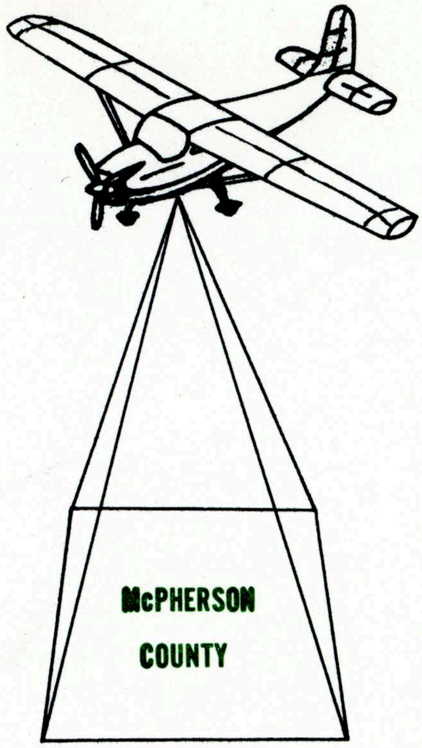

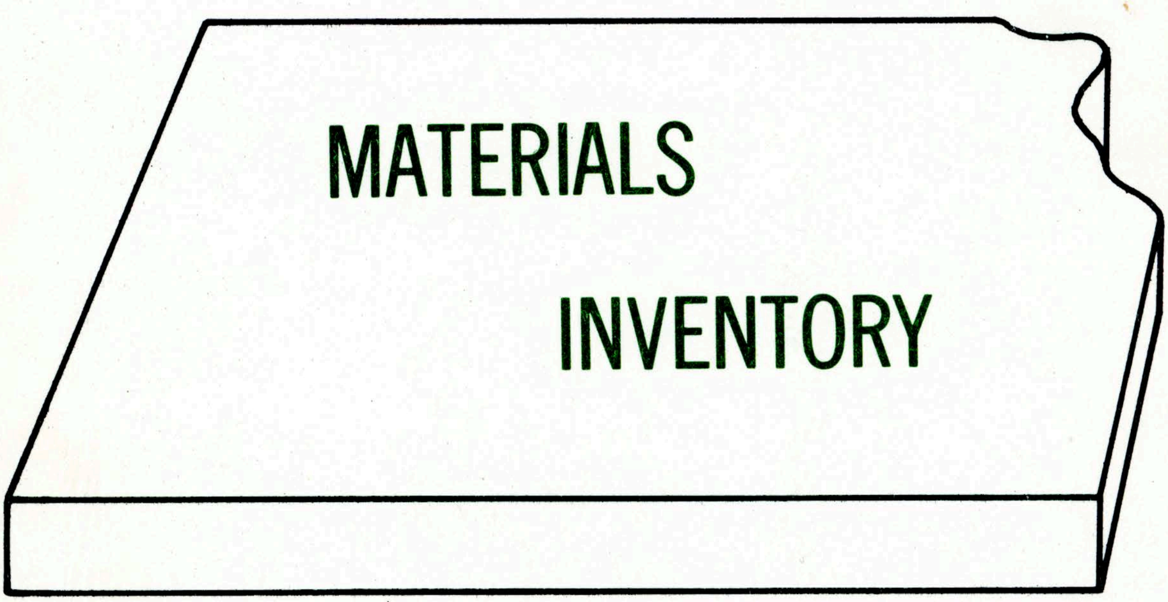

PREPARED BY THE
STATE HIGHWAY COMMISSION OF KANSAS
LOCATION AND DESIGN CONCEPTS DEPARTMENT
IN COOPERATION WITH THE
U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BUREAU OF PUBLIC ROADS

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

MATERIALS INVENTORY OF McPHERSON COUNTY, KANSAS

by

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

1969

Materials Inventory Report No. 9

the Why ? What ? & How ? Of This Report

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

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

Turn To The Materials Inventory Section

See
TABULATION OF CONSTRUCTION MATERIALS
Page 23

for material
BY TYPE
USE COLUMN 1

For Quality Data
See Figure 14
Page 34

for material
BY INTENDED USE
USE COLUMN 3

for **DESCRIPTION** of MATERIAL

Column 4 gives page of DESCRIPTION which includes engineering characteristics, approximate locations, and references to materials maps.

for **AVAILABILITY** of MATERIAL

Column 5 gives the approximate location in the county where the material may be found.

MATERIALS MAPS

SEE PINK SHEET PAGE 35

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

SITE DATA FORMS

OPEN SITES - NOT SAMPLED	GREEN SHEET PAGE 37
OPEN SITES - SAMPLED	GREEN SHEET PAGE 87
PROSPECTIVE SITES - NOT SAMPLED	GREEN SHEET PAGE 107
PROSPECTIVE SITES - SAMPLED	GREEN SHEET PAGE 125

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 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 statewide inventory of construction materials, on a county basis, to help meet the demands of present and future construction needs.

Prior to this time, no extensive or county wide materials investigations had been completed in McPherson County. However, two reports, Frye and Leonard (1952) and Williams and Lohman (1949) 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 D. L. Jarboe, Second Division Materials Engineer, and F. R. Rankin, McPherson 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 and A. H. Stallard of the Location and Design Concepts Department.

ABSTRACT

The topography of McPherson County is controlled by the broad flat north-south trending McPherson buried valley which traverses this area. The drainage is controlled by the Smoky Hill River to the north and the Arkansas River which traverses Reno County to the south.

Bedrock units in McPherson County are a source of clay shale and crushed stone. Unconsolidated deposits are sources of fine aggregate, mineral filler, and sand and gravel.

Select clay shale zones in the Kiowa Shale Formation are sources of raw material for manufacturing lightweight aggregate. Crushed aggregate from irregular sedimentary quartzite zones in the Dakota Formation is suitable for all phases of road construction.

Fine material useful in base course construction may be obtained from the Grand Island Formation, Dune Sand and Alluvium. Mineral filler is produced from the Delmore Formation and the Pearlette Ash zone in the Sappa Formation. The Delmore Formation, Grand Island Formation, and Alluvium are sources of sand and gravel.

Although most unconsolidated materials in McPherson County have undesirable engineering properties, they are used in highway construction because of their wide distribution and the lack of better material. Clay shale found in the Wellington, Kiowa, and Dakota units is undesirable for embankment and subgrade and groundwater problems are common in these units.

GENERAL INFORMATION SECTION

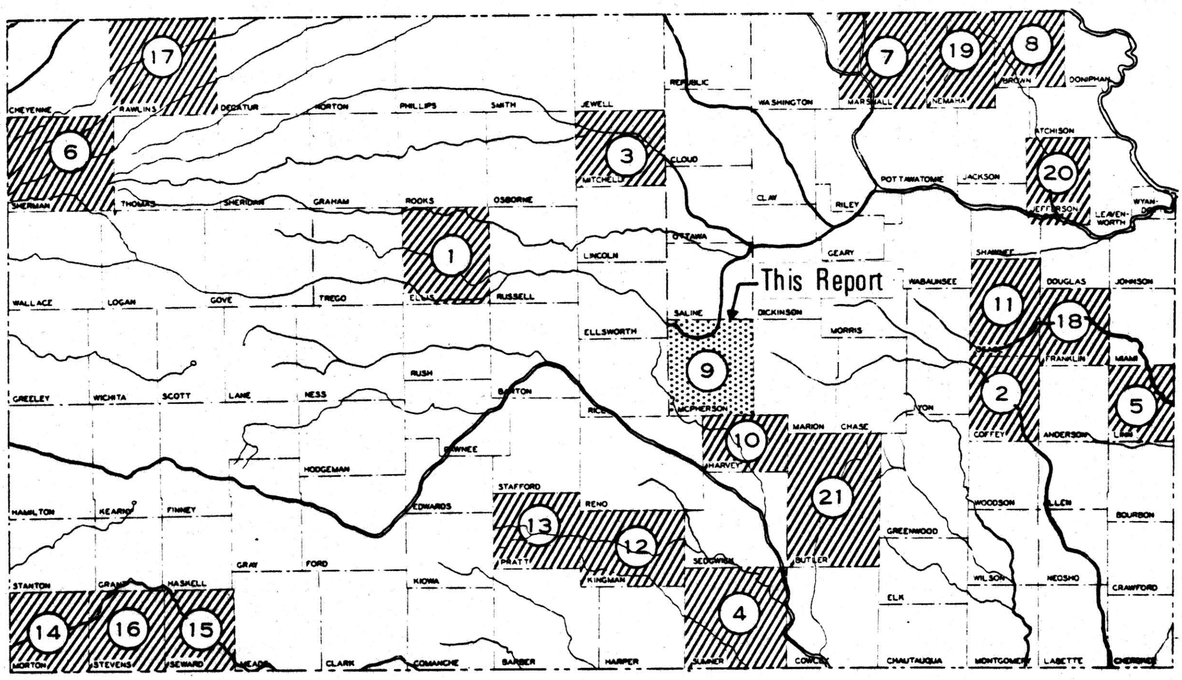


Figure 1. Index map of Kansas showing the location of McPherson County along with the report number and location of other counties for which reports have been or are being completed.

McPHERSON COUNTY

McPherson County has an area of 900 square miles. The population was 24,299 in 1968, according to the Kansas State Board of Agriculture. It lies in the Great Bend and Smoky Hill physiographic regions of Kansas.

The northern two-fifths of McPherson County is drained by the Smoky Hill River and its tributaries and the remainder by the Arkansas River which runs through Reno County to the south. Undrained depressions of various sizes are common. An example is Lake Inman, in southwestern McPherson County, one of the largest undrained depressions in the state.

McPherson County is served by lines of the Missouri Pacific; Union Pacific; Atchison, Topeka, and Santa Fe; and the Chicago, Rock Island and Pacific Railroads. All towns except Roxbury are served by one or more lines.

U. S. Highway 56 runs east-west through Windom, McPherson, Galva, and Canton. U. S. 81 extends north-south through Lindsborg, McPherson, and Mound Ridge. K-4 goes through Marquette to Lindsborg, junctions with U. S. 81 and follows it north out of the county. Except for the northern portion, most of the county has a well-developed system of rural roads, most of which are surfaced.

METHODS OF INVESTIGATION

This report consists of three phases: 1. Research and review of available information, 2. Photo interpretation, and 3. Field reconnaissance.

During phase one, pertinent information on geology, soils, and construction materials was reviewed and the general geology of the county was determined. Quality tests on samples taken in McPherson County were then correlated with the geologic units.

Phase two consisted of study and interpretation of aerial photographs. Geologic source beds and material sites were classified on the photographs and sites were correlated with the geology. Prospective material locations were selected on the basis of the geology and aerial photographic pattern elements. Figure 2 shows the photographic coverage of McPherson County.

Phase three, field reconnaissance, enabled the photo interpreter to examine the construction material, to verify his mapping, and further (or better) acquaint himself with the county geology. At this time, geologic classification of open and prospective sites were confirmed. Prospective sites were evaluated from material produced from pits in the same unit.

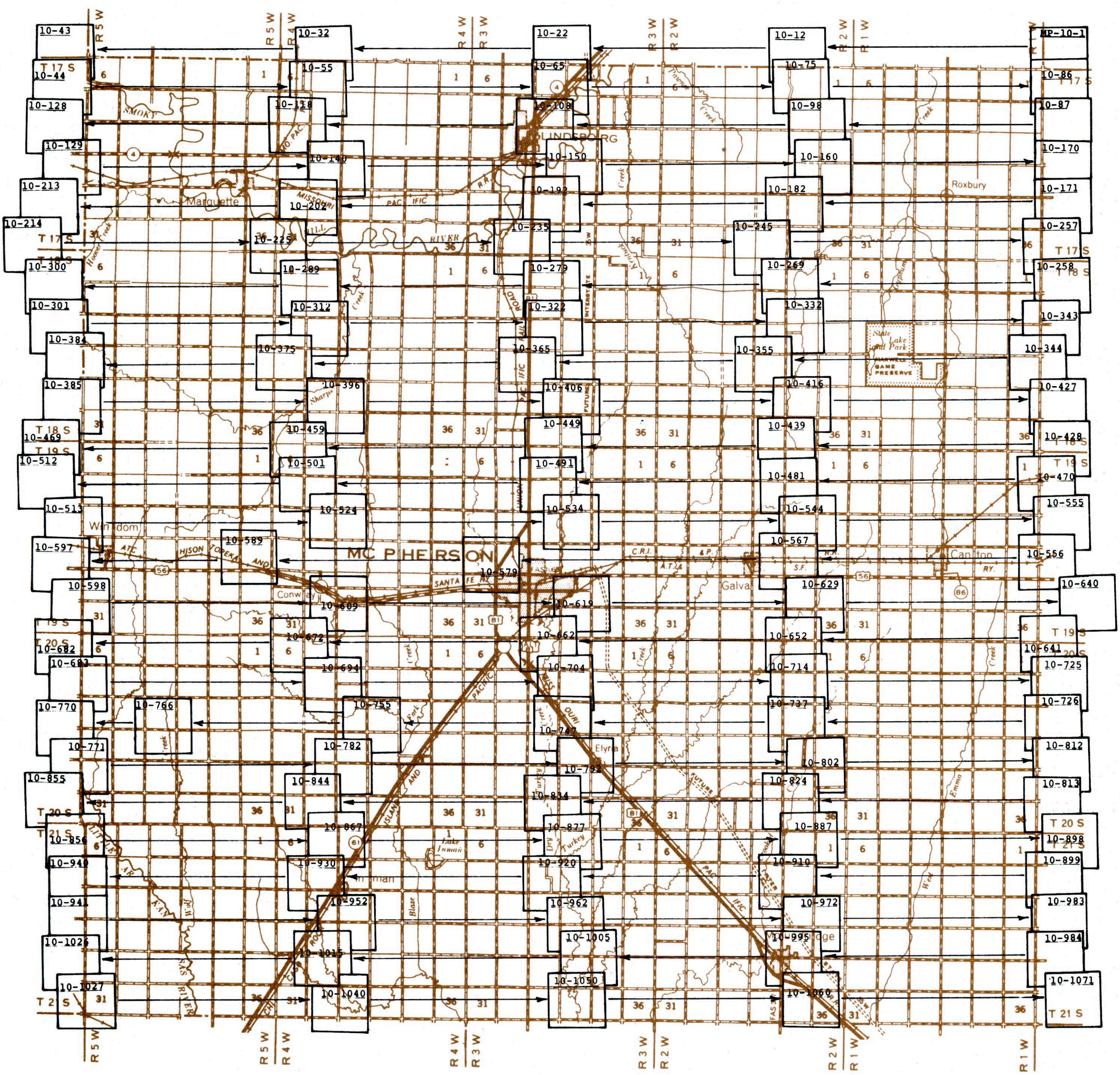
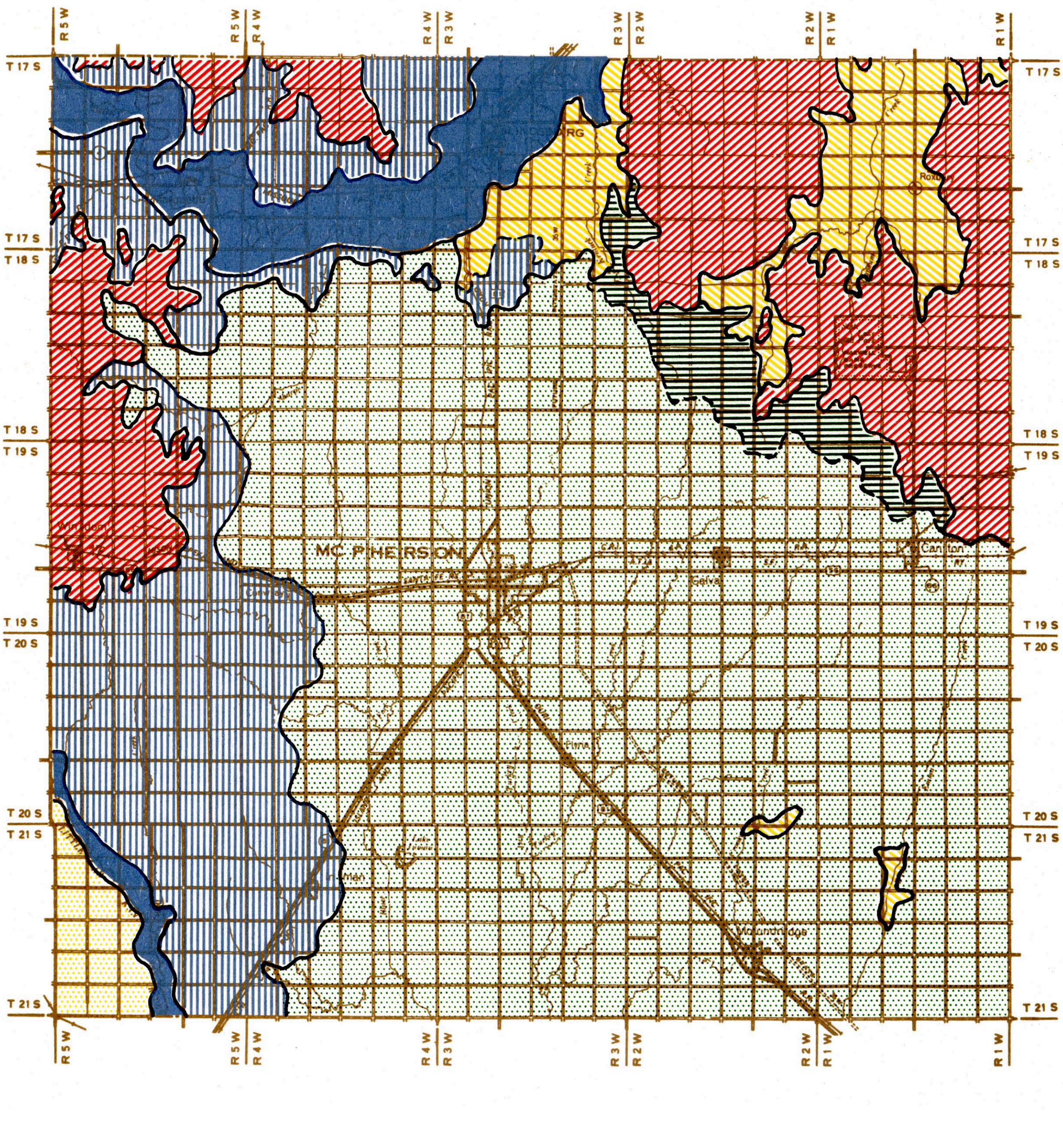


Figure 2. Aerial photographic coverage map for McPherson County. The numbers refer to photographs taken by the State Highway Commission of Kansas. The county was photographed at 6,000 feet (scale one inch = 1,000 feet) in December 1963. Aerial photographs are on file in the Photogrammetry Laboratory, State Office Building, Topeka, Kansas.

GEOLOGY SECTION



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 according to current geologic nomenclature, and (c) establish a uniform system of material source bed classification.

It is important to note that the quality of material from a given source may vary from one location to another, especially when dealing with unconsolidated deposits.

Usually the geologic classification of unconsolidated deposits denotes age rather than material type; therefore, deposits laid down during the same time period in different parts of the state may have the same geologic name or classification. But, they may vary in composition because of different parent material, mode of deposition, or carrying capacity of the depositing agent. By knowing the geologic age, origin, landform and quality information of the source units, one can derive general information for untested material sites and prospective locations.

The McPherson County geology is based, primarily, on information from bulletins of the State Geological Survey written by Williams and Lohman (1949) and Frye and Leonard (1952). Figure 3 is a geologic timetable illustrating period and era relationship.

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.
CENOZOIC	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, vari-colored clay, sandstone, conglomerate. Outcropping igneous rock.*	Ceramic materials; building stone, concrete aggregate, and other construction rock; water.
MESOZOIC	JURASSIC	25,000,000	*Sandstones and shales, chiefly subsurface.*	
MESOZOIC	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.
PALEOZOIC	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.
PALEOZOIC	MISSISSIPPIAN	30,000,000	*Mostly limestone, predominantly cherty.*	Oil, zinc, lead, gas, chat and other construction materials.
PALEOZOIC	DEVONIAN	55,000,000	*Subsurface only. Limestone, black shale.*	Oil
PALEOZOIC	SILURIAN	40,000,000	*Subsurface only. Limestone.*	Oil
PALEOZOIC	ORDOVICIAN	80,000,000	*Subsurface only. Limestone, dolomite, sandstone, shale.*	Oil, gas, water.
PALEOZOIC	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)

*Committee on Measurement of Geologic Time, National Research Council

State Geological Survey of Kansas

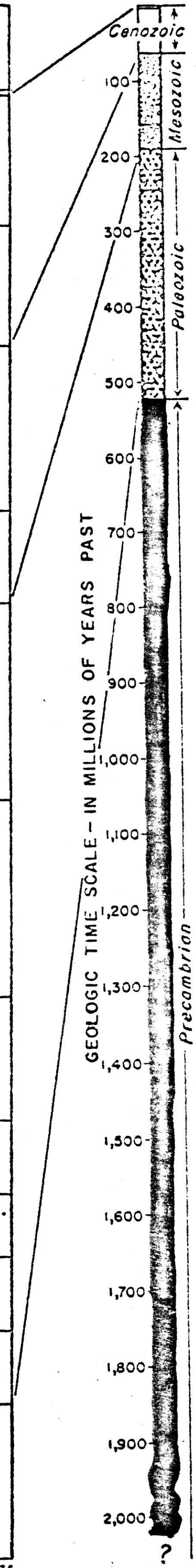


Figure 3. Geologic timetable *(Reproduced with the permission of the State Geological Survey of Kansas).*

Graphic Legend	Thickness	System	Series	Stage	Formations	Generalized Description	Construction Materials
	0 - 3'	Quaternary	Pleistocene	Recent	Soil Mantle		
	0 - 75'				Alluvium	Clay, silt, sand, and gravel composed of siliceous material, arkose, pieces of limestone, ironstone, and sandstone; light tan.	**Aggregate** **Road Surfacing Material** Base Course Material
	0-30'				Dune Sand	Fine sand with varying amounts of silt and clay; cross bedded; light tan.	**Mineral Filler** **Base Course Material**
	0 - 1.5'			Wisconsinan	Bignell Formation	Clayey silt, tan-brown, may contain caliche.	None
	0 - 40'				Peoria Formation	Clayey silt, tan, contains zones and nodules of caliche. May have the "Brady Buried soil" at the top.	None
	0 - 90'			Sangamonian and Illinoisan	Loveland Formation	Silt and sandy silt, slightly clayey, contains zones and nodules of caliche. May have "Sangamon Buried Soil" at the top.	None
	0 - 260'			Kansan and Yarmouthian	Sappa Formation	Clayey silt, tan-brown, containing a volcanic ash zone (Pearlette Ash) of variable thickness and purity.	Mineral Filler
					Grand Island Formation	Siliceous silt, sand, and arkosic gravel with some pieces of limestone and ironstone; cross bedded; light tan to brown.	**Aggregate** **Road Surfacing Material** Base Course Material
	0 - 75'	Tertiary			Delmore Formation	Silt and fine sand, cross bedded, tan to light gray.	**Mineral Filler** Road Surfacing Material
	0 - 150'	Cretaceous	Lower ? Cretaceous		Dakota Formation	Erratic beds of vari-colored clay shale silty shale, dark brown ironstone, and brown to gray sandstone. Localized zones of the sandstone may be calcium cemented and are termed "quartzite".	Aggregate **Road Surfacing Material** Riprap
	0 - 120'				Kiowa Shale Formation	Clay shale, laminated, dark gray to black.	**Lightweight Aggregate**
	0 - 6'	Permian	Lower Permian	Cimarronian	Stone Corral Formation	Dolomite, massive, porous, light gray.	None
	0 - 275'				Ninnescah Shale Formation	Silty shale with localized zones of siltstone and thin limestone; mostly maroon but may contain some thin green colored zones.	None
	200' - 550'				Wellington Shale Formation	Clayey, silty, gypie, and limy shale; mostly gray; however, may be maroon and green near the top. The Milan Dolostone marks the top of the formation but is not prominent in McPherson County. A thick bed of salt occurs near the center and the fossil insect bearing Carlton Limestone Member occurs a short distance below the salt.	None

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

Figure 4 illustrates the surface geology and stratigraphic position of each material source.

McPherson County is underlain by igneous and metamorphic rocks of Pre-Cambrian age. These rocks are overlain by approximately 4,000 to 4,500 feet of limestone, sandstone, shale, clay, silt, sand, and gravel. Most of the consolidated sedimentary bedrock belongs to the Paleozoic Era with the Wellington, Ninnescah, and Stone Corral Formations being exposed. The oldest, the Wellington Shale Formation, was deposited as seas began to retreat from the land. After deposition of the Wellington, the area became a landmass or a near shore environment in which the red beds of the Ninnescah Shale were deposited. However, dolomite of the Stone Corral Formation may indicate the return to a marine environment.

Uplift in the eastern United States ended the Paleozoic and started the Mesozoic Era. The Kiowa Shale and Dakota Formation represent the Mesozoic in McPherson County. The Kiowa is a marine shale and the Dakota is considered a delta deposit.

Formation of the Rocky Mountains ended the Mesozoic and began the Cenozoic Era. Extensive erosion of bedrock took place in central Kansas until late Tertiary time when the Delmore Formation was deposited in McPherson County.

The Pleistocene Epoch of the Quaternary Period was a time of glacial and interglacial cycles. Figure 5 shows the divisions of the Quaternary Period and the approximate duration of each. The glacial ages (Nebraskan, Kansan, Illinoisan, and Wisconsinan) represent times of major glacial advancement while the three interglacial ages (Aftonian, Yarmouthian, and Sangamonian) represent times of major glacial recession and stability. Only the *Nebraskan* and *Kansan* glaciers reached Kansas with glacial activity being restricted to the northeastern portion of the state. Although no ice reached McPherson County, the glaciers played a controlling role in the development of the Pleistocene deposits in the county.

The Nebraskan glacier just touched the northeast corner of the state. At the beginning of Nebraskan time, the McPherson County area was probably characterized by subdued relief with broad alluviated valleys joined by alluviated tributaries. A considerable thickness of alluvial deposits probably existed throughout the period but this material was removed as the Kansan glacier advanced.

Kansan ice entered the state from the northeast and advanced beyond the southern limit of Nebraskan glacial activity overriding the Flint Hills in Washington, Marshall, and Pottawatomie Counties. Meltwater from the Washington and Marshall County areas flowed southwestward through the Blue River channel to what is now the Kansas River, then westward past Junction City along the present Smoky Hill River channel to Salina, then south to Lindsborg and on through McPherson County. As a result, a deep, wide channel was formed through the county. As the Kansan ice began to retreat, the stream velocity became slower and the valleys became alluviated with clay, silt, sand, and gravel. Due to alluviation of the old channel, structural adjustment over a large area, and stream piracy from the east, the McPherson channel was abandoned. The change in drainage resulted in the Kansas River drainage system of today.

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

The McPherson valley was filled with as much as 150 feet of material and referred to in this report as the Grand Island and Sappa Formations. Volcanic activity in the southern Rocky Mountains filled the atmosphere with ash particles and prevailing winds carried some of the ash into Kansas. This material was deposited at various points in McPherson County as part of the Sappa Formation and is referred to as the "Pearlette Volcanic Ash." Subsequently, the granular material has been masked by Loess, Alluvium, and Colluvium.

The Illinoisan stream patterns in Kansas were controlled by adjustments to events associated with Kansan glaciation. Crete terraces of Illinoisan age are abundant along the Smoky Hill drainage but none are found in McPherson County.

In late Illinoisan and Sangamonian time, parts of McPherson County were covered by wind-blown silts. These deposits are referred to as the Loveland Formation.

Only a limited amount of change in the drainage system occurred in the central part of the state during Wisconsinan time; however, winds continued to deposit silt over much of Kansas including McPherson County. The Peoria and Bignell Formations comprise these deposits.

During Recent time, streams and gulleys have been modified into their present form. Sand dunes have been active southwest of the Little Arkansas River, but are presently stabilized. Solutioning of salt in the Wellington Formation has resulted in the development of numerous undrained depressions in the southern part of the county.

GEO-ENGINEERING SECTION

INTRODUCTION

This section is a general appraisal of the material available in McPherson County for embankment, shoulder and subgrade construction. General recommendations concerning backslope and bridge foundations are presented and potential ground-water problems and the quality of water available for concrete are briefly reviewed. <u>Detailed field investigation may be necessary to ascertain the severity of specific problems and to make recommendations concerning design and construction procedures.</u>

MATERIAL USAGE

Embankment and Subgrade

Much of McPherson County is occupied by the broad, flat McPherson valley. Material from this area has a high clay content, a P.I. that ranges from approximately 23 to 48 and is classified as an A-6 or A-7 type soil according to A.A.S.H.O. standards. It is often desirable to stabilize the upper six inches of this material with hydrated lime.

Upland areas in the northeast and northwest parts of the county are covered by wind-blown clayey silts termed Loess. Elsewhere, soil is derived from underlying bedrock. The Loess has engineering characteristics similar to the materials found in the McPherson valley. Usually, silty clay and clays are derived from the underlying Wellington, Kiowa Shale, and Dakota Formations. Most of these soils have a plastic index between 20 and 30; however, the most adverse material may have P.I.'s in the 40's.

Clay shales may be encountered in cuts in the Wellington Shale, Kiowa Shale, and Dakota Formation. According to a limited amount of sampling and testing, P.I.'s as high as 36 are common in this type of material.

Backslope Steepenss and Stabilization

Backslopes constructed in soil mantle are generally cut on a 3:1 slope and seeded to prevent erosion. Hard, unweathered shale, such as the Ninnescah, may be set on a ½:1 slope and weathered shale slopes may range from 1:1 to 3:1 depending on the depth of the cut. Slip-outs are common in backslopes constructed in shales of the Wellington, Kiowa and Dakota Formations. These units are exposed in the northeast and northwest portions of the county. Variable backslopes are usually required in sandstone found in the Dakota Formation due to variation in cementation. Well-cemented sandstone usually requires a ½:1 slope while poorly cemented rock may require a 3:1 slope.

Bridge Foundation Support

The McPherson County terrain has abundant undrained depressions, many of which are caused by solutioning of salt in the underlying Wellington Formation. Examples of solution sinks may be seen in the SW¼ sec.22, T21S, R4W where a small bridge and the road have subsided, and in the E½ sec.10, T19S, R4W near the Big Basin. Solution sinks should not be confused with blow-out depressions found in Dune Sand topography.

Because of the variable composition and consolidation of geologic units in McPherson County, adequate support for bridge footings will be acquired at variable depths. For example, bearing should be obtained within a few feet of the top of the hard, silty Ninnescah Shale, but footings probably will be placed several feet into the clayey material of Kiowa Shale, Dakota and Wellington Formations.

The support provided by sandstone found in the Kiowa Shale and Dakota Formation may be variable because of cementation. However, sandstone is a comparatively good foundation material.

Only thin limestones are present in McPherson County. These zones, found in the Kiowa Shale and Wellington Formation, should provide good support for bridge structures if the underlying material is not weathered.

In many areas of the McPherson valley, mantle is much too thick to consider bedrock as a means of support and friction piling will be necessary.

POSSIBLE HYDROLOGY PROBLEMS IN ROAD CONSTRUCTION

The Wellington Shale contains limy zones which carry water after periods of rainfall. Several hydrology problems have also been experienced in the Kiowa Shale and Dakota Formation. Fractures in the shale section provide channels for downward percolation of surface water and sandstone zones are known aquifers. Because of the erratic nature of sandstone, ground-water problems are difficult to detect and correct.

Terrace deposits in McPherson County are composed of clay, silt, sand, and gravel. In some areas, lenses of silt and clay are embedded in granular material. These lenses may prevent the downward percolation of water and result in a perched water table. This situation along with a relatively high water table in low areas may cause stability problems in subgrades.

QUALITY OF WATER

The discussion of ground-water is based on a report by Williams and Lohman (1949), with primary consideration given to the main sources of water and the degree of mineralization, especially the sulfate and chloride content.

The Wellington and Ninnescah Shale Formations provide only a very limited amount of water in McPherson County. Although water from these units is comparatively high in dissolved solids, it is usable for concrete mix water.

The Grand Island Formation is the principal source of groundwater in this area. The water from this unit is of good quality except in areas where salt water has entered the formation from natural or industrial sources. Most wells will yield water low enough in sulfate and chloride for use in concrete construction.

Dune Sand in southwestern McPherson County produces only small quantities of water. Tests show that the water has a high iron content but a low sulfate and chloride ion concentration.

Large quantities of water is available from Alluvium of the Smoky Hill and Little Arkansas Rivers. Smaller quantities are available from Alluvium of the smaller streams (i.e. Turkey and Gypsum Creeks). Water from these sources will probably be hard, but satisfactory for use in Portland Cement concrete except where contaminated by oil field brines.

MATERIALS INVENTORY SECTION

GENERAL INFORMATION

Lightweight aggregate, sedimentary quartzite, fine aggregate, mineral filler, and sand and gravel are available in McPherson County. Sand and gravel from the Grand Island Formation is the most significant source in the area. According to Mr. F. R. Rankin, McPherson County Engineer, Grand Island sand and gravel is used for construction and maintenance of county roads along with coarse material imported from Harvey County.

The construction material types, their use and availability are tabulated on page 23. Test results from a limited amount of sampling and testing are presented in figure 14.

CONTENTS

Material Type	Geologic Source	Material Usage	Page Described	Locality Where Available
Lightweight Aggregate	Kiowa Shale Formation	Lightweight concrete aggregate.	Page 25	Limited to the northern ½ of the county.
Crushed Aggregate	Dakota Formation (Sedimentary Quartzite)	Concrete aggregate, bituminous aggregate, light type surfacing and rip-rap.	Page 25	Limited to small areas in the northeastern part of the county.
Fine Aggregate and Mineral Filler	Delmore Formation	Mineral filler		Northeastern ¼ of the county.
	Grand Island Formation	Base course material	Page 28	Scattered high terraces along the Smoky Hill River and Gypsum Creek valleys in the northern portion of the county and in the McPherson Valley which covers the eastern 3/4 of McPherson County.
	Sappa Formation (Pearlette Ash Zone)	Mineral filler	Page 29	Generally found in the same area as the Grand Island, however, the volcanic ash zone in the Sappa is found mostly in the northwestern ¼ of the county.
	Dune Sand	Base course material	Page 30	Select locations in the extreme southwestern portion of the county. (Southwest of the Little Arkansas River).
	Alluvium	Base course material	Page 30	Material of economic value is found only along Smoky Hill River in the northwestern ¼ of the county.
Sand and Gravel	Delmore Formation	Concrete aggregate, bituminous aggregate, light type surfacing material, base course aggregate.	Page 31	Northeastern ¼ of the county.
	Grand Island Formation	Concrete aggregate, bituminous aggregate, light type surfacing material, base course aggregate.	Page 31	Scattered high terraces along Smoky Hill River and Gypsum Creek valleys in the northern portion of the county and in the McPherson valley which covers the eastern 3/4 of McPherson County.
	Alluvium	Concrete aggregate, bituminous aggregate, light type surfacing material, base course aggregate.	Page 33	Material of economic value is found only along the Smoky Hill River in the northwestern ¼ of the county.

Figure 6. A tabulation of the construction material types and their availability in McPherson County.

DESCRIPTION OF CONSTRUCTION MATERIAL

Lightweight Aggregate

Kiowa Shale Formation

The Kiowa Shale in McPherson County is predominantly a dark gray, thin, laminated shale, with thin sandstone and limestone zones. When weathered, it becomes light gray to yellowish-gray in color. The thickness is approximately 120 feet.

The Kiowa is found in upland areas in northeastern and northwestern McPherson County along both sides of the buried McPherson valley. This shale is covered in some areas, by sandstone and silty shale of the Dakota Formation. Because it is difficult to distinguish between the Kiowa and Dakota, they are included in the same map unit.

The Kiowa is easy to produce and has wide distribution. The raw shale is fired and crushed and may be used as lightweight aggregate. Quality information indicates the Los Angeles wear to be 20.3 percent, the soundness loss ratio 0.99, and the absorption on two samples was 10.2 and 10.9 percent. Details of quality information are shown in figure 14. Because of high absorption, it is not suitable for use in bituminous construction, but will meet standards for concrete aggregate. However, the aggregate is relatively expensive, which limits its use in highway construction.

Crushed Aggregate

Dakota Formation (Sedimentary Quartzite)

The Dakota Formation is composed of clay shale, silty shale, sandstone, ironstone, and sedimentary quartzite. The shale zones are generally gray, but may be maroon or rusty brown in some areas.

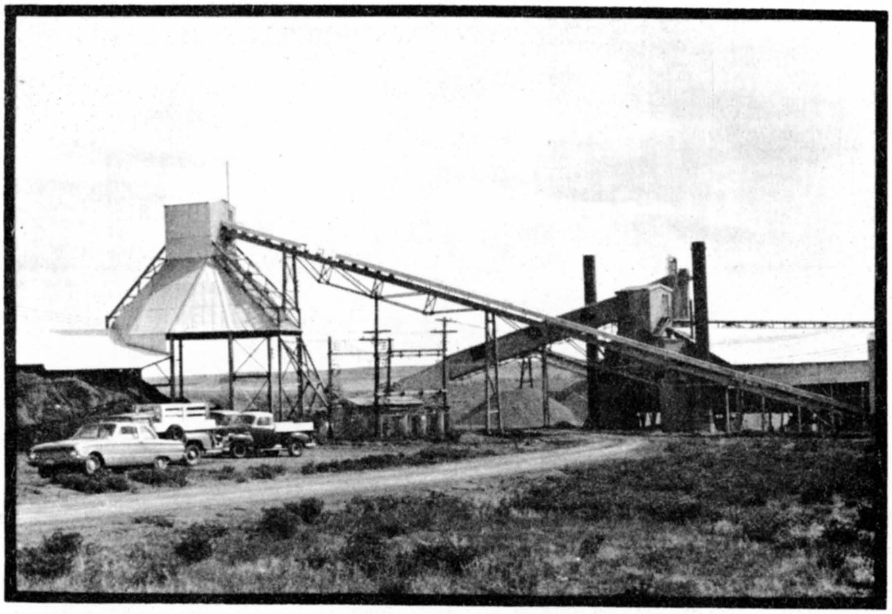


Figure 7. Buildex Incorporated firing plant for production of lightweight aggregate located near Marquette, Kansas, SW¼ sec. 6, T17S, R4W.

The ironstone is dark red-brown and forms good exposure patterns due to its resistance to erosion. The sandstone has variable cemented zones forming prominent outcrops and may range from red-brown in weathered exposures to various shades of gray in freshly cut sections.

Calcium cemented sandstone zones called *sedimentary quartzite* are an important source of material. These zones are so well bonded that upon fracturing, the break will penetrate the individual grains rather than break around them. This material forms large concretions embedded in a matrix of unconsolidated or partially cemented sand.

Quartzite may be used as bituminous aggregate, concrete aggregate, light type surfacing material, and riprap. The thickness of the quartzite zones was observed to be as much as 30 feet; however, the total thickness of the Dakota in McPherson County may be as much as 150 feet. The quartzite is delineated on the materials map (plates II and IV) by a red-dashed line in the Kiowa-Dakota Formations map unit.

Like the Kiowa, the Dakota is found in the upland areas in northeastern and northwestern McPherson county.

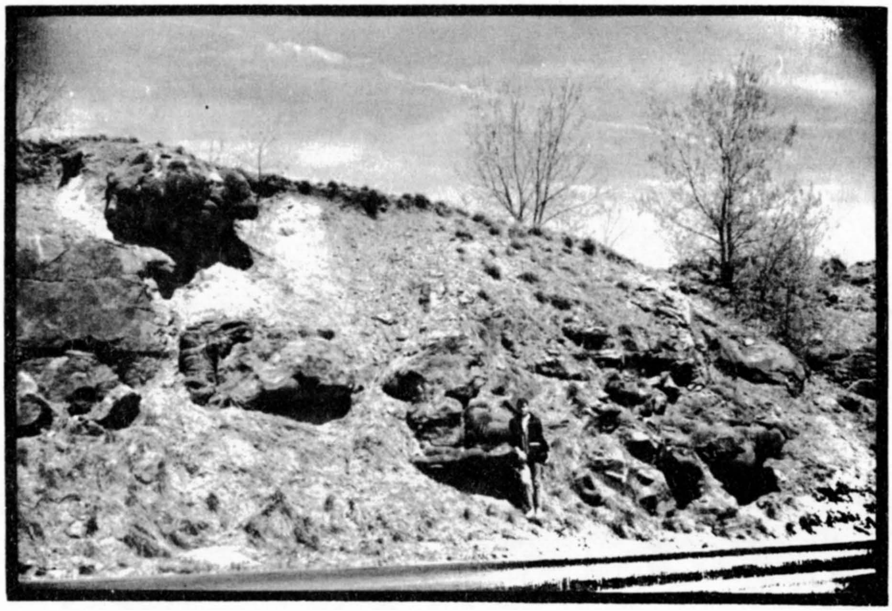


Figure 8. Dakota quartzite exposure in a road cut near Roxbury, Kansas, SE¼ sec.24, T17S, R2W.

Results of quality tests conducted on samples of quartzite are shown in figure 14. However, because of the erratic nature of quartzite deposits, the test data may not reflect the true quality of this material. Analysis of samples taken from the Dakota revealed that the Los Angeles wear ranged from 26.3 to 61.9 percent, the soundness loss ratio from 0.96 to 0.99, and the absorption from 1.02 to 4.27 percent. Samples which have a wear value of less than 45 percent were probably composed of true sedimentary quartzite and those which display a higher value, were probably obtained from a poorer bonded material, such as iron-cemented sandstone.

Fine Aggregate and Mineral Filler

Delmore Formation

The Delmore Formation is composed of tan and light gray silt, fine sand, and some sand and gravel. Nearly all material is fine-textured and has prominent cross-bedding characteristics. The unit forms ancient terraces in the northeastern portion of the county.

Select sites of low plastic index, silt and fine sand in the Delmore are excellent sources of mineral filler. Information concerning the gradation of the material is presented in figure 14.

Figure 9. Mineral filler pit in the Delmore Formation, SE¼ sec.30, T18S, R1W.

Grand Island Formation

The Grand Island Formation is an ancient floodplain deposit found in high terraces along the Smoky Hill River and comprises a major part of the fill in the McPherson valley. Varying thicknesses of the Sappa Formation, loess, and soil mantle cover much of the Grand Island and are included in this map unit.

The formation is comprised of tan, silt, sand, and arkosic gravel along with pieces of limestone and ironstone. The silt and fine sand may be suitable for use as partial aggregate for base course.

Quality and gradation data on the Grand Island are shown in figure 14.

Sappa Formation

The Sappa Formation which overlies the Grand Island, is composed of tan-brown, clayey silt with volcanic ash zones (Pearlette) of variable thickness. Ash deposits are found in the northeastern and north-central portion of the county along the boundaries of the McPherson valley.

Unaltered ash is an important source of mineral filler; however, most deposits are rendered useless by silt and clay contamination. Available test information shows that the plastic index of the ash ranges from 1 to 21. Additional test information is shown in figure 14.

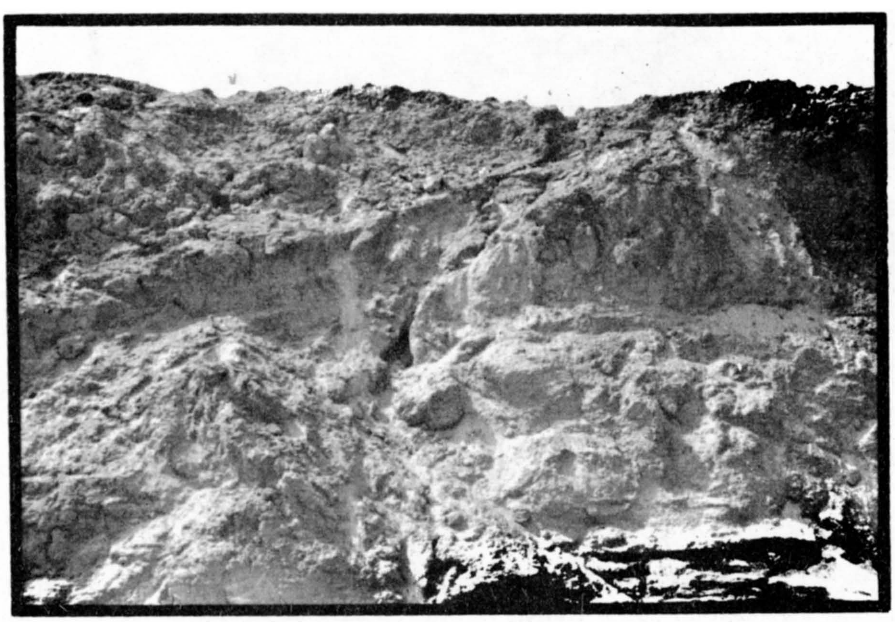


Figure 10. Pearlette volcanic ash pit NE¼ sec. 32, T17S, R2W.

Dune Sand

Dune Sand in McPherson County is composed of light tan sand with varying amounts of silt and clay. The thickness ordinarily does not exceed 20 to 30 feet. The dunes are restricted to the southwestern corner of the county, south of the Little Arkansas River.

No quality tests were conducted on Dune Sand in McPherson County; however, binder soil may be produced at select locations. The sand has been used at some localities in the state as a total aggregate in base course construction.

Alluvium

Because Alluvium in most of the smaller streams is thin, only the thicker deposits in the Smoky Hill River valley are significant.

Figure 11. Sand dunes in extreme southwestern McPherson County.

This material is composed of clay, silt, sand, and gravel with a predominance of fines which display a high plastic index. Base course binding material has been produced from pits located one mile southeast of Lindsborg.

The base course binder pits are produced by open pit excavation methods. The watertable is high in the Alluvium and if encountered, it may render the material useless.

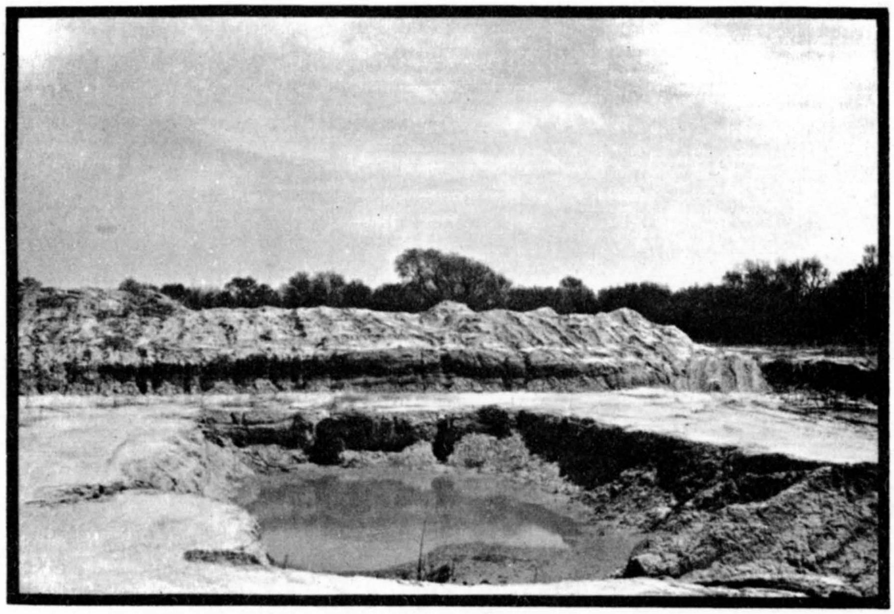


Figure 12. Alluvial base course binder pit in the Smoky Hill River valley, NW¼ sec.21, T17S, R3W.

Sand and Gravel

Delmore Formation

The Delmore Formation is composed mostly of tan to light gray silt and fine sand used mostly as mineral filler; however, a small amount of sand and gravel may be produced. The bulk of the coarser material is used for surfacing lightly traveled rural roads. Gradation information is shown in figure 14.

Grand Island Formation

The Grand Island is comprised of tan-colored siliceous silt, sand, and arkosic gravel along with pieces of limestone and ironstone. Localized terraces along Gypsum Creek, in northeastern McPherson, contain sand and gravel composed primarily of ironstone and limestone. The texture ranges from fine to coarse with the fine fraction being more prominent.

Figure 13. Grand Island sand and gravel in a pit, SW¼ sec. 1, T17S, R4W.

Grand Island sand and gravel is the most important construction material in the county. This material is used in bituminous and concrete construction as well as for light type surfacing material. Washing may be necessary in some pits to eliminate the clay binder.

Production of sand and gravel from the Grand Island is restricted to northern McPherson County. Elsewhere, excessive overburden is encountered. Grand Island sand and gravel produced near Burrton in Harvey County is used in southern McPherson County.

Available quality information for this unit shows the Los Angeles wear ranges from 30.2 to 37.8 percent, the soundness loss ratio from 0.91 to 0.97, and the absorption from 0.40 to 1.0 percent. Additional test information is shown in figure 14.

Alluvium.

Although Alluvium is found along many streams in McPherson County, the Smoky Hill River valley is the most important source.

The Alluvium is composed of clay, silt, sand, and gravel. The sand and gravel is mostly siliceous and arkosic with some pieces of ironstone and limestone. A good quality sand and gravel can be produced from this source if the fine material is removed. Tests show a Los Angeles wear range from 30.2 to 31.8 percent and the soundness loss ratio from 0.93 to 0.95. No information concerning percentage of absorption was available. The material will generally meet specifications for concrete and bituminous construction, and for light type surfacing. Figure 14 provides detailed test information on the Alluvium.

It is necessary to use pumping operations to recover the alluvial sand and gravel. Because of the high water table it is more difficult and costly to produce aggregate from this unit than from the Grand Island.

Location	Material Type	Percent Retained 2	1½	3/4	3/8	4	8	16	30	50	100	Wash	G.F.	L.L.	P.I.	Wet Sp.Gr.	Dry Sp.Gr.	Wt./Cu.Ft.	LA Wear	Soundness	Absorption	Source of Data
Source of Material: Kiowa Shale Formation																						
SW¼ Sec. 6, T17S, R4W	Lightweight Aggregate	0	0	0	28	93	97	98	98	98	99	0.4	-	-	-	1.59	-	49.74	-	0.99	10.9	1 Sample
SW¼ Sec. 6, T17S, R4W	"	0	0	0	0	17	40	67	83	91	95	3.89	3.93	-	-	1.45	-	48.35	20.3	0.99	10.2	1 Sample
Source of Material: Dakota Formation																						
NW¼ Sec. 14, T18S, R2W	Quartzite															2.64	-	-	34.0	0.97	-	SHC Form 619, No. 59-1
NW¼ Sec. 14, T18S, R2W	Quartzite															2.67	-	-	26.3	0.97	-	SHC Form 619, No. 59-1
NW¼ Sec. 14, T18S, R2W	Quartzite															2.61	2.58	-	26.6	0.98	1.38	1 Quality Sample
NW¼ Sec. 3, T18S, R2W	Quartzite (?)															2.52	2.50	-	52.9	0.97	1.02	1 Quality Sample
NW¼ Sec. 1, T18S, R2W	Quartzite															2.47	2.37	-	41.3	0.99	4.27	1 Quality Sample
NW¼ Sec. 25, T18S, R2W	Quartzite															2.61	2.58	-	30.0	0.97	1.34	1 Quality Sample
SW¼ Sec. 11, T18S, R2W	Quartzite (?)															2.56	2.51	-	61.9	0.96	1.98	1 Quality Sample
SW¼ Sec. 11, T18S, R2W	Quartzite (?)															2.57	2.53	-	54.1	0.97	1.58	1 Quality Sample
Source of Material: Delmore Formation																						
NE¼ Sec. 31, T18S, R1W	Sand & Gravel	0	0	0	0	0	0	2	15	47	81	9.0	-	-	-	-	-	-	-	-	-	AVE. SHC Form 619, No. 59-9A
SE¼ Sec. 30, T18S, R1W	Fine Sand	0	0	0	0	1	1	5	22	66	88	-	-	-	2	-	-	-	-	-	-	AVE. SHC Form 619, No. 59-10A
SE¼ Sec. 30, T18S, R1W	Sand & Gravel	0	0	0	13	22	36	59	83	95	97	0.81	4.07	-	-	-	-	-	-	-	-	1 Quality Sample
SE¼ Sec. 30, T18S, R1W	Fine Sand	0	0	0	0	1	1	1	1	2	10	17.53	-	-	-	-	-	-	-	-	-	1 Quality Sample
SE¼ Sec. 30, T18S, R1W	Fine Sand	0	0	0	0	0	0	0	0	0	62	8.27	-	-	-	2.59	-	87.90	-	-	-	1 Quality Sample
Source of Material: Grand Island Formation																						
SE¼ NE¼ Sec. 16, T18S, R4W	Sand & Gravel	0	0	0	0	0	1	5	22	68	84	14.0	-	19	3	-	-	-	-	-	-	SHC Form 619, No. 59-2
SW¼ Sec. 35, T19S, R1W	Sand & Gravel	0	0	0	0	0	1	5	17	46	70	-	-	-	8	-	-	-	-	-	-	AVE. SHC Form 619, No. 59-4
NW¼ NW¼ Sec. 27, T21S, R2W	Sand & Gravel	0	0	0	0	0	1	7	39	85	92	7.0	-	20	1	-	-	-	-	-	-	SHC Form 619, No. 59-6
SE¼ Sec. 31, T18S, R4W	Sand & Gravel	0	0	0	0	1	5	16	43	76	85	13.0	2.27	-	-	-	-	-	-	-	-	AVE. SHC Form 619- No. 59-7
SW¼ Sec. 29, T18S, R4W	Sand & Gravel	0	0	0	2	4	21	59	89	95	96	3.52	3.67	-	-	2.60	-	107.9	34.2	0.97	-	AVE. SHC Form 619, No. 59-10
SE¼ Sec. 21, T18S, R4W	Sand & Gravel	0	0	0	0	1	6	19	44	84	94	6.0	2.50	-	-	2.60	-	107.6	30.2	0.93	-	AVE. SHC Form 619, No. 59-8
SE¼ Sec. 16, T18S, R4W	Sand & Gravel	0	0	0	0	2	8	29	70	95	97	2.10	2.99	-	-	2.62	-	106.04	-	-	-	1 Quality Sample
SE¼ Sec. 16, T18S, R4W	Sand & Gravel	0	0	0	0	1	4	22	76	96	98	1.24	2.97	-	-	2.62	-	103.2	36.6	0.97	-	SHC 619 Form No. 59-2
NE¼ Sec. 19, T17S, R5W	Sand & Gravel	0	0	1	3	6	20	53	85	96	98	1.88	-	-	-	2.61	-	108.6	32.6	0.96	0.6	1 Quality Sample
NE¼ Sec. 17, T17S, R5W	Sand & Gravel	0	0	0	4	8	17	43	75	91	96	3.70	3.51	-	-	2.60	-	109.95	35.3	0.91	0.40	1 Quality Sample
SE¼ Sec. 29, T18S, R4W	Sand & Gravel	0	0	0	0	0	1	2	10	28	28	39.4	0.69	22	6	2.59	-	103.8	37.8	0.96	1.0	Hole 1, SHC Form 619, No. 59-15
SE¼ Sec. 29, T18S, R4W	Sand & Gravel	0	0	0	0	3	19	52	78	87	90	8.8	32.9	25	9	2.59	-	103.8	37.8	0.96	1.0	Hole 6, SHC Form 619, No. 59-15
SW¼ Sec. 29, T18S, R4W	Sand & Gravel	0	0	0	1	1	1	5	28	63	72	23.9	1.71	16	3	2.59	-	103.8	37.8	0.96	1.0	Hole 1, SHC Form 619, No. 59-10
SW¼ Sec. 29, T18S, R4W	Sand & Gravel	0	0	0	1	3	17	59	89	97	98	1.4	3.64	21	8	2.59	-	103.8	37.8	0.96	1.0	Hole 24, SHC Form No. 59-10
Source of Material: Sappa Formation																						
NE¼ Sec. 32, T17S, R2W	Volcanic Ash	0	0	0	0	0	0	0	0	0	0	77.0	-	-	-	-	-	-	-	-	-	AVE. SHC Form 619, No. 59-5
NE¼ Sec. 32, T17S, R2W	Volcanic Ash	0	0	0	0	0	0	0	0	0	0	-	-	52	16	-	-	-	-	-	-	1 Sample
NE¼ Sec. 32, T17S, R2W	Volcanic Ash	0	0	0	0	0	0	0	0	0	0	-	-	61	21	-	-	-	-	-	-	1 Sample
NW¼ Sec. 15, T18S, R4W	Volcanic Ash	0	0	0	0	0	0	0	0	1	2	-	-	34	1	-	-	-	-	-	-	AVE. SHC Form 619, No. 59-11
SW¼ Sec. 22, T18S, R4W	Volcanic Ash	0	0	0	0	0	0	1	1	1	6	-	-	23	3	-	-	-	-	-	-	AVE. SHC Form 619, No. 59-12
Source of Material: Alluvium																						
NW¼ Sec. 9, T17S, R5W	Sand & Gravel	0	0	0	3	10	31	69	90	97	98	1.81	3.98	-	-	2.60	-	108.3	31.8	0.95	-	SHC Form 619, No. 59-9
NW¼ Sec. 9, T17S, R5W	Sand & Gravel	0	0	1	2	8	28	67	89	96	98	2.29	3.89	-	-	2.60	-	107.6	30.2	0.93	-	1 Quality Sample
E½ NW¼ Sec. 21, T17S, R3W	Fine Sand	0	0	0	0	0	0	0	1	5	30	-	-	-	-	-	-	-	-	-	-	AVE. SHC Form 619, No. 59-16
NE¼ Sec. 7, T17S, R5W	Fine Sand	0	0	0	0	0	0	0	1	22	69	22.0	0.92	-	-	-	-	-	-	-	-	Hole 1, SHC Form 619, No. 59-3

Figure 14. Results of tests completed on samples of material from several geologic source beds in McPherson County.