

SOIL SURVEY OF THE GRAND ISLAND AREA, NEBRASKA.

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LOCATION AND BOUNDARIES OF THE AREA.

The Grand Island area lies almost entirely within Hall County, which is situated in the southeastern central part of Nebraska. The area is about 90 miles west of Lincoln, the State capital, and 155 miles distant from Omaha, the chief city and important market town of the State. The area embraces a narrow strip $1\frac{1}{2}$ miles wide in the western border of Merrick and Hamilton counties and a strip of the same width in the eastern border of Buffalo County. On the north Hall County is bounded by Howard County and on the south by Adams County.

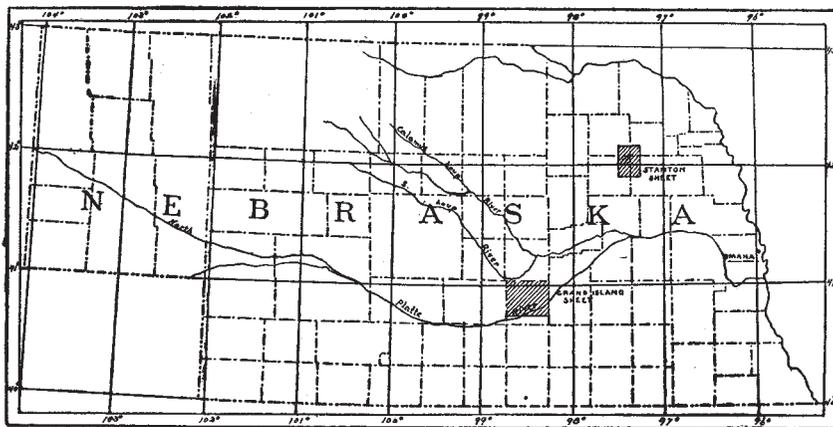


FIG. 46.—Sketch map showing location of the Grand Island area, Nebraska.

The Grand Island area is included between parallels $40^{\circ} 45'$ and 41° north latitude and meridians $98^{\circ} 15'$ and $98^{\circ} 45'$ west longitude. It comprises a land area of about 446 square miles, or 285,504 acres.

The base maps used in the soil survey were the Grand Island and Wood River quadrangles of the United States Geological Survey. These show the roads, houses, streams, and the general topography of the country.

HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

Hall County, within which the greater part of the area covered by the present soil survey lies, is one of the oldest counties in the State, having been settled in 1857, three years after the Territory of Nebraska had been established and two years before Hall County was organized. It is situated in the sixth tier of counties west of the Missouri River and about 150 miles west of Omaha.

About the year 1856-57 a great many settlements in the Platte (then Nebraska) River Valley were projected by residents of States farther east. The colonies for these settlements were generally sent out by speculators who intended to lay out towns, expecting that a railroad would at some time in the future be extended up this valley. The settlement of this area was made by a colony of Germans and a few Americans who came from Davenport, Iowa.

Numerous hardships were suffered by these pioneers during the first winter. Provisions ran low and, on account of the impassable condition of the streams and the severity of the weather, no means were at hand for procuring additional supplies. Parties sent back to Omaha early in the fall for food and raiment were unable to reach the settlement again until the following June, and during the intervening time many of the colonists were confronted by death from starvation or freezing. The summer of 1858 brought them a considerable harvest, but this was nearly all destroyed by a prairie fire. Thus the settlers struggled on till the fall of 1859, when one of their number secured a Government contract for the delivery of 2,000 bushels of corn at Fort Kearney, at \$2 a bushel. During the winter some of the settlers found work at the fort; and the days of privation were at an end.

In the winter of 1858-59 the stage line was extended from Omaha through Grand Island to Fort Kearney, and the first post-office was established in the spring of 1859.

Since the settlement of the county in 1857 grasshopper swarms have appeared no less than eight times. The most disastrous of these visitations occurred in 1874, when they came in great numbers, forming clouds so thick that the light of the sun was darkened. They remained for several days, and every green thing was destroyed.

Corn and wheat formed the staple crops of the early settlers, as they do of the farmers to-day. With grain farming is usually combined the raising of hogs and cattle or sheep. The farmers are fast accumulating property and are improving and beautifying their homes.

CLIMATE.

The climate of this area is that common to inland regions of considerable elevation and remote from large bodies of water. The region is characterized by winters of considerable severity, summers

of unusual warmth, a limited rainfall, and many marked and sudden changes of temperature. The atmosphere is dry, and there is a large percentage of sunshine.

The following table, compiled from the Weather Bureau records for Grand Island and St. Paul, the latter being 12 miles to the north of the area, shows fairly well the conditions in this area as regards temperature and rainfall, the figures being normals, computed on records covering the last eight years:

Normal monthly and annual temperature and precipitation.

Month.	Grand Island.		St. Paul.		Month.	Grand Island.		St. Paul.	
	Temperature.	Precipitation.	Temperature.	Precipitation.		Temperature.	Precipitation.	Temperature.	Precipitation.
	° F.	Inches.	° F.	Inches.		° F.	Inches.	° F.	Inches.
January.....	24.8	0.49	22.8	0.34	August.....	73.5	3.01	75.5	3.05
February....	24.0	.76	25.8	.60	September..	65.1	2.63	66.7	2.71
March.....	23.6	1.38	34.8	1.03	October.....	52.1	2.34	53.6	2.07
April.....	51.4	3.86	51.0	3.13	November..	35.1	.84	36.8	.77
May.....	61.0	4.17	62.4	2.63	December...	30.3	.90	29.0	.47
June.....	71.7	5.14	72.3	5.26	Year..	49.9	28.09	50.6	26.02
July.....	75.8	2.57	76.8	3.96					

During the cold winter months the land freezes to a depth of several feet, and it occasionally happens that alfalfa is injured in this way. The average date of the last killing frost in spring at Grand Island is April 22, and at St. Paul May 1, while the first in fall occurs on October 5 and October 2, for the two stations respectively. The summers are usually very warm, the temperature frequently rising above 100°, but this heat is not very oppressive, on account of the dryness of the atmosphere and the strong breezes which usually blow at such times.

The years 1893 and 1894 were exceptionally dry and scarcely any crops were harvested, but since that time there has been sufficient rainfall. The area has an advantage over many others in that the rainfall is most abundant during April, May, June, and July—the critical months for crops.

Evaporation in this area is facilitated by the relatively high summer temperature, the prevalence of moderate to strong winds, and the low relative humidity. Sunshine bears an important relation to the health of a community as well as to agriculture, and this area is unusually favored in this respect, particularly during the season when the staple crops are ripening and during harvest.

The Grand Island area is rarely visited by cyclones, and they are said to be less destructive here than in other parts of the State. During the spring and summer months, however, local rain storms occur, always attended by thunder and lightning and very strong winds. These often do some damage. In general this area may be said to have a healthful climate.

PHYSIOGRAPHY AND GEOLOGY.

The general slope of the area surveyed is toward the northeast, following the course of the Platte River. With a trifling exception the whole of the area is within the limits of the Platte Valley—a wide valley lying between two distinct escarpments. The Platte enters the area near the southwest corner, flows in a northeasterly direction, and leaves it about 12 miles north of the southern boundary. Wood River enters the area from the west, about 3 miles north of the Platte, and flows in a direction nearly parallel with the latter, emptying into it about 8 miles west of the city of Grand Island. In this part of its course the Platte River is a broad, shallow stream. Across the western border of the area, in Buffalo County, it separates into two streams, between which lies a broad, fertile island about 60 miles in length. This extends across the area surveyed and is known as Grand Island. Besides the Platte and Wood rivers the only other stream of any importance is Prairie Creek, about 100 miles in length, which rises in Buffalo County and flows across the northern half of the area.

The average elevation of the area is about 1,980 feet above sea level. In general the surface of the area is that of an undulating prairie. The uplands are not abrupt and broken, but are generally made up of long and gentle slopes. The valleys are usually well drained, and average from 2 to 9 miles in width. All this extent of country is interspersed by a number of small, spring-fed streams, clear and with a rapid flow. There is but little native timber in the area, but there is a large acreage of groves and wind-breaks that have been planted by the settlers.

In the southeast corner of the area, near Doniphan, the topography is somewhat broken, presenting an irregular rolling surface, in which are several sharp draws and depressions. The most pronounced of these depressions is about $5\frac{1}{2}$ miles east of the town. Here is an oval-shaped area about 1 square mile in extent that sinks 20 feet below the general level of the country. Another much larger depression occurs about 1 mile southeast of Doniphan. This contains about 4 square miles and is partly a swamp. These depressions are found at various places in this part of the State, and where they have to be crossed make the problem of road building a difficult one. They are usually boggy and during the rainy periods are largely under water.

About 2 miles north of Doniphan are the bluffs of the Platte River. These are comparatively low and are capped in many places by sand that has been blown from the river bed during the dry season. Between the bluffs and the river is a narrow strip of lowland, varying in width from a few rods to 2 miles, which is subject to overflow during heavy freshets, but is so seldom inundated that excellent farms are operated on it.

Passing from the low bluff line on the south of the river the surface rises gradually toward the northwest and opens out as a broad expanse of nearly level country, with only here and there a slight rise in elevation. One can travel for about 11 miles north from the Grand Island bridge without encountering as much as a 20-foot rise.

In the northwest corner of the survey is a triangular area of hills, about 40 square miles in extent, which form a part of the divide between the Platte and Loup rivers and constitute the highest point in the area. They are about 2,100 feet above sea level and are well dissected by streams.

Owing to its slight fall and the enormous amount of material it has to carry, the Platte River is cutting its bed very slowly, depositing about as much material as it carries away. It is now swinging to the south, and is gradually grinding back its southern bluff line. About 4 miles northwest of Grand Island are a number of low, grass-covered sand dunes of irregular shape that seem to have been left here by the river in its swing to the south.

In the northeastern part of the area is a considerable amount of fine sand. This seems to have been blown from the bed of the Loup River and deposited on the divide before the country was settled. Before that time the prairies were periodically fired by the Indians, and the sand had not time to produce sufficient vegetation to prevent the winds from carrying it long distances. This sand was brought down by the Loup River from the sand hills in the northwestern part of the State.

Geologically, the region which includes the present survey is distinctly Pleistocene. It is composed of loess, alluvium, and sand. The sand has been brought down by the Platte and Loup rivers from the sand hills of the Arikaree formation in the northwestern part of the State, and has been blown across the country by the wind.

By far the most important formation in the area is the loess of the Pleistocene. It covers more than half the area, and is of remarkable depth. In proximity to streams it is often cut into walls and canyons. Such exposures have a rough, prismatic structure, and stand in nearly vertical walls. The loess weathers into a soft, fine sandy loam with a large proportion of sand or silt and considerable calcareous matter, together with a small amount of clay. The proportion of sand or clay varies somewhat, but ordinarily the material is very uniform in composition and texture.

The loess seems to be generally productive, whether found on the hills or in the valleys, and even the subsoil when exposed on the surface sustains plant growth almost from the first. It has considerable organic matter in it, and when exposed to the weather quickly changes from a characteristic bright buff to a reddish color. This change in color is hastened by the oxidation of certain mineral constituents.

As is characteristic of typical loess, this is penetrated by numerous vertical tubes, probably root holes, which have a white coating of lime. These tubes assist the distribution of the soil moisture.

The loess is generally known to the farmer as "yellow clay," although there is really very little clay in it. It is composed mainly of fine sand and silt. The soils of the area surveyed are, with trifling exceptions, derived entirely from this formation.

SOILS.

Five distinct soil types were recognized and mapped in the area surveyed. The following table shows the actual and proportional extent of each:

Areas of different soils.

Soil.	Acres.	Per cent.
Marshall silt loam	137,984	48.3
Sioux fine sandy loam	60,352	21.1
Miami sand	29,440	10.3
Sioux sandy loam	29,184	10.2
Meadow	28,544	10.0
Total	285,504

MARSHALL SILT LOAM.

The soil of the Marshall silt loam consists of a very fine sandy to silty loam of a gray or blackish color, with a depth of from 8 to 15 inches. It has a mealy feel, and usually contains a large amount of organic matter. In places a thin layer of sand has been blown onto the area of this soil south of the Platte River. Throughout the more rolling areas of the Marshall silt loam are sharp ridges or knolls, where the soil is a gray silty or fine sandy loam. The subsoil of this type to a depth of 36 inches varies from a yellowish silty loam to a brown, compact fine to very fine sandy loam. In one place the subsoil may be a very fine sand, while in another place, not more than 100 yards distant, it may be a heavy silty loam to a depth of 24 inches, under which will be found a fine sandy loam.

In all typical areas of the Marshall silt loam there is present a considerable quantity of lime concretions, which are usually small, white, rounded, and very hard. This lime when wet cements the soil together and makes it act like a clay, hence the local name of "yellow clay." Underlying the subsoil of this type is a fine yellow sand and silt many feet deep.

The Marshall silt loam is the most important of the soil types

encountered in this area, in respect to both extent and agricultural value. It occurs in a large body of about 40 square miles in the southeastern corner of the area, just south of the Platte River, in the vicinity of Doniphan. The largest area is found in the north central and northwestern parts of the area surveyed, beginning at Abbott, extending southward in an irregular outline to Alda, and then following a line running west within one-fourth of a mile of Wood River to Shelton and extending to the northern edge of the area. This section embraces approximately 165 square miles. A small area of this soil, about 2 square miles in extent, lies just southwest of the town of Wood River.

The surface features of the Marshall silt loam vary considerably. The country south of the Platte River occupied by this type has a high, rolling surface, with an occasional steep slope, and a bluff line which rises some 40 to 60 feet above the river level. This bluff portion is greatly eroded in many places. The type is found on the broad, level area north of Shelton, Wood River, and Alda. In the northwestern corner of the area the soil occupies the hilly and rolling section of the area surveyed. The elevation ranges from 1,900 feet in the level areas to 2,120 feet in the more rolling areas.

This soil has excellent natural drainage in the northwestern part of the area, and also in the portion just south of the Platte River. In the northwestern part erosion has been very active. There are a few depressions east of Doniphan that can not be drained, and they have been mapped as Meadow. The large level area north of Wood River extending across to Abbott has fairly good drainage for the most part, but in some places it is rather poor. A few small spots of alkali, due to imperfect drainage, were seen in these low areas.

The Marshall silt loam is derived from the weathering of the loess formation, which is either a deposit of wind-blown material or a glacial mud left here at the close of the glacial period. Whatever may be its origin, since its deposition it has weathered to some extent, and the finer material from the surface has gradually worked downward, giving rise to the silty or compact subsoil of this soil.

The principal crops grown upon the Marshall silt loam are corn, wheat, oats, alfalfa, and sugar beets, while the minor crops are barley, millet, sorghum, potatoes, and garden vegetables. Corn gives a yield of from 30 to 60 bushels to the acre; wheat, from 15 to 40 bushels; oats, from 30 to 60 bushels; and alfalfa, from 5 to 6 tons. Sugar beets do well, yielding from 10 to 18 tons to the acre. The minor crops give good yields. Several small orchards were observed on this soil, the fruit being produced chiefly for home consumption. In the flat area southwest of Abbott some of the soil is devoted to pasturage and affords good grazing.

The Marshall silt loam is naturally a rich soil, of remarkable depth, and great productiveness. It stands drought exceedingly well, owing to the porous nature of both soil and subsoil, which gives it the power to retain a large proportion of the rainfall. This type of soil is extensively developed in Nebraska, covering, as it does, a considerable proportion of the eastern, central, and southern parts of the State. Where improved it is worth from \$30 to \$50 an acre, and it is justly recognized as the best soil in the Grand Island area for general farming operations.

Below are given the mechanical analyses of several typical samples of the Marshall silt loam:

Mechanical analyses of Marshall silt loam.

No.	Locality.	Description.	Organic matter.								
				Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.06 mm.	Silt, 0.06 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.	
			<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	
9521	1 mile E. of Doniphan.	Silty loam, 0 to 15 inches.	1.66	0.00	0.74	0.66	2.72	30.78	56.70	8.00	
9519	12 miles N. of Shelton.	Silty loam, 0 to 12 inches.	2.61	.10	.50	.30	3.38	21.52	60.90	13.00	
9517	7 miles NE. of Wood River.	Silty loam, 0 to 12 inches.	2.08	.32	.42	.30	1.76	20.20	60.90	15.60	
9522	Subsoil of 9521	Brown silty loam, 15 to 36 inches.	.86	Tr.	.60	.44	1.88	27.84	61.74	7.50	
9520	Subsoil of 9519.....	Gray silty loam, 12 to 36 inches.	1.59	.00	Tr.	.52	1.90	26.44	61.70	9.40	
9518	Subsoil of 9517.....	Yellow silty loam, 12 to 36 inches.	.16	.00	.44	.30	.74	9.38	62.70	25.90	

The following sample contained more than one-half per cent of calcium carbonate (CaCO_3): No. 9518, 0.86 per cent.

SIoux FINE SANDY LOAM.

The soil of the Sioux fine sandy loam consists of a fine sandy loam of a dark-gray to blackish color, with a depth of from 10 to 15 inches. A few areas, especially along Wood River and the north channel of the Platte River, are more nearly a fine loamy sand. In typical areas this soil contains large quantities of organic matter, which occasionally gives a silty feel to the soil.

The subsoil varies somewhat, but the largest and most typically developed areas are underlain to a depth of 36 inches by a fine to medium sandy loam of a light-brown color. In the lowland areas, near the streams, the subsoil is sometimes a loamy fine sand, while there are spots in the level upland areas where the subsoil is a medium

sandy loam. The whole of this type is generally underlain by sand and gravel at a depth of from 3 to 8 feet.

This soil occurs in large areas along the channels of the Platte River, extending diagonally across the area from the southwest corner to the northeast side. Large bodies of it are also found about 2 miles north of Grand Island, extending out as far as Abbott, and an area runs from Shelton east along the Union Pacific Railroad to within 3 miles of Alda. Smaller areas are scattered over the southern, central, and northern parts of the area.

The Sioux fine sandy loam has the most uniform surface features of any type found in the area. It occupies the broad, flat, level areas along the Platte River and the level areas found north of Grand Island. The country from Alda west to Shelton is nearly level, having a rise of only 6 feet to the mile. This area is called "second-bottom land" by the farmers, while the areas lying adjacent to the streams are known as "lowland," or "bottom land."

The soil has fairly good drainage in the upland or second-bottom areas, while the greater part of the entire area has an elevation of from 3 to 20 feet above the water level of the streams, which makes it possible successfully to use artificial drainage. Open ditches are seen throughout the type. These give good results and do not need to be placed very close together, as the subsoil is sufficiently sandy to allow the water readily to seep into the ditches. There are, however, some low areas of this soil, both near the streams and in the uplands, which are poorly drained, and in wet seasons the crops on these places suffer from lack of proper cultivation. Only a small percentage of the Sioux fine sandy loam is subject to overflow.

Throughout this soil type occur small spots of alkali, due to imperfect drainage, but these are relatively unimportant, and have not as yet given any trouble. They are usually very conspicuous, showing a white, barren surface, though in some instances they are covered with salt grass.

This type of soil is of alluvial origin, being formed by the deposition and reworking of material by the Platte River and other streams in the area. The Platte River within the area, cutting its channel through the loess formation, and running through a sandhill region outside the area, carries large quantities of sand, fine sand, and silt, and it is through the deposition of this material that this soil has been formed. Since its deposition it has been flooded and reworked, and constantly added to by fresh deposits. In some places a considerable amount of organic matter is found, even in the subsoil.

The Sioux fine sandy loam, in agricultural value, ranks second among the soils of this area. It produces good crops of corn, wheat, oats, alfalfa, sugar beets, barley, millet, potatoes, and sorghum. Corn yields from 25 to 50 bushels; wheat, from 15 to 35 bushels; oats, from

25 to 60 bushels; sugar beets, from 8 to 18 tons; and alfalfa, from 4 to 7 tons per acre. On the lowland areas a large quantity of wild grass is cut, which makes an excellent quality of hay.

This soil appears to be fairly well adapted to the crops grown upon it. It is naturally a rich soil, and seldom requires any fertilization to produce a good crop. In some instances the farmers allow their barnyard manure to lie heaped up around the barn in preference to hiring labor and having it hauled to the fields. This manure should be placed on the fields whether they apparently need it at present or not, for in this way their productiveness can be greatly prolonged if not indefinitely maintained.

Below are given the mechanical analyses of samples of this soil type:

Mechanical analyses of Sioux fine sandy loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.05 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
				P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
9535	5 miles SE. of Wood River.	Fine sandy loam, 0 to 12 inches.	2.61	1.20	4.46	4.86	16.76	21.82	38.50	11.66
9541	3 miles NW. of Grand Island.	Fine sandy loam, 0 to 15 inches.	1.02	.78	5.48	6.38	12.06	21.30	40.20	13.42
9537	3 miles SW. of Wood River.	Fine sandy loam, 0 to 10 inches.	.60	.40	4.06	3.64	9.76	18.34	44.50	18.40
9536	Subsoil of 9535.....	Fine sandy loam, 12 to 36 inches.	Tr.	.50	2.58	2.54	26.46	20.16	34.30	13.10
9542	Subsoil of 9541.....	Medium sandy loam, 15 to 36 inches.	.72	1.86	14.30	12.40	22.20	13.70	21.66	13.66
9538	Subsoil of 9537.....	Sandy loam, 10 to 36 inches.	.48	2.80	9.14	6.28	15.94	17.04	32.60	16.10

The following samples contained more than one-half per cent of calcium carbonate (CaCO_3): No. 9535, 6.55 per cent; No. 9536, 4 per cent.

SIoux SANDY LOAM.

The surface soil of the Sioux sandy loam is a medium to coarse gray to dark-gray sandy loam with a depth of from 8 to 12 inches. It usually has a small quantity of small rounded gravel scattered over the surface, while in some places considerable organic matter gives it the feel of a loam with sharp sand particles scattered through it. In the areas of this soil type are found patches of sand, which occur as slight knolls. In these the soil is distinctly sandy, but their small extent does not permit their being shown on a map of the scale used.

The subsoil is generally a light-colored, coarse, loamy sand to a depth of 36 inches, containing a high percentage of very coarse sand

and small waterworn gravel. In a few places the subsoil of this type is a sandy loam very similar to the soil. At a depth of from 30 to 36 inches there is generally found a coarse sand mixed with large quantities of gravel.

The Sioux sandy loam occurs in large bodies in the vicinity of Grand Island, 3 miles south of that city on the Platte River, east of Alda along the Union Pacific Railroad, east of Shelton, and in many smaller areas scattered along the Platte River. Some typical bodies of the soil occur just south of the river, in the neighborhood of Doniphan.

This soil occupies for the most part the broad, level and gently rolling upland areas. It is found on the ridges or low bluffs along the north channel of the Platte River, where it rises some 3 to 10 feet above the bottom land, and in many places it forms the boundary between the meadow type and the Sioux fine sandy loam.

Considering its generally flat surface, the Sioux sandy loam has, for the most part, fairly good natural drainage, but some areas are so level that the rainfall can only be removed through seepage. The open and porous subsoil allows this to take place quickly and thoroughly. In years of scanty rainfall this soil dries out so readily that crops are considerably damaged, and it is only in favorable seasons that good crops are grown.

The Sioux sandy loam is an alluvial soil, being formed by the deposition of material by the Platte River, and consists of sand, silt, and a small proportion of clay. The underlying coarse sand and waterworn gravel are very likely the old bed of the river. Small areas of this type, found south of the Platte River, probably consist of sand blown from the bed of the stream and mixed with materials derived from the loess.

The main crops grown upon this soil are corn, alfalfa, and oats, with some wheat and sugar beets. Corn does fairly well, producing from 15 to 40 bushels per acre in a favorable season. Wheat and oats give only moderate yields. Sugar beets are said to do well on this soil where the subsoil is more nearly a sandy loam. Alfalfa probably gives better returns than any other crop, but even with this crop the yield is light, being from 3 to 5 tons per acre. A considerable part of the Sioux sandy loam is devoted to pasture, especially on the large area near Grand Island.

No one crop has received special attention on this soil. It is used for general farming, and in favorable seasons produces fairly well, but in dry seasons it suffers severely from drought. It is probably better adapted to pasturage than to the production of any crop grown in the area. It could be greatly improved by heavy applications of barnyard manure and lime. At present lands of this type of soil bring from \$10 to \$30 an acre.

Below are given the mechanical analyses of typical samples:

Mechanical analyses of Sioux sandy loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	SILT, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
9533	2 miles NE. of Grand Island.	Dark sandy loam, 0 to 12 inches.	2.19	1.88	14.36	9.78	11.56	16.62	34.82	10.10
9531	3 miles NE. of Doniphan.	Coarse sandy loam, 0 to 10 inches.	.99	1.88	13.06	10.26	18.40	24.50	20.60	10.72
9529	4 miles E. of Wood River.	Gray sandy loam, 0 to 10 inches.	1.76	.80	9.56	8.54	10.28	19.98	37.60	12.30
9534	Subsoil of 9533.....	Yellow sand, 12 to 36 inches.	.34	5.50	24.08	22.96	32.64	6.66	3.00	5.10
9530	Subsoil of 9529.....	Coarse loamy sand, 10 to 36 inches.	.34	7.76	25.74	18.00	19.40	7.60	13.00	8.20
9532	Subsoil of 9531.....	Brown sandy loam, 10 to 30 inches.	.70	4.48	22.78	12.18	19.78	18.68	10.70	11.40

MIAMI SAND.

The soil of the Miami sand consists of a medium to fine sand of brownish to grayish color, with a depth of 8 or 10 inches. In some places where this soil occurs on the islands in the river it is a brown or yellowish fine sand. It sometimes happens that the sand is slightly loamy for a few inches, owing to the presence of a small amount of organic matter, but as a general thing it is practically free from organic matter, and is a loose and incoherent sand. The subsoil is a medium to fine sand reaching to a depth of 36 inches or more. It is slightly lighter in color than the soil, and has a very uniform texture throughout. In a few areas found along the river waterworn gravel is scattered in the subsoil at a depth of from 30 to 36 inches, and such areas are frequently underlain with a coarse sand containing gravel. This soil type, although loose and incoherent, seems to hold water fairly well, and it is this feature which makes it as productive as it is.

The Miami sand occurs in a large area of very irregular outline just west of Grand Island, to the north of Abbott in a long strip on the side of the map, and along the three channels of the Platte River, but chiefly along the north channel. A body of this soil is found in the extreme northwest corner of the area surveyed, and some typical areas occur as narrow strips in the Marshall silt loam area in the vicinity of Doniphan.

This soil occupies some of the lowest and also the highest situations of any soil in the area. Its average elevation is about 1,900 feet. It

occupies for the most part rolling areas, and is characterized by hillocks and dunes which rise from 10 to 40 feet above the surrounding soil formations. As found along the river channels, it occurs in narrow, rounded ridges which rise from 2 to 10 feet above the other soils.

The surface of this type is generally rolling enough to afford good surface drainage, while the porous character of the subsoil allows the free movement of seepage water. A few areas of this soil along the river are wet in spots, but these places can be drained by open ditches at a nominal expense. There are, however, some depressions where drainage would be impracticable on account of the expense. In general, this soil can be cultivated immediately after a rain, and grazing it when wet does not pack it or interfere with the growth of the native grass.

This soil type undoubtedly owes its origin both to wind and to water action. The Loup River, which runs within a few miles of the northern boundary of the area, passes through the sandhill region of the Arikaree formation in the western part of the State, and at times of high water brings down considerable sand and deposits it along its banks. The strong winds that sweep across this country blow this sand inland. The area of this soil found in the northwest corner of the area and to the north of Abbott was probably derived from this source. The large area of Miami sand observed just west of Grand Island and the many smaller areas seen along the Platte River have been left by the river in its swing to the south, and have been greatly modified by the action of the winds. The Platte River partially dries up during the summer, and the sand in its channel is blown inland, taking the form of ridges and dunes. Since this sand has been deposited it has undergone but little weathering, and is to-day a medium to fine sand of uniform texture, loose and incoherent.

The Miami sand is an easily tilled soil, and responds more freely to fertilizers than any other soil in the area. Alfalfa does better on this soil type than any other crop grown in the area, producing from 3 to 5 tons per acre. It is difficult to secure a good stand of the seedlings on this soil, but when once established the crop does fairly well. Corn, wheat, oats, and some sugar beets are grown, but give only moderate yields, even in favorable seasons. The greater part of the type is used for pasturage, and it produces a good quality of native grass. The price of the Miami sand ranges from \$10 to \$20 an acre, depending on location and improvements.

The Miami sand is undoubtedly the best truck soil in the area surveyed, although only a small quantity of truck is at present grown. It produces potatoes of good quality, but has to be fertilized heavily to give large yields. This soil can be greatly improved in texture and capacity to hold water by the addition of barnyard manure and other forms of organic material.

Below are given the mechanical analyses of typical samples of this soil:

Mechanical analyses of Miami sand.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
9543	5 miles SW. of Wood River.	Light-brown sand, 0 to 8 inches.	0.25	5.30	13.06	11.86	34.98	31.98	1.70	1.10
9545	4 miles W. of Grand Island.	Dark-yellow sand, 0 to 8 inches.	.73	1.88	12.88	17.92	40.48	20.34	2.90	3.10
9547	2 miles NW. of Grand Island.	Loamy fine sand, 0 to 10 inches.	.71	.00	1.70	4.24	35.30	43.50	10.66	4.60
9544	Subsoil of 9543....	Medium to fine sand, 8 to 36 inches.	.05	4.60	14.10	12.90	39.50	23.64	3.20	2.00
9546	Subsoil of 9545....	Yellow medium sand, 8 to 36 inches.	.37	.42	11.68	22.96	45.58	15.38	.50	3.30
9548	Subsoil of 9547....	Medium to fine sand, 10 to 36 inches.	.37	.34	2.80	4.14	28.96	43.56	12.82	6.98

MEADOW.

The soil of the Meadow generally consists of sandy loam, varying in texture from fine to coarse, with an occasional spot of silty loam. Large areas of fine loamy sand occur quite frequently, especially on the islands of the river and along the streams. This soil varies in depth from a few inches to several feet. In nearly every case the lowland sandy loam is underlain by a medium, or more often a coarse sand, usually containing a large percentage of small, rounded gravel deposited by the river. The upland phase of the Meadow is underlain by a sandy or silty loam. All the Meadow, whether upland or lowland, contains a high percentage of organic matter, and is considered a rich soil. It is naturally more productive than some of the upland soils, but its position renders it practically worthless for general farming purposes.

The largest areas of Meadow are found along the north and middle channels of the Platte River. It covers the greater part of the islands in the river. Smaller areas are found scattered here and there in the upland, especially in the region east of Doniphan and southwest of Abbott. These spots occupy depressions in gently rolling and level areas, and the soil is usually heavier than the adjacent upland soil types.

The areas found in the upland soils serve as basins to catch the rainfall. Some of these dry up during the summer, while others remain wet the entire year. Along the streams the areas are only

from 1 to 6 feet above the normal water level of the river, and are subject to annual overflow.

The Meadow has scarcely any natural surface drainage, and open ditches are used to carry off the surplus water. In some areas found along the river the surface is higher near the stream, and sinks gradually, forming a troughlike depression between the foreland and the upland. The drainage of these areas by gravity is impracticable, since the surface of the land in this trough is only slightly higher than the water level in the river. Some parts of the Meadow, however, could be drained, at considerable expense, by ditches, if they were skillfully constructed.

The Meadow soil is of alluvial origin, being formed through the deposition of material by the Platte River. In some places it has resulted from the washing away of several feet of surface soil, leaving the land too low and wet for cultivation. The large areas of Meadow on the islands in the river and adjoining the streams have sand dunes scattered over them. These dunes are formed of sand blown out of the river bed when it was practically dry.

At present the Meadow areas are not under cultivation, and in their present condition can not be utilized for farming, except during very dry seasons. Considerable areas were tilled during the dry years of 1893 and 1894, but prior to that time none had been cultivated, nor has any been cultivated since. As the soil is naturally productive, it supports a heavy growth of native grass, and large quantities of excellent hay are harvested annually. The land is also used quite extensively for pasturage. Several ranches are located along the Platte River, and many cattle were observed grazing upon the meadows. Under present conditions the Meadow land is thus utilized to the best advantage, and it can not be bought for less than \$10 an acre, usual prices ranging from that figure to \$25.

AGRICULTURAL METHODS.

The agricultural methods in this area do not differ from those in other parts of central Nebraska. About 98 per cent of the land is cultivated with machinery of the latest type. The 6-horse gang plow has displaced the 2-horse turn plow; the 2-horse cultivator is now used where the single-horse double-shovel plow or harrow was formerly; and the binder and header have taken the place of the cradle and reaper. The use of these modern machines enables one man to do the work of five using the older implements.

The sugar beet—an important product of the area—seems to do best on a comparatively heavy soil, and the Sioux fine sandy loam more nearly answers the requirements of this crop than any of the other soils of the area. The beet requires a deep seed bed, and to secure the best results the field should be broken to a depth of 15

inches. Planting should be done as early in the spring as possible, and usually takes place in April or May. The seed is sowed in rows about 18 inches apart, and the plants are thinned to stand 8 inches apart in the row. The distance between rows allows the use of horse cultivators. The beets are thinned as soon as they show four leaves. Cultivation is begun when the seedlings mark the rows, and is continued as late as practicable. The ground is stirred to a depth of 3 or 4 inches, and upon thorough cultivation depends, to a large extent, the yield and quality of the crop. Harvesting of the crops should be postponed to as late a date as possible, in order to increase the sugar content and to avoid the trouble and expense of preserving the crop for the manufacturer. In gathering the crop the beets are first loosened by a plow made especially for the purpose, and then pulled out by hand. They are next topped with a large knife and placed in piles, with the leaves thrown over them as a protection against sun or frost until they can be delivered to the factory.

As a rule the farmers do not use the subsoil plow in preparing the fields for grain crops, but many of them practice summer fallowing. The weeds that follow the wheat are thought to be a sufficient fertilizer for the following crop. The best farmers, however, put a thin coating of barnyard manure over their wheat land, and obtain excellent results. This not only stimulates growth, but serves as a protection against frosts during the winter months.

Most of the wheat and rye is sown in the fall, while practically all the oats is sown in the spring. In order to get the wheat in early and to avoid unnecessary labor, many farmers use the one-horse wheat drill, which enables them to sow their wheat between the rows of corn before the latter is harvested. In the spring a heavy roller or drag is drawn over the field to break down the cornstalks, so that they may be out of the way of the reaper.

In growing corn, level cultivation is usually practiced, and the experience of the farmers in this area tends to recommend it for land that is well drained. On wet lands the ridge method is preferred, as it allows the excess of water to drain away from the plants, providing freer aeration of the roots and preventing the baking of the soil.

The usual rotation of crops followed in this area is wheat, corn, and oats. Rye is sometimes substituted for wheat. Some farmers use a four-year rotation, adding corn after oats. In growing beets a two-year rotation is practiced, some grain crop being grown every other year. Buckwheat is especially recommended for this purpose, and millet is often used. While these rotations are generally followed, many of the best farmers produce wheat or corn for three years in succession on the same field. Corn for two years is even more frequently the plan, but oats are rarely grown for more than one year on the same ground. The sugar beet requires relatively large sup-

plies of the different mineral plant foods, especially potash and phosphate, and for this reason should not be grown on the same land oftener than once in two years. The use of well-rotted barnyard manure is recommended for this crop.

AGRICULTURAL CONDITIONS.

The Grand Island area has rich, productive, and easily tilled soils, and an abundant water supply. The farming class throughout this area are in a prosperous condition. The improvements on the better class of farms consist of a comfortable one or two-story dwelling house, neatly painted; a large barn, usually painted red, with room for stabling the work stock and storing hay for immediate use, and several smaller buildings and sheds for the protection of cattle and farm machinery and the housing of grain. On the smaller farms the houses are not so large, and occasionally in the hill or bluff portion of the area there is seen an adobe house built of the Marshall silt loam. Windmills are found on nearly every farm. The fences in the area are for the most part made of three strands of barbed wire.

In 1893 and 1894 the farms were burdened with mortgages as the result of the severe drought of 1893. Since that time, however, there has been sufficient rainfall, and the farmers have raised good crops, decreasing their indebtedness until at present they are practically free from debt. They are improving their surroundings, buying improved farm machinery, and increasing and improving their stock.

The greater part of the land in this area is owned and cultivated by the farmers. The average farmer keeps from three to eight horses for farm work. He usually hires one laborer, and by the use of improved labor-saving machinery he can cultivate a large acreage. The tenant system is practiced to some extent. A cash rental of from \$2 to \$5 an acre is usually charged. On a share basis from one-third to two-thirds of the crops are given for the use of the land, the higher proportion being paid where the landlord furnishes the land, buildings, stock, feed, and farm implements, and keeps the place in repair. In a few cases the tenant gets one-half of the crop under this arrangement.

At the present time the farms in the Grand Island area vary considerably in size. There are some 40-acre farms, some of 80 acres, many of 160 acres, some of 320 acres, occasionally one of 640 acres, and a few ranches, the largest of which covers 9,200 acres, 1,200 being planted to alfalfa. The average size of the farms of this area, however, is 160 acres, although frequently one person owns more than one tract.

One serious drawback to farming operations in this area, is the scarcity of labor. White labor is the only kind that can be secured. It is quite efficient and commands a high price. A farm hand receives from \$25 to \$30 a month the year round, with board and lodging,

while day labor, hired during the busiest season, can not be had for less than from \$1.50 to \$2.50 a day and subsistence. Children large enough to pull weeds out of the sugar-beet rows can earn from 50 cents to \$1 a day. The scarcity of labor is one of the chief reasons why the sugar-beet industry has not flourished to a greater extent. Large heaps of valuable barnyard manure lie about in the yards because the farmers can not secure labor at a reasonable price to have it hauled to the field. The scarcity of labor has been one of the important reasons for the adoption of modern labor-saving machinery of all kinds.

In an area with so little variety in topography, and so few soil types, it is natural to expect little diversity in crops or agricultural methods. The principal products of the area are corn, wheat, oats, alfalfa, and sugar beets, while the secondary crops are, barley, millet, sorghum, timothy and clover, garden vegetables, sweet and Irish potatoes, and pumpkins. Wild grass is also an important crop in the lowlands. Corn, wheat, and oats are the staple grain products, and are raised on every soil in the area except the Meadow. Alfalfa and an excellent quality of native grass constitute the hay crops of the area. Alfalfa does well on the Marshall silt loam and the Sioux fine sandy loam, and gives ordinary yields on the other soil types. It thrives best in a mealy, sandy loam with a light subsoil, and reaches its highest development where there are ample supplies of lime, potash, and magnesia. The Marshall silt loam contains considerable quantities of lime, and hence supplies the main element of plant food needed by this plant. The wild grass which is cut from the Meadow land in large quantities, and also from the low-lying areas of the Sioux fine sandy loam, makes an excellent hay, which sells for a good price. Sugar beets are raised on every soil in the area, but the greater part of the crop is grown upon the Sioux fine sandy loam, on account of its position near the beet factory. The Marshall silt loam is reported by many to be a better soil for beets than the Sioux fine sandy loam, but its distance from the factory prevents its being used for this crop to any great extent. The value of the beet crop is of course small as compared with the income from the grain and cattle industries.

The raising and fattening of cattle is the main source of revenue in this area. Nearly every farmer keeps some beef cattle, which he pastures during the summer and fattens for market in the fall. Some hogs are also raised here. Grain is very cheap in this area, and it is considered more profitable to feed part of it and of the hay to cattle than to ship these products in their more bulky form. A number of men make a practice of buying sheep from the western part of the State, or from Colorado and Wyoming, feeding them during the fall and early winter, and then shipping them to the large markets. This is

said to be a paying business, besides offering a market for some of the grain. Milch cows are kept on every good farm and the surplus milk is run through a separator and the cream taken to the creamery. Dairying is not carried on so extensively as it was at one time, from the fact that most of the farmers who have been in the country any length of time have become so prosperous that they have turned to easier ways of making money.

The transportation facilities of the area are good. The main line of the Union Pacific Railroad passes through the area in a northeast and southwest direction, and a branch of this road extends northward from Grand Island. The Burlington and Missouri River Railroad crosses the northern and eastern sections of the area surveyed, while the St. Joseph and Grand Island Railroad enters the area from the south and terminates at Grand Island. There is no point in the area more than 8 or 10 miles from a railway station, and numerous sidings have been put in between stations for the convenience of shippers. The farmers complain of high freight rates.

Good dirt roads are found along every section line, running north and south and east and west, and dividing the country into a huge checkerboard with sections a mile square. These roads are in good condition the greater part of the year. Some wet and boggy places are seen, which could be easily removed by proper road construction. There are three bridges across the Platte River in this area, and bridges across other streams are found at nearly every section line. The rural free delivery of mail is in operation in all parts of the area, and is a great convenience to the farmers.

The Grand Island area has no large cities, Grand Island, with a population of about 8,000, being the largest; hence the local markets for its produce are limited. There is a creamery at Grand Island which handles most of the cream produced in the area, while the sugar factory located there uses the beets grown in the area. Shelton, Wood River, and Doniphan consume part of the produce. All the towns in the area have grain elevators situated near the railroad station, which greatly facilitate the shipment of grain. South Omaha, Omaha, Chicago, and St. Joseph are the chief markets for the cattle of the area.

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