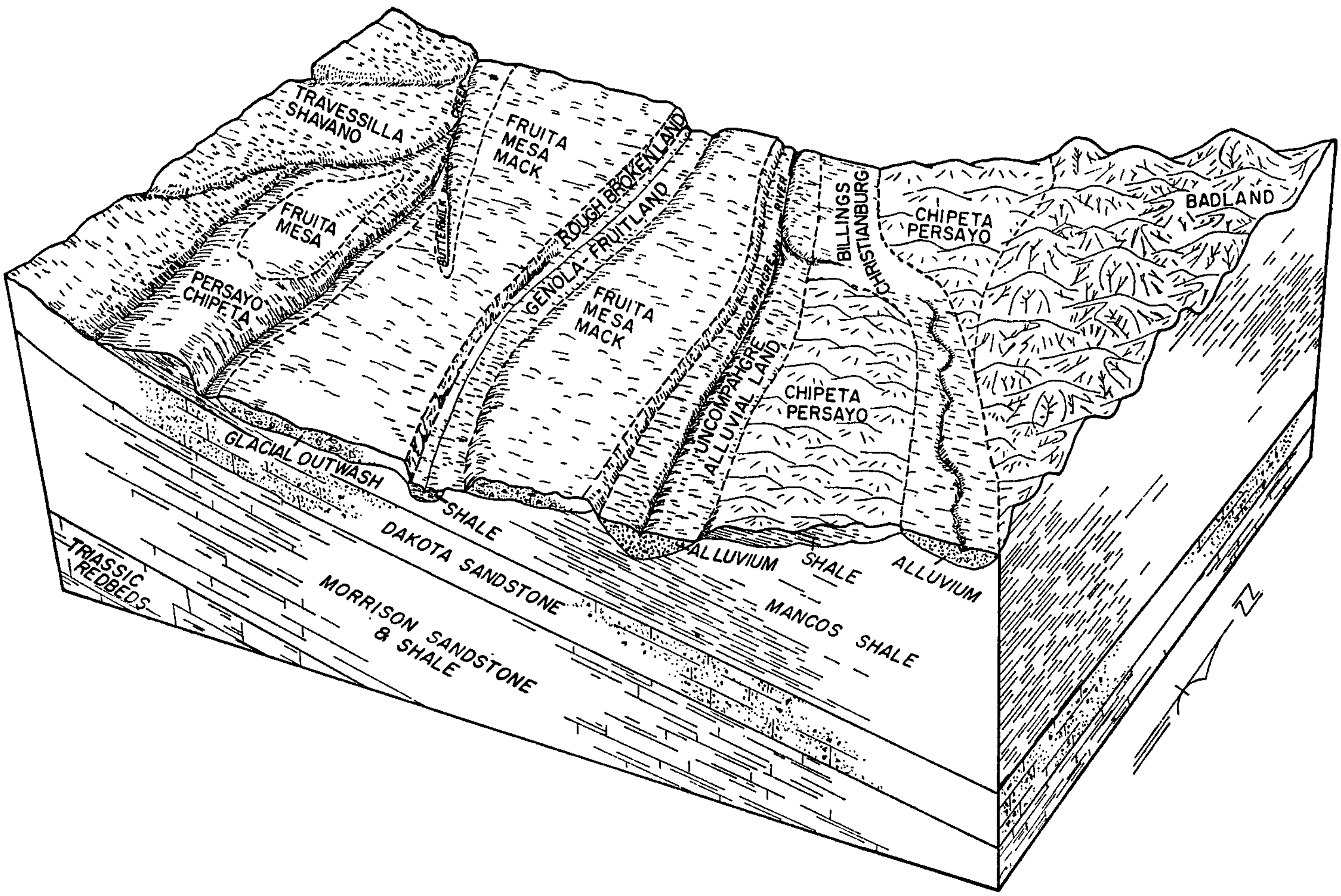
SOIL SURVEY

DELTA-MONTROSE AREA Colorado



UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
COLORADO AGRICULTURAL EXPERIMENT STATION

Issued July 1967

Major fieldwork for this soil survey was done in the period 1942–49. Soil names and descriptions were approved in 1965. Unless otherwise indicated, statements in the publication refer to conditions in the survey Area in 1965. This survey was made cooperatively by the Soil Conservation Service and the Colorado Agricultural Experiment Station; it is part of the technical assistance furnished to the Shavano, Uncompahgre, Cimarron, and Delta Soil Conservation Districts.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY of the Delta-Montrose Area, Colo., contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, or other structures; and in appraising the value of tracts of land for agriculture, industry, or recreation.

Locating Soils

All the soils of the Delta-Montrose Area are shown on the detailed map at the back of this report. This map consists of many sheets that are made from aerial photographs. Each sheet is numbered to correspond with numbers shown on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbol. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information in the report. This guide lists all of the soils of the Area in alphabetic order by map symbol. It shows the page where each kind of soil is described and also the page for the capability unit in which the soil has been placed.

Individual colored maps showing the relative suitability or limitations of soils for many specific purposes can be developed by using the soil map and information in the text. Interpretations not included in the text can be developed by grouping the soils according to their suitability or limitations for a particular use. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about the soils in the section "Descriptions of the Soils" and then turn to the section "Use and Management of the Soils." In this way, they first identify the soils on their farm and then learn how these soils can be managed and what yields can be expected. The "Guide to Mapping Units" at the back of the report will simplify use of the map and report. This guide lists each soil and land type mapped in the Area and the page where each is described. It also lists, for each soil and land type, the capability units for irrigated and nonirrigated soils and the page where each of these is described.

Engineers will want to refer to the section "Engineering Uses of Soils." Tables in that section show characteristics of the soils that affect engineering.

Persons interested in science will find information about how the soils were formed and how they were classified in the section "Genesis, Morphology and Classification of Soils."

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

Newcomers in the Delta-Montrose Area will be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the Area."

Cover picture: Schematic drawing that shows the relationship of some soils in the Area to each other and to the topography.

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EXPLANATION

Series Year and Series Number

Series year and number were dropped from all soil surveys sent to the printer after December 31, 1965. Many surveys, however, were then at such advanced stage of printing that it was not feasible to remove series year and number. Consequently, the last issues bearing series year and number will be as follows:

Series 1957, No. 23, Las Vegas and Eldorado Valleys Area, Nev.
Series 1958, No. 34, Grand Traverse County, Mich.
Series 1959, No. 42, Judith Basin Area, Mont.
Series 1960, No. 31, Elbert County, Colo. (Eastern Part)
Series 1961, No. 42, Camden County, N.J.
Series 1962, No. 13, Chicot County, Ark.
Series 1963, No. 1, Tippah County, Miss.

Series numbers will be consecutive in each series year, up to and including the numbers shown in the foregoing list. The soil survey for Tippah County, Miss., will be the last to have a series year and series number.

SOIL SURVEY OF DELTA-MONTROSE AREA, COLORADO

REPORT BY A. J. CLINE, CLAYTON SPEARS, FORREST MEHAFFEY, EDWIN KUBIN, RICHARD FRANKLIN, AND CARL PACHEK, SOIL CONSERVATION SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE COLORADO AGRICULTURAL EXPERIMENT STATION

THE DELTA-MONTROSE AREA extends from the south-central part of Delta County southward through Montrose County and into Ouray County (fig. 1). It is irregularly shaped and is about 34 miles long and about 15 miles wide. It covers some 254,990 acres. Delta is the county seat of Delta County, and Montrose of Montrose County.

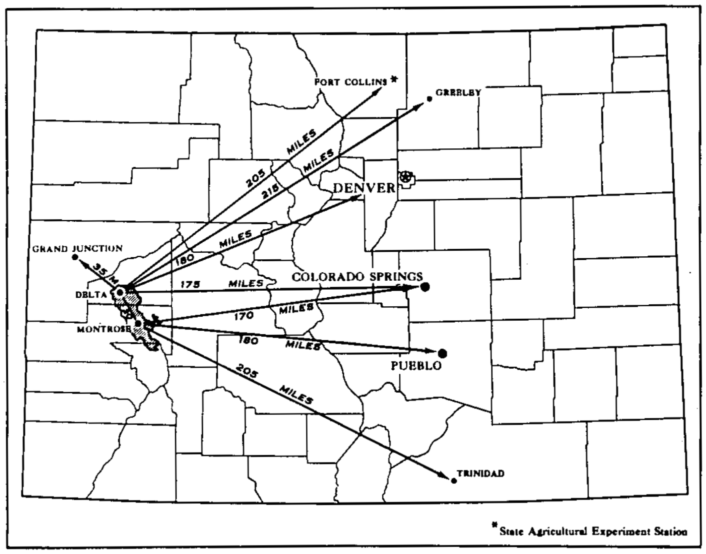

Figure 1.—**Location of the Delta-Montrose Area in Colorado.**

This Area is mainly irrigated. Only small parts are in range and woodland. The principal crops are sugar beets, alfalfa, corn, small grain, and pinto beans, but potatoes, onions, sorghums, and truck crops are grown also. Cattle raising and sheep raising are profitable enterprises.

How This Soil Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in the Delta-Montrose Area, where they are located, and how they can be used.

They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. To use this report efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, the major horizons of all the soils of one series are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Billings and Fruitland, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the natural, undisturbed landscape. Soils of one series can differ somewhat in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man.

Many soil series contain soils that differ in texture of their surface layer. According to such differences in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Fruitland fine sandy loam and Fruitland sandy clay loam are two soil types in the Fruitland series. The difference in texture of their surface layers is apparent from their names.

Some types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into phases. The name of a soil phase indicates a feature that affects management. For example, Fruitland sandy clay loam, 0 to 2 percent slopes, is one of several phases of Fruitland sandy clay loam, a soil type that has a slope range of 0 to 5 percent.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this report was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientists have a problem of delineating areas where different kinds of soils are so intricately mixed or occur in individual areas of such small size that it is not practical to show them separately on the map. Therefore, they show this mixture of soils as one mapping unit and call it a soil complex. Ordinarily, a soil complex is named for the major kinds of soil in it, for example, Chipeta-Persayo complex, 5 to 10 percent slopes.

Another kind of mapping unit is the undifferentiated group, which consists of two or more soils that may occur together without regularity in pattern or relative proportion. The individual tracts of the component soils could be shown separately on the map, but the differences between the soils are so slight that the separation is not important for the objectives of the soil survey. An example is Luhon and Travessilla soils.

A third kind of mapping unit is the soil association. It is a large acreage that consists of two or more soils and is uniform in pattern and proportion of the dominant soils, though these soils may differ greatly. An example is Chipeta-Persayo-Mesa association, 2 to 10 percent slopes.

Also, on most soil maps, areas are shown that are so rocky, so shallow, or so frequently worked by wind and water that they scarcely can be called soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Gullied land or Badland, and are called land types rather than soils.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soils in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soils. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in a way that it is readily useful to different groups of readers, among them farmers, ranchers, managers of woodland, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in the soil survey reports.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, and then adjust them according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this report shows, in color, the soil associations in the Delta-Montrose Area. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in an area, who want to compare different parts of an area, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

The general soil map of this Area shows nine soil associations. Most of the associations are on flood plains and alluvial fans, but some are on terraces, mesas, valley side slopes, and foothills. The slopes range from nearly level to steep.

1. Mesa-Orchard association

Deep, nearly level and gently sloping, moderately fine textured soils on mesas, high terraces, and old alluvial fans

This soil association makes up large parts of the western two-thirds of the Area. The soils formed mainly in thick, gravelly deposits on ancient stream terraces or alluvial fans. Geologic erosion has worn away so much of the original landscape that the soils now occur on elevated benches or mesas and are as much as 100 feet above the stream channels. The tops of the mesas are gently sloping or undulating, and the drainage pattern is somewhat weak.

In addition to the dominant Mesa and Orchard soils, Hinman and Mack soils are included. Mesa soils are the most extensive. All of the soils in this association are brown to reddish brown and are underlain by strong accumulations of lime. They differ from one another in minor respects, such as degree of development, texture, and parent material, but all are well drained and friable. The texture ranges from fine sandy loam to clay loam. Orchard soils formed from basaltic material; the rest are of mixed origin.

In this association is some of the best irrigated farmland in the Area. The soils are naturally fertile, are low in salts, and if properly managed are not highly erodible. They are suited to alfalfa, sugar beets, corn (fig. 2), and small grain, and to apples and sour cherries. Frost and a short growing season make it risky to grow peaches, apricots, and sweet cherries. The soils have high water-holding capacity and are well suited to irrigation.

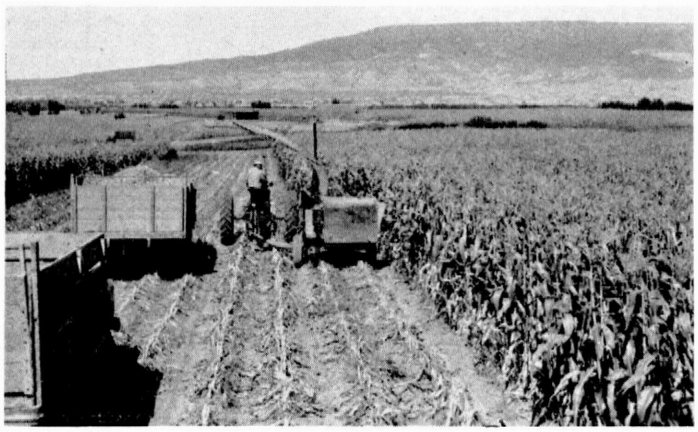

***Figure 2.*—Harvesting corn for silage on the Mesa-Orchard soil association.**

2. *Chacra-Menoken association*

Moderately deep, nearly level soils derived from shale on uplands

This association is in the eastern part of the valley of the Uncompahgre River, between the towns of Montrose and Olathe. The total acreage is fairly small. The association consists of light-colored soils that formed residually on calcareous Cretaceous shale and siltstone. It occurs on undulating and rolling uplands, which are believed to be the oldest and most stable landscape in the shale hills.

Chacra and Menoken soils are brown to yellowish-brown, moderately fine textured soils that normally are calcareous throughout and contain soluble salts, which are inherent in the parent materials. Chacra soils developed residually over shale. Menoken soils resemble Chacra soils but are immature. Included in the association are many small areas of the shallow Chipeta and Persayo soils and small bodies of Billings and Christianburg soils that border small stream channels. All these soils have high water-holding capacity, but they take in water slowly and release it slowly to plants.

Chacra and Menoken soils are only moderately productive. They are underlain by shale beds at a depth of less than 40 inches. These beds restrict free underdrainage, and consequently the soils become increasingly saline if they are irrigated. They are difficult to work but can be farmed if carefully managed. They are well suited to small grain.

3. *Bostwick-Cerro association*

Deep, gently sloping, moderately fine textured soils on alluvial fans and valley side slopes

This association is in the cooler parts at the eastern edge of the Area. It includes Bostwick Park, which is east of Montrose, and small areas north and south of Cedar Creek. These areas are about 1,000 feet higher than most of the Area.

Bostwick soils are the most extensive. These are well-drained, dark-colored soils that formed in micaceous parent material derived from gneiss and schist. Cerro soils, which are well-drained soils in rolling to steep areas, formed in glacial till and, in many places, are stony. Included in this association are Poudre soils, which are dark colored, medium textured, and poorly drained. They occur in swales adjacent to Bostwick soils. Also included are small areas of Blanyon soils, which occur with Bostwick and Poudre soils. Blanyon soils are fine-textured, well-drained soils on terraces. Doak soils occur with Cerro soils but are of minor extent.

The soils of this association are productive, but their use for crops is limited because of the climate. Small grain and hay are grown on the well-drained soils; hay and pasture are grown on the poorly drained soils. Cerro and Doak soils are of limited use because they are stony and steep (fig. 3). In some places they are nonarable unless the stones are removed.

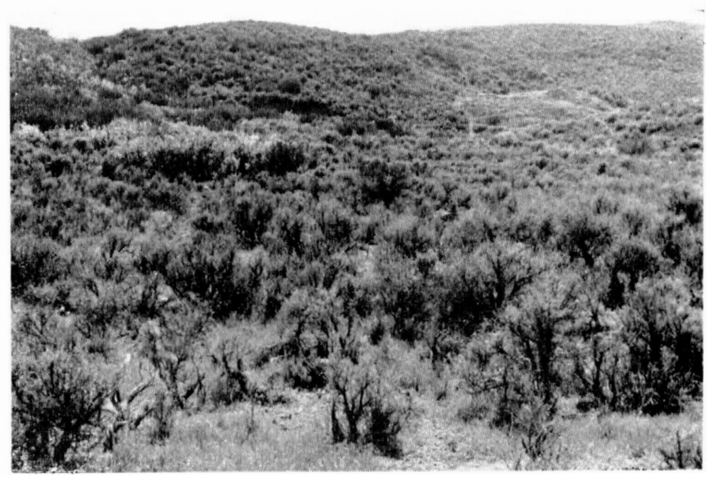

***Figure 3.*—A rough part of the Bostwick-Cerro soil association.**

4. *Colona-Salt Lake association*

Deep, nearly level and gently sloping, fine-textured, moderately well drained to poorly drained soils on flood plains

This association is mainly on the terraces of the Uncompahgre River south of the town of Montrose. A small part is southwest of the town of Delta.

Colona soils are moderately well drained clays that have a concentration of lime in the substratum. Salt Lake soils are poorly drained, calcareous alluvial clays. They have a concentration of lime in the lower part and have the prominent mottling that is evidence of poor drainage. Both soils have slow permeability and slow subsoil drainage (fig. 4).

Colona soils are moderately productive and are used mainly as irrigated cropland. They are well suited to hay crops. Careful management of irrigation is needed to prevent the accumulation of salts. Undrained Salt Lake soils are relatively unproductive, but drained areas are similar to Colona soils in suitability and in management needs. Both soils are difficult to work.

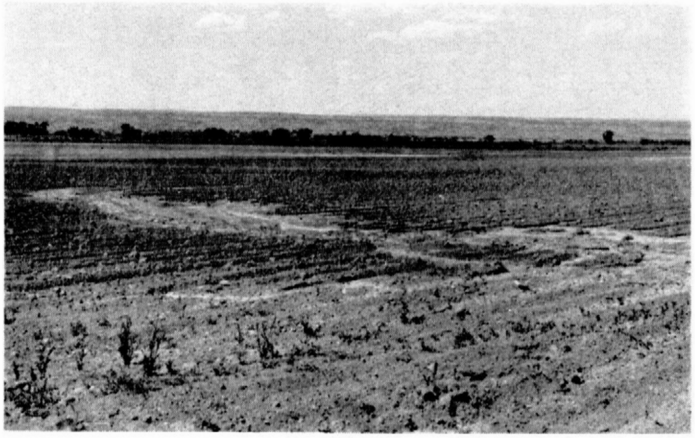

Figure 4.—**Water has broken across the furrows on this sloping part of the Colona-Salt Lake soil association.**

5. Genola-Fruitland association

Deep, nearly level and very gently sloping, medium-textured and moderately coarse textured soils on alluvial fans

This association occurs west of the Uncompahgre River. It consists of alluvial soils derived from sedimentary rock. The soils are principally very gently sloping. Small areas are on moderately steep valley side slopes.

Genola soils are grayish-brown, calcareous alluvial soils. They are medium textured and well drained. Fruitland soils are similar to Genola soils but are moderately coarse textured. Both soils have a brown to reddish-brown subsoil. Included in the association is a moderate acreage of Woodrow soils, which resemble Genola and Fruitland soils but are moderately fine textured. Also included are a few small areas of poorly drained, highly saline soils that are not suited to cultivation.

This association consists mainly of productive soils and is mostly cultivated. If the soils are irrigated, they are well suited to most crops common to the Area. They hold moisture well and are not highly susceptible to erosion (fig. 5).

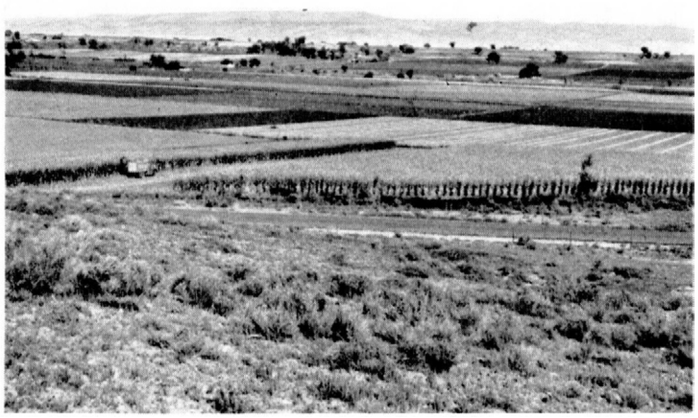

Figure 5.—**Part of the Genola-Fruitland soil association. Shavano soils are in the foreground.**

6. Uncompahgre association

Deep, nearly level, medium-textured, somewhat poorly drained soils on flood plains and low terraces.

This association is on the flood plains of the Uncompahgre River and the Gunnison River. It consists of nearly level alluvial soils that formed in stratified alluvium of mixed origin.

Uncompahgre soils are dark-colored, calcareous soils that are stratified with sandy material and have rust-colored mottles in the subsoil. Included in this association are small areas of Billings, Christianburg, Ravola, and Genola soils and poorly drained, highly saline soils. Also included are undifferentiated soils that formed in recent alluvium and are extremely variable in texture, color, and drainage.

The soils in this association are moderately productive, but they have a fluctuating water table that interferes somewhat with crop growth. In addition, they are occasionally flooded and receive deposits of silt from the floodwaters (fig. 6). Irrigated areas are used for small grain, row crops, and hay crops. Uncultivated areas support a good cover of native grass, willow, and cottonwood.

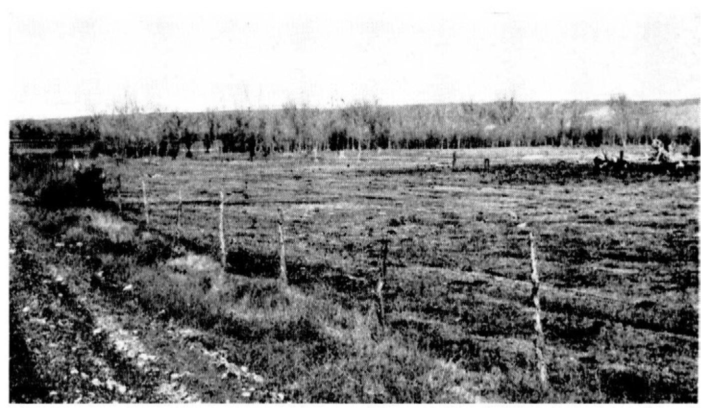

Figure 6.—**An undeveloped part of the Uncompahgre soil association. These soils generally require drainage before satisfactory yields can be obtained.**

7. Billings-Christianburg association

Deep, nearly level and gently sloping, fine textured and moderately fine textured soils on alluvial fans, flood plains, and terraces

This association occurs along the Gunnison River and east of the Uncompahgre River. It consists of alluvial soils that formed in material weathered from calcareous, saline, olive or gray shale. These soils, which are nearly level and gently sloping, occur principally on alluvial fans and valley side slopes. They are, for the most part, in the drier parts of the Area. Their native vegetation is a sparse cover of greasewood, saltbush, and some saltgrass.

Billings and Christianburg soils are dominant (fig. 7). Billings soils are well-drained, moderately fine textured, calcareous alluvial soils that are moderately saline. Christianburg soils are similar to Billings soils but are fine textured. Included in this association are small acreages of Ravola soils, which formed from the same kind of olive or gray shale but are medium textured. Also included are small areas of shallow Chipeta and Persayo soils, also derived from shale. All the soils of this association are subject to severe sheet erosion, gully erosion, and piping.

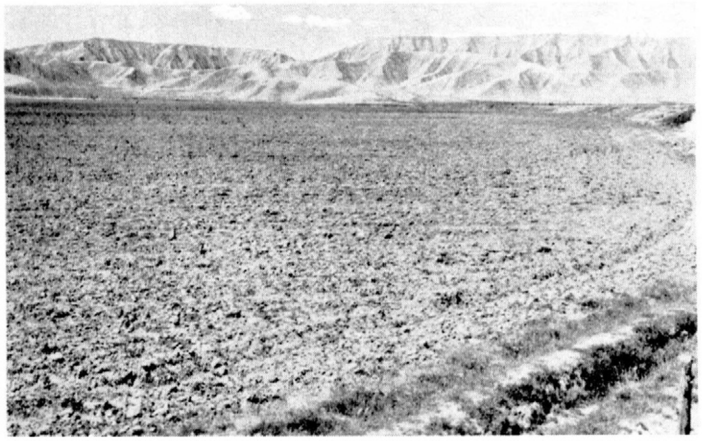

Figure 7.—A part of the Billings-Christianburg soil association. Barren shale hills and Badland are in background.

Billings and Ravola soils are productive and are suited to most of the crops grown in the Area. Christianburg soils, which are heavy clays, are difficult to work and are better suited to hay crops than to cultivated crops. If these soils are irrigated, careful management is required to prevent the accumulation of salts, which would limit the choice of crops. Removing the salts is very difficult because water moves slowly through these soils.

8. *Chipeta-Persayo association*

Shallow, nearly level, gently sloping and hilly, fine textured and moderately fine textured soils derived from shale

This association occurs mainly east of the Uncompahgre River. The topography is undulating to hilly and is highly dissected. Most areas are desertlike and have scanty vegetation. Exposures of shale are common in the hilly part. Such areas are practically devoid of vegetation. The soils are calcareous. They formed in material weathered from yellow or gray clay shale.

Chipeta and Persayo soils are underlain by shale beds at a depth of less than 18 inches. On the steeper slopes, the shale is either just a few inches below the surface or is exposed. Erosion is severe because of the nature of the soils and the lack of adequate ground cover. Dissection of the steeper slopes is common, and deep gullies occur throughout much of the association. Included in this association are small areas of Billings and Christianburg soils along the drainageways and areas of Badland and Rough broken land, shale and till materials.

These soils are unproductive and generally are better suited to native range than to crops. Some of the undulating slopes are used with some success for the production of shallow-rooted crops, such as onions. Drainage, preventing salt accumulations, and maintaining fertility are major problems if these soils are irrigated.

9. *Rock outcrop-Travessilla association*

Bare rock outcrop and shallow, rolling to steep, moderately coarse textured soils on hills, ridges, and sides of mesas

This association occurs along the margins of the Area. Normally, it is higher than the other soil associations and receives more precipitation. The soils are shallow over sandstone or glacial till and ordinarily are rolling to steep (fig. 8). The vegetation in the lower parts consists of native grass, and that in the higher parts, of pinyon, juniper, and oakbrush.

The Travessilla soils are shallow over sandstone and normally have many rocks and stones on the surface. On the eastern edge of the Area are Rock outcrop and Cerro soils, which formed from glacial till and have stones in the profile and on the surface. Also in the association are small areas of Shavano, Luhon, Chipeta, and Persayo soils. Shavano soils are immature, are 18 to 40 inches thick over sandstone, and are undulating or rolling. Luhon soils, which formed from calcareous alluvial material, are deep and highly calcareous. Chipeta and Persayo soils, which formed from clay shale, are very shallow.

This association generally is better suited to native range than to crops, but a few areas of Luhon and Shavano soils on smoother slopes can be cultivated. Small grain and hay are the most suitable crops.

Figure 8.—An area of the Rock outcrop-Travessilla soil association. The trees in the background are pinyon and juniper.

Descriptions of the Soils

In this section the soil series and land types are discussed in alphabetic order, and a profile typical of each series is given. Following the description of each series, each mapping unit in the series is described and any differences from the typical profile are pointed out.

Following the name of each mapping unit is the symbol that identifies the soil or land type on the detailed map at the back of the report. At the end of each description, the capability classification of the mapping unit is shown. The page on which each mapping unit and each capability unit is described is listed in the "Guide to Mapping Units" near the back of the report. The approximate acreage and proportionate extent of each mapping unit are given in table 1.

Alluvial Land

Alluvial land (Al) is extremely variable in color, texture, depth, and drainage. The alluvium has been recently deposited on flood plains and, less extensively, on the

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

Soil	Area	Extent
	Acres	*Percent*
Alluvial land	3, 680	1. 4
Badland	20, 220	7. 9
Billings gravelly clay loam, 0 to 2 percent slopes	2, 560	1. 0
Billings gravelly clay loam, 2 to 5 percent slopes	280	. 1
Billings gravelly clay loam, 5 to 10 percent slopes	200	. 1
Billings silty clay, 0 to 2 percent slopes	6, 000	2. 3
Billings silty clay, 2 to 5 percent slopes	520	. 2
Billings silty clay, 5 to 10 percent slopes	360	. 1
Billings silty clay, loamy substratum, 0 to 2 percent slopes	1, 160	. 5
Billings silty clay, shale substratum, 0 to 2 percent slopes	1, 360	. 5
Billings silty clay, shale substratum, 2 to 5 percent slopes	320	. 1
Billings silty clay loam, 0 to 2 percent slopes	21, 320	8. 3
Billings silty clay loam, 2 to 5 percent slopes	3, 520	1. 4
Billings silty clay loam, 5 to 10 percent slopes	1, 400	. 5
Billings silty clay loam, gravel substratum, 0 to 2 percent slopes	1, 400	. 5
Billings silty clay loam, shale substratum, 0 to 2 percent slopes	4, 520	1. 8
Billings silty clay loam, shale substratum, 2 to 5 percent slopes	640	. 2
Blanyon silty clay loam, 2 to 5 percent slopes	200	. 1
Blanyon silty clay loam, moderately wet variant	80	([1])
Bostwick fine sandy loam, coarse subsoil variant, 5 to 10 percent slopes	80	([1])
Bostwick gravelly loam, 2 to 5 percent slopes	200	. 1
Bostwick loam, 0 to 2 percent slopes	280	. 1
Bostwick loam, 2 to 5 percent slopes	2, 080	. 8
Bostwick loam, 5 to 10 percent slopes	200	. 1
Bostwick stony loam, 2 to 5 percent slopes	200	. 1
Bostwick stony loam, 5 to 10 percent slopes	520	. 2
Bostwick stony loam, 10 to 30 percent slopes	1, 160	. 5
Cerro clay loam, 1 to 5 percent slopes	1, 160	. 5
Cerro clay loam, 5 to 10 percent slopes	520	. 2
Chipeta silty clay, 0 to 2 percent slopes	940	. 4
Chipeta silty clay, 2 to 5 percent slopes	4, 440	1. 7
Chipeta-Persayo complex, 5 to 10 percent slopes	2, 280	. 9
Chipeta-Persayo complex, 5 to 10 percent slopes, eroded	3, 360	1. 3
Chipeta-Persayo-Mesa association, 2 to 10 percent slopes	800	. 3
Chipeta-Persayo-Rance complex, 2 to 10 percent slopes	1, 640	. 6
Christianburg silty clay, 0 to 2 percent slopes	1, 640	. 6
Christianburg silty clay, 2 to 8 percent slopes	880	. 3
Colona clay, 0 to 2 percent slopes	1, 240	. 5
Colona clay, 2 to 8 percent slopes	1, 040	. 4
Colona clay, gravel substratum, 0 to 2 percent slopes	1, 160	. 5
Doak clay loam, 2 to 5 percent slopes	560	. 2
Doak stony clay loam, 2 to 10 percent slopes	120	([1])
Fruita loam, 0 to 2 percent slopes	240	. 1
Fruita clay loam, 5 to 10 percent slopes	120	([1])
Fruitland fine sandy loam, 0 to 2 percent slopes	1, 000	. 4
Fruitland fine sandy loam, 2 to 5 percent slopes	520	. 2
Fruitland sandy clay loam, 0 to 2 percent slopes	3, 120	1. 2
Fruitland sandy clay loam, 2 to 5 percent slopes	1, 000	. 4
Fruitland sandy clay loam, stony substratum, 0 to 2 percent slopes	440	. 2
Fruitland sandy clay loam, stony substratum, 2 to 5 percent slopes	160	([1])
Genola clay loam, 0 to 2 percent slopes	5, 520	2. 2
Genola clay loam, 2 to 5 percent slopes	1, 020	0. 4
Genola clay loam, saline, 0 to 2 percent slopes	120	([1])
Gullied land	4, 480	1. 8
Hinman clay loam, 0 to 2 percent slopes	2, 520	1. 0
Luhon clay loam, 2 to 5 percent slopes	280	. 1
Luhon clay loam, 5 to 10 percent slopes	240	. 1
Luhon gravelly clay loam, 5 to 10 percent slopes	160	([1])
Luhon stony clay loam, 5 to 10 percent slopes	400	. 2
Luhon and Travessilla soils	80	([1])
Mack clay loam, 0 to 2 percent slopes	1, 440	. 6
Mack clay loam, 2 to 5 percent slopes	480	. 2
Mack clay loam, 5 to 10 percent slopes	160	([1])
Mack gravelly clay loam, 0 to 2 percent slopes	400	. 2
Menoken-Chacra clay loams, 0 to 2 percent slopes	1, 000	. 4
Mesa clay loam, 0 to 2 percent slopes	24, 920	9. 8
Mesa clay loam, 2 to 5 percent slopes	2, 760	1. 0
Mesa clay loam, 5 to 10 percent slopes	360	. 1
Mesa gravelly clay loam, 0 to 2 percent slopes	2, 000	. 8
Mesa gravelly clay loam, 2 to 5 percent slopes	2, 680	1. 0
Mesa gravelly clay loam, 5 to 10 percent slopes	920	. 4
Mesa gravelly clay loam, shale substratum, 0 to 2 percent slopes	120	([1])
Mesa gravelly clay loam, shale substratum, 5 to 10 percent slopes	200	. 1
Mesa stony clay loam, 2 to 10 percent slopes	160	([1])
Orchard clay loam, 0 to 2 percent slopes	3, 880	1. 5
Orchard clay loam, 2 to 5 percent slopes	1, 280	. 5
Orchard gravelly clay loam, 0 to 2 percent slopes	400	. 2
Orchard gravelly clay loam, 2 to 5 percent slopes	160	([1])
Persayo silty clay loam, 0 to 2 percent slopes	4, 760	1. 9
Persayo silty clay loam, 2 to 5 percent slopes	9, 840	3. 9
Poudre loam	120	([1])
Rance complex, 0 to 2 percent slopes	200	. 1
Rance complex, 2 to 5 percent slopes	880	. 3
Rance complex, 5 to 10 percent slopes	200	. 1
Ravola clay loam	760	. 3
Rock outcrop and Rough broken land	3, 880	1. 5
Rock outcrop-Travessilla association, rolling	4, 640	1. 8
Rock outcrop-Travessilla association, steep	7, 040	2. 8
Rough broken land	11, 240	4. 4
Rough broken land, shale and till materials	16, 720	6. 6
Rough stony land, shale and till materials	2, 120	. 8
Rough stony land, till materials	1, 480	. 6
Saline wet land	6, 320	2. 5
Salt Lake clay, drained	480	. 2
Sandy land	90	([1])
Shavano sandy clay loam, 2 to 5 percent slopes	4, 040	1. 6
Shavano sandy clay loam, 5 to 10 percent slopes	1, 680	. 7
Travessilla fine sandy loam, 0 to 10 percent slopes	1, 600	. 6
Uncompahgre clay loam	1, 040	. 4
Uncompahgre clay loam, wet	240	. 1
Uncompahgre fine sandy loam	920	. 4
Uncompahgre gravelly loam	320	. 1
Uncompahgre loam	3, 280	1. 3
Uncompahgre loam, wet	2, 400	. 9
Vernal clay loam, 0 to 2 percent slopes	4, 320	1. 7
Vernal clay loam, 2 to 5 percent slopes	400	. 2
Vernal gravelly clay loam, 0 to 2 percent slopes	240	. 1
Vernal gravelly clay loam, 2 to 5 percent slopes	160	([1])
Wet alluvial land	960	. 4
Woodrow clay loam, 0 to 2 percent slopes	1, 320	. 5
Water	320	. 1
Total	254, 990	100. 0

[1] Less than 0.05 percent.

side slopes of the larger streams in this Area. The largest acreage is along the Uncompahgre River and the Gunnison River. Normally, the water table is high and limits use of the land. The erosion hazard varies. Gullies occur in a few places.

The native vegetation consists of willow, cottonwood, and grasses. The use of this land type as pasture or as hay meadow depends on the accessibility of the areas and the drainage. (Capability unit VIIw-1 nonirrigated)

Badland

Badland (Ba) consists of barren or nearly barren outcrops of gypsiferous and saline shale and some soil material. The shale is in various stages of weathering. The landscape is one of rolling hills separated by very narrow valleys or by gullies. In some of the valleys and drainageways are moderately deep soils like those of the Christianburg and Billings series. The slope range is 2 to 20 percent or more. This land type is extensive in the eastern part of the Area, east and south of the town of Olathe.

In some areas the parent shale contains an abnormally large amount of gypsum, and strata of light-gray or white gypsum or gypsiferous earth are a prominent part of the bedrock. Seepage and the movement of ground water have caused soluble salts to concentrate in low places and on sidehills where seepage water emerges.

Badland supports little vegetation and is of limited value, even as range. It is almost impermeable. Consequently, a large amount of water runs off after a normal rain, and flash floods follow heavy rains. Erosion is active. The silt carried away by runoff is a hazard to the surrounding soils and to those downstream. (Capability unit VIIIes-1 nonirrigated)

Billings Series

The soils of the Billings series are deep, well drained, and moderately fine textured or fine textured. They are grassland soils that formed on alluvial fans in sediments washed from adjacent exposures of gray and olive shale and siltstone. Soils of this series are extensive in the valleys of the Uncompahgre River and the Gunnison River, south and west of the town of Delta.

Billings soils have a grayish-brown, platy or granular surface layer 4 to 6 inches thick. They have a weakly developed, light yellowish-brown, calcareous subsoil that is massive or has weak, subangular blocky structure. The substratum, which begins 12 to 14 inches below the surface, is light yellowish-brown, calcareous silty clay loam or clay loam.

These soils are calcareous throughout. In some places and at variable depths, they have a weak accumulation of visible calcium carbonate or calcium sulfate. The structure of these soils is weak and unstable. The organic-matter content is low. Gullying and piping are common.

Typical profile of Billings silty clay loam, 490 feet south and 100 feet west of the center of sec. 21, T. 49 N., R. 9 W.:

A1—0 to 6 inches, silty clay loam; grayish brown (2.5Y 5/2) when dry, dark grayish brown (2.5Y 4/2) when moist; moderate, fine, granular structure; uppermost 1 inch weak platy and vesicular; slightly hard when dry, friable when moist; calcareous; pH 8.2; clear, smooth boundary.

C1—6 to 18 inches, silty clay loam; light yellowish brown (2.5Y 6/3) when dry, light olive brown (2.5Y 5/3) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; calcareous; pH 8.2; gradual boundary.

C2—18 to 60 inches, silty clay loam; light yellowish brown (2.5Y 6/3) when dry, olive brown (2.5Y 4/3) when moist; massive; hard when dry, friable when moist; calcareous; pH 8.2.

The depth to shale generally is more than 60 inches, but locally it is between 30 and 60 inches. Areas where shale is at a depth of less than 60 inches were mapped as shale substratum phases. Stratification and accumulations of calcium carbonate, where present, are weak. Areas adjacent to old terraces have a cover of gravel and cobblestones or have some gravel and cobblestones throughout the profile. As a result of irrigation or seepage, some areas are moderately saline. In these areas an efflorescence of salts is common on the surface when the soil is dry.

In many places Billings soils adjoin Woodrow, Genola, and Ravola soils. Billings soils have more olive and yellowish hues than Woodrow soils. They are more olive in color and finer in texture than Genola soils. Billings soils resemble Ravola soils in color but are finer textured.

The principal grasses are alkali sacaton, galleta, saltgrass, Indian ricegrass, and western wheatgrass. Fourwing saltbush, sagebrush, and rabbitbrush are characteristic brushy plants, but these have been replaced to a large degree by greasewood and cheatgrass. Billings soils are moderately productive if irrigated. If they are properly managed, they are suited to alfalfa, corn, sugar beets (fig. 9), and small grain. A few areas are used for orchards.

Figure 9.—Irrigating sugar beets on Billings silty clay.

Billings gravelly clay loam, 0 to 2 percent slopes (BcA).—This soil normally occurs at the upper end of alluvial fans and is adjacent to escarpments capped by sandy and gravelly deposits. It has a profile similar to the one described as typical of the Billings series, but the surface layer is browner, and a thin mantle of gravel and cobblestones that washed from the escarpments covers the surface. The largest acreage is along the eastern boundary of the Area, east of the town of Delta.

This soil is used mainly as range. Tillage is difficult unless the larger stones are removed. The vegetation consists of greasewood and annual weeds. (Capability unit VIs–1 nonirrigated; IIs–1 irrigated)

Billings gravelly clay loam, 2 to 5 percent slopes (BcB).—This soil occurs at the upper end of alluvial fans and is adjacent to escarpments capped by gravelly and sandy material. It has a profile similar to the one described as typical of the Billings series, but its surface layer is browner, and a thin mantle of gravel and cobblestones washed from the escarpments covers the surface. The surface layer is 15 to 50 percent gravel and cobblestones. This soil is mostly in the valleys of the Uncompahgre River and its tributaries, west and north of the town of Montrose.

This soil is used mainly as native range. Tillage and the use of farm machinery are difficult unless the larger stones are removed. (Capability unit VIs–1 nonirrigated; IIIe–2 irrigated)

Billings gravelly clay loam, 5 to 10 percent slopes (BcC).—This soil occurs at the upper end of alluvial fans and is adjacent to escarpments capped by gravelly and sandy material. It has a profile similar to the one described as typical of the Billings series, but its surface layer is browner, and a thin mantle of gravel and cobblestones washed from the escarpments covers the surface. The surface layer is 15 to 50 percent gravel and cobblestones. This soil is mostly in the valleys along the Uncompahgre River and its tributaries, west and south of the town of Montrose.

This soil is used mainly as native range. The slope is unfavorable for irrigation, and the cobblestones and gravel make tillage and the use of farm machinery difficult. Normally, this soil supports a good cover of native short grasses, sagebrush, and cactus. (Capability unit VIIe–2 nonirrigated; IVe–2 irrigated)

Billings silty clay, 0 to 2 percent slopes (BdA).—This soil occurs at the lower end of gently sloping alluvial fans. It has a profile similar to the one described as typical of the Billings series, but the surface layer is finer textured and is 6 to 10 inches thick. This soil occurs throughout most of the Area.

This soil is used as native range and as irrigated cropland. If irrigated, it is more difficult to till than the Billings silty clay loams. It has a slower rate of water intake and is susceptible to ponding. Because of the slower intake rate and somewhat poorer surface drainage, this soil is more likely to become saline than the silty clay loams. It is erodible, and piping is common. (Capability unit VIs–1 nonirrigated; IIIs–1 irrigated)

Billings silty clay, 2 to 5 percent slopes (BdB).—This soil occurs at the lower end of moderately sloping alluvial fans. It has a profile similar to the one described as typical of the Billings series but has a mantle of fine-textured material 6 to 12 inches thick. It occurs mostly in the southern half of the Area.

This soil is used mainly as native range. It is irrigated in places. If irrigated, it is more difficult to till than the Billings silty clay loams. It can be tilled within a narrower range of moisture content, has a slower rate of water intake, and tends to have poorer surface drainage. Because of the slower intake rate and poorer surface drainage, it is more likely to become saline than the silty clay loams. It is erodible, and piping is common. (Capability unit VIs–1 nonirrigated; IVe–1 irrigated)

Billings silty clay, 5 to 10 percent slopes (BdC).—This soil occurs on the steeper parts of alluvial fans. It has a profile similar to the one described as typical of the Billings series but has a 6- to 10-inch mantle of fine-textured material. It occurs mainly in the southern part of the Area.

This soil is used mainly as native range, but it produces only a scanty cover of salt-tolerant grasses and shrubs. Because of the slope, the erosion hazard is severe. Gully erosion and sheet erosion are active in cultivated areas. (Capability unit VIIe–2 nonirrigated; IVe–2 irrigated)

Billings silty clay, loamy substratum, 0 to 2 percent slopes (BeA).—This soil generally occurs at the lower end of alluvial fans that merge with the alluvial terraces along the Uncompahgre River. It has a profile similar to the one described as typical of the Billings series, but the substratum is loam or silt loam at a depth of 30 to 48 inches. In some places gravel occurs in the substratum.

This soil is used as range and as irrigated cropland. The substratum is more friable and permeable than that of the Billings silty clay loams, but the clayey surface layer, 6 to 12 inches thick, slows infiltration and makes tillage difficult at some degrees of moisture content. (Capability unit VIs–1 nonirrigated; IIIs–1 irrigated)

Billings silty clay, shale substratum, 0 to 2 percent slopes (BfA).—This soil occurs on the parts of alluvial fans where the shale substratum is close to the surface. It has a profile similar to the one described as typical of the Billings series but is underlain by shale bedrock at a depth of 30 to 48 inches. This soil occurs mainly in the eastern third of the Area, east of the towns of Olathe and Delta.

This soil is used mainly as native range. The shale substratum restricts free underdrainage; as a result, salinity is more severe than in the Billings silty clay loams. (Capability unit VIs–1 nonirrigated; IVs–2 irrigated)

Billings silty clay, shale substratum, 2 to 5 percent slopes (BfB).—This soil occurs on the parts of alluvial fans where shale bedrock is close to the surface. It has a profile similar to the one described as typical of the Billings series but is underlain by shale bedrock at a depth of 30 to 48 inches. This soil occurs principally in the eastern third of the Area, east of the towns of Olathe and Delta.

This soil is used mainly as native range. The shale substratum restricts free underdrainage; as a result, salinity is more severe than in the Billings silty clay loams. Erosion is a severe hazard, but piping is not a hazard. (Capability unit VIs–1 nonirrigated; IVe–1 irrigated)

Billings silty clay loam, 0 to 2 percent slopes (BgA).—This soil occurs at the lower end of nearly level alluvial fans. It has a profile similar to the one described as typical of the Billings series. Included in mapping were a few areas that have a surface layer of loam or silt loam.

This soil can be irrigated successfully. Because of its position on the landscape, it is likely to be more saline than the other Billings silty clay loams. Sheet erosion is not a serious hazard, but piping is. (Capability unit VIs–1 nonirrigated; IIs–1 irrigated)

Billings silty clay loam, 2 to 5 percent slopes (BgB).—This soil occurs on the central and upper parts of alluvial fans. It has a profile similar to the one described as typical of the Billings series.

This soil can be irrigated, but it is less well suited to irrigation than the more nearly level Billings soils. In many places it is severely gullied, and piping is common. (Capability unit VIs–1 nonirrigated; IIIe–2 irrigated)

Billings silty clay loam, 5 to 10 percent slopes (BgC).—This soil normally is at the upper edge of alluvial fans and along small streams. It has a profile similar to the one described as typical of the Billings series.

This soil is used primarily as native range. It is not used extensively for crops, because of the slope, severe erosion hazard, and the slow penetration of moisture. It is susceptible to severe erosion and is gullied in many places. (Capability unit VIIe–2 nonirrigated; IVe–2 irrigated)

Billings silty clay loam, gravel substratum, 0 to 2 percent slopes (BhA).—This soil occurs at the outer edge of alluvial fans. It has a profile similar to the one described as typical of the Billings series, but it overlies sand, gravel, and cobblestones at a depth of 20 to 48 inches. The largest acreage is along the western edge of the valley of the Uncompahgre River.

Included in mapping were small areas that have a substratum of very gravelly earth instead of coarse sand, gravel, and cobblestones. These inclusions have less rapid subsoil drainage than the rest of this mapping unit.

This is a moderately productive soil. It is used as range or as irrigated cropland. The coarse-textured substratum provides more rapid subsoil drainage than is typical of Billings silty clay loams. Piping is not a hazard. (Capability unit VIs–1 nonirrigated; IIs–1 irrigated)

Billings silty clay loam, shale substratum, 0 to 2 percent slopes (BkA).—This soil is on the parts of alluvial fans where shale beds lie close to the surface. It has a profile similar to the one described as typical of the Billings series but is underlain by shale beds at a depth of 20 to 50 inches. This soil occurs throughout the Area but is most extensive east of the Uncompahgre River and north of the town of Montrose.

This soil is used as range or as irrigated cropland. It is less well suited to deep-rooted crops and orchard fruits than the deeper Billings soils. The shale beds restrict subsoil drainage, and unless this soil is carefully managed, moderate salinity is likely to develop. Piping generally is not a hazard. (Capability unit VIs–1 nonirrigated; IVs–2 irrigated)

Billings silty clay loam, shale substratum, 2 to 5 percent slopes (BkB).—This soil is on the parts of alluvial fans where shale beds lie close to the surface. It has a profile similar to the one described as typical of the Billings series but is underlain by beds of shale at a depth of 20 to 50 inches. This soil occurs throughout the valleys of the Uncompahgre River and the Gunnison River and is most extensive east of the Uncompahgre River and north of the town of Montrose.

This soil is used principally as range, but some areas are irrigated. If irrigated, it becomes saline in many places as a result of restricted subsoil drainage. This soil requires careful management. It is susceptible to severe erosion, but piping generally is not a hazard. (Capability unit VIs–1 nonirrigated; IVe–1 irrigated)

Blanyon Series

The soils of the Blanyon series are deep, moderately fine textured, and strongly developed. They are grassland soils that occur at the bottom of small valleys or in concave drainageways. They formed in uniform, fine-textured, micaceous alluvium derived from gneiss, schist, glacial till, and sedimentary rock. Soils of this series occur as small areas in Bostwick Park, east of the town of Montrose.

Blanyon soils have a pinkish-gray to dark-brown, granular surface soil 5 to 6 inches thick. They have a brown or dark-brown subsoil of silty clay that has strong prismatic and angular blocky structure. The substratum, below a depth of 30 to 40 inches, is pinkish-gray or brown, calcareous silty clay in which calcium carbonate has accumulated. Bedrock normally occurs at a depth of 60 inches or more.

These soils are not distinctly mottled or gleyed, though they have moderately slow surface drainage and slow permeability. They are not highly susceptible to erosion. The organic-matter content is moderately high, and the structure is stable.

Typical profile of Blanyon silty clay loam, 900 feet north of the southwest corner of sec. 11, T. 49 N., R. 8 W.:

A1—0 to 6 inches, silty clay loam; pinkish gray (7.5YR 6/2) when dry, dark brown (7.5YR 4/2) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; noncalcareous; pH 7.2; gradual, smooth boundary.

B2t—6 to 30 inches, silty clay; brown (7.5YR 5/2) when dry, dark brown (7.5YR 4/2) when moist; moderate, coarse, prismatic structure breaking to strong, medium, angular blocky; very hard when dry, firm when moist; thin, continuous clay films; noncalcareous; pH 7.4; gradual, smooth boundary.

Cca—30 to 60 inches, silty clay; pinkish gray (7.5YR 6/2) when dry, brown (7.5YR 5/3) when moist; massive; extremely hard when dry, very plastic when wet; few concretions of calcium carbonate; calcareous; pH 8.2.

In a few areas these soils are more poorly drained than typical and have bright-colored mottles starting just below the surface layer. In places bluish gleyed horizons occur below the subsoil. Where these soils adjoin deposits of glacial till, they may have a thin mantle of gravel.

Blanyon soils are finer textured than Bostwick soils, which they adjoin, and have a lighter colored surface layer. They are noncalcareous to a greater depth than Colona soils and have a more strongly developed subsoil.

Western wheatgrass, slender wheatgrass, basin wildrye, and squirreltail are the principal grasses, but big sagebrush and rabbitbrush form a brushy cover in some areas. Sedges, rushes, and foxtail barley grow in depressions where moisture collects.

Blanyon silty clay loam, 2 to 5 percent slopes (BnB).—This soil generally is on the outer concave edge of small terraces along stream channels. It has a profile similar to the one described as typical of the Blanyon series. The main areas are in the northern part of Bostwick Park.

This soil is valuable as range or as native hay meadow. In a few places it is irrigated and is used for alfalfa, native hay, or small grain. (Capability unit VIe–2 nonirrigated; IIIe–3 irrigated)

Blanyon silty clay loam, moderately wet variant (Bp).—This soil is in concave areas or slight depressions on flood plains and in valleys along small streams. It has a profile similar to the one described as typical of the Blanyon series, but in the subsoil and substratum are many bright-colored mottles and spots caused by alternating wet and dry periods. In a few places a uniformly blue or gray coloration occurs below a depth of 3 or 4 feet. This soil is in the northern part of Bostwick Park. Slopes are less than 2 percent.

This soil is used as native range or as native hay meadow. It is somewhat poorly drained or poorly drained. The water table fluctuates from near the surface to a depth of 5 feet or more. Runoff is occasionally ponded. (Capability unit VIw–1 nonirrigated; IVw–1 irrigated)

Bostwick Series

The soils of the Bostwick series are deep, well drained, and moderately coarse textured or medium textured. They are grassland soils that formed in thick, uniform, medium-textured, calcareous deposits of alluvium derived chiefly from gneiss and schist. In places they have been modified by local eolian sediments. Soils of this series are moderately extensive on alluvial fans and valley side slopes in Bostwick Park.

Bostwick soils have a brown or dark-brown surface layer of friable granular loam or silt loam 4 to 8 inches thick. They have a brown or dark-brown subsoil of moderately well developed clay loam that has subangular blocky structure. The substratum, below a depth of 18 to 30 inches, is light-brown, calcareous loam or silt loam. Moderately large amounts of mica occur throughout the profile. Bedrock is generally at a depth of 60 inches or more.

These soils are not likely to erode if they are properly managed. The organic-matter content and the supply of plant nutrients are high, and the structure is stable.

Typical profile of Bostwick loam, 1,380 feet west and 250 feet north of the southeast corner of sec. 19, T. 49 N., R. 7 W. (Montrose County):

A1—0 to 4 inches, loam; brown (7.5YR 5/2) when dry, dark brown (7.5YR 3/2) when moist; moderate, fine, crumb structure; slightly hard when dry, very friable when moist; many mica flakes; neutral; pH 7.0; clear, smooth boundary.

B1—4 to 8 inches, light clay loam; brown (7.5YR 5/2) when dry, dark brown (7.5YR 3/2) when moist; moderate, medium, subangular blocky structure; hard when dry, very friable when moist; many mica flakes; noncalcareous; pH 7.2; clear, smooth boundary.

B2t—8 to 18 inches, clay loam; brown (7.5YR 5/3) when dry, brown or dark brown (7.5YR 4/3) when moist; weak, coarse, prismatic structure breaking to moderate, subangular blocky; hard when dry, friable when moist; thin, continuous clay films on aggregate faces; many mica flakes; noncalcareous; pH 7.2; clear, smooth boundary.

B3ca—18 to 27 inches, clay loam; light brown (7.5YR 6/3) when dry, brown (7.5YR 5/3) when moist; weak, subangular blocky structure; hard when dry, very friable when moist; thin, patchy clay films; many mica flakes; concretions and threads of calcium carbonate; calcareous; pH 8.0; gradual, smooth boundary.

Cca—27 to 60 inches, loam; light brown (7.5Y 6/4) when dry, brown (7.5Y 5/4) when moist; massive; hard when dry, very friable when moist; concretions and threads of calcium carbonate; many mica flakes; calcareous; pH 8.2.

Bostwick soils generally are more than 60 inches thick, but locally they may be no more than 40 inches thick over gneiss and schist. The surface soil normally is loam, but it is clay loam in some places. The ca horizon may be weak or lacking, but lime normally occurs at a depth between 15 and 30 inches.

Bostwick soils have a coarser textured subsoil and substratum than Blanyon soils, which they adjoin in many places.

Bostwick soils support western wheatgrass, slender wheatgrass, junegrass, Indian ricegrass, and big sage. Oakbrush, mountain-mahogany, and juniper grow at the higher elevations. If irrigated, these soils are suited to small grain, alfalfa, and native hay.

Bostwick gravelly loam, 2 to 5 percent slopes (BsB).—This soil occurs both at the upper end of alluvial fans that merge with steeply sloping, rocky and gravelly areas and at the mouth of the small streams that cut through the fans. It has a profile similar to the one described as typical of the Bostwick series, but the surface layer is 15 to 25 percent gravel. The gravel has come from exposures of parent rock and from adjacent small areas of glacial till. The largest acreage is along the eastern side of Bostwick Park.

This soil is used both as range and as irrigated cropland. Gravel and cobblestones in the surface layer interfere somewhat with tillage and are hard on farm machinery. (Capability unit VIe–2 nonirrigated; IIIe–3 irrigated)

Bostwick loam, 0 to 2 percent slopes (BtA).—This soil occurs at the lower end of alluvial fans. It has a profile similar to the one described as typical of the Bostwick series. It is mainly in the eastern half of Bostwick Park.

If irrigated, this soil is suited to small grain, alfalfa, and native hay. Oakbrush, pinyon, and a few pines grow on the higher parts. This soil is not readily susceptible to erosion if it is well managed. (Capability unit VIe–2 nonirrigated; IIIc–1 irrigated)

Bostwick loam, 2 to 5 percent slopes (BtB).—This soil is on alluvial fans. It has a profile similar to the one described as typical of the Bostwick series. It is most extensive in the eastern half of Bostwick Park.

If irrigated, this soil is suited to alfalfa, small grain, and native hay. Mountain-mahogany, oakbrush, juniper, and a few small trees grow at the higher elevations. Irrigation is somewhat more difficult than on Bostwick loam, 0 to 2 percent slopes. Gully erosion is severe where runoff concentrates, principally in the western part of

Bostwick Park. Otherwise, this soil is not readily susceptible to erosion if it is well managed. (Capability unit VIe–2 nonirrigated; IIIe–3 irrigated)

Bostwick loam, 5 to 10 percent slopes (BtC).—This soil generally occurs at the upper end of alluvial fans. It has a profile similar to the one described as typical of the Bostwick series. It is most extensive in the eastern third of Bostwick Park.

This soil is used as range and generally supports native grasses, forbs, and woody plants. Some parts are irrigated, but the slope makes irrigation somewhat more difficult than on the more gently sloping Bostwick soils. Gully erosion is a hazard unless this soil is carefully managed. (Capability unit VIe–2 nonirrigated; IVe–2 irrigated)

Bostwick stony loam, 2 to 5 percent slopes (BwB).—This soil is at the upper end of alluvial fans that merge with steep stony areas and adjacent to small streams where floodwaters have deposited a covering of stones and cobblestones. The profile is similar to the one described as typical of the Bostwick series, but the surface layer is 15 to 40 percent stones and cobblestones. The largest acreage is in Bostwick Park, along the eastern margin of the Area.

This is a moderately productive soil. It is used only as native range. Cobblestones and gravel make tillage difficult and increase wear on farm machinery. In places removing the stones is not practical. This soil is not susceptible to serious erosion if it is well managed and protected. (Capability unit VIIs–1 nonirrigated)

Bostwick stony loam, 5 to 10 percent slopes (BwC).—This soil is at the upper end of alluvial fans and along small streams. It has a profile similar to the one described as typical of the Bostwick series, but its surface layer is 15 to 40 percent stones and cobblestones.

This soil is better suited to range than to tilled crops. Tillage is extremely difficult because of the slope and the stones and cobblestones. Removing the stones is not practical. This soil is moderately susceptible to erosion. (Capability unit VIIs–1 nonirrigated)

Bostwick stony loam, 10 to 30 percent slopes (BwD).—This soil is at the upper end of steeply sloping alluvial fans that merge with rough, broken, and stony areas and adjacent to small streams that drain such areas. The profile is similar to the one described as typical of the Bostwick series, but stones and cobblestones make up 15 to 50 percent of the surface layer and are scattered throughout the entire profile.

This soil is better suited to range than to tilled crops. The slope and stones make it unsuitable for tillage. A few of the more gently sloping parts are tilled, but they are not highly productive. (Capability unit VIIs–3 nonirrigated)

Bostwick Series, Coarse Subsoil Variant

These soils are deep, well drained, and moderately coarse textured. They formed on alluvial fans and valley side slopes in uniform, calcareous material washed from micaceous schist and gneiss. Soils of this series are not extensive in the Area. They are mainly on the eastern slopes of Bostwick Park.

Bostwick soils, coarse subsoil variant, have a grayish-brown surface layer of friable, micaceous fine sandy loam 5 to 10 inches thick. They have a moderately well developed, brown to dark-brown subsoil of micaceous heavy fine sandy loam that has prismatic to blocky structure. The substratum, which begins at a depth of 30 to 40 inches, is yellowish-brown, weakly calcareous, micaceous fine sandy loam. These soils are noncalcareous to a depth of 30 to 40 inches and have only a weak accumulation of secondary calcium carbonate in the substratum. Normally, the depth to bedrock is 60 inches or more.

If unprotected, these soils are susceptible to wind erosion. The organic-matter content is moderately high, and the structure is moderately stable.

Typical profile of Bostwick fine sandy loam, coarse subsoil variant, 1,570 feet east and 1,820 feet north of the southwest corner of NW¼ of sec. 29, T. 49 N., R. 7 W. (Montrose County):

A1—0 to 5 inches, fine sandy loam; grayish brown (10YR 5/2) when dry, very dark grayish brown (10YR 3/2) when moist; moderate, fine, crumb and granular structure; hard when dry, very friable when moist; much visible mica; noncalcareous; pH 6.8; clear, smooth boundary.

A3—5 to 11 inches, fine sandy loam; brown (10YR 5/3) when dry, dark brown (10YR 3/3) when moist; weak to moderate, medium, subangular blocky structure breaking to fine granular; hard when dry, very friable when moist; much visible mica; noncalcareous; pH 6.8; clear, smooth boundary.

B2t—11 to 28 inches, heavy fine sandy loam; brown (10YR 5/3) when dry, dark brown (10YR 3/3) when moist; weak to moderate, coarse, prismatic structure breaking to moderate, coarse and medium, subangular blocky; hard when dry, very friable when moist; thin, patchy clay films and clay bridges between sand grains; much visible mica; noncalcareous; pH 7.0; clear, smooth boundary.

B3—28 to 36 inches, fine sandy loam; pale brown (10YR 6/3) when dry, brown or dark brown (10YR 4/3) when moist; weak, coarse, subangular blocky structure; slightly hard when dry, very friable when moist; some clay bridges between sand grains; much mica; noncalcareous; pH 7.2; gradual, smooth boundary.

Cca—36 to 60 inches, light fine sandy loam or heavy loamy fine sand; light yellowish brown (10YR 6/4) when dry, dark yellowish brown (10YR 4/4) when moist; massive; soft when dry, very friable when moist; much visible mica; some small concretions of calcium carbonate; weakly calcareous; pH 7.8.

The surface layer is chiefly fine sandy loam, but it is loamy fine sand in some places. The depth to bedrock is less than 60 inches in some places.

In many places these soils are adjacent to typical Bostwick soils, which are finer textured. They have a coarser textured subsoil and substratum than Cerro soils and a much higher content of mica. They resemble Poudre soils, but have a better developed solum, as shown by distinct accumulations of silicate clay, are better drained, and have little or no mottling.

These soils are used both as native range and as irrigated cropland. In their natural state, they have a fair cover of slender wheatgrass, needle-and-thread, Indian ricegrass, big sage, and juniper. Small grain and alfalfa are suitable crops.

Bostwick fine sandy loam, coarse subsoil variant, 5 to 10 percent slopes (BrC).—This soil occurs on alluvial fans, principally on the east side of Bostwick Park. It is coarser textured throughout than typical Bostwick soils.

In its natural state, this soil supports a fair cover of slender wheatgrass, needle-and-thread, Indian ricegrass, big sage, and juniper. If irrigated, it can be used for tilled crops, but it requires more irrigation water than the finer textured soils in the Area. Small grain and alfalfa are suited if this soil is well managed. This soil is susceptible to wind erosion. (Capability unit VIe-2 nonirrigated; IVe-4 irrigated)

Cerro Series

The soils of the Cerro series are deep, well drained, and moderately fine textured. They formed on foothills and mountain slopes in stony, moderately fine textured, calcareous glacial till derived mostly from rhyolite and andesite bedrock but partly from sedimentary rock. Soils of this series are moderately extensive in the Area, principally on uplands bordering the eastern edge of the valley of the Uncompahgre River, south and east of the town of Montrose.

Cerro soils have a grayish-brown or very dark grayish-brown, friable, granular surface layer 6 to 16 inches thick. They have a brown or dark-brown, moderately well developed subsoil of clay loam that has moderate, subangular blocky structure. The substratum, which begins 20 to 30 inches from the surface, is pale-brown, calcareous stony clay loam. Bedrock normally occurs at a depth of 60 inches or more.

These soils are not highly susceptible to erosion if they are well managed. The organic-matter content is high, and the structure is stable.

Typical profile of Cerro clay loam, 1,450 feet south of the northwest corner of sec. 2, T. 48 N., R. 8 W.:

A1—0 to 6 inches, clay loam; grayish brown (10YR 5/2) when dry, very dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; slightly hard when dry, very friable when moist; some stones on the surface; noncalcareous; pH 7.0; clear, smooth boundary.

B1—6 to 9 inches, clay loam; grayish brown (10YR 5/2) when dry, very dark grayish brown (10YR 3/2) when moist; moderate, medium and fine, subangular blocky structure; very hard when dry, friable when moist; few patchy clay films; noncalcareous; pH 7.0; clear, smooth boundary.

B2t—9 to 20 inches, clay loam; brown (7.5YR 5/2) when dry, brown or dark brown (7.5YR 4/2) when moist; moderate, medium, prismatic structure breaking to moderate, medium, subangular blocky; very hard when dry, friable when moist; thin, continuous clay films; noncalcareous; pH 7.4; clear, smooth boundary.

B3ca—20 to 29 inches, clay loam; grayish brown (10YR 5/2) when dry, dark grayish brown (10YR 4/2) when moist; weak, coarse, subangular blocky structure; hard when dry, friable when moist; few thin, patchy clay films; some secondary calcium carbonate occurs as concretions and seams; calcareous; pH 8.0; gradual, smooth boundary.

Cca—29 to 60 inches, stony clay loam; pale brown (10YR 6/3) when dry, brown (10YR 5/3) when moist; massive; hard when dry, friable when moist; about 20 percent of the horizon is stones and cobblestones; some secondary calcium carbonate occurs as concretions and seams; calcareous; pH 8.2.

The profile is thinner and the depth to calcium carbonate is less than normal on the steeper slopes. The dark-colored surface layer is thicker than normal at the lower end of alluvial fans.

Cerro soils are similar to Bostwick and Doak soils and occur in the same general part of the Area. Cerro soils contain much less mica than Bostwick soils, are calcareous nearer the surface, and formed in stony glacial till instead of in alluvium. Cerro soils have a darker colored surface layer than Doak soils, are thicker, and are leached to a greater depth.

Cerro soils support a fairly dense cover of western wheatgrass, muttongrass, Indian ricegrass, mountain-mahogany, pinyon, and juniper. Some areas are tilled.

Cerro clay loam, 1 to 5 percent slopes (CcB).—This soil is on hillsides and at the lower end of alluvial fans. It has a profile similar to the one described as typical of the Cerro series. The largest acreage is on the foothills south and east of the town of Montrose.

Areas used as range support a cover of native grasses, mountain-mahogany, and scattered trees. Cleared areas are suited to most of the common crops. This soil is not readily susceptible to erosion if management is good. (Capability unit VIe-2 nonirrigated; IIIe-3 irrigated)

Cerro clay loam, 5 to 10 percent slopes (CcC).—This soil is on alluvial fans and on foothills and mountain slopes. It has a profile similar to the one described as typical of the Cerro series. The largest acreage is south and east of the town of Montrose.

This soil is used as range and as irrigated cropland. It is somewhat less suitable for tillage than Cerro clay loam, 1 to 5 percent slopes. Areas used as range support grass, oakbrush, and scattered trees. (Capability unit VIe-2 nonirrigated; IVe-2 irrigated)

Chacra Series

The soils of the Chacra series are moderately deep, well drained, and moderately fine textured. They are grassland soils on upland slopes and ridges. They formed in moderately fine textured, calcareous parent material that weathered from the underlying sedimentary shale and siltstone. Soils of this series are moderately extensive in this Area. They occur mainly east and south of the town of Olathe.

Chacra soils have a pale-brown or brown, friable, granular surface layer 4 to 5 inches thick. They have a weakly developed, pale-brown or yellowish-brown, moderately fine textured subsoil of moderate structure. The substratum, below a depth of 12 to 14 inches, is very pale brown, calcareous loam that grades to soft siltstone or shale. A weak accumulation of secondary calcium carbonate occurs in the lower subsoil and in the upper substratum in the form of small concretions. Bedrock is at a depth of 18 to 40 inches.

These soils are highly susceptible to erosion. The organic-matter content is low, and the structure is unstable.

Typical profile of Chacra loam, NW¼NW¼ sec. 13, T. 50 N., R. 10 W. (Montrose County):

A1—0 to 5 inches, loam; pale brown (10YR 6/3) when dry, brown (10YR 5/3) when moist; moderate, very fine, granular structure; soft when dry, very friable when moist; weakly calcareous; pH 7.8; clear, smooth boundary.

B2t—5 to 12 inches, clay loam; pale brown (10YR 6/3) when dry, yellowish brown (10YR 5/4) when moist; weak, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard when dry, friable when moist; few, thin, patchy clay films on faces of aggregates; weakly calcareous; pH 7.8; gradual, smooth boundary.

B3ca—12 to 16 inches, light clay loam or heavy loam; light yellowish brown (2.5Y 6/3) when dry, light olive brown (2.5Y 5/3) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; few patchy clay films; weak accumulation of secondary calcium carbonate concretions; calcareous; pH 8.0; gradual, smooth boundary.

Cca—16 to 30 inches, loam; pale yellow (2.5Y 8/3) when dry, pale yellow (2.5Y 7/4) when moist; massive; slightly hard when dry, very friable when moist; moderate accumulation of secondary calcium carbonate concretions and calcium sulfate crystals; calcareous; pH 8.2; gradual, smooth boundary.

R—30 to 40 inches +, unweathered or only weakly weathered siltstone, bedrock, and interbedded clay shale; calcareous.

Typically, these soils are weakly calcareous at or near the surface, but they are noncalcareous to a depth of 8 to 10 inches in some places. The accumulation of secondary calcium carbonate generally is moderate, but it ranges locally from strong to weak. The depth to bedrock ranges from 20 to 40 inches.

In this Area the Chacra soils are mapped only with Menoken soils. Chacra soils have a more strongly developed subsoil than Menoken soils and a distinct accumulation of silicate clay. They have a somewhat less well developed subsoil than Doak soils, which are 60 inches deep to bedrock. Chacra soils are deeper to bedrock than Persayo soils, and they have a more strongly developed subsoil and a distinct accumulation of silicate clay.

Chacra soils support a fair growth of Indian ricegrass, needle-and-thread, and woody plants. If irrigated and well managed, these soils are productive. They are suited to most of the common crops.

Chipeta Series

The soils of the Chipeta series are shallow, well drained, and fine textured. They formed on upland hills and ridges and on steeply sloping parts of valley side slopes in thin, fine-textured, calcareous parent material that weathered from exposures of Cretaceous shale. Soils of this series are extensive throughout the Area. Large tracts are in the eastern part, north and east of the town of Montrose.

Chipeta soils have a pale-yellow or light yellowish-brown, granular surface layer about 4 inches thick. They have a gray subsoil that closely resembles the underlying shale but has weak, blocky structure. The shale, which generally begins at a depth of about 10 inches, is high in lime and contains crystals of calcite and gypsum. Its color is variable but is gray or light yellowish brown in most places.

Typical profile of Chipeta silty clay, near the southwest corner of the NW¼ of sec. 26, T. 51 N., R. 10 W.:

A1—0 to 4 inches, silty clay; pale yellow (2.5Y 7/3) when dry, light yellowish brown (2.5Y 6/3) when moist; moderate, very fine, granular structure; slightly hard when dry, very friable when moist; calcareous; pH 8.2; gradual, smooth boundary.

C—4 to 10 inches, silty clay; gray (2.5Y 6/1) when dry, dark gray (2.5Y 4/1) when moist; massive or very weak, medium, subangular blocky structure; very hard when dry, very plastic when wet; some concretions of calcium carbonate and crystals of calcium sulfate; calcareous; pH 8.2; gradual, smooth boundary.

R—10 to 60 inches +, weakly weathered clay shale colored gray, light olive brown, or yellowish brown; gypsum and calcite crystals in places.

Chipeta soils are almost uniform throughout the Area. The principal variations are in the depth to shale bedrock and the amount of induration of the parent rock.

Chipeta soils are finer textured than Persayo soils, with which they occur. They resemble Christianburg soils in many respects, but the depth to shale bedrock is less than 18 inches, as compared with 60 inches or more in Christianburg soils.

The characteristic vegetation on Chipeta soils consists of mat saltbush, Gardner saltbush, shadscale saltbush, and scatter stands of galleta, Salina wildrye, and squirreltail. Chipeta soils are not suitable for tillage. They are used only as range, unless they occur in fields with soils that are tilled.

Chipeta silty clay, 0 to 2 percent slopes (CeA).—This soil has a profile similar to the one described as typical of the Chipeta series. It occurs throughout the Area but is most extensive in the desertlike part north and east of the town of Montrose.

This soil is tilled only where it occurs within fields containing other soils. It is highly susceptible to erosion and requires careful management. (Capability unit VIs-1 nonirrigated)

Chipeta silty clay, 2 to 5 percent slopes (CeB).—This soil occurs on the sides of hills and ridges throughout the Area. It has a profile similar to the one described as typical of the Chipeta series. The largest acreage is north and east of the town of Montrose.

This soil is tilled only where it occurs within fields containing other soils. It is highly susceptible to erosion and requires careful management. (Capability unit VIIs-2 nonirrigated)

Chipeta-Persayo complex, 5 to 10 percent slopes (ChC).—This complex consists of soils that are typical of the Chipeta and the Persayo series. These soils occur in a complex pattern in hilly areas where Cretaceous shale is near the surface. They occur throughout the Area but are most extensive in the drier parts north and east of the town of Montrose and near the town of Delta.

These soils are seldom tilled, unless they lie within fields containing other soils. They are highly susceptible to erosion and require very careful management. (Capability unit VIIs-2 nonirrigated)

Chipeta-Persayo complex, 5 to 10 percent slopes, eroded (ChC2).—This complex is on the sides and crests of hills and ridges. It consists of typical Chipeta and Persayo soils. It occurs throughout the survey Area but is most extensive south and east of the town of Delta.

The annual precipitation is less than 9 inches. Because the vegetation is sparse, rains of moderately high intensity cause severe erosion and wash a large amount of silt into the streams. Gully erosion is active. The areas between the gullies are only slightly eroded, but the gully pattern is intricate and it controls the use of the soils. After even a normal rainfall, much water runs off through the gullies and much silt is washed downslope. (Capability unit VIIIes-1 nonirrigated)

Chipeta-Persayo-Mesa association, 2 to 10 percent slopes (CkC).—This association is on the outer margin of high mesas, where geologic erosion has removed part of the soil material and has cut into the underlying shale. It consists of typical Chipeta, Persayo, and Mesa soils. Most of the acreage is made up of Chipeta soils. Only small remnants of Mesa soils remain.

These soils are not suitable for cultivation. They support a sparse cover of saltbush and scattered stands of galleta and squirreltail grasses. They are highly susceptible to erosion. (Capability unit VIIs–2 nonirrigated)

Chipeta-Persayo-Rance complex, 2 to 10 percent slopes (CIC).—This complex is on hills and ridges where Cretaceous shale beds that contain a large amount of crystalline calcium sulfate are near the surface. Typical Chipeta, Persayo, and Rance soils make up about equal parts of the complex. The largest areas are near the towns of Delta and Montrose.

These soils are tilled only where they occur within fields containing other soils. They are highly susceptible to erosion and require careful management. (Capability unit VIIs–2 nonirrigated)

Christianburg Series

The soils of the Christianburg series are deep, well drained, and fine textured. They formed on alluvial fans, flood plains, and terraces in uniform, fine-textured, calcareous alluvium derived from olive and gray sedimentary rock. Soils of this series occur throughout the Area, but they are most extensive in the valley of the Uncompahgre River, south and east of the town of Delta, and in the valley of the Gunnison River west of Delta.

Christianburg soils have a light brownish-gray, granular surface layer 4 to 6 inches thick. They have a light brownish-gray subsoil of calcareous clay or silty clay that has weak, blocky structure. The substratum, below a depth of 15 to 20 inches, is light brownish-gray, calcareous, massive clay or silty clay. Bedrock normally occurs at a depth of 60 inches or more.

These soils are susceptible to erosion and piping. The organic-matter content is fairly low, and the structure is unstable.

Typical profile of Christianburg silty clay, 0.1 mile north of the southwest corner of the NW¼ of sec. 36, T. 51 N., R. 10 W. (Montrose County) :

A1—0 to 4 inches, silty clay; light brownish gray (2.5Y 6/2) when dry, dark grayish brown (2.5Y 4/2) when moist; strong, fine, granular structure; slightly hard when dry, friable when moist, very plastic when wet; calcareous; pH 8.2; clear, smooth boundary.

C1—4 to 14 inches, silty clay; light brownish gray (2.5Y 6/2) when dry, dark grayish brown (2.5Y 4/2) when moist; very weak, coarse, subangular blocky structure; extremely hard when dry, firm when moist, very plastic when wet; calcareous; pH 8.2; gradual, smooth boundary.

C2—14 to 60 inches, silty clay; light brownish gray (2.5Y 6/2) when dry, dark grayish brown (2.5Y 4/2) when moist; massive; extremely hard when dry, firm when moist, very plastic when wet; some minor strata of coarser textured material; calcareous; pH 8.2.

Typically, the surface layer is clay or silty clay, but it is coarser textured in some places where new material has been recently deposited. In some places and at variable depths, there is a weak accumulation of calcium carbonate. Locally, internal drainage is slow, and there is commonly a strong accumulation of salts. Bedrock generally is at a depth of 60 inches or more. Locally, substrata of gravel or shale occur at a depth of 30 to 60 inches.

Christianburg soils are finer textured than Billings and Ravola soils, which they adjoin in many places. They are similar to Colona soils in many respects but have a less well developed solum.

Big sagebrush, shadscale, fourwing saltbush, rabbitbrush, and greasewood give these soils a brushy appearance. Western wheatgrass, galleta, alkali sacaton, and saltgrass make up the understory. In many places the vegetation now consists of greasewood and annual weeds. These soils are moderately productive, but their fine texture makes it difficult to till and to irrigate them. They are used as native range and as irrigated cropland.

Christianburg silty clay, 0 to 2 percent slopes (CmA).—This soil occurs on flood plains and terraces and at the lower end of alluvial fans. It has a profile similar to the one described as typical of the Christianburg series. It is most extensive south and east of the town of Delta.

If irrigated, this soil can be used successfully for tilled crops, but tillage is difficult at some seasons of the year because the surface layer is fine textured and infiltration is slow. Careful management is needed to overcome problems of poor drainage and salinity. This soil is susceptible to erosion, particularly gullying and piping. (Capability unit VIs–1 nonirrigated; IVs–1 irrigated)

Christianburg silty clay, 2 to 8 percent slopes (CmC).—This soil occurs on small flood plains and alluvial fans. It has a profile similar to the one described as typical of the Christianburg series. It is most extensive south and east of the town of Delta.

This soil is tilled in a few places, but it is better suited to native range than to crops because of its slope and its fine texture. It is susceptible to erosion, particularly gullying. (Capability unit VIIe–2 nonirrigated)

Colona Series

The soils of the Colona series are deep, moderately well drained, and mainly fine textured. They are grassland soils that formed on flood plains and at the low end of alluvial fans in uniform, fine-textured, calcareous alluvium derived mainly from sedimentary rocks. Soils of this series are moderately extensive in the Area. They occur mainly in the valley of the Uncompahgre River south of Montrose and along the western border of the Area.

Colona soils have a thin, light olive-brown surface layer of granular silty clay loam or clay 3 to 4 inches thick. They have a light yellowish-brown or light olive-brown, friable, fine-textured subsoil that has weak, prismatic to angular blocky structure. The substratum, below a depth of 18 to 20 inches, is pale-olive or olive-brown, fine-textured, calcareous alluvium. Bedrock normally occurs at a depth of 60 inches or more.

These soils are only moderately susceptible to erosion. The organic-matter content is moderate, and the structure is moderately stable.

Typical profile of Colona clay, 0.3 mile east and 0.2 mile south of the northwest corner of sec. 7, T. 47 N., R. 8 W. (Montrose County) :

A1—0 to 3 inches, clay; light olive brown (2.5Y 5/3) when dry, olive brown (2.5Y 4/3) when moist; moderate or strong, very fine, subangular blocky or granular structure; slightly hard when dry, friable when moist, very plastic when wet; noncalcareous; pH 7.8; gradual, smooth boundary.

B2—3 to 12 inches, silty clay; light yellowish brown (2.5Y 6/3) when dry, light olive brown (2.5Y 5/3) when moist; very weak, coarse, prismatic structure breaking to moderately strong, fine, angular blocky; extremely hard when dry, friable when moist, very plastic when wet; few patchy clay films, principally on vertical faces; weakly calcareous; pH 7.8; gradual, smooth boundary.

B3ca—12 to 18 inches, silty clay; pale olive (5Y 6/3) when dry, olive (5Y 5/3) when moist; weak, coarse, subangular blocky structure; extremely hard when dry, very firm when moist, very plastic when wet; some secondary calcium carbonate and calcium sulfate appearing as crystals and small concretions; calcareous; pH 8.0; gradual, smooth boundary.

C1ca—18 to 36 inches, silty clay; pale olive (5Y 6/3) when dry, olive (5Y 5/3) when moist; massive; extremely hard when dry, very firm when moist, very plastic when wet; moderate accumulations of calcium carbonate and calcium sulfate appearing as crystals, concretions, and thin seams and streaks; calcareous; pH 8.0; gradual, smooth boundary.

C2ca—36 to 60 inches +, silty clay; pale olive (5Y 6/3) when dry, olive (5Y 5/3) when moist; massive; extremely hard when dry, very firm when moist, very plastic when wet; some accumulated calcium carbonate and calcium sulfate, but less than in C1ca horizon; calcareous; pH 8.2.

The surface layer generally is clay, but it is silty clay or clay loam in places. Soluble salts occur on the surface in places where excess irrigation water has been permitted to accumulate. Normally, the structure of the subsoil is weak, but it is moderate in some places. The amount of secondary calcium carbonate and calcium sulfate varies, but there is always a distinct accumulation of these elements. Generally, bedrock occurs at a depth of 60 inches or more. Locally, the substratum is sand and gravel.

In many places Colona soils are adjacent to Christianburg and Billings soils. Colona soils have a more strongly developed subsoil than Christianburg soils, and, unlike them, have a weak accumulation of secondary calcium carbonate. Colona soils are finer textured than Billings soils and have a more strongly developed solum.

In their natural state, Colona soils support a good cover of western wheatgrass, muttongrass, and other high-quality grasses. They are productive and are used both as native range and as irrigated cropland. They are better suited to hay crops than to cultivated crops because their fine texture makes tillage difficult.

Colona clay, 0 to 2 percent slopes (CoA).—This soil has a profile similar to the one described as typical of the Colona series. It is most extensive in the valley of the Uncompahgre River, south of the town of Montrose.

This soil can be irrigated successfully if well managed, but improper irrigation causes it to become saline. This soil is better suited to alfalfa and native hay than to crops that require frequent tillage. It is not highly susceptible to erosion, but gullies have formed in places. (Capability unit VIs–1 nonirrigated; IIIs–1 irrigated)

Colona clay, 2 to 8 percent slopes (CoC).—This soil is on flood plains and at the low end of alluvial fans. It has a profile similar to the one described as typical of the Colona series. It is most extensive in the valley of the Uncompahgre River, south of the town of Montrose.

If irrigated, this soil can be used successfully for tilled crops, but it is better suited to alfalfa and native hay. It is better drained and less likely to become saline than the less sloping Colona soils, but it is less suitable for irrigation and is more susceptible to erosion, particularly gullying. (Capability unit VIIe–2 nonirrigated; IVe–2 irrigated)

Colona clay, gravel substratum, 0 to 2 percent slopes (CsA).—This soil is on alluvial fans and terraces, generally at the margin of the flood plain where finer textured sediments have been deposited over coarser textured alluvium. The profile is similar to the one described as typical of the Colona series, but sand and gravel occur at a depth of 30 to 60 inches. The main areas border the Uncompahgre River, south and west of the town of Montrose.

If irrigated, this soil can be used successfully for tilled crops, but it is better suited to hay crops because the surface layer and subsoil are fine textured. Because of its coarse-textured substratum, this soil has better subsoil drainage than the other Colona soils in this Area. It is not likely to erode if well managed. (Capability unit VIs–1 nonirrigated; IIIs–1 irrigated)

Doak Series

The soils of the Doak series are deep, well drained, and mainly moderately fine textured. They are grassland-forest soils on gently sloping and moderately sloping hillsides and mountain slopes. They formed in uniform, moderately fine textured, calcareous parent material derived from a mixture of reworked glacial till and alluvium. Soils of this series are inextensive in the Area and occur principally in the southeastern part, east of the town of Colona.

Doak soils have a grayish-brown, friable, granular surface layer 4 to 6 inches thick. They have a brown to dark-brown subsoil of heavy clay loam that is moderately well developed and has prismatic to subangular blocky structure. The substratum, which begins 18 to 20 inches below the surface, is light-gray, pale-brown, or brown, moderately fine textured, calcareous local alluvium derived from beds of glacial till and sedimentary rock. Immediately below the subsoil is a moderate accumulation of secondary calcium carbonate. Normally, bedrock occurs at a depth of 60 inches or more.

These soils are not highly susceptible to erosion. The organic-matter content is moderately high, and the structure is stable.

Typical profile of Doak clay loam, 700 feet east and 200 feet south of the center of sec. 8, T. 47 N., R. 8 W. (Montrose County):

A1—0 to 4 inches, light clay loam; brown (7.5YR 5/2) when dry, brown or dark brown (7.5YR 4/2) when moist; coarse, subangular blocky structure breaking to moderate to strong, granular; noncalcareous; pH 7.0; clear, smooth boundary.

B1—4 to 7 inches, clay loam; brown (7.5YR 5/3) when dry, brown or dark brown (7.5YR 4/3) when moist; weak, medium, prismatic structure breaking to moderate, fine, subangular blocky; hard when dry, friable when moist; thin, patchy clay films; noncalcareous; pH 7.0; clear, smooth boundary.

B2t—7 to 14 inches, heavy clay loam or silty clay loam; brown (7.5YR 5/3) when dry, brown or dark brown (7.5YR 4/3) when moist; moderate to strong, fine and medium, prismatic structure breaking to moderate to strong, fine and medium, angular and subangular blocky; very hard when dry, firm when moist; moderate, continuous clay films; noncalcareous; pH 7.2; clear, smooth boundary.

B3ca—14 to 18 inches, silty clay loam; light brown (7.5YR 6/3) when dry, brown (7.5YR 5/3) when moist; weak to moderate, medium, subangular blocky structure; very hard when dry, friable when moist; thin, patchy clay films; calcium carbonate concretions; calcareous; pH 7.8; gradual, smooth boundary.

C1ca—18 to 30 inches, silty clay loam; light gray (10YR 7/2) when dry, brown (10YR 5/3) when moist; massive; very hard when dry, friable when moist; much secondary calcium carbonate occurring as concretions, seams or streaks, and finely divided forms; calcareous; pH 8.0; gradual, smooth boundary.

C2ca—30 to 60 inches, silty clay loam; pale brown (10YR 6/3) when dry, brown (10YR 5/3) when moist; massive; very hard when dry, friable when moist; some secondary calcium carbonate but less than in the horizon above; calcareous; pH 8.0.

This surface layer generally is light clay loam, but it is loam or silt loam in places. There may be a covering of stones and rock where Doak soils adjoin Cerro soils. The accumulation of secondary calcium carbonate normally is moderate, but it is strong in some places. Typically, the depth to bedrock is 60 inches or more, though it may be less locally.

In many places Doak soils occur just downslope from Cerro soils. They are calcareous nearer the surface than Cerro soils and have a lighter colored surface layer. Doak soils resemble Fruita soils but have a finer textured subsoil. Compared with Woodrow soils, Doak soils have a more strongly developed solum, as evidenced by a distinct accumulation of silicate clay in the subsoil.

In their natural state, Doak soils have a cover of western wheatgrass, junegrass, mountain-mahogany, and scattered trees. These soils are moderately productive if irrigated, but getting water to them is difficult because of their position on the landscape.

Doak clay loam, 2 to 5 percent slopes (DoB).—This soil is on hillsides and mountainsides. It has a profile similar to the one described as typical of the Doak series. Most of the acreage is on foothills east of the town of Colona.

If irrigated, this soil can be used successfully for tilled crops, but irrigation is difficult because of the slope and the position of this soil on the landscape. This soil is not highly susceptible to erosion. (Capability unit VIe-2 nonirrigated; IIIe-3 irrigated)

Doak stony clay loam, 2 to 10 percent slopes (DsC).—This soil is on alluvial fans and hillsides. It has a profile similar to the one described as typical of the Doak series, but it has a mantle of stones and cobblestones washed from glacial till. It is most extensive on foothills east of the town of Colona.

Because of the slope and the stones, this soil is better suited to range than to cultivated crops. The vegetation consists of western wheatgrass and scattered trees. This soil is not highly susceptible to erosion. (Capability unit VIIs-1 nonirrigated)

Fruita Series

The soils of the Fruita series are deep, well drained, and medium textured or moderately fine textured. They are grassland soils that formed on alluvial fans in uniform, medium-textured, calcareous alluvium weathered from sedimentary rock, mainly sandstone. Soils of this series are moderately extensive in this Area. They are mainly north and west of the town of Montrose.

Fruita soils have a pinkish-gray, friable, granular surface layer 4 to 5 inches thick. They have a weakly developed subsoil of brown or dark-brown loam or clay loam that has prismatic and blocky structure. The substratum, which begins at a depth of 18 to 20 inches, is brown or light-brown, calcareous loam or clay loam. Weak accumulations of secondary calcium carbonate occur in the lower part of the subsoil and the upper part of the substratum. Bedrock normally occurs at a depth of 60 inches or more.

These soils are susceptible to erosion unless protected. The organic-matter content is moderately low, and the structure is moderately stable.

Typical profile of Fruita loam, 150 feet west and 50 feet south of the northeast corner of sec. 2, T. 48 N., R. 10 W. (Montrose County):

A1—0 to 4 inches, light loam; pinkish gray (7.5YR 6/2) when dry, brown or dark brown (7.5YR 4/2) when moist; moderate, fine, granular structure; slightly hard when dry, very friable when moist; noncalcareous; pH 7.8; gradual, smooth boundary.

B2t—4 to 13 inches, heavy loam; brown (7.5YR 5/2) when dry, brown or dark brown (7.5YR 4/2) when moist; moderate, fine, prismatic structure breaking to moderate to strong, fine, subangular blocky; hard when dry, friable when moist; many, thin, patchy clay films; noncalcareous; pH 7.8; gradual, smooth boundary.

B3ca—13 to 18 inches, loam; pinkish gray (7.5YR 6/2) when dry, brown or dark brown (7.5YR 4/2) when moist; weak to moderate, medium, subangular blocky structure; hard when dry, very friable when moist; a few, thin, patchy clay films; weak accumulation of secondary calcium carbonate concretions; calcareous; pH 8.0; gradual, smooth boundary.

C1ca—18 to 26 inches, loam; light brown (7.5YR 6/4) when dry, brown (7.5YR 5/4) when moist; massive; hard when dry, very friable when moist; weak to moderate accumulation of secondary calcium carbonate concretions; calcareous; pH 8.2; gradual, smooth boundary.

C2ca—26 to 60 inches, loam or gravelly loam; light brown (7.5YR 6/4) when dry, brown (7.5YR 5/4) when moist; massive; hard when dry, very friable when moist; weak accumulation of secondary calcium carbonate concretions; 10 to 20 percent gravel.

Typically, the surface layer is loam, but it is clay loam in a few places. The horizons of calcium carbonate accumulation are distinct, although the content of calcium carbonate varies. In some places gravel and channery fragments of sandstone occur throughout the profile.

Fruita soils adjoin Woodrow soils. They are better developed, as evidenced by the distinct accumulation of silicate clay, which Woodrow soils lack. Fruita soils are similar to Bostwick soils but lack the high content of mica, which is characteristic of those soils, and have a less well developed subsoil. In some places Fruita soils occur with Mesa soils, which lack a gravelly substratum.

In their natural state, Fruita soils support a cover of galleta, blue grama, big sagebrush, snakeweed, and some pinyon. They are moderately productive and are suited to most of the common tilled crops.

Fruita loam, 0 to 2 percent slopes (FaA).—This soil is on alluvial fans and upland slopes. It has a profile similar to the one described as typical of the Fruita series. The largest acreage in this Area is west of the town of Montrose.

The natural cover consists of galleta, blue grama, snakeweed, and scattered pinyon. If irrigated, this soil can be used successfully for alfalfa, small grain, sugar beets, and orchard fruits. It is moderately susceptible to erosion. (Capability unit VIe–1 nonirrigated; I–1 irrigated)

Fruita clay loam, 5 to 10 percent slopes (FbC).—This soil is on alluvial fans and upland slopes. It has a profile similar to the one described as typical of the Fruita series, but the surface layer is somewhat finer textured. Most of it is north of the town of Montrose.

This soil can be irrigated and used for tilled crops, but it is better suited to hay crops. The slope makes it less suitable for irrigation than Fruita loam, 0 to 2 percent slopes. This soil is moderately susceptible to erosion. (Capability unit VIe–1 nonirrigated; IVe–2 irrigated)

Fruitland Series

The soils of the Fruitland series are deep, well drained, and moderately coarse textured or moderately fine textured. They are grassland soils that formed on alluvial fans in uniform, moderately coarse textured, calcareous alluvium derived from sedimentary rock and old Pleistocene alluvium. Soils of this series are moderately extensive in this Area, principally in the southwestern part, west of the town of Montrose.

Fruitland soils have a brown or light brownish-gray, granular surface layer 6 to 8 inches thick. They have a subsoil of light-brown fine sandy loam that has weak structure. The substratum, below a depth of 15 to 16 inches, is pink or brown, calcareous, friable fine sandy loam. Normally, the depth to bedrock is 60 inches or more.

The organic-matter content of these soils is moderately high, and the structure is moderately stable. Unprotected areas are susceptible to wind erosion.

Typical profile of Fruitland fine sandy loam, 300 feet east and 200 feet north of the southwest corner of the SE¼ of sec. 5, T. 49 N., R. 10 W. (Montrose County):

A1—0 to 6 inches, fine sandy loam; light brownish gray (10YR 6/2) when dry, dark grayish brown (10YR 4/2) when moist; moderate, fine, granular structure; soft when dry, very friable when moist; calcareous; pH 8.0; clear, smooth boundary.

AC—6 to 12 inches, fine sandy loam; light brown (7.5YR 6/3) when dry, brown or dark brown (7.5YR 4/3) when moist; weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist; calcareous; pH 8.0; clear, smooth boundary.

C—12 to 60 inches +, fine sandy loam; pink (7.5YR 7/4) when dry, brown (7.5YR 5/4) when moist; massive; slightly hard when dry, very friable when moist; calcareous; pH 8.0.

Typically, the surface layer is fine sandy loam, but it is finer textured in some places. Although these soils normally are free of stone, areas that are adjacent to mesas are capped with gravelly and cobbly Pleistocene deposits, have a mantle of stones and cobblestones, or have some stones and cobblestones throughout the profile. Figure 10 shows a typical area of Fruitland soils.

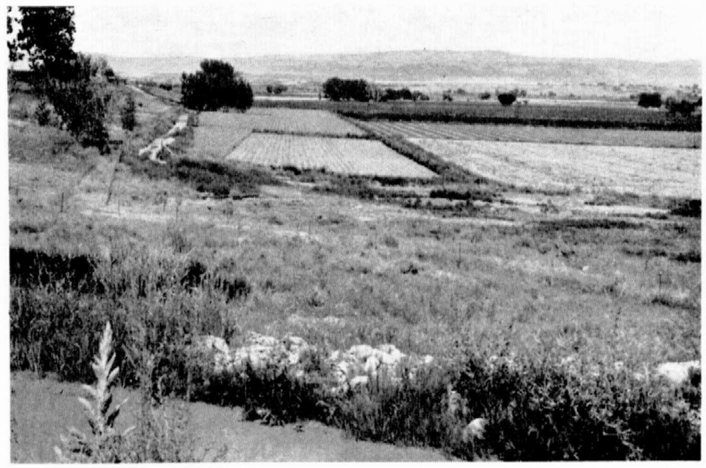

Figure 10.—A typical area of Fruitland soils.

Fruitland soils have a coarser textured subsoil and substratum than Genola soils, which they adjoin in many places. They are similar to Billings soils and Ravola soils but are redder and coarser textured.

In their natural state, Fruitland soils support a fair cover of needle-and-thread, three-awn, cactus, and blue grama. They are productive if irrigated. Many areas are used for orchards.

Fruitland fine sandy loam, 0 to 2 percent slopes (FrA).—This soil is on alluvial fans. It has a profile similar to the one described as typical of the Fruitland series. It is most extensive west of the town of Montrose.

This soil is well suited to orchards. It can be used successfully for tilled crops. If unprotected it is moderately susceptible to wind erosion. (Capability unit VIe–1 nonirrigated; IIe–2 irrigated)

Fruitland fine sandy loam, 2 to 5 percent slopes (FrB).—This soil is on alluvial fans. It has a profile similar to the one described as typical of the Fruitland series. It is most extensive in the valley along the Uncompahgre River, west of the town of Montrose.

This soil can be used successfully for tilled crops. Row crops and orchards can be irrigated easily. This soil is moderately susceptible to erosion. (Capability unit VIe–1 nonirrigated; IIIe–4 irrigated)

Fruitland sandy clay loam, 0 to 2 percent slopes (FsA).—This soil is on alluvial fans. Except for the sandy clay loam surface layer, which is 12 to 15 inches thick, the profile is similar to the one described as typical of the Fruitland series. Most of the acreage is in the western third of the Area, mainly in the valley along the Uncompahgre River.

This soil can be used successfully for tilled crops and is particularly well suited to orchards. It is only moderately susceptible to erosion. (Capability unit VIe–1 nonirrigated; IIe–2 irrigated)

Fruitland sandy clay loam, 2 to 5 percent slopes (FsB).—This soil is on alluvial fans. Except for the sandy clay loam surface layer, which is 12 to 15 inches thick, the profile is similar to the one described as typical of the Fruitland series. This soil is in the western third of the Area.

This soil can be used successfully for tilled crops and is especially well suited to orchards. It is more difficult to irrigate than Fruitland sandy clay loam, 0 to 2 percent slopes. It is moderately susceptible to erosion. (Capability unit VIe-1 nonirrigated; IIIe-4 irrigated)

Fruitland sandy clay loam, stony substratum, 0 to 2 percent slopes (FtA).—This soil is on alluvial fans. It has a profile similar to the one described as typical of the Fruitland series, but the surface layer is sandy clay loam, 12 to 15 inches thick, and a substratum of very gravelly and stony fine sandy loam occurs at a depth of 30 to 60 inches. This soil occurs in the western third of the Area, mainly in the valley of small tributary streams of the Uncompahgre River.

This soil can be used successfully for tilled crops. Because of its stony substratum, it tends to be droughty and requires frequent light irrigations. It is moderately susceptible to erosion. (Capability unit VIe-1 nonirrigated; IIIs-2 irrigated)

Fruitland sandy clay loam, stony substratum, 2 to 5 percent slopes (FtB).—This soil is on alluvial fans. It has a profile similar to the one described as typical of the Fruitland series, but the surface layer is sandy clay loam, 12 to 15 inches thick, and a substratum of very gravelly and stony fine sandy loam occurs at a depth of 30 to 60 inches. Most of the acreage is in the western third of the Area, in the valley of small tributary streams of the Uncompahgre River.

This soil can be used successfully for tilled crops. Because of its coarse-textured substratum, this soil holds less available water than other Fruitland soils and requires frequent light irrigations. It is moderately susceptible to erosion. (Capability unit VIe-1 nonirrigated; IIIe-1 irrigated)

Genola Series

The soils of the Genola series are deep, well drained, and mainly moderately fine textured. They are grassland soils that formed on alluvial fans in uniform, calcareous, medium-textured alluvium derived primarily from sedimentary rock. Soils of this series are extensive throughout the Area, but the largest acreage is in the western third.

Genola soils have a brown or grayish-brown, friable, granular surface layer 4 to 6 inches thick. They have a subsoil of brown or dark-brown, calcareous clay loam that is massive or has weak, subangular blocky structure. The substratum, below a depth of 15 to 20 inches, is brown, calcareous loam. Normally, the depth to bedrock is 60 inches or more.

These soils are susceptible to erosion. The organic-matter content is moderately low, and the structure is only moderately stable.

Typical profile of Genola clay loam, 200 feet east and 50 feet south of the northwest corner of sec. 23, T. 50 N., R. 11 W. (Montrose County):

A1—0 to 4 inches, light clay loam; light brownish gray (10YR 6/2) when dry, dark grayish brown (10YR 4/2) when moist; moderate, medium, granular structure; slightly hard when dry, very friable when moist; calcareous; pH 8.0; clear, smooth boundary.

AC—4 to 10 inches, clay loam; light brown (7.5YR 6/3) when dry, brown or dark brown (7.5YR 4/3) when moist; weak, medium, subangular blocky structure; hard when dry, very friable when moist; calcareous; pH 8.0; gradual, smooth boundary.

C1—10 to 60 inches, loam; light brown (7.5YR 6/3) when dry, brown (7.5YR 5/3) when moist; massive; hard when dry, very friable when moist; calcareous; pH 8.2.

The surface layer generally is light clay loam, but in some areas the texture is loam throughout. In some places there are strata of fine sandy loam in the substratum, and in others, weak accumulations of secondary calcium carbonate. In low areas where irrigation water has been allowed to accumulate, Genola soils have become weakly or moderately saline.

Genola soils have a coarser textured subsoil and substratum than Woodrow soils, which they adjoin in many places. Their solum is not so well developed as that of Fruita soils, which have a distinct accumulation of silicate clay in the subsoil. Genola soils have a finer textured subsoil and substratum than Fruitland soils, which they adjoin in a few places. They closely resemble Ravola soils but are redder.

In their natural state, Genola soils support a cover of blue grama, galleta, western wheatgrass, and sage. If irrigated, they are productive and are suited to most of the crops grown in the Area. Many areas are used for orchards.

Genola clay loam, 0 to 2 percent slopes (GeA).—This soil is at the lower end of alluvial fans. It has a profile similar to the one described as typical of the Genola series. The total acreage in this Area is large, and most of it is along the western border of the Area, north and west of the town of Montrose.

In its natural state, this soil has a good cover of blue grama, galleta, western wheatgrass, and sage. If irrigated and carefully managed, it can be used successfully for tilled crops. Many areas are used for orchards. This soil is only slightly susceptible to erosion. (Capability unit VIe-1 nonirrigated; I-1 irrigated)

Genola clay loam, 2 to 5 percent slopes (GeB).—This soil occurs on alluvial fans. It has a profile similar to the one described as typical of the Genola series. Included in mapping were small areas of Fruita and Woodrow soils. This soil is mainly west of the town of Montrose.

This soil has a native cover of blue grama, galleta, western wheatgrass, and sage. Under irrigation it can be used successfully for crops suited to the Area. Orchards do well. This soil is moderately susceptible to erosion. (Capability unit VIe-1 nonirrigated; IIIe-1 irrigated)

Genola clay loam, saline, 0 to 2 percent slopes (GsA).—This soil occurs in slightly concave areas at the lower end of alluvial fans. It has a profile similar to the one described as typical of the Genola series. Irrigation water has been allowed to accumulate, and as a result, soluble salts have accumulated on the surface and in the uppermost 4 or 5 inches of the profile. The salts on the surface appear as a weak, light-gray or white crust. The acreage is mainly along the Uncompahgre River, north and west of the town of Montrose.

This soil is unproductive or only moderately productive, depending on the concentration of soluble salts. The native cover consists of poor-quality salt-tolerant grass. Some areas are tilled but with only moderate success. Salt-tolerant crops do best. This soil is not susceptible to erosion, except where runoff from higher areas crosses it and causes gullying. (Capability unit VIs-1 nonirrigated; IIIs-3 irrigated)

Gullied Land

Gullied land (Gu) occurs in and along small drainageways where runoff has concentrated and cut into the soils (fig. 11). Deep gullies dominate the landscape and largely control use. This land type occurs throughout the Area.

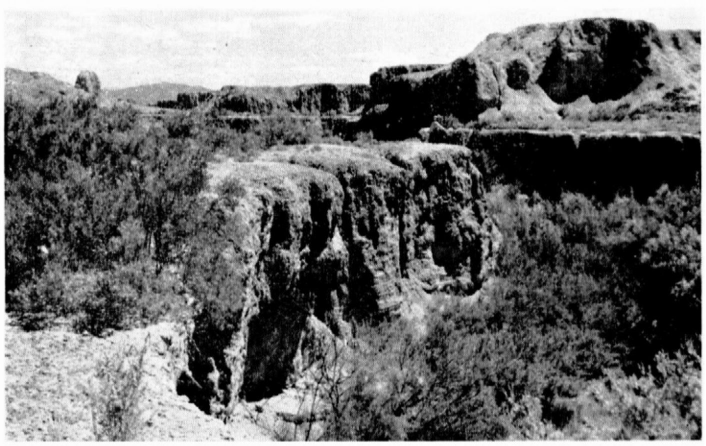

Figure 11.—An area of Gullied land along drainageways in Billings and Christianburg soils.

Gullied land is of little use except as native range. Even this use is limited because the gullies prevent free movement of animals and the vegetation is sparse. (Capability unit VIIIes-1 nonirrigated)

Hinman Series

The soils of the Hinman series are deep, well drained or moderately well drained, and moderately fine textured or fine textured. They formed on alluvial fans and valley side slopes in moderately uniform, calcareous old alluvium derived from many kinds of sedimentary and crystalline rock. Soils of this series are most extensive west and south of the town of Delta and west of the town of Montrose. The total acreage is moderate.

Hinman soils have a light brownish-gray or dark grayish-brown, friable, granular surface layer 4 to 6 inches thick. They have a light brownish-gray to grayish-brown, moderately well developed subsoil of clay loam or clay that has moderate prismatic and blocky structure. The substratum, below a depth of 18 or 20 inches, is pinkish-gray or brown, calcareous gravelly loam or clay loam. A moderate accumulation of secondary calcium carbonate occurs in the lower part of the subsoil and the upper part of the substratum. Typically, the depth to bedrock is 60 inches or more. Below a depth of 20 or 30 inches, the content of gravel rapidly increases, and in some areas it is more than 50 percent below a depth of 40 inches.

These soils are not highly susceptible to erosion. The organic-matter content is moderately high, and the structure is stable.

Typical profile of Hinman clay loam, 0.1 mile east and 100 feet south of the center of sec. 36, T. 49 N., R. 10 W. (Montrose County):

A1—0 to 4 inches, light clay loam; light brownish gray (10YR 6/2) when dry, dark grayish brown (10YR 4/2) when moist; moderate, medium, granular structure; hard when dry, very friable when moist; noncalcareous; pH 7.8; clear, smooth boundary.

B2t—4 to 12 inches, heavy clay loam or light clay; light brownish gray (10YR 6/2) when dry, dark grayish brown (10YR 4/2) when moist; moderate, fine, prismatic structure breaking to moderate or strong, fine, angular and subangular blocky; extremely hard when dry, firm when moist, very plastic when wet; thin, nearly continuous clay films; weakly calcareous; pH 7.8; gradual, smooth boundary.

B3ca—12 to 19 inches, light clay loam; pinkish gray (7.5YR 6/2) when dry, brown (7.5YR 5/2) when moist; weak to moderate, fine, prismatic structure breaking to moderate, fine, subangular blocky; very hard when dry, friable when moist; thin, patchy clay films; weak accumulation of secondary calcium carbonate concretions; calcareous; pH 8.0; gradual, smooth boundary.

C1ca—19 to 29 inches, heavy loam; pinkish gray (7.5YR 6/2) when dry, brown (7.5YR 5/2) when moist; massive; hard when dry, very friable when moist; moderate accumulation of secondary calcium carbonate occurring as concretions or streaks and in seams; calcareous; pH 8.2 gradual, smooth boundary.

C2ca—29 to 60 inches +, gravelly loam; pinkish gray (7.5YR 6/2) when dry, brown (7.5YR 5/2) when moist; massive; hard when dry, friable when moist; gravel makes up 20 to 30 percent of upper part and as much as 50 to 60 percent of lower part; weak accumulation of secondary calcium carbonate occurring as concretions and as coatings on gravel; calcareous; pH 8.2.

The surface layer normally is clay loam, but in places it is so thin that clay turned up from the subsoil in tillage predominates to a depth of 6 or 7 inches. Typically, the accumulation of secondary calcium carbonate is moderate in the lower part of the subsoil and in the substratum, but it is strong in some profiles. The amount of gravel varies. Gravel occurs throughout the profile in some places and nearly everywhere increases in amount downward.

Hinman soils have a finer textured subsoil than Mesa soils, which they adjoin in many places, and normally have a weaker accumulation of secondary calcium carbonate. Hinman soils have a coarser textured and more gravelly substratum than Colona soils, which lack a distinct accumulation of silicate clay in the subsoil. They have a finer textured subsoil and somewhat more gravel in the substratum than Mack soils, with which they occur.

Shadscale, snakeweed, big sagebrush, galleta, Indian ricegrass, blue grama, and needle-and-thread are the principal plants. These soils are productive. They are used as native range or, if irrigation water is available, as cropland.

Hinman clay loam, 0 to 2 percent slopes (HcA).—This soil is on old alluvial fans. It has a profile similar to the one described as typical of the Hinman series. It is extensive throughout the western half of the Area.

This soil can be used successfully for tilled crops if irrigation water is available, but it requires careful management under irrigation because the subsoil is fine textured. This soil is not highly susceptible to erosion. (Capability unit VIe–1 nonirrigated; Hs–1 irrigated)

Luhon Series

The soils of the Luhon series are deep, well drained, and moderately fine textured. They are grassland soils that formed on alluvial fans in uniform, strongly calcareous alluvium derived from sedimentary rock. Soils of this series are moderately extensive in the Area. The largest acreage is in Bostwick Park.

Luhon soils have a light brownish-gray to grayish-brown, friable, granular surface layer 3 to 5 inches thick. They have a light-brown subsoil that is moderately fine textured and calcareous and has weak, prismatic or subangular blocky structure. The substratum, below a depth of 8 to 12 inches, is pinkish-white, very strongly calcareous loam or clay loam. These soils have strong concentrations of secondary calcium carbonate in the uppermost 30 inches. Normally, the depth to bedrock is 60 inches or more.

These soils are highly susceptible to erosion. The organic-matter content is fairly low, and the structure is unstable.

Typical profile of Luhon clay loam, one-fourth mile east and 400 feet north of the center of sec. 15, T. 49 N., R. 8 W. (Montrose County):

A1—0 to 3 inches, light clay loam; light brownish gray (10YR 6/2) when dry, dark grayish brown (10YR 4/2) when moist; moderate, fine, granular structure; slightly hard when dry, very friable when moist; calcareous; pH 8.0; gradual, smooth boundary.

AC—3 to 8 inches, light clay loam; light brown (7.5YR 6/3) when dry, brown or dark brown (7.5YR 4/3) when moist; weak to moderate, medium, prismatic structure breaking to weak to moderate, medium, subangular blocky; hard when dry, very friable when moist; calcareous; pH 8.0; gradual, smooth boundary.

C1ca—8 to 30 inches, light clay loam; pinkish white (7.5YR 8/2) when dry, pinkish gray (7.5YR 6/2) when moist; massive; hard when dry, friable when moist; strong accumulation of secondary calcium carbonate, principally in finely divided forms; calcareous; pH 8.2; gradual, smooth boundary.

C2ca—30 to 60 inches, light clay loam; pinkish gray (7.5YR 7/2) when dry, brown (7.5YR 5/2) when moist; massive; very hard when dry, friable when moist; moderate accumulation of secondary calcium carbonate, principally as concretions and in thin seams and streaks; 10 to 15 percent of horizon may be stones and cobblestones; calcareous; pH 8.2.

On the surface in some places is a scattering of gravel and cobblestones derived from adjacent areas of glacial till. The depth to the maximum accumulation of secondary calcium carbonate generally is between 8 and 16 inches.

Luhon soils are redder than Billings soils, which lack a strong concentration of secondary calcium carbonate. Luhon soils resemble Genola soils, which also lack a strong concentration of secondary carbonate. Luhon soils have a stronger concentration of calcium carbonate than Fruita soils but, unlike those soils, lack a distinct accumulation of silicate clay minerals.

In their natural state, Luhon soils have a fair cover of blue grama, galleta, western wheatgrass, and sage. They can be irrigated successfully and used for suitable crops.

Luhon clay loam, 2 to 5 percent slopes (LcB).—This soil is at the lower end of alluvial fans. It has a profile similar to the one described as typical of the Luhon series. All the acreage is in the western part of Bostwick Park.

This soil supports a fair cover of blue grama, galleta, western wheatgrass, and sage. It can be tilled with moderate success if irrigation water is available. This soil is highly susceptible to erosion. (Capability unit VIe–2 nonirrigated; IIIe–3 irrigated)

Luhon clay loam, 5 to 10 percent slopes (LcC).—This soil is on alluvial fans. It has a profile similar to the one described as typical of the Luhon series. Most of the acreage is in the western part of Bostwick Park.

This soil has a fair cover of blue grama, galleta, western wheatgrass, and sage. It can be tilled with moderate success if irrigation water is available, but it is somewhat less suitable for crops than Luhon clay loam, 2 to 5 percent slopes. Irrigated pasture crops or other close-growing crops are better suited. If unprotected, this soil is highly susceptible to erosion, particularly gully erosion. (Capability unit VIe–2 nonirrigated; IVe–2 irrigated)

Luhon gravelly clay loam, 5 to 10 percent slopes (LgC).—This soil is on alluvial fans, generally adjacent to areas of glacial till or in areas from which till has been removed. The profile is similar to the one described as typical of the Luhon series, but a mantle of gravel covers the surface. The largest areas are on the western slopes in Bostwick Park.

This soil supports a fair cover of blue grama, galleta, western wheatgrass, and sage. It can be tilled if irrigated, but the gravel interferes with tillage, is hard on farm machinery, and decreases yields to some extent. This soil is susceptible to erosion but is somewhat less susceptible than the nongravelly Luhon soils on slopes of 5 to 10 percent. (Capability unit VIe–2 nonirrigated; IVe–2 irrigated)

Luhon stony clay loam, 5 to 10 percent slopes (LsC).—This soil is on alluvial fans and valley side slopes and generally is adjacent to areas of glacial till or in areas from which till has been largely removed. The profile is similar to the one described as typical of the Luhon series, but stones and boulders are on the surface. All of this soil is on the western slopes in Bostwick Park.

This soil has a fair cover of western wheatgrass, junegrass, sage, and blue grama. Because of the stones, it is generally unsuitable for cultivation. It is tilled only where it occurs as small areas within fields of tilled soils. It is moderately susceptible to gullying, and some areas are severely gullied. (Capability unit VIIs–1 nonirrigated)

Luhon and Travessilla soils (Lt).—These soils are at the upper end of alluvial fans and on side slopes. The profile of the Luhon soil is similar to the one described as typical of the Luhon series, and the profile of the Travessilla soil is similar to the one described as typical of the Travessilla series. In some places sandstone bedrock occurs at or near the surface, and in other places the surface is mantled with stones and boulders. The Travessilla soil, which is shallow, is closer to the areas of exposed bedrock than the Luhon soil, which is deep. The slope range is 2 to 10 percent. These soils are in Bostwick Park.

These soils are suitable only for native range. They have a fair cover of western wheatgrass, junegrass, brush, sage, and juniper. This cover is somewhat better on the Luhon soil than on the Travessilla soil. Because of the fairly large amount of water that runs off, gully erosion is a hazard, not only to these soils but also to soils downslope. (Capability unit VIIs-1 nonirrigated)

Mack Series

The soils of the Mack series are deep, well drained, and moderately fine textured. They formed on upland slopes and old alluvial fans in uniform, calcareous old alluvium derived principally from sandstone. Soils of this series are moderately extensive in the Area, principally in the western third.

Mack soils have a pale-brown or brown, friable, granular surface layer 3 to 4 inches thick. They have a light-brown or brown, moderately well developed B2t horizon of sandy clay loam that has moderate, prismatic to subangular blocky structure. The substratum, below a depth of 15 or 16 inches, is light-brown or brown, calcareous loam or sandy clay loam that has some channery fragments of sandstone in the lower part. Strong accumulations of secondary calcium carbonate occur in the lower part of the subsoil and in the upper part of the substratum.

These soils are moderately susceptible to erosion. The organic-matter content is moderately high, and the structure is unstable.

Typical profile of Mack clay loam, 480 feet east of the southwest corner of the NW¼ of sec. 20, T. 51 N., R. 11 W. (Delta County):

A1—0 to 4 inches, light clay loam; pale brown (10YR 6/3) when dry, brown or dark brown (10YR 4/3) when moist; moderate, fine, granular structure; slightly hard when dry, very friable when moist; weakly calcareous; pH 7.8; clear, smooth boundary.

B2t—4 to 12 inches, sandy clay loam; light brown (7.5YR 6/4) when dry, brown or dark brown (7.5YR 4/4) when moist; moderate, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard when dry, very friable when moist; thin, patchy clay films; about 2 percent of horizon is fragments of sandstone; weakly calcareous; pH 7.8; clear, smooth boundary.

B3ca—12 to 16 inches, loam; light brown (7.5YR 6/4) when dry, brown (7.5YR 5/4) when moist; weak, medium, subangular blocky structure; hard when dry, very friable when moist; weak accumulation of secondary calcium carbonate concretions; about 2 percent of horizon is fragments of sandstone; calcareous; pH 8.2; clear, smooth boundary.

C1ca—16 to 24 inches, loam; white (10YR 8/2) when dry, very pale brown (10YR 7/3) when moist; massive; hard when dry, very friable when moist; strong accumulation of secondary calcium carbonate, principally in finely divided forms; about 5 percent of horizon is fragments of sandstone; calcareous; pH 8.2; gradual, smooth boundary.

C2ca—24 to 60 inches, channery sandy clay loam; light brown (7.5YR 6/4) when dry, brown (7.5YR 5/4) when moist; massive; hard when dry, friable when moist; about 15 percent of horizon is fragments of sandstone; moderate accumulation of secondary calcium carbonate, principally concretions; calcareous; pH 8.2.

Mack soils typically have a surface layer of loam or fine sandy loam, but the surface layer is so thin in this Area that clay loam from the subsoil makes up most of the uppermost 7 inches. These soils typically are weakly calcareous, but in some places they are noncalcareous to a depth of 8 to 12 inches. In most places there is only a scattering of gravel in the surface layer and subsoil, but where Mack soils are adjacent to Mesa soils, they have a mantle of gravel and cobblestones in places. Although the lower part of the substratum generally is 10 to 15 percent sandstone fragments, in some places there are few or no fragments.

Mack soils adjoin Mesa soils in many places. They lack the very gravelly substratum that is typical of Mesa soils. They resemble Orchard soils, but the parent material of Mack soils contained little or no material derived from basalt or from ferromagnesian minerals. In addition, Mack soils have a distinct accumulation of silicate clay, which Orchard soils lack. Mack soils are similar to Doak soils but, unlike those soils, have a strong accumulation of secondary calcium carbonate in the lower subsoil and upper substratum.

The native vegetation consists of shadscale and a scattered stand of big sagebrush, rabbitbrush, snakeweed, galleta, blue grama, and pricklypear. These soils are productive. If irrigated and carefully managed, they are suited to all the commonly grown crops.

Mack clay loam, 0 to 2 percent slopes (MaA).—This soil is on uplands and old alluvial fans. It has a profile similar to the one described as typical of the Mack series. The largest acreage is in the western third of the Area.

This soil can be tilled successfully if irrigation water is available. It is only moderately susceptible to erosion. (Capability unit VIe-1 nonirrigated; IIe-1 irrigated)

Mack clay loam, 2 to 5 percent slopes (MaB).—This soil is on upland slopes and old alluvial fans. It has a profile similar to the one described as typical of the Mack series. Most of the acreage is in the western third of the Area.

This soil is suited to tilled crops and produces good yields of suitable crops if well managed. It is more difficult to irrigate than Mack clay loam, 0 to 2 percent slopes. It is moderately susceptible to erosion if poorly managed. (Capability unit VIe-1 nonirrigated; IIIe-1 irrigated)

Mack clay loam, 5 to 10 percent slopes (MaC).—This soil is on upland slopes and old alluvial fans. It has a profile similar to the one described as typical of the Mack series, but the surface layer and subsoil generally are thinner. This soil is mainly in the western third of the Area.

Because of the slope, this soil is difficult to irrigate and is better suited to native range than to tilled crops. It is moderately susceptible to erosion, particularly gully erosion. (Capability unit VIe-1 nonirrigated; IVe-2 irrigated)

Mack gravelly clay loam, 0 to 2 percent slopes (MgA).—This soil is on alluvial fans, generally near Mesa soils, from which it has received gravelly material. The profile is similar to the one described as typical of the Mack series, but the surface layer is 15 to 40 percent gravel and cobblestones. The largest acreage is in the northwestern part of the Area.

This soil generally is used as native range unless it occurs within fields of tilled soils. Tillage is difficult because of the gravel and cobblestones. Some areas cannot be tilled unless gravel and cobblestones are removed. This soil is moderately susceptible to erosion if poorly managed. (Capability unit VIe–1 nonirrigated; IIIs–2 irrigated)

Menoken Series

The soils of the Menoken series are moderately deep, well drained or moderately well drained, and moderately fine textured. They formed on upland slopes and at the upper end of alluvial fans in uniform, calcareous parent material weathered residually from the underlying shale and siltstone. Soils of this series are moderately extensive in the Area, mainly east and south of the town of Olathe.

Menoken soils have a light brownish-gray or grayish-brown, friable, granular surface layer 4 to 5 inches thick. They have a light yellowish-brown or light olive-brown, moderately fine textured subsoil that has weak, prismatic structure or moderate, subangular blocky structure. The substratum, below a depth of 14 to 18 inches, is light brownish-gray, calcareous clay loam. A weak accumulation of secondary calcium carbonate occurs in the lower part of the subsoil and in the upper part of the substratum. The depth to bedrock ranges from 18 to 40 inches.

These soils are highly susceptible to erosion, particularly gully erosion. The organic-matter content is low, and the structure is unstable.

Typical profile of Menoken clay loam, 1,200 feet east and one-fourth mile north of the center of sec. 11, T. 50 N., R. 10 W. (Montrose County):

A1—0 to 5 inches, light clay loam; light brownish gray (10YR 6/2) when dry, grayish brown (10YR 5/2) when moist; moderate, fine, granular structure; slightly hard when dry, very friable when moist; calcareous; pH 8.0; clear, smooth boundary.

B2—5 to 14 inches, light clay loam; light yellowish brown (2.5Y 6/3) when dry, light olive brown (2.5Y 5/3) when moist; weak to moderate, medium, subangular blocky structure; hard when dry, friable when moist; few, thin, patchy clay films; calcareous; pH 8.0; gradual, smooth boundary.

C1ca—14 to 26 inches, light clay loam; light brownish gray (2.5Y 6/2) when dry, grayish brown (2.5Y 5/2) when moist; massive; hard when dry, friable when moist; weak accumulation of secondary calcium carbonate occurring as small concretions and thin seams and streaks; a few crystals of calcium sulfate; calcareous; pH 8.4; gradual, smooth boundary.

R—26 inches +, shale and siltstone; grayish brown to yellow; platy; soft; unweathered or partly weathered; calcareous.

These soils typically are calcareous at the surface, but in some places they are leached to a depth of 6 inches. The depth to bedrock ranges from 18 to 40 inches; it is hard to determine in some places because the upper part of the bedrock is so strongly weathered. Concretions of calcium carbonate and calcium sulfate range from weak to moderate, and in some places there is no calcium sulfate.

In this Area Menoken soils are mapped only with Chacra soils. Menoken soils, which adjoin Billings soils in many places, are shallower to bedrock than those soils and have a more weakly developed subsoil. Menoken soils closely resemble Persayo soils but are deeper to bedrock and have a more strongly developed subsoil. Menoken soils are finer textured than Chipeta soils, are deeper to bedrock, and have a more strongly developed subsoil.

Menoken soils support shadscale, mat saltbush, Gardner saltbush, and a scattered stand of galleta, Salina wildrye, and squirreltail grasses.

Menoken-Chacra clay loams, 0 to 2 percent slopes (MkA).—These soils occur on upland slopes where bedrock is fairly near the surface. The Menoken soil has a profile similar to the one described as typical of the Menoken series, and the Chacra soil has a profile similar to that of the Chacra series. These soils are principally in the eastern and southeastern parts of the Area.

If irrigated, these soils can be used successfully for tilled crops. Shale bedrock near the surface restricts drainage, and consequently overirrigation could cause a harmful accumulation of soluble salts in places. These soils are moderately susceptible to erosion if poorly managed. (Capability unit VIs–1 nonirrigated; IVs–2 irrigated)

Mesa Series

The soils of the Mesa series are deep, well drained, and moderately fine textured. They are grassland soils that formed on mesas and high terraces in gravelly or very gravelly, calcareous alluvium of mixed mineralogy. Soils of this series are extensive in this Area, mainly in the western half.

Mesa soils have a pinkish-gray or brown, friable, granular surface layer 3 to 4 inches thick. They have a moderately well developed, brown or light-brown subsoil that is moderately fine textured and has moderate, prismatic and blocky structure. The substratum, below a depth of 15 to 16 inches, is very pale brown or brown loam that is calcareous and very gravelly and cobbly. A strong accumulation of secondary calcium carbonate occurs in the lower part of the subsoil and the upper part of the substratum. Generally, the depth to bedrock is 60 inches or more.

These soils are susceptible to erosion if poorly managed. The organic-matter content is fairly low, and the structure is only moderately stable.

Typical profile of a Mesa soil, 1/10 mile south and 1/4 mile east of the center of sec. 1, T. 49 N., R. 10 W. (Montrose County):

A1—0 to 4 inches, loam; pinkish gray (7.5YR 6/2) when dry, brown or dark brown (7.5YR 4/2) when moist; moderate to strong, fine, granular structure; hard when dry, very friable when moist; noncalcareous; pH 7.6; clear, smooth boundary.

B2t—4 to 12 inches, clay loam; light brown (7.5YR 6/3) when dry, brown or dark brown (7.5YR 4/3) when moist; moderate, fine, prismatic structure breaking to moderate to strong, fine, subangular blocky; hard when dry, very friable when moist; thin, nearly continuous clay films; 5 to 10 percent gravel; noncalcareous; pH 7.4; clear, smooth boundary.

B3ca—12 to 16 inches, clay loam; pink (7.5YR 7/4) when dry, brown (7.5YR 5/4) when moist; weak, medium, prismatic structure breaking to weak, medium, subangular blocky; hard when dry, very friable when moist; few thin, patchy clay films; 5 to 10 percent gravel; weak accumulation of secondary calcium carbonate concretions; calcareous; pH 8.0; gradual, smooth boundary.

C1ca—16 to 32 inches, gravelly clay loam; very pale brown (10YR 8/3) when dry, very pale brown (10YR 7/3) when moist; massive; hard when dry, friable when moist; strong accumulation of secondary calcium carbonate in finely divided forms; 40 percent gravel; calcareous; pH 8.2; gradual, smooth boundary.

C2ca—32 to 60 inches, very gravelly clay loam; very pale brown (10YR 7/4) when dry, light yellowish brown (10YR 6/4) when moist; massive; hard when dry, friable when moist; moderate to strong accumulation of secondary calcium carbonate occurring as concretions and as coatings on the underside of rocks; 60 percent gravel; grades downward to gravel and sand at a depth below 60 inches; calcareous; pH 8.2.

Undisturbed Mesa soils normally have a thin surface layer of loam, but in this Area the surface layer is made up of clay loam brought up from the subsoil. Typical Mesa soils are noncalcareous in the surface layer and in the upper part of the subsoil, but locally they are weakly calcareous throughout because they have been irrigated with calcareous water. The gravel content of the subsoil ranges from 0 to as much as 20 percent. In the substratum it ranges from 30 to 70 percent.

In many places Mesa soils are adjacent to Mack soils, which lack the very gravelly and cobbly lower subsoil and substratum typical of Mesa soils. Mesa soils resemble Hinman soils but have a coarser textured subsoil. They closely resemble Orchard soils, but their parent material, unlike that of Orchard soils, contained little or no material derived from basalt or from ferromagnesian minerals.

In their natural state, Mesa soils support a good cover of galleta, Indian ricegrass, needle-and-thread, blue grama, and cactus. If irrigated, they are highly productive and are suited to most crops commonly grown in the Area.

Mesa clay loam, 0 to 2 percent slopes (MlA).—This soil is on top of high mesas. It has a profile similar to the one described as typical of the Mesa series. The total acreage in this Area is large, and most of it is in the western half.

If irrigated, this soil can be used successfully for tilled crops. Because the subsoil is gravelly, there is no need to provide underdrainage before irrigation starts. The water-holding capacity is fair, at least to a depth of 40 to 60 inches, because enough clay loam is mixed with the gravel. These soils are not highly susceptible to erosion. (Capability unit VIe–1 nonirrigated; IIe–1 irrigated)

Mesa clay loam, 2 to 5 percent slopes (MlB).—This soil is on high terraces. It has a profile similar to the one described as typical of the Mesa series. Most of the acreage is west of the Uncompahgre River.

If irrigated and well managed, this soil can be used successfully for tilled crops, but it is not so easy to irrigate as Mesa clay loam, 0 to 2 percent slopes. Underdrainage is free because of the gravelly substratum, and unless bedrock is near the surface, drainage and salinity problems are not likely to develop. This soil is not highly susceptible to erosion. (Capability unit VIe–1 nonirrigated; IIIe–1 irrigated)

Mesa clay loam, 5 to 10 percent slopes (MlC).—This soil is on old mesas and terraces. It has a profile similar to the one described as typical of the Mesa series, but the surface layer and subsoil are thinner and there is a higher percentage of gravel in the subsoil. This soil is west of the Uncompahgre River.

Because of the slope, this soil is difficult to manage, and it generally is used as native range. It is moderately susceptible to erosion. (Capability unit VIe–1 nonirrigated; IVe–2 irrigated)

Mesa gravelly clay loam, 0 to 2 percent slopes (MoA).—This soil is on old high terraces. It has a profile similar to the one described as typical of the Mesa series, but the surface layer is 15 to 30 percent gravel and cobblestones. The main acreage is west of the Uncompahgre River.

Some of this soil is tilled, but gravel and cobblestones make tillage difficult and are hard on farm machinery. Some of the larger stones should be removed. This soil is not highly susceptible to erosion. (Capability unit VIe–1 nonirrigated; IIIs–2 irrigated)

Mesa gravelly clay loam, 2 to 5 percent slopes (MoB).—This soil is partly on old high terraces and alluvial fans and partly along small drainageways that have cut into the terraces. The profile is similar to the one described as typical of the Mesa series, but the surface layer is 15 to 30 percent gravel and cobblestones. Most of the acreage is west of the Uncompahgre River.

This soil supports a good cover of galleta, needle-and-thread, blue grama, and cactus. If irrigated, it can be used successfully for tilled crops, but stones and gravel make tillage difficult and are hard on farm machinery. Some of the larger stones should be removed. This soil is not highly susceptible to erosion. (Capability unit VIe–1 nonirrigated; IIIe–1 irrigated)

Mesa gravelly clay loam, 5 to 10 percent slopes (MoC).—This soil is on high terraces and along the small streams that have cut into the terraces. It has a profile similar to the one described as typical of the Mesa series, but the surface layer is 15 to 40 percent gravel and cobblestones. Most of the acreage is west of the Uncompahgre River.

This generally is used as native range. It is used as cropland only where it occurs in fields with soils that are tilled. This soil is difficult to irrigate because of the slope and is difficult to till because of the gravel and cobblestones. It is not highly susceptible to erosion. (Capability unit VIe–1 nonirrigated; IVe–2 irrigated)

Mesa gravelly clay loam, shale substratum, 0 to 2 percent slopes (MsA).—This soil is at the outer edge of old terraces where alluvial sediments are thin and overlie sedimentary rock. It has a profile similar to the one described as typical of the Mesa series, but the surface layer is 15 to 40 percent gravel and cobblestones, and the depth to shale beds is between 30 and 60 inches. Most of the acreage is west of the Uncompahgre River.

This soil can be used successfully for tilled crops, but the gravel and cobblestones make tillage difficult and are hard on farm machinery. In addition, the shale substratum restricts subsoil drainage and is likely to cause problems of drainage and salinity. This soil is not highly susceptible to erosion. (Capability unit VIe–1 nonirrigated; IVs–2 irrigated)

Mesa gravelly clay loam, shale substratum, 5 to 10 percent slopes (MsC).—This soil is partly at the outer edge of high terraces where alluvial deposits are thin and overlie sedimentary rock and partly along small streams that drain the terraces. The profile is similar to the one described as typical of the Mesa series, but the surface layer is 15 to 40 percent gravel and cobblestones, and the depth to shale bedrock is between 30 and 60 inches. The main acreage is on the mesas west of the Uncompahgre River.

This soil generally is used as native range. Because of the slope and the gravel and cobblestones, it is not generally tilled. It is moderately susceptible to erosion. (Capability unit VIe–1 nonirrigated; IVe–2 irrigated)

Mesa stony clay loam, 2 to 10 percent slopes (MtC).—This soil is on high terraces and old alluvial fans, generally next to rough and stony uplands. It has a profile similar to the one described as typical of the Mesa series, but it has a mantle of stones and boulders. The main acreage is west of the Uncompahgre River.

This soil generally is used as native range. It is not suited to tillage, since it is impractical to remove the stones. It is moderately susceptible to erosion. (Capability unit VIIs–3 nonirrigated)

Orchard Series

The soils of the Orchard series are deep, well drained, and moderately fine textured. They are grassland soils that formed on high terraces and old alluvial fans in gravelly, calcareous alluvium derived principally from basalt or from ferromagnesian-rich rock. Soils of this series are moderately extensive in the Area and occur mainly in the northern and northeastern parts.

Orchard soils have a light brownish-gray or dark grayish-brown, friable, granular surface layer 4 to 5 inches thick. They have a moderately well developed, brown or light-brown subsoil of clay loam that has moderate, prismatic and blocky structure. The substratum, which begins 18 to 20 inches below the surface, is white or light-gray, very strongly calcareous very gravelly loam or clay loam. A strong accumulation of secondary calcium carbonate occurs in the lower subsoil and upper substratum. The depth to bedrock generally is 60 inches or more.

These soils are gravelly in the lower part of the subsoil and are increasingly gravelly with depth. Below a depth of 60 inches they grade to basaltic sand and gravel.

These soils are susceptible to erosion. The organic-matter content is fairly low, and the structure is moderately stable.

Typical profile of Orchard clay loam, 1/4 mile south and 1/10 mile east of the northwest corner of sec. 1, T. 15 S., R. 95 W. (Delta County):

A1—0 to 5 inches, light clay loam; light brownish gray (10YR 6/2) when dry, dark grayish brown (10YR 4/2) when moist; moderate, medium, crumb and granular structure; slightly hard when dry, very friable when moist; weakly calcareous; pH 7.8; clear, smooth boundary.

B2t—5 to 14 inches, clay loam; brown (7.5YR 5/3) when dry, brown or dark brown (7.5YR 4/3) when moist; moderate, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard when dry, friable when moist; many thin, patchy clay films; about 10 percent gravel; weakly calcareous; pH 7.8; gradual, smooth boundary.

B3ca—14 to 19 inches, light clay loam; pinkish gray (7.5YR 6/2) when dry, brown (7.5YR 5/2) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; weak accumulation of secondary calcium carbonate concretions; few, thin, patchy clay films; 10 percent basaltic gravel; calcareous; pH 8.0; gradual, smooth boundary.

C1ca—19 to 46 inches, very gravelly loam or clay loam; white (10YR 8/2) when dry, light gray (10YR 7/2) when moist; massive; hard when dry, friable when moist; strong accumulation of secondary calcium carbonate in finely divided forms; 40 to 60 percent basaltic gravel; calcareous; pH 8.4; gradual, smooth boundary.

C2ca—46 to 60 inches +, very gravelly loam; pinkish gray (7.5YR 7/2) when dry, pinkish gray (7.5YR 6/2) when moist; massive; hard when dry, friable when moist; moderate accumulation of secondary calcium carbonate, principally concretions; 60 to 70 percent basaltic gravel; calcareous; pH 8.4.

Typically, the surface layer is light clay loam, but in some places it is loam to a depth of 4 inches. In exposed cuts the basaltic sand, gravel, and stones impart a dark-gray coloration. Orchard soils normally are almost free of gravel to a depth of 15 inches, but in some places they are gravelly throughout. Untilled areas generally are noncalcareous in the uppermost 4 to 6 inches.

In many places Orchard soils adjoin Mesa soils, which formed in mixed mineral material instead of in material derived from basalt or from ferromagnesian minerals. Orchard soils occur with Mack soils, which lack ferromagnesian influence and have a much more gravelly substratum than Orchard soils.

In their natural state, Orchard soils have a good cover of galleta, Indian ricegrass, western wheatgrass, blue grama, and sage. They are productive soils, if irrigated and properly managed, and are well suited to most crops. Many areas are used for orchards.

Orchard clay loam, 0 to 2 percent slopes (OcA).—This soil is on high terraces. It has a profile similar to the one described as typical of the Orchard series. It occurs throughout the Area.

If irrigated, this soil can be used successfully for tilled crops. Many areas are used for fruit orchards. This soil is only moderately susceptible to erosion. (Capability unit VIe–1 nonirrigated; IIe–1 irrigated)

Orchard clay loam, 2 to 5 percent slopes (OcB).—This soil is on high terraces. It has a profile similar to the one described as typical of the Orchard series.

If irrigated, this soil can be used successfully for tilled crops, but it is better suited to close-growing crops. A few areas are used for fruit orchards. This soil is only moderately susceptible to erosion. (Capability unit VIe–1 nonirrigated; IIIe–1 irrigated)

Orchard gravelly clay loam, 0 to 2 percent slopes (OgA).—This soil is on high terraces. It has a profile similar to the one described as typical of the Orchard series, but the surface layer is 15 to 40 percent basaltic gravel.

This soil can be used successfully for tilled crops, although the gravel in the surface layer is hard on farm machinery and makes tillage somewhat difficult. This soil is only moderately susceptible to erosion. (Capability unit VIe–1 nonirrigated; IIIs–2 irrigated)

Orchard gravelly clay loam, 2 to 5 percent slopes (OgB).—This soil is on high terraces. It has a profile similar to the one described as typical of the Orchard series, but the surface layer is 15 to 40 percent basaltic gravel. The largest acreage is in the northeastern part of the Area.

This soil can be used successfully for tilled crops. Many areas are used for fruit orchards. Many areas have to be leveled before they can be irrigated satisfactorily. This soil is only moderately susceptible to erosion. (Capability unit VIe-1 nonirrigated; IIIe-1 irrigated)

Persayo Series

The soils of the Persayo series are shallow, well drained, and moderately fine textured. They are grassland soils that formed on upland slopes and ridges in a thin layer of calcareous material weathered in place from underlying sedimentary rock. Soils of this series are extensive throughout the Area but occur mainly in the eastern third.

Persayo soils have a pale-yellow or light yellowish-brown, friable, granular surface layer 2 to 3 inches thick. They have a light yellowish-brown or pale-yellow, moderately fine textured, calcareous subsoil that contains a large amount of partly weathered shale chips. The substratum, which begins at a depth of 12 to 15 inches, consists of gray and yellow shale and siltstone that are unweathered or only partly weathered. Concretions of calcium carbonate and crystals of calcium sulfate are common throughout the subsoil and substratum. The depth to bedrock ranges from 8 to 18 inches.

These soils are highly susceptible to erosion. The organic-matter content is low, and the structure is unstable.

Typical profile of Persayo silty clay loam, 0.1 mile north of the southeast corner of sec. 22, T. 51 N., R. 10 W. (Montrose County):

A1—0 to 3 inches, silty clay loam; light yellowish brown (2.5Y 6/3) when dry, light olive brown (2.5Y 5/3) when moist; moderate to strong, fine, granular structure; slightly hard when dry, very friable when moist; calcareous; pH 8.2; gradual, smooth boundary.

C1—3 to 12 inches, silty clay loam; pale yellow (2.5Y 7/3) when dry, light yellowish brown (2.5Y 6/3) when moist; massive or very weak, fine, granular structure; hard when dry, very friable when moist; few calcium sulfate crystals; calcareous; pH 8.2; gradual, smooth boundary.

R—12 inches +, unweathered or partly weathered, gray and yellow, calcareous shale and siltstone.

The principal variations are in depth and hardness of the shale bedrock and in the amount of gypsum in the profile. The surface soil is leached of lime in places.

Persayo soils are coarser textured than Chipeta soils, which they adjoin in many places. They resemble Menoken soils but are less deep to bedrock and have a less well developed subsoil. Persayo soils resemble Travessilla soils but are finer textured in the surface layer and subsoil and are underlain by soft sedimentary rock instead of by hard sandstone.

In their natural state, Persayo soils have a poor cover of weeds, cactus, saltbush, and some native grasses. Small areas that are within tilled fields are tilled along with the other soils.

Persayo silty clay loam, 0 to 2 percent slopes (PeA).—This soil occurs on upland slopes and ridge crests. It has a profile similar to the one described as typical of the Persayo series. The largest acreage is in the eastern third of the Area, north and east of the town of Montrose.

This soil supports a sparse cover of native grasses, weeds, cactus, and saltbush. If irrigated, it is fairly well suited to onions and other shallow-rooted crops. Only a small part is farmed. Where this soil is irrigated, very careful management is needed to control erosion and to prevent waterlogging and salt accumulations. (Capability unit VIs-1 nonirrigated; IVs-3 irrigated)

Persayo silty clay loam, 2 to 5 percent slopes (PeB).—This soil is on upland hills and ridges. It has a profile similar to the one described as typical of the Persayo series. The largest acreage is in the eastern third of the Area.

This soil supports only a sparse cover of native grasses, weeds, cactus, and saltbush. Few areas are tilled, except those that occur within tilled fields. This soil is highly susceptible to erosion. (Capability unit VIIs-2 nonirrigated)

Poudre Series

The soils of the Poudre series are deep, somewhat poorly drained or poorly drained, and medium textured. They are grassland soils that formed on flood plains in stratified, calcareous, highly micaceous material derived from schist and gneiss bedrock. Soils of this series are inextensive in the area and occur only on the flood plains of streams that drain Bostwick Park.

Poudre soils have a gray or very dark gray, friable, granular, highly micaceous surface layer 12 to 14 inches thick. They have a subsoil of gray or very dark gray, calcareous sandy loam that is strongly mottled with iron stains as a result of poor drainage. The substratum, at a depth below 24 to 40 inches, is pale-brown or brown sandy loam. It is calcareous, strongly mottled, and gleyed. There is little or no accumulation of secondary calcium carbonate, but many mica fragments are scattered throughout the profile. The depth to bedrock generally is 60 inches or more.

These soils are not readily susceptible to erosion. The organic-matter content is high, and the structure is stable.

Typical profile of Poudre loam, 1/4 mile south and 1/4 mile east of the center of sec. 33, T. 50 N., R. 8 W. (Montrose County):

A11—0 to 14 inches, loam; gray (10YR 5/1) when dry, very dark gray (10YR 3/1) when moist; moderate, medium, granular structure; slightly hard when dry, very friable when moist; much mica; many large, prominent 7.5YR 4/4 mottles make up 15 percent of mass; weakly calcareous; pH 7.8; gradual, smooth boundary.

A12—14 to 30 inches, sandy loam; gray (10YR 5/1) when dry, very dark gray (10YR 3/1) when moist; weak, medium, subangular blocky structure breaking to weak granular; slightly hard when dry, very friable when moist; much mica; many, large, prominent 7.5YR 4/4 and 10YR 4/2 mottles make up 25 percent of mass; weakly calcareous; pH 7.8; gradual, smooth boundary.

C1—30 to 60 inches, sandy loam; pale brown (10YR 6/3) when dry, brown (10YR 5/3) when moist; massive; slightly hard when dry, very friable when moist; much mica; many, large, prominent 10YR 5/1 and 7.5YR 4/4 mottles make up 25 to 30 percent of mass; calcareous; pH 8.0.

In some places these soils are unmottled to a depth of 12 to 14 inches. In places the lower substratum is olive colored. Dark colors similar to those in the surface layer generally extend to a depth of more than 24 inches. These soils normally are weakly calcareous at the surface, but they are noncalcareous in some places to a depth of 14 to 18 inches.

Poudre soils adjoin Blanyon soils in many places. Poudre soils are much coarser textured and are more poorly drained and more strongly mottled. They are more poorly drained and more strongly mottled than Luhon soils and Bostwick soils, coarse subsoil variant. In addition, Poudre soils are much darker colored than Luhon soils and lack the accumulation of secondary calcium carbonate present in them. Poudre soils lack the distinct accumulation of silicate clay that is characteristic of Bostwick soils that have a coarse subsoil.

Poudre soils support a heavy cover of water-tolerant grasses, rushes, and sedges. These soils are used mainly as range and for native hay.

Poudre loam (0 to 2 percent slopes) (Po).—This soil is in slight depressions on flood plains. The profile is similar to the one described as typical of the Poudre series. All of the acreage is in Bostwick Park.

This soil supports a heavy cover of water-tolerant grasses and sedges. Because of poor drainage, few areas are tilled. Many areas are used for native hay. This soil is not readily susceptible to erosion. (Capability unit VIw–1 nonirrigated; IVw–1 irrigated)

Rance Series

The soils of the Rance series are moderately deep, moderately well drained, moderately fine textured, and highly gypsiferous. They are grassland soils that formed on old alluvial fans and high terraces in gypsiferous parent material, partly residuum derived from the shale bedrock and partly a thin mantle of alluvium. Soils of this series are inextensive in the Area and occur mainly on uplands south and east of the town of Olathe.

Rance soils have a light-brown or brown, friable, granular surface layer 4 to 6 inches thick. They have a pink or light-brown, gypsiferous subsoil of clay loam that has weak structure. The substratum, which begins at a depth of 18 to 20 inches, is pinkish-white to pink, gypsiferous clay loam that grades downward into unweathered gypsiferous shale beds. In the substratum are strong accumulations of calcium sulfate, principally in the form of crystals or finely divided particles. The depth to bedrock ranges from 20 to 40 inches.

These soils are moderately susceptible to erosion. The organic-matter content is low, and the structure is unstable.

Typical profile of Rance clay loam, 1,010 feet west and 1,060 feet north of the southeast corner of sec. 30, T. 51 N., R. 9 W. (Montrose County):

A1—0 to 6 inches, light clay loam; light brown (7.5YR 6/4) when dry, brown (7.5YR 5/4) when moist; moderate, very fine, granular structure; soft when dry, very friable when moist; some gravel; calcareous; pH 8.2; gradual, smooth boundary.

C1cs—6 to 18 inches, light clay loam; pink (7.5YR 7/4) when dry, light brown (7.5YR 6/4) when moist; massive; soft when dry, very friable when moist; weak accumulation of calcium sulfate crystals; some gravel; calcareous; pH 8.2; diffuse, smooth boundary.

C2cs—18 to 40 inches, light clay loam; pinkish white (7.5YR 8/2) when dry, pink (7.5YR 7/3) when moist; massive; soft when dry, very friable when moist; strong accumulation of calcium sulfate occurring as crystals and in finely divided particles; some gravel; calcareous; pH 8.4; diffuse, smooth boundary.

R—40 inches +, gypsiferous gray and yellow shale.

These soils normally have a scattering of pebbles throughout the upper horizons, apparently pebbles derived from old alluvial outwash deposited on gypsiferous shale beds. The depth to bedrock ranges from 18 to 40 inches. The depth to the strong accumulation of calcium sulfate ranges from 12 to 20 inches.

Rance soils are shallower to bedrock than Persayo soils, which they adjoin and which lack strong accumulations of calcium sulfate in the subsoil and substratum. Rance soils resemble the Menoken soils, but Rance soils are not so well developed as Menoken soils, and they contain more calcium sulfate in the substratum. Rance soils are deeper to bedrock than Luhon soils.

In their natural state, Rance soils have only a fair cover of alkali sacaton, saltbush, and some western wheatgrass. A few areas are tilled and used for irrigated crops.

Rance complex, 0 to 2 percent slopes (RaA).—This complex is made up principally of Rance soils that have a profile similar to the one described as typical of the Rance series. Included in mapping were areas of similar but shallower soils, areas of Chipeta soils, and small areas of Billings soils along drainageways. Also included were small areas of Chacra and Menoken soils. This complex occurs principally south and east of the town of Olathe.

These soils contain a large amount of gypsum. Attempts at using them for tilled crops have generally been unsuccessful. Saltbush is the common natural cover. These soils are highly susceptible to erosion. (Capability unit VIs–1 nonirrigated)

Rance complex, 2 to 5 percent slopes (RaB).—This complex is on alluvial fans and old high terraces. Most of it is made up of Rance soils that have a profile similar to the one described as typical of the Rance series. Included in mapping were areas of similar but shallower soils, of Chipeta soils, and of Persayo soils. This complex is principally in the eastern and southeastern parts of the Area.

Attempts at using these soils for tilled crops have met with little success. They are highly susceptible to erosion, and gullies are common. (Capability unit VIIs–2 nonirrigated)

Rance complex, 5 to 10 percent slopes (RaC).—This complex is at the outer margin of old alluvial fans and high terraces where geologic erosion has cut into the old surface. It is principally in the eastern and southeastern parts of the Area. Most of it is made up of Rance soils that have a profile similar to the one described as typical of the Rance series but are not so deep. Included in mapping were areas of Chipeta and Persayo soils in the steeper parts and small areas of Billings soils along drainageways.

These soils are not suited to cultivation. They are highly susceptible to erosion. Gullies are common. (Capability unit VIIs–2 nonirrigated)

Ravola Series

The soils of the Ravola series are deep, well drained, and moderately fine textured. They formed on alluvial fans in uniform, calcareous alluvium derived from gray and olive sedimentary rock. Soils of this series are moderately extensive in the Area, principally in the northeastern part.

Ravola soils have a surface layer of light brownish-gray or dark grayish-brown, granular clay loam 4 to 7 inches thick. They have a subsoil of light brownish-gray to grayish-brown loam that has little or no structure. The substratum, which begins at a depth of 12 or 14 inches, is light brownish-gray to dark grayish-brown calcareous loam. The depth to bedrock normally is 60 inches or more.

These soils are highly susceptible to erosion. The organic-matter content is low, and the structure is unstable.

Typical profile of Ravola clay loam, 350 feet north and 50 feet west of the southeast corner of sec. 1, T. 15 S. R. 95 W. (Delta County):

Ap—0 to 7 inches, clay loam; light brownish gray (2.5Y 6/2) when dry, dark grayish brown (2.5Y 4/2) when moist; moderate, medium, granular and crumb structure; slightly hard when dry, very friable when moist; calcareous; pH 8.0; clear, smooth boundary.

C—7 to 60 inches, loam; light brownish gray (2.5Y 6/2) when dry, grayish brown (2.5Y 5/2) when moist; massive; hard when dry, friable when moist; calcareous; pH 8.2.

In some places the surface layer is loam or fine sandy loam to a depth of 6 or 7 inches. The structure is weak in some places at a depth between 7 and 15 inches. In some places and at variable depths, there are accumulations of secondary calcium carbonate.

Ravola soils are coarser textured than Billings soils, which they commonly adjoin. They are yellower in hue than Genola soils. Their parent material, unlike that of Orchard soils, contained little or no material derived from basalt.

Ravola soils are productive. The native grasses are saltgrass, alkali sacaton, basin wildrye, and western wheatgrass. Big sagebrush, rabbitbrush, and greasewood are prominent brushy plants. If irrigated, Ravola soils are well suited to most crops commonly grown in the Area. A few areas are used for orchards.

Ravola clay loam (0 to 2 percent slopes) (Rl).—This soil is at the lower end of gently sloping alluvial fans. It has a profile similar to the one described as typical of the Ravola series. Most of the acreage is in the northeastern part of the Area.

If irrigated, this soil can be used successfully for tilled crops. It is susceptible to erosion, particularly gullying. (Capability unit VIe–1 nonirrigated; IIe–1 irrigated)

Rock Outcrop and Rough Broken Land

Rock outcrop and Rough broken land (Rr) is made up of shallow soils and bare rock outcrops on the steeply sloping sides of mesas. The higher parts consist of massive cliffs of Cretaceous sandstone, and the lower parts of mixed colluvium. The slope range is 10 to 40 percent. Included in the areas mapped are soils like those described as typical of the Travessilla series and scattered pockets of Shavano soils. The main acreage is in the western part of the Area.

This land type supports a fair cover of grass, sage, and cactus, and a scattering of juniper. It is suitable only as range. The steep slopes and areas of Rock outcrop restrict the movement of livestock and limit the amount of forage available to them. Erosion is a moderate hazard, and gullies are common. (Capability unit VIIs–3 nonirrigated)

Rock Outcrop-Travessilla Association, Rolling

Rock outcrop-Travessilla association, rolling (RtC) is a complex of bare rock outcrops and shallow Travessilla soils on the top, rim, and upper part of steeply sloping mesas. The higher parts consist of massive cliffs of Cretaceous sandstone, and the lower parts of exposed beds of shale and sandstone, colluvium, and shallow soils. The slope range is 10 to 40 percent. The main areas are in the western part of the Area.

This complex is unsuitable for tillage. It is moderately good for range and supports a fair to good cover of native grass, sage, and cactus, and a scattering of juniper. Cattle can move about to some extent on the lower slopes but not on the escarpmentlike upper slopes. The large areas of Rock outcrop limit the amount of forage. Included in mapping were a few areas on gentler slopes where the soil pattern is largely a mixture of sandstone outcrops and shallow Travessilla soils. These areas provide better grazing than generally is available, but the acreage is small. (Capability unit VIIs–3 nonirrigated)

Rock Outcrop-Travessilla Association, Steep

Rock outcrop-Travessilla association, steep (RtE) is a complex that is 90 percent bare rock outcrops and shallow Travessilla soils. Included in the areas mapped are deeper soils of the Luhon series, which have a strong accumulation of calcium carbonate. The slope range is 40 to more than 60 percent. This complex is moderately extensive in the Area and is near the eastern boundary, east of the town of Montrose.

This complex is unsuitable for cultivation. It supports a fair cover of native grass, forbs, and brush suitable for wildlife. The escarpments, steep slopes, and rock outcrops restrict the movement of livestock. Erosion is a moderate hazard. (Capability unit VIIIes–1 nonirrigated)

Rough Broken Land

Rough broken land (Ru) is on the steeply sloping sides of mesas. It consists of exposures of sedimentary shale and sandstone, extremely gravelly alluvial material, colluvial debris, and shallow soils. Typically, Orchard and Mesa soils have formed in the gravelly alluvium, which is at the upper part of the slopes. Midway on the slope are almost barren exposures of sedimentary shale and sandstone. At the base are shallow soils, exposures of sedimentary rock, and colluvial debris. The slope range is 10 to 60 percent. This land type occurs throughout the Area but is mainly in the western and southeastern parts.

This land type is unsuitable for tillage and is used exclusively as native range. It supports a fair to good cover of native grass, sage, cactus, and brush. Many areas are bare, and the steep upper slopes cannot be reached by cattle. Nevertheless, these areas are valuable as range and furnish grazing late in summer and in fall. (Capability unit VIIs-3 nonirrigated)

Rough Broken Land, Shale and Till Materials

Rough broken land, shale and till materials (Rv) occurs on the steeply sloping sides of erosional valleys and isolated mesas. It consists principally of many exposures of barren shale and of soils similar to those described for the Chipeta and Persayo series. In places there is an overwash of stony till. The slope range is 10 to 40 percent. This land type occurs throughout the Area but is most extensive east and south of the town of Montrose.

This land type can be used only as range because of the steep topography and shallow soils. Mat saltbush and shadscale make up most of the cover, which is sparse. Erosion is a serious hazard. In many places gullies have formed an intricate pattern and have cut into the shale parent material. Even when rainfall is normal, large volumes of water run off and wash large amounts of silt onto the surrounding soils. (Capability unit VIIIes-1 nonirrigated)

Rough Stony Land, Shale and Till Materials

Rough stony land, shale and till materials (Rw) occurs on the steep, hilly sides of erosional valleys at the southern edge of Bostwick Park. The slope range is 10 to 50 percent. Some areas are made up of glacial till, and some are made up of fragments of shale and soft sandstone. A mantle of stones and boulders covers the till. Included in mapping were Cerro soils in the glacial till areas and Persayo soils in the shale areas.

This land type is used as native range. It supports a fair cover of native grass and, in some places, a rather dense cover of sagebrush. It is accessible to livestock but is only fairly productive of forage. Erosion is a slight to moderate hazard. The shale areas are most likely to erode. (Capability unit VIIs-3 nonirrigated)

Rough Stony Land, Till Materials

Rough stony land, till materials (Ry) occupies steep and very steep, erosional valleys at the southern edge of Bostwick Park. The slope range is 20 to 60 percent or more. Old glacial deposits are exposed on the upper slopes. On the surface is a mantle of stones and boulders. Included in mapping were small areas of Cerro soils.

This land type is used as native range. It supports a moderately good cover of native grass, oakbrush, and mountain-mahogany, and a scattering of pinyon pine. The lower slopes are easily accessible to livestock. Erosion is a slight to moderate hazard. (Capability unit VIIs-3 nonirrigated)

Saline Wet Land

Saline wet land (Sa) is in low concave areas. The texture ranges from clay to sandy loam, and the color ranges from reddish brown to olive. This land type is poorly drained or very poorly drained. It occurs throughout the irrigated parts of the Area and has a moderately large total acreage.

These areas are poorly drained and excessively saline because of seepage and runoff from irrigated fields upslope. The water table is near the surface during the growing season but recedes in winter. When dry, these areas have a 1- to 2-inch white crust of accumulated salts, mainly calcium carbonate and calcium sulfate but partly other salts. The surface layer is impregnated with salt, is loose and fluffy when dry, and is strongly aggregated.

This land type is unsuitable for cultivation. It supports only a sparse cover of salt- and water-tolerant grass and sedges. (Capability unit VIIIes-1 nonirrigated)

Salt Lake Series

The soils of the Salt Lake series are deep, imperfectly drained or poorly drained, and fine textured. They are grassland soils that formed on flood plains and very gently sloping alluvial fans in uniform, very calcareous alluvium derived from olive and gray sedimentary rock. Soils of this series are inextensive in the Area and occur principally in the valley of the Uncompahgre River, south of the town of Montrose.

Salt Lake soils have a gray to black, granular or subangular blocky surface layer 7 to 18 inches thick. They have a dark-gray to black, fine-textured, calcareous subsoil that is massive or has weak, blocky structure. The substratum, which begins at a depth of 15 to 20 inches, is gray to black, calcareous clay that is strongly mottled with brighter colored streaks and stains. Typically, the depth to bedrock is 60 inches or more. Strong accumulations of secondary calcium carbonate occur in the lower subsoil and substratum.

These soils are not likely to erode if they are well managed. The organic-matter content is moderately high, and the structure is stable.

Typical profile of Salt Lake clay, 800 feet north of the southeast corner of the NE¼ of sec. 8, T. 48 N., R. 9 W. (Montrose County):

O1—1 inch to 0, fibrous organic mat consisting primarily of undecomposed grasses.

A11—0 to 7 inches, clay; gray (10YR 5/1) when dry, black (10YR 2/1) when moist; strong, very fine, angular blocky structure; slightly hard when dry, very friable when moist; calcareous; pH 8.0; clear, smooth boundary.

A12—7 to 15 inches, clay; dark gray (10YR 4/1) when dry, black (2.5Y 2/1) when moist; very weak, coarse, prismatic structure breaking to moderate, fine, angular blocky; hard when dry, very plastic when wet; calcareous; pH 8.0; clear, smooth boundary.

A13ca—15 to 20 inches, clay; dark gray (10YR 4/1) when dry, black (2.5Y 2/1) when moist; weak, coarse, prismatic structure breaking to moderate, medium, angular blocky; extremely hard when dry, very plastic when wet; moderate accumulation of secondary calcium carbonate occurring as small crystals and in seams and streaks; calcareous; pH 8.2; clear, smooth boundary.

C1cag—20 to 60 inches, clay; light gray (5Y 6/1) when dry, dark gray (5Y 4/1) when moist; weak, medium and coarse, subangular blocky structure; extremely hard when dry, very plastic when wet; common, medium, distinct 5Y 4/3 mottles make up about 20 percent of soil mass; strong accumulation of calcium carbonate occurring as large concretions; few slickensides; calcareous; pH 8.0.

Some areas of these soils lack the thin mat of organic material. Mottling ordinarily begins at a depth of 12 to 18 inches and is moderate and distinct. The lower horizons generally are olive in hue. The structure is variable in the lower horizons but generally is moderate to weak blocky throughout the substratum. Concentrations of secondary calcium carbonate, which are characteristic of these soils, start at a depth of 12 to 18 inches and continue downward. They generally occur as concretions ½ to 1 inch in diameter.

Compared to Colona soils, which they adjoin in many places, Salt Lake soils are more poorly drained and have a darker colored surface layer, a more strongly mottled substratum and subsoil, and a stronger accumulation of secondary calcium carbonate. In a few places Salt Lake soils adjoin Christianburg soils, which lack a strong accumulation of secondary calcium carbonate. They are more poorly drained than Christianburg soils and have a darker colored surface layer and a more strongly mottled substratum.

Salt Lake soils support a fairly dense cover of moisture-tolerant native grasses. They are unproductive unless artificially drained. If drained, they can be tilled but are better suited to hay crops.

Salt Lake clay, drained (0 to 2 percent slopes) (Sc).—This soil is on flood plains and alluvial fans where the slope range is 0 to 2 percent. It has a profile similar to the one described as typical of the Salt Lake series. The largest acreage in the Area is west of the Uncompahgre River, south of the town of Montrose.

This soil has been artificially drained and is no longer subject to prolonged wetness nor to a fluctuating water table. It can be used with moderate success for tilled crops but is better suited to hay. It does not erode readily if well managed. (Capability unit VIs–1 nonirrigated; IVs–1 irrigated)

Sandy Land

Sandy land (Sd) consists of wind-reworked material similar to that in which Orchard soils formed. This material was derived from alluvial deposits high in basalt or in ferromagnesian minerals. It is deep, excessively drained, coarse textured, and calcareous. This land type is on old high terraces in the northeastern part of the Area, north of the Gunnison River. The slope range is 5 to 20 percent. The total acreage is small. A typical area is 250 feet west and 100 feet south of the northeast corner of the SE¼ of sec. 4, T. 15 S., R. 95 W. (Delta County).

A surface layer of light brownish-gray or grayish-brown, loose, single-grain sand or loamy sand, 3 to 4 inches thick, overlies light-gray to dark-gray, calcareous fine sand. The sand fraction is typically dark colored. It imparts a gray color to the soil mass in most places. There is no discernible accumulation of calcium carbonate. The organic-matter content is low. The depth to bedrock ordinarily is 60 inches or more.

This land type has little agricultural value except as range. It supports a sparse cover of weeds and grass. It is highly susceptible to further wind erosion. Because the material has a high content of basaltic sand, it is valuable for use in making cinder blocks. (Capability unit VIIe–1 nonirrigated)

Shavano Series

The soils of the Shavano series are moderately deep, well drained, and moderately fine textured. They formed on uplands in calcareous material weathered in place from the underlying sandstone and interbedded soft shale. Soils of this series are moderately extensive in the Area and occur mainly in the western and southeastern parts.

Shavano soils have a light-brown or brown, friable, granular surface layer 4 to 5 inches thick. They have a very pale brown or light yellowish-brown subsoil of calcareous sandy clay loam that has weak prismatic to blocky structure. The substratum, which begins 17 to 18 inches below the surface, is very pale brown to light yellowish-brown, calcareous sandy clay loam that grades into partly weathered sandstone bedrock at a depth ranging from 18 to 40 inches. Weak accumulations of secondary calcium carbonate occur in the lower subsoil and upper substratum.

These soils are moderately susceptible to erosion. The organic-matter content is fairly low, and the structure is moderately stable.

Typical profile of Shavano sandy clay loam, 350 feet east of the northwest corner of sec. 3, T. 48 N., R. 10 W. (Montrose County):

A1—0 to 3 inches, sandy clay loam; light brown (7.5YR 6/3) when dry, brown (7.5YR 5/3) when moist; weak to moderate, fine, granular structure; slightly hard when dry, very friable when moist; calcareous; pH 8.0; clear, smooth boundary.

AC—3 to 7 inches, sandy clay loam; very pale brown (10YR 7/3) when dry, light yellowish brown (10YR 6/4) when moist; moderate to strong, very fine, subangular blocky structure; hard when dry, very friable when moist; calcareous; pH 8.2; gradual, smooth boundary.

Cca—7 to 26 inches, sandy clay loam; very pale brown (10YR 7/3) when dry, light yellowish brown (10YR 6/4) when moist; massive; hard when dry, very friable when moist; some channery and flaggy fragments of sandstone; weak accumulation of secondary calcium carbonate occurring as concretions and as coatings on sandstone fragments; calcareous; pH 8.2; gradual, smooth boundary.

R—26 inches +, hard, weakly weathered, calcareous sandstone.

These soils typically are sandy clay loam throughout, but in some places they have a thin surface layer of fine sandy loam. The sandstone fragments vary in amount and make up less than 30 percent of the surface layer and subsoil. The depth to bedrock ranges from 20 to 30 inches.

Shavano soils are finer textured and deeper to bedrock than Travessilla soils, with which they occur in many places. They resemble Menoken soils but are coarser textured and are underlain by fairly hard sandstone instead of by soft shale. In a few places Shavano soils adjoin Luhon soils. They are sandier than Luhon soils and lack the strong accumulation of secondary calcium carbonate present in those soils.

Sagebrush, shadscale, galleta, blue grama, and western wheatgrass make up most of the cover on Shavano soils. These soils are only moderately productive of tilled crops and are better used as native range.

Shavano sandy clay loam, 2 to 5 percent slopes (ShB).—This soil is on gently sloping and undulating upland hills and ridges and tops of mesas. It has a profile similar to the one described as typical of the Shavano series. Most of the acreage is in the western and southeastern parts of the Area.

This soil supports a fair cover of native grass, brush, and scattered trees and is used primarily as range. It is not suitable for tillage, because bedrock is fairly near the surface. It is moderately susceptible to erosion. (Capability unit VIe-1 nonirrigated; IVe-3 irrigated)

Shavano sandy clay loam, 5 to 10 percent slopes (ShC).—This soil is on the tops of mesas and on upland hills and ridges. It has a profile similar to the one described as typical of the Shavano series. Most of the acreage is in the western and southeastern parts of the Area.

This soil supports a fair cover of native grass, brush, and scattered trees and is used mainly as range. It is not suitable for tillage. It is moderately susceptible to erosion. (Capability unit VIe-1 nonirrigated)

Travessilla Series

The soils of the Travessilla series are shallow, well drained, and moderately coarse textured. They are grassland soils that formed on upland hills and ridges and on the edge of mesas in calcareous material weathered residually from the underlying sandstone bedrock. Soils of this series are moderately extensive in the Area and occur mainly in the western half.

Travessilla soils have a light brownish-gray or grayish-brown, friable, granular surface layer 2 to 3 inches thick. They have a moderately coarse textured, calcareous subsoil that has very weak, subangular blocky structure. The substratum, which begins 12 to 18 inches below the surface, is hard sandstone bedrock.

These soils are moderately susceptible to erosion. They yield large amounts of runoff water. The organic-matter content is low, and the structure is unstable.

Typical profile of Travessilla fine sandy loam, 200 feet north of the southwest corner of sec. 35, T. 49 N., R. 10 W. (Montrose County):

A1—0 to 4 inches, fine sandy loam; light brownish gray (10YR 6/2) when dry, grayish brown (10YR 5/2) when moist; moderate, fine, granular and crumb structure; soft when dry, very friable when moist; calcareous; pH 8.0; clear, smooth boundary.

C—4 to 8 inches, fine sandy loam; light brownish gray (10YR 6/2) when dry, grayish brown (10YR 5/2) when moist; slightly hard when dry, very friable when moist; massive; calcareous; pH 8.2; clear, smooth boundary.

R—8 inches +, hard, calcareous sandstone.

These soils are fairly uniform. On the surface are varying amounts of loose stones and rocks. In some places a weak accumulation of calcium carbonate occurs above the bedrock, which is at a depth of 8 to 18 inches.

Travessilla soils are coarser textured and shallower to bedrock than Shavano soils, with which they normally occur. They resemble Persayo soils, which also are shallow, but Travessilla soils are coarser textured and are underlain by sandstone bedrock instead of by beds of shale. They are coarser textured and less deep to bedrock than Fruita soils, with which they occur in some places.

In their natural state, Travessilla soils support a moderate cover of galleta, needle-and-thread, three-awn, and juniper. They are not suitable for tillage.

Travessilla fine sandy loam, 0 to 10 percent slopes (TrC).—This soil is on upland hills and ridges. It has a profile similar to the one described as typical of the Travessilla series. It occurs throughout the Area but is most extensive in the western half.

This soil supports a fair cover of galleta, needle-and-thread, three-awn, and juniper. It is not suitable for tillage. If overgrazed it is moderately susceptible to erosion, particularly wind erosion. (Capability unit VIIs-1 nonirrigated)

Uncompahgre Series

The soils of the Uncompahgre series are deep, somewhat poorly drained, and moderately coarse textured to moderately fine textured. They formed on flood plains and low terraces in stratified, calcareous alluvium derived from many kinds of rock. Soils of this series are extensive in this Area, mainly along the Uncompahgre River.

Uncompahgre soils have a gray or very dark gray, friable, granular surface layer 6 to 12 inches thick. They have a gray or dark-gray, stratified but predominantly medium-textured subsoil that is mottled with stains and streaks of gray and brown. The substratum, which begins at a depth of 20 to 30 inches, is light brownish-gray or grayish-brown mixed alluvium that is calcareous and stratified but predominantly medium textured. It is strongly mottled with streaks and stains of gray and brown. The depth to bedrock is 60 inches or more.

These soils are not highly susceptible to erosion. The organic-matter content is moderately high, and the structure is stable.

Typical profile of Uncompahgre loam, 400 feet east and 400 feet north of the center of sec. 7, T. 47 N., R. 8 W. (Montrose County):

A1—0 to 10 inches, loam; gray (10YR 5/1) when dry, very dark gray (10YR 3/1) when moist; moderate, medium, granular structure; slightly hard when dry, very friable when moist; calcareous; pH 8.0; clear, smooth boundary.

ACg—10 to 19 inches, loam; gray (10YR 6/1) when dry, dark gray (10YR 4/1) when moist; stratified with thin lenses of fine sandy loam; massive; hard when dry, friable when moist; common, medium, faint 10YR 4/4 mottles; calcareous; pH 8.0; gradual, smooth boundary.

Cg—19 to 60 inches, loam; light brownish gray (2.5Y 6/2) when dry, grayish brown (2.5Y 5/2) when moist; stratified with thin lenses of fine sandy loam; massive; hard when dry, friable when moist; many, large, distinct 10YR 4/4 mottles; small amount of quartzitic gravel; calcareous; pH 8.2.

The thickness of the surface layer ranges from about 6 to 12 inches. The texture varies from place to place.

Although these soils typically are calcareous throughout, their uppermost few inches is noncalcareous in some places. The degree of and depth to stratification vary widely, but the texture is dominantly loam from a depth of about 8 to a depth of 30 inches. The depth to mottling ranges up to 18 to 20 inches.

Uncompahgre soils are coarser textured, are less well drained, and have a darker colored surface layer than Billings soils, which they adjoin in many places. Uncompahgre soils resemble Genola soils but have a darker colored surface layer and are less well drained. Drainage is comparable to that of Blanyon soils, but Uncompahgre soils are coarser textured, have a darker colored surface layer, and lack the accumulations of silicate clay typical of Blanyon soils.

In their natural state, Uncompahgre soils support a dense cover of grass, willow, and cottonwood. The water table, which is high at least part of each year, harms crops in some places. Nevertheless, these soils are moderately productive and are used for celery and many other crops.

Uncompahgre clay loam (0 to 2 percent slopes) (Uc).—This soil is on flood plains and low terraces. Except for the surface layer, the profile is similar to the one described as typical of the Uncompahgre series. The largest acreage borders the Uncompahgre River.

This soil supports a good cover of native grasses, willows, and scattered cottonwood. It can be tilled successfully but should be artificially drained because the water table is high at some period nearly every year. This soil is not highly susceptible to erosion, but occasionally it is flooded and receives deposits of silt. (Capability unit VIw-2 nonirrigated; IIw-1 irrigated)

Uncompahgre clay loam, wet (0 to 2 percent slopes) (Ug).—This soil is in slight depressions on the flood plains and is wet most of the year. Except for the surface layer, the profile is similar to the one described as typical of the Uncompahgre series, but all layers generally are mottled. All the acreage borders the Uncompahgre River.

This soil supports a fair cover of water-tolerant grass and willow and is used primarily as native range and for native hay. It is not suitable for tilled crops unless artificially drained. It is not highly susceptible to erosion. (Capability unit VIw-2 nonirrigated; IIIw-1 irrigated)

Uncompahgre fine sandy loam (0 to 2 percent slopes) (Uh).—This soil is on flood plains and low terraces. Except for the surface layer, the profile is similar to the one described as typical of the Uncompahgre series. Most of the acreage borders the Uncompahgre River.

This soil supports a fair cover of willow and grass. It can be used for tilled crops, but the water table fluctuates and at some time of the year is near enough to the surface to be damaging to crops. This soil is moderately susceptible to wind erosion. (Capability unit VIw-2 nonirrigated; IIw-1 irrigated)

Uncompahgre gravelly loam (0 to 2 percent slopes) (Um).—This soil generally is on those parts of the flood plain nearest the Uncompahgre River and those adjacent to terraces underlain by sand and gravel. It has a profile similar to the one described as typical of the Uncompahgre series, but the surface layer is 15 to 30 percent gravel.

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This soil supports a good native cover of grass, willow, and scattered cottonwood. The gravel in the surface layer is hard on farm machinery and makes tillage difficult unless the larger pieces are removed. Because of the gravel this soil is somewhat less valuable as cropland than other Uncompahgre soils. It is not highly susceptible to erosion. (Capability unit VIw-2 nonirrigated; IIw-1 irrigated)

Uncompahgre loam (0 to 2 percent slopes) (Un).—This soil is on flood plains and low terraces. It has a profile similar to the one described as typical of the Uncompahgre series. Most areas border the Uncompahgre River.

This soil supports a good native cover of grass, willow, and scattered cottonwood. It can be used for tilled crops, but the water table fluctuates and generally is near enough to the surface at some part of the year to cause damage to crops. This soil is not highly susceptible to erosion, but flooding and deposition of silt are common. (Capability unit VIw-2 nonirrigated; IIw-1 irrigated)

Uncompahgre loam, wet (0 to 2 percent slopes) (Uw).—This soil is in slight depressions on flood plains and low terraces. It has a profile similar to the one described as typical of the Uncompahgre series. Most areas border the Uncompahgre River.

This soil supports a fair cover of water-tolerant grass, willow, and scattered cottonwood. It is likely to be ponded for long periods, and the water table is at or near the surface much of the year; consequently, it is not suitable for tilled crops unless artificially drained. This soil is not highly susceptible to erosion, but it is subject to flooding and siltation. (Capability unit VIw-2 nonirrigated; IIIw-1 irrigated)

Vernal Series

The soils of the Vernal series are deep, well drained, and moderately fine textured. They are grassland soils that formed on stream terraces in fairly uniform, calcareous material underlain by clean sand and gravel. Soils of this series are moderately extensive in the Area, mainly at the edges of the valley of the Uncompahgre River, south and west of the town of Montrose.

Vernal soils have a light-brown to brown, friable, granular surface layer 4 to 5 inches thick. They have a moderately well developed, brown or reddish-brown subsoil that is moderately fine textured and has prismatic and blocky structure. The substratum, which begins 18 to 20 inches below the surface, is light-colored, calcareous, loose sand and gravel. Accumulations of secondary calcium carbonate occur in the lower part of the subsoil and the upper part of the substratum. The depth to bedrock ordinarily is 60 inches or more.

These soils are not highly susceptible to erosion. The organic-matter content is moderate, and the structure is stable.

Typical profile of a Vernal soil, one-fourth mile east and 600 feet north of the southwest corner of sec. 17, T. 49 N., R. 8 W. (Montrose County):

A1—0 to 4 inches, loam; light brown (7.5YR 6/3) when dry, brown or dark brown (7.5YR 4/3) when moist; moderate, fine, granular structure; soft when dry, very friable when moist; noncalcareous; pH 7.2; gradual, smooth boundary.

B2t—4 to 15 inches, clay loam; reddish brown (5YR 5/3) when dry, reddish brown (5YR 4/3) when moist; moderate, fine, prismatic structure breaking to moderate, fine, subangular blocky; hard when dry, friable when moist; thin, patchy clay films on faces of soil aggregates; some quartzitic gravel; noncalcareous; pH 7.4; clear, smooth boundary.

B3ca—15 to 18 inches, gravelly loam; light reddish brown (5YR 6/3) when dry, reddish brown (5YR 5/3) when moist; weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist; few, thin, patchy clay films; weak accumulation of secondary calcium carbonate occurring as concretions and as coatings on gravel fragments and sand; calcareous; pH 8.2; clear, wavy boundary.

IICca—18 to 40 inches +, loose, calcareous, coarse sand, gravel, and cobblestones; fragments in uppermost 12 inches thickly coated with secondary calcium carbonate.

In this Area most Vernal soils have a slightly thicker and finer textured surface layer than is typical of the series, because plowing has mixed the topmost 7 to 10 inches. These soils are moderately uniform. The main variation is in the depth to sand and gravel, which ranges from 15 to 40 inches. The amount of secondary calcium carbonate varies from place to place, but the uppermost 12 inches of the sand and gravel generally has a strong concentration and is weakly cemented in places.

Vernal soils have a lighter colored surface layer than Uncompahgre soils, which they commonly adjoin. Their subsoil and substratum, unlike those of the Uncompahgre soils, are well drained and unmottled and have distinct accumulations of silicate clay. In some places Vernal soils occur with Woodrow soils, which, in contrast, are calcareous throughout and lack a distinct accumulation of silicate clay and a substratum of clean sand and gravel. Vernal soils resemble Mesa soils but have lower water-holding capacity.

In their natural state, Vernal soils support a good cover of galleta, Indian ricegrass, blue grama, and cactus. If irrigated, they can be used for tilled crops. Because of the substratum of coarse sand and gravel, these soils have a somewhat lower water-holding capacity than other soils in the valley of the Uncompahgre River.

Vernal clay loam, 0 to 2 percent slopes (VeA).—This soil is on terraces. It has a profile similar to the one described as typical of the Vernal series. Most areas are south and west of the town of Montrose.

This soil supports a good cover of galleta, Indian ricegrass, blue grama, and cactus. It can be used successfully for tilled crops. It requires frequent irrigation because coarse gravel in the substratum limits the water-holding capacity. (Capability unit VIe–1 nonirrigated; IIIs–2 irrigated)

Vernal clay loam, 2 to 5 percent slopes (VeB).—This soil is at the edge of terraces. It has a profile similar to the one described as typical of the Vernal series. The largest areas are south and west of the town of Montrose.

This soil supports a good cover of galleta, Indian ricegrass, blue grama, and cactus. If irrigated, it can be used successfully for tilled crops, but it is somewhat more difficult to irrigate than Vernal clay loam, 0 to 2 percent slopes. Because of the coarse gravel substratum, the water-storage capacity is moderately low, and frequent irrigation is required. (Capability unit VIe–1 nonirrigated; IIIe–1 irrigated)

Vernal gravelly clay loam, 0 to 2 percent slopes (VgA).—This soil occurs as elongated areas on terraces parallel to river channels. It has a profile similar to the one described as typical of the Vernal series, but the surface layer and subsoil are 15 to 30 percent gravel and cobblestones. Most of the acreage is south and west of the town of Montrose.

This soil supports a good cover of galleta, Indian ricegrass, blue grama, and cactus. If irrigated, it can be used for tilled crops, but the gravel makes tillage difficult and is hard on farm machinery. This soil is not likely to erode if well managed. (Capability unit VIe–1 nonirrigated; IIIs–2 irrigated)

Vernal gravelly clay loam, 2 to 5 percent slopes (VgB).—This soil is on alluvial terraces. It has a profile similar to the one described as typical of the Vernal series, but the surface layer and subsoil are 15 to 30 percent gravel and cobblestones. Most areas of this soil are south and west of the town of Montrose.

This soil supports a good cover of galleta, Indian ricegrass, blue grama, and cactus. Some is tilled and irrigated, but spreading water evenly is difficult because of the slope. Where irrigation is successful, crops can be grown. The gravel in the surface layer makes tillage difficult and is hard on farm machinery. This soil is not likely to erode if well managed. (Capability unit VIe–1 nonirrigated; IIIe–1 irrigated)

Wet Alluvial Land

Wet alluvial land (Wa) varies widely in texture, degree of mottling, and gleying. It is flooded frequently, and the water table is at or near the surface most of the year. Drainage is poor. This land type occurs as fairly small areas along old oxbow channels of the Gunnison River and the Uncompahgre River.

This land type is not suitable for tillage. It supports a cover of water-tolerant grass, willow, and scattered cottonwood. (Capability unit VIIw–1 nonirrigated)

Woodrow Series

The soils of the Woodrow series are deep, well drained, and moderately fine textured. They are grassland soils that formed on alluvial fans in uniform, calcareous alluvium derived from mixed sedimentary rock and Pleistocene deposits. Soils of this series are moderately extensive in this Area and occur principally in the Shavano Valley.

Woodrow soils have a light brownish-gray or dark grayish-brown, friable, granular surface layer 4 to 6 inches thick. They have a brown or dark-brown subsoil of clay loam that has weak, subangular blocky structure. The substratum, which begins 20 to 30 inches below the surface, is brown or dark-brown, calcareous clay loam. In some places the substratum has weak accumulations of secondary calcium carbonate. The depth to bedrock generally is 60 inches or more.

These soils are only moderately susceptible to erosion. The organic-matter content is moderate, and the structure is moderately stable.

Typical profile of Woodrow clay loam, one-fourth mile east of the southwest corner of the SE¼ of sec. 4, T. 48 N., R. 10 W. (Montrose County):

A1—0 to 4 inches, clay loam; light brownish gray (10YR 6/2) when dry, dark grayish brown (10YR 4/2) when moist; moderate, medium, granular structure; soft when dry, very friable when moist; calcareous; pH 8.0; clear, smooth boundary.
AC—4 to 10 inches, clay loam; brown (7.5YR 5/2) when dry, brown or dark brown (7.5YR 4/2) when moist; weak, fine, subangular blocky structure breaking to moderate, medium, granular; slightly hard when dry, very friable when moist; calcareous; pH 8.2; gradual, smooth boundary.
C—10 to 60 inches +, clay loam; brown (7.5YR 5/2) when dry, brown or dark brown (7.5YR 4/2) when moist; massive; hard when dry, very friable when moist; calcareous; pH 8.2.

The surface layer is loam in some small areas. Locally, it is darker colored and less than 4 inches thick. Accumulations of secondary calcium carbonate occur in some places and at variable depths below 10 to 15 inches.

Woodrow soils are finer textured than Genola soils, which they adjoin in many places. They resemble Billings soils but have a redder hue. They adjoin Vernal soils in some places but lack a distinct accumulation of silicate clay and a substratum of sand and gravel.

In their natural state, Woodrow soils support a good cover of galleta, Indian ricegrass, blue grama, and cactus. If irrigated, they can be used for tilled crops.

Woodrow clay loam, 0 to 2 percent slopes (WoA).—This soil is on alluvial fans. It has a profile similar to the one described as typical of the Woodrow series. The main areas are in the Shavano Valley.

This soil supports a good cover of galleta, Indian ricegrass, blue grama, and cactus. If irrigated, it can be used successfully for tilled crops. It is not highly susceptible to erosion. (Capability unit VIe-I nonirrigated; IIe-1 irrigated)

Use and Management of the Soils

This section discusses the general classification of soils according to their relative suitability for farming; the management of the soils of this Area for irrigated crops and for range; the probable yields of irrigated crops; the potential of the soils for use as woodland; and the soil properties that affect highway engineering, conservation engineering, and home building.

Capability Groups of Soils

Capability classification is the grouping of soils to show, in a general way, their suitability for most kinds of farming. It is a practical classification based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment. The soils are classified according to degree and kind of permanent limitation, but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soils; and without consideration of possible but unlikely major reclamation projects.

In the capability system, all kinds of soils are grouped at three levels: the capability class, subclass, and unit. These are discussed in the following paragraphs.

Capability Classes, the broadest grouping, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I. Soils have few limitations that restrict their use.
Class II. Soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.
Class III. Soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.
Class IV. Soils have very severe limitations that restrict the choice of plants, require very careful management, or both.
Class V. Soils subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife food and cover. No soils in the Delta-Montrose Area are in class V.
Class VI. Soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife food and cover.
Class VII. Soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife.
Class VIII. Soils and landforms have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

Capability Subclasses are soil groups within one capability class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c* shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in it are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

Capability Units are soil groups within a subclass. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-2 or IIIe-4. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation, and the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph. The Arabic numeral specifically identifies the capability unit within each subclass.

Management by Capability Units

In this section each capability unit in the Delta-Montrose Area is described, and the use and management of the soils are discussed. All of the soils in classes I, II, III, and IV are irrigated.

Most of the Delta-Montrose Area is irrigated land used for crops. Small areas are used as range, and there are tracts of Rough broken land unsuitable for either crops or range. Since the annual rainfall is less than 9 inches, all production of cultivated crops depends on irrigation. Sugar beets, corn, alfalfa, and small grain are the principal crops. Pinto beans, potatoes, onions, and irrigated pasture are crops of secondary importance, and some acreage is used for the production of vegetables and fruits.

Careful management of irrigation water is essential. Overirrigation and seepage from reservoirs, canals, and laterals contribute to the development of a high water table and cause accumulations of soluble salts. Lining canals, laterals, and field ditches with concrete reduces seepage losses materially. To prevent overirrigation, it is necessary to know the rate of water intake and the water requirements of the crop, and to adjust the timing of irrigation and the amount of water applied accordingly.

Piping and gullying are serious hazards to the finer textured soils of the survey Area. The Billings, Christianburg, and Colona soils are most susceptible to this kind of damage. Piping causes the formation of underground channels, through which both irrigation water and soil material are lost. Eventually, sinkholes and gullies develop. Both irrigated areas and adjoining areas of range are affected. Figure 12 shows the various stages of piping erosion and the gullies and sinkholes that ultimately form.

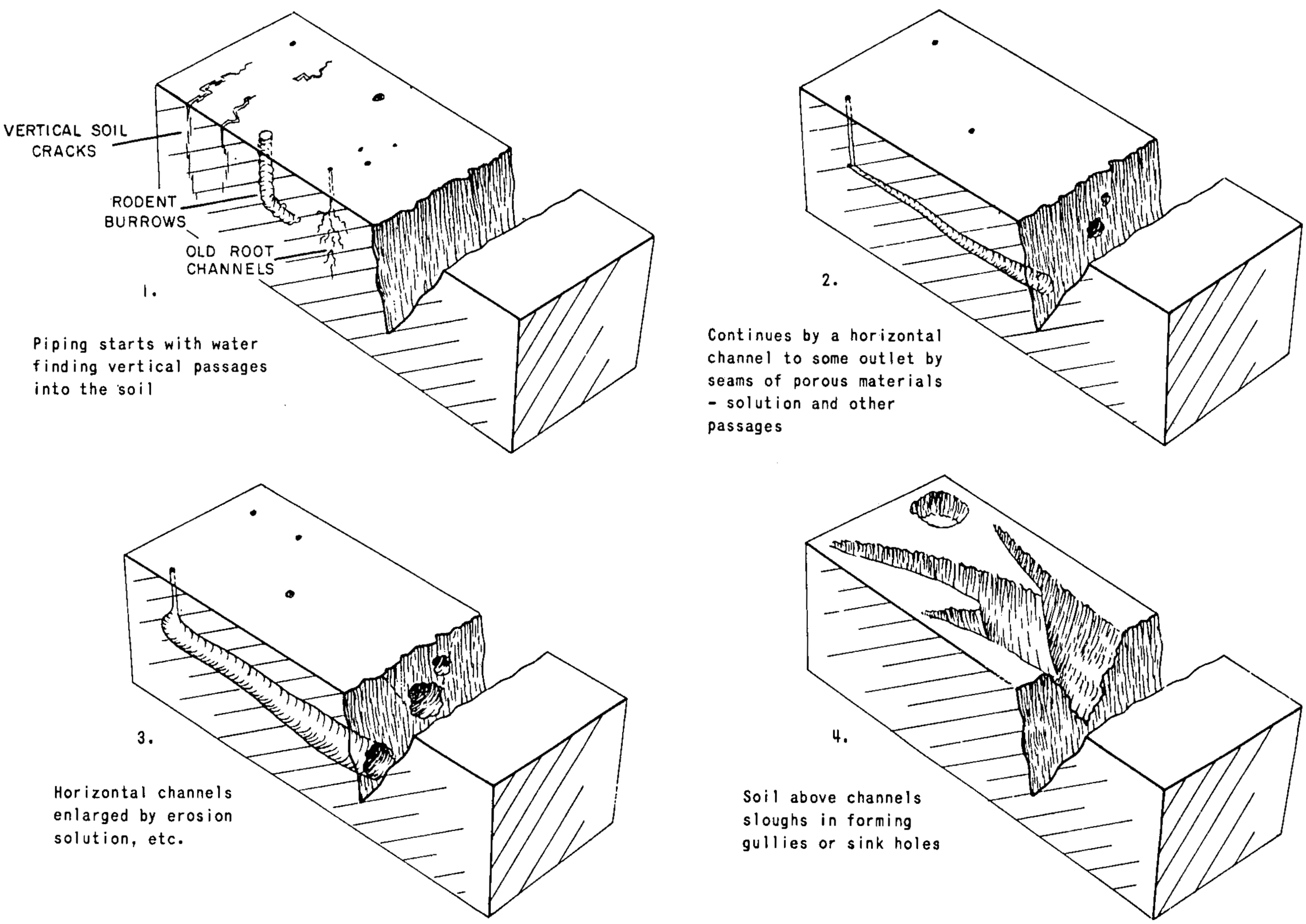

Figure 12.—**Stages of piping erosion.**

Class I. Soils that have few limitations that restrict their use

Unit I-1

This capability unit consists of deep, light-colored, well-drained soils that have a medium-textured or moderately fine textured surface layer and a moderately permeable subsoil. These soils are level or nearly level.

These are some of the most desirable soils in the Area for crops. They are easily tilled, are moderate to high in natural fertility, and have high capacity for holding moisture that plants can use. Erosion is not a hazard. Most of the acreage is cultivated.

All field crops, truck crops, and orchard fruits suited to the Area can be grown on these soils. A commonly used cropping system consists of alfalfa, sugar beets, corn, and beans or small grain in an 8-year rotation. If the organic-matter content is maintained at a high level and a high-residue crop is grown about a third of the time, these soils can be used continuously for row crops. Truck crops and orchard fruits do well, particularly where air drainage is good.

All methods of irrigation can be used on these soils, but irrigation by sprinkler or border methods is not common. Normal practices of irrigation farming, including land preparation, cultivation, maintenance of fertility, and water management, provide adequate protection against deterioration of the soils.

Class II. Soils that have moderate limitations that reduce the choice of plants or require moderate conservation practices

Subclass IIe. Soils Subject to Moderate Erosion if They Are Not Protected

Unit IIe-1

This capability unit consists of moderately deep and deep, light-colored, well-drained soils that have a moderately fine textured surface layer and a moderately permeable subsoil. These soils are gently sloping, and some have limy gravel or cobblestones below a depth of 20 inches.

These soils are moderately high in fertility and are suited to all crops grown in the Area. The moderately fine textured surface layer restricts infiltration, and the gravelly or cobbly layers reduce the water-holding capacity. The hazard of water erosion is slight to moderate, and wind erosion is a hazard if the surface is left without a protective cover.

Most of this unit is irrigated and cultivated. A suitable cropping system consists of alfalfa, sugar beets, corn, and beans or small grain grown in rotation. The system could also include truck crops, orchard fruits, and other specialty crops. In some areas a shortage of water after midseason restricts the choice of crops.

Conserving water and plant nutrients and preventing furrow erosion are major management needs. Water moves into the gravelly subsoil and leaches plant nutrients from layers above. Effective practices on these soils are leveling, lining the irrigation ditches, measuring irrigation water carefully, and applying water by means of siphon tubes or gated pipes.

Unit IIe-2

In this capability unit are deep, moderately coarse textured or moderately fine textured, light-colored, well-drained soils that have a permeable subsoil. They occur on gently sloping alluvial fans.

These soils are moderately fertile. They take in water at a moderate to rapid rate and have moderate water-holding capacity. Both wind erosion and water erosion are moderate hazards in places because the surface soil is sandy.

Most of this unit is cultivated. A cropping system commonly used consists of alfalfa, sugar beets, corn, and small grain in an 8-year rotation. Some farms that grow crops for feeding livestock use a system of alfalfa, irrigated pasture, and corn. The supply of plant nutrients can be kept at a high level by turning under crop residues and by applying barnyard manure and commercial fertilizer.

Most of these soils have an adequate source of irrigation water. Irrigation should be managed so as to prevent deep penetration of water and leaching of plant nutrients. Leveling and adequate preparation of the land, short runs, a small head, and frequent, light irrigation are necessary.

Subclass IIw. Soils That Have Moderate Limitations Because of Excess Water

Unit IIw-1

This capability unit consists of deep, dark-colored, imperfectly drained soils that are moderately coarse textured to moderately fine textured. These soils are on nearly level flood plains, mostly on those adjacent to the Uncompahgre River.

Unless these soils are artificially drained, the choice of crops is limited. The water table is high during the growing season, and salts have accumulated in some spots. Drained areas are well suited to alfalfa, sugar beets, and irrigated pasture. Good management of irrigation water is necessary to avoid waterlogging. Occasional floods leave deposits of silt. Erosion is not a serious hazard if management is good. Fertilizers and crop residues are needed to maintain productivity.

Subclass IIs. Soils That Have Moderate Limitations Because of Salinity and Tilth

Unit IIs-1

In this capability unit are deep, light-colored, moderately saline, well-drained soils that have a moderately fine textured surface layer and a slowly permeable subsoil. These soils occur on level or nearly level terraces.

These soils are moderate to high in fertility and hold a good supply of moisture that plants can use. They take in water slowly, and they are saline, hard to work, and erodible. Water erosion is a severe hazard in some places, and piping is an especially serious hazard. Because of the slow intake rate and the silty texture of the surface layer, runoff is excessive and gullies are common in drainageways.

A commonly used cropping system consists of alfalfa, sugar beets, corn, and small grain in an 8-year rotation.

Also common are irrigated pastures. A small grain normally is planted with alfalfa as a nurse crop. The growing season is sufficiently long for corn to mature. About a third of the corn is cut for silage. Beans and other crops that have a low tolerance for salt are not suited, and orchards are rare. The water supply generally is adequate for crops, but a few areas are short of water after midseason.

Unless the surface layer is moist, preparing a seedbed is difficult. Maintaining the organic-matter content improves tilth and hastens the movement of air and water. All crop residues should be turned under.

The major management needs are conserving water and controlling erosion. Effective practices are leveling, lining the irrigation ditches, applying water by means of siphon tubes or gated pipes, and providing adequate means for disposing of waste water.

Class III. Soils that have severe limitations that reduce the choice of plants, require special conservation practices, or both

Subclass IIIe. Soils Subject to Severe Erosion if They are Cultivated and Not Protected

Unit IIIe-1

This capability unit consists of moderately deep or deep, light-colored, well-drained, gently sloping soils. The surface layer is moderately fine textured, and the subsoil is moderately permeable. Some of these soils are gravelly throughout, and some are underlain by cobblestones, gravel, or weakly cemented, limy gravel below a depth of 20 inches.

These soils are moderate to high in fertility and have moderate water-holding capacity. Most of the acreage is irrigated. Because of the slope, erosion is a moderate hazard, especially in irrigation furrows. Close-growing crops should be included in the crop rotation, to control erosion.

Conserving water and maintaining fertility are major management needs. In irrigating, it is necessary to prevent water from penetrating deeply because it leaches plant nutrients from layers above. Short runs and frequent, light irrigations are needed. Maintaining a high content of organic matter in the surface layer reduces the erosion hazard.

Unit IIIe-2

The soils in this capability unit are deep, light colored, moderately saline, and well drained. They have a moderately fine textured surface layer and moderately slow permeability in the subsoil. They are on gently sloping alluvial fans and valley slopes.

These soils are moderate to high in fertility and have high water-holding capacity. They take in water slowly, and consequently are likely to become saline. The slope, the silty texture, and the slow infiltration rate all contribute to an erosion hazard. Gully erosion is common, and piping is a hazard in cultivated areas.

Only salt-tolerant crops are suited to these soils. Beans, orchard fruits, and some truck crops are not ordinarily grown. The 8-year cropping system common in the Area is used, but more years of irrigated pasture and alfalfa are included than on the soils of other units.

Unless the surface layer is moist, plowing and seedbed preparation are difficult. Good tilth can be maintained and permeability improved by keeping the organic-matter content high. All crop residues should be turned under.

Major management needs are conserving water and reducing the erosion hazard. Among the effective practices are smoothing the fields and controlling the irrigation head and the length of irrigation runs.

Unit IIIe-3

This capability unit consists of deep, light-colored and dark-colored, well-drained soils that have a medium-textured or moderately fine textured surface layer and a moderately permeable subsoil. The underlying material is stony or very limy. These soils are gently sloping or undulating and occur at an elevation of about 7,000 feet.

The soils in this unit are moderately high or high in fertility. The water-holding capacity is good unless it is limited by the stony substratum. The choice of crops is limited because at this high an altitude the growing season is short and the temperature is cool in summer. Erosion is a moderate hazard in areas that are cultivated and left unprotected. Scattered gullies have formed in cultivated fields.

Alfalfa, irrigated pasture, and small grain are the main crops. Row crops are not commonly grown. Close-growing crops keep erosion to a minimum. Barnyard manure and commercial fertilizer are needed to improve tilth and to maintain fertility. In some areas the supply of irrigation water is inadequate after midseason. Gradient ditches and irrigation by the corrugation method provide efficient means of using water.

Unit IIIe-4

This capability unit consists of deep, moderately coarse textured and moderately fine textured, light-colored, well-drained soils that have a permeable subsoil. They occur on gently sloping and undulating alluvial fans.

These soils are moderate in fertility. The intake of water is moderate to rapid, and the water-holding capacity is moderate. Wind erosion and water erosion are moderate hazards because of the slope and the sandy texture.

These soils are suited to all crops grown in the Area, and most of the acreage is cultivated. An 8-year crop rotation is suitable, but the number of row crops should be limited because the soils erode readily. Crop residues should be turned under, and barnyard manure and commercial fertilizer applied. These measures help to maintain fertility, and they keep the organic-matter content at a high level and thereby reduce the hazard of erosion.

In most places the supply of irrigation water is adequate, but good management is required to prevent deep percolation and leaching of plant nutrients. Effective management practices include adequate land preparation, adjustment of the irrigation head and the length of runs, and frequent light irrigation.

Subclass IIIw. Soils That Have Severe Limitations Because of Excess Water

Unit IIIw-1

This capability unit consists of deep, dark-colored, poorly drained, medium-textured and moderately fine textured soils on nearly level flood plains.

These soils are unproductive. The water table is near the surface, and salt accumulations are common where water has evaporated from the surface. Erosion is not a hazard, but floods occasionally deposit silt in some places.

Before they can be used for crops, these soils need to be drained and leached, then irrigated and supplied with organic matter. At present they are suitable only for irrigated pasture and water-tolerant grasses. Drainage is difficult in some areas, particularly where the water table is controlled by the height of the water in a river. Outlets are hard to find, and the expense of drainage is high in proportion to the benefits.

Subclass IIIs. Soils That Have Severe Limitations Because of Moisture Capacity, Salinity, or Tilth

Unit IIIs-1

This capability unit consists of deep, light-colored, moderately saline, well-drained soils that have a fine-textured surface layer and a slowly permeable subsoil. These soils are on level or gently sloping terraces.

These soils are moderately high in fertility, but they are hard to work and have accumulations of salt in some places. Although they have high water-holding capacity, they take in water very slowly and release it slowly to plants. Water erosion is a serious hazard. Runoff is excessive, and gully erosion is common. Piping also is common in all the soils except those that have a gravelly substratum.

All salt-tolerant crops common to the Area are suited to these soils. A suitable cropping system consists of alfalfa, sugar beets, corn, and small grain. Irrigated pasture commonly is included. In some areas a shortage of water after midseason restricts the choice of crops.

Major management needs are improving tilth and conserving water. Unless the surface layer is moist, cultivation and seedbed preparation are difficult. Good tilth can be maintained and permeability improved by adding barnyard manure and commercial fertilizer to increase yields, and then turning under all crop residues. Practices that help to reduce the erosion hazard and to conserve water include leveling, adjusting the length of irrigation runs, and controlling the irrigation head.

Unit IIIs-2

This capability unit consists of moderately deep, light-colored, well-drained soils that have a moderately fine textured surface layer and a moderately permeable subsoil. These soils are gravelly throughout or have gravel or stones at a depth below 20 inches. They are on level or gently sloping, high terraces.

These soils are moderately high in fertility. They take in water at a moderate rate but have limited water-holding capacity because of the gravel and stones. Erosion is only a slight hazard and does not limit use if the soils are carefully managed.

Most of this unit is used for crops. All crops suited to the Area can be grown. Alfalfa and irrigated pasture crops are the most common because the gravel is hard on plows and cultivators.

The supply of water is generally adequate, but since the water-holding capacity is limited, irrigation management is the major need. Supplying just the right amount of water is a problem. If the soils are overirrigated, water moves into the gravelly or stony material below the subsoil and leaches plant nutrients from the layers above. Irrigation runs should be short.

Unit IIIs-3

This unit consists of deep, light-colored, moderately fine textured soils that have an accumulation of soluble salts on the surface. These soils are in level or slightly concave areas at the lower end of alluvial fans.

These soils are low in fertility. They are saline because of overirrigation. Water that is allowed to stand on the surface evaporates and leaves a crust of salts.

Unless these soils are improved, they are suited only to salt-tolerant crops and grasses. Major needs include improving water management on the soils upslope, draining, leaching, and improving tilth and permeability by adding organic matter.

Subclass IIIc. Soils That Are Limited in the Choice of Crops Because of a Short Growing Season

Unit IIIc-1

This capability unit consists of deep, dark-colored, well-drained soils that have a medium-textured surface layer and a moderately permeable subsoil. These soils are in nearly level and gently sloping areas in the higher parts of the survey Area.

These soils are high in fertility. The rate of water intake is good, and the water-holding capacity is good. Nevertheless, the choice of crops is limited because at the high altitude in which these soils occur, the growing season is short and the temperature in summer is cool.

All of this unit is cultivated. Alfalfa, irrigated pasture, and small grain are the principal crops. Potatoes were once grown but are no longer a profitable crop. Because the water supply in this part of the Area is inadequate after midseason, conserving water is a major need. Effective practices consist of adjusting the length of irrigation runs and irrigating lightly and frequently by the corrugation method.

Class IV. Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both

Subclass IVe. Soils Subject to Severe Erosion if They Are Cultivated and not Protected

Unit IVe-1

This capability unit consists of moderately deep and deep, light-colored, fine textured and moderately fine textured, moderately saline soils. These soils are gently sloping or undulating. The moderately deep soils are underlain by shale at a depth of about 20 inches.

These soils are moderate to high in fertility and have good capacity for holding moisture that plants can use. They take in water slowly and have a slowly permeable subsoil. Correcting salinity and maintaining tilth are management problems. Because of the slope and the slow rate of water intake, runoff is excessive and water erosion is a severe hazard in some places. There are scattered gullies. Piping erosion occurs only in the deep soils. The underlying shale prevents it in the moderately deep ones.

Most salt-tolerant crops common to the Area are grown on these soils, but row crops should be grown infrequently because of the hazard of furrow erosion. Alfalfa, irrigated pasture, and small grain are well suited. Beans, orchard fruits, and truck crops are grown rarely.

Cultivation and seedbed preparation are difficult unless the organic-matter content of the surface layer is high and the moisture content is adequate. Organic matter, which improves tilth and permeability, can be maintained by turning under all crop residues and by fertilizing the soils with barnyard manure and commercial fertilizer.

Conserving water and controlling erosion are major management needs. Effective practices consist of smoothing, adjusting the length of irrigation runs, reducing the head of water, and applying water by means of siphon tubes or gated pipes.

Unit IVe–2

This capability unit consists of moderately deep or deep, medium-textured to fine-textured soils that are sloping or gently rolling. In some places the soils are gravelly and the depth is restricted by shale or calcareous gravel.

The natural fertility is good. Infiltration is moderately slow, and the water-holding capacity is good. Erosion is a serious hazard because of the slope.

Irrigated pasture, alfalfa, and small grain are suitable crops. Sugar beets, corn, beans, and other row crops are not suited, because of the erosion hazard.

Good water management is a major need. It is difficult to get even penetration of water by surface irrigation. Erosion can be controlled by maintaining a good cover of close-growing crops, by using the corrugation method of irrigating, and by irrigating from a small head of water. Sprinkler irrigation is suitable also.

Unit IVe–3

This capability unit consists of moderately shallow, light-colored, medium-textured, undulating soils. These soils are underlain by sandstone at a depth of about 20 inches, and in places they have sandstone fragments on the surface and throughout the profile.

Infiltration is good, but the water-holding capacity is moderately low. Water erosion is a moderate to severe hazard if the surface is left without a protective cover.

These soils are not well suited to cultivation, because of the sandstone fragments and the underlying sandstone. Irrigated pasture, alfalfa, small grain, and other close-growing crops can be grown.

Conserving irrigation water and controlling erosion are major management needs. Effective practices are shortening irrigation runs, irrigation by the corrugation method, and reducing the head of water. Distributing water evenly is difficult. Sprinkler irrigation is well suited.

Unit IVe–4

This capability unit consists of deep, dark-colored, moderately coarse textured, well-drained soils that are sloping or rolling. These soils are all in Bostwick Park, in the higher parts of the Area.

These soils are productive. They are sandy and have a moderately rapid infiltration rate and moderate water-holding capacity. Water erosion and wind erosion are severe hazards if there is no protective cover.

At the high altitude in which these soils occur, the choice of crops is limited by a short growing season and cool temperatures in summer. In addition, there is a shortage of water late in the season. Irrigated pasture and small grain are suitable, but alfalfa is not.

Conserving water is the major management need. Effective practices consist of shortening the irrigation runs and applying small amounts of water. Light, frequent irrigations help to prevent deep percolation and the leaching of plant nutrients.

Subclass IVw. Soils That Have Very Severe Limitations for Cultivation Because of Excess Water

Unit IVw–1

The soils in this capability unit are deep, dark colored, medium textured or moderately fine textured, and somewhat poorly drained. They have a water table near the surface. They are in level or slightly concave positions in the higher parts of the Area.

These soils are high in fertility and have a moderate infiltration rate and good water-holding capacity. The water table is near the surface. Erosion is not a hazard.

The high water table and the climate limit the choice of crops. Irrigated pasture is suitable, and small grain is grown in some places.

Draining these soils is difficult because outlets are inadequate, but drainage is not essential for hay and pasture. The high water table eliminates the need for frequent irrigation, but if it is lowered, better pasture plants can be introduced.

Subclass IVs. Soils That Have Very Severe Limitations Because of Moisture Capacity, Salinity, or Tilth

Unit IVs–1

This capability unit consists of deep, light-colored, fine-textured, saline soils that have a very slowly permeable subsoil. These soils are somewhat poorly drained in places. They occur on nearly level or gently sloping terraces.

These soils are moderately fertile and have very slow infiltration. Salt accumulations are common. Because water infiltrates slowly, prolonged irrigation is needed to moisten the root zone. Erosion is not a serious hazard, but piping is common.

Cultivation and the preparation of seedbeds are difficult. Measures are needed that improve tilth, increase the rate of infiltration, and maintain the organic-matter content. The common crops are close-growing perennials, such as irrigated pasture and alfalfa.

Conserving water is a major management need. Effective practices are leveling, irrigating by the corrugation method, reducing the head of water, and disposing of waste water.

Unit IVs–2

The soils in this capability unit are moderately deep, light colored, moderately fine textured or fine textured, saline, and well drained. They are underlain by shale at a depth of about 20 inches. They occur on nearly level or gently sloping terraces.

These soils are moderately high in fertility and have slow to very slow infiltration. They have moderate water-holding capacity but do not give up moisture readily to plants. They are difficult to work unless moist. The underlying shale restricts the penetration of moisture and roots. As a result of overirrigation, the water table rises in places and some areas become saline. Erosion is not a hazard if there is adequate cover and piping does not occur.

A commonly used cropping system consists of alfalfa, sugar beets, corn, and small grain in an 8-year rotation. Beans, truck crops, and orchard fruits are not suited, because the soils are saline and only moderately deep. Adding organic matter by turning under crop residues improves tilth and permeability.

Conserving water is a major need. Effective practices are leveling, adjusting the length of irrigation runs in relation to the infiltration rate, reducing the head of water, and disposing of waste water.

Unit IVs–3

The soils in this capability unit are shallow, light colored, moderately fine textured, well drained, and saline. They are nearly level or gently sloping and are underlain by shale at a depth of 18 inches or less.

Most of this unit is in native range, and only a small acreage is cultivated. The choice of cultivated crops is limited by slow infiltration and limited water-holding capacity. Because shale is fairly near the surface, a high water table, seepage, and salinity are common problems.

Shallow-rooted grasses and small grain are well suited to these soils, but deep-rooted crops are not.

These soils can be improved by turning under all crop residues and applying barnyard manure and commercial fertilizer. Good water management is a major need, for overirrigation causes seepage and increases salinity.

Class VI. Soils that have severe limitations that make them generally unsuited to cultivation and that limit their use largely to pasture or range, woodland, or wildlife food and cover

Subclass VIe. Soils Severely Limited, Primarily by Risk of Erosion if Protective Cover Is Not Maintained

Unit VIe–1

This capability unit consists of moderately deep or deep, well-drained soils that have a moderately coarse textured, medium-textured, or moderately fine textured surface layer and a subsoil of sandy loam to clay loam. These soils are on nearly level to sloping uplands. Some have gravel throughout, and others are underlain by sandstone or calcareous cobblestones or pebbles at a depth of 20 inches or more. The rest of the soils are 60 inches or more deep to stony material.

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These soils are productive and have good water-holding capacity. They occur in desert areas and have a sparse cover of galleta, saltbush, western wheatgrass, and annual weeds. Both wind erosion and water erosion are moderate hazards in the gently sloping areas, and gullies are common in the steeper areas. If irrigated, most of the acreage is suited to cultivation, but without irrigation it is all too dry for cultivated crops and is used as range. The range should be reserved for use in winter. Reseeding is difficult, except during years when the moisture supply is better than usual.

Unit VIe–2

This capability unit consists of deep, well-drained soils that have a medium-textured or moderately fine textured surface layer and a well-developed subsoil. Most of them are dark colored. A few are light colored and are calcareous throughout. These soils are nearly level to strongly sloping and are at a high elevation on uplands.

These soils are moderately high in fertility and have good water-holding capacity. Water erosion is a moderate hazard, and a good plant cover is needed to prevent gullying on the steeper slopes.

If irrigated, these soils are productive, but the choice of crops is limited because of the high elevation and short growing season. Without irrigation, these soils are not suited to cultivated crops and are used as range.

The native vegetation consists of serviceberry, sagebrush, Gambel oak and other woody plants, and a mixture of wheatgrass, bluegrass, needlegrass, and other good forage plants. Range seeding is feasible. The best stands are obtained where good seedbeds are prepared and suitable grasses are properly planted.

Subclass VIw. Soils Severely Limited by Excess Water and Generally Unsuitable for Cultivation

Unit VIw–1

The soils in this capability unit are deep, dark colored, medium textured or moderately fine textured, and somewhat poorly drained. They occur in nearly level or slightly concave areas at a high elevation.

These soils are high in fertility, but they have a water table at or near the surface. They are suited to cultivated crops only if they are drained and irrigated. Without irrigation they are suited only to native grass, which is cut for hay in some years. Erosion is not a serious hazard.

The native vegetation includes Nebraska sedge, redtop, bluejoint, Baltic rush, and other plants that grow on moist or wet soils. Reed canarygrass is suitable for seeding. The range should be protected against overgrazing.

Unit VIw–2

This capability unit consists of deep, dark-colored, somewhat poorly drained soils that are moderately fine textured to moderately coarse textured. These soils are chiefly on the nearly level flood plains adjacent to the Uncompahgre River.

These soils are moderately high in fertility, are permeable, and hold water well. The water table normally is high during the growing season, and as a result, spots of salt accumulate. Erosion is not a serious hazard on these soils, but floods occasionally deposit silt on the surface.

These are productive soils, but they are suited to cultivated crops only if they are irrigated and, as a rule, drained. The native vegetation includes cottonwood, willow, wheatgrass, redtop, sedges, saltgrass, and other plants that grow on bottom lands. Considerable forage is available for grazing, but yields are uncertain because of periodic floods and silting.

Subclass VIs. Soils Generally Unsuitable for Cultivation and Limited for Other Uses by Their Moisture Capacity, Salinity, or Other Features

Unit VIs–1

This capability unit consists of shallow to deep, light-colored, well-drained, saline soils that are fine textured or moderately fine textured. The soils are on nearly level or gently sloping terraces and uplands.

Most of these soils are deep, but a few are shallow to clay shale. A few are high in gypsum. All these soils take in water slowly and release it slowly to plants. Tilth generally is poor. Water erosion is a severe hazard in some places. Runoff is excessive because infiltration is slow and the surface layer is silty. Much silt is washed into the streams through sheet erosion. Piping erosion is a severe hazard on the deep soils; as a result, an intricate pattern of gullies has formed in places.

For the most part, the soils in this unit are suitable for cultivation if they are irrigated and properly fertilized. Without irrigation, they are suitable only for range.

These soils receive less than 9 inches of precipitation annually. The natural vegetation is a sparse cover of salt-tolerant plants, mainly greasewood, rabbitbrush, saltbush, alkali sacaton, saltgrass, and wheatgrass. Careful management of grazing is needed to maintain the good forage plants and to prevent invasion by inferior kinds. Seeding these arid, saline soils is not feasible, except in years when the moisture supply is exceptionally favorable.

Class VII. Soils that have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife

Subclass VIIe. Soils Very Severely Limited, Chiefly by Risk of Erosion if Protective Cover Is Not Maintained

Unit VIIe–1

In this capability unit are deep, light-colored, very sandy soils that are gently sloping or hilly.

These soils are too droughty for cultivated crops and furnish limited grazing for only a short time in spring. They have low water-holding capacity and support only a sparse cover of annual weeds and grasses. Wind erosion is a serious hazard because the surface soil is loose and the vegetation is sparse.

Unit VIIe–2

The soils in this capability unit are deep, light colored, fine textured or moderately fine textured, and saline. They are on sloping and strongly sloping alluvial fans.

These soils have good water-holding capacity, but they take in water slowly and release it slowly to plants. They occur in the desert areas. The vegetation is too sparse to provide protection against erosion. Runoff is excessive on the steeper slopes and washes large quantities of silt into the streams. Both sheet erosion and gully erosion are serious hazards.

These soils are suited to cultivated crops only if they are irrigated. Irrigating them is difficult, however, because of slow infiltration and the serious erosion hazard. The native vegetation consists of a sparse cover of saltbush, alkali sacaton, rabbitbrush, and annual weeds. Careful management is required to maintain the cover, because reseeding these arid soils is not practical.

Subclass VIIw. Soils Very Severely Limited by Excess Water

Unit VIIw–1

This capability unit consists of deep, light-colored to dark-colored, stratified soils that vary greatly in color, texture, depth, and drainage. These soils are on bottom lands adjacent to the major streams.

These soils are flooded frequently and normally have a high water table. Salt accumulations are common. Erosion is not a serious hazard, but flooding causes silt to accumulate in some places.

Draining these soils is not practical, and consequently they are not suitable for cultivation. They are used only for grazing. The natural plant cover, which normally is good, consists of cottonwood, willow, and salt-tolerant grass.

Subclass VIIs. Soils Very Severely Limited by Low Water-Holding Capacity, Stones, or Other Soil Features

Unit VIIs–1

This capability unit consists of shallow to deep, medium-textured or moderately fine textured, well-drained soils that are stony and rocky. These soils are undulating to steep. Stones cover 20 to 50 percent of the surface.

These soils have moderate infiltration and moderate water-holding capacity, but the stones on the surface and in the profile make them unsuitable for cultivation. Erosion is a serious hazard, and gullies are common.

If well managed, these soils support a fair to good stand of native vegetation. Reseeding is not practical, and grazing should be so regulated that only half the stand of desirable grass is used each year.

Unit VIIs–2

The soils in this unit are shallow to moderately deep, light colored, moderately fine textured or fine textured, and saline. They are undulating to steep.

These soils have low to moderately high water-holding capacity, but they take in water slowly and release it slowly to plants. They are moderately saline, and in some places their subsoil contains a large amount of gypsum. Runoff is excessive and washes off large quantities of silt, which contribute to the silt load of the streams in the Area. Erosion is a severe hazard, and both sheet erosion and gully erosion are active.

The annual precipitation is low. The vegetation is sparse, and not enough moisture is available to make reseeding practical. Consequently, these soils are not good for range. They require very careful management for maintenance of the cover and control of erosion.

Unit VIIs–3

This capability unit consists of shallow to moderately deep, very stony, hilly to very steep soils. Sandstone and shale crop out, and the steeper slopes terminate in almost vertical escarpments.

These soils are too stony, too shallow, and too steep for cultivation. Erosion is a hazard, especially where the vegetation is sparse.

All of this unit is in native range and normally supports a good plant cover. Only a few areas are inaccessible to livestock. Grazing needs to be carefully regulated by distributing livestock on the higher slopes, as well as on the gentler slopes. In this way, overgrazing can be avoided at the base of hills.

Class VIII. Soils and landforms that have limitations that preclude their use for commercial plant production and that restrict their use to recreation, wildlife, or water supply, or to esthetic purposes

Subclass VIIIes. Areas That Have Little Potential for Plants

Unit VIIIes–1

This capability unit consists of very steep, rocky soils, rolling shale hills, Gullied land, and excessively saline areas. The soil material ranges from partly weathered shale to deep, fine-textured soils.

The native vegetation consists of a sparse cover of plants that tolerate salt and water. Steep areas that have little or no vegetation are actively eroding and have many gullies. Bare, steep-sided gullies have formed along small drainageways in the deep soils. These steep, gullied areas, as well as the stony areas, are inaccessible to livestock.

Saline wet spots occur where seepage and runoff accumulate in low depressions. The water table is at or near the surface, but it may recede during winter. When the soils are dry, salts form a thick crust on the surface and even coat some of the leaves of plants.

Predicted Yields of Crops

Table 2 lists, for each soil in the survey Area, the predicted average yields per acre of the principal irrigated crops under two levels of management. These predictions were based on interviews with farmers and on records kept by various agencies that deal with crop production.

The columns A show predictions of yields to be obtained under common management, which consists of (1) seeding at the proper rate, (2) controlling weeds, insects, and diseases, (3) applying a minimum of fertilizer, (4) harvesting by efficient methods, and (5) supplying enough irrigation water.

The columns B show predictions of yields to be expected under improved management, which consists of (1) seeding at the proper rate and at the right time, (2) controlling insects, weeds, and diseases, (3) leveling the soils, realining ditches, supplying enough irrigation water, and otherwise improving irrigation practices, (4) draining wet areas, (5) leaching out excess soluble salts, (6) seeding improved crop varieties, and (7) fertilizing adequately with organic and commercial fertilizer, and turning under crop residues.

Table 2.—*Predicted average yields per acre of the principal irrigated crops under two levels of management*

[Yields in columns A are those obtained under common management; those in columns B are yields to be expected under improved management. Dashed lines indicate that soil is not suited to the crop specified or that the growing season is too short for the crop to mature]

Soil	Sugar beets		Alfalfa		Corn		Malting barley	
	A	B	A	B	A	B	A	B
	Tons	*Tons*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Billings gravelly clay loam, 0 to 2 percent slopes	14	25	3.0	5.0	75	125	60	85
Billings gravelly clay loam, 2 to 5 percent slopes	12	23	2.5	4.0	65	115	50	75
Billings gravelly clay loam, 5 to 10 percent slopes	------	------	2.0	4.0	------	------	40	70
Billings silty clay, 0 to 2 percent slopes	11	22	3.0	5.0	70	100	50	75
Billings silty clay, 2 to 5 percent slopes	10	20	2.5	4.0	65	90	40	70
Billings silty clay, 5 to 10 percent slopes	------	------	1.5	3.5	------	------	40	70
Billings silty clay, loamy substratum, 0 to 2 percent slopes	14	25	3.0	5.0	75	125	60	85
Billings silty clay, shale substratum, 0 to 2 percent slopes	15	24	3.0	4.5	65	120	50	80
Billings silty clay, shale substratum, 2 to 5 percent slopes	10	18	2.0	3.0	55	75	40	70
Billings silty clay loam, 0 to 2 percent slopes	15	26	3.0	5.0	80	130	60	85
Billings silty clay loam, 2 to 5 percent slopes	12	23	2.5	4.0	65	115	50	75
Billings silty clay loam, 5 to 10 percent slopes	------	------	2.0	3.5	------	------	40	70
Billings silty clay loam, gravel substratum, 0 to 2 percent slopes	14	25	3.0	5.0	80	130	60	85
Billings silty clay loam, shale substratum, 0 to 2 percent slopes	13	23	3.0	4.5	75	120	50	80
Billings silty clay loam, shale substratum, 2 to 5 percent slopes	12	22	2.5	4.5	70	120	50	75
Blanyon silty clay loam, 2 to 5 percent slopes	------	------	2.5	4.5	------	------	[1] 40	[1] 60
Blanyon silty clay loam, moderately wet variant [2]	13	23	3.0	4.5	75	120	50	75
Bostwick fine sandy loam, coarse subsoil variant, 5 to 10 percent slopes	------	------	3.0	4.5	------	------	50	75

See footnotes at end of table.

TABLE 2.—*Predicted average yields per acre of the principal irrigated crops under two levels of management*—Continued

Soil	Sugar beets		Alfalfa		Corn		Malting barley	
	A	B	A	B	A	B	A	B
	Tons	*Tons*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Bostwick gravelly loam, 2 to 5 percent slopes			2. 5	4. 5			[1] 35	[1] 55
Bostwick loam, 0 to 2 percent slopes			2. 5	4. 5			[1] 45	[1] 65
Bostwick loam, 2 to 5 percent slopes			2. 0	4. 0			[1] 30	[1] 50
Bostwick loam, 5 to 10 percent slopes			2. 5	4. 5			30	50
Cerro clay loam, 1 to 5 percent slopes			2. 5	4. 5			[1] 40	[1] 60
Cerro clay loam, 5 to 10 percent slopes			2. 5	4. 5			[1] 30	[1] 50
Christianburg silty clay, 0 to 2 percent slopes	11	20	3. 0	4. 5	60	90	50	75
Colona clay, 0 to 2 percent slopes	11	22	2. 5	4. 5	80	110	55	80
Colona clay, 2 to 8 percent slopes			2. 5	4. 5			50	75
Colona clay, gravel substratum, 0 to 2 percent slopes	11	22	2. 5	4. 5	80	110	55	80
Doak clay loam, 2 to 5 percent slopes	10	20	2. 5	4. 5	70	100	50	75
Fruita loam, 0 to 2 percent slopes	15	25	3. 0	5. 0	80	130	65	95
Fruita clay loam, 5 to 10 percent slopes			3. 0	4. 5			55	80
Fruitland fine sandy loam, 0 to 2 percent slopes	12	25	3. 0	5. 0	80	130	65	95
Fruitland fine sandy loam, 2 to 5 percent slopes	11	24	3. 0	4. 5	80	120	60	90
Fruitland sandy clay loam, 0 to 2 percent slopes	12	25	3. 0	5. 0	80	130	65	95
Fruitland sandy clay loam, 2 to 5 percent slopes	11	24	3. 0	4. 5	80	120	60	90
Fruitland sandy clay loam, stony substratum, 0 to 2 percent slopes	10	20	3. 5	4. 5	60	90	55	80
Fruitland sandy clay loam, stony substratum, 2 to 5 percent slopes	9	18	2. 5	4. 0	55	85	50	75
Genola clay loam, 0 to 2 percent slopes	12	25	3. 0	5. 0	80	130	65	95
Genola clay loam, 2 to 5 percent slopes	11	24	3. 0	4. 5	75	120	60	90
Genola clay loam, saline, 0 to 2 percent slopes [2]	12	25	3. 0	5. 0	80	130	65	95
Hinman clay loam, 0 to 2 percent slopes	13	25	3. 0	5. 0	80	130	65	95
Luhon clay loam, 2 to 5 percent slopes	11	24	3. 0	4. 5	80	120	60	90
Luhon clay loam, 5 to 10 percent slopes			2. 0	4. 0			45	70
Luhon gravelly clay loam, 5 to 10 percent slopes			2. 0	4. 0			45	70
Mack clay loam, 0 to 2 percent slopes	12	25	3. 0	5. 0	80	130	65	95
Mack clay loam, 2 to 5 percent slopes	11	24	3. 0	4. 5	80	120	60	90
Mack clay loam, 5 to 10 percent slopes			2. 5	4. 5			45	70
Mack gravelly clay loam, 0 to 2 percent slopes	11	24	3. 0	5. 0	80	120	65	95
Menoken-Chacra clay loams, 0 to 2 percent slopes	12	22	3. 0	4. 5	80	110	60	80
Mesa clay loam, 0 to 2 percent slopes	12	25	3. 0	5. 0	80	130	65	95
Mesa clay loam, 2 to 5 percent slopes	11	24	3. 0	4. 5	80	125	60	90
Mesa clay loam, 5 to 10 percent slopes			2. 5	4. 0			45	70
Mesa gravelly clay loam, 0 to 2 percent slopes	10	20	2. 0	3. 5	60	90	60	80
Mesa gravelly clay loam, 2 to 5 percent slopes	10	18	2. 0	3. 0	55	85	55	75
Mesa gravelly clay loam, 5 to 10 percent slopes			1. 5	2. 5			40	65
Mesa gravelly clay loam, shale substratum, 0 to 2 percent slopes	10	18	2. 0	3. 0	45	75	50	75
Mesa gravelly clay loam, shale substratum, 5 to 10 percent slopes			1. 0	2. 0			20	40
Orchard clay loam, 0 to 2 percent slopes	14	25	3. 0	5. 0	80	130	60	85
Orchard clay loam, 2 to 5 percent slopes	12	23	2. 5	4. 0	65	115	50	75
Orchard gravelly clay loam, 0 to 2 percent slopes	12	23	3. 0	4. 0	70	110	60	75
Orchard gravelly clay loam, 2 to 5 percent slopes	11	21	2. 0	4. 0	65	100	50	70
Persayo silty clay loam, 0 to 2 percent slopes	9	14	1. 5	2. 5	45	65	40	55
Poudre loam			2. 0	4. 0			[1] 35	[1] 55
Ravola clay loam	14	25	3. 0	5. 0	80	130	65	95
Salt Lake clay, drained	12	22	2. 5	4. 5	80	100	50	75
Shavano sandy clay loam, 2 to 5 percent slopes	10	16	2. 0	3. 0	65	95	50	80
Uncompahgre clay loam [2]	14	25	3. 0	5. 0	75	120	60	90
Uncompahgre clay loam, wet [2]	14	25	3. 0	5. 0	75	120	60	90
Uncompahgre fine sandy loam [2]	12	25	3. 0	5. 0	75	130	65	95
Uncompahgre gravelly loam [2]	10	22	3. 0	4. 5	70	110	55	80
Uncompahgre loam [2]	12	25	3. 0	5. 0	75	130	65	95
Uncompahgre loam, wet [2]	12	25	3. 0	5. 0	75	130	65	95
Vernal clay loam, 0 to 2 percent slopes			3. 0	4. 5			[1] 45	[1] 65
Vernal clay loam, 2 to 5 percent slopes			2. 5	4. 0			[1] 30	[1] 50
Vernal gravelly clay loam, 0 to 2 percent slopes			2. 5	4. 0	50	70	[1] 45	[1] 65
Vernal gravelly clay loam, 2 to 5 percent slopes			2. 5	3. 5	40	65	[1] 30	[1] 50
Woodrow clay loam, 0 to 2 percent slopes	12	25	3. 0	5. 0	80	130	65	95

[1] Yield shown is for wheat. Some growing seasons are too short for malting barley to mature.
[2] Yield to be expected only after the soil has been drained.

Range

Range makes up roughly 15 percent of the Delta-Montrose Area. Most of it consists of small, odd-shaped areas that are intermingled with irrigated cropland. Larger tracts occur along the boundaries of the Area, particularly in the southeastern part.

The small areas generally are used for irrigated pasture or for cropland that is grazed after the crops have been harvested. The larger tracts generally are grazed during winter and early in spring.

Among the major range management needs in the Delta-Montrose Area are fencing, seeding, controlling brush, improving facilities for applying water (fig. 13), and controlling grazing.

Figure 13.—**This pond on Shavano soils is used for livestock, as well as for watering rangeland.**

Technical help in managing range can be obtained from the local office of the Soil Conservation Service.

Kinds of range and vegetation

Part of the Delta-Montrose Area is in the desert climatic zone, and part is in the foothill zone. The desert zone receives less than 11 inches of rainfall annually, and the foothill zone receives between 11 and 15 inches.

In the desert zone the vegetation consists principally of mat saltbush and Gardner saltbush on the uplands where the soils are fine textured; shadscale saltbush and galleta on uplands where the soils are medium textured; greasewood on lowlands that have been subjected to overflow; and saltgrass in seep areas and areas that are flooded by waste irrigation water from upslope.

In the foothill zone, sagebrush and grasses grow on the deeper, more gently sloping soils. Pinyon and juniper and an understory of grasses, forbs, and browse grow in the rougher, steeper areas.

Woodland

No timber of commercial value grows in the Delta-Montrose Area. Cottonwood and willow grow along the Uncompahgre River, but they are useful mainly for protecting the riverbanks from erosion. Some wooded areas on bottom lands are used for pasture.

Pinyon pine, one-seed juniper, and Utah juniper grow on some of the steep slopes at the southern end of the Area. Native stands of these trees grow also on Rough broken land in the Shavano Valley and on Kinnikin Heights; on Luhon and Travessilla soils in Bostwick Park; and on Rough stony land, shale and till materials, in Shinn Park. Pinyon and juniper have invaded some of the more nearly level areas of deeper soils adjacent to the soils just named, probably as a result of fire or heavy grazing, which reduced the competition from grasses and permitted the trees to get a start. Generally, these areas are small, and it may be advisable to clear them of trees and use them for grass or some other more profitable use. Clearing the steep soils generally is not wise, because erosion could become a serious hazard, and the potential for grass or any other type of cover is probably low.

The pinyon-juniper forest type does not produce wood crops at present, but it does provide considerable protection for deer and other wildlife in this Area. Some of the juniper is cut for fenceposts. The pinyon pine produces nuts, and to some extent is cut for firewood. Management of these trees should be limited to providing protection against fire and overgrazing. The expense of more intensive management would not be justified.

Engineering Uses of Soils [1]

The primary use of a soil from an engineering standpoint is as a construction material. The engineer is therefore interested in the properties that determine the suitability of the soil as building material and that impose limitations or special requirements for its use in construction. Soil properties that are of special interest to the engineer are those that affect the construction and maintenance of roads, airports, pipelines, building foundations, facilities for water storage, erosion-control structures, irrigation and drainage systems, and sewage disposal systems. The soil properties most important to the engineer are permeability to water, shear strength, compaction characteristics, soil drainage, shrink-swell characteristics, grain size, plasticity, depth of productive soil, and reaction. Depth to the water table, depth to bedrock, water-holding capacity, and topography are also important.

It should be emphasized that the engineering interpretations reported here may not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and excavations deeper than the depth of layers here reported. Even in these situations, the soil map at the back of this report is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

The information in this section can be used by engineers to—

1. Make preliminary estimates of the soil properties that are important in planning agricultural drainage systems, farm ponds, irrigation systems, and diversion terraces.

[1] The tables in this section were prepared by T. G. SPANNAGEL, area engineer, Soil Conservation Service.

2. Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways, airports, pipelines, and cables, and in planning detailed investigations at the selected locations.
3. Locate probable sources of gravel and other construction material.
4. Make soil and land use studies that will aid in selecting and developing industrial, residential, and recreational sites.
5. Correlate performance of engineering structures with soil mapping units to develop information for planning that will be useful in designing structures and planning certain engineering practices.
6. Determine the suitability of soils for cross-country movement of vehicles and construction equipment.
7. Supplement the information obtained from other published maps, reports, and aerial photographs for the purpose of making maps and reports that can be used readily by engineers.
8. Develop other preliminary estimates for construction purposes, pertinent to the particular area.

Some of the terms used by soil scientists may not be familiar to engineers, and some words—for example, *soil*, *clay*, *silt*, and *sand*—may have special meanings in soil science. These terms and others are defined in the Glossary at the back of this report.

Engineering classification systems

Agricultural scientists classify soils by using the textural classification system of the U.S. Department of Agriculture. In this system, the textural classification is determined mainly by the percentage of soil material smaller than 2 millimeters. The engineering systems now most widely used to classify soils are the Unified System,[2] and the system developed by the American Association of State Highway Officials (AASHO).[3]

The Unified soil classification system was established by the Waterways Experiment Station, Army Corps of Engineers. This system is based on identification of soils according to their texture, plasticity, and liquid limit. In the Unified System, the symbols SW and SP are for clean sands; SM and SC are primarily for sands with nonplastic or plastic fines, (G replaces S if the major coarse fraction is gravel); ML and CL are primarily for nonplastic or plastic, fine-grained materials of low liquid limit; and MH and CH are primarily for nonplastic or plastic, fine-grained materials of high liquid limit. Some soil materials have characteristics that are borderline between the major classes and are given a borderline classification, such as ML–CL.

The AASHO system is based on the bearing strength of soils. It groups soils of about the same general load-carrying capacity and service. All materials are classified in seven basic groups. The groups range from A–1 (gravelly soils of high bearing capacity, the best soils for road subgrade) to A–7 (clayey soils having low strength when wet, the poorest soils for subgrade). Within each group, the relative engineering value of the soil material is indicated by a group index number. Group indexes range from 0 for the best material to 20 for the poorest. They can be established only by examination of the soil material. The group index number is shown in parentheses after the soil group number.

Engineering properties and interpretations

Information and interpretations of most significance to engineers are presented in tables 3, 4, and 5.

Table 3 presents data obtained by laboratory tests on soil samples taken from selected soil profiles.

Table 4 gives estimates of particle-size distribution and of the following soil properties that affect engineering work: permeability, available water capacity, reaction, salinity, dispersion, and shrink-swell potential.

The rates of permeability given in this table are based on the movement of water through an undisturbed soil. The rates depend largely on the texture and structure of the soil.

Available water capacity is the approximate amount of capillary water in a soil at field capacity. At the wilting point of common crops, this amount of water will wet the given soil to a depth of 1 inch without deeper percolation.

Reaction, which indicates the degree of acidity or alkalinity of a soil, is expressed as a pH value.

Estimates of salinity are based on the electrical conductivity of a saturated soil extract, as expressed in millimhos per centimeter at 25° C.

Dispersion, as used in this report, refers to the degree to which particles less than 0.005 millimeter in diameter are separated or dispersed. It is to be distinguished from the unaggregated, or single grain, condition common in clean sand. Dispersed soils generally can be recognized in the field by piping and can be seen in gullies and road cuts that contain numerous cracks. They commonly become slick when wet and form a crust when dry. Soils high in sodium, specifically those that are more than 15 percent exchangeable sodium, are likely to be dispersed. Acid silty soils that developed under poor surface and internal drainage are also likely to be dispersed.

Shrink-swell potential indicates the volume change to be expected when the soil material changes in moisture content. In general, soils classed as CH and A–7 have high shrink-swell potential. Clean sand and most other nonplastic soil materials have low shrink-swell potential.

Table 5 gives the suitability of the soils for certain uses and describes specific characteristics that affect design and construction of highways and structures. These interpretations are based on estimates in table 4, on the test data in table 3, on other available test data, and on field experience.

[2] WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS. UNIFIED SOIL CLASSIFICATION SYSTEM. Tech. Memo. No. 3-357, v. 1. 1953.

[3] AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS. STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING. Pt. 1, Ed. 8. 1961.

TABLE 3.—*Engineering test data for soil samples taken from selected soil profiles*

[Tests performed by the Colorado Department of Highways (Delta Div.) in accordance with standard procedures of the American Association of State Highway Officials (AASHO). Profiles for test data, Project No. F-019-1, dated Feb. 23, 1950. Dashed lines mean absence of data]

Soil name and location	Depth from surface	Specific gravity	Percentage passing sieve [1]—				Liquid limit	Plasticity index	Classification	
			No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)			AASHO	Unified [2]
Billings silty clay loam:	*(Feet)*									
On Delta-Montrose County line, in SW¼ sec. 21, T. 51 N., R. 10 W. New Mex. P.M. (Sample No. 54A).	0.6 to 3.5	2.79	93	89	79	60	31.5	21.0	A-6(5)	CL.
Chipeta silty clay:										
1,900 feet S. and 500 feet E. of NW. corner sec. 15, T. 50 N., R. 10 W., New Mex. P.M. (Sample No. 18A).	1.0 to 5.9	2.72	98	95	86	84	44.5	23.8	A-7-6(13)	CL.
700 feet N. and 400 feet W. of SE. corner sec. 10, T. 50 N., R. 10 W., New Mex. P.M. (Sample No. 21A).	.8 to 10.0	2.60	94	92	90	87	36.8	21.5	A-6(10)	CL.
1,400 feet W. of NE. corner sec. 33, T. 51 N., R. 10 W., New Mex. P.M. (Sample No. 47A).	.6 to 3.5	2.77	100	98	95	91	39.4	12.5	A-6(15)	CL.
Genola clay loam:										
500 feet S. of W¼ corner sec. 3, T. 50 N., R. 11 W., New Mex. P.M. (Test No. 12).	.0 to 4.0	------	87	80	72	48	29.0	13.0	A-6-4	SM-ML.
Mack gravelly clay loam:										
2,050 feet N. of SW. corner sec. 27, T. 51N., R. 11 W., New Mex. P.M. (Test No. 5).	.0 to 5.0	------	91	87	82	41	[3] NP	NP	A-4(1)	SM.
Menoken clay loam:										
200 feet S. and 1,600 feet W. of NE. corner sec. 35, T. 50 N., R. 10 W., New Mex. P.M. (Sample No. 1A).	1.0 to 4.0	2.67	95	92	88	83	40.7	20.0	A-7-6(12)	CL.
Mesa clay loam:										
900 feet S. and 1,800 feet E. of NW. corner sec. 26, T. 50 N., R. 10 W., New Mex. P.M. (Sample No. 6A).	1.0 to 3.5	2.74	97	95	91	78	37.0	19.6	A-6(11)	CL.
120 feet S. and 1,500 feet E. of NW. corner sec. 26, T. 50 N., R. 10 W., New Mex. P.M. (Sample No. 7A).	1.2 to 4.0	2.71	95	92	85	58	26.2	17.0	A-4(5)	ML-CL.
1,400 feet S. and 600 feet E. of NW. corner sec. 10, T. 50 N., R. 10 W., New Mex. P.M. (Sample No. 27A).	1.45 to 4.0	2.74	38	31	23	14	26.5	19.9	A-2-4(0)	GC.
1,300 feet N. of SW. corner sec. 17, T. 51 N., R. 11 W., New Mex. P.M. (Test No. 6).	.0 to 3.0	------	97	93	88	47	24.0	10.0	A-4(2)	SM.
Mesa gravelly clay loam:										
1,600 feet N. and 1,700 feet W. of SE. corner sec. 28, T. 51 N., R. 10 W., New Mex. P.M. (Sample No. 48A).	.8 to 4.0	2.75	92	90	82	59	33.4	NP	A-4(5)	ML.
2,200 feet N. and 1,800 feet W. of SE. corner sec. 28, T. 51 N., R. 10 W., New Mex. P.M. (Sample No. 49A).	.7 to 4.0	2.77	77	69	58	42	31.5	21.5	A-4(1)	SM.
650 feet S. and 2,700 feet W. of NE. corner sec. 28, T. 51 N., R. 10 W., New Mex. P.M. (Sample No. 52A).	.8 to 4.0	2.78	88	82	72	57	29.8	21.6	A-4(4)	ML.

See footnotes at end of table.

TABLE 3.—*Engineering test data for soil samples taken from selected soil profiles*—Continued

Soil name and location	Depth from surface	Specific gravity	Percentage passing sieve [1]— No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Liquid limit	Plasticity index	Classification AASHO	Unified [2]
Persayo silty clay loam:	(Feet)									
1,000 feet E. and 1,320 feet S. of W¼ corner sec. 23, T. 50 N., R. 10 W., New Mex. P.M. (Sample No. 9A).	1.0 to 4.0	2.71	99	98	97	96	46.5	21.9	A-7-6(15)	CL.
700 feet E. and 400 feet S. of W¼ corner sec. 23, T. 50 N., R. 10 W., New Mex. P.M. (Sample No. 10A).	1.0 to 3.5	2.70	96	91	82	64	33.2	17.7	A-6(8)	CL.
900 feet N. of W¼ corner sec. 23, T. 50 N., R. 10 W., New Mex. P. M. (Sample No. 13A).	1.0 to 3.5	2.54	97	94	92	85	39.5	24.9	A-6(10)	CL.
300 feet S. and 1,300 feet W. of NE. corner sec. 33, T. 51 N., R. 10 W., New Mex. P.M. (Sample No. 44A).	.8 to 4.0	2.79	97	96	94	91	44.8	21.3	A-7-6(14)	CL.
120 feet S. and 1,300 feet W. of NE. corner sec. 33, T. 51 N., R. 10 W., New Mex. P.M. (Sample No. 45A).	.8 to 5.0	2.79	91	89	86	83	40.5	23.4	A-7-6(11)	CL.
Rock outcrop-Travessilla association:										
700 feet S. of W¼ corner sec. 17, T. 49 N., R. 9 W., New Mex. P.M. (Test No. 84).	1.0 to 3.0	------	100	100	99	93	32.0	15.0	A-6(10)	ML.
Uncompahgre loam:										
Near E¼ corner sec. 20, T. 51 N., R. 10 W., New Mex. P.M. (Test No. 60).	.5 to 3.0	2.67	43	38	27	17	27.0	19.7	A-2-4(0)	GM.

[1] According to Designation: T 88-57, "Mechanical Analysis of Soils," in "Standard Specifications for Highway Materials and Methods of Sampling and Testing," pt. 1, Ed. 8 (1961), published by AASHO. Results of this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes for soils.

[2] SCS and BPR have agreed to consider that all soils having plasticity indexes within two points of the A-line are to be given a borderline classification. Examples of borderline classifications obtained by this use are SM-ML and ML-CL.

[3] NP=Nonplastic.

Genesis, Morphology, and Classification of Soils

Soil is a natural body having characteristics developed as the result of the action, over a period of time, of dynamic forces in the environment upon parent material. The character of the soil in any landscape differs from place to place, depending upon the nature and intensity of the factors that influenced its development.

Factors Affecting Soil Genesis

Five major factors are influential in the development of a soil at any specific location: climate, biological forces, time, relief, and parent materials. All of these factors are highly complex. There are many kinds of climate, and many kinds and combinations of biological forces. Parent materials vary widely in physical, chemical, and mineralogical properties, and there are great differences in the length of time that the other factors have been acting upon the parent material. In many places, but not all, the activities of man have modified the effect of the five major factors.

The history of the development of soil characteristics is called soil genesis. The characteristics themselves are called, collectively, soil morphology. Although much is known about soil genesis, it is not possible to reconstruct the precise history of a soil's development from the data available to a soil scientist. Consequently, the natural system of soil classification used in the United States is based on morphologic features. It is possible to select morphologic features of soils known to result from given processes of soil genesis and, guided by an understanding of soil genesis, to use these features as the basis of a usable form of soil classification.

The following sections give a general evaluation of the factors influential in the development of the soils of the Delta-Montrose Area and of the manner in which the resulting soil morphology has been used to group the soils into the units of the classification system.

Climate

The climate of most of the Delta-Montrose Area is arid-continental. Summers are hot and dry, and winters cold and dry. The average annual precipitation at the Delta Weather Station, in the north-central part of the survey Area, is 8.3 inches. Nearly 6 inches of that total falls during the months from April to October. Only in the months of July and August is the average rainfall more than 1 inch. The average annual temperature is 51° F., and the average temperature for the months of June, July, and August is 72°. The average frost-free season is 146 days.

At the Montrose Weather Station, in the south-central part of the survey Area, the average annual precipitation is 9.1 inches. Of this total, 6.1 inches falls during the summer months of April through October. In the months of April, August, and September, the average rainfall is 1 inch or more. The average annual temperature is 48.5°, and the average temperature for the months of June, July, and August is 69°. The average frost-free season is 152 days.

Data recorded at these two weather stations characterize the climate of most of the survey Area but are not representative of the climate in Bostwick Park and the southeastern parts of the Area. No precise weather data for these sections are available, but the general character of the climate can be approximated by projecting data from stations in similar areas.

Most of the Delta-Montrose Area is at elevations of 5,000 to 6,500 feet. Elevations in Bostwick Park and in the southeastern part of the survey Area range from 7,000 to 8,000 feet. It is to be expected that mean temperatures will be lower at these higher elevations, and that the average precipitation will be greater. By projecting data from the Norwood Weather Station, which is at an elevation of 7,017 feet and about 35 miles southwest of Montrose, it is to be expected that the average annual precipitation will be about 16 inches, that precipitation will exceed 1 inch in all but 3 months of each year, and that the mean annual temperature will be approximately 45°. In June, July, and August, the temperature will average about 64°.

The effect of the climate on soil development can only be approximated, since recorded weather data cover only a period of 30 to 50 years, whereas the time required for development of distinct soil horizons in this Area may be measured in thousands of years. It would be unsound to assume that the recorded data represent a true picture of the climate over all or even a major portion of the genetic history of the soils. It is possible, however, to draw logical parallels between general characteristics of the climate and general characteristics of the soils. Such an approach to the genetic impact of climate is of considerable value in the understanding of soil genesis, even though it is recognized that the climatic history of the soils cannot be reconstructed precisely.

The amount of water available and the distribution of water in relation to temperature are of prime importance in soil genesis. They play a major role in the growth and activity of organic life in and on the soil, in the physical translocation of substances in solution or suspension, and in controlling the rate and direction of chemical processes. If it is assumed that water has been in short supply through a governing period in the genetic history of the soils, it would be expected that, in relatively permeable parent material, the depth to which readily soluble calcium compounds have been transported would be comparatively shallow, that the soils and the individual horizons would be thin, and that removal of soluble calcium compounds from the upper soil horizons would not have been complete.

The morphology of the soils of most of this Area is in accordance with these assumptions. Virgin soils that have distinct horizons have a solum less than 20 inches thick, have a strong accumulation of secondary calcium carbonate at a depth of 12 to 16 inches, and have been leached sufficiently to be noneffervescent or acid in only the uppermost few inches. It seems probable, that the amount and distribution of precipitation have been about the same as at present through a large part of the genetic history of the soils. If the present conditions represent only a stage of cyclic variation, then the total genetic effect of such variation has been the same as though the supply of moisture had been short throughout the period of soil genesis.

The soils in Bostwick Park and in the southeastern part of the Area show evidence that, for at least a controlling period in their genetic history, they received greater amounts of precipitation than the soils in the rest of the Area. In these localities, virgin soils that have distinct horizons have a solum more than 24 inches thick, have a less strongly developed ca horizon, are leached of free carbonate to a depth of 10 to 20 inches, and have a thicker and darker-colored surface horizon. A difference in vegetation is further evidence that precipitation was more abundant. In these higher localities, the vegetation consists of brush and scattered trees, but in the rest of the Area the vegetation consists of grass and sage.

Although the pattern of precipitation may have differed from the present pattern at times during the soils' genetic history, the general relationship between present-day variations in precipitation within the survey Area are reflected in differences in soil morphology. Moreover, soil morphology in the various parts of the Area is consistent with what could logically be anticipated had the present-day precipitation pattern been consistent throughout the soils' genetic history.

The relationship between temperature and soil morphology in the Delta-Montrose Area is more obscure than that between precipitation and soil morphology. This obscurity is due partly to the lack of significant variations in temperature within the survey Area and partly to the fact that in this Area temperature influences soil genesis mainly through determining the effectiveness of moisture. Thus, the effect of temperature is so interwoven with the effect of precipitation that it is impossible to separate them precisely.

The hot summer temperatures that coincide with periods of maximum precipitation in this Area materially decrease the effectiveness of the moisture. Evaporation is very rapid in most of the Delta-Montrose Area during the hot summer months, and much of the rainfall during this period evaporates before it has any effect on soil genesis. The result is the same as that of a reduction in the total amount of precipitation.

TABLE 4.—*Estimated physical*

Soil series and map symbols	Depth from surface	Classification		
		USDA texture	Unified	AASHO
	Inches			
Alluvial land (Al).	0–48	(1)	(1)	(1)
Badland (Ba).	(1)	(1)	(1)	(1)
Billings:				
Gravelly clay loams (BcA, BcB, BcC).	0–12	Gravelly clay loam	CL	A–7
	12–60	Silty clay loam	CL	A–7
Silty clays (BdA, BdB, BdC).	0–12	Silty clay	CH	A–7
	12–60	Silty clay loam	CL	A–7
Silty clay, loamy substratum (BeA).	0–12	Silty clay	CH	A–7
	12–60	Loam	CL–ML	A–6
Silty clays, shale substratum (BfA, BfB).	0–12	Silty clay	CH	A–7
	12–48	Silty clay loam	CL	A–7
Silty clay loams (BgA, BgB, BgC).	0–36	Silty clay loam	CL	A–7
	36–60	Silty clay loam and clay loam	CL	A–7
Silty clay loam, gravel substratum (BhA).	0–48	Silty clay loam	CL	A–7
	48–60	Gravelly clay loam	CL	A–6
Silty clay loams, shale substratum (BkA, BkB).	0–36	Silty clay loam	CL	A–7
Blanyon:				
Silty clay loam (BnB).	0–6	Silty clay loam	CL	A–7
	6–60	Silty clay	CH	A–7
Silty clay loam, moderately wet variant (Bp).	0–6	Silty clay loam	CL	A–7
	6–60	Silty clay	CH	A–7
Bostwick:				
Fine sandy loam, coarse subsoil variant, and gravelly loam (BrC, BsB).	0–8	Gravelly loam or fine sandy loam	ML	A–4
	8–30	Clay loam	CL	A–6
	30–60	Loam	ML	A–4
Loams (BtA, BtB, BtC).	0–8	Loam	ML	A–4
	8–30	Clay loam	CL	A–6
	30–60	Loam	ML	A–4
Stony loams (BwB, BwC, BwD).	0–8	Stony loam	ML	A–4
	8–30	Clay loam	CL	A–6
	30–60	Loam	ML	A–4
Cerro (CcB, CcC).	0–20	Clay loam	CL	A–6
	20–60	Stony clay loam	CL	A–6
Chacra (MkA). (For Menoken part of MkA, see Menoken series.)	0–5	Loam	ML	A–4
	5–17	Clay loam	CL	A–6
	17–30	Loam	ML	A–4
Chipeta (CeA, CeB, ChC, ChC2, CkC, ClC). (For Persayo part of ChC, ChC2, CkC, and ClC, see Persayo series; for Mesa part of CkC, see Mesa series; and for Rance part of ClC, see Rance series.)	0–10	Silty clay	CH	A–7
Christianburg (CmA, CmC).	0–14	Silty clay to silty clay loam	CH	A–7
	14–60	Silty clay	CH	A–7
Colona:				
Clays (CoA, CoC).	0–3	Clay	CH	A–7
	3–60	Silty clay	CH	A–7
Clay, gravel substratum (CsA).	0–3	Clay	CH	A–7
	3–30	Silty clay	CH	A–7
	30–60	Gravel	GC-GW	A–1

See footnotes at end of table.

and chemical properties of soils

Percent passing sieve size— No. 4 (4.7 mm.)	Percent passing sieve size— No. 10 (2.0 mm.)	Percent passing sieve size— No. 200 (0.074 mm.)	Permea-bility	Available water capacity	Reaction	Salinity	Dispersion	Shrink-swell potential
			Inches per hour	*Inches per inch of soil*				
(1)	(1)	(1)	(1)	(1)	Moderately alkaline	Slight to moderate	Low to high	Low to high.
(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1).
85–90	80	75–80	0. 3–0. 5	0. 19	Moderately alkaline	Moderate to high	Moderate	Moderate.
90–95	80–90	75–80	0. 3–0. 5	. 19	Moderately alkaline	Moderate to high	Moderate to high	Moderate.
95–100	90–95	80–90	0. 1–0. 3	. 21	Moderately alkaline	Moderate to high	Moderate to high	High.
90–95	80–90	75–80	0. 3–0. 5	. 18	Moderately alkaline	Moderate to high	Moderate to high	Moderate.
95–100	90–95	85–90	0. 1–0. 3	. 21	Moderately alkaline	Moderate to high	Moderate to high	High.
90–95	80–90	60–70	0. 5–1. 0	. 17	Moderately alkaline	Moderate to high	Moderate to high	Low to moderate.
95–100	90–95	85–90	0. 1–0. 3	. 21	Moderately alkaline	Moderate to high	Moderate to high	High.
90–95	80–90	75–80	0. 3–0. 5	. 19	Moderately alkaline	Moderate to high	Moderate to high	Moderate.
85–90	80–85	75–80	0. 3–0. 5	. 17	Moderately alkaline	Moderate	Moderate	Moderate.
85–90	80–85	75–80	0. 3–0. 5	. 17	Moderately alkaline	Moderate	Moderate	Moderate.
85–90	80–85	75–80	0. 3–0. 5	. 17	Moderately alkaline	Moderate	Moderate	Moderate.
60–70	55–65	50–60	0. 5–0. 75	. 15	Moderately alkaline	Moderate	Moderate	Moderate.
85–90	80–85	75–80	0. 3–0. 5	. 17	Moderately to highly alkaline.	Moderate to high	Moderate	Moderate.
90–95	80–90	75–80	0. 3–0. 7	. 19	Mildly alkaline	Slight	Low	Moderate.
95–100	90–95	85–90	0. 2–0. 4	. 21	Mildly alkaline	Slight	Low	High.
90–95	80–90	75–80	0. 3–0. 7	. 19	Mildly alkaline	Moderate to high	Low	Moderate.
95–100	90–95	85–90	0. 2–0. 4	. 21	Mildly alkaline	Moderate to high	Low	High.
70–85	60–75	55–60	1. 0–1. 5	. 14	Mildly alkaline	Slight to none	Low	Low.
90–95	80–90	75–80	0. 3–0. 7	. 19	Mildly alkaline	Slight to none	Low	Moderate.
70–80	60–75	55–60	0. 5–1. 0	. 15	Moderately alkaline	Slight to none	Low	Low.
80–95	70–85	65–70	1. 0–1. 5	. 15	Mildly alkaline	Slight	Low	Low.
90–95	80–90	75–80	0. 3–0. 7	. 19	Mildly alkaline	Slight	Low	Moderate.
70–80	60–75	55–60	0. 5–1. 0	. 15	Mildly alkaline	Slight	Low	Low.
60–65	50–60	45–55	1. 3–1. 7	. 11	Mildly alkaline	Slight	Low	Low.
90–95	80–90	75–80	0. 3–0. 7	. 19	Mildly alkaline	Slight	Low	Moderate.
70–80	60–75	55–60	0. 5–1. 0	. 15	Mildly alkaline	Slight	Low	Low.
85–90	75–85	60–75	1. 0–2. 0	. 15	Mildly alkaline	Slight to none	Low	Moderate.
70–85	60–75	55–60	0. 5–1. 7	. 12	Moderately alkaline	Slight to none	Low	Moderate.
85–90	75–85	35–45	1. 0–2. 0	. 14	Mildly alkaline	Low	Low	Low.
85–90	75–85	55–60	1. 0–1. 5	. 16	Mildly alkaline	Low	Low	Low.
85–90	75–85	35–45	1. 0–2. 0	. 14	Mildly alkaline	Low	Low	Low
95–100	90–95	80–90	0. 1–0. 3	. 21	Moderately alkaline	Moderate	Moderate	High.
95–100	90–95	80–90	0. 1–0. 4	. 21	Moderately alkaline	Moderate to severe.	Moderate to high.	High.
95–100	90–95	80–90	0. 1–0. 3	. 21	Moderately alkaline	Moderate to severe.	Moderate to high.	High.
90–95	85–90	80–85	0. 1–0. 3	. 21	Mildly alkaline	Moderate	Moderate	High.
95–100	90–95	80–90	0. 1–0. 4	. 21	Mildly alkaline	Moderate	Moderate	High.
95–100	90–95	80–90	0. 1–0. 3	. 21	Mildly alkaline	Moderate	Moderate	High.
95–100	90–95	80–90	0. 1–0. 4	. 21	Mildly alkaline	Moderate	Moderate	High.
30–35	10–15	5–10	(1)	(1)	Mildly alkaline	None to slight	Low	Low.

TABLE 4.—*Estimated physical and chemical*

Soil series and map symbols	Depth from surface	Classification		
		USDA texture	Unified	AASHO
	Inches			
Doak:				
Clay loam (DoB).	0–7	Clay loam	CL	A–6
	7–14	Clay loam	CL	A–7
	14–60	Silty clay loam	CL	A–7
Stony clay loam (DsC).	0–7	Stony clay loam	CL	A–6
	7–14	Clay loam	CL	A–7
	14–60	Silty clay loam	CL	A–7
Fruita:				
Loam and clay loam (FaA, FbC).	0–4	Loam to clay loam	ML to CL	A–4
	4–60	Loam	ML to CL	A–4
Fruitland:				
Fine sandy loams and sandy clay loams (FrA, FrB, FsA, FsB).	0–12	Sandy loam to sandy clay loam	SM to SC	A–4
	12–60	Fine sandy loam	SM	A–4
Sandy clay loams, stony substratum (FtA, FtB).	0–30	Sandy loam to sandy clay loam	SM	A–4
	30–60	Stony sandy loam	GM	A–2
Genola:				
Clay loams (GeA, GeB).	0–10	Clay loam	CL	A–6
	10–60	Loam	ML	A–6
Clay loam, saline (GsA).	0–10	Clay loam	CL	A–6
	10–60	Loam	ML	A–4
Gullied land (Gu).	(1)	(1)	(1)	(1)
Hinman (HcA).	0–29	Clay loam	CL	A–6
	29–60	Gravelly clay loam	CL	A–6
Luhon:				
Clay loams (LcB, LcC, Lt). (For Travessilla part of Lt, see Travessilla series.)	0–30	Clay loam	CL	A–6
	30–60	Clay loam	CL	A–6
Gravelly clay loam and stony clay loam (LgC, LsC).	0–10	Gravelly and stony clay loam	GC	A–2
	10–60	Clay loam	CL	A–6
Mack:				
Clay loams (MaA, MaB, MaC).	0–14	Clay loam	CL	A–6
	14–60	Loam	SM	A–4
Gravelly clay loam (MgA).	0–10	Clay loam	CL	A–6
	10–60	Loam	SM	A–4
Menoken (MkA). (For Chacra part of MkA, see Chacra series.)	0–26	Clay loam	CL	A–6
Mesa:				
Clay loams and stony clay loam (MlA, MlB, MlC, MtC, CkC).	0–16	Clay loam	CL	A–6
	16–32	Gravelly clay loam	GC	A–4
	32–60	Very gravelly clay loam	GP	A–2
Gravelly clay loams (MoA, MoB, MoC).	0–8	Gravelly clay loam	CL	A–6
Gravelly clay loams, shale substratum (MsA, MsC).	0–8	Gravelly clay loam	CL	A–6
	8–16	Clay loam	CL	A–6
	16–30	Gravelly clay loam	GC	A–4
Orchard:				
Clay loams and gravelly clay loams (OcA, OcB, OgA, OgB).	0–19	Clay loam	CL	A–6
	19–46	Gravelly loam	GC	A–2
	46–60	Very gravelly loam	GP	A–2
Persayo (PeA, PeB, ChC, ChC2, CkC, ClC).	0–12	Silty clay loam	CL	A–7
Poudre (Po).	0–14	Loam	ML	A–5
	14–60	Sandy loam	SM	A–4

See footnotes at end of table.

properties of soils—Continued

Percent passing sieve size— No. 4 (4.7 mm.)	Percent passing sieve size— No. 10 (2.0 mm.)	Percent passing sieve size— No. 200 (0.074 mm.)	Permeability	Available water capacity	Reaction	Salinity	Dispersion	Shrink-swell potential
			Inches per hour	*Inches per inch of soil*				
85–90	78–85	70–75	0.3–0.5	0.17	Mildly alkaline	Low	Low	Moderate.
90–95	85–90	75–85	0.2–0.4	.19	Mildly alkaline	Low	Low	Moderate.
90–95	85–90	75–85	0.2–0 3	.19	Mildly alkaline	Low	Low	Moderate.
75–85	70–80	70–75	0.3–0.5	.17	Mildly alkaline	Low	Low	Moderate.
90–95	85–90	75–85	0.2–0.4	.19	Mildly alkaline	Low	Low	Moderate.
90–95	85–90	75–85	0.2–0.3	.19	Mildly alkaline	Low	Low	Moderate.
90–95	80–85	50–60	1.0–1.5	.16	Mildly alkaline	Low	Low	Low.
90–95	80–85	55–65	0.75–1.5	.16	Mildly alkaline	Low	Low	Low.
95–100	85–90	35–40	2.5–3.0	.12	Moderately alkaline	Low	Low	Low.
95–100	85–90	35–40	2.5–3.0	.1	Moderately alkaline	Low	Low	Low.
95–100	85–90	35–40	2.5–3.0	.12	Moderately alkaline	Low	Low	Low.
30–40	20–25	15–20	[1]	[1]	[1]	Low	Low	Low.
95–100	90–95	75–80	1.0–1.5	.17	Moderately alkaline	Low	Low	Low.
85–90	75–80	50–65	1.0–1.5	.16	Moderately alkaline	Low	Low	Low.
95–100	90–95	75–80	1.0–1.5	.17	Moderately alkaline	Moderate to severe.	Moderate	Low.
95–100	85–90	65–70	1.0–1.5	.16	Moderately alkaline	Moderate to severe.	Moderate	Low.
[1]	[1]	[1]	[1]	[1]	[1]	[1]	[1]	[1].
90–95	85–90	75–80	0.2–0.5	.19	Mildly alkaline	Low	Low	Moderate.
70–75	65–70	50–55	0.2–5.0	.19	Moderately alkaline	Low	Low	High.
95–100	90–95	75–80	0.5–1.0	.17	Mildly alkaline	Low	Low	Moderate.
70–75	65–70	55–60	0.75–1.0	.15	Moderately alkaline	Low	Low	Low.
45–50	40–45	20–30	1.5–2.0	.11	Mildly alkaline	Low	Low	Low.
70–95	65–90	55–80	0.75–1.0	.15	Moderately alkaline	Low	Low	Low.
85–90	75–85	55–60	1.0–1.5	.16	Mildly alkaline	Low	Low	Moderate.
85–90	75–85	35–45	1.0–2.0	.14	Mildly alkaline	Low	Low	Low.
85–90	75–85	55–60	1.0–1.5	.16	Mildly alkaline	Low	Low	Moderate.
80–90	75–85	35–45	1.0–2.0	.14	Mildly alkaline	Low	Low	Low.
95–100	90–95	75–80	0.5–1.0	.16	Moderately alkaline	Low	Low	Moderate.
90–95	80–90	65–70	0.1–1.5	.17	Mildly alkaline	Low	Low	Moderate.
55–60	45–50	35–40	2.0–4.0	.07	Moderately alkaline	Low	Low	Low.
35–40	25–30	10–15	[1]	[1]	Moderately alkaline	Low	Low	Low.
70–80	60–70	50–60	1.0–1.5	.14	Mildly alkaline	Low	Low	Low.
70–80	60–70	50–60	1.0–1.5	.14	Mildly alkaline	Low	Low	Low.
90–95	80–90	65–70	0.75–1.0	.17	Moderately alkaline	Low	Low	Moderate.
55–60	45–50	35–40	2.0–4.0	.06	Moderately alkaline	Moderate to low	Low	Low.
80–85	70–75	55–65	0.75–2.0	.16	Mildly alkaline	Low	Low	Moderate.
40–45	25–30	10–15	2.5–3.0	.06	Moderately alkaline	Low	Low	Low.
30–40	25–30	5–10	----------	----------	Moderately alkaline	Low	Low	Low.
95–100	95–100	95–100	0.3–0.5	.21	Moderately alkaline	Moderate	Low	High.
95–100	85–90	65–70	2.0–2.5	.18	Mildly alkaline	Moderate	Low	Low.
95–100	85–90	40–50	3.0–4.0	.13	Moderately alkaline	Moderate	Low	Low.

TABLE 4.—*Estimated physical and chemical*

Soil series and map symbol	Depth from surface	Classification		
		USDA texture	Unified	AASHO
	Inches			
Rance (RaA, RaB, RaC, ClC).	0–40	Clay loam	CL	A–6
Ravola (Rl).	0–8	Clay loam	CL	A–7
	8–60	Loam	ML	A–6
Rock outcrop, Rough broken land, and Rough stony land (Rr, RtC, RtE, Ru, Rv, Rw, Ry).	(2)	(2)	(2)	(2)
Saline wet land (Sa).	(1)	(1)	(1)	(1)
Salt Lake (Sc).	0–60	Clay	CH	A–7
Sandy land (Sd).	0–60	Fine sand	SP	A–3
Shavano (ShB, ShC).	0–7	Sandy clay loam	SM	A–2
	7–26	Sandy clay loam	SM	A–2
Travessilla (TrC, Lt).	0–8	Fine sandy loam	SM	A–2
Uncompahgre:				
Clay loams (Uc, Ug).	0–10	Clay loam	CL	A–6
	10–60	Loam	ML	A–4
Fine sandy loam (Uh).	0–8	Fine sandy loam	SM	A–2
	8–30	Loam	ML	A–4
	30–60	Sand and gravel	GP or GW	A–1 to A–2
Gravelly loam (Um).	0–10	Gravelly loam	ML	A–4
Loams (Un, Uw).	0–60	Loam	ML	A–4
Vernal:				
Clay loams and gravelly clay loams (VeA, VeB, VgA, VgB).	0–18	Clay loam	CL	A–6
	18–60	Sand and gravel	GP-GM	A–1
Wet alluvial land (Wa).	(1)	(1)	(1)	(1)
Woodrow (WoA).	0–60	Clay loam	CL	A–7

[1] Properties not estimated.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as a source of—				Highway location
	Topsoil	Sand	Gravel	Road fill	
Alluvial land (Al)	Fair	Fair if washed and screened.	Fair if washed and screened.	Fair to good	Fair to poor, depending on drainage and salinity.
Badland (Ba)	Poor	Unsuitable	Unsuitable	Poor	Very poor; shallow to shale

properties of soils—Continued

Percent passing sieve size—			Permea-bility	Available water capacity	Reaction	Salinity	Dispersion	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)						
			Inches per hour	*Inches per inch of soil*				
85–90	75–80	65–70	0. 75–1. 0	0. 18	Moderately alkaline	Moderate	Moderate	Moderate to high.
95–100	90–95	85–90	0. 3–0. 5	. 21	Moderately alkaline	Low	Low	Moderate to high.
95–100	85–90	65–70	1. 5–2. 5	. 17	Moderately alkaline	Low	Low	Moderate.
(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2).
(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1).
95–100	90–95	85–90	0. 1–0. 3	. 21	Mildly alkaline	Moderate	Low	High.
100	95–100	5	5. 0–6. 0	. 08	Mildly alkaline	Low	Low	Low.
95–100	85–90	25–35	1. 75–2. 5	. 14	Mildly alkaline	Low	Low	Low.
75–80	85–90	25–35	1. 5–2. 0	. 13	Moderately alkaline	Low	Low	Low.
80–85	75–80	20–30	3. 0–4. 5	. 10	Moderately alkaline	Low	Low	Low.
90–95	80–90	65–70	1. 0–1. 5	. 18	Moderately alkaline	Moderate to low	Low	Moderate.
85–90	75–85	50–60	2. 0–3. 0	. 15	Moderately alkaline	Moderate to low	Low	Low.
90–95	75–80	25–30	3. 0–5. 0	. 12	Moderately alkaline	Low	Low	Low.
90–95	75–80	65–70	2. 0–2. 5	. 15	Moderately alkaline	Low	Low	Low.
25–35	10–15	5	(1)	(1)	Mildly alkaline	Low	Low	Low.
65–70	55–60	50–55	2. 5–3. 5	. 14	Moderately alkaline	Low	Low	Low.
85–90	75–85	60–65	2. 0–3. 5	. 16	Moderately alkaline	Low	Low	Low.
85–90	75–80	65–70	0. 75–1. 5	. 19	Mildly alkaline	Low	Low	Moderate.
15–20	10–15	5–10	(1)	(1)	Moderately alkaline	Low	Low	Low.
(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1).
85–90	80–85	75–80	0. 3–0. 5	. 17	Moderately alkaline	Low	Low	Moderate to high.

[2] No estimates of the engineering properties of these land types were made. RtC and RtE are partly Travessilla soils, and RtE is partly Luhon soils. See Travessilla and Luhon series.

interpretations for soils

Dikes and diversions	Farm ponds		Agricultural drainage	Irrigation	Degree of limitation for—	
	Reservoir area	Embankment			Filter fields for sewage disposal	Homesites
Fair to good in areas with low salinity.	Fair; moderate seepage.	Fair to good if properly compacted.	Moderate or high water table in some areas.	Fair to good where both salinity and water table are low.	Severe	Severe.
Very poor; erodible; saline.	Poor; saline; shallow to shale.	Poor; erodible; saline.	Poor; slow internal drainage.	Not suitable; shallow; saline.	Severe; slow internal drainage.	Severe.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as a source of—				Highway location
	Topsoil	Sand	Gravel	Road fill	
Billings:					
Gravelly clay loams (BcA, BcB, BcC).	Fair	Poor	Poor	Fair in uppermost 12 inches, poor below depth of 12 inches.	Poor stability and bearing value.
Silty clays (BdA, BdB, BdC)	Poor	Unsuitable	Unsuitable	Poor	Poor stability and bearing value.
Silty clay, loamy substratum (BeA).	Poor	Unsuitable	Unsuitable	Poor	Poor stability and bearing value in uppermost 3 feet; fair to good below depth of 3 feet.
Silty clays, shale substratum (BfA, BfB).	Poor	Unsuitable	Unsuitable	Poor	Poor stability and bearing value; shale substratum undesirable.
Silty clay loams (BgA, BgB, BgC).	Poor	Unsuitable	Unsuitable	Poor	Poor stability and bearing value.
Silty clay loam, gravel substratum (BhA).	Poor	Fair if washed and screened.	Good if washed and screened.	Poor to depth of 4 feet, good below depth of 4 feet.	Poor stability and bearing value; good substratum drainage.
Silty clay loams, shale substratum (BkA, BkB).	Poor	Unsuitable	Unsuitable	Poor	Poor stability and bearing value; shale substratum undesirable.
Blanyon:					
Silty clay loam (BnB)	Poor	Unsuitable	Unsuitable	Poor	Poor stability and bearing value.
Silty clay loam, moderately wet variant (Bp).	Poor	Unsuitable	Unsuitable	Poor	Poor stability and bearing value; high water table.
Bostwick:					
Fine sandy loam, coarse subsoil variant (BrC).	Good	Fair if washed and screened.	Poor	Good	Good stability and bearing value; well drained.
Gravelly loam (BsB)	Fair to good.	Poor	Fair in uppermost 12 inches if washed and screened.	Fair	Fair stability and bearing value; well drained.
Loams (BtA, BtB, BtC)	Good	Poor	Poor	Fair	Fair stability and bearing value; well drained.
Stony loams (BwB, BwC, BwD)	Poor	Poor	Fair if washed and screened.	Fair to good	Good stability and bearing value; well drained.

interpretations for soils—Continued

Dikes and diversions	Farm ponds: Reservoir area	Farm ponds: Embankment	Agricultural drainage	Irrigation	Degree of limitation for—: Filter fields for sewage disposal	Degree of limitation for—: Homesites
Subject to cracking on drying; low stability; erodible.	Fair; subject to moderate seepage and piping.	Poor stability; erodible.	Slow internal drainage; subject to buildup of water table.	Moderately well suited on slopes of less than about 4 percent.	Severe; slow internal drainage.	Severe.
Subject to cracking on drying; low stability; erodible.	Good if bottom is properly compacted.	Poor stability; erodible.	Slow internal drainage; subject to buildup of water table.	Moderately well suited on slopes of less than about 5 percent.	Severe; slow internal drainage.	Severe.
Subject to cracking on drying; low stability; erodible.	Poor; subject to moderate seepage.	Poor stability; erodible.	Fair to good internal drainage.	Moderately well suited.	Moderate; moderate internal drainage.	Moderate.
Subject to cracking on drying; erodible.	Poor; subject to seepage and piping.	Poor stability; erodible.	Slow internal drainage.	Poorly suited; subject to buildup of water table.	Severe; slow internal drainage.	Severe.
Subject to cracking on drying; low stability; erodible.	Subject to moderate seepage.	Poor stability; erodible.	Slow internal drainage.	Moderately well suited on slopes of less than 5 percent.	Severe; slow internal drainage.	Severe.
Subject to cracking on drying; erodible.	Poor; subject to high seepage.	Poor stability; erodible.	Good substratum drainage.	Moderately well suited.	Moderate; moderate internal drainage.	Moderate.
Subject to cracking on drying; erodible.	Poor; subject to seepage and piping.	Poor stability; erodible.	Slow internal drainage.	Poorly suited; slow internal drainage.	Severe; slow internal drainage.	Severe.
Subject to cracking on drying; erodible.	Good; low seepage.	Poor stability; erodible.	Slow internal drainage; subject to buildup of water table.	Moderately well suited on slopes of less than about 5 percent.	Severe; subject to buildup of water table.	Severe.
Subject to cracking on drying; erodible.	Good; low seepage.	Poor stability; erodible.	Poorly drained.	Poorly suited without major drainage.	Severe; high water table.	Severe.
Good stability; slow permeability if compacted; moderately erodible.	Poor; subject to high seepage.	Good stability; slow permeability if compacted.	Well drained.	Very erodible on slopes of 5 to 10 percent.	Slight; well drained.	Slight.
Moderate stability; slow permeability if compacted.	Fair; moderate seepage.	Moderate stability; slow permeability if compacted.	Well drained.	Moderately well suited.	Moderate; moderate internal drainage.	Moderate or slight.
Moderate stability; slow permeability if compacted.	Fair; moderate seepage.	Moderate stability.	Well drained.	Moderately well suited on slopes of less than 5 percent.	Moderate; moderate internal drainage.	Moderate.
Good stability; slow permeability if compacted.	Poor; high seepage.	Good stability; slow permeability if compacted.	Well drained.	Poorly suited.	Moderate; moderate internal drainage.	Moderate.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as a source of—				Highway location
	Topsoil	Sand	Gravel	Road fill	
Cerro (CcB, CcC)	Fair	Fair if washed and screened.	Good if washed and screened.	Fair to good	Good stability and bearing value; well drained.
Chacra (MkA). (For Menoken part of MkA, see Menoken series.)	Fair	Unsuitable	Unsuitable	Fair to poor	Poor stability and bearing value; high in gypsum; moderately shallow to shale.
Chipeta:					
Silty clays (CeA, CeB, ChC, ChC2, CkC, ClC). (For Persayo part of ChC, ChC2, CkC, and ClC. see Persayo series; for Mesa part of CkC, see Mesa series; and for Rance part of ClC, see Rance series.)	Poor	Unsuitable	Unsuitable	Poor	Poor stability and bearing value; shallow to shale.
Christianburg (CmA, CmC)	Poor	Unsuitable	Unsuitable	Poor	Poor stability and bearing value; high shrink-swell potential.
Colona:					
Clays (CoA, CoC)	Poor	Unsuitable	Unsuitable	Poor	Poor stability and bearing value.
Clay, gravel substratum (CsA)	Poor	Fair below depth of 36 inches if washed and screened.	Good below depth of 36 inches if washed and screened.	Poor to depth of 36 inches.	Poor stability and bearing value.
Doak:					
Clay loam (DoB)	Fair	Unsuitable	Unsuitable	Fair	Fair stability and bearing value.
Stony clay loam (DsC)	Poor	Poor	Fair if washed and screened.	Fair	Fair stability and bearing value.
Fruita:					
Loam and clay loam (FaA, FbC).	Good	Fair below depth of 30 inches if washed and screened.	Fair below depth of 30 inches if washed and screened.	Good	Good stability and bearing value; well drained.
Fruitland:					
Fine sandy loams and sandy clay loams (FrA, FrB, FsA, FsB).	Good	Fair if washed and screened.	Fair if washed and screened.	Good	Good stability and bearing value; well drained.
Sandy clay loams, stony substratum (FtA, FtB).	Good	Fair if washed and screened.	Fair if washed and screened.	Good	Good stability and bearing value; well drained.

interpretations for soils—Continued

Dikes and diversions	Farm ponds		Agricultural drainage	Irrigation	Degree of limitation for—	
	Reservoir area	Embankment			Filter fields for sewage disposal	Homesites
Good stability; slow permeability if compacted.	Poor; moderate to high seepage.	Good stability; slow permeability if compacted.	Well drained	Moderately well suited on slopes of less than 5 percent.	Moderate or slight; fair to good internal drainage.	Moderate or slight.
Poor stability; subject to cracking on drying; erodible.	Poor: subject to seepage and piping.	Poor stability; subject to cracking on drying; erodible.	Slow internal drainage.	Poorly suited; subject to buildup of water table.	Severe; slow internal drainage.	Severe.
Poor stability; erodible.	Poor; subject to seepage.	Poor stability; subject to cracking.	Very slow internal drainage.	Poorly suited; shallow; some steep slopes.	Severe; slow internal drainage.	Severe.
Subject to cracking on drying; poor stability; erodible.	Good; low seepage.	Poor stability; erodible.	Very slow internal drainage.	Difficult to manage; slow rate of water intake.	Severe; slow internal drainage.	Severe.
Poor stability; erodible.	Fair to good; low seepage.	Poor stability; erodible.	Slow internal drainage.	Moderately well suited on slopes of less than about 4 percent.	Severe; slow internal drainage.	Severe.
Poor stability; erodible.	Poor; subject to moderate or high seepage.	Poor stability; erodible.	Good substratum drainage.	Moderately well suited.	Moderate; slight below depth of about 3 feet.	Moderate.
Fair stability; moderately erodible.	Fair; subject to moderate seepage.	Fair stability; moderately erodible.	Well drained; internal drainage moderately slow.	Moderately well suited on slopes of less than 5 percent.	Severe; slow internal drainage.	Moderate.
Fair stability; moderately erodible.	Fair; subject to moderate seepage.	Fair stability; moderately erodible.	Well drained; internal drainage moderately slow.	Moderately well suited on slopes of less than 5 percent.	Moderate or severe; moderate internal drainage.	Moderate.
Good stability; slow permeability if compacted.	Poor; subject to moderate seepage.	Good stability; slow permeability if compacted.	Well drained	Well suited on moderate slopes.	Slight; well drained.	Slight.
Erodible; moderately slow permeability if compacted.	Poor; subject to high seepage.	Erodible; moderately slow permeability if compacted.	Well drained	Well suited; easily tilled.	Slight; well drained.	Slight.
Good stability; moderate permeability if compacted; stony below depth of 30 inches.	Poor; subject to high seepage.	Good stability; moderate permeability if compacted.	Well drained	Moderately well suited.	Slight; well drained.	Slight.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as a source of—				Highway location
	Topsoil	Sand	Gravel	Road fill	
Genola:					
Clay loams (GeA, GeB)	Fair to good.	Fair below depth of 30 inches if washed and screened.	Unsuitable	Good	Good stability and bearing value; well drained.
Clay loam, saline (GsA)	Poor	Fair below depth of 30 inches if washed and screened.	Unsuitable	Fair	Good stability and bearing value; high water table; moderate salinity.
Gullied land (Gu)	Poor	Unsuitable	Unsuitable	Fair to poor	([1])
Hinman (HcA)	Poor	Fair below depth of 30 inches if washed and screened.	Fair below depth of 30 inches if washed and screened.	Poor to depth of 30 inches; fair below depth of 30 inches.	Poor stability and bearing value.
Luhon:					
Clay loams (LcB, LcC)	Fair	Poor	Fair below depth of 30 inches if washed and screened.	Fair to good	Moderate stability and bearing value.
Gravelly clay loam and stony clay loam (LgC, LsC).	Poor	Poor	Fair if washed and screened.	Fair to good	Moderate stability and bearing value.
Undifferentiated (Lt). (For Travessilla part of Lt, see Travessilla series.)	Poor	Poor	Fair if washed and screened.	Fair	Moderate stability and bearing value.
Mack:					
Clay loams (MaA, MaB, MaC).	Good	Fair if washed and screened.	Good if washed and screened.	Good	Good stability and bearing value; well drained.
Gravelly clay loam (MgA)	Fair	Fair if washed and screened.	Good if washed and screened.	Good	Good stability and bearing value; well drained.
Menoken (MkA). (For Chacra part of MkA, see Chacra series.)	Fair	Unsuitable	Unsuitable	Fair to poor	Poor stability and bearing value; high in gypsum; moderately shallow to shale.

See footnote at end of table.

interpretations for soils—Continued

Dikes and diversions	Farm ponds		Agricultural drainage	Irrigation	Degree of limitation for—	
	Reservoir area	Embankment			Filter fields for sewage disposal	Homesites
Good stability; slow permeability if compacted.	Fair; subject to moderate seepage.	Good stability; slow permeability if compacted.	Well drained	Well suited	Moderate or slight below depth of 30 inches.	Slight.
Good stability; slow permeability if compacted; moderate salinity.	Fair; subject to moderate seepage.	Slow permeability if compacted.	Poorly drained	Poorly suited without drainage.	Severe; high water table.	Severe.
(1)	(1)	(1)	(1)	Unsuitable	Severe; unsuitable.	Severe; unsuitable.
Poor stability; subject to cracking on drying; slow permeability.	Fair to good; low seepage.	Poor stability; subject to cracking on drying; slow permeability.	Slow internal drainage to substratum.	Moderately well suited.	Moderate below depth of 30 inches.	Moderate.
Moderate stability; slow permeability if compacted.	Fair; moderate seepage.	Moderate stability; slow permeability if compacted.	Well drained	Moderately well suited on slopes of less than about 5 percent.	Moderate; moderate internal drainage.	Moderate.
Moderate stability; slow permeability if compacted.	Poor; moderate seepage.	Moderate stability; slow permeability if compacted.	Well drained	Poorly suited; steep slopes.	Moderate or slight; moderate internal drainage.	Moderate.
Fair	Unsuitable; subject to seepage.	Fair	Well drained	Unsuitable; shallow.	Severe; slow internal drainage.	Severe.
Good stability; slow permeability if compacted.	Poor; subject to moderate or high seepage.	Good stability; slow permeability if compacted.	Well drained	Well suited on slopes of less than about 5 percent.	Slight; well drained.	Slight.
Good stability; slow permeability if compacted.	Poor; subject to moderate or high seepage.	Good stability; slow permeability if compacted.	Well drained	Well suited; good water-holding capacity.	Slight; well drained.	Slight.
Poor stability; subject to cracking on drying; erodible.	Poor; subject to seepage and piping.	Poor stability; subject to cracking on drying; erodible.	Slow internal drainage.	Poorly suited; subject to buildup of water table.	Severe; slow internal drainage.	Severe.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as a source of—				Highway location
	Topsoil	Sand	Gravel	Road fill	
Mesa:					
Clay loams (MlA, MlB, MlC, CkC).	Fair to good.	Fair if washed and screened.	Good if washed and screened.	Good	Good stability and bearing value; well drained.
Gravelly clay loams (MoA, MoB, MoC).	Poor	Fair	Good if washed and screened.	Good	Good stability and bearing value; well drained.
Gravelly clay loams, shale substratum (MsA, MsC).	Poor	Fair to depth of 30 inches.	Good to depth of 30 inches if washed and screened.	Good to depth of 30 inches.	Good stability and bearing value to depth of 30 inches; shale at depth of more than 30 inches.
Stony clay loam (MtC)	Poor	Poor	Good if washed and screened.	Fair to good; large stones.	Good stability and bearing value; stony.
Orchard:					
Clay loams (OcA, OcB)	Fair	Fair if washed and screened.	Good if washed and screened.	Good; stony	Good stability and bearing value; well drained.
Gravelly clay loams (OgA, OgB).	Poor	Fair if washed and screened.	Good if washed and screened.	Good to depth of 40 inches.	Good stability and bearing value.
Persayo (PeA, PeB, ChC, ChC2, CkC, ClC).	Poor	Unsuitable	Unsuitable	Poor	Poor stability and bearing value; shallow to shale.
Poudre (Po)	Good	Fair if washed and screened.	Poor	Poor; highly micaceous.	Poor stability and bearing value; high water table.
Rance (RaA, RaB, RaC, ClC)	Poor	Poor	Fair if washed and screened.	Poor	Poor stability and bearing value; high in gypsum; erodible.
Ravola (Rl)	Fair	Unsuitable	Unsuitable	Fair	Fair stability and bearing value; well drained.
Rock outcrop, Rough broken land, and Rough stony land (Rr, RtC, RtE, Ru, Rv, Rw, Ry).	Unsuitable	Unsuitable	Unsuitable	Unsuitable	Very shallow to sandstone or shale.
Saline wet land (Sa)	Unsuitable	Poor	Poor	Poor	Poor; high water table; high salinity.

interpretations for soils—Continued

Dikes and diversions	Farm ponds		Agricultural drainage	Irrigation	Degree of limitation for—	
	Reservoir area	Embankment			Filter fields for sewage disposal	Homesites
Good stability; slow permeability if compacted.	Poor; subject to moderate or high seepage.	Good stability; slow permeability if compacted.	Well drained; minor areas have high water table.	Well suited; erodible on slopes of more than 5 percent.	Slight; well drained.	Slight.
Good stability; slow permeability if comcompacted.	Poor; subject to moderate or high seepage.	Good stability; slow permeability if compacted.	Well drained; minor areas have high water table.	Well suited; erodible on slopes of more than about 5 percent.	Slight; well drained.	Slight.
Good stability; slow permeability if compacted.	Poor; subject to moderately high seepage.	Good stability; slow permeability if compacted.	Internal drainage restricted by shale at depth of more than 30 inches.	Moderately well suited on slopes of less than about 5 percent.	Severe	Severe.
Good stability; slow permeability if compacted.	Poor; subject to high seepage.	Good stability; slow permeability if compacted.	Well drained	Poorly suited; steep slopes; stony surface.	Slight; well drained.	Moderate.
Good stability; slow permeability if compacted.	Poor; subject to high seepage.	Good stability	Well drained	Moderately well suited on slopes of less than about 5 percent.	Slight; well drained.	Slight.
Moderate stability; slow permeability if compacted.	Poor; subject to high seepage.	Fair; moderate stability; slow permeability if compacted.	Well drained	Tillage difficult because of high content of stones and gravel.	Slight; well drained.	Slight.
Poor stability; subject to cracking on drying; erodible.	Fair; subject to moderate seepage.	Poor stability; subject to cracking on drying; erodible.	Slow internal drainage.	Poorly suited	Severe	Severe.
Poor stability; moderately erodible.	Poor; subject to moderate or high seepage.	Poor stability; erodible.	High water table; poorly drained.	Moderately well suited if drained.	Severe if not drained.	Severe.
Poor stability; subject to cracking on drying; high in gypsum.	Poor; subject to very high seepage and piping.	Poor stability; subject to cracking on drying; high in gypsum.	Normally well drained, but subject to buildup of water table on shale.	Poorly suited	Severe; subject to buildup of water table.	Severe.
Fair stability; slow permeability if compacted; erodible.	Fair; subject to moderate seepage.	Fair stability; slow permeability if compacted.	Well drained	Well suited	Moderate or slight.	Slight.
Poor; shallow; stony.	Unsuitable; shallow to sandstone or shale; steep slopes.	Shallow; stony	Slow internal drainage; shallow.	Unsuitable; stony, steep, and shallow.	Severe; shallow	Severe.
Fair to poor; high salinity; poor stability; erodible.	Poor; subject to moderate or high seepage.	Fair to poor; high salinity; poor stability; erodible.	Poorly drained	Unsuitable without drainage.	Severe; slow internal drainage.	Severe.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as a source of—				Highway location
	Topsoil	Sand	Gravel	Road fill	
Salt Lake (Sc)	Poor	Unsuitable	Unsuitable	Poor	Poor stability and bearing value; moderate water table.
Sandy land (Sd)	Poor	Good	Unsuitable	Poor	Moderate stability and bearing value; well drained.
Shavano (ShB, ShC)	Fair	Good if washed and screened.	Poor	Good	Good stability and bearing value; well drained.
Travessilla (TrC, Lt)	Poor	Poor	Unsuitable	Poor	Shallow to sandstone
Uncompahgre: Clay loams (Uc, Ug)	Fair	Good if washed and screened.	Poor	Fair	Fair stability and bearing value; moderate to high water table.
Fine sandy loam, gravelly loam, and loam (Uh, Um, Un, Uw).	Good	Good if washed and screened.	Fair to good if washed and screened.	Good	High water table common
Vernal: Clay loams (VeA, VeB)	Fair	Good below depth of 18 inches if washed and screened.	Good below depth of 18 inches if washed and screened.	Good	Good stability and bearing value; well drained.
Gravelly clay loams (VgA, VgB).	Poor	Good below depth of 18 inches if washed and screened.	Good below depth of 18 inches if washed and screened.	Good	Good stability and bearing value; well drained.
Wet alluvial land (Wa)	Poor	([1])	([1])	([1])	Subject to flooding and high water table.
Woodrow (WoA)	Fair	Unsuitable	Unsuitable	Poor	Poor stability and bearing value; high water table common.

[1] Properties not estimated.

Interpretations for soils—Continued

Dikes and diversions	Farm ponds		Agricultural drainage	Irrigation	Degree of limitation for—	
	Reservoir area	Embankment			Filter fields for sewage disposal	Homesites
Poor stability; subject to cracking on drying.	Good; low seepage.	Poor stability; subject to cracking on drying.	Slow internal drainage.	Moderately well suited if drained.	Severe; slow internal drainage.	Severe.
Poor; rapid permeability; erodible.	Poor; subject to very high seepage.	Poor; rapid permeability; erodible.	Well drained	Unsuitable; low water-holding capacity; erodible.	Slight; well drained.	Severe.
Good stability; slow permeability if compacted; moderately erodible.	Poor; subject to seepage.	Good stability; slow permeability if compacted; moderately erodible.	Well drained	Moderately well suited on slopes of less than about 5 percent.	Moderate; sandstone.	Slight.
Poor; shallow; moderate permeability.	Poor; subject to seepage through fractured sandstone.	Poor; shallow; moderate permeability.	Slow internal drainage; shallow.	Unsuitable; shallow; erodible.	Severe; shallow	Severe.
Fair stability; slow permeability if compacted; erodible.	Poor; subject to moderate seepage.	Fair stability; slow permeability if compacted; erodible.	High water table common.	Moderately well suited if drained.	Severe; high water table.	Severe.
Fair stability; slow permeability if compacted; erodible.	Poor; subject to high seepage.	Fair stability; slow permeability if compacted.	High water table common.	Moderately well suited if drained.	Severe; high water table.	Severe.
Fair to depth of 18 inches; shallow to gravelly and sandy material.	Unsuitable; subject to high seepage.	Fair to depth of 18 inches; shallow to sandy and and gravelly material.	Well drained	Moderately well suited; requires frequent irrigation.	Slight; well drained.	Slight.
Fair to depth of 18 inches; shallow to gravelly and sandy material.	Unsuitable; subject to high seepage.	Fair to depth of 18 inches; shallow to sandy and gravelly material.	Well drained	Moderately well suited; requires frequent irrigation.	Slight; well drained.	Slight.
(1)	Unsuitable; subject to high seepage.	(1)	Subject to flooding and high water table.	Unsuitable; subject to flooding.	Severe; high water table.	Severe.
Poor stability; subject to cracking on drying; slow permeability if compacted.	Good; low seepage.	Poor stability; subject to cracking on drying; slow permeability if compacted.	Slow internal drainage; subject to buildup of water table.	Moderately well suited; subject to buildup of water table.	Severe; slow internal drainage.	Severe.

219-981—67——5

It has previously been pointed out that an increase in elevation in this Area has a direct relationship to precipitation, and an inverse relationship to temperature. Bostwick Park and the foothills receive greater amounts of precipitation than other parts of the Area, and they have cooler temperatures, which increase the effectiveness of the moisture. The result is the same as that of an increase in the total amount of precipitation.

Temperature influences soil genesis in other ways, but the precise effect is difficult to characterize. For example, soil temperature strongly influences microbiologic activity, which figures prominently in soil genesis. In the absence of precise data, only generalizations can be made concerning this effect of temperature. At the Montrose Weather Station, the average air temperature is below freezing during December, January, and February and fairly cold during November and March. For these 5 months of each year, the soil temperature is such as to reduce drastically the amount of microbiologic activity in the soils. For the rest of the year, the soil temperature is favorable to microbiologic growth and activity.

Other effects of temperature on plant growth and chemical activity can be shown, but it is impossible to evaluate the results precisely. Moreover, it is important to an understanding of soil genesis in the Delta-Montrose Area not to consider temperature and precipitation as separate and distinct forces. It is the combined effect of temperature and precipitation and the other factors of soil genesis that results in the formation of a specific soil.

Living organisms

Living organisms that affect soil formation can be divided, on the basis of physical size, into macro and micro groups, and the macro group into animal and vegetable life.

The macrobiologic group includes the visible plants and animals that live in or on the soil. The effect of vegetation is of greater significance in this Area than the effect of animal life, which is likely to be limited to physical changes of a local nature.

The composition and density of plant growth differ between the broad geographic divisions of the Area and, less obviously, exist among the different soils in a given landscape. The strongest contrast is that between the vegetation of Bostwick Park and the southeastern foothills and that of the rest of the survey Area. Most of the Area has a native cover of grass, sage, weeds, and saltbush and produces a relatively small amount of vegetation annually. Bostwick Park and the foothills have a heavier growth of grass, brush, and scattered trees.

Throughout most of the Area, the yearly return of organic matter to the soil is small and a large proportion of it is in the form of roots. Consequently, the soils have relatively small amounts of organic matter in their surface horizons, slightly greater amounts in subsurface horizons, and a rapid decrease in organic-matter content below a depth of 6 or 8 inches. As a result of this distribution of organic matter, the soils have a fragile, crustlike, vesicular, poorly aggregated surface horizon 1 or 2 inches thick overlying more stable and more firmly aggregated subsurface and subsoil horizons. In Bostwick Park and the foothills, where the supply of moisture is more ample, larger amounts of organic matter are returned to the soil. Not only is the total organic-matter content higher, but organic matter is to be found at greater depths. Decomposition is slower, and the products of decomposition impart darker colors to the soil.

Lesser differences in the vegetative cover on the well-drained soils in any given landscape can, in many cases, be related to specific soil characteristics. In these instances, it is difficult to determine if there has been any significant effect on soil genesis, or if the differences in the vegetation are not, themselves, the result of differences in soil characteristics and of a somewhat different environment for plants.

In this Area, the effect of vegetation depends more on the amount of vegetation than on the composition of the vegetation. For example, in the drier parts of the Area there are spots where runoff water accumulates and the plant cover is denser than in the immediate vicinity. In such places the soils resemble those in Bostwick Park. Similar local variations in Bostwick Park result in surface horizons that are thicker and darker than ordinary.

Animal life has affected soil genesis in the Delta-Montrose Area to a lesser relative extent. Some mixing of soil by rodents and earthworms is common in all soils, but in general, in the Delta-Montrose Area this has not resulted in spectacular local alteration of soil characteristics. Some localized effects of cicadas on soil structure have been observed and, in isolated areas, some alteration caused by gophers. Worm casts are common in the more moist soils, and the activity of ants has resulted in some mounding. Overgrazing by domestic livestock and wild game is actively influencing soil genesis, but the effect on soil morphology is not yet clearly expressed.

Very little is known of the influence of micro-organisms on the soils of the Delta-Montrose Area, though it is certain that the activity of such organisms has far-reaching effects. Organisms suited to alternate wet and dry periods in a well-aerated, mildly or moderately alkaline environment probably predominate. In some parts of the survey Area, the microbiological complex may be affected by excess accumulations of soluble salt, strong alkalinity, or poor drainage during the irrigation season.

Time

If the effects of all other soil-forming factors are equal, the parts of any given landscape that have been subjected to soil-formation processes for the longest period of time will have the strongest degree of soil horizonation. The chronological age of a soil is not easily measured, however. Unless specific dating can be accomplished by geomorphic or archeological studies or by determining the degree of decay of radioactive substances, the age of a soil can be stated only in relative terms based on comparisons of soil morphology.

On the basis of degree of solum development, the landscapes and soils of the Delta-Montrose Area can be placed in three major groups according to age: (1) flood plains, local alluvial fans, and actively eroding landscapes; (2)

alluvial fans of intermediate age; and (3) high terraces, old alluvial fans, and glacial till deposits.

The flood plains, local alluvial fans, and actively eroding landscapes are the youngest of these groups, in terms of soil development. They occupy a large part of the survey Area, including the flood plain and recent terrace system of the Uncompahgre and Gunnison Rivers, the alluvial fans bordering these deposits in the smaller tributary valleys, and the actively eroding shale areas throughout the survey Area. The soils are young and generally lack genetic horizons, except for a thin, slightly darkened A horizon. The Billings soils are typical. In most of this chronological group, the landscapes and surficial deposits are geologically young. In the case of the actively eroding shale areas, the basic landscapes may be of greater age, but the exposed shale material is removed before the soil-forming factors have had sufficient time to act upon it and produce distinct horizons.

The alluvial fans of intermediate age occupy a much smaller part of the survey Area. They occur on the fan slopes east of Delta, on the dissected fans in the southwestern part of the Area, and in the upper parts of the valley of the Uncompahgre River, south of Montrose. The soils in these localities are older. They have A, B2, and Ca horizons that are evident but only weakly developed. Generally, the B2 horizon is distinguished by a higher chroma or redder hue, a moderate grade of structure, and, in places, a weak accumulation of silicate clay. A weakly developed horizon of secondary calcium carbonate occurs below the B2 horizon. Included in this group are some fan slopes in Bostwick Park. The soils on these slopes lack a distinct B2 horizon but have a very strong accumulation of secondary calcium carbonate at a depth of 12 to 20 inches. The Luhon soils are typical.

The high terraces, old alluvial fans, and glacial till deposits are intermediate in total area. These landscapes occur throughout the survey Area and include the high, flat-topped, mesalike remnants of old terraces bordering the Uncompahgre and Gunnison Rivers and their tributaries, a few terraces in the upper part of the valley of the Uncompahgre River, the fan slopes on the eastern slopes of Bostwick Park, and the small bodies of glacial till in the southeastern foothills. These are considered to be the oldest landscapes in the survey Area. The soils have been in place for a long time, and the active soil-forming factors have produced moderately well developed horizons, including a B2t horizon that has a distinct accumulation of silicate clay. The Mesa and Bostwick soils are typical.

Relief

Soil genesis is affected both by major differences in elevation and landform and by relatively small differences in landform within a given landscape. In either case, the effect is indirect.

Major differences in elevation result in differences in climate, and differences in climate account for significant differences in soil morphology. (See the discussion in the section dealing with climate as a force in soil formation.)

Distinct differences in soil morphology are associated with relatively minor differences in slope and landform within a given landscape. In such circumstances, relief influences soil formation by virtue of its control of runoff. Where the total amount of rainfall is small, slight differences in the supply of moisture may account for relatively great differences in soil morphology. In the drier sections of the Area, soils in concave spots where runoff water concentrates show more evidence of horizonation than other soils of the immediate landscape. The evidence may be only a thicker and darker colored surface layer, or it may be as significant as a distinct B2 horizon.

Nearly level, low-lying soils on the recent alluvial fans and stream deposits are commonly influenced by a high water table and periodic flooding. Position and topography are such that this excess water is discharged very slowly. Vegetation is dense and furnishes far more organic matter to the soil than the adjacent drier soils receive. The extra water in the subsoil greatly reduces the amount of air available, and the reduction of minerals leads to relatively low chroma and intense mottling. The Salt Lake soils are typical.

Runoff from steeply sloping and convex areas results in the soils of these areas being much drier than other soils of the survey Area. These soils have a thin surface soil and, for the most part, are shallow. There is little movement of salts or minerals within their profiles. Chipeta soils are typical.

In Bostwick Park and in the southeastern foothills, where the amount of precipitation is greater, soils in concave areas usually have thicker horizons, are leached of free calcium carbonate to a greater depth, and, in extreme cases, are mottled and gleyed.

Parent material

Differences in physical, chemical, and mineralogical properties of parent material have all been influential in soil genesis in the Delta-Montrose Area. Generally, these differences in parent material affect soil properties that have been chosen for classifying soils at the series level, but they may also affect properties that are useful in placing soils in higher categories in the classification system.

The parent material of most of the soils in the Delta-Montrose Area contained relatively large amounts of soluble compounds of calcium, magnesium, and sodium. Carbonates and sulfates are the predominant anions, and there are minor amounts of chlorides and nitrates. A reduction in the concentrations of these metallic ions is necessary before there can be free movement of colloid-size particles. Most of the soils that have a well-developed solum also have a distinct accumulation of secondary calcium carbonate and other salt accumulations below the solum.

The texture and other physical characteristics of the parent material also influence soil genesis. Thus, soils formed in eolian sand develop through a different set of genetic processes than soils, such as the Christianburg, that formed in alluvial clay.

Generally, the parent material was of mixed mineral composition. In only two cases has a difference in mineralogy been recognized as being of enough importance to affect the classification of the soils.

The parent material of the Orchard soils was derived largely from basalt, and the separation of the Orchard series from the Mesa series is based on this characteristic.

In the second instance, soils that formed in parent material containing a large amount of mica in the form of small visible flakes have been kept separate. The Poudre series has this characteristic.

There are five major kinds of parent materials in the Area: (1) recent alluvial deposits, (2) old alluvial deposits, (3) residual materials, (4) eolian sediments, and (5) glacial till.

Recent alluvial deposits are the most extensive kind of parent material. They range in texture from sand to clay, are calcareous, and are derived from a variety of parent rock. They occur as flood plains, terraces, or alluvial fans, and have been transported mainly by water. Deposits of local origin, derived from a single kind of rock, inherit the characteristics of the parent rock. Other deposits are mixed.

The old alluvial deposits are the second most extensive kind of parent material in the Area. For the most part, these deposits are on old high terraces or old alluvial fans formed during past alluvial cycles. They occur throughout most of the survey Area. They usually contain gravel and cobblestones, and these coarse fragments become more numerous with depth. Above a depth of 5 feet, the material is usually gravelly or very gravelly loam or clay loam. The material below a depth of 6 to 8 feet may be 90 percent or more sand, gravel, and cobblestones.

The old alluvial deposits in the western and central parts of the survey Area came from a variety of igneous and metasedimentary rock. The coarse fragments are mostly gneiss, schist, and quartzite. The sediments in the areas east of Delta and bordering the Gunnison River came from basalt and contain a high proportion of dark-colored ferromagnesian minerals. The deposits in the southwestern part of the Area were derived from sandstone and contain much less gravel and fewer cobblestones.

The residual parent material in the survey Area was derived mainly from sedimentary rock. The soft shale, siltstone, and sandstone of the Mancos and Dakota formations are the principal sources. Residual material occurs throughout the Area and is very prominent in the shale hills north and east of Montrose. It is the third most extensive kind of parent material.

The fourth most extensive kind of parent material is the glacial till that occurs as a thin, discontinuous, surficial deposit in Bostwick Park and in the southeastern foothills. The original sheet of till apparently was thin, and only small remnants now exist. The till consisted of calcareous, bouldery and stony clay loams derived from metasedimentary and sedimentary rocks and mixed by the action of the glaciers.

The eolian sediments are thick deposits of minor extent occurring mostly as sand dunes at the edge of old terraces. These materials consist of wind-reworked basaltic alluvium, and occur mostly on the terraces north of the Gunnison River. Enough basalt sand is included to give the deposits a dark-gray appearance.

Thin deposits of eolian material have probably fallen over all of the survey Area, since climate and sedimentation cycles favor eolian movement. Such deposits have been so thoroughly incorporated into the soils and other parent materials that they can no longer be identified as separate deposits.

Activities of man

Although not usually accorded equal status with the other soil-forming factors, the activities of man unquestionably have influenced, and will continue to influence, soil genesis in this Area. The effect may be relatively minor, or it may be catastrophic in terms of soil morphology. Catastrophic results of man's activity may include the destruction of soil horizons by accelerated erosion, by tillage, or by leveling in preparation for irrigation, and the collection of brackish salt-bearing waters in low parts of the landscape, as a result of seepage from irrigation or disturbance of the natural drainage patterns. Less severe effects include changes in the genetic environment, such as result from irrigation, overgrazing, or the destruction of native vegetation and the substitution of tilled crops or other plant species.

The duration of man's influence on soil genesis has been so short that it has not resulted in major changes in soil morphology, except for the destruction of soil horizons. Therefore, there is no good basis for evaluating the results. In the Delta-Montrose Area, the most noticeable results are a buildup of organic matter in irrigated plow layers, the recalcification of the surface horizon by the use of saline irrigation water, and the development of mottling in soils previously well drained.

Classification of Soils by Higher Categories

The soil series recognized in the Delta-Montrose Area are classified by great soil groups and orders as follows:

	Series
Zonal Order—	
Sierozem group	Chacra, Fruita, Hinman, Mack, Mesa, Orchard, Vernal.
Brown group	Blanyon, Doak.
Chestnut group	Bostwick, Cerro.
Intrazonal Order—	
Humic Gley group	Poudre, Salt Lake, Uncompahgre.
Calcisol group	Luhon, Rance.
Azonal Order—	
Lithosol group	Chipeta, Persayo, Travessilla.
Regosol group	Shavano.
Alluvial group	Billings, Christianburg, Colona,[1] Fruitland, Genola, Menoken,[1] Ravola, Woodrow.

[1] Intergrade to Sierozem.

A detailed profile of a representative soil of each series is given in the section "Descriptions of the Soils."

In the following pages, each of the great soil groups represented in the Area is discussed in terms of its definitive morphology. A series typical of each group is identified, and significant differences between this series and the others in the same group are noted.

Sierozems

The Sierozem soils in the Delta-Montrose Area developed under a thin cover of grass, sage, cactus, and saltbush. The average annual precipitation ranges from 8 to 10 inches. Summers are hot, and winters cold. The average annual temperature ranges from 48° to 51° F., and the average summer temperature ranges from 69° to 72°. The soils developed from most of the common kinds of parent material and on normal to subnormal relief.

Virgin soils of this group typically have an A1–B2t–B3ca–Cca (or R) horizon sequence. The A horizon is thin, light colored, and commonly vesicular or platy. A transitional B1 or A3 horizon more than 1 or 2 inches thick is generally lacking. The B2t horizon is thin, is usually brighter colored than the A horizon, and has weak to moderate prismatic structure and moderate subangular blocky structure. The clay content of the B2t horizon is generally 30 to 75 percent greater than that of the A horizon. Clay films are thin and range from patchy to continuous. A relatively thick B3ca horizon that contains accumulations of secondary calcium carbonate and has weaker structure and, usually, less clay than the B2t horizon is typical of the soils of this group. Below the solum is a strong, thick horizon of calcium carbonate. The calcium carbonate equivalent of this horizon ranges from 8 to 40 percent or more. The reaction in the Cca horizon is commonly, but not invariably, strongly alkaline.

The content of organic matter is 0.7 to 2.0 percent in the A horizon and in the upper part of the B2t horizon, but it decreases rapidly with depth. The C/N ratio is generally less than 15 in all horizons. The A horizon and the upper part of the B2t are generally noncalcareous and have a pH range of 7.0 to 7.8. The lower parts of the B2t horizon and B3ca horizon are calcareous and have a pH range of 8.0 to 8.5. Where the concentration is strongest, the calcium carbonate equivalent of the Cca horizon ranges from 10 to more than 40 percent. The range in pH of the Cca horizon is 8.2 to 9.0. Values in excess of 8.6 vary within short distances. Base saturation is high in all horizons. Calcium is the dominant cation, and carbonate the principal anion. The exchangeable sodium percentage is generally less than 5 percent, but locally it may exceed 15 percent in parts of the Cca horizon.

The Sierozem great soil group is represented in the Delta-Montrose Area by the Mesa, Chacra, Mack, Fruita, Hinman, Orchard, and Vernal series.

Mesa soils are typical. For a detailed description of the Mesa soils, see page 22, in the section "Descriptions of the Soils."

Chacra soils have less distinct horizonation than Mesa soils, are calcareous at shallower depths, and have a weaker and thinner ca horizon. Chacra soils lack gravel and cobblestones in the lower part of the substratum. They developed in material weathered residually from shale and are underlain by bedrock at a depth of 40 inches or less.

Mack soils lack the very gravelly and cobbly substratum and subsoil that are characteristic of Mesa soils.

Fruita soils have less distinct horizonation than Mesa soils, have a thinner and less strongly developed Cca horizon, and lack the gravelly and cobbly substratum that is characteristic of Mesa soils.

Hinman soils have a finer textured B2t horizon than Mesa soils, and have less gravel in the substratum and subsoil.

Orchard soils closely resemble Mesa soils, but they developed in parent material that contained large amounts of dark-colored ferromagnesian minerals.

Vernal soils have a thinner and less strongly developed Cca horizon than Mesa soils. The solum of Vernal soils rests abruptly on a substratum of clean sand and gravel.

Brown soils

The Brown soils in the Delta-Montrose Area developed under a moderate cover of grass, sage, and cactus. The average annual precipitation ranges from 10 to 15 inches. Summers are hot, and winters cold. The average annual temperature ranges from 37° to 49° F., and the average summer temperature ranges from 69° to 71°. Brown soils occur in the southern and southeastern parts of this survey Area. They developed in parent material weathered residually from sedimentary rock, in locally transported alluvial fan materials, and in deposits of glacial till. They occur on normal to subnormal relief.

Virgin soils of this group typically have an A1–B1–B2t–B3ca–Cca (or R) horizon sequence. The A horizon is thin, light colored, and usually moderately granular. Generally there is a transitional B1 or A3 horizon, 3 to 4 inches thick. The B2t horizon is thicker than that of the Sierozem soils and has moderate to strong prismatic and subangular blocky structure. The clay content of the B2t horizon is generally 30 to 80 percent greater than that of the A horizon. Clay films range from patchy to nearly continuous. The B3ca horizon is 4 to 8 inches thick. It has weaker structure and contains less clay than the B2t horizon, and it has a weak to moderate accumulation of secondary calcium carbonate. The Cca horizon is moderately well developed, and its calcium carbonate equivalent ranges from 8 to 25 percent.

The content of organic matter ranges from 1 to 3 percent in the A horizon and the upper part of the B2t, but it decreases rapidly with depth. The C/N ratio is generally less than 15 in all horizons. The A horizon and the upper part of the B2t are generally noncalcareous and have a pH range of 7.0 to 7.8. The B3ca and Cca horizons are calcareous and have a pH range of 8.0 to 8.5. Where the concentration is strongest, the calcium carbonate equivalent of the Cca horizon ranges from 8 to 25 percent. A pH value in excess of 8.6 is uncommon in the Cca horizon. All horizons are base saturated. Calcium is the dominant cation, and carbonate the principal anion. The exchangeable sodium percentage is low in all horizons.

The Brown great soil group is represented in the Delta-Montrose Area by the Doak and Blanyon series. The Blanyon soils differ from the Doak soils described in detail in having a thicker solum and in having a finer textured B2t horizon.

Doak soils are typical. For a detailed description of the Dack soils, see page 15, in the section "Descriptions of the Soils."

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Blanyon soils have a thicker solum and a finer textured B2t horizon than Doak soils.

Chestnut soils

The Chestnut soils in the Delta-Montrose Area developed under a moderately good cover of grass, pinyon, juniper, and brush. The average annual precipitation ranges from 15 to 20 inches. Summers are warm, and winters cold. The average annual temperature ranges from 45° to 48° F., and the average summer temperature ranges from 64° to 70°. These soils developed mainly in relatively old alluvial fan materials and in glacial till. They occur on normal to subnormal relief.

Virgin soils of this group typically have an A1–B1–B2t–B3–C horizon sequence. The A horizon is moderately dark colored, moderately thick, and granular. Between the A1 and the B2t horizon is a moderately thick transitional A3 or B1 horizon. The B2t horizon is moderately thick, is noncalcareous, and has weak to moderate, medium, prismatic structure that breaks to moderate to strong, medium, subangular blocky. Prismatic structure is generally less well developed in the Chestnut soils of the Delta-Montrose Area than in the Brown soils or the Sierozem soils. Typically, the Chestnut soils have only a very weak horizon of secondary calcium carbonate accumulation, or none at all, but the reaction of the lower part of the solum and of the C horizon is slightly to moderately alkaline. The clay content of the B2t horizon is 30 to 80 percent greater than that of the A1 horizon. Clay films in the B2t horizon are thin and range from patchy to continuous.

The content of organic matter ranges from 1.5 to 3 percent in the A1 horizon and the upper part of the B2t horizon, and it decreases slowly with depth. The C/N ratio is generally less than 16 in all horizons. The A1, B2t, and B3 horizons are generally noncalcareous and have a pH range of 6.8 to 7.8. The C horizon is either noncalcareous or weakly calcareous and has a pH range of 7.8 to 8.5. Typically, all horizons are base saturated. Calcium is the dominant cation, and carbonate the principal anion. The exchangeable sodium percentage is low in all horizons.

The Chestnut great soil group is represented in the Delta-Montrose Area by the Bostwick and Cerro series.

Bostwick soils are typical. For a detailed description of the Bostwick series, see page 10, in the section "Descriptions of the Soils."

Cerro soils contain much less mica than Bostwick soils, are calcareous at a shallower depth, and have a stronger ca horizon.

Humic Gley soils

The Humic Gley soils in the Delta-Montrose Area developed under a moderately heavy cover of grass, brush, and scattered cottonwood. These soils occur throughout the survey Area. They have been strongly influenced by a high water table and periodic flooding. Ground water has had more effect than precipitation. The average annual soil temperature ranges from 45° to 50° F. These soils have developed on recent alluvial fans and stream deposits. Relief is generally subnormal.

Virgin soils of this group typically have a thick, dark-colored A1 horizon and a highly mottled or gleyed C horizon. The A horizon is thick or moderately thick, is moderately dark colored, and has subangular blocky or granular structure. The C horizon has a relatively low chroma and is moderately to intensely mottled with stains and streaks of brighter hue or chroma. Some soils of this group have accumulations of secondary calcium carbonate.

The content of organic matter ranges from 1.5 to 5 percent in the A horizon and the upper part of the C horizon, and decreases slowly with depth. The C/N ratio is less than 15 in all horizons. The soils of this group may be either calcareous or noncalcareous at the surface. The pH ranges from 7.8 to 8.6. All horizons are base saturated. Calcium is the dominant cation, and carbonate or sulfate the principal anion. The percentage of exchangeable sodium is generally less than 5 in all horizons.

The Humic Gley great soil group is represented in the Delta-Montrose Area by the Uncompahgre, Salt Lake, and Poudre series.

Uncompahgre soils are typical. For a detailed description of the Uncompahgre series, see page 30, in the section "Descriptions of the Soils."

Salt Lake soils are finer textured than Uncompahgre soils, and they have strong accumulations of secondary calcium carbonate above a depth of 30 inches.

Poudre soils have a thicker, darker colored surface horizon than Uncompahgre soils and are coarser textured. They developed in material that is high in mica, and they do not ordinarily have a distinct horizon of calcium carbonate accumulation.

Calcisols

The Calcisols in the Delta-Montrose Area developed under a thin cover of short grass, sage, and cactus. The average annual precipitation ranges from 8 to 14 inches, and the average annual temperature ranges from 47° to 50° F. These soils formed mainly in residual or locally transported material weathered from Cretaceous shale. They generally occur on normal relief.

Virgin soils of this group typically have an A1–Cca horizon sequence. The A horizon is thin, light colored, and in many places vesicular or platy. The Cca horizon is well developed. The accumulation of secondary calcium carbonate begins within a few inches of the surface and reaches a maximum at a depth of 12 to 16 inches.

The content of organic matter ranges from 0.7 to 1.5 percent in the A horizon and the upper part of the Cca horizon, but decreases rapidly below the Cca. The C/N ratio generally is less than 15 in all horizons. These soils are calcareous throughout and have a pH range of 8.0 to 8.6. Where the concentration is strongest, the calcium carbonate equivalent of the Cca horizon ranges from 15 to more than 40 percent. All horizons are base saturated. Calcium is the dominant cation, and carbonate the principal anion. The exchangeable sodium percentage is low—usually less than 5 percent—in all horizons.

The Calcisol great soil group is represented in the Delta-Montrose Area by the Luhon and Rance series. The Luhon soils are typical. For a detailed description of the Luhon series, see page 20, in the section "Descriptions of the Soils."

Rance soils have a strong accumulation of calcium sulfate within 30 inches of the surface, rather than the strong accumulation of calcium carbonate that is typical of the Luhon soils.

Lithosols

The Lithosols in the Delta-Montrose Area developed under a variety of native cover, including grass, sage, and juniper. These soils occur throughout the Area but mainly in the drier parts, where the annual precipitation is 8 to 10 inches. They occur on young landscapes and are developing in thin deposits of material weathered residually from underlying rock, including sandstone and shale. They occur on excessive to normal relief.

Virgin soils in this group typically have an A1–C(or Cca)–R horizon sequence. The A horizon is thin and light colored—generally only slightly darker colored than the underlying C horizon. The C horizon is thin; is structureless or has weak subangular blocky structure; and commonly contains discontinuous accumulations of secondary calcium carbonate or calcium sulfate. The depth to bedrock is less than 18 inches.

The content of organic matter in the A horizon and the upper part of the C horizon ranges from 0.7 to 1.5 percent. Below the C horizon it decreases rapidly. The C/N ratio is less than 15 in all horizons. The A and C horizons are generally calcareous and have a pH range of 8.0 to 8.6. In the lower part of the C horizon, immediately above the bedrock, the pH may locally be in excess of 8.6. Accumulations of secondary calcium carbonate and calcium sulfate are common but are not consistently developed and are a characteristic of the parent material itself. All horizons are base saturated. Calcium is the dominant cation, and carbonate and sulfate are the principal anions. The exchangeable sodium percentage generally is less than 10, but it may exceed that amount locally in the layer immediately above the bedrock.

The Lithosol great soil group is represented in the Delta-Montrose Area by the Chipeta, Persayo, and Travessilla series.

Chipeta soils are typical. For a detailed description of the Chipeta series, refer to page 13, in the section "Descriptions of the Soils."

Persayo soils have moderately fine textured A and C horizons.

Travessilla soils have sandy loam or loam A and C horizons and have hard sandstone bedrock above a depth of 18 inches.

Regosols

The Regosols in the Delta-Montrose Area developed under a thin cover of grass, sage, cactus, and saltbush and, in places, under a thin stand of pinyon. The average annual precipitation ranges from 8 to 15 inches. Summers are hot, and winters are cold. The average annual temperature ranges from 45° to 51° F., and the average summer temperature ranges from 69° to 72°. These soils developed either in material that weathered residually from underlying sedimentary rock or in thick deposits of eolian sand. They occur on normal to excessive relief.

Virgin soils of this group have an A1–C (or R) horizon sequence. The A horizon is thin, generally calcareous, and light colored—only slightly darker colored than the C horizon. The C horizon is calcareous, is massive or has very weak subangular blocky structure, and may or may not have discontinuous accumulations of secondary calcium carbonate.

The content of organic matter ranges from 0.3 to 2.0 percent in the A horizon and the upper part of the C horizon, but it decreases rapidly below the C horizon. The C/N ratio is less than 15 in all horizons. The A and C horizons are calcareous and have a pH range of 8.0 to 8.4. All horizons are base saturated. Calcium is the dominant cation, and carbonate the principal anion. The exchangeable sodium percentage is low.

The Regosol great soil group is represented in the Delta-Montrose Area by the Shavano series. For a detailed description of this series, see page 29, in the section "Descriptions of the Soils."

Alluvial soils

The Alluvial soils in the Delta-Montrose Area developed in recent accumulations on flood plains and alluvial fans. The vegetation is varied, but grass, brush, and scattered cottonwood trees predominate. These soils occur throughout the survey Area and take in the entire climatic range. They are so young that the differences in climate have not resulted in distinct differences in soil morphology.

Virgin soils of this group typically have an A–C horizon sequence. The A horizon is thin, light colored, and granular. The C horizon has a wide range in texture. It is typically calcareous and massive. These soils have little or no genetic horizonation, but they may have strongly contrasting horizons resulting from physical stratification of the alluvium. Thin, discontinuous accumulations of secondary calcium carbonate or calcium sulfate may occur at any depth.

The content of organic matter ranges widely. In the soils of the well-drained alluvial fans, in the dry parts of the Area, an organic-matter content of 1 or 2 percent is common, while on the flood plains and low terraces, where water is abundant and the vegetation denser, an organic-matter content of 1 to 3 percent is common. Generally, the Alluvial soils in this Area are calcareous at the surface and have a pH range of 7.8 to 8.6. All horizons are base saturated. Calcium is the dominant cation, and carbonate and sulfate are the principal anions. The exchangeable sodium percentage varies but generally is less than 10 in the control section.

The Alluvial great soil group is represented in the Delta-Montrose Area by the Billings, Ravola, Fruitland, Genola, Woodrow, and Christianburg series.

Billings soils are typical. For a detailed description of the Billings series, see page 7, in the section "Descriptions of the Soils."

Ravola soils are coarser textured than Billings soils.

Woodrow soils closely resemble Billings soils but have hues of 10YR or redder.

Genola soils and Fruitland soils are coarser textured than Billings soils, and they have hues of 10YR or redder.

Christianburg soils are finer textured than Billings soils.

The Colona and Menoken soils are Alluvial soils, but they have stronger evidence of horizonation than typical soils of the Alluvial group and are considered intergrades to the Sierozem group. These soils have a thin cover of short grass, sage, cactus, and saltbush. The average annual precipitation ranges from 8 to 10 inches. Summers are hot, and winters cold. The average annual temperature ranges from 48° to 51° F., and the average summer temperature ranges from 69° to 72°. These soils developed in alluvial fan material of intermediate age, in recent alluvial fan material and flood-plain deposits, and in parent material weathered residually from underlying sedimentary rock.

When virgin, the Colona and Menoken soils have an A1–B2–Cca–C (or R) horizon sequence. The A horizon is thin, light colored, and in many places vesicular or platy. Usually there is no transitional A3 or B1 horizon. The B2 horizon is redder in hue and higher in chroma than the A horizon. It has moderate prismatic and blocky structure, or it shows evidence of translocation of calcium carbonate. Below the B2 horizon there is usually a weak but distinct accumulation of secondary calcium carbonate. Thin, shiny patches, presumed to be of silicate clay, can be found on the surfaces of the soil aggregates in the B2 horizon.

The organic-matter content of the Colona and Menoken soils ranges from 0.7 to 2 percent in the A horizon and the upper part of the B2 horizon, but it decreases rapidly with depth. The C/N ratio generally is less than 15 in all horizons. Typically, the uppermost few inches is noncalcareous and the rest of the profile is calcareous. The range in pH is 7.6 to 8.5. Where the concentration is strongest, the calcium carbonate equivalent of the Cca horizon ranges from 3 to 10 percent. All horizons are base saturated. Calcium is the dominant cation, and carbonate or sulfate the principal anion. The exchangeable sodium percentage is generally less than 5 in all horizons.

General Nature of the Area

The Delta-Montrose Area lies along the western flank of the Rocky Mountains, at an elevation of 5,000 to about 8,000 feet. It is an intermountain valley drained by the Uncompahgre River and the Gunnison River and their tributaries. The Gunnison River enters the northeastern corner of the Area, flows westward near the northern boundary, and leaves near the northwestern corner. The Uncompahgre River enters at the southern boundary and flows in a northwesterly direction to its confluence with the Gunnison River, northwest of Delta. Horsefly, Happy Canyon, Dry, Spring, and Roubideau Creeks are the principal tributaries of the Uncompahgre River that rise on the Uncompahgre Plateau west of the survey Area. Cedar Creek is the principal tributary that enters from the east.

The principal towns in the survey Area are Montrose, which in 1960 had 5,044 inhabitants; and Delta, which is located at the confluence of the Uncompahgre River and the Gunnison River and which, in 1960, had a population of 3,832. Smaller towns are Olathe, Austin, and Colona.

Geology

The geologic formations present in the Delta-Montrose Area include sedimentary rocks of Cretaceous age and unconsolidated sediments of Quaternary age. They are the Burro Canyon, Dakota sandstone, and Mancos shale formations. The main structural feature that affects the bedrock formations in this Area is the Uncompahgre uplift, which borders the valley of the Uncompahgre River in the southwestern part. This great fault block is tilted gently toward the northeast. The surface of the plateau is formed by the resistant Dakota sandstone, from which the overlying Mancos shale has nearly all been stripped by erosion. Mancos shale underlies most of the valley of the Uncompahgre River.

Throughout much of the valley, particularly the part west of the river, the Mancos shale is mantled by surficial alluvial and eolian deposits of the Pleistocene age and the Recent age. These deposits consist of gravelly alluvium on the terraces and high-level erosional surfaces and of alluvium on the flood plains of all the larger streams. Deposits of light-red, sandy and silty materials, which mantle parts of the benches and mesas throughout the Area, appear to be mainly wind laid, although they may also have been reworked by water to some extent.

Climate [4]

The climate of the Delta-Montrose Area is typical of many of the lower intermountain valleys of the west. It is characterized by low precipitation, low humidity, abundant sunshine, and a wide range in annual and daily temperatures.

The primary air circulation over the Area is from the west. Because mountains surround the Area, much of the moisture from the west is lost in passage over them. In winter, cold polar air from the north and northwest may be trapped in the valleys for several days, but it commonly is moved out of the Area within 2 or 3 days by the prevailing westerly winds.

Table 6 gives average monthly temperatures and maximum and minimum temperatures recorded at the U.S. Weather Bureau Station at Delta. The annual precipitation at the town of Delta is about 8 inches, or about 1 inch less than that at the town of Montrose. Table 7 shows the temperature and precipitation at Montrose.

The spring season in the Delta-Montrose Area generally is mild, and there is little difficulty in preparing seedbeds. Normally, the germination of crops seeded in spring is not delayed because of unfavorable weather. However, the moisture requirement for crops is high during much of the growing season because of the high temperature and low humidity. Consequently, all farming is dependent upon irrigation for supplemental moisture. Fall months typically are dry, mild, and satisfactory for harvest.

[4] JOSEPH BERRY, State climatologist, U.S. Weather Bureau, assisted in the preparation of this section.

TABLE 6.—*Means and extremes of temperature at Delta between 1931 and 1960*

[Elevation 5,125 feet]

Month	Mean daily: Maximum	Mean daily: Minimum	Mean monthly	Record highest: Degrees	Record highest: Year	Record lowest: Degrees	Record lowest: Year	Mean degree days [1]	Mean number of days with maximum temperature—Equal to or more than 90° F.	Mean number of days with maximum temperature—Equal to or less than 32° F.	Mean number of days with minimum temperature—Equal to or less than 32° F.	Mean number of days with minimum temperature—Equal to or less than 0° F.
	° F.	*° F.*	*° F.*	*° F.*		*° F.*						
January	38.7	14.1	26.4	66	1956	−24	1948	1,197	0	7	31	3
February	46.7	19.5	33.1	69	1958	−27	1951	893	0	2	26	1
March	57.5	25.7	41.6	80	1956 [2]	4	1953	725	0	0	27	0
April	68.7	34.4	51.6	92	1943	8	1945	408	(3)	0	12	0
May	79.0	42.5	60.8	99	1954	22	1953	167	3	0	3	0
June	88.6	49.0	68.8	106	1954	29	1954	39	16	0	(3)	0
July	94.4	55.1	74.8	105	1940	40	1956	0	27	0	0	0
August	91.1	53.5	72.3	102	1949 [2]	39	1960	0	21	0	0	0
September	84.3	44.9	64.6	100	1950 [2]	27	1946	69	8	0	1	0
October	71.3	34.5	52.9	90	1947 [2]	18	1960 [2]	375	(3)	0	13	0
November	52.2	22.0	37.1	74	1958	−11	1931	837	0	1	26	(3)
December	40.9	16.1	28.5	63	1939	−13	1956	1,132	0	5	30	2
Year	67.8	34.3	51.0	106	1954	−27	1951	5,842	75	15	169	6

[1] Base 65° F.
[2] Also on earlier dates.
[3] Less than ½ day.

TABLE 7.—*Temperature and precipitation*

[All data from Montrose, except data for snow cover; data for snow cover from Delta, Colo. Elevation at Montrose, 5,830 feet]

Month	Temperature: Average daily: Maximum	Temperature: Average daily: Minimum	Temperature: Two years in 10 will have at least 4 days with—Maximum temperature equal to or higher than—	Temperature: Two years in 10 will have at least 4 days with—Minimum temperature equal to or lower than—	Precipitation: Average total	Precipitation: Two years in 10 will have—Less than—	Precipitation: Two years in 10 will have—More than—	Average number of days with snow cover	Average depth of snow on days with snow cover
	° F.	*° F.*	*° F.*	*° F.*	*Inches*	*Inches*	*Inches*		*Inches*
January	39	14	53	−1	0.6	0.3	1.1	7	3
February	43	19	58	4	.6	.3	.9	5	2
March	52	26	65	13	.6	.4	1.0	(1)	2
April	63	35	76	24	1.0	.4	1.5	----	----
May	73	42	85	32	.7	.3	1.3	----	----
June	85	50	94	41	.5	.1	.9	----	----
July	91	56	96	50	.7	.3	1.1	----	----
August	87	54	94	47	1.3	.6	1.7	----	----
September	80	47	91	36	1.0	.3	1.5	----	----
October	67	36	80	26	.9	.3	1.4	----	----
November	50	23	65	10	.6	.3	.9	2	3
December	41	16	55	3	.6	.3	.8	10	2
Year	64	35	[2] 99	[3] −8	9.1	7.1	10.8	25	2

[1] Less than ½ day.
[2] Average annual highest maximum.
[3] Average annual lowest minimum.

Long periods of high wind velocity are uncommon. In spring the wind normally is from the southwest. It is this southwesterly wind that causes most of the wind erosion in the Area.

Rainstorms of high intensity, accompanied by minor amounts of hail, may occur during spring and summer, but damaging storms are not frequent.

Probabilities of the last freezing temperature in spring and first in fall at the towns of Delta and Montrose are given in table 8. In all of the Area, except Bostwick Park, the length of the growing season is suitable for the production of the irrigated crops listed in the section "Use and Management of the Soils." The average length of the growing season is 146 days at Delta and 152 days at Montrose. The estimated length of the growing season at Bostwick Park is 105 days.

Agriculture

The average farm in this Area is 80 to 100 acres in size. The crops are diversified, and all need to be irrigated in this dry climate. Major crops are alfalfa, irrigated pasture grasses and legumes, corn, small grain, sugar beets, and beans. The acreage in malting barley has increased in the past few years. Several small farms use most of their cropland for truck crops. Grass pasture occurs throughout the Area on the steeper slopes, on the shallow soils, and in odd areas. It is also included in crop rotations as a conservation measure.

Less than 1 percent of the survey Area is used for the production of fruit crops, but apples, sweet cherries, sour cherries, peaches, pears, and some apricots are grown commercially. Although the soils are well suited to tree fruits, the climate is marginal for all except apples and sour cherries. In some years freezing temperatures early in spring kill the fruit in the bloom stage. Subzero weather in midwinter causes some damage to the bark of trees, and the extreme temperatures kill the fruit buds, particularly those of peaches.

Orchard fruits do best in the northern third of the Area, west of the Uncompahgre River. Peaches and sweet cherries are best suited to the well-drained soils of the Mesa-Orchard soil association (see the general soil map at the back of this report). The Mesa and Orchard soils are friable and nonsaline. They occur on mesas and in sloping areas where air drainage is good. Some fruit is grown also on the silty, slightly saline Billings and Colona soils that have good air drainage.

Fruits for individual or local consumption are grown in farm and city gardens throughout most of the Area except the parts at higher elevations east and south of Montrose. Few landowners rely entirely on fruit for their livelihood, since the production varies widely from year to year. The annual yield for the entire Area is about 100,000 bushels of apples, 50,000 bushels of peaches, 3,500 bushels of pears, and 175,000 pounds of cherries.

Fruit production has declined during the past 10 years. Contributing to this decline are climate, marketing conditions, diseases, insects, and the cost or shortage of labor.

Raising cattle and sheep is a profitable enterprise. Most cattle in the Area are sold as calves to contract buyers who ship them by truck to the midwest and to Arizona for feeding out. Some calves are fed out locally, especially near the town of Delta. Available as food are corn silage, grain corn, sorghum, beet pulp left as a byproduct in the manufacture of sugar, and barley that does not meet malting requirements.

In factories at Delta, sugar beets are processed and tree fruits are canned for shipment to markets.

Most of the beans are dried and shipped by truck to markets in the southwestern States. Vegetables and potatoes are shipped to Denver by rail and trucks. Malting barley is shipped to a distillery at Golden. Dairy products are shipped to Delta and Grand Junction for further processing.

TABLE 8.—*Probabilities of freezing temperatures after specified days in spring and before specified days in fall*

Station	Temperature	Probability in spring			Probability in fall			Period between last occurrence in spring and first in fall
		1 year in 10 later than—	2 years in 10 later than—	5 years in 10 later than—	1 year in 10 earlier than—	2 years in 10 earlier than—	5 years in 10 earlier than—	
	°F.							Days
Delta.	16 or lower	April 4	March 29	March 17	October 30	November 4	November 14	242
	20 or lower	April 16	April 10	March 29	October 19	October 24	November 3	219
	24 or lower	April 26	April 19	April 8	October 9	October 14	October 24	200
	28 or lower	May 14	May 8	April 26	September 29	October 4	October 14	171
	32 or lower	May 25	May 19	May 8	September 16	September 21	October 1	146
Montrose.	16 or lower	April 5	March 30	March 18	November 4	November 9	November 17	244
	20 or lower	April 13	April 7	March 27	October 24	October 28	November 6	224
	24 or lower	April 28	April 22	April 11	October 16	October 21	October 29	201
	28 or lower	May 13	May 7	April 25	October 6	October 11	October 20	178
	32 or lower	May 25	May 19	May 7	September 23	September 28	October 7	152

Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster, such as a clod, crumb, block, or prism.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crops is reduced.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, mineral particles less than 0.002 millimeter in diameter. As a textural class, soil that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Firm.—When moist, soil crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Friable.—When moist, soil crushes easily under gentle to moderate pressure between thumb and forefinger and can be pressed together into a lump.

Hard.—When dry, soil moderately resists pressure; can be broken with difficulty between thumb and forefinger.

Loose.—Noncoherent; will not hold together in a mass.

Plastic.—When wet, soil is readily deformed by moderate pressure but can be pressed into a lump; forms a wire when rolled between thumb and forefinger.

Soft.—When dry, soil breaks into powder or individual grains under very slight pressure.

Sticky.—When wet, soil adheres to other material; tends to stretch somewhat and pull apart, rather than pull free from other material.

Cover crop. A close-growing crop grown primarily to improve the soil and to protect it between periods of regular crop production; or a crop grown between trees in orchards.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Internal soil drainage. The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers, and by the height of the water table, either permanent or perched. Relative terms for expressing internal drainage are *none, very slow, slow, medium, rapid,* and *very rapid.*

Mottled. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Permeability. The quality that enables a soil to transmit water and air. The terms used to express permeability rates are—

In. per hr.	
Less than 0.05	Very slow
0.05 to 0.20	Slow
0.20 to 0.80	Moderately slow
0.80 to 2.50	Moderate
2.50 to 5.00	Moderately rapid
5.00 to 10.00	Rapid

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

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4. 5	Neutral	6. 6 to 7. 3
Very strongly acid	4. 5 to 5. 0	Mildly alkaline	7. 4 to 7. 8
Strongly acid	5. 1 to 5. 5	Moderately alkaline	7. 9 to 8. 4
Medium acid	5. 6 to 6. 0	Strongly alkaline	8. 5 to 9. 0
Slightly acid	6. 1 to 6. 5	Very strongly alkaline.	9. 1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium. The terms used to indicate salinity of the soils are based on the electrical conductivity of saturated soil extract as expressed in millimhos per centimeter at 25° C.

	Mmhos. per cm.
None	Less than 2. 0
Slight	2. 0 to 4. 0
Moderate	4. 0 to 8. 0
High	8. 0 to 16. 0
Very high	Over 16. 0

Sand. As a soil separate, individual rock or mineral fragments 0.05 to 2.0 millimeters in diameter. Most sand grains consist of quartz, but sand may be of any mineral composition. As a textural class, soil that is 85 percent or more sand and not more than 10 percent clay.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants. Soil has properties resulting from the integrated effect of climate and living matter acting upon parent material, as conditioned by relief, over periods of time.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular.* Structureless soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. (See also, Clay, Sand, and Silt.) The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifiying "coarse," "fine," or "very fine."

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