

SOIL SURVEY

Greeley County, Kansas



UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
in Cooperation with
KANSAS AGRICULTURAL EXPERIMENT STATION

HOW TO USE THE SOIL SURVEY REPORT

THIS REPORT is about the soils of Greeley County. The soil survey was made to find out the nature and extent of each soil. In making the survey, soil scientists dug holes and examined surface soils and subsoils in cultivated fields and native grasslands. They measured slopes with a hand level; observed differences in growth of crops, weeds, and grasses; and recorded all the things about the soils that they believed might affect their suitability for use as cropland or rangeland.

The soil scientists placed the soil boundaries on aerial photographs. Then cartographers prepared from the photographs the detailed soil map in the back of this report.

Locating the Soils

Use the index for the map sheets to locate areas on the large map. The index is a small map of the county on which numbered rectangles have been drawn to show where each sheet of the large map is located. The boundaries of the soils are outlined on each sheet of the soil map, and there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they appear on the map. The symbol will be inside the area if there is enough space; otherwise, it will be outside the area and a pointer will show where it belongs.

Suppose, for example, an area located on the map has the symbol Rm. The legend for the detailed map shows that this symbol identifies Richfield silt loam, 0 to 1 percent slopes. This soil and all others mapped in the county are described in the section "Descriptions of the Soils."

Finding Information

Few readers will be interested in all of the soil survey report. It has special sections for different groups, as well as sections that may be of value to all.

Farmers and those who work with farmers can learn about the soils in the section "Descriptions of the Soils" and can identify those on their farm. They can learn how these soils can be managed by reading the section "Use and Management of the Soils."

The soils are placed in capability units; that is, groups of soils that need similar management and respond in about the same way. For example, in the section "Descriptions of the Soils," Richfield silt loam, 0 to 1 percent slopes,

is shown to be in capability unit IIIc-1. The management suitable for this soil, therefore, will be described under the heading "Capability Unit IIIc-1" in the section "Use and Management of the Soils."

The soils are placed in range sites, which are kinds of rangeland. For example, Ulysses silt loam, 0 to 1 percent slopes, is placed in the Loamy Upland range site. Each range site has a given potential production of grasses and other vegetation. A description of each range site is given in the section "Range Management."

The "Guide to Mapping Units, Capability Units, and Range Sites" at the back of the report will simplify the use of the map and the report. The guide gives the map symbol for each soil; the name of the soil and the page on which the soil is described; the capability unit in which the soil has been placed and the page on which it is described; and the range site in which the soil occurs and the page on which it is described.

If you want help in making plans for your farm, consult a local representative of the Soil Conservation Service or the county agricultural agent. Members of the staff of the State agricultural experiment station and others familiar with farming in Greeley County will also be glad to help.

Soil scientists will find information about how the soils were formed and how they are classified in the section "Soil Classification and Development."

Students, teachers, and other users will find information about soils and their management in various parts of the report, depending on their particular interest.

Newcomers in Greeley County will be especially interested in the section "General Soil Areas," which describes the broad pattern of the soils. They may also wish to read the section "General Nature of the County," which gives additional information about the county.

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This cooperative soil survey was made by the United States Department of Agriculture and the Kansas Agricultural Experiment Station to provide a basis for determining the best agricultural uses of the soils. The Soil Conservation Service conducted the fieldwork for the survey. This work was completed in 1958, and all statements in this report, unless otherwise specified, refer to conditions at that time. The soil survey is part of the technical assistance furnished to the Greeley County Soil Conservation District.

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I



Growth Through Agricultural Progress

SOIL SURVEY OF GREELEY COUNTY, KANSAS

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KANSAS AGRICULTURAL EXPERIMENT STATION

GREELEY COUNTY has an area of 501,120 acres, or 783 square miles. It occurs in western Kansas on the border of Colorado and is about midway between Nebraska and Oklahoma (fig. 1). It occupies part of the nearly level to gently rolling high plains between the Arkansas River to the south and the Smoky Hill River to the north.

Agriculture is the only industry in Greeley County. Wheat, grain sorghum, and cattle are the main sources of income. Most of the acreage in the county is cultivated. A small acreage is irrigated by deep-well pumping systems. The areas remaining in native grass are mostly on slopes adjacent to drainageways.

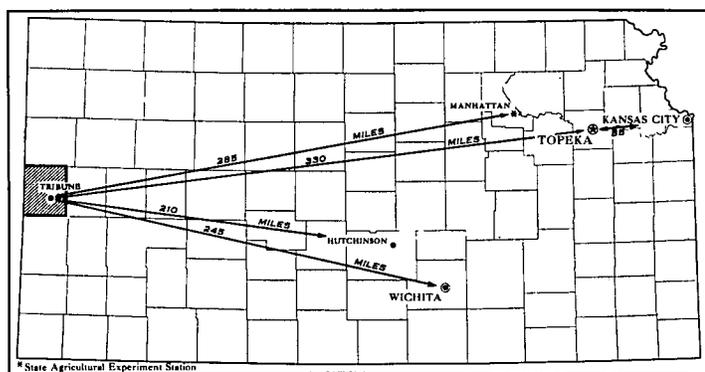


Figure 1.—Location of Greeley County in Kansas.

General Soil Areas

The soils of Greeley County occur in a pattern that is closely related to the topography (lay of the land) and to the type of material in which the soils have developed. Because of this pattern, the county can be divided into two general soil areas, or, as they are sometimes called, soil associations (fig. 2).

Richfield-Ulysses Soil Association

The soils of this association occupy nearly level to gently sloping, undissected tablelands of the county (fig. 3). Richfield silt loam and Ulysses silt loam are the main soils. Ulysses loam and Colby silt loam are less extensive. All of these soils have developed in the deep, silty loess that mantles much of the High Plains and most of Greeley County.

Richfield silt loam, the most extensive soil in the county, comprises most of this soil association. It has a dark silt loam surface layer over a dark, somewhat more clayey

subsoil that grades to light-colored, friable, calcareous loess at about 12 to 15 inches. It occupies the broad, nearly level areas that have poorly defined drainageways and a few small, enclosed depressions or potholes. Lofton clay loam is the dark, clayey soil that occupies these low areas.

The Ulysses soils occur on nearly level and gentle slopes. They have moderately dark loam and silt loam surface layers that grade at about 8 to 12 inches to the light-colored, underlying loess. The light-colored, calcareous Colby silt loam is inextensive and occurs on gentle to moderate slopes. Goshen silt loam is a minor but important soil. It is a deep, dark soil developed from local alluvial sediments in the narrow, nearly level upland swales and drainageways having no definite channel.

Nearly all of this area is used for cash crops of wheat and grain sorghum. Wind erosion is a hazard on the nearly level soils. Both wind and water erosion are hazards on gentle slopes. Water conservation is necessary for profitable crop production on all the soils.

Ulysses-Colby Soil Association

The soils of this association occupy the gentle to steep slopes adjacent to and including the more deeply entrenched upland drainageways. The few areas of this association are shown on the map in figure 2. Ulysses loam, Ulysses silt loam, and Colby silt loam are the principal soils of these areas. They have developed in the loess or similar silty sediments that mantle most of the county.

Ulysses soils have moderately dark loam to silt loam surface layers over very light-colored, friable, calcareous silt loam subsoils. They occupy most of the gentle slopes of 1 to 3 percent, and a few areas have slopes as much as 5 percent. Colby silt loam has a light-colored, silt loam surface layer slightly darker than the underlying silty loess. This soil is friable and calcareous throughout. It normally occupies most of the moderate and steep slopes of from 3 to 15 percent and occurs in small areas of 1 to 3 percent slopes. Some areas were formerly Ulysses loam or silt loam, but erosion has removed the dark surface layer so that these areas are now indistinguishable from Colby soils.

The soils of the Goshen, Potter, Mansker, Manter, and Lincoln series also occur in this general soil area but are much less extensive. Goshen silt loam is a deep, dark soil occupying the generally narrow, nearly level, upland swales and valley benches. Potter soils are shallow and generally less than 12 inches deep over hard caliche or limestone. Mansker soils are between 12 and 30 inches deep over the same material. Potter and Mansker soils occur in such a pattern that it was not practical to map them separately. They occupy moderate to steep, sometimes broken slopes of about 5 to 20 percent. The deep,

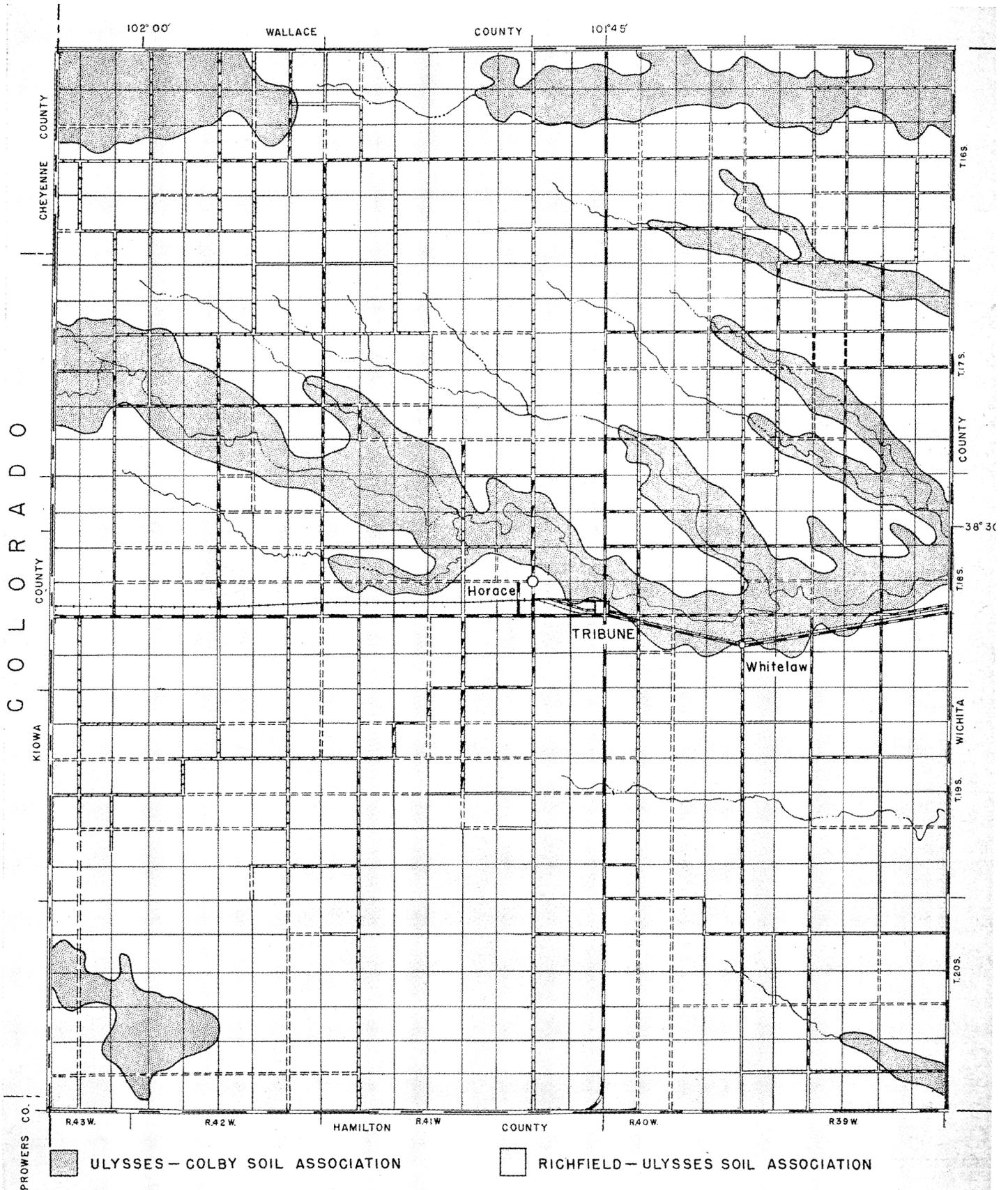


Figure 2.—General soil areas of Greeley County.

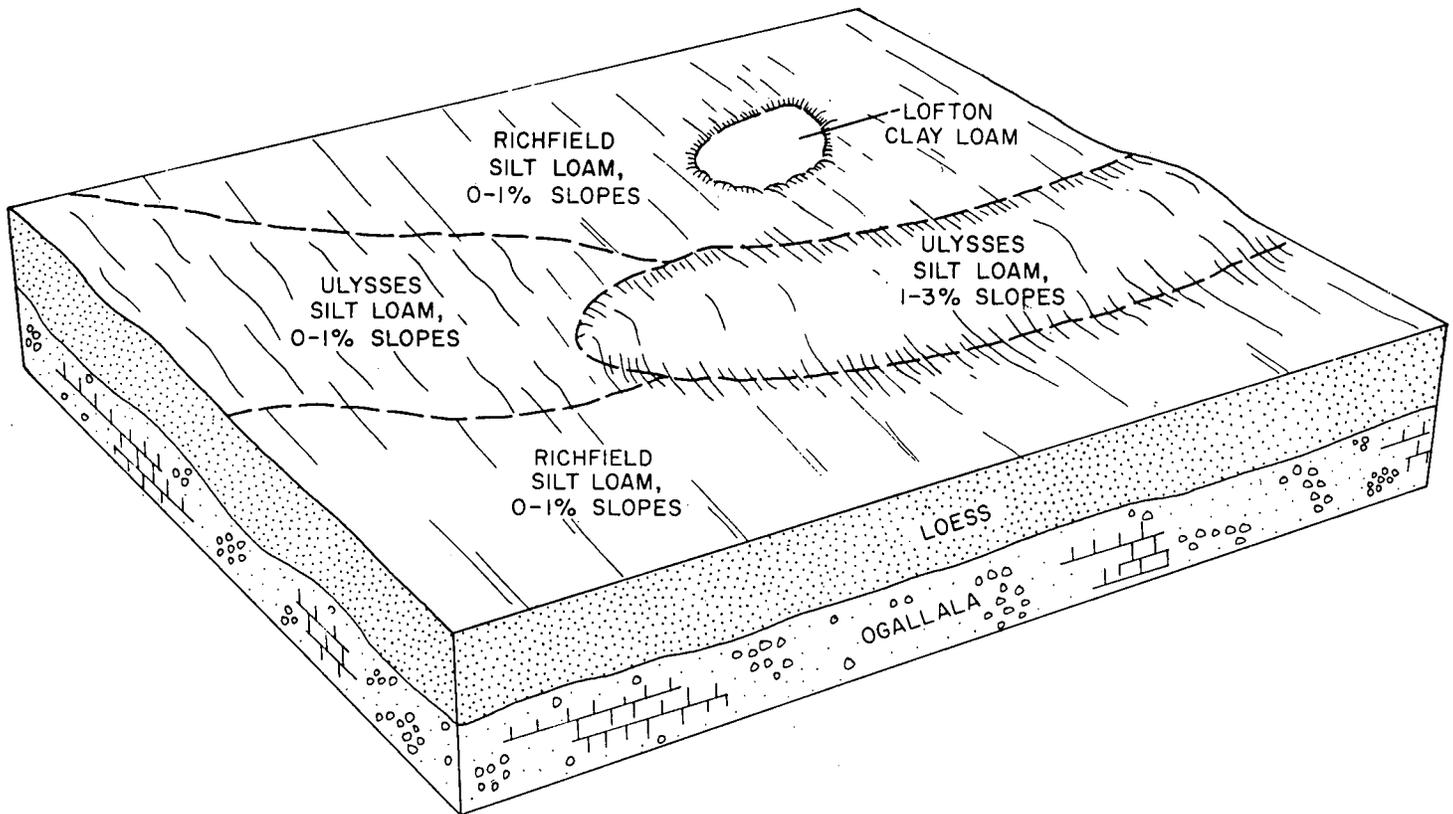


Figure 3.—Typical section of the Richfield-Ulysses soil association.

moderately dark Manter fine sandy loam is only a few hundred acres in extent. It occurs on hummocky topography having slopes of about 5 to 15 percent. Lincoln fine sandy loam is a light-colored, shallow soil with a fine sandy loam surface layer and a loose, loamy sand to sand subsoil. It occupies the low flood plain of White Woman Creek.

Most of the soils in this association that occur on gentle to moderate slopes are cultivated. Wheat and grain sorghum are the principal crops. The soils on the steeper and more broken slopes remain in native grass and are used for grazing. Wind and water erosion are hazards. Conservation of water is necessary for successful growing of crops.

Descriptions of the Soils

The soils mapped in Greeley County are described in this section, and the main facts about each are given. These descriptions contain some technical terms, which are explained in the Glossary in the back of this report and in the Soil Survey Manual.¹ The capability unit and range site, described in other sections of this report, are given for each soil.

The scientists who made the soil map dug many holes to examine the characteristics of the different layers that make up each soil. They noted the lay of the land, the condition of crops and other plants and their habits of

growth, the kind and character of the underlying material wherever it was exposed, and any other characteristics of the landscape that would indicate the nature and extent of each kind of soil being mapped. Slope gradients were measured with a hand level. Aerial photographs were used as a base map on which to draw the boundaries between the soil mapping units.

Soil scientists designate the different soil layers, or horizons, with letters of the alphabet. The thickness of the various horizons is determined by the appearance and feel of the soil material. Color, texture, structure, and consistence are all used to distinguish between horizons. The color of each horizon is indicated by both a descriptive term and the Munsell notation. The Munsell notation names the hue, value, and chroma in the standard color charts used by soil scientists.

Soil texture refers to the relative proportions of the sand, silt, and clay particles that make up the soil mass. Sands are coarse, clays are fine, and silts are intermediate in size. In the field, texture is determined by feel, but some samples are analyzed in a laboratory for comparison.

Structure refers to the arrangement of the soil particles in the natural aggregations found in the soil. Important characteristics of structure are shape (granular, subangular blocky, and so on), size, and grade (distinctness). Soil without definite structure is described as massive if the material is coherent and as single grain if it is not. Loose sand is a good example of single grain.

Consistence is determined by feel and is gauged by the resistance of the aggregates to pressure. Both moist and dry consistence are generally indicated.

¹ SOIL SURVEY STAFF. SOIL SURVEY MANUAL. U.S. Dept. Agr. Handbook No. 18. 503 pp., illus., 1951.

The upper part of the soil is called the A horizon. It is usually darker than deeper layers because of organic matter. The subsoil, or B horizon, is next below the A horizon. It contains more clay than the A horizon—enough to make it seem heavier and feel stickier when wet. Some soils, especially weakly developed and young soils, may not have a B horizon. The underlying, or parent, material, designated as C horizon, is similar to the horizons above but has been affected very little by accumulation of organic matter, weathering, or other factors of soil formation. In Greeley County the parent material generally contains free lime, is lighter colored, and has less structure than the horizons above.

Some soil conditions, such as rock outcrops or depressions, are shown by special spot symbols on the soil map. The applicable symbol is explained in the legend for the soil map.

The location and distribution of the soils in Greeley County are shown on the soil map. The acreage of each mapping unit is given in table 1.

TABLE 1.—Approximate acreage and proportionate extent of the soils

| Soil | Acres | Percent |
|---|---------|---------|
| Colby silt loam, 1 to 3 percent slopes | 15,556 | 3.1 |
| Colby silt loam, 3 to 5 percent slopes | 7,578 | 1.5 |
| Colby silt loam, 5 to 15 percent slopes | 7,600 | 1.5 |
| Goshen silt loam | 22,295 | 4.4 |
| Goshen silt loam, bench | 5,063 | 1.0 |
| Lincoln fine sandy loam | 3,295 | .7 |
| Lofton clay loam | 3,597 | .7 |
| Manter fine sandy loam, 5 to 15 percent slopes | 342 | .1 |
| Potter-Mansker complex | 1,167 | .2 |
| Richfield silt loam, 0 to 1 percent slopes | 305,285 | 60.9 |
| Ulysses silt loam, 0 to 1 percent slopes | 18,700 | 3.7 |
| Ulysses silt loam, 1 to 3 percent slopes | 99,236 | 19.8 |
| Ulysses loam, 1 to 3 percent slopes | 9,368 | 1.9 |
| Ulysses loam and silt loam, 3 to 5 percent slopes | 1,756 | .4 |
| Intermittent water | 282 | .1 |
| Total | 501,120 | 100.0 |

Colby silt loam, 1 to 3 percent slopes (Cb).—This is a deep, friable, light-colored soil of the uplands. It is weakly developed in deep loess or other silty sediments on gentle slopes.

This soil has a grayish-brown, calcareous silt loam surface soil that is only slightly darker than the underlying parent loess. Free lime occurs throughout the profile. The soil is moderately permeable to plant roots, air, and water and has the capacity to hold a large amount of water available to plants.

Colby silt loam differs from the associated Ulysses silt loam in having a lighter colored and calcareous surface soil. The associated Richfield silt loam is much darker than Colby silt loam and has a more clayey subsoil.

Typical profile (300 feet south and 550 feet east of the west quarter corner of sec. 16, T. 19 S., R. 42 W.; in a cultivated field with slopes of about 2½ percent):

A_p 0 to 5 inches, grayish-brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) when moist; weak, granular structure; friable when moist, slightly hard when dry; calcareous; gradual boundary.

AC 5 to 10 inches, silt loam that has an intermediate and mixed color of about grayish brown (10YR 5.5/2); dark grayish brown (10YR 4.5/2) when moist; moderate, medium, granular structure; numerous worm casts; similar to horizon above; gradual boundary.

C_{ca} 10 to 20 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; very weak; medium, sub-angular blocky structure; friable when moist, slightly hard when dry; calcareous with faint films and streaks of lime; some worm casts; gradual boundary.

C 20 to 52 inches +, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) when moist; massive; porous; very friable; calcareous.

Significant variations in the profile are not common. The thickness of the darkened surface soil ranges from 3 to 9 inches. The horizon of lime accumulation contains noticeable amounts of segregated lime in places.

Included with Colby silt loam, 1 to 3 percent slopes, are small areas of Ulysses silt loam and Ulysses loam. Some cultivated areas of Colby silt loam may be eroded areas that were formerly Ulysses silt loam. After the dark surface layer is removed, Ulysses silt loam is not distinguishable from Colby silt loam, and the eroded soil is mapped as Colby silt loam, 1 to 3 percent slopes.

A light-colored loam soil that occupies very small areas on the crests of knolls and ridges is also included with Colby silt loam, 1 to 3 percent slopes. This soil is not extensive enough to be mapped separately. Where it is in a Colby silt loam area, it was included with this soil. The following profile description is typical of this included soil under cultivation:

A_p 0 to 5 inches, brown (10YR 5.5/3) loam, dark brown (10 YR 4/3) when moist; weak, granular structure; friable; calcareous.

C_{ca} 5 to 18 inches, pale-brown (10YR 6/3) sandy loam, brown (10YR 5/3) when moist; massive but porous; very friable; strongly calcareous, with films and streaks of segregated lime; gradual boundary.

C 18 to 50 inches +, pale-brown (10 YR 6/3), weakly stratified loam and sandy loam, brown (10YR 5/3) when moist; massive; friable when moist, soft when dry; calcareous.

Colby silt loam, 1 to 3 percent slopes, is not well suited to crops, but much of it is cultivated. Wheat and sorghum are grown under a system that alternates crops with fallow. Runoff and removal of soil by water erosion are excessive unless proper conservation practices are used. Wind erosion is a serious and constant hazard. Soil blowing occurs when the soil is not adequately protected by cloddiness, vegetation, or crop residue. (Capability unit IVe-1; Loamy Upland range site.)

Colby silt loam, 3 to 5 percent slopes (Cc).—This soil occurs mainly on moderate slopes adjacent to the deeper drainageways.

Minor areas of Ulysses soils and Colby silt loam, 1 to 3 percent slopes, have been included with this soil in mapping.

Some areas of Colby silt loam, 3 to 5 percent slopes, are cultivated, but the soil is not well suited to crops. The organic-matter content is very low, and the soil seals and slicks over during rainstorms. Runoff is excessive, and large amounts of soil are removed by water erosion. Wind erosion is also a serious hazard. (Capability unit VIe-1; Loamy Upland range site.)

Colby silt loam, 5 to 15 percent slopes (Cd).—This nonarable soil has a profile like that of Colby silt loam, 1 to 3 percent slopes. It is chiefly on slopes of more than 5 percent along the larger and deeper drainageways.

Mapped with this soil are (1) valley floors less than 200 feet wide that are occupied by Goshen silt loam; and (2) a few areas of Potter and Mansker soils that are less than 20 acres in size. These included soils make up about 15 percent of Colby silt loam, 5 to 15 percent slopes, and are in areas too small for separate consideration in range planning and management.

Most of Colby silt loam, 5 to 15 percent slopes, is still covered by the native mid grass and short grass and is used for grazing. A few small areas in large fields of arable soils have been plowed. These cultivated areas generally have been severely eroded. Most of them have been abandoned as cropland. Areas still cultivated should be seeded to native grasses and used as rangeland. (Capability unit VIe-1; Loamy Upland range site.)

Goshen silt loam (Go).—This is a deep, dark, friable soil. It occupies the nearly level, generally concave floors of shallow upland swales. It has developed in silty material that has come from the Ulysses and Richfield soils on the slightly higher adjacent slopes. The dominant slope is less than 1 percent but is sufficient for good surface drainage. The soil is porous and permeable, absorbs water readily, and has good internal drainage. The darkened surface soil is much thicker and slightly darker than that of the associated Ulysses and Richfield soils.

Typical profile (300 feet west and 700 feet south of northeast corner of sec. 29, T. 20 S., R. 40 W.; in cultivated field) :

- A₁ 0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2.5/2) when moist; moderate, medium, granular structure; friable when moist, hard when dry; noncalcareous; abrupt boundary.
- B₁ 7 to 15 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate to strong, medium, granular structure; friable when moist, hard when dry; thin, patchy clay films on surfaces of structural aggregates; noncalcareous; gradual boundary.
- B₂ 15 to 27 inches, dark grayish-brown (10YR 4/2) silty clay loam, dark brown (10YR 3/3) when moist; slightly less dark in lower half; moderate, medium, subangular blocky structure; firm when moist, very hard when dry; thin, continuous clay films; moderately porous and permeable; noncalcareous; gradual boundary.
- B₃ 27 to 48 inches, grayish-brown (10YR 5/2) light silty clay loam, brown (10YR 4/2.5) when moist; weak, medium, subangular blocky structure; firm when moist, hard when dry; moderately permeable; calcareous; a few films and streaks of segregated lime; gradual boundary.
- C 48 to 78 inches +, similar to above horizon but without segregated lime.

Significant variations in the profile are not common. Subsoil texture ranges from heavy silt loam to silty clay loam; the finer textures occur in the broader swales. The depth to calcareous material ranges from about 15 to about 30 inches.

Goshen silt loam seldom makes up whole fields, but it is moderately extensive in the county and is important agriculturally because of its high productivity. Most of it is cultivated with other cropland. Wheat and sorghum are the chief crops. Crops generally benefit from the extra moisture received as runoff from adjacent areas. Yields are slightly higher than those from the associated Ulysses and Richfield soils. Water erosion is negligible, but wind erosion will occur where the soil is dry and lacks growing vegetation or its residue. (Capability unit IIIc-2; Lowland range site.)

Goshen silt loam, bench (Gt).—This is a deep, dark, friable soil. It occurs on the nearly level terraces or benches along White Woman Creek that are above overflow. The soil has developed mainly in silty sediments that show only weak stratification, if any. It is porous and permeable, has good capacity to hold available water, and has slow runoff and good internal drainage.

Although this soil is similar to the typical Goshen silt loam, it is darkened less deeply and has free lime higher in the profile. This phase receives less extra moisture as runoff from adjoining areas than Goshen silt loam.

Typical profile (600 feet east and 300 feet south of north quarter corner of sec. 26, T. 18 S., R. 40 W.; in native grass pasture on bench about 15 feet above the level of the flood plain of White Woman Creek) :

- A₁ 0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; friable when moist, hard when dry; noncalcareous; gradual boundary.
- B₂ 8 to 17 inches, dark grayish-brown (10YR 4/2) light silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, subangular blocky structure; friable when moist, hard when dry; noncalcareous; weak, discontinuous clay films on structural aggregates; gradual boundary.
- B₃ 17 to 28 inches, grayish-brown (10YR 5/2) light silty clay loam, dark brown (10YR 4/3) when moist; weak, subangular blocky structure; friable when moist, slightly hard when dry; calcareous; few, faint lime films; gradual boundary.
- C 28 to 54 inches +, pale-brown (10YR 6/3), slightly stratified loam and silt loam, brown (10YR 4.5/3) when moist; massive (structureless); very friable when moist, soft when dry; calcareous.

Significant variations in the profile are not common. In some places, below a depth of about 20 inches, there are darkened layers that are remnants of buried soils. Depth to free lime ranges from about 10 to 20 inches. In some places the surface layer is a loam. In many places the B horizon is more weakly expressed than in the typical profile.

Much of the Goshen silt loam, bench, is planted to wheat and sorghum. The soil is well suited to crop production, but conservation of moisture is essential for profitable yields. Wind erosion is a hazard where the soil is dry and not protected by vegetation or cloddiness. (Capability unit IIIc-1; Loamy Upland range site.)

Lincoln fine sandy loam (Lf).—This soil is in areas of only slightly darkened, very sandy alluvium on the flood plain of White Woman Creek. The creek channel, 5 to 10 feet deep, is included within the soil as mapped. The mapped areas are generally interrupted by this narrow, meandering channel. Recurrent floods deposit fresh material on the soil.

This soil has a calcareous, fine sandy loam surface layer, 6 to 12 inches thick, underlain by stratified, very sandy material that ranges from coarse sand to loamy fine sand. The ground water table is everywhere more than 10 feet below the surface and in most places is much deeper.

Typical profile (800 feet east and 300 feet north of the west quarter corner sec. 7, T. 18 S., R. 40 W.; in native grass pasture on flood plain of White Woman Creek) :

- A₁ 0 to 5 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 3.5/2) when moist; weak, granular structure; very friable when moist, soft when dry; calcareous; gradual boundary.

AC 5 to 12 inches, brown (10YR 5/3) light fine sandy loam, dark brown (10YR 4/3) when moist; structureless; very friable when moist, loose when dry; calcareous; few coarse sand grains and fine gravel; gradual boundary.

C 12 to 24 inches +, pale-brown (10YR 6/3) stratified sand and gravel; loose; calcareous.

The soil is generally calcareous to the surface. In places, however, it is noncalcareous to a depth of 10 inches. The first few inches of surface soil ranges from loam to loamy fine sand, but the prevailing texture is fine sandy loam. A few gravel bars occur at or below the surface. These bars are a valuable source of gravel for roads and other construction work.

Lincoln fine sandy loam is unsuitable for crops because of low water-holding capacity (droughtiness), high susceptibility to wind erosion without cover, and frequent flooding, channel cutting, and depositing of sand. Most of the areas are used for range. The native vegetation is sparse and consists of mid grasses and short grasses, sand sage, and yucca. (Capability unit VIIw-1.)

Lofton clay loam (lo).—This is a deep, dark, moderately fine textured soil. It occupies the small, upland depressions locally called potholes or buffalo wallows. These enclosed depressions have no surface drainage and receive extra water as runoff. The soil is slowly permeable, and water may be ponded for several days to more than a week.

This soil has a small total acreage and occurs mainly in association with nearly level areas of Richfield and Ulysses soils. Lofton soils are darker and more clayey than either Richfield or Ulysses soils.

Typical profile (northwest corner of sec. 30, T. 19 S., R. 41 W.; in floor of a depression in a cultivated field):

A₁ 0 to 6 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, granular structure; friable when moist, hard when dry; noncalcareous; abrupt boundary (plow slice).

B₂ 6 to 24 inches, dark grayish-brown (10YR 4/1.5) light clay, very dark gray (10YR 3/1) when moist; mixed weak, subangular blocky and blocky structure; firm when moist, very hard when dry; thin, almost continuous clay films on structural aggregates; noncalcareous; gradual boundary.

B₃ 24 to 40 inches, light brownish-gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, granular structure; friable when moist, hard when dry; noncalcareous; gradual boundary.

C 40 to 55 inches +, pale-brown (10YR 6/3) heavy silt loam, brown (10YR 5/3) when moist; massive (structureless); friable when moist, slightly hard when dry; calcareous; very few small lime concretions.

The profile varies from one depression to another, but not to an extent that significantly affects use and management of the soil. The variations depend upon the size of the depression and the extent of its drainage area; they are mainly in texture of surface soil and subsoil and in depth to free lime.

Most areas of Lofton clay loam are cultivated along with the associated soils. Water is ponded long enough at times to delay planting and harvesting. Crops are frequently drowned and lost or are replanted. Wind erosion is also a hazard on cultivated areas. (Capability unit IVw-1; Loamy Upland range site.)

Manter fine sandy loam, 5 to 15 percent slopes (Md).—This is a deep, moderately dark, sandy soil. It occupies knolls and ridges where slopes are greater than 5 percent.

The few small areas of this soil are generally high points in the landscape. The soil takes water readily and holds a moderate amount available. It occurs in association with Ulysses loam, 1 to 3 percent slopes, and Ulysses loam and silt loam, 3 to 5 percent slopes.

Typical profile (800 feet west and 600 feet north of southeast corner of sec. 29, T. 18 S., R. 39 W.; in virgin native grass pasture with slopes of about 7 percent):

A₁ 0 to 14 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, granular structure; friable when moist, slightly hard when dry; noncalcareous; gradual boundary.

B₂ 14 to 20 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) when moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky; friable when moist, hard when dry; noncalcareous; abrupt boundary.

C 20 to 40 inches +, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) when moist; massive but quite porous; very friable when moist, soft when dry; calcareous; a few, faint films and streaks of lime.

Significant variations in the profile are not common. Below a depth of 30 inches, the soil is underlain in some places by unconforming calcareous silt loam or silty clay loam. The depth to calcareous parent material averages about 16 inches but ranges from 12 to 26 inches. The texture of the darkened surface soil ranges from fine sandy loam to light loam.

Some areas of Ulysses loam that were too small to map separately are included with this soil. These areas occupy less than 5 percent of the total area.

Most of Manter fine sandy loam, 5 to 15 percent slopes, is not suited to crops. It is in native grass and is used for range. When the soil is cultivated, erosion results, regardless of precautions. For proper land use, any areas now cultivated should be reseeded to suitable native grasses and used as range. Important range practices are those that will protect and improve the grass cover. (Capability unit VIe-2; Sandy range site.)

Potter-Mansker complex (Px).—This mapping unit consists primarily of shallow and moderately deep soils over caliche and limestone. The shallow soils are the Potter. They are grayish brown and less than 12 inches deep over hard caliche or limestone. The moderately deep soils are the Mansker. They are about grayish brown and are from 12 to 30 inches deep over semihard caliche. Geologic erosion has gradually removed the mantle of loamy sediment and exposed the underlying caliche and limestone in which Potter and Mansker soils have developed. The soils of this complex occupy the steeper slopes along the well-entrenched upland drainageways. They are mainly along White Woman and Ladder Creeks.

Potter soils make up about 45 percent of the complex; Mansker soils, 40 percent; and Colby silt loam, the remaining 15 percent.

Typical profile of Potter fine sandy loam (400 feet west and 450 feet north of the center of sec. 10, T. 16 S., R. 40 W.; in native grass pasture):

A₁ 0 to 5 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 3.5/2) when moist; weak, granular structure; friable when moist, slightly hard when dry; some coarse sand grains, fine gravel, and limestone fragments on the surface; calcareous; gradual boundary.

AC 5 to 10 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; moderate, fine, granular structure; friable when moist, slightly hard when dry; numerous clusters of worm casts; occasional fragments of caliche; calcareous; abrupt boundary.

C 10 inches +, white, hard caliche or limestone.

Typical profile of Mansker loam (400 feet west and 300 feet north of the center of sec. 10, T. 16 S., R. 40 W.; in native grass pasture) :

A₁ 0 to 7 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, granular structure; friable when moist, slightly hard when dry; occasional fragments of caliche; calcareous; gradual boundary.

AC 7 to 20 inches, light brownish-gray (10YR 6.5/2) loam, grayish brown (10YR 5/2) when moist; moderate, fine, granular structure; friable when moist, slightly hard when dry; numerous worm casts; occasional fragments of caliche; calcareous; abrupt boundary.

C_{ca} 20 to 24 inches, nearly white (10YR 7.5/2.5) light clay loam, pale brown (10YR 6/3) when moist; firm when moist, hard when dry; strongly calcareous, about 40 percent of the mass is segregated lime; gradual boundary.

C 24 inches +, white, moderately dense, semihard and hard caliche.

Significant variations in profiles of the Potter and Mansker soils are not common. The texture of the Potter soil ranges from loam to sandy loam. The depth averages between 6 to 8 inches but is as much as 12 inches in places. The texture of the Mansker soil ranges from loam to clay loam. The depth ranges from 12 to 30 inches over caliche but averages about 20 inches. Stony outcrops almost barren of vegetation are common. Slopes range from about 5 to 20 percent; some rough broken slopes occur.

The acreage of the Potter-Mansker complex is small, nonarable, and valuable only for grazing. It supports moderate to good stands of native grasses consisting chiefly of blue grama, side-oats grama, and some little bluestem. Careful grazing management is necessary to maintain good forage production. (Capability unit VIe-3; Breaks range site.)

Richfield silt loam, 0 to 1 percent slopes (Rm).—This is a deep, dark, well-drained soil of the uplands. It has developed in deep loess on the high, nearly level tablelands. It is widely distributed and occurs in large areas. This is the most extensive and agriculturally important soil of the county.

Richfield silt loam has a dark grayish-brown silt loam surface layer over dark grayish-brown silty clay loam subsoil. This subsoil grades to lighter colored, very friable, calcareous silty clay loam at 10 to 18 inches. The soil is fertile and will hold large amounts of water for plants. It is moderately permeable to air, water, and plant roots.

Richfield silt loam resembles soils of the Ulysses series but has a more clayey subsoil and is usually noncalcareous to greater depths.

Typical profile (800 feet south and 400 feet west of the center of sec. 33, T. 18 S., R. 39 W.; in nearly level, cultivated field) :

A_p 0 to 5 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, granular structure; friable when moist, slightly hard when dry; noncalcareous.

B₂ 5 to 13 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, subangular blocky structure; moderately firm when moist, hard when dry; thin, continuous clay films on surfaces of structural aggregates; noncalcareous; gradual boundary.

B_{3ca} 13 to 22 inches, grayish-brown (10YR 5/2) light silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, subangular blocky structure; friable when moist, hard when dry; calcareous; thin films and streaks of segregated lime; gradual boundary.

C_{ca} 22 to 36 inches, light brownish-gray (10YR 6/2) light silty clay loam, dark grayish brown (10 YR 4/2) when moist; massive (structureless); very friable when moist, slightly hard when dry; calcareous, with few small, soft lime concretions; gradual boundary.

C 36 to 54 inches +, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; massive; very friable when moist, soft when dry; calcareous.

Variations in the profile are not common but occur in some places. Darkened layers that represent remnants of buried soils occur in places at depths of 18 to 48 inches. Although not unusual, these buried layers are not typical of this soil. They are not related to the present soil or to any features of the present landscape.

Included with Richfield silt loam are some areas of Ulysses soils. It was impractical to map these small areas separately. These inclusions total only about 1 percent of the total soil area.

Richfield silt loam is well suited to crops, and most of it is cultivated. The main crops are wheat and sorghum. Yields are satisfactory in most years if the crops are grown on fields that have been fallowed. Conservation and storage of moisture are essential for profitable crop production. Wind erosion is a hazard where the soil is dry and not protected by growing vegetation, plant residues, or cloddiness. Most cultivated areas of this soil have had some wind erosion. This erosion has not been severe enough, however, to change the use and management requirements of the soil. (Capability unit IIIc-1; Loamy Upland range site.)

Ulysses silt loam, 0 to 1 percent slopes (Uc).—This is a deep, moderately dark, friable, well-drained soil of the uplands. It has developed in deep loess on the high, nearly level tablelands.

The soil has a dark grayish-brown, granular, silt loam surface layer that grades to pale-brown, calcareous loess. It is fertile and moderately permeable to air, water, and plant roots. It has the capacity to hold a large amount of water available to plants.

Ulysses silt loam is associated with the more extensive Richfield silt loam. It has less clayey and more friable subsoil and is calcareous at shallower depths than the associated soil. Although both soils are nearly level, Ulysses silt loam generally has slightly stronger slopes than Richfield silt loam.

Typical profile (1,100 feet north and 500 feet east of the center of sec. 8, T. 20 S., R. 42 W.; in a cultivated field with slopes of about $\frac{3}{4}$ of 1 percent) :

A_p 0 to 4 inches, dark grayish-brown (10YR 4.5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, granular structure; friable when moist, hard when dry; noncalcareous; abrupt boundary (plow slice).

A₁ 4 to 10 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; friable when moist, hard when dry; many worm casts; noncalcareous; gradual boundary.

- AC 10 to 18 inches, grayish-brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) when moist; moderate, medium, granular structure; friable when moist, slightly hard when dry; abundant worm casts, more than in horizon above; calcareous.
- C_{ca} 18 to 30 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; almost structureless; very friable when moist, slightly hard when dry; calcareous; faint films and streaks of segregated lime; gradual boundary.
- O 30 to 52 inches +, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; structureless; very friable when moist, soft when dry; essentially unaltered parent loess; calcareous.

Significant variations in the profile are not common. The thickness of the darkened surface layer ranges from about 6 to 14 inches. The surface soil is calcareous in many cultivated areas, but noncalcareous to a depth of 12 inches in others.

Included with this soil as mapped are small areas of Richfield and Goshen silt loams. It was impractical to map these inclusions separately. They occupy less than 5 percent of the total area.

Ulysses silt loam is well suited to crops, and most of it is now cultivated. The main crops are wheat and sorghum. Satisfactory yields are obtained during most years if crops are seeded on land that has been fallowed. Conservation of moisture is essential for profitable crop production. Wind erosion occurs where the soil is dry and not protected by growing vegetation, plant residues, or sufficient cloddiness. Most cultivated areas have had some wind erosion. Permanent soil damage has been slight, however, and the use and management requirements of the soil have not changed. (Capability unit IIIc-1; Loamy Upland range site.)

Ulysses silt loam, 1 to 3 percent slopes (Ud).—This gently sloping soil has a profile like Ulysses silt loam, 0 to 1 percent slopes. The surface layer is thicker and somewhat darker than that of the associated Colby silt loam. Parts of some areas that adjoin Richfield silt loam have slopes that are less than 1 percent.

Included with this soil as mapped are small areas of Colby silt loam. The included areas comprise less than 5 percent of the total mapping unit.

Ulysses silt loam, 1 to 3 percent slopes, is suited to the same crops as Ulysses silt loam, 0 to 1 percent slopes. It has the same limitations and hazards, plus the danger of water erosion. Unless proper conservation practices are used, runoff and soil removal are excessive. Most cultivated areas of this soil have had some erosion. Permanent damage has been too slight, however, to change the use and management requirements. Moderately eroded Ulysses soils are indistinguishable from Colby soils and are mapped as Colby soils. (Capability unit IIIe-1; Loamy Upland range site.)

Ulysses loam, 1 to 3 percent slopes (Uc).—This is a deep, moderately dark, well-drained upland soil. It is like Ulysses silt loam in all characteristics except texture. In the upper 12 to 24 inches, the soil is a friable loam that contains more sand and less clay than the same horizons in Ulysses silt loam. This soil has developed in loess that has been somewhat mixed with windblown sand. Areas of this soil are adjacent to and generally south of the shallow valleys along intermittent upland streams.

Ulysses loam occurs in association with the more extensive Ulysses silt loam and Colby silt loam.

Typical profile (600 feet east and 100 feet south of northwest corner of sec. 30, T. 18 S., R. 39 W.; in virgin grass pasture with slopes of about 2½ percent) :

- A₁ 0 to 10 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; friable when moist, slightly hard when dry; noncalcareous; gradual boundary.
- AC 10 to 16 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) when moist; some mixing of dark and light material from above and below; moderate, medium, granular structure, mainly worm casts; friable when moist, slightly hard when dry; calcareous; gradual boundary.
- C 16 to 50 inches +, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; massive (structureless); very friable when moist, slightly hard when dry; porous and permeable; calcareous; occasional small, soft lime concretions in upper 14 inches.

Variations in the profile are not common. Depth of the darkened surface soil and depth to the calcareous material are similar to those given for Ulysses silt loam, 0 to 1 percent slopes.

Included with this soil as mapped are small areas of Ulysses silt loam and Colby silt loam. Also included are small areas (generally less than 5 acres) of a soil that has a darkened sandy loam surface layer and that grades to silty material with depth. These small areas are so intermingled with Ulysses loam that it was impractical to map them separately. The inclusions total about 10 percent of this mapping unit.

Most of Ulysses loam, 1 to 3 percent slopes, is used for cash crops of wheat and sorghum. Yields are generally satisfactory when the crops are seeded on fallowed fields. The soil is well suited to crops, but conservation and storage of moisture are necessary for high yields. Wind and water erosion are hazards. Wind erosion will occur where the soil is dry and not protected by vegetation, plant residues, or cloddiness. In many cultivated fields, the finer soil particles have been separated and removed by wind, and, as a result, 2 or 3 inches of the surface soil is now sandy loam. Unless proper conservation practices are used consistently, soil and water losses from runoff will be excessive. (Capability unit IIIe-1; Loamy Upland range site.)

Ulysses loam and silt loam, 3 to 5 percent slopes (Ub).—The soils of this inextensive mapping unit are as described for Ulysses silt loam and Ulysses loam. This unit, however, occurs on moderately steep slopes. These slopes are generally adjacent to the well-defined and entrenched, intermittent upland streams, mainly White Woman and Ladder Creeks.

Some small areas of the associated Colby silt loam and Manter fine sandy loam are included with this mapping unit. These inclusions make up about 5 percent of the total area.

Ulysses loam and silt loam, 3 to 5 percent slopes, is not well suited to crops, but some of it is now cultivated. Water erosion is a serious hazard. The hazard of wind erosion is the same as on other units of Ulysses soils. Most cultivated areas have had some erosion. Areas of this unit so much thinned by erosion that they are indistinguishable from Colby silt loam are mapped as Colby silt loam, 3 to 5 percent slopes. (Capability unit IVE-1; Loamy Upland range site.)

Erosion

Erosion is the removal of soil and geologic materials by natural agencies, mainly wind, running water, and gravity. This discussion deals with accelerated soil erosion, which should not be confused with geologic erosion. Geologic erosion is the gradual removal of soil under natural conditions in an undisturbed environment. Accelerated erosion is the increase in soil erosion brought about by manmade changes in the vegetation or in soil conditions.

Wind and water are the main active forces of soil erosion in Greeley County. Wind erosion is always a hazard and becomes serious during the recurring droughts. The high wind velocities and limited vegetation characteristic of periods of drought on the High Plains contribute to widespread soil movement. Water erosion is a hazard on all sloping, silty soils that are cultivated. Runoff and erosion occur during the hard, dashing thunderstorms when water falls faster than it enters the soil. Practices that slow or decrease runoff will conserve valuable moisture and help control water erosion.

The effects of erosion differ. Some are permanent and cause enough damage to require changes in use and management. Others may temporarily impair the soil until conservation practices are applied. Replanting crops, reseeding rangeland, and emergency tillage and smoothing may obliterate most of the temporary effects of erosion. Although these practices may restore full use of the soil, they are time consuming and costly.

During the course of the soil survey fieldwork, the effects of erosion were observed. Some of the effects of wind erosion were as follows:

1. Small, low hummocks and drifts of soil form on nearly level and smoothly sloping, cultivated fields where the soil is blowing. These "blow piles" (fig. 4.) will continue to blow unless the soil is smoothed and tilled to provide a roughened surface that resists erosion. If the surface is roughened by tillage, as needed, until vegetation grows, there will be no serious, permanent damage and full use of the soil can be restored.



Figure 4.—Small hummocks of silt accumulate behind obstructions during wind erosion on this nearly level soil.

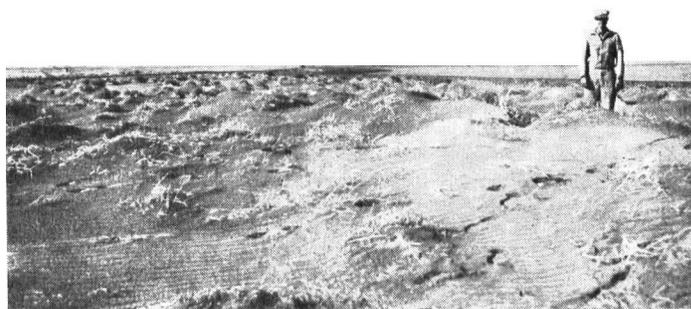


Figure 5.—Silts and fine sands deposited in the weed cover on a field adjacent to blowing areas.

2. The tops of ridges and knolls in the more undulating parts of the Greeley County plains are more exposed to the wind than the adjacent, nearly level soils. Consequently, the soil blows more often in these areas, and much of it has been deposited on smoother areas nearby. Some of the finer soil particles are blown long distances and are lost from the area. The silt and sand deposits that remain on the nearby areas are often calcareous. Since calcareous sediments tend to blow more readily than those that are not calcareous, these deposits may start wind erosion in a field that would otherwise be stable.
3. Soil may drift from actively eroding, cultivated fields to adjacent rangeland and damage, or destroy, the native vegetation. The grassland soil is not permanently damaged, but its utility is impaired until the grass has been reestablished either by deferred grazing or by reseeding. Soil may also drift from an eroding field to another cultivated field that is protected from erosion by weeds, crop residues, etc. This drifting creates problems on uneroded, cultivated fields (fig. 5).

Soils that have been so eroded that the use and management requirements have changed are mapped as eroded phases. No eroded phase of any soil could be clearly recognized in Greeley County. Some soils, however, have been so altered by erosion that they now have the same characteristics as some closely associated soil. In Greeley County, areas of Ulysses silt loam that have lost the darkened surface layer through erosion cannot be distinguished from the normally light-colored Colby silt loam. Such areas are mapped as Colby silt loam. Therefore, the two mapping units, Colby silt loam, 1 to 3 percent slopes, and Colby silt loam, 3 to 5 percent slopes, contain some soil that probably was Ulysses silt loam before erosion.

Measures needed to control erosion vary according to the kind of soil, degree of slope, and land use. Some alternatives are generally possible when choosing a combination of practices that will control erosion on a given site. These practices are discussed more fully in the section "Management by Capability Units." For more specific and detailed information, see a local representative of the Soil Conservation Service.

Use and Management of the Soils

In this section the management needs of the soils in various uses are discussed. The capability classification of the soils is explained, and the soils are grouped according to their capability. Management by capability units is also discussed. In addition, yields are estimated for each arable soil.

Principles of Cropland Management

The soils of Greeley County were originally covered with grass. The grass roots gave the soil a desirable granular structure and also helped to hold the soil in place. The living and dead vegetation on the surface gave protection from wind and rain. The wind had little chance to disturb the soil, and rainfall was absorbed rapidly. Erosion was limited to a slow, harmless rate. Soil-forming factors were at work, and the rate of soil development was about equal to that of soil removed by erosion. The different soils were in balance with their environment.

During the last 50 years, more and more grassland has been plowed to produce cereal crops. Soil under cultivation declines in organic-matter content and loses desirable soil structure. This poorer physical condition, together with management systems that leave the soil unprotected, have accelerated soil erosion. Valuable water needed by crops is lost as runoff.

The basic principle of soil conservation is to keep the soil receptive to moisture at all times by a protective vegetative cover. It is not necessary to restore the original native grass. Stubble mulching and minimum tillage will keep vegetation on the surface and increase the intake of water. Terracing, contouring, and stripcropping may also be effectively used. A single practice may be applied to reduce erosion or conserve moisture, or several may be used in combination. Soil and water conservation is more

complete when some combination of practices is used. Some of the principles of cropland management are discussed as follows.

Cropping systems.—A cropping system consists of the kind and sequence of crops grown on a given area of cropland over a period of time. It may consist of a regular rotation of different crops grown in definite order, or only one crop grown on the same area year after year. Another cropping system, commonly called a flexible system, may include different crops but lack a definite and planned order in which the crops follow each other.

The flexible cropping system, shown in table 2, can be used as a guide to plan for more stable production of crops. It shows the best method of management for fields where the cover condition and depth of moist soil are known on the selected dates. The approximate dates of June 1, July 15, and September 1 have been selected to measure the depth of moist soil and to determine the cover condition of the field. Decisions as to the best management are then made, based on this information.

Since moisture storage is to be considered, crops are planted primarily for protective cover if the depth of moist soil is less than 24 inches at planting time. Also to be considered in the flexible cropping system is the cover condition of the field. A field has adequate cover if growing plants and plant residue, together with roughness or cloddiness of soil surface, are able to reduce wind erosion to a minimum.

A soil management system includes the cropping system and other practices, such as stubble mulching, tillage, contouring, stripcropping, and terracing. To control erosion, the cropping system and other practices used with it must hold soil damage by wind and water to a minimum, and soil productivity must be maintained or increased.

There will be many seasons when the total amount of available moisture under continuous cropping is not enough to produce crops economically. After harvest, the

TABLE 2.—A flexible cropping system, in which wheat is the principal crop, and needed conservation practices are used¹

| Date | Depth of moist soil <i>Inches</i> | Adequate cover on field | Inadequate cover on field |
|---------|--------------------------------------|---|--|
| June 1 | Less than 24..... | Manage soil until the depth of moist soil is 24 inches; then plant sorghum, or manage until July 15. | Manage soil until the depth of moist soil is 24 inches; then plant sorghum, or roughen surface and manage until July 15. |
| | More than 24..... | Plant sorghum, or manage for wheat..... | Plant sorghum, or roughen surface and manage for wheat. |
| July 15 | Less than 30..... | Manage soil for wheat and expect to seed wheat primarily for a cover crop, but possibly for a grain crop. | Plant sorghum for a cover crop, or plant early maturing grain sorghum. |
| | More than 30..... | Manage soil for wheat, expecting a grain crop..... | Manage soil for wheat and expect to seed wheat primarily for a cover crop, but possibly for a grain crop. |
| Sept. 1 | Less than 36..... | Plant wheat, expecting a grain crop (the soil should be moist to a depth of at least 24 inches at seeding time); if there is not enough moisture for seeding wheat, manage for crop production for the next year. | Plant wheat for a cover crop, but possibly for a grain crop; if there is not enough moisture for seeding of wheat, roughen surface and manage for sorghum or wheat to be grown in the next year. |
| | More than 36..... | Plant wheat, expecting a grain crop; if there is not enough surface moisture for seeding of wheat, manage for crop production for the next year. | Plant wheat for a cover crop, but possibly for a grain crop; if there is not enough moisture for seeding wheat, roughen surface and manage for sorghum to be grown in the next year. |

¹ Prepared by FRED MEYER, JR., work unit conservationist, Soil Conservation Service, Syracuse, Kans.

land must be so managed that additional soil moisture accumulates before the next crop is seeded. During this fallow period, generally called summer fallow, plant growth and wind and water erosion must be controlled.

Tillage.—Tillage in a dryland region has many objectives. It is used to manage crop residues, to control weeds, and to maintain desirable structure of the soil. All of these practices are important in production of crops.

Crop residues must be managed and weeds must be controlled to provide suitable conditions for seeding and managing the next crop. However, crop residues will do the most good if they are left on the surface to protect the soil from erosion and loss of structure caused by raindrop splash (fig. 6). Undercutting equipment may be used to leave residues on the surface and still kill weeds.

A roughened surface must be created by tillage if the soil becomes bare of protective vegetation and is subject to wind erosion. Surface roughening decreases the damage from soil blowing as long as the clods are of a size that will resist wind movement.

A desirable soil structure is one that has aggregates of a size that will not blow. If the stable aggregates are large enough, only the minimum amount of tillage needed to eradicate weeds and manage residues should be used. Too much tillage breaks down the aggregate and allows the soil to crust and blow.

Tilling when the soil has the proper moisture content is important in maintaining good soil structure. Excessive tillage when the soil is dry may cause unnecessary breakdown of the soil. Compact layers or tillage pans will be caused by tilling the soil, particularly a loam or silt loam, when it is too wet.

Almost every year, all cultivated areas are tilled at least once or twice. Tillage will reduce erosion only if it leaves plant residues on the surface soil or marked ridges across the direction of wind or water movement. Because ridges cause problems in later planting, surface residues are particularly important.

Stubble mulching.—Stubble mulching is a system of managing plant residues to protect the soil. Tilling, planting, and harvesting are so managed that the residue is kept on the surface until the next growing crop can protect the soil.



Figure 7.—Wheat stubble left on the surface by subsurface tillage protects the soil.

When properly managed, plant residues will reduce soil and water losses by protecting the soil surface from raindrop impact and wind movement (fig. 7). The moisture intake of the soil will be increased by reducing the tendency of the soil to form crusts that seal the surface.

Stubble mulching should be used on all cropland. The methods used depend on the type of soil, the cropping system, the amount of residue, the season of the year, and the physical condition of the soil. The amount of residue required to protect the soil depends on the kind of residue, the height of stubble, the surface roughness, the texture, and the cloddiness. Although stubble mulching is basic to a good system of conservation farming, it is important that the other needed conservation measures also be used.

Contouring.—In contour farming, tillage and planting are carried on parallel to terraces or contour guidelines. Furrows, ridges, and wheel tracks are then nearly on the level. These furrows and ridges hold more rain where it falls and thus decrease runoff and erosion. Because of the additional water absorbed by the soil and made available for crops, yields are increased. Somewhat less power is required in contour farming than for farming up and down the hill.

Contouring is most effective when used with other conservation measures, such as stubble mulching, terracing, and contour stripcropping (fig. 8).

Terracing.—This is the construction of ridges across slopes to intercept runoff. On sloping land, terraces help to control erosion and to conserve moisture that would otherwise be lost as runoff.

Contouring and other conservation measures should be used along with terraces. Each row planted on the contour between terraces acts as a miniature terrace; it holds back some water to soak into the soil. Terracing and contouring will increase yields, as well as decrease soil and water losses.

The horizontal distance needed between terraces is determined by the slope and the kind of soil. Since much of the precipitation occurs during storms of high intensity, the terrace system acts as a safety valve for other conservation practices, such as contouring, stubble mulching, and contour stripcropping.



Figure 6.—Subsurface tillage leaves sorghum stubble on the surface to protect the soil.



Figure 8.—Level terraces and contouring used to reduce runoff and erosion.

Stripcropping.—This is a system of growing suitable crops in narrow strips on the same field. Strips of erosion-resistant crops, or of their residues, are alternated with other crops or fallow land. Good stands of growing wheat and sorghum and the thick, heavy stubble remaining after harvest are erosion resistant. Stripcropping helps control wind erosion by shortening the distance that loose soil can move. Water erosion is reduced by the barrier of growing crops.

Two types of stripcropping are (1) contour stripcropping and (2) wind stripcropping. Contour stripcropping is used on sloping land to help control both wind and water erosion. The strips are arranged on the contour; terraces or contour guidelines are used to establish the pattern. Wind stripcropping is used on nearly level land and on the coarser textured soils, where water erosion is not a problem. It is also used on more sloping land, where slopes are so complex that farming on the contour is not practical. Strips are uniform in width and usually straight (fig. 9). They are arranged across the direction of the prevailing northerly and southerly winds.

The width of strips needed to control soil blowing varies with soil types. Strips may be wider on silt loam and clay loam soils than on sandy soils.

Stripcropping will minimize soil blowing but will not fully control it when used alone. It is much more effective when used with good residue management, minimum tillage, and other needed conservation measures.

Irrigation.—Irrigation is not widely used in Greeley County. However, it is important on farms that have enough available water to develop an irrigation system. At present, there are about 40 wells irrigating approximately 5,000 acres of cropland. Most of the acreage irrigated is on Richfield silt loam, 0 to 1 percent slopes, and Ulysses silt loam, 0 to 1 percent slopes. The irrigation water is of good quality. Salinity, alkalinity, or soil drainage cause no problems.

Good irrigation management must provide for (1) most efficient use of the limited irrigation water, (2) maintenance or improvement of soil fertility and tilth, and (3) control of erosion. Land leveling and contour irrigation are some of the practices that will help to use water efficiently and to control erosion. Other engineering or mechanical practices may be needed, depending on the site.



Figure 9.—Stripcropping on Richfield silt loam, 0 to 1 percent slopes.

For further information on irrigation and related engineering problems, see a local representative of the Soil Conservation Service.

Use of deep-rooted legume crops, crop residues, and commercial fertilizers will help to maintain fertility and tilth. The Kansas Agricultural Experiment Station at Manhattan and the branch station at Garden City maintain laboratories for testing soils to determine fertilizer needs. These services are available to the public at a small charge per sample.

Establishing native grass seedings.—Seeding of suitable native grasses can be successful on both cropland and depleted rangeland. The following practices are needed to obtain and maintain satisfactory stands:

1. Select good-quality live seed of suitable species.
2. Seed in an erosion-resistant cover. To obtain sufficient cover in which to seed grass on cropland, plant sorghum in close-drilled rows about July 15 of the year before the grass is to be seeded.
3. Seed in a firm seedbed. Ordinarily, no tillage is required because the soil under the cover crop is sufficiently firm.
4. Exclude livestock until after the seed matures in the second season of growth. Graze lightly thereafter until grasses are well established.

For further information on seeding native grass, suitable species, establishing protective cover, and availability of seed, see a local representative of the Soil Conservation Service.

Capability Classification

The soils of the county have been grouped to show their suitability for crops and range. This grouping is based on the ability of the soils to produce the common cultivated crops and pasture plants over a long period without deterioration of the soil.

The Soil Conservation Service has established eight land capability classes. Arable soils are grouped in classes I through IV according to their potentialities and limitations for sustained production of the commonly cultivated crops. Nonarable soils are grouped in classes V

through VII according to their potentialities and limitations for the production of permanent vegetation. Soils grouped in class VIII cannot be profitably managed for plant production.

All eight classes do not occur in Greeley County. Because of low rainfall, recurrent drought, and the associated wind erosion problem, all the soils have at least severe limitations in use. All soils, therefore, have been placed in classes III, IV, VI, and VII. In irrigated areas soils may be placed in classes I and II if the climatic limitation has been removed by relatively permanent irrigation systems.

Each capability class contains soils that have about the same degree of limitations, potentialities, and management problems. The soils in the same class may have some distinctly different characteristics, however, and would therefore have different kinds of hazards and limitations. The soils of each capability class have been grouped into four subclasses according to kind of limitation and hazard. The subclasses, designated by letter symbols, are: e—erosion hazard; w—wetness; s—soil, root-zone limitations; c—climatic limitations. Normally, in an area the size of a county, not all the subclasses are represented in a capability class.

Soil groupings, called capability units, are made within the subclasses. Each capability unit consists of soils that are uniform enough to (1) produce similar kinds of cultivated crops and pasture with similar management practices; (2) require similar conservation treatment; and (3) have comparable potential productivity. The soils in one capability unit require similar management and give similar response, although they may have characteristics that cause them to be placed in different soil series.

In the following pages, the capability classes, subclasses, and units in the county are defined.

Class III.—Soils that can be used for crops but have severe limitations that reduce the choice of plants, or require special conservation practices, or both.

Subclass IIIc: Soils having moderate climatic limitations.

Unit IIIc-1: Nearly level loamy soils.

Unit IIIc-2: Well-drained loamy swale soils.

Subclass IIIe: Soils highly susceptible to erosion when used for crops.

Unit IIIe-1: Gently sloping loamy soils.

Class IV.—Soils that can be used for crops but have very severe limitations that restrict the choice of plants, require very careful management, or both.

Subclass IVe: Soils extremely susceptible to erosion when cultivated.

Unit IVe-1: Sloping, calcareous loamy soils.

Subclass IVw: Soils adversely affected by excess water.

Unit IVw-1: Upland depressions.

Class VI.—Soils that have severe limitations that make them generally unsuitable for crops. The limitations are such that they cannot be corrected, such as (1) steep slope, (2) severe hazard of erosion, (3) stoniness, (4) shallow root zone, or (5) low available moisture-holding capacity. Physical conditions are such that reseeding permanent grasses and renovating depleted rangeland are feasible.

Subclass VIe: Nonarable soils that have a severe erosion hazard if cover is not maintained.

Unit VIe-1: Steep loamy soils.

Unit VIe-2: Steep sandy soils.

Unit VIe-3: Shallow, sloping loamy soils.

Class VII.—Soils that have very severe limitations that make them unsuited to cultivation and that have severe limitations or hazards when grazed. They require more careful management than soils in class VI.

Subclass VIIw: Soils severely affected by excess water.

Unit VIIw-1: Unstable flood plains.

Management by capability units

The capability units and the applicable management practices are more fully discussed in the following pages. The significant features of the soils in each capability unit are described, together with the hazards and limitations. Suggestions for use and management follow the listing of the soils in each capability unit. The principles of cropland management referred to under the management for each capability unit were discussed in the first part of this section.

CAPABILITY UNIT IIIc-1—NEARLY LEVEL LOAMY SOILS

This unit consists of deep, dark, fertile soils of the uplands. These soils have smooth, nearly level slopes. The surface soils are silt loam, and the subsoils are silt loam and silty clay loam. The soils are permeable and have a high available moisture-holding capacity. Low precipitation and recurrent drought limit crop production. Wind erosion is a hazard when the soils are dry and not protected by growing vegetation or its residue, or by clods. The soils in this unit are:

Richfield silt loam, 0 to 1 percent slopes (Rm).

Ulysses silt loam, 0 to 1 percent slopes (Uc).

Goshen silt loam, bench (G†).

Wheat and sorghum are well suited to these soils. Good management should include (1) the use of suitable crops in a flexible cropping system, (2) the minimum amount of tillage consistent with good yields, and (3) adequate crop residues to protect the soil (fig. 10). In addition, con-



Figure 10.—Sorghum stubble on Richfield silt loam, 0 to 1 percent slopes. The stubble helps to hold snow where it falls.

touring, terracing, and stripcropping may be effectively applied. Only that part of crop residues not needed for soil protection should be grazed.

Most of the limited amount of irrigation in Greeley County is on the soils in this capability unit. The soils are well suited to crop production under irrigation and will produce satisfactory yields of most crops suitable for the area. Good irrigation management of these soils includes agronomic practices that will maintain or improve fertility and tilth. Such practices are (1) use of a crop sequence that includes a deep-rooted legume, (2) use of crop residues to maintain organic matter and tilth, and (3) application of commercial fertilizer as needed. Engineering and mechanical measures are needed to help conserve irrigation water and to use it efficiently. Further information on irrigation and related engineering problems can be obtained from a local representative of the Soil Conservation Service.

CAPABILITY UNIT IIIc-2.—WELL-DRAINED LOAMY SWALE SOILS

Only one soil is in this capability unit. This deep, dark, fertile soil occupies nearly level swales of the uplands. The texture of the surface soil is silt loam, and that of the subsoil is silty clay loam. The soil is permeable and has a high available moisture-holding capacity. Runoff from adjacent areas provides some extra moisture for this soil. Low rainfall and recurrent drought limit crop production. Wind erosion occurs where the soil is dry and not protected by clods, or by growing vegetation or its residue. The soil in this unit is:

Goshen silt loam (Go).

Wheat and sorghum are well suited to this soil. Good management includes the use of suitable crops in a flexible cropping system and the minimum amount of tillage consistent with good yields. Adequate crop residues should be used to protect the soil. Stripcropping, contouring, and terracing are effective aids in conserving water and may be used where they are suitable by engineering standards.

This soil is well suited to irrigated crops. Small acreages are irrigated along with the soils of capability unit IIIc-1. Irrigation practices are similar to those discussed for capability unit IIIc-1.

CAPABILITY UNIT IIIc-1.—GENTLY SLOPING LOAMY SOILS

The soils in this unit are deep, moderately dark, and fertile. They are on gently sloping uplands. The surface soils and subsoils are loam or silt loam in texture. The surfaces tend to seal and slick over during rainstorms, and as a result, runoff and erosion are excessive. The subsoils are permeable, have high available moisture-holding capacity, and are easily penetrated by plant roots. Wind erosion will occur when the soils are dry and not protected by clods, growing vegetation, or plant residues. The soils in this unit are:

Ulysses silt loam, 1 to 3 percent slopes (Ud).

Ulysses loam, 1 to 3 percent slopes (Uc).

Wheat and sorghum are suited to these soils. Good management includes the use of suitable crops in a flexible cropping system and the minimum amount of tillage consistent with good yields. Crop residues should be fully utilized for soil protection. Other needed conservation measures are terracing and contouring. Contour strip-

cropping is also effective in helping to control erosion.

Very little, if any, of the acreage of the soils in this capability unit is used for irrigated crops. The use of these soils for irrigated crops is limited mainly by slope. On irrigated areas, water erosion must be controlled and available irrigation water efficiently utilized. Otherwise, these soils have the same potential for crop production under irrigation as those on nearly level slopes in capability units IIIc-1 and IIIc-2.

CAPABILITY UNIT IVc-1.—SLOPING, CALCAREOUS LOAMY SOILS

This unit consists of deep, silty soils on gently to moderately sloping uplands. The surface soils are moderately dark to light-colored silt loam and loam and are generally calcareous at or near the surface. Subsoils are friable, calcareous, permeable silt loams and loams that have a high available moisture-holding capacity and are easily penetrated by plant roots. The soils are low in organic matter. Surfaces tend to seal and slick over during rainstorms, and excessive runoff and erosion result. Wind erosion will occur where the soils are dry and not protected by clods, growing vegetation, or plant residues. The soils in this unit are:

Colby silt loam, 1 to 3 percent slopes (Cb).

Ulysses loam and silt loam, 3 to 5 percent slopes (Ub).

These soils may be used for crops but are not well suited to them. They are better suited to native grasses for range. Yields of wheat and sorghum are usually low, but good yields are obtained during years when precipitation is greater than average. Because of the hazard of serious wind and water erosion, the soils must be protected at all times. During prolonged droughts, crops must be planted solely to provide protection from wind erosion.

If the soils in this unit are used for crops, they require management that includes suitable crops grown in a flexible cropping system and the minimum amount of tillage needed for good yields (fig. 11). Crop residues should be left on the soils, and terracing, contouring, and contour stripcropping should be practiced. Wind stripcropping should be used on slopes that are too complex for a satisfactory system of terraces or contour lines. Principles of



Figure 11.—Tillage was needed to stop soil blowing on Colby silt loam, 1 to 3 percent slopes, because protective residues were lacking.

good range management are discussed in the section "Range Management."

Only a very small acreage of the soils of this unit is irrigated. Crop production under irrigation is limited mainly by slope. On irrigated areas, erosion must be controlled and available irrigation water efficiently utilized. Further information on irrigation and related engineering problems can be obtained from a local representative of the Soil Conservation Service.

CAPABILITY UNIT IV_w-1.—UPLAND DEPRESSIONS

This unit includes only one soil. It is a deep, dark, slowly permeable soil in small upland depressions. Water is ponded on the surface for a few to several days after rainstorms. Planting and harvesting are often delayed, and growing crops may be drowned out. Wind erosion is a hazard, particularly after crops have been lost and no cover remains on the soil. The soil in this unit is:

Lofton clay loam (Lo).

When used for crops, this soil is usually managed like the surrounding soil. Soil and water conservation practices on the adjacent soils, such as terracing, contouring, and stubble mulching, will keep some of the runoff from the depressions occupied by this soil. Surface drainage is sometimes feasible, depending upon the site. Further information and aid in managing this soil can be obtained from a local representative of the Soil Conservation Service.

CAPABILITY UNIT VI_e-1.—STEEP LOAMY SOILS

This unit consists of deep, light-colored silty soils on moderately to steeply sloping uplands. These soils are silt loam in texture and calcareous throughout their depth. The subsoils are permeable, have a high available moisture-holding capacity, and are easily penetrated by plant roots. Wind and water erosion are serious hazards on areas not protected by vegetation. The soils in this unit are:

Colby silt loam, 3 to 5 percent slopes (Cc).

Colby silt loam, 5 to 15 percent slopes (Cd).

These soils are suitable only for range. Runoff and erosion are excessive when they are cultivated. Suitable native grasses should be seeded on any areas now cultivated. Good management should be used to maintain or improve the grass, as it produces forage for livestock. More information on range management for these soils is given under the Loamy Upland site in the section "Range Management."

CAPABILITY UNIT VI_e-2.—STEEP SANDY SOILS

This unit includes only one soil. It is a deep, moderately dark sandy soil on steeply sloping to hummocky uplands. The surface soil is sandy loam, and the subsoil is loam to sandy loam. The soil takes in water readily and has a moderately good capacity to hold available moisture. Wind erosion is a serious hazard on areas not protected by vegetation. Water erosion is a moderate hazard during thunderstorms if the soil is not adequately protected. The soil in this unit is:

Manter fine sandy loam, 5 to 15 percent slopes (Md).

This soil is suited only for range. Areas now being cultivated should be seeded to suitable native grasses and

used for range. Good management of this soil consists of proper range use and deferred grazing. Such management will prevent overgrazing and the resulting soil damage from erosion. More information on good range management for these soils is given under the Sandy site in the section "Range Management."

CAPABILITY UNIT VI_e-3.—SHALLOW, SLOPING LOAMY SOILS

This unit consists of only one mapping unit. It is a complex of soils of the uplands and includes both shallow and moderately deep soils over hard caliche and limestone. These soils have moderate to steep slopes. They are light-colored, friable, calcareous sandy loam and loam. Plant-root zones are limited, and the available moisture-holding capacity is moderately low. Many rock outcrops occur on the steeper slopes. The complex of soils in this unit is:

Potter-Mansker complex (Px).

This complex of soils is suitable only for range. Wind and water erosion will occur if the grass is overgrazed. Little can be done to protect the soils except to manage grazing so that the grass cover is maintained or improved. Good range management of this unit is discussed under the Breaks site in the section "Range Management."

CAPABILITY UNIT VII_w-1.—UNSTABLE FLOOD PLAINS

This unit includes only one soil. It is a shallow, light-colored, calcareous sandy soil occupying the flood plain of White Woman Creek. The soil consists of sandy loam that overlies coarse sand at a depth of about 12 inches. It is subject to flooding, sand deposition, shifting of stream channels, and scouring. It has a low available moisture-holding capacity and a restricted root zone. Wind erosion is a hazard on unprotected areas. The soil in this unit is:

Lincoln fine sandy loam (Lf).

This soil is nonarable and has only limited value for use as native grass range. Because of its characteristics and its position on the flood plain, the soil, as well as the plant cover, is somewhat unstable. The native vegetation is variable and mixed. Management requirements vary according to the site. Generally, grazing must be controlled in order to maintain the existing vegetation. Brush control or eradication may be desirable on some areas. Further information on the use and management of this soil can be obtained from a local representative of the Soil Conservation Service.

Yield Estimates

Little information is available about average crop yields over a long period on individual soils of Greeley County. Long-time records are needed to smooth out fluctuations in yields caused by recurring droughts and abnormally high precipitation.

Estimates of the average yield per seeded acre of wheat and grain sorghum are given for the arable soils in the county. These estimates are based on data obtained from farmers and from the Tribune and Garden City branches of the Kansas State Agricultural Experiment Station. Most of the data were for wheat on Ulysses and Richfield silt loams. Average yields have been estimated for other soils based on this information.

Table 3 shows (1) estimated long-time average yields per seeded acre that may be obtained by using the prevailing, or most common, management (columns A); (2) the estimated average yields that may be obtained by using improved management (columns B).

The prevailing, or most common management, used in wheat production is as follows:

1. Tillage operations are in straight lines, generally parallel to field boundaries.
2. Frequent tillage is performed with equipment that soon destroys crop residues.
3. A cropping system of alternate wheat and fallow is used. Winter wheat is seeded in early autumn on land that was kept free of live vegetation during the growing season. If the stand of wheat is not satisfactory or the young, growing wheat is blown out of the soil during winter or spring, the land is planted to sorghum or again fallowed for wheat.

TABLE 3.—Estimated long-time average yields from seeded wheat and grain sorghum under prevailing (A) and improved management (B)

| Soil | Yield per acre | | | |
|---|--------------------|------|---------------|------|
| | Wheat ¹ | | Grain sorghum | |
| | A | B | A | B |
| Colby silt loam, 1 to 3 percent slopes | 10.0 | 14.0 | 10.0 | 12.0 |
| Goshen silt loam | 16.0 | 20.0 | 22.0 | 27.0 |
| Goshen silt loam, bench | 14.5 | 18.0 | 15.0 | 18.0 |
| Lofton clay loam | 9.0 | 13.0 | 13.0 | 15.0 |
| Richfield silt loam, 0 to 1 percent slopes | 14.5 | 18.0 | 15.0 | 18.0 |
| Ulysses silt loam, 0 to 1 percent slopes | 14.0 | 18.0 | 15.0 | 18.0 |
| Ulysses silt loam, 1 to 3 percent slopes | 11.5 | 16.0 | 12.0 | 14.5 |
| Ulysses loam, 1 to 3 percent slopes | 11.0 | 16.0 | 13.0 | 15.5 |
| Ulysses loam and silt loam, 3 to 5 percent slopes | 11.0 | 15.0 | 11.0 | 14.0 |

¹ Wheat yields reflect the general use of summer fallow.

4. Crop residues are grazed, if available. Both seeded and volunteer wheat are usually grazed during the fall and winter.

The prevailing management used to produce grain sorghum is as follows:

Sorghum is seeded on land that was in wheat the previous season. Following wheat harvest, the soil is plowed with a one-way disk to obtain a stand of volunteer wheat for fall pasture. The soil is generally tilled at least twice in the spring before seeding on about June 1. The first tillage is used to kill the volunteer wheat. Subsequent tillage is shallow and is intended to control weeds and to prepare seedbeds. Sorghum is then drilled in rows spaced at about 20-inch intervals. After the seedlings emerge, they are cultivated at least once with a rotary-hoe type of implement. Later, if the weeds are numerous, the crop may be sprayed with a chemical weedkiller. Because of inadequate moisture, the sorghum on many

fields is not harvested for grain but is grazed off by sheep and cattle. The residues remaining after harvest on other fields are also grazed.

Improved management is as follows:

1. Needed soil and water conservation practices are used to control erosion and to conserve water. These practices are given for each capability unit in the section "Management by Capability Units."
2. Crops are grown in a flexible cropping system in which grain or cover crops are planted, depending upon soil moisture and cover conditions. A suggested flexible cropping system is given in the section "Principles of Cropland Management."

Range Management²

Rangeland makes up about 11 percent of the total acreage in Greeley County. It is scattered throughout the county, but some areas are concentrated along White Woman and Ladder Creeks. It is generally not suitable for cultivation.

The raising of livestock, mainly feeder-stocker cattle, is the second largest agricultural industry in Greeley County. The success of this industry depends on the way ranchers and farmers manage their range and other feed resources. There are few cattle-breeding herds in the county.

Management principles and practices

High production of forage and conservation of soil, water, and plants on rangeland are obtained by maintenance of range already in good and excellent condition, and by improving the range if it is depleted. This vegetation is improved by managing the grazing so as to encourage the growth of the best native forage plants.

Leaf development, root growth, flower-stalk formation, seed production, forage regrowth, and food storage in the roots are essential stages in the development and growth of grass. To maintain maximum forage yields and peak animal production, grazing must be regulated to permit these natural processes of growth.

Livestock are selective in grazing and constantly seek the more palatable and nutritious plants. If grazing is not carefully regulated, the better plants are eventually eliminated. If heavy grazing is continued, even the second-choice plants will be thinned out or eliminated, and undesirable weeds or invaders will take their place (fig. 12).

Research and the experience of ranchers have shown that when only about half the yearly volume of grass is grazed, damage to the desirable plants is minimized and the range is improved. The half that is left to grow has the following effects on the range:

1. It enables plants to store food for quick and vigorous growth after droughts and in the spring.
2. It allows roots to increase in number and length so that they can reach additional moisture and plant nutrients. (Overgrazed grass cannot reach deep moisture because not enough green shoots are left to provide food needed for good root growth.)

² By PETER N. JENSEN, range conservationist, Soil Conservation Service, Dodge City, Kans.

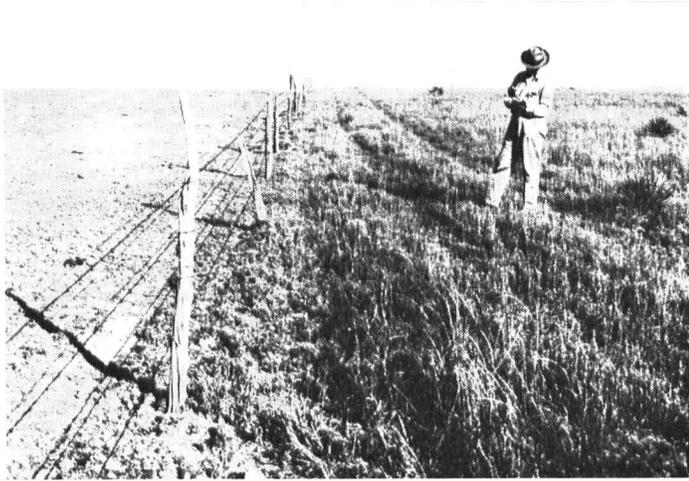


Figure 12.—Range on left has been overgrazed. Better grasses will gradually die out unless grazing is controlled.

3. It protects the soil from wind and water erosion. Grass is the best kind of cover to prevent erosion.
4. It allows the better grasses to maintain or improve their vigor and thus crowd out or prevent weeds.
5. It serves as a mulch that allows a rapid intake of water. The more stored in the ground, the better the growth of grass for grazing.
6. It stops snow where it falls so that it may melt and soak into the soil for later use.
7. It provides a greater feed reserve for the dry years that otherwise might force the sale of livestock. Also, it provides greater forage production in productive years.

Sound range management requires adjustment in the stocking rate from season to season according to forage production. Range management should provide for reserve pastures or other feed during droughts or other periods of low forage production. Thus, the forage can be moderately grazed at all times. It is often desirable to keep part of the livestock readily salable, such as stocker steers. Such flexibility allows the rancher to balance livestock production with forage production without the sale of breeding animals.

Grazing practices that improve rangeland, cost little to use, and are needed on all rangeland, regardless of other practices used, are defined as follows:

1. *Proper range use.*—This is the rate of grazing that will maintain plant vigor, forage reserves, and adequate residues for soil and water conservation. In addition, the composition of vegetation that has deteriorated is improved by this practice.
2. *Deferred grazing.*—This is the postponement of grazing on native rangeland for a definite period. This practice will increase the vigor of the forage or permit the desirable plants to reproduce naturally by seed. In addition, deferred grazing will build up a reserve of forage for later use.
3. *Rotation-deferred grazing.*—This is a grazing system in which one or more pastures are rested at planned intervals throughout the growing season. Each pasture is given a different rest period each

successive year to permit the desirable forage plants to develop and produce seed.

The following are practices that improve range management and help to control livestock:

1. *Range seeding.*—This is the establishment by seeding or reseeding of native or improved dominant grasses on rangeland. The land to be seeded should have a climate and a soil that naturally support range so that management of grazing is the only practice needed to maintain forage. A mixture of species that are dominant in the climax vegetation and locally suitable should be seeded. Seed produced no farther away than 250 to 400 miles south or 100 to 150 miles north of the site should be planted. Grasses should be seeded in forage or grain sorghum stubble. This type of cover protects the soil from erosion, provides a firm seedbed, and helps to control weeds. The mulch helps to retain moisture in the upper layer of the soil. The newly seeded areas should not be grazed for at least 2 years. This gives the plants time to become firmly established.
2. *Water developments.*—These should be distributed over the entire range, if possible, so that livestock do not have to go too far to water. Good distribution of watering places helps to achieve uniform use of the range. Generally, wells, ponds, and dugouts furnish water for livestock (fig. 13), but in some areas water is hauled. The nature of each range will determine which type of water development is the most practical.
3. *Fences.*—These should be constructed to provide for good livestock and range management. Ranges may have to be separated according to seasonal use. In some areas range sites that are large enough and have enough differences should be fenced separately.
4. *Salting.*—This practice is necessary to supplement native range forage. Salting at different places periodically will improve grazing distribution.

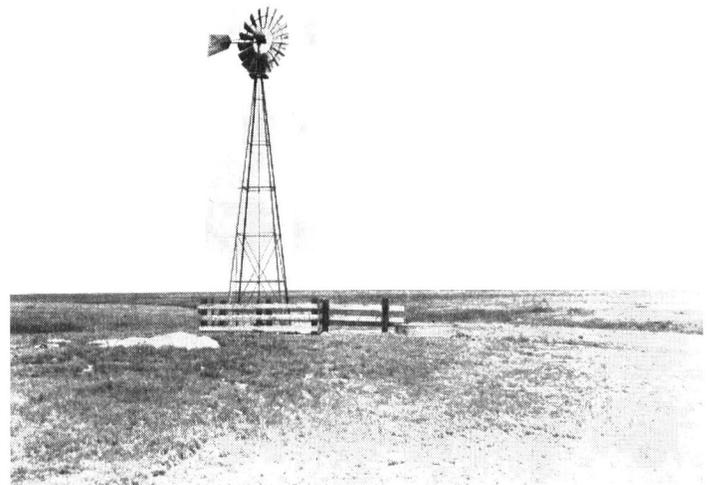


Figure 13.—Wells pumped by windmills are dependable sources of water in Greeley County.

5. *Weed and brush control.*—Chemical or mechanical control of undesirable plants may be needed on some areas to improve forage and also to make easier the handling of livestock.

Livestock management that achieves high production and conserves range resources includes :

1. A feed and forage program that provides for available range forage, concentrates, and hay or tame pastures, or both, to keep livestock in good condition throughout the year. During emergencies, use of reserved roughages for feed and deferred grazing of native pastures will indirectly conserve plant cover, soil, and water. These feed reserves are in addition to normal winter requirements. Feed shortages can be avoided by reserving the surplus produced in years of high yields. Feed reserves may be stored in stacks, pits, or silos (fig. 14).
2. A breeding program that provides for the type of livestock most suitable for the range, a supply of calves in seasons when forage is most nutritious, and continued animal improvement consistent with the type of range and climate.
3. Culling of nonproductive animals from the herds.

Range sites

Different kinds of range produce different kinds and/or amounts of grass. For proper range management, an operator should know the different kinds of land or range sites in his holdings and the plants each site can grow. Management can then be used that will favor the growth of the best forage plants on each kind of land.

Range sites are areas of rangeland that differ from each other in their ability to produce a significantly different kind or amount of climax, or original, vegetation. A significant difference is one that is great enough to require different grazing use or management to maintain or to improve the present vegetation. *Climax vegetation* is the combination of plants that originally grew on a given site. The most productive combination of range plants on a site is generally the climax type of vegetation.

Range condition is classified according to the percentage of vegetation on the site that is original, or climax, vege-

tation. This classification is used for comparing the kind and amount of present vegetation with that which the site can produce. Changes in range condition are due primarily to intensity of grazing and to drought. Range condition is expressed as follows :

| <i>Condition class</i> | <i>Percentage of climax vegetation on the site</i> |
|------------------------|--|
| Excellent..... | 76-100 |
| Good..... | 51-75 |
| Fair..... | 26-50 |
| Poor..... | 0-25 |

The range sites in Greeley County are Loamy Upland, Breaks, Lowland, and Sandy. The Loamy Upland range site makes up about 60 percent of the rangeland. The other range sites make up the remaining 40 percent.

These range sites are described in this section. The descriptions include (1) the names and map symbols of the soils in each site; (2) the dominant vegetation on the site when it is in excellent condition; (3) and the management practices needed to maintain or improve the range condition.

In the descriptions of range sites, native vegetation is referred to in terms of *increasers*, *decreasers*, and *invaders*. Decreasers and increasers are climax plants. Decreasers are the most heavily grazed and are consequently the first to be destroyed by overgrazing. Increasers withstand grazing better, or are less palatable to the livestock; they increase under grazing and replace the decreasers. Invaders are plants that encroach when the climax vegetation has been reduced.

Yields on the different range sites are influenced mainly by climate, nature of the individual soil, and management. Yields for top growth of forage for range sites in excellent condition may be expected to vary with amounts of rainfall received each year. In addition, yields will be influenced by the amount of grazing use received in past years. Disappearances of forage are due to rodents, insects, trampling, and other causes. These factors vary from year to year and greatly affect the annual yield of forage.

Following is an estimate of the total top growth of forage for the range sites in excellent condition under average rainfall conditions.

| <i>Range site :</i> | <i>Air-dry weight (lbs. per acre)</i> |
|---------------------|---------------------------------------|
| Loamy Upland..... | 1,250 to 2,000 |
| Lowland..... | 3,000 to 4,000 |
| Sandy..... | 1,500 to 2,000 |
| Breaks..... | 1,500 to 2,000 |

LOAMY UPLAND SITE

This range site includes level to steeply sloping soils of the uplands that have loam to clay loam surface soils and subsoils. These soils are moderately permeable, well drained, and high in water-holding capacity. The soils in this range site are :

- Colby silt loam, 1 to 3 percent slopes (Cb).
- Colby silt loam, 3 to 5 percent slopes (Cc).
- Colby silt loam, 5 to 15 percent slopes (Cd).
- Goshen silt loam, bench (Gt).
- Lofton clay loam (Lo).
- Richfield silt loam, 0 to 1 percent slopes (Rm).
- Ulysses silt loam, 0 to 1 percent slopes (Uc).
- Ulysses silt loam, 1 to 3 percent slopes (Ud).
- Ulysses loam, 1 to 3 percent slopes (Ua).
- Ulysses loam and silt loam, 3 to 5 percent slopes (Ub).



Figure 14.—Bundled forage sorghum furnishes winter feed and can be held in reserve for emergency periods.

The climax vegetation is a mixture of such grasses as blue grama, buffalograss, western wheatgrass, side-oats grama, and little bluestem. Buffalograss is the main increaser under grazing. Blue grama and buffalograss are the dominant grasses under proper degree of use. Annuals are the principal invaders. In droughty years pricklypear is the common invader.

Grazing practices needed to maintain or improve the condition class are proper range use, deferred grazing, and rotation-deferred grazing.

LOWLAND SITE

Only one soil is in this range site. It is a nearly level, deep, moderately permeable silt loam to clay loam. It has a high water-holding capacity. The site receives extra moisture from occasional floods or run-in from higher areas. The soil in this range site is:

Goshen silt loam (Go).

Decreaser grasses in the climax vegetation, such as switchgrass, big bluestem, Indiangrass, Canada wild-rye, little bluestem, and side-oats grama, make up at least 55 percent of the total cover. Other perennial grasses and several forbs make up the rest. The increasers, which consist of western wheatgrass, blue grama, and buffalograss, may make up 45 percent of the climax vegetation.

Grazing practices needed to maintain or improve the range condition class are proper range use, deferred grazing, and rotation-deferred grazing.

SANDY SITE

This range site includes only one soil. It is a deep, moderately to steeply sloping soil of the uplands. It has a fine sandy loam surface soil and sandy loam to sandy clay loam subsoil. It is moderately permeable and has a moderate to high water-holding capacity.

The soil mapping unit and map symbol are:

Manter fine sandy loam, 5 to 15 percent slopes (Md).

Decreaser grasses in the climax vegetation, such as sand bluestem, little bluestem, switchgrass, and side-oats grama make up about 55 percent of the cover. Other perennial grasses and forbs make up the rest.

Dominant increaser grasses, such as blue grama, sand dropseed, buffalograss, sand paspalum, and perennial forbs, make up the other 45 percent. Sand sagebrush and small soapweed are the dominant woody increasers. Common invaders are perennial three-awn grasses, windmillgrass, and annuals.

Grazing practices needed to maintain or improve the range condition class are proper range use, deferred grazing, and rotation-deferred grazing.

BREAKS SITE

This range site consists of a complex of soils. These soils occupy steep and somewhat broken slopes. They are shallow over caliche and limestone. Textures range from loam to sandy loam. The soils are permeable and well drained.

The soil mapping unit and map symbol are:

Potter-Mansker complex (P_x).

Decreaser grasses in the climax vegetation, such as little bluestem and side-oats grama, make up about 60 percent of the cover. Other perennial grasses and forbs make up

the rest. Dominant increasers, such as blue grama, hairy grama, sand dropseed, hairy dropseed, and perennial forbs, make up the other 40 percent. Common invaders are broom snakeweed and ring muhly.

Grazing practices needed to maintain or improve the condition class are proper range use, deferred grazing, and rotation-deferred grazing.

UNCLASSIFIED

The following Greeley County soil is not classified as to range site because of its instability resulting from deposition, shifting of stream channel, flooding, and other factors:

Lincoln fine sandy loam (Lf).

This soil is weakly developed in the calcareous, stratified sandy alluvium comprising the flood plains of White Woman Creek. It has an unstable plant cover because of flooding and wind erosion. The plant cover is fairly sparse and varies between floodings, deposition, and shifting of the stream channel. It consists mostly of sand dropseed, blue grama, sand sagebrush, and small soapweed.

Wildlife Management

Small, odd areas of land that are otherwise unproductive can be improved and used to provide food and cover for wildlife. Such areas are ditchbanks, fence rows, stock-water ponds and adjacent areas, small upland depressions (potholes), and farmstead windbreaks. Some of the practices needed to improve these areas are (1) plantings of trees, grass, and food-bearing shrubs, (2) construction of ponds, (3) control of grazing, and (4) protection from burning.

The ring-necked pheasant is in all parts of the county and is the best known game bird. The number of pheasants varies. It is reduced considerably during long droughts when food, water, and nesting cover are scarce. Jackrabbits are numerous. Cottontail rabbits thrive along the intermittent streams and near farmsteads where they can find cover. Coyotes are present in large numbers. A few prairie dog towns may still be seen in native pastures. Many doves and migratory waterfowl stop over in the county during seasonal migration. Most of the smaller birds and songbirds native to the High Plains also inhabit the county.

More information on developing and improving areas for wildlife can be obtained from a local representative of the Soil Conservation Service, or from the Kansas Forestry, Fish, and Game Commission.

Woodland Management

Trees are not native to Greeley County. Except in areas that have extra moisture, they will survive only if cultivated and carefully tended. Trees and shrubs are planted only for farmstead windbreaks and for shade and landscaping.

Windbreak plantings are desirable for protection of farmsteads and livestock. They can be successfully established and maintained by proper planning and care. Grass and weeds must be controlled to prevent competition for available moisture. Cultivation or tillage will control

weeds and permit water and air to penetrate the soil easily. Irrigation and diversion of runoff from other areas to the windbreak site will provide extra moisture for the trees. Trees grown in irrigated windbreaks will grow faster and provide protection much sooner than those grown on dryland.

The soils have been grouped into tree-planting sites as listed below. Lincoln fine sandy loam, Lofton clay loam, and Potter-Mansker complex are not included, as they are not suitable sites for planting trees.

| <i>Silty Upland</i> | <i>Sandy Upland</i> | <i>Silty Lowland</i> |
|--|---|----------------------|
| Colby silt loam, 1 to 3 percent slopes. | Manter fine sandy loam, 5 to 15 percent slopes. | Goshen silt loam. |
| Colby silt loam, 3 to 5 percent slopes. | | |
| Colby silt loam, 5 to 15 percent slopes. | | |
| Goshen silt loam, bench. | | |
| Richfield silt loam, 0 to 1 percent slopes. | | |
| Ulysses loam, 1 to 3 percent slopes. | | |
| Ulysses loam and silt loam, 3 to 5 percent slopes. | | |
| Ulysses silt loam, 0 to 1 percent slopes. | | |
| Ulysses silt loam, 1 to 3 percent slopes. | | |

More information on planting of trees and development of farmstead windbreaks can be obtained from a local representative of the Soil Conservation Service and the county agricultural agent.

The most drought-tolerant tree species suited to this county are eastern redcedar, Rocky Mountain juniper, Siberian elm (Chinese elm), and Osage-orange. In table 4 are given the suitable trees and shrubs for windbreaks in each site on dryland and irrigated soils and approximate average height attained in 10 years.

TABLE 4.—*Suitable trees and shrubs for windbreaks in each site on dryland and irrigated soils and approximate average height attained in 10 years*

| Suitable trees and shrubs | Approximate average height at age of 10 years | | | | | |
|-----------------------------|---|------------|--------------|------------|---------------|------------|
| | Silty Upland | | Sandy Upland | | Silty Lowland | |
| | Dry-land | Irrigated | Dry-land | Irrigated | Dry-land | Irrigated |
| | <i>ft.</i> | <i>ft.</i> | <i>ft.</i> | <i>ft.</i> | <i>ft.</i> | <i>ft.</i> |
| Tamarisk..... | 10 | 20 | 10 | 15 | 12 | 20 |
| Russian-olive..... | 12 | 22 | 13 | 22 | 15 | 22 |
| Osage-orange..... | 12 | 22 | 13 | 22 | 15 | 22 |
| Mulberry..... | 15 | 20 | 17 | 24 | 18 | 24 |
| Siberian elm..... | 22 | 32 | 25 | 35 | 26 | 32 |
| Honeylocust..... | 12 | 22 | 14 | 24 | 15 | 22 |
| Eastern redcedar..... | 5 | 9 | 8 | 11 | 8 | 9 |
| Rocky Mountain juniper..... | 5 | 9 | 8 | 11 | 8 | 9 |
| Ponderosa pine..... | 6 | 9 | 8 | 11 | 8 | 9 |
| Skunkbush sumac..... | 5 | 9 | 6 | 9 | 6 | 9 |

Climate³

The climate of Greeley County, based on data collected at Tribune, Kans., for 60 years, in the period from 1888 to 1958, may be classed as semiarid. This area lacks rainfall, because of its location in the "rainfall shadow" east of the Rocky Mountains and west of the major northward flow of moist air from the gulf.

Because it is far inland and moderately high in elevation (approximately 3,600 feet), the county has many features of a continental climate. There are large daily and annual ranges in temperature, low humidity, and much sunshine. The climate is invigorating.

The climate is reflected in the native vegetation. Open, treeless plains and short grasses are evidence of the prevailing marginal precipitation.

A graph of the temperature, based on records of the U.S. Weather Bureau at Tribune, Kans., is shown in figure 15. It includes the mean maximum, minimum, and monthly temperatures and the extremes of temperature for each month. Also shown are the most probable periods in which temperatures of 100° F., freezing and frost-free temperatures, and zero temperatures, or lower, might be experienced.

The annual range of temperature observed at Tribune is from 109° F. (July 25, 1940) to -24° (January 12, 1932 and February 9, 1933), a difference of 133°. A wider monthly range is noted in the winter than in the summer. The difference between highest and lowest temperatures is 103° in January and 68° in July.

Temperatures of 100° F. have occurred as early as May 17 (1927) and as late as September 13 (1955). The record shows, however, that all the dates from June 10 through September 3 have had temperatures of 100° at least once in the 46 years of record. Temperatures of 100° have been recorded 10 times on July 9 and 16 and August 1.

Temperatures of 32° or lower have been recorded as early as September 9 (1941) and as late in the spring as June 2 (1917). From the middle of November through March 5, the temperature can be expected to drop to 32° or lower each night, as such temperatures have been recorded on practically each night in that part of the year over the 46 years of record.

Zero temperatures have occurred as early as November 2 and as late as March 27. A temperature of zero or lower may be expected in about 1 year in 10 on any date from mid-December until about mid-February. Zero temperatures have occurred most frequently on January 23—eleven times in the 46 years of record.

The average monthly precipitation recorded at the U.S. Weather Bureau Station, Tribune, Kans., is given in figure 16. June is the month of greatest average fall, 2.75 inches. The precipitation in each of the months of May, June, July, and August averages more than 2 inches. Each receives five to eight times the average of the precipitation of the winter months.

Averages of weather data in the plains make smooth graphs but do not show the significant variations of the weather. For example, July rainfall averages 2.75 inches, but only in 19 of the 60 Julies on record has the rainfall

³This section by A. D. ROBR, State climatologist, U.S. Weather Bureau, Topeka, Kans.

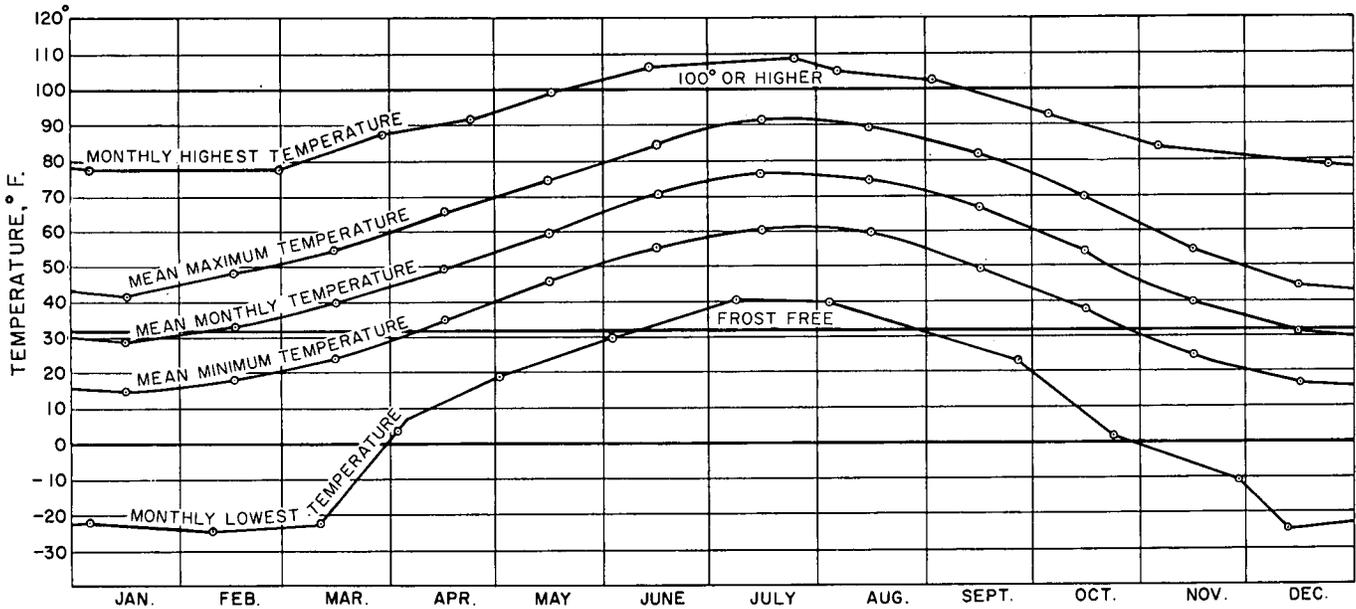


Figure 15.—Means and extremes of temperature, Tribune, Kans.

been within an inch, plus or minus, of that amount. A total of 14 Julies had more than 3.75 inches; 27 received less than 1.75 inches. The greatest July total was 8.45 inches in 1958. The two smallest July totals were 0.11 inch in 1952 and only a trace in 1955.

The annual precipitation and the precipitation during the growing season (March through August), based on records of the U.S. Weather Bureau at Tribune, Kans., are shown by a bar graph in figure 17. The variability of both seasonal and annual precipitation is evident from the graph. Twice in the 60 years recorded (1926 and 1934), the total precipitation in the growing seasons was only about 5 inches. Once (1915) it was over 30 inches, or six times as great. Trends of wet and dry periods also appear

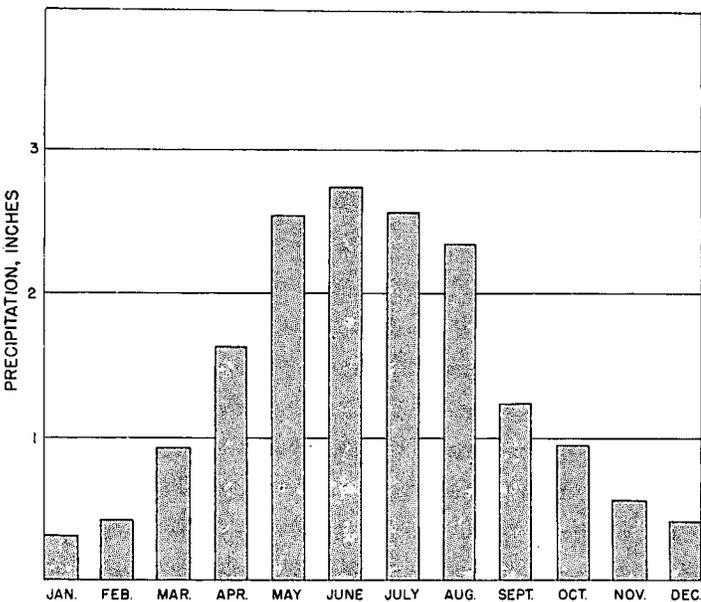


Figure 16.—Average monthly precipitation, Tribune, Kans.

in the chart. Two periods in which the rainfall was near or above average during the consecutive growing season are shown, one from 1912 through 1924, and the other from 1940 through 1951. The growing seasons for the intervening years, 1925-39 and 1952-56, show a decided deficiency in precipitation.

The precipitation during the growing season is on the average 77 percent of the annual total, but again the distribution through the year varies greatly. In the wet year of 1915, 92 percent of the precipitation fell from March through August, but in the third wettest year, 1923, only 62 percent, or 17.98 inches, of the annual total, 29.00 inches, was received in the growing season. During the remaining 6 months, only 11.11 inches fell. In contrast, during the dry year of 1952, 86 percent, or 8.24 inches, of the annual total of 9.59 inches fell from March through August. Only 1.36 inches fell in the other 6 months. About 25 percent of the growing seasons receive less than 8.50 inches, 57 percent receive less than the normal 12.81 inches (see summer average, fig. 17), and only 25 percent have more than 15.50 inches.

Rainfalls of 1 inch or more during 24 hours are rather infrequent. However, each month except December has had one or more such rains in the 60 years of record. Only 5 years have not had at least one rain of more than 1 inch in 24 hours. July is the month of the greatest number of rains of 1 inch or more in 24 hours. In this month, 26 rainfalls of 1 inch occurred. June and August had the heaviest 24-hour falls; 4.46 inches fell on August 8, 1940, and 5.25 inches on June 14 and 15, 1914. The greatest fall was 6.46 inches on June 4, 1932.

Dry periods of 30 consecutive days occur about once a year; these periods have not more than 0.25 inch of precipitation on any day from April through September. The maximum length of a dry period, as defined, has been almost 2½ months.

The amount and time of occurrence of winter precipitation, largely in the form of snow, are very uncertain. Some snow is recorded in all months from September

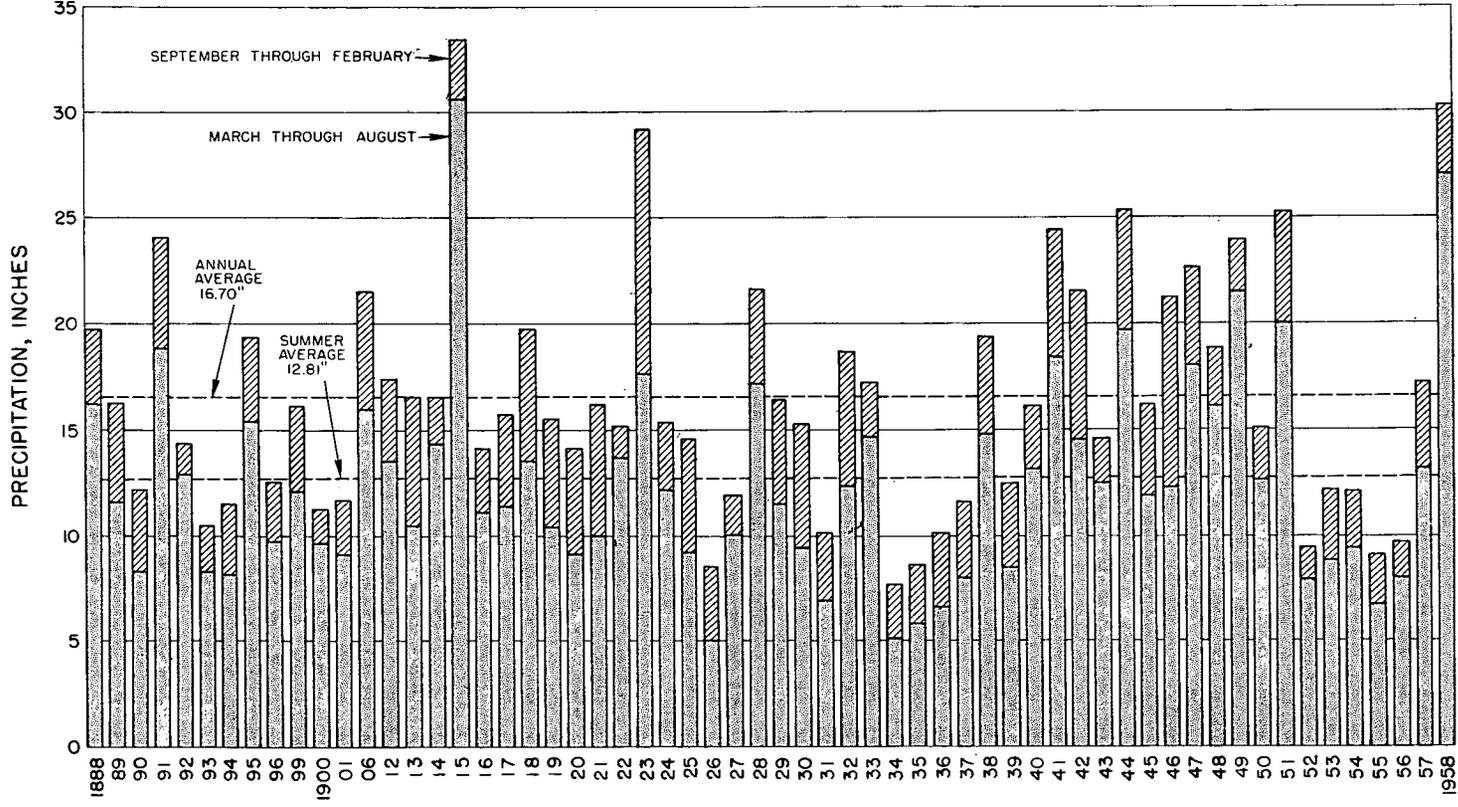


Figure 17.—Annual precipitation, Tribune, Kans., 1888-1958. Data are missing for the years omitted. The shaded part of the bar shows precipitation during the growing season, March through August; the hatched part of the bar, precipitation September through February.

through May. March is the month of highest average snowfall, 8.7 inches; several heavy snowfalls were recorded in this month. December has the next highest average, slightly more than 4 inches. Each of the 6 months from November through April has had 10 inches or more at least once. On the other hand, the entire winter season of 1934-35 brought only 3.8 inches to Tribune. Two very snowy winters in succession, 1946-47 and 1947-48, together furnished almost 10 feet of snow. The greatest monthly snowfall of record was 45 inches in March 1924.

In this western country, the wind blows continuously, generally from southern parts. Bothersome velocities sometimes last several days. On the other hand, the good breeze and low humidity make this area more pleasant than many others. Highest wind velocities generally occur during thunderstorms or wind shifts from south to north and may occasionally be damaging.

High winds, together with fine snow and low temperatures, occur occasionally and have been so severe that they tie up rail and highway traffic and cause great difficulties for livestock. Duststorms sometimes erode much of the topsoil and lower visibility to a few yards, especially in long periods of dry weather when the soil lacks a vegetative cover.

Hailstorms are particularly dreaded in this region. They may consist of a few small stones of little consequence to many the size of peas or marbles driven by high winds. Occasionally, the hailstones are large chunks of ice of baseball size.

Dr. L. D. Bark, associate professor of physics and agricultural meteorology, Kansas State University, Manhattan, Kans., has provided information on the probability of weekly totals of precipitation, using the daily record on punched cards for Tribune, Kans. Probabilities were computed from the incomplete gamma function devised by Barger and Thom.⁴ The gamma function is described by Friedman and Janes.⁵

Computations were made on a computer, using the program developed by Hartley and Lewish^{6,7} for the study of precipitation probability for the North Central Region. The period used for analysis was from 1914 to 1958.⁸

The probabilities of receiving certain amounts of precipitation in any 1 week in the year are shown in figure 18. The top curve indicates the possibility of receiving at least 0.02 inch of rain in 1 week. This small amount is not agriculturally significant to a dry area, such as Greeley County, but it does show that at least some precipitation can be expected any time of the year. However, the chances of receiving any measurable precipitation are low

(about 1 year out of 3) in the winter period, late November through January.

The bottom curve in the figure indicates that a weekly total precipitation of 1.00 inch or more is fairly rare. Even in the most probable period, the chances of receiving an inch of rain are only about 1 year out of 6 (15 to 16 percent). From October through March, there is practically no chance of receiving an inch or more of precipitation in 1 week.

The intermediate curves in the figure show similar information for amounts of precipitation greater than 0.20 and 0.60 inch in 1 week.

Soil Classification and Development

Soils are classified on the basis of the kinds of layers, or *soil horizons*, that are found in a vertical soil section, or *soil profile*. On the basis of similarities of soil profile characteristics, the soils of Greeley County are classified into nine classes, called soil series. The soils grouped within a soil series may vary somewhat in surface texture or in slope, but they are similar in the kind, thickness, and arrangement of soil horizons in their profiles. Each soil series is named for a place near where it was first identified; for example, the Manter series is named for the town of Manter in western Kansas.

Soil series are further classified into broader classes called great soil groups. Soil series within each great soil group may differ greatly in characteristics, such as thickness of profile and degree of development of the different horizons, but they have major profile characteristics in common and have similar kinds of horizons arranged in the same sequence. The nine soil series in Greeley County are classified into five great soil groups, of which the Chestnut great soil group is the most extensive. Table 5 shows the classification of the soil series into great soil groups and some important characteristics of each of the soil series in the county.

The development of soils and the variations among them have been influenced by the effects of native vegetation, climate, parent rock material, topography, and the length of time since soil formation began.

The soils have developed under a vegetative cover consisting primarily of short prairie grasses. Some mid grasses and tall grasses grow on flood plains and on shallow soils and sandy soils.

The climate is temperate, continental, and semiarid. The average annual temperature is about 52.5° F., and the average annual precipitation is 16.7 inches.

Most of the soils have developed in calcareous, silty, and sandy sediments deposited during Pleistocene time. Some outcrops of older formations occur in the erosional valleys of White Woman and Ladder Creeks. Of these outcrops, only those of the Ogallala formation, deposited during Pliocene time, are important to a study of the soils of the county. A small outcrop of the Smoky Hill chalk member of the Niobrara formation (Cretaceous age) occurs in the western part of the county along White Woman Creek. No soils have been mapped on this outcropping chalk formation, which has been included with the associated soils on the Ogallala formation. The approximate position of the geologic formations, and the relationship of these formations to each other and to the soils that have

⁴ BARGER, GERALD L., and THOM, H. C. S. EVALUATION OF DROUGHT HAZARD. *Agron. Jour.* 41: 519-527, illus. 1949.

⁵ FRIEDMAN, DON G., and JANES, BYRON E. ESTIMATION OF RAINFALL PROBABILITIES. *Storrs Agr. Expt. Sta. Bul.* 332, 22 pp., illus.

⁶ HARTLEY, H. O., and LEWISH, W. T. FITTING OF DATA TO THE TWO PARAMETER GAMMA DISTRIBUTION WITH SPECIAL REFERENCE TO RAINFALL DATA. 650 Program 6.008 ISU Stat. Lab., Iowa St. Univ. 46 pp. Ames Iowa. 1959. [Limited publication.]

⁷ HARTLEY, H. O., and LEWISH, W. T. DETERMINING PROBABILITIES FROM A FITTED GAMMA DISTRIBUTION. 650 Program No. 6.007 ISC, Stat. Lab., Iowa St. Col. 41 pp. Ames, Iowa. 1959. [Limited publication.]

⁸ NORTH CENTRAL REGIONAL TECHNICAL COMMITTEE ON WEATHER INFORMATION FOR AGRICULTURE. CHANCES OF RECEIVING SELECTED AMOUNTS OF PRECIPITATION IN THE NORTH CENTRAL REGION OF THE U.S. First Rpt., NC 26 Com. Prog., 277 pp., illus., 1959.

developed on the exposed parts are shown by diagram in figure 19.

Soils Developed in Loess

Richfield, Ulysses, and Colby soils have all developed in the loess deposit that mantles most of Greeley County. This loess ranges in thickness from a few feet on valley slopes to as much as 30 feet on the high, flat tablelands. The loess deposits are pale brown (10YR 6/3, dry), calcareous, and high in silt (0.5 to 0.002 millimeter). Analyses of loess samples taken in Hamilton and Logan Counties show the loess to be silt loam in texture, averaging about 65 percent silt and 20 percent clay (less than 0.002 millimeter).

Of the soils developed in loess, Richfield silt loam has the highest degree of profile development. This soil is

a member of the Chestnut great soil group. It occurs on the nearly level areas that generally have slopes of less than 0.5 percent. This soil has well defined and easily distinguishable A, B, and C horizons. It has a dark-colored, granular A horizon containing less than 30 percent clay underlain by a dark-colored, subangular blocky B horizon containing about 34 to 38 percent clay.

Colby silt loam, a Regosol with slopes of about 3 percent and greater, has the least amount of profile development. It has an A horizon that is only slightly darkened and no B horizon. It is generally calcareous to the surface.

The Ulysses soils are intermediate between the Colby and Richfield soils in degree of profile development. Ulysses soils are classified as Chestnut soils intergrading to the Regosol group. They generally have slopes of about 0.5 to 3 percent. In some areas, however, they have

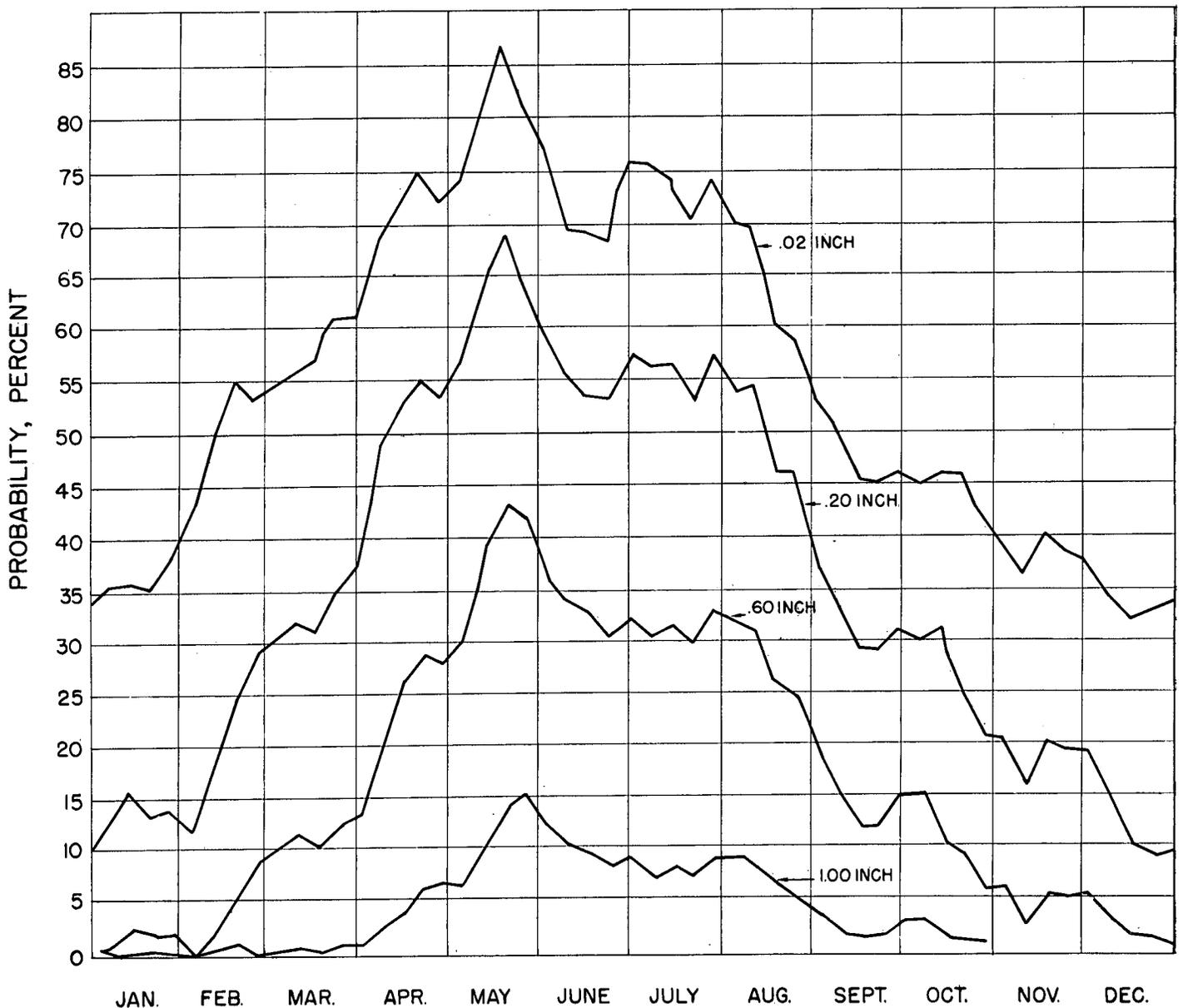


Figure 18.—Probability, in percent, of receiving 0.02, 0.20, 0.60, and 1.00 inch, or more, of precipitation in a 7-day period.

TABLE 5.—Classification and important characteristics of soils of Greeley County

| Great soil group and series | Parent material | Position | Slope | Color and texture of— | | Calcareous at (depth)— | Kind of limiting layer |
|---|-------------------------------|----------------|-------------------------------------|--|--|------------------------|------------------------------------|
| | | | | A horizon | B horizon | | |
| Calcisols: Mansker | Thin loess over caliche. | Upland | Moderately sloping. | Grayish-brown loam. | | Surface | Caliche at depth of 18 inches. |
| Chestnut soils: Goshen | Silty alluvium and colluvium. | Upland swales. | Nearly level | Dark grayish-brown silt loam. | Dark grayish-brown silty clay loam. | 24 inches | None. |
| Lofton | Loess | Upland | Flat (depressional). | Dark grayish-brown clay loam. | Dark-gray silty clay loam. | 30 inches | None. |
| Manter | Mixed eolian silts and sands. | Upland | Hummocky to steeply sloping. | Dark grayish-brown fine sandy loam. | Brown fine sandy loam. | 16 inches | None. |
| Richfield | Loess | Upland | Nearly level | Dark grayish-brown silt loam. | Dark grayish-brown silty clay loam. | 14 inches | None. |
| Chestnut soils (intergrading to Regosols): Ulysses | Loess | Upland | Nearly level to moderately sloping. | Dark grayish-brown silt loam and loam. | Dark grayish-brown silt loam or light silty clay loam. | 8 inches | None. |
| Regosols: Colby | Loess | Upland | Gently to steeply sloping. | Grayish-brown silt loam. | | Surface | None. |
| Lithosols: Potter | Caliche | Upland | Steep | Grayish-brown fine sandy loam. | | Surface | Caliche at depth of 8 inches. |
| Alluvial soils: Lincoln | Sandy alluvium. | Flood plain. | Nearly level | Grayish-brown fine sandy loam. | | Surface | Coarse sand at depth of 12 inches. |

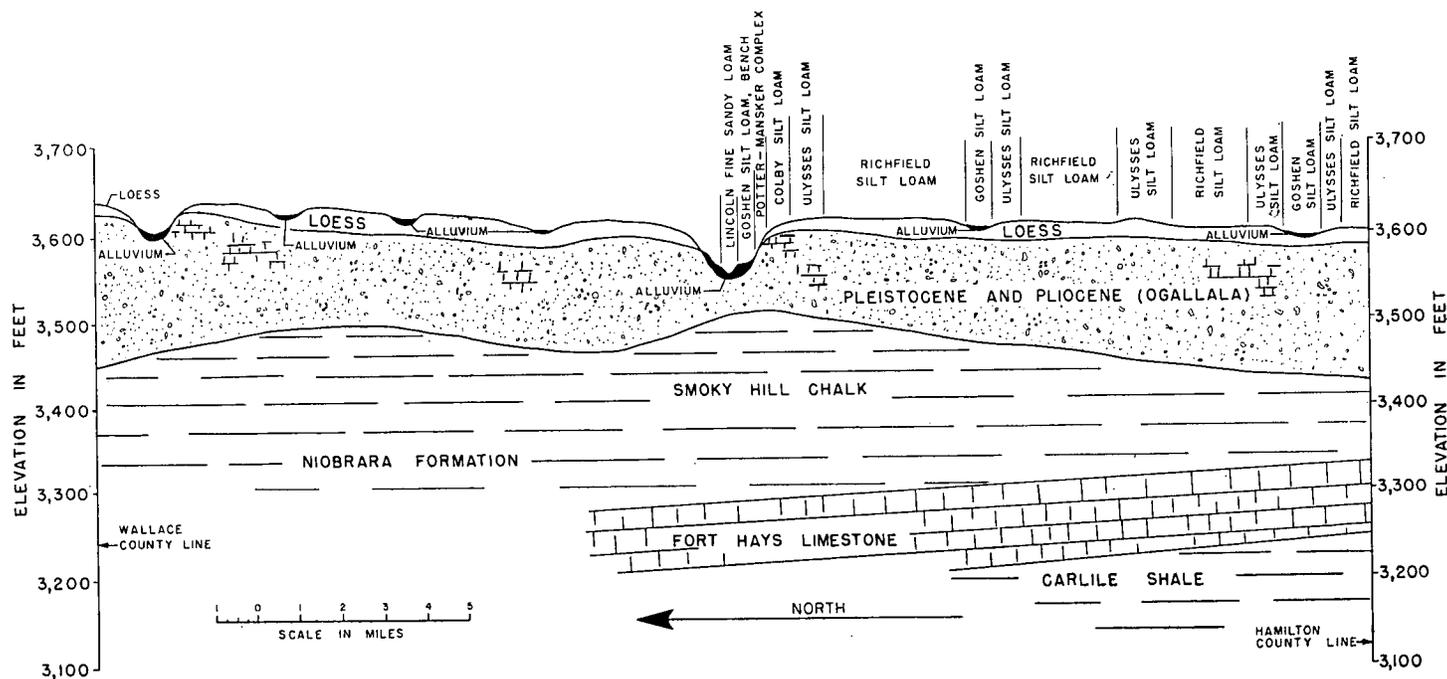


Figure 19.—Approximate geologic cross section (north and south) through central Greeley County.

slopes of 4 and 5 percent. The Ulysses soils have a moderately dark A horizon and a very weak B horizon, or none. They are generally calcareous within 10 inches of the surface.

Lofton clay loam is a Chestnut soil closely associated with the soils developed in loess. It occupies the many shallow, undrained depressions that occur throughout the county. These areas hold water for several to many hours after heavy rains. The A horizon of the Lofton soils is dark-colored clay loam, and the B horizon is heavy silty clay loam or light clay. Unaltered loess generally occurs below a depth of about 4 feet.

Some laboratory measurements of various properties of soils developed in loess are given in table 6. The Richfield and Colby soils were sampled in adjoining Hamilton County, and the Ulysses soils were sampled in Logan County. The samples were analyzed by the Soil Survey Laboratory, Lincoln, Nebr.

Soils Developed in Upland Sandy Sediments

Manter fine sandy loam is a Chestnut soil that occurs in small areas in Greeley County. It occupies sandy ridges and knolls. Some time after the loess was deposited, wind moved sandy material (presumably from outcrops of the Ogallala formation) into knolls and ridges. Such areas now have subdued dune topography. The knolls and ridges are generally bordered on the west by broad, shallow, low areas that in places are depressions. They are bordered on the east by nearly level areas of Richfield and Ulysses soils.

Manter fine sandy loam has a dark-colored, fine sandy loam A horizon and an indistinct sandy loam or loam B horizon that contains an appreciable amount of silt.

Underlying material commonly ranges from sandy loam to loam and may be weakly stratified. This is the only sandy soil of the uplands that occurs in the county.

Soils Developed in the Ogallala Formation

The Potter soil is the only one in the county developed wholly in rocks of the Ogallala formation. It is a Lithosol developed on the outcrops of indurated caliche. The Potter soil occurs along the White Woman and Ladder Creeks where geological erosion has removed the overlying sediments. The A horizon is generally calcareous fine sandy loam, less than 12 inches thick over weathered caliche. The Potter soil was mapped in complex with Mansker loam. The Mansker soil is a moderately deep Calcisol, underlain by the Ogallala caliche. It usually occurs just above the Potter soil where the silty sediments are thin. The Mansker soil has a moderately dark, calcareous A horizon. The layer, transitional to highly calcareous materials below, is thick and sometimes stony.

Soils Developed in Alluvium

The only true Alluvial soil in Greeley County is Lincoln fine sandy loam. It is a young, light-colored, calcareous soil, weakly developed in the alluvium of the flood plain of White Woman Creek. The limited extent of soil profile development is shown by a slight accumulation of organic matter and some darkening in the A horizon.

Goshen silt loam and Goshen silt loam, bench, are Chestnut soils that have developed in alluvial-colluvial sediments. These sediments came mainly from the adjacent, higher soils developed in loess. The Goshen soils have a thick, dark-colored, granular silt loam A horizon and a

TABLE 6.—Laboratory analyses of soils developed in loess

| Soil and horizon | Depth | Organic matter | | CaCO ₃ equivalent | Cation-exchange capacity | pH | Particle-size distribution | | |
|-----------------------------------|---------------|----------------|----------------|------------------------------|--------------------------|-----|----------------------------|----------------|----------------|
| | | Organic carbon | Nitrogen | | | | Clay | Silt | Sand |
| Richfield silt loam (cultivated): | <i>Inches</i> | <i>Percent</i> | <i>Percent</i> | <i>Percent</i> | <i>Meg./100 gm.</i> | | <i>Percent</i> | <i>Percent</i> | <i>Percent</i> |
| A _{1p} ----- | 0-4 | 1.17 | 0.109 | ----- | 22.8 | 7.5 | 29.0 | 53.9 | 17.1 |
| B ₂₁ ----- | 4-8 | 1.02 | .101 | 1 | 29.4 | 7.1 | 37.4 | 52.3 | 10.3 |
| B ₂₂ ----- | 8-11 | .94 | .105 | 1 | 28.9 | 7.8 | 38.1 | 49.7 | 12.2 |
| B _{2ca} ----- | 11-24 | .55 | .064 | 18 | 21.7 | 8.2 | 33.9 | 58.9 | 7.2 |
| C _{ca} ----- | 24-36 | .31 | ----- | 10 | 22.5 | 8.3 | 26.8 | 66.4 | 6.8 |
| C ₁ ----- | 36-50 | .23 | ----- | 8 | 22.9 | 8.6 | 24.6 | 67.7 | 7.7 |
| C ₂ ----- | 50-72+ | .23 | ----- | 8 | 22.8 | 8.5 | 24.6 | 67.6 | 7.8 |
| Ulysses silt loam (cultivated): | | | | | | | | | |
| A _{1p} ----- | 0-5 | 1.35 | .136 | ----- | 23.2 | 7.4 | 25.1 | 62.7 | 12.2 |
| A ₁ ----- | 5-7 | 1.03 | .104 | 2 | 24.0 | 8.0 | 27.9 | 61.9 | 10.2 |
| B ₂ ----- | 7-14 | .79 | .083 | 3 | 24.7 | 8.0 | 29.8 | 61.3 | 8.9 |
| B _{ca} ----- | 14-25 | .52 | .056 | 10 | 23.1 | 8.1 | 25.9 | 64.8 | 9.3 |
| C ₁ ----- | 25-36 | .25 | ----- | 10 | 22.0 | 8.1 | 21.9 | 68.1 | 10.0 |
| C ₂ ----- | 36-48 | .18 | ----- | 7 | 20.9 | 8.3 | 17.1 | 71.3 | 11.6 |
| C ₃ ----- | 48-63+ | .18 | ----- | 7 | 21.0 | 8.2 | 18.9 | 69.9 | 11.2 |
| Colby silt loam (virgin grass): | | | | | | | | | |
| A _{1p} ----- | 0-2 | 1.20 | .097 | ----- | 18.5 | 8.1 | 18.0 | 50.6 | 31.4 |
| A ₁ ----- | 2-7 | 1.23 | .128 | 14 | 20.9 | 8.2 | 27.4 | 49.9 | 22.7 |
| AC----- | 7-18 | .71 | .075 | 12 | 19.9 | 8.1 | 28.0 | 57.1 | 14.9 |
| AC _{ca} ----- | 18-30 | .28 | .030 | 10 | 20.0 | 8.5 | 22.3 | 64.2 | 13.5 |
| C ₁ ----- | 30-44 | .20 | ----- | 9 | 18.5 | 8.8 | 18.7 | 64.3 | 17.0 |
| C ₂ ----- | 44-65+ | .14 | ----- | 9 | 17.0 | 8.8 | 14.2 | 66.7 | 19.1 |

dark-colored, subangular blocky silty clay loam B horizon. They are leached of lime to depths of 15 to 30 inches and are darkened to about the same depths. Goshen silt loam occurs on nearly level floors of shallow upland swales that receive considerable runoff from adjacent areas. Goshen silt loam, bench, occupies distinct, nearly level terraces along White Woman Creek. It is well above overflow from the creek but receives some extra moisture from adjoining higher areas. This soil receives somewhat less extra moisture than Goshen silt loam and is therefore darkened to less depth and has a texture horizonation that is slightly weaker.

General Nature of the County

Some of the general characteristics of the county are discussed in this section. These include history, agriculture, community facilities, physical features, and water supplies.

History

Greeley County was organized in 1888. The population has always been small, but it fluctuates markedly. It decreases during prolonged droughts and increases after enough precipitation has fallen to produce crops. Agriculture is the only industry in the county.

Until World War I, the agriculture of the area was mainly subsistence farming, but there were some large ranches. Native grass covered most of the land in the county. Grain and forage for domestic livestock were the main crops. After the tractor was used for farm power, and as wheat became an important crop, more and more grassland was plowed. Large-scale, extensive, cash-grain farms were established. Notably large acreages were plowed in the late 1920's and in the 1940's. In 1940 approximately 300,000 acres remained in native grass. In 1957 the number had declined to about 56,000 acres.

In 1911 the Tribune branch of the Kansas Agricultural Experiment Station (fig. 20) was established. The station tests crop varieties for suitability and yield. Various

methods of tillage and planting are studied. Complete weather records are also kept.

Farmers became concerned about soil erosion and land deterioration during the drought and duststorms of the 1930's. They also noted water erosion on the sloping, cultivated soils as more rain fell on the area in the early 1940's. In 1948 the farmers and landowners organized the Greeley County Soil Conservation District. The purpose was to encourage proper use of land and to conserve the soil and water resources in the county. Since the district was formed, soil and water conservation practices, such as terracing, contouring, stubble mulching, stripcropping, and supplemental irrigation, have been used on many acres of cropland. Suitable native grasses have been reseeded on some nonarable soils. Range-improvement practices have been used on many more acres of native grass pasture.

Agriculture

Farming is on a large scale and highly mechanized. Most of the cultivated land is in farms planted mainly to commercial crops of wheat and sorghum. These crops are sold and shipped out of the county at harvesttime. The raising of livestock is a small industry mainly confined to the sloping lands adjacent to White Woman and Ladder Creeks. Many cattle and sheep are brought into the county to graze for short, seasonal periods.

Crops

Wheat and sorghum are the only important crops that are climatically suited to dryland farming in this part of the High Plains. These crops are usually grown in a cropping system that allows the land to be fallow every other year. During the fallow period, weeds are controlled to conserve moisture and to store it for use by the following crop.

In the early history of the county, a large acreage was used to produce corn, oats, and barley. These crops have declined in importance and almost none are now planted. A small acreage of corn is grown on irrigated land and used for silage and grain.

Range

About 11 percent of the land in Greeley County is in native grass and is used for range. Most of this land is nonarable or marginal for cultivation. It supports the mid grasses and short grasses native to the High Plains. A few small areas of sandy land and sandy bottom land support taller grasses.

Livestock

Table 7 shows the number of livestock in the county in stated years. Beef cattle usually outnumber other classes of livestock, but the number varies greatly from year to year, depending on the season. The numbers of cattle and sheep are usually high in fall and winter, particularly following favorable growing seasons. These animals are brought in from range areas in this State and other States when wheat pasture or sorghum stubble, or both, are available. Farmers who have summer range keep a few cows.



Figure 20.—Headquarters of the Tribune branch of the Kansas Agricultural Experiment Station, 1 mile west of Tribune.

TABLE 7.—Number of livestock in Greeley County in stated years

| Livestock | 1940 | 1945 | 1950 | 1954 |
|-----------------------|--------|--------|--------|--------|
| Horses and mules..... | 388 | 201 | 259 | 191 |
| Cattle..... | 4,439 | 10,331 | 7,516 | 15,608 |
| Sheep..... | 2,539 | 6,479 | 1,244 | 5,265 |
| Chickens..... | 11,043 | 10,050 | 12,190 | 14,434 |

Farm labor and equipment

Power equipment is used for all tillage, seeding, and harvesting operations. Large, wheel-type tractors are generally used, but a few operators use the track type. Wheat and grain sorghum are harvested with large, self-propelled combines. Most farmers own adequate equipment for tillage and planting, but many have part or all of their grain combined by custom operators from outside, who commonly furnish much of the labor, combines, and trucks necessary for the harvest.

Labor demand is seasonal. Local labor is about adequate for planting and tillage. Transient labor is usually enough for the peak demand during harvest.

Community Facilities

Tribune and Horace are the only towns in the county. Tribune, the county seat, is located in about the center of the county on the Missouri Pacific Railroad and at the intersection of State Highways Nos. 96 and 27. Horace is on the railroad, 2 miles west of Tribune and about half

Tenure and size of farms

According to the Census of Agriculture, there were 267 farms in the county in 1954. The farms averaged more than 1,500 acres each. A few farmers own all the land they operate. Commonly, one operator may rent additional land from four or five owners. According to the 1954 census, 35 operators were full owners, 135 were part owners, 96 were tenants, and 1 was a manager. Leasing arrangements are usually on a crop-share basis. Considerable land is farmed by operators who live outside the county.

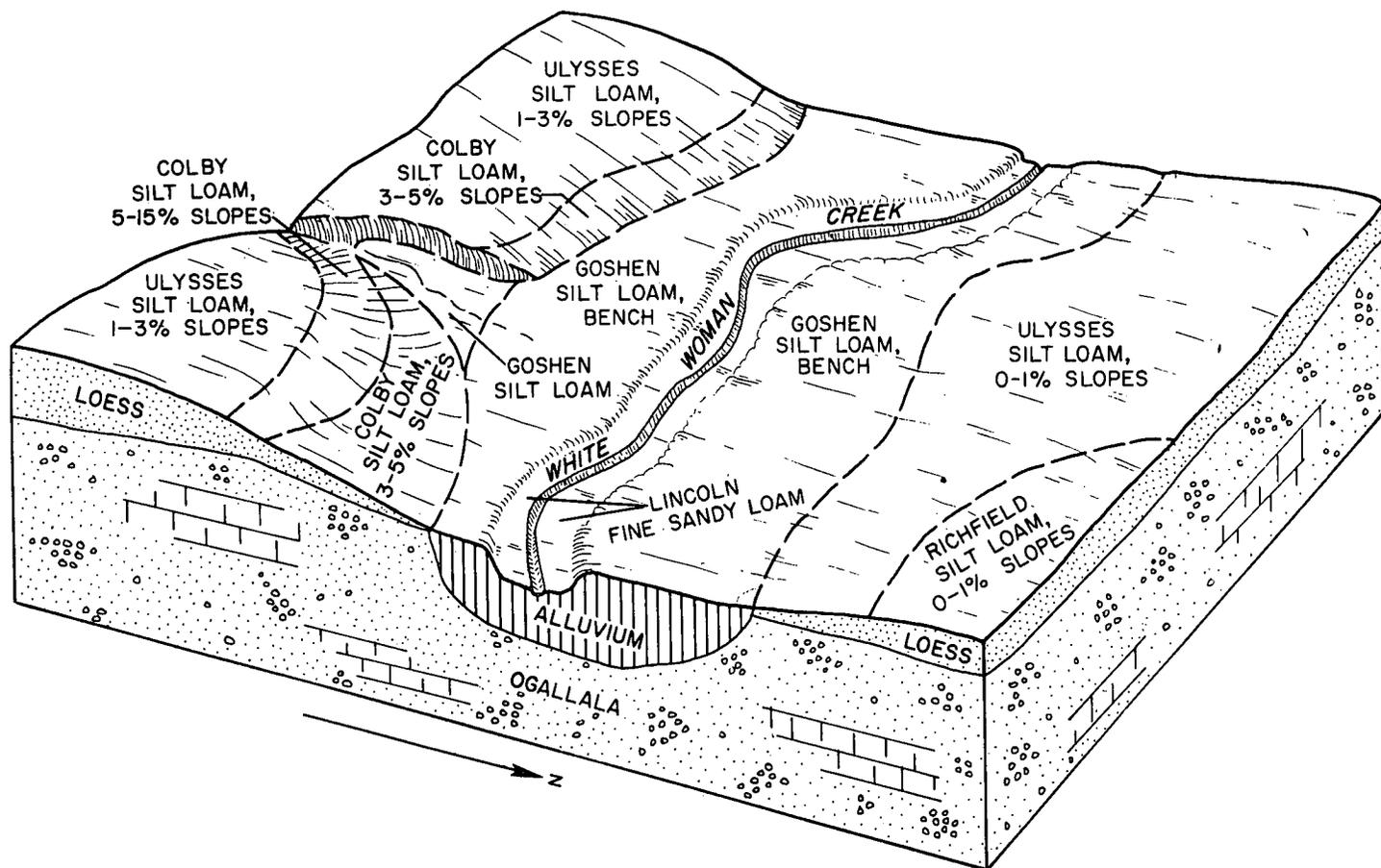


Figure 21.—Cross section of the valley of White Woman Creek in Greeley County.

a mile north of Highway No. 96. Both towns have facilities for handling grain and for storage. The railroad and the two highways provide transportation to terminal elevators and markets. Greeley County is organized into one school district. Both the high school and grade school are located at Tribune.

Topography and Drainage

Greeley County is on the high, nearly level tableland that divides the Arkansas and Smoky Hill River drainage areas. Ladder and White Woman Creeks flow intermittently across the county from west to east. Both creeks rise in eastern Colorado. Ladder Creek enters the county near the northwestern corner. It drains eastward into Wichita and Scott Counties and joins the Smoky Hill River in Logan County. White Woman Creek enters the county a few miles south of Ladder Creek and drains to the southeast (fig. 21). It passes into Wichita County about midway between the north and south county lines. From this point, it flows slightly southeast and empties into the White Woman Creek basin in Scott County. This basin, located southeast of Scott City, is a large, depressed area that makes up the most northern part of the Scott-Finney depression. A few other small drainages in Greeley County drain southeastward into this depression.

The extreme southwestern corner of the county slopes westward and drains into Prowers County, Colo. A large

depression, or sink, known as Dead Horse Lake, is in the southwestern part of Greeley County. The lowest parts of this depression have a drainage area of several square miles and are intermittently ponded by runoff from higher areas. During very wet seasons, water may remain in these low areas for several months before it evaporates or seeps downward.

Elevations range from about 3,900 feet in the northwestern corner of the county to about 3,475 feet in the southeastern corner. The land surface slopes gently to the southeast at about 15 feet to the mile.

Water Supplies

All of the water for domestic use and most of the water for livestock come from wells. Most of these are drilled wells, 50 to 150 feet deep. The water is obtained from the Ogallala formation. Wells that will supply enough water for domestic and livestock use are obtainable almost anywhere except in the southwestern two or three townships. Water to irrigate field crops is obtained in limited amounts in the area east and north of Tribune. This water is also pumped from the Ogallala formation. All the water from wells drilled in the Ogallala formation is moderately hard but is quite satisfactory for domestic, livestock, and irrigation use. Some small dams have been constructed across intermittently flowing streams of the uplands to impound water for livestock use.

Glossary

Aggregate. A single mass or cluster of soil consisting of many soil particles held together.

Alluvium. Sand, silt, mud, or other sediments deposited by running water.

Buried soil. Soil covered by more recently deposited materials in which the present soil has formed.

Calcareous soil or soil material. Soil containing sufficient free calcium carbonate (in many places with magnesium carbonate) to effervesce (fizz) visibly when treated with hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate, or of mixed calcium and magnesium carbonates, characteristic of warm desert and semiarid regions.

Classification, soil. Soils are arranged into groups, in several categories, on the basis of their characteristics. Beginning with the lowest category, the soil type, soils are classified on the basis of progressively fewer characteristics into the groups of more inclusive categories, namely, series, family, great soil group, suborder, and order.

Clay. Small mineral soil particles less than 0.002 millimeters in diameter. As a soil textural class, soil material that contains 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A coating or film of clay that has been deposited on the surface of a soil aggregate.

Clay loam. Soil material containing 27 to 40 percent clay and 20 to 45 percent sand.

Colluvium. Soil material or mixtures of soil material and rock fragments that have moved downslope and accumulated through the influence of gravity, including creep and local wash.

Complex, soil. A soil mapping unit consisting of two or more soil types or phases so intermingled that they cannot be separated on the scale of mapping used.

Concretions. Local concentration of certain chemical compounds, such as calcium carbonate or compounds of iron, that form nodules of mixed composition and of various sizes, shapes, and coloring.

Consistence, soil. The attributes of soil material that are expressed by the degree and kind of cohesion and adhesion or by the resistance to deformation or rupture. Terms commonly used to describe consistence are *loose, soft, hard (when dry); friable, firm, loose (when moist); and sticky, plastic (when wet)*. *Friable* soil, for example, is easily crumbled by the fingers.

Deep soil. Terms that relate to depth of soil need to be defined in relation to the purpose for which they will be used. In this report, a soil described as deep has an effective root zone of 36 inches, or more, over rock or other strongly contrasting material.

Horizon, soil. A layer of soil, approximately parallel to the soil surface, that has characteristics produced by soil-forming processes. The relative positions of the several soil horizons in the soil profile and their nomenclature are given below:

A horizon. The surface horizon of a mineral soil having maximum biological activity, or eluviation (movement of soil materials from one place to another within the soil), or both.

B horizon. A layer of soil, usually beneath the A horizon, in which clay, iron, and aluminum compounds, and accessory organic matter have accumulated. It has well-defined characteristics, in contrast to horizons above and below, of texture, structure, and usually color.

C horizon. A layer of unconsolidated material, relatively little affected by organisms and presumed to be similar in physical, chemical, and mineralogical composition to the material from which at least part of the overlying solum has developed.

Gravel. Rounded or angular fragments of stone from 2 millimeters to 3 inches in diameter.

Loam. Soil material containing 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

Loamy sand. Soil material containing at the upper limit 85 to 90 percent sand, and the percentage of silt plus 1½ times the percentage of clay is not less than 15; at the lower limit it contains not less than 70 to 85 percent sand, and the percentage of silt plus twice the percentage of clay does not exceed 30.

Loamy soils. A general expression for soils with textures intermediate between clays and sands.

Loess. A geologic, wind-transported deposit of relatively uniform fine sediments, high in silt content.

Mechanical analysis. A physical analysis of soil materials to determine the percentage amounts of the various soil separates, such as sand, silt, and clay.

Outwash sediments. Old alluvial sediments generally now in upland positions that consist of more or less sorted gravel, sand, silt, or clay.

Phase, soil. The subdivision of a soil type or other soil classification unit on the basis of variations in characteristics that are not significant to the classification of the soil in its natural landscape but are significant to the use and management of the soil. Differences in slope and degree of erosion account for the main variations of this kind in western Kansas.

Profile, soil. A vertical section of the soil through all its horizons and extending into the underlying or parent material.

Quarter corner. A place, midway between the corners, on the perimeter of a section of land which is 1 mile square and contains 640 acres. Lines connecting quarter corners from opposite sides divide the section into quarters, each ¼ mile square containing 160 acres.

Relief. The differences in altitude of a land surface, considered collectively.

Sand. Individual mineral particles having diameters of 0.05 to 2.0 millimeters. The textural class name for soil material that contains 85 percent or more of sand, and the percentage of silt, plus 1½ times the percentage of clay, does not exceed 15.

Sandy clay. Soil material containing 35 percent or more of clay and 45 percent or more of sand.

Sandy clay loam. Soil material that contains 20 to 35 percent clay, less than 28 percent silt, and 45 percent or more sand.

Sandy loams. Soil material that contains either 20 percent clay or less, and the percentage of silt plus twice the percentage of clay exceeds 30, and 52 percent or more sand; or less than 7 percent clay, less than 50 percent silt, and between 43 and 52 percent sand.

Series, soil. A group of soils that have horizons similar in their differentiating characteristics and arrangement within the profile, except for texture of the surface soil, and are formed from similar parent materials. Each soil series is given the name of a town or other geographic feature, generally one near the

place where it was first identified, such as Colby, Richfield, or Ulysses.

Silt. Individual mineral particles having diameters of 0.002 to 0.05 millimeters. The textural class name for soil material containing 80 percent or more silt and less than 12 percent clay. Locally, the term silt is also used to refer to loamy sediments of any size class that were deposited by floodwaters.

Silt loam. Soil material that contains 50 percent or more silt and 12 to 27 percent clay, or 50 to 80 percent silt and less than 12 percent clay.

Silty clay. Soil material that contains 40 percent or more clay and 40 percent or more silt.

Silty clay loam. Soil material that contains 27 to 40 percent clay and less than 20 percent sand.

Solum. The upper part of the soil profile, above the parent material, in which the processes of soil formation are active. This includes the A and B horizons in mature soils.

Structure, soil. The aggregation of primary soil particles into compound particles that are separated from adjoining aggregates by surfaces of weakness. An individual soil aggregate is called a ped.

Subsoil. Generally, that part of the soil below the plow layer in which plant roots grow. The B horizon in soils with distinct profiles.

Texture, soil. Refers to the relative proportions of clay, silt, and sand in soil material. It is indicated by the textural class name—such as silt loam or sandy clay—of the soil. (See Clay; Loam; Sand; Silt; and also the definitions of the following textural classes: Clay loam; Loamy sand; Sandy clay; Sandy clay loam; Sandy loam; Silt loam; Silty clay; Silty clay loam.)

Coarse-textured soil. Soil material of textural classes of sand and loamy sand. (Also known as light texture.)

Fine-textured soil. Soil material of textural classes of sandy clay, silty clay, and clay. (Also known as heavy texture.)

Tilth. The physical condition of a soil in respect to its fitness for growth of specified plants.

Topsoil. A general term used in at least four different senses: (1) surface soil layer or plow layer; (2) the original or present dark-colored upper soil; (3) the A horizon; (4) presumed fertile soil material used to spread on lawns, gardens, and roadbanks.

Type, soil. A subdivision of a soil series based on texture of the A horizon. The name of a soil type consists of the series name plus the textural class name of the A horizon; examples are Colby silt loam and Ulysses loam.

GUIDE TO MAPPING UNITS, CAPABILITY UNITS, AND RANGE SITES

[See table 1, p. 4, for approximate acreage and proportionate extent of the soils, and table 3, p. 16, for estimated average yields per acre on arable soils under dryland farming]

| Map symbol | Mapping unit | Page | Capability unit | Page | Range site | Page |
|------------|---|------|-----------------|------|------------------|------|
| Cb | Colby silt loam, 1 to 3 percent slopes | 4 | IVe-1 | 14 | Loamy Upland | 18 |
| Cc | Colby silt loam, 3 to 5 percent slopes | 4 | VIe-1 | 15 | Loamy Upland | 18 |
| Cd | Colby silt loam, 5 to 15 percent slopes | 4 | VIe-1 | 15 | Loamy Upland | 18 |
| Go | Goshen silt loam | 5 | IIIc-2 | 14 | Lowland | 19 |
| Gt | Goshen silt loam, bench | 5 | IIIc-1 | 13 | Loamy Upland | 18 |
| Lf | Lincoln fine sandy loam | 5 | VIIw-1 | 15 | (¹) | 19 |
| Lo | Lofton clay loam | 6 | IVw-1 | 15 | Loamy Upland | 18 |
| Md | Manter fine sandy loam, 5 to 15 percent slopes | 6 | VIe-2 | 15 | Sandy | 19 |
| Px | Potter-Mansker complex | 6 | VIe-3 | 15 | Breaks | 19 |
| Rm | Richfield silt loam, 0 to 1 percent slopes | 7 | IIIc-1 | 13 | Loamy Upland | 18 |
| Ua | Ulysses loam, 1 to 3 percent slopes | 8 | IIIe-1 | 14 | Loamy Upland | 18 |
| Ub | Ulysses loam and silt loam, 3 to 5 percent slopes | 8 | IVe-1 | 14 | Loamy Upland | 18 |
| Uc | Ulysses silt loam, 0 to 1 percent slopes | 7 | IIIc-1 | 13 | Loamy Upland | 18 |
| Ud | Ulysses silt loam, 1 to 3 percent slopes | 8 | IIIe-1 | 14 | Loamy Upland | 18 |

¹ Because the soil and vegetation are unstable, this soil is not considered a true range site.

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