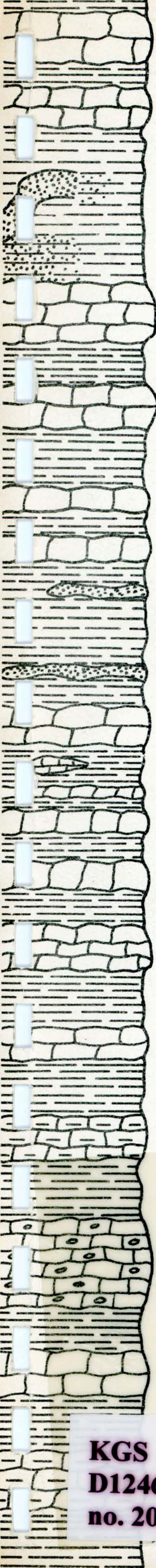
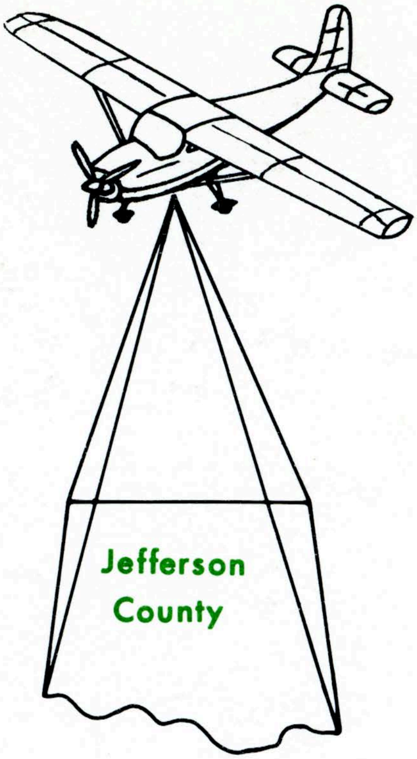
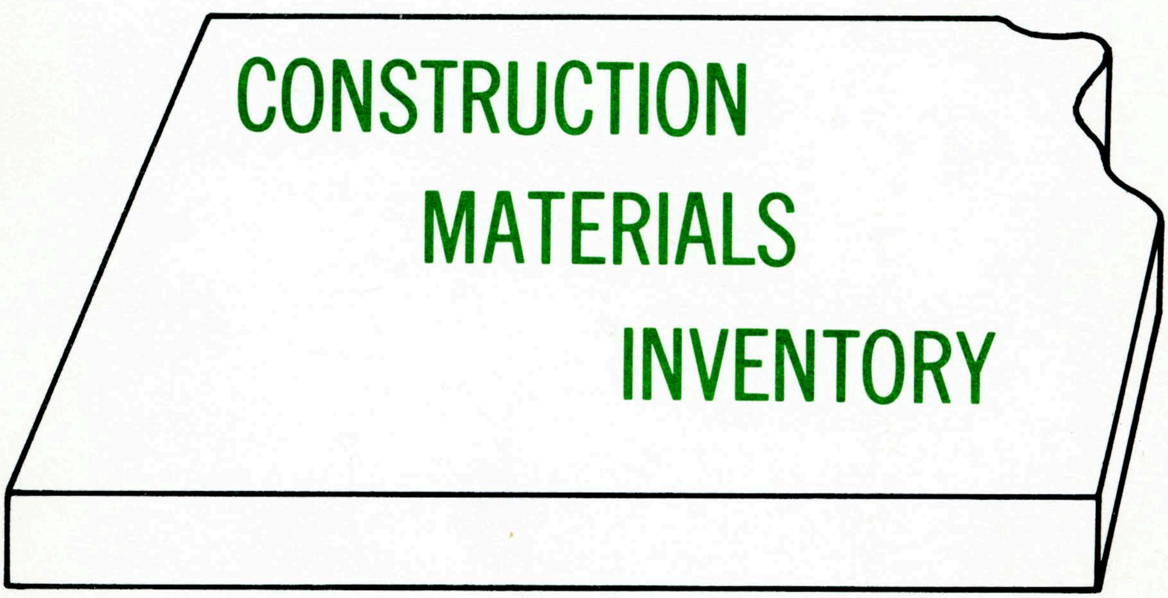
Environmental Geology







CONSTRUCTION MATERIALS INVENTORY

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

CONSTRUCTION MATERIALS INVENTORY OF JEFFERSON 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

1971

Construction Materials Inventory Report No. 20

the **WHY ?**

WHAT ?

HOW ?

of This Report

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

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

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

> *Prospective sites are select geologic locations where construction material may be found.*

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 evaulation and location of these sites.

Beginning on page 5 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 Jefferson County.

TO LOCATE AND EVALUATE

A MAPPED SITE OF CONSTRUCTION MATERIAL IN JEFFERSON COUNTY

TURN TO THE MATERIALS INVENTORY SECTION

See
TABULATION OF CONSTRUCTION MATERIALS
Figure 7 , Page 19

for material
BY TYPE
USE COLUMN 1

For Quality Data
See Figure 16
Page 37

for material
BY INTENDED USE
USE COLUMN 2

for **DESCRIPTION** of material

Column 3 gives page of DESCRIPTION which includes engineering characteristics, approximate locations, and references to materials map.

for **AVAILABILITY** of material

Column 4 gives relative amounts available, general location, and references to materials map.

MATERIALS MAP

SEE PINK SHEET, PAGE 39

Material source units, as well as all open sites, are mapped. Each site is referenced to an individual data form.

SITE DATA FORMS

OPEN SITES; NOT SAMPLED	GREEN SHEET, PAGE 40
OPEN SITES; SAMPLED	GREEN SHEET, PAGE 48
PROSPECTIVE SITES; SAMPLED	GREEN SHEET, PAGE 74
PROSPECTIVE SITES; NOT SAMPLED	GREEN SHEET, PAGE 82

Each site data form includes a map for site location and provides information concerning landownership, material quality (if available), geologic age, and site accessibility.

CONTENTS

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 Federal Highway Administration and the State Highway Commission of Kansas, financed by highway planning and research funds. The objective of the project is to *provide a statewide inventory of construction materials*, on a county basis, to help meet the demands of present and future construction needs.

Several publications issued by the State Geological Survey of Kansas, concerning Jefferson and surrounding counties, provided the basic geologic information used in this investigation. Detailed geologic and soil data were obtained from soil surveys and centerline geologic profile prepared for design of major highways in the county by the State Highway Commission.

Appreciation is extended to John M. Griffith, First Division Materials Engineer and Lonnie Moffitt, Jefferson County Engineer, for verbal information on construction materials in the area.

This report was prepared under the guidance of J. D. McNeal, State Highway Engineer; the project leader, R. R. Biege, Jr., Engineer of Location and Design Concepts; and G. M. Koontz of the Location and Design Concepts Department.

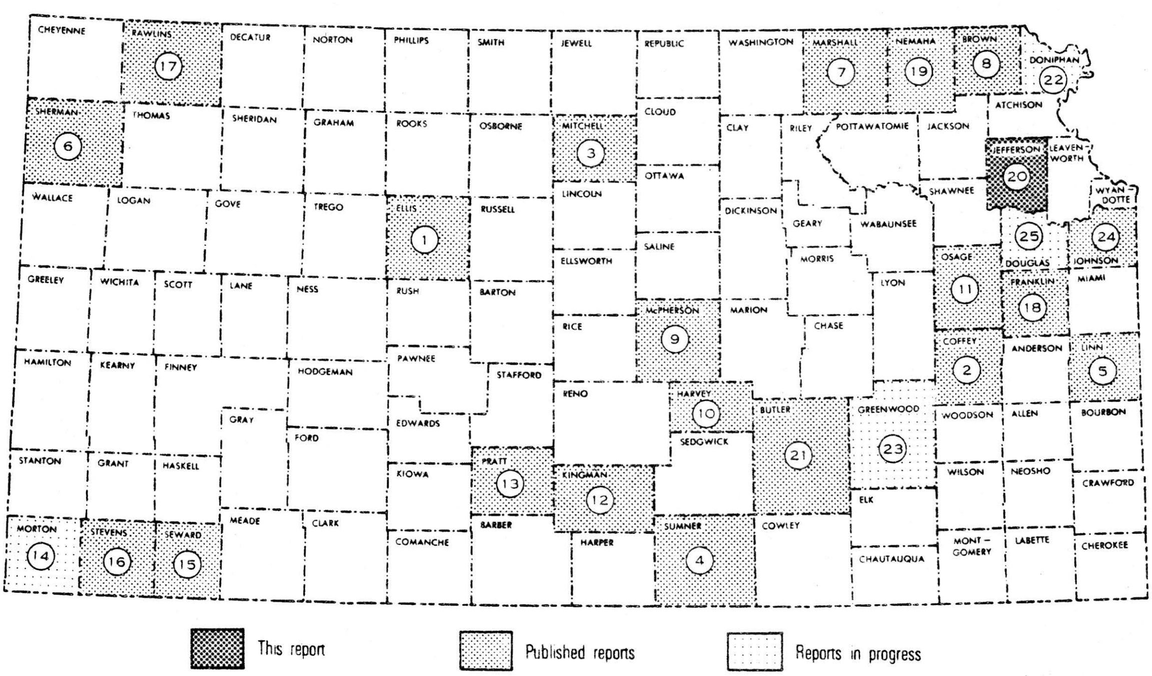


Figure 1. Index map of Kansas showing the location of Jefferson County along with the report number and location of counties for which reports have been completed or are being completed.

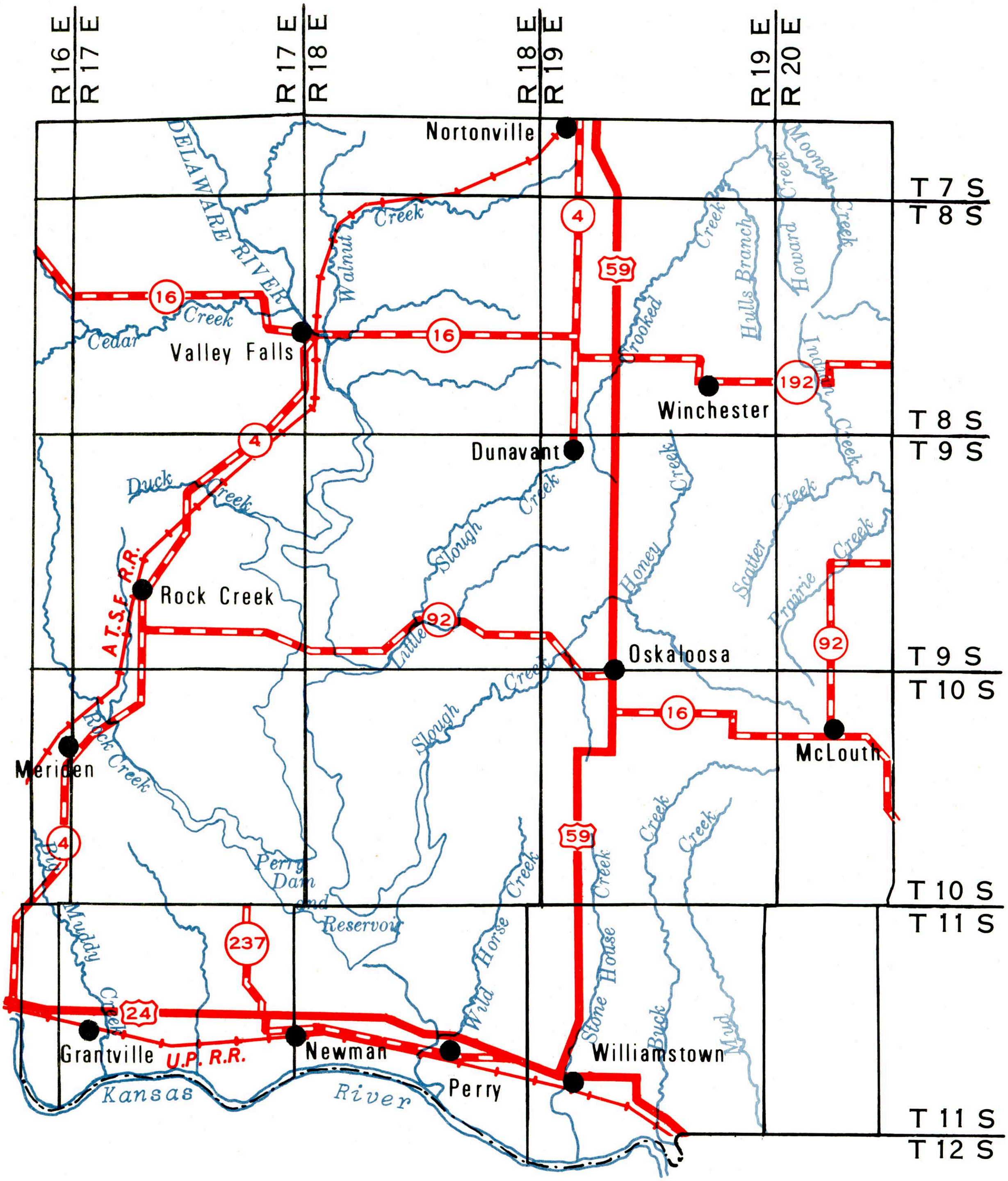
ABSTRACT

Jefferson County is located in northeastern Kansas and is a part of the Glaciated physiographic division of Kansas. The terrain is characterized by a gently rolling topography in the uplands with steeper slopes being prominent along the major drainage channels.

Sources of construction materials in Jefferson County are restricted to thicker limestone beds of Pennsylvanian age, siliceous sand and gravel from the Kansas River valley, and a very limited amount of sand and gravel derived from Glacial Drift. Nearly one-half of the county is covered by Glacial Drift which makes the production of limestone economically infeasible in some areas.

Aggregate produced from the Plattsmouth Member can be used in most types of road construction, while the Ervine Creek produces variable material. The Hartford and Curzon produces marginal material due mainly to their badly weathered condition.

Ground-water will cause construction problems in limestone and some sandstone units in the thicker shales. Many of the shale units are composed of highly plastic material. Much of the Glacial Drift is highly plastic and ground-water problems may be encountered in isolated sand and gravel pockets.



Scale: 6 Miles

Figure 2. Drainage and major transportation facilities in Jefferson County.

FACTS ABOUT JEFFERSON COUNTY

Jefferson County has an area of approximately 560 square miles and a population of 11,945 in 1970, according to the Bureau of the Census. It lies in the Glaciated physiographic division of Kansas.

The topography of Jefferson County is characterized by the comparatively wide valleys of the Kansas and Delaware Rivers. Prominent limestone-capped escarpments, along with moderate to steep slopes, characterize the terrain along valleys of major drainage channels. The upland surface, which is covered mostly by Glacial Drift, comprises approximately one half of the land area of the county. This part of the county is characterized by gently rolling hills. Figure 2 shows the major drainage and transportation facilities in Jefferson County.

METHODS OF INVESTIGATION

Investigation and preparation of this report consisted of three phases: (1) research and review of available information, (2) photo interpretation, and (3) field reconnaissance.

During phase one, relevant information concerning geology, soils, and construction materials of the county was reviewed and the general geology was determined. Quality test results of samples taken in Jefferson County were then correlated with the various geologic units and unconsolidated deposits.

Phase two consisted of study and interpretation of aerial photographs taken by the Kansas Highway Commission at a scale of one inch equals 1,000 feet. Figure 3 illustrates aerial photographic coverage of Jefferson County. Geologic source beds and all open materials sites were mapped and classified on aerial photographs. All materials sites were then correlated with the geology of the county.

Phase three was conducted after initial study of aerial photographs. A field reconnaissance was conducted by the author to examine construction materials, to verify doubtful mapping situations, and to acquire supplemental geologic information. Geologic classification of open sites was confirmed and prospective sites were observed.

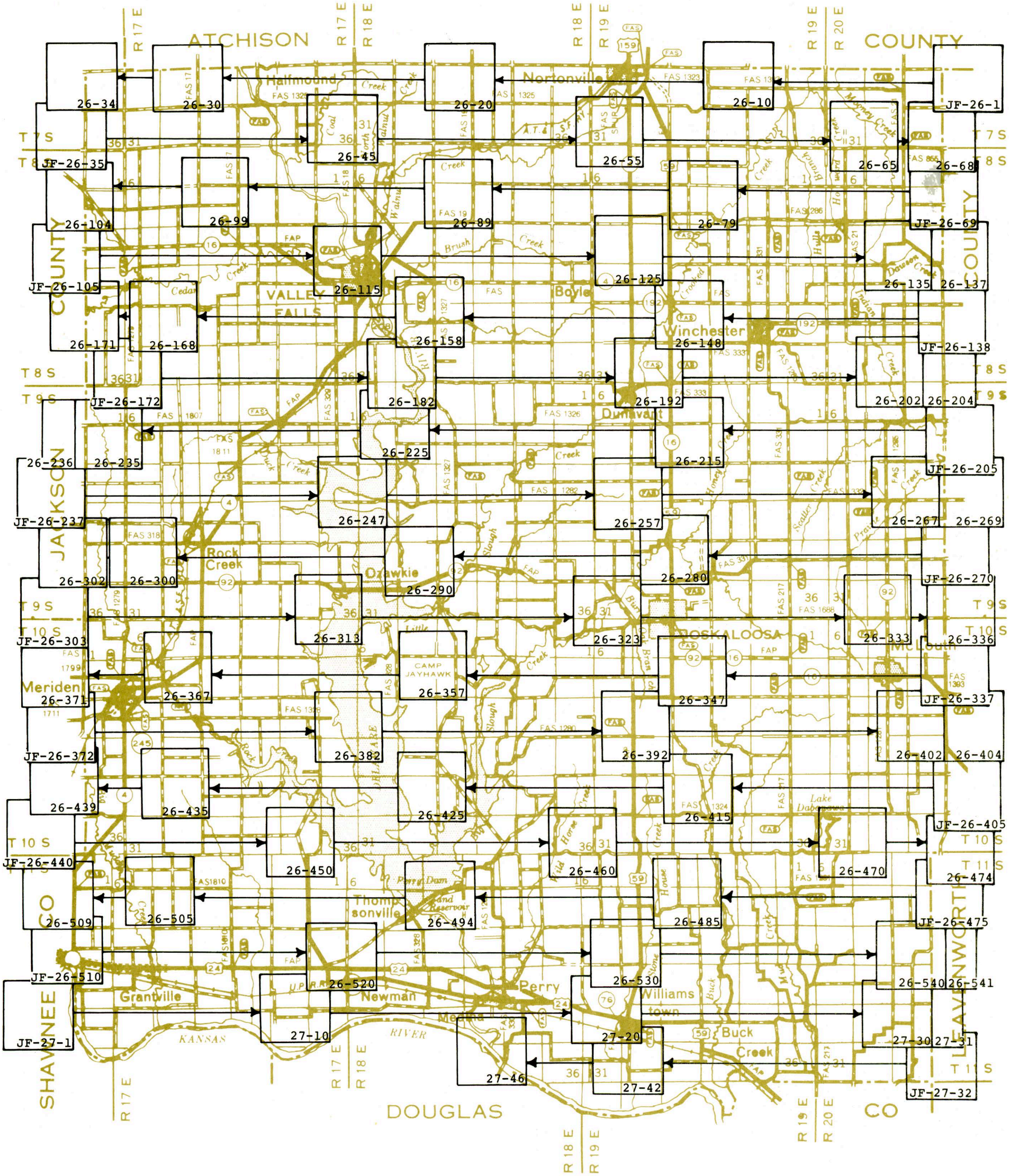
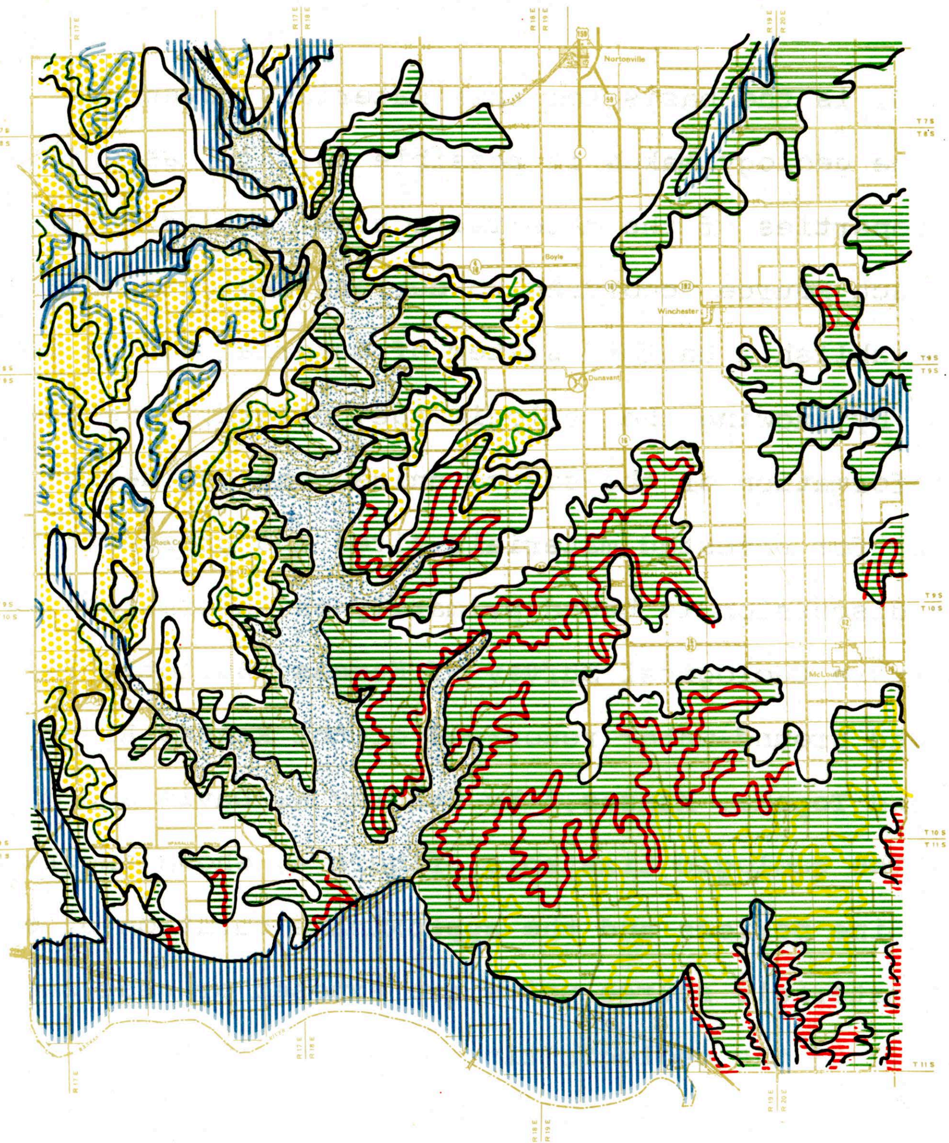


Figure 3. Aerial photographic coverage map for Jefferson County. The numbers refer to photographs taken by the State Highway Commission of Kansas. The county was photographed at 6,000 feet (scale one inch = 1,000 feet) in April, 1967. Aerial photographs are on file in the Photogrammetry Laboratory, State Office Building, Topeka, Kansas.

GEOLOGY SECTION



LEGEND

- Alluvium
- Glacial Drift
- Wabaunsee Group
- Base, Emporia Ls. Fm.
- Base, Bern Ls. Fm.
- Shawnee Group
- Base, Deer Cr. Ls. Fm.
- Base, Lecompton Ls. Fm.
- Douglas Group
- Perry Reservoir

GENERAL GEOLOGY

GEOLOGY is the basis for this materials inventory. Knowledge of the geology makes it possible to: (a) ascertain the general properties of the material source, (b) identify and classify each source according to current geologic nomenclature, and (c) establish a uniform system of material source bed classification. By knowing the geologic age, origin, landform, and quality information of the source units, one can derive general information for untested materials sites and prospective locations.

This discussion is based primarily on information obtained from the State Geological Survey of Kansas, Bulletin 96, part 5, "Geology and ground-water resources of the Kansas River between Lawrence and Topeka, Kansas," by Stanley N. Davis and William A. Carlson. The geologic timetable, figure 4, shows in graphic form the major time periods and the approximate duration of each. Since the materials source units are exposed or near surface, only a small part of the geologic time portrayed in figure 4 is represented in the surface geology of Jefferson County. Figure 5 (Page 9) illustrates the surface geology and stratigraphic position of each material source unit in Jefferson County.

Rocks which occur in the subsurface, but do not crop out in Jefferson County, range from Precambrian to late Pennsylvanian age. The Precambrian rocks are believed to be granitic types. As much as 2,700 feet of Paleozoic rocks, composed of limestone, dolomite, sandstone, and shale, overlie the older Precambrian rocks. Marine deposits of late Pennsylvanian age are the oldest

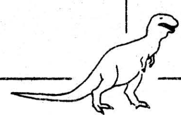
ERAS	PERIODS	ESTIMATED LENGTH IN YEARS	TYPE OF ROCK IN KANSAS	PRINCIPAL MINERAL RESOURCES
CENOZOIC	QUATERNARY (PLEISTOCENE) 	1,000,000	Glacial drift; river silt, sand, and gravel; dune sand; wind-blown silt (loess); volcanic ash.	Sand and gravel; volcanic ash; agricultural soils; water.
CENOZOIC	TERTIARY 	59,000,000	Silt, sand, and gravel; fresh-water limestone; volcanic ash; bentonite; diatomaceous marl; opaline sandstone.	Sand and gravel; volcanic ash; diatomaceous marl; water.
MESOZOIC	CRETACEOUS	70,000,000	Chalky shale, dark shale, vari-colored clay, sandstone, conglomerate; outcropping igneous rock.	Concrete and bituminous aggregate, light type surfacing, shoulder and subgrade material, riprap, and building stone; ceramic materials; water.
MESOZOIC	JURASSIC	25,000,000	Sandstone and shale, chiefly subsurface.	
MESOZOIC	TRIASSIC	30,000,000		
PALEOZOIC	PERMIAN 	25,000,000	Limestone, shale, evaporites (salt, gypsum, anhydrite), red sandstone and siltstone, chert, and some dolomite.	Concrete and bituminous aggregate, light type surfacing, shoulder and subgrade material, riprap, and building stone; natural gas, salt, gypsum, water.
PALEOZOIC	PENNSYLVANIAN 	25,000,000	Alternating marine and non-marine shale; limestone, sandstone, coal, and chert.	Concrete and bituminous aggregate, light type surfacing, shoulder and subgrade material, riprap, and limestone and shale for cement; ceramic materials; oil, coal, gas, and water.
PALEOZOIC	MISSISSIPPIAN 	30,000,000	Mostly limestone, predominantly cherty.	Chat and other construction materials; oil, zinc, lead, and gas.
PALEOZOIC	DEVONIAN	55,000,000	Subsurface only. Limestone and black shale.	Oil.
PALEOZOIC	SILURIAN	40,000,000	Subsurface only. Limestone.	Oil.
PALEOZOIC	ORDOVICIAN	80,000,000	Subsurface only. Limestone, dolomite, sandstone, and shale.	Oil, gas, and water.
PALEOZOIC	CAMBRIAN 	80,000,000	Subsurface only. Dolomite and 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.

Figure 4. Geologic timetable

rocks exposed in Jefferson County. Limestone units of this age are the most abundant and important materials source units in the county.

The events that took place during the Cenozoic Era have had a dominant influence on the construction materials resources of Jefferson County. During late Tertiary or early Quaternary time, chert gravel derived from the west was deposited by the antecedent stream of the present-day Kansas River. During the Pleistocene, the Kansan glacier overrode most of these deposits.

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 and the sequence of glaciation played a controlling role in the stream activity in Jefferson County. Figure 6 is a geologic timetable showing the divisions of the Quaternary Period and the approximate length of each. The glacial ages (Nebraskan, Kansan, Illinoisan, and Wisconsinan) represent the advance of the glaciers, while the three interglacial ages (Aftonian, Yarmouthian, and Sangamonian) represent periods of major glacial recession. The Recent Age represents the time which has elapsed since the last retreat of the Wisconsinan glacier.

During the initial advance of the Kansan glacier, the Atchison Formation, which usually consists of cross-bedded sand and gravel, was laid down. Today this material is usually found in the lower part of ancient stream channels. The Atchison Formation was not identified in Jefferson County during this investigation.

System	Series	Stage	Graphic Legend	Thickness	Type of Deposit	Map Symbol	General Description	Construction Material
Quaternary	Pleistocene	Wisconsinan and Recent		0-80'	Alluvium	Qal	Clay, silt, and fine sand that grades downward to fine and coarse gravel in Kansas River valley. Silt and clay characterizes the Alluvium in the valleys of the major tributaries of the Kansas River.	Construction aggregate, light type surfacing material.
		Wisconsinan		0-90'	Terrace Deposit (Newman)	Qn	Silt and clay that grades downward into sand and gravel in the Kansas River valley.	Construction aggregate, light type surfacing material.
		Illinoisan		0-90'	Terrace Deposit (Buck Creek)	Qbc	Brownish-red clayey silt grading downward into fine sand, sand, and some gravel.	Construction aggregate, light type surfacing material.
		Kansan		0-30'	Terrace Deposit (Menoken)	Qm	Silt and sandy silt, reddish-tan grading downward into sand and gravel.	Construction aggregate, light type surfacing material.
				0-60'	Glacial Drift	Qgd	Primarily clay and silt, reddish-brown to brown at surface, blue-gray at depth. Contains some stratified sand and gravel along with some boulders.	Light type surfacing material.

Note: Pleistocene deposits may be in contact with any older outcropping rock.

System	Series	Group	Graphic Legend	Formations and Members		Map Symbol	Thickness	General Description	Construction Material
Pennsylvanian	Upper Pennsylvanian	Wabaunsee Group		Emporia Limestone	Harveyville Shale	Ꝑr			
					Reading Limestone		2'	A dark blue limestone, characteristically in two or three compact beds.	Light type surfacing material.
				Auburn Shale					
				Bern Limestone	Wakarusa Limestone	Ꝑb	2'-3'	A hard, olive-gray, crystalline limestone.	Light type surfacing material.
					Soldier Creek Shale				
					Burlingame Limestone		1'-9'	A deep brown, thick-bedded limestone with a mottled, brecciated appearance in the upper part.	Light type surfacing material, riprap.
				Scranton Shale					
				Howard Limestone	Utopia Limestone	Ꝑh	5'-6'	A shaly, thin-bedded limestone about three or four feet thick overlain by a better quality limestone about two feet in thickness.	Light type surfacing material.
					Winzeler Shale				
					Church Limestone				
					(Nodaway Coal)				
					Aarde Shale				
				Severy Shale					
		Shawnee Group		Topeka Limestone	Coal Creek Limestone	Ꝑt			
					Holt Shale				
					Du Bois Limestone				
					Turner Creek Shale				
					Sheldon Limestone				
					Jones Point Shale				
					Curzon Limestone		±7'	A gray, medium-bedded, compact limestone with shale seams.	Construction aggregate, light type surfacing material, riprap.
					Iowa Point Shale				
					Hartford Limestone		±5'	A light gray, fine-grained, hard, thin-bedded to massive limestone that weathers a brownish-orange color.	Construction aggregate, light type surfacing material, riprap.
				Calhoun Shale					
				Deer Creek Limestone	Ervine Creek Limestone	Ꝑdc	13'-18'	A light gray, dense, wavy-bedded limestone with thin shale partings.	Construction aggregate, light type surfacing material, riprap.
					Larsh-Burroak Shale				
					Rock Bluff Limestone				
					Oskaloosa Shale				
					Ozawkie Limestone		6'-10'	A brownish-gray, shaly, compact limestone that weathers to a yellowish-brown color.	Light type surfacing material, riprap.
				Tecumseh Shale					
				Lecompton Limestone	Avoca Limestone	Ꝑl			
					King Hill Shale				
					Beil Limestone		3'-4'	A light gray, thin and wavy-bedded limestone with lesser amounts of siltstone and claystone.	Light type surfacing material, riprap.
					Queen Hill Shale				
					Big Springs Limestone				
					Doniphan Shale				
					Spring Branch Limestone		±5'	A dark, medium gray, finely crystalline limestone that weathers to a yellowish-brown color.	Light type surfacing material, riprap.
				Kanwaka Shale					
				Oread Limestone	Kereford Limestone	Ꝑo	±6'	An olive-gray, shaly limestone that weathers to a yellowish-brown color. It has irregular bedding.	Light type surfacing material, riprap.
					Heumader Shale				
					Plattsmouth Limestone		±18'	A medium gray, finely crystalline, wavy-bedded limestone which has scattered chert nodules. It weathers to a yellowish-gray color.	Construction aggregate, light type surfacing material, riprap.
					Heebner Shale				
					Leavenworth Limestone				
					Snyderville Shale				
					Toronto Limestone		9'-12'	A gray, shaly limestone that weathers to a brown color. It is fairly massive with some thin shale partings.	Light type surfacing material, riprap.
		Douglas Group		Lawrence Formation					

Figure 5. Generalized geologic column of the surface geology in Jefferson County.

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 6. Geologic timetable of the Quaternary Period.

According to Davis and Carlson (1952), the effect of the Kansan glacier on the topography in this area was fourfold: (1) the Pre-Kansan river valley was cut wider and deeper by meltwater as the glacier advanced toward the area; (2) the uplands were stripped of some bedrock by the advancing ice; (3) the Kansas River valley was filled with glacial outwash which became progressively finer-grained as the glacier was dissipated; and (4) the uplands were mantled with Glacial Drift after the glacier was gone from the area.

According to Lohman and Frye (1940), the Kansas River, as it exists today, had its beginning during the Kansan glacial advance and was essentially an ice-marginal river. As the Kansan ice dissipated, most activity affecting the construction materials resources of Jefferson County took place in the Kansas River valley. Alluvial deposits continued to accumulate in the Kansas River valley to an elevation approximately 80 feet above the present floodplain. Dissected remnants of this surface appear along the north bank of the Kansas River valley in Jefferson County. This terrace is named the Menoken terrace and is underlain by silt, sand, and gravel.

During Illinoisan time, the bedrock floor of the Kansas River was cut 50 to 60 feet below its former level. After this entrenchment, the valley was aggraded to about 35 feet above the present floodplain. This terrace surface is preserved in only a few places along the major valley due mainly to lateral river erosion; however, it is found in many of the minor tributary valleys. This terrace is named the Buck Creek terrace from a well-developed surface along Buck Creek in Jefferson County (sec. 17, T11S, R19E). The terrace is characterized primarily by silt and silty clay in the upper portion, with sand and some gravel being encountered in the lower part.

The youngest major terrace in the Kansas River valley was formed during late Wisconsinan and early Recent time. According to Davis and Carlson (1952), the upper 10 to 25 feet is composed of silt and silty clay, with granular material being encountered at lower depths. This terrace is named the Newman terrace from the town of Newman in Jefferson County, where a large segment of the terrace is unmodified by tributary streams.

The Kansas River floodplain was formed during Recent time and is composed of silt and silty clay on the surface. Although granular material is encountered at lower depths, production of such material is from the Kansas River rather than in the floodplain proper.

GEO-ENGINEERING

Because of the diversification of Jefferson County geology, the nature of geo-engineering problems varies considerably from one part of the county to another. Northeastern Jefferson County is covered by thick Glacial Drift. The highest areas are capped with loess. In the western part, drift has been removed by erosion except in the interstream areas. Southeastern Jefferson County has been stripped of drift cover and the terrain is characterized by interbedded limestone and shale. The Kansas River valley occupies the southern-most part of the county.

Moderate cuts and fills will be encountered in northeast Jefferson County. All cuts will be common excavation except along major drainage channels. However, large quartzite boulders are scattered throughout the area. Isolated sand and gravel deposits are common in Glacial Drift and are usually a source of ground-water. Except for local sand and gravel deposits, most soil derived from drift is composed of silty clay, clay loam, and in more severe cases, clay. Most material is an A-6 or A-7 type of soil according to A.A.S.H.O. standards.

Similar conditions exist in western Jefferson County where drift caps high terrain; however, rock excavation, clay shales, and ground-water problems associated with limestone and sandstone units will be encountered at lower elevations.

In southeastern Jefferson County, the terrain is characterized by steep slopes and rock excavation will be encountered in most cuts. Limestone is more prominent in the eastern part of the area. Ground-water problems can be anticipated when gradeline intercepts many of the limestones and some sandstones found in shale units. Soil in this area is a mixture of residual, glacial, and windblown material. Most soil is an A-6 or A-7 type according to A.A.S.H.O. standard.

The Kansas River valley is characterized by relatively flat terraces and floodplains of Pleistocene age. Generally, the surface material is composed of clay, silt, and fine sand, with granular material being prominent in the lower part of the Alluvium. Available test data show a high percentage of clay-sized particles and plasticity indices that range from 21 to 42.

Water for concrete-mix purposes is available from major drainage channels; however, large quantities can be produced only from the Kansas River valley. Although chemical analyses show that the water is suitable for construction purposes, tests should be conducted to insure that local surface contamination has not rendered it unsuitable for use in concrete construction.

MATERIALS INVENTORY SECTION

GENERAL INFORMATION

Pennsylvanian limestone makes up a major part of the construction materials resources of Jefferson County. Siliceous sand and gravel can be produced from Pleistocene terraces and the Kansas River floodplain, but it is much more economical to produce such material from the Kansas River.

According to Mr. Lonnie Moffitt, Jefferson County Engineer, the county uses crushed aggregate from the Ervine Creek and Plattsmouth Limestone Members.

The construction materials types, their uses, and availability are tabulated in figure 7. Test results from a limited amount of sampling and testing are presented in figure 16 (page 37).

CONTENTS OF CONSTRUCTION
MATERIALS INVENTORY SECTION

CONTENTS OF CONSTRUCTION
MATERIALS INVENTORY SECTION
(con't.)

TYPE and geologic source	USE	DESCRIPTION page	AVAILABILITY
LIMESTONE			
Toronto Limestone Member	Light type surfacing. Riprap.	20	Limited source in southeast part of the county. Plate VI.
Plattsmouth Limestone Member	Construction aggregate. Light type surfacing. Riprap.	21	Good source in southeast part of the county. Plate VI.
Kereford Limestone Member	Light type surfacing. Riprap.	23	Very limited source in southeast part of the county. Plate VI.
Spring Branch Limestone Member	Light type surfacing. Riprap.	24	Limited source in central and southern part of the county. Plates III, IV, V, and VI.
Beil Limestone Member	Light type surfacing. Riprap.	25	Very limited source in central and southern part of the county. Plates III, IV, V, and VI.
Ozawkie Limestone Member	Light type surfacing. Riprap.	26	Limited source in southwest, central, and northeast part of the county. All plates.
Ervine Creek Limestone Member	Construction aggregate. Light type surfacing. Riprap.	27	Good source in southwest, central, and northeast part of the county. All plates.
Hartford Limestone Member	Construction aggregate. Light type surfacing. Riprap.	29	Moderate source in western part of the county. All plates.
Curzon Limestone Member	Construction aggregate. Light type surfacing. Riprap.	29	Moderate source in western part of the county. All plates.
Utopia Limestone Member	Light type surfacing.	31	Very limited source in western part of the county. Plates I, III, and V.
Burlingame Limestone Member	Light type surfacing.	32	Limited source in northwest part of the county. Plates I, and III.
Wakarusa Limestone Member	Light type surfacing.	32	Very limited source in northwest part of the county. Plates I and III.
Reading Limestone Member	Light type surfacing.	33	Very limited source in northwest part of the county. Plates I and III.
SILICEOUS SAND AND GRAVEL			
Quaternary Glacial Drift	Light type surfacing.	34	Very limited source. All plates.
Quaternary Terraces	Construction aggregate. Light type surfacing.	35	Limited source in southern part of the county. Plates V and VI.
Quaternary Alluvium	Construction aggregate. Light type surfacing.	36	Good source in Kansas River valley. Plates V and VI.

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

DESCRIPTION OF CONSTRUCTION MATERIAL

Limestone

Oread Limestone Formation

In Jefferson County the Oread Formation has an average thickness of approximately 54 feet. It is divided into four limestone and three shale members of which only the Toronto, Plattsmouth, and Kereford Limestone Members are considered materials source units. Only the Plattsmouth has been produced extensively in the area.

Toronto Limestone Member

The Toronto is a massive, medium-gray limestone which develops into a thin-bedded, light- to medium-brown limestone when weathered. The limestone is somewhat shaly and ferruginous and contains scattered chert nodules in the upper part. A prominent shale seam is present near the middle of the ledge. The thickness of the member ranges from nine to twelve feet. Figure 8 shows a weathered exposure of the Toronto in a road cut in southeastern Jefferson County.

The Toronto has not been produced in Jefferson County because of its inaccessibility and because a much better quality rock is available in the overlying Plattsmouth Limestone Member.

No quality tests have been completed on samples of the Toronto in Jefferson County. The Toronto has been produced on a very limited basis in other counties to the south (Douglas, Franklin, and Coffey Counties) and in most cases, the rock has high absorption

Figure 8. An exposure of the Toronto Limestone Member of the Oread Formation in a road cut in NE¼ sec. 31, T11S, R20E.

qualities. Because of this and its shaly characteristics, the material usually isn't considered for bituminous and concrete construction. Quality tests usually indicate that the Toronto could be used for riprap and the rock has been used for light type surfacing material in some counties to the south; however, a brown-colored, dusty aggregate is produced from the Toronto and may not be acceptable in some local areas.

Exposures of the Toronto are restricted to the southeastern part of the county. Heavy overburden will be encountered in most areas and when the ledge occupies high terrain, solution cracks and cavities are usually filled with residual clay.

Plattsmouth Limestone Member

The Plattsmouth is a light bluish-gray, fine-grained, wavy-bedded limestone with scattered chert nodules occurring in the middle of the ledge. Numerous horizontal partings and vertical joints occur in the Plattsmouth and a prominent shale seam, about three inches thick, separates the upper ten feet from the lower seven to eight feet of the ledge.

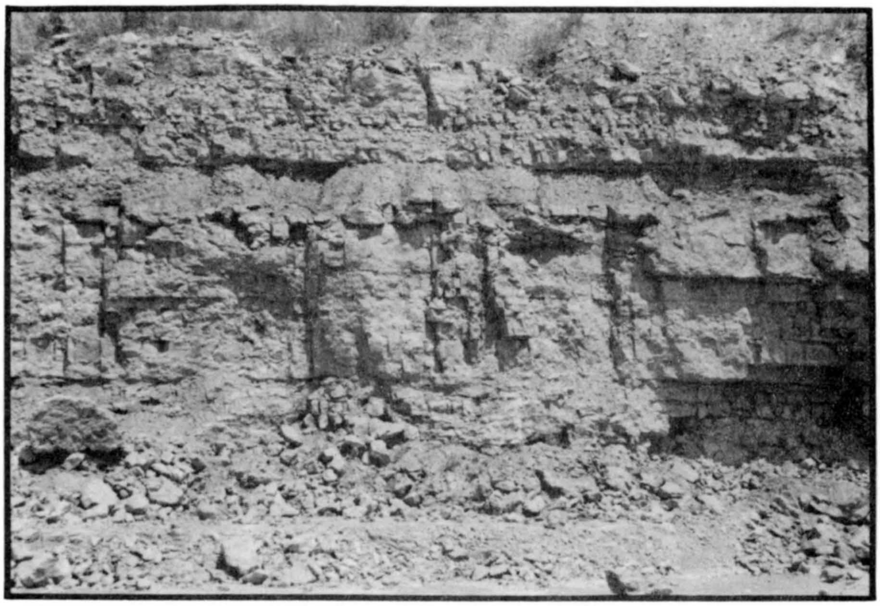


Figure 9. An exposure of the Plattsmouth and overlying Kereford Limestone Members of the Oread Formation in a quarry near Williamstown, Kansas.

The Plattsmouth has been produced extensively in south-eastern Jefferson County. Six quarries in this area have been sampled and tested by the State Highway Commission of Kansas. Detailed test information is shown in chart form in figure 16, page 37. One should note that the poorer quality test results were on samples obtained in two quarries where only the upper portion was exposed. The lower portion is of better quality than the severely weathered upper portion; therefore, the material from these quarries should not be considered representative of the Plattsmouth in Jefferson County.

The results of most quality tests indicate that aggregate produced from the Plattsmouth is suitable for concrete aggregate and in some cases for bituminous construction. In addition, the aggregate is used for light type surfacing material and riprap. The Plattsmouth is mapped on plate VI.

Kereford Limestone Member

The Kereford is the uppermost member of the Oread Formation. It consists of a light olive-gray limestone and thin calcareous shales that are highly fossiliferous. It weathers to irregular thin beds and a tan-gray color. In Jefferson County the Kereford has a thickness that ranges from six to seven feet. Figure 9 (page 22) shows the Kereford and the underlying Plattsmouth Member in an open quarry near Williamstown, Kansas.

To the south, the Kereford is much thicker and contains a higher percent of shale. Where the unit is thicker, a portion of the ledge has been used for aggregate and riprap.

In Jefferson County, the unit has not been produced because of its soft nature and the availability of a better quality material from the underlying Plattsmouth Member. If produced in Jefferson County, aggregate from the Kereford would probably be limited in use to light type surfacing material. No quality test data are available for this source in this area. Its exposure pattern is restricted to the southeast corner of Jefferson County (plate VI).

Lecompton Limestone Formation

In Jefferson County the Lecompton Formation has an average thickness of approximately 35 feet. It has four limestone and three shale members which are, in ascending order: the Spring Branch Limestone, Doniphan Shale, Big Springs Limestone, Queen Hill Shale, Beil Limestone, King Hill Shale, and Avoca Limestone. Because the upper beds are not resistant to weathering, the Lecompton does not form a prominent escarpment and the upper boundary is not sharply defined in many areas. Only the Big Spring and the Beil Members are considered potential sources of construction materials.

Spring Branch Limestone Member

The Spring Branch is a dark-gray, finely-crystalline limestone that weathers into fairly large massive ledges and yellow-brownish in color. In some areas the upper two feet is a light-gray, soft, shaly limestone which weathers to a tan color. The total thickness of the Spring Branch ranges from four to seven feet and has an average thickness of five feet.

The Spring Branch has not been quarried in Jefferson County and only on a very limited basis elsewhere in eastern Kansas. Because of its soft and shaly nature, this material would not meet specifications for concrete and bituminous construction, but would be usable for light type surfacing material. No quality test data are available for Jefferson County. The Spring Branch is exposed in the southeastern part of the county (plates III, IV, V, and VI).

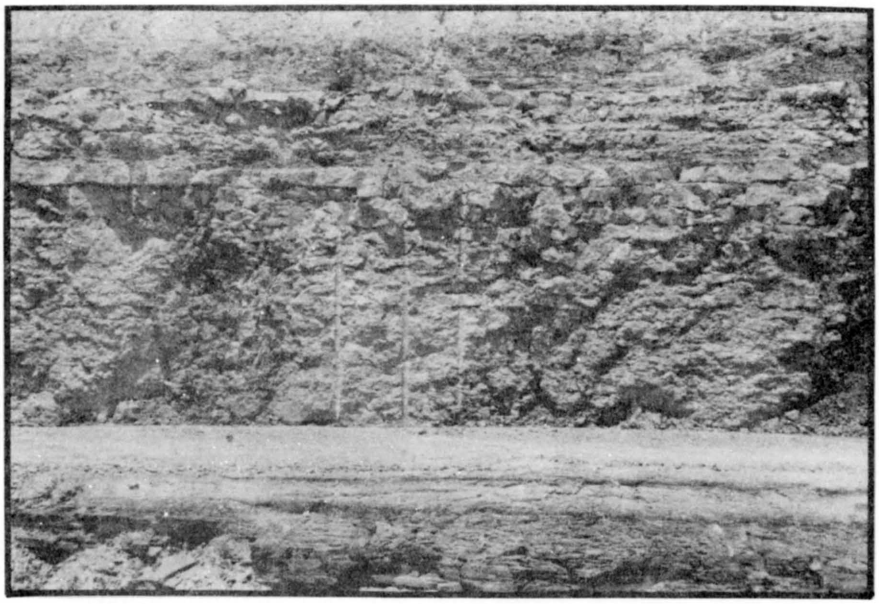


Figure 10. The Spring Branch Limestone Member of the Lecompton Formation in a road cut in the NE¼ sec. 14, T11S, R19E.

Beil Limestone Member

The Beil Limestone Member is composed of a light-gray limestone and interbedded shale which weathers to a very light tannish-gray color. The unit is very susceptible to weathering and good outcrops are found only in stream valleys. It has an average thickness of approximately six feet.

The Beil has not been produced in Jefferson County and only on a very limited basis elsewhere in eastern Kansas. No quality tests have been completed but the soft and shaly nature of the rock would preclude its use in either concrete or bituminous construction. Aggregate from the Beil could be used for light type surfacing material; however, a much better quality of rock is available in the underlying Oread Limestone Formation and overlying Deer Creek Limestone Formation. The exposure pattern of the Beil is shown on plates III, IV, V, and VI.

Deer Creek Limestone Formation

The Deer Creek Limestone Formation is composed of five members. They are, in ascending order: the Ozawkie Limestone, the Oskaloosa Shale, the Rock Bluff Limestone, the Larsh-Burroak Shale, and the Ervine Creek Limestone Member. In Jefferson County the full thickness of the Deer Creek is approximately 28 feet and the formation has been mapped as one unit. However, only two limestone members, the Ozawkie and Ervine Creek, are considered to be source units of construction materials.

Ozawkie Limestone Member

The Ozawkie is a massive bed of gray limestone that weathers to a brown color. In other areas it consists of two limestones separated by a clayey shale. When two limestones are present, the unit has a thickness from six to eleven feet. The single bed usually ranges from four to five feet.

The Ozawkie has been produced in some counties to the south for riprap. Very little has been produced in Jefferson County due to its shaly nature and the availability of better rock in the overlying Ervine Creek Limestone Member. Tests indicate the rock is variable and its wear and absorption properties are marginal. Quality information is available in chart form in figure 16 (page 37).

Generally the Ozawkie will not meet specifications for concrete and asphalt aggregate but may be used for light type sur-

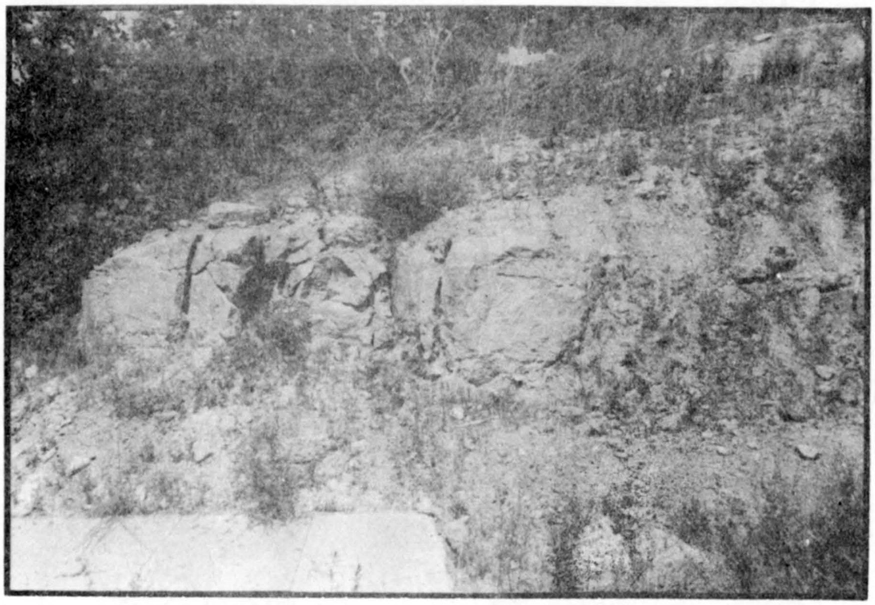


Figure 11. An exposure of the Ozawkie Limestone Member of the Deer Creek Limestone Formation in a road cut in the SE¼ sec. 20, T9S R19E.

facing material and riprap.

Ervine Creek Limestone Member

The Ervine Creek Limestone Member is a light-gray to white, fine-grained limestone containing scattered chert nodules. On a fresh surface it appears somewhat massive but it weathers into thin, wavy beds that are light brown in color. Small shale seams are prominent in most weathered exposures.

The Ervine Creek Limestone has been quarried extensively throughout the county. Fourteen sites have been sampled and tested by the State Highway Commission of Kansas. Detailed rock quality information is presented in chart form in figure 16, page 37.

Most of the limestone which displayed unsound qualities was

Figure 12. The Ervine Creek Limestone of the Deer Creek Formation in a road cut in the SW¼ sec. 29, T9S, R18E.

tested from a small number of quarries located in the central and northeastern part of the county. All have Glacial Drift overburden. The rock is badly weathered despite the 12 to 15 feet of overburden, because it was exposed before the Glacial Drift was deposited. A better quality of rock is available from the Ervine Creek in quarries near the Delaware River and in southwestern Jefferson County.

Generally the material from the Ervine Creek will meet specifications for concrete and bituminous construction and can be used for riprap and light type surfacing material.

The exposure pattern of the Deer Creek Limestone is shown on all plates.

Topeka Limestone Formation

The Topeka Limestone Formation is composed of nine members. They are, in ascending order: the Hartford Limestone, the Iowa Point Shale, the Curzon Limestone, the Jones Point Shale, the Sheldon Limestone, the Turner Creek Shale, the DuBois Limestone, the Holt Shale, and the Coal Creek Limestone Members. In Jefferson County the lowest members, the Hartford and Curzon Limestones, are weather resistant, and are the most commonly exposed units in the formation. These two units, having an aggregate thickness of 12 feet, are the main construction materials source units in the Topeka Formation.

Hartford Limestone Member

The Hartford is a light-gray, fine-grained limestone that is altered to a yellowish-brown color by weathering. It may be silty in the upper and lower portions and has a thickness of four to five feet.

Curzon Limestone Member

The Curzon is a light-gray, crystalline, thin-bedded, dense limestone with thin shale seams near the middle. Chert nodules are present in some outcrops. It commonly weathers to a dark yellowish-orange color. In Jefferson County, the Curzon has a thickness that ranges from six to eight feet.

The Hartford and Curzon Limestone Members have been produced in Jefferson County but not as extensively as the Ervine Creek or Plattsmouth. The State Highway Commission of Kansas has tested composite samples from five sites in Jefferson County. Therefore, from the quality point of view, the two members were treated as one producing unit. The most consistent, good quality rock is produced from the Curzon.

Detailed rock quality information is presented in chart form in figure 16, page 37. Generally the material is marginal for bituminous and concrete construction but can be used for light type surfacing material and riprap.

The Hartford-Curzon Members are exposed over a wide area in

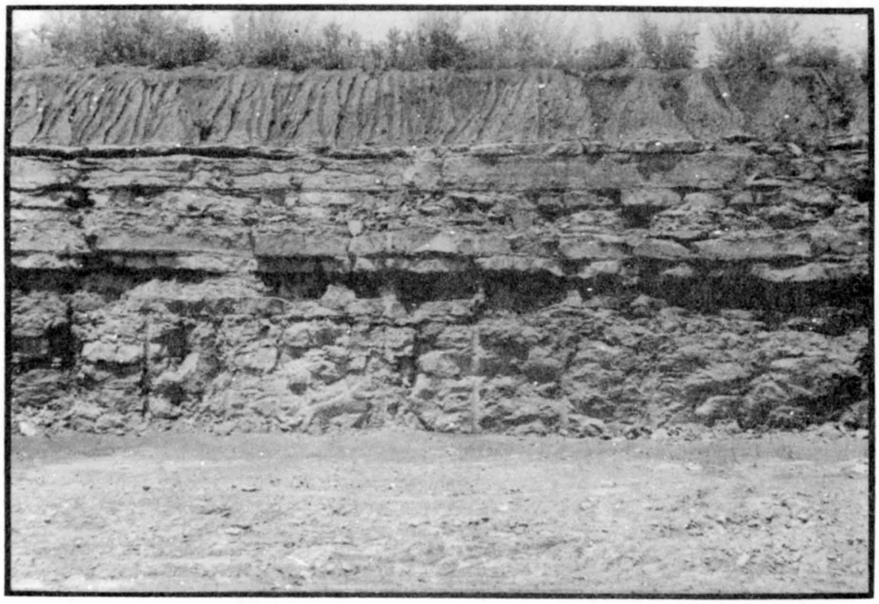


Figure 13. The Hartford and Curzon Limestone Members of the Topeka Formation in a road cut in the SE¼ sec. 29, T9S, R18E.

Jefferson County. Erosion by the Delaware River and its tributaries is a controlling factor of the exposure pattern. In the western part of the exposure area, the Topeka forms the highest element of topography. In much of this area, the Topeka has been badly weathered and only a remnant of the ledge is left. Although a topographic bench is present, only a limited amount of rock can be produced in these areas.

Howard Limestone Formation

In Jefferson County the Howard Limestone Formation is composed of four members. They are, in ascending order: the Aarde Shale, the Church Limestone, the Winzeler Shale, and the Utopia Limestone Members. Only the Utopia Limestone Member has ever been utilized for construction materials, and then on a limited basis.

The Utopia is the main source for construction material in the Howard Limestone; however, it is the top member of the formation and is susceptible to weathering.

Utopia Limestone Member

The Utopia is composed of a light brownish-gray, fine-grained, silty limestone which is about five to six feet thick. Shale seams occur in the middle and upper part of the lower unit. The upper unit is light-gray, fine-grained, platy limestone which is about four feet thick. It weathers to a light yellowish-brown color.

The Utopia has not been quarried in Jefferson County; however, a limited number of samples have been tested to the south of this area. The tests indicate the material is marginal for use in concrete and bituminous construction but can be used for light type surfacing material. The outcrop area includes most of western Jefferson County (plate III). The exposures are rare due to weathering of the rock or Glacial Drift cover.

Bern Limestone Formation

The Bern Limestone Formation is composed of three members which are, in ascending order: the Burlingame Limestone, the Soldier Creek Shale, and the Wakarusa Limestone. The formation varies from 15 to 20 feet in thickness. Only the two limestone units are sources of construction material.

Burlingame Limestone Member

Generally the Burlingame is a light-gray, hard, crystalline limestone that has a mottled or brecciated appearance with a maximum thickness of six feet. However, in northwest Jefferson County, the unit shows little or no brecciation and the thickness of the ledge diminishes considerably. In many exposures, the units weather to a deep-brown color.

This member has been quarried in nearby counties but it has not been produced in Jefferson County. This is due primarily to its thin nature.

One quality test on the Burlingame in Jefferson County indicated a marginal grade material with the absorption being too high for use as bituminous aggregate; however, it may be used in concrete and other phases of road construction. Information in adjacent areas indicate the quality of the Burlingame becomes better to the south and poorer to the north.

Wakarusa Limestone Member

The Wakarusa, which is the top member of the Bern Limestone, is found about nine feet above the top of the Burlingame. The intervening shale is the Soldier Creek Member.

The Wakarusa is a hard, blue-gray limestone about two or three feet thick. It is rarely produced for construction material except when the underlying Burlingame is produced.

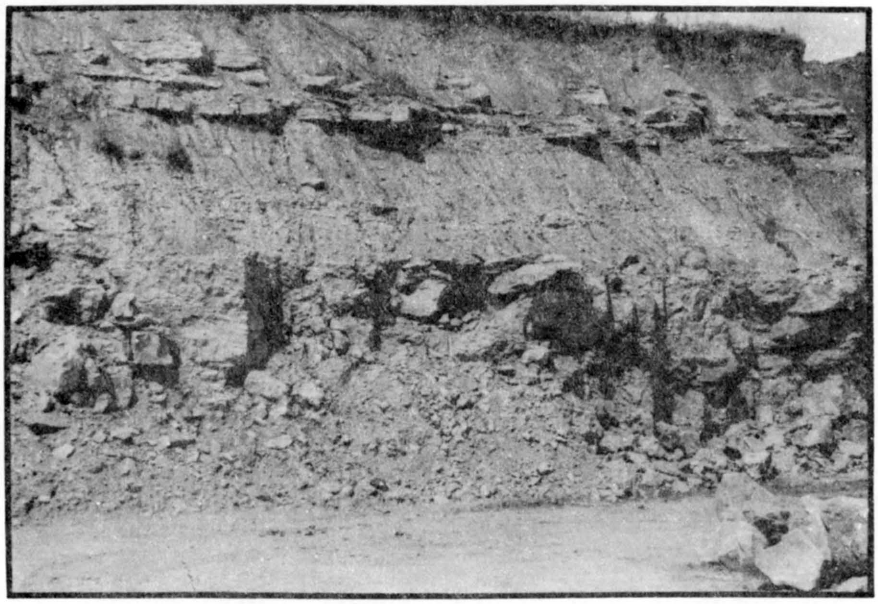


Figure 14. An exposure of the Bern Limestone Formation in a quarry in Shawnee County.

The Wakarusa has never been quarried in Jefferson County and only on a very limited basis elsewhere in the state. No quality tests have been conducted on rock from the Wakarusa but material from this ledge should meet most specifications for concrete and bituminous construction, riprap, and light type surfacing material.

Emporia Limestone Formation

Reading Limestone Member

The Reading Limestone Member is the youngest Pennsylvanian Limestone that was mapped during this investigation. The Reading is a dark gray-blue, dense limestone that weathers to a yellow-brown color. The thickness of the ledge is about two feet.

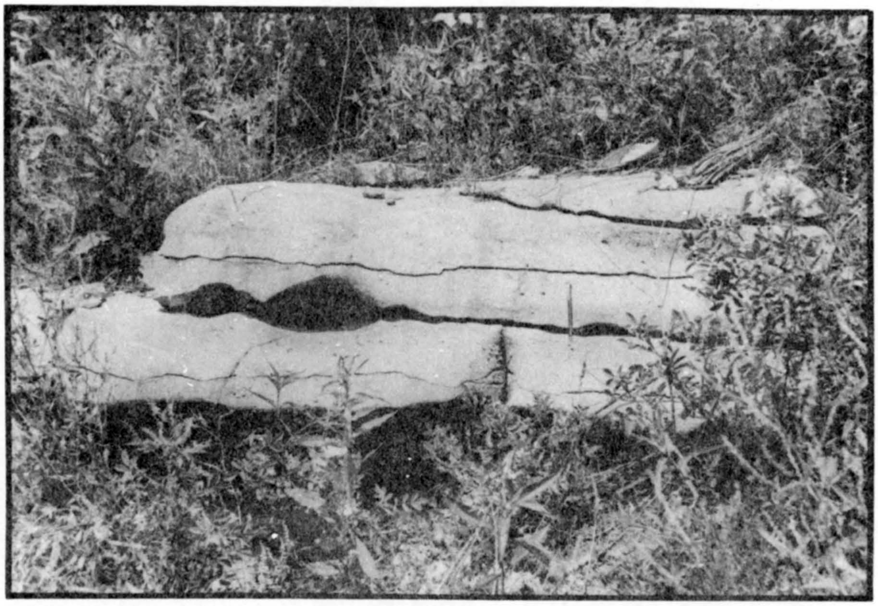


Figure 15. An exposure of the Reading Limestone Member of the Emporia Limestone Formation in a road cut in NE¼ sec. 25, T7S, R16E.

The Reading has been quarried in Jefferson County for structural stone but not for construction aggregate.

Material from the Reading could be used for riprap and light type surfacing material but will not meet the requirements for bituminous or concrete construction.

Sand and Gravel

Glacial Drift

In this report the term "Glacial Drift" is used to include all material laid down either directly or indirectly by glacial ice. Such deposits may include material laid down by the ice itself, by meltwater from the ice, or material deposited in lakes associated with the glacier.

Thick deposits of Glacial Drift cover at least 30 percent of the county; however, thinner deposits are much more widespread. Although some of the thicker deposits are over 100 feet thick, very little construction material has been produced from this unit in Jefferson County. Most of the Drift is composed of unstratified, unsorted till with small deposits of stratified glacial outwash. Glacial quartzite erratics can be found throughout the area.

No commercial Glacial Drift sand and gravel pits are present in Jefferson County; however, a few pits have been opened to obtain a very low grade aggregate for local use.

No quality test data are available from Glacial Drift in Jefferson County.

Quaternary Terraces

Quaternary Terraces that range from Kansan to Recent in age are included in this section. These terraces, which include the Menoken, Buck Creek, and Newman, are found primarily in the Kansas River valley; however, remnants of the younger terraces are found in the floodplains of some of the smaller tributaries. These terraces do not add to the construction material resources of Jefferson County since the upper part of each is composed of different combinations of fine sand, silt, and clay. Granular material is found at lower depths but no material has been produced from this source in the area due mainly to the availability of siliceous sand and gravel in the Kansas River channel.

Quaternary Alluvium

This map unit includes the material that has been laid down during Recent time in the floodplains of the major channels. Siliceous sand and gravel can be produced only from the Kansas River floodplain because the material found in the Delaware River and smaller channel floodplains consists primarily of silt and clay with small quantities of interbedded sand and gravel.

Production can be accomplished in the floodplain proper by pumping operations once the overburden is removed, but the most economical approach would probably be a pumping operation along the Kansas River. The site of the pumping operation would be dependent upon proximity of the project and the roads available for hauling purposes. Most production from this source is near Lawrence in Douglas County and Topeka in Shawnee County. However, sand and gravel have been produced at two points along the Kansas River in Jefferson County during the past decade. One site just west of Perry was used to pump sand for the Perry Reservoir Dam and the other was located near Grantville in western Jefferson County. Limited testing on samples of sand and gravel from these sites indicates a good quality siliceous aggregate is available. More detailed quality information is available in chart form in figure 16 (page 37). Although very little gradation data are available for sites in Jefferson County, samples taken in Shawnee and Douglas Counties had as much as 28 percent retained on the one and one-half inch sieve though most of the material is much finer. Such material can be used to supplement aggregate but large volumes of material would have to be handled to obtain a complete aggregate.

Site No.	Material Type	Percent Retained								Wash	G.F.	P.I.	L.L.	Sp.Gr. Sat.	Sp.Gr. Dry	Wt./Cu. Ft.	% Wear	Soundness	% Absorption	Source of Data
		3/4	3/8	4	8	16	30	50	100											
Source of Material: Alluvium - Qal																				
SG+22	Sand and Gravel	1	3	9	30	65	90	98	99	1.40	3.95			2.62		110.01	36.9	0.98	0.7	One sample SHC form 619, No. 44-19
SG+23	Sand and Gravel													2.61		111.71			0.30	One sample SHC form 619, No. 44-29
Source of Material: Burlingame Member - Pb (Bern Formation)																				
LS+31	Limestone													2.49	2.37		25.4(B)	0.94	5.08	One sample SHC form 619, No. 44-20
Source of Material: Topeka Formation - Pt																				
LS+15	Limestone													2.61	2.53		28.6	0.90	3.33	One sample SHC form 619, No. 44-27, Lab. No. 19049
														2.58	2.48		33.2(B)	0.85	4.28	One sample SHC form 619, No. 44-27, Lab. No. 19380
LS+19	Limestone													2.62	2.53		31.5	0.91	3.30	Av. 3 samples SHC form 619, No. 44-32
LS+32	Limestone													2.39			39.4(A)	0.73	5.12	One sample SHC form 619, No. 44-7
Source of Material: Ervine Creek Member - Pdc (Deer Creek Formation)																				
LS+7	Limestone													2.59	2.49		31.7(B)	0.88	3.64	One sample SHC form 619, No. 44-16
LS+8	Limestone													2.56	3.49		28.9(B)	0.97	2.70	One sample SHC form 619, No. 44-26, Lab. No. 25143
LS+9	Limestone													2.50			34.4	0.98	2.94	One sample SHC form 619, No. 44-12, Lab. No. 48947
LS+10	Limestone													2.52	2.43		34.4	0.94	3.62	One sample SHC form 619, No. 44-31, Lab. No. 66-2177
LS+11	Limestone													2.48	2.35		38.9(B)	0.86	5.25	One sample SHC form 619, No. 44-13, Lab. No. 14662
LS+12	Limestone													2.52	2.42		31.1(B)	0.89	4.25	One sample SHC form 619, No. 44-28, Lab. No. 32935
														2.53	2.43		29.9(B)	0.85	3.96	One sample SHC form 619, No. 44-28, Lab. No. 33107
LS+13	Limestone													2.44	2.32		36.5	0.94	5.10	One sample SHC form 619, No. 44-21, Lab. No. 13203
LS+14	Limestone													2.58			30.9(B)	0.95	2.50	One sample SHC form 619, No. 44-14
LS+16	Limestone													2.58			29.1(A)	0.96	1.61	One sample SHC form 619, No. JF Co.#2, Lab. No. 50421
														2.46			49.8(A)	0.95	3.81	One sample SHC form 619, No. JF Co.#2, Lab. No. 50422
LS+17	Limestone													2.45	2.33		36.7	0.91	5.31	One sample SHC form 619, No. 44-23
LS+18	Limestone													2.43			32.6(A)	0.94	3.98	One sample SHC form 619, No. 44-17
LS+20	Limestone													2.56	2.49		30.9	0.93	3.17	One sample SHC form 619, No. 44-22
LS+21	Limestone													2.56			30.9(A)	0.97	2.84	One sample SHC form 619, No. 44-18, Lab. No. 75034
														2.62			26.3(B)	0.94	2.22	One sample SHC form 619, No. 44-18, Lab. No. 78112
LS+30	Limestone													2.45			33.6(A)	0.94	3.81	One sample SHC form 619, No. JF Co.#6
LS+33	Limestone													2.48			30.8(A)	0.89	2.60	One sample SHC form 619, No. JF Co.#1, Lab. No. 50415
														2.38			38.0(A)	0.91	4.67	One sample SHC form 619, No. JF Co.#1, Lab. No. 50416
Source of Material: Ozawkie Member - Pdc (Deer Creek Formation)																				
LS+34	Limestone													2.56			32.1(A)	0.91	2.25	One sample SHC form 619, No. JF Co.#3, Lab. No. 50413
														2.35			42.6(A)	0.87	5.19	One sample SHC form 619, No. JF Co.#3, Lab. No. 50414
Source of Material: Plattsmouth Member - Po (Oread Formation)																				
LS+24	Limestone													2.57			32.0(A)	0.73	2.57	One sample SHC form 619, No. JF Co.#5, Lab. No. 50417
														2.60			30.4(A)	0.93	1.67	One sample SHC form 619, No. JF Co.#5, Lab. No. 50418
														2.43			37.1(A)	0.96	4.42	One sample SHC form 619, No. JF Co.#5, Lab. No. 50419
														2.52			34.2(A)	0.90	2.55	One sample SHC form 619, No. JF Co.#5, Lab. No. 50420
LS+25	Limestone													2.48			38.0(A)	0.98	3.12	One sample SHC form 619, No. 44-3, Lab. No. 50428
														2.55			28.7(A)	0.92	2.87	One sample SHC form 619, No. 44-3, Lab. No. 50427
LS+26	Limestone													2.56			29.5	0.95	2.40	One sample SHC form 619, No. 44-1, Lab. No. 50423
														2.53			30.7	0.92	3.18	One sample SHC form 619, No. 44-1, Lab. No. 50624
														2.53			35.6	0.76	3.62	One sample SHC form 619, No. 44-1, Lab. No. 50425
														2.52			32.3	0.93	2.70	One sample SHC form 619, No. 44-1, Lab. No. 50426
LS+27	Limestone													2.54			30.7(B)	0.95	3.10	One sample SHC form 619, No. 44-10, Lab. No. 96308
LS+28	Limestone													2.51	2.44		28.6(A)	0.96	3.21	One sample SHC form 619, No. 44-24
LS+29	Limestone													2.65			29.5	0.95	3.29	One sample SHC form 619, No. 44-15

Figure 16. Results of tests completed on samples of material from the various geologic source beds in Jefferson County.