river dredges. First of all, permits. Pit dredges are permitted by the State Conservation Commission with approval from the appropriate county commission. River dredges are permitted by the United States Army Corps of Engineers with approval of plans by the Division of Water Resources of the Kansas Department of Agriculture. At the time of this report, there were seven pit dredges operating in the Kansas River corridor and nine river dredges. All the river dredges operated from just west of Topeka down stream to the river's mouth. A pit dredge requires much more land. At minimum it is estimated that 100 acres are required for a successful pit dredge operation, and this land is often expensive bottom land. A river dredge requires only about 10 acres of land necessary for the screening and storage of material, and this is generally located along the river bank. A pit dredge operation generally requires drilling or some sort of exploration program to ensure that adequate supplies of sand and gravel are available for mining. This generally is not necessary for the river dredge. With a pit dredge, overburden must be removed at some cost and the pit must be excavated down to the water table, which may be at some depth below the surface. On a river dredge, there is no overburden and no unnecessary excavation is needed. Unused material produced by pit dredging incurs some cost to be disposed of or removed. With a river dredge, there is very little in the way of unusable material. Pit dredges also require reclamation. With river dredges there is no reclamation. In addition, when a pit dredge is shut down, they leave a large hole in the flood plain in which the water table is exposed, creating a potential avenue of pollution and also a potential loss of water resources through evaporation. In general, in the lower Kansas River area, sand produced by pit dredging is 50% more expensive than sand produced by river dredges.

Bleckinger, in a 1997 master's project in Civil Engineering at the University of Kansas, did an analysis of sand mining alternatives along the Kansas River. He evaluated most of the water well logs located at the Kansas Geological Survey for wells drilled in the Kansas River valley. For these he determined overburden ratios which is the ratio of overburden in volume to ton of underlying sand and gravel, and he did this for each mile square section for which information existed. After analyzing various factors affecting the cost, he was left with 74 potentially profitable pit dredging sites in the Kansas River valley. Most of these are in the upper part of the Kansas River valley from Shawnee County westward. Forty-nine occur in Shawnee, Pottawatomie, and Wabaunsee counties where the flood plain is quite wide. Only nine potentially profitable pit dredging sites were found east of Douglas County.

CONCLUSIONS ON DREDGING

Conclusions regarding dredging in the Kansas River are as follows: in general, the Kansas City to Lawrence stretch of the river favors river dredging. In this area the flood plain is much narrower and the land available for pit dredging is tightly restricted by commercial development, railroad yards, highways, pipelines and expensive farmland. In addition, the overburden, that unusable material lying above the commercially valuable sand and gravel, is much thicker in this portion of the river valley.

The Lawrence to Topeka stretch of the river is slightly more conducive to pit dredging. Here the flood plain is a little bit wider, however, the overburden is still thick, and the depth to the water table is also a problem. In addition, much of the land in this area is farmed and more expensive and difficult to obtain. The Topeka to Junction City stretch of the river appears to be the most likely area for successful pit dredging. Here the flood plain is quite wide making more land available that is less expensive. Commercial and industrial usage of the flood plain is less than in areas down river. In addition, the overburden is thinner and the water table is much closer to the surface. At the present time, all dredges operating above Topeka in the Kansas River valley, are pit dredges.

ALTERNATIVE SOURCES OF SAND AND GRAVEL

For this discussion I refer you to Figure 2.8, the two maps of eastern Kansas with the arcs drawn in various locations. A major expense in the use of sand and gravel is its transportation costs. Ten cent per ton-mile is an average cost for transporting sand and gravel. However, this may range from \$.08 to \$.25 per ton-mile. Most producers do not haul sand and gravel farther than 50 miles. They find these long runs are less profitable than shorter hauling distances. This effectively rules out the Arkansas River as a source for sand and gravel in the Kansas River area except in unusual circumstances. In 1993, such unusual circumstances occurred when flooding along the Kansas River caused the dredges to shut down. At this time, some sand and gravel was shipped into the Kansas River area from the Arkansas River, and this sand and gravel was selling for \$15.00 a ton. This compares to \$3.60 a ton average for Kansas River sand at plants in the Kansas City area. If river dredging were removed from the Kansas River, the few pit dredges on the narrow flood plain of the lower Kansas River valley would be inadequate to meet the demand in that rapidly growing area, and pit dredges in the upper Kansas River valley would be too far away and transportation costs would be very high. As a result, more Missouri sand would have to be used. And even after attempts are made to remove the troublesome lignite, it is still not suitable for some construction jobs. If no sand were taken at all from the Kansas River, only the lower parts of its tributaries and the Missouri River would be sources in northeastern Kansas. The lower map of Figure 2.8, shows that Topeka would lie outside 50 mile arcs drawn around these sources and as a result transportation costs in this area would be very large.

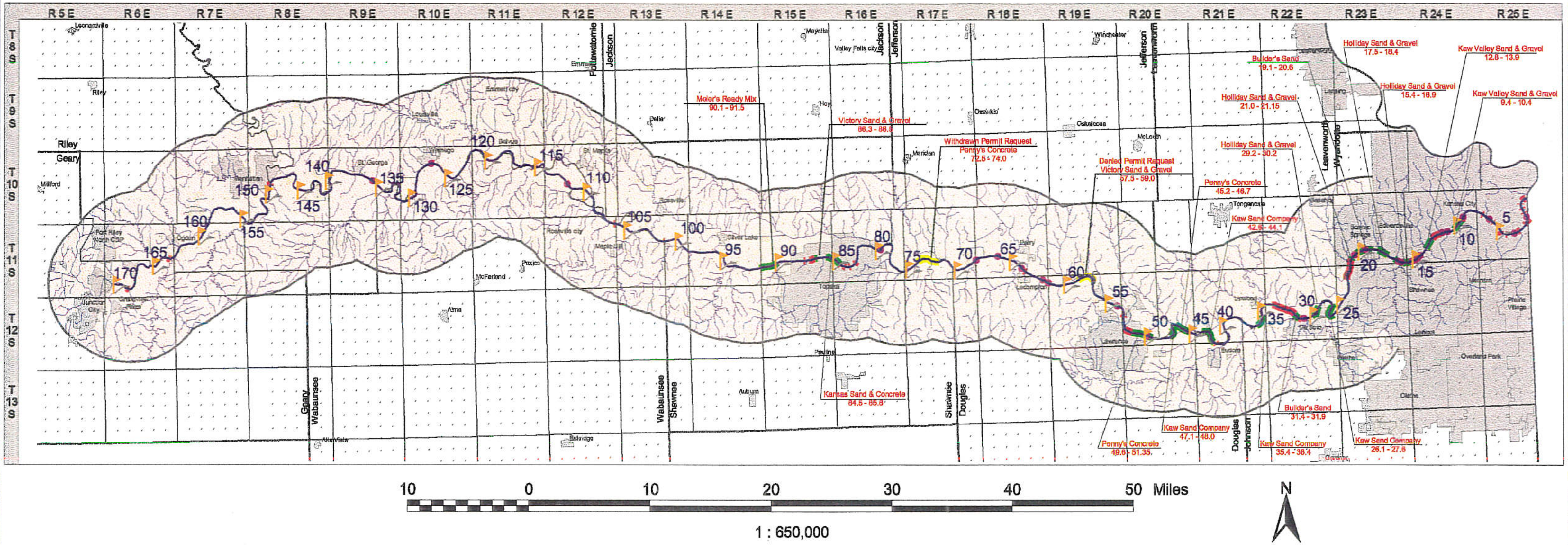
Continued growth in the 10 county area along the Kansas River will guarantee a strong demand for aggregate. Between 1980 and 1996, there was a 20% increase in population in these 10 counties. This compares to a 9% increase for this state as a whole during this same period. It is important that adequate reserves of aggregates are available to meet this increasing demand.

Kansas Geological Survey

Figure 1.1

Kansas Geological Survey
Kansas River Study

Kansas River Corridor - River Permits and Exclusion Zones to River Dredging - October, 1997



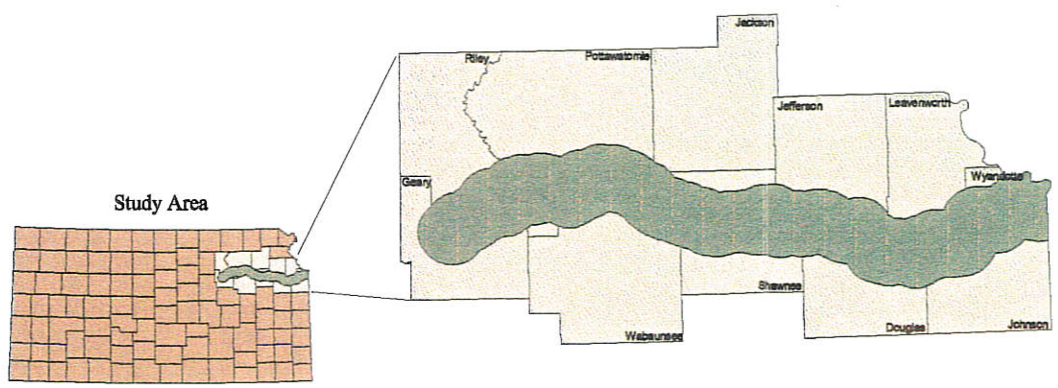
Primary Features:

- Streams and Rivers
- No Dredging Zone
- Sand Permit
- Withdrawn/Denied Permit Applications
- Pipeline Crossing
- River Mile Marker

Base Map Features:

- County Boundaries
- City boundaries
- Township boundaries
- Section corner points

Study Area



Citation Information:

Base map information (County boundaries, City Boundaries, Township boundaries, Section Corner Points, and Hydrography were obtained from the State of Kansas Data Access and Support Center (DASC) at the Kansas Geological Survey (KGS)

Permits, Restricted Areas, and River Mile Markers were extracted from other cartographic sources and digitized for use on the Kansas River Study.

Projection Information:

Lambert Conformal Conic (Clarke 1866)	
Central Meridian	-98 15 00
Reference Latitude	36 00 00
Standard Parallel 1	33 00 00
Standard Parallel 2	45 00 00

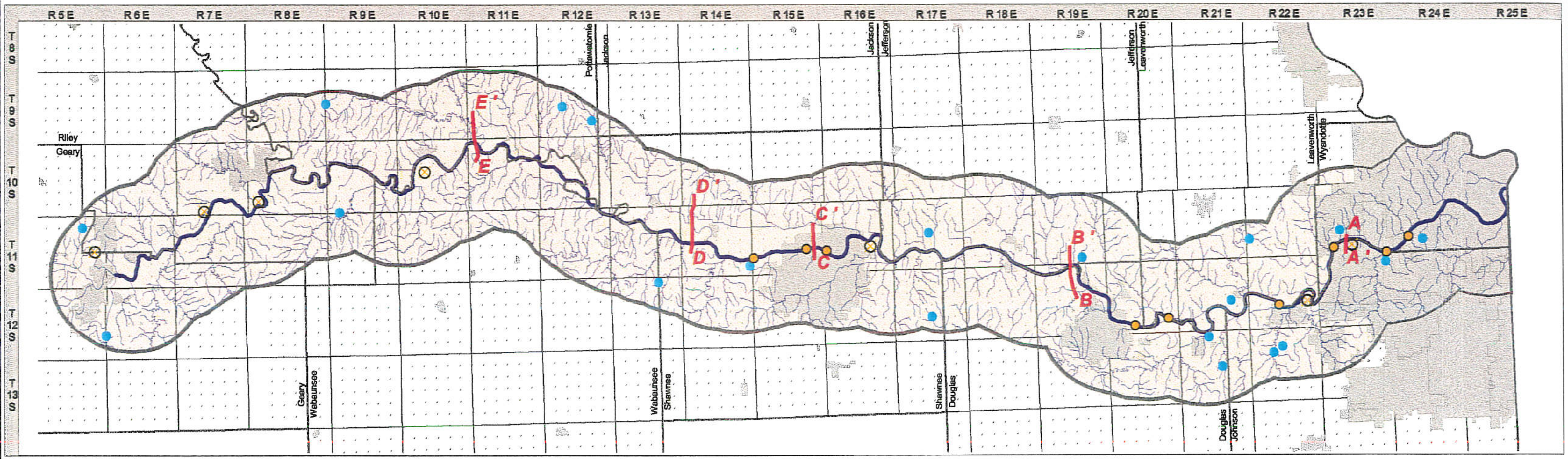
1-15

Kansas Geological Survey

Figure 2.1

Kansas Geological Survey
Kansas River Study

Industrial Mineral Operations and Cross Section Locations along the Kansas River Corridor



10 0 10 20 30 40 50 Miles

1 : 650,000

N

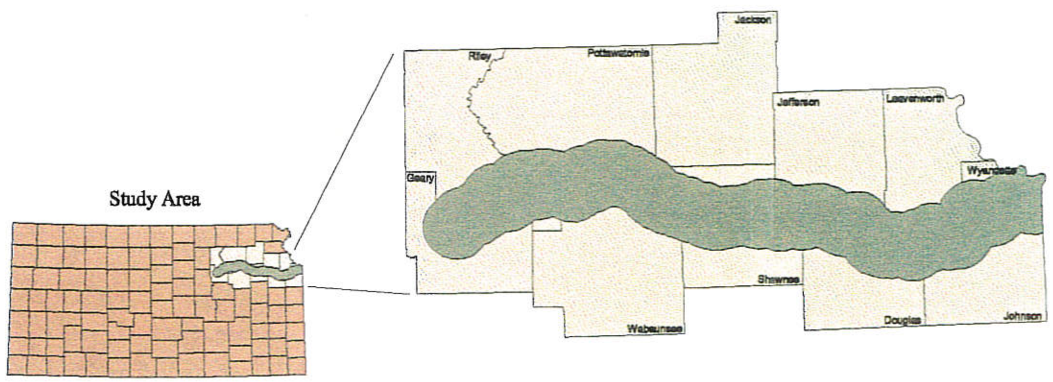
Primary Features:

- Streams and Rivers
- Cross-Section Locations (A - A ')
- River Dredge Locations
- Pit Dredge Locations
- Crushed Limestone
- Building Limestone

Base Map Features:

- County Boundaries
- City boundaries
- Township boundaries
- Section corner points

Study Area



Citation Information:

Base map information (County boundaries, City Boundaries, Township boundaries, Section Corner Points, and Hydrography were obtained from the State of Kansas Data Access and Support Center (DASC) at the Kansas Geological Survey (KGS)

Pit dredge locations were obtained by converting legal descriptions to geographic coordinates. River dredge locations were plotted using river mile markers as a reference

Projection Information:
Lambert Conformal Conic (Clarke 1866)

Central Meridian	-98 15 00
Reference Latitude	36 00 00
Standard Parallel 1	33 00 00
Standard Parallel 2	45 00 00

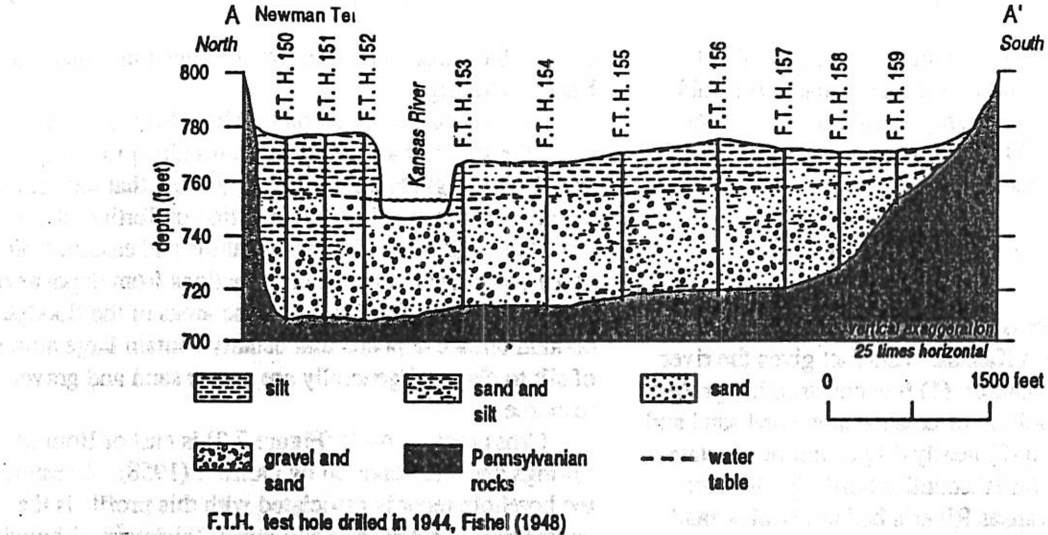


FIGURE 2.2—Cross section A–A′ of the Kansas River, east of Bonner Springs, Kansas. Modified from Dufford (1958, p. 10).

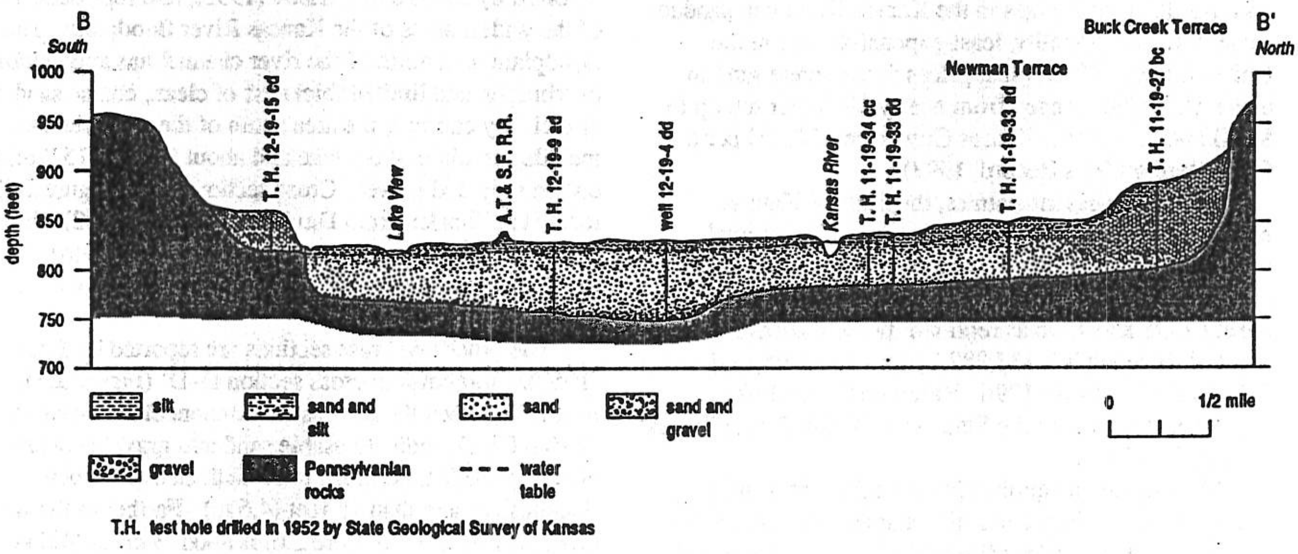


FIGURE 2.3—Cross section B–B′ of the Kansas River, northwest of Lawrence, Kansas. Modified from Davis and Carlson (1952, pl. 3).

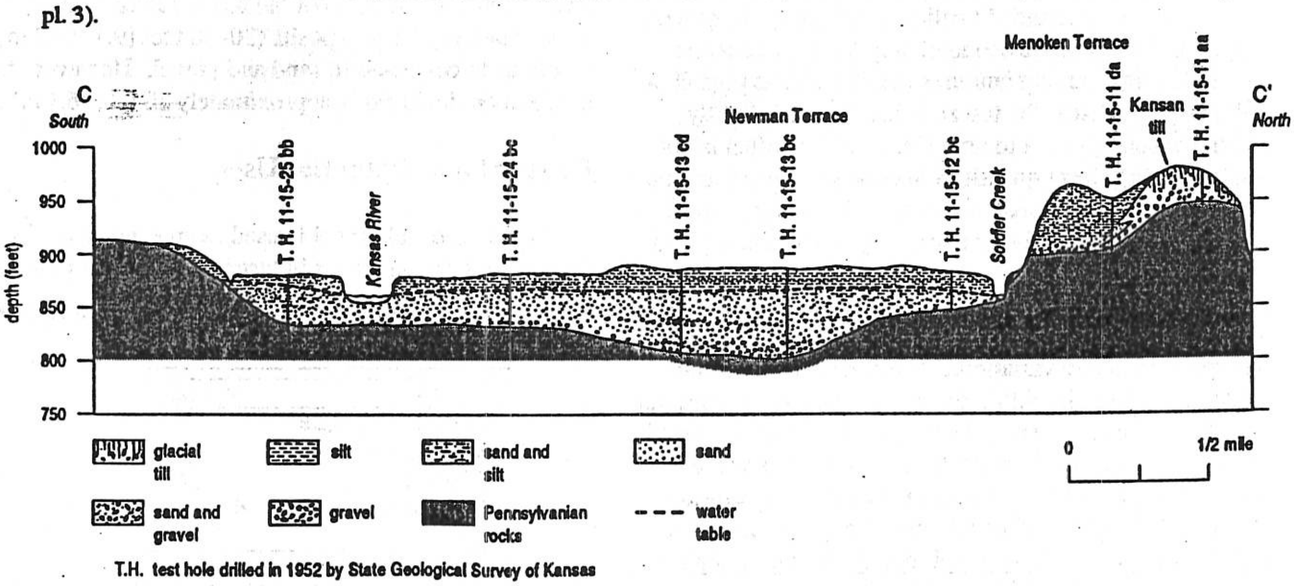


FIGURE 2.4—Cross section C–C′ of the Kansas River at Topeka, Kansas. Modified from Davis and Carlson (1952, pl. 3).

1-17

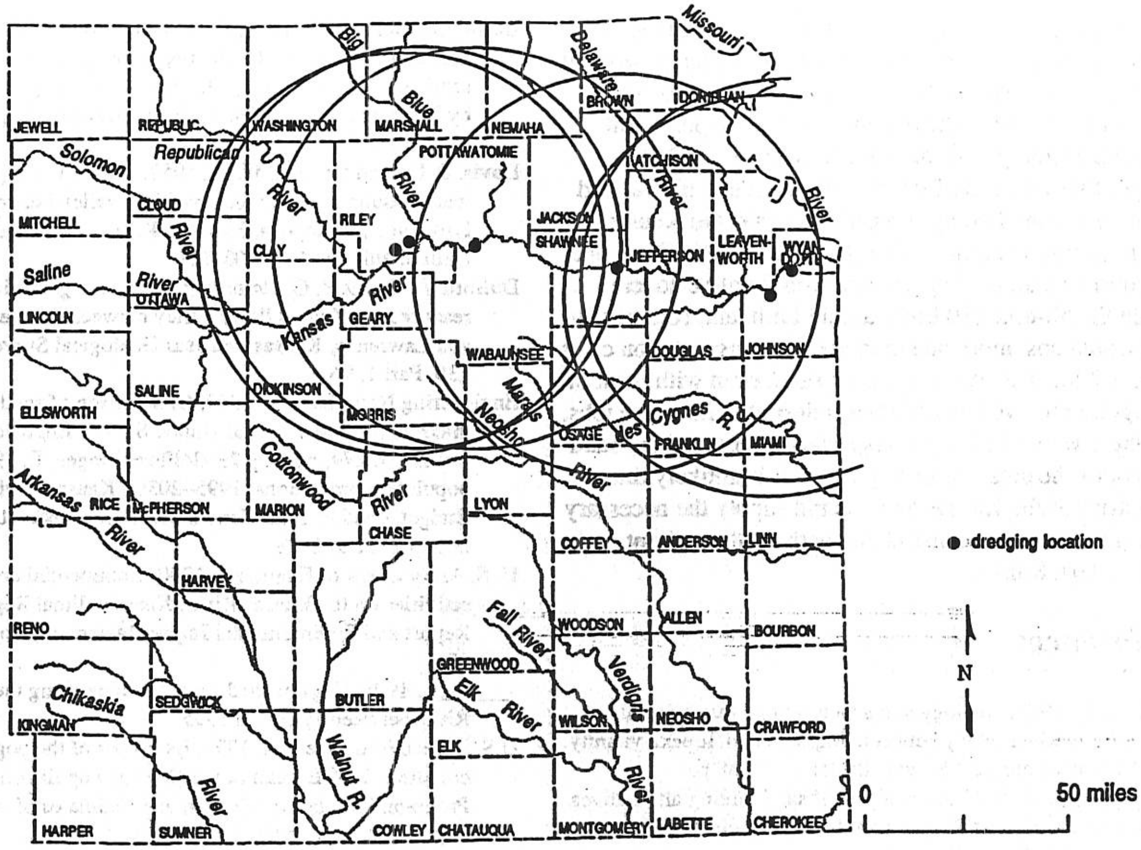


FIGURE 2.7—MAP OF EASTERN KANSAS WITH ARCS OF 50-MILE (80-KM) RADIUS FROM EXISTING PIT-DREDGING OPERATIONS.

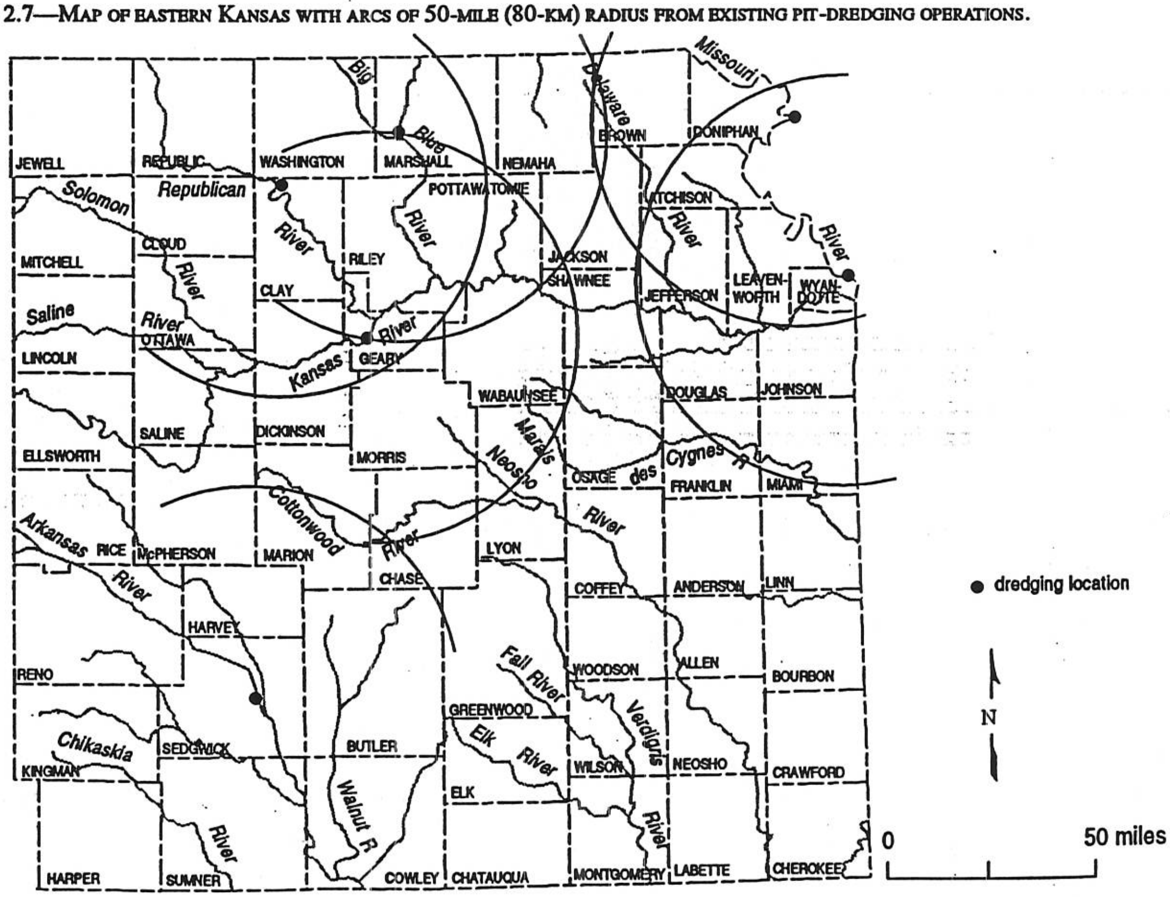


FIGURE 2.8—MAP OF EASTERN KANSAS WITH ARCS OF 50-MILE (80-KM) RADIUS FROM EXISTING OPERATIONS OTHER THAN THE KANSAS RIVER.

1-18