

AN ANALYSIS OF THE NATURAL
LAND TYPES OF DEUEL COUNTY,
NEBRASKA

Thesis for the Degree of M. S.
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Rudolph Ulrich
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THESIS

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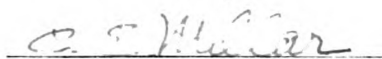
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Major professor

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AN ANALYSIS OF THE NATURAL LAND
TYPES OF DEUEL COUNTY, NEBRASKA

by

Rudolph Ulrich

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INTRODUCTION

The term "natural land type" has appeared frequently in publications (1, 6, 9, 11, 12, 14, 15, 16, 18, 19, and 20) ^{*} in the past few years, and in discussions by technologists interested in land classification and inventory of land resources.

According to Veatch (16), a major natural land type in any geographic area is based upon the major relief features or physiographic divisions to which are added elements of soil, minor configuration features, and natural vegetation. Refinements in the classification of these elements provide criteria for the recognition of minor land types. Land types may include a number of soil types or a single soil type. Frequency, proportion, or the distribution pattern, of natural configuration features such as lakes, sinkholes, streams, potholes, swamps, and different kinds of soil characterize, as well as suggest the proper use and value of land types.

For the most part, the descriptions of natural landscapes in the literature have been impressionistic, qualitative, or concerned with geologic origin. Quantitative

*
Literature cited in bibliography.

description is rarely attempted. For comparing landscapes, for economic land classification, or land planning, quantitative presentation of component parts by percentage of area is more valuable than qualitative analysis. The purpose of this thesis is to analyze quantitatively the natural land types in a selected area, as a test of the foregoing concepts and postulations.

The natural land types classified and analyzed are in Deuel County in the western part of Nebraska. This area is a relatively simple landscape but was selected because of the availability of detailed information provided by a recently completed soil conservation survey. This survey offered an opportunity to study in great detail the micro-relief and soil variations present in a natural land type. In some instances, slope separations as small as one-half acre were delineated. The predominating percent of slope was likewise very closely delineated inasmuch as slopes of 1, 2, and 3 percent were separated. These minute slope separations were made because of the varying soil and moisture conservation recommendations on the gently sloping, medium-textured soils which comprise most of the county.

The soil conservation survey was made from 1940 to 1943 by the U. S. Soil Conservation Service as a basis

for soil and moisture conservation recommendations in the Deuel County Soil Conservation District. The initial and progress inspections were made by the late Dr. F. A. Hayes, Bureau of Plant Industry, U. S. Department of Agriculture. The final inspection was made by B. H. Williams of the same bureau. The field survey under the direction of R. D. Greenawalt was accomplished upon 4 inch equal one mile aerial photographs. R. D. Greenawalt, D. F. Bertelson, and John Willard were the principal surveyors. The writer was assigned to the district from December 1941 to April 1942.

DESCRIPTION OF DEUEL COUNTY, NEBRASKA

I. GEOGRAPHY

Deuel County is in the southeastern corner of that section of western Nebraska which lies directly north of the state of Colorado. The first permanent white settlers came to the area in 1885. The county was organized on January 21, 1889 after a vote on November 6, 1888 which separated it from Cheyenne County to the west. In 1909, the county was divided, and the major portion lying to the north was organized into Garden County. In its present form, the county is rectangular in outline having a length of 30 miles east to west and 15 miles north to south. According to census data, the area is 439 square miles of which 435 square miles are listed as dry land and 4 square miles as water surface. Chappell, with a population of 1,093 in 1940, is the county seat.

Physiographically, the county is a portion of the High Plains. Here the gentle southeasterly-sloping plain is dissected into two tablelands by Lodgepole Creek and the South Platte River. Lodgepole Creek, a perennially flowing stream, enters the county midway along the

western border and flows southeasterly to a point midway along the southern border after which it flows into Colorado for a short distance and joins the South Platte River.

The much larger, but more erratic-flowing, South Platte River flows northeasterly across the southeastern corner of the county. For most of the year, the South Platte River is almost dry because of the extensive storage of its waters for irrigation purposes in northeastern Colorado.

Lodgepole Creek and the South Platte River have only a few short intermittent tributaries in Deuel County. These minor drainageways, locally known as "sand draws", are rather deeply entrenched and have steeply sloping gravelly and stony enclosing slopes. The largest and most important of these intermittent streams are Sand Draw, O'Neil Draw, Walrath Draw, and Dry Creek. A large portion of the upland has no established drainage, and most of the run-off collects in depressional areas where it evaporates or slowly percolates into the soil.

The drainageways and low ridges of loess or sand on the upland exhibit a northwest to southeast alignment. This phenomenon (12) has been observed in many places on the High Plains. The prevailing winds from the southeast

in the summer and northwest in the winter are generally credited for this orientation of the surface features and drainage from northwest to southeast irrespective of structural bed rock conditions.

Bench marks of 3,928 feet, 3,793 feet, and 3,613 feet above sea level have been established by the U. S. Geological Survey from west to east across the upland of the northern portion of the county. The elevation of Chappell in the valley of Lodgepole Creek is 3,697 feet; and Big Springs, in the South Platte River valley in the southeastern corner of the county, has an elevation of 3,370 feet.

The main line of the Union Pacific Railroad follows the valleys of the South Platte River and Lodgepole Creek. Lincoln Highway, U. S. No. 30, crosses the county from east to west about equidistant from the north and south county boundaries.

II. GEOLOGY

Surface configuration and many of the soil conditions found in Deuel County are closely related to the surface geologic formations. Various members of the Ogallala formation of Pliocene age, together with Pleistocene gravels, and loess of the Peorian interglacial substage

are the principal geologic formations.

The oldest formation, the Brule Clay of Oligocene age (21), is a pinkish to gray silty clay. It has no known outcrop in Deuel County, but it would be exposed in several places along the north side of Lodgepole Creek valley west of Chappell if colluvial material did not obscure its presence. A series of borings 50 to 60 feet deep were made in 1945 under the supervision of Mr. E. C. Reed.* The borings were made in transects across the valley of Lodgepole Creek from Colorado to Wyoming. This survey revealed that Brule Clay is found everywhere at very shallow depths under the recent gravelly alluvium of Lodgepole Creek. Thus while the formation does not outcrop, it is important because it rarely yields water for drinking purposes or pump irrigation.

The most important bedrock formation upon which soils are forming is the Ogallala formation. This formation rests unconformably upon Brule Clay. Older members, principally Arikaree and Gering, of the White River series are absent in this area. Either the older formations were never deposited, or they were removed by erosion after their deposition. The Ogallala formation

* Unpublished information obtained in interview with Mr. E. C. Reed, Assistant State Geologist, Dept. of Conservation and Surveys, U. of Nebraska, Lincoln, Nebr.

is thought to be 400 to 500 feet thick in Deuel County, and it is divided into four members. From top to bottom these are:

1. Kimball (Algal) limestone, 50 feet
2. Sidney gravels
3. Ash Hollow limey sandstone, 150-250 feet
4. Valentine sandstone, 50-100 feet

The Ogallala formation is differentiated into these member formations on the basis of lithology and fossil seeds. In many places, the fossil seeds cannot be found; and lithology such as color, induration, structure, and mineralogic composition are employed to separate the beds. Generally, the division between Valentine and Ash Hollow is set where fossil Krynitzkia seeds are found. In addition, Valentine sandstone is more greenish, more massive, less limey, and less indurated than Ash Hollow.

The Ash Hollow, intensively studied (21) in Keith County just east of Deuel County, is a series of hard and soft layers of limey sandstone. In part, it is cemented by lime and consists of interbedded buff to gray or pinkish, structureless clay, silt, and sand. Pebbles are erratically present, and the basal portion is a coarse gravelly conglomerate. The hard beds are

light gray. Much light colored sandy clay with streaks and nodules of calcium carbonate is present. Quartz and feldspar compose about 95% of the mineral content; but garnet, micas, tourmaline, magnetite, zircon, hornblende, olivine, sillimanite, and epidote are found. The caliche-like beds become very hard and erosion-resistant on exposure. The softer interbedded sands, silts, and gravels disintegrate readily leaving ledge-like caliche beds projecting over the softer materials below. Because of its whitish appearance, Ash Hollow is locally known as "mortar beds".

Sidney gravels are believed to be mostly stream channel deposits and have only been found in the type locality in Kimball County, Nebraska. In Deuel County, the Kimball limestone rests directly on the Ash Hollow without the occurrence of intervening Sidney gravels.

Biorbias, of which there are living descendants today, reached their greatest development at the time the Kimball limestone was deposited, and they help separate Kimball limestone from Ash Hollow. Kimball limestone (5) is whiter, has a higher lime content and contains less sand and silt than the Ash Hollow. It tends to form a hard resistant caprock.

The Ogallala formation is generally considered

fluviatile in origin. According to this theory (8), a heterogenous mass of sand, silt, and gravel from the Rocky Mountains was deposited unconformably upon the eroded Brule Clay plain in an arid climate. The heavily loaded streams with variable volumes of water were continually overrunning their banks, dividing, recombining, aggrading and degrading, and being diverted by their own deposits.

Hay (7) and Williston (23) advance the theory of lacustrine deposition of the Ogallala formation. To have been of lacustrine origin, however, the formation could not be so heterogenous and gravel strewn at all depths. In lakes, gravels are a shoreline feature and in symmetrical lines which should parallel the Rocky Mountains in this case. Instead, the gravels are found at all depths and irregularly from west to east. Lenses of algal limestone probably were locally deposited in lakes and ponds, and some aeolian material was undoubtedly interbedded. Seemingly, the fluviatile origin of the Ogallala formation is the best explanation and most nearly accounts for the relatively smooth plain that was deposited by the end of Pliocene, and Tertiary, time.

During the Pleistocene, the climate became more humid accompanied by possible uplift. The streams entrenched themselves into the Ogallala plain, and

tributaries started to dissect the upland. The hard caliche layers in the Ogallala formation, aided by protective vegetative cover, resisted the entrenchment to the utmost. Thus most of the intrenchment was confined to the valleys of the South Platte River and Lodgepole Creek which had a continuous supply of water. The intermittent tributaries or draws formed much more slowly. The intermittent streams worked mainly by sapping the soft interbedded materials in the Ogallala formation, and the eventual gravitational collapse of the undercut resistant caliche-like or limestone layers. Steep walled, intrenched valleys were the result. The intermittent side draws have a northwest-southeast alignment paralleling the same alignment of the aeolian ridges indicating that the available run-off water was funneled into the developing intermittent draws and canyons.

Evidence indicates the intrenching process was periodically interrupted and gravel deposition occurred in the valleys. The best evidence is the findings of the afore-mentioned series of transects and borings made in 1945 across the valley of Lodgepole Creek. These borings disclose gravel deposits overlapping the rims of the valley. The overlapping by gravels of the contact plane of the Kimball limestone and Ash Hollow

limey sandstone makes it doubtful these deposits are Sidney gravels. Gravels of Sidney age would be interbedded between Kimball and Ash Hollow. The gravels are believed to be early Pleistocene, probably of Holdrege age. Holdrege time correlates with the Nebraskan ice advance in the eastern part of Nebraska and northeastern United States. Mountain glaciers to the west were concurrently active. The sand and gravel outwash deposits of Holdrege time completely filled the valleys in addition to covering hundreds of square miles of upland in Nebraska.

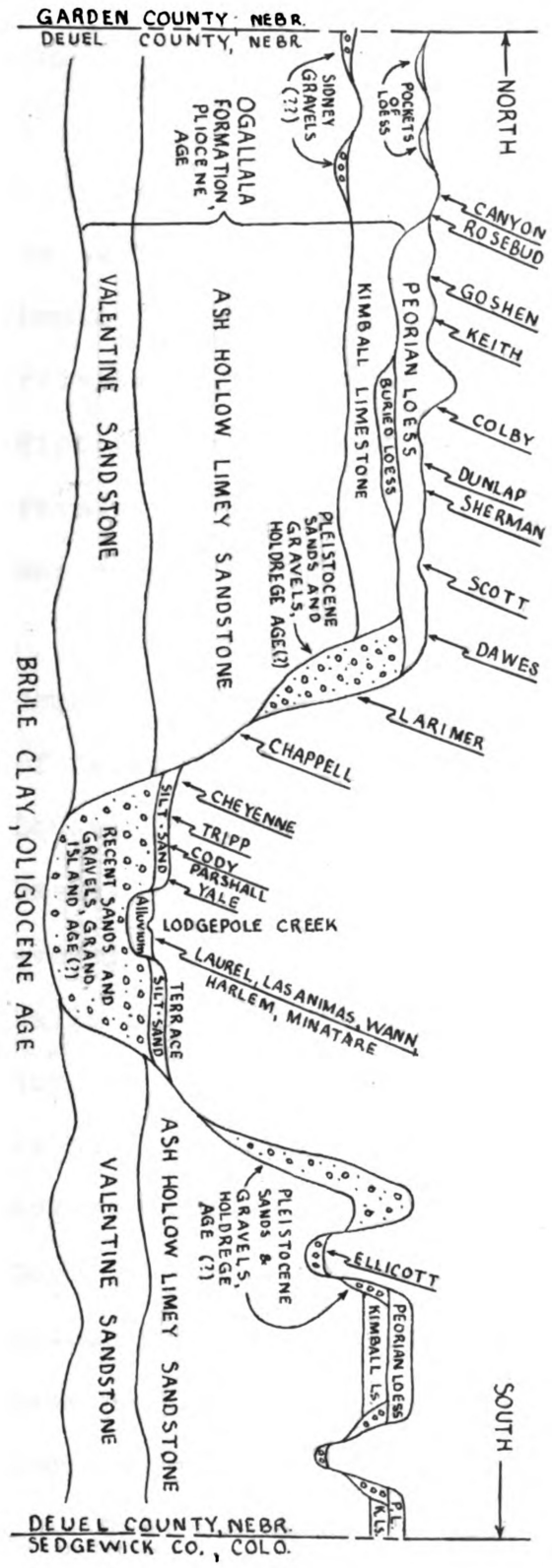
In the succeeding interglacial period, known as Aftonian, between the Nebraskan and Kansan ice stages, the valley intrenchment was renewed possibly accompanied by uplift. Apparently, this interglacial period was dry, and in parts of Nebraska an Aftonian deposit known as Fullerton Clay (10) is found which includes some aeolian material. However, there is no evidence of Fullerton Clay in Deuel County. Instead, the partial clearing of the gravel-filled valleys was the principal activity in Deuel County as valley intrenchment was renewed during Aftonian time. However, much of the gravel still remains high on the flanks of the valleys where it now forms a very steeply sloping, gravelly lithosol.

When the succeeding Kansan ice sheet occupied eastern Nebraska, another gravel formation was deposited at a lower level in the intrenched valleys. Part of this gravel was derived from the higher lying gravels of the valley flanks, and part was brought in by the rejuvenated streams from the mountains to the west. These gravels are thought to be Grand Island in age. Grand Island is correlated with the Kansas ice age in the northeastern United States. As in the Holdrege, Grand Island time was accompanied by the widespread filling of the river valleys of Nebraska, as well as much of the upland, with sand and gravel deposits.

The last important Pleistocene deposits in Deuel County are loessial chiefly of the Peorian interglacial period between the Iowan and Wisconsin ice sheets. Most authorities now accept Iowan as ^{ly}early Wisconsin rather than a separate ice sheet. Peorian loess has a yellowish-buff color and consists chiefly of silt and some fine sand in Deuel County. The deposit of loess mantled unconformably much of the Ogallala plain. It is relatively thin, two to six feet deep, except for a few ridges in the northeastern part of the county which may exceed fifty feet. Buried soil profiles are numerous indicating more than one loessial invasion occurred.

Some of the lower loess may be part of the Loveland formation of Sangamon interglacial age. Loveland loess is typically reddish-brown in color and contains more clay than Peorian loess. These loesses constitute the parent materials of much of the soil. Portions of the river valley terraces were also covered with loess. According to Kirk Bryan (2), most of the loess was derived by frost action from glacial outwash plains. Anti-cyclonic winds blowing off the glaciers in the western mountains combined with the prevailing Westerlies to transport the material. Secondary changes in the loess produced the yellowish-buff color and vertical structure, and some of concretionary calcareous properties. Condra, Reed, and Gordon (3) take exception to the Bryan theory of the origin of loess in Nebraska. They list the major sources of loess as: (a) fresh glacial drift, (b) White River formations, (c) bad lands, (d) High Plains, (e) Sandhills region, (f) old glacial till sheets, and (g) alluvial deposits. Figure 1 is a generalized diagrammatic correlation between the geology and soils of Deuel County.

FIGURE 1
NORTH-SOUTH DIAGRAMMATIC PROFILE ACROSS DEUEL
COUNTY SHOWING CORRELATION OF SOIL TYPES AND
GEOLOGIC FORMATIONS



III. CLIMATE

Climatically, Deuel County is classed as sub-humid or semi-arid. It has varied in successive years from humid to arid. The summers are clear and hot with a relatively low humidity and high rate of evaporation. Winters are long and cold, but relatively open. Snow rarely remains more than a few days, but some years it may cover the ground most of the winter.

There are no long time weather records in Deuel County. The nearest weather station is one mile west of Deuel County at Lodgepole in Cheyenne County. At Lodgepole over a 50 year period, annual precipitation has varied from 10.00 to 28.36 inches with a yearly average of 17.07 inches. About 70% of the moisture falls during the growing season from April to October. However, after the month of June, rainfall is increasingly scanty, and crop damaging droughts may occur in July, August, and September. Most of the rain falls in the form of summer thunderstorms. The hail which often accompanies the rain is a constant menace, and each year partial or complete crop destruction occurs in local areas.

Snow has been recorded in every month of the year

but June, July, and August. The yearly average of snow is 32.6 inches.

Prevailing winds from May to September are from the southeast. During the remainder of the year, the prevailing winds are from the northwest. The yearly average wind velocity is 9.2 m.p.h. Winds reach their greatest average intensities in March, April, and May when they average 10.4 m.p.h.. High winds from 46 to 73 m.p.h. have been reported, but tornadoes are of rare occurrence.

The growing season averages 137 days per year. The average date of the last frost in the Spring is May 12, and the average date of the first frost in the Fall is September 26. The latest frost date recorded in the Spring is June 6, and the earliest frost date recorded in the Fall is August 25.

The mean annual temperature at Lodgepole is 48.8° F. The maximum temperature on record is 112° F. Great, and sometimes very rapid, temperature changes may occur from day to day and from day to night. Table 1 summarizes the more important climatic data as recorded at Lodgepole, Cheyenne County, over a 50 year period.

IV. NATURAL VEGETATION

The tableland of Deuel County was naturally covered

Table 1
The More Important Climatic Data as Observed at Lodgepole, Nebraska
(1895-1945)

Month	TEMPERATURE			Mean	PRECIPITATION			Average Snowfall Inches	Avg. days with .01" or more	
	Mean	Absolute			Driest Year (1910)	Wettest Year (1915)	Absolute			
		Max.	Min.				Max.			Min.
December	27.8	76	-33	0.55	0.25	0.60	1.70	T	5.4	2
January	26.1	70	-31	0.38	0.15	1.00	1.61	T	4.0	2
February	28.5	73	-36	0.56	0.10	0.65	1.80	T	5.5	3
March	36.5	86	-18	0.95	0.60	1.53	2.90	T	7.4	3
April	47.2	92	-6	2.29	0.55	6.92	6.92	.10	4.6	5
May	56.9	98	10	2.70	2.01	6.30	6.41	T	0.9	7
June	66.6	105	25	2.51	1.72	3.42	7.45	T	0	7
July	73.4	112	37	2.32	1.12	1.86	8.07	.67	0	6
August	72.2	108	33	2.01	1.41	2.03	5.01	T	0	5
September	62.4	103	17	1.33	2.04	2.29	3.85	T	0.1	3
October	50.8	96	0	0.93	T	1.56	2.84	0	2.0	3
November	37.5	84	-22	0.54	0.05	0.20	1.95	0	2.7	2
Year	48.8	112	-36	17.07	10.00	28.36	8.07	0	32.6	48

Following frost data figures through year 1940:

Average first killing frost in autumn - September 26th
" last " " spring - May 12th (Growing season 137 days)

Earliest killing frost in autumn - August 25th
Latest " " spring - June 6th

by short grass prairie, and a mixture of short and tall grasses occupied the moist bottomland sites.

On the medium-textured upland soils of the tableland, three species dominated the natural vegetation; (a) Blue grama, Bouteloua gracilis; (b) Buffalo grass, Buchloe dactyloides; and (c) Western wheatgrass, Agropyron smithii.

On the sandy upland soils of the tableland, three species are important in addition to those listed above: (a) needlegrass, Stipa comata; (b) Sand dropseed, Sporobolus cryptandrus; and (c) Niggerwool (Blackroot), Carex filifolia.

On the very sandy soils of the sandhills along the east bank of Lodgepole Creek in the south central part of the county, Sand Reedgrass, Calamovilfa longifolia, is an important species in addition to sand dropseed, needlegrass, niggerwool, western wheatgrass, and minor amounts of blue grama and buffalo grass.

On the moister soils on the bottomlands, Big bluestem, Andropogon furcatus; Little bluestem, Andropogon scoparius; and Switch grass, Panicum virgatum, are important species in addition to some of the other species just listed.

On the more alkaline and salty soils, Salt grass, Distichlis stricta, is the most abundant grass species.

Cacti (prickly pear), yucca, and sagebrush are common on sandy, gravelly soils and on overgrazed pasture.

The more common weedy species in the region include false buffalo grass, prairie triple awn, downy brome grass, tumbleweed, ragweed, mare's tail, Russian thistle, pigweed, sand burr, cocklebur, and wild lettuce.

Willow and cottonwood trees, a few along Lodgepole Creek and a greater number along the South Platte River, comprise the tree species native to the county. A few old tree claims consisting mostly of ash, elm, boxelder, and cottonwood still survive in a poor condition on the upland. The more recent shelterbelt plantings, principally about farmsteads, are largely red cedar, Ponderosa pine, Chinese elm, hackberry, locust, ash, cottonwood, boxelder, plum, and Russian olive. If watered and cultivated to minimize grass and weed competition, shelterbelts make fair to good growth. Excepting cottonwood, trees in the county rarely make more growth than necessary for fence posts or fuel.

V. SOILS

The mature soils of Deuel County belong in the Pedocal Order and in the Chestnut Brown Great Soil Group. Both the geologic formations and the topography have had great influence in determining the character of the soils.

Most of the soils on the tableland are developing from loess of Peorian age. Locally where the loess is very thin or absent, the limey sandstone of the Ogallala formation is the principal source of the soil parent material. The slopes on the high tableland are mostly in one, two, and three percent gradient classes.

The bottomland and terrace plains are dominated by soils with a high content of original or reworked Pleistocene sands and gravels. On portions of the terraces, sufficient loess was deposited during Peorian time to produce soils analogous to the upland soils of the Keith series. The bottomlands are narrow and largely composed of loams and fine sandy loams.

The very sandy soils are concentrated in the sandhills along the east bank of Lodgepole Creek in the south central portion of the county. It is believed that these soils are local aeolian sands from Lodgepole Creek. The sands are known to overlies older topography. The sand invasion of the border lands to the east of Lodgepole Creek is continuing periodically but at a very reduced rate.

The field survey included soils in 24 series subdivided into 50 soil types and phases, plus Riverwash,

Rough Broken Land, and Dunesand, the latter in stabilized and unstabilized divisions.

The Peorian loess which unconformably caps the Ogallala limey sandstone tableland is the most extensive soil forming parent material in the county. The normal Chestnut Brown soils developing on this loess are members of the Keith series. Two types were mapped: (a) silt loam, and (b) fine sandy loam. Keith silt loam has a friable, fine crumb, dark gray brown surface soil 7-14 inches thick developing over an equally thick, cloddy to prismatic, friable, silty clay loam or silt loam subsoil. The parent material is a massive, limey, yellowish loess. Keith silt loam is the most extensive soil in the county and constitutes the principal soil type of the tableland. It occurs on slopes from 1-10%, but most frequently on slopes from 1-4%.

Sherman silt loam is essentially the same soil as Keith for two to three feet, but it overlays the buried dark surface horizon of an earlier, more mature, but still friable soil. Sherman silt loam is the second most extensive soil type on the tableland. It occurs on one and two percent slopes.

Dunlap silt loam is very similar to Keith, but the surface soil is thicker, and the subsoil is a heavier,

more prismatic silty clay loam. The type is considered a semi-claypan transitional between the friable Keith series and the columnar claypans of the Dawes series. Dunlap silt loam is found on level to slightly depressed topography and is the third most extensive soil type on the tableland.

Dawes silt loam has a columnar, solonetz-like claypan and generally occupies slightly depressed to very level areas. It has a thinner surface soil, the lower inch or more of which may be an ashen gray, leached A₂ horizon. A recent paper by Williams (22) states that this soil type may be overmature and not due to sodium saturation and imperfect drainage usually considered necessary for solonetz development. The parent material is limey silt over gravels at a shallow depth. The type is of minor areal importance and occurs chiefly on the margins of what may be an old high terrace at the confluence of Lodgepole Creek and South Platte River.

Goshen silt loam is a colluvial-alluvial soil occurring chiefly on the tableland. It is dark colored for two or three feet and has a poorly defined structure. The type occurs in swales, minor depressions, and narrow drainage channels.

Bridgeport silt loam is a very minor type in the

county. It is found on gentle colluvial slopes and develops on light colored silty material eroded from adjacent upland. It has a very shallow profile consisting of 5-10 inches of dark brownish surface soil over a friable, massive, limey, yellowish silt.

Colby silt loam is a shallow, immature soil developing on loessial deposits. It is found on the steeper slopes where conditions are too unfavorable for deeper Keith profiles to develop. The soil is grayish-brown for 3-7 inches and generally rests on a massive, limey, yellowish silt of Peorian age. On the most favorable sites, 3-7 inches of brownish, cloddy B horizon may be present. The type is confined almost entirely to the northeastern part of the county.

Scott silty clay loam is soil formed in shallow basin depressions. It has a thin dark colored surface soil 5-10 inches thick, the last one to three inches of which may be a platy, light gray, leached A_2 horizon. The subsoil is a dense, massive, plastic clay. The underlying clay is so impervious that these depressional features are often intermittent ponds.

The Rosebud series includes soils normally developing on the limey Tertiary sandstone. The principal types are: (a) loam, and (b) fine sandy loam which are

somewhat analogous to the Keith series. Small areas of Rosebud loam, deep solum phase, were mapped. The heavy subsoil phase of Rosebud loam has a massive, reddish clay subsoil overlying a gravelly sand parent material.

The Canyon series includes shallow lithosols developing on limey Tertiary sandstone. It is analogous to Colby. It is generally light colored to the surface, often chalky in appearance, and it typically develops on the steeper slopes. The Canyon series included: (a) loams, and (b) gravelly loams.

The Anselmo series includes sandy soils developing over a fine sand-silt admixture of sufficient body to form a fairly productive sandy soil. Two types were mapped: (a) fine sandy loam, and loamy fine sand. The series is principally associated with the very sandy soils in the south central portion of the county, but small areas are found in numerous places where wind action has produced a mixture of fine sand and silt.

Soils of the Larimer and Chappell series characterize the abruptly sloping breakland between the High Plains and the terrace along the South Platte River and Lodgepole Creek. The Larimer series includes brownish lithosols developing on the steeply sloping limey and sandy Pleistocene gravel deposits high on the valley

flanks. Slopes of 15-25% are typical. (A) Sandy loams, and (b) gravelly loams were mapped in the Larimer series.

The Chappell series typically develops on the more favorable colluvial slopes below the Larimer "breaks". The surface soil is dark brown, friable, and 10-16 inches deep. The subsoil is increasingly lighter colored, gravelly, and incoherent with depth; and the parent material is a limey, silt-gravelly sand mixture usually of colluvial origin. (A) loams, and (b) sand loams were mapped in the Chappell series with the sandy loam more shallow and lighter texture throughout the profile. Most of the Chappell soils occur on slopes from 5-10% although the range is 3-12%.

The Cheyenne series is essentially the Chappell profile on a terrace. The series occurs on 1 and 2% slopes. Four types and phases were mapped: (a) loam; (b) loam, deep solum phase; (c) fine sandy loam; and (d) fine sandy loam, deep solum phase.

Tripp silt loam is essentially the Keith profile on a terrace. It has developed on loess of the same age as the loess which mantled the upland. The type occurs on 1 and 2% slopes. As on the upland, buried profiles occur. These areas were separated as Tripp silt loam, buried soil phase.

The Parshall series includes calcareous wind and water deposited sediments now in terrace positions. These soils are often calcareous to the surface and increasingly sandy with depth. Three types and phases were mapped: (a) silt loam; (b) fine sandy loam; and (c) fine sandy loam, heavy subsoil phase.

The non-calcareous stream deposited sediments now in terrace positions were classified in the Cody series as (a) loams, and (b) fine sandy loams.

Soils with a columnar, solonetz-like claypan, similar to Dawes silt loam on the upland, were also found on the terrace. These soils are members of the Yale series. Three types and phases were mapped: (a) silt loam; (b) fine sandy loam; (c) fine sandy loam, sand covered phase. The sand covered phase has 8-24 inches of grayish-brown fine sandy loam over the original dark grayish brown surface soil of Yale silt loam.

Light colored calcareous silty or only slightly sandy alluvial soils were classified in the Laurel series. The surface soil is grayish brown, 8-12 inches thick, the subsoil is alternating layers of silt and fine sand. Two types were mapped: (a) loam, and (b) fine sandy loam. Occasionally, the Laurel loam

had a puddled structure, a cheesy consistency, and was salty to the surface. This condition was separated as Laurel loam, alkali phase.

The dark colored alluvial soils with a silt loam surface soil, and a calcareous silty subsoil were mapped in the Wann series as: (a) loam, and (b) fine sandy loam. The parent material of the Wann series is calcareous and sandy to only slightly silty.

Moderately heavy alluvial soils which were generally salty were mapped as Minatare silty clay loam. The surface soil is 8-14 inches thick, grayish brown, has a puddled structure, and contains visible salt streaks in the lower portion. The subsoil is a mottled gray, calcareous, massive, sandy clay with numerous iron stains. The parent material is sandy clay alluvium.

The Las Animas series includes shallow, light colored, calcareous alluvial sand or sand-gravel mixtures. Two types were mapped: (a) fine sandy loam, and (b) loamy fine sand.

The Ellicott series is essentially alluvial Larimer. It occurs in the bottoms of the sand draws and consists largely of the Pleistocene sands and gravels eroding from the higher lying Larimer soils.

The South Platte River channels were classified as

Riverwash. For much of the year, the South Platte River is intermittent in flow and consists of a few shifting channels through light colored sand, gravel, and only slightly silty alluvium.

The Valentine series includes brownish, very sandy surface soils 3-7 inches thick overlying deep, incoherent, single grained fine sands. Two types were mapped: (a) loamy fine sand, and (b) fine sand. A hummocky to low dune-like topography is associated with this series.

The least developed of the very sandy soils, with only an inch or two of brownish material over incoherent fine sand, were classified as Dunesand. Two separations were made: (a) stabilized, and (b) unstabilized.

LAND TYPE ANALYSIS

I. PROCEDURE

The initial step in the land type analysis was to prepare a map, on a scale of 1 inch equal 1 mile, of the major natural land types. For this purpose, the soil conservation survey was used. The detailed survey information permitted a precise determination of the land type boundaries, and the county readily falls into three distinct major land types because of the soil and topographic conditions.

The most extensive major land type occupies the gently sloping medium-textured soils of the short-grass high plains. It occupies the tableland north of Lodgepole Creek and South Platte River, and a smaller similar area of tableland in the southwest corner of the county.

The second most extensive major land type is a complex of steeply sloping, gravelly breakland; gravelly to medium-textured level terrace land; and variable narrow bottomlands which occupies the intrenched valleys of the South Plate River-Lodgepole Creek-intermittent sand draw drainage system. This

land type is covered by short grass on all except the wettest sites of the terrace and bottomland which support mixed tall and short grasses.

The third major land type occupies a relatively small part of the county, but it is typical of an estimated one-fifth of the state of Nebraska. This land type is a small area of sandhills located to the east of Lodgepole Creek and north of the Colorado state line. The land type has a hummocky to dune-like topography and is covered with mixed tall and short grasses.

Having delineated the three major land types, an estimate of their soil and slope composition was made by a series of linear transects. As previously mentioned, much of the county has a northwest-southeast trend due to the action of the wind. In order to estimate conditions in the areas where this alignment was evident, the transects were made from southwest to northeast, that is at right angles to the trend. As the trend changed, the angle of transection was varied. The transects were made through the middle, or as near to the middle as possible, of each section of land in each land type. The measurements were made with a celluloid scale graduated in tenths of inches. Measurements were made and recorded to the nearest half of an one-tenth inch unit, or to approxi-

mately one-twentieth of an inch or 66 feet of linear distance. When the number of transects is large, close estimates of the actual area have been obtained by this method. There were 161 photographs containing from one to four sections of land survey. The photographs were numbered from 1 to 161, and the linear units of traverse were recorded for each photograph by soil survey unit for each land type. Figure 2 is a typical transect record sheet. When the traverses were completed, the individual totals by photographs for each soil survey delineation were compiled and totalled for each land type. The percentage of each soil survey delineation in a land type was then computed. These individual per centages by soil survey unit made any combination of soil type, slope, or erosion possible by grouping and addition. Finally, quantitative graphical presentations by land types were prepared based on a variation of the method and procedure suggested by Veatch (17). This method is based on the fact that any given natural land surface has relief irregularities. Differences may only be a few feet, or of mountainous proportions, but any tract of land will have three components: (a) relatively level highland, whether it be a plateau, crest of a ridge, or top of a knoll;

Figure 2

Example of the Linear Traverse Record
Sheets

Photo Number 28
Deuel Loess Plains Land Type

Soil Type	Slope- Erosion condition*	Units of .1 inch Linear Traverse	Total
Keith silt loam	1-1P	5, 5.5, 1, 6.5, 10.5, 6.5	35
" "	2-1P	4, 4, 2.5, 1, 4.5, 2.5, 1, 1.5	21
Keith fine sandy loam	2-1P	4, 2, 2, 4.5, 6, 1, 4	23.5
" "	3-1P	4.5	4.5
" "	3-2R	6	6
Sherman silt loam	1-1P	3, 3, 5.5, 1, 7.5, 7, 2.5, 1, 1, 3.5	35
Goshen silt loam	1-0	0.5	0.5
Scott silty clay loam	1-0	1	1
Chappell sandy loam	3-1P	1	1
Chappell loam	3-1P	1.5	1.5
"	8-2R	1.5	1.5

Chappell Intrenched Valley Land Type

Chappell loam	8-1P	2.5	2.5
Larimer gravelly sandy loam	15-1P	11.5, 3	14.5

*

First number is dominant percent of slope. Second number and letter indicates estimated combined water and/or wind erosion.

(b) relatively level lowland, such as a river bottom, gentle swale, or a depression; and (c) the slopes connecting (a) and (b). Quantitative graphical presentations of these three components can then be employed to summarize and compare different land areas. In the illustrations presented by Veatch, the (a) and (b) components are plotted as level lines, and (c) is integrated into an average slop line. He suggests that each slope condition may be presented, and that is the way they are shown in this paper to more clearly present the micro-relief. To emphasize the small differences which generally prevail, all the slopes were exaggerated five times. The composite corresponding soil type condition was plotted as a plane square along the base of the graph. Any side of the square is equal to the percentage composition, and the square itself is an estimate of the composite areal extent of the soil-slope condition in the land type.

Wind and water erosion throughout the county was predominantly slight to moderate removals of the A horizon, or topsoil. One, 1, erosion was mapped when an estimated 0-25% of the topsoil had been removed; and two, 2, erosion was mapped when 25-50% of the topsoil had been removed. Degrees of erosion

more severe than two were infrequent or confined to small areas. This is largely because of the relatively recent use of most of the cultivated land, the nature of the soils, or the topography. Almost all of the cultivated land is level to gently sloping. Generally, the steep, gravelly, and very sandy soils have remained in grass, or are quickly returned to grass if cultivated. It is for these reasons that no attempt is made to present the information obtained on erosion.

Tables 2, 3, and 4 list in tabular form the results of transects of the land types and subsequently presented in graphs 1, 2, and 3.

II. THE NATURAL LAND TYPES OF DEUEL COUNTY

A. DEUEL LOESS PLAINS LAND TYPE

The most extensive land type in the county occupies the gently sloping high plains composed of medium-textured soils naturally vegetated by short grasses. It occupies the tableland north of Lodgepole Creek and South Platte River, and a smaller area of tableland in the southwest corner of the county. These two areas are part of the extensive structural platform with a gentle southeasterly slope known as the Cheyenne Table.

Table 2

Tabular Summary of Deuel Loess Plains Land Type

Position	Soil Type	Slope, %	% of Land type	Accumu- lating %
Level	Keith silt loam	1	15.97	15.97
upland	Sherman silt loam	1	10.34	26.31
Depress- ional	Scott silty clay loam	1	1.59	27.90
upland	Dunlap silt loam	1	5.34	33.24
Level	Dawes silt loam	1	1.27	34.51
upland	Miscellaneous	1	0.70	35.21
	Keith silt loam	2	34.34	69.55
	Keith fine sandy loam	2	1.84	71.39
	Miscellaneous	2	2.06	73.45
Sloping	Keith silt loam	3	1.18	74.63
upland	Miscellaneous	3	0.92	75.55
	Keith silt loam	4	7.13	87.68
	Miscellaneous	4	2.38	85.06
	Keith silt loam	5	1.62	86.68
	Miscellaneous	5	1.36	88.04
	Miscellaneous	6	1.36	89.40
	Chappell loam	7	1.28	90.68
	Miscellaneous	7	1.21	91.89
	Miscellaneous	8	0.97	92.86
	Miscellaneous	9-20	0.79	93.65
Level				
colluvial-	Goshen silt loam	1	4.43	98.08
alluvial	Miscellaneous	2	1.78	99.86
bottom- land				

Natural vegetation: Principally the short grasses: blue grama, and buffalo. Minor amounts of western wheatgrass, needlegrass, and niggerwool.

Table 3

Tabular Summary of the Chappell Intrenched
Valley Land Type

Position	Soil Type	Slope, % of Land type		Accumu- lating %
Level				
upland	Keith & Sherman silt loams	2.3	0.27	00.27
Sloping	Larimer gravelly sandy	25 & 30	0.29	00.56
upland	loam			
	Larimer gravelly sandy loam)			
	Larimer sandy loam)	20	9.17	09.73
	Canyon stony loam	20	0.05	09.78
	Larimer gravelly sandy loam)			
	Larimer sandy loam)	15	5.49	15.27
	Miscellaneous	15	0.85	16.12
	Larimer gravelly sandy loam			
	Larimer sandy loam	12	1.98	18.10
	Chappell sandy loam	12	1.85	19.95
	Miscellaneous	12	0.38	20.33
	Chappell sandy loam	10	2.51	22.84
	Chappell loam	10	1.80	24.64
	Miscellaneous	10	1.39	26.03
	Chappell loam	8	3.80	29.83
	Miscellaneous	8	1.77	31.60
	Chappell loam	7	7.41	39.01
	Chappell sandy loam	7	2.77	41.78
	Miscellaneous	7	0.72	42.50
	Miscellaneous	6	0.89	43.39
	Chappell loam	5	2.60	45.99
	Miscellaneous	5	1.42	47.41
	Chappell loam	4	1.28	48.69
	Miscellaneous	4	1.92	50.61
	Miscellaneous	3	0.24	50.85
	Miscellaneous	2	1.16	52.01
	Miscellaneous	1	0.05	52.06

Table 3 (con'd)

Tabular Summary of the Chappell Intrenched
Valley Land Type

Position	Soil Type	Slope, %	% of Land type	Accumu- lating %
Terrace	Cheyenne loam	2	8.05	60.11
	Cheyenne fine sandy loam	2	5.27	65.38
	Cheyenne loam, deep solum phase	2	1.40	66.78
	Tripp silt loam	2	2.77	69.55
	Miscellaneous	2	1.22	70.77
	Yale silt loam	)	2.32	73.09
	Yale fine sandy loam			
	Tripp silt loam	1	3.34	76.43
	Parshall fine sandy loam	1	2.17	78.60
	Miscellaneous	1	2.43	81.03
Bottom- land	Ellicott gravelly sandy loam	2	3.97	85.00
	Ellicott sandy loam	2	1.99	86.99
	Miscellaneous	2	0.72	87.71
	Laurel loam	1	3.21	90.92
	Las animas fine sandy loam	1	1.88	92.80
	Minatare silty clay loam	1	1.29	94.09
	Miscellaneous	1	2.78	96.87
	Riverwash	x	3.24	100.11

Natural Vegetation: Predominantly the short grasses: blue grama, buffalo, and western wheat. Some sand drop-seed, sand reedgrass, yucca, cacti, carex (sp) on the poorest sites; salt grass on the alkali soils; and a few tall grasses such as big and little bluestem on the most favorable bottomland sites. Scattered cottonwood and willow trees are found along the South Platte River.

Table 4

Tabular Summary of Freeman Sandhills Land Type

Position	Soil Type	Slope, %	% of Land type	Accumu- lating %
High dunes	Dunesand, unstabil- ized	*	xx** 16.40	16.40
Low	Dunesand, stabilized	x	13.89	30.29
Hummocks	Valentine fine sand	x	34.66	64.95
	Valentine loamy fine sand	x	01.70	66.65
Sloping land	Anselmo loamy fine sand	7	01.06	70.94
	Valentine fine sand	5	00.98	71.92
	Anselmo loamy fine sand	4	02.93	74.85
Level upland	Valentine fine sand	2	06.03	80.88
	Valentine loamy fine sand	2	04.59	85.47
	Anselmo loamy fine sand	2	05.61	91.08
	Valentine loamy fine sand	1	01.95	93.03
	Anselmo loamy fine sand	1	05.82	98.85
	Anselmo fine sandy loam	1	01.15	100.00

Natural Vegetation: Principally sand reed grass, sand dropseed, and western wheatgrass, and smaller amounts of blue grama, buffalo, sandhills bluestem, cacti, and yucca.

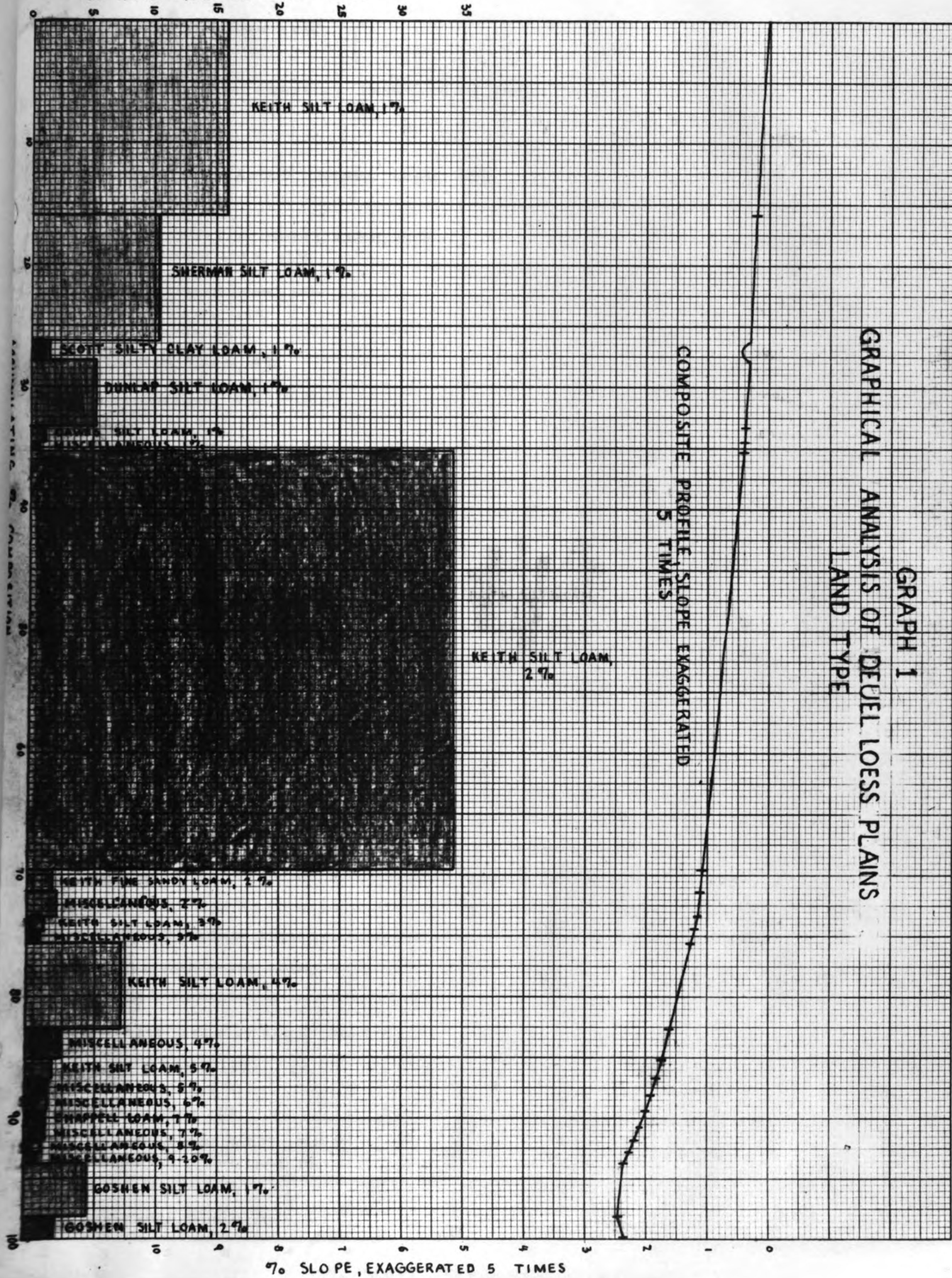
*

Dune-like topography

**

Hummocky topography

7% SOIL TYPE IN LAND TYPE

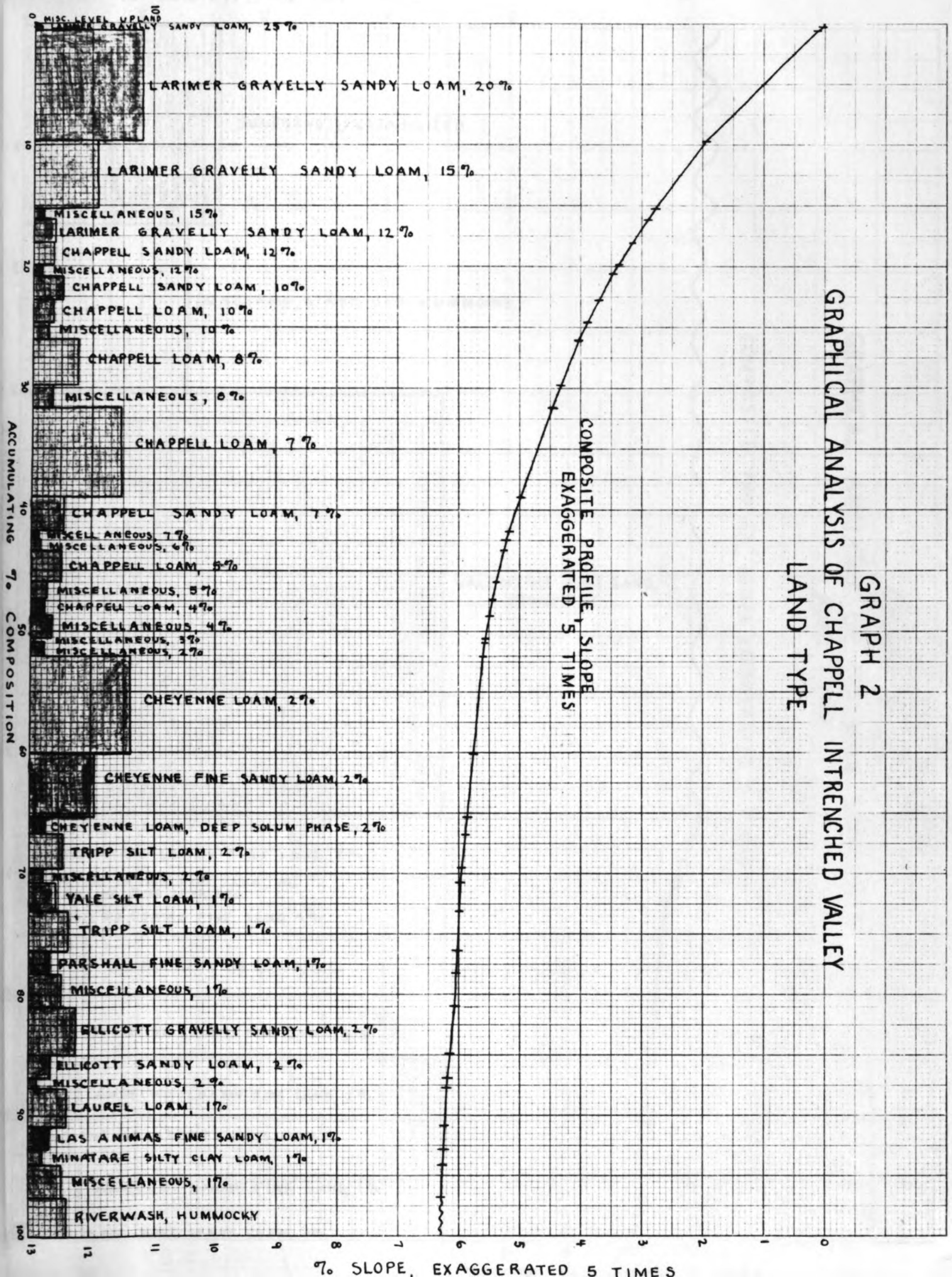


GRAPH 1
GRAPHICAL ANALYSIS OF DEUEL LOESS PLAINS
LAND TYPE

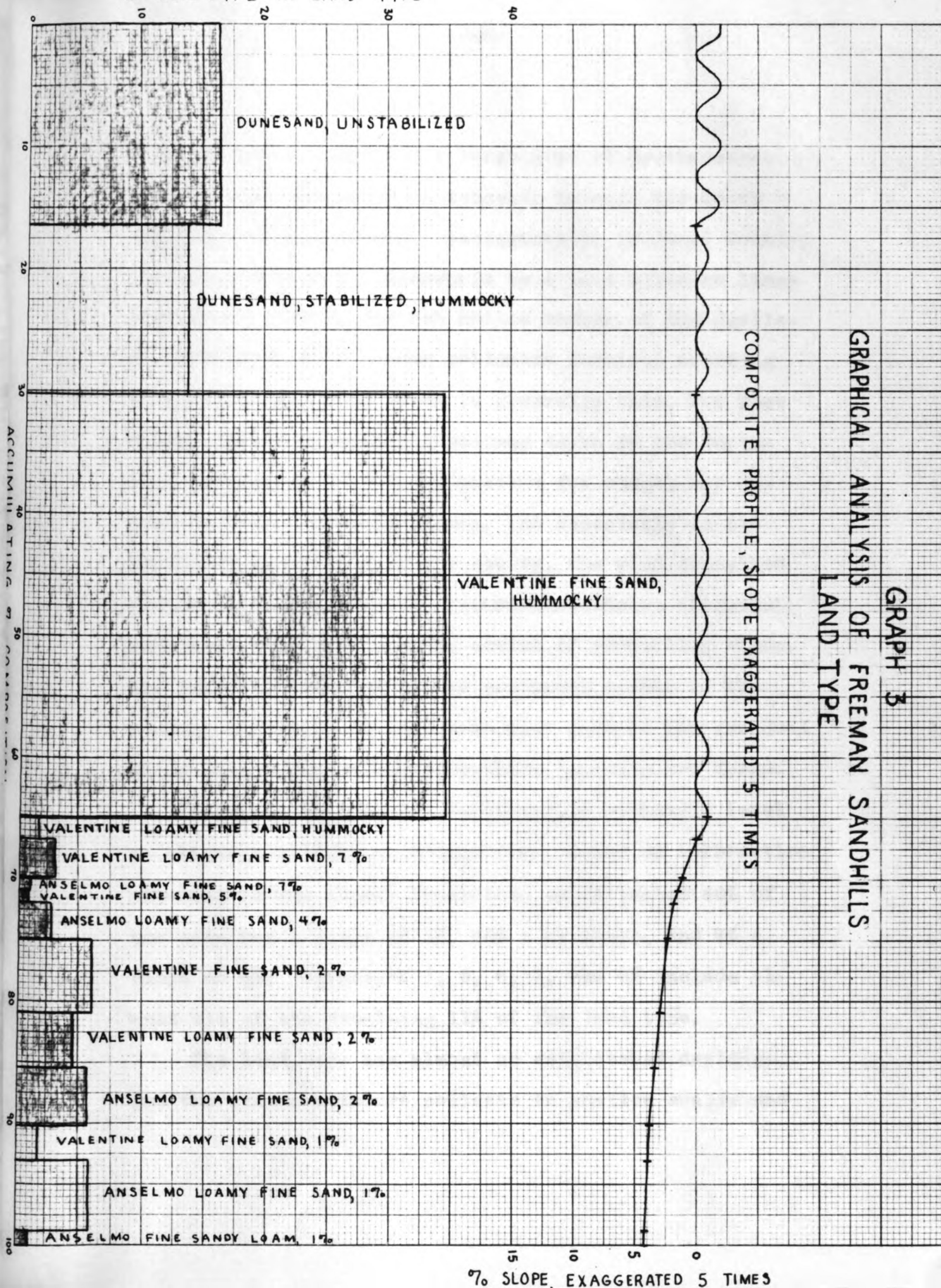
COMPOSITE PROFILE SLOPE EXAGGERATED
5 TIMES

7% SLOPE, EXAGGERATED 5 TIMES

7% SOIL TYPE IN LAND TYPE



% SOIL TYPE IN LAND TYPE



This tableland comprises a large area of Southwestern Nebraska and Northeastern Colorado between the South and North Platte Rivers. Geologically, in Deuel County, these tablelands are underlaid by a late Pliocene limey sandstone, chiefly the Ash Hollow member of the Ogallala formation, with a thin yellowish loessial covering of Peorian age. The loess is generally thin, 2-6 feet thick, and it reaches its maximum depth in the northeast portion of the county where a few ridges may exceed 50 feet. In many places, and especially in the northeastern section of the county, the wind deposited sediments have assumed a northwest-southeast alignment generally attributed to the action of prevailing winds. The loess is thinnest in the northwest corner of the county, and it is in this area that most of the residual soils developing on limey Tertiary deposits are found.

Topographically, the tableland is virtually level to slightly billowy or undulating. Based on information obtained in the linear transects, an estimated 40% of the area has a slope of 1%, 40% a 2% slope, and 9% a slope of 4%. Slopes of 3, 5, 6, 7, and 8% include almost all of the remaining 11% of the land type.

The land type has almost no established drainage, and the excess moisture collects in shallow swales and

depressional areas where it slowly percolates or evaporates. A small amount of water drains off the table into the few, generally short, intermittent drainageways.

The most widely distributed soil type of the land type is Keith silt loam. This soil type consists of 7-14 inches of dark gray brown, friable, fine crumb to slightly granular surface soil overlying an equally thick, cloddy to indistinctly prismatic, but friable and slightly heavier subsoil. The parent material is yellowish, massive, limey Peorian loess. Approximately 16% of the land type is classified as Keith silt loam with a 1%, 34.5% with a 2%, 2% with a 3%, and 7% with a 4% slope. This is approximately 60% of the land type. In addition, Keith silt loam, or the sandier Keith fine sandy loam, comprise a considerable portion of the miscellaneous soils with a slope of 5, 6, 7, or 8%.

Sherman silt loam is very similar to Keith silt loam with essentially the same soil in the surface and subsoil but having a buried soil profile within three feet. The slopes are either 1 or 2%. This soil type occupies about 10.5% of the land type.

Dunlap silt loam comprises approximately 5.5% of the land type. It is similar to Keith and Sherman, but the surface soil is thicker and the subsoil is a heavier, more

prismatic silty clay loam. It is confined to 1% slopes.

Goshen silt loam is an alluvial-colluvial soil occurring in shallow swales, minor depressions, and drainage channels. It is dark colored for two or three feet and has an ill-defined, friable structure. The type comprises about 4.5% of the land type and occurs on 1 and 2% slopes.

A conspicuous feature of the land type is the shallow depressions upon which water may remain for a long period of time. As a consequence of the excess moisture, a dense claypan has developed under the shallow surface soil, the lower portion of which may contain a highly leached, gray A₂ horizon. This soil was mapped as Scott silty clay loam with a 1% slope. It occupies about 1.5% of the land type. The areas vary from a matter of square feet to five or more acres in size.

Miscellaneous soil types on 5-8% slopes comprise most of the remainder of the land type. The principal soils are Keith silt loam, Keith fine sandy loam, and Chappell loam. Other soil types represented in the land type in small amounts are members of the Rosebud, Canyon, Dawes, Anselmo, Colby, and Larimer series.

The natural vegetation is chiefly the short grasses; Blue grama, Bouteloua gracilis; and Buffalo grass, Buchloe dactyloides. Small amounts of Needlegrass,

Stipa comata; Western wheatgrass, Agropyron smithii; and Niggerwool, Carex filifolia, are the principal associates.

B. CHAPPELL INTRENCHED VALLEY LAND TYPE

The second most extensive land type in the county is the steeply sloping and gravelly textured breakland; gravelly to medium-textured level terrace land; and the loamy narrow bottomlands which occupy the intrenched valleys of the South Platte River-Lodgepole Creek-intermittent and draw drainage system. The intrenchment into the late Tertiary plain is 200 or more feet. Evidence indicates the intrenchment was interrupted several times during the early Pleistocene when the entire drainage system appears to have been completely choked by coarse gravels and sandy outwash from glaciers to the west. Subsequently, most of the gravel was removed, but much of it still remains high on the bluffs or flanks of the drainage system. 12-25% slopes are typical. For the most part, these steeply sloping soils are gravelly lithosols classified as Larimer stony loam. In some areas, hard, resistant, caliche-like beds in the Ash Hollow member of the Ogallala formation are present, and small areas of the limey sandstone lithosols were mapped as members of the Canyon series.

The sparse short grass plant growth includes some yucca, cacti, and sagebrush.

Below the steeply sloping lithosols and on the more gently sloping colluvial slopes and fans, the soils of the Chappell series are present on slopes from 3-12%. These soils are quite dark and loamy in the surface but become increasingly lighter colored and gravelly with depth. The short grass vegetation is more luxuriant and accounts for most of the grazing value of the intricately associated Chappell and Larimer soils. Approximately 18% of the land type is classified in the Larimer series. Soils of the Chappell series comprise approximately 32% of the land type. Small areas of soils in the Keith, Colby, Rosebud, Anselmo, and Valentine series are included, but the Larimer-Chappell association thoroughly dominates the characteristics and use of about 50% of the land type.

Below the steeply sloping Larimer-Chappell association are a number of terrace soils on 1 and 2% slopes. Members of the Cheyenne series are the most extensive and occupy about one-half of the terrace. The Cheyenne series is quite similar to the Chappell series. Typically, the Cheyenne series develops on the gravelly aprons and fans deposited by the sand draws upon the

portions of the terrace adjacent to the bluffs. Other series on the terrace include Tripp, Parshall, Cody, and Yale. The Tripp series is very similar to the Keith series of the upland, and in addition contains areas with buried soil profiles similar to the Sherman series. The Parshall series is a calcareous mixture of wind and/or alluvially deposited silt and fine sand which becomes increasingly lighter textured with depth. The Cody series is sandier than the Parshall series and non-calcareous. The Yale series includes columnar, solonetz-like claypan soils developed under the influence of salts and poor drainage. About 30% of the land type is occupied by terrace soils, and the Cheyenne series, in turn, occupies about half of the terrace land.

The bottomlands occupy approximately 19% of the land type. The very gravelly and sandy materials in the intermittent drainageways of the Larimer-Chappell association in the bluff areas were mapped in the Ellicott series as: (a) gravelly sandy loam, or (b) sandy loam. These areas are locally known as "sand draws", and the soil is largely a level alluvial derivative of the Larimer series. Approximately 5% of the land type is classified as Ellicott.

About 3% of the land type is mapped as Riverwash.

This material consists of recent, hummocky, braided, light-colored, sand-silt deposits along the South Platte River. For long periods of the year, the South Platte River is a few interlaced and shifting channels in a broad band of recent alluvial deposits. Willows or cottonwoods are found in many places in the riverbed area.

Laurel loam occupies a little more than 3% of the land type. This soil type is the most extensive of the cultivatable alluvial soils. It is gray brown, often calcareous to the surface, and is generally silty to only slightly sandy in texture.

Las Animas fine sandy loam, a lighter colored and more shallow soil than Laurel, occupies a little less than 2% of the land type.

Minatare silty clay loam, a moderately heavy alluvial soil with a puddled structure and visible salt streaks, is found on slightly more than 1% of the land type.

Among the miscellaneous alluvial soils occupying a little less than 3% of the land type are Harlem silt loam, Wann loam, Laurel fine sandy loam, Laurel loam (alkali phase), Goshen silt loam, and Scott silty clay loam. Harlem silt loam is a dark colored silty soil with a lighter colored silty and calcareous subsoil.

The Wann series is also dark colored, often limey to the surface, but is poorly drained.

The natural vegetation varies with the site conditions. The dry, gravelly sites associated with the Larimer and Ellicott soils are very sparsely vegetated with blue grama, western wheatgrass, buffalo grass, dropseed, and occasionally yucca, cactus, or sagebrush. On the terrace, blue grama, buffalo, western wheatgrass, and some little bluestem predominate with minor amounts of other species. On alkali soils, salt grass and alkali dropseed predominate over the species listed above. A few willow and cottonwood trees are found chiefly along the South Platte River.

C. FREEMAN SANDHILLS LAND TYPE

This land type is of minor areal extent in Deuel County. It is located along the east bank of Lodgepole Creek in the south central portion of the county. The sand is believed to be of local aeolian origin from sandy alluvial material along Lodgepole Creek. The sand is known to overlies gravelly Pleistocene and Tertiary materials and silty upland soils. Low dune to hummocky topography predominates in the land type, and there is approximately a 30 foot difference in relief.

(A) Dunesand, unstabilized, and (b) dunesand, stabilized, with a dune-like or hummocky topography occupies 30% of the area. These types are essentially light colored fine sands without profile development.

Valentine fine sand with a hummocky topography occupies a little less than 35% of the land type. Valentine soils have 3-7 inches of brownish surface material overlying incoherent light colored fine sands.

On the remaining 35% of the land type, the topography was sufficiently uniform to warrant a slope designation. The slopes varied from 1-7%, with 1 and 2% slopes predominate. About 15% of the land type was mapped as Anselmo loamy fine sand, mostly on 1, 2, and 4% slopes. This soil has more silt in the profile and sufficient development to separate it from the Valentine series. However, it is not recommended for cultivation. Only about 1% of the superior Anselmo fine sandy loam was mapped.

The natural vegetation is chiefly sand reedgrass, sand dropseed, and western wheatgrass. Small amounts of blue grama, buffalo, sandhills bluestem, yucca, cacti, and sagebrush are also present.

III. SIGNIFICANCE OF THE MAJOR AND MINOR COMPONENTS OF THE LAND TYPES

A. DEUEL LOESS PLAINS LAND TYPE

The distinctive features, (1) nearly level topography, and (2) fertile and friable medium-textured soils, of the Deuel loess plains land type are revealed in the following list of major components:

- 1) Keith silt loam---1% slope---16.0%
- 2) Sherman silt loam-1% slope---10.3%
- 3) Dunlap silt loam--1% slope--- 5.3%
- 4) Goshen silt loam--1% slope--- 4.4%
- 5) Keith silt loam---2% slope---34.3%

total 70.3% of the land
 type

The soil components listed above are highly fertile and free of properties detrimental to crop production. Given good crop rotations, adequate moisture, and protection from wind erosion, and they are all highly adapted to large scale mechanized farming. To conserve moisture and control wind erosion, an estimated 90% of the dry-land farmers are practicing some form of "stubble mulch" or subsurface tillage which has long been advocated by Duley and Russell (4). Where slopes are regular, contour cultivation is advisable on the 2% slopes

of Keith silt loam. Wartime conditions induced operators to convert to virtually a 1-1 rotation of winter wheat and summer fallow. However, any small grain crop is adapted to these soils. Under irrigation, corn, sugar beets, and alfalfa would do well. With the advent of deep well pump irrigation in many places on the High Plains, e.g., the 400 foot wells pumping as much as 3,000 gallons per minute in Box Butte County, Nebraska, more intensive and diversified farming is a future possibility.

The more important minor components of the Deuel loess plains land type include:

- 1) Scott silty clay loam---1% slope---1.6%
- 2) Dawes silt loam-----1% slope---1.3%
- 3) Keith fine sandy loam---2% slope---1.8%
- 4) Keith silt loam-----3-4-5% slope---9.9%
- 5) Chappell loam-----7% slope---1.3%

Total	16.0% of the land type
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These components possess properties which make them inferior to the major components. Scott silty clay loam is a highly leached claypan soil. As a consequence of the incomplete drainage system, it occupies depressional areas throughout the land type. The areas vary from a matter of square feet to five or more

acres. Cultivate crops do not thrive, and cultivation is generally extremely difficult. Many of these areas are still in native grass. When large and conveniently situated, they furnish some pasture. Most frequently, however, they are irregularly located throughout the cultivatable soils and do not lend themselves to any satisfactory use.

Dawes silt loam is also a claypan soil, but it has a deeper surface soil than Scott. The slopes are nearly level as a rule, but not so depressed as to invite the intermittent ponding characteristic of the Scott type. The soil is inclined to be more droughty, and the fertility and yields are lower than obtained from the friable silty soils.

Keith fine sandy loam is a more sandy and shallow soil than the heavier silt loam. The fertility is lower and the soil is more subject on exposure to blowing. Greater corn yields are obtained from this type than the silt loam especially in dry years. Greater protection from wind erosion and contouring regular slopes is advisable.

Keith silt loam on 3, 4, and 5% slopes generally possess more shallow profiles than the more level Keith situations. Fertility is somewhat lower, and the

erosion hazard is greater. Contouring and terraces are recommended on the more regular slopes. In many cases difficulty arises, however, because these component conditions are isolated and appear as irregularly-shaped swells or ridges upon an otherwise nearly level plain.

Chappell soils are inclined to be droughty as a consequence of their gravelly subsoils. They occur on a variety of slopes from 3-10%. It is advisable to retain in or return to permanent vegetation most of the Chappell soils. However, they frequently appear as small isolated areas and do not lend themselves to their best use.

An important series elsewhere on the High Plains, but a minor component in the Deuel land type is Rosebud. In Deuel County, most of this series is medium-textured. It is generally more shallow than the analogous Keith series, but on similar slopes lends itself to about the same practices.

Among the more infrequent minor components are the shallow lithosols. These include: (a) Colby, developing on Peorian loess; (b) Larimer, developing on Pleistocene gravels; and (c) Canyon, developing on limey Tertiary sandstone. These components are typically found on steep slopes and are best adapted to

permanent vegetation. Their occurrence as small isolated areas complicates management according to their best use.

B. CHAPPELL INTRENCHED VALLEY LAND TYPE

The major and minor components of this land type are highly variable in character, and frequently they are very intimately and intricately associated. The major components are:

1) Bluffland:

- a) Larimer gravelly sandy loam --12-25% slope--
Larimer sandy loam 16.9%
- b) Chappell sandy loam-----4-12% slope-----
Chappell loam 26.0%

2) Terraceland:

- a) Cheyenne fine sandy loam--2% slope-----
Cheyenne loam 13.3%
- b) Tripp silt loam-----1-2% slope-----
6.1%

3) Bottomland:

- a) Ellicott gravelly sandy loam --2% slope-----
Ellicott sandy loam 5.9%
- b) Riverwash-----x slope-----
3.2%
- c) Laurel loam-----1-2% slope-----
3.2%

Total 74.6% of
the land type

The Larimer and Chappell soils thoroughly dominate the blufflands. Typically, they are very intimately and intricately associated, and together they occupy about 43% of the land type. Both series should remain in permanent vegetation. The steeply sloping Larimer soils support a very meager plant cover, and as much as 50 acres may be required to support one animal unit. The more gently sloping Chappell soils on the colluvial slopes support considerable plant cover. Generally, 10-12 acres of combined Larimer-Chappell soils are considered necessary to sustain one animal unit. The grazing season generally extends from the middle of April to the middle of November.

Cheyenne (a) loam and (b) fine sandy loam dominate the terrace portion of the land type. Almost half of the terrace is occupied by these two types. Gravelly subsoils incline these types to droughtiness, and wind erosion is a problem if they are clean cultivated. Yields even under irrigation are not high. Irrigation of these soils, especially the fine sandy loam, is of questionable value.

The most productive terrace soils are members of the Tripp series, chiefly silt loam. This type is analogous to Keith silt loam of the upland. Ditch

irrigation has long been practiced, and pump irrigation is becoming much more important. As a consequence of the supplemental water, more diversified crop rotations are practiced. Sugar beets, alfalfa, and corn are the most important crops.

The bottomlands are dominated by three conditions. Soils of the Ellicott series are the most extensive. They are essentially alluvial Larimer, and they support a scanty vegetative cover. They are suitable for only limited grazing.

The hummocky Riverwash sand-silt deposits are similar to the Ellicott and provide limited grazing only.

Laurel loam is the most extensive of the bottomland soils adapted to cultivation. Diversified cropping is practicable. In addition, much of this soil type is still in native grass which is cut for hay or is used as pasture.

The minor components of the Chappel land type include:

1) Level upland

- a) Keith silt loam----- 2-3% slope---0.3%
 Sherman silt loam

2) Bluffland

- a) Keith silt loam -- 2-8% slope---3.5%
 ^N fine sandy loam

- b) Rosebud loam-----5-1% slope---1.3%
- c) Canyon stony loam-----10-20% slope---0.8%
- d) Colby silt loam-----4-10% slope---0.4%

3) Terraceland

- a) Cheyenne loam, deep solum
phase-----2% slope-----2.0%
- b) Yale silt loam-----1-2% slope-----2.2%
- c) Cody loam -----1-2% slope-----2.1%
" fine sandy loam
- d) Parshall silt loam -1-2% slope-----2.7%
" fine sandy loam-

4) Bottomlands

- a) Las Animas fine sandy loam-1-2% slope---1.9%
- b) Goshen silt loam-----1-2% slope---1.0%
- c) Minatare silty clay loam--- 1% slope---1.3%
- d) Wann loam----- 1% slope---0.7%

Total 20.2%
 of the land
 type

Keith and Sherman silt loams occupy the few remaining tableland remnants of the land type. Their isolated location and small areal extent make their use difficult under cultivation.

In a similar way, the Keith soils found as a minor component in the Blufflands are generally small and difficultly accessible. These areas, however, greatly

improve the grazing value of the Blufflands.

The associated Rosebud soils in the gravelly Blufflands are similar to the Keith soils just discussed.

Canyon stony loam and Colby silt loam are shallow lithosols similar to Larimer and should be retained in permanent vegetation.

Cheyenne loam, deep solum phase, is the best of the Cheyenne soils on the terrace. The greater depth to gravels improves the type and crop yields are higher.

Parshall (a) silt loam, and (b) fine sandy loam are quite similar to Tripp in characteristics and adaptability to cultivation.

Cody (a) loam, and (b) fine sandy loam are transitional from the Parshall to Cheyenne series and about intermediate in crop adaptability.

Yale silt loam has a columnar solonetz-type claypan, similar to Dawes of the tableland, which depreciates its value for crops. Sub-surface moisture conditions generally are more satisfactory than with Dawes, however, and crop diversification is greater under irrigation.

The minor components of the bottomland include:
(a) Las Animas fine sandy loam; (b) Goshen silt loam;

(c) Minatare silty clay loam; and (d) Wann loam. Goshen and Wann are adapted to diversified cropping systems under irrigation. Las Animas fine sandy loam is light colored throughout the profile, and as a consequence of the low organic matter content crop yields are lower. Much of the Las Animas is still in native grass which is cut for hay. Minatare silty clay loam is an excessively saline soil condition. It should remain in permanent grass. The salt grass which is very abundant on this soil type is an inferior pasture grass. It is only palatable for a few weeks during the early stages of growth. After that, it quickly turns brown and becomes very coarse and dry.

C. FREEMAN SANDHILLS LAND TYPE

The Freeman land type is dominated by hummocky to dune-like incoherent fine sands with little or no profile development. The minor components also have very sandy but more developed profiles, and the slopes are more uniform and gentle. Virtually without exception the soils of this land type should remain in permanent vegetation. The major components include:

1) Dunesand, unstabilized--Dune-like topography--	16.4%
2) Dunesand, stabilized----Hummocky topography---	13.9%
3) Valentine fine sand-----Hummocky topography---	<u>34.7%</u>
Total	65.0% of the land type

The major components thoroughly dominate the Freeman land type. Dunesand, unstabilized, is a hazard to the continued use of the land type. These areas should be grazed very lightly, if at all, until conditions are stabilized. Similarly, Dunesand, stabilized, should be restrictedly grazed to maintain adequate protective vegetative cover. Valentine fine sand with a hummocky topography has a few inches of brownish surface development. Generally, the vegetation is more abundant, and the site better protected. Excessive grazing is not advisable.

The minor components of the land type include:

1) Anselmo loamy fine sand--1-2% slope--	11.4%
2) Valentine fine sand----- 2% slope--	6.0%
3) Valentine loamy fine sand 2% slope--	4.6%
4) Anselmo fine sandy loam-- 1% slope--	<u>1.2%</u>
Total	23.2% of the land type

The minor components of the land type generally occupy the more uniform and gently sloping topography. They also have better profile development and support more vegetation.

Anselmo loamy fine sand contains sufficient silt in the subsoil to retain more moisture and supply more nutrients. Vegetation is more abundant, and the carrying capacity is greater. The type is subject to severe wind erosion if the vegetation is removed, however, so it is not recommended for cultivation.

Valentine (a) fine sand, and (b) loamy fine sand on 2% slopes comprise 10.6% of the land type. These soil types support fairly good vegetative cover, but require careful management to prevent depletion of the vegetation and wind erosion.

SUMMARY

The natural land types described and analyzed are in Deuel County in Western Nebraska. Physiographically, the county is a portion of the Cheyenne Tableland of the High Plains, and consists of a gently sloping loess capped Tertiary tableland dissected to a depth of about 200 feet by two streams. Prevailing winds have produced a northwest to southeast alignment of many surface features and many of the intermittent drainageways.

Surface configuration and many soil conditions found in the county are closely related to the geologic formation. Chief among the geologic formations present are various members of the Ogallala formation of Pliocene age, early Pleistocene gravels, and loess of Peorian interglacial age. Peorian loess is by far the most important soil forming parent material in the county.

Climatically, Deuel County is semi-arid or sub-humid with an average annual rainfall of 17.07 inches, a mean annual temperature of 48.8° F., and an average growing season of 137 days.

The natural vegetation of the county is short grass, chiefly Blue grama and Buffalo grass. Western wheatgrass,

needlegrass, and Niggerwool are the most important minor associated grasses. Native tree growth is limited to a few cottonwood and willow along Lodgepole Creek and the South Platte River.

The normal soils of the county are members of the Chestnut Brown Great Soil Group. Members of the Keith series developing on the tableland from Peorian loess are by far the most important soils present. Soils of the closely similar Sherman, Dunlap, and Goshen series comprise a majority of the remaining soils of the tableland. The steeply sloping blufflands are dominated by shallow soils, chiefly the Larimer and Chappell series, which contain a high proportion of Pleistocene gravels. The Cheyenne series, very similar to the gravelly Chappell series, dominates the terrace soils of the county. The bottomland soils are gravelly, sandy, or loamy. A small area of sandhills of local origin consist almost entirely of very sandy soils, chiefly Dunesand and members of the Valentine series.

Three natural land types are present in Deuel County. The Deuel Loess Plains Land Type occupies the gently sloping tableland composed of friable medium textured soils and short grass vegetation. About 40% of the land type has a 1% slope, 40% a 2% slope, and almost all the

remaining 20% has a slope from 3-8%. The land type is dominated by friable soils of the Keith, Sherman, Dunlap, and Goshen series. The 1 and 2% slopes of these series occupy upwards of 80% of the land type. Minor associated soil series include Dawes, Rosebud, Canyon, Scott, Chappell, and Colby. As a consequence of the gently sloping topography, and the fertile and friable medium textured soils, the land type is highly adapted to large scale mechanized farming. As a wind erosion control measure, "stubble mulch" or subsurface tillage is practiced by an estimated 90% of the farmers. Most of the land is managed in a 1-1 rotation of winter wheat and summer fallow.

The Chappell Intrenched Valley Land Type is much more variable in composition and use adaptability. Steeply sloping gravelly blufflands dominate 50% of the land type. Two soil series, the Larimer and Chappell, occupy the blufflands almost to the exclusion of all other series. Slopes from 12-25% are typical of the gravelly lithosols of the Larimer series, and slopes of 4-12% are associated with the Chappell series occupying the colluvial slopes below the Larimer soils. These two series are best adapted to permanent vegetation and grazing.

About 30% of the Chappell Intrenched Valley Land Type is terrace land with a slope of 1 and 2%. Approximately half of the terrace, in turn, is occupied by soils of the Cheyenne series which have gravelly subsoils. The best terrace soils are members of the Tripp series, chiefly silt loam in texture. The Tripp series is very similar to the Keith series of the upland. Irrigation, both pump and canal, are practiced on the terrace, and cropping practices are more complex. Sugar beets, alfalfa, corn, and small grains are the most important crops.

The bottomlands of the Chappell Intrenched Valley Land Type comprise less than 20% of the land type. About half of the bottomlands, in turn, are composed of the very gravelly Ellicott series or very sandy Riverwash. These areas are non-cultivable and provide only limited grazing. Similarly, the Las Animas and Minatare series are best adapted to permanent hay meadow or grazing, the former because of its light sandy texture and the latter because it is excessively saline. The best bottomland soils, comprising about 3.5% of the land type, are members of the Laurel and Harlem series. Diversified cropping, including sugar

beets, alfalfa, and corn, are practiced on these soils.

The third land type is the Freeman Sandhills Land Type. The area occupied by this land type is very small. The soils are very sandy, possess little or no profile development, and are associated with a hummocky to dune-like topography. Dunesand, stabilized and unstabilized, Valentine fine sand, and Anselmo loamy fine sand comprise almost all of the soils present in the land type. Due to the extremely sandy nature of the soils, limited grazing is the only recommended land use.

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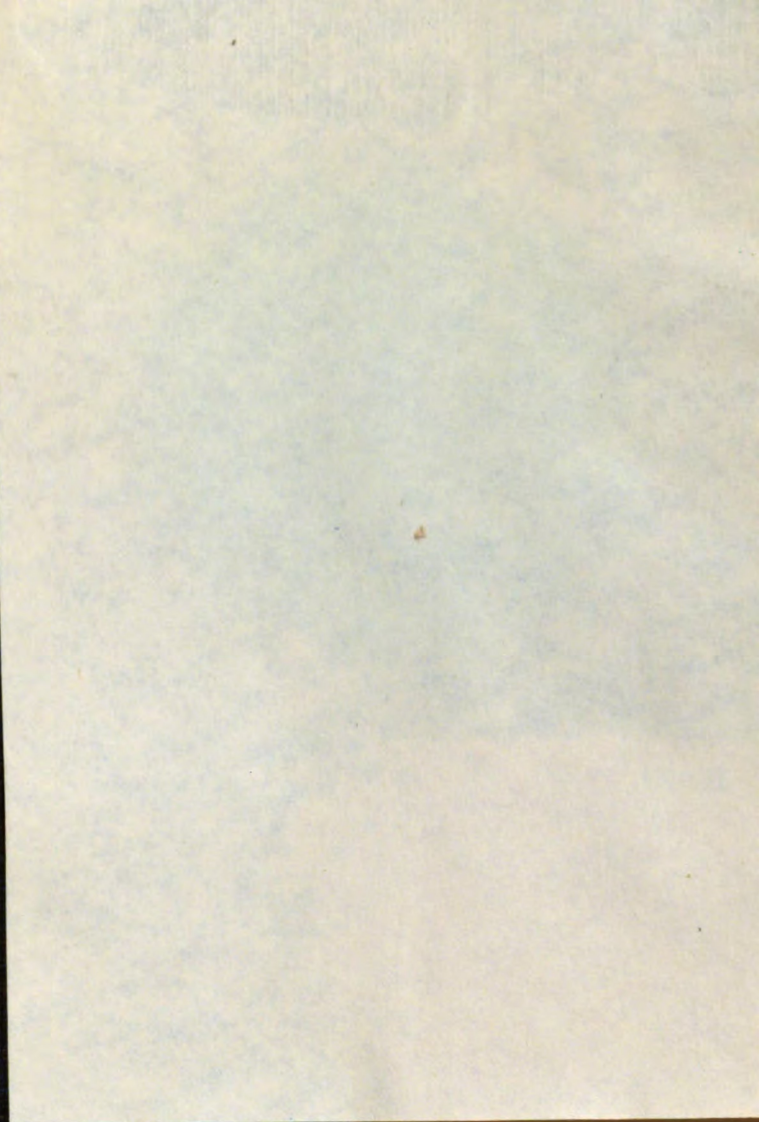
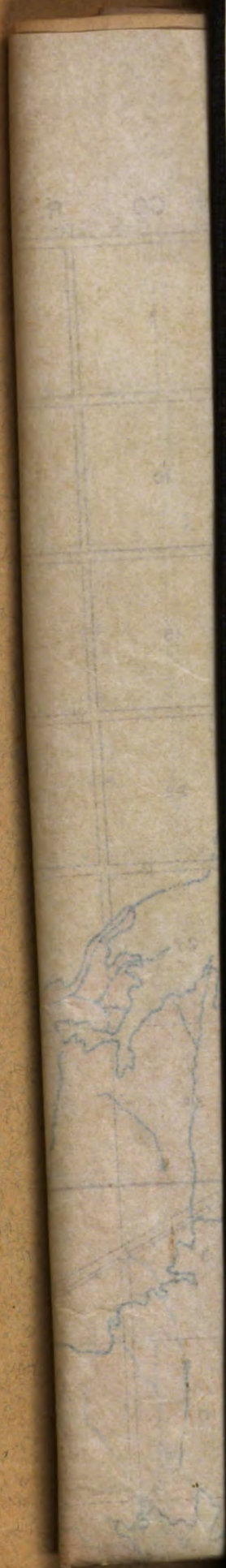
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