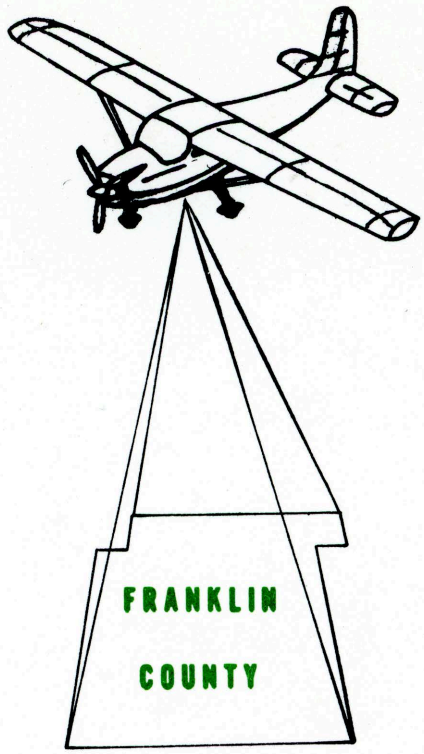


MATERIALS INVENTORY

PREPARED BY THE
STATE HIGHWAY COMMISSION OF KANSAS
LOCATION AND DESIGN CONCEPTS DEPARTMENT
IN COOPERATION WITH THE
U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BUREAU OF PUBLIC ROADS

State Highway Commission of Kansas
Planning and Development Department -
Location and Design Concepts Department

MATERIALS INVENTORY OF FRANKLIN COUNTY, KANSAS

by

Alvis H. Stallard, Geologist
assisted by
Robert L. Kibby
Photo Interpretation Section

Prepared in Cooperation with the
U. S. Department of Transportation
Federal Highway Administration
Bureau of Public Roads

1969

Materials Inventory Report No. 18

the Why ?

What ?

& How ?

Of This Report

This report was compiled for use as a guide when prospecting for construction material in Franklin County.

> *Construction material includes all granular material, consolidated rock, and mineral filler suitable for use in highway construction.*

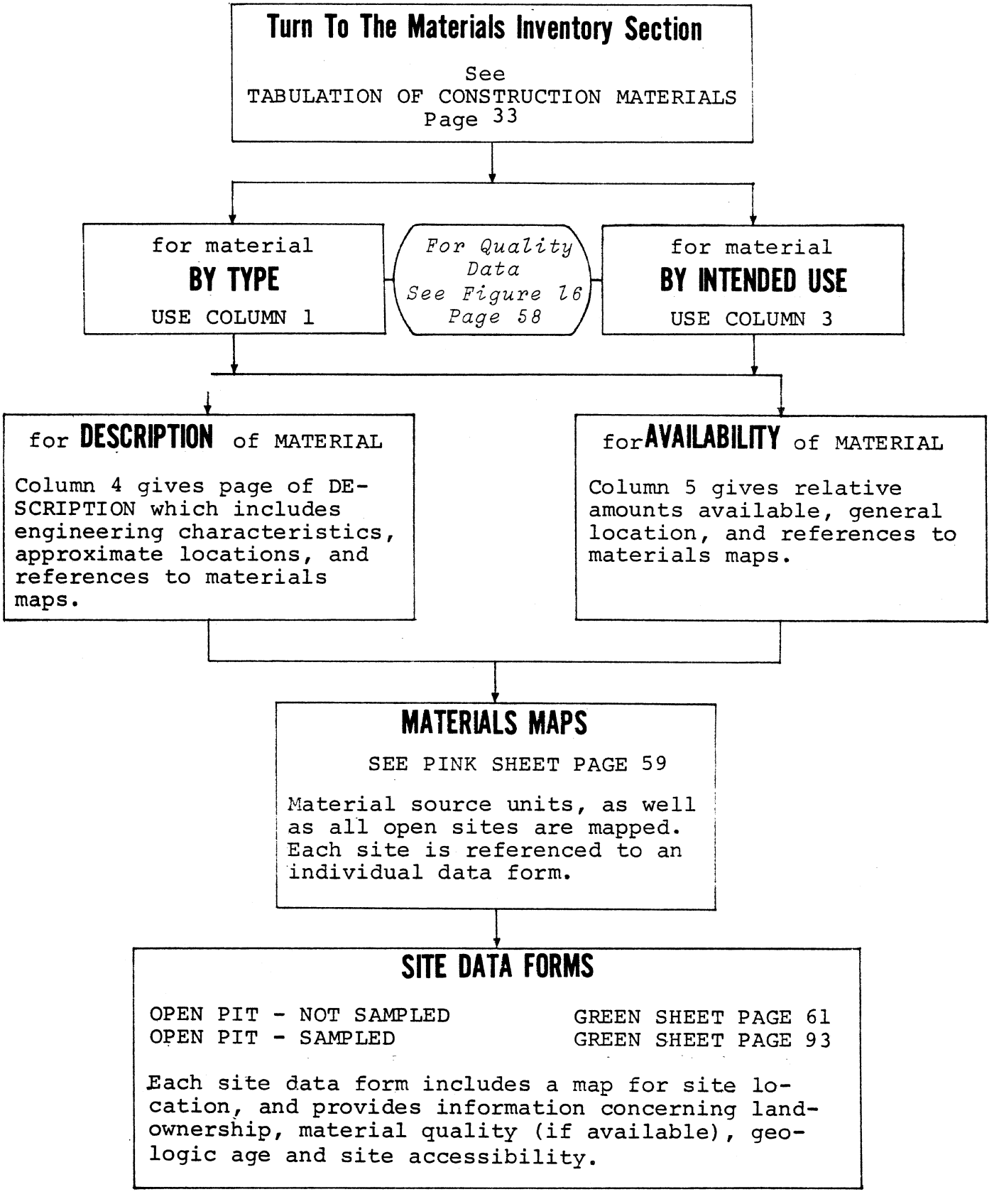
Known open sites, both sampled and unsampled, and all geologic units and deposits considered to be a source of construction material are described and mapped.

The diagram opposite shows how the MATERIALS INVENTORY SECTION may be used to evaluate and locate mapped sites.

The individually mapped sites certainly do not constitute the total construction material resources of the county. And, the data outlined in the diagram may be used for purposes other than the evaluation and location of these sites.

Beginning on page 7 is a section explaining the Geology of the county. This information (along with the maps, descriptions, and test data) provides the means of evaluating and locating additional construction material sources in the geologic units throughout Franklin County.

TO LOCATE AND EVALUATE
A MAPPED SITE OF CONSTRUCTION MATERIAL IN FRANKLIN COUNTY



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PREFACE

This report is one of a series compiled for the Highway Planning and Research Program, "Materials Inventory by Photo Interpretation." The program is a cooperative effort of the Bureau of Public Roads and the State Highway Commission of Kansas, financed by highway planning and research funds. The objective of the project is to provide a state-wide inventory of construction materials, on a county basis, to help meet the demands of present and future construction needs.

No extensive materials investigations have been completed in Franklin County; however, one report by Ball and others (1963), provided geological information. Detailed geologic and soil data were obtained from soil surveys and centerline geological profiles prepared for design of major highways in the county by the State Highway Commission.

Appreciation is extended to Mr. Robert Lister, Franklin County Engineer and Mr. Jim Farrell, Fourth Division Materials Engineer for verbal information concerning construction materials in this area.

The report was prepared under the guidance of Mr. John D. McNeal, State Highway Engineer, the project engineer, Mr. Ray R. Biege, Jr., Engineer of Location and Design Concepts, and Mr. Glen M. Koontz, Coordinating Engineer, Location and Design Concepts Department.

ABSTRACT

Franklin County is located in east-central Kansas and is a part of the Osage Cuestas physiographic division. The terrain is characterized by alternating beds of unequally resistant limestones, shales, and sandstones which give rise to a gently rolling topography. The county is drained by the Marais des Cygnes River, Pottawatomie Creek, and their tributaries.

Construction material can be produced from Pennsylvanian limestones, shales, and sandstones and from unconsolidated deposits of Pliocene(?) and Pleistocene age.

A fairly good quality of aggregate, riprap and light type surfacing material can be produced from thick limestone units that are exposed in the western and eastern quarters of the county. The most abundant supply of limestone is found in the eastern part of the county.

An abundant supply of fine sandstone is available in the central part of the county from the Tonganoxie and Ireland Sandstone units. The Weston Shale, which is exposed in the same general area, is a source of raw material for lightweight aggregate. A very limited supply of chert gravel is available in Tertiary and Quaternary Terraces located along the north bluff of the Marais des Cygnes River valley to the west and east of the city of Ottawa.

Because Franklin County has an average annual rainfall of 36 inches, ground-water and other geo-engineering problems can be anticipated. Most of the soil mantle encountered in the county is highly plastic and would be classified as an A-6 or A-7 soil according to the American Association of State Highway Officials (A.A.S.H.O.) soil classification system. A good quality of water for concrete mix purposes can be produced in some areas but not in large quantities. The Alluvium is the best aquifer in the county but this source may be contaminated by surface water especially in the eastern part of the county where oil wells are located.

GENERAL INFORMATION SECTION

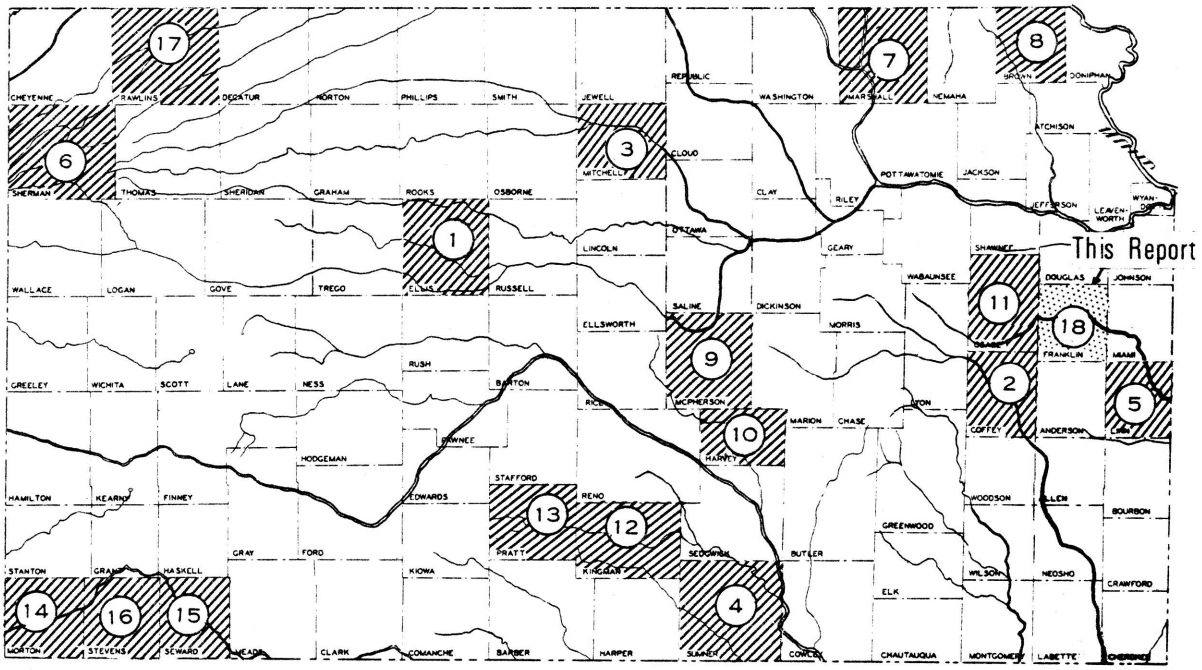


Figure 1. Index map of Kansas showing the location of Franklin County along with the number and location of counties for which reports have been or are being completed.

FRANKLIN COUNTY

Franklin County has an area of 576 square miles and a population of 21,447 in 1968 according to the Kansas State Board of Agriculture. It lies in the Osage Cuestas physiographic division of Kansas and is bounded by parallels 38° 07' and 38° 44' north latitude and meridians 95° 04' and 95° 31' west longitude.

Figure 1 shows the location of Franklin County and other counties currently included in the materials inventory program.

The topography of Franklin County is characterized by gently rolling plains with moderate to steep slopes adjacent to the major drainage channels. The drainage of the area is to the east and is controlled by the Marais des Cygnes River and Pottawatomie Creek.

Franklin County is served by the Missouri Pacific and the Atchison, Topeka, and Santa Fe Railroads. Highway US-59 extends north-south through the central part of the county. Interstate 35, when completed, will cross the county diagonally from the southwest to the northeast corner. US-50 runs nearly parallel to the proposed I-35 route in the southwestern part of the county and coincides with I-35 from Ottawa to the northeast corner of the county. State Highway 68 extends east-west across the county, passing through Pomona and Ottawa. There is also a well developed system of secondary roads throughout the county.

METHODS OF INVESTIGATION

Investigation for this report consisted of three phases: 1. Research and review of available information, 2. Photo interpretation, and 3. Field reconnaissance.

During phase one, pertinent information pertaining to the geology, soils, and construction materials was reviewed, and the general geology of the county, relative to material sources, was determined. The results of quality tests of samples taken in Franklin County were correlated with the various geologic units and deposits.

Phase two consisted of study and interpretation of aerial photographs taken by the State Highway Commission at a scale of one inch equals 2,000 feet. Figure 2 shows the photographic coverage of Franklin County.

The geologic source beds were mapped and classified on photographs as were all open material sites previously sampled and reported. Then all material sites were correlated with the geology of the county.

Phase three, field reconnaissance of the county, was conducted after initial study of the aerial photographs. This enabled the interpreter to examine the material with which he was working, to verify doubtful mapping situations, and to better acquaint himself with the geology of the county.

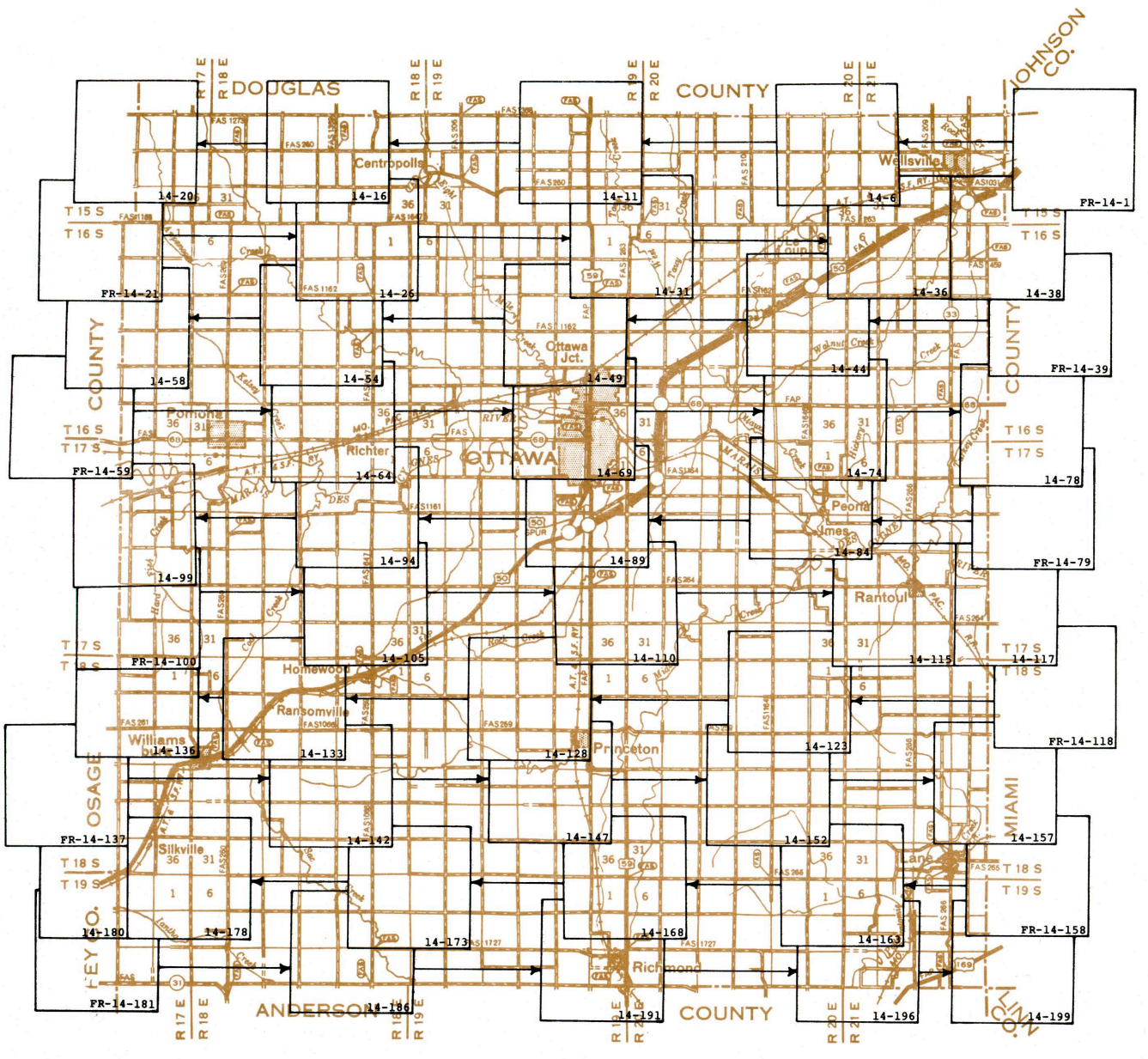
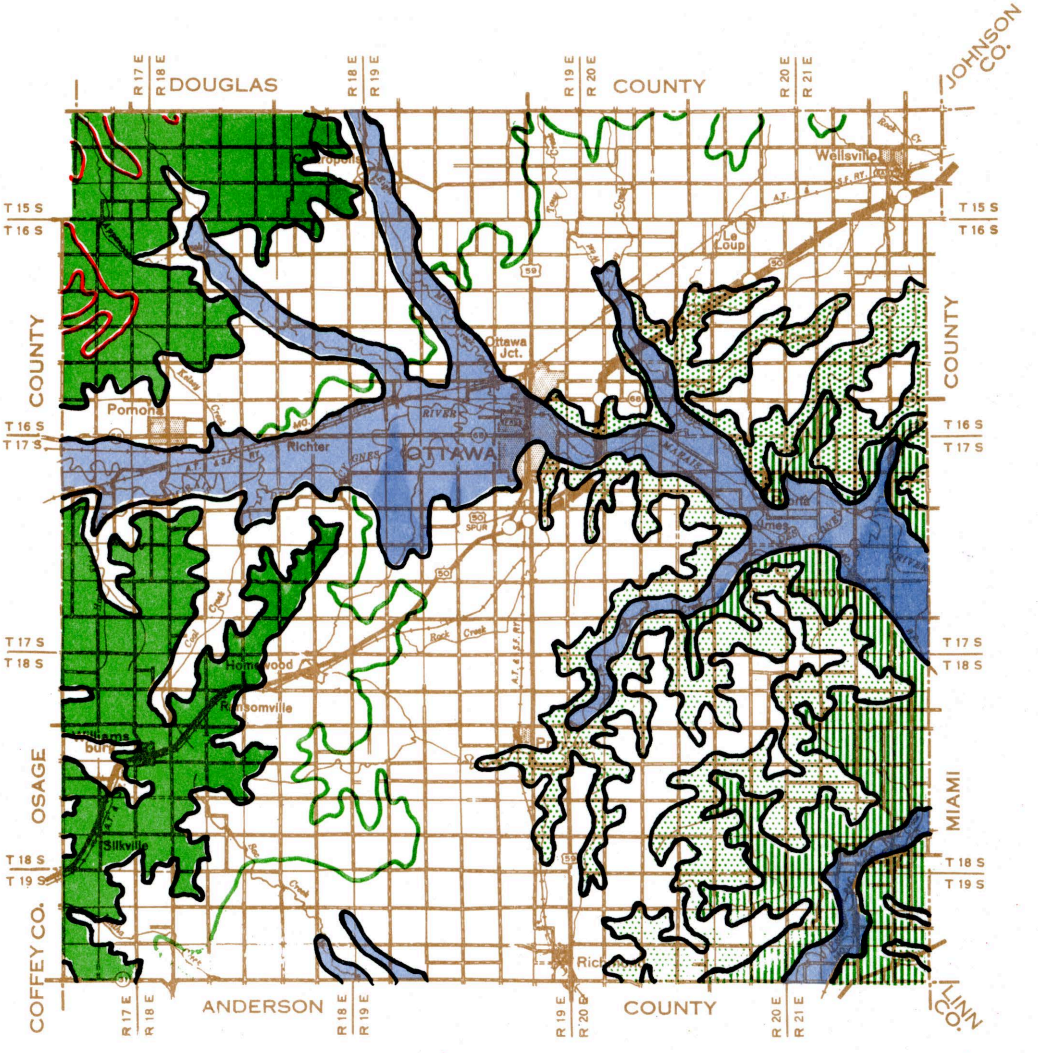


Figure 2. Aerial photographic coverage map for Franklin County. The numbers indicate photograph numbers on flights taken by the Photogrammetry Section, State Highway Commission of Kansas, April 6, 1967 at a scale of 1:24,000. Aerial photographs are on file in the Photogrammetry Laboratory, State Office Building, Topeka, Kansas.

GEOLOGY SECTION



GENERAL GEOLOGY

GEOLOGY is used as the basis for conducting this materials inventory project because all material source units are the product of geologic agents. This makes it possible to ascertain the general properties of the material source, to identify and classify each according to current geologic nomenclature, and thereby, establish a uniform system of material source bed classification. However, it is important to note that the quality of material from a given source may vary from one location to another, especially when one is dealing with unconsolidated deposits. Usually the geologic classification attached to unconsolidated deposits denotes age rather than material type; therefore, two deposits laid down during the same time period in different parts of the state may have the same geologic name or classification, but may vary in composition because of the difference in parent material, mode of deposition, or carrying capacity of the depositing agent.

In essence, by knowing the mode of deposition, type of source bed, geologic age, type of landform associated with a particular source unit, and the results of quality tests completed on samples obtained from similar deposits, one can derive general information concerning the material in prospective sites. Consequently, sites selected for development generally can be located by data obtained elsewhere from the same source unit.

Franklin County geology, as discussed in this report, is based primarily on a report by Ball and others (1963). The geologic timetable, figure 3, shows in graphic form the major time

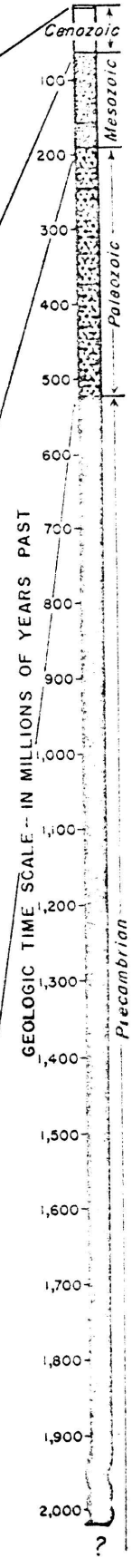
periods and the approximate duration of each. Inasmuch as the materials source units are exposed or near the surface, only a small part of this discussion pertains to the subsurface geology of the county.

Rocks which occur in the subsurface, but do not outcrop in Franklin County, range from Precambrian to late Pennsylvanian in age. The Precambrian rocks are believed to be primarily granitic types. According to Merriam (1963, page 78), between 2,000 and 2,500 feet of Paleozoic rocks, composed of limestone, dolomite, sandstone, and shale overlie the older Precambrian rocks in this general area.

Sediments of late Pennsylvanian age, which are the oldest rocks exposed in this area, make up a large part of the terrain in the county. Limestone units of this age are the most abundant and significant material source units in Franklin County. Figure 4 is a generalized geologic column of the surface geology of Franklin County which illustrates the relative stratigraphic position of the geologic source units. Most Pennsylvanian sediments were laid down in marine environments; however, it is believed that sandstone units (Tonganoxie and Ireland Sandstone) were deposited in ancient drainage channels that existed in eastern Kansas during late Pennsylvanian time. Presumably the area was flat enough that a slight change in sea level would cause wide spread submergence or emergence. It was during these periods of emergence that the sandstone was deposited. The ancient valley in which the Tonganoxie was deposited was formed sometime after the Weston Shale had been laid down. In some areas in eastern Kansas this channel eroded down into the underlying Stanton Lime-

ERAS	PERIODS	ESTIMATED LENGTH IN YEARS	TYPE OF ROCK IN KANSAS	PRINCIPAL MINERAL RESOURCES
CENOZOIC	QUATERNARY (PLEISTOCENE) 	1,000,000	*Glacial drift; river silt, sand, and gravel; dune sand; wind-blown silt (loess); volcanic ash.*	Water, agricultural soils, sand and gravel, volcanic ash.
	TERTIARY	59,000,000	*River silt, sand, and gravel; fresh-water limestone; volcanic ash; bentonite; diatomaceous marl; opaline sandstone.*	Water, sand and gravel, volcanic ash, diatomaceous marl.
MESOZOIC	 CRETACEOUS	70,000,000	*Chalk, chalky shale, dark shale, varicolored clay, sandstone, conglomerate. Outcropping igneous rock.*	Ceramic materials; building stone, concrete aggregate, and other construction rock; water.
	JURASSIC	25,000,000	*Sandstones and shales, chiefly subsurface.*	
	TRIASSIC	30,000,000		
PALEOZOIC	PERMIAN 	25,000,000	*Limestone; shale; evaporites (salt, gypsum, anhydrite); red sandstone and siltstone; chert; some dolomite.*	Natural gas; salt; gypsum; building stone, concrete aggregate, and other construction materials; water.
	PENNSYLVANIAN 	25,000,000	*Alternating marine and non-marine shale, limestone, and sandstone; coal; chert.*	Oil, coal, limestone and shale for cement manufacture, ceramic materials, construction rock, agricultural lime, gas, water.
	MISSISSIPPIAN 	30,000,000	*Mostly limestone, predominantly cherty.*	Oil, zinc, lead, gas, chat and other construction materials.
	DEVONIAN	55,000,000	*Subsurface only. Limestone, black shale.*	Oil
	SILURIAN	40,000,000	*Subsurface only. Limestone.*	Oil
	ORDOVICIAN 	80,000,000	*Subsurface only. Limestone, dolomite, sandstone, shale.*	Oil, gas, water.
	CAMBRIAN	80,000,000	*Subsurface only. Dolomite, sandstone.*	Oil
PRE-CAMBRIAN	(Including PROTEROZOIC and ARCHEOZOIC ERAS)	1,600,000,000 +	*Subsurface only. Granite, other igneous rocks, and metamorphic rocks.*	Oil and gas.

(Not scaled for geologic time or thickness of deposits)



State Geological Survey of Kansas

Figure 3. Geologic timetable (*Reproduced with the permission of the State Geological Survey of Kansas*).

System	Series	Stage	Graphic Legend	Thickness	Type of Deposit	Map Symbol	General Description	Construction Material
Quaternary	Pleistocene	Recant and Wisconsinan		40'±	Alluvium and Low Terraces	Qal	Composed of clay, silt with varying amounts of poorly sorted sand and gravel.	Light type surfacing material.
		Illinoisan (?) and Kansan (?)		0 to 25'	Terrace Deposit	Qt	Composed of silt and clay with concentrations of poorly sorted chert gravel and clay matrix.	Light type surfacing material.
		Nebraskan (?)		0-12'	Terrace Deposit	Tt	Composed of sand and gravel, mainly chert, which has been weathered extensively and contaminated with brownish-red clay matrix.	Light type surfacing material.
Tertiary	Pliocene							

Note: Pleistocene deposits and Pliocene (?) Chert Gravel Terraces may be in contact with any older outcropping rock.

System	Series	Group	Graphic Legend	Thickness	Formations and Members		Map Symbol	General Description	Construction Material
Pennsylvanian	Virgilian Stage	Shawnee Group			Lecompton Limestone	Doniphan Shale		Brown, massive limestone, impure, containing sandy or silty zones and thin shale partings.	Light type surfacing material. Riprap Crushed aggregate for various types and phases of highway construction.
				5'-7'		Spring Branch Ls.	Pls		
				50'	Kanwaka Shale	Jackson Park Shale	Pk	Comprises two shale units and one limestone. Lower part is a tan to gray calcareous and clayey shale. Upper part is a tan, silty to clayey shale.	Possible source of raw material for light type aggregate.
						Clay Creek Ls.			
						Stull Shale			
				11'	Oread Limestone	Kereford Ls.	Pok	A buff to gray, wavy-bedded limestone which, because of impurities, is very susceptible to weathering.	Light type surfacing material. In some areas, acceptable for other types of highway construction.
						Heumader Shale			
				18'		Plattsmouth Ls.	Pop	A light gray limestone characterized by wavy bedding and scattered chert nodules. Thin shale seams are common.	Light type surfacing material. Riprap Crushed aggregate for most types and phases of highway construction.
						Heebner Shale			
						Leavenworth Ls.			
						Snyderville Shale		A fairly massive gray to brown limestone that commonly weathers into thin irregular beds.	Light type surfacing material. Riprap Crushed aggregate for some phases of highway construction.
				8'-12'		Toronto Ls.	Pot		
		Douglas Group		66'	Lawrence Shale	Upper Williamsburg Coal	Pl	Upper part composed of gray, silty to sandy shale which contains two coal beds. Lower part (Ireland Sandstone) is a light gray, well-sorted sandstone which weathers to various shades of tan and brown.	Fine sand for base course and filler material.
						Lower Williamsburg Coal			
						Ireland Sandstone			
				58'	Stranger Formation	Robbins Shale	Pst	Comprises five members but only the Tonganoxie Sandstone is an important material source unit. It has a variable composition but consists primarily of fine grained quartzose, siltstone and sandstone.	Fine sand for base course and filler material.
						Haskell Ls.			
						Vinland Shale			
						Westphalia Ls.			
						Tonganoxie Sandstone			
	Missourian Stage	Pedee Group		37'	Weston Shale		Pw	A gray-blue, clayey shale that is relatively free of silt.	Raw material for lightweight aggregate.
		Lansing Group		40'	Stanton Limestone	South Bend Ls.	Ps	Comprised of five members. The Captain Creek and Stoner Limestone Members are important material source units. The upper part (Stoner Limestone) is a light gray, fine-grained limestone that weathers into relatively thin irregular beds. The lower part (Captain Creek Limestone) is a light gray to tan limestone which is characterized by wavy-bedding in the upper part.	Light type surfacing material. Riprap Crushed aggregate for various phases and types of highway construction.
						Rock Lake Shale			
						Stoner Ls.			
						Eudora Shale			
						Captain Creek Ls.			
					Vilas Shale				
				20'	Plattsburg Limestone	Spring Hill Ls.	Pp	Comprises three members, with two limestone units being important material source units in eastern Kansas; however, only the upper member (the Spring Hill Limestone) is produced in Franklin County. It is a fine-grained, gray limestone.	Light type surfacing material. Riprap Crushed aggregate for various types and phases of highway construction.
						Hickory Creek Shale			
						Merriam Ls.			
		Kansas City Group			Bonner Springs Shale				
		Zarah Subgroup		55'	Wyandotte Limestone	Farley Ls.	Pwy	Comprises five members, however, not all members are present in Franklin County. The Frisbie, Argentine, and when present the Farley Limestone Members are important source units. The upper-most member (Farley Limestone) is a light gray and brown limestone that has a lithology similar to that of the Argentine in some areas. The middle unit (Argentine Member) is a light gray limestone with chert nodules that weather into wavy-beds. The Frisbie Limestone (basal member) is a brown, dense limestone which is a single massive bed.	Light type surfacing material. Riprap Crushed aggregate for various types and phases of highway construction.
						Island Creek Shale			
						Argentine Ls.			
						Frisbie Ls.			
					Lane Shale				
		Linn Subgroup		9'	Iola Limestone	Raytown Ls.	Pir	Upper member of the Iola Limestone. A thin-bedded, gray to light gray limestone characterized by discontinuous shale partings.	Light type surfacing material. Riprap Crushed aggregate for various types and phases of highway construction.

Figure 4. Generalized geologic column of the surface geology in Franklin County.

stone Formation. Subsequently, the valley was filled with sandstone. Alternating periods of submergence and emergence followed as indicated by marine sediments, unconformities and fossil types. It was during a similar period of emergence that the Ireland Sandstone was laid down in an ancient drainage channel. In some areas the channel eroded through marine shales and into the underlying Tonganoxie Sandstone. Swampy conditions existed intermittently during this time span as indicated by several prominent coal beds. Marine conditions returned at which time the youngest Pennsylvanian rocks that are present in western Franklin County were deposited.

Mesozoic sediments are not found in Franklin County since the county is part of an area which was probably a landmass during most of the Mesozoic Era (Triassic and Jurrasic Periods). It is assumed that during this time large amounts of older Paleozoic rocks were removed by erosion.

The sea made its final invasion of Kansas during the late Mesozoic Era (Cretaceous Period) and if any sediments were deposited in Franklin County during this time, they were subsequently removed by erosion during Cenozoic time.

The events that took place during the Cenozoic Era were a dominant influence on the construction material resources of Franklin County. During most of the earlier Tertiary Period, the surface of the area was probably subjected to erosion which removed rocks of late Pennsylvanian age. During late Tertiary time, it is believed that the antecedent streams of the present day channels deposited terraces composed primarily of chert gravel. Today these deposits occur 85 to 100 feet above the Marais des Cygnes River floodplain.

The Quaternary Period represents a time of repeated glacial and interglacial cycles. Glacial activities in Kansas were restricted to the northeastern corner of the state; however, the sequence of glaciation which occurred during this time played a controlling role in the stream activity in Franklin County. Figure 5 is a geologic timetable which shows the divisions of the Quaternary Period and the approximate length of each. The glacial ages (Nebraskan, Kansan, Illinoisan, and Wisconsinan) represents the advance of the glaciers, while the three interglacial ages (Aftonian, Yarmouthian and Sangamonian) represent the time of major glacial recession. The Recent Age represents the time which elapsed since the retreat of the Wisconsinan glacier.

The deposition of chert gravel, that presumably took place during late Tertiary time, continued into the Quaternary Period. At different intervals of time the streams degraded their channels leaving the previously deposited material at higher elevations and at the same time exposed older Pennsylvanian bedrock. Terrace deposits today are found between 55 to 70 feet above the floodplain and are believed to have been laid down during Kansan and Illinoisan time.

Presumably, the present day channels were alluviated during Wisconsinan and early Recent time. Later, streams in this area began to erode their channels and, therefore, began to cut into their own sediments and bedrock.

In this report, the alluvial terraces which were deposited during late Tertiary and Quaternary time have been mapped as three separate material source units. The grouping of the various

Divisions of the Quaternary Period				
Period	Epoch	Age	Estimated length of age duration in years	Estimated time in years elapsed to present
Quaternary	Pleistocene	Recent		10,000
		Wisconsinan Glacial	45,000	55,000
		Sangamonian Interglacial	135,000	190,000
		Illinoisan Glacial	100,000	290,000
		Yarmouthian Interglacial	310,000	600,000
		Kansan Glacial	100,000	700,000
		Aftonian Interglacial	200,000	900,000
		Nebraskan Glacial	100,000	1,000,000

Figure 5. Geologic timetable of the Quaternary Period

age deposits as single material map units was based on similarity in topographic position and lithology. The chert gravel terraces are shown on the materials map as Tertiary Terraces. Kansan and Illinoisan terraces have been designated as one source unit and are mapped as Quaternary Terraces. Floodplains and terraces deposited during Wisconsinan and Recent time have been mapped as Quaternary Alluvium.

GEO-ENGINEERING SECTION

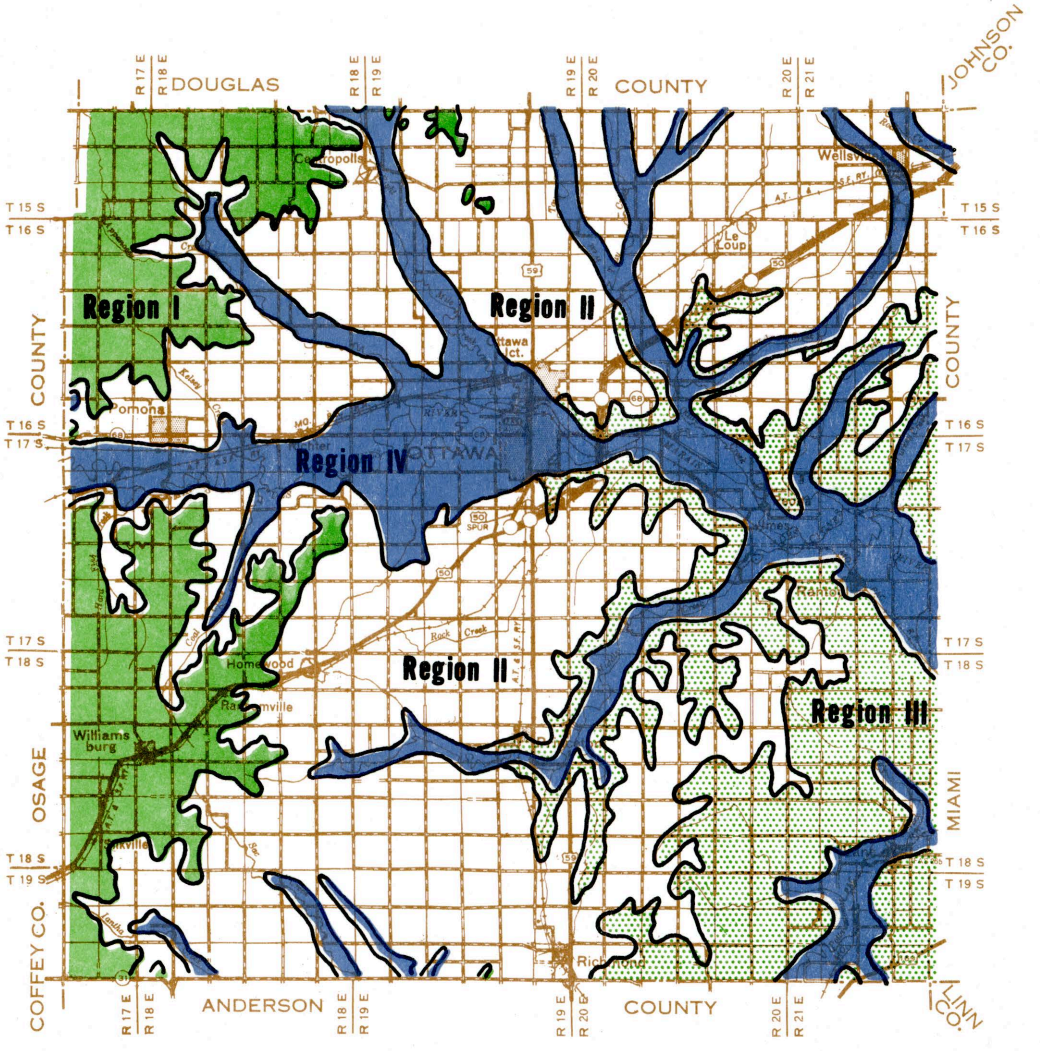


Figure 6. Physiographic map of Franklin County.

INTRODUCTION

This section is a general appraisal of the material available in Franklin County for embankment, shoulder, and subgrade construction. Geo-engineering problems that are frequently encountered in Franklin County are discussed. Potential and existing ground-water problems and the quality of water available for concrete are briefly reviewed. Detailed field investigation would be necessary to ascertain the severity of specific problems and to make recommendations concerning design and construction procedures.

Because of diversified geologic conditions, Franklin County has been divided into four physiographic regions. The nature of geo-engineering problems encountered in each will vary; however, some problems are common throughout the county.

Region I

Region I is located in the extreme western part of Franklin County (see figure 6). The geology is characterized by interbedded limestone and shales which belong to the Shawnee Group.

Region I is characterized by gently rolling topography in the interstream areas with moderate to steep slopes adjacent to the major drainage channels. For the most part, the Spring Branch Limestone caps the high terrain in the extreme northwest corner and limestone members of the Oread Formation occupy the highest element of topography elsewhere. The stratigraphic relationship of these units is illustrated in the generalized geologic column, figure 4.

Deep cuts and fills will be required for most improvements in this area. Most of the cuts will be rock excavation through limestone ledges. Ground-water problems can be anticipated along the base of most limestone units as well as some of the sandstone horizons in the thicker shales. For example, the Toronto Limestone and sandstone in the Snyderville Shale were carrying water when encountered by a highway improvement in nearby Osage County.

The soil mantle in Region I is primarily residual but some eolian and alluvial deposits are present. Most of the mantle derived from the bedrock has a high clay content and high plastic index. With the exception of those derived from sandstone, these soils would be classified as silty clay loam, clay loam or even clay, according to the Kansas textural classification system. Most would be classified as A-6 or A-7 according to the A.A.S.H.O. soil classification system. The shales often exhibit high plastic indices (15-40) and are unstable, especially in areas where groundwater is present.

Most material in this area is satisfactory for embankment purposes; however, much of the soil is objectionable for shoulder and subgrade construction. Most "A" horizon soils are acceptable for slopes since they sustain vegetation.

Water is available in relatively small quantities from shallow wells (100 feet or less) drilled in units of the Shawnee Group. Water is usually obtained from fractured limestone and shale. In Osage County to the west, sandstone zones in the thicker shale units of the Shawnee Group are good producers, but they occupy high terrain in Region I of Franklin County and only small quantities of water can be obtained.

Test data indicate a good quality water is produced from the shallow aquifers in the area; however, in the southern part, water from the deeper Ireland Sandstone has a high sulfate and chloride content making it unsuitable for concrete.

Region II

Region II takes in most of the central part of the county except for the Alluvium of the major drainage channels (see figure 6). Rocks of the Douglas and Pedee Groups are exposed in this area. Three thick shale formations (Lawrence, Stranger and Weston) make up the geology with thick sandstone units being present in two of these formations. Two coal units, which have been mined, are found in the Lawrence Shale and thin discontinuous limestones are found in the Stranger Formation.

The area is characterized by gently rolling hills of moderate relief with a rougher terrain in areas where the sandstone is exposed. Deep cuts will encounter unweathered shale and sandstone which will probably be rock excavation. Weathered material en-

countered in shallow cuts will be common excavation. Ground-water problems can be anticipated where the Upper and Lower Williamsburg Coal are present and where lenticular sandstone zones are underlain by shale.

Slides are common in all shale units exposed, especially the Weston. Special and detailed investigations will be required to make recommendations concerning the design of road structures that encounter this unit, especially if ground-water is present. Abandoned mines in the Upper and Lower Williamsburg Coal are found in the western part of Region II near the boundary of Region I. Where the coal was within 20 feet of the surface, it was mined by stripping. Otherwise, the drifting method was used. Strip mines, when traversed, should be well drained to keep water from being impounded. The open drifts will not be a problem as long as the Toronto Limestone overlies the mined-out area.

Mantle derived from the various shales take on the engineering properties of the parent material. It is highly plastic and is usually classified as a silty clay or clay according to the Kansas textural classification system and as an A-6 or A-7 soil according to the A.A.S.H.O. soil classification system. Most of the shales have plastic indices that range from 20 to 29. Soils derived from the Ireland Sandstone (Lawrence Shale Formation) and the Tonganoxie Sandstone (Stranger Formation) usually have a plastic index of less than ten. All material encountered in Region II is acceptable for embankment purposes but most shales are objectionable for subgrade and shoulder construction. Such material could be improved with hydrated lime or by blending with a better quality material.

According to available ground-water data, the main aquifers in Region II are the Ireland Sandstone (Lawrence Formation) and the Tonganoxie Sandstone (Stranger Formation); however, most of the water produced in the western and southwestern part of the area is pumped from the underlying Stanton and Plattsburg Limestone Formations. Test data show that only moderate amounts of water are obtained from the Ireland and Tonganoxie at any given location and that the quality of water from both aquifers is very erratic. Generally, the shallower wells, where the aquifers are not confined, produce the best water; however, quality tests should be conducted before using the water for concrete.

Region III

Region III includes the east-central and southern part of the county except for the alluvial valleys of the Marais des Cygnes River and Pottawatomie Creek (see figure 6). Rocks included in the Lansing and Kansas City Groups are exposed in the area. The stratigraphy of this area is illustrated in the lower part of the generalized geologic column, figure 4.

Region III is similar to Region I inasmuch as it is characterized by, primarily, interbedded limestones and shales. However, the limestone units are thicker and more numerous.

The area is characterized by gentle to moderate relief in the area between the Marais des Cygnes River and Pottawatomie Creek with a much more rugged terrain near the major drainage channels. The most severe relief is along the valley walls in the eastern part of the area where thick limestone units cap the terrain. Deep cuts will be required in this area for most highway

improvements and a large amount of rock excavation will be encountered especially in the eastern part of the region. Groundwater has been encountered along the base of most of the limestone units and in some areas, in black fissile shale found in the Eudora Shale Member and in sandstone zones found in the Lane, Bonner Springs, and Vilas Shale Members.

Most of the soils found in this area are residual and usually have a high clay content. They have a plastic index that ranges from 20 to 45 and are classified as a clay according to the A.A.S.H.O. soil classification system. Soils derived from sandstone included in the shales are much less plastic but they make up only a small percentage of the mantle. Shales usually have a high clay content and high swell properties.

Like that in Region I, most of the material in Region III is acceptable for embankment, but, in most cases, is objectionable for subgrade and shoulder construction. Some of the "A" horizon soils are acceptable for slope development since they will support vegetation.

Probably all limestones and shales in the Kansas City and Lansing Groups will yield water locally in variable amounts, however, most wells in this area yield a relatively low quantity of water.

Aquifers that yield water in Region III of Franklin County also provide water for domestic purposes in adjoining Miami County. Test results on samples of water from these aquifers in Miami County (Miller 1966, page 28) indicate that a good quality of water is produced from these units. Relatively shallow oil wells are numerous around the towns of Peoria and Rantoul in Franklin County and might

cause water contamination. Water from this region used for concrete should be tested.

Region IV

Region IV includes the Alluvium of the Marais des Cygnes River and Pottawatomie Creek valleys (see figure 6). This material is composed primarily of unconsolidated sediments of middle and late Pleistocene age. The general stratigraphy of these deposits is illustrated in the generalized geologic column of Franklin County in figure 4.

The area is characterized by broad flat valley floors and low terraces. Highway improvements in the area will encounter only shallow cuts and all material will be common excavation except possibly in the Pottawatomie Creek valley where members of the Iola Limestone Formation extend into the valley floor. Borrow will probably be required for fill in some of the low lying areas.

Soils in Region IV are derived from the Alluvium, and because of their mode of deposition (stream laid), radical changes in soil type may occur in very short horizontal distances. Granular material is present, mostly in the lower part of the valley fill. Available test data show a high percent of clay-size particles and plastic indices that range from 15 to 40. Much of this soil is objectionable for subgrade construction, but in some regions it is not feasible to eliminate its use. In such cases the material will have to be stabilized, or the pavement thickness adjusted. Most material is suitable for shoulders, slopes, and embankments.

The ground-water table may be encountered by road structures in some of the low-lying areas. Water may be encountered elsewhere in perched water tables which occur when an impermeable clay deposit

located high in the valley fill, prevents surface water from percolating down to the normal water table. Field investigation will be required to locate such areas.

The best source of water for concrete mix purposes in Franklin County is in Region IV. Available test data on samples of water from the Alluvium in adjoining counties indicate that a moderate supply (45 gallons per minute) of good quality water can be produced from this area. The main problem is the contamination of the aquifer by oil wells. This problem could be acute in the eastern part of Region IV near the towns of Peoria and Rantoul. Although most of the oil wells are in uplands (in Region III) most of the pollution from these wells occurs in surface streams which ultimately enter the alluvial valleys in Region IV. Chemical analyses should be conducted on water samples, especially in the eastern part of Region IV, to insure that water with a low sulfate and chloride content is available.

MATERIALS INVENTORY SECTION

GENERAL INFORMATION

In Franklin County 37 pits or quarries have been active during the past. Seven have been sampled and tested by the State Highway Commission during the past five years. Results of these tests are shown in figure 16.

Pennsylvanian Limestone makes up a major part of the construction material resources of Franklin County. Generally the units meet specifications for construction purposes when properly processed. However, some units contain shale seams and in many areas are contaminated by overlying residual clay. Sandstone units present in some of the thicker Pennsylvanian Shales provide a source of fine sand in Franklin and adjacent counties; however, production of this material has been limited. The Weston Shale provides raw material for the production of lightweight aggregate. A relatively small number of chert gravel deposits are located in high terraces along the Marais des Cygnes River. These deposits have been used for light type surfacing material on township roads, but most of the existing pits are depleted. According to Mr. Robert Lister, Franklin County Engineer, the county maintains most of the rural roads in this area with crushed limestone produced in Franklin, northern Anderson and south Douglas Counties.

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Material Types	Geologic Source	Material Usage	Description	Availability
Limestone	Raytown Limestone Member	Crushed aggregate. Light type surfacing material. Riprap	Page 35	Very limited source in southeast corner of this county. Plate VI.
	Wyandotte Limestone Formation	Crushed aggregate. Light type surfacing material. Riprap.	Page 36	Moderate source in southeastern part of the county. Plates IV and VI.
	Plattsburg Limestone Formation	Crushed aggregate. Light type surfacing material. Riprap.	Page 39	Moderate source in eastern part of county. Plates II, IV and VI.
	Stanton Limestone Formation	Crushed aggregate. Light type surfacing material. Riprap.	Page 41	Good source in eastern part of the county. Plates II, IV, V and VI.
	Toronto Limestone Member	Light type surfacing material. Riprap.	Page 44	Moderate source in western part of county. Plates I, III and V.
	Plattsmouth Limestone Member	Crushed aggregate. Light type surfacing material. Riprap	Page 46	Moderate source in western part of county. Plates I, III and V.
	Kereford Limestone Member	Light type surfacing material.	Page 48	Very limited source in western part of the county. Plates I, III and V.
	Spring Branch Limestone Member	Light type surfacing material.	Page 49	Very limited source in the northwestern corner of the county. Plate I.
Sandstone	Tonganoxie Sandstone (Stranger Formation)	Light type surfacing material. Fine aggregate.	Page 50	Moderate source in central part of the county. All plates.
	Ireland Sandstone (Lawrence Formation)	Light type surfacing material. Fine aggregate.	Page 51	Moderate source in central part of the county. Plates I, II, III and V.
Chert Gravel	Tertiary Terraces	Light type surfacing material.	Page 53	Limited source. Plates I, III and VI.
	Quaternary Terraces	Light type surfacing material.	Page 53	Very limited source. Plate IV.
	Quaternary Alluvium	Light type surfacing material.	Page 54	Very limited source. All plates.
Shale	Weston Shale	Lightweight aggregate.	Page 55	Moderate source. All plates.
	Kanwaka Shale	Lightweight aggregate.	Page 57	Very limited source. Plate I.
Crushed aggregate refers to aggregate used for concrete and bituminous construction.				

Figure 7. A summary of the construction materials types and their availability in Franklin County.

DESCRIPTION OF CONSTRUCTION MATERIALS

Limestone

Iola Limestone Formation (Raytown Limestone Member)

The Iola Limestone Formation consists of three members which are, in ascending order: the Paola Limestone, the Muncie Creek Shale and the Raytown Limestone Members.

Exposures of the Iola are limited to a small area in the extreme southeastern part of Franklin County. In most cases, only the upper member, the Raytown Limestone, is exposed. Because of its limited outcrop area, the Iola represents only a small part of the construction materials resources of the county. Since it is the thickest, and for the most part, the only exposed Iola Member in the county, only the Raytown is shown on the Franklin County materials map.

The Raytown is a thin-bedded, gray to light gray limestone characterized by discontinuous shale partings. It ranges in thickness from eight to eleven feet.

The Raytown has not been produced in Franklin County because of its inaccessibility. No quality tests have been made on Raytown samples in this area. However, it has been sampled and produced extensively in nearby Miami and Anderson Counties. In these counties, the Raytown is up to 24 feet thick and is an important source of construction material. The good quality of the Raytown to the east and south of Franklin County is reflected in the test results listed on the following page.

Anderson County

	Sample No. I	Sample No. II
Specific gravity (saturated)	2.58	2.59
Specific gravity (dry)	2.52	2.53
Los Angeles wear	28.0 %(B)	28.6 %(B)
Soundness loss ratio	0.96	0.99
Percent absorption	2.19%	2.12%

Miami County

	Sample No. I	Sample No. II
Specific gravity (saturated)	2.60	2.61
Specific gravity (dry)	2.55	2.55
Los Angeles wear	29.8 %(B)	27.0 %(B)
Soundness loss ratio	0.95	0.95
Percent absorption	2.15%	2.60%

The outcrop pattern of the Raytown is illustrated on plate VI. All exposures are found in or near the alluvial valley of Pottawatomie Creek and its tributaries. All quarry sites would be near or in the valley floor with an increasing amount of overburden near the valley walls.

If the quality of the Raytown is similar to that produced in adjacent counties, the material could be used for most phases of highway construction.

Wyandotte Limestone Formation

The Wyandotte Limestone Formation is separated from the Iola Limestone by as much as 60 feet of the Lane Shale Formation. The best exposures of the Wyandotte are along the bluffs near the Marais des Cygnes River and Pottawatomie Creek in the east-central and southeastern parts of the county.

The Wyandotte normally has five members which in ascending order are: Frisbie Limestone, Quindaro Shale, Argentine Limestone, Island Creek Shale, and Farley Limestone. In Franklin County the

Quindaro Shale is absent and the Island Creek Shale and Farley Limestone Members are highly irregular. The Wyandotte Formation map unit, as used in this report, represents the Frisbie, Argentine and Farley Limestone Members. The Argentine is the most important source unit.

The Frisbie Limestone Member has an average thickness of about four feet. It is a brown, dense limestone which has a single, massive, vertical-jointed bed devoid of shale partings. Bedding characteristics, and in some cases color, can be used to differentiate it from the overlying Argentine.

The Argentine Limestone is the most persistent member of the Wyandotte Formation. It is a light gray limestone that weathers into wavy beds two inches to two feet thick. Chert nodules are distributed randomly in the upper 15 feet of the unit. The thickness of the member ranges from approximately 15 to 34 feet; however, it thins in the subsurface to the west of its outcrop area in Franklin County and disappears to the south in Anderson County.

The Farley Limestone, the uppermost member of the Wyandotte Limestone Formation, is approximately five feet thick and is lithologically similar to the Argentine. In some areas, however, it consists of light gray and brown, detrital limestone beds with an aggregate thickness of about seven feet.

Because the individual members have variable thicknesses, the Wyandotte Formation is highly variable in Franklin County. According to Ball and others (1963, page 9) it has a maximum thickness of 40 feet in this area. The main exposure area of the Wyandotte in Franklin County is encompassed by range 21 east and townships 17, 18, and 19 south. The exposure pattern of the Wyandotte is illustrated on plates IV and VI.

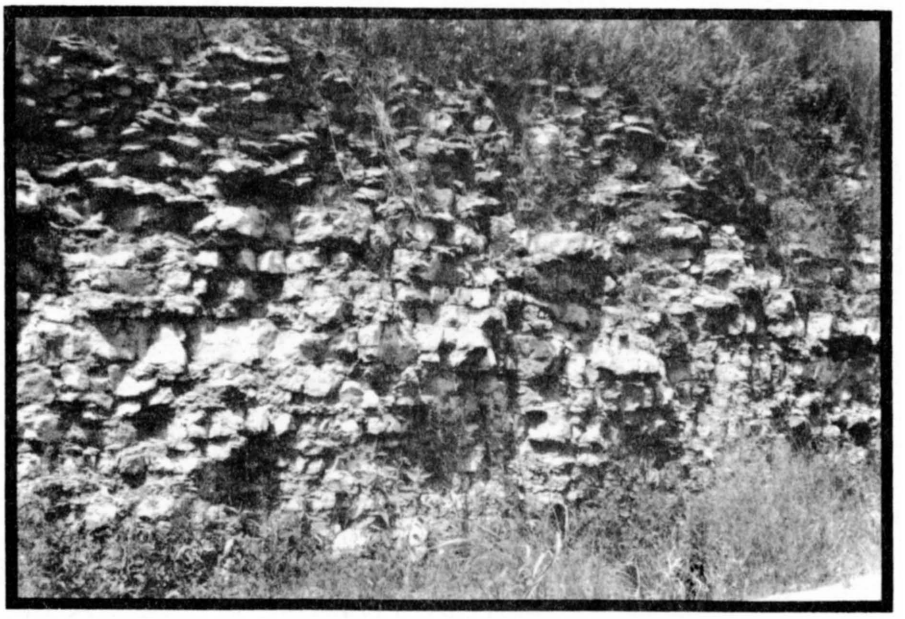

Figure 8. An exposure of the Argentine Limestone Member of the Wyandotte Limestone Formation in a road cut, SE¼ sec. 8, T17S, R21E.

Six quarries in the Wyandotte were found in Franklin County; however, only one has been sampled and tested by the State Highway Commission of Kansas. Limited quality test results indicate that material produced from the Wyandotte in Franklin County has a specific gravity (saturated) of 2.50 (one sample), a specific gravity (dry) of 2.39 and 2.40 (two samples), a Los Angeles wear that ranges from 33.7 to 36.4 percent, a soundness loss ratio that ranges from 0.96 to 0.99, and an absorption that ranges from 4.25 to 4.51 percent. Material of similar quality is produced from the Argentine in nearby Miami County; however, tests indicate that the absorption usually ran between 2.2 and 3.6 percent. It should be noted that in some areas the Farley Limestone (uppermost member of the Wyandotte) may have high absorption properties. This portion of the Wyandotte can be avoided during production if the rock displays inferior engineering properties. Based on quality test results, material produced from the Wyandotte in Franklin County

would be acceptable for most phases of highway construction except those requiring a minimum of four percent absorption. However, material displaying better absorption properties has been produced from the Wyandotte in nearby counties.

Chemical analyses on samples of the Argentine (the thickest unit in Wyandotte Formation) were conducted by Runnels and Schleicher (1952) the results of which are presented in the following table:

	CaO	MgO	SiO_2	Al_2O_3	Fe_2O_3	K_2O	Na_2O	Calculated $CaCO_3$
Sample 1	53.40%	0.57%	2.34%	0.64%	0.35%	0.07	0.04	95.31
Sample 2	54.01%	0.54%	0.63%	0.16%	0.97%	----	----	96.31

Plattsburg Limestone Formation

The Plattsburg Limestone Formation is separated from the Wyandotte Limestone Formation by a few tenths to as much as 45 feet of the Bonner Springs Shale Formation. The Plattsburg Limestone, which overlies the Bonner Springs, is a major limestone source unit in Franklin County as well as many other eastern Kansas counties.

The Plattsburg Limestone Formation is comprised of the Merriam Limestone, Hickory Creek Shale, and Spring Hill Limestone Members. In other parts of the state, both the Merriam and Spring Hill have been produced; however, the Spring Hill is the most important source unit and is the only member that has been quarried in Franklin County.

The Merriam is a gray to bluish-gray limestone that weathers to a light brown color. Normally the Merriam consists of four limestone beds and weathers into a prominent ledge; however, an additional limestone unit is present in some exposures in Franklin County. According to Ball and others (1963, page 16) this ledge,

which occurs in the middle portion of the unit, is approximately six feet thick and is very prominent in the southeastern part of the county (townships 16, 17, 18, and 19 south and ranges 20 and 21 east). This limestone is gray to tan in color and is characterized by thin cross-stratified bedding.

The Spring Hill Limestone is the uppermost member of the Plattsburg and has an aggregate thickness range from 11 to 16 feet. Generally it is an irregularly bedded, fine-grained, gray limestone. However, the member is easily separated into three units: a thick limestone in the basal part, a thin shale unit in the middle, and a thin limestone in the upper part. Because of the thickness, the basal bed is an important construction material source; however, the lithology of the rock is variable within this lower unit and the quality of the aggregate may vary from one horizon to another.

Because all production from the Plattsburg in Franklin County is in the Spring Hill, all quality tests were conducted on samples from this unit. Figure 9 shows the Spring Hill in a quarry near Ottawa.

Five quarries have been active in the Plattsburg in Franklin County but only one has been sampled and tested recently by the State Highway Commission of Kansas. Test results show that material produced from this unit has a specific gravity (saturated) of about 2.58, a specific gravity (dry) of about 2.51 and a Los Angeles wear of about 31.8 percent (B). The soundness loss ratio ranges from 0.95 to 0.97 and the absorption varies from 3.02 to 3.16 percent. Material of similar quality has been produced from the Spring Hill in nearby Anderson County. Quality test results show that the Spring Hill can be used for most phases and types of highway construction if properly processed.

Figure 9. The Spring Hill Limestone Member of the Plattsburg Limestone Formation in a quarry, SE¼ sec. 6, T17S, R20E.

Exposures of the Plattsburg Formation are restricted to the eastern and southeastern part of the county. The outcrop pattern is illustrated on plates II, IV, and VI.

A chemical analyses on a sample of the Spring Hill obtained in Franklin County by Runnels and Schleicher (1956) shows the following percentages:

CaO	MgO	SiO_2	Al_2O_3	Fe_2O_3	S	P_2O_5	Calculated $CaCO_3$
47.73%	1.95%	6.70%	2.08%	1.27%	0.11%	.03%	85.12%

Similar results were obtained on samples obtained in nearby counties; however, a marked increase in the percent of SiO_2 was observed in one county to the north.

Stanton Limestone Formation

The Stanton Limestone Formation is above the Plattsburg Limestone. They are separated by one to twenty-three feet of the Vilas

Shale Formation. The Stanton comprises five members which, in ascending order are: the Captain Creek Limestone, the Eudora Shale, the Stoner Limestone, the Rock Lake Shale and the South Bend Limestone. The two most important material source units are the Captain Creek and Stoner Limestone Members. Because of their close proximity they have been mapped as one unit, and for the most part, they represent the Stanton Formation map unit in this report. Figure 10 shows these two members in a quarry near Ottawa. Both beds have been produced extensively in eastern Kansas and in some areas, material from both beds is produced at the same site.

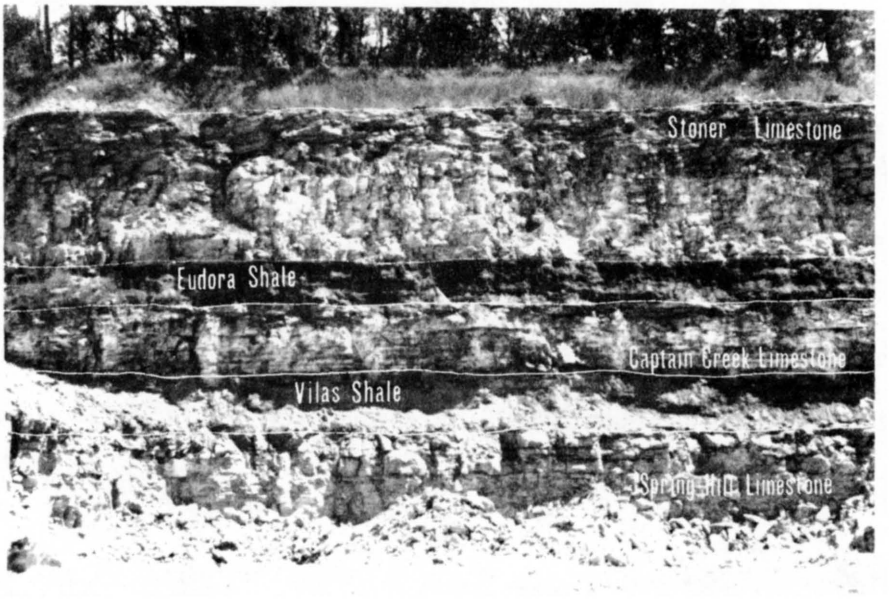

Figure 10. A view of the Stoner and Captain Creek Limestone Members of the Stanton Limestone Formation along with the Spring Hill Limestone Member of the Plattsburg Limestone Formation.

The Captain Creek Member is a light gray to tan limestone which is characterized by thin, even bedding in the lower half and thin, wavy-bedding in the upper half. The upper half usually has shades of blue, gray and brown coloring. According to Ball and

others (1963, page 20), the Franklin County quarrymen call this mottled unit the "calico rock." It usually has a thickness of about seven feet.

The Stoner is a light gray, fine-grained limestone which weathers into thin to thick irregular beds. It has an aggregate thickness of approximately 18 feet. The Stoner has been quarried more than any other limestone unit in Franklin County due mainly to its extensive surface exposure.

Eleven Stanton Limestone quarries were detected in Franklin County, five of which have been recently sampled and tested. Usually the two producing members (Captain Creek and Stoner) have an aggregate thickness of 25 feet (excluding about seven feet of the intervening Eudora Shale Member).

Material produced from the Captain Creek and Stoner is similar in quality. Available test data on the Stanton shows the specific gravity (saturated) ranges from 2.51 to 2.61, the specific gravity (dry) from 2.41 to 2.56, the Los Angeles wear from 29.4 to 37.3(B) percent, the soundness loss ratio from 0.95 to 0.98 and the absorption from 2.01 to 4.17 percent. Generally a more consistent quality of material can be produced from an unweathered ledge.

Material from the Stanton (Captain Creek and Stoner Limestone) can be used for most phases and types of highway construction; however, material produced at site $\frac{LS+37}{Ps}$ (Stoner Limestone), had an absorption of 4.17 percent which would be excessive for use in bituminous construction. It should be noted that in many areas in eastern Kansas the thickness and quality of these two units are highly variable.

The results of chemical analyses conducted by Runnels and Schleicher (1956) on samples of the Captain Creek and Stoner Limestone are presented in the following tables:

Stoner Limestone Member

	%CaO	%MgO	%SiO_2	%Al_2O_3	%Fe_2O_3	%SO_3	%P_2O_5	Calculated $CaCO_3$
Sample 1	51.63	1.16	3.84	1.14	0.72	.06	Trace	92.06
Sample 2	53.97	0.51	1.72	0.39	0.50	Trace	Trace	96.32
Sample 3	51.67	0.80	4.23	0.89	1.13	-----	.03	92.15
Sample 4	52.70	Trace	5.22	0.17	0.71	Trace	.04	93.97

Captain Creek Limestone Member

	%CaO	%MgO	%SiO_2	%Al_2O_3	%Fe_2O_3	%SO_3	%P_2O_5	Calculated $CaCO_3$
Sample 1	49.58	2.45	3.43	0.91	1.38	.33	.11	87.83
Sample 2	50.90	2.09	2.31	0.54	1.46	.51	.12	89.93
Sample 3	48.97	2.77	3.27	1.00	1.32	.14	.03	87.02

Exposures of the Stanton in Franklin County are controlled by the drainage pattern of the Marais des Cygnes River, Pottawatomie Creek and the tributaries of these streams. Most exposures are found in the eastern half of the county and are illustrated on plates II, IV, V, and VI.

Oread Limestone Formation (Toronto Limestone Member)

The Toronto Limestone is the lower member of the Oread Formation. The Toronto is a fairly massive, gray to brown limestone that commonly weathers into relatively thin irregular beds. The unit is commonly eight to twelve feet thick, but is quite erratic in thickness especially in the northwestern part of the county. In some localities the Toronto is missing while in other areas it attains abnormally great thickness. The distribution of the unit is illustrated on plate I.

Figure 11. An exposure of the Toronto Limestone Member of the Oread Limestone Formation in a road cut, SW corner of sec.29, T15S, R18E.

Two Toronto quarries have been active in Franklin County during the past but no large volume of rock was produced. No quality tests have been completed on samples of the Toronto in Franklin County, but test results are available from Douglas and Coffey County. A comparison of these results indicates better material is produced from the Toronto to the north. The test results from Douglas County show ranges of specific gravity (saturated) from 2.56 to 2.61, specific gravity (dry) from 2.48 to 2.55, Los Angeles wear from 29.1 to 32.2(B) percent, soundness loss ratio from 0.90 to 0.96, and absorption from 2.41 to 3.65 percent. Test results from Coffey County show ranges of specific gravity (saturated) from 2.48 to 2.51, specific gravity (dry) from 2.33 to 2.41, Los Angeles wear from 31.4 to 38.18(B) percent, soundness loss ratio from 0.91 to 0.96 and absorption from 4.46 to 5.26 percent.

Chemical analyses conducted by Runnels and Schleicher (1956) on samples of the Toronto in Douglas County indicate a relatively wide variation in chemical composition from one exposure to another. The results of these analyses are tabulated below:

	CaO	MgO	SiO_2	Al_2O_3	Fe_2O_3	SO_3	P_2O_5	Calculated $CaCO_3$
Sample 1	44.19%	3.36%	8.26%	1.32%	3.97%	-----	0.04%	78.78%
Sample 2	38.60%	9.39%	3.22%	0.61%	5.10%	Trace	-----	68.89%
Sample 3	52.34%	0.55%	3.48%	1.17%	1.08%	-----	0.02%	93.38%
Sample 4	53.11%	0.54%	3.16%	0.82%	0.54%	-----	0.01%	94.77%

Although the Toronto has been used for construction material in eastern Kansas, quarrying of the ledge has not been as extensive as other limestone members of the Oread Formation. Test data indicate that aggregate from the Toronto could be used for light type surfacing and some other types of highway construction. However, in many areas the absorption values are marginal.

Exposures of the Toronto are in the western part of the county, and are illustrated on plates I, III, and V.

Oread Limestone Formation (Plattsmouth Limestone Member)

The Plattsmouth Limestone Member occurs in the middle part of the Oread Formation. It is a light gray limestone characterized by thin wavy bedding and scattered chert nodules. Thin shale seams are commonly found in most exposures. The Plattsmouth is continuous throughout the county and has a thickness of approximately 18 feet.

Two Plattsmouth quarries have been active in Franklin County but no sampling or testing of the material has been accomplished by the State Highway Commission of Kansas. Quality test results obtained in Douglas and Osage Counties show ranges of specific gravity (saturated) from 2.51 to 2.67, specific gravity (dry) from 2.48 to

Figure 12. The Plattsmouth Limestone Member of the Oread Limestone Formation in a road cut, NE¼ sec.29, T15S, R18E.

2.54, Los Angeles wear from 26.0 to 39.2(A) percent and 27.8 to 38.2(B) percent, soundness loss ratio from 0.90 to 0.93 and absorption from 1.58 to 3.78 percent. In some isolated cases absorption values exceed 4.0 percent but such cases usually occurred in areas where the ledge was badly weathered.

Aggregate from the Plattsmouth is suitable for use as light type surfacing material, riprap and structural stone. Based on the results of quality tests, material from the Plattsmouth is suitable for concrete aggregate and in some cases for bituminous construction. However, in some areas the absorption values are marginal.

The results of chemical analyses conducted by Runnels and Schleicher (1956) on samples of the Plattsmouth taken in nearby Douglas and Osage Counties are tabulated on the following page.

Douglas County

	CaO	MgO	SiO_2	Al_2O_3	Fe_2O_3	SO_3	S	P_2O_5	Calculated $CaCO_3$
Sample 1	49.39%	0.76%	7.62%	0.93%	1.01%	0.06%	0.08%	0.10%	87.83%
Sample 2	50.44%	0.97%	6.41%	1.44%	0.44%	0.13%	-----	0.02%	89.83%

Osage County

	CaO	MgO	SiO_2	Al_2O_3	Fe_2O_3	SO_3	S	P_2O_5	Calculated $CaCO_3$
Sample 1	49.59%	2.15%	3.89%	1.04%	1.32%	0.16%	0.20%	Trace	88.32%

The Plattsmouth is exposed in the western part of Franklin County where, in many instances, it occupies the highest element of topography. In many of these areas, it is not feasible to quarry the unit because weathering has reduced its thickness and contaminated the rock with residual clay. The outcrop pattern is illustrated on plates I, III, and V.

Oread Limestone Formation (Kereford Limestone Member)

Uppermost in the Oread Formation is the Kereford Limestone Member. The Kereford is continuous in Franklin County and in most areas it occupies the highest element of topography. Because of this and its susceptibility to weathering, only the lower part of the member is present. This part of the ledge is a buff to gray wavy-bedded limestone which, because of impurities, weathers like shale. Because of its weathering characteristics and topographic position, good exposures of the Kereford are rare in Franklin County. The ledge forms a less conspicuous bench above the more resistant Plattsmouth.

According to Ball and others (1963, page 36), the average thickness of the unit is approximately 11 feet. This is based on

data from drillers logs and measured sections. The full thickness was never observed in the field.

The Kereford is not a major source unit of construction material in eastern Kansas, but it is a source of aggregate, riprap and agricultural lime in adjoining Osage County. In this area it has an abnormal thickness of 25 feet and a highly variable lithology. Aggregate from the Kereford has been used for light type surfacing material and in areas where the ledge is abnormally thick, quality test results indicate it would be acceptable for other types of highway construction. No material from the Kereford has been produced in Franklin County mainly because the ledge is usually in a badly weathered state and contaminated by the residual soil cover.

The Kereford is exposed in the northwestern part of the county. The outcrop pattern is illustrated on plates I and III.

Lecompton Limestone Formation (Spring Branch Limestone Member)

The Lecompton is the youngest Pennsylvanian rock unit exposed in Franklin County. It overlies the Kanwaka Shale and its exposure is limited to the extreme northwest corner of the county. Only the lower two members of the Lecompton are exposed in Franklin County; the Spring Branch Limestone and Doniphan Shale. Only the former is considered a construction material source unit.

The Spring Branch is a dark brown, massive-bedded limestone. The unit is relatively impure, containing clay and quartzose sand impurities. The thickness of the ledge ranges from five to seven feet. Like the Kereford Limestone of the Oread Formation, the Spring Branch occupies the highest element of topography in Franklin County. It is usually contaminated by overlying residual clay. The Spring Branch has not been produced extensively in eastern Kansas

and not at all in Franklin County. A few inactive small quarries were found in adjoining Osage County.

A few quality tests are available on samples of the Spring Branch in adjacent Osage County and this data indicate that a fairly good quality material can be produced from this unit. However, it is necessary to select the best rock in the outcrop and avoid sandy and silty zones. Aggregate from the Spring Branch has been used for light type surfacing material but because of the availability of rock from the underlying Oread Formation and the overlying Ervine Creek Limestone Formation, only a limited amount of the Spring Branch has been used in other phases of highway construction.

Exposures of the Spring Branch are limited to the northwest portion of the county as shown on plate I.

Sandstone

Stranger Formation (Tonganoxie Sandstone)

The Stranger Formation consists of five members. In ascending order they are: Tonganoxie Sandstone, Westphalia Limestone, Vinland Shale, Haskell Limestone, and Robbins Shale. The upper and lower boundaries are highly variable, and in some areas, the limestone members are missing. Where the limestones are present, they are not considered to be important construction material source units.

The main material source unit in the Stranger is Tonganoxie Sandstone. This unit varies in composition and thickness. For example, in one area it consists of a sandstone-shale pebble conglomerate and in another it is composed of a cross-stratified, very fine to fine-grained quartzose siltstone and sandstone (Ball and others, 1963, page 23). Although a full thickness of the Tonganoxie

cannot be observed at one locality, Ball and others (1963, page 23) state that the approximate thickness range of the Tonganoxie is three to fifty feet.

Sandstone has been quarried in sec.14, T16S, R19E. Figure 13 shows an exposure of this sandstone in a road cut near the quarry. According to Ball and others (1963, page 40) the material was used as subgrade material for paving projects in the city of Ottawa.

Figure 13. An exposure of sandstone in the Stranger Formation in a road cut, SE¼ sec. 11, T16S, R19E.

This material might be used to supplement hot mix aggregate for gradation purposes, but no tests have been conducted for this purpose. The Stranger Formation is exposed in a north-south direction across the middle part of the county. Its exposure pattern is illustrated on all plates.

Lawrence Shale Formation (Ireland Sandstone)

The Lawrence Shale overlies the Stranger Formation and contains two named members, Ireland Sandstone and Amazonia Limestone.

The Amazonia has not been identified in Franklin County. According to Ball and others (1963, page 28) the Ireland Sandstone is not recognized in T19S and in the southern half of T18S and the term Lawrence Shale is applied to all strata between the top of the underlying Stranger Formation and the base of the overlying Oread Formation (Toronto Limestone Member).

The term Ireland Sandstone applies to predominantly sandstone lithology in the lower part of the Lawrence Shale, and it is this unit that is a potential source of sandstone for construction purposes. The boundaries of the Ireland are highly variable and neither the upper nor lower contact represents a single stratigraphic horizon.

Sandstone, siltstone, and silty shale are the main constituents of the Ireland. Subangular to subrounded quartz sand and silt particles and flakes of mica, cemented by both calcium carbonate and silica, form the sandstone. Quite often the matrix has been leached and the sandstone is friable. Sieve analyses conducted by Ball and others (1963, page 29) indicate that the sand of the Ireland is extremely well sorted.

Sandstone from the Ireland has been quarried in nearby counties for use as light type surfacing material and for fine hot mix aggregate. If the sand grains are left in the cemented state, coarser aggregate can be obtained, but it will not meet soundness requirements because of the poor binding properties of the cementing agent.

No material has been produced from the Lawrence Shale in Franklin County. The Lawrence is exposed primarily in the western one-half of the county and its outcrop pattern is illustrated on plates I, II, III, and V.

Chert Gravel

Tertiary Terraces

Deposits of late Pliocene(?) and early Pleistocene are included in this map unit. These deposits, which are composed largely of chert gravel, lie approximately 85 to 100 feet above the Marais des Cygnes River floodplain and are located along the north bluffs of the river between Ottawa and Richter. The chert gravel and sand are bound in a red-brown clay matrix. This matrix has been leached of all calcareous material. Presumably, these terraces correspond to similar deposits in Osage County noted by O'Connor and others (1955, page 7) and those reported in the Osage County Materials Inventory, report number 11 of this series.

Chert gravel has been produced from several pits in Franklin County for light type surfacing material, but most of these pits have been exhausted. Aggregate for other types of highway construction has been produced from similar, but more extensive, deposits to the west of Franklin County. Other remnants of the terraces have been mapped and chert gravel could be produced from many of these areas. The geographic extent of the high chert gravel deposits is shown on plates I and III.

Quaternary Terraces

Chert gravel deposits, similar to those found in the Tertiary Terraces, are found east of Ottawa and are included in the Quaternary Terraces map unit. Figure 14 shows an abandoned chert gravel pit located in this unit. These terraces, probably of Kansan and Illinoisan ages, are located about 55 to 70 feet above the Marais des Cygnes River floodplain. Unlike the Tertiary Terraces, the deposits contain some small glacial erratics.

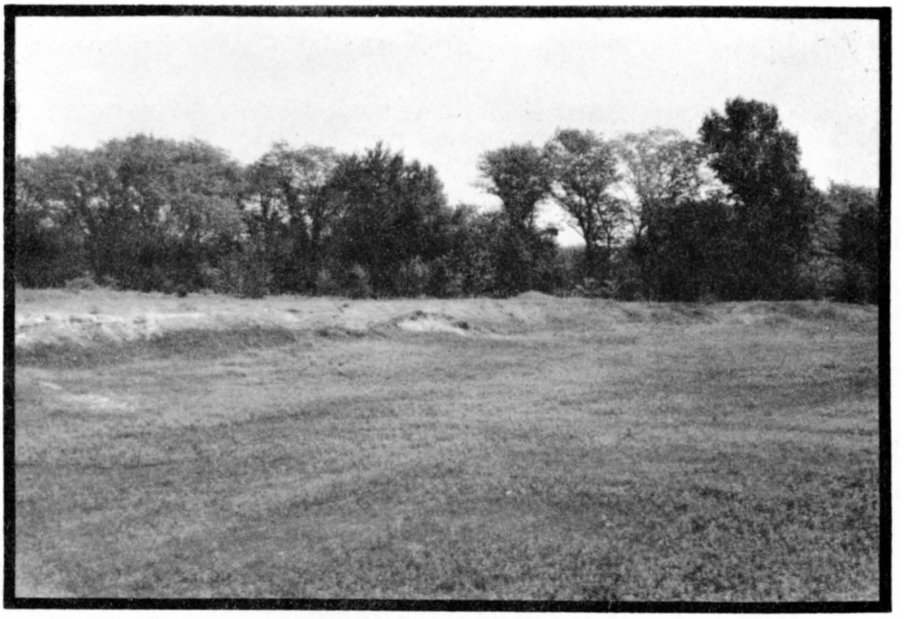

Figure 14. A depleted chert gravel pit, SE¼ sec.33, T16S, R20E.

Because of the difference in age and slight difference in composition, these Quaternary deposits have been mapped as a separate source unit; however, their use as construction material is essentially the same as those deposits found in the Tertiary Terrace. The geographic distribution of these younger terraces is limited and only a small amount of material from these beds has been produced, most of which has been used for light type surfacing material. The geographic extent of the Quaternary Terrace is shown on plates II and IV.

Quaternary Alluvium

Remnants of terrace deposits found within the major drainage channel valleys and the floodplains are included in the Quaternary Alluvium map unit. These Wisconsinan and Recent Deposits are composed primarily of clay, silt, and sand in the upper part with larger size material in the lower portion.

Chert gravel has been commercially produced from Quaternary Alluvium in other major drainage channels in eastern Kansas, but not from any that traverse Franklin County. Since the headwaters of the Marais des Cygnes River are eroding Permian beds to the west (source beds for chert gravel), it is conceivable that chert gravel could be produced from this unit in Franklin County. However, as a result of the thick overburden, and because the deposits are poorly sorted, production from this unit would be difficult. Such material probably would have to be produced by pumping operations. Chert gravel of any significant volume would be found only in the Marais des Cygnes valley. Although the Quaternary Alluvium map unit appears on all sections of the Franklin County materials map, the smaller stream valleys probably contain mostly fine material.

Shale for Lightweight Aggregate

Weston Shale Formation

The Weston Shale, which overlies the Stanton Limestone Formation, is a blue-gray, clayey shale relatively free of silt. The unit is shown on the Franklin County materials map. However, since the upper contact commonly grades into the overlying Stranger Formation, the upper boundary is depicted on the materials map as a dashed line.

According to Ball and others (1963, page 23) the Weston has a thickness range of about 45 to 110 feet and averages about 60 feet. Ball also reports potential Weston Shale quarry sites near rail and highway transportation facilities in the NW¼ SW¼ sec.34, T15S, R20E and near the center of the west line of the SW¼ sec.30, T15S, R21E. Approximately 75 feet of Weston Shale is available at

these localities and quarrying would not result in appreciable loss of farm land.

At the time this report was compiled, the Weston was being quarried at a site in the NW¼ sec.23, T17S, R19E by Buildex, Inc. of Ottawa, Kansas. Figure 15 shows this quarry. The raw material is transported to the processing plant in the SE¼ sec.14, T17S, R19E. Limited testing by the State Highway Commission, indicated the following specific gravity (saturated) ranged from 1.59 to 1.94, specific gravity (dry) about 1.80, Los Angeles wear about 23.0 percent, the soundness loss ratio ranged from 0.93 to 0.97 and absorption ranged from 7.36 to 9.65.

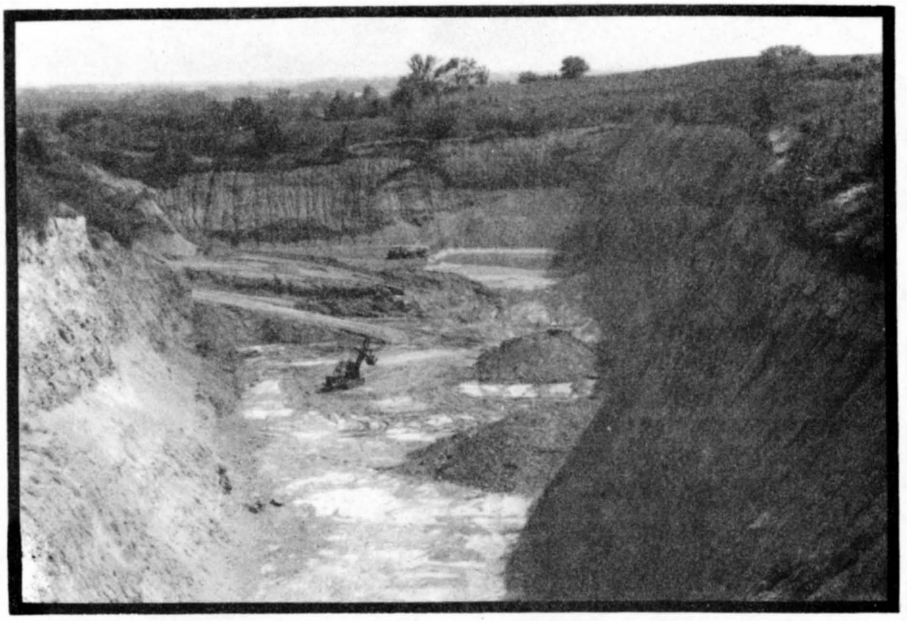

Figure 15. An open pit where the Weston Shale being produced for raw material in the production of lightweight aggregate.

Good exposures of the Weston in Franklin County are limited, due mainly to mantle cover. The outcrop area of the Weston lies across the middle part of the county and is illustrated on all six plates.

Kanwaka Shale Formation

The Kanwaka Shale Formation overlies the Oread Limestone Formation and comprises three members: Jackson Park Shale, Clay Creek Limestone and Stull Shale. The Jackson Park is a tan,calcareous shale in the upper part and a gray, clayey shale in the lower. Its average thickness is about 25 feet. The Clay Creek Limestone is a gray, dense limestone ranging from two to four feet in thickness. The Stull Shale is a tan, silty to clayey shale that is locally sandy. It is approximately 30 feet thick in Franklin County

The Kanwaka is not a significant material source unit but material has been produced in different areas of the state. A good quality aggregate has been produced from the Clay Creek Limestone Member in Coffey County. Because of its variability in thickness and lithology, an outcrop in Franklin County is of inferior quality. Both the Jackson Park and the Stull Shale Members have been tested by the State Geological Survey (O'Connor and others, 1955, page 23) as a potential source of lightweight aggregate. Bloating tests show that material from both shale units has a unit weight of 41 to 42 pounds per cubic foot.

Raw material for lightweight aggregate may be produced from the Kanwaka but the unit is not a significant materials source unit in Franklin County. The exposure area is limited to the extreme northwest corner of the county which is illustrated on plate I.

Site No.	Material Type	Sp.Gr. Sat.	Sp.Gr. Dry	% Wear	Soundness	% Absorption	Source of Data
Source of Material: Weston Shale-Pw							
SH+35	Shale	1.76	1.80	23.0(D)	0.95	8.51	Av. 3 Samples SHC Form 619 No. 30-13
Source of Material: Stoner Member-Ps (Stanton Formation)							
LS+31	Limestone	2.58	2.52	30.8	0.97	2.52	Av. 2 Samples SHC Form 619 No. 30-12
LS+32	Limestone	2.60	2.55	29.5(B)	0.98	2.02	Av. 2 Samples SHC Form 619 No. 30-15
LS+33	Limestone	2.59	2.53	27.3(B)	0.95	2.33	One Sample SHC Form 619 No. 30-11 Lab. No. 32967
LS+34	Limestone	2.56	2.48	33.1(B)	0.99	3.25	One Sample SHC Form 619 No. 30-4
LS+37	Limestone	2.52	2.42	37.3(B)	0.95	4.06	Av. 2 Samples SHC Form 619 No. 30-9
Source of Material: Captain Creek Member-Ps (Stanton Formation)							
LS+33	Limestone	2.57	2.48	30.5(B)	0.95	3.68	One Sample SHC Form 619 No. 30-11 Lab. No. 32747
Source of Material: Spring Hill Member-Pp (Plattsburg Formation)							
LS+33	Limestone	2.58	2.51	31.8(B)	0.96	3.12	One Sample SHC Form 619 No. 30-11 Lab. No. 32968
Source of Material: Wyandotte Formation-Pwy							
LS+36	Limestone	2.50	2.40	35.0(B)	0.97	4.38	Av. 2 Samples SHC Form 619 No. 30-14

Figure 16. Results of tests completed on samples of material from geologic source units in Franklin County.