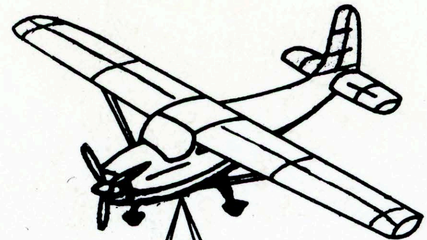

# SEWARD COUNTY

# CONSTRUCTION MATERIALS INVENTORY



Report No. 15

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

# CONSTRUCTION MATERIALS INVENTORY OF SEWARD COUNTY, KANSAS

by

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

1970

Construction Materials Inventory Report No. 15

## the **Why ?**

## **What ?**

## **& How ?**

## **of this Report**

This report was compiled for use as a guide when prospecting for construction material in Seward 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 a means of evaluating and locating additional construction material sources throughout Seward County.

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

**TURN TO THE MATERIALS INVENTORY SECTION**

See
TABULATION OF CONSTRUCTION MATERIALS
Figure 7, page 17

for material
**BY TYPE**
use column 1

*For Quality Data*
*See Figure 14*
*Page 26*

for material
**BY INTENDED USE**
use column 2

for **DESCRIPTION** of material

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

for **AVAILABILITY** of material

Column 4 gives the general location of AVAILABLE material and references the materials maps.

**MATERIALS MAPS**

SEE PINK SHEET PAGE 27

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 29 |
| OPEN SITES; SAMPLED | GREEN SHEET PAGE 65 |
| PROSPECTIVE SITES; NOT SAMPLED | GREEN SHEET PAGE 87 |
| PROSPECTIVE SITES; SAMPLED | GREEN SHEET PAGE 95 |

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

# CONTENTS

# PREFACE

This report is one of a series compiled for the Highway Planning and Research Program, "Materials Inventory by Photo Interpretation." The program is a cooperative effort of the Federal Highway Administration and the State Highway Commission of Kansas, financed by highway planning and research funds. The objective of the project is to provide a statewide inventory of construction materials, on a county basis, to help meet the demands of present and future construction needs (figure 1).

Prior to this time, no extensive or county-wide materials investigations had been completed in Seward County. However, two reports by Byrne and McLaughlin (1948) and Frye and Leonard (1952) provided geological information. Detailed geologic and soil data were obtained from soil surveys and centerline geological profiles prepared for design of major highways by the State Highway Commission.

Appreciation is extended to G. B. Sigsbee, Sixth Division Materials Engineer and C. T. Berglund, Seward County Engineer for verbal information on the construction material resources of the county.

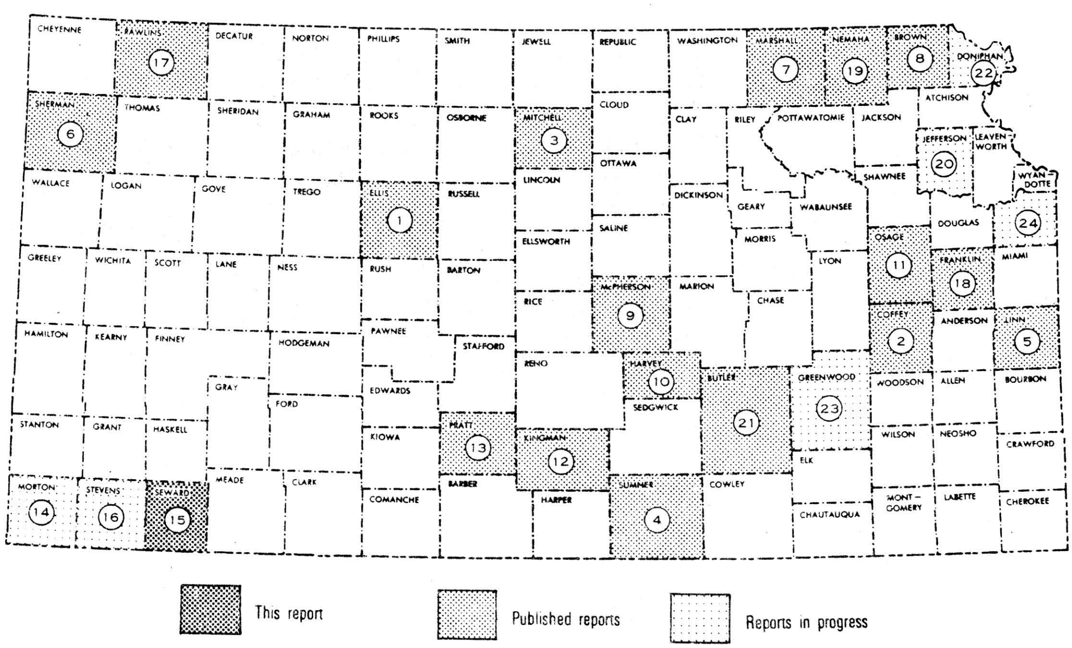



*Figure 1. Index map of Kansas showing the location of Seward County along with the report number and location of other counties for which reports have been or are being completed.*

# ABSTRACT

Seward County lies in southwest Kansas in the *High Plains* physiographic division. The topography is mostly flat with some gently rolling hills in the Dune Sand areas. The surface drainage is controlled by the Cimarron River; however, much internal drainage exists.

A thick blanket of unconsolidated material, mostly granular in nature, blankets Seward County. Although bedrock exposures are not found, localized areas contain poorly indurated silt, sand, and gravel termed *mortar bed*. Exposed geologic units include, from oldest to youngest: the Ogallala Formation, Grand Island Formation, Sappa Formation, Loess, Dune Sand, and Alluvium and Terrace Deposits. Most construction material is obtained from the Cimarron River valley area where Loess and (or) Dune Sand overburden is thin.

The Grand Island Formation is the major source of sand and gravel. Lesser amounts of granular material may be produced from the Ogallala, Sappa, and Alluvium and Terrace Deposits. The Sappa Formation is a source of both caliche gravel and volcanic ash. The ash, which occurs as widely scattered zones of irregular thickness, is an important source of mineral filler.

A combination of Loess and Dune Sand blankets the surface over a large part of the county. For the most part, these are not important construction materials sources. However, Loess may be used in embankment, subgrade, and as slope material, and select Dune Sand may be utilized for binder soil.

Geo-engineering problems are at a minimum in Seward County because of the nearly flat terrain and the semi-arid climate. One of the major problems is with bridge crossings on the Cimarron River since the stream migrates widely in its floodplain and scours deeply in its channel during flood stage. A minor problem may arise on road construction because the surface material does not support vegetation readily and thus, is vulnerable to erosion by wind and water.

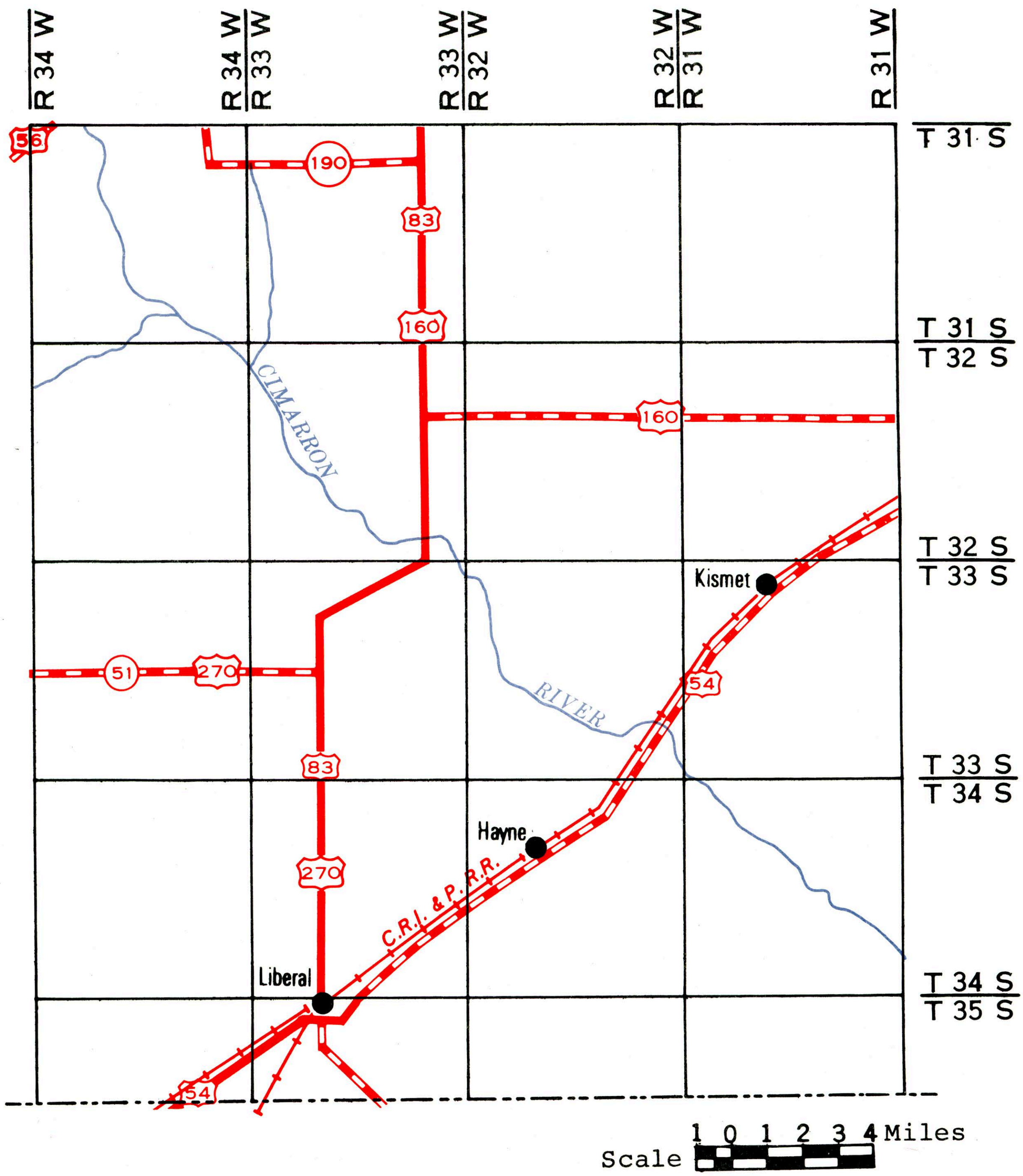



*Figure 2. Drainage and major transportation facilities in Seward County.*

## FACTS ABOUT SEWARD COUNTY

Seward County, with an area of 643 square miles, lies on the *High Plains* in southwest Kansas. According to the Kansas State Board of Agriculture, the population was 16,100 in 1969 with more than 14,000 living in the city of Liberal.

Much of the county is drained by the Cimarron River which traverses the area from northwest to southeast. However, abundant internal drainage exists as indicated by the numerous undrained depressions. Highways in the county include U. S. 160, 83, 54, and 270, along with Kansas Highway 190. The county roads are not well-developed due to the low population. One railroad, the Chicago Rock Island and Pacific, serves Kismet and Liberal. Figure 2 shows the drainage and transportation facilities in the county.

## METHODS OF INVESTIGATION

This report consists of three phases: (1) research and review of available information, (2) photo interpretation, and (3) field reconnaissance.

Phase one consisted of gathering and reviewing pertinent information on geology, soils, and construction material. During this phase the general geology of the county was determined. Quality tests on samples taken in Seward County were then correlated with the geologic units.

During phase two, study and interpretation of the aerial photographs was accomplished. Geologic source beds and material sites were classified on the photographs and sites were correlated with the geology. Prospective materials locations were selected on the basis of geology and aerial photographic pattern elements. Figure 3 shows the photographic coverage of Seward County.

Phase three, a field reconnaissance of the county, was conducted after the initial study of the aerial photographs. This enabled the interpreter to examine the material with which he was working, to verify doubtful mapping situations, and to better acquaint himself with the geology of the county. At this time, the geologic classification of open and prospective sites was confirmed.

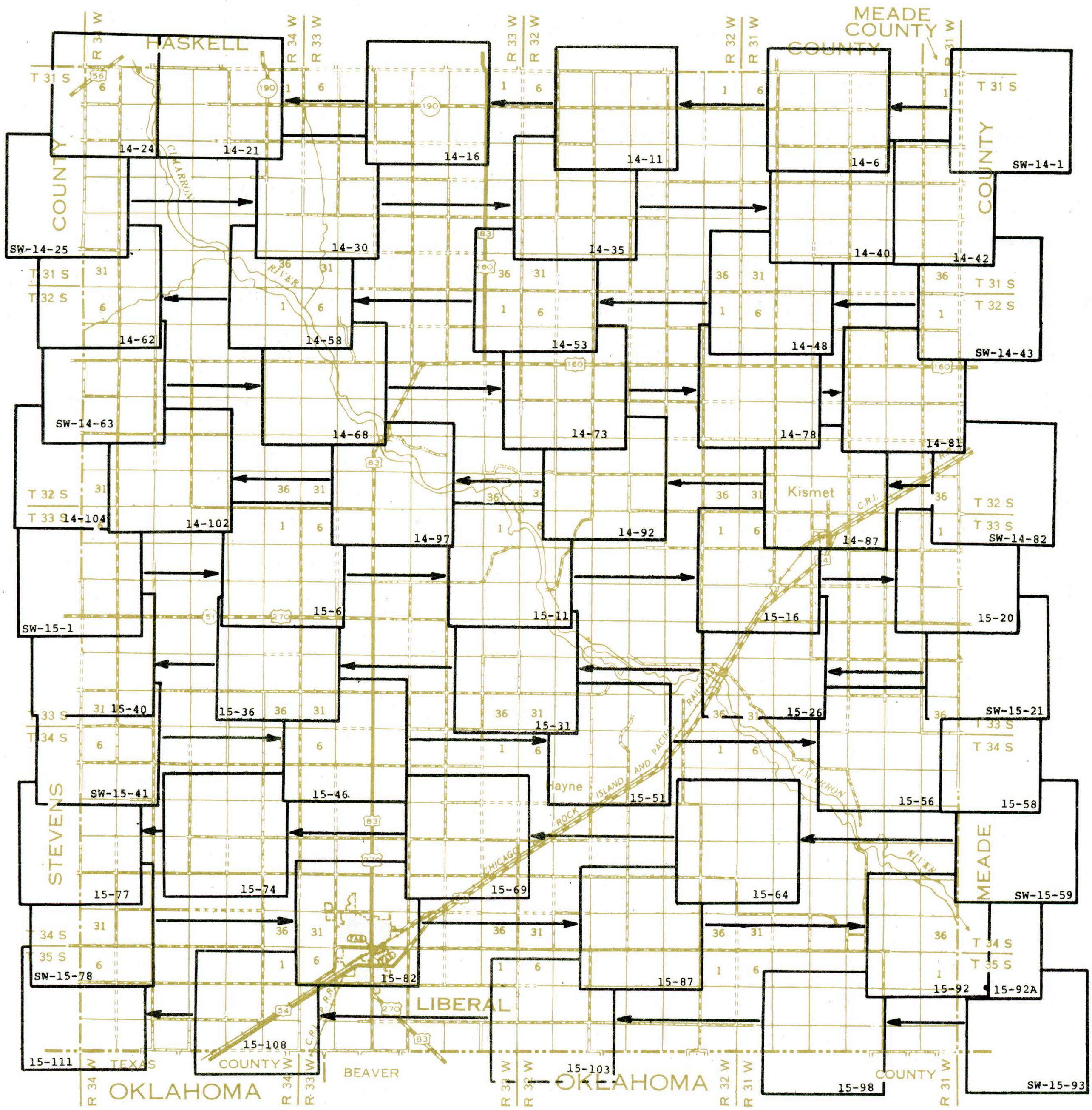
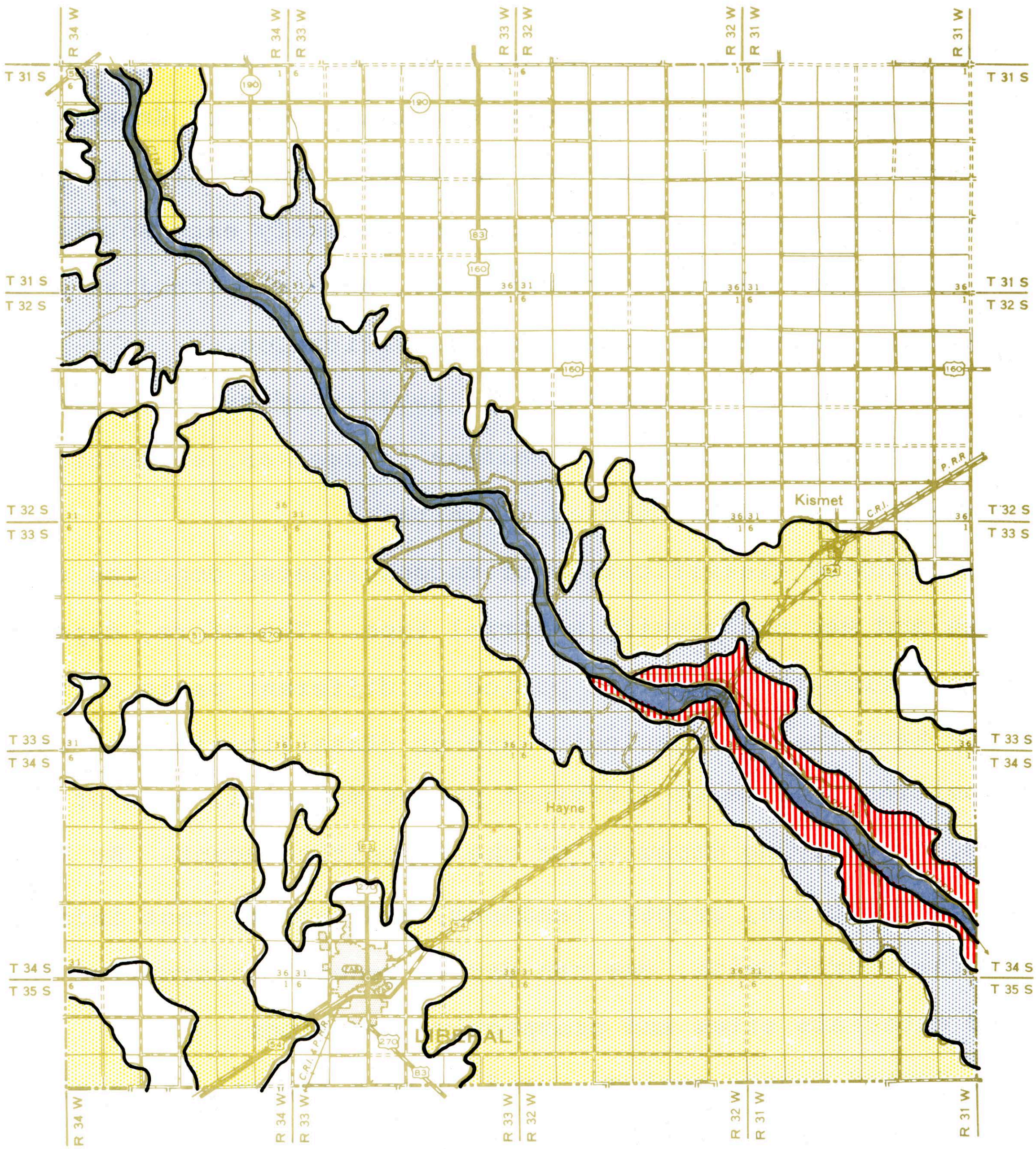


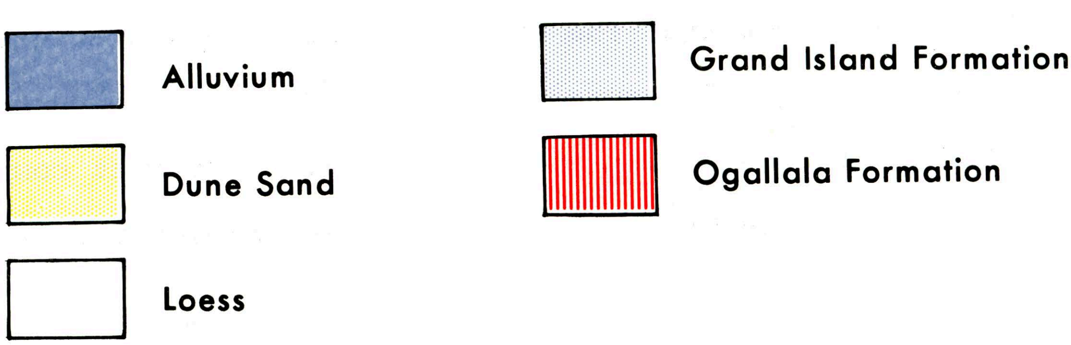

*Figure 3. Aerial photographic coverage map for Seward County. The numbers refer to photographs taken by the State Highway Commission of Kansas. The county was photographed at 12,000 feet (scale one inch equals 2,000 feet) on October 11 and 12, 1966. Aerial photographs are on file in the Photogrammetry Laboratory, State Office Building, Topeka, Kansas.*

## GEOLOGY SECTION




*General Geology of Seward County.*

### LEGEND



# GENERAL GEOLOGY

GEOLOGY is used for conducting materials inventories because material sources are the product of geologic agents. Knowledge of geology makes it possible to: (a) ascertain the general properties of the material source, (b) identify and classify each source according to current geologic nomenclature, and (c) establish a uniform system of material source bed classification.

*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.*

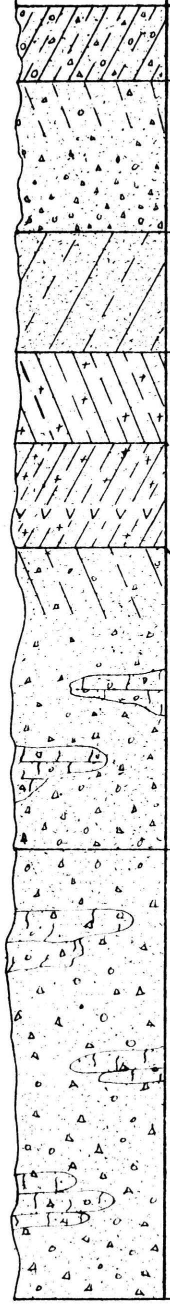
The geologic classification of unconsolidated deposits denotes age and may not signify material type. Therefore, deposits laid down during the same time period in different parts of the state may have the same geologic name or classification but vary in composition because of different parent material, mode of deposition, or carrying capacity of the depositing agent. By knowing the geologic age, origin, landform, and quality test information of the source units, one can derive general information for untested materials sites and prospective locations.

The Seward County geology, used in this report, is based primarily on information from bulletins of the State Geological Survey written by Byrne and McLaughlin (1948) and Frye and Leonard (1952). Figure 4 is a geologic timetable illustrating period-era relationship. Figure 5 illustrates the surface geology and stratigraphic position of each material source.

The oldest buried rock is the Pre-Cambrian basement complex of igneous and metamorphic origin. Upon this complex rest sedimentary

| ERAS | PERIODS | ESTIMATED LENGTH IN YEARS | TYPE OF ROCK IN KANSAS | PRINCIPAL MINERAL RESOURCES |
|---|---|---|---|---|
| CENOZOIC | QUATERNARY (PLEISTOCENE)  | 1,000,000 | Glacial drift; river silt, sand, and gravel; dune sand; wind-blown silt (loess); volcanic ash. | Sand and gravel; volcanic ash; agricultural soils; water. |
| | TERTIARY  | 59,000,000 | Silt, sand, and gravel; fresh-water limestone; volcanic ash; bentonite; diatomaceous marl; opaline sandstone. | Sand and gravel; volcanic ash; diatomaceous marl; water. |
| MESOZOIC | CRETACEOUS | 70,000,000 | Chalky shale, dark shale, vari-colored clay, sandstone, conglomerate; outcropping igneous rock. | Concrete and bituminous aggregate, light type surfacing, shoulder and subgrade material, riprap, and building stone; ceramic materials; water. |
| | JURASSIC | 25,000,000 | Sandstone and shale, chiefly subsurface. | |
| | TRIASSIC | 30,000,000 | | |
| PALEOZOIC | PERMIAN  | 25,000,000 | Limestone, shale, evaporites (salt, gypsum, anhydrite), red sandstone and siltstone, chert, and some dolomite. | Concrete and bituminous aggregate, light type surfacing, shoulder and subgrade material, riprap, and building stone; natural gas, salt, gypsum, water. |
| | PENNSYLVANIAN  | 25,000,000 | Alternating marine and non-marine shale; limestone, sandstone, coal, and chert. | Concrete and bituminous aggregate, light type surfacing, shoulder and subgrade material, riprap. and limestone and shale for cement; ceramic materials; oil, coal, gas, and water. |
| | MISSISSIPPIAN  | 30,000,000 | Mostly limestone, predominantly cherty. | Chat and other construction materials; oil, zinc, lead, and gas. |
| | DEVONIAN | 55,000,000 | Subsurface only. Limestone and black shale. | Oil. |
| | SILURIAN | 40,000,000 | Subsurface only. Limestone. | Oil. |
| | ORDOVICIAN  | 80,000,000 | Subsurface only. Limestone, dolomite, sandstone, and shale. | Oil, gas, and water. |
| | CAMBRIAN | 80,000,000 | Subsurface only. Dolomite and sandstone. | Oil. |
| PRE-CAMBRIAN | (Including PROTEROZOIC and ARCHEOZOIC ERAS) | 1,600,000,000 + | Subsurface only. Granite, other igneous rocks, and metamorphic rocks. | Oil and gas. |

*Figure 4. Geologic timetable.*



| Graphic Legend | Thickness | System | Series | Stage | Formations | Generalized Description | Construction Materials |
|---|---|---|---|---|---|---|---|
| | 0 to 30'± | Quaternary | Pleistocene | Recent and Wisconsinan | Colluvium | Sand, gravel, silt, and clay; tan-brown in color. | None |
| | 0 to 75'± | | | | Alluvium and Terrace Deposits | Fine and medium sand with arkosic gravel and some silt; tan-brown in color. | Bituminous aggregate.<br>Concrete aggregate.<br>Base course material.<br>Shoulder material.<br>Road surfacing material. |
| | 0 to 60'± | | | | Dune Sand | Fine to medium sand with minor amounts of silt and clay; light tan-brown in color. | Binder soil. |
| | 0 to 40'± | | | Illinoisan Sangamonian and Wisconsinan | Loess | Clayey silt, tan in color with zones and nodules of caliche. | Embankment material.<br>Subgrade material.<br>Slope material. |
| | 0 to 100'± | | | Kansan and Yarmouthian | Sappa Formation | Clayey silt and fine sand with extremely heavy accumulation of caliche; tan-brown in color. Contains irregular beds of Pearlette volcanic ash. | Road surfacing material.<br>Mineral filler. |
| | | | | | Grand Island Formation | Fine, medium, and coarse sand and arkosic gravel with minor amounts of silt and clay; tan-brown in color. Contains irregular cemented zones. | Bituminous aggregate.<br>Concrete aggregate.<br>Base course material.<br>Shoulder material. |
| | 500'± | Tertiary | Pliocene | | Ogallala Formation | Fine, medium,and coarse sand and arkosic gravel with abundant calcium carbonate; tan-white in color. Contains irregular cemented zones termed mortar bed. | Bituminous aggregate.<br>Concrete aggregate.<br>Base course material.<br>Shoulder material.<br>Light type surfacing material |

*Figure 5. A generalized geologic column of the surface geology in Seward County.*

rocks laid down during the Paleozoic Era. These rocks, mostly marine in origin, range from Cambrian to Permian in age. Some Silurian and Devonian sediments are missing in at least part of the county due to the Mississippian erosional cycle. Red beds and evaporites found in the upper Paleozoic (Permian System) indicate a trend toward a continental environment.

Uplift in the eastern United States ended the Paleozoic Era and ushered in the Mesozoic. This era includes the Triassic, Jurassic, and Cretaceous Periods. During this time, a small amount of deposition occurred in the Triassic and Jurassic; however, these deposits were removed by subsequent erosion before sediments of the Cretaceous System were deposited. Rocks of Cretaceous age (Dakota Formation) underlie the northwest corner of the county and adjacent areas.

Formation of the Rocky Mountains ended the Mesozoic and initiated the Cenozoic Era. Deposits laid down during this era are responsible for the surface deposits found in the county. The oldest unconsolidated deposits were laid down during the Pliocene Epoch of the Tertiary Period and are termed the Ogallala Formation. This formation, an ancient alluvial fan spread over the high plains, resulted from rapid erosion in the Rocky Mountain area. The Ogallala is present throughout Seward County but is blanketed by younger deposits over most of the area.

As the Tertiary Period came to a close, cooler climates occurred in Seward County. These changes marked the beginning of the Quaternary Period. As a result of cooler climates, ice accumulated and flowed southward from the polar ice cap in North America. This ice age is termed the Pleistocene Epoch.

The Pleistocene Epoch represents a time of repeated glacial and interglacial cycles. Figure 6 is a geologic timetable which shows the divisions of the Quaternary Period and the approximate length of each. The glacial ages (Nebraskan, Kansan, Illinoisan, and Wisconsinan) represent times of major glacial advancement while the three interglacial ages (Aftonian, Yarmouthian, and Sangamonian) are periods of glacial recession and stability. Glacial activity was restricted to the northeast portion of Kansas; however, the sequence of glaciation played a controlling role in the development of Pleistocene nomenclature and the classification of Pleistocene deposits in Seward County.

The oldest Quaternary bed found in Seward County is the Grand Island Formation which is composed mostly of stream-deposited silt, sand, and gravel. Above this unit is the Yarmouthian Age Sappa Formation, a water-lain clay, silt, and fine sand with scattered lenses of volcanic ash. Later in the period, during Illinoisan and Sangamonian time, barren stream valleys in Seward County and surrounding areas provided a source of Loess which covers portions of the upland area. This wind-deposited silt is most prominent in the northeast portion of the county.

During Wisconsinan time, low terraces were formed along the Cimarron River valley. Also, additional Loess accumulation may have occurred in the county at this time.

In Recent time, the alluvial floodplain of the Cimarron River has developed, and the Dune Sand topography has been molded into its present form. The dunes are much more abundant south of the

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

*Figure 6. Geologic timetable of the Quaternary Period.*

Cimarron River and may indicate a northward stream migration. Numerous undrained depressions have developed in the Dune Sand and Loess-covered areas.

## GEO-ENGINEERING

Geo-engineering problems are not severe in Seward County because of: (1) absence of bedrock exposures, (2) abundance of granular material, (3) presence of low P.I. soils, (4) availability of relatively pure water, and (5) a semi-arid climate.

Material from all geologic units has been utilized for road construction purposes. Although material such as Loess may have undesirable plastic properties, it is not detrimental in road construction because of the low annual precipitation.

Much of the material in Seward County does not support vegetation readily, especially the granular Ogallala, Grand Island, Dune Sand, and Alluvium and Terrace Deposits. The northeast portion, containing Loess cover, supports vegetation best. Because of the dry climate and the small amount of top soil, the granular materials will support only hardy vegetation. When granular material is disturbed in road construction, it may be difficult to retain backslopes and fills because of erosion by wind and water. To help curb erosion, slopes in granular material should not exceed 3:1, and should be seeded with a hardy grass and mulched.

Because they cover such a large area, dunes are the source of most erosion problems. They are still active in some areas of Seward County, especially along the Cimarron River. Dune movement varies with the annual rainfall and erosional problems may be especially severe if dunes are disturbed during dry periods.

Because of the semi-arid climate, ground-water problems are not severe. Small problems may exist in areas where impervious layers of silt and clay prevent the downward percolation of surface water and a perched water table is formed.

During flood stage, water of the Cimarron River scours, both horizontally and vertically, causing rapid meandering and deep erosion. On several occasions, bridges and fills have been washed out. In these floods, deep scour undermined the support causing damage to the structure even though piling was driven to required bearing.

To help prevent loss of bridges, H-beam piling may be used in construction rather than pipe or concrete piling. Usually H-beam penetrates deeper into the unconsolidated material providing a deeper foundation for the structure. Also, study of the meandering history of the river by a series of aerial photographs helps locate a relatively stable crossing where the least meandering has taken place.

According to Byrne and McLaughlin (1948), ground-water is produced primarily from the Ogallala Formation with some yield from the Grand Island Formation and Alluvium and Terrace Deposits. Water from all sources is hard, with the alluvial water being the most highly mineralized. Test information indicates all water would be acceptable for use in Portland Cement concrete.

# MATERIALS INVENTORY SECTION

## GENERAL INFORMATION

Construction material in Seward County may be produced from five sources: Ogallala, Grand Island and Sappa Formations, Dune Sand, and Alluvium and Terrace Deposits. The Ogallala, Grand Island, and Alluvium and Terrace Deposits are sources of sand and gravel suitable for several phases of road construction. The Pearlette Ash zone in the Sappa is an excellent source of mineral filler. Also, accumulations of caliche in the Sappa are sources of aggregate for light type surfacing, and binder soil may be obtained from select locations in the Dune Sand.

Most construction material in Seward County is produced along a two and one-half mile band roughly paralleling the Cimarron River. In this zone overburden is thin, giving access to the material beds. Although material underlies most or all of the county, Dune Sand and Loess overburden prevent feasible recovery.

Loess is normally not considered a construction material source. More often, it is given geo-engineering consideration because of undesirable plastic properties. It was mapped in this report because of the large area it blankets.

CONTENTS

| TYPE and geologic source | USE | DESCRIPTION page | AVAILABILITY |
|---|---|---|---|
| <u>Sand and Gravel</u> | | | |
| Ogallala Formation | Concrete aggregate. Bituminous aggregate. Base course material. Shoulder material. Light type surfacing material. | 18 | Southeast part of the county along the Cimarron River. Shown on plates IV and VI. |
| Grand Island Formation | Concrete aggregate. Bituminous aggregate. Base course material. Shoulder material. Light type surfacing material. | 19 | Thin band on either side of the Cimarron River from the northwest to the southeast corners of the county. Shown on plates I, III, IV, and VI. |
| Sappa Formation (Caliche) | Light type surfacing material. | 20 | Thin band on either side of the Cimarron River from the northwest to southeast corners of the county. Also found in small areas in the Dune Sand topography where the sand is thin exposing or nearly exposing the Sappa. The Sappa Formation and (or) caliche pits are shown on plates I, III, IV, V, and VI. |
| Alluvium and Terrace Deposits | Concrete aggregate. Bituminous aggregate. Base course material. Shoulder material. Light type surfacing material. | 21 | Immediate stream valley of the Cimarron River from the northwest to the southeast corner of the county. Shown on plates I, II, IV, and VI. |
| <u>Mineral Filler</u> | | | |
| Sappa Formation (Pearlette Ash Zone) | Mineral Filler. | 22 | Highly scattered areas in a thin band parallel to the Cimarron River from the northwest to the southeast corner. Shown on plates I, III, IV, and VI. |
| <u>Binder Soil</u> | | | |
| Dune Sand | Base course binder | 23 | Select locations in the southern one-half of the county. Shown on plates I, III, IV, V, and VI. |
| <u>Silt</u> | | | |
| Loess | Embankment, subgrade, and slope material. | 24 | Upland area in the northern one-third of the county and a few scattered areas in the southern portion. Shown on plates I, II, III, IV, and V. |

*Figure 7. Tabulation of the construction material types and their availability in Seward County.*

# DESCRIPTION OF CONSTRUCTION MATERIAL

## Sand and Gravel

*Ogallala Formation*

The Ogallala Formation, generally tan to grayish-white in color, consists of clay, silt, sand, and gravel with nodules and stringers of caliche. Resistant outcrops termed *mortar bed* are found where calcium carbonate has cemented the material together. Thickness of the formation may be as much as 500 feet.

The Ogallala is exposed in the southeast part of Seward County along the Cimarron River (figure 8). Because much of the formation is partially covered with colluvium, the map unit is termed *Ogallala Formation with varying Colluvial cover.* This map unit is shown on plates IV and VI.

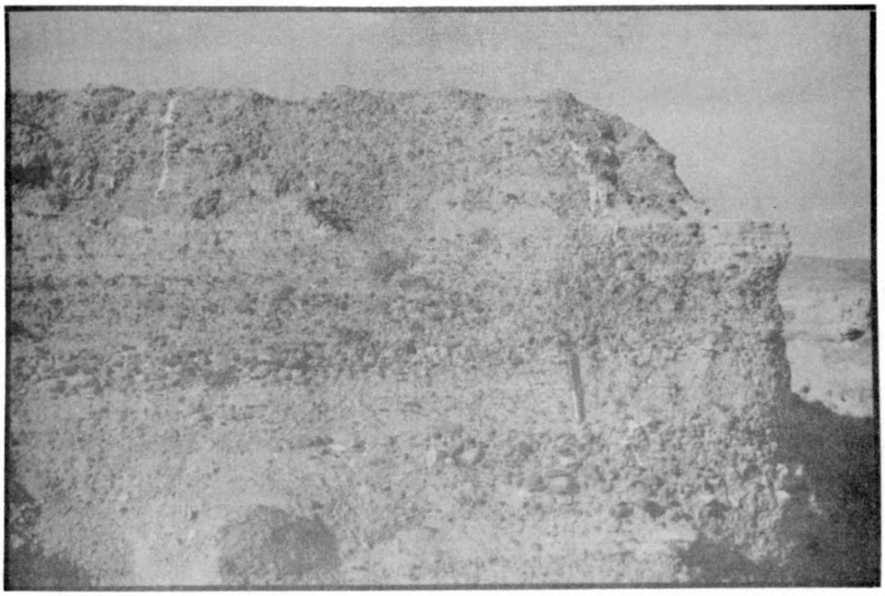


*Figure 8. Close-up of Ogallala sand and gravel in a materials pit, NW¼ sec. 1, T35S, R31W.*

Quality test results are not available on the Ogallala Formation in Seward County; but, the material is similar to that found in the Grand Island Formation. However, at some locations, sand and gravel from the Ogallala has a calcium carbonate coating on the grains that lower the quality. Material from this source *may* meet specifications for concrete and bituminous aggregate and can be used for shoulder, subgrade, and light type surfacing material. All production is by dry excavation methods.

*Grand Island Formation*

The Grand Island Formation is composed mostly of tan-colored silt, sand, and arkosic gravel. The unit, about 50 feet thick, is the best source of granular material available in the county. It is similar to the Ogallala Formation, from which it is derived, but may be of better quality because most of the calcium carbonate coating has been scoured off during transportation.

The Grand Island is exposed on both sides of the Cimarron River, where the stream has cut through younger deposits. The most extensive deposits of sand and gravel are found north of U. S. 54 Highway, especially around the Arkalon area (figure 9). The Grand Island was mapped in conjunction with the Sappa Formation as *Grand Island and Sappa Formations* map unit. These units are shown on plates I, III, IV, and VI.

This material is suitable for use as concrete and bituminous aggregate as well as base course, shoulder, and light type surfacing material. Because of the abundance of fine material, it may be necessary to process large quantities of material to obtain the

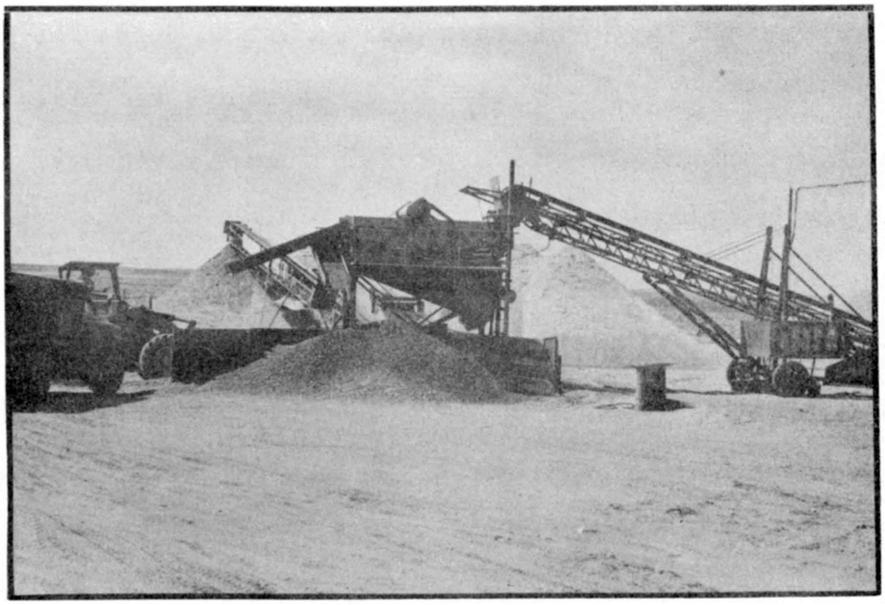


*Figure 9. Sand and gravel pit in the Grand Island Formation, SW¼ sec.34, T32S, R33W.*

desired gradation. The Grand Island is produced by dry excavation in Seward County. Quality information shows the Los Angeles wear range from 26.0 to 36.2 percent, the soundness loss ratio from 0.94 to 0.99 and the absorption from 0.40 to 0.81 percent. Additional test information on the Grand Island is shown in chart form in figure 14 (page 26).

*Sappa Formation (Caliche)*

The Sappa Formation, which may be as much as 50 feet thick, is composed of clay, silt, fine sand, caliche, and scattered zones of volcanic ash. At some localities large concentrations of caliche can be utilized as gravel for light type surfacing purposes (figure 10).

Because of difficulty in distinguishing the Sappa Formation from the Grand Island, the two units were mapped together as a

*Figure 10. Caliche gravel pit in the Sappa Formation, NE¼ sec. 3, T34S, R31W.*

single unit. In numerous locations, Dune Sand overlies the Sappa; however, in some areas, the dunes are thin, and the Sappa is exposed or near surface. These small *windows* give access to caliche laded zones in the unit. The Sappa Formation and (or) caliche pits are shown on plates I, III, IV, V, and VI.

No quality test results are available on any of the caliche pits. However, the caliche nodules are soft, and the gravel is contaminated with silt and clay. The material is of poor quality and probably will not be used for purposes other than light type surfacing.

*Alluvium and Terrace Deposits*

The Alluvium and Terrace Deposits are composed of tan-colored clay, silt, sand, and gravel. The texture ranges from fine to coarse with the fine fraction being most prominent. The thickness is estimated to be as much as 70 feet. These deposits cover only the immediate stream valley of the Cimarron River (figure 11). This map unit is illustrated on plates I, II, IV, and VI.

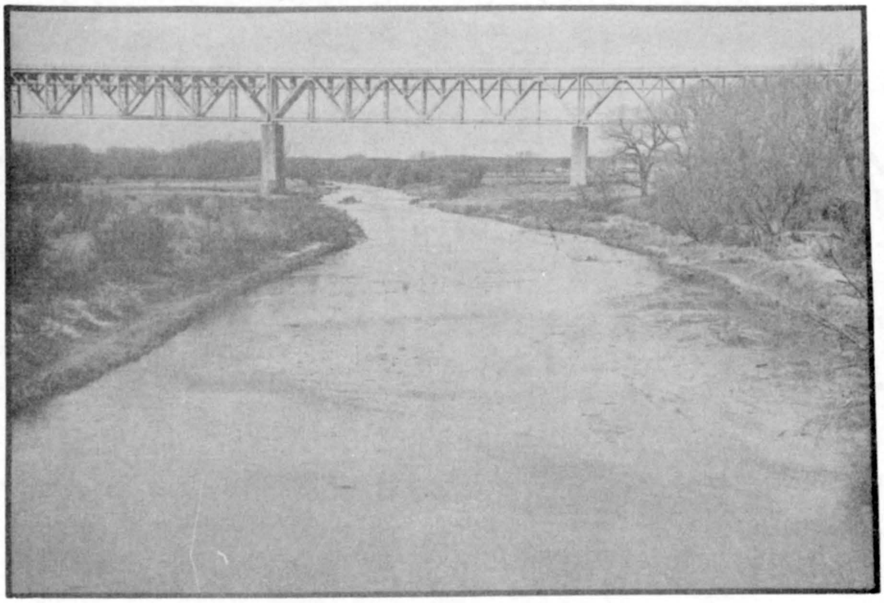


*Figure 11. Alluvium and low terraces of the Cimarron River, sec. 25, T33S, R32W.*

Gradation information on one alluvial site in Seward County is shown in figure 14, page 26. Because the material is similar to that produced from the Ogallala and Grand Island, it probably could be used in concrete, bituminous, base course and shoulder construction, and as light type surfacing material.

## Mineral Filler

### *Sappa Formation (Pearlette Ash Zone)*

The Sappa Formation contains scattered zones of volcanic ash that are important sources of mineral filler for bituminous mixes (figure 12). In its pure state, the ash is nearly white and has a

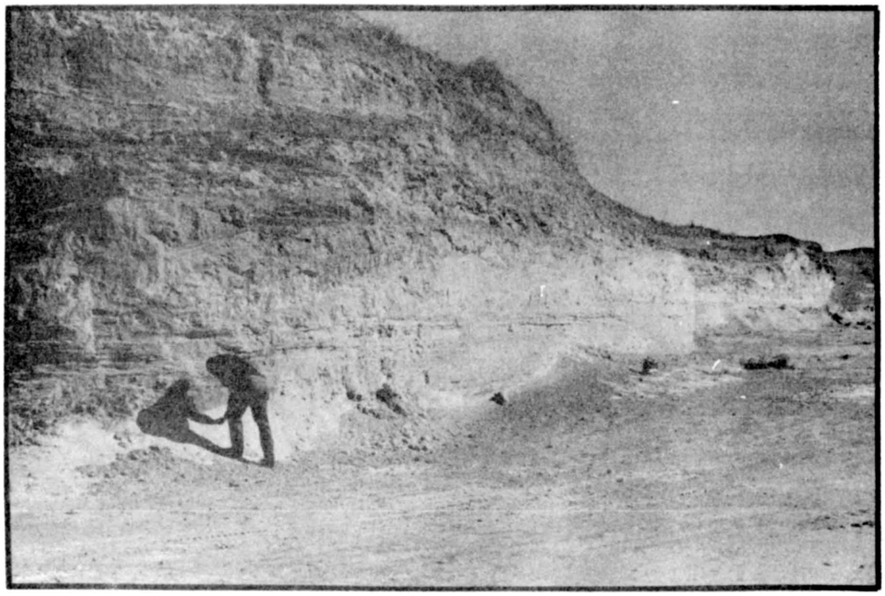


*Figure 12. Face of a Pearlette volcanic ash pit, NE¼ sec.13, T33S, R32W.*

plastic index of zero. However, much of the material has been contaminated, and weathered by percolating ground-water. Pearlette ash beds are irregular and generally do not exceed ten feet in thickness. Most deposits of economic importance range from three to five feet thick. Gradation data on one ash deposit is shown in figure 14, page 26.

Ash has been found at scattered localities in a band parallel to the Cimarron River (Grand Island and Sappa Formation map unit). The map unit is shown on plates I, III, IV, and VI.

## Binder Soil

### *Dune Sand*

Although dunes are found north of the Cimarron River, they are most prominent in the southern two-thirds of the county (figure 13).

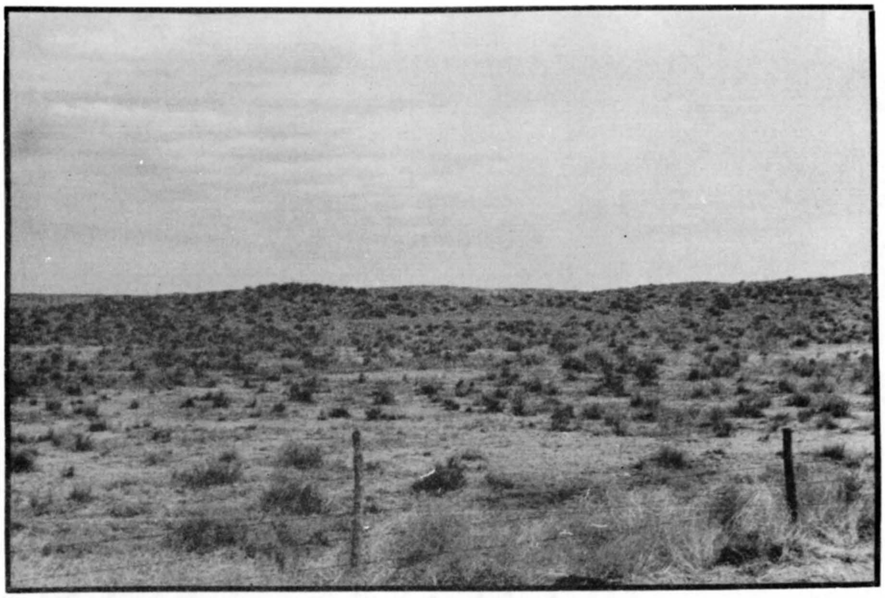


*Figure 13. Typical Dune Sand topography, S½ sec.34, T34S, R34W.*

They are composed mostly of fine sand with some silt and clay.

Dune Sand has been utilized to a *limited* extent as total aggregate on a few miles of low traffic volume roadway where more desirable materials were a considerable distance from the construction site. The dune material used most is a high plastic index silt. This *binder soil* has been produced only from select locations inasmuch as most of the material is too coarse for this purpose. Dune Sand is shown on plates I, III, IV, V, and VI.

## Silt

### *Loess*

Wind-deposited, clay-bound silt termed Loess, mantles a large part of the northern one-third and small areas in the southern two-thirds of Seward County.

The Loess is tan-brown in color and may be as much as 40 feet thick. Caliche nodules are commonly scattered throughout the unit.

Because large areas of the county are blanketed with Loess, this material is utilized for embankment and subgrade purposes. Sometimes Loess is used for slope protection where development of a turf is desired; otherwise, the material has no special use in road construction. Loess is mapped on plates I, II, III, IV, and V.

| Site No. | Material Type | Percent Retained 1½ | 3/4 | 3/8 | 4 | 8 | 16 | 30 | 50 | 100 | 200 | Wash | G.F. | P.I. | L.L. | Sp.Gr. Wet | Wt./Cu.Ft. | L.A. Wear | Soundness | Absorption | Source of Data |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Grand Island Formation - Qsgi** | | | | | | | | | | | | | | | | | | | | | |
| SG+61 | Sand & Gravel | 0 | 1 | 3 | 7 | 15 | 31 | 59 | 85 | 95 | -- | 4.0 | 3.29 | -- | -- | 2.57 | 108.0 | 33.2 | 0.99 | -- | Av. 9 samples, SHC form 619 No. 88-1 |
| SG+64 | Sand & Gravel | 0 | 0 | 7 | 14 | 25 | 45 | 71 | 90 | 96 | -- | 3.2 | 3.49 | -- | -- | 2.56 | 113.0 | 36.2 | 0.97 | -- | Av. 6 samples, SHC form 619 No. 88-2 |
| SG+35 | Sand & Gravel | 0 | 1 | 4 | 6 | 14 | 27 | 59 | 92 | 98 | -- | 5.0 | 3.01 | 17.0 | 2. | 2.58 | 107.9 | 35.2 | 0.99 | -- | Av. 8 samples, SHC form 619 No. 88-7 |
| SG+44 | Sand & Gravel | 0 | 2 | 4 | 8 | 19 | 37 | 73 | 94 | 98 | -- | 4.0 | 3.35 | 19.0 | 1. | 2.59 | 112.9 | 35.0 | 0.97 | -- | Av. 7 samples, SHC form 619 No. 88-8 |
| SG+53 | Sand & Gravel | 0 | 5 | 10 | 16 | 24 | 34 | 60 | 90 | 98 | -- | 3.0 | 3.40 | 16.0 | 1. | 2.60 | 114.0 | 34.1 | 0.99 | -- | Av. 8 samples, SHC form 619 No. 88-9 |
| SG+63 | Sand & Gravel | 0 | 3 | 5 | 12 | 24 | 43 | 73 | 95 | 99 | -- | 4.7 | 3.53 | 17.6 | 2. | 2.58 | 114.1 | 26.6 | 0.99 | -- | Av. 8 samples, SHC form 619 No. 88-10 |
| SG+45 | Sand & Gravel | 0 | 2 | 4 | 8 | 19 | 39 | 71 | 91 | 97 | -- | 4.5 | 3.35 | 17.8 | 2. | 2.58 | 111.9 | 29.2 | 0.98 | -- | Av. 8 samples, SHC form 619 No. 88-11 |
| SG+47 | Sand & Gravel | 0 | 0 | 2 | 6 | 15 | 35 | 63 | 87 | 95 | -- | 3.0 | 3.03 | 18.0 | -- | 2.59 | 113.0 | 29.0 | 0.99 | -- | Av.12 samples, SHC form 619 No. 88-12 |
| SG+54 | Sand & Gravel | 0 | 4 | 11 | 17 | 29 | 43 | 68 | 87 | 98 | -- | 6.0 | 3.58 | 15.0 | -- | 2.60 | 119.8 | 34.2 | 0.98 | -- | Av. 7 samples, SHC form 619 No. 88-13 |
| SG+39 | Sand & Gravel | 0 | 3 | 7 | 14 | 26 | 41 | 66 | 91 | 97 | -- | 3.5 | 3.46 | 16.5 | 2. | 2.59 | 117.4 | 33.4 | 0.98 | -- | Av. 8 samples, SHC form 619 No. 88-14 |
| SG+43 | Sand & Gravel | 0 | 3 | 7 | 11 | 21 | 37 | 62 | 85 | 93 | -- | 4.7 | 3.19 | 17.7 | -- | 2.60 | 114.4 | 27.4 | 0.98 | -- | Av. 9 samples, SHC form 619 No. 88-16 |
| SG+49 | Sand & Gravel | 0 | 1 | 5 | 9 | 15 | 31 | 55 | 83 | 91 | -- | 4.6 | 2.92 | -- | -- | 2.59 | 103.6 | 34.4 | 0.97 | 0.81 | 1 sample, SHC form 619 No. 88-19 |
| SG+38 | Sand & Gravel | 2 | 10 | 21 | 37 | 54 | 71 | 87 | 96 | 99 | -- | 0.72 | 4.77 | -- | -- | 2.61 | 117.4 | 28.8 | 0.98 | 0.70 | 1 quality sample, SHC Lab. No. 97867 |
| SG+40 | Sand & Gravel | 0 | 8 | 15 | 22 | 32 | 49 | 72 | 92 | 96 | -- | 2.0 | 3.86 | -- | -- | 2.56 | 111.5 | 34.0 | 0.99 | -- | 1 quality sample, SHC Lab. No. 44952 |
| SG+62 | Sand & Gravel | 0 | 5 | 10 | 17 | 30 | 48 | 67 | 84 | 94 | -- | 6.2 | 3.53 | -- | -- | -- | --- | 32.5 | 0.99 | -- | 1 quality sample, SHC Lab. No. 66-4893 |
| SG+42 | Sand & Gravel | 0 | 2 | 10 | 22 | 43 | 63 | 82 | 95 | 97 | -- | 2.2 | 4.14 | -- | -- | 2.62 | 108.1 | 26.0 | 0.98 | 0.50 | 1 quality sample, SHC Lab. No. 556 |
| SG+41 | Sand & Gravel | 0 | 7 | 13 | 21 | 32 | 51 | 78 | 93 | 98 | -- | 1.2 | 3.93 | -- | -- | 2.62 | 114.6 | 30.0 | 0.99 | -- | 1 quality sample, SHC Lab. No. 79860 |
| SG-37 | Sand & Gravel | 0 | 1 | 5 | 10 | 27 | 57 | 83 | 94 | 96 | -- | 3.2 | 3.73 | -- | -- | 2.57 | 110.0 | 35.0 | 0.94 | -- | 1 quality sample, SHC Lab. No. 45037 |
| SG+51 | Sand & Gravel | 0 | 3 | 7 | 12 | 21 | 35 | 56 | 78 | 91 | -- | 5.5 | 3.03 | -- | -- | 2.57 | 110.2 | 30.6 | 0.97 | -- | 1 quality sample, SHC Lab. No. 69699 |
| SG+36 | Sand & Gravel | 1 | 5 | 9 | 15 | 24 | 40 | 62 | 82 | 93 | -- | --- | 3.31 | -- | -- | 2.60 | 115.7 | 33.3 | 0.99 | -- | 1 quality sample, SHC Lab. No. 68708 |
| SG+46 | Sand & Gravel | 0 | 3 | 8 | 17 | 28 | -- | -- | -- | 96 | -- | 1.0 | 3.63 | -- | -- | -- | --- | -- | -- | -- | 1 quality sample, SHC Lab. No. 12537 |
| SG+48 | Sand & Gravel | 0 | 4 | 12 | 24 | 40 | 57 | 76 | 89 | 95 | -- | 2.5 | 3.97 | -- | -- | 2.60 | 119.0 | 36.1 | 0.98 | 0.40 | 1 quality sample, SHC Lab. No. 65-3027 |
| **Sappa Formation - Qsgi** | | | | | | | | | | | | | | | | | | | | | |
| VA+52 | Volcanic Ash | 0 | 0 | 1 | 1 | 2 | 3 | 4 | 6 | 14 | -- | 75.0 | -- | -- | -- | -- | --- | -- | -- | -- | Av. 8 samples, SHC form 619 No. 88-17 |
| **Alluvium - Qal** | | | | | | | | | | | | | | | | | | | | | |
| SG+50 | Sand & Gravel | 0 | 8 | 17 | 31 | 43 | -- | -- | -- | 99 | -- | 1.0 | 4.25 | -- | -- | -- | --- | -- | -- | -- | 1 quality sample, SHC Lab. No. 28072 |

*Figure 14. Results of tests completed on samples of material from the Grand Island and Sappa Formations and the Alluvium in Seward County.*