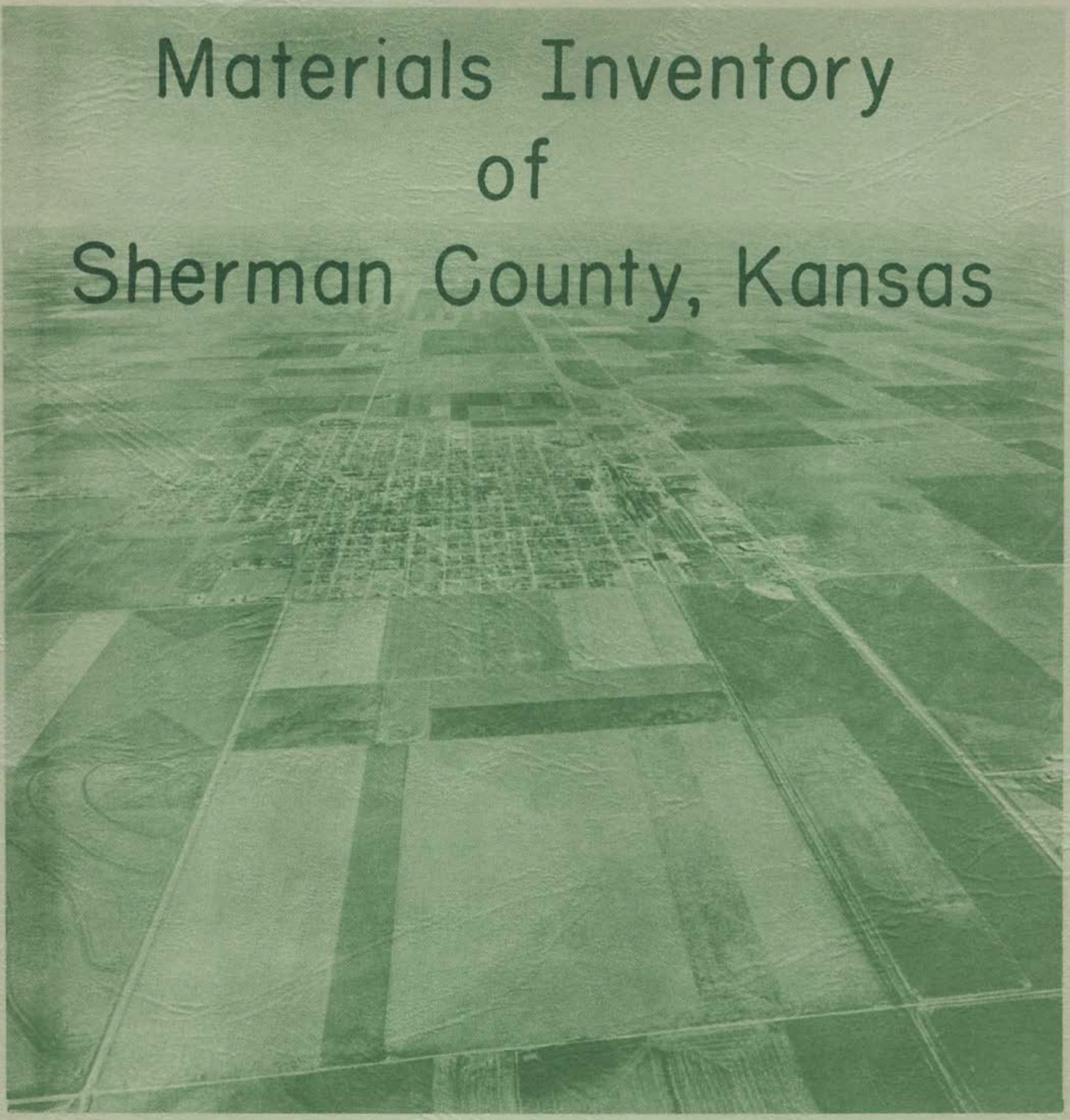
Materials Inventory of Sherman County, Kansas



prepared by

The State Highway Commission of Kansas

in cooperation with

The U.S. Department of Commerce

Bureau of Public Roads

State Highway Commission of Kansas

Research Department - Photronics Department

MATERIALS INVENTORY OF SHERMAN COUNTY, KANSAS

by

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Photogrammetry Section

Prepared in Cooperation with
U. S. Department of Commerce
Bureau of Public Roads

1964

Materials Inventory Report No. 6

SUGGESTED USE OF THE REPORT

The Materials Inventory of Sherman County is the sixth report of a series of county materials inventories prepared by the State Highway Commission of Kansas in cooperation with the Bureau of Public Roads. The report includes: 1. an introduction which describes the nature of the report and gives general information concerning Sherman County; 2. an explanation of the procedures used in compiling the information contained herein; 3. a brief explanation of the origin of the geologic units that are source beds for construction materials in the county, and a detailed description of the materials which have been produced from these units; 4. county materials maps (Plates I through VI) which show the geographic locations where the various source beds can be found in the county, along with the locations of all open materials sites and prospective materials sites; 5. appendixes I through IV which contain site data forms for each open and each prospective materials site. Each site data form has a sketch showing the materials site and surrounding landmarks, the name of the landowner, the name of the geologic source bed, and a resume' of all test data available for the site.

When this report is used as a guide for planning an exploration program or making an assessment of the materials resources of Sherman County, the reader may find the following suggestions helpful.

After becoming familiar with the nature of the report, the reader may wish to refer to the section "Construction Materials Resources of Sherman County". In this portion of the report a geologic history of Sherman County is presented which describes the geologic events which led to the deposition of the various source beds and set forth the geologic nomenclature used throughout the report. The construction materials resources of Sherman County are also inventoried in this portion of the report. A study of the Construction

Materials Inventory will reveal the types of material available in the county, their geologic source beds, the localities where they are found, and a description of their engineering properties.

When the reader has determined which geologic source bed may contain material that will meet his requirements, he should then refer to the county materials maps. From these maps he can find the areas in which this bed is present, the locations of sites which have produced material from this source, the locations of prospective materials sites in this source bed, and references to site data forms for each open or prospective site.

For example, the reader determines from the study of Construction Materials Inventory that sand and gravel from the Ogallala Formation and Alluvium may fulfill the materials specifications for a project in the northeast part of the county. The materials map (Plate II) shows several open pits along Beaver Creek. If the reader is interested in site $\frac{SG+36}{To}$ he refers to Appendix I where detailed information about this particular site is given on a site data form. This information will enable him to plan his exploration program in an orderly fashion.

PREFACE

This is one of a series of county construction materials reports compiled as a product of the Highway Planning and Research Program, Project 64-6, "Materials Inventory by Photo Interpretation", a cooperative effort between the Bureau of Public Roads and the State Highway Commission of Kansas, financed by Highway Planning and Research funds. The materials inventory program was initiated to provide a survey of all existing construction materials in Kansas on a county basis to help meet the demands of present and future construction needs.

The objectives of the program are to map and describe all material source beds in the respective counties and correlate geologic nomenclature with such sources for classification purposes. The program does not propose to eliminate field investigations, but it should substantially reduce and help organize field work.

Previous to this time, no extensive or county-wide materials investigation had been completed in Sherman County. Several geologists have published reports that refer to the county either directly or in a general way, and a detailed report, "Geology and Ground-Water Resources of Sherman County, Kansas" (1953), by Prescott has been issued by the State Geological Survey of Kansas. In addition, several preliminary soil surveys have been made, and centerline geological profiles prepared for road design purposes by the State Highway Commission of Kansas along the major highways that traverse Sherman County; however, available information on materials suitable for construction purposes has been very meager.

Aggregate quality test results, pertinent information pertaining to materials produced, and geologic data on Sherman County used in this report were supplied by the Materials Department and the Geology Section of the

Design Department. The report was prepared under the guidance of J. D. McNeal, Engineer of Planning and Research; project leader, R. R. Biege, Jr., Engineer of Aerial Surveys and Photogrammetry Section; and A. H. Stallard of the Photogrammetry Section. Appreciation is extended to A. C. Lundgren, Division Materials Engineer, for verbal information on construction materials in the area.

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ABSTRACT

The construction material resources of Sherman County are restricted to the Ogallala Formation and the more recent alluvial deposits found in the major stream valleys.

The Ogallala Formation, which is the primary source of construction material in Sherman County, underlies the entire county except for a small area along the North Fork of the Smoky Hill River where it has been eroded away. This formation is composed chiefly of silt, sand, and gravel with some localized calcium-cemented zones termed mortar bed. Volcanic ash deposits, suitable for use as mineral filler, are commonly found in the Ogallala in other counties, but only one isolated exposure of low quality ash is known to exist in Sherman County.

The Ogallala Formation is overlain by the Loveland and Peoria Formations which have a combined thickness of up to fifty feet in the upland areas of the county. The presence of these thick silt deposits generally makes it economically infeasible to produce construction material from the Ogallala in these areas, but it can be produced along the valleys where stream action has removed most of the silt overburden. All of the material pits in Sherman County are located in the stream valleys where a minimum amount of overburden is present.

The Alluvium which is found in the major stream valleys is composed of silt, sand, and gravel derived from the Ogallala, Loveland, and Peoria Formations. Because the Ogallala is the source of the sand and gravel in the alluvial deposits, material of similar quality can be produced from both sources; however, the more abundant supply of material available from the older Ogallala deposits has retarded exploitation of the Alluvium.

Geo-engineering in Sherman County merits some attention in this materials inventory with respect to: 1. material use considerations, 2. mineralization of available water with respect to its use in concrete mixes, and 3. difficulties which may exist from ground water seepage in road construction. The latter two considerations are of little concern because the available water is relatively free of mineralization and the semi-arid climate minimizes the occurrence of hydrology problems in road construction. Some of the materials available for construction purposes would be of major concern, because of their swell and shrinkage characteristics, if the area had a higher annual rainfall. The major highway engineering concerns are stabilization of backslope materials and finding adequate bearing for bridge foundation supports.

INTRODUCTION

The purpose of this report is to present information concerning the availability, location, and nature of material deposits for use in road construction in Sherman County, and to provide a guide for materials prospecting in the county.

Scope

This investigation includes all of Sherman County. All geological units that are considered to be a construction material source are mapped and described. The term construction materials, as used in this report, includes all granular material suitable for use in the various phases of road construction. Mineral filler is included in the term.

Nature of the Report

Because all material source beds are the product of geologic agents, the materials inventory program is based largely on the geology of the county being investigated. The use of geology as the basis of the materials inventory enables one to ascertain the general engineering properties of the material source unit and to identify and classify each source bed according to current geologic nomenclature. By adopting geologic nomenclature to materials inventories, a uniform system of material source bed classification is established. However, the quality of material that can be produced from a given source bed may vary from one county to another, especially when dealing with unconsolidated deposits. In most instances, the geologic classification attached to unconsolidated deposits denotes age and not material type. Therefore, two deposits which were laid down during the same period, but located

in different parts of the state may have the same geologic name or classification but may vary in composition because of different parent material. The gradation of material present in either deposit is greatly affected by the mode of deposition and the carrying capacity or energy of the depositing agent.

In essence, the geology of the county provides a basis for mapping material source beds and a criterion for evaluating the general quality of the material.

The mapping of the various geologic units is accomplished on aerial photography of the county. Because of their conspicuous exposure pattern, most consolidated geologic units can be mapped with a minimum amount of field checking. Unconsolidated deposits of sand and gravel are inconsistent and do not show a prominent exposure pattern, but they can be located on aerial photographs through a knowledge of the geology of the county and interpretation of significant terrain features that are discernible on the aerial photographs.

By knowing the mode of deposition, source bed, geological age, type of landform associated with a particular material, and the results of the quality tests completed on samples obtained from similar deposits, one can derive general information concerning the material in a particular area. Consequently, prospective sites can be selected for development on the basis of the general merits of the material.

General Information

Sherman County, having an area of 1,055 square miles, had a population of 6,850 in 1964 according to the Kansas State Board of Agriculture. The county lies within the High Plains physiographic division of Kansas and is bounded by parallels 39° 08' and 39° 34' north latitude and meridians 101° 23'

and 102° 03' west longitude. It is bounded on the north by Cheyenne and Rawlins Counties, on the east by Thomas County, on the south by Logan and Wallace Counties, and on the west by Kit Carson County, Colorado.

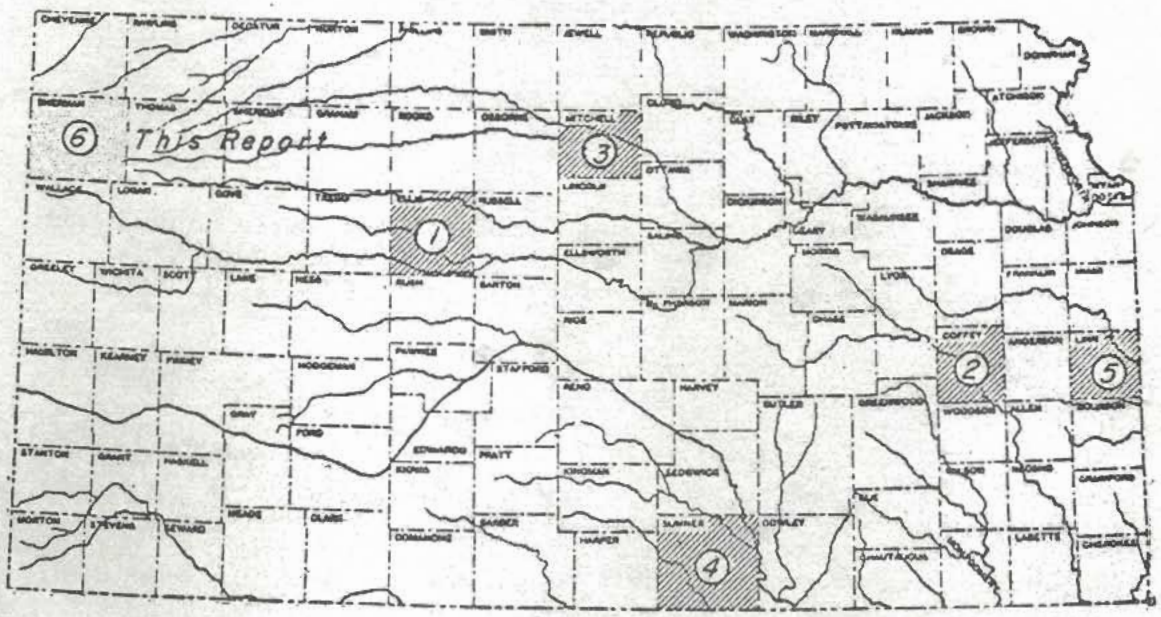

Figure 1. Index Map of Kansas showing the location of Sherman County along with the report number and location of other counties for which reports are published or being processed.

The topography of the county consists of flat to gentle rolling plains dissected by a few shallow valleys. Numerous shallow undrained depressions are common in the nearly flat upland plain. After heavy rains these depressions hold water and become temporary ponds which range from a few feet to more than half a mile in diameter and may contain water for weeks or months after the rains have occurred.

The North and South Forks of Sappa Creek and the North and South Forks of Beaver Creek drain the northern three-fourths of the county. The North Fork of the Smoky Hill River flows east-southeast and drains the southern one-fourth of Sherman County. These streams are intermittent except during years of extremely high precipitation at which time some of the streams have been known to flow year around.

Sherman County is served by the main line of the Chicago, Rock Island and Pacific Railway Company which crosses the county east to west through Edson, Goodland, Ruleton, and Kanorado.

Two major highways serve Sherman County: U.S. Highway 24 bisects the county in an east-west direction, and State Highway 27 extends north-south across the county. Both highways pass through Goodland, the principal city and County Seat of Sherman County. The system of county and township roads is not well developed in Sherman County due to the low population density.

PROCEDURES

The investigation for this report was carried out, essentially, in four phases which are as follows: first, research and review of available information; second, photo interpretation; third, field reconnaissance; and fourth, final correlation of data, map compilation, and report writing. With the exception of the first, the phases of this investigation were not completed as separate operations but were completed contemporaneously as each section of the report required.

Research of Available Information

All available data and information pertaining to the geology, soils, and construction materials of Sherman County were reviewed. The general geology of the county, relative to construction materials, was determined. During this process, the results of quality tests already completed on samples taken in Sherman County were correlated with the various geologic units and deposits present in the county.

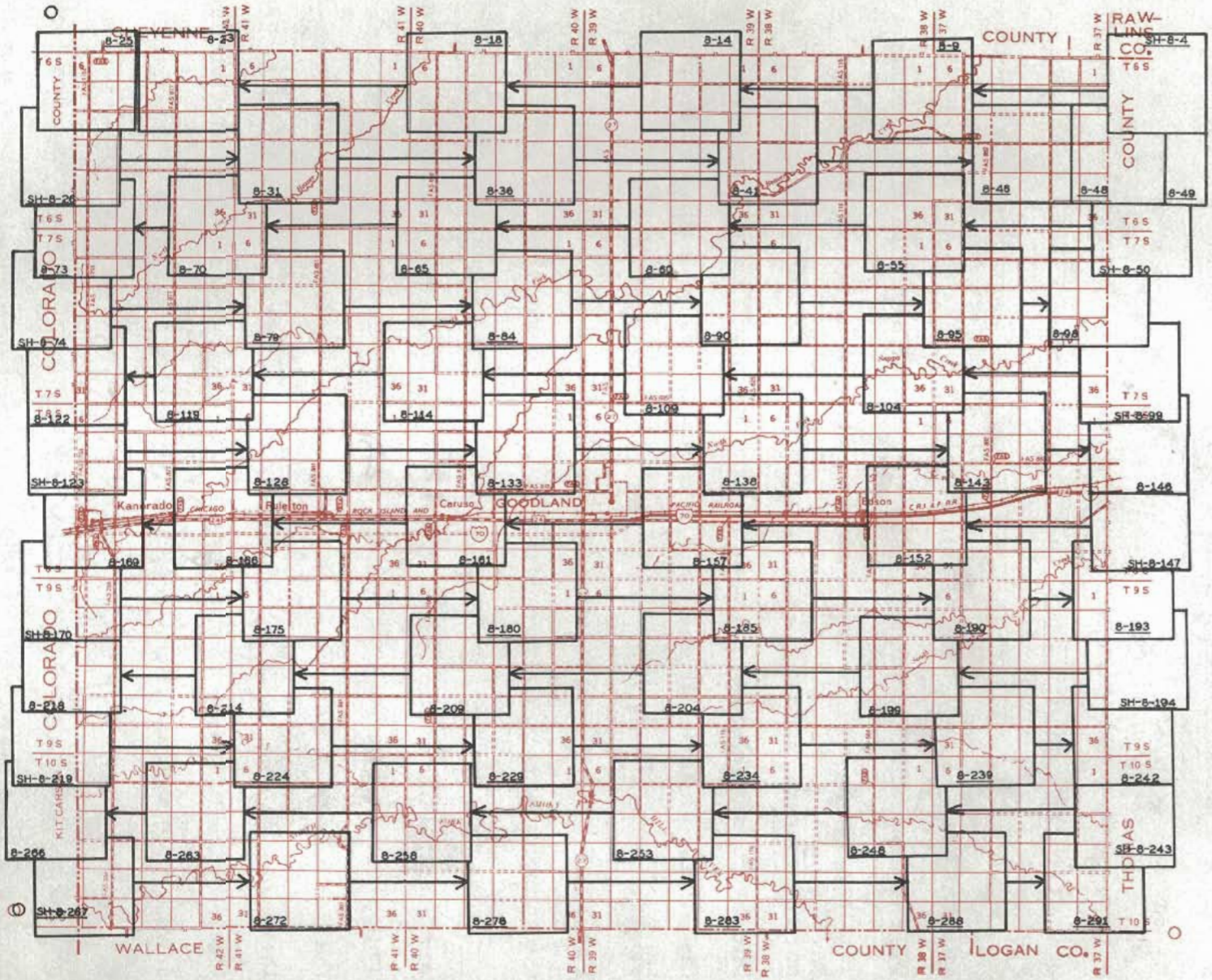

Figure 2. Aerial photographic coverage map. The numbers which are underlined with black indicate photograph numbers on flights taken by the Photogrammetry Section of the Kansas State Highway Commission on June 24 and 25, 1964. Aerial photographs are on file in the Photogrammetry Laboratory, State Office Building, Topeka, Kansas.

Photo Interpretation

The second phase of the investigation consisted of study and interpretation of aerial photographs taken by the State Highway Commission of Kansas at a scale of 1:24,000 (1 inch represents 2,000 feet). Figure 2, page 5, is an aerial photographic coverage map of Sherman County on which is indicated that portion of the county covered by each photo.

Initially, the whole county was studied on aerial photographs. During this process, all open material sites which had been sampled and tested were located on the photographs and on a cronar base map of the county. The locations of all open material sites which had not been sampled or reported were also transferred to the base map. All sites were then correlated with the geology of the county. The geologic source beds that were discernible on aerial photographs were mapped and classified on the photographic prints. This information was then transferred to the base map. Prospective sites were tentatively selected on the basis of the geology of the county and the aerial photographic pattern elements.

Figure 3, page 7, which is a portion of an aerial photograph taken over west-central Sherman County, illustrates the photo interpretation procedure. This picture shows a series of sand and gravel pits located along the bank of the North Fork of Beaver Creek. The high topographic position of three of these pits, in relation to the stream valley, attests to the fact that they are located in the Ogallala Formation. The other pit is located in Alluvium laid down by this stream. Beds of calcium cemented sand and gravel, typical of the Ogallala, are exposed approximately three-fourths of a mile east of these pits. The mottled appearance of the vegetation which covers the area between these two exposures implies that deposits of granular material are very thinly masked in this locale. Localities with similar features are shown on the county materials map as prospective areas for ground exploration purposes.

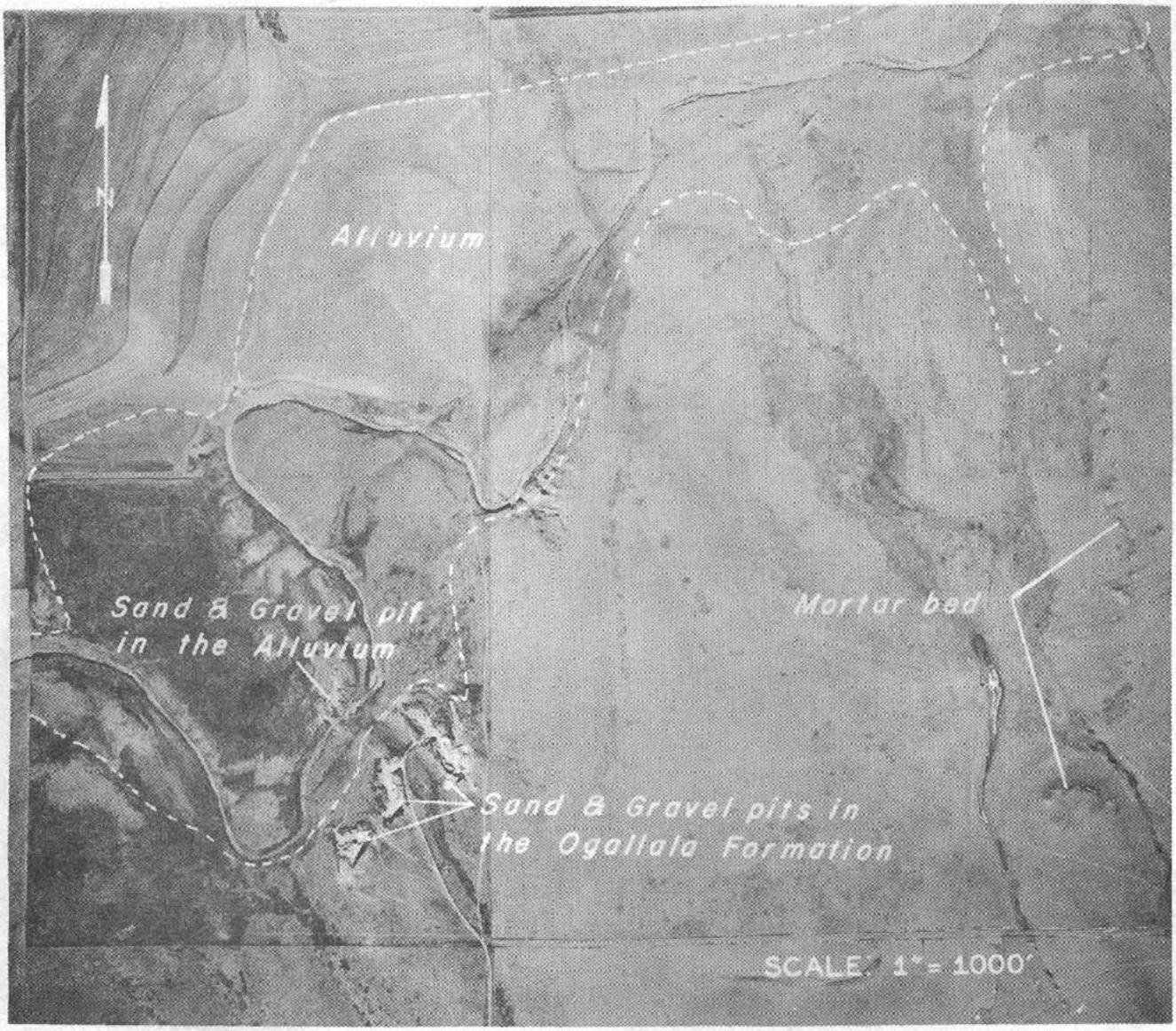

Figure 3. Exposures of the Ogallala Formation along the valley of the North Fork of Beaver Creek.

A rather sharp break in the terrain marks the boundary between the Ogallala Formation and the Alluvium which fills the Beaver Creek valley. The uniform, light tone portrayed by the sediments in the stream channel provides evidence that the stream is presently carrying granular material, and a small pit in the Alluvium reveals that the stream has carried sand and gravel in the past.

The cultivated ground, which is located in the northwest quarter of the photograph, indicates that a heavy soil mantle is probably present in that area.

Even though good quality sand and gravel may be present under the thick silt cover, ordinarily they are not utilized as construction material because of the high cost of removing large amounts of overburden.

After an initial field check, the mapping process was completed and a general description of the geological source beds was written. The quality of the material that might be produced from a particular source bed was ascertained, in most instances, by correlating the quality test results with the geological unit from which the test samples were obtained, and by a field study of the producing unit. The general description of the material should be used as a guide in selecting geologic units for the production of construction materials. If a site is to be developed, a detailed sampling and testing program will be required.

Field Reconnaissance

As previously mentioned, a field reconnaissance of the county is usually conducted after the first study of the aerial photographs has been completed. This enables the photo interpreter to examine the material with which he is working, to verify doubtful mapping situations, and to acquaint himself better with the geology of the county. All open sites were also inspected to verify the geologic classification.

A limited amount of exploratory drilling was completed during the second field check. This drilling was limited to locations where stream action had removed most of the overlying silts from the Ogallala Formation, but where the formation was not exposed. Six of the sites which were explored contained sufficient quantities of granular material to merit more detailed investigation in the future. These six sites, along with others which were selected on the basis of evidence obtained by photo interpretation procedures, are shown on the Sherman County materials map.

Map Compilation and Report Writing

The fourth phase consisted of the final correlation of all new information gathered during the investigation with existing information, of writing the report, and of the final compilation of site data forms and county construction materials maps.

Only geologic units or deposits that contribute to the construction material resources of Sherman County were mapped. The map units representing material source beds are based primarily on geologic age. In general, the quality of material produced from each geologic source bed has been fairly consistent throughout the county; however, the gradation of material may change from one pit to another because both source beds (Ogallala Formation and Alluvium) are alluvial deposits and the sorting of material during deposition varied from area to area.

All existing and prospective sites are identified on the county materials map by appropriate designations and symbols. The site symbol will indicate the status of the materials site to the user of the report--that is, whether it is a prospective or an open site and whether or not it has been sampled. The site designation will convey to the reader the type of material which can be found at the location, the estimated quantity of material, the number of the corresponding data form for that site, and the geologic age and formation name of the source bed. The map legend explains all letter and map symbols used in the site designations.

To furnish the user of the report with all available information, a data form was completed for each material site depicted on the materials map. The site data forms are included as appendices I through VI in this report.

Appendix I contains site data forms for all sites indicated on the Sherman County materials map as being open but not sampled by the State Highway Commission of Kansas. Appendix II contains a site data form for each site shown on the materials map as a prospective site; sampled. Test data are presented on the site data form for each site in this appendix. Appendix III contains a site data form for each site depicted on the materials map as open site; sampled. Test data are presented on the site data form for each site which is included in this appendix. Appendix IV contains site data forms for sites which are shown on the materials map as being prospective sites; not sampled.

Geologic data are presented on each site data form to facilitate future correlation. To further aid in determining the type of material which should be expected in untested sites, references are made to nearby pits located in the same source bed where test results are available.

A sketch of each site was drawn illustrating major cultural and natural features of the immediate area to help locate the exact site in the field, and landowner information is presented for each materials site as it is recorded in the Sherman County Register of Deeds office.

The text of the report was completed by presenting the geologic history of the county as it pertained to the various material source beds present, a general description of the material available in the county, and a general description of geologic units which, in the past, have displayed unsound engineering properties.

CONSTRUCTION MATERIALS RESOURCES OF SHERMAN COUNTY

Geologic History of Sherman County

The geologic history of Sherman County is presented, in this report, in general terms intended for the layman. Figure 4, page 12, is a geologic timetable reproduced with the permission of the State Geologic Survey of Kansas which shows the divisions of geologic time and the approximate length of each time period. It should be noted that each time period, with the exception of the Quaternary, represents several million years and that climatic and geographic conditions have been vastly different from those which exist at the present time.

The formations and units which are exposed at the surface in Sherman County total only a few hundred feet in thickness. From these exposed deposits, the geologic history of surface and near surface units may be interpreted. The history of older buried rock units must be studied through the use of drill-hole logs and other data obtained during exploration for oil and gas.

In Sherman County, as in the remainder of Kansas, crystalline rocks (i.e. granite and gneiss) of Pre-Cambrian age forms the "basement" rock upon which the oldest paleozoic sediments were deposited. Sherman County was invaded by the sea in the middle Cambrian time and remained a sea until some time in the Ordovician Period when the area was uplifted (Prescott, 1953, p. 19). These earliest Paleozoic deposits are represented in the subsurface by thick dolomites and limestones and are overlain by several hundred feet of younger sediments.

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

(Not scaled for geologic time or thickness of deposits)

*Committee on Measurement of Geologic Time, National Research Council

State Geological Survey of Kansas

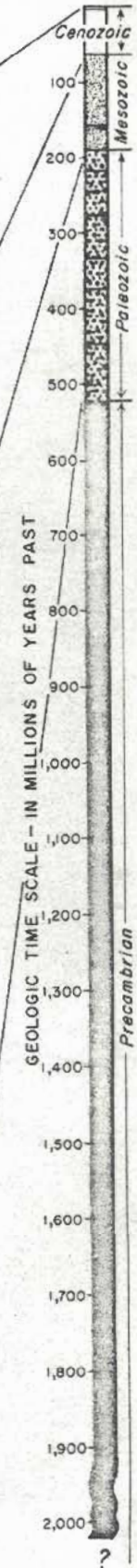

Figure 4. Geologic Timetable

Rocks of Silurian and Devonian age probably do not underlie Sherman County. The area is thought to have been a low landmass or shallow sea at this time and presumably, very little deposition or erosion occurred.

The land then subsided and the seas invaded the area in early Mississippian time with some limestones and shales being deposited. Late in the Mississippian, the sea withdrew and some of the rocks of this age were eroded away.

The Pennsylvanian Period in Sherman County was characterized by alternating submergence and emergence which resulted in the deposition of sandstone, shale, limestone, and coal.

This same area, in earliest Permian time, was a sea in which beds of shale and limestone were deposited. Later in the Permian Period, non-marine sediments (redbeds) and evaporites were deposited. According to Krumbein and Sloss, (1956, p. 372) these non-marine deposits were laid down by sluggish streams or in temporary lakes on a broad, nearly flat, alluvial plain.

The Mesozoic Era was ushered in by uplift of the region above sea level where it remained during the Triassic and early Jurassic Periods (Prescott, 1953, p. 25). In the late Jurassic subsidence occurred, at which time some gray-green shales representing the Morrision Formation were deposited. This period of deposition was followed by emergence of the area at the close of the Jurassic or early in the Cretaceous Period. The area was submerged later in Cretaceous time. Deltaic deposits, represented by the Dakota Formation, were laid down at or near sea level, and overlying marine shales, chalky shale, and limestones were deposited in the deeper sea which existed late in the Cretaceous Period.

The rise of the Rocky Mountains ended the Mesozoic and gave birth to the Cenozoic Era. While streams from these newly formed mountains were laying down sheets of silt, sand, and gravel north of Sherman County (out of Kansas), the surface of western Kansas was being eroded of any sediments that might have been deposited in earliest Tertiary time along with various thicknesses of upper Cretaceous rocks (Prescott, 1953, p.26). Conditions were reversed in late Tertiary time, probably due to differential uplift of the land, and streams from the Rocky Mountains made extensive deposits of silt, sand, and gravel over western Kansas. These deposits compose the Ogallala Formation. At the close of the Tertiary Period, Sherman County was characterized by a flat alluvial plain which probably contained many fresh water lakes in which the "Algal limestone" was deposited. Discontinuous beds of this limestone cap the Ogallala in parts of the county.

Uplift occurred to the west in Quaternary time and the streams of western Kansas began to cut through Pliocene (late Tertiary) deposits. During the Quaternary Period, several occurrences of stream erosion and deposition took place as may be shown by the terraces of various age along the major drainage to the east of Sherman County; however, alluvial terraces of more than one age have not been found in the county. Late in Quaternary time, a thick mantle of wind transported silt (Loveland and Peoria Formations) was deposited over much of western and central Kansas. A short period of stability existed between the deposition of the Loveland and Peoria Formations, at which time the Sangamon Buried Soil was developed.

Shallow undrained depressions were developed in the upland area of Sherman County in the latter part of the Quaternary Period. These depressions, which range from a few feet to as much as half a mile in diameter, hold water after periods of heavy rainfall until it has evaporated or percolated into the mantle.

Erosional processes have modified the topography since the wind blown silts were deposited. Some alluvial silt, sand, and gravel derived from the Ogallala, Loveland, and Peoria Formations blanket the valley floors of the major streams.

Construction Materials Inventory

This section of the report inventories the construction material resources of Sherman County. Only geologic units which are producers or are considered to be potential producers of construction material are discussed. Figure 5, page 16, is a generalized geologic column of the surface geology of Sherman County which illustrates the relative stratigraphic position of each source bed. The county materials map which is divided into six equal portions, Plates I through VI, shows the geographic areas where construction materials source beds are exposed or near the surface.

Figure 6, page 17, is a tabulation of the various types of material available in Sherman County. The source beds from which each material type can be produced are listed, along with the page number where the engineering characteristics of each of these geologic sources are described. The reader is reminded to study these descriptions thoroughly when making a *preliminary assessment* of the construction materials resources of the county. To further aid in making this assessment, the general localities where the geologic source beds are located are also shown in this figure.

Graphic Legend	Outcrop Thickness	System	Stratigraphic Units: Series	Stratigraphic Units: Formations and Members		Generalized Description	Construction Materials
	0' to 35'	Quaternary	Pleistocene	Top Soil Colluvium and Alluvium		Soil, mostly composed of silty clay, may be underlain by colluvial and/or alluvial clay, silt, sand and gravel.	Aggregate and Road Surfacing Material
	0' to 40'			Peoria Silt Formation		Silt, slightly clayey, tan, contains zones and nodules of caliche.	None
	0' to 8'			Loveland Silt Formation		Silt and sandy silt, slightly clayey, may have the "Sangamon Buried Soil" at the top.	None
	0' to 296'	Tertiary	Pliocene ?	Ogallala Formation	Kimball Member	Silt, sand, gravel, chert, caliche, irregular calcium cemented zones termed mortar bed. Top may be marked by "Algal Lime".	Aggregate, Road Surfacing Material, and Mineral Filler
					Ash Hollow Member	Silt, sand and gravel, contains irregular calcium cemented zones termed mortar bed. May contain thin fresh water limestone zones and volcanic ash.	Aggregate, Road Surfacing Material, and Mineral Filler
					Valentine Member	Silt, sand and gravel, may contain irregular calcium cemented zones termed mortar bed along with fresh water limestone, bentonitic clay and opaline sandstone.	Aggregate, Road Surfacing Material, and Mineral Filler
	600' to 900'	Cretaceous	Upper Cretaceous	Pierre Shale Formation	Lake Creek Shale Member	Shale, clayey, flakey, dark gray and black, limestone concretionary zones and concretionary limonite zones.	None

Figure 5. Generalized geologic column of the surface geology of Sherman County.

Material Type	Geologic Source	Description	Locality where available
Sand & Gravel	Ogallala Formation	page 17	Throughout the county. (Most readily accessible where streams have eroded away the overlying silts.)
	Alluvium	page 22	In the major stream valleys.
Mineral Filler	Ogallala Formation	page 17	Throughout the county. (Most readily accessible where streams have eroded away the overlying silts.)
	Alluvium	page 22	In the major stream valleys.

Figure 6. A recapitulation of the construction material types and their availability in Sherman County.

Tertiary System
Ogallala Formation

The Ogallala Formation, which is the primary source of construction material in Sherman County, is composed chiefly of silt, sand, and gravel with some localized calcium-cemented zones termed mortar bed. When exposed, mortar bed forms the most prominent physiographic feature of the formation because of its resistance to erosion (Figure 7, page 18). Volcanic ash deposits are common in this formation; however, only one isolated exposure of very low quality ash was found in Sherman County. Discontinuous beds of hard, thin Algal limestone mark the top of the formation in some parts of the county, but these beds are too thin to provide a source of construction material (Figure 8, page 18). Lenses of opaline sandstone are found in Rawlins County to the northeast, but exposures of this material are not known to exist in Sherman County.

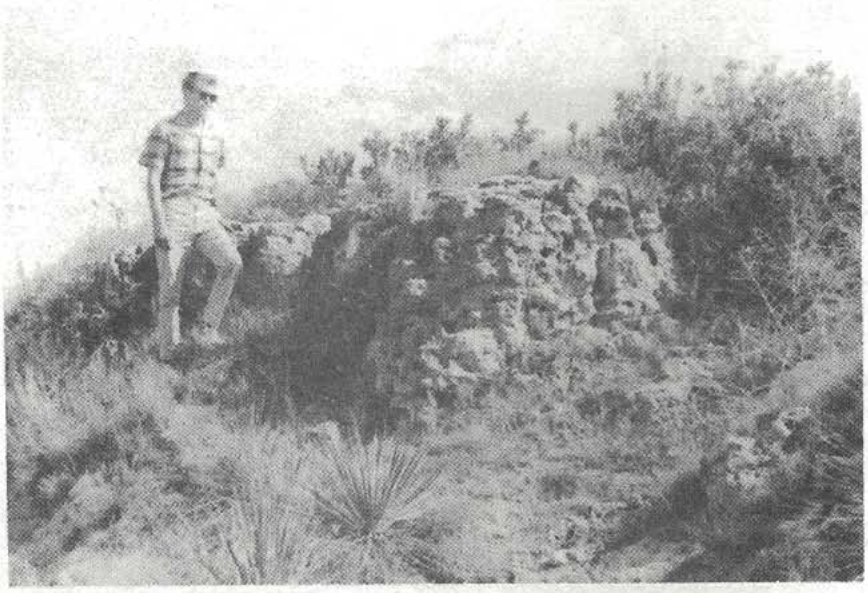

Figure 7. Mortar bed in the Ogallala Formation, SW¼, Sec. 7, T10S, R39W.

Figure 8. Algal limestone marking the top of the Ogallala Formation, SW¼, Sec. 15, T6S, R42W.

As previously described, the Ogallala Formation underlies all of Sherman County except for a small area in the south central portion where the North Fork of the Smoky Hill River has eroded the unit away, exposing the underlying Pierre Shale Formation. The Ogallala is not generally considered as a source of construction material in the upland area of Sherman County because of the thick silt cover of the Loveland and Peoria Formations. Because of erosion, the overburden is generally much thinner along the streams and consequently, most of the sand and gravel pits are located near major drainage channels in Sherman County. Sand and gravel in the Ogallala are obtained by dry pit excavation methods.

Exploratory drilling in other counties has led to the discovery of sand and gravel deposits in the Ogallala Formation which are of sufficient quantity and quality to warrant the removal of unusually large amounts of overburden. Projects in Sherman County which will require large quantities of material may also lead to exploratory efforts, and results similar to those experienced in other counties can be anticipated. Because the overlying silts obliterate all clues concerning the lithology of the underlying deposits, drilling operations in the upland areas must be conducted on a random basis.

In this report, only stream valleys where the Ogallala Formation is near the surface are considered to be prospective areas. On the county materials map these locations have been divided into two classifications. One map symbol delineates the areas which show, on aerial photography, topographic characteristics typical of Ogallala exposures, while the other symbol represents areas where erosion has removed some of the overlying silts, and the Ogallala is thought to be relatively close to the surface. Prospective sites have been restricted to locations where there appears to be a minimum amount of overburden.

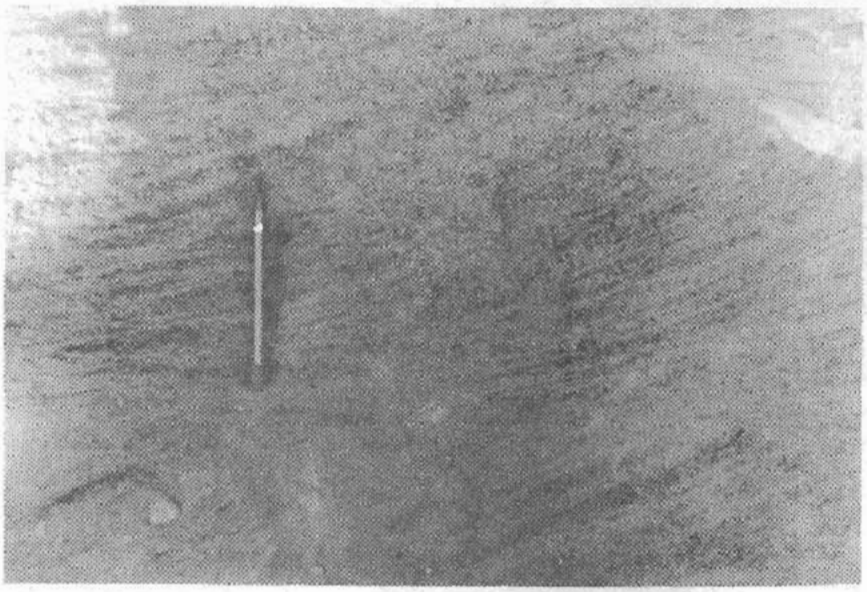

Figure 9. Close-up view of a sand and gravel deposit in the Ogallala Formation. Note the cross bedding characteristic.

Because the Ogallala is an alluvial deposit, the gradation of material derived from this source bed is not uniform throughout the county; however, when properly processed, the granular material from the Ogallala is generally acceptable for highway construction purposes. The test results studied did not indicate the plasticity of the material tested; however, further research revealed that most pit locations produce material with a relatively low plastic index. Figure 10, page 21, tabulates the results of gradation and quality tests performed on construction material taken from the Ogallala Formation in Sherman County.

Location	Material Type	Percent Retained										Wash	G.F.	P.I.	L.L.	Sp.Gr.	Wt./Cu.Ft.	Wear	Soundness	Source of Data
		1	3/4	3/8	4	8	16	30	50	100										
SOURCE OF MATERIAL: Ogallala Formation																				
NE 1/4, Sec.8, T8S, R41W	Sand & Gravel	-	4	10	19	38	60	81	93	96		3	4.01	-	-	2.60	110	27.4	0.99	Average of 17 test holes.
NE 1/4, Sec.28, T8S, R24W	Sand & Gravel	-	4	11	24	50	76	93	97	98		1	4.53	-	-	2.61	114	28.5	0.99	Average of 8 test holes.
SE 1/4, Sec.6, T10S, R39W	Sand	-	2	5	11	23	40	56	76	88		8	3.02	-	-	-	-	-	-	Average of 17 test holes.
SE 1/4, Sec.6, T10S, R39W	Sand	-	2	6	14	25	42	59	78	90		6	3.16	-	-	-	-	-	-	Average of 10 test holes.
NW 1/4, Sec.26, T10S, R38W	Sand	-	3	9	16	27	53	71	81	89		10	3.39	-	-	-	-	-	-	Average of 12 test holes.
NE 1/4, Sec.26, T10S, R38W	Sand	-	2	4	8	17	40	65	83	91		7	3.10	-	-	-	-	-	-	Average of 18 test holes.
NW 1/4, Sec.9, T10S, R38W	Sand & Gravel	2	5	11	19	31	48	66	81	87		10	3.50	-	-	-	-	-	-	Representative samples taken from Daily Aggregate Reports.
Sec.6, T10S, R39W	Sand & Gravel	-	1	7	18	30	42	57	75	88		9	3.18	-	-	-	-	-	-	Representative samples taken from Daily Aggregate Reports.
SOURCE OF MATERIAL: Alluvium																				
SE 1/4, Sec.10, T7S, R40W	Sand & Gravel	-	2	6	14	34	65	88	98	99		1	4.06	-	-	2.58	110	29.5	0.998	Average of 11 test holes.
NE 1/4, Sec.15, T7S, R40W	Sand & Gravel	-	2	5	13	31	56	83	94	96		3	3.80	-	-	2.60	110	29.0	0.998	Average of 5 test holes.
NE 1/4, Sec.20, T7S, R40W	Sand & Gravel	-	1	4	13	36	66	87	98	99		1	4.04	-	-	2.60	112	29.3	0.99	Average of 10 test holes.
NE 1/4, Sec.21, T7S, R40W	Sand & Gravel	-	2	6	14	36	65	86	98	99		1	4.06	-	-	2.60	110	27.4	0.99	Average of 9 test holes.
N 1/2, Sec. 34, T 7 S, R41W	Sand & Gravel	-	4	11	22	42	62	83	93	95		4	4.12	-	-	2.60	111	29.1	0.98	Average of 21 test holes.
SW 1/4, Sec.4, T8S, R41W	Sand & Gravel	-	1	7	18	42	72	90	98	99		1	4.27	-	-	2.61	111	28.6	0.96	Average of 10 test holes.
NE 1/4, Sec.3, T8S, R40W	Sand & Gravel	-	2	6	12	24	44	69	89	93		6	3.39	-	-	2.56	113.8	27.7	0.97	Average of 14 test holes.
NW 1/4, Sec.29, T8S, R40W	Filler Sand	-	-	1	2	3	5	10	23	29		59	0.73	-	-	-	93.8	-	-	Average of 8 test holes.
NW 1/4, Sec.17, T7S, R39W	Sand	-	2	4	10	20	37	58	78	88		9	2.97	-	-	-	-	-	-	Average of 38 test holes.

Figure 10. Results of tests completed on samples taken from the Ogallala Formation and Alluvium.

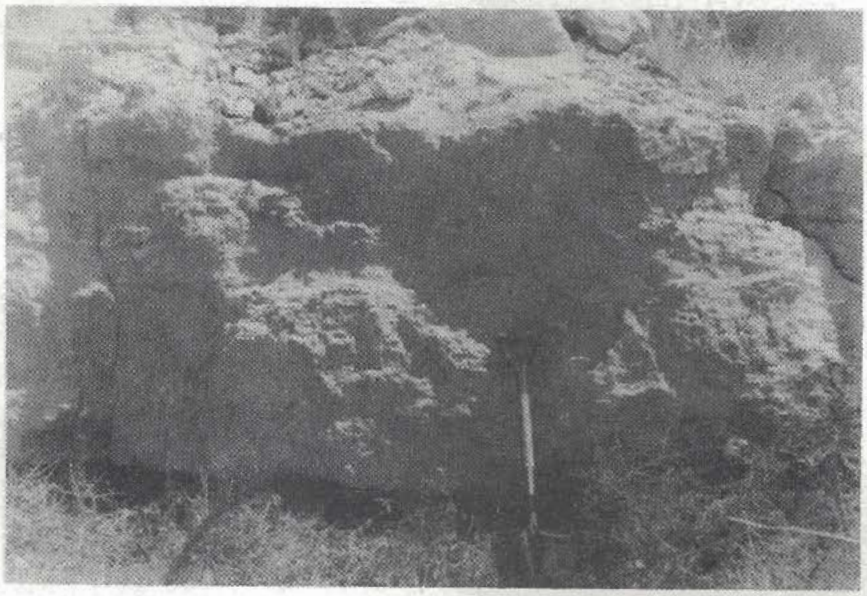

Figure 11. Impure volcanic ash bed in the Ogallala Formation, NE¼, Sec. 16, T8S, R40W.

Mineral filler in Sherman County is derived mainly from the silt and fine sand found in the upper portion of sand and gravel pits in the Ogallala Formation. Another minor source in the county is an isolated volcanic ash bed in the Ogallala. Because this ash is limited in exposure and relatively thin and impure, only a small amount has been used for mineral filler. Figure 11 is a ground view of the volcanic ash in the pit area.

Quaternary System
Alluvium

The valleys of the South Fork of Beaver Creek, the South Fork of Sappa Creek and the North Fork of the Smoky Hill River are filled with alluvial deposits of Quaternary age. These deposits are composed of varying amounts of silt, sand, and gravel which have been derived from the Ogallala, Loveland,

and Peoria Formation. Material for construction purposes has been produced in Sherman County from all the previously mentioned stream valleys except for the South Fork of Sappa Creek.

Figure 10, page 21, tabulates the available test results on material taken from this source bed. Because the granular portion of the Alluvium is derived from the Ogallala Formation, it generally has the same engineering properties as material taken from the older deposits.

Most of the alluvial material has been taken by dry pit excavation methods. Only one existing pit, which provides material from this source bed, is below the water table. Material is removed from this location by pumping operations.

Material from one location along Beaver Creek (NW 1/4, Sec. 29, T8S, R40W) has been tested as a possible source of mineral filler. This material was composed of fine sand, an average of 59% of which passed the No. 200 sieve. The results of gradation tests performed on this material are given in Figure 10, page 21. It is probable that material with similar grading could be found at other locations along the major stream channels.

Geo-Engineering

Materials Usage Considerations

When economic consideration precludes the utilization of selected borrow, it is necessary to incorporate material available along the right of way into the construction of highway projects. In such cases, precautions should be taken to insure that the various material types are used where they can most closely conform to controlling specifications. In this section of the report the engineering properties of the geologic units exposed in the county, which should be

considered when determining the usage of the available material, are discussed. For the purpose of this discussion the geologic units are grouped as follows: the Pierre Shale, the Ogallala Formation, and the Loveland and Peoria Formation.

Pierre Shale

Only one exposure of the Pierre Shale - The Lake Creek Member, which contains numerous concretionary zones embedded in a matrix of dark gray to black clayey shale - is found in Sherman County. This location is along the Smoky Hill River valley approximately four miles east of present K-27 Highway.

Material from this shale is unsatisfactory for use in subgrade and shoulder construction because of its high plasticity and high swell and shrinkage factors. If encountered, this material should be used in the lower portion of embankment construction and should be subgraded in cut sections which traverse this unit. Where weathered shale is encountered, it may be necessary to waste this material. Backslope steepness should not exceed 3:1 to prevent occurrence of slipout and slides.

In bridge design some difficulty may be anticipated in selecting the elevation at which the required bearing capacity can be obtained for spread footings in the Pierre Shale. However, it is unlikely that the Pierre will be found close enough to the surface in Sherman County to be a consideration in this type of bridge design. Most bridges in the county will be supported by piling, some of which may encounter the Pierre. This type of construction also may pose problems in accurately predicting the pile tip elevation at which the required bearing will be reached.

Ogallala Formation

The Ogallala Formation is composed chiefly of silt, sand, and gravel with some localized calcium-cemented zones, termed mortar bed. The granular character of this material along with its low plasticity makes it suitable for use in subgrade construction; however, these same properties enable rapid erosion to occur. In view of this stability condition, slopes constructed of this material should be 3:1 or flatter and seeded to prevent erosion. In some areas where mortar bed is encountered, vertical slopes may be constructed; however, eventual slumping may produce maintenance problems.

Most of the major bridges in this portion of the state are supported by piling driven into the Ogallala. As in the Pierre Shale, a great deal of difficulty has been experienced in determining the final pile tip elevation. In recent years the State Highway Commission of Kansas has relied on information gained through the use of the No. 2 McKiernan-Terry Air Hammer, commonly known as the Kansas Penetrometer, to estimate the elevation at which a given bearing could be reached. The use of this equipment has enabled the designer to make relatively accurate estimates of pile tip elevations, but due to the variable composition of the Ogallala some major variations from plan elevations may be encountered.

Loveland and Peoria Formations

The Loveland and Peoria Formations, which are composed of up to 50 feet of slightly clayey to sandy silt, blanket most of Sherman County. These silts have potential high shrinkage and swell properties, but present no problem in this area due to the low annual rainfall.

Backslopes constructed in this material require some stabilization if they are to be maintained over a long period of time. The Loveland and Peoria silts will stand temporarily in vertical backslopes, but permanent slopes should not be constructed steeper than 3:1 and should be seeded to prevent erosion.

In the past the Sangamon Buried Soil, located stratigraphically at the top of the Loveland Formation, was of some concern in highway construction due to its high plasticity and impermeable nature. The unit is a known water carrier in areas where the amount of rainfall is sufficient to cause water to percolate down through the overlying silt and accumulate on this buried soil. Inasmuch as the Sangamon is not well developed in Sherman County and because of the semi-arid climate, it is not considered a geo-engineering problem.

Pollution of Water Resources

According to Prescott (1953) ground-water is produced primarily from the Ogallala Formation and the alluvial deposits of the major streams in Sherman County. The mineral content in the water from both sources is comparatively low; however, it is generally higher in the Alluvium.

Due to the low population of the towns in the county and the absence of perennial streams which could be used as disposal channels, contamination of water with sewage is practically nonexistent in Sherman County. The lack of any appreciable oil and gas production likewise eliminates possible pollution from salt water brine. Therefore, it is probable that most water produced in Sherman County will meet the requirements for use in concrete as specified by current State Highway Commission of Kansas specifications.

Possible Hydrology Problems in Road Construction

The geologic units exposed in Sherman County could potentially cause hydrology problems if rainfall amounts were more substantial; however, these problems do not exist because of the semi-arid climate.

The numerous undrained depressions found in the county are frequently a source of water problems because they may contain water for weeks or months after heavy rainfall. The location of these depressions should be determined prior to construction of roadways and adequate precautions should be exercised to limit the possibilities of flooding and road failure.

GLOSSARY OF SIGNIFICANT TERMS

Aggrade: To raise the grade or level (a river valley, a stream bed, etc.), by depositing particles of clay, silt, sand, or gravel.

Alluvium: A deposit of clay, silt, sand, or gravel laid down by running water.

Arkosic Gravel: Gravel composed of mineral fragments derived from weathered granite.

Geologic era: Largest unit of geologic time, separated on the basis of crustal disturbance so profound they are called revolutions.

Geologic period: Divisions of geologic eras set off by relatively great crustal movements called disturbances.

Gradation factor: The value obtained by adding the percentage of material retained on 1 1/2", 3/4", 3/8", Nos. 4, 8, 16, 30, 50, and 100 sieves respectively and by dividing this sum by 100.

Igneous rocks: Rocks produced under conditions involving great heat, as rocks crystallized from molten material.

Liquid limit: Determined by tests performed in accordance with Section Y-4 of the State Highway Commission of Kansas standard specifications, 1960 edition.

Lithology: Physical properties such as grain size, mineral content, color, etc. of geologic deposits.

Los Angeles wear: Determined by tests performed in accordance with the latest procedures outlined by A.A.S.H.O. Designation T 96.

Plastic index: Determined by tests performed in accordance with Section Y-4 of the State Highway Commission of Kansas standard specifications, 1960 edition.

Pleistocene series: Deposits laid down during the Quaternary Period.

Prospective materials site: A geographic location where geologic conditions are favorable for the discovery of construction material.

Open materials site: A pit or quarry which has produced or is producing material that may be suitable for some phase or phases of road construction.

Soundness: Determined by tests performed in accordance with Section Y-15 of the State Highway Commission of Kansas standard specifications, 1960 edition.

Specific gravity: Determined by tests performed in accordance with A.A.S.H.O. Designation T 84.

Stratigraphic position: The vertical position of a geologic unit in relation to other geologic units.

Unconsolidated deposits: Usually refers to deposits not older than Pleistocene age where individual grains of material have not been cemented together (i.e. clay, silt, sand, or gravel).

Wash: (Material passing the No. 200 sieve) Determined by tests performed in accordance with A.A.S.H.O. Designation T 11.

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