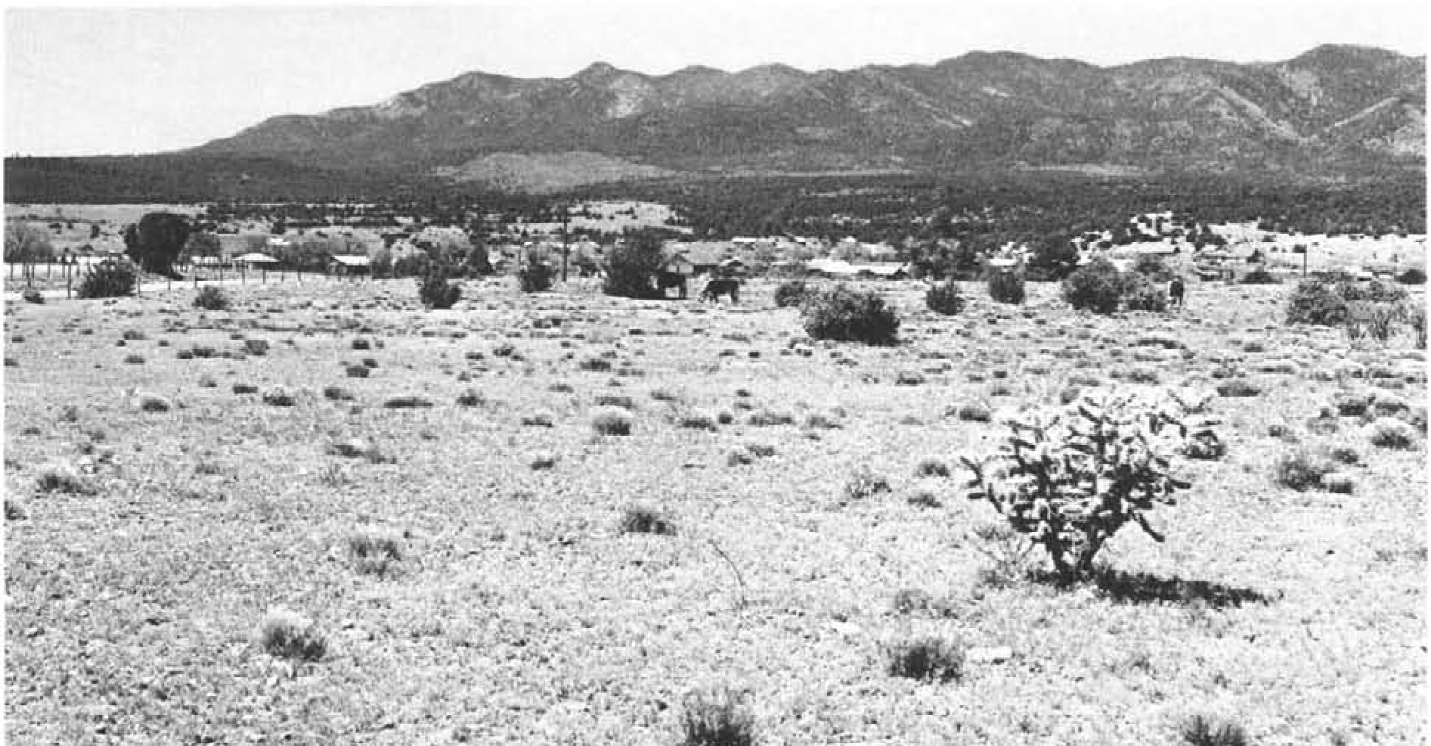
Issued January 1970

SOIL SURVEY

Torrance Area New Mexico



UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service and Forest Service
In cooperation with
NEW MEXICO AGRICULTURAL EXPERIMENT STATION

Major fieldwork for this soil survey was done in the period 1955–62. Soil names and descriptions were approved in 1965 and 1968. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1962. This survey of the Torrance Area was made cooperatively by the Soil Conservation Service, the Forest Service, and the New Mexico Agricultural Experiment Station. It is a part of the technical assistance furnished to the East Torrance, Edgewood, and Claunch-Pinto Soil and Water Conservation Districts.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, or other structures; and in judging the suitability of tracts of land for agriculture, industry, or recreation.

Locating Soils

All the soils of the Torrance Area are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by a 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. This guide lists all 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 units, the range site, and the timber suitability group in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. 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.

Ranchers, farmers and those who work with the soils can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units, range sites, and timber suitability groups.

Those interested in woodland can refer to the section "Use of the Soils for Timberland," where the soils of the Area are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Use of the Soils for Wildlife."

Ranchers and others can find, under "Use of the Soils for Range," groupings of the soils according to their suitability for range and descriptions of the vegetation on each range site.

Engineers and builders can find, under "Engineering Uses of the Soils" tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices and structures.

Scientists and others can read about how the soils were formed and how they are classified in the section "Genesis, Classification, and Morphology of the Soils."

Newcomers in the Torrance Area may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "Additional Facts About the Area."

Cover: An area of Witt loam, 1 to 6 percent slopes, near the community of Manzano. The Manzano Mountains are in the background.

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SOIL SURVEY OF TORRANCE AREA, NEW MEXICO

BY BOB G. BOURLIER AND R. E. NEHER, SOIL CONSERVATION SERVICE, AND D. B. CREZEE, K. J. BOWMAN, AND D. W. MEISTER, FOREST SERVICE [1]

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE AND FOREST SERVICE, IN COOPERATION WITH THE NEW MEXICO AGRICULTURAL EXPERIMENT STATION

THE TORRANCE AREA consists of Torrance County and adjoining areas of the Cibola National Forest in Bernalillo, Valencia, and Lincoln Counties. It is about in the geographic center of New Mexico, east of the Rio Grande and on the western edge of the High Plains. Estancia, the county seat of Torrance County, is southeast of Albuquerque and south of Santa Fe. Distances by air from Estancia to the principal cities in the State are shown in figure 1.

The Torrance Area is about 65 miles long and about 60 miles wide. It contains 2,208,008 acres, or approximately 3,450 square miles. The Cibola National Forest makes up about 116,120 acres in the western part of the Area and about 138,450 acres in the southern part.

The Estancia Lake Basin drains the Estancia Valley, which extends through the western part of Torrance County and the southern part of Santa Fe County. About two-thirds of the irrigated land in the Estancia Valley occurs in the Torrance Area. The uplands to the east of the Estancia Valley, and the mountainous lands generally, are not suitable for cultivation and are used for range and for timberland. Most of the dry cropland is in the western part of the Area, where climatic conditions are more favorable.

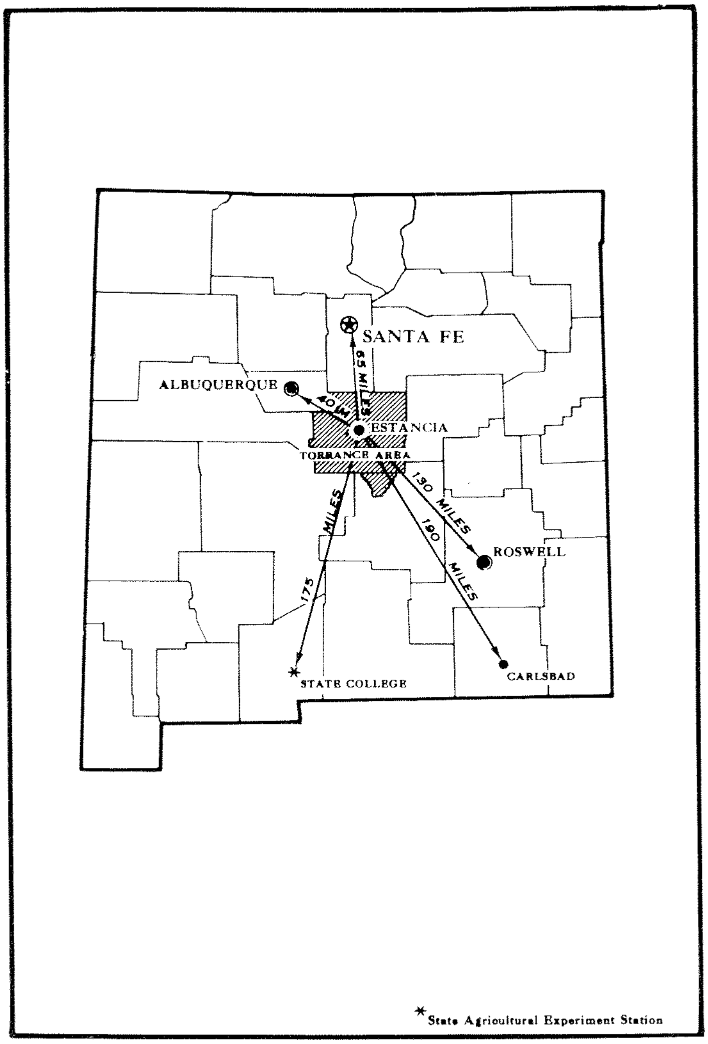

Figure 1.—Location of the Torrance Area in New Mexico.

How This Soil Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in the Torrance Area, where they are located, and how they can be used. They went into the Area knowing they likely would find many soils they had already seen and perhaps some they had not. As they traveled over the Area, 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 publication efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

[1] Some of the field mapping was done by J. J. FOLKS, J. A. HUGHES, L. G. BERGLAN, AND J. M. OGLESBY, all of the Soil Conservation Service, and by D. E. BUCHANAN of the New Mexico Agricultural Experiment Station.

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. Witt and Manzano, for example, are the names of two soil series. All soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the natural 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 the texture of their surface layer. According to such differences in texture, separations called soil types are made. Within a series, all soils having a surface layer of the same texture belong to one soil type. Witt loam and Witt clay loam are two soil types in the Witt 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, Witt loam, 0 to 1 percent slopes, is a phase of Witt loam, a soil type that has a slope range of 0 to 6 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 publication was prepared from 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 such small individual tracts that it is not practical to show them separately on the map. Such a mixture of soils is shown on the map as one mapping unit and is called a soil complex. Ordinarily, a complex is named for the major kinds of soil in it, for example, Kim-Otero-Pastura complex.

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 Otero and Palma soils.

Some mapping units contain more than one kind of soil in a pattern more open and less intricate than that of a soil complex. Such a mapping unit is called a soil association. A soil association differs from a soil complex in that its component soils could be mapped separately, at ordinary scales such as 4 inches per mile, and would be if practical advantages made the effort worthwhile. A soil association, like a soil complex, is named for the major soils in it, for example, Witt-Harvey-Pinon loams, 1 to 9 percent slopes.

Most surveys include areas where the soil material is so rocky, so shallow, or so frequently worked by wind and water that it cannot be classified by soil series. These areas are shown on the map like other mapping units, but they are given descriptive names, such as Badland, and are called land types.

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 those soils that are suitable for cultivation.

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 such a way that it is readily useful to different groups of readers, among them ranchers, farmers, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in soil surveys. 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, 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.

Soil Survey Intensities

Part of the Torrance Area was mapped at low intensity and part at medium intensity (fig. 2).

Rangeland and timberland were mapped at low intensity. The soils were examined at moderate to wide intervals. In several places two or more soils were mapped together as a complex or an association. Each of these multiple mapping units was named for the major soil series occurring in it, and the dominant soil was named first, for example, Kim-Otero-Pastura complex. If the acreage of an individual soil was large enough, that soil was mapped separately. A wide range of slope was permitted within a unit if there was no major difference in use and management.

The major dryfarming areas and the major areas used for irrigated crops were surveyed at medium intensity. The soils were examined at closer intervals than those mapped at low intensity and were mapped in more detail and at a larger scale. Most mapping units consist of individual soils, rather than of associations or complexes. Slope classes were combined if there was no significant difference in use and management.

The scale of the soil maps at the back of this survey is the same for both intensities, and the soils are discussed in the text without reference to survey intensities.

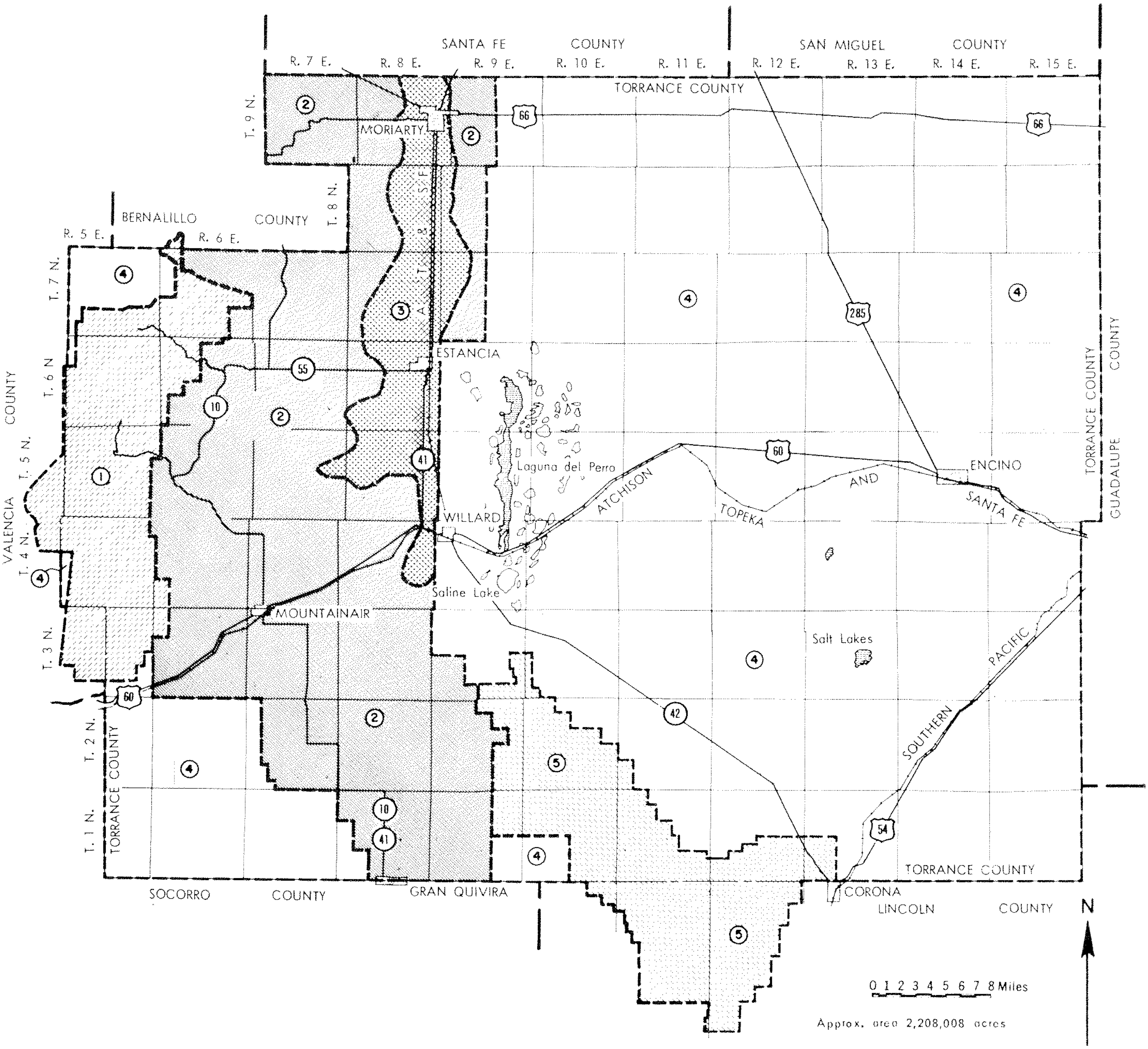

Figure 2.—**Land use and survey intensities in the Torrance Area. Legend: 1. Cibola National Forest, Manzano Mountains; timberland and grassland—low intensity. 2. Major dryfarming area—medium intensity. 3. Major irrigated farming area—medium intensity. 4. Major grassland area—low intensity. 5. Cibola National Forest, Gallinas Mountains; timberland and grassland—low intensity.**

Physiography, Relief, and Drainage

The western two-thirds of the Torrance Area (fig. 3) lies within the Basin and Range Province, and the eastern third in the Great Plains Province (*5*).[2] The main physical feature is the Estancia Valley, a relatively flat basin oriented in a general north and south direction and completely surrounded by higher land. The valley is about 12 miles long and as much as 1 mile wide. A number of playa lakes—the largest is Laguna del Perro—occur on its floor. Elevations in the valley range from about 6,000 feet in playa areas to about 7,500 feet along the western border, where the valley merges with the Manzano Mountains. Elevations reach about 6,400 feet where the northern end of the valley merges with a plateau in the southern part of Santa Fe County.

The Manzano Mountains, along the western rim of the Estancia Valley, also form the western boundary of the Torrance Area. The western side of the mountains is very steep, but the eastern side is more gently sloping. Elevations range from about 7,500 feet to 10,000 feet.

[2] Italicized numbers in parentheses refer to Literature Cited, page 148.

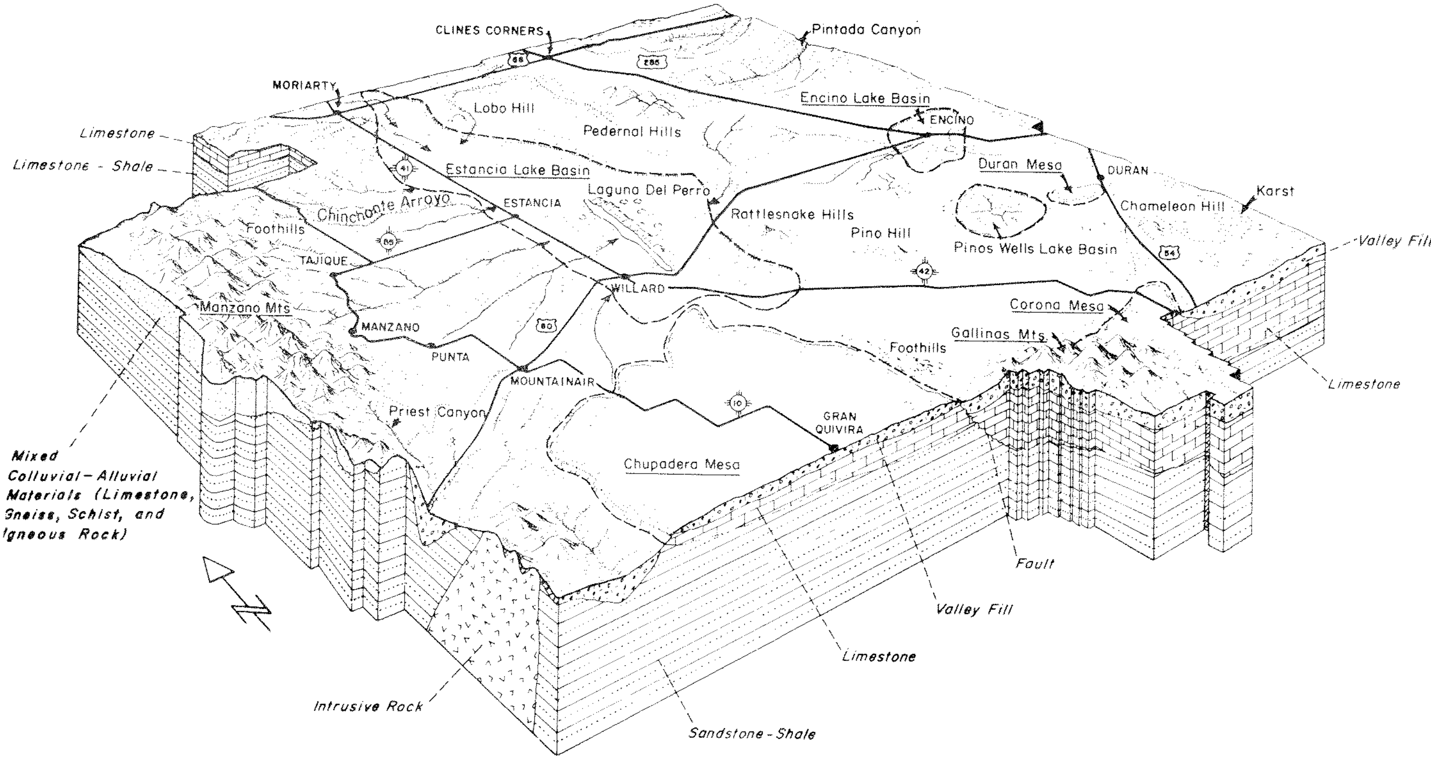

Figure 3.—The main physical features and geologic strata of the Torrance Area.

South of Estancia Valley the prominent escarpment of the Chupadera Mesa rises about 500 feet above the valley floor. It is cut in several places by open valleys, so that much of the surface drainage is toward the Estancia Valley. The northeastern part of the Chupadera Mesa is gently rolling and is marked by a few shallow potlakes. The mesa rises toward the southeast, where it joins the Gallinas Mountains. The western part is deeply dissected by many drainage channels. The highest elevation on the mesa is about 7,200 feet.

The Pedernal Hills rise on the eastern rim of the Estancia Valley. This range of hills is characterized by gentle to steep, rocky slopes. Elevations range from about 6,200 feet to 7,600 feet. These hills mark the boundary between the Basin and Range Province and the Great Plains Province. The Gallinas Mountains in the southern part of the Torrance Area also form part of the boundary between these provinces.

The main physical feature in the Great Plains Province is the eastward-sloping eastern uplands. These uplands are indented by the relatively shallow and small Encino and Pinos Wells Lake Basins, and by still smaller adjoining basins. The elevations of these uplands range from about 6,000 feet to 7,000 feet. The elevations of the Encino and Pinos Wells Basins range from about 6,100 feet to 6,500 feet.

East and southeast of these two closed basins are isolated buttes that stand above the general level of the potlake-marked terrain in the southeastern part of the Torrance Area. Similar features are prominent in the northeastern part also. In most places these uplands are gently rolling. The walls of Pintada Canyon and its tributaries are generally steep and rocky. The valleys draining the eastern slopes of the Pedernal Hills are broad and open but become more rugged toward the eastern boundary of the Area.

Surface drainage of most of the Torrance Area is into closed basins, mainly Estancia, Encino, and Pinos Wells Lake Basins, and within these basins into playa lakes. Water stands on the surface of the playas only a short time before evaporating. Most surface drainage on the Chupadera Mesa is into sinkholes or potlakes. The same is true in the southeastern part of the Area. Surface drainage from the southern slopes of the Gallinas Mountains and the southwestern corner of the Torrance Area is into the trough called Jornada del Muerto. The Abo Canyon west of Mountainair and the western slopes of the Manzano Mountains drain into the Rio Grande. Surface drainage in the northeastern part of the Area is into the Rio Grande, by way of the Pecos River.

Climate[3]

The Torrance Area is about 700 miles from both the Pacific Ocean and the Gulf of Mexico, the sources of its rain and snow. The terrain and the elevations vary widely, and the climate ranges from semiarid in valley areas to subhumid in the western and southern mountains. In winter most of the moisture is brought in by storms that move inland from the Pacific Ocean. Storms that follow a southerly path across the continent, and especially those associated with cold low-pressure systems aloft, bring most of the moisture. The mountains along the western and southern borders of the Area catch much of the winter

[3] By George Von Eschen, State climatologist, U.S. Weather Bureau.

precipitation, so winters are normally dry in the valleys on the leeward side of the mountains.

As the path of the Pacific storms moves northward in spring, the general air circulation changes and brings moisture from the Gulf of Mexico. At the lower elevations, more than 70 percent of the year's moisture normally falls between the beginning of May and the end of October. In the western and southern mountains, only about 60 percent of the year's precipitation is received in summer, but these areas also receive more winter moisture than those at the lower elevations.

Much of the winter precipitation is snow, which averages about 20 inches a year in basin areas and more than 6 feet in mountain areas. In the valleys snow normally does not stay on the ground more than a few days, but the higher mountains are snow covered most of the winter in some years.

Most of the summer moisture falls during brief, but occasionally heavy, thundershowers. The more intense storms may drop several inches of rain in a short time and cause considerable local flooding.

The average yearly precipitation differs considerably from one part of the Area to another. The central basin is the driest area; it receives slightly more than 11 inches of moisture in an average year. The annual precipitation is nearly 15 inches at the higher elevations in the east-central part of the Area, but the amount decreases to about 13 inches along the eastern border. The amount of precipitation increases rapidly with elevation, rising to more than 22 inches at the higher elevations in the mountains. A usual characteristic of a semiarid climate is the wide range in annual precipitation. At Estancia, in the valley, annual totals over a 39-year period have ranged from less than 5 inches to almost 24 inches. At Tajique, in the western foothills about 13 miles west of Estancia and about 1,000 feet higher, the annual totals over a 40-year period have ranged from 8½ inches to more than 32 inches. Table 1 gives precipitation data for Tajique and Estancia.

The temperature pattern of the Area, as shown in table 2, is characteristic of a continental climate at these elevations. It has the usual seasonal changes for its latitude, as well as the wide annual and daily changes that are common in the arid Southwest. The daily range in temperature is usually about 30° F. but frequently exceeds 50°. The annual range in temperature is about 100° to 120°.

Winters are rather cold at these elevations, but clear, sunny weather in winter brings considerable daytime warming, and temperatures in the midforties are common. The clear winter weather also favors nighttime cooling, and minimum temperatures usually are below freezing from mid-October to mid-April and below zero several times each winter. In most places temperatures decrease with increasing elevation, but in the Torrance Area the clear, dry winter weather and the saucerlike terrain of the closed basin form a perfect combination for nighttime radiational cooling, air drainage, and sharp temperature inversions over the lower valleys. As a result, minimum winter temperatures in the valleys average several degrees lower than those recorded 1,000 feet higher in the surrounding mountains.

In summer the daytime temperature usually exceeds 90° F. on about 30 days each year. A temperature as high as 100° is rare in the valleys, and such a temperature has never been recorded at the higher elevations in the western part of the Area.

Table 3 shows the probability of occurrence of the last freezing temperature in spring and the first in fall, and other temperature thresholds.

The temperature data are based on readings made in an instrument shelter about 5 feet above the ground. Temperatures at ground level may be several degrees lower than those recorded in the shelter, and freezing

TABLE 1.—*Precipitation data for Tajique and Estancia*

[Elevation at Tajique 7,100 feet; at Estancia 6,107 feet]

Month	Precipitation									
	Average total		One year in 5 will have—				Average number of days with precipitation of—			
			Less than—		More than—		0.10 inch or more		0.25 inch or more	
	Tajique	Estancia	Tajique	Estancia	Tajique	Estancia	Tajique	Estancia	Tajique	Estancia
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Days*	*Days*	*Days*	*Days*
January	1. 13	0. 54	0. 42	0. 08	1. 54	0. 85	3	2	2	1
February	1. 18	. 51	. 39	. 14	1. 41	. 97	3	2	1	1
March	1. 36	. 59	. 64	. 08	1. 89	. 88	4	2	2	1
April	1. 51	. 63	. 42	. 07	1. 94	1. 10	3	2	2	1
May	1. 59	. 69	. 68	. 09	1. 87	1. 12	3	2	1	1
June	1. 38	. 89	. 17	. 11	1. 56	1. 40	3	2	1	1
July	2. 92	1. 79	1. 27	1. 03	3. 19	2. 20	6	5	4	3
August	2. 96	2. 36	1. 60	1. 27	3. 85	3. 54	7	5	4	3
September	2. 28	1. 20	. 28	. 08	2. 96	1. 57	4	3	3	2
October	1. 76	1. 19	. 56	. 11	2. 14	2. 05	3	3	2	1
November	. 98	. 37	. 16	(1)	1. 46	. 80	2	1	1	1
December	1. 27	. 61	. 51	. 18	1. 57	1. 14	3	2	2	1
Year	20. 32	11. 37	12. 84	6. 93	22. 22	13. 63	44	31	25	17

[1] Trace.

TABLE 2.—*Temperature data for Tajique and Estancia*

[Elevation at Tajique 7,100 feet; at Estancia 6,107 feet]

Month	Temperature							
	Average daily maximum		Average daily minimum		Two years in 10 will have at least 4 days with—			
					Maximum temperature equal to or higher than—		Minimum temperature equal to or lower than—	
	Tajique	Estancia	Tajique	Estancia	Tajique	Estancia	Tajique	Estancia
	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
January	43	46	17	15	56	60	2	−1
February	47	52	20	19	58	63	3	5
March	53	58	23	24	68	70	11	11
April	63	67	30	32	76	78	18	19
May	72	76	38	39	84	87	27	30
June	82	86	46	47	92	94	36	38
July	83	88	51	52	92	95	44	46
August	81	86	50	51	89	93	44	45
September	76	81	44	43	86	90	35	33
October	65	70	34	33	76	80	24	22
November	53	57	23	20	65	68	9	8
December	45	48	19	15	58	62	4	1
Year	64	68	33	33	[1] 92	[1] 96	[2] −8	[2] −9

[1] Average annual highest maximum. [2] Average annual lowest minimum.

TABLE 3.—*Probabilities of specified low temperatures in spring and in fall at Tajique and Estancia*

[Elevation at Tajique 7,100 feet; at Estancia 6,107 feet]

Probability	Dates of given probability and temperature									
	24° F.		28° F.		32° F.		36° F.		40° F.	
	Tajique	Estancia	Tajique	Estancia	Tajique	Estancia	Tajique	Estancia	Tajique	Estancia
Spring:										
1 year in 10 later than	May 13	May 8	June 1	May 16	June 7	June 5	June 19	June 18	June 29	June 29
2 years in 10 later than	May 8	May 5	May 22	May 11	June 3	May 29	June 16	June 11	June 28	June 19
5 years in 10 later than	Apr. 28	Apr. 20	May 10	May 4	May 23	May 15	June 5	June 4	June 18	June 14
Fall:										
1 year in 10 earlier than	Oct. 6	Oct. 5	Sept. 27	Sept. 29	Sept. 20	Sept. 19	Sept. 10	Sept. 7	Sept. 1	Aug. 26
2 years in 10 earlier than	Oct. 17	Oct. 7	Oct. 4	Oct. 4	Sept. 24	Sept. 24	Sept. 12	Sept. 11	Sept. 4	Sept. 1
5 years in 10 earlier than	Oct. 23	Oct. 22	Oct. 15	Oct. 11	Oct. 3	Oct. 3	Oct. 21	Sept. 15	Sept. 11	Sept. 10

temperatures may occur at ground level both later and earlier than the dates indicated.

Wind velocities have not been recorded in the Torrance Area, but records at Otto Airport, just across the survey boundary, show an average annual wind velocity of 7.1 miles per hour. The windiest season normally comes late in winter and in spring, when the average hourly velocity approaches 10 miles per hour. Occasionally during this period, velocities of more than 30 miles per hour persist for several hours. This is also usually the driest season of the year, and wind causes considerable erosion of soils that lack adequate plant cover. Most of the strong winds blow from a westerly direction, but local topography has considerable influence on both wind direction and velocity.

Many of the summer thundershowers are accompanied by hail, and such storms seriously damage cultivated crops. Since most of the Area is rangeland or is uncultivated, the actual hail damage has been negligible in most years. Small tornadoes have been sighted in the Area, but recorded storms have been brief and have occurred over open country so that tornado damage has not been substantial.

The average annual relative humidity is about 50 percent. The weather is generally drier late in winter and in spring, and the relative humidity usually falls to about 30 percent, and frequently below 20 percent, during the warmer part of the day. Dry air is usually associated with periods of temperature extremes, and consequently, the infrequent high or low temperatures cause little discomfort.

In a semiarid climate the amount of precipitation is usually marginal for farming. It varies considerably, and there may be prolonged periods without measurable moisture. In winter, or from September through March, the average time between rainfalls of 0.25 inch or more is 42 days in the valley areas, but only 20 days in the western and southern mountain areas. Periods of 100 days or more between such rains are not at all uncommon, and a period of 213 days, from December 1, 1933 to July 7, 1934, was recorded at Estancia without a day when there was as much as 0.25 inch of rainfall. In summer the average time between rains of 0.25 inch or more is about 11 days, both in the valleys and in the mountain areas.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in the Torrance 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.

In this Area there are 11 soil associations. These are discussed in the following pages.

1. Washoe-Ildefonso association

Strongly sloping to steep, stony soils formed in mixed alluvium

This association is on the western foot slopes of the Manzano Mountains. It consists of gravelly, cobbly, and stony soils (fig. 4) and makes up about 1 percent of the Torrance Area.

Washoe soils, the most extensive in the association, contain large amounts of gravel and cobblestones. They have a thin surface layer of brown cobbly loam. Below this is a moderately thick subsoil of reddish-brown gravelly clay loam, over a pinkish-white layer of gravel cemented with lime.

Ildefonso soils have a thin surface layer of dark-brown, limy stony sandy loam. They have a subsoil of limy gravelly loam. Below this is very gravelly sandy loam, high in content of lime and weakly cemented in the upper part.

Also in this association are gently sloping to strongly sloping Scholle soils, which are shallow over soft lime, and gently sloping to strongly sloping Tesajo soils, which are deep and very gravelly and are leached free of lime.

The soils of this association are not well suited to installation of earthen structures, such as farm ponds, because of rapid seepage in the sandy and gravelly strata. The topsoil can be used as fill in pond embankments if adequately compacted. Pipelines to carry water for livestock can be installed, but they must be bedded with topsoil in the very rocky or gravelly areas. Diversions, terraces, and waterways are not used in this association, because of the steep slopes and the unfavorable properties of the soils. The gravel, cobblestones, and stones are suitable for use as riprap or as material for pervious blankets.

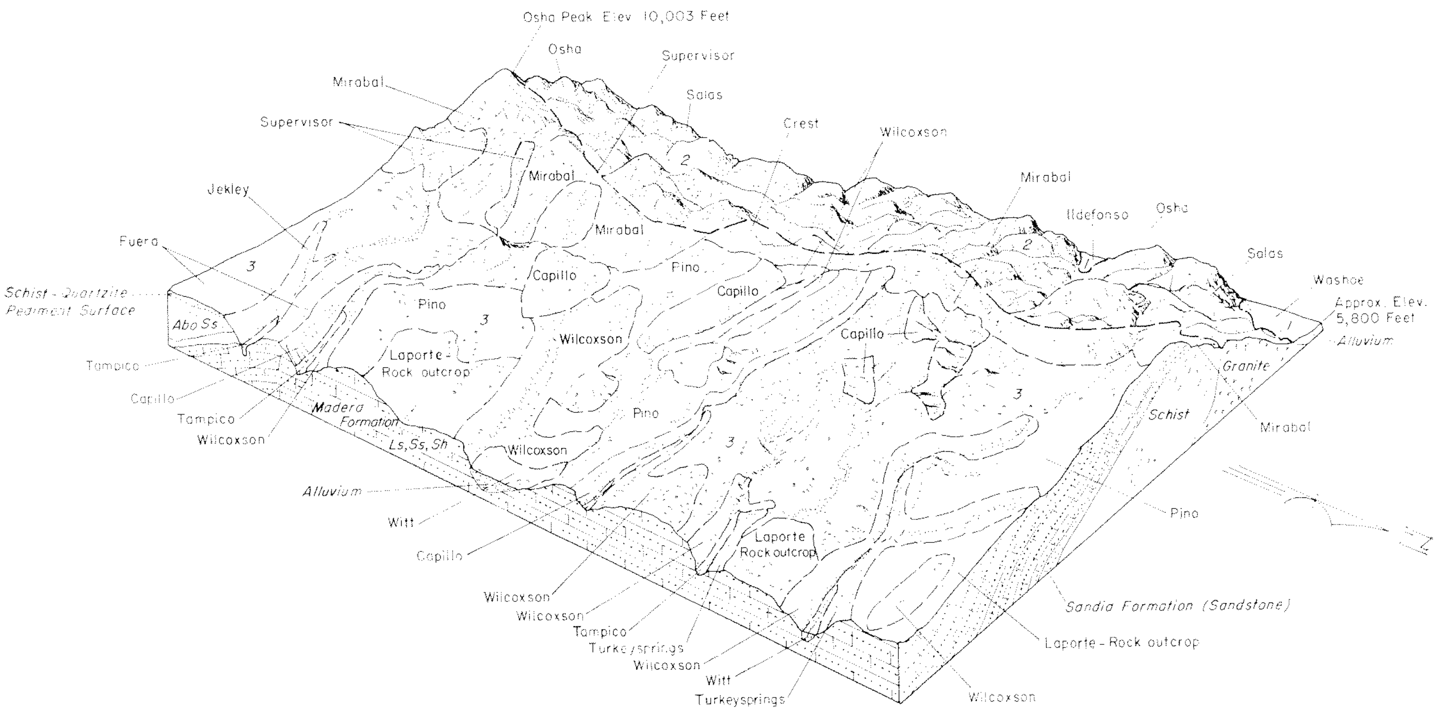

Figure 4.—**Major soil series of associations 1, 2, and 3.**

This association is used mainly as native range. The vegetation is sparse because the climate is hot and dry. Short and mid grasses, juniper, cactus, and yucca make up most of the plant cover.

2. *Salas-Rock outcrops and slides association*

Steep or very steep, stony soils on mountains, and Rock land

This association is on the western slopes of the Manzano and Gallinas Mountains. It consists of steep or very steep, stony soils (see fig. 4) and of rock outcrops, rock slides, rock cliffs, and escarpments. The rock areas on the slopes of the Manzano Mountains are made up mostly of limestone exposed on the uplifted escarpment face and igneous intrusions below the limestone. The rock areas on the slopes of the Gallinas Mountains are sandstone and felsite. This association makes up about 2 percent of the Torrance Area.

Salas soils, the most extensive in the association, have a surface layer of dark-brown stony loam. Their subsoil is reddish-brown stony clay loam. Their parent material weathered from light olive-gray schist bedrock.

The rock outcrops and slides are very steep. Geologic erosion removes the weathered rock material about as fast as it accumulates, and there is seldom enough soil to support plants.

Also in this association are Erramouspe and Osha soils, which are steep to very steep. Erramouspe soils are on slopes of the Gallinas Mountains. They are stony and droughty. Osha soils occur as piedmont fans on canyon side slopes of the Manzano Mountains. They are calcareous.

This association is generally not suited to conservation engineering structures, because the areas are steep and rocky and inaccessible. Some of the rock is suitable for use as riprap or as material for pervious blankets. In places there is enough soil material for constructing embankment-type ponds in the narrow, V-shaped drainageways that occur in the association. Concrete structures or small earthen dams can also be installed.

This association is used mainly for production of native forage for livestock and for wildlife habitats. The vegetation is mainly pinyon and juniper, short and mid grasses, mountain-mahogany, and cactus. Springs provide water for livestock and wildlife.

3. *Wilcoxson-Supervisor-Pino association*

Gently sloping to very steep soils formed over limestone, sandstone, schist, and felsite

This association is on forested mountain slopes at the highest elevations of the western and southern parts of the Torrance Area. It consists of moderately deep and deep, stony and nonstony, acid soils (see fig. 4) and makes up about 1 percent of the Area.

Wilcoxson soils, the most extensive in the association, have a thin layer of decomposing forest litter over a thin surface layer of very dark grayish-brown stony loam. Their subsoil is brown stony clay that is leached nearly free of lime in the upper part but has some visible lime in the lower part. Limestone bedrock is at a depth of about 20 to 30 inches.

Supervisor soils, which are acid and very steep, occur on north- and east-facing slopes. They normally have a thin layer of decomposing forest litter over a thick layer of dark grayish-brown loam. This layer grades through a moderately thick layer of grayish-brown very stony loam to a substratum of very pale brown very stony loam. Schist bedrock is at a depth of about 30 inches.

Pino soils, the least extensive of the major soils of the association, are on gently sloping crests and steep side slopes of ridges. They normally have a thin layer of decomposing forest litter over a moderately thick surface layer of brown silt loam. Their subsoil is brown to light yellowish-brown, acid clay, and the substratum is pale-yellow, massive clay. In places limestone bedrock is at a depth of about 4 feet.

Also extensive in this association are Pinata soils, which are on moderately steep to very steep side slopes of ridges in the southern part of the Area. These soils normally have a thin layer of decomposing forest litter over a thick surface layer of stony loam that is very dark grayish brown in the upper part and pinkish gray in the lower part. The subsoil consists of about 3 feet of reddish-brown stony clay. It overlies acid felsite bedrock.

Also in this association are forested soils of the Capillo, Fortwingate, Fuera, Stroupe, Tampico, Tecolote, and other series.

Most of the soils of this association are underlain by bedrock at a depth of 2 to 5 feet. Pit-type ponds are impractical to construct, but shallow excavations can be made to obtain material for constructing embankment-type ponds in the less sloping areas. Diversions can be constructed on the gentle slopes for diverting runoff into the reservoir area.

Tampico soils, which occur in narrow drainageways, are more suitable than other soils of this association for ponds and reservoirs, provided excavation does not expose the gravelly substratum. If the gravelly material is exposed, it should be platted with nongravelly soil and compacted when moist.

Pipelines for stock water can be installed, but only with difficulty. The depth of the installation would need to be at least 2 feet because of the winter cold to be expected at these elevations. If depth to bedrock is less than 2 feet, it is necessary to bed plastic pipe with soil that is relatively free of rock, then build up a thick mound of soil over the pipe to protect it against freezing.

This association is well suited to engineering structures generally used in developing recreational facilities.

The soils of this association receive the largest amount of effective precipitation, are exposed to the widest seasonal variations in temperature, and occur on many of the steepest slopes, yet they are the least eroded and the most productive of the mountain soils in this Area. They produce most of the commercial timber harvested in the Area and provide fine habitats for deer, bear, and turkey. Livestock graze on these soils. The vegetation is mainly ponderosa pine, limber pine, Douglas-fir, white fir, and alligator juniper, with an understory of deciduous oaks and shrubs and a ground cover of short and mid grasses. Fresh-water springs are common, and they provide ample water for livestock and wildlife, and for human consumption. Most of the recreational facilities within the Cibola National Forest are in this association.

4. Witt-Wilcoxson-Turkeysprings association

Gently sloping to very steep soils formed over limestone, sandstone, and shale and in valley fill; on foothills

This association is mainly in the foothills on the eastern slopes of the Manzano Mountains. It consists of deep, gently sloping to strongly sloping, upland soils and shallow and moderately deep, steep to very steep, wooded soils (fig. 5). It makes up about 12 percent of the Torrance Area.

Witt soils, the most extensive in the association, occur on gently sloping to strongly sloping alluvial fans. They have a thin surface layer of light-brown to brown loam. Their subsoil is reddish-brown to dark-brown clay loam that is leached free of lime in the upper part. Below this is pinkish-white, limy loam.

Wilcoxson soils are on upland ridge crests and on benches between ridges of shallow soils. They are gently sloping to strongly sloping. They have a moderately thick surface layer of dark-brown clay loam over a subsoil of very hard, reddish-brown clay that is limy in the lower part. The substratum is pinkish-white, very limy silty clay loam that grades into weathered limestone at a depth of about 4 feet, except in stony areas.

Turkeysprings soils are the least extensive of the major soils of the association, but they are the most prominent because of their stoniness and steep, wooded slopes. They occur on side slopes of ridges. They have a thin layer of decomposing forest litter over a moderately thick surface layer of dark grayish-brown stony loam. Their subsoil is brown stony clay that contains some visible lime in the lower part. Below this is a substratum of very pale brown, limy, very stony silt loam. Limestone bedrock is at a depth of 4 feet or less.

Pinon and Laporte soils occupy a large acreage in this association. These are shallow soils on crests and side slopes of ridges. Alicia, Encierro, and Washoe soils make up the rest of this association.

Witt soils have the best overall properties for engineering installations. They are moderately to slowly permeable and have moderate to high shrink-swell potential. Farm ponds, diversions, terraces, and pipelines can be installed easily because the soils are deep and free of stones.

Wilcoxson soils also have good properties for engineering installations, such as terraces and diversions. In stony areas, however, where bedrock is at a depth of only 16 to 30 inches, these soils are unsuitable for construction of pit-type farm ponds or stock-water pipelines.

Turkeysprings soils can be used for constructing diversions and embankments for farm ponds, but care must be taken to have enough soil in the fill to make the embankment homogeneous, rather than mostly stone in some places.

Pinon and Laporte soils are not suitable for installation of conservation engineering structures, because bedrock is only about 10 inches below the surface. Alicia soils are suitable for construction of farm ponds, terraces, and diversions, and for installation of pipelines. Encierro soils are unsuitable for conservation engineering structures, because they are rocky and are underlain by sandstone bedrock at a depth of only 9 inches. Washoe soils are gravelly and have moderate seepage, but they can be used for water storage if the soil is adequately compacted.

The limestone rock that is near the surface in the Turkeysprings, Laporte, and Pinon soils is suitable for crushing for construction uses.

Many of the deep, upland areas in this association have been dryfarmed in the past, but in recent years most of

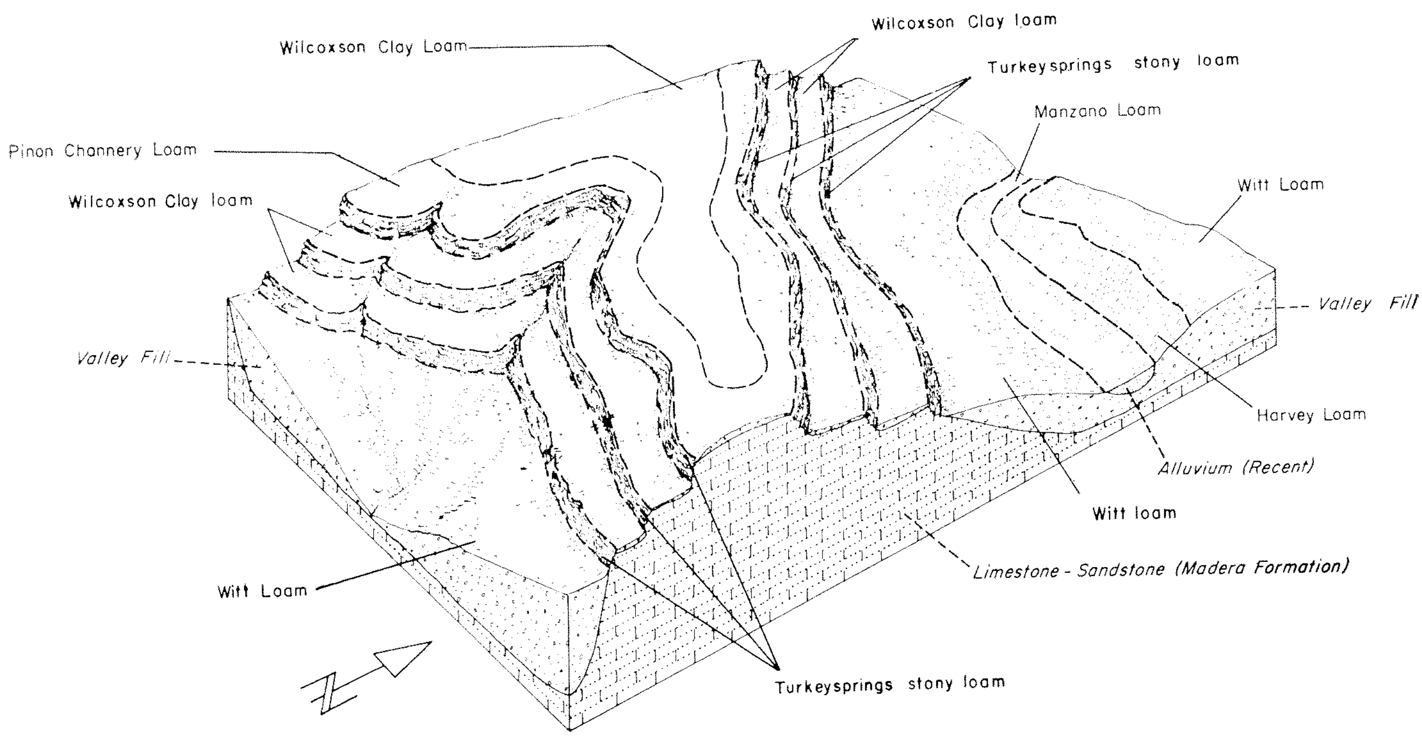

***Figure 5.*—Major soil series of association 4.**

these areas have been returned to native grass. Wheat, corn, and pinto beans are the principal crops on the remaining cropland. Much of this association is heavily wooded with pinyon and juniper, which provide a suitable habitat for deer, bear, and turkey. Some of the trees are harvested for fenceposts and firewood. Short and mid grasses, cool- and warm-season grasses, and cholla cactus, make up most of the ground cover. Much of this association provides good summer range for livestock. Major creeks and streams provide water.

5. *Witt-Harvey-Manzano association*

Nearly level to strongly sloping soils formed in valley fill or mixed alluvium

This association (fig. 6) is in the western and southern parts of the Torrance Area. It occurs on crests and side slopes of piedmont fans, on flood plains, and in swales. It consists of moderately deep and deep upland soils. The association makes up about 14 percent of the Torrance Area.

Witt soils, the most extensive, are mainly on the piedmont crests. They have a thin surface layer of light-brown loam that is leached free of lime. They have a thick subsoil of reddish-brown to dark-brown clay loam that is leached free of lime in the upper part. Pinkish-white, very limy loam begins at a depth of about 4 feet.

Harvey soils are mainly on the truncated side slopes of fans and are gently sloping to strongly sloping. They are limy to the surface. In most places they have a moderately thick surface layer of light-brown or grayish-brown loam. The lower part is more limy than the upper part. This layer grades through very pale brown loam to very limy, pink loam that is nearly impervious to roots.

Manzano soils have a thick surface layer of grayish-brown loam or clay loam over a thick subsoil of dark grayish-brown clay loam. They have a substratum of limy, brown light clay loam that is readily penetrated by roots, air, and water. They occur in swales and on flood plains.

Also in this association are Tapia, Pinon, and Dean soils, which are shallow, and Wilcoxson soils, which are deep. There are also areas of Carnero and Clovis soils.

Witt, Harvey, and Manzano soils have good overall characteristics for engineering installations. They are moderately to slowly permeable and have a moderate to high shrink-swell potential. They are well suited to irrigation structures and engineering practices. They are deep and free of stones. Farm ponds, diversions, terraces, and pipelines can be installed easily.

Tapia soils are underlain by semi-indurated caliche at a depth of less than 35 inches. They are not suitable for farm ponds, but diversions, terraces, and pipelines can be installed with little difficulty. Pinon soils are not suitable for conservation engineering structures, because they are underlain by bedrock at a depth of only about 10

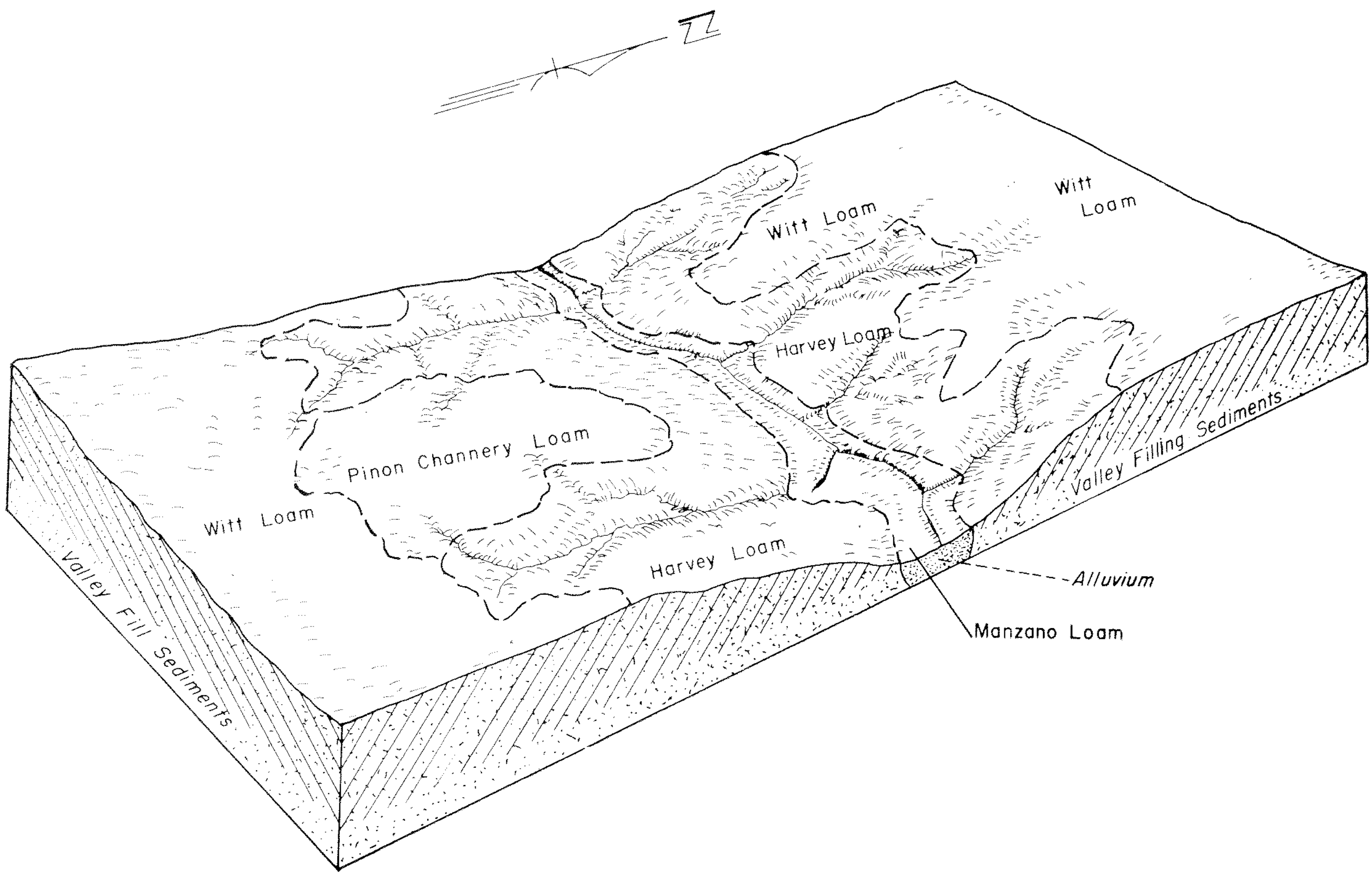

Figure 6.—**Major soil series of association 5.**

inches. Dean soils are gravelly and are moderately to rapidly permeable. They are not suitable for farm ponds. Diversions and terraces can be installed with difficulty. Wilcoxson soils have good characteristics for conservation engineering structures, except farm ponds. Their shallowness over bedrock makes them unsuitable for pit-type ponds.

This association was formerly a major area for dryland farming, but crop failures were common because of the unfavorable climate, and many farms were returned to rangeland. Nevertheless, this association is still the most extensively dryfarmed part of the Torrance Area. Wheat, corn, and pinto beans are the principal crops. About 45 percent of the irrigated acreage in the Area is in this association. Alfalfa, corn, pinto beans, wheat, and potatoes are the main crops. Witt soils, the main dryland soils, are also the most extensively eroded soils of the association. Manzano soils are the most fertile and most productive cropland and rangeland soils of the Torrance Area. The Pinon soils in this association are wooded.

Much of the acreage of this association in the southern part of the Area has moderate to heavy stands of pinyon and juniper, which provide not only habitats for wildlife but also fenceposts and firewood.

Areas of this association not used for cultivation or trees are used for range. Short and mid grasses and cactus are the dominant vegetation.

6. *Willard-Ildefonso-Karde association*

Level to strongly sloping soils formed in lake sediments on terraces; gently sloping to steep soils formed in wind-deposited materials on hills

This association (fig. 7) consists of shallow and moderately deep, saline and nonsaline soils on lake terraces and wind-deposited hills. It includes the Estancia, Encino, and Pinos Wells Lake Basins. The association makes up about 15 percent of the Torrance Area.

Willard soils, the most extensive, are slightly saline near the lake margins, and they are progressively more saline toward the center of the lake basins. About two-thirds of the acreage of Willard soils is moderately to strongly saline and is affected by alkali. These soils have a moderately thick surface layer of light brownish-gray loam and a subsoil of pale-brown, limy clay loam. Below this is very limy, light yellowish-brown light clay loam. Lacustrine lake sediments generally begin at a depth of about 2 feet, but the depth ranges from about 10 inches to 30 inches.

Ildefonso soils occur on the margins of the lake basins, on shoreline benches. They have a moderately thick surface layer of brown to pale-brown, limy fine sandy loam and a subsoil of pale-brown, limy gravelly fine sandy loam. Below this is very pale brown, very limy gravelly fine sandy loam. In places the surface layer is loamy fine sand.

Karde soils occur on wind-deposited dunes or hills on the leeward side of playa lakes. The playas are near the center of the lake basins. These soils have a thin surface layer of light-gray, limy loam over several feet of pale-yellow silt loam that is high in content of lime and soluble salts. They are moderately to strongly saline.

Also in this association are the moderately deep, coarse-textured Pedrick soils, the deep and fertile Manzano soils on broad flood plains near the lake margins, and the alkaline Harvey soils near the western margin of the Estancia Lake Basin.

The nonsaline areas of Willard soils are suitable for all irrigation structures. Both the saline and nonsaline areas are suitable for farm ponds, diversions, and stock-water pipelines. The use of uncoated metal pipelines is not advisable in areas of Willard loam, strongly saline, because of the corrosion hazard.

Ildefonso soils are suitable for all irrigation installations. They are erodible and rapidly permeable and are

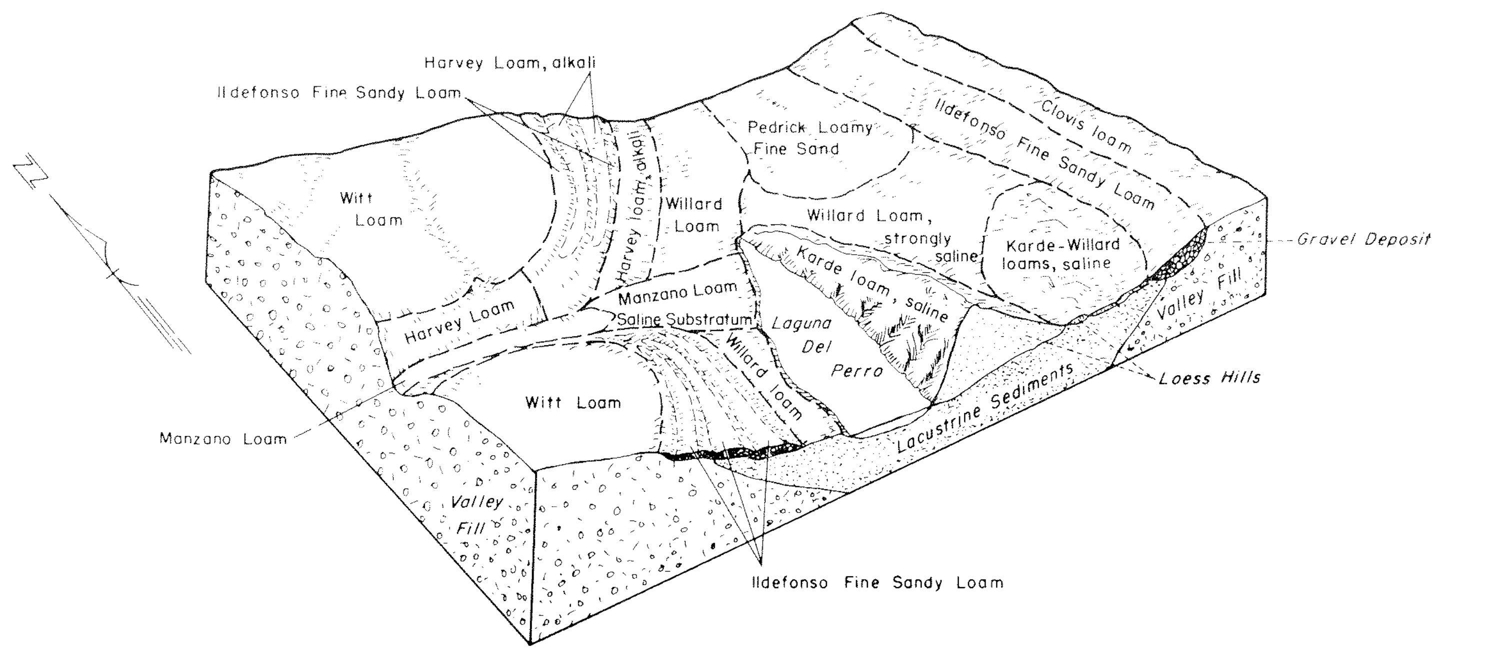

Figure 7.—**Major soil series of association 6.**

not well suited to embankments or farm ponds because of a seepage hazard. Pipelines can be installed.

Karde soils are suitable for building stock ponds, diversions, and terraces. Pipelines can be installed easily.

Pedrick soils are erodible and are rapidly permeable. They make fair embankments, but rapid seepage can be expected if they are used for farm ponds, because the soil material is difficult to compact.

Harvey soils in this association are normally alkaline and saline. They are well suited to all conservation engineering structures or practices, but stock-water pipelines should be of plastic material because of the hazard of corrosion of metal pipes.

About 55 percent of the irrigated acreage in the Area is in this association. The main irrigated soils are the Manzano soils, the Ildefonso soils, and the nonsaline areas of the Willard soils. Alfalfa, pasture, corn, sugar beets, and barley are the principal crops. The rest of this association is used for range. Short and mid grasses and chamiza are the main vegetation. Salt-tolerant grasses are dominant. There are few trees except those planted around farmsteads. Underground water is abundant in most places, but the water in the lower part of the lake basins is generally unsuitable for irrigation. The saline-alkali Willard soils should not be irrigated, because most crops cannot tolerate the salt.

7. *Clovis-Otero-Rock land association*

Gently sloping to very steep soils formed over acid igneous rocks and in valley fill

This association occurs mainly in the Pedernal Hills, but also as smaller areas in the eastern part of Torrance County. It consists of both deep and shallow soils that formed in valley fill washed from the surrounding hills. The association makes up about 6 percent of the survey Area.

Clovis soils, the most extensive in the association, occur on upland piedmont fans. They are gently sloping to moderately sloping. In most places they have a thin surface layer of lime-free brown loam. Their subsoil is brown to light-brown clay loam that is limy in the lower part. A substratum of pink loam, nearly impervious to plant roots, is at a depth of about 30 inches.

Otero soils also are on fans, mainly near the western and southern edges of the association. They are gently sloping to strongly sloping and are slightly hummocky in many places. In most places they have a thick surface layer of light-brown fine sandy loam that contains some lime. Their subsoil is light-brown fine sandy loam that contains more lime than the surface layer. The substratum is very limy, very pale brown fine sandy loam that is permeable to roots, air, and water. In places the surface layer is leached free of lime.

Rock land occurs on strongly sloping to very steep hills and mountain slopes. It consists mainly of pebbles, cobblestones, stones, and boulders, of all sizes and shapes. Cobblestones and stones 10 to 20 inches in diameter are the most common. There is little or no soil material between the rocks, and consequently little vegetation.

Also in this association are Kech, Scholle, and Chilton soils, which are shallow and gravelly. Kech soils are on low hills and ridgetops, Scholle soils on the upper part of piedmont fans, and Chilton soils on the side slopes of piedmont fans.

Some of the areas of Clovis and Otero soils have been dryfarmed, and most of these areas have been severely eroded by wind. Many abandoned fields have either reverted to grassland by natural reseeding or have been seeded.

Underground water is more difficult to obtain in this association than in other parts of the Area. The water table is deep, and dry holes are common. Ponds are needed to furnish water for livestock. Installation of pipelines should be considered if a source of water is available. Clovis and Scholle soils are well suited to both pit-type and embankment-type ponds. Otero and Chilton soils are too permeable to be suitable for ponds, and Kech soils are too shallow to be suitable for either ponds or pipelines. Clovis, Otero, Scholle, and Chilton soils are well suited to installation of pipelines. Otero soils are difficult to compact and are erodible. They should not be used for dikes, diversions, terraces, or embankments.

This association is used mainly for range. The vegetation is mostly short and mid grasses, cactus, and yucca. There is some pinyon pine and juniper at the higher elevations and some scrub oak on areas of Rock land. Rock land and the gravelly hills offer a suitable habitat for antelope, and most of the antelope population of the Torrance Area is in this association.

8. *Tapia-Dean-Pastura association*

Nearly level to strongly sloping soils formed over caliche on uplands

This association, the largest in the survey Area, is almost entirely in the eastern part of Torrance County. It consists of shallow to moderately deep soils underlain by caliche. The association makes up 18 percent of the Torrance Area.

Tapia soils, the most extensive in the association, occur on crests of piedmont fans. They are nearly level to moderately sloping and are moderately deep. In most places they have a thin surface layer of brown loam. Their subsoil is brown to light-brown clay loam. White, massive, fractured caliche is at a depth of about 20 inches; it restricts root penetration. The surface layer and the upper part of the subsoil are leached free of lime.

Dean soils occur both on crests and on side slopes of piedmont fans. They are gently sloping to strongly sloping and are shallow over partly cemented caliche. They normally have a thin surface layer of light brownish-gray loam. Their subsoil is light-gray gravelly loam, weakly cemented with lime in the upper part. This limy layer grades to a less limy substratum of very pale brown gravelly loam. Grass roots are confined mainly to the surface layer.

Pastura soils occur both on crests and on side slopes of piedmont fans. They are gently sloping to strongly sloping. They normally consist of less than 12 inches of light brownish-gray to pale-brown loam over indurated caliche.

Harvey, Rance, Prewitt, and Manzano soils make up the rest of this association. Harvey soils are deep and limy and occur on side slopes of the fans. Rance soils are moderately deep over gypsum. Prewitt and Manzano soils are deep, dark-colored, loamy soils in narrow drainageways.

Many areas of Tapia soils have been dryfarmed and then abandoned. Erosion has removed much of the topsoil from these abandoned fields, and it is still a hazard. Nearly all of the areas formerly cultivated have been reseeded to native grasses and returned to range. A few areas have been left to revert naturally to grass.

The consolidated caliche underlying the major soils of this association interferes with construction of pit-type ponds for watering livestock. Embankment-type ponds are watertight, but sites suitable for such ponds are scarce. Usually, large areas must be stripped of topsoil in order to get enough soil material to build embankments. The best sites are in areas of Prewitt and Manzano soils, two of the minor soils of this association, where enough good-quality soil material is available. In some areas the caliche underlying Dean and Pastura soils has been excavated for use in road construction.

Pipelines can be installed in the soils of this association, but they must be bedded with topsoil in areas where there are coarse fragments of caliche. Rance soils are underlain by gypsum and, because of the piping hazard, should not be used for earthen structures.

This association is used mainly for native range. Short and mid grasses and cactus are the main vegetation, but there are a few juniper trees.

9. *Penistaja-Steep rock land association*

Nearly level to strongly sloping soils on uplands, and moderately sloping to very steep rocky areas on hillsides, mesa escarpments, and breaks

This association is in the southern and eastern parts of the Torrance Area. It consists of shallow, moderately deep, and deep soils, and of steep rock land (fig. 8). The soils are on upland piedmont fans. The rock land consists of moderately sloping to very steep hillsides, mesa escarpments, and breaks. This association makes up about 15 percent of the survey Area.

Penistaja soils, the most extensive in the association, normally have a thin surface layer of brown fine sandy loam over a subsoil of light-brown or reddish-brown sandy clay loam. Below this is light reddish-brown fine sandy loam that is high in lime content but permeable to roots, air, and water. Penistaja soils are deep and are leached of lime to a depth of about 20 inches.

Steep rock land is also extensive in this association. The rock is mainly sandstone. Thin layers of limestone cap the sandstone in some of the areas near the crest of escarpments and hills. The rock land rises some 500 feet or more above the lower lying uplands. Ledges and stairstep topography are common. Shallow pockets of soil between the ledges support most of the plant life.

Figure 8.—**Landscape in association 9. Penistaja soils are on the piedmont fans in the foreground. Steep rock land is on the mesa escarpment in the background.**

Also in this association are moderately deep Hagerman soils and shallow Bernal, Travessilla, and Laporte soils.

Farm ponds, diversions, terraces, and pipelines can be constructed in the Penistaja soils, but some seepage can be expected in ponds unless the soils are well compacted. In places it is necessary to plait the excavated pit with finer textured subsoil material.

Hagerman soils are well suited to all conservation engineering structures, except farm ponds. In most places bedrock is too near the surface for pit-type ponds, but the surface layer and the subsoil are suitable for embankment-type ponds. In places the soil is too shallow over bedrock for pipelines, unless the rock is ripped or blasted out.

Bernal, Travessilla, and Laporte soils are too shallow and the rock land is too steep and rough for engineering construction. Pipelines could be installed, but the rock would have to be blasted out.

Erosion is a problem in constructing waterways on Hagerman and Penistaja soils, unless protective measures are applied.

Nearly all of this association is used for range. The upland soils are the most productive grassland soils in the survey Area. The vegetation consists of light to heavy stands of pinyon and juniper, short and mid grasses, cactus, and yucca. Brush control is not difficult on the upland soils. The trees and understory vegetation provide a suitable habitat for deer.

A few areas of Penistaja soils are used for small grains and row crops. There are many abandoned fields—formerly in cultivation—that have been severely eroded by wind. Range reseeding has been successful on these old fields.

10. *La Fonda-Alicia-Rock outcrop association*

Gently sloping to strongly sloping soils formed in alluvium from red beds; moderately sloping to very steep rock outcrops

This association is mainly in the eastern and southwestern parts of the Torrance Area. It consists of deep, loamy soils on upland piedmont fans and moderately sloping to very steep rock outcrops. This association makes up about 9 percent of the survey Area.

La Fonda soils, the most extensive in the association, normally have a thin surface layer of reddish-brown loam over a subsoil of light reddish-brown heavy loam. Below this is light reddish-brown loam that is more limy than the surface layer and the subsoil.

Alicia soils have a moderately thick surface layer of reddish-brown loam. Their subsoil is reddish-brown clay loam that is leached of lime in the upper part. The substratum is light reddish-brown, limy loam.

Rock outcrops are moderately sloping to very steep. They are on side slopes of hills and escarpments, and in breaks areas. The rocks are dominantly red-bed shale, siltstone, and sandstone, but some are limestone, gypsum, and caliche. These rocky areas erode rapidly, and soil accumulates too slowly to support much plant life. In places the outcrops are dissected by numerous shallow gullies, and in other places the surface relief has a stairstep appearance.

In some areas the slopes are nearly vertical, and the ridgetops are 200 feet above the surrounding uplands.

Also in this association are Encierro, Chilton, Scholle, and Pinon soils and areas of Steep rock land. Encierro soils are shallow over sandstone; they occur on rolling ridge crests and side slopes. Chilton soils are limy and gravelly; they occur on side slopes of piedmont fans. Scholle soils are gravelly; they occur on crests of gravelly piedmont fans. Pinon soils are shallow over limestone bedrock; they occur on wooded ridge crests.

The soils of this association are highly susceptible to water erosion, which rapidly forms deep gullies and canyons. They are unstable and are difficult to seal. They also slake easily when saturated, and consequently are subject to piping. At times, spillways require repair after overflow because of the erodibility of the soils.

Farm ponds can be constructed in the La Fonda and Alicia soils. Pit-type ponds with desilting basins are more suitable than other types. Pipelines for livestock water can be installed in all of the soils of this association, with the exception of Pinon and Encierro soils, which are shallow.

This association is mostly over red beds, and its soils are the most susceptible to water erosion of any in the survey Area. It is suited to grasses, and most of the acreage is used for range. Short and mid grasses, cactus, yucca, and scattered scrub trees are the main vegetation. A few areas are dryfarmed to row crops. There are many old fields, and most of these are severely eroded. They are rapidly reverting to rangeland, either by seeding or by natural regeneration of forage plants.

11. Otero-Palma-Trail association

Undulating to rolling soils formed in wind-reworked materials on upland alluvial fans

This association is mainly in the southern part of the survey Area. It consists mostly of deep, sandy soils on undulating upland fans. It makes up about 4 percent of the survey Area.

Otero soils, the most extensive, are limy. They normally have a moderately thick surface layer of light-brown fine sandy loam or loamy fine sand over a similar, but more limy, subsoil. The substratum is very pale brown fine sandy loam that has more visible lime than the subsoil. In places the surface layer is leached of lime.

Palma soils are normally leached of lime in the surface layer and the upper part of the subsoil. They have a thin surface layer of brown or reddish-brown fine sandy loam or loamy fine sand over a subsoil of reddish-brown heavy fine sandy loam. The lower part is lighter colored and contains some visible lime. Below this is light reddish-brown fine sandy loam that contains much visible lime.

Trail soils are the least extensive of the major soils in this association. They are nonlimy. They normally have a thin surface layer of pale-brown loamy fine sand over deep deposits of brown fine sand.

Penistaja and Chupadera soils make up the rest of the association. The Penistaja soils are deep and nonlimy; they have a sandy clay loam subsoil. The Chupadera soils are moderately deep and limy and overlie limestone bedrock.

All of the soils of this association are rapidly permeable. They are highly susceptible to water erosion and to wind erosion.

Earthen structures constructed on these soils do not function satisfactorily unless sealing materials are used. Stock ponds often leak and are difficult to seal. Range pipelines are well suited to all of the soils, except the Chupadera soils, which are underlain by fractured limestone at a depth of about 20 to 30 inches.

This association is used mainly for native forage. It supports a moderate to heavy stand of pinyon and juniper, and some of the trees are cut for fenceposts and firewood. Short, mid, and tall grasses, and yucca are the common ground cover. Many old fields are scattered throughout the association, and most have been severely eroded by wind. Only a few remain to be reseeded. These abandoned fields need protection from overgrazing until the plant cover is well established.

Descriptions of the Soils

This section describes the soils mapped in the Torrance Area. In the pages that follow, each mapping unit is described individually. Miscellaneous land types, such as Badland, are described in alphabetic order along with the soils. Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. At the end of the description of each mapping unit are listed the capability unit, and the range site and timber suitability group, if any, in which the mapping unit has been placed. The page where each of these groups is described can be found readily by referring to the Guide to Mapping Units.

The approximate acreage and proportionate extent of each mapping unit are given in table 4. Detailed technical descriptions of the soil series are given in the section "Genesis, Classification, and Morphology of the Soils."

TABLE 4.—*Approximate acreage and proportionate extent of the soils*

Soil	Acres	Percent	Soil	Acres	Percent
Alicia loam, 1 to 6 percent slopes	18, 722	0. 8	Clovis soils, 0 to 5 percent slopes, eroded	12, 570	. 6
Badland	4, 477	. 2	Clovis-Dean loams, 0 to 5 percent slopes	8, 396	. 4
Bernal-Slickspot complex	1, 849	. 1	Clovis and Scholle soils	17, 806	. 8
Bernal-Travessilla fine sandy loams	38, 015	1. 7	Crest stony loam, 5 to 50 percent slopes	3, 735	. 2
Blown-out land	1, 519	. 1	Dean loam, 1 to 9 percent slopes	52, 175	2. 4
Capillo loam, 15 to 50 percent slopes	3, 982	. 2	Duncan loam, dark variant	1, 100	(1)
Carnero loam, 3 to 8 percent slopes	3, 107	. 1	Encierro channery loam, 1 to 9 percent slopes	8, 287	. 4
Chilton gravelly loam	4, 670	. 2	Erramouspe stony loam, 30 to 60 percent slopes	1, 201	(1)
Chilton-La Fonda complex, 1 to 9 percent slopes	6, 456	. 3	Fortwingate stony loam, 5 to 40 percent slopes	2, 653	. 1
Chupadera loamy fine sand, 5 to 15 percent slopes	10, 405	. 5	Fuera cobbly loam, 5 to 20 percent slopes	4, 420	. 2
Clovis loam, 0 to 5 percent slopes	87, 897	4. 0			

TABLE 4.—*Approximate acreage and proportionate extent of the soils*—Continued

Soil	Acres	Percent
Fuera cobbly loam, 20 to 60 percent slopes	1, 943	. 1
Hagerman fine sandy loam, 1 to 5 percent slopes	43, 927	2. 0
Hagerman-Dean complex, 1 to 5 percent slopes	44, 221	2. 0
Harvey loam, 0 to 1 percent slopes	3, 107	. 1
Harvey loam, 1 to 9 percent slopes	115, 820	5. 2
Harvey loam, alkali	7, 611	. 3
Harvey-Dean loams, 1 to 9 percent slopes	95, 797	4. 3
Harvey and Dean soils, eroded	24, 813	1. 1
Hassell loam, 2 to 5 percent slopes	1, 847	. 1
Ignacio fine sandy loam, 1 to 5 percent slopes	2, 525	. 1
Ildefonso fine sandy loam, 0 to 2 percent slopes	14, 227	. 6
Ildefonso fine sandy loam, 0 to 5 percent slopes	28, 693	1. 3
Ildefonso loamy fine sand, 0 to 5 percent slopes	14, 904	. 7
Ildefonso stony sandy loam, 10 to 30 percent slopes	1, 272	. 1
Jekley silty clay loam, 20 to 40 percent slopes	614	[1]
Karde loam, saline	25, 943	1. 2
Karde-Willard loams, saline	38, 846	1. 8
Kech gravelly loam, 1 to 9 percent slopes	3, 483	. 2
Kim-Otero-Pastura complex	7, 245	. 3
Kim-Pastura-Tapia loams	46, 980	2. 1
Kim-Pinon-Witt loams	6, 570	. 3
La Fonda loam, 1 to 9 percent slopes	51, 916	2. 3
La Fonda loam, gravelly substratum, 2 to 8 percent slopes	1, 796	. 1
La Fonda-Alicia loams, 1 to 9 percent slopes	21, 764	1. 0
La Fonda-Rock outcrop complex	26, 100	1. 2
Laporte-Rock outcrop complex	49, 005	2. 2
Manzano loam, 0 to 1 percent slopes	32, 691	1. 5
Manzano loam, 1 to 5 percent slopes	8, 205	. 4
Manzano loam, saline substratum, 0 to 1 percent slopes	25, 201	1. 1
Mirabal stony sandy loam, high elevation, 10 to 70 percent slopes	4, 227	. 2
Mirabal stony sandy loam, 40 to 80 percent slopes	6, 319	. 3
Moriarty clay loam, 0 to 1 percent slopes	1, 517	. 1
Moriarty clay loam, 2 to 6 percent slopes	900	[1]
Osha gravelly loam, 10 to 50 percent slopes	1, 601	. 1
Osha gravelly loam, calcareous variant, 20 to 80 percent slopes	1, 047	[1]
Otero and Palma soils	69, 040	3. 1
Otero and Palma soils, hummocky	1, 509	. 1
Pastura loam, 1 to 9 percent slopes	20, 019	. 9
Pastura loam, 9 to 25 percent slopes	2, 665	. 1
Pedrick loamy fine sand	27, 661	1. 3
Pedrick loamy fine sand, hummocky	8, 911	. 4
Penistaja fine sandy loam, 0 to 1 percent slopes	1, 365	. 1
Penistaja fine sandy loam, 1 to 6 percent slopes	82, 696	3. 8
Penistaja loamy fine sand, hummocky, 1 to 8 percent slopes	14, 128	. 6
Penistaja sandy clay loam, 1 to 6 percent slopes, eroded	1, 575	. 1
Penistaja-Dean complex, 1 to 5 percent slopes	7, 087	. 3
Penistaja-Dean fine sandy loams, 1 to 5 percent slopes	8, 197	. 4
Pinata stony loam, 25 to 50 percent north slopes	2, 669	. 1
Pinata stony loam, 20 to 60 percent south slopes	6, 225	. 3
Pinata-Stroupe stony loams, 5 to 20 percent slopes	9, 647	. 4
Pinata-Stroupe stony loams, 20 to 50 percent slopes	3, 998	. 2
Pino loam, loamy substratum, 3 to 12 percent slopes	1, 619	. 1
Pino silt loam, 2 to 30 percent slopes	6, 011	. 3
Pinon channery loam, 3 to 20 percent slopes	92, 401	4. 2
Prewitt and Manzano soils	21, 079	1. 0
Rance-Gypsum land complex	14, 453	. 7
Rock land	9, 510	. 4
Rock outcrop-Pinon-La Fonda complex	29, 806	1. 3
Rock outcrops and slides	12, 507	. 6
Salas stony loam, 30 to 70 percent slopes	17, 678	. 8
Scholle gravelly loam, 1 to 9 percent slopes	4, 943	. 2
Scholle loam, 1 to 5 percent slopes	2, 420	. 1
Steep rock land	50, 261	2. 3
Stony alluvial land	1, 119	[1]
Stony steep land	6, 715	. 3
Stroupe stony loam, 15 to 70 percent slopes	2, 646	. 1
Supervisor loam, 40 to 80 percent slopes	2, 640	. 1
Tampico loam	1, 752	. 1
Tapia loam, 0 to 5 percent slopes	51, 076	2. 3
Tapia-Dean loams, 0 to 5 percent slopes	113, 839	5. 1
Tapia and Dean soils, eroded	9, 301	. 4
Tecolote stony loam, 20 to 70 percent slopes	3, 946	. 2
Tecolote stony loam, thick surface variant, 20 to 70 percent slopes	757	[1]
Tesajo gravelly sandy loam, 2 to 15 percent slopes	6, 172	. 3
Trail loamy fine sand, 5 to 10 percent slopes	10, 218	. 5
Turkeysprings stony loam, 20 to 50 percent slopes	19, 943	. 9
Washoe cobbly loam, 9 to 25 percent slopes	3, 047	. 1
Washoe gravelly loam, 1 to 9 percent slopes	2, 977	. 1
Wilcoxson clay loam, 2 to 10 percent slopes	7, 330	. 3
Wilcoxson loam, thick surface, 1 to 6 percent slopes	8, 164	. 4
Wilcoxson stony loam, 5 to 20 percent slopes	3, 121	. 1
Wilcoxson stony loam, 20 to 50 percent north slopes	13, 999	. 6
Wilcoxson stony loam, 15 to 45 percent south slopes	8, 427	. 4
Willard loam	39, 020	1. 8
Willard loam, eroded	3, 668	. 2
Willard loam, strongly saline	60, 633	2. 7
Willard fine sandy loam	6, 100	. 3
Witt loam, 0 to 1 percent slopes	23, 261	1. 1
Witt loam, 1 to 6 percent slopes	105, 256	4. 8
Witt clay loam, 0 to 1 percent slopes, eroded	10, 881	. 5
Witt clay loam, 1 to 6 percent slopes, eroded	47, 563	2. 2
Witt-Harvey loams, 0 to 3 percent slopes	4, 439	. 2
Witt-Harvey-Pinon loams, 1 to 9 percent slopes	22, 437	1. 0
Intermittent lakes	18, 564	. 8
Towns and villages	3, 518	. 2
Total	2, 208, 008	100. 0

[1] Less than 0.05 percent.

For full information on the mapping units, it is necessary to read these technical descriptions as well as the descriptions of the mapping units, which follow here. For more general information about the soils, the reader can refer to the section "General Soil Map," in which the broad patterns of soils are described.

Many of the terms used in the soil descriptions and other parts of the report are defined in the Glossary.

Alicia loam, 1 to 6 percent slopes (Al).—This soil occurs on piedmont fans and valley fills on the uplands in the western and eastern parts of the Torrance Area. The surface layer, about 6 inches thick, consists of friable, reddish-brown, granular loam. It rests on a subsoil of reddish-brown clay loam that has weak subangular blocky structure. The subsoil, about 21 inches thick, is weakly calcareous. It grades to a substratum of light reddish-brown limy loam that is readily penetrated by roots.

Included with this soil are small areas of La Fonda loam, 1 to 9 percent slopes; Manzano loam, 0 to 1 percent slopes; and Witt loam, 1 to 6 percent slopes.

This soil is moderate in fertility and in organic-matter content. It is subject to severe water erosion and wind erosion when not protected by plant cover. Headcuts and gullies are common in areas that receive runoff from surrounding areas. The water-storage capacity is moderate. Roots, air, and water penetrate readily. Surface runoff is slow to medium, depending on slope. Internal drainage is medium.

This soil is used mainly for range. The native vegetation consists mostly of blue grama, galleta, sand dropseed, ring muhly, cactus, and light to moderate stands of scrub pinyon and juniper. Some small areas in the western part of the Area are dryfarmed to corn and pinto beans. Many fields have been abandoned. Some have been left to revert to the natural vegetation, and some have been reseeded to native grasses. (Dryland capability unit IVe-3 if in climatic zone 4, and VIs-2 if in climatic zone 5; Loamy range site)

Badland (5 to 30 percent slopes) (Ba).—This land type occurs near the northeastern boundary of the survey Area. It consists of rough, broken, and dissected areas with many drainage channels. A nearly vertical escarpment stands at the head of the many intermittent drainageways. This escarpment is being gradually eroded back into the uplands. Elevations vary by as much as 500 feet.

About 75 percent of Badland consists of raw shale and sandstone outcrops. There is some—but not much—limestone, indurated caliche, and gypsum. About 25 percent of this land type consists of small areas of soils on the gentler slopes. The surface layer of these soils is loam to fine sandy loam in texture and brown or dark reddish brown in color. The subsoil is sandy clay loam or clay loam in texture and reddish brown or dark reddish brown in color. The soils are normally noncalcareous.

Included in mapping were small areas of Alicia loam, 1 to 6 percent slopes; Hagerman fine sandy loam, 1 to 5 percent slopes; and Bernal-Travessilla fine sandy loams.

This land type is used only for production of native forage. The vegetation is very sparse. It consists mainly of blue grama, sand dropseed, scrub oak, and juniper. Badland is subject to severe water erosion, and grazing practices that encourage plant density and forage production are essential to keep erosion to a minimum. (The raw shale and sandstone outcrops are in dryland capability unit VIIIs-1; the small areas of soils are in dryland capability unit VIIe-1. Badland occurs in climatic zone 5. It is in Hills range site)

Bernal-Slickspot complex (0 to 3 percent slopes) (Bs).—This complex (fig. 9) occurs on uplands in the northeastern part of the survey Area. Bernal soils make up about 70 to 85 percent of the acreage, and Slickspots, 15 to 30 percent. Included are small areas of Travessilla fine sandy loam.

Bernal soils have a surface layer of brown fine sandy loam about 3 inches thick. This layer is noncalcareous and has moderate granular structure. The subsoil is brown and reddish-brown sandy clay loam about 9 inches thick. The subsoil has moderate subangular blocky and prismatic structure. It rests abruptly on noncalcareous sandstone bedrock that has few fractures.

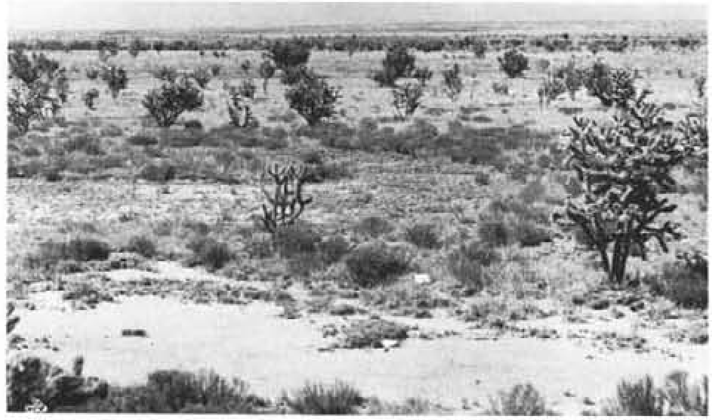

Figure 9.—**An area of Bernal-Slickspot complex. Slickspots, such as those in the foreground, are common in areas of Bernal soils.**

Slickspots are barren areas that normally have a thin, eroded surface layer of light-brown loam. This layer is about 1 inch thick and abruptly overlies a noncalcareous subsoil of dark reddish-brown blocky clay about 10 inches thick. The lower part of the subsoil contains substantial amounts of soluble salts and is normally strongly alkaline. The subsoil rests abruptly on noncalcareous sandstone bedrock, coated in many places with a thin layer of calcium carbonate.

This complex, particularly the Slickspot areas, is subject to severe wind erosion. The moisture-storage capacity is limited because the soils are shallow over rock. Bernal soils absorb water at a moderate rate, but Slickspots have a very slow intake rate. Runoff is slow to medium.

Native range is the main use of this complex. Slickspots are mostly barren, but in places alkali sacaton and saltgrass grow near the edges. Bernal soils have a cover of blue grama, sand dropseed, ring muhly, cactus, yucca, and a few junipers. (Dryland capability unit VIs-4, climatic zone 5; the Bernal soil is in Loamy range site)

Bernal-Travessilla fine sandy loams (1 to 9 percent slopes) (Bt).—This complex occurs on the crests and side slopes of foothills in the western, southern, and eastern parts of the survey Area. Bernal soils are the more open part of the landscape (fig. 10). They make up 40 to 60 percent of the acreage. Travessilla soils also make up 40 to 60 percent of the acreage, but most commonly a smaller part than Bernal soils. Included in mapping were areas of Hagerman fine sandy loam, 1 to 5 percent slopes, which make up about 5 percent of the mapping unit, and areas of Laporte-Rock outcrop complex, which make up about 2 percent.

Bernal soils are deeper and less stony than Travessilla soils. They have a surface layer of brown fine sandy loam about 3 inches thick. This layer is noncalcareous and has moderate granular structure. The subsoil is reddish-brown sandy clay loam, about 9 inches thick, that has moderate blocky and moderate prismatic structure. Noncalcareous sandstone bedrock that is fractured in the upper part is at a depth of about 12 inches.

Travessilla soils are very shallow. They occur near rock outcrops and on convex ridges in the landscape. They consist of about 5 inches of noncalcareous granular fine sandy

Figure 10.—An area of Bernal-Travessilla fine sandy loams. The grassed openings among the trees are areas of Bernal soils. The wooded areas are Travessilla soils.

loam over fractured noncalcareous sandstone bedrock. Stones and outcrops are common in Travessilla soils. In places they cover as much as 25 percent of the surface.

Both Bernal and Travessilla soils are droughty, because they are shallow over bedrock. Fractures in the bedrock contain some soil material, which provides additional space for root growth and water storage. These soils absorb water readily and have moderate internal drainage above the rock. Runoff is medium to rapid and occurs mainly after the soil has become saturated. Water erosion is moderate to severe.

The main use of these soils is the production of native vegetation. The grass forage is grazed by domestic livestock and wildlife. Posts and firewood are cut from the scrub trees. The underlying sandstone is a source of roadbuilding material. The vegetation is sparse and consists mainly of blue grama, sand dropseed, galleta, snakeweed, cactus, some scrub oak, and moderate to heavy stands of pinyon and juniper. (Dryland capability unit VIIs–1, climatic zones 4 and 5; the Bernal soil is in Loamy range site; the Travessilla soil is in Shallow Sandstone range site)

Blown-out land (0 to 2 percent slopes) (Bu).—This land type consists mostly of abandoned fields, formerly dry-farmed, that have been so severely eroded by wind that little or none of the original soil material is left (fig. 11). The original soils were probably of the Willard and Pedrick series. These areas are mainly in the Estancia and Encino Lake Basins. The topography is undulating in places.

Most of the surface layer has been blown away, and the underlying lacustrine deposits are exposed. These deposits are generally pale brown, olive, or yellowish in color, and they range from loam to clay loam in texture. Many areas contain strong concentrations of lime and soluble salts. In some places there is a thin, brown or light-brown surface layer that ranges in texture from loam to fine sandy loam.

Some areas have undulating topography because wind removes soil from one place and deposits it in another. These accumulations are seldom more than 4 feet deep.

These eroded areas are low in fertility and in organic-matter content. They absorb water at a moderate rate and have slow to medium internal drainage. Runoff is slow to very slow. Water erosion is not a hazard, but controlling wind erosion is a continuous problem. In many places the lacustrine deposits restrict root penetration and thus make it difficult for native grasses to get established.

Figure 11.—An area of Blown-out land in the Encino Lake Basin. About 3 feet of soil material and parent material has been blown away.

Most of the fields are idle and have been either reseeded to native grasses or left to revert to grasses. Three-awn, ring muhly, alkali sacaton, blue grama, and sand dropseed make up most of the vegetation. Some of the areas that are being grazed by livestock need to be fenced and protected from overgrazing until grasses have become well established. (Dryland capability unit VIs–3, climatic zones 4 and 5; Salt Flats range site)

Capillo loam, 15 to 50 percent slopes (Ca).—This soil occurs in the Manzano Mountains, in the western part of the Area, mainly on north- and east-facing slopes. It has about 3 inches of decomposing forest litter over a surface layer of about 3 inches of very dark brown, friable loam. The subsoil is dark grayish-brown clay loam that grades to dark yellowish-brown clay in the lower part. It has moderate blocky structure and has been leached free of lime. This layer grades to partly weathered, calcareous shale at a depth of about 40 inches.

Included in mapping were areas of Wilcoxson stony loam, 20 to 50 percent north slopes, and areas of Wilcoxson stony loam, 15 to 45 percent south slopes. Each of the included areas makes up about 7 percent of the mapping unit.

This soil absorbs water readily and has a high capacity to store moisture for plants. Internal drainage is slow. The surface litter and vegetation protect the soil against excessive runoff and erosion; however, if the protective cover is destroyed by fire or if too much timber is harvested, runoff becomes rapid and severe erosion results.

This soil is used mainly for production of commercial timber and for wildlife habitats. The shrubs and grasses provide some forage for livestock. The native vegetation consists mostly of Douglas-fir, ponderosa pine, white fir, Gambel oak, Oregongrape, lupine, and blue grama. (Dryland capability unit VIIe–5, climatic zone 4; timber suitability group 2)

Carnero loam, 3 to 8 percent slopes (Ce).—This soil occurs on upland piedmont fans in the foothills of the Gallinas Mountains. The surface layer, about 3 inches thick, is brown granular loam that has been leached free of lime. The subsoil is reddish-brown clay loam that has moderate subangular blocky structure. This layer is about 16 inches thick and is leached free of lime in the upper part. Below the subsoil is about 13 inches of strongly calcareous, reddish-brown light clay loam resting on sandstone bedrock. Sandstone pebbles are scattered throughout the profile.

Included areas of Bernal soils make up about 15 percent of the acreage. Also included are small areas of Manzano loam, 1 to 5 percent slopes.

This soil is subject to severe wind erosion and water erosion when not protected by plant cover. It is easily penetrated by plant roots and has a moderate capacity to store moisture. It absorbs water at a moderate rate and has medium internal drainage. Runoff is medium. Surface pebbles protect the soil from erosion but tend to restrict the density of the plant cover.

This soil is used mainly for production of native forage. It supports a moderate to thick stand of pinyon and juniper, with a ground cover of blue grama, sand dropseed, ring muhly, and scattered oakbrush. Some scrub trees are harvested for posts and firewood. (Dryland capability unit VIs–4, climatic zone 5; Loamy range site)

Chilton gravelly loam (8 to 20 percent slopes) (Cg).—This soil occurs on side slopes of piedmont fans in the southwestern and eastern parts of the survey Area. The surface layer, about 9 inches thick, consists of brown, limy gravelly loam. It has weak to moderate, fine, granular structure. Below this is about 6 inches of very limy, light-brown gravelly loam that is seldom penetrated by plant roots. This layer grades to a less limy, very gravelly substratum.

Included in mapping were areas of Scholle gravelly loam, 1 to 9 percent slopes, and areas of Washoe cobbly loam, 9 to 25 percent slopes, each making up about 5 percent of the mapping unit. Also included were areas of Chilton soils where the slope is less than 8 percent. The included Chilton soils make up about 10 percent of the mapping unit.

This soil has a low capacity to store moisture for plants, and it is droughty because of its high gravel content. It absorbs water readily and has medium to rapid internal drainage. Runoff is rapid on moderately steep areas and moderate on strongly sloping areas. Surface gravel tends to limit the density of the plant cover but helps to keep wind erosion and water erosion to a minimum. Most plant roots are restricted to the surface layer.

This soil is used mainly for production of native grasses. In some areas the gravel beds are thick enough to be a source of roadbuilding material. Controlled grazing helps to increase plant density and also helps to reduce water loss through excessive runoff. The vegetation consists mostly of blue grama, black grama, sand dropseed, and scattered cactus and juniper. (Dryland capability unit VIs–1, climatic zones 4 and 5; Shallow range site)

Chilton-La Fonda complex, 1 to 9 percent slopes (Cl).—This complex occurs on piedmont fan ridge crests and side slopes of fans in the eastern part of the Area. Chilton soils are on the crests and upper side slopes in the more strongly sloping areas. They make up 40 to 60 percent of the complex and ordinarily are dominant. They have a surface layer, about 9 inches thick, of brown to grayish-brown, calcareous gravelly loam, overlying about 6 inches of very limy gravelly loam grading to a less limy, more gravelly substratum.

La Fonda soils make up 40 to 60 percent of the complex but most commonly about 45 percent. They occur on lower side slopes in nearly level to moderately sloping areas. They have a surface layer, about 4 inches thick, of reddish-brown, friable loam, grading to a subsoil, about 20 inches thick, of reddish-brown heavy loam. The subsoil has weak prismatic and subangular blocky structure. It grades into light reddish-brown, limy, structureless loam. The surface layer and the subsoil contain some lime but much less than the substratum.

Included in mapping were areas of La Fonda-Alicia loams, 1 to 9 percent slopes, and areas of Clovis and Scholle soils. The included areas make up less than 5 percent of the mapping unit.

Chilton soils are droughty because their gravelly layers have low capacity to store moisture. They absorb water readily and have medium to rapid internal drainage. Runoff is moderate. The density of the plant cover is restricted because the surface layer is gravelly, and plant roots seldom penetrate the very limy subsoil. The gravel in the surface layer helps to control wind erosion and water erosion.

La Fonda soils are erodible. They are low in fertility and in organic-matter content, but they respond to good management when weather conditions are favorable. These soils take in water at a moderate rate and have medium internal drainage. They have moderate capacity to store moisture.

These soils are not suited to cultivation. They are used mainly for production of native grasses. Chilton soils are sources of road subgrade material. Blue grama, sand dropseed, and cactus are common on both soils. Black grama grows on the Chilton soil, and galleta and yucca grow on the La Fonda soil. (Dryland capability unit VIs–1, climatic zone 5; the Chilton soil is in Shallow range site; the La Fonda soil is in Loamy range site)

Chupadera loamy fine sand, 5 to 15 percent slopes (Cm).—This soil occurs on crests and side slopes of ridges on the Chupadera Mesa, in the southern part of the Area. It is shallow to moderately deep. The surface layer consists of brown loamy fine sand, about 6 inches thick, that has weak granular structure. Below this is about 6 inches of brown loamy fine sand of weak subangular blocky structure, and below this, about 8 inches of very limy, light brownish-gray fine sandy loam. The fine sandy loam grades into weathered limestone bedrock at a depth of about 24 inches.

Included in the areas mapped are small areas of Otero and Palma soils, areas of Pinon channery loam, 3 to 20 percent slopes, and areas of Trail loamy fine sand, 5 to 10 percent slopes.

This soil is subject to severe wind erosion when not protected with adequate plant cover. It has low capacity to store moisture. The surface layer takes in water rapidly, and internal drainage is rapid above the bedrock. Plant roots penetrate easily but are restricted mainly to the material above the weathered bedrock. Surface runoff is slow.

This soil is suited to production of native grasses. Grazing should be managed so that plants can increase in vigor and density and so help to control wind erosion. The vegetation consists mainly of blue grama, sand dropseed, little bluestem, New Mexico feathergrass, needle-and-thread, snakeweed, and moderate to thick stands of pinyon and juniper. In places there are scattered ponderosa pines. (Dryland capability unit VIc-1, climatic zones 4 and 5; Sandy range site; timber suitability group 5)

Clovis loam, 0 to 5 percent slopes (Cn).—This soil (fig. 12) is moderately deep over a high-lime zone. It occurs on upland piedmont fans in all parts of the Area. The surface layer, about 5 inches thick, consists of brown, friable, noncalcareous loam. It has strong granular structure. This layer grades to about 14 inches of brown clay loam that is leached free of lime in the upper part. The clay loam has subangular blocky structure. A layer of light-brown, limy, massive clay loam begins at a depth of about 22 inches. This grades, at a depth of about 30 inches, to very limy, massive loam that impedes the growth of most plant roots.

About 6 percent of the acreage, mostly in the western part of the Area, has slopes of less than 1 percent. Included

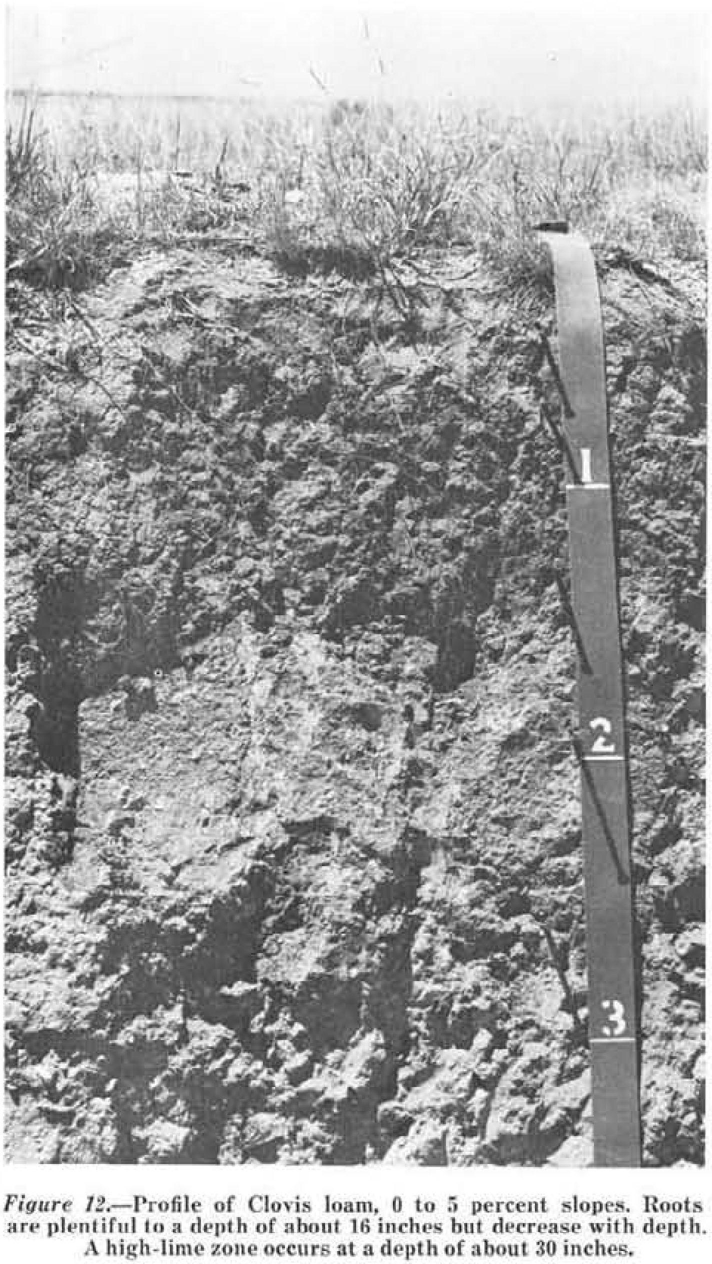

Figure 12.—Profile of Clovis loam, 0 to 5 percent slopes. Roots are plentiful to a depth of about 16 inches but decrease with depth. A high-lime zone occurs at a depth of about 30 inches.

in mapping were small areas of Harvey loam, 0 to 1 percent slopes; Harvey loam, 1 to 9 percent slopes; Witt loam, 0 to 1 percent slopes; and Dean loam, 1 to 9 percent slopes.

This soil is easy to till, but it should be tilled at a time when it is moist enough to form clods, because otherwise, the surface will not be rough enough to resist erosion. This soil will compact readily, however, if it is tilled when too wet. Varying the depth of tillage helps to prevent formation of a plowpan.

This soil absorbs water at a moderate rate and can hold a moderate to high amount of water for plants. Runoff is slow to medium, and internal drainage is medium. Fertility and the organic-matter content are moderate. This soil is subject to severe wind and water erosion when not protected by adequate amounts of plant residue.

Cuts made in leveling should be limited to 10 inches in depth, in order to make sure that tillage will not bring up the underlying limy material.

This soil is used for production of native grasses, for irrigated farming, and for dryfarming. About 98 percent of the acreage is native range. The vegetation consists mainly of blue grama, galleta, sand dropseed, ring muhly, and cactus. Crop failures are common in dryfarmed areas, and many fields have been abandoned. Alfalfa, corn, potatoes, pinto beans, and sugar beets are the principal irrigated crops. Wheat, corn, and pinto beans are the main dryland crops. (Dryland capability unit IVc-3 if in climatic zone 4, and VIc-1 if in climatic zone 5; irrigated capability unit IIe-1 where the slope is 1 percent or less; Loamy range site)

Clovis soils, 0 to 5 percent slopes, eroded (Co).—These soils occur on uplands in the western and eastern parts of the Area. Wind erosion has removed most or all of the original surface layer, and the subsoil of brown clay loam is exposed. Some areas have lost part of the subsoil, and others have received deposits of loamy material. In many places the topography is undulating as a result of erosion and deposition. Where most severely eroded, the soils are limy in the surface layer. In many places the high-lime layer is at a depth of about 20 inches.

About 10 percent of the acreage, mostly in the western part of the Area, has slopes of less than 1 percent. Included in mapping were small areas of Witt clay loam, 0 to 1 percent slopes, eroded; Witt clay loam, 1 to 6 percent slopes, eroded; Harvey loam, 1 to 9 percent slopes; and Dean loam, 1 to 9 percent slopes.

These soils are subject to further erosion unless protected. They should be returned to grass and protected during the growing season until the grass is well established. They crust over readily after heavy rains, and the crust makes runoff rapid and intake slow. The water-storage capacity is moderate to high. Plant roots are confined mostly to the less limy uppermost 20 inches.

Most of this soil has been dryfarmed and then abandoned. Many abandoned fields have been reseeded to native grasses, but stands are difficult to establish, mainly because rainfall is erratic. The soils are used principally for production of native forage. The vegetation consists mostly of weeds, principally Russian-thistle. There are scattered clumps of blue grama, sand dropseed, three-awn, and ring muhly. Blue grama, side-oats grama, and sand dropseed are the grasses most commonly used for reseeding. (Dryland capability unit VIc-1, climatic zones 4 and 5; Loamy range site)

Clovis-Dean loams, 0 to 5 percent slopes (Cp).—This complex occurs on upland piedmont fans in the eastern part of the Area. Clovis loam, the darker colored and less sloping part of the complex, makes up about two-thirds of the acreage. It normally has a surface layer, about 5 inches thick, of friable, brown, granular loam that is leached free of lime. This overlies a subsoil of brown clay loam that is free of lime in the upper part. The subsoil has subangular blocky structure. At a depth of about 30 inches, it grades to a high-lime layer of pink, massive material.

Dean loam, the limy, lighter colored part of the complex, makes up the rest of the acreage. It occurs on low, nearly circular mounds that appear to be areas where rodents burrowed into the soil, reworked it, and brought much of the lime to the surface. This soil normally has a surface layer, about 3 inches thick, of limy, light brownish-gray, friable loam. Below this is about 4 inches of more limy material that has weak subangular blocky structure. At a depth of about 7 inches is a very limy, light-gray layer that is partly cemented and contains many caliche fragments. This layer stops the penetration of plant roots.

Included in mapping were areas of Harvey loam, 1 to 9 percent slopes, that make up less than 10 percent of the acreage, and areas of Tapia-Dean loams, 0 to 5 percent slopes, that make up less than 2 percent.

These soils are subject to severe wind erosion when not protected with sufficient cover. Climatic conditions are not favorable for dryfarming. These soils absorb water readily and have medium internal drainage. Runoff is medium to rapid. Clovis loam has a moderate to high capacity for storing moisture, but Dean loam has a low to moderate capacity. In many places in this complex, plants are less numerous and less vigorous on the Dean soil because that soil is droughty and the surface layer is limy.

This complex is used mostly for production of native grass. Wind erosion can be controlled through control of grazing. The vegetation on the Clovis soil consists mainly of blue grama, galleta, ring muhly, and cactus; and that on the Dean soil of blue grama, sand dropseed, winterfat, and cactus. There are a few juniper trees on both soils. (This complex is in climatic zone 5. The Clovis soil is in dryland capability unit VIc–1; Loamy range site. The Dean soil is in dryland capability unit VIe–2; Limy range site)

Clovis and Scholle soils (1 to 9 percent slopes) (Cs).—This soil association occurs on upland piedmont fans in the eastern part of the Area. The Clovis soils make up 50 to 70 percent of the mapping unit but ordinarily about 60 percent. The Scholle soils make up 15 to 35 percent but ordinarily about 25 percent.

Included in mapping were areas of Chilton soils that make up 5 to 15 percent of the acreage. Also included is about 900 acres of a soil that has a surface layer of gravelly sandy loam, is leached free of lime to a depth of about 30 inches, and absorbs water rapidly. This included soil occurs on gently sloping to strongly sloping piedmont fans in the foothills on the southern slopes of the Manzano Mountains.

The Clovis soils occur mainly on nearly level to moderately sloping piedmont crests, but some of the areas are on the truncated side slopes. These soils have a surface layer, about 5 inches thick, of brown, friable loam that is free of lime. This layer grades to a subsoil of brown clay loam that has subangular blocky structure. A limy zone begins at a depth of about 16 inches; the lime content gradually increases with depth and, at a depth of about 30 inches, is high enough to restrict most plant roots.

Scholle soils are mainly on the piedmont fans. They normally have a surface layer, about 5 inches thick, of brown, granular, gravelly loam that is leached free of lime. This layer has subangular blocky structure. The subsoil, which consists of about 10 inches of gravelly clay loam, is reddish brown and nonlimy in the upper part but light brown and limy in the lower part. It has moderate subangular blocky structure. The substratum is structureless, pinkish-white, very limy, gravelly loam. It is about 30 percent gravel; in the material below the substratum, the content of gravel and of lime decreases with depth.

Chilton soils are mainly on strongly sloping sides of piedmont fans. They normally have a surface layer, about 9 inches thick, of brown or grayish-brown gravelly loam that is friable and limy. The subsoil is very gravelly and very limy and restricts most plant roots.

The soils in this association are subject to moderate or severe wind erosion. They absorb water readily and have a moderate to high capacity to store moisture. Runoff is slow to medium on the gentler slopes but rapid on the stronger slopes. All of the soils have medium internal drainage. The gravelly subsoil of the Scholle and Chilton soils makes those soils droughty in years when rainfall is low. The surface gravel helps to control runoff and erosion.

These soils are unsuitable for cultivation, because they are gravelly and the climate is unfavorable. They are suited to grass, but the composition and density of the vegetation vary from one soil to another. Generally, the vegetation is thickest on the Clovis soils. Plants common to all of the soils are blue grama, sand dropseed, galleta, ring muhly, snakeweed, and cactus. There are a few juniper trees in places. Some of the areas of Scholle and Chilton soils are sources of gravelly material suitable for road construction. (This association is in climatic zone 5. The Clovis soils are in dryland capability unit VIc–1; Loamy range site. The Scholle soils are in dryland capability unit VIs–1; Shallow range site)

Crest stony loam, 5 to 50 percent slopes (Ct).—This soil (fig. 13) occurs near the crest of the Manzano Mountains, on moderately sloping to very steep stairstep slopes, mainly on the eastern slopes.

About 4 inches of decomposing forest litter covers the surface. The surface layer, about 6 inches thick, is friable stony silt loam. It is very dark gray in the upper part and light brownish gray in the lower part. It grades to very stony, reddish-brown clay that has subangular blocky structure. The subsoil is extremely hard. It extends to a depth of about 24 inches, where weakly fractured limestone bedrock begins.

Included in mapping were areas of Rock outcrops and slides that make up about 10 percent of the mapping unit.

Severe erosion results if fire destroys the vegetation. Under native cover, this soil absorbs water readily and has medium to slow internal drainage. Because of the rock content and the shallow root zone, the water-storage capacity is low. Runoff is medium. Stones on the surface limit plant density.

This soil supports a cover of Gambel oak, some ponderosa pine and Douglas-fir, and an understory of maple, snowberries, yarrow, and Carex. It provides a suitable habitat for wildlife and a small amount of forage for

Figure 13.—An area typical of Crest stony loam, 5 to 50 percent slopes. Gambel oak is the main vegetation. The soil in the foreground is of the Wilcoxson series.

livestock. Mature and diseased trees are harvested regularly. (Dryland capability unit VIIe-7, climatic zone 4; timber suitability group 4)

Dean loam, 1 to 9 percent slopes (De).—This soil occurs on crests and side slopes of ridges, mainly in the eastern part of the Area. The surface layer, about 3 inches thick, consists of light brownish-gray loam that has weak crumb structure. This layer grades to about 4 inches of light brownish-gray loam that has weak subangular blocky structure. These layers are limy; they grade to very limy, weakly cemented, light-gray gravelly loam beginning at a depth of about 7 to 23 inches. Below a depth of 23 inches, the soil becomes progressively less limy and there is less cementation.

About 45 percent of this mapping unit consists of Dean soils that have a surface layer of fine sandy loam and absorb water rapidly. Included in mapping were small areas of Harvey loam, 1 to 9 percent slopes; Pastura loam, 1 to 9 percent slopes; and Tapia and Dean soils, eroded.

This soil is subject to severe wind erosion and water erosion if the forage is overgrazed. Plant vigor and plant density are low because the soil is limy and droughty. Stands of grasses deteriorate rapidly if abused. This soil absorbs moisture readily but has a low capacity to store it. Runoff is medium to rapid, depending on the slope. Internal drainage is slow to medium.

This soil is used mainly for production of native grass. In places caliche is excavated for use as road subgrade and as surfacing material for farm-to-market roads. The vegetation consists mainly of blue grama, sand dropseed, black grama, side-oats grama, ring muhly, winterfat, snakeweed, and cactus. Yucca is common in the more sandy areas. (Dryland capability unit VIe-2, climatic zone 5; Limy range site)

Duncan loam, dark variant (0 to 1 percent slopes) (Du).—This soil is moderately to strongly saline and alkali. It occurs on lake terraces near the western margin of the Estancia Lake Basin. The uppermost 2 inches consists of friable, brown loam. This abruptly overlies 4 inches of dark-brown heavy clay loam that has strong subangular blocky structure. This part of the soil is highly organic and is leached nearly free of lime. The subsoil is brown heavy clay loam that has moderate prismatic and blocky structure. It contains some lime and soluble salts and is very strongly alkaline. This layer becomes lighter colored and coarser textured with depth. It rests abruptly on a white, massive, lime-cemented hardpan at a depth of about 20 inches. The hardpan is about 11 inches thick.

Included in mapping were small areas of Harvey loam, alkali, and Willard loam, strongly saline.

This soil crusts over readily after heavy rain and shrinks upon drying. The shrinkage causes formation of cracks as much as 2 inches wide and several feet deep. Surface runoff and internal drainage are slow to very slow. Most grass roots are restricted to the material above the cemented layer. During periods of above-normal rainfall, the water table is at or near the surface. Both the soil and the ground water contain harmful amounts of soluble salts, and consequently, only salt-tolerant plants survive. Occasionally, this soil is inundated for a brief period after heavy rain on the uplands to the west.

This soil is not suited to cultivation. It is used mainly for range. The vegetation consists of alkali sacaton and saltgrass. Some of the areas are nearly barren. (Dryland capability unit VIs-3, climatic zone 5; Salt Flats range site)

Encierro channery loam, 1 to 9 percent slopes (Ec).—This soil occurs on crests and side slopes of ridges in the foothills to the south of the Manzano Mountains. The topography is undulating. The surface layer consists of about 2 inches of dark-brown channery loam that has thin platy and granular structure. This layer grades through about 3 inches of reddish-brown channery loam to the subsoil. The subsoil consists of reddish-brown channery loam over stony light clay that has moderate, subangular blocky structure. It is leached free of lime in many places. This material rests abruptly on fractured sandstone bedrock. Some soil material similar to that of the subsoil extends downward into the fractured rock.

Included in mapping were a few outcrops of sandstone and small areas of Encierro channery loam where the slope is more than 9 percent.

This soil is shallow and droughty. It has low water-storage capacity. It absorbs water at a moderate to rapid rate. Runoff is medium to rapid, and internal drainage is medium. Plant roots are restricted to the soil material above the bedrock. Channery fragments of sandstone on the surface limit plant density but help to retard runoff and control erosion. Water erosion is moderate on the stronger slopes.

This soil is not suited to cultivation. It is used mainly for production of native forage. Some scrub trees are harvested for fenceposts and firewood. The vegetation consists of blue grama, galleta, sand dropseed, snakeweed, cactus, and light to moderate stands of pinyon and juniper. (Dryland capability unit VIs-1, climatic zones 4 and 5; Shallow range site)

Erramouspe stony loam, 30 to 60 percent slopes (Er).—This soil occurs on dry, southern and western slopes of the Gallinas Mountains, in the southern part of the Area. It normally has about 2 inches of decomposing forest litter over a surface layer, about 5 inches thick, of very dark gray, friable, stony loam. The surface layer has moderate crumb structure. The upper part of the subsoil is dark-brown clay loam. The lower is noncalcareous, reddish-brown clay loam. The subsoil has moderate crumb and blocky structure. It rests abruptly on partly weathered felsite bedrock at a depth of about 35 inches.

Under normal conditions runoff is slow to medium and erosion is slight, but erosion is severe if the vegetation is destroyed by fire. Roots, air, and water penetrate the surface layer easily. The capacity to store moisture is moderate, and internal drainage is medium.

The vegetative cover on this soil is suitable for wildlife habitats, and some of the grasses are suitable for grazing. Some scrub trees are harvested for posts and firewood. The vegetation consists mainly of pinyon and juniper; the understory is Gambel oak; and the ground cover is made up of blue grama, side-oats grama, mountain muhly, and Arizona fescue. (Dryland capability unit VIIe-2, climatic zone 4; Mountain Shale range site)

Fortwingate stony loam, 5 to 40 percent slopes (Fo).—This soil occurs on moderately sloping crests and very steep side slopes of ridges in the Gallinas Mountains. The slopes face north and east. About 2 inches of decomposing forest litter covers a surface layer of light-gray, friable stony loam that has weak platy and moderate granular structure. This layer is about 6 inches thick. It grades to a subsoil of reddish-brown, stony heavy clay loam at a depth of about 11 inches. This layer has moderate blocky structure. It is extremely hard and becomes limy at a depth of about 25 inches. At a depth of 30 inches, it rests abruptly on fractured sandstone bedrock. In most places the slope is about 30 percent.

Included in mapping were small areas of Pinata stony loam, 25 to 50 percent north slopes; Pinata stony loam, 20 to 60 percent south slopes; and Pinata-Stroupe stony loams, 20 to 50 percent slopes.

Under normal conditions surface runoff is slow and water erosion is slight, but severe erosion will result if the plant cover is destroyed by fire or heavy logging. Water penetrates readily, but internal drainage is slow. The water-storage capacity is high. The hard, fine-textured subsoil retards root penetration. The surface litter and the rocks help to retard runoff and limit erosion.

This soil has a cover of ponderosa pine and alligator juniper and an understory of gray oak, blue grama, and little bluestem. It is suitable for wildlife habitats and provides some forage for livestock. Mature and diseased trees are harvested regularly. (Dryland capability unit VIIe-6, climatic zone 4; timber suitability group 3)

Fuera cobbly loam, 5 to 20 percent slopes (Fr).—This soil occurs on foothill piedmont fans on east-facing slopes of the Manzano Mountains. It normally has about 2 inches of decomposing forest litter over a surface layer about 11 inches thick. The uppermost 2 inches consists of very dark grayish-brown cobbly loam that has moderate platy and crumb structure; the lower 9 inches is light-gray cobbly fine sandy loam that has granular structure. The surface layer is friable and noncalcareous. It rests abruptly on a subsoil of yellowish-brown blocky clay that grades to pale-brown stony silty clay. The subsoil is noncalcareous and very hard and is mottled with olive brown in the lower part. It is about 37 inches thick. The substratum is massive, pale-brown heavy clay loam. Weathered schist bedrock begins at a depth of about 60 inches.

In some places this soil developed in thin piedmont fan deposits over interbedded sandstone and shale of the Permian red beds. In many of these areas the subsoil is more reddish than is typical and also more alkaline.

Under the present plant cover, runoff is slow and water erosion is slight, but severe water erosion will result if the vegetation is burned or destroyed by excessive logging.

This soil absorbs water readily, but downward movement is somewhat restricted because the subsoil is slowly or very slowly permeable. It has a high capacity to store moisture for plants. The surface rocks and litter help to retard runoff and limit erosion.

This soil is used mainly for production of commercial timber and for wildlife habitats. There is very little forage for livestock. Mature and diseased trees are harvested regularly. The vegetation consists mostly of ponderosa pine and white fir with an understory of oak and a ground cover of mountain grasses. (Dryland capability unit VIIe-6, climatic zone 4; timber suitability group 3)

Fuera cobbly loam, 20 to 60 percent slopes (Fu).—This soil occurs on side slopes of piedmont fans on the eastern slopes of the Manzano Mountains. It is normally shallower and more stony than the adjacent Fuera soil on the crests. In many places the layer of decomposing forest litter is very thin or lacking. The surface layer is about 9 inches thick; it is very dark grayish brown in the upper part and light gray below. This layer is very cobbly loam that has moderate crumb and granular structure and has been leached free of lime. The subsoil is very hard, yellowish-brown clay in the upper part and stony silty clay mottled with gray and olive brown in the lower part. The subsoil is about 2 feet thick and grades to a very stony, pale-brown substratum. Weathered schist begins at a depth of about 4 feet.

Included in mapping were small areas of Jekley silty clay loam, 20 to 40 percent slopes; Steep rock land; and a few outcrops of Permian red beds.

This soil contains more rock than Fuera cobbly loam, 5 to 20 percent slopes. It is more droughty than that soil, and plants are established with greater difficulty. Runoff is medium, and water erosion is moderate. Severe erosion will result if the vegetation is destroyed by fire or if the plant cover is destroyed by heavy logging.

This soil absorbs water readily, but the fine-textured subsoil is slowly to very slowly permeable. It has a moderate capacity to store moisture. The surface rocks and the forest litter help to retard runoff and limit erosion.

The vegetation is mainly ponderosa pine but includes some alligator juniper and oak. Mature and diseased trees are harvested. Wildlife browse the understory. (Dryland capability unit VIIe-7, climatic zone 4; timber suitability group 4)

Hagerman fine sandy loam, 1 to 5 percent slopes (Ha).—This soil occurs on upland piedmont fans and ridgetops in the eastern part of the Area. It is about 30 inches deep over sandstone bedrock. The surface layer is brown, friable, noncalcareous fine sandy loam that has weak platy and moderate granular structure. It is about 3 inches thick. It grades at a depth of about 3 inches to a subsoil of reddish-brown sandy clay loam. The subsoil has moderate prismatic and moderate to strong subangular blocky structure. It is less permeable than the surface layer and has been leached free of lime in the upper part. A layer of limy, light-brown sandy clay loam, about 3 inches thick, is just above the bedrock.

Included in mapping were small areas of Bernal-Slickspot complex; Bernal-Travessilla fine sandy loams; Penistaja fine sandy loam, 1 to 6 percent slopes; and some outcrops of sandstone.

The surface layer of this soil is easily penetrated by roots, air, and water. Roots are restricted to the surface layer and the subsoil. The water-storage capacity is moderate. Surface runoff and internal drainage are medium. Water erosion is moderate and wind erosion severe if the plant cover is depleted by overgrazing.

This soil is not suitable for cultivation, because the climate is unfavorable. It is used mainly for production of native grass. The vegetation consists of blue grama, galleta, sand dropseed, snakeweed, cactus, and thin stands of pinyon and juniper. Some scrub trees are harvested for fenceposts and firewood. (Dryland capability unit VIs-4, climatic zone 5; Loamy range site)

Hagerman-Dean complex, 1 to 5 percent slopes (Hd).—This complex occurs on crests and side slopes of upland ridges in the eastern part of the Area. Hagerman soils, which are deeper, darker colored, and less sloping than Dean soils, make up about 55 to 65 percent of the acreage. They are normally about 30 inches deep over sandstone bedrock. They have about 3 inches of friable, brown fine sandy loam overlying about 24 inches of reddish-brown sandy clay loam that is limy in the lower part. The sandy clay loam has prismatic and subangular blocky structure. Below this is about 3 inches of limy, light-brown sandy clay loam, just above the bedrock.

Dean soils, the lighter colored part of the complex, make up about 20 to 30 percent of the acreage. They have concentrations of caliche fragments on the surface. Normally, they have a surface layer, about 7 inches thick, of light-brown, friable loam over a weakly cemented layer that has a high content of lime and becomes more friable with depth.

Bernal soils make up about 10 to 20 percent of this complex. They are on narrow ridge crests. They normally have a surface layer, about 3 inches thick, of brown, granular fine sandy loam, and a subsoil, about 9 inches thick, of reddish-brown sandy clay loam that has subangular blocky structure. Sandstone bedrock is at a depth of about 12 inches.

Small areas of Bernal-Slickspot complex were included in mapping. These soils are easily penetrated by roots, air, and water, but most plant roots are confined to the more permeable upper layers. Internal drainage is medium. Runoff is slow to medium on Hagerman and Bernal soils and medium to rapid on Dean soils. Severe wind erosion will result if the protective grasses are overgrazed. Dean soils are normally more easily eroded than Hagerman or Bernal soils. Dean and Bernal soils are more droughty than Hagerman soils because they are shallower.

This complex is used mainly for production of native grass. Hagerman soils are the most productive part of the complex, and Dean soils the least. Plants common to all of the soils are blue grama, sand dropseed, ring muhly, galleta, cactus, yucca, snakeweed, and juniper. Black grama and snakeweed are more common on Dean soils than on other parts of the complex. (Dryland capability unit VIs-4, climatic zone 5. The Hagerman soil is in Loamy range site; the Dean soil is in Limy range site)

Harvey loam, 0 to 1 percent slopes (He).—This limy soil occurs on upland alluvial piedmont fans in the western part of the Area and on lake terraces near the western margin of the Estancia Lake Basin.

This soil is slightly darker colored than is typical of Harvey soils. Also, it has accumulations of soluble salts in the substratum. The surface layer is brown, friable, calcareous loam about 10 inches thick. It has weak granular structure. This layer grades at a depth of about 14 inches to very limy, pink heavy loam. This material is massive. It extends to a depth of several feet and is less limy below a depth of 24 inches. Soluble salts occur below a depth of 3 feet.

Included in mapping were small areas of Dean loam, 1 to 9 percent slopes; Harvey loam, 1 to 9 percent slopes; and Harvey loam, alkali.

This soil is easy to till. It is easily eroded by wind and should be tilled by methods that leave crop residue on the surface. An adequate plant cover is essential to control blowing. Roots, air, and water penetrate easily, but plant roots are confined mostly to the less limy upper layers.

The water-storage capacity is moderate to high. Runoff is slow to medium, and internal drainage is medium. On the lake terraces, the water table is sometimes within 5 feet of the surface, especially during wet periods. Soluble salts are present in small amounts in some areas. The natural fertility is low, and fertilizer is needed in order to get maximum crop yields.

This soil is used mainly for production of native grass. It is not suitable for dryland farming, but about 600 acres is under irrigation. Corn, pinto beans, and alfalfa are the main irrigated crops. The native vegetation consists of blue grama, galleta, sand dropseed, winterfat, and cactus. (Dryland capability unit VIe-2, climatic zones 4 and 5; irrigated capability unit IIIe-6; Limy range site)

Harvey loam, 1 to 9 percent slopes (Hf).—This is the most extensive soil in the Torrance Area. It occurs on upland crests and side slopes of piedmont fans throughout the Area.

This soil is typical of the Harvey series. It has a surface layer, about 11 inches thick, of friable, calcareous loam that has moderate granular structure in the upper part and weak subangular blocky structure in the lower part. This layer grades to pink, very limy loam that begins at a depth of about 16 inches. The pink loam is massive or has weak subangular blocky structure. The lime content decreases slightly below a depth of 31 inches.

In about 9 percent of the acreage, the surface layer is fine sandy loam. Most of this coarser textured soil is in the eastern part of the Area, but there is a small acreage about 3 miles east of the town of Mountainair. Included in mapping were areas of Harvey loam, 0 to 1 percent slopes; Dean loam, 1 to 9 percent slopes; Witt loam, 1 to 6 percent slopes; Ildefonso fine sandy loam, 0 to 5 percent slopes; and areas of Otero and Palma soils.

This soil is low in fertility and in organic-matter content. It is easily eroded by wind or water, and erosion is severe if the soil is clean tilled or if plant residues are grazed too closely. It absorbs water readily and has a moderate to high capacity to store moisture for plants. Soil-conserving practices, such as emergency tillage, contour tillage, or deferred grazing, help to limit erosion. Runoff is medium on gently sloping areas and rapid on strongly sloping areas; internal drainage is medium. Plant roots are confined mostly to the less limy upper layers.

About 1,100 acres of this soil is irrigated. Most of the irrigated acreage has slopes of 1 to 5 percent. In many places the irrigated acreage adjoins other irrigated soils and is managed in the same way as these adjoining soils. This soil is used mainly for production of native grass. The vegetation consists of blue grama, galleta, sand dropseed, winterfat, cactus, and scattered pinyon and juniper. Yucca is common on the sandier areas. (Dryland capability unit VIe–2, climatic zones 4 and 5; irrigated capability unit IVe–1 where the slope is 1 to 3 percent; Limy range site)

Harvey loam, alkali (0 to 1 percent slopes) (Hg).—This soil occurs on lake terraces along the western margin of the Estancia Lake Basin. It is less limy and redder in the substratum than the typical Harvey soil.

The surface layer normally consists of brown, granular loam or fine sandy loam, about 5 inches thick, that grades to about 8 inches of light-brown, calcareous loam that has weak subangular blocky structure. At a depth of about 13 inches the soil is pink to light reddish-brown light clay loam that has weak subangular blocky structure. The soil material has a high content of lime and soluble salts and is strongly to very strongly alkaline. In places the surface layer contains soluble salts and the subsoil is finer textured and less limy.

Included in mapping were small areas of Harvey loam, 0 to 1 percent slopes, and Duncan loam, dark variant.

This soil is moderately to strongly alkaline and slightly to moderately saline. In many places it has a finer textured subsoil and substratum than is typical of Harvey soils. During periods of above-normal rainfall, the water table is commonly within 5 feet of the surface. In places the upper layers contain soluble salts. In many places tillage is difficult.

This soil is subject to severe wind erosion if the crop residue is plowed under. It absorbs water at a slow to moderate rate. The subsoil is medium textured or moderately fine textured and is slowly to moderately permeable. It can store a large amount of water, but at times the water is too saline for plants to use. Runoff is medium.

Heavy applications of barnyard manure, along with applications of commercial fertilizer and a good crop rotation, help to increase fertility and productivity. A heavy application of water once each year helps to keep the salts leached below the reach of most crop roots.

This soil is used mainly for production of native forage. About 1,700 acres is irrigated. Salt-tolerant crops, such as alfalfa, barley, sugar beets, corn, and irrigated pasture, are suitable. Alkali sacaton and some blue grama, sand dropseed, sand sage, and yucca are the main range plants. (Dryland capability unit VIs–3, climatic zone 5; irrigated capability unit IIIs–4; Salt Flats range site)

Harvey-Dean loams, 1 to 9 percent slopes (Hh).—These soils are on crests and side slopes of upland piedmont fans throughout the Area. In some places they were mapped as a complex, and in others as an association. The Harvey loam makes up about 55 to 75 percent of the acreage, and the Dean loam 25 to 45 percent.

Where the two soils were mapped as an association, the Harvey loam is the darker colored, more sloping part of the landscape. Where they were mapped as a complex, it is the darker colored, more nearly level part. Typically, it has a surface layer of light-brown, calcareous loam, about 11 inches thick, that has granular structure in the upper part and subangular blocky structure breaking to granular in the lower part. This layer grades to pink, very limy loam beginning at a depth of about 16 inches and continuing to a depth of about 31 inches, where the lime content begins to decrease.

Where the two soils were mapped as an association, the Dean loam occurs on convex ridge crests. Where they were mapped as a complex, it occurs on low, convex, moundlike knolls. Typically, it has a surface layer of calcareous, light brownish-gray loam, about 7 inches thick, over a very limy, light-gray, weakly cemented layer, about 16 inches thick, that becomes less cemented with depth.

About 11 percent of this mapping unit consists of Harvey and Dean soils that have a surface layer of fine sandy loam. About 5 percent consists of Harvey and Dean soils, eroded. Pastura loam, 1 to 9 percent slopes, makes up less than 2 percent, as do areas of Prewitt and Manzano soils.

These soils are limy and friable. They are easily eroded and need to be protected with plant residue at all times. Wind erosion is normally more serious than water erosion. Surface runoff is rapid to medium, depending on the slope. Internal drainage is medium. Dean loam has less capacity to store moisture than Harvey loam. Both soils are readily penetrated by roots, air, and water, but most roots are confined to the less limy upper layers.

These soils are used mainly for production of native grass. The native vegetation on Harvey loam consists of blue grama, sand dropseed, galleta, winterfat, and cactus. That on the Dean soil consists of blue grama, black grama, sand dropseed, three-awn, ring muhly, winterfat, and cactus. Ordinarily, the vegetation is more vigorous and more dense on Harvey loam than on Dean loam. Deferred grazing and proper stocking help to keep enough plant residue on the surface to control erosion. Some areas of Dean loam yield caliche suitable for roadbuilding material. (Dryland capability unit VIe–2, climatic zones 4 and 5; Limy range site)

Harvey and Dean soils, eroded (1 to 9 percent slopes) (Hm).—This undifferentiated unit occurs mostly in the western part of the Area, on piedmont fans and truncated side slopes. Harvey soils make up about 50 to 65 percent of the acreage, and Dean soils 35 to 50 percent.

Harvey soils occur as the darker colored, less limy areas where windblown topsoil has accumulated. The surface layer is normally about 10 inches of light-brown, friable loam or fine sandy loam. Below this is about 4 inches of pale-brown, limy loam or fine sandy loam over a substratum of very limy, pink or very pale brown loam.

Dean soils occur as the lighter colored, more limy areas from which erosion has removed most or all of the surface layer. Normally, Dean soils have a surface layer of pale-brown, limy, friable loam or fine sandy loam, about 2 inches thick, over a layer of white or very pale brown, very limy, massive caliche that is weakly cemented in places. Caliche pebbles are common on the surface.

Included in mapping were areas of Harvey-Dean loams, 1 to 9 percent slopes, and Pastura loam, 1 to 9 percent slopes, each of which makes up about 1 percent of the mapping unit.

These soils have been dryfarmed in the past and then abandoned because of lack of rainfall. Soil loss has been serious because plant cover was hard to establish during dry years. Wind erosion has been more severe than water erosion. The surface is smooth in some places but irregular in others because the soil has been blown out of some fields and heaped up in others.

These soils have lost most of their inherent fertility and are hard to manage. Their limy surface layer and their erodibility make establishing protective plant cover difficult. They are less easily penetrated by roots, air, and water than uneroded Harvey and Dean soils. Surface runoff is medium to rapid, and internal drainage is medium. The water-storage capacity of Dean soils is low, and that of Harvey soils is moderate.

These soils are no longer suited to dryfarming, and their main use now is the production of native grass. They need to be fenced and protected from overgrazing until plant cover is sufficiently well established to control erosion. Many areas have been reseeded to suitable native grasses, such as blue grama, side-oats grama, and sand dropseed. (Dryland capability unit VIe–2, climatic zones 4 and 5; Limy range site)

Hassell loam, 2 to 5 percent slopes (Hs).—This soil occurs on tops and side slopes of piedmont fans in the foothills on the southern slopes of the Manzano Mountains. The surface layer is dark-brown, weakly calcareous, friable loam that has weak platy and moderate granular structure. It is about 3 inches thick and grades to a subsoil of reddish-brown heavy clay loam of moderate subangular blocky structure. A layer of very limy, pink, massive loam begins at a depth of about 16 inches and extends to a depth of about 28 inches, where a less limy and redder substratum begins. Partly weathered red shale occurs at a depth of about 38 inches.

Included in mapping were small areas of Encierro channery loam, 1 to 9 percent slopes.

The hazard of wind erosion is slight to moderate. Runoff is medium. The surface layer absorbs moisture at a moderate rate, and the subsoil is moderately permeable. The water-storage capacity is moderate. Roots are confined mostly to the surface layer and the subsoil. Fertility is moderate. The response to management is good.

This soil is not suited to cultivation, because the climate is unfavorable. It can be used for production of native grass. A few small fields were formerly cultivated, but they have been returned to grass. The vegetation consists of blue grama, galleta, ring muhly, and a few junipers. (Dryland capability unit VIs–2, climatic zones 4 and 5; Loamy range site)

Ignacio fine sandy loam, 1 to 5 percent slopes (Ig).—This soil occurs on slightly undulating uplands in the eastern part of the survey Area. The surface layer consists of about 4 inches of brown, friable, nonlimy fine sandy loam. This layer overlies about 10 inches of brown fine sandy loam, of weak prismatic and weak subangular blocky structure, that has been leached free of lime. Below this is brown, limy, massive fine sandy loam that rests abruptly on sandstone bedrock at a depth of about 25 inches.

Included in mapping were small areas that are less than 20 inches deep over bedrock and areas where the bedrock is exposed.

Roots, air, and water penetrate this soil easily. Surface runoff is slow, and internal drainage is medium to rapid. The water-storage capacity is low to moderate. Most roots are restricted to the upper layers. The hazard of wind erosion is severe. Proper use of range and deferment of grazing help to limit erosion.

This soil is used for production of native grass. The vegetation consists of sand dropseed, blue grama, yucca, snakeweed, Apache-plume, and scattered juniper. (Dryland capability unit VIe–1, climatic zone 5; Sandy range site)

Ildefonso fine sandy loam, 0 to 2 percent slopes (Ih).—This soil occurs on lake terraces, mainly between shoreline ridges in the western part of the Estancia Lake Basin. The surface layer is brown, limy fine sandy loam about 5 inches thick. It has weak granular structure. This is underlain by 5 inches of pale-brown fine sandy loam of weak subangular blocky structure. The upper part of the substratum is pale-brown gravelly fine sandy loam of weak subangular blocky structure, and the lower part is very pale brown and massive. The content of lime and the content of gravel are high and increase with depth.

Included in mapping were small concave areas that receive runoff from higher lying soils. In many places these included areas have a moderately fine textured subsoil. Lacustrine sediments occur below a depth of 30 inches in many places. Also included were small areas of Ildefonso fine sandy loam, 0 to 5 percent slopes, and Harvey loam, 0 to 1 percent slopes.

This soil is readily eroded by wind. It is easily compacted when moist. The surface layer is easily tilled and readily penetrated by roots, air, and water. Fertility is low to moderate, and the organic-matter content is low to moderate. Runoff is slow, and internal drainage is medium. The water-storage capacity is low to moderate. Most plant roots are confined to the less gravelly and less limy upper layers. High-residue crops help to keep wind erosion in check.

This soil is used for production of native grass and for irrigated farming. Alfalfa, corn, and small grains are the principal irrigated crops. The native vegetation consists of blue grama, sand dropseed, ring muhly, winterfat, snakeweed, and cactus. Some areas are sources of gravel suitable for roadbuilding material. (Dryland capability unit VIe–2, climatic zones 4 and 5; irrigated capability unit IIIe–6; Limy range site)

Ildefonso fine sandy loam, 0 to 5 percent slopes (Ik).—This soil occurs on shoreline terraces in the lake basins of the eastern part of the survey Area and on shoreline ridges along the western margin of the Estancia Lake Basin. The surface layer, about 10 inches thick, is friable, limy fine sandy loam that is brown in the upper part and pale brown in the lower part. It has weak subangular blocky and weak granular structure. The subsoil is gravelly, very limy, very pale brown, massive material about 10 inches thick. The substratum is very gravelly and less limy than the subsoil.

Included in mapping were small areas on short slopes of more than 5 percent. In places lacustrine sediments occur below a depth of 30 inches. In some areas the high-lime layer is lacking and nearly clean beds of sand and gravel are within 40 inches of the surface. Also included in mapping were small areas of Harvey loam, 1 to 9 percent slopes.

This soil is subject to severe wind and water erosion if the protective plant cover is removed. It takes in moisture at a moderate rate, and its water-storage capacity is low. Runoff ranges from slow to rapid, depending on the slope; internal drainage is medium. Fertility is low, and the organic-matter content is low. Most plant roots are confined to the less limy upper layers. Leveling is apt to expose the limy and gravelly substratum, but crops can still be grown if heavy applications of manure and fertilizer are made.

Most of this soil is used for production of native grass. Some areas in the western part of the Area are irrigated. Alfalfa and corn are the main irrigated crops. Many areas are sources of gravel and sand suitable for mortar and concrete work and for road surfacing and subgrade material. The native vegetation consists of blue grama, sand dropseed, ring muhly, winterfat, snakeweed, and cactus. (Dryland capability unit VIe–2, climatic zone 5; irrigated capability unit IIIe–6 where the slope is 2 percent or less, and IVe–1 where the slope is 2 to 5 percent; Limy range site)

Ildefonso loamy fine sand, 0 to 5 percent slopes (Im).—This soil occurs on shoreline terraces, mainly along the eastern and southern margins of the Estancia Lake Basin. It is coarser textured than typical Ildefonso soils, and in many places has a less limy and darker colored surface layer.

This soil has a brown, friable surface layer of loamy fine sand, about 8 inches thick, that has been partly reworked by wind. The subsoil is pale-brown gravelly light fine sandy loam that has weak subangular blocky structure. This layer contains some lime but less than the layer below. It grades at a depth of about 20 inches to very pale brown, very limy gravelly fine sandy loam. The lime content normally decreases gradually below a depth of 30 inches.

Included in mapping were small areas of Otero and Palma soils and small areas of Ildefonso fine sandy loam, 0 to 5 percent slopes.

This soil is subject to severe wind erosion when not protected by plant cover. It absorbs water rapidly and has a low capacity to store moisture. It is generally more gravelly, and consequently more droughty, in areas on terrace ridges. Runoff is slow, and internal drainage is rapid. Fertility is low, and the organic-matter content is low.

This soil is used for production of native grass. Some areas are sources of gravel and sand suitable for mortar and concrete work and also for road surfacing and subgrade material. The native vegetation consists of sand dropseed, blue grama, three-awn, yucca, snakeweed, and a few juniper trees. (Dryland capability unit VIe–1, climatic zone 5; Sandy range site)

Ildefonso stony sandy loam, 10 to 30 percent slopes (Is).—This is a shallow soil that occurs on upland piedmont fans on western foot slopes of the Manzano Mountains. It is coarser textured than is typical of Ildefonso soils, and it has a strongly cemented lime layer.

The surface layer is friable, brown stony sandy loam, about 6 inches thick, that has weak platy and weak granular structure. This layer contains some lime. Below it is about 7 inches of brown gravelly loam that has weak subangular blocky structure. The gravelly loam contains some lime. It rests abruptly on very limy, very pale brown very gravelly sandy loam that is strongly cemented with lime in the uppermost few inches. Below a depth of about 29 inches, the soil is less limy and more gravelly.

This soil is dissected by many small arroyos that have nearly vertical side slopes. These arroyos contain numerous deposits of stones, cobblestones, gravel, and sand.

Included in mapping were small areas of La Fonda loam, gravelly substratum, 2 to 8 percent slopes.

This soil has a low capacity to store moisture because it is shallow and coarse textured. It absorbs water rapidly but loses much moisture through evaporation. It is subject to severe water erosion caused by runoff from higher lying soils. Runoff is slow to moderate, and internal drainage is medium.

This soil is used mainly for production of native forage. In some areas the arroyo bottoms contain deposits of sand, gravel, and stones suitable for use in construction work. The native vegetation consists of blue grama, ring muhly, cactus, yucca, rabbitbrush, scrub oak, and a few juniper trees. (Dryland capability unit VIIs–3, climatic zones 4 and 5; Hills range site)

Jekley silty clay loam, 20 to 40 percent slopes (Je).—This is a red-bed soil on the sides of canyons in the southeastern part of the Manzano Mountains. A thin layer of decomposing forest litter, about an inch thick, covers the surface. The upper part of the surface layer is dusky-red, friable, granular silty clay loam about 5 inches thick. The lower part is weak-red silty clay loam, 6 inches thick, that has moderate subangular blocky structure. Both parts are free of lime. Below this is a subsoil of dark reddish-brown silty clay loam to weak-red silty clay that has moderate subangular blocky structure. It contains a few sandstone fragments and is free of lime. Partly weathered red-bed shale occurs in the substratum at a depth of about 46 inches.

The slope is most commonly about 25 percent. In places the surface layer and subsoil are stony. Sandstone and shale crop out in some places.

This soil is easily penetrated by roots, air, and water. The fine-textured subsoil does not restrict roots. The water-storage capacity is high. Internal drainage is slow. At present, surface runoff is slow to medium, but it would be rapid without adequate plant cover. This soil is subject to severe water erosion if the natural vegetation is destroyed by fire or if the areas are excessively logged.

This soil supports a mixed stand of ponderosa pine, Douglas-fir, and white fir and an understory of mulberry, yucca, and cool-season grasses. The principal uses are wildlife habitats and production of timber. The understory provides some grazing for livestock. Mature and diseased trees are harvested. (Dryland capability unit VIIe–5, climatic zone 4; timber suitability group 2)

Karde loam, saline (3 to 25 percent slopes) (Ka).—This soil is moderately to strongly saline. It occurs on hills or on dunes on the leeward sides of playa lakes (fig. 14) in the Estancia, Encino, and Pinos Wells Lake Basins.

This soil normally has a slightly darkened surface layer as a result of small accumulations of organic matter; otherwise, it is fairly uniform throughout the profile. The

Figure 14.—**A playa lake. Salts have accumulated on the barren floor. Karde loam, saline, occurs on the hills at the far side.**

surface layer is light-gray loam that is limy and slightly saline; it has weak granular structure. Below this is pale-yellow silt loam that has weak blocky structure to a depth of about 24 inches but is massive below this depth. This material is very limy and contains visible soluble salts.

Included in mapping were many small intermittent playa lakes, which have little or no agricultural value, and small areas of Karde-Willard loams, saline.

Salinity limits the kinds and amounts of plants that can be grown. Fertility is very low. The organic-matter content is very low, and consequently the soil crusts readily and tends to shed water. The water-holding capacity is moderate. Roots seldom penetrate below a depth of about 30 inches, because of the salt content. Surface runoff is medium to rapid, depending on the slope. Internal drainage is medium. Rill and gully erosion is moderate to severe on the stronger western slopes and slight to moderate on the eastern slopes. Wind erosion is severe on the western slopes and slight on the eastern slopes. The western slopes are generally more droughty than the eastern slopes because they are steeper and face the prevailing winds; consequently, the vegetation is normally less vigorous and less dense on western slopes than on eastern slopes.

This soil is used for production of native forage. It supports sparse stands of alkali sacaton, blue grama, chamiza, and wolfberry. (Dryland capability unit VIIs-4, climatic zone 5; Salt Flats range site)

Karde-Willard loams, saline (0 to 9 percent slopes) (Kd).—This complex occurs in lake basins, mainly on the leeward side of playas. The surface is hummocky. Each of the two major soils makes up 45 to 55 percent of any given area of the complex, but Karde loam is dominant in most areas.

Karde loam occurs on low convex dunes. It normally has a surface layer, about 5 inches thick, of light-gray, granular loam. Below this layer, and extending to a depth of several feet, is friable, pale-yellow silt loam that contains substantial amounts of soluble salts. This soil is moderately alkaline and moderately to strongly saline.

Willard loam occurs in the nearly level to slightly concave areas between dunes. It receives runoff from the dunes. This soil has a surface layer of grayish-brown loam, about 5 inches thick, that has weak platy and moderate granular structure and is slightly saline. The subsoil is dark grayish-brown to very dark grayish-brown light clay loam that becomes lighter colored and more limy with depth. It has weak blocky structure and is moderately to strongly alkaline and moderately to strongly saline. This layer grades to pale-olive or pale-yellow, limy, massive, stratified lacustrine sediments at a depth of about 20 inches. These sediments have a texture of loam or clay loam and are strongly alkaline and moderately to strongly saline.

In some areas of the Willard loam near the playas, the water table is within 5 feet of the surface. Soluble salts are on the surface in places. This soil is permeable to roots, air, and water. It has a moderate to high capacity to store moisture, but the high salt content limits the capacity of some plants to absorb moisture.

The Karde loam tends to crust over more readily than the more permeable Willard loam, and it sheds water down onto that soil. Runoff is medium to rapid on the Karde loam and slow to very slow on the Willard loam. The Karde loam is subject to severe wind erosion and slight to moderate water erosion.

These soils are used principally for range. The vegetation is limited to salt-tolerant species, such as alkali sacaton, chamiza, blue grama, and wolfberry. The Willard loam produces two to three times as much forage as the Karde loam, mainly because it receives additional moisture from runoff and from ground water. (This complex is in the climatic zone 5. The Karde soil is in dryland capability unit VIIs-4; the Willard soil is in dryland capability unit VIs-3. Both soils are in Salt Flats range site)

Kech gravelly loam, 1 to 9 percent slopes (Kg).—This soil occurs on crests and side slopes of ridges in the Pedernal Hills, in the eastern part of the survey Area. The surface layer, about 4 inches thick, is pale-brown, friable gravelly loam that has been leached free of lime. It has moderate granular structure. The subsoil is clay loam that has weak prismatic and moderate subangular blocky structure. It is brown and nonlimy in the upper part and light brown and limy in the lower part. It is about 12 inches thick and grades at a depth of about 16 inches to partly weathered acid gneiss.

In some places the surface layer is stony. There are a few outcrops of igneous rock. Included in mapping were small areas of Rock land.

This soil is shallow and gravelly and, consequently, droughty. It absorbs water readily and has low capacity to store moisture. Surface runoff is medium to rapid, and internal drainage above the rock is medium. The hazard of wind and water erosion is slight. Surface gravel tends to limit the density of the plant cover.

This soil is not suited to cultivation. It is used for production of native forage. Livestock and wildlife, mainly sheep and antelope, often graze the forage too heavily. Where feasible, this soil should be fenced off and managed separately in order to control grazing. The native vegetation consists of blue grama, black grama, galleta, sideoats grama, ring muhly, snakeweed, and cactus. (Dryland capability unit VIs-1, climatic zone 5; Shallow range site)

Kim-Otero-Pastura complex (1 to 9 percent slopes) (Ko).—This complex occurs on nearly level to rolling topography in the southeastern part of the survey Area. The Kim and Otero soils each make up about 30 to 40 percent of the acreage. Kim soils are dominant in many areas, and Otero soils in some. The Pastura soils are less extensive. They make up about 25 to 35 percent of the acreage. Included in mapping were areas of Prewitt and Manzano soils in narrow swales.

The Kim soils occur mainly on side slopes of hills and ridges. They normally have a surface layer of grayish-brown, limy loam about 11 inches thick. This layer has moderate granular structure and shows evidence of being reworked by worms. The subsoil is pale-brown, limy loam that has moderate granular structure. It is about 5 inches thick and grades to a substratum of light yellowish-brown, very limy loam. This layer has weak subangular blocky structure; it is easily penetrated by roots, air, and water. Limestone or caliche bedrock is below a depth of 40 inches in places.

Otero soils occur on the foot slopes of ridges and in concave areas between hills and ridges. Some of the areas have been reworked by wind, and the relief is slightly hummocky in many places. The surface layer is normally light-brown fine sandy loam about 17 inches thick. It is friable and limy and has weak subangular blocky and moderate granular structure. The subsoil is light-brown fine sandy loam, about 11 inches thick, that contains more lime than the surface layer. This layer is structureless. It grades to a substratum of very pale brown, structureless, very limy fine sandy loam. The substratum does not restrict plant roots. In places Otero soils have been leached free of lime to a depth of about 10 inches.

Pastura soils normally occur on gently sloping ridges or hilltops. They consist of friable, brown to pale-brown, limy loam, about 10 inches thick, over pinkish-white indurated caliche. Caliche pebbles are common on the surface. Plant roots are restricted to the surface layer.

Kim soils are easily penetrated by roots, air, and water. They have a high capacity to store moisture for plants. They are subject to severe wind erosion if the plant cover is removed. Surface runoff is medium to rapid, and internal drainage is medium. Fertility is moderate, and the organic-matter content is moderate.

Otero soils take in water rapidly, but their capacity to store moisture is low to moderate. They are easily eroded by wind. Surface runoff is slow, and internal drainage is medium to rapid. Fertility is low.

Pastura soils are shallow. They absorb water readily but have a low capacity to store moisture. Surface runoff is medium to rapid, and internal drainage is medium above the caliche. Plant roots are confined mostly to the surface layer. The plant density is sparse because the soil is droughty and because of the surface gravel. Plant density can be increased by deferred grazing and proper use.

These soils are not suited to cultivation. They are used for production of native forage. Blue grama, side-oats grama, black grama, snakeweed, and cactus are common on Kim and Pastura soils. Sand dropseed, blue grama, galleta, yucca, cactus, and juniper are the most common vegetation on Otero soils. Otero soils are the most productive, and Pastura soils are the least productive. Control of grazing reduces the hazard of erosion. (All of the soils are in climatic zone 5. The Kim soil is in dryland capability unit VIc–1; Loamy range site. The Otero soil is in dryland capability unit VIe–1; Sandy range site. The Pastura soil is in dryland capability unit VIIs–1; Shallow range site)

Kim-Pastura-Tapia loams (1 to 9 percent slopes) ((Kp).—This soil association occurs on rolling topography in the northeastern and southeastern parts of the survey Area. Kim and Pastura loam each make up about 35 to 45 percent of the acreage; Kim loam is normally dominant. Tapia loam is less extensive; it makes up about 15 to 25 percent of the acreage. Included in mapping were areas of Prewitt and Manzano soils in narrow drainageways and small potlakes. Also included were small areas of Bernal-Slickspot complex.

Kim loam occurs on moderately to strongly sloping side slopes of ridges and hills. In most places it has a surface layer, about 11 inches thick, of grayish-brown, friable limy loam that has been reworked by earthworms. This layer has moderate granular structure. The subsoil is pale-brown, friable loam that is more limy than the surface layer. It has moderate granular structure and is about 5 inches thick. It grades to a substratum of light yellowish-brown, very limy loam that has weak subangular blocky structure. This layer is readily penetrated by roots, air, and water.

Pastura loam is shallow. It occurs on gently sloping to moderately sloping hilltops. It normally consists of friable, light brownish-gray to pale-brown, limy loam, about 10 inches thick, overlying a thick bed of indurated caliche. Small caliche pebbles are common on the surface.

Tapia loam occurs as gently sloping areas between ridges and hills. It has a surface layer, about 3 inches thick, of brown, friable loam that has been leached free of lime. It has moderate granular structure. This layer grades to a subsoil of light-brown clay loam that has been leached free of lime in the upper part. The subsoil has weak prismatic and moderate subangular blocky structure. It is about 18 inches thick. The substratum is massive, white, partly cemented caliche that restricts most plant roots.

The Kim loam absorbs moisture readily, and its capacity to store moisture is high. It is easily eroded by wind when not protected by plant cover. Surface runoff is medium to rapid, and internal drainage is medium. Fertility is moderate to low.

The Pastura loam is shallow and droughty. Most roots are confined to the surface layer. It takes in water readily but has a low water-holding capacity. Surface runoff is medium to rapid, and internal drainage above the caliche is medium. Surface gravel and droughtiness limit plant density in many places.

The Tapia loam is subject to moderate wind erosion and water erosion if the plant cover is overgrazed or is destroyed by fire. It has a moderate capacity to store moisture for plants. Surface runoff is slow to medium, and internal drainage is medium. Fertility is moderate, and the organic-matter content is moderate. Roots, air, and water penetrate easily, but most roots are confined to the upper layers.

This association is not suited to cultivation. Native range is the principal use. Of the major soils in the association, Tapia loam is the most productive of native grasses, and Pastura loam the least. Blue grama, black grama, side-oats grama, three-awn, snakeweed, cactus, and a few juniper trees are the common vegetation on the Kim and Pastura soils. Blue grama, galleta, ring muhly, and cactus are the most common plants on the Tapia soil. In places the caliche deposits underlying the Pastura soil are a source of roadbuilding material. (All of the soils are in climatic zone 5. The Kim soil is in dryland capability unit VIc–1; Loamy range site. The Pastura soil is in dryland capability unit VIIs–1; Shallow range site. The Tapia soil is in dryland capability unit VIs–4; Loamy range site)

Kim-Pinon-Witt loams (1 to 9 percent slopes) (Kw).—This soil association occurs on rolling hills in the northeastern part of the survey Area. Kim loam makes up about 45 to 55 percent of the acreage, Pinon channery loam makes up about 25 to 35 percent, and Witt loam about 15 to 40 percent. Included in mapping were small areas of Harvey loam, 1 to 9 percent slopes, and areas of Prewitt and Manzano soils in narrow drainageways and small potlakes.

Kim loam occurs on moderately to strongly sloping hillsides. This soil normally has a surface layer, about 11 inches thick, of grayish-brown, friable, limy loam that has been reworked by earthworms. This layer has moderate granular structure. The subsoil is pale-brown, friable, limy loam that has moderate granular structure. It is about 5 inches thick and grades to a substratum of light yellowish-brown loam. The substratum is high in lime content and has weak subangular blocky structure.

Pinon channery loam occurs mainly on thickly wooded hill crests. It has a surface layer, about 6 inches thick, of brown, friable, limy channery loam that has moderate granular structure. The subsoil is channery loam about 12 inches thick. The upper part is light brown and limy and has weak subangular blocky structure. The lower part is very limy, pinkish white, and structureless. Partly weathered limestone bedrock is at a depth of about 18 inches.

Witt loam occurs on gently sloping flanks of ridges and hills. It has a surface layer, about 6 inches thick, of brown, friable loam that has been leached free of lime. This layer grades to a subsoil of dark-brown clay loam that has moderate prismatic and moderate subangular blocky structure. The upper part of the subsoil has been leached free of lime. A substratum of pinkish-white loam that is very high in lime content begins at a depth of about 36 inches.

Kim loam is easily penetrated by roots, air, and water. It is subject to moderate wind erosion and water erosion if the plant cover is destroyed. It has a high capacity to store moisture. Surface runoff is medium to rapid, and internal drainage is medium. Fertility is moderate, and the organic-matter content is moderate.

Pinon channery loam is shallow and droughty. It takes in water at a medium to rapid rate but has a low water-holding capacity. Surface runoff is slow to medium, and internal drainage is medium. Plant roots are restricted by the bedrock.

Witt loam is subject to moderate wind erosion and water erosion. It has a high capacity to store moisture. Surface runoff is slow to medium, and internal drainage is medium. Fertility is moderate, and the organic-matter content is moderate. Roots, air, and water readily penetrate the surface layer but are restricted by the substratum.

These soils are not suited to cultivation. They are used for production of native forage. Witt loam produces the most forage, and Pinon channery loam the least. Blue grama, galleta, sand dropseed, ring muhly, cactus, and snakeweed are the most common plants on the Kim and Witt soils. Thick stands of pinyon and juniper, with an understory of blue grama and cactus, are the most common plants on Pinon channery loam. Some of the trees are harvested for fenceposts and firewood. (All of the soils are in climatic zone 5. The Kim and Witt soils are in dryland capability unit VIc–1; Loamy range site. The Pinon soil is in dryland capability unit VIIs–1; Shallow range site)

La Fonda loam, 1 to 9 percent slopes (La).—This soil occurs on upland piedmont fans and on crests and slopes of ridges, mainly in the northeastern and southwestern parts of the Area. The surface layer, about 4 inches thick, is reddish-brown, friable loam that contains lime and has moderate platy and moderate granular structure. This layer grades to a subsoil, about 19 inches thick, of light reddish-brown heavy loam that has weak prismatic and moderate subangular blocky structure. The lower part of the subsoil is more limy and coarser textured than the upper part. The substratum is massive, light reddish-brown loam that is more limy in the upper part than in the lower. It is readily permeable to roots, air, and water.

Included in mapping were small areas of Alicia loam, 1 to 6 percent slopes, a few outcrops of soft gypsum, and areas of gravelly deposits along the banks of drainage channels. Also included were some abandoned severely eroded fields.

This soil is readily eroded by wind and water when the surface is left unprotected. It absorbs water at a moderate rate and has a moderate to high capacity to store moisture. It tends to slake upon wetting. It is easily tilled. Runoff is medium to rapid, depending on the slope. Internal drainage is medium. Fertility is low, and the organic-matter content is low.

This soil is not suited to cultivation, because the climate is unfavorable. Some of the areas were formerly dry-farmed, but these are being rapidly converted to range, either by natural regeneration or by mechanical reseeding. Many of these abandoned fields have been severely eroded, and they need to be fenced and protected from overgrazing until plants are well established. Proper use of range will limit erosion. The vegetation consists of blue grama, sand dropseed, galleta, yucca, cactus, and some pinyon and juniper. (Dryland capability unit VIc–1, climatic zones 4 and 5; Loamy range site)

La Fonda loam, gravelly substratum, 2 to 8 percent slopes (Lg).—This soil occurs on terraces that are subject to flooding along streams in the southern foothills of the Manzano Mountains. It differs from La Fonda loam, 1 to 9 percent slopes, in having a gravelly substratum and in being leached of lime in the surface layer.

The surface layer, about 12 inches thick, is reddish-brown, friable loam that has moderate granular structure and is free of lime. The subsoil, about 18 inches thick, is reddish brown and has weak to moderate subangular blocky structure. The upper part has a loam texture and is free of lime; the lower part has a gravelly loam texture and contains some visible lime. The substratum is light reddish-brown, structureless very gravelly loam that contains some visible lime. This gravelly layer is normally at a depth of more than 20 inches. The gravel content ranges from about 25 to 80 percent.

Included in the areas mapped are small areas of La Fonda loam, 1 to 9 percent slopes. There are also a few deep, U-shaped gullies.

This soil is subject to severe water erosion, and it is occasionally to frequently flooded. Floodwaters cover the vegetation along the streambanks with sediments. The overflow is beneficial to the growing plants if the water stands for only a short time. Headcuts and gullies form easily along cow trails and service roads that run in the direction of streamflow. Diversions help to control erosion by spreading floodwaters over a broader area.

This soil absorbs water rapidly and has moderate capacity to store it. Surface runoff is medium to rapid, and internal drainage is medium. Most of the plant roots are confined to the less gravelly upper layers.

This soil is not suited to cultivation, because of the erosion and overflow hazards. It is a productive grassland soil if it is properly managed. The vegetation consists of blue grama, western wheatgrass, ring muhly, Apache-plume, and some pinyon and juniper. (Dryland capability unit VIew–2, climatic zones 4 and 5; Bottomland range site)

La Fonda-Alicia loams, 1 to 9 percent slopes (Lm).—This soil association occurs on upland piedmont fans in the eastern part of the survey Area. The La Fonda loam makes up 60 to 80 percent of the acreage, and the Alicia loam 20 to 40 percent. Included in mapping were small areas of Chilton gravelly loam on the banks of drainageways, some abandoned severely eroded fields, and a few areas of Alicia loam, 1 to 6 percent slopes, on broad, gently sloping piedmont fans.

The La Fonda loam normally occurs on moderately to strongly sloping truncated side slopes of the fans. It has a surface layer, about 5 inches thick, of reddish-brown, friable loam or fine sandy loam. This layer has moderate granular structure, and it contains some lime. It grades to a subsoil, about 20 inches thick, of light reddish-brown heavy loam that has weak subangular blocky structure. The subsoil is permeable and is more limy in the lower part. It grades to a substratum of light reddish-brown or pink loam. The substratum is structureless and very limy, but it does not limit root penetration.

The Alicia loam occurs mainly on gently sloping crests of the fans. It has a surface layer, about 6 inches thick, of brown to reddish-brown, friable loam that has moderate subangular blocky structure breaking to moderate granular. This layer has been leached free of lime. The subsoil is reddish-brown clay loam that has moderate prismatic and moderate subangular blocky structure. It has been leached of lime in the upper part. This layer is about 3 feet thick and grades to a substratum of pink, very limy loam. The substratum is structureless and nearly impervious to plant roots. There are a few waterworn pebbles in this soil.

These soils are readily eroded by wind or water; Alicia loam is the more stable. Gullies are common on the stronger slopes. Both soils tend to slake upon wetting. They absorb water readily and have a moderate to high capacity to store moisture for plants. Fertility is low and the organic-matter content is low in the La Fonda loam, but both are moderate in the Alicia loam. Surface runoff is medium to rapid, depending on the slope. Internal drainage is medium. Deferred grazing and proper use of range help to limit erosion.

These soils are used for production of native forage. Blue grama, sand dropseed, side-oats grama, galleta, ring muhly, yucca, snakeweed, cactus, and scattered juniper trees make up most of the native vegetation. Most of the abandoned fields have been returned to range, either by natural reseeding or by mechanical seeding. In many places seeding has not been successful, and efforts to establish grass should be renewed. Fencing these areas until plants have become well established may be necessary. (Dryland capability unit VIc-1, climatic zone 5; Loamy range site)

La Fonda-Rock outcrop complex (2 to 15 percent slopes) (Lo).—This complex occurs on upland piedmont fans and side slopes of ridges in the eastern and southwestern parts of the survey Area.

La Fonda soils make up 45 to 60 percent of the acreage. They normally occur on gently sloping to moderately sloping fans below the rock outcrops. They have a surface layer of reddish-brown, friable loam that has moderate granular structure. This layer is about 4 inches thick and grades to a subsoil of reddish-brown or light reddish-brown heavy loam that has weak prismatic and weak subangular blocky structure. This layer is about 20 inches thick and has visible lime in its lower part. The substratum is light reddish-brown, limy loam. It is structureless and is more limy than the surface layer and the subsoil. Plant roots are not restricted by this layer.

Rock outcrop makes up 40 to 55 percent of the acreage. These outcrops normally occur above the La Fonda soils on moderately sloping to moderately steep side slopes of ridges. They consist mostly of Permian, Jurassic, and Triassic red-bed sandstone, siltstone, and shale. In many places they are capped with limestone and gypsum. These weathered rocks support some plant life, but they are generally nearly impervious to roots, air, and water. In places the slopes are short and nearly vertical.

Included in mapping were small areas of Alicia loam, 1 to 6 percent slopes, and small areas of Rance-Gypsum land complex.

The La Fonda soils are subject to severe wind erosion and water erosion if they lack plant cover. They slake readily, and gullies form easily. Moisture is absorbed at a moderate rate, and the water-storage capacity is moderate to high. Surface runoff is medium to rapid, and internal drainage is medium. Fertility is low to moderate, and the organic-matter content is low to moderate.

The Rock outcrop part of the complex has low capacity to store water. Most of the soil material that weathers from these rocks is washed away as fast as it forms. Surface runoff is rapid, and the water intake rate is slow to medium. Internal drainage is slow.

This complex is not suited to cultivation, because rainfall is erratic and scanty. It is suited to range. The La Fonda soil produces most of the usable forage. The native vegetation on these soils is mainly blue grama, galleta, sand dropseed, ring muhly, cactus, yucca, and a few junipers. The Rock outcrop part of the complex supports a sparse cover of blue grama, black grama, sand dropseed, snakeweed, and scattered junipers. Proper use of forage helps to limit erosion. (Dryland capability unit VIIs-1, climatic zones 4 and 5. The La Fonda part is in Loamy range site. The Rock outcrop part is in Shallow Sandstone range site)

Laporte-Rock outcrop complex (3 to 25 percent slopes) (Lp).—This complex occurs on rocky crests and side slopes of ridges in all parts of the survey Area.

Laporte soils make up 40 to 80 percent of the acreage. They occur in pockets between rock outcrops. They are more extensive on ridge crests than on the steeper side slopes. These soils have a layer, about 11 inches thick, of grayish-brown to very pale brown, granular stony loam overlying weakly fractured limestone bedrock. The lower 4 inches of this layer contains some visible lime. The depth to rock ranges from about 4 inches to 22 inches. Roots are confined to the soil above the bedrock (fig. 15).

Rock outcrops make up 20 to 60 percent of the acreage. These areas are more common on side slopes than on crests. The rocks are mainly limestone, but there are a few strata of sandstone. The outcrops generally occur as narrow bands or ledges that form stairstep relief on side slopes of ridges. Some occur in a random pattern on ridge crests.

Included in mapping were small areas of Bernal-Travessilla fine sandy loams; Pinon channery loam, 3 to 20 percent slopes; Steep rock land; and Turkeysprings stony loam, 20 to 50 percent slopes.

Laporte soils are droughty because they are stony and shallow. They absorb water at a moderate to rapid rate, but their capacity to store moisture is low. Surface runoff is medium to rapid, and internal drainage is medium. The rock outcrops shed water rapidly. The only moisture retained is that which accumulates in the fractures, and this is rapidly taken up by plant roots or is lost through evapo-

Figure 15.—**Typical cross section of Laporte-Rock outcrop complex. Note the abundance of rock and lateral root growth in the Laporte soil at the right.**

ration. Plant roots are confined mainly to the soil above the bedrock, but they commonly penetrate the rock fractures where water and soil material have collected.

Range is the principal use of this complex. The vegetation consists of moderate to heavy stands of pinyon and juniper with an understory of blue grama, galleta, ring muhly, snakeweed, yucca, and Gambel oak. Wildlife, mainly deer, often browse the understory. Some pinyon and juniper trees are harvested for fenceposts and firewood. The rock is suitable for crushing for use in road construction. Brush control is generally impractical, because of the erosion hazard. (Dryland capability unit VIIs-3, climatic zones 4 and 5; Hills range site)

Manzano loam, 0 to 1 percent slopes (Ma).—This soil occurs on flood plains and in swales and depressions in all parts of the survey Area. The surface layer, about 9 inches thick, is grayish-brown to dark-brown, friable loam that has moderate granular structure. It has been leached of lime. This layer grades to a subsoil, about 18 inches thick, of dark grayish-brown light clay loam that has weak prismatic and moderate subangular blocky structure. The lower part of the subsoil is lighter colored than the upper part and contains some visible lime. The substratum is brown light clay loam that has weak subangular blocky structure and contains some visible lime. In many places the surface layer and the subsoil are clay loam. In other places the surface layer is covered with as much as 10 inches of recent overburden that has a texture of loam or fine sandy loam.

Small areas of Moriarty clay loam, 0 to 1 percent slopes, were included in mapping. Also included were small areas, commonly known as gravel bars, that have a high amount of gravel in the subsoil and substratum. Some strong slopes, where streams have cut channels down through an older flood plain, are shown on the soil map by escarpment symbols.

This is one of the most fertile and productive soils in the Area. It is high in organic-matter content and is easily tilled. It absorbs water at a moderate rate and has a high capacity to store moisture for plants. Surface runoff and internal drainage are slow. In areas where this soil has a clay loam surface layer it is easily compacted, takes in water slowly, and is more difficult to till.

This soil is subject to severe water erosion and overflow damage. Overflow normally occurs about once each year, usually late in summer. It is generally more beneficial than harmful because the growing plants need the additional moisture, but in some places the fresh sediments deposited by floodwaters kill the vegetation. Headcutting is common in trails, furrows, or roads that run in the direction of the waterflow. Diversions or water spreaders reduce the erosion hazard by slowing the water and spreading it over a broader area.

This soil is used mainly for production of native forage, but it is equally well suited to dryland and irrigated farming. An abundance of grass forage is produced in areas that receive overflow, and much of it is put up for hay for supplemental feed in winter and during dry spells. Blue grama, western wheatgrass, vine-mesquite, and alkali sacaton are the dominant native plants, but there is some chamiza and cactus. This soil is well suited to stock ponds because of its location and good sealing properties.

Only a few areas near the foothills of the Manzano Mountains are being dryfarmed. Corn, pinto beans, and wheat are the principal dryland crops. Rainfall is often erratic and scanty, and many fields have been returned to grass.

About 1,500 to 2,000 acres of this soil in the western part of the Area is irrigated. Alfalfa, corn, potatoes, pinto beans, and sugar beets are suitable irrigated crops. Close-growing crops, such as alfalfa, potatoes, and pinto beans, may be damaged by overflow if flooding occurs at harvesttime. (Dryland capability unit IVew-1 if in climatic zone 4, and VIew-2 if in climatic zone 5; irrigated capability unit IIew-1; Bottomland range site)

Manzano loam, 1 to 5 percent slopes (Mb).—This soil occurs on flood plains and in swales in the southern part of the Area. It has been more deeply leached of lime than Manzano loam, 0 to 1 percent slopes. It normally has a surface layer, about 7 inches thick, of brown, friable loam that has moderate granular structure. This layer grades to a subsoil of dark grayish-brown or dark-brown clay loam that has weak and moderate prismatic structure breaking to moderate and strong subangular blocky. The subsoil is about 44 inches thick and has been leached of lime. The substratum is brown limy loam that has weak subangular blocky structure.

Included in mapping were small areas of Prewitt and Manzano soils and areas of Moriarty clay loam, 2 to 6 percent slopes.

This soil is occasionally to frequently flooded, and water erosion is a hazard in places. Overflow normally occurs at least once each year, usually late in summer. Generally, it is more beneficial than harmful because much of the water is absorbed by the soil and is available for plants. Headcuts and gullies form easily in cow trails or roads that parallel the direction of waterflow. In places diversions and water spreaders help to prevent headcutting and gullying. Sediments sometimes are deposited in thick layers that cover the vegetation.

This soil is fertile and is easily tilled. It absorbs water readily and has a high capacity to store moisture for plants. It is well suited to stock ponds because it has good sealing qualities, and it is normally deep enough to provide enough soil material to construct dams. Surface runoff is medium, and internal drainage is moderately slow.

This soil is used mainly for production of native forage. Blue grama, western wheatgrass, galleta, snakeweed, cactus, and scattered juniper trees make up most of the native vegetation. A small acreage is being dryfarmed to corn and pinto beans, but crop failures are common. (Dryland capability unit IVew-1 if in climatic zone 4, and VIew-2 if in climatic zone 5; Bottomland range site)

Manzano loam, saline substratum, 0 to 1 percent slopes (Mc).—This soil occurs on flood plains in the Estancia and Encino Lake Basins. It differs from Manzano loam, 0 to 1 percent slopes, in having lacustrine deposits within 36 inches of the surface. It normally has a surface layer, about 7 inches thick, of grayish-brown, friable loam that has moderate granular structure. This layer has been leached of lime. The subsoil, about 18 inches thick, is brown to light brownish-gray clay loam that has moderate prismatic and moderate subangular blocky structure. The lower part is lighter colored and coarser textured and contains some visible lime. The substratum consists of pale-yellow, stratified, limy lacustrine sediments. Its most common texture is loam or clay loam. These sediments are slightly to moderately saline and alkali.

Small areas of Willard loam, strongly saline, and Manzano loam, 0 to 1 percent slopes, were included in mapping.

This soil is high in fertility and in organic-matter content. It is easily tilled. It should not be left without protective cover during the windy season, because it erodes readily. It absorbs water at a moderate rate and has a high capacity to store moisture for plants. Surface runoff is slow, and internal drainage is medium.

In areas near the margin of the lake basins, the upper layers are not normally saline or alkali, but in areas nearer the playa lakes, the soil is slightly to moderately affected by salts. Most of the acreage is flooded only once in 2 to 4 years. A few areas near the lake margins receive overflow every year. Irrigated crops are sometimes damaged if overflow occurs at harvesttime.

This soil is used mainly for production of native forage. Blue grama, ring muhly, alkali sacaton, chamiza, and cactus are the common plants. About 1,500 to 1,800 acres is irrigated. Alfalfa, corn, potatoes, sugar beets, pinto beans, and small grains are the principal irrigated crops. (Dryland capability unit VIs-4, climatic zone 5; irrigated capability unit IIew-1; Loamy range site)

Mirabal stony sandy loam, high elevation, 10 to 70 percent slopes (Mh).—This soil occurs on mountain slopes and peaks near the crest of the Manzano Mountains. This soil is moderately deep. Normally, a layer of decomposing forest litter, an inch thick, covers the surface. The surface layer, about 3 inches thick, consists of very dark grayish-brown stony fine sandy loam. This layer grades to a subsoil of brown very stony fine sandy loam. The subsoil is structureless or has weak subangular blocky structure. It grades to weathered schist rock at a depth of about 14 inches. This soil is medium acid from the surface.

Small areas of Rock outcrops and slides were included in mapping.

Water erosion is the main hazard. Severe erosion will result if the plant cover is destroyed by fire. This soil has a low capacity to store moisture. It absorbs water rapidly and has rapid internal drainage. Surface runoff is medium to rapid, depending on the slope. Cool temperatures at these high elevations keep evaporation losses small.

This soil is used mainly for timber, for wildlife habitats, and for recreation. It supports an overstory of ponderosa pine, limber pine, Douglas-fir, and white fir, and an understory of Gambel oak, mountain brome, Arizona fescue, and Carex. Mature and diseased trees are harvested regularly. In places livestock graze the understory. (Dryland capability unit VIIe-7, climatic zone 4; timber suitability group 4)

Mirabal stony sandy loam, 40 to 80 percent slopes (Ml).—This soil occurs on eastern slopes of the Manzano Mountains, just below the crest. A layer of decomposing forest litter, about 2 inches thick, covers the surface layer of dark grayish-brown, friable stony sandy loam. This layer is about 9 inches thick, and it is lighter colored in the lower part. It has weak crumb structure. The subsoil is pale-brown, structureless, stony sandy loam about 12 inches thick. This layer rests on hard, fractured schist bedrock at a depth of about 21 inches. This soil is slightly acid in the surface layer and neutral in the lower part.

The slope is commonly about 60 percent. Included in mapping were small areas of Rock outcrops and slides.

This soil is subject to severe water erosion if the plant cover is destroyed by fire. It absorbs water rapidly and has rapid internal drainage. It has low capacity to store moisture. Roots penetrate easily. Most roots are confined to the surface layer and the subsoil, but a few penetrate the fractures in the bedrock. Runoff is rapid. Surface rocks help to check runoff and control erosion.

This soil supports a forest cover, mostly of ponderosa pine and Douglas-fir, with an understory of Gambel oak, mountain brome, Arizona fescue, and various forbs. The timber is used for wood products, but only diseased and mature trees are harvested. Wildlife browse the understory, and domestic livestock graze the more accessible areas. These areas are also used for recreation. (Dryland capability unit VIIe-7, climatic zone 4; timber suitability group 4)

Moriarty clay loam, 0 to 1 percent slopes (Mm).—This soil occurs on flood-plain terraces and in swales, mainly along the Manzano Arroyo in the western part of the Area.

The surface layer, about 8 inches thick, is dark reddish-gray, friable clay loam that has moderate granular structure. It grades to a subsoil of reddish-brown or dark reddish-brown clay that has weak prismatic and moderate to strong blocky structure. The subsoil is about 3 feet thick. It grades to a substratum of reddish-gray clay. The lower part of the subsoil and the substratum are mottled with reddish brown. This soil is mildly alkaline. It is limy throughout, but visible lime occurs only in the substratum.

Included in mapping were small areas of Manzano loam, 0 to 1 percent slopes, and scattered ridges of gravelly deposits.

This soil is flooded about once a year, usually late in summer. Floods are generally more beneficial than harmful because the growing plants need the additional moisture. Headcuts and gullies form in areas where the water is swift and concentrated. Diversions and water spreaders are needed in places to reduce the erosion hazard by slowing the water and spreading it over a broader area.

This soil absorbs water slowly and has very slow internal drainage. It has a high capacity to store moisture, but the water is often held too tightly for roots to absorb it. It tends to slake easily upon wetting. Cracks as much as 3 inches wide and several feet deep form when the soil dries. Surface runoff is slow. Fertility is high, and the organic-matter content is high.

This soil is not suited to cultivation, because it is clayey and poorly drained. Native range is the principal use. Blue grama, western wheatgrass, alkali sacaton, and buffalograss make up most of the vegetation. (Dryland capability unit VIew-1, climatic zones 4 and 5; Salty Bottomland range site)

Moriarty clay loam, 2 to 6 percent slopes (Mo).—This soil occurs on flood-plain terraces in the extreme western part of the Area. It is redder than Moriarty clay loam, 0 to 1 percent slopes, and is moderately alkaline. The surface layer, about 9 inches thick, is limy, dark reddish-brown clay loam or silty clay loam that has strong granular structure in the upper part and weak subangular blocky structure in the lower part. This layer rests on a subsoil, about 30 inches thick, of limy, reddish-brown clay that has weak subangular blocky structure. The subsoil grades to a substratum of limy, massive, reddish-brown silty clay loam.

Included in mapping were small areas of La Fonda loam, gravelly substratum, 2 to 8 percent slopes, and a few deep, U-shaped gullies.

This soil slakes readily upon wetting and is subject to severe water erosion. Overflow causes serious damage in areas where headcuts and gullies have dissected the flood plain. Sheet erosion is common on areas that were once farmed. Deep arroyos carry most of the runoff, but overflow can be expected about once in 2 to 4 years. In places diversion dikes or dams are useful in controlling headcuts and gullies.

This soil is slowly to very slowly permeable to roots, air, and water. It has a high capacity to store moisture, but the moisture is not readily available to plants. Cracks as much as 3 inches wide and several feet deep form during dry periods. Surface runoff is medium to rapid.

This soil is used mainly for production of native forage. The native vegetation is sparse. It consists mainly of Russian-thistle, blue grama, sand dropseed, ring muhly, western wheatgrass, and a few juniper trees. There are a few abandoned severely eroded fields, and in these fields it is difficult to establish vegetation. These fields need to be fenced and protected from overgrazing until plants are well established. (Dryland capability unit VIew-1, climatic zones 4 and 5; Salty Bottomland range site)

Osha gravelly loam, 10 to 50 percent slopes (Oa).—This soil occurs on mountain crests and side slopes in the Manzano Mountains in the western part of the Area. A layer of decomposing forest litter, about 3 inches thick, covers the surface. The surface layer, about 18 inches thick, is grayish-brown to brown gravelly loam that has weak subangular blocky structure. A bleached subsurface layer of pale-brown gravelly sandy loam, about 14 inches thick, lies between the surface layer and the subsoil. It grades to the subsoil, about 18 inches thick, of brown, very gravelly heavy sandy loam that has weak subangular blocky structure. Weakly fractured granite bedrock is at a depth of about 50 inches. This soil is free of lime and ranges from slightly acid to neutral in reaction.

The slope is most commonly about 40 percent. In some small areas it is less than 10 percent and in others more than 50 percent. Rock outcrops and slides were included in mapping.

Under the present plant cover, surface runoff is slow to medium. This soil is easily eroded by water if the vegetation is destroyed by fire or by excessive logging. It absorbs water rapidly and has rapid internal drainage. It has a low to moderate capacity to store moisture for plants. Surface rocks and the organic layer on the surface help to retard runoff and limit erosion.

Timber production and wildlife habitats are the main uses of this soil. Ponderosa pine and Douglas-fir and an understory of Gambel oak, mountain brome, Arizona fescue, and scattered pinyon and juniper trees make up most of the vegetation. Livestock graze the understory in accessible areas. Mainly, it is the mature and diseased trees that are harvested. Some areas are suitable for recreation. (Dryland capability unit VIIe-6, climatic zone 4; timber suitability group 3)

Osha gravelly loam, calcareous variant, 20 to 80 percent slopes (Og).—This soil occurs on mountain slopes in the southern part of the Manzano Mountains. It is limy and is finer textured than Osha gravelly loam, 10 to 50 percent slopes.

This soil normally has a surface layer, about 10 inches thick, of brown, friable gravelly or stony loam that has moderate granular structure. The subsurface layer, about 6 inches thick, is bleached, light-brown stony loam that tongues into the subsoil. The subsoil is reddish-yellow stony clay loam. It has moderate subangular blocky structure and contains visible lime in the lower part. Fractured quartzite bedrock occurs at a depth of about 40 inches. This soil is mildly alkaline in the surface layer but moderately alkaline in the lower layers.

The slope is commonly about 50 percent. In places a thin layer of decomposing litter is on the surface. Small areas of Rock outcrops and slides were included in mapping.

This soil is subject to severe water erosion if the vegetation is destroyed by fire. It takes in water rapidly and has medium to rapid permeability. It has a moderate capacity to store moisture for plants. Under the present plant cover, runoff is medium to rapid. On the southern slopes, evaporation is rapid and the soil is droughty.

This soil supports dense stands of pinyon and juniper. The understory consists of mountain-mahogany, Canada thistle, side-oats grama, and junegrass. It is suitable for wildlife habitats, and livestock can graze the more accessible areas. There are a few ponderosa pines on the northern slopes, but not enough for commercial use. (Dryland capability unit VIIe-2, climatic zones 4 and 5; Mountain Shale range site; timber suitability group 5)

Otero and Palma soils (1 to 9 percent slopes) (Op).—This unit occurs in undulating areas in the eastern and southern parts of the survey Area. Otero soils are the more extensive. They make up 55 to 75 percent of the acreage. They are limy and are lighter colored than Palma soils. They normally have a surface layer, about 6 inches thick, of light-brown, friable fine sandy loam or loamy fine sand. This layer has moderate granular structure. The subsoil, about 11 inches thick, is similar in color, texture, and lime content to the surface layer, but its structure is weak subangular blocky. The substratum is light-brown to very pale brown, structureless fine sandy loam that contains much visible lime. In places the surface layer has been leached of lime.

Palma soils make up 25 to 45 percent of the acreage. They normally have a surface layer, about 6 inches thick, of nonlimy, brown to reddish-brown, friable fine sandy loam or loamy fine sand that has strong granular structure. This layer rests on a subsoil of reddish-brown heavy fine sandy loam that has weak to moderate prismatic structure and moderate subangular blocky structure. The subsoil, about 17 inches thick, has been leached of lime in the upper part (fig. 16). It grades to light reddish-brown, limy fine sandy loam in the lower part. The substratum is light reddish-brown, structureless fine sandy loam that has much visible lime in the upper part. The lime decreases with depth. In some places this soil is limy in the surface layer and in the upper part of the subsoil.

These soils are normally coarser textured in the southern part of the Area on the Chupadera Mesa and eastward toward Pino Hill. Included in the areas mapped are small areas of Chupadera loamy fine sand, 5 to 15 percent slopes; Trail loamy fine sand, 5 to 10 percent slopes; and Otero and Palma soils, hummocky. There are a few sandstone outcrops, and in a few places the soils are underlain by deposits of soft gypsum at a depth of about 40 inches. Also included is a small acreage near the eastern escarpment of the Chupadera Mesa of a soil that is similar to Palma soils but has a cemented layer in the subsoil and has been more deeply leached of lime than Palma soils.

These sandy soils are easily eroded by wind when they are not adequately protected by plant cover. They absorb water rapidly and have a moderate capacity to store moisture for plants. They release the moisture readily, and plants respond quickly to rainfall. Surface runoff is slow to very slow, and internal drainage is medium to rapid. Fertility is low, and the organic-matter content is low.

These soils are used mainly for production of native forage. Yields are less affected by lack of rainfall than are yields on finer textured upland soils. Sand dropseed, blue grama, and yucca make up most of the native forage in areas in the eastern part of the survey Area. The most common plant cover in the southern part of the Area is made up of light to moderate stands of pinyon and juniper and an understory of sand dropseed, blue grama, sand sage, yucca, and cactus. Some trees are cut for posts and firewood. There are a few old fields, nearly all of which have been reseeded to grass. Proper use of range and deferred grazing help to maintain a plant cover adequate for protection against wind erosion. (Dryland capability unit VIe-1, climatic zones 4 and 5; Sandy range site)

Otero and Palma soils, hummocky (1 to 5 percent slopes) (Or).—This unit occurs in abandoned fields in the eastern part of the Area. Otero soils occupy 60 to 80 percent of the acreage, and Palma soils 20 to 40 percent.

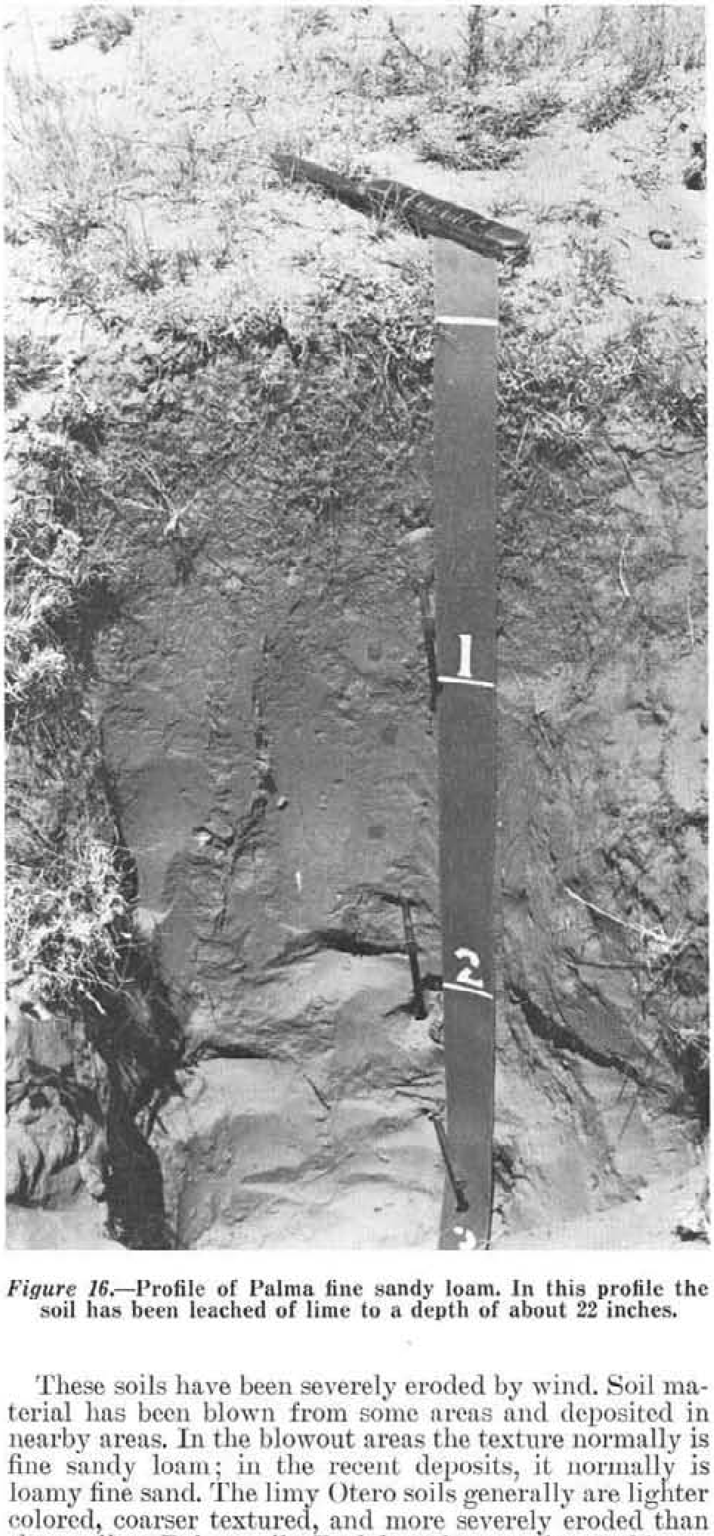

Figure 16.—**Profile of Palma fine sandy loam. In this profile the soil has been leached of lime to a depth of about 22 inches.**

These soils have been severely eroded by wind. Soil material has been blown from some areas and deposited in nearby areas. In the blowout areas the texture normally is fine sandy loam; in the recent deposits, it normally is loamy fine sand. The limy Otero soils generally are lighter colored, coarser textured, and more severely eroded than the nonlimy Palma soils. Both have been so thoroughly reworked by wind that normal profiles are rare.

These soils are very low in fertility and in organic-matter content. They are rapidly permeable to roots, air, and water. Their capacity to store moisture for plants is low to moderate. Surface runoff is very slow to slow. Severe damage from wind erosion is the most serious hazard.

Native range is the principal use of these soils. Vegetation of any kind has been difficult to establish. The areas should be fenced and protected from overgrazing until the plants are well established and the soils stabilized. Reseeding by mechanical means is not advisable, because disturbing the surface layer leaves it susceptible to blowing. Hand seeding is the best method. The native vegetation consists mainly of sand dropseed, yucca, and annual weeds. (Dryland capability unit VIe–1, climatic zone 5; Sandy range site)

Pastura loam, 1 to 9 percent slopes (Pa).—This soil occurs on crests and side slopes on uplands in the eastern part of the Area. It consists of about 10 inches of friable, limy loam over deposits of pinkish-white, indurated caliche (fig. 17). The upper part of the surface layer is light brownish gray and has strong granular structure; the lower part is pale brown and has weak subangular blocky structure. Most plant roots are confined to the surface layer. The caliche is laminated and more strongly cemented in the upper part.

Included in mapping were areas of Dean loam, 1 to 9 percent slopes, which makes up about 15 percent of the acreage. Also included were small areas of Harvey loam, 1 to 9 percent slopes, and a few outcrops of caliche.

This soil is shallow and has limited space for moisture storage. It takes in water at a moderate to rapid rate and has medium internal drainage. Surface runoff is slow to medium, and water erosion is slight. Wind erosion is moderate to severe when the plant cover is not adequate for protection.

This soil supports a sparse cover of blue grama, black grama, side-oats grama, three-awn, needlegrass, snakeweed, cactus, yucca, and juniper. Native range is the principal use. In places caliche has been excavated for use in road construction. Plant density can be increased and the more desirable plants encouraged by proper use of range and deferred grazing. (Dryland capability unit VIIs–1, climatic zones 4 and 5; Shallow range site)

Figure 17.—Profile of Pastura loam, 1 to 9 percent slopes. Indurated caliche is at a depth of about 10 inches.

Pastura loam, 9 to 25 percent slopes (Pb).—This soil occurs on shoulders and side slopes on uplands in the western and eastern parts of the Area. It has a thinner surface layer than Pastura loam, 1 to 9 percent slopes. It normally consists of about 4 inches of light brownish-gray to very pale brown, friable, limy loam over indurated caliche. The surface layer has moderate granular structure. It contains many small, hard pebbles and fragments of caliche. The caliche is laminated and more strongly cemented in the uppermost 2 feet than in the lower part. Most plant roots are confined to the surface layer.

Included in mapping were small areas where the slope is less than 9 percent or more than 25 percent. Caliche outcrops are common.

This soil is very shallow. It has a low capacity to store water and is very droughty. It is generally more droughty and more susceptible to wind and water erosion in areas where it has a southern exposure. The surface layer is readily permeable to roots, air, and water. Surface runoff is rapid, and water erosion is severe. Internal drainage is slow to medium.

This soil is suited only to production of native forage. A sparse cover of blue grama, black grama, three-awn, snakeweed, juniper, and scrub oak makes up the vegetation. Grazing should be controlled to help limit erosion. Caliche is sometimes excavated for use in road construction. (Dryland capability unit VIIs–1, climatic zones 4 and 5; Shallow range site)

Pedrick loamy fine sand (0 to 1 percent slopes) (Pd).—This soil occurs on slightly undulating lake terraces in the Estancia and Pinos Wells Lake Basins.

This soil has a surface layer, about 17 inches thick, of pale-brown to brown, limy, friable, single-grain loamy fine sand. The subsoil is about 18 inches thick and is single grain or has granular structure. Its upper part is pale-brown light fine sandy loam; its lower part is more limy, very pale brown heavy fine sandy loam that has weak subangular blocky structure. The substratum consists of mixed, stratified lacustrine deposits, mainly yellowish, grayish, and whitish, that average about clay loam in texture. These deposits are very limy and contain high concentrations of soluble salts in places. The depth to the lacustrine deposits ranges from 15 to 40 inches. In places the upper part of the surface layer has been leached of lime.

Small areas of Willard fine sandy loam and Ildefonso loamy fine sand, 0 to 5 percent slopes, were included in mapping.

This soil is subject to severe wind erosion if the grass cover is depleted. It absorbs water rapidly and has rapid internal drainage. It has low capacity to store moisture, but it releases moisture to plants readily when moisture is available. The surface layer is friable and easily tilled. Surface runoff is very slow. Fertility is low, and the organic-matter content is low.

This soil is used mainly for production of native grass. Because of the erosion hazard and the low production potential, it is better suited to native range than to other uses. The vegetation consists mainly of sand dropseed, blue grama, galleta, sand sage, yucca, and alkali sacaton. There are a few pinyon and juniper trees. Overgrazed areas are easily eroded by wind.

Less than 150 acres of this soil is irrigated. Sprinkler irrigation is best; if surface irrigation is used, the runs should be short. Alfalfa and small grains are the principal irrigated crops. Crop residue should be left on the surface for protection against erosion. (Dryland capability unit VIe-1, climatic zones 4 and 5; irrigated capability unit IVe-2; Sandy range site)

Pedrick loamy fine sand, hummocky (0 to 2 percent slopes) (Pe).—This soil occurs in the Estancia and Pinos Wells Lake Basins on nearly level, hummocky lake terraces. The areas were formerly farmed or have been severely overgrazed.

Uneroded areas of this soil are similar to Pedrick loamy fine sand. In most places the original surface layer has been removed and the soil material deposited in nearby dunes. In many places the dunes are less than 4 feet thick, but in some areas they are more than 6 feet thick. Generally, the surface layer consists of about 10 inches of limy, pale-brown, single-grain loamy fine sand. This layer rests on a subsoil, about 5 inches thick, of very pale brown, single-grain loamy fine sand or light fine sandy loam. The subsoil overlies stratified yellowish, grayish, and whitish lacustrine deposits that are high in lime and soluble salts. In places all of the soil has been removed by erosion and the lacustrine sediments are exposed.

A few small areas of Blown-out land were included in mapping.

Most of this eroded soil has been stabilized, but wind erosion is still the major hazard. The capacity to store moisture is low. Surface runoff is very slow to slow. Roots, air, and water penetrate readily. Erosion has resulted in a decrease in fertility and loss of organic matter.

This soil is better suited to native range than to cultivated crops, but a few areas have been leveled and irrigated. Alfalfa, pasture, and barley are the main irrigated crops. The native vegetation is mostly sand dropseed, blue grama, sand sage, and yucca. If reseeding is necessary, it should be done by hand, so as to avoid disturbing the surface. Reseeded areas should not be used for grazing until the plants are well established. (Dryland capability unit VIe-1, climatic zone 5; irrigated capability unit IVe-2; Sandy range site)

Penistaja fine sandy loam, 0 to 1 percent slopes (Pf).—This soil occurs on upland ridgetops on the Chupadera Mesa in the southern part of the Area. It has been more deeply leached of lime than Penistaja fine sandy loam, 1 to 6 percent slopes.

This soil normally has a surface layer, about 5 inches thick, of brown, friable fine sandy loam that has moderate granular structure. This layer grades to a subsoil of brown sandy clay loam that has weak to moderate prismatic structure breaking to moderate subangular blocky. The subsoil is about 50 inches thick; the uppermost 20 inches has been leached of lime. The substratum is light reddish-brown, massive heavy fine sandy loam that contains a moderate amount of visible lime.

Included in mapping were small areas of Penistaja fine sandy loam, 1 to 6 percent slopes, and Witt loam, 0 to 1 percent slopes, and a few areas that have been cultivated and severely damaged by wind erosion.

This soil is subject to severe wind erosion when clean tilled or when the vegetation is overgrazed. It is easily tilled. It absorbs water at a moderate to rapid rate and has medium internal drainage. The water-storage capacity is moderate to high, and the moisture is readily available when present. Fertility is moderate, and the organic-matter content is moderate. Surface runoff is slow.

This is one of the better grass-producing soils in the survey Area. It is used mainly for production of native forage. The vegetation consists mainly of blue grama, sand dropseed, galleta, and cactus and includes scattered yucca, pinyon, and juniper. A few areas are dryfarmed, but crop failures are common because of the prolonged dry spells. Wheat and pinto beans are the main crops. Crop residue should be left on the surface for protection against wind erosion. A few trees are harvested for fenceposts and firewood. (Dryland capability unit IVe-4 if in climatic zone 4, and VIe-1 if in climatic zone 5; Loamy range site)

Penistaja fine sandy loam, 1 to 6 percent slopes (Pg).—This soil occurs on upland piedmont fans in the southern and eastern parts of the Area. It is typical of the Penistaja series.

The surface layer, about 5 inches thick, is normally brown, friable fine sandy loam that has been leached of lime. It has moderate granular structure. It grades to a subsoil of light-brown or brown sandy clay loam that has weak prismatic and moderate subangular blocky structure. The subsoil has been leached of lime to a depth of about 12 inches; the lower 12 inches contains a small amount of visible lime. The substratum is reddish-brown to light reddish-brown fine sandy loam that has weak subangular blocky structure in the upper part but is massive below a depth of about 53 inches. The lower part is lighter colored and contains a moderate amount of visible lime. Sandstone bedrock occurs below a depth of 40 inches in places.

Included in mapping were small areas of Hagerman fine sandy loam, 1 to 5 percent slopes; Witt loam, 1 to 6 percent slopes; and Bernal-Travessilla fine sandy loams.

This soil is easily eroded when not protected with plant cover or crop residue. It is moderate in fertility and in organic-matter content. It is readily permeable to roots, air, and water. Tillage is easy. Internal drainage and surface runoff are medium. The water-storage capacity is moderate to high, and the moisture is readily available to plants.

This is one of the better grass-producing soils in the survey Area. It is dependable, even in years when rainfall is below normal. The vegetation consists mainly of blue grama, sand dropseed, galleta, cactus, yucca, and light to moderate stands of pinyon and juniper. Some of the trees are cut for fenceposts and firewood. Mechanical methods of brush control are well suited.

A few areas are being dryfarmed, but crop failures are common in years when rainfall is below normal. Wheat and pinto beans are the main crops. Emergency tillage and stubble mulching help to limit erosion. Many fields are being returned to grass. Mechanical reseeding has been successful. (Dryland capability unit IVe-4 if in climatic zone 4, VIe-1 if in climatic zone 5; Loamy range site)

Penistaja loamy fine sand, hummocky, 1 to 8 percent slopes (Ph).—This soil occurs on upland piedmont fans in the southeastern part of the Area. It is hummocky and is thicker, coarser textured, and lighter colored than Penistaja fine sandy loam, 1 to 6 percent slopes. The crests of the hummocks are rarely more than 4 feet higher than the concave foot slopes; they are normally about 2 feet higher.

The surface layer has been reworked by wind; windblown material has accumulated, and the surface layer is consequently about 10 inches thick. It consists of yellowish-brown, friable loamy fine sand that has been leached of lime. It has moderate granular structure. The subsoil, about 30 inches thick, is light-brown to brown light sandy clay loam of weak prismatic and weak subangular blocky structure. The upper part of the subsoil has been leached of lime, and the lower part is lighter colored and contains a small amount of visible lime. The substratum is light reddish-brown, massive fine sandy loam that contains a moderate amount of visible lime. In places the surface layer is as much as 20 inches thick.

Included in mapping were small areas of Penistaja fine sandy loam, 1 to 6 percent slopes; Witt loam, 1 to 6 percent slopes; and Trail loamy fine sand, 5 to 10 percent slopes. Also included were a few areas that have a layer of limy gravel at a depth of about 2 feet.

Wind erosion is the major problem to be considered in managing this soil because soil loss will be excessive if the plant cover is destroyed. Surface runoff is very slow, and water penetrates rapidly. Internal drainage is medium. The capacity to store moisture for plants is moderate, and plant roots can readily absorb the moisture.

This soil supports moderate to heavy stands of pinyon and juniper and an understory of sand dropseed, blue grama, little bluestem, galleta, yucca, and cactus. Range is the principal use. Mechanical methods of brush control can be used, but brush should be left on the soil as protection against wind erosion. Some trees are cut for posts and firewood. (Dryland capability unit VIe–1, climatic zone 5; Sandy range site)

Penistaja sandy clay loam, 1 to 6 percent slopes, eroded (Pm).—This soil occurs in abandoned fields on uplands in the southern and eastern parts of the survey Area. It differs from Penistaja fine sandy loam, 1 to 6 percent slopes, in having lost most or all of its surface layer and, in places, part of the subsoil through wind erosion.

The topography varies from smooth to undulating. In some fields the soil has eroded uniformly and the surface is smooth, but in others the soil has been removed from some areas and deposited nearby. The accumulations are normally less than 12 inches deep, and the soil is coarser textured than that in the blown-out areas. The upper 8 inches of the subsoil consists of nonlimy, brown sandy clay loam that has weak prismatic and moderate subangular blocky structure. The lower 15 inches is light-brown, limy sandy clay loam that has weak subangular blocky structure. In most places the nonlimy part of the subsoil is at the surface, and in places the lighter colored, limy material. The substratum is light reddish-brown, massive fine sandy loam that contains a moderate amount of visible lime.

Included in mapping were small areas of Penistaja fine sandy loam, 1 to 6 percent slopes.

This soil is subject to further deterioration unless wind erosion is kept in check by emergency tillage or by growing protective cover. Most of the natural fertility has been lost through erosion. Surface runoff is medium to rapid, and water erosion is severe on the stronger slopes. The water-intake rate is slow, and the water-storage capacity is moderate. Internal drainage is medium.

Most of this soil has been reseeded to blue grama, sideoats grama, and sand dropseed. Grasses are usually planted with a grass drill, and in most places good stands have been established. Young seedlings need to be protected from overgrazing. Galleta, ring muhly, and three-awn make up part of the plant cover. Range is the principal use. A few areas are dryfarmed to pinto beans, wheat, and corn. Dryfarming is risky because rainfall is scanty and erratic. (Dryland capability unit IVe–4 if in climatic zone 4, VIc–1 if in climatic zone 5; Loamy range site)

Penistaja-Dean complex, 1 to 5 percent slopes (Pn).—This complex occurs on upland piedmont fans in the eastern part of the Area. The Penistaja soils make up 60 to 80 percent of the acreage, and the Dean soils 20 to 40 percent. Included in mapping were small areas of Harvey loam, 1 to 9 percent slopes, and a few abandoned fields that have been severely eroded by wind.

This complex shows the influence of rodent activity in years past. Rodents probably burrowed into the Penistaja soil and brought limy material from the substratum to the surface and mixed it with material from the upper layers. The mixing changed the soil enough that the original Penistaja soil now resembles a Dean soil. The Dean soils in this complex are less limy than normal, and in many places they lack a layer of partly cemented caliche.

The Penistaja soils are the darker colored, smoother parts of the complex. The surface layer, about 5 inches thick, normally consists of brown fine sandy loam that has been leached of lime and has moderate granular structure. It grades to a subsoil of brown to light-brown sandy clay loam. The subsoil, about 30 inches thick, has weak prismatic and moderate subangular blocky structure. The upper part has been leached of lime. The lower part is lighter colored and contains a small amount of visible lime. The substratum is massive, light reddish-brown fine sandy loam or loam that contains both soft lime and lime concretions. It is permeable to roots, air, and water.

The Dean soils are the lighter colored part of the complex. They occur on low, circular mounds. The surface layer, about 4 inches thick, normally consists of pale-brown to brown loam that has weak granular structure and contains a small to moderate amount of lime. The subsoil, about 10 inches thick, is light-brown loam that has weak subangular blocky structure and contains a moderate amount of visible lime. The substratum is very limy, massive, very pale brown loam that contains many pebbles of partly cemented caliche. This layer is less permeable to roots than the upper layers.

The Penistaja soils are moderate in fertility and in organic-matter content. They absorb water readily and have moderate to high water-storage capacity. Surface runoff and internal drainage are medium. The Dean soils are low in fertility and in organic-matter content. They erode readily and are less permeable to plant roots than the Penistaja soils. They absorb moisture at a moderate rate, but their water-storage capacity is low. Runoff is medium to rapid, and internal drainage is medium.

This complex is used for production of native forage. The soils are fairly stable if the vegetation is not overgrazed. The Penistaja soils produce most of the edible forage. Many of the abandoned fields have been reseeded to grass. Blue grama, sand dropseed, galleta, ring muhly, yucca, snakeweed, cactus, and light to moderate stands of pinyon and juniper are common on both soils. A few trees are cut for fenceposts and firewood. (Both soils are in climatic zone 5. The Penistaja soil is in dryland capability unit VIe–1; Loamy range site. The Dean soil is in dryland capability unit VIe–2; Limy range site)

Penistaja-Dean fine sandy loams, 1 to 5 percent slopes (Po).—This soil association occurs on upland piedmont fans in the southeastern part of the Area. The Penistaja fine sandy loam makes up 55 to 70 percent of the acreage, and the Dean fine sandy loam 30 to 45 percent.

The Penistaja soils occur as the deeper, darker colored, somewhat concave parts of the association. In many places the surface layer is thicker than is typical for Penistaja soils, and in some places it has been reworked by wind and is hummocky. In most places the surface layer is brown fine sandy loam about 10 inches thick. It has moderate granular structure and has been leached of lime. This layer grades to a subsoil of brown or reddish-brown sandy clay loam that is about 25 inches thick. The subsoil has weak prismatic and moderate subangular blocky structure and has been leached of lime in the upper part. The lower part is lighter colored and contains a small amount of visible lime. The substratum is pale-brown or light reddish-brown, massive fine sandy loam that has a high content of visible lime.

Dean soils occur mainly as the light-colored parts of the association. They are commonly on small, convex ridges. Like the Penistaja soils, the Dean soils in this association are hummocky in places and have a surface layer that is thicker than is typical. The surface layer normally consists of about 4 inches of light brownish-gray, friable, limy fine sandy loam that has weak granular structure. It rests on a subsoil, about 3 inches thick, of light brownish-gray or pale-brown loam that has weak subangular blocky structure and contains a moderate amount of visible lime. The substratum is massive, very pale brown, gravelly caliche that is partly cemented in the uppermost few inches. This layer restricts many plant roots. In some places sandstone bedrock occurs below the caliche at a depth of some 15 inches or more.

In areas where these soils have been reworked by wind, they not only have a thicker surface layer, but in many places are coarser textured. Included in mapping were small areas of Bernal-Travessilla fine sandy loams.

The Penistaja fine sandy loam is readily eroded when not protected by adequate plant cover. It is moderate in fertility and in organic-matter content. It is readily permeable to roots, air, and water. The water-storage capacity is moderate to high. Runoff is slow to medium, and internal drainage is medium.

The Dean fine sandy loam is subject to severe wind erosion if the protective plant cover is destroyed. Fertility is low, and the organic-matter content is low. Plant roots are confined mostly to the surface layer and subsoil, but water and air move freely. The intake of water is rapid, but the capacity to store moisture is slow. Surface runoff is slow to medium.

This association supports moderate to heavy stands of pinyon and juniper and a sparse understory of sand dropseed, blue grama, scrub oak, yucca, and cactus. The main use is native range. Some trees are harvested for posts and firewood. Generally, the Penistaja soil supports the most grass and the Dean soil the most trees. Mechanical brush control will increase the production of edible forage. The debris should be left on the soil, to provide some protection against blowing. (Both soils are in dryland capability unit VIe–2, climatic zone 5. The Penistaja soil is in Loamy range site. The Dean soil is in Limy range site)

Pinata stony loam, 25 to 50 percent north slopes (Pr).—This soil occurs on north-facing canyon side slopes in the Gallinas Mountains. It is the typical Pinata soil. About 2 inches of decomposing forest litter covers the surface. The surface layer, about 10 inches thick, is stony loam. The upper part is very dark brown and has strong crumb structure. The lower part is pinkish gray and has weak to moderate platy structure and moderate granular structure. This layer tongues into the upper part of the subsoil. The subsoil is reddish-brown stony clay that has moderate subangular blocky structure that becomes weaker with depth. This layer is about 35 inches thick and grades to partly weathered felsite bedrock. This soil is nonlimy. The rock content ranges from about 30 percent in the surface layer to 50 percent in the subsoil.

Included in mapping were areas of Pinata stony loam, 20 to 60 percent south slopes, and small areas where the slope is less than 25 percent or more than 50 percent.

Runoff is medium to rapid. If the vegetative cover is burned or heavily logged, the hazard of water erosion is severe. Water penetrates the surface layer rapidly, but moves slowly through the subsoil. This soil has a moderate to high capacity to store moisture for plants. Most roots are confined to the surface layer and the subsoil. Evaporation is low.

Timber production and wildlife habitats are the main uses of this soil. Ponderosa pine, Douglas-fir, alligator juniper, Gambel oak, and gray oak make up the main part of the vegetation. Cool-season grasses make up the understory. Mature and diseased trees are harvested. Livestock graze the understory in the more accessible areas. (Dryland capability unit VIIe–6, climatic zone 4; timber suitability group 3)

Pinata stony loam, 20 to 60 percent south slopes (Ps).—This soil occurs on south-facing canyon side slopes in the Gallinas Mountains. It is droughty and is thinner and stonier than the Pinata soil on north-facing slopes.

A layer of decomposing forest litter, about 2 inches thick, covers a surface layer of stony loam about 8 inches thick. The upper part of the surface layer is dark brown and has moderate crumb structure. The lower part is pinkish gray and has weak platy and moderate granular structure. Soil from the lower part tongues into the upper part of the subsoil. The subsoil, about 32 inches thick, is brown to reddish-brown stony light clay that has weak to moderate subangular blocky structure. It grades at a depth of about 40 inches to fractured felsite bedrock. This soil is nonlimy. The rock content ranges from about 40 percent in the surface layer to 60 percent in the subsoil.

Included in mapping were small areas of Pinata stony loam, 25 to 50 percent north slopes, and Fortwingate stony loam, 5 to 40 percent slopes. Also included were areas of shallow soils on the ridge crests.

This soil, being exposed to the direct rays of the sun, is warmer than the Pinata soil on north-facing slopes. Because it faces the prevailing winds, evaporation is more rapid than on the north-facing phase, and the vegetation is more sparse. Under the present plant cover, runoff is slow to medium and water erosion is slight, but runoff will be rapid and erosion severe if the vegetation is burned or is destroyed by excessive logging. This soil absorbs water rapidly, but it has low to moderate capacity to store moisture for plants. Internal drainage is medium to slow.

This soil supports open stands of ponderosa pine, Douglas-fir, alligator juniper, Gambel oak, gray oak, and an understory of cool-season grasses. Mature and diseased trees are harvested commercially. Wildlife browse the understory, and livestock graze the more accessible areas. (Dryland capability unit VIIe-7, climatic zone 4; timber suitability group 4)

Pinata-Stroupe stony loams, 5 to 20 percent slopes (Pt).—This complex occurs on foothill ridges in the Gallinas Mountains. The Pinata stony loam makes up 55 to 70 percent of the acreage, and the Stroupe stony loam, 30 to 45 percent. Included in mapping were small areas where the slope is less than 5 percent or more than 20 percent.

These soils are less stony than is typical. The Pinata stony loam is much shallower than a typical Pinata soil, and it has a different kind of native vegetation.

The Pinata stony loam is the steeper, less stony, more heavily wooded part of this complex. About an inch of decomposing forest litter covers the surface. The upper part of the surface layer is brown or dark-brown stony loam that has moderate crumb structure. The lower part, about 6 inches thick, is pink, friable stony loam that has weak platy and moderate granular structure. This part of the surface layer tongues into a subsoil, about 15 inches thick, that has moderate to strong blocky and subangular blocky structure. The subsoil grades to felsite bedrock at a depth of about 21 inches. This soil is nonlimy. Stones make up about 15 percent of the surface layer, and gravel makes up about 30 percent of the subsoil.

Stroupe stony loam is the less sloping, more open part of the complex. It has a surface layer, about 5 inches thick, of dark grayish-brown, friable stony loam that has moderate granular structure. This layer grades to a subsoil, about 18 inches thick, of reddish-brown stony clay loam that has weak prismatic and moderate subangular blocky structure. The upper part of the subsoil has been leached of lime, and the lower part is lighter colored and contains a small amount of visible lime. The substratum consists of very limy, massive, pink stony loam. The stone content ranges from 20 percent in the surface layer to 50 percent in the subsoil.

These soils have a low to moderate capacity to store moisture. They absorb water at a moderate rate and have medium internal drainage. Runoff is medium to rapid, depending on the slope. Water erosion will be moderate to severe if the vegetative cover is destroyed.

Native range is the principal use of these soils. Stroupe stony loam produces most of the edible forage, and Pinata stony loam produces the most wood products. Moderate to heavy stands of pinyon and juniper and an understory of scrub oak, blue grama, galleta, and yucca make up the main part of the vegetation. There are a few ponderosa pines. Some pinyon and juniper are cut for fenceposts and firewood. Wildlife browse the understory. (Both soils are in dryland capability unit VIIs-3, climatic zone 4; Hills range site)

Pinata-Stroupe stony loams, 20 to 50 percent slopes (Pu).—These soils occur on mountainside slopes in the Gallinas Mountains. The Pinata stony loam makes up 55 to 75 percent of the acreage, and the Stroupe stony loam, 25 to 45 percent. Included in mapping were areas where the slope is less than 20 percent.

The Pinata soil in this complex is shallower than a typical Pinata soil. It formed in material weathered from sandstone rather than from felsite, and it supports a different kind of vegetation than a typical Pinata soil. The Stroupe soil is less stony and has a redder subsoil than is typical of Stroupe soils; it formed in material weathered from sandstone rather than from felsite.

The Pinata stony loam is nonlimy. It is generally the steeper, stonier, more thickly wooded part of the complex. A layer of decomposing forest litter, about 3 inches thick, covers the surface. The surface layer is about 6 inches thick. The dark-colored upper part is very thin and in places almost entirely lacking. The lower part consists of light brownish-gray stony loam that has weak platy and moderate crumb structure. This layer tongues into the upper part of the subsoil. The subsoil, about 18 inches thick, consists of reddish-brown stony clay that has moderate subangular blocky structure. It grades at a depth of about 24 inches to sandstone bedrock. The stone content ranges from 60 percent in the surface layer to 70 percent in the subsoil.

Stroupe stony loam is the less stony, less sloping, more open part of the complex. It has a surface layer, about 2 inches thick, of dark-brown stony loam that has weak granular structure. The surface layer grades to a subsoil, about 18 inches thick, of dark reddish-brown stony clay that has weak prismatic and strong blocky structure. The subsoil has been leached of lime in the upper part, and the lower part is lighter colored and contains a small amount of visible lime. It grades to pink, very limy, massive stony loam, which grades to weathered sandstone at a depth of about 24 inches. The rock content ranges from 30 percent in the surface layer to 50 percent in the subsoil.

These soils are subject to excessive runoff, severe water erosion, and rapid evaporation if the protective cover is overgrazed or is destroyed by fire. Under the present plant cover, runoff is slow to medium on the Pinata soil and medium to rapid on the Stroupe soil, and water erosion is slight to moderate. The Pinata soil absorbs water rapidly, and the Stroupe soil absorbs water at a moderate rate. Both soils have medium internal drainage and low to moderate capacity to store moisture. Most roots are confined to the surface layer and the subsoil.

These soils support moderate to heavy stands of pinyon and juniper and an understory of scrub oak, blue grama, and yucca. There are a few ponderosa pines. Some trees are harvested for fenceposts and firewood. The Pinata soil produces most of the woody vegetation, and the Stroupe soil most of the edible forage. Wildlife habitats and livestock range are the principal uses of these soils. (Dryland capability unit VIIe-2, climatic zone 4; Mountain Shale range site)

Pino loam, loamy substratum, 3 to 12 percent slopes (Pv).—This soil occurs on piedmont fans on the eastern foot slopes of the Manzano Mountains. Normally, about an inch of decomposing forest litter covers the surface. The surface layer is about 6 inches thick. Its upper part is grayish-brown loam that has moderate crumb structure. The lower part is brown, friable very fine sandy loam that has weak platy and moderate granular structure. This layer tongues into the upper part of the subsoil. The subsoil, several feet thick, consists of brown or light-brown clay loam that has moderate to strong subangular blocky structure. In places it contains a massive hardpan at a depth of about 2 feet. This soil contains no lime. It overlies alluvium derived from mixed, acid material.

Slopes of about 6 percent are the most common. Included in mapping were small areas of Fuera cobbly loam, 5 to 20 percent slopes, and Witt loam, 1 to 6 percent slopes.

At present, runoff is slow and erosion slight, but runoff will be rapid and water erosion severe if the vegetative cover is destroyed by fire or by excessive logging. This soil absorbs water rapidly and has medium to slow internal drainage. The capacity to store moisture for plants is high.

This soil is used mainly for production of commercial timber, for wildlife habitats, and for livestock range. It is also suitable for recreational uses. Dense stands of ponderosa pine and an understory of scrub oak, junegrass, and other cool-season grasses make up the native vegetation. Some oak is cut for posts and firewood. Mature and diseased trees are harvested for commercial wood products. (Dryland capability unit VIIe–6, climatic zone 4; timber suitability group 3)

Pino silt loam, 2 to 30 percent slopes (Pw).—This soil occurs on ridgetops on the eastern slopes of the Manzano Mountains. A layer of decomposing forest litter, about 2 inches thick, covers the surface. The surface layer, about 10 inches thick, consists of brown, friable silt loam that has weak subangular blocky and moderate crumb structure. It grades to a subsoil, about 22 inches thick, of brown clay that has moderate prismatic and moderate to strong subangular blocky structure. This layer is lighter colored in the lower part. The substratum is pale-yellow and olive-yellow, massive clay about 12 inches thick. It overlies hard limestone bedrock. The soil is nonlimy.

Slopes are most commonly about 8 percent. Included in mapping were small areas of Wilcoxson stony loam, 5 to 20 percent slopes, and Capillo loam, 15 to 50 percent slopes. A few stones occur on the surface in places.

Under the present plant cover, runoff is slow to medium and water erosion is slight, but severe water erosion will result if the vegetation is destroyed by fire or excessive logging. This soil absorbs moisture rapidly, but it has slow internal drainage. It has a high capacity to store moisture.

This soil supports ponderosa pine, lesser amounts of Douglas-fir and juniper, and an understory of Gambel oak, squirreltail, Carex, and cool-season grasses. It is used mainly for commercial production of timber and for wildlife habitats. It is also suitable for recreational uses. Livestock graze the understory in the more accessible areas. Mature and diseased trees are harvested commercially. A few scrub oaks are cut for posts and firewood. (Dryland capability unit VIIe–6, climatic zone 4; timber suitability group 3)

Pinon channery loam, 3 to 20 percent slopes (Px).—This soil occurs on crests and side slopes of ridges throughout the survey Area. The surface layer, about 6 inches thick, consists of brown, friable, limy channery loam that has moderate granular structure. The subsoil, about 4 inches thick, consists of light-brown channery loam that has weak subangular blocky structure. The substratum is massive channery loam that is very high in lime content. It rests abruptly on partly weathered, fractured limestone bedrock. The content of channery limestone ranges from 40 percent in the surface layer to 70 percent in the subsoil. In a few places this soil has a leached surface layer and a more strongly developed subsoil. As the slope increases, the surface layer thins and the rock content increases.

Small areas of Laporte-Rock outcrop complex and Turkeysprings stony loam, 20 to 50 percent slopes, were included in mapping. Also included were small areas that have partly cemented caliche in the substratum, rather than limestone. South of Mountainair, below the Chupadera Mesa, is a small acreage of a soil that contains quartzite gravel mixed with lime, rather than channery fragments of limestone. Slopes of less than 3 percent are common on ridgetops.

This soil has a low capacity to store moisture for plants. It takes in water at a moderate to rapid rate. Runoff is very slow to slow, and internal drainage is medium. Water erosion is slight to moderate, depending on the slope. Severe erosion will result if the plant cover is destroyed.

This soil supports moderate to heavy stands of pinyon and juniper and an understory of blue grama, sand dropseed, cactus, and scrub oak. Mechanical brush control practices are practical and are widely used. The brush should be left on the surface for protection against erosion until grasses have become established. Livestock range is the principal use, but many of the trees are cut for posts and firewood. Deer and other wildlife find suitable habitats. A few areas were formerly farmed, but most have been returned to grass in recent years. In places limestone has been quarried for use in road construction. (Dryland capability unit VIIs–1, climatic zones 4 and 5; Shallow range site)

Prewitt and Manzano soils (0 to 3 percent slopes) (Pz).—This unit occurs on alluvial flood plains and swales in the southern and eastern parts of the survey Area. The Prewitt soils make up 60 to 80 percent of the acreage, and the Manzano soils 20 to 40 percent.

The Prewitt soils normally have a surface layer, about 8 inches thick, of brown, friable loam that contains a small amount of lime. This layer has weak granular structure. It rests on a subsoil, about 10 inches thick, of brown, limy light clay loam that has weak subangular blocky structure. The substratum is brown, massive light clay loam that contains some visible lime. In many places this layer is made up of stratified layers of coarser and finer particles. Recent deposits of coarser textured material are common on the surface. In some places the surface layer is clay loam.

The Manzano soils are normally darker colored and more strongly developed than the Prewitt soils. Their surface layer, about 9 inches thick, consists of grayish-brown or dark-brown, friable loam that has been leached of lime. It has moderate granular structure. This layer grades to a subsoil of dark grayish-brown light clay loam that has weak prismatic and moderate subangular blocky structure. The upper part of the subsoil has been leached nearly free of lime. The lower part is lighter colored and contains a small amount of visible lime. The subsoil is about 20 inches thick. It overlies a substratum of brown light clay loam that contains more visible lime. The substratum has weak subangular blocky structure. In places there are recent deposits of coarser textured material on the surface. In some places this soil has a clay loam texture throughout the profile.

Included in mapping were small areas that have a gravelly subsoil or substratum. Also included were small areas of Moriarty clay loam, 0 to 1 percent slopes.

These soils are subject to flooding and to severe water erosion. Flooding occurs about once a year, usually late in summer. Sometimes the floods deposit layers of sediment thick enough to cover the vegetation. Headcuts are common in places where the water is swift or where it follows livestock trails or roads. Generally, however, overflow is more beneficial than harmful because much of the water is absorbed by the soil and becomes available for plant use.

These soils absorb water at a moderate to slow rate, and they have a high capacity to store moisture for plants. Surface runoff is slow to medium, and internal drainage is medium.

These soils are fertile. They support a dense growth of blue grama, western wheatgrass, vine-mesquite, ring muhly, snakeweed, and chamiza, and a few junipers. Livestock range is the main use, but a small acreage near the village of Manzano is being farmed. Corn, pinto beans, and sorghum are the main crops. Water spreaders and diversions help to slow floodwater, spread it over a wider area, and so reduce the erosion hazard. Most areas of these soils are good sites for ponds. (Dryland capability unit IVew–1 if in climatic zone 4, VIew–2 if in climatic zone 5; Bottomland range site)

Rance-Gypsum land complex (1 to 9 percent slopes) (Rg).—This complex occurs on rolling hills and piedmont fans in the southwestern and southeastern parts of the Area. The Rance soils, ordinarily dominant, make up 45 to 60 percent of the acreage, and Gypsum land, 40 to 55 percent.

The Rance soils are the darker colored, somewhat concave parts of the complex. They have a surface layer, about 3 inches thick, of light brownish-gray, friable silt loam. This layer has strong granular structure. The subsoil, about 23 inches thick, consists of pale-brown silt loam. The upper part has weak subangular blocky structure; the lower part is massive. This layer overlies white, soft, structureless, silty gypsum. The soil is limy throughout, and the lime content gradually increases with depth. The depth to gypsum ranges from 15 to 35 inches.

Gypsum land occurs as lighter colored, sparsely vegetated areas on convex ridgetops. It normally consists of about 1 inch of light-gray silt loam of moderate platy and moderate granular structure overlying soft, white, silty gypsum. In some places the gypsum is exposed, but in others about 4 inches of soil material covers the deposits.

The soil material above the gypsum is generally browner and commonly thicker in the southwestern part of the Area. A fine sandy loam texture is common. In some areas the gypsum is consolidated but only semihard. Included in mapping were small areas of La Fonda-Rock outcrop complex. About 10 percent of the complex consists of soils deeper than Gypsum land but shallower than the Rance soils.

The Rance soils are moderate in fertility and in organic-matter content. They are readily eroded when not protected by adequate plant cover. They absorb water at a moderate rate and have a moderate capacity to store moisture for plants. Surface runoff is slow, and internal drainage is medium.

Gypsum land is very droughty, and few plants can tolerate the high gypsum content. The surface crusts over readily and tends to shed water. Water is absorbed slowly, and the capacity to store moisture is low. Runoff is rapid, and internal drainage is medium to rapid. Most plant roots are confined to the uppermost layer. These areas are readily eroded by wind and water.

This complex is used for production of native forage. The Rance soils produce the greater amount, mainly blue grama, galleta, and ring muhly. Snakeweed, gyp grama, and sage are the most common plants on Gypsum land. Sand dropseed, yucca, pinyon, and juniper are common in the southwestern part of the Area. The gypsum deposits are not being mined at present. Some trees are harvested for posts and firewood. (Dryland capability unit VIIs–2, climatic zones 4 and 5. The Rance soils are in Loamy range site. Gypsum land is in Gyp Flats range site)

Rock land (3 to 25 percent slopes) (Rk).—This land type occurs on hills and mountains in the eastern part of the survey Area. Rocks make up about 85 to 98 percent of the acreage, and shallow soil about 2 to 15 percent (fig. 18).

Rock land occurs mainly on uniform convex slopes that range from 1 to 75 percent but are ordinarily 3 to 25 percent. In places the slope is rough and broken, and the rocks are larger than is common. Most of the rocks are acid; they consist mainly of igneous rock, gneiss, schist, and quartzite. There is some limestone. The rock form is mainly subangular, but there are angular and platy forms also. Pieces of rock range in size from 1 inch in diameter to more than 10 feet, but ordinarily they are 10 to 15 inches in diameter. Small pockets of brown to reddish-brown loam or fine sandy loam occur between rocks and in fractures. Generally, the soil material is less than 20 inches deep, but in places it is 3 to 4 feet deep.

Included in mapping were small areas of Kech gravelly loam, 1 to 9 percent slopes, and small areas of Clovis loam, 0 to 5 percent slopes.

The water intake rate between the rocks and in the fractures is rapid, and internal drainage is rapid. The water-storage capacity is very low. Surface runoff ranges from medium to very rapid, depending on the slope. Erosion removes soil material nearly as fast as it forms.

The vegetation consists of a sparse growth of blue grama, side-oats grama, black grama, snakeweed, juniper, and, on the northern slopes, scrub oak. Livestock and wildlife range is the principal use. Antelope graze the lower

Figure 18.—Rock land in the Pedernal Hills. Rocks cover about 90 percent of the surface in this area.

hills. Some of the areas are sources of rock suitable for use in roadbuilding. (Dryland capability unit VIIs-1, climatic zone 5; Shallow range site)

Rock outcrop-Pinon-La Fonda complex (10 to 60 percent slopes) (Rp).—This complex occurs on ridgetops, side slopes, and breaks of mesa escarpments (fig. 19) in the southwestern and eastern parts of the survey Area. On the steeper escarpments, outcrops cover about 80 to 90 percent of the surface. They consist of sandstone, siltstone, gypsum, caliche, and some limestone. The slope generally ranges from 3 to 80 percent; some of the slopes are nearly vertical. Limestone and caliche are ordinarily near the crest of the escarpment. The face of the escarpment is dissected by numerous rills and gullies. In some places above the ledge rock, there are small pockets of soil material. The escarpments rise 25 to 400 feet above the surrounding uplands.

The Pinon soils are on narrow ridgetops. They do not occur in all areas of the complex, and in any given area they make up 10 percent or less of the acreage. Their slope is generally less than 5 percent, which is less than is typical of the complex as a whole. They normally have a surface layer, about 4 inches thick, of brown or grayish-brown channery loam that has moderate granular structure. The subsoil, about 4 inches thick, consists of light-brown or light grayish-brown channery loam that has weak subangular blocky structure. The substratum, about 6 inches thick, is very limy, pinkish-white channery loam overlying limestone or partly cemented caliche.

The La Fonda soils make up 5 to 15 percent of the complex. They occur near the base of escarpments on slopes of 3 to 15 percent. They are commonly dissected by shallow V-shaped gullies and are continuously being eroded or receiving new colluvial deposits of soil material. They normally have a surface layer, about 6 inches thick, of reddish-brown, friable, limy loam or fine sandy loam that has moderate granular structure. This layer grades to a subsoil, about 18 inches thick, of light reddish-brown, limy loam or heavy loam that has weak subangular blocky structure. The substratum consists of limy, light reddish-brown, massive loam. The recent deposits are lighter colored, and many are gravelly.

Included in mapping were small areas of Laporte-Rock outcrop complex, La Fonda-Rock outcrop complex, and Rance-Gypsum land complex.

The Rock outcrop part of this complex is mostly steep, erodible, and barren. Runoff is very rapid, and water erosion is severe. The Pinon soils are shallow and rocky. They absorb water readily and have medium internal drainage. Surface runoff is medium. The La Fonda soils have a moderate capacity to store moisture, and they absorb water at a moderate rate. Runoff is medium to rapid, and internal drainage is medium. The La Fonda soils are easily eroded when runoff is rapid.

Figure 19.—**An area typical of Rock outcrop-Pinon-La Fonda complex. Pinon soils occur on the mesa top, Rock outcrop on the escarpment, and La Fonda soils on the foot slopes.**

Livestock range and wildlife habitat are the principal uses of this complex. The La Fonda soils produce most of the edible forage, and the Pinon soils produce most of the woody vegetation. Rock outcrop supports a few juniper trees and a little blue grama and sand dropseed. The Pinon soils support moderate to heavy stands of pinyon and juniper and an understory of blue grama, sand dropseed, galleta, cactus, and snakeweed. The La Fonda soils mainly support blue grama, sand dropseed, galleta, snakeweed, and a few juniper trees. (Dryland capability unit VIIe-1, climatic zones 4 and 5. Rock outcrop is in Breaks range site; the Pinon soils are in Shallow range site; the La Fonda soils are in Loamy range site)

Rock outcrops and slides (50 to 100 percent slopes) (Rs).—This land type occurs mainly on western slopes of the Manzano Mountains and near the crest of the Gallinas Mountains. Rock outcrops make up 70 to 85 percent of the acreage. They occur mainly just below the western rim of the Manzano Mountains. The relief is normally stairstep or is characterized by cliffs. The slope ranges from moderately sloping on top of the cliffs to very steep or vertical on the escarpments. The slope is commonly about 80 percent. Rock outcrops, mostly limestone, form the cliffs. There is also some igneous rock, gneiss, and schist. Vertical dropoff from the crest of the cliffs to the next lower protruding shelf ranges from 3 feet to more than 50 feet. Some soil material accumulates in small pockets and in fractures in the bedrock on the crest of the cliffs. These pockets of soil support most of the plant life. The soil is mainly dark colored, loamy, and shallow.

Rock slides make up about 15 to 30 percent of the acreage. They are on very steep slopes in the Manzano and Gallinas Mountains. These areas consist of fragments of igneous rock, limestone, gneiss, schist, and felsite, of various sizes and shapes. The slides result from weathering of exposed rock on cliffs and peaks. Material eventually breaks loose and slides downhill. The slides denude the slope of vegetation, and rock piles accumulate at the foot of slopes and near obstructions. Rock slides include both the denuded areas and the rock piles.

Runoff is very rapid, and erosion is very severe. Little or no water is held for plants.

These areas are suitable only for wildlife habitats, mainly for birds and deer. There is some scrub oak and a few ponderosa pines and junipers. (Dryland capability unit VIIIs-1, climatic zone 4)

Salas stony loam, 30 to 70 percent slopes (Sa).—This soil occurs on the western slopes of the Manzano Mountains. It is nonlimy. The surface layer, about 6 inches thick, consists of dark-brown, friable stony loam that has moderate granular structure. This layer grades to a subsoil of reddish-brown stony silty clay loam or stony clay loam of moderate subangular blocky structure. The subsoil is about 25 inches thick and overlies massive schist bedrock.

In about one-third of the acreage, the surface layer is stony sandy loam. Included are some narrow ridgetops where the slope is 5 to 10 percent and a few small arroyos that contain mixed alluvial sediments. In some places the areas mapped include a soil that has a layer of lime at a depth of about 12 to 18 inches.

This soil is subject to severe water erosion if the vegetative cover is destroyed. Under the present plant cover, water erosion is slight and surface runoff is medium to rapid. This soil is droughty because of its exposure to the sun and to the prevailing winds and also because its capacity to store moisture is low to moderate. It absorbs water rapidly and has medium to rapid internal drainage. Rocks cover much of the surface; they limit plant density, but they help to control runoff and erosion.

The principal use of this soil is native range. Light to moderate stands of pinyon and juniper, and an understory of blue grama, side-oats grama, cactus, mountain mahogany, and yucca make up the vegetation. Both wildlife and livestock graze the understory. (Dryland capability unit VIIe–2, climatic zones 4 and 5; Mountain Shale range site)

Scholle gravelly loam, 1 to 9 percent slopes (Sc).—This soil occurs on upland piedmont fans in the southwestern and eastern parts of the survey Area.

The surface layer, about 5 inches thick, consists of brown, friable gravelly loam that has moderate subangular blocky and moderate granular structure. This layer has been leached of lime. The subsoil, about 10 inches thick, consists of gravelly clay loam that has weak prismatic and moderate subangular blocky structure. The upper part is reddish brown and has been leached nearly free of lime; the lower part is light brown and contains a moderate amount of lime. It grades to a substratum of pinkish-white to pink, massive gravelly loam. The upper part of the substratum contains much visible lime, but the lime content gradually decreases with depth. The gravel content ranges from about 20 percent in the surface layer to about 30 to 40 percent in the substratum.

Included in mapping were areas of Chilton gravelly loam; Witt loam, 1 to 6 percent slopes; and Clovis loam, 0 to 5 percent slopes.

This soil has a low to moderate water-storage capacity. It absorbs water at a moderate rate and has medium internal drainage. Runoff is slow to medium. Wind erosion and water erosion are moderate if the soil is not protected by adequate plant cover. Fertility is low to moderate, and the organic-matter content is low to moderate.

Native range is the principal use. The native vegetation consists of blue grama, sand dropseed, galleta, ring muhly, cactus, yucca, and a few pinyon and juniper trees. Some areas are sources of gravel suitable for roadbuilding. (Dryland capability unit VIs–1, climatic zones 4 and 5; Shallow range site)

Scholle loam, 1 to 5 percent slopes (Sh).—This soil occurs on upland piedmont fans on the Chupadera Mesa in the southwestern part of the survey Area.

It is deeper and less gravelly than Scholle gravelly loam, 1 to 9 percent slopes, and is more limy in the surface layer. It has a surface layer, about 4 inches thick, of light-brown, friable loam that contains a few waterworn pebbles. This layer has moderate granular structure and is slightly limy. It grades to a subsoil of pinkish-gray clay loam that has weak prismatic and moderate subangular blocky structure. The lower part of the subsoil is slightly lighter colored; it contains much visible lime and a few waterworn pebbles. It is about 17 inches thick and grades to a substratum of light reddish-brown, very limy gravelly clay loam. This layer has weak subangular blocky structure. It is about 30 percent gravel.

Included in mapping were a few small areas of Witt loam, 1 to 6 percent slopes.

This soil is low to moderate in fertility and in organic-matter content. It is readily eroded by wind if the plant cover is destroyed or overgrazed. It takes in water at a moderate rate and has a moderate capacity to store moisture for plants. Surface runoff is slow to medium, and internal drainage is medium. Most plant roots are confined to the surface layer and the subsoil.

This soil is not suited to cultivation, because rainfall is scanty and erratic. It is used mainly for production of native forage. The vegetative cover consists of light to moderate stands of pinyon and juniper and an understory of blue grama, sand dropseed, galleta, snakeweed, and cactus. Some of the trees are harvested for posts and firewood. There are a few abandoned fields that were formerly cultivated. Most of these have been severely eroded by wind. Many of the fields have been returned to grass through mechanical reseeding or natural reseeding and are being used as range. They need to be protected from overgrazing until plants are well established. (Dryland capability unit VIs–1, climatic zones 4 and 5; Loamy range site)

Steep rock land (20 to 80 percent slopes) (Sm).—This land type occurs on mesa breaks, escarpments, or side slopes of ridges in the southern and eastern parts of the survey Area. These steep, rocky slopes range in height from less than 50 feet to more than 500 feet from base to crest. Slopes of 50 to 75 percent are most common. The surface relief is normally stairstep or is characterized by ledges, but in places it is rough and broken. The steps, or ledges, formed from outcrops that were exposed through stream channel erosion or, more commonly, through faulting and uplifting. Rock outcrops and surface stones cover about 90 percent of the surface. They are more numerous on slopes facing south and west than on slopes facing north and east. Glorieta sandstone is common in the eastern part of the Area; it is capped with Chupadera limestone on the Chupadera Mesa escarpment. In areas west and north of Mountainair, the rock is mainly Abo sandstone.

Included in mapping were recent mixed colluvial-alluvial materials that have accumulated at the base of these slopes. About 10 percent of the acreage is made up of shallow soils in small pockets and in fractures between rocks. The soils derived from sandstone are normally sandy, nonlimy, and reddish brown. The soils derived from limestone are loamy, limy, and brown. Also included in mapping were several small tracts on north-facing slopes in the northeastern part of the Area. These tracts support some commercial timber.

This land type is subject to severe water erosion if the plant cover is destroyed. Runoff is rapid. Only a limited amount of moisture is stored in the small pockets of soil and in the rock fractures. The slopes that have a southern or western aspect are more droughty than others because they are exposed to the sun and the prevailing winds.

Livestock range and wildlife habitats are the main uses of this land type. The vegetation is stunted; it consists mainly of light to heavy stands of pinyon and juniper and an understory of blue grama, side-oats grama, sand dropseed, ring muhly, and scrub oak. A few trees are cut for posts and firewood. This land type is not suited to mechanical brush control, because of the erosion hazard. (Dryland capability unit VIIe-3, climatic zones 4 and 5; Breaks range site)

Stony alluvial land (5 to 15 percent slopes) (Sn).—This land type occurs on arroyo bottoms and streambeds in mountainous areas in the western and southern parts of the survey Area. The drainageways are narrow, normally less than 200 feet wide. They extend from the lower elevations of about 5,800 feet to the higher elevations of about 7,500 feet. The surface is covered by numerous waterworn stones, cobblestones, pebbles, and pockets of sand weathered from mixed igneous rock, schist, gneiss, felsite, sandstone, or limestone. In places loamy and clayey sediments are intermingled with the rock particles or have accumulated in small pockets.

Included in mapping were small areas of Tampico loam and Prewitt and Manzano soils.

Stony alluvial land is subject to frequent overflow, and serious water erosion occurs during each period of inundation. Soil does not form, because sediments do not remain in place for any length of time. This land has a low capacity to store moisture. Most of the water received either is lost through runoff or enters underground water strata.

The most common plants on Stony alluvial land are woody plants; their large, deep root systems can penetrate the coarse material in search of moisture and plant nutrients. The vegetation at the lower elevations consists mainly of scrub oak, hackberry, chokecherry, snowberry, algerita, and alkali sacaton. Ponderosa pine, willow, scrub oak, pinyon, and juniper are the most common plants at the higher elevations. Recreation, wildlife habitat, and timber production are the main uses. A few mature pines are harvested. During wet periods flowing water is often available for wildlife and livestock. (Dryland capability unit VIIe-7, climatic zone 4; timber suitability group 4)

Stony steep land (25 to 75 percent slopes) (So).—This land type occurs on canyon side slopes of piedmont fans that border arroyos in the southwestern part of the Area and on mountain slopes in the Pedernal Hills in the eastern part of the survey Area. It occurs at elevations ranging from 6,500 to 7,600 feet. The relief is normally a uniform, steep slope that has a few small V-shaped gullies entrenched from the crest to the base of the slope. About 90 percent of the surface is covered with fragments of igneous rock, quartzite, gneiss, and schist, of various sizes. There are a few limestone rocks. The rocks on the side slopes of the piedmont fans are mostly waterworn or rounded. Many are less than 12 inches in diameter. The rocks in the Pedernal Hills area are mostly angular or subangular. They range from a few inches to several feet in diameter but are most commonly about 10 to 25 inches across.

Sandstone crops out in a few places in the southwestern part of the Area. About 10 percent of the acreage consists of shallow soils in small pockets and between rocks. These soil materials are normally loamy, nonlimy, and brown.

Stony steep land has a low capacity to store moisture. Surface runoff is rapid to very rapid. Most of the water that falls runs off and carries with it the weathered soil particles about as fast as they form. Larger chunks of rock are moved downslope by heavy rains, and they accumulate in the drainageways or at the base of the slopes.

The vegetation is sparse, but it provides some forage for livestock and wildlife. It consists of blue grama, black grama, side-oats grama, sand dropseed, some scrub oak, and light to moderate stands of pinyon and juniper. This land type should be grazed lightly so that plant residue can accumulate for protection against severe erosion. In places the rock is suitable for use in road construction or as riprap. (Dryland capability unit VIIs-3, climatic zones 4 and 5; Hills range site)

Stroupe stony loam, 15 to 70 percent slopes (Sp).—This soil occurs on side slopes of hills and on mountain slopes in the Gallinas Mountains in the southern part of the survey Area. It has a surface layer, about 4 inches thick, of dark-brown, friable stony loam that has moderate granular structure. This layer has been leached of lime. It grades to a subsoil, about 16 inches thick, of brown stony clay that has weak prismatic and moderate subangular blocky structure. The upper part of this layer has been leached of lime. The subsoil grades to fractured, partly weathered felsite bedrock that has some subsoil material in the fractures. Rocks and stones make up about 85 percent of the surface layer and the lower part of the subsoil and about 30 percent of the upper part of the subsoil.

Included in mapping were small areas of Pinata soils on the cooler, moister, north-facing slopes.

This soil is subject to severe water erosion if the plant cover is destroyed. It absorbs water rapidly but has a low capacity to store moisture for plants. Surface runoff and internal drainage are medium to rapid. The surface stones help to check runoff and limit erosion.

This soil supports sparse stands of side-oats grama, blue grama, black grama, cactus, yucca, and gray oak, and a few pinyon and juniper trees. Livestock and wildlife graze the edible forage. The rock is suitable for use as riprap in earthen structures. (Dryland capability unit VIIe-2, climatic zone 4; Mountain Shale range site)

Supervisor loam, 40 to 80 percent slopes (Sr).—This soil occurs on north- and east-facing canyon side slopes in the Manzano Mountains. A layer of decomposing forest litter, about 3 inches thick, covers the surface. The surface layer, about 13 inches thick, consists of dark grayish-brown loam that has weak granular structure. It grades to a subsoil, also about 13 inches thick, of grayish-brown stony loam that has weak subangular blocky structure. The substratum is very pale brown stony loam that has very weak subangular blocky structure. It grades at a depth of about 30 inches to hard schist bedrock. This soil is nonlimy. The surface layer is free of stones, but the subsoil is about 40 percent stones, and the substratum 80 percent.

The slope is most commonly about 60 percent. Small areas of Mirabal stony sandy loam, 40 to 80 percent slopes, were included in mapping.

Severe erosion will result if the vegetative cover is destroyed by fire or excessive logging. Runoff will also be very rapid. Runoff is slow to medium. This soil absorbs water rapidly and has medium to rapid internal drainage. It has a moderate capacity to store moisture for plants.

This is one of the more productive soils for commercial timber in the Area, but harvesting is difficult because of the very steep slopes. White fir, Douglas-fir, scattered ponderosa pine, and an understory of Oregongrape, lupine, Carex, and junegrass make up the vegetative cover. Mostly, mature and diseased trees are harvested. Wildlife browse the understory, and livestock graze the more accessible areas. (Dryland capability unit VIIe-5, climatic zone 4; timber suitability group 2)

Tampico loam (1 to 6 percent slopes) (Ta).—This soil occurs on narrow canyon bottoms and on flood plains in the mountains of the western and southern parts of the survey Area. Profile characteristics vary with location, mainly because of differences in parent material. There is much variation also in the amount of and depth to gravel and in color and texture. Generally, the soil in the Manzano Mountains is darker, more clayey in the subsoil, and more alkaline than the soil in the Gallinas Mountains.

This soil normally has a surface layer, about 19 inches thick, of grayish-brown, very friable loam that has weak subangular blocky structure breaking to weak crumb structure. This layer grades to a subsoil, also about 19 inches thick, of brown, friable, gravelly heavy loam that has moderate subangular blocky structure. This layer grades to a substratum of reddish-brown, massive gravelly clay loam. The soil is nonlimy. It is free of gravel in the surface layer and contains as much as 35 percent gravel in the subsoil and substratum. A thin layer of litter is at the surface in places.

Included in mapping were areas of Stony alluvial land in the streambeds and some areas near the heads of drainageways where the slope exceeds 6 percent.

This soil is subject to occasional or frequent overflow from flooding streams and from runoff from nearby steeper soils. Erosion often results in the formation of headcuts and gullies if the surface is not protected with adequate plant cover or forest litter. Overflow can be expected once or twice a year, normally in summer or when the spring thaw begins. Some of the higher lying areas receive little or no runoff. The windthrow hazard is most severe in spring when the soil is wet.

This soil is very high in fertility and in organic-matter content. It absorbs water readily and has a moderate to high capacity to store moisture. It is easily penetrated by plant roots. Internal drainage is medium. In many areas along streambanks, the underlying moisture keeps the soil moist much of the time. Surface runoff is medium in the open grassland areas and slow in the forested areas.

This soil has a better potential for the production of commercial timber than any other soil in the Torrance Area. It produces more edible forage for wildlife and livestock than any of the soils with which it is associated. It is also the soil best suited to establishment of recreational facilities. Most of the water for wildlife and domestic use comes from nearby streams. The vegetation consists mostly of ponderosa pine, Douglas-fir, and white fir and an understory of blue grama, Kentucky bluegrass, western wheatgrass, maple, Gambel oak, gray oak, and many browse plants and forbs. Mostly, mature and diseased trees are harvested. Some oak is cut for fenceposts and firewood. A few perennial streams are stocked with trout and provide fishing in season. Some of the areas are used for campgrounds and picnic facilities. (Dryland capability unit VIew-3, climatic zone 4; timber suitability group 1)

Tapia loam, 0 to 5 percent slopes (Tc).—This soil occurs on upland piedmont fans in the western and eastern parts of the survey Area. The surface layer, about 3 inches thick, is brown friable loam that has moderate granular structure. This layer has been leached of lime. It grades to a subsoil, about 18 inches thick, of light-brown clay loam that has weak prismatic and moderate subangular blocky structure. The upper part of the subsoil has been leached of lime; the lower part contains a moderate amount of visible lime. It overlies a substratum of white, massive, weakly fractured caliche. The depth to caliche ranges from 12 inches in the western part of the Area to 35 inches in the eastern part.

In the southern foothills of the Manzano Mountains, the subsoil is reddish brown, and limestone bedrock, below the caliche deposits, is at a depth of about 2 feet. Included in mapping were areas of Dean loam, 1 to 9 percent slopes, and Clovis loam, 0 to 5 percent slopes.

This soil occurs in areas where rainfall is scanty and erratic, and for this reason it is not suited to cultivation. It is subject to severe wind erosion when plowed or when the plant cover is severely overgrazed. It takes in water at a moderate rate and has medium internal drainage. The water-storage capacity is low to moderate. Surface runoff is slow to medium. Most plant roots are confined to the surface layer and subsoil.

This soil is presently used for production of native forage. A few areas were formerly cultivated, but most of these have been reseeded to grass and are being grazed. Blue grama, sand dropseed, galleta, ring muhly, cactus, winterfat, and snakeweed are common at the lower elevations, and there are light to moderate stands of pinyon and juniper at the higher elevations. In a few places the caliche deposits are excavated for use in road construction. (Dryland capability unit VIs-4, climatic zones 4 and 5; Loamy range site)

Tapia-Dean loams, 0 to 5 percent slopes (Td).—This unit occurs on upland piedmont fans in the eastern part of the Area. In places these soils occur as a complex, but in other places they occur as an association. In the complexes the soils have apparently been altered as a result of rodent activity. The animals burrowed into the caliche deposits underlying the normal Tapia loam and brought this material to the surface and mixed it with material from the surface layer and the subsoil. The mixing destroyed the structure and increased the lime content of the upper layers. The rodent dens occur as low mounds on the surface. Where these soils occur in association they could have been mapped separately, but doing so would have served no practical purpose.

The Tapia loam makes up 55 to 70 percent of the acreage. It is the darker colored, deeper, more nearly level of the two major soils. It normally has a surface layer, about 4 inches thick, of brown, friable loam that has moderate granular structure. This layer has been leached of lime. It grades to a subsoil, about 20 inches thick, of dark-brown clay loam that has weak prismatic and moderate subangular blocky structure. The upper part of the subsoil has been leached of lime. The substratum is very limy, massive, pinkish-white or white, weakly fractured caliche that becomes more friable with depth. The upper few inches are more strongly cemented than the lower part. The depth to caliche ranges from 15 to 35 inches.

The Dean loam makes up 30 to 45 percent of the acreage. It occurs on low mounds or on the crests of ridges and is limy, light colored, and shallower than the Tapia loam. Many caliche pebbles are on the surface. The surface layer, about 3 inches thick, consists of light brownish-gray, limy loam that has weak granular structure. The subsoil, about 4 inches thick, is also light brownish-gray, limy loam, but its structure is weak subangular blocky. It overlies a substratum of very limy, light-gray, massive gravelly loam. This layer consists of caliche; the upper part is the more strongly cemented. The depth to caliche ranges from 8 to 15 inches.

Included in mapping were small areas of Pastura loam, 1 to 9 percent slopes; Harvey loam, 1 to 9 percent slopes; and Prewitt and Manzano soils.

These soils are not suited to cultivation, because they occur in areas where rainfall is low and the hazard of wind erosion is severe if the surface is not protected by adequate plant cover. They absorb moisture at a moderate rate and have medium internal drainage. The Tapia loam stores more water for plant use than the Dean loam, and it produces more vegetation. Surface runoff is slow to medium. Most plant roots are confined to the surface layer and the subsoil.

This is one of the largest mapping units in the Torrance Area. It is used mostly for production of native forage for livestock. Blue grama, galleta, sand dropseed, ring muhly, winterfat, snakeweed, and cactus are common. Stands of grasses are thicker and more vigorous on the Tapia loam; weeds are more prevalent on the Dean loam. In some places caliche has been excavated for use in road construction. (Both soils are in climatic zone 5. Tapia loam is in dryland capability unit VIs–4; Loamy range site. Dean loam is in dryland capability unit VIe–2; Limy range site)

Tapia and Dean soils, eroded (0 to 5 percent slopes) (Te).—This unit occurs on upland piedmont fans, mostly in abandoned fields in the western and eastern parts of the survey Area. These soils have been severely eroded by wind. Most or all of the original surface layer has been blown away, and in places, part of the subsoil. The relief is smooth in some places and slightly undulating in others.

The Tapia soils make up 45 to 65 percent of the acreage. They are the darker colored, less limy, deeper, more nearly level of the two major soils. The subsoil is exposed, and there are many caliche pebbles on the surface. This layer is about 12 inches thick and consists of dark-brown, slightly limy clay loam that has weak prismatic and moderate subangular blocky structure. It overlies a massive substratum of white or pinkish-white, partly cemented caliche. The depth to caliche ranges from 12 to 20 inches.

The Dean soils make up 35 to 55 percent of the acreage. They occur on low mounds or ridges and are light colored, very limy, and shallower than Tapia soils. The subsoil is exposed, and there are many caliche pebbles on the surface. This layer is about 6 inches thick and consists of light brownish-gray, very limy loam. It overlies a substratum of massive, white or pinkish-white, partly cemented caliche. The depth to caliche ranges from 6 to 10 inches.

Small areas of Pastura loam, 1 to 9 percent slopes, were included in mapping. Also included were a few areas where the slope exceeds 5 percent. The Dean soils make up about 95 percent of some areas.

These soils are no longer cultivated, because they occur in areas where rainfall is low and the hazard of erosion is severe. They are in poor physical condition and are subject to severe sheet erosion and further wind erosion. The water-storage capacity is low, and evaporation losses are high. The Tapia soils are slowly permeable to roots, air, and water; the Dean soils are moderately permeable. Surface runoff is medium to rapid. Most roots are confined to the less limy upper layers.

Most of these areas have been reseeded to native grass, but some have been left to revert naturally. Good stands are difficult to establish because of the poor physical condition of the soils, their droughtiness, and their susceptibility to blowing. Several attempts may be necessary to establish a good stand of grass. The seedlings need protection from overgrazing until they are well established. It may be necessary to grow a cover crop or nurse crop before reseeding with grasses. Much of the vegetation is annual weeds, but there is some blue grama, sand dropseed, ring muhly, and snakeweed. Emergency tillage should be used to control blowing when the soil contains enough moisture to form clods. (Both soils are in climatic zones 4 and 5. The Tapia soils are in dryland capability unit VIs–4; Loamy range site. The Dean soils are in dryland capability unit VIe–2: Limy range site)

Tecolote stony loam, 20 to 70 percent slopes (Tf).—This soil occurs mainly on south-facing slopes in the Gallinas Mountains in the southern part of the survey Area. A layer of decomposing forest litter, about 3 inches thick, covers the surface. The surface layer consists of stony loam about 20 inches thick. The uppermost 3 inches is gray and has moderate to strong crumb structure. The lower 17 inches is pinkish white and has weak subangular blocky structure breaking to moderate granular. This layer is friable. It tongues into the subsoil, which consists of reddish-brown stony clay loam that has moderate subangular blocky structure. This soil is nonlimy. Stones make up 30 percent of the surface layer and 60 percent of the subsoil. In many places the depth to bedrock is more than 40 inches.

Included in mapping were small areas of Pinata stony loam, 20 to 60 percent south slopes; Tecolote stony loam, thick surface variant, 20 to 70 percent slopes; Rock outcrops and slides; and small areas where the depth to bedrock is less than 40 inches.

This soil is readily eroded because of the slope. Under the present plant cover, runoff is slow to medium and water erosion is slight, but runoff will be very rapid and erosion severe if the vegetation is burned or if the timber is heavily logged.

This soil absorbs water rapidly but has low to moderate water-storage capacity. Internal drainage is medium to rapid. Loss of moisture through evaporation is greater on the south-facing slopes, and the soils in these areas tend to be more droughty than those on north-facing slopes.

This soil supports open stands of ponderosa pine and Douglas-fir. There is also some pinyon and juniper. The understory consists of Gambel oak and native cool-season grasses. These areas are used mainly for production of timber and for wildlife habitats. Mostly mature and diseased trees are cut for lumber. Livestock graze the more accessible areas. (Dryland capability unit VIIe–7, climatic zone 4: timber suitability group 4)

Tecolote stony loam, thick surface variant, 20 to 70 percent slopes (Tg).—This soil is in the Cibola National Forest in the vicinity of the Gallinas Lookout in the Gallinas Mountains. It occurs on mountain slopes at high elevations. The dark-colored part of the surface layer is about three times as thick as in typical Tecolote soils.

About 2 inches of decomposing forest litter covers the surface. The surface layer, about 9 inches thick, consists of gray stony loam that has moderate crumb structure. It has been leached free of lime. Below this is a subsurface layer, about 17 inches thick, of bleached, pinkish-gray stony very fine sandy loam. This material tongues into a subsoil, about 3 feet thick, of light-brown to brown, lime-free stony clay loam that has weak blocky structure. Partly weathered felsite bedrock is at a depth of about 5 feet.

Some areas of Rock outcrops and slides were included in mapping.

This soil absorbs water at a medium to rapid rate, but its capacity to store moisture is low because of the stone content. Runoff is slow to medium, and internal drainage is medium. The surface stones and organic litter help to check runoff and control erosion. The hazard of water erosion will be severe if the plant cover is destroyed by fire or by excessive logging.

This soil is used for timber, wildlife habitat, recreation, and grazing. The vegetation consists mainly of ponderosa pine, Douglas-fir, and limber pine. The understory consists of Gambel oak and cool-season grasses. Many of the trees harvested are mature or diseased. (Dryland capability unit VIIe-5, climatic zone 4; timber suitability group 2)

Tesajo gravelly sandy loam, 2 to 15 percent slopes (Th).—This soil occurs in the extreme western part of the Area, on upland piedmont foothill fans. The areas are dissected by many drainage channels.

In most places the surface layer, about 21 inches thick, consists of brown gravelly sandy loam that has weak subangular blocky structure breaking to moderate granular. It grades to pale-brown very gravelly sandy loam that is massive or has very weak subangular blocky structure. This material is several feet thick. This soil is nonlimy. Gravel makes up about 60 percent of the surface layer and as much as 90 percent of the soil material below.

About one-third of the acreage consists of soils that have a loamy texture and limy subsurface material. In many areas near springs or seeps, this soil has a lime-cemented layer at a depth of 1 to 2 feet. In some places the subsoil contains gravelly clay loam. Included in mapping were many small drainage channels that contain numerous coarse deposits derived from mixed parent material.

This soil absorbs water rapidly, but it has a low capacity to store moisture. Evaporation is excessive. Surface runoff is medium to rapid, depending on the slope. Internal drainage is rapid. This soil is easily eroded by water, and gullies often are formed by runoff from higher lying soils. Wind erosion is moderate. This soil is readily permeable to plant roots, but droughtiness and the rock content tend to limit plant density.

This soil is not suited to cultivation. It is used mainly for native range. Blue grama, side-oats grama, black grama, sand dropseed, cactus, snakeweed, yucca, and light stands of juniper make up the main vegetation. The edible forage is grazed mainly by domestic livestock, but some wildlife browse these areas also. The many drainage channels contain coarse materials of various sizes that are suitable for certain types of roadbuilding and other construction. Control of grazing and proper use of plant residue help to protect the soil against erosion. (Dryland capability unit VIs-1, climatic zones 4 and 5; Shallow range site)

Trail loamy fine sand, 5 to 10 percent slopes (Tm).—This soil occurs on hummocky, wind-reworked eolian uplands along and below the eastern edge of the Chupadera Mesa. The surface layer, about 7 inches thick, consists of pale-brown loamy fine sand. The sand is single grain. It overlies several feet of brown or strong-brown fine sand. Generally, this soil has been leached of lime to a depth of about 5 feet, but in places lime occurs at a depth of 20 inches.

Included in mapping were areas of Chupadera loamy fine sand, 5 to 15 percent slopes; Penistaja loamy fine sand, hummocky; and a small acreage of active sand dunes.

This soil is susceptible to severe wind erosion when it is not protected with adequate plant cover. It is droughty because of coarse texture and low capacity to store moisture. Water penetrates the surface readily and moves rapidly through the soil. Surface runoff is very slow. The soil is very low in organic-matter content and in fertility. In many places the crests of the hummocks or dunes are more droughty and more sparsely vegetated than the concave foot slopes.

This soil is used mainly for livestock range. It supports moderate to thick stands of pinyon and juniper and an understory of blue grama, sand dropseed, little bluestem, and ring muhly. There are a few ponderosa pines. Deer and other wildlife find habitats in these areas. Some trees are cut for fenceposts and firewood. Mechanical brush control methods are not suited to this soil, because a tree cover is essential to control soil blowing. The active dunes need to be fenced and protected from trampling and grazing. The grasses should not be overgrazed. (Dryland capability unit VIIe-4, climatic zones 4 and 5; Deep Sand range site)

Turkeysprings stony loam, 20 to 50 percent slopes (Tn).—This soil occurs on canyon walls and side slopes of foothill remnants on the eastern slopes of foothills of the Manzano Mountains. A decomposing layer of forest litter, about 1 inch thick, covers the surface. The surface layer, about 9 inches thick, is slightly limy, friable, and dark grayish brown. The upper part is stony loam that has moderate crumb structure, and the lower part is stony clay loam that has weak subangular blocky structure breaking to moderate granular. This layer rests on a subsoil of brown stony clay that has weak subangular blocky structure. The subsoil, about 15 inches thick, is lighter colored and more limy in the lower part. The substratum consists of massive, very pale brown stony silt loam. It contains a moderate amount of visible lime. It rests abruptly on limestone bedrock at a depth of 15 to 48 inches. The stone content ranges from 30 percent in the surface layer to 80 percent in the substratum.

Included in mapping were small areas of Pinon channery loam, 3 to 20 percent slopes; Laporte-Rock outcrop complex; and Rock outcrops and slides. The rock outcrops are mostly limestone ledge rock that forms nearly vertical cliffs. They make up about 15 to 25 percent of the acreage.

Water erosion is the main hazard. Under the present plant cover, runoff is slow to medium and erosion slight to moderate, but runoff will be very rapid and erosion severe if the vegetation is destroyed by fire. This soil absorbs water rapidly, and it has medium internal drainage. Its capacity to store moisture is low to moderate, and the soil tends to be droughty. The areas on north-facing slopes commonly are less stony, deeper, and better vegetated.

This soil is used mainly for livestock range and wildlife habitats. The vegetation consists of heavy stands of pinyon and juniper and an understory of scrub oak, mountain-mahogany, blue grama, junegrass, squirreltail, cactus, yucca, and snakeweed. There are a few stunted ponderosa pines. Some trees are cut for posts and firewood, mostly for local consumption. (Dryland capability unit VIIe-2, climatic zones 4 and 5; Mountain Shale range site)

Washoe cobbly loam, 9 to 25 percent slopes (Wa).—This soil occurs on truncated slopes of piedmont fans in the foothills, mainly on southern and eastern slopes of the Manzano Mountains but to a lesser extent on western slopes. It is commonly at higher elevations than Washoe gravelly loam, 1 to 9 percent slopes, and it contains larger fragments of rock.

This soil has a surface layer, about 5 inches thick, of grayish-brown, friable cobbly loam that has moderate granular structure. The subsoil is reddish-brown very gravelly clay loam that has moderate angular and subangular blocky structure. It is about 35 inches thick and grades to a massive substratum of reddish-brown or yellowish-red very gravelly clay loam to loam.

This soil is nonlimy in most places. The content of gravel and cobblestones ranges from 60 percent in the surface layer to 85 percent in the substratum. In places a thin mineral layer is at the surface. The surface layer and the subsoil are thinner in areas on western slopes, and in many places the substratum is cemented with lime in the upper part.

Included in mapping were small areas of Tesajo gravelly sandy loam, 2 to 15 percent slopes; Chilton gravelly loam; and Fuera cobbly loam, 20 to 60 percent slopes.

This soil is droughty because of the cobblestones and a low to moderate capacity to store water. It is subject to severe water erosion when not protected with adequate plant cover. It absorbs water rapidly and has medium internal drainage. Surface runoff is medium to rapid. Evaporation losses are higher and the soil is more droughty on south- and west-facing slopes. The rock content generally increases and rock fragments are larger in size as the slope becomes steeper.

This soil is used mainly for production of native forage. The vegetation consists of moderate to heavy stands of pinyon and juniper and an understory of blue grama, sand dropseed, galleta, cactus, scrub oak, and snakeweed. There are a few ponderosa pines at the higher elevations. Deer and other wildlife find habitats. Livestock graze the more accessible areas. Some trees are harvested for fenceposts and firewood. Some areas are sources of gravel or rock suitable for use in road construction or as riprap for earthen structures. (Dryland capability unit VIIs-3, climatic zone 4; Hills range site)

Washoe gravelly loam, 1 to 9 percent slopes (Wb).—This soil occurs on piedmont fan crests and side slopes in the southern and eastern foothills of the Manzano Mountains. The surface layer, about 6 inches thick, consists of light brownish-gray, friable gravelly loam that has weak platy and moderate granular structure. It grades to a subsoil, about 38 inches thick, of reddish-brown very gravelly clay loam that has moderate angular and subangular blocky structure. It is lighter colored in the lower part. The subsoil is less permeable than the surface layer. It grades to a substratum of brown or strong-brown, massive very gravelly loam. The gravel content ranges from 25 percent in the surface layer to about 75 percent in the substratum. A thin layer of decomposing litter occurs on the surface in places. This soil is nonlimy in most areas.

Included in mapping were areas of Scholle gravelly loam, 1 to 9 percent slopes; Chilton gravelly loam; Fuera cobbly loam, 5 to 20 percent slopes; and Witt loam, 1 to 6 percent slopes.

This soil is not suited to cultivation, because of its gravel content. It absorbs water rapidly but has a low to moderate capacity to store moisture. It is readily permeable to plant roots. Surface runoff is medium to rapid, depending on the slope. Internal drainage is medium. The stronger slopes are subject to severe water erosion when not protected with adequate plant cover or residue.

This soil supports moderate to heavy stands of pinyon and juniper and an understory of blue grama, sand dropseed, galleta, ring muhly, scrub oak, cactus, and snakeweed. Livestock range is the principal use, but deer and other wildlife find habitats. Some trees are cut for fenceposts and firewood, mostly for local use. The gravelly subsoil and substratum are sources of material suitable for use in road construction. (Dryland capability unit VIs-1, climatic zone 4; Shallow range site)

Wilcoxson clay loam, 2 to 10 percent slopes (Wc).—This soil occurs on upland foothill ridge crests, mainly on eastern slopes of the Manzano Mountains but to a lesser extent on the southeastern part of the Chupadera Mesa. It is the typical Wilcoxson soil.

The surface layer, about 9 inches thick, consists of dark-brown, friable clay loam that has weak platy and moderate granular structure. This layer has been leached of lime. The subsoil, about 28 inches thick, consists of reddish-brown clay that has weak to strong subangular blocky structure. It is less permeable than the surface layer. It has been leached nearly free of lime in the upper part but becomes more limy with depth. The substratum consists of massive, pinkish-white silty clay loam that contains a moderate to large amount of visible lime. Limestone bedrock occurs below a depth of 40 inches in places.

Where this soil occurs on the Chupadera Mesa, the surface layer consists of brown loam about 7 inches thick. The subsoil, about 10 inches thick, consists of light silty clay or silty clay loam. Bedrock is at a depth of about 26 inches.

Included in mapping were areas of Laporte-Rock outcrop complex; Turkeysprings stony loam, 20 to 50 percent slopes; Witt loam, 1 to 6 percent slopes; and Steep rock land.

This soil is not suited to cultivation, because it is too clayey. It absorbs water slowly and has slow to very slow internal drainage. It has a high capacity to store moisture, but it releases water slowly to plants. It is subject to moderate or severe wind and water erosion when cultivated or overgrazed. Surface runoff is medium to rapid.

This soil is used mainly for production of native forage. Some areas have been cultivated, but most of these have now been abandoned. Many of these fields have been reseeded to native grasses, and adequate stands have been obtained. Blue grama, galleta, western wheatgrass, cactus, snakeweed, and light to moderate stands of pinyon and juniper make up most of the vegetation. Livestock range is the principal use; deer and other wildlife find habitats. Some of the trees are cut for posts and firewood, mostly for local consumption. (Dryland capability unit VIs-2, climatic zone 4; Clayey range site)

Wilcoxson loam, thick surface, 1 to 6 percent slopes (Wd).—This soil occurs on upland piedmont fans in the foothills of the Gallinas Mountains. The surface layer, about 10 inches thick, normally consists of brown to dark-brown loam that has moderate granular structure in the upper part and weak subangular blocky structure in the lower part. This layer has been leached free of lime. It grades through about 11 inches of brown clay loam that has strong blocky structure to the underlying subsoil. The subsoil consists of reddish-brown, hard clay that has strong prismatic and strong blocky structure. It has been leached free of lime to a depth of about 26 inches, where some visible lime occurs. This layer grades to a more friable substratum of reddish-brown, limy clay loam at a depth of about 42 inches.

Included in mapping were small areas of Pinata-Stroupe stony loams, 5 to 20 percent slopes; Carnero loam, 3 to 8 percent slopes; and Manzano loam, 1 to 5 percent slopes.

This soil is subject to severe wind and water erosion if the plant cover is removed. It is moderate in fertility and in organic-matter content. It has a high capacity to store moisture for plants. The surface layer absorbs water at a moderate rate and is readily penetrated by plant roots. Surface runoff is slow to medium, and internal drainage is slow to medium. Tillage is easy.

This soil is suited to production of native forage. It could be farmed in years when the weather is favorable. The vegetation consists of blue grama, ring muhly, western wheatgrass, snakeweed, and a few pinyon and juniper trees. It provides protective cover for wildlife, as well as protection against erosion. Some of the trees are harvested for posts and firewood. (Dryland capability unit IVe–3 if in climatic zone 4, and VIs–2 if in climatic zone 5; Loamy range site)

Wilcoxson stony loam, 5 to 20 percent slopes (We).—This soil occurs on foothill ridge crests on eastern slopes of the Manzano Mountains. It formed under forest vegetation. It differs from Wilcoxson clay loam, 2 to 10 percent slopes, in being stony, coarser textured in the surface layer, less reddish in the subsoil, and shallower.

About 2 inches of decomposing forest litter covers the surface. The surface layer, about 2 inches thick, consists of very dark grayish-brown stony loam that has moderate granular structure. It has been leached of lime. The subsoil, about 14 inches thick, consists of brown or dark grayish-brown clay that has weak angular and subangular blocky structure and has been leached of lime in the upper part. The lower part is lighter colored and limy, and its texture is clay loam. The subsoil grades to partly weathered limestone bedrock at a depth of about 16 inches. The stone content ranges from 25 percent in the surface layer to 50 percent in the subsoil. The depth to bedrock ranges from 10 to 20 inches.

Included in mapping were areas of Pino silt loam, 2 to 30 percent slopes; Turkeysprings stony loam, 20 to 50 percent slopes; Wilcoxson stony loam, 15 to 45 percent south slopes; and Laporte-Rock outcrop complex.

Under the present plant cover, runoff is slow to medium and this soil is subject to slight erosion, but severe water erosion will result if the vegetation is destroyed by fire.

This soil absorbs water rapidly, but it has a low water-storage capacity. Internal drainage is medium.

This soil is used mainly for production of timber and for wildlife habitats. It supports open stands of ponderosa pine, pinyon, and alligator juniper and an understory of scrub oak, junegrass, squirreltail, blue grama, and Carex. Livestock graze the understory in places. Mature and diseased trees are harvested. (Dryland capability unit VIIe–7, climatic zone 4; timber suitability group 4)

Wilcoxson stony loam, 20 to 50 percent north slopes (Wf).—This soil occurs on north- and east-facing side slopes of ridges on the eastern slopes of the Manzano Mountains. It differs from the typical Wilcoxson soil in being stony and forested, and in being moderately deep and browner than is typical.

A layer of decomposing forest litter, about 3 inches thick, covers the surface. The surface layer, about 2 inches thick, consists of very dark grayish-brown stony loam that has weak crumb structure. It has been leached free of lime. This layer grades at a depth of 7 inches to a subsoil, about 18 inches thick, of grayish-brown stony clay that has moderate subangular blocky structure. The upper part of the subsoil is fine textured and is darker colored and less limy than the lower part. The subsoil grades to a layer, about 5 inches thick, of brownish-yellow, massive, limy, stony silty clay loam. Limestone bedrock occurs at a depth of about 30 inches. Limestone crops out in places.

Water erosion is the most serious hazard on this steep soil. Normally, runoff is slow and erosion is slight, but runoff will be excessive and erosion severe if the plant cover is destroyed by fire or if logging is excessive. This soil absorbs water at a medium to rapid rate and has a moderate capacity to store moisture for plants. Internal drainage is medium. The surface stones and the litter help to check runoff and control erosion.

This soil is used mainly for production of timber and for wildlife habitats. The vegetation is mainly ponderosa pine but includes lesser amounts of pinyon and juniper and an understory of Gambel oak, New Mexico locust, and side-oats grama and other cool-season grasses. Mostly, mature and diseased trees are harvested. (Dryland capability unit VIIe–6, climatic zone 4; timber suitability group 3)

Wilcoxson stony loam, 15 to 45 percent south slopes (Wg).—This soil occurs on south-facing side slopes of ridges on the eastern slope of the Manzano Mountains. It is shallower and more stony than the same kind of soil on north- and east-facing slopes.

This soil differs from the typical Wilcoxson soil in being stony and moderately deep, in being steeper and browner, and in being forested. Normally, about 4 inches of decomposing forest litter covers the surface. The surface layer, about 2 inches thick, consists of very dark grayish-brown stony loam that has weak granular structure. This layer has been leached free of lime. It grades at a depth of about 7 inches to a transitional layer of dark grayish-brown stony heavy clay loam that has moderate subangular blocky structure. The subsoil is about 15 inches thick. Its upper part consists of brown clay that has been leached nearly free of lime; its lower part consists of yellowish-brown clay loam that contains some visible lime. This layer has weak subangular and angular blocky structure. Limestone bedrock is at a depth of about 2 feet.

Included in mapping were a few areas of limestone rock outcrops and small areas of Turkeysprings stony loam, 20 to 50 percent slopes.

At present, runoff is slow to medium and erosion is slight, but severe erosion will result if the plant cover is destroyed by fire or by excessive logging.

This soil absorbs water at a medium to rapid rate and has medium internal drainage. It has a moderate capacity to store moisture for plants. The surface litter and the stones help to retard runoff and limit erosion.

This soil supports open stands of ponderosa pine and Douglas-fir mixed with pinyon, juniper, and alligator juniper. The understory consists of Gambel oak, Oregon-grape, blue grama, junegrass, and squirreltail. The commercial timber is harvested regularly, and wildlife browse the understory. (Dryland capability unit VIIe–7, climatic zone 4; timber suitability group 4)

Willard loam (0 to 1 percent slopes) (Wk).—This soil occurs on lake terraces near the margins of lake basins. It is the typical Willard soil (fig. 20). The surface layer, about 8 inches thick, consists of friable, light brownish-gray loam that has weak subangular blocky structure breaking to moderate granular. It is limy and slightly saline. The subsoil, about 10 inches thick, is more limy than the surface layer and is also slightly saline. Its upper part consists of light brownish-gray loam, and its lower part of pale-brown clay loam. It is friable and has weak subangular blocky structure.

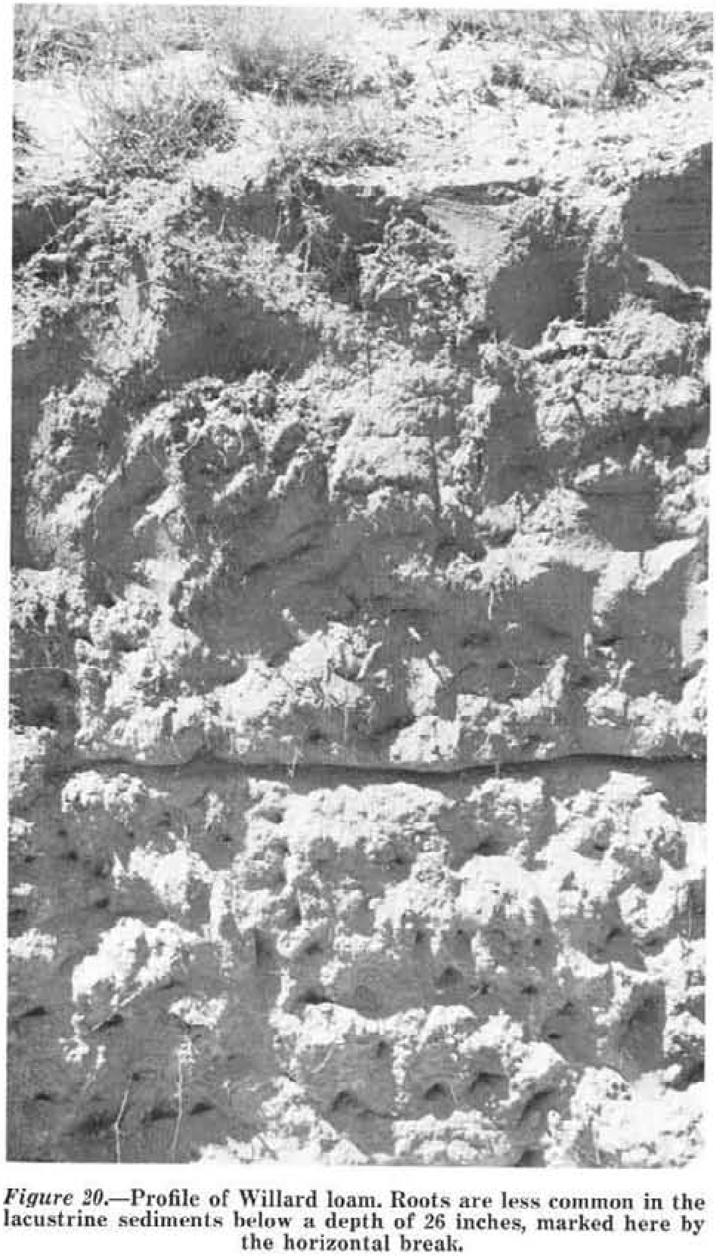

Figure 20.—**Profile of Willard loam. Roots are less common in the lacustrine sediments below a depth of 26 inches, marked here by the horizontal break.**

The substratum consists of very limy, light yellowish-brown light clay loam that has weak subangular blocky structure. It grades at a depth of about 26 inches to stratified, limy, lacustrine sediments. The depth to these moderately saline sediments ranges from 10 to 30 inches.

Included in mapping were areas of Willard loam, strongly saline; Willard fine sandy loam; and Pedrick loamy fine sand. In an area southeast of the town of Moriarty, a transitional soil, about 1 mile wide east and west and about 2 miles long, separates Willard loam from Witt loam, 0 to 1 percent slopes. This transitional soil was mapped with Willard loam, but in places it is more like a Witt soil, a better soil for crops.

This soil is low in fertility and in organic-matter content. It is slightly saline in the surface layer and subsoil and slightly to moderately saline below. It has a moderate capacity to store moisture for plants. Surface runoff is slow, and internal drainage is medium.

This soil is easily tilled, but it is subject to severe wind erosion when clean tilled or when the vegetation is severely overgrazed. It should not be plowed deeper than 8 inches. Roots, air, and water penetrate readily, but most plant roots are confined to the less limy surface layer and subsoil.

This soil is used mainly for production of native forage and for irrigated farming. The native vegetation consists of blue grama, sand dropseed, galleta, cactus, and some alkali sacaton and chamiza. Proper use of grass forage will improve the condition of the range and lessen the erosion hazard.

Some 3,500 to 4,000 acres is irrigated. Alfalfa, corn, sugar beets, and barley are the main crops. This soil should not be left without protective cover during the windy season, because it tends to erode easily. (Dryland capability unit VIe–2, climatic zone 5; irrigated capability unit IIIs–1; Limy range site)

Willard loam, eroded (0 to 1 percent slopes) (Wl).—This soil occurs on lake terraces in the western part of the Estancia Lake Basin. It has a thinner surface layer than uneroded areas of Willard loam. The surface layer, about 4 inches thick, consists of light brownish-gray, friable, limy loam that has weak granular structure. Below this is about 5 inches of very limy, light yellowish-brown, structureless loam. This layer is underlain by stratified lacustrine sediments that are yellowish, olive, and gray in color and mostly clay loam in texture. These sediments are very limy, moderately to strongly saline, and moderately alkaline. In places all of the surface layer has been lost through erosion.

Included in mapping were small areas of uneroded Willard soils that have a thin surface layer. Also included were small areas where the surface is uneven or hummocky.

This soil is moderately saline and moderately alkaline. Surface runoff is slow to medium, and internal drainage is medium to slow. The capacity to store moisture for plants is moderate.

This soil is easy to till, but the surface layer compacts and crusts over readily in areas where the underlying sediments have been brought up in plowing. It should be tilled as shallowly as possible because tillage often brings up the more limy, lighter colored, underlying deposits. It is readily penetrated by roots, air, and water, but most plant roots are confined to the surface layer because the underlying sediments are toxic. The natural fertility has been impaired and the organic-matter content reduced through erosion. Crop residue should be left on the surface for protection against erosion during the windy season. Applying barnyard manure and plowing under green-manure crops will improve fertility and supply organic matter.

Most of this soil is in abandoned dry cropland fields. About 600 acres is now being irrigated. Alfalfa, sugar beets, and barley are the principal crops. The rest of the acreage is used for production of native grass; these areas should be protected from overgrazing until plants are well established. The native forage consists of blue grama, sand dropseed, ring muhly, galleta, and some alkali sacaton. (Dryland capability unit VIs–3, climatic zones 4 and 5; irrigated capability unit IVs–2; Salt Flats range site)

Willard loam, strongly saline (0 to 1 percent slopes) (Wm).—This soil occurs on lake terraces in the lower parts of the Estancia, Encino, and Pinos Wells Lake Basins. It differs from Willard loam in having a fine-textured subsoil and in being more saline and more alkaline.

This soil normally has a surface layer, about 5 inches thick, of grayish-brown or light brownish-gray, friable loam. This layer has moderate granular structure and is slightly to moderately saline and alkaline. The subsoil, about 12 inches thick, consists of dark grayish-brown or very dark grayish-brown light clay loam that has weak subangular blocky structure and is moderately saline and moderately to strongly alkaline. This layer grades to a substratum of limy, pale-yellow or pale-olive, stratified lacustrine sediments that average about clay loam in texture. In most places the sediments are moderately to strongly saline and alkaline. The depth to the sediments ranges from 15 to 25 inches.

Included in mapping were small areas of Karde loam, saline, and Willard loam.

The surface layer of this soil crusts over easily upon wetting, and the crust restricts the intake of water in some places. The capacity to store moisture is moderate to high, but in places the water table brings soluble salts into the surface layer and the strong concentration of salts limits the capacity of plants to absorb moisture. Most plant roots are confined to the less saline and less alkaline upper layers. Normally, this soil is more saline and more alkaline where it occurs closer to playas near the center of the lake basins. Surface runoff is slow to medium, and internal drainage is slow to medium.

This soil is used mainly for production of native forage. A few areas are being irrigated; they are used mainly for pasture. Irrigation is not generally desirable, because the soil is moderately to strongly saline and alkali and the ground water is unsuitable. If irrigation of a sizable acreage is planned, a detailed soil survey of the tract should be made and the ground water should be analyzed. Alkali sacaton, blue grama, and chamiza are the main forage plants. (Dryland capability unit VIs–3, climatic zone 5; Salt Flats range site)

Willard fine sandy loam (0 to 1 percent slopes) (Wh).—This soil occurs on lake terraces on the western side of the Estancia Lake Basin. Its surface is slightly hummocky in many places.

This soil normally has a surface layer, about 10 inches thick, of grayish-brown or brown, friable fine sandy loam that has weak granular structure and has been leached nearly free of lime. The subsoil, about 8 inches thick, consists of light brownish-gray, limy loam that has weak subangular blocky structure. This layer grades to a substratum of light yellowish-brown, very limy loam. Stratified lacustrine deposits begin at a depth of about 24 inches. These sediments are moderately saline and limy, and their texture is generally clay loam.

Small areas of Willard loam and Pedrick loamy fine sand were included in the areas mapped.

This soil is subject to severe wind erosion if it is clean tilled or if the native forage is severely overgrazed. It is low in fertility and in organic-matter content. It absorbs moisture rapidly and has a moderate capacity to store moisture, but it is often droughty because of the texture of the surface layer. Surface runoff is slow, and internal drainage is medium. Crop residue left on the surface during the windy season helps to protect the soil against wind erosion. Proper use of native forage also helps to control blowing.

This soil is used mainly for production of native forage. Less than 400 acres is irrigated. Alfalfa, corn, and barley are the principal irrigated crops. To irrigate this soil efficiently, a farmer must use short runs and large heads of water in order to get the water across the soil without overirrigating the upstream side. The native vegetation consists of sand dropseed, blue grama, galleta, sand sage, yucca, winterfat, and some alkali sacaton and chamiza. (Dryland capability unit VIe–2, climatic zone 5; irrigated capability unit IIIs–1; Limy range site)

Witt loam, 0 to 1 percent slopes (Wn).—This soil occurs on broad piedmont fans on uplands in the western part of the Torrance Area. It is typical of the Witt series as these soils occur in this survey Area. The surface layer, about 5 inches thick, consists of friable brown loam that is leached of lime. It has weak platy structure and weak granular structure. The subsoil consists of about 42 inches of reddish-brown to dark-brown clay loam. The upper part has weak prismatic structure and moderate to strong granular structure; the lower part has moderate prismatic structure and moderate to strong angular and subangular blocky structure. The uppermost 17 inches of the subsoil is leached free of lime, but the lower part contains a small amount of visible lime and is lighter colored. The substratum, a pinkish-white loam, begins at a depth of 38 to 60 inches. It is massive, limy, and nearly impervious to plant roots.

Included with this soil are small areas of Harvey loam, 0 to 1 percent slopes; Witt clay loam, 0 to 1 percent slopes, eroded; Tapia loam, 0 to 5 percent slopes; Witt loam, 1 to 6 percent slopes; and Clovis loam, 0 to 5 percent slopes.

This soil is moderately fertile. It is easily tilled but is subject to severe wind erosion when not protected by adequate plant cover. It absorbs water at a moderate rate and has a high capacity to store moisture for plants. When moist, it is easily compacted, and then it is less permeable to roots, air, and water. Internal drainage is medium to slow. Surface runoff is slow to medium, and the hazard of water erosion is slight. Most plant roots are confined to the surface layer and the less limy part of the subsoil.

This soil is used mainly for native forage and for irrigated farming. Some 5,000 to 6,000 acres is under irrigation. Alfalfa, corn, pinto beans, potatoes, sugar beets, barley, and wheat are the principal irrigated crops. Using tillage methods that roughen the surface and leaving crop residue on the soil are the best ways to control soil blowing.

A few areas are dryfarmed, but crop failures are common because rainfall is infrequent and erratic. Wheat, pinto beans, and corn are the main dryland crops. Emergency tillage and stubble mulching help to control erosion.

The native vegetation consists mainly of blue grama, ring muhly, sand dropseed, galleta, side-oats grama, cactus, and chamiza. Scattered pinyon and juniper occur at the higher elevations. Proper use of grass is the best way to control wind erosion on native range. (Dryland capability unit IVe–3 if in climatic zone 4, and VIc–1 if in climatic zone 5; irrigated capability unit IIe–1; Loamy range site)

Witt loam, 1 to 6 percent slopes (Wp).—This soil occurs on upland piedmont fans in the western part of the survey Area. It is not so deeply leached as Witt loam, 0 to 1 percent slopes. The surface layer, about 4 inches thick, consists of friable brown loam that is leached of lime. It has moderate platy structure and moderate to strong granular structure. It grades to a subsoil consisting of about 34 inches of reddish-brown to dark-brown clay loam. The subsoil has moderate prismatic and moderate subangular blocky structure. It is less permeable than the surface layer. The upper part is leached of lime. The substratum is pinkish-white to pink, massive, limy loam that is nearly impervious to roots. The depth to the substratum ranges from 30 to about 48 inches.

Small areas of Witt soils in which the slope exceeds 6 percent were included in mapping. Also included were small areas of Clovis loam, 0 to 5 percent slopes, and Witt clay loam, 1 to 6 percent slopes, eroded.

In many areas in or near the foothills of the western part of the survey Area, this soil has been more deeply leached than is typical. In places the subsoil and the substratum contain a few to many waterworn pebbles. Generally, areas of this soil at the higher elevations are less reddish, darker colored in the surface layer, and less limy in the substratum than areas at the lower elevations.

This soil is moderate in fertility and in organic-matter content. It is easily tilled but is readily eroded by wind and water if clean tilled or if not protected by enough plant cover. It absorbs moisture at a moderate rate and has a high capacity for moisture storage. When moist it is easily compacted, and when compacted it is slowly permeable. Surface runoff is medium to rapid. Internal drainage is medium to slow.

This is the major dryland soil in the Area. Pinto beans, wheat, and corn are the main crops. Contour farming, use of crop residue, and terracing are the best ways to control erosion.

About 1,200 to 1,400 acres of this soil is irrigated. Alfalfa, corn, pinto beans, potatoes, sugar beets, barley, and wheat are the principal irrigated crops. Crop residue should be left on the surface for protection against blowing. Land leveling slows the runoff and controls the erosion that results if too large a head of irrigation water is used.

Much of the acreage has been cultivated in the past but abandoned because of drought and plant diseases. Most of the acreage has been returned to native range through natural or mechanical reseeding and is used for native forage. Wind and water erosion have been slight to moderate, but through proper use, range vegetation has become fairly well established. The vegetation consists mainly of blue grama, galleta, sand dropseed, ring muhly, snakeweed, and cactus. Western wheatgrass and thin to medium stands of pinyon pine and juniper grow at the higher elevations. (Dryland capability unit IVe–3 if in climatic zone 4, VIc–1 if in climatic zone 5; irrigated capability unit IIIe–1 where the slope is 1 to 3 percent; Loamy range site)

Witt clay loam, 0 to 1 percent slopes, eroded (Wo).—This soil occurs on upland piedmont fans in the western part of the survey Area. The original surface layer and part of the subsoil have been lost through erosion. The soil that remains, formerly the subsoil, is about 40 inches thick. It consists of reddish-brown or dark-brown clay loam. It has weak to moderate prismatic structure breaking to moderate and strong blocky structure. The upper part has been leached free of lime, but visible patches of lime occur in the lower part. This layer overlies a substratum of massive, limy, pinkish-white loam at a depth of 36 to 48 inches. The substratum restricts most plant roots.

Included with this soil in mapping were small areas of Harvey loam, 0 to 1 percent slopes; Tapia and Dean soils, eroded; and Witt clay loam, 1 to 6 percent slopes, eroded. In places the surface layer is limy, and soil blowing has removed the fine-textured material that contained organic matter and plant nutrients.

The topography is generally smooth, but in many areas it is undulating as a result of blowing and deposition of soil material. The accumulations of soil are generally less than 2 feet thick, and in many places the soil has a loam texture.

This soil absorbs water slowly and has a high capacity to store moisture for crops. Surface runoff is medium, and internal drainage is medium.

Much of the acreage has been seeded to native grasses and is used for production of native forage. In many places the stands of grass are sparse, and these areas should be reseeded and protected from overgrazing until plants are well established. The native vegetation consists mainly of Russian-thistle, but there is some sand dropseed, blue grama, and ring muhly.

A few areas are dryfarmed, but crop failures are common because the climate is unfavorable. The plow layer compacts and crusts readily and is hard to till. Crop residue should be left on the surface during the windy season to help control blowing. Tillage that leaves the soil rough and cloddy is also helpful. Wheat and pinto beans are the principal dryland crops.

About 200 acres of this soil is irrigated. Alfalfa, corn, potatoes, and pinto beans are the principal irrigated crops. (Dryland capability unit IVe–3 if in climatic zone 4, and VIc–1 if in climatic zone 5; irrigated capability unit IIe–1; Loamy range site)

Witt clay loam, 1 to 6 percent slopes, eroded (Wr).—This soil occurs on upland ridge crests and on the side slopes of piedmont fans in the western part of the survey Area. The original surface layer and part of the subsoil have been lost through erosion. The remaining soil consists of reddish-brown or dark-brown clay loam. It has moderate prismatic structure breaking to moderate and strong blocky structure. The upper part has been leached free of lime. It overlies a substratum of very limy, pinkish-white, structureless loam that is nearly impervious to plant roots. The depth to this layer ranges from about 30 to 40 inches.

Included are small areas of Harvey loam, 1 to 9 percent slopes; Tapia and Dean soils, eroded; and Witt clay loam, 0 to 1 percent slopes, eroded.

The surface is smooth or slightly undulating. The undulations result from blowing and deposition of soil material. The accumulations of soil are generally less than 2 feet thick, and in many places the texture is loam. In places the surface layer is limy.

Most of the organic matter and plant nutrients have been lost through erosion. This soil absorbs water slowly but has a high capacity to store moisture. Surface runoff is rapid. Internal drainage is medium. Wind erosion is a continuing hazard because it is difficult to get plant cover sufficiently well established to control blowing.

Most of the acreage has been returned to range by natural reseeding or by mechanical seeding. In many places the plant cover is sparse, and these areas need reseeding and protection from overgrazing until plants are well established. The native vegetation consists of Russian-thistle, sand dropseed, blue grama, and ring muhly.

A few areas are dryfarmed, but crop failures are common and the cultivated acreage is rapidly being converted to range. The plow layer is hard to till and compacts easily. It crusts readily, and when crusted it sheds much of the water that falls. Tillage that leaves the soil rough and cloddy and that leaves crop residue on the surface helps to control erosion.

Less than 100 acres of this soil is irrigated. Pinto beans, wheat, and corn are the principal dryland crops. Wheat and pinto beans are the main irrigated crops. (Dryland capability unit IVe–3 if in climatic zone 4, and VIc–1 if in climatic zone 5; irrigated capability unit IIIe–1 where the slope is 1 to 3 percent; Loamy range site)

Witt-Harvey loams, 0 to 3 percent slopes (Ws).—This complex occurs on upland piedmont fans in the western part of the survey Area. Witt loam makes up 55 to 70 percent of the acreage, and Harvey loam 30 to 45 percent. Included are small areas in which the slope is more than 3 percent and small areas that have been severely eroded by wind.

Witt loam is the darker colored, nonlimy, more nearly level part of the complex. The surface layer consists of friable brown loam, about 4 inches thick, that has moderate platy and moderate granular structure and has been leached of lime. In some places, however, this layer is limy. It grades to a subsoil of dark-brown or reddish-brown clay loam about 40 inches thick. The subsoil has moderate prismatic and moderate subangular blocky structure. It is normally leached of lime in the upper part but has a slight to moderate amount of visible lime in the lower part. The substratum is pinkish-white to white, massive loam that contains a large amount of visible lime and is nearly impervious to plant roots. The depth to this limy substratum ranges from 30 to 60 inches.

Harvey loam is the lighter colored, limy part of the complex. It occurs on low, circular mounds that appear to be old rodent dens. The rodents burrowed into the Witt soil and brought very limy material from the substratum to the surface and mixed it with material from the subsoil and surface layer. The mixing destroyed the structure and increased the lime content of the upper layers, and in this manner changed Witt loam to Harvey loam. The surface layer of Harvey loam is brown and limy. It has weak to moderate granular structure, is about 4 inches thick, and grades to a subsoil of light-brown loam. The subsoil is more limy than the surface layer. It is about 8 inches thick and has weak subangular blocky structure breaking to weak granular structure. The substratum is very limy, pinkish-white to pink, massive loam that is readily permeable to plant roots. In most areas caliche pebbles are common on the surface.

These soils absorb water at a moderate rate. The Witt soil has a high capacity to store moisture, but the Harvey soil has only a moderate capacity. Both surface runoff and internal drainage are medium to slow. Fertility and organic-matter content are moderate in the Witt soil and low in the Harvey soil. Both soils are subject to severe wind erosion and slight to moderate water erosion if cultivated or if severely overgrazed.

This complex is used mainly for range. Blue grama, galleta, sand dropseed, side-oats grama, ring muhly, and cactus make up most of the plant cover on the Witt soil. Blue grama, sand dropseed, galleta, ring muhly, winterfat, and snakeweed are the common plants on the Harvey soil. The range should not be overgrazed.

This complex is not suited to dryland farming, because rainfall is scanty and erratic and erosion is a hazard.

Some of the areas are irrigated. Wheat, corn, alfalfa, sugar beets, pinto beans, and potatoes are the principal irrigated crops. Cultivated areas can be protected against wind erosion by leaving crop residue on the surface or by keeping the surface rough through the windy season. (Dryland capability unit IVe–3 if in climatic zone 4, and VIc–1 if in climatic zone 5; irrigated capability unit IIe–1 where the slope is 1 percent or less. The Witt soil is in the Loamy range site, and the Harvey soil is in the Limy range site)

Witt-Harvey-Pinon loams, 1 to 9 percent slopes (Wt).—This soil association occurs on upland crests, side slopes, and wooded hilltops in the southwestern part of the survey Area. The Witt loam makes up 40 to 60 percent of the acreage; the Harvey loam, 20 to 40 percent; and the Pinon channery loam, 15 to 30 percent. Included are small areas of Laporte-Rock outcrop complex and areas of Prewitt and Manzano soils that occur in narrow drainageways.

The Witt loam is the less sloping part of the association. The surface layer, about 4 inches thick, consists of brown, friable loam that has been leached of lime. It has moderate platy and moderate granular structure. This layer grades to a subsoil of dark-brown clay loam that is less permeable than the surface layer. The subsoil has moderate prismatic and moderate subangular blocky structure. The upper part has been leached of lime. The lower part contains a small amount of visible lime and is lighter colored. The subsoil is about 34 inches thick and overlies a substratum of massive, very limy, white or pinkish-white loam. The depth to the substratum ranges from about 30 inches to 60 inches.

The Harvey loam is a limy soil on side slopes of ridges and hills bordering drainage channels. The surface layer, about 5 inches thick, consists of limy, friable, brown to grayish-brown loam that has moderate granular structure.

It grades to a subsoil of pale-brown to light brownish-gray loam that is more limy than the surface layer. The subsoil, about 8 inches thick, has weak subangular blocky structure. It grades to a substratum of very limy, white or very pale brown, massive loam. The substratum is friable and contains much visible lime. It does not limit root penetration. Small, hard caliche pebbles are common on the surface.

The Pinon loam is a shallow soil on wooded hilltops. The surface layer, about 4 inches thick, consists of friable, brown or grayish-brown, limy channery loam that has moderate granular structure. The subsoil, about 6 inches thick, consists of light-brown to light brownish-gray, limy channery loam that has very weak subangular blocky structure. The substratum is very limy, pinkish-white or white, massive channery loam that grades to weathered limestone bedrock at a depth of about 14 inches. The depth to bedrock ranges from 7 to 20 inches. Limestone crops out but covers less than 15 percent of the surface.

The Witt loam is susceptible to severe wind erosion if cultivated or if severely overgrazed. It is moderate in fertility and in organic-matter content. It absorbs water at a moderate rate and has a high capacity to store moisture. Surface runoff is slow to medium, and internal drainage is medium to slow.

The Harvey loam is subject to severe wind erosion and, on the stronger slopes, to moderate water erosion. It is low in fertility and in organic-matter content. It is readily permeable to roots, air, and water. This soil has a moderate capacity to store moisture, but because of the lime content the moisture is not readily available to plants. Surface runoff is medium to rapid.

The Pinon loam absorbs water rapidly but it stores little moisture because it is shallow over bedrock. Because of the lime content, the moisture stored is not readily available to plants. Surface runoff is slow to medium. Internal drainage is medium.

The soils of this association are used mainly for native range. The vegetation consists of blue grama, galleta, sand dropseed, ring muhly, snakeweed, winterfat, cactus, and thin to moderate stands of pinyon and juniper. The Witt and Harvey soils produce most of the forage for livestock. Winterfat and snakeweed are most common on the Harvey loam. The Pinon loam has a sparse cover of blue grama, sand dropseed, snakeweed, and cactus, but it produces dense stands of pinyon and juniper, some of which is cut for fenceposts and firewood. It provides the best wildlife habitats in the association. Mechanical brush control substantially increases grass production on the Pinon soil. This association is generally unsuitable for dryland farming. (Witt loam, 1 to 6 percent slopes, is in dryland capability unit IVe-3 if in climatic zone 4, and VIc-1 if in climatic zone 5; Loamy range site. Harvey loam is in dryland capability unit VIe-2 in both climatic zones; Limy range site. Pinon channery loam is in capability unit VIIs-1 in both climatic zones; Shallow range site)

Use and Management of the Soils

Ranching and farming are the most important uses of the soils of the Torrance Area. Pasturing livestock, growing feed, and producing cash crops for market and home use are the most important enterprises.

This section discusses the management of range and describes the rangeland of the Area by range sites. It explains the capability classification system and the way in which its application in the Torrance Area is affected by the climate. It describes the use of the soils for unirrigated cropland, irrigated cropland, timberland, wildlife habitats, and engineering.

Use of the Soils for Range[4]

Grazing is the major land use compatible with the dry climate of the Torrance Area, and about 93 percent of the acreage is used as range. Ranches are a few hundred acres to as much as 70,000 acres in size. Hay and small grain are grown on irrigated soils for use as supplemental feed in winter and in years when rainfall is less than normal. Even with the use of this supplemental feed, much of the range is overgrazed. The information in this section can be of use in planning a range management system that will result in increased production of forage and adequate protection for the soils.

Range management practices

Proper use of range is necessary to insure that the range vegetation will remain in good condition and that enough plant residue will be left for control of erosion and for maintenance of the water-intake rate and the water-holding capacity. Research and experience show that if plants are to retain their vigor and their ability to reproduce, grazing must be controlled so that only about 50 percent, by weight, of the current year's growth is removed. Selection of a key species in the vegetation and close observation of increasing or decreasing abundance of that species are essential for effective control of grazing. Sandy soils, such as those of the Trail series, and shallow soils, such as those of the Travessilla, Pastura, and Pinon series, are especially likely to deteriorate if the vegetation is not kept in good condition.

Deferment of grazing allows range plants to regain their vigor and produce seed and thus is effective in improving the condition of range that has deteriorated. It is especially beneficial to such soils as Trail loamy fine sand.

Distribution of livestock, by herding and by the placement of water (fig. 21) and salt, promotes uniform use of range. On soils that are easily eroded, such as the sandy Chupadera, Ildefonso, Otero, Palma, Pedrick, and Trail soils and the shallow Dean, Karde, Pastura, Pinon, and Travessilla soils, it may be necessary to take measures to prevent excessive concentration of cattle around stock ponds and salt areas.

Seeding to increase forage production and to convert abandoned cropland to range (fig. 22) is feasible for all parts of the Area except associations 1, 2, and 3. It is most effective on deep and moderately deep, loamy and sandy soils, such as Alicia loam and Pedrick loamy fine sand. It is not a suitable practice for very steep soils or very shallow soils, such as those of the Travessilla series. The chance of success in reseeding can be greatly improved by first eliminating low-value plants and then establishing an annual as a cover crop in which to start the new grass.

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[4] By IVAN W. DODSON, JR., range conservationist, Soil Conservation Service.

Figure 21.—Stock pond on Harvey-Dean loams, 1 to 9 percent slopes, in the Limy range site. Well-placed stock ponds help to keep cattle distributed.

Figure 22.—A new stand of native grass on Penistaja-Dean complex, 1 to 5 percent slopes. This is abandoned cropland that has been converted to range by seeding.

Clean seed of suitable species and of varieties adapted to the climate is essential. The best kind of grass drill available should be used, to insure planting at the proper rate and at the right depth. To give the new grass a chance to get established, grazing of reseeded range should be deferred until the end of the second growing season.

Control of weeds and brush to improve the condition of deteriorated rangeland is practical in associations 1, 4, 5, 8, 9, and 10. Pinyon, juniper, cholla cactus (fig. 23), pricklypear cactus, and dagger cholla are the undesirable plants most common in this Area. Mechanical, chemical, or biological means of control can be used, but mechanical methods have been most successful. Pinyon and juniper are usually uprooted by bulldozers or by chains pulled by heavy equipment. Cactus is usually eradicated by hand grubbing or by the use of small bulldozers. Such methods are practical on deep and moderately deep soils, such as Carnero loam, 3 to 8 percent slopes. They may create

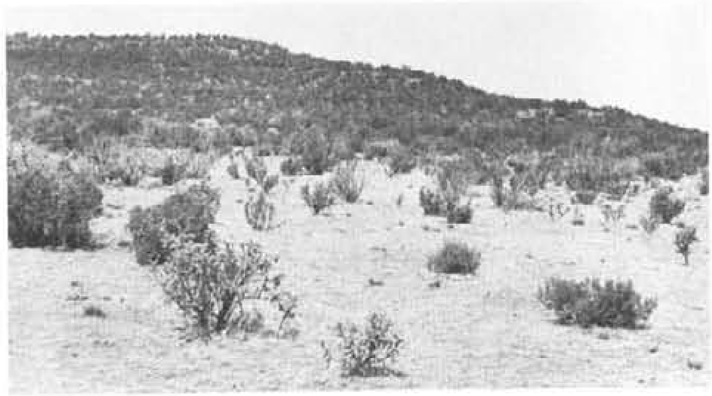

Figure 23.—Loamy range site in deteriorated condition. Cholla cactus invades when the range is overgrazed.

erosion hazards if applied to sandy soils, such as Trail loamy fine sand, 5 to 10 percent slopes, when the condition of the range vegetation is poor or fair. Brush control is ordinarily not practical on steep or unproductive soils.

Range sites and condition classes

Range sites are distinctive kinds of rangeland with different potentials for producing native plants. Each range site has a characteristic plant community and, unless materially altered by physical deterioration, retains its ability to reproduce this characteristic plant community.

Range sites are differentiated according either to differences in the kinds of plants that make up the potential plant community and the proportion of each kind or to differences in the total production of herbage when the composition of the plant community is essentially the same. The differences in the kinds or amounts of vegetation must be enough to necessitate some variation in management, such as a different rate of stocking. Distinctions between range sites are not based on differences in soils or in climate, unless such differences result in differences in the potential plant community.

Individual factors of the environment associated with differences in potential vegetation include a water table within the root zone and a highly saline condition. Differences in soil texture, soil depth, or topographic position are other factors that result in significant differences in plant composition or in yields.

Range condition refers to the composition of the present vegetation on a given site in relation to the composition of the potential vegetation. It is expressed in terms of range condition classes. Four classes are defined, each representing a degree of deterioration of the plant cover. A site is in excellent condition if 76 to 100 percent of the stand is of the same composition as the potential stand. It is in good condition if the percentage is between 51 and 75, in fair condition if the percentage is between 26 and 50, and in poor condition if the percentage is less than 25.

Under prolonged excessive grazing, the more palatable plants are commonly replaced by less desirable plants. Range plants are classified in three broad categories, based on their response to grazing. These categories are identified as decreasers, increasers, and invaders. Decreasers are plants that decrease in relative abundance under prolonged moderately heavy to heavy grazing. They are mostly perennials that are sought out by livestock because they are the most palatable. Increasers are plants that normally increase in abundance as the decreasers decline. If moderately heavy to heavy grazing continues, plants that increase at first may subsequently decrease. The forage value of increaser plants ranges from high to low. The low-value plants, which are less palatable to livestock, tend to increase more rapidly than the high-value plants. Invaders are plants that become established only after the more desirable vegetation has been depleted. They are not part of the potential plant community for the particular range site, but they may be normal components of the potential plant community on other range sites in the same general area.

For effective planning of range management, it is necessary to know not only the present condition of the range but the trend, that is, whether the condition is improving or deteriorating. Signs of a trend toward deterioration include the appearance of bare spots, crusting and compaction of the soil, erosion, the formation of hummocks, a decline in vigor and a reduction in the proportion of the better range plants, and invasion by plants not native to the site. Signs of a trend toward improvement include the presence in the stand of plants of different ages, including seedlings; an improvement in the vigor of the better range plants and an increase in the proportion of such plants in the stand; and the progressive accumulation of plant residue.

Descriptions of range sites

The soils of the Torrance Area are grouped into 14 range sites, which are described in the following pages. The description of each discusses the important characteristics common to all the soils in the site, and it lists the principal plants in the potential plant community. The names of the range sites reflect readily recognized permanent physical features, such as the nature of the soils, the climate, the topography, or a combination of these, and thus help readers to identify and remember the different kinds of rangeland.

The names of the soil series represented are mentioned in the description of each range site, but the listing of the series name does not necessarily indicate that all the soils of a series are in the same range site. To find the range site for any given soil, refer to the Guide to Mapping Units. Some of the land types in the Torrance Area and parts of others are not suitable for range and have not been placed in range sites. The areas not assigned to range sites are parts of Badland, the Slickspot component of Bernal-Slickspot complex, the Rock outcrop parts of Laporte-Rock outcrop complex and Rock outcrop-Pinon-La Fonda complex, and all of the areas mapped as Rock outcrops and slides. Also unassigned are intermittent lakes, gravel pits, and caliche pits.

Table 5 gives the estimated total annual yields of air-dried forage, in pounds per acre, on range in excellent condition, in dry years and in wet years. The estimates include the leaves, stems, and twigs of all plants. Yields vary considerably from year to year, especially on bottom lands that receive additional moisture from overflow from time to time.

TABLE 5.—*Estimated annual yields of forage on range in excellent condition*

[Dry years are years when precipitation is less than normal; wet years are years when precipitation is normal or more]

Range site	Dry years	Wet years
	Lb./acre (air dried)	*Lb./acre (air dried)*
Bottomland	1, 500	6, 000
Breaks	500	1, 600
Clayey	500	1, 600
Deep Sand	600	2, 000
Gyp Flats	200	1, 100
Hills	200	900
Limy	300	1, 600
Loamy	500	1, 600
Mountain Shale	500	1, 600
Salt Flats	800	2, 500
Salty Bottomland	1, 100	4, 000
Sandy	800	1, 800
Shallow	500	1, 800
Shallow Sandstone	500	2, 200

BOTTOMLAND RANGE SITE

This site is made up of deep, medium-textured soils of the La Fonda, Manzano, and Prewitt series. These soils are nearly level to moderately sloping. They occur in swales and on flood plains and are flooded occasionally.

These soils absorb water at a moderate rate and have a high capacity to store moisture. They have a high content of organic matter.

If this site is in excellent condition, decreasers make up about 70 percent of the vegetation. Wright's sacaton may be dominant. The understory consists of mid and short grasses, most commonly side-oats grama, western wheatgrass, and vine-mesquite. The main increasers are blue grama, galleta, mat muhly, and buffalograss. The extra moisture from floods makes this site very productive.

BREAKS RANGE SITE

This site is made up only of Steep rock land, which consists of steep mesa breaks, sandstone escarpments, and rock outcrops; and the Rock outcrop part of the Rock outcrop-Pinon-La Fonda complex. Included in the areas are soils that are shallow or very shallow over sandstone. The soils are medium textured to moderately coarse textured. They have a low capacity to store moisture.

If this site is in excellent condition, mid grasses are dominant. Associated with the dominant grasses are tall and short grasses, forbs, half-shrubs, shrubs, pinyon, and juniper. Decreasers, mainly little bluestem, side-oats grama, and black grama, make up about 60 percent of the potential plant cover. New Mexico feathergrass, spike muhly, and needle-and-thread are other decreasers that occur in small amounts. Blue grama is the major increaser and may make up 25 percent of the vegetation if the range is in good condition. Less important increasers are hairy grama, wolftail, fringed sage, pinyon, juniper, and oak. If the range is in excellent condition, none of these will make up more than 5 percent of the vegetation. The most common invaders are ring muhly, cholla cactus, and pricklypear cactus.

CLAYEY RANGE SITE

This site consists of only one soil, Wilcoxson clay loam, 2 to 10 percent slopes, which is a deep soil on upland ridgetops in the northwestern part of the Area. This soil absorbs water slowly, but it has a high capacity to store moisture.

In excellent condition, this site has a cover of native bunch grasses and limited amounts of woody plants. Generally, the dominant decreasers are alkali sacaton and western wheatgrass, and the principal increaser is blue grama. Four-wing saltbush and winterfat are less common decreasers.

DEEP SAND RANGE SITE

This site consists of only one soil, Trail loamy fine sand, 5 to 10 percent slopes, which is a deep, structureless soil on dunelike terrain. This soil absorbs nearly all of the rainfall it receives, but it has a low capacity to retain the moisture. Wind erosion is severe when the plant cover is not adequate.

The potential vegetation on this range site is a mixture of tall and mid grasses. Sand bluestem, little bluestem, Indian ricegrass, and big bluestem are the chief decreasers. Increasers that occur in moderate amounts include blue grama, hairy grama, sand sage, and four-wing saltbush. Common invaders include pinyon, juniper, oak brush, cholla, pricklypear, snakeweed, and spring muhly.

GYP FLATS RANGE SITE

This site is made up of the Gypsum land part of Rance-Gypsum land complex, which occurs mainly in the eastern and southwestern parts of the Area. This land type generally consists of a mantle of soil, 1 to 4 inches thick, over deposits of soft gypsum. In places the gypsum is exposed. The areas are level to moderately sloping or are on rolling uplands.

The decreasers in the potential vegetation are alkali sacaton, black grama, blue grama, needle-and-thread, four-wing saltbush, and side-oats grama. Increasers are gyp grama, gyp dropseed, coldenia, fluffgrass, and three-awn.

HILLS RANGE SITE

This site is made up mostly of shallow, rocky soils of the Ildefonso, Laporte (fig. 24), Pinata, Stroupe, and Washoe series and of areas of Badland and of Stony steep land. The soils are moderately sloping to steep. They occur on crests and side slopes of ridges, and as mesa breaks and escarpments.

If this site is in excellent condition, the vegetation consists of open stands of pinyon and juniper and an understory of grasses and shrubs. Decreasers make up 60 percent or more of the cover. These are mainly side-oats grama, little bluestem, and western wheatgrass. Increasers make up as much as 20 percent. These are commonly blue grama, wolftail, galleta, mountain-mahogany, and oak. Common invaders are broom snakeweed, ring muhly, and sleepygrass.

Figure 24.—**Soil cut showing the sandstone that underlies Laporte soils. This is an area of Hills range site in fair condition. The vegetation is mostly scrub pinyon, juniper, oak, and blue grama.**

LIMY RANGE SITE

This site is made up of predominantly moderately deep, medium-textured, limy soils of the Dean, Harvey, Ildefonso, and Willard series. These soils occur on the crests and side slopes of ridges in the uplands. They are underlain by fragmented or soft caliche.

These soils absorb water at a moderate to rapid rate, but they have a low capacity to store moisture. Water moves through the profile, and roots penetrate without severe restriction.

If this site is in excellent condition, decreasers make up 70 percent or more of the vegetation. There are a few shrubs, including winterfat and small soapweed. The principal decreasers are black grama, needle-and-thread, New Mexico feathergrass, side-oats grama, little bluestem, and winterfat. The major increasers are spike dropseed, sand dropseed, small soapweed, and ring muhly. The most common invaders are broom snakeweed, pinyon, and juniper.

LOAMY RANGE SITE

This site makes up about 55 percent of the rangeland in the Torrance Area. It consists mainly of deep to moderately deep soils on upland piedmont fans that have a loamy surface layer. These are soils of the Alicia, Bernal, Carnero, Clovis, Hagerman, Hassell, Kim, La Fonda, Manzano, Penistaja, Rance, Scholle, Tapia, Wilcoxson, and Witt series. The slope of these soils ranges from level to strong, but in most places it is less than 10 percent.

These soils absorb water at a moderate to rapid rate and have a good water-storage capacity. Wind and water erosion are hazards if the soils are not protected.

The soils in this site respond well to range conservation practices, including brush control and seeding.

In excellent condition, this site has a cover of perennial grasses. Blue grama, an increaser, is the dominant species, but it usually does not make up more than half of the total stand. Next in abundance among the increasers are buffalograss and galleta. Decreasers include side-oats grama, western wheatgrass, Indian ricegrass, and small amounts of little bluestem. Usually, no single decreaser makes up more than 25 percent of the plant cover. The most common invaders are burrograss, ring muhly, cholla cactus, pricklypear cactus, pinyon, and juniper. After prolonged overgrazing, the plant cover consists of buffalograss, ring muhly, and a blue grama sod of low vigor.

MOUNTAIN SHALE RANGE SITE

This site is made up of shallow to deep, medium-textured, stony soils of the Erramouspe, Osha, Pinata, Salas, Stroupe, and Turkeysprings series. These soils are steep to very steep. They occur on mountain slopes and canyon side slopes in the western and southern parts of the survey Area. They have a low capacity to store moisture.

If this site is in excellent condition, the vegetation consists of scattered stands of pinyon and juniper and ponderosa pine and an understory of mid and short grasses, forbs, and shrubs. Decreasers make up 60 percent or more of the potential vegetation. These are mainly mountain muhly, pine dropseed, side-oats grama, prairie junegrass, spike muhly, and little bluestem. The major increasers are Arizona fescue, blue grama, western wheatgrass, pinyon, juniper, and ponderosa pine.

SALT FLATS RANGE SITE

This site is made up of shallow and moderately deep, saline-alkali soils of the Duncan, Harvey, Karde, and Willard series and of Blown-out land. The soils are nearly level to steep and have a loamy surface layer. They occur on terraces in lake basins and on rough hills. They are susceptible to severe damage by wind erosion when they are not adequately protected with vegetation.

If in excellent condition, this site supports a good stand of perennial decreasers. Alkali sacaton is dominant. The other common decreasers are western wheatgrass, blue grama, vine-mesquite, and four-wing saltbush. In places western wheatgrass makes up as much as 20 percent of the plant composition. Each of the other associated species normally makes up not more than 5 percent of the vegetation. The most common increaser species are galleta, buckwheat, burrograss, mat muhly, and saltgrass. The major invaders are ring muhly and broom snakeweed.

SALTY BOTTOMLAND RANGE SITE

This site consists of deep, moderately fine textured soils of the Moriarty series. The soils are level to moderately sloping. They occur in swales and on flood plains and are frequently flooded for short periods.

These soils absorb water slowly. They have a high capacity to store moisture but release moisture to plants very slowly.

The vegetation on this site consists of a mixture of perennial bunch grasses and an understory of sod-forming grasses. If the range is in excellent condition, the predominant grasses are alkali sacaton, blue grama, and western wheatgrass. Smaller amounts of four-wing saltbush, winterfat, and other grasses and forbs are included.

SANDY RANGE SITE

This site consists of deep and moderately deep, coarse textured and moderately coarse textured soils of the Chupadera, Ignacio, Ildefonso, Otero, Palma, Pedrick, and Penistaja series. These soils are level to moderately steep. They occur on upland slopes.

These soils absorb water rapidly but have a low to moderate capacity to store moisture.

If this site is in excellent condition, the vegetation is a mixture of tall, mid, and short grasses. At the lower elevations, there are nearly pure stands of black grama in places. Common decreaser species are sand bluestem, Porter's muhly, little bluestem, indiangrass, Indian ricegrass, black grama, side-oats grama, needle-and-thread, New Mexico feathergrass, and squirreltail. These species make up about 40 percent of the plant composition. Blue grama, an increaser species, makes up about 60 percent of the plant cover. Less abundant increasers include sand dropseed, mesa dropseed, spike dropseed, tumble lovegrass, purple lovegrass, squawbush, three-awn, ring muhly, small soapweed, sand sage, galleta, broom snakeweed, butterweed, and other annual grasses and forbs. Common invaders are oak, cholla cactus, pricklypear cactus, pinyon, and juniper.

SHALLOW RANGE SITE

This site is made up of shallow to moderately deep soils of the Chilton, Encierro, Kech, Pastura, Pinon, Scholle, Tesajo, and Washoe series and of areas of Rock land. The soils are gently sloping to moderately steep and are medium textured and moderately coarse textured. They occur on crests (fig. 25) and side slopes of ridges. Gravel and larger fragments of rock occur on the surface and throughout the profile.

These soils absorb water at a medium to rapid rate, but they have low to moderate moisture-storage capacity. They are droughty because they are shallow over rock or caliche.

If this site is in excellent condition, short and mid grasses are dominant. Forbs and shrubs are common, and in places as much as 10 percent of the vegetation consists of woody plants. Decreasers make up 50 percent or more of the climax vegetation. The more important of the decreaser grasses are side-oats grama, black grama, little bluestem, and New Mexico feathergrass. Blue grama, the major increaser, makes up as much as 25 percent of the vegetation. Less abundant increasers are hairy grama, galleta, sand dropseed, and small soapweed. The most common invaders are broom snakeweed, pinyon, juniper, ring muhly, and buffalograss.

SHALLOW SANDSTONE RANGE SITE

This site consists of the Travessilla part of Bernal-Travessilla fine sandy loams and of the Rock outcrop part of La Fonda-Rock outcrop complex.

The Travessilla soil is shallow to very shallow over sandstone. It occurs on uplands and is level or undulating. It absorbs water at a rapid to moderate rate, but its water-holding capacity is generally low.

If this site is in excellent condition, short and mid grasses are dominant. Trees, shrubs, and forbs are common, and in places they make up more than 30 percent of the vegetation. The principal decreasers are black grama, side-oats grama, and needle-and-thread. The major increaser is blue grama, which makes up as much as 40 percent of the plant cover in places. Less abundant increasers are bigelow sagebrush, galleta, tobosa, pinyon, juniper, and dropseed grasses. Common invaders are mesquite and rabbitbrush.

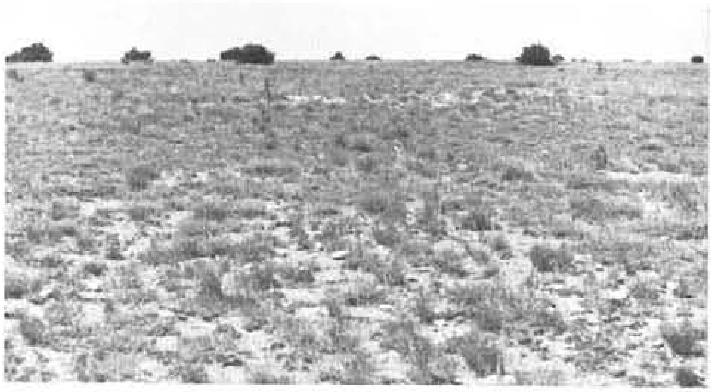

Figure 25.—An area typical of Shallow range site. The vegetation is sparse. The soil is Pastura loam, 1 to 9 percent slopes.

Capability Classification

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 the limitations of the soils, the risk of damage when they are used, and the way they respond to treatment when used for the common field crops and forage crops. The classification does not apply to most horticultural crops or to rice and other crops that have special requirements.

In this system all the kinds of soils are grouped at three levels: the capability class, the subclass, and the unit. The eight capability classes in the broadest grouping are designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, forage, or wood products.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes there can be up to four subclasses. The subclass is indicated 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* means that water in or on the soil will interfere 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, saline, alkali, or stony; and *c*, used in only some parts of the country, indicates that the chief limitation is a climate that is too dry or too cold. For some soils, erosion and one of the other kinds of limitations have about equal importance, and the subclass symbol shows both kinds; VIew–3 is an example.

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

Within the subclasses are the capability units. These groups of soils 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–1 or IIIe–6. 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. The Arabic numeral specifically identifies the capability unit. In the Torrance Area, the capability units are set up and numbered within a system of capability classification that is used throughout the land resource area of which this survey Area is a part. Not all of the capability units in this system are applicable, and for this reason the numbering of the capability units is not consecutive in all cases. The names of the soil series represented are mentioned in the description of each capability unit, but the listing of the series name does not necessarily indicate that all the soils of a series are in the same capability unit.

Soils are classified in capability classes, subclasses, and units in accordance with the degree and kind of their permanent limitations, but without consideration of major and generally expensive land-forming that would change the slope, depth, or other characteristics of the soil; and without consideration of possible, but unlikely, major reclamation projects.

The capability classes in the classification system are described in the following pages, as are the subclasses and units in which the soils of the Torrance Area have been grouped for discussion of their use for dryfarming.

Class I. Soils that have few limitations that restrict their use. There are no class I soils in the Torrance Area.

Class II. Soils that have some limitations that reduce the choice of plants or that require moderate conservation practices. There are no dryland class II soils in this survey Area.

Class III. Soils that have severe limitations that reduce the choice of plants, or require special conservation practices, or both. There are no dryland class III soils in this Area.

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

- Subclass IVe. Soils that are subject to very severe wind or water erosion if they are cultivated and not protected.
  - Unit IVe–3. Deep and moderately deep, friable, well-drained soils on level to moderately sloping uplands; medium-textured or moderately fine textured surface layer.
  - Unit IVe–4. Deep, friable, well-drained, moderately coarse textured soils on level to moderately sloping upland fans.
- Subclass IVew. Soils that are subject to severe wind or water erosion and to overflow damage.
  - Unit IVew–1. Deep, fertile, well-drained, medium-textured and moderately fine textured soils on level to moderately sloping flood plains and in swales.

Class V. Soils that are not likely to erode but that have other limitations, impractical to remove without major reclamation, that limit their use largely to pasture or range, timberland, or wildlife food and cover. There are no Class V soils in the Torrance Area.

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

- Subclass VIc. Soils that are generally not suitable for cultivation, because of unfavorable climatic conditions.
  - Unit VIc–1. Deep and moderately deep, friable, well-drained soils on level to strongly sloping upland alluvial fans and ridge crests.
- Subclass VIe. Soils that are severely limited, chiefly by risk of erosion if protective cover is not maintained.
  - Unit VIe–1. Deep and moderately deep, moderately coarse textured and coarse textured soils on level to strongly sloping uplands.
  - Unit VIe–2. Shallow to deep, limy, medium-textured and moderately coarse textured soils on nearly level to strongly sloping uplands.

Subclass VIew. Soils that are subject to severe wind and water erosion and to flooding.

Unit VIew–1. Deep, moderately fine textured, moderately well drained soils on flood plains and in swales.

Unit VIew–2. Deep, dark-colored, friable, well-drained, medium-textured and moderately fine textured soils in swales and on flood plains.

Unit VIew–3. Deep, dark-colored, friable soils of mountain swales and on flood plains.

Subclass VIs. Soils that are generally unsuitable for cultivation and are limited for other uses by low water-holding capacity, stones, salinity, or other features.

Unit VIs–1. Shallow to deep, gravelly, well-drained soils on nearly level to strongly sloping alluvial fans.

Unit VIs–2. Deep, slowly permeable, medium-textured and moderately fine textured upland soils on nearly level to strongly sloping foothill ridge crests.

Unit VIs–3. Shallow to deep, saline-alkali soils in lake basins and on level to nearly level terraces.

Unit VIs–4. Shallow and moderately deep, medium-textured soils that are underlain by caliche, bedrock, or lacustrine sediments.

Class VII. Soils that have very severe limitations that make them unsuitable for cultivation and that restrict their use largely to grazing, timberland, or wildlife habitats.

Subclass VIIe. Soils that are subject to severe wind or water erosion.

Unit VIIe–1. Moderately sloping to very steep, erodible soils that formed over red beds.

Unit VIIe–2. Shallow to deep, very strongly sloping to very steep, stony, well-drained, medium-textured soils of high mountains.

Unit VIIe–3. Steep to very steep, stony escarpments.

Unit VIIe–4. Deep, coarse-textured, nearly level to strongly sloping, wind-reworked soils.

Unit VIIe–5. Moderately deep and deep, well-drained, medium-textured and moderately fine textured, forested soils on strongly sloping to very steep mountain slopes.

Unit VIIe–6. Moderately deep to deep, medium-textured, gently sloping to very steep, forested soils.

Unit VIIe–7. Shallow to deep, stony, medium-textured and moderately coarse textured, moderately sloping to very steep, forested soils.

Subclass VIIs. Soils that are very severely limited by moisture capacity, stones, or other soil features.

Unit VIIs–1. Mostly very shallow and shallow, medium-textured and moderately coarse textured, nearly level to strongly sloping upland soils.

Unit VIIs–2. Very shallow to moderately deep, undulating, medium-textured soils that formed in gypsiferous material.

Unit VIIs–3. Shallow and moderately deep, rocky soils on moderate to very steep slopes in the foothills.

Unit VIIs–4. Deep, wind-deposited, saline-alkali soils of lake basins.

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

Subclass VIIIs. Rock land that has little potential for production of vegetation.

Unit VIIIs–1. Rocky and barren land.

Use of the Soils for Dryfarming

In the Torrance Area the main hazards in the use of the soils for dryfarming are inadequate and irregular rainfall, torrential showers, blowing snow, high winds of long duration, wide fluctuations in temperature, and a relatively short growing season. The principal dryland crops are winter wheat, pinto beans, corn grown for grain, and grain sorghum.

Climatic zones

New Mexico is divided into seven climatic zones, on the basis of differences in the amount of effective precipitation, with special emphasis on spring precipitation (*9*). Zone 1 gets the most rainfall, and zone 7 the least.

The Torrance Area is partly in zone 4 and partly in zone 5 (fig. 26). Zone 4 usually receives more than 12 inches of precipitation annually. It includes most of the unirrigated cropland of the Area. Zone 5 usually receives less than 12 inches of precipitation annually. This is not enough to make it practical to grow crops, and the resulting lack of plant cover and of organic matter leaves the soils susceptible to erosion and deterioration.

Since the amount of effective precipitation is closely related to the suitability of a soil for growing crops, some soils that occur in both climatic zones have two capability classifications for dryland use. The Guide to Mapping Units shows the relationship between climatic zones and capability classification. Irrigation offsets the climatic hazard of insufficient rainfall, so each soil has only one classification for use under irrigation.

Management practices

Some of the practices needed to manage the dryfarmed soils of this Area are discussed in the following paragraphs.

USE OF CROP RESIDUE.—Good management of crop residue helps to protect the soils against wind erosion, to conserve moisture, and to control weeds.

One method of managing residue is stubble mulching, which is the practice of cultivating so as to leave a protective cover of residue on the surface in which to plant the next crop. The Clovis, Penistaja, Wilcoxson, and Witt soils of this Area are suited to this kind of residue management. In stubble mulching, tillage and harvesting are accomplished with equipment that leaves the residue from the previous crop anchored in the soil. Sweeps, rod weeders, chisels, and field cultivators are commonly used. Drills that will plant into the residue are necessary also. Deep-furrow or shoe-type drills work best if the residue is heavy; disk-type drills are adequate if the residue is

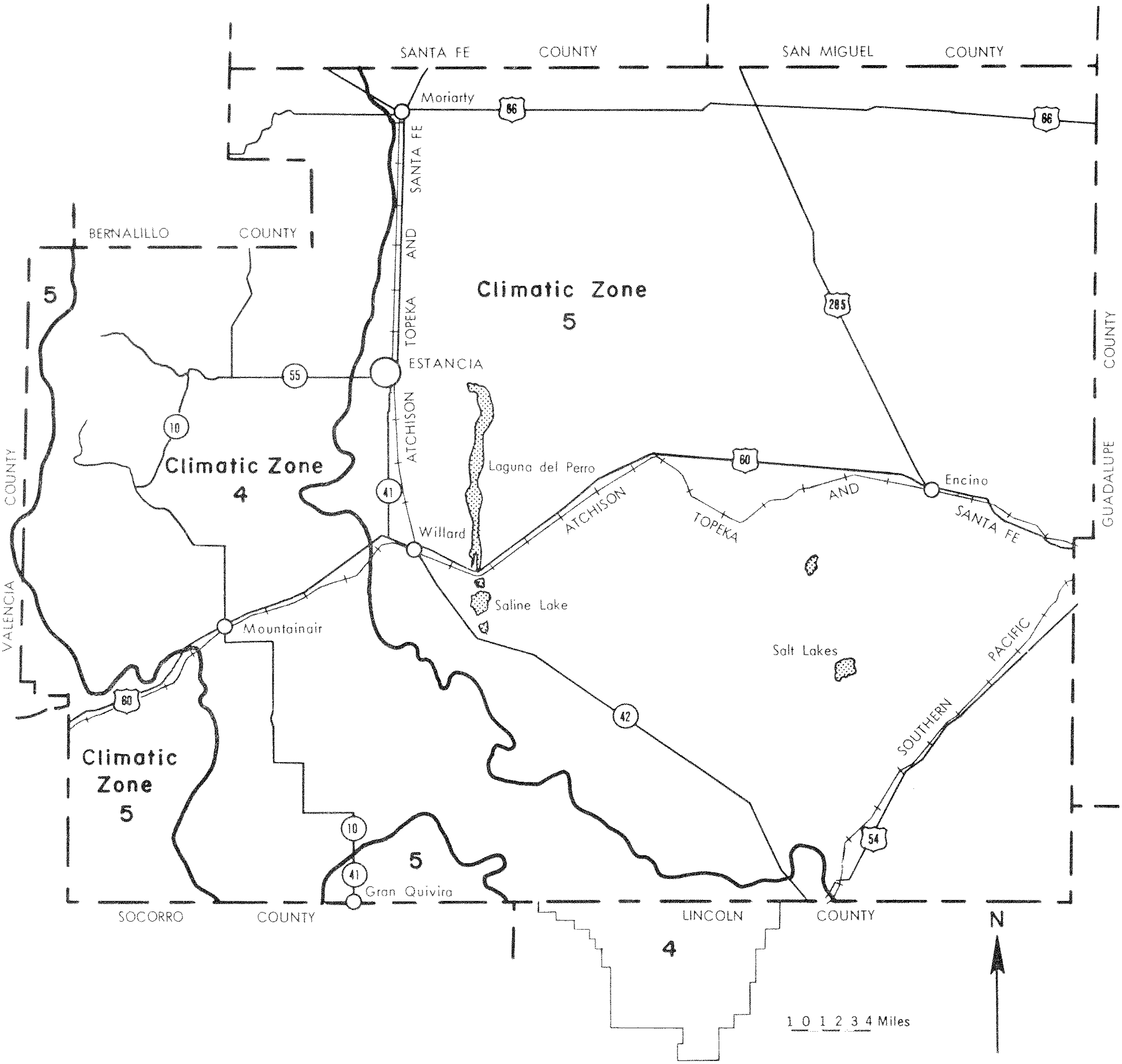

Figure 26.—**Division of Torrance Area into climatic zones 4 and 5.**

moderate or light. The amount of residue needed for protection depends on the texture of the surface soil. A moderately coarse textured soil, such as Ildefonso fine sandy loam, needs a larger amount than a medium-textured soil, such as Manzano loam.

Another method is to leave crop residue on the surface during the windy seasons of fall, winter, and spring, then incorporate it into the soil when the critical period for wind erosion is over. This kind of residue management is suitable for Manzano and Prewitt soils, which are on flood plains and because of their position on the landscape are somewhat protected from the wind.

Emergency tillage.—Emergency tillage consists of roughening the soil surface with chisels or listers, so as to make it resistant to wind erosion. It is a practice that can be put into effect quickly, but it should be resorted to only if there is not enough residue for protection. If used routinely, it breaks down soil structure and causes loss of moisture.

To be most effective, emergency tillage should be on the contour or across the direction of the prevailing winds. A soil that is 20 to 35 percent clay, such as Witt loam, forms more stable clods when roughened than a soil that is only 5 to 15 percent clay, such as Pedrick loamy fine sand.

Terracing and contour farming.—These mechanical practices help to conserve moisture and to limit erosion (fig. 27). The greater the slope, the greater the need for terraces. Terraces are more important on Witt loam, 1 to 6 percent slopes, than on Witt loam, 0 to 1 percent slopes.

The effectiveness of terracing depends on maintenance and management. If neglected, the terraces will deteriorate and erosion will result. Plowing parallel to terraces and in such a way as to move the soil into them is an important practice in keeping terraces in repair.

Terraces should always be supplemented by the best possible cropping system. All terraced fields should be farmed on the contour.

Diversions.—Diversions are used primarily to protect cropland from excessive runoff from higher lying areas. They are needed mostly in the western part of the survey Area, on soils of the Alicia, Penistaja, Wilcoxson, and Witt series, to divert water away from sloping cropland. Diversions require suitable outlets. A pasture of native grass is generally the best kind of outlet.

Diversions are also used to channel runoff water from distant areas into storage reservoirs or stock ponds.

Stripcropping.—This is a protective practice that consists of growing crops in alternate bands or strips. One band is planted to a tall, leafy crop that leaves a large quantity of residue. The next band either is planted to a low-residue crop or is left fallow. Crops suitable for the protective bands are grain sorghum, forage sorghum, sudangrass, and tall perennial grasses. These crops protect the companion low-residue crops from sand blasting by wind and also protect the soil after the companion crop is harvested. On a highly erodible soil such as Penistaja fine sandy loam, the strips that are fallow or are planted to low-residue crops should be listed before the windy season begins. Listing controls local blowing and limits accumulation of soil in the bands of high-residue crops.

Figure 27.—**Snow-topped furrows on Witt loam, 1 to 6 percent slopes. Contour farming helps to hold moisture where it falls and limits erosion.**

Cropping systems.—A good cropping system conserves the soil, uses available moisture efficiently, protects the soil from wind and water erosion, helps to control weeds, insects, and disease, and fits into a long-time plan for land use that is feasible and economically sound. In the Torrance Area, a cropping system should include crops that provide maximum resistance to wind during March, April, and May, when the risk of wind erosion is greatest. Conservation cropping systems are applicable to all the arable soils of climatic zone 4 that are used for dryfarming, mainly those of the Penistaja, Alicia, Manzano, and Witt series.

Management of dryland soils by capability units

This section gives information about the soils that are placed in dryland capability units. Those soils that are suitable for dryland generally need management that differs from that needed on the same soil if it is irrigated. Many of the soils that are suitable for dryland also occur in the drier parts of the Area and are suitable for range. Such soils need different management.

In the following pages each dryland capability unit in the Torrance Area is discussed, and suggestions for the use and management of the soils are given. To find the capability classification of any given soil, refer to the Guide to Mapping Units.

DRYLAND CAPABILITY UNIT IVe-3

This unit consists of deep and moderately deep, well-drained, level to moderately sloping upland soils of the Alicia, Clovis, Harvey, Wilcoxson, and Witt series. These soils are friable and medium textured or moderately fine textured.

All of the soils in this unit are subject to severe wind erosion unless they have a cover of crop residue or are otherwise protected.

The uneroded soils are easy to till, are moderate in fertility, and are readily permeable to roots, air, and water. They have a moderate to high capacity to store moisture because of their depth and because their subsoil is moderately fine textured. They are subject to moderate sheet and rill erosion during periods of heavy rainfall. The Witt clay loams in this unit are examples of soils that have already been damaged by wind erosion. They are low in fertility and are less permeable to roots, air, and water than the uneroded soils. They are also more difficult to till and more easily compacted.

A crop of small grain or sorghum, either of which leaves large amounts of residue, is needed about 2 years in 3. Proper management of the crop residue adds organic matter to the soil and helps to control wind erosion. Listing or chiseling may be necessary if the amount of residue is not sufficient for control of wind erosion during the windy season. Such emergency tillage has only a temporary effect, however, and may have to be repeated.

Lack of moisture, not lack of fertility, limits production on these soils. Terracing and contour farming are ways of conserving moisture. Terracing also helps to keep these soils from eroding, but it may not be necessary if a drilled crop of small grain or sorghum is grown every year and the residue is kept on the surface.

These soils are better suited to production of native grass than to cultivated crops, but if weather conditions are favorable, crop yields are good. Winter wheat, pinto beans, grain sorghum, and corn are the main cultivated crops.

DRYLAND CAPABILITY UNIT IVe-4

This unit consists of deep, well-drained, level to moderately sloping soils of the Penistaja series. These soils are friable and moderately coarse textured. They are on upland piedmont fans.

These soils are coarser textured than those in dryland capability unit IVe-3 and are more susceptible to erosion. The hazard of wind erosion is severe if the soils are left without protective plant cover. Moderate sheet and rill erosion is common after heavy rain.

All of the soils have medium internal drainage and a moderate to high capacity to store moisture. The uneroded soils are moderate in fertility and absorb moisture at a moderate to rapid rate. They are easily tilled. The one eroded soil in this unit absorbs water at a slow to moderate rate. It is lower in fertility and is less easy to till than the uneroded soils, and establishing plants on it is more difficult.

Growing high-residue crops 2 years out of 3 and keeping the residue on the surface are ways to maintain soil tilth and fertility. Low-residue crops, such as beans, can be grown a third of the time without causing soil deterioration, provided they are alternated with strips of high-residue crops, such as soybeans and corn. Terracing is advisable where the slope exceeds 3 percent, unless high-residue crops are grown every year.

If there is not enough crop residue for protection against wind erosion, emergency tillage with chisels or listers should be resorted to as often as needed to control blowing. Overtillage should be avoided; it breaks down the clods and leaves the surface smoother and more erodible.

Diversions and grassed waterways are needed in places to intercept runoff from adjoining grasslands.

Because of the erosion hazard, these soils are better suited to grass than to cultivated crops, but they can be used for cultivated crops, such as beans, wheat, and sorghum, if an intensive cropping system is followed.

DRYLAND CAPABILITY UNIT IVew-1

This unit consists of deep, fertile, well-drained soils of the Manzano and Prewitt series. These soils are friable, medium textured and moderately fine textured, and level to moderately sloping. They are on flood plains and in swales.

These are the most productive dryland soils in the survey Area. They respond readily to management, but they are erodible and subject to overflow. Flooding caused by excessive runoff can be expected about once a year, usually in summer. Close-growing crops, such as pinto beans and wheat, are damaged by the floods because some of the plants are washed out and some are covered with loamy sediments. Flooding causes headcuts and gullies in some places, mainly where the slope is more than 1 percent. In most years, however, overflow is more beneficial than damaging because it supplies additional moisture. Wind erosion is a problem on clean-tilled areas.

These soils are easily tilled. They are readily permeable to roots, air, and water but will compact if tilled when too moist. They have a high capacity to store moisture.

A cropping system consisting of 2 years of a high-residue crop, such as corn, followed by 1 year of pinto beans is the system most commonly followed in farming these soils. Crop residue needs to be kept on the surface for protection against wind erosion and headcutting. Small grains grown year after year provide residue for controlling erosion, provided the residue is left on the surface by stubble mulching.

Wind erosion can be controlled temporarily by listing or chiseling crosswise to the direction of the prevailing winds, but frequent emergency tillage breaks down the clods too finely.

Diversions are needed in some areas to protect crops from floodwaters. They may be used also to distribute water more uniformly so as to slow it down and lessen the hazard of erosion. Crop rows should follow the direction of waterflow, so that the furrows will be flushed free of silt and trash and water will not pond and drown out crops.

These soils are suited to grass, but cultivated crops can be grown if the amount of precipitation during the growing season is normal. Sorghum and corn for grain are the main crops. Close-growing crops, such as winter wheat and pinto beans, are suited, but they are often damaged by floods.

DRYLAND CAPABILITY UNIT VIc-1

This unit consists of deep and moderately deep, well-drained, friable soils of the Alicia, Clovis, Harvey, Kim, La Fonda, Penistaja, and Witt series. These are level to strongly sloping soils on upland piedmont fans and ridge crests, mostly in the eastern and southern parts of the Area, and in both climatic zones.

All of these soils have a moderate to high capacity to store moisture and have medium internal drainage. They are subject to severe wind and water erosion when not protected with adequate cover.

The uneroded soils are easily penetrated by roots, air, and water. Runoff is slow to medium.

The eroded soils were formerly cultivated but have been abandoned. Most of the surface layer has been blown away, and the less fertile, finer textured subsoil is exposed. These soils absorb water more slowly than the uneroded soils, and runoff is medium to rapid.

These soils are generally unsuitable for dryfarming, because rainfall is scanty and erratic. They are better suited to production of native grass. Most of the abandoned fields have been reseeded to native grasses, but establishing adequate stands has been difficult. These areas should be protected from overgrazing until the plants are well established.

DRYLAND CAPABILITY UNIT VIe-1

This unit consists of deep and moderately deep, moderately coarse textured and coarse textured soils on uplands, mostly in the central part of the Area and on the Chupadera Mesa in the southern part. These are soils of the Chupadera, Ignacio, Ildefonso, Otero, Palma, Pedrick, and Penistaja series. They are level to strongly sloping. They occur in both climatic zones and make up about 6 percent of the survey Area.

Generally, these soils absorb water rapidly and have medium to rapid internal drainage. They are low in fertility and have a low to moderate capacity to store moisture for plants. Runoff is slow to very slow.

These soils are generally unsuitable for dryfarming, because they are droughty and susceptible to severe wind

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erosion. They need adequate plant cover at all times for protection against wind erosion. They should never be tilled or be grazed too closely. The hummocky surface layer of some of the soils results from wind erosion.

DRYLAND CAPABILITY UNIT VIe-2

This unit consists of shallow to deep, limy, medium-textured and moderately coarse textured soils of the Dean, Harvey, Ildefonso, Penistaja, and Willard series. These soils are nearly level to strongly sloping. They occur on uplands in all parts of the Area, except in the mountains, and are in both climatic zones. They make up about 16 percent of the Area.

These soils are underlain by a high-lime layer at a depth of about 6 to 15 inches. This layer is almost impenetrable to roots and is slowly permeable to water and air. Runoff is moderate to rapid, and internal drainage is medium. The moisture-storage capacity is low to moderate.

These soils are not suitable for dryfarming, because of shallowness, droughtiness, and a severe hazard of wind erosion. They are suited to production of native grass. A plant cover adequate for protection against erosion is essential.

DRYLAND CAPABILITY UNIT VIew-1

This unit consists of deep, moderately fine textured, moderately well drained soils of the Moriarty series. These are alluvial soils on flood plains and in swales in the western and southern parts of the Area. They occur in both climatic zones and make up about 1 percent of the Area.

These soils absorb water slowly. A fine-textured subsoil enables them to hold a large amount of water, but the water is often held so tightly that it is not readily used by plants. Runoff is slow to medium, and internal drainage is very slow to slow.

These soils usually are flooded about once each year. Sediments carried by floodwaters are harmful to grass when deposited in thick layers. Headcuts and gullies often form in overgrazed areas and in the lower part of the swales where the floodwater flows most rapidly. Water spreaders and diversion dams help to limit erosion by slowing down the water and allowing more time for it to soak in. These soils provide excellent sites for stock ponds because they have a high content of clay and a high swelling capacity. They are better suited to grass than to cultivated crops because of the flood hazard and the risk of water erosion.

DRYLAND CAPABILITY UNIT VIew-2

This unit consists of deep, dark-colored, well-drained soils of the La Fonda, Manzano, and Prewitt series. These soils are friable and are medium textured and moderately fine textured. They occur on flood plains and in swales, mostly in climatic zone 5. They make up about 3 percent of the Area.

These soils are susceptible to both wind and water erosion and to damage from overflow. Headcuts and gullies are common but can be controlled by diversions and water spreaders, which slow down the water and allow more time for it to soak in. The sediments deposited by floodwaters are sometimes so thick that plants do not survive. Ranch roads and livestock trails in many of the swales are primary avenues for erosion. Water moves faster down these roads and trails than it would through grassed channels, and headcutting and deep gullies result.

These soils absorb water at a slow to moderate rate and have a high capacity to store moisture for plants. Runoff is slow to medium, and internal drainage is slow to medium.

These soils are suited to production of native grass. They are susceptible to severe wind erosion if they are overgrazed.

DRYLAND CAPABILITY UNIT VIew-3

Tampico loam is the only soil in this capability unit. It is a predominantly deep, dark-colored, well-drained soil in mountain swales and on flood plains and in many of the narrow bottoms of arroyos and stream channels in the mountains. It occurs only in climatic zone 4.

This soil is shallow to deep. In many areas it is very stony. Areas near flowing streams are wet much of the time. They are subject to overflow from the streams and to runoff from surrounding soils. Sediments carried by floodwaters are deposited along the streambanks and in thin layers along the margins of the arroyos. Gullies form readily, except in areas where there are many cobblestones and stones.

This soil is generally high in fertility and in organic-matter content. It absorbs water at a moderate to rapid rate and has a moderate to high capacity to store moisture. Runoff is slow to medium.

This soil is not suited to cultivation, because of the erosion hazard and the overflow hazard and because in many places it is too sloping or too stony. It is well suited to trees and is the most productive timbered soil in the Area. There are sites suitable for campgrounds and picnic facilities.

DRYLAND CAPABILITY UNIT VIs-1

This unit consists of shallow to deep, gravelly, well-drained soils of the Chilton, Encierro, Kech, La Fonda, Scholle, Tesajo, and Washoe series. These soils are nearly level to strongly sloping. They occur on upland piedmont fans and ridges in both climatic zones and make up about 2 percent of the survey Area.

These soils absorb moisture at a moderate to rapid rate. They are slightly susceptible to wind and water erosion. Runoff is slow to medium, and internal drainage is medium to rapid. The La Fonda soils have a moderate to high capacity to store moisture, but all of the other soils have low moisture-storage capacity.

These soils are not suited to cultivation, because they are generally shallow and gravelly or their slope is too strong. They are well suited to grass, but plant density is restricted in places by surface gravel. Some of the areas are sources of gravel suitable for use in highway construction and in masonry.

DRYLAND CAPABILITY UNIT VIs-2

This unit consists of deep, nearly level to strongly sloping soils of the Alicia, Hassell, and Wilcoxson series. These soils are medium textured and moderately fine textured. They occur on upland piedmont fans and on foothill crests in both climatic zones.

These soils are moderately or slowly permeable. They have a high capacity to store moisture, but the water is held so tightly that it is not readily usable by plants. Runoff is medium to slow, and internal drainage is slow to medium.

These soils are not suited to cultivated crops, because their subsoil is moderately fine textured or fine textured and their surface layer is firm. They are well suited to grass.

DRYLAND CAPABILITY UNIT VIs-3

This unit consists of shallow to deep, saline-alkali soils of the Duncan, Harvey, and Willard series, and of Blownout land. These soils are level to nearly level. They occur on terraces in lake basins in both climatic zones and make up about 4 percent of the Area.

These soils absorb water at a slow to moderate rate. They have a high capacity to store moisture, but if the water is saline it is not readily absorbed by plants. Runoff is very slow to slow, and internal drainage is medium to very slow. Soluble salts occur near the surface in places, as a result of the fluctuating water table and rapid evaporation.

These soils are not suited to cultivated crops, because they are alkali and saline and some are shallow. They are suited to production of salt- and alkali-tolerant native grasses.

DRYLAND CAPABILITY UNIT VIs-4

This unit consists of shallow and moderately deep, medium-textured soils of the Bernal, Carnero, Dean, Hagerman, Manzano, and Tapia series and of the Slickspot land type, which is mapped as a complex with Bernal soils. These soils are underlain by caliche, bedrock, or lacustrine sediments. They occur in both climatic zones.

These soils absorb water readily and release it easily to plants. They are slightly to moderately susceptible to wind and water erosion. They are not suited to dryfarming, because they have a restrictive layer that limits water storage and slows penetration by plant roots. They are well suited to the production of native grass.

DRYLAND CAPABILITY UNIT VIIe-1

This unit consists of moderately sloping to very steep, erodible soils of the La Fonda series and of Badland and Rock outcrop. The topography is rough and rolling and includes nearly vertical canyon walls and mesa escarpments. These areas occur in the eastern and southwestern parts of the survey Area, mainly in climatic zone 5 but partly in climatic zone 4. They make up about 3 percent of the acreage.

Exposed red-bed sandstone and shale make up most of this unit, but there are pockets of reddish soil in the many small drainage channels. In some places on the crests of slopes there are shallow soils that formed in material derived from limestone. Runoff is rapid to very rapid, and water erosion removes the soil material about as fast as it forms.

These soils and land types are suited only to grass and scrub trees. They provide suitable habitats for some kinds of wildlife. The plant cover is very sparse and should be protected from overgrazing.

DRYLAND CAPABILITY UNIT VIIe-2

This unit consists of shallow to deep, well-drained, medium-textured soils on high mountains. These are soils of the Erramouspe, Osha, Pinata, Salas, Stroupe, and Turkeysprings series. They are stony and very strongly sloping to very steep. They occur in both climatic zones and make up about 2 percent of the survey Area.

These soils absorb moisture at a moderate to rapid rate, but they have a low to moderate capacity to store it. Although slowed by surface stones and gravel, runoff is medium to rapid, and consequently water erosion is a severe hazard. Internal drainage is medium.

These soils support some grass and scrub trees which provide suitable habitats for wildlife. Cattle graze the understory.

DRYLAND CAPABILITY UNIT VIIe-3

This capability unit is made up only of Steep rock land, which consists of much barren rock mixed with shallow, undifferentiated soils. Steep rock land includes the faces of mesa breaks or escarpments and the steep side slopes of ridges in the foothills. It occurs in all parts of the survey Area and in both climatic zones. It makes up about 2 percent of the acreage.

Runoff is rapid in these areas, and the hazard of water erosion is severe. Wildlife find suitable habitats. There is some grass forage for livestock, but the vegetative cover is sparse and should not be overgrazed.

DRYLAND CAPABILITY UNIT VIIe-4

This unit consists only of Trail loamy fine sand, 5 to 10 percent slopes. This soil is deep, coarse textured, and nearly level to strongly sloping. It is droughty and erodible. It occurs on uplands in both climatic zones.

This soil absorbs water rapidly but has rapid internal drainage and a low capacity to store moisture. It is low in fertility and low in organic-matter content. Unless protected by adequate plant cover, it is highly susceptible to wind erosion. The grasses should not be overgrazed.

DRYLAND CAPABILITY UNIT VIIe-5

This unit consists of moderately deep and deep, well-drained, medium-textured and moderately fine textured soils of the Capillo, Jekley, Supervisor, and Tecolote series. These soils are strongly sloping to very steep. They occur in the mountains of the western and southern parts of the survey Area, in climatic zone 4.

These soils absorb water at a moderate to rapid rate and have a moderate to high capacity to store moisture. Internal drainage is slow to medium.

These soils are forested and are suited to production of timber. The present plant cover and surface litter hold runoff and erosion to a minimum, but the runoff becomes excessive and the hazard of water erosion severe if the vegetative cover is removed or destroyed. These areas offer food and shelter for wildlife.

DRYLAND CAPABILITY UNIT VIIe-6

This unit consists of moderately deep to deep, medium-textured, gently sloping to very steep soils of the Fortwingate, Fuera, Osha, Pinata, Pino, and Wilcoxson series. These soils occur in the mountains of the western and southern parts of the survey Area in climatic zone 4.

These soils absorb water at a moderate to rapid rate and have a moderate to high capacity to store moisture. Internal drainage is slow to medium.

These soils are forested. At present, runoff is checked and erosion controlled by forest litter, stones, and shrubs, but runoff will be excessive and the hazard of water erosion severe if the vegetative cover is removed or destroyed by fire. Timber production and wildlife habitat are suitable uses.

DRYLAND CAPABILITY UNIT VIIe-7

This unit consists of shallow to deep, medium-textured and moderately coarse textured soils of the Crest, Fuera, Mirabal, Pinata, Tecolote, and Wilcoxson series, and of Stony alluvial land. These soils are moderately sloping to very steep. They occur in the mountains of the western and southern parts of the Torrance Area, in climatic zone 4.

These soils absorb water at a rapid rate, but their capacity to store moisture is low to moderate. Internal drainage is slow to medium.

These soils are forested. At present, runoff is checked and erosion controlled by the vegetative cover, stones, and forest litter, but runoff will be excessive and the hazard of water erosion will be severe if the plant cover is destroyed by fire or heavy logging. Timber production and wildlife habitat are suitable uses.

DRYLAND CAPABILITY UNIT VIIs-1

This unit consists mainly of very shallow and shallow, medium-textured and moderately coarse textured soils of the Bernal, La Fonda, Pastura, Pinon, and Travessilla series, and of Rock land and Rock outcrop. These are nearly level to strongly sloping soils on crests and side slopes of ridges in both climatic zones. They are underlain by caliche, shale, or sandstone bedrock. They make up about 11 percent of the Area.

These soils absorb water at a moderate to rapid rate. All have a low capacity to store moisture, except the La Fonda soil, which has a moderate to high capacity. Internal drainage above the parent material is medium. Runoff is excessive when the root zone is saturated. The hazard of wind and water erosion on overgrazed areas is severe.

These soils are suited only to production of native grasses. The vegetation is sparse and should not be overgrazed.

DRYLAND CAPABILITY UNIT VIIs-2

This unit consists only of Rance-Gypsum land complex. This complex occurs on barren or nearly barren convex ridge crests, in densely vegetated concave swales, and on side slopes. On the ridge crests the soil material is generally no more than 2 inches deep over deposits of soft gypsum. In the concave areas, it is as much as 35 inches deep.

The surface layer crusts easily upon wetting and drying and somewhat restricts root penetration and the intake of water. Runoff and internal drainage are medium to rapid. The Gypsum land part of this complex is droughty and is easily eroded by wind and water.

This complex is better suited to production of native grass than to other uses. No commercial use is presently being made of the gypsum deposits, but such use may be feasible in the future.

DRYLAND CAPABILITY UNIT VIIs-3

This unit consists of shallow and moderately deep, rocky soils of the Ildefonso, Laporte, Pinata, Stroupe, and Washoe series, and of Rock outcrop and Stony steep land. These soils and land types are moderately sloping to very steep. They occur in the mountain foothills, mainly in climatic zone 4 but to a lesser extent in climatic zone 5.

These soils absorb water at a moderate to rapid rate, but they have a low capacity to store moisture because they are shallow and rocky. Internal drainage is medium to rapid. Surface rock and the plant cover help to check runoff and limit erosion, but runoff will be excessive and erosion severe if the vegetation is destroyed by fire or overgrazing.

These soils are better suited to production of native grass than to other uses. Most areas provide enough food and cover for wildlife. Stone and gravel taken from these areas is suitable for roadbuilding.

DRYLAND CAPABILITY UNIT VIIs-4

This unit consists of deep, saline-alkali soils of the Karde series. These soils occur on the leeward sides of salt lakes in climatic zone 5.

These soils are droughty because they tend to crust over easily upon wetting and drying, and the crust causes much of the moisture to run off. The capacity to store moisture is moderate, but if the water is strongly saline it is not readily absorbed by plants. The soils are moderately stable when protected with sufficient plant cover, but they erode easily when overgrazed. In some places windblown deposits are being continually added to these soils, and establishment of grass is slow.

These soils are suitable only for production of native grass.

DRYLAND CAPABILITY UNIT VIIIs-1

This unit consists of Badland and Rock outcrops and slides. These land types occur in both climatic zones, mainly in the foothills and mountains. They are mostly barren rock or exposed parent material. The acreage is not extensive.

These areas are not suited to crops, to grass, or to timber, because they are too rocky or too steep. The vegetation consists of scattered clumps of grass and, here and there, a coniferous tree. These areas are suitable only for wildlife habitats, or, possibly, for recreational uses.

Estimated yields of dryland crops

The estimates of yields given in table 6 are averages that can be expected over a period of years and may not apply to a specific field for any particular year. These estimates are based on fertility trials carried out in New Mexico and on information gathered through interviews with farmers, ranchers, and other informed persons.

The table shows estimates of yields under two levels of management. The figures in columns A represent yields that can be expected under an average level of management. Those in columns B represent yields that can be expected under a high level of management.

Under an average level of management, one or more of the following is assumed—

1. Crop residue is not properly managed.
2. Tillage alone is used to control wind erosion.
3. Rainfall is not conserved, and runoff and water erosion are not controlled.
4. The soil is compacted by being cultivated when wet or is pulverized by excessive tillage.
5. Control of insect pests, plant diseases, and weeds is irregular or lacking.
6. Preparation of the seedbed is poor.
7. Varieties of crops are not suitable.

Under a high level of management, all of the following are assumed—

1. Wind erosion is controlled by proper use of crop residue and, if necessary, by emergency tillage.

TABLE 6.—*Estimated average yields per acre of principal dryland crops under two levels of management*

[Columns A show yields to be expected under an average level of management; columns B, yields to be expected under a high level of management. Only the soils used to a significant extent for the specified crops are listed]

Soil	If annual rainfall is—																	
	0 to 6 inches						6 to 10 inches						10 inches or more					
	Wheat		Pinto beans		Corn		Wheat		Pinto beans		Corn		Wheat		Pinto beans		Corn	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Cwt.*	*Cwt.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Cwt.*	*Cwt.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Cwt.*	*Cwt.*	*Bu.*	*Bu.*
Alicia loam, 1 to 6 percent slopes	3	4	1	2	3	4	6	8	2	3	8	10	15	18	4	5	15	18
Clovis loam, 0 to 5 percent slopes	3	4	1	2	3	4	7	9	3	4	9	11	17	20	5	6	17	20
Manzano loam, 0 to 1 percent slopes	4	5	2	3	4	5	8	10	4	5	10	12	20	25	6	8	20	25
Penistaja fine sandy loam, 0 to 1 percent slopes	3	4	1	2	3	4	7	9	3	4	9	11	17	20	5	6	17	20
Penistaja fine sandy loam, 1 to 6 percent slopes	3	4	1	2	3	4	6	8	2	3	8	10	15	18	4	5	15	18
Penistaja sandy clay loam, 1 to 6 percent slopes, eroded	2	3	1	2	2	3	6	8	2	3	7	9	13	16	3	4	13	16
Witt loam, 0 to 1 percent slopes	3	4	1	2	3	4	7	9	3	4	9	11	17	20	5	6	17	20
Witt loam, 1 to 6 percent slopes	3	4	1	2	3	4	6	8	2	3	8	10	15	18	4	5	15	18
Witt clay loam, 0 to 1 percent slopes, eroded	3	4	1	2	3	4	6	8	2	3	8	10	15	18	4	5	15	18
Witt clay loam, 1 to 6 percent slopes, eroded	2	3	1	2	2	3	4	6	1	2	5	7	10	13	2	3	10	13
Witt-Harvey loams, 0 to 3 percent slopes	3	4	1	2	3	4	6	8	2	3	8	10	15	18	4	5	15	18

2. Rainfall is conserved and water erosion is limited by controlling runoff by means of terraces and diversions and by contour tillage.
3. The soil is tilled when the moisture content is such that clods will form but excessive compaction will not result.
4. Suitable varieties are planted at the proper time and in well-prepared seedbeds.
5. Insects, disease, and weeds are controlled.

In the Torrance Area, yields of dryland crops are more directly related to the amount of precipitation and to the time of year that it falls than to differences among the soils. For this reason, three estimates are given for each soil under each level of management. Each estimate is based on a specified amount of effective precipitation during the growing season. For wheat, the growing season is considered to be the months of September through June. For corn and pinto beans, it is considered to be the months of April through September.

The minimum amounts of precipitation that can be considered effective are half an inch in 1 day between May 1 and September 30 and a fourth of an inch in 1 day between October 1 and April 30. During the May–September period, a fourth of an inch is effective if half an inch occurs on either the preceding or the following day. Smaller amounts of precipitation evaporate quickly and add little or nothing to the reserve of moisture in the soil.

Soils used only for range are not listed in table 6.

Use of the Soils for Irrigated Crops

This section discusses the management practices needed to protect the soils from erosion and to maintain tilth and fertility in irrigated soils in the Torrance Area. The irrigated soils are mainly in the vicinity of Moriarty, Estancia, and Willard. Other small areas are in the Encino Basin and in the vicinity of Manzano. The principal irrigated crops are alfalfa, corn, potatoes, sugar beets, pinto beans, barley, and wheat.

Some of the practices needed to manage the irrigated soils of this Area are discussed in the following pages.

IRRIGATION.—At present, only about 21,800 acres in the Torrance Area is irrigated, mainly areas of Manzano, Willard, and Witt soils. The irrigation water comes mostly from wells. Most of the pumps are powered by butane, natural gas, or electricity, but a few are diesel powered. Most of the wells yield 400 to 1,000 gallons per minute. In the vicinity of Willard, McIntosh, and Moriarty, there are larger wells that yield 1,000 to 2,000 gallons per minute.

In the Estancia Valley, the availability of underground water for irrigation varies from one place to another. At Estancia, the water table is near the surface, but in the western part of the irrigated area it is at a depth of 200 feet. In most wells water is pumped from a depth of 70 to 120 feet.

Generally, the quality of the irrigation water is good, but some of the wells in the lower part of the Estancia Lake Basin near the playa lakes contain harmful amounts of sodium. Crops grown in these areas are stunted and seldom reach maturity.

Furrow and border irrigation systems are the most common. Furrow irrigation is used for most row crops and truck crops grown on gently sloping areas of such soils as Witt loam. Border irrigation is suitable for drilled legumes, irrigated pasture, and small grains grown on nearly level areas of such soils as Manzano loam and Willard loam. Some farmers use reservoirs or overnight storage tanks to collect heads of water adequate for irrigation. In some places water from two or more wells is combined to supply enough water for one field.

Sprinkler irrigation is used on such soils as Pedrick loamy fine sand, where water intake is rapid.

Waste of irrigation water increases production costs and may damage both soil and crop. Much irrigation water is lost when it is conveyed in open earthen ditches, especially on soils such as Ildefonso fine sandy loam, 0 to 2 percent slopes. Seepage causes much of the loss, but evaporation accounts for substantial loss on hot days. Weeds in irrigation ditches not only use the water but also increase the seepage loss. Underground pipe or concrete lining in earthen ditches helps to reduce the water loss and to distribute the water evenly.

A well-designed conservation irrigation system minimizes erosion damage and limits loss of water. In planning an irrigation system, it is important to know how fast the soil absorbs water, how much water it will hold, and how much is available to plants. A Clovis loam, for example, will absorb water more slowly than a Pedrick loamy fine sand. Technical help in planning a conservation irrigation system is available through the local office of the Soil Conservation Service.

Management of crop residue.—Leaving crop residue on or near the surface is a way to protect the soil from erosion. Protection is needed especially in fall, winter, and spring, when soil blowing is most likely. After harvest, the residue is usually left undisturbed through the winter. When the seedbed is prepared in spring, the residue is then incorporated into the soil. Leaving the residue on the surface through the winter provides a cover that protects the soil from erosion. It also improves the water-intake rate, reduces evaporation of soil moisture, helps to maintain the organic-matter content, and preserves soil structure.

The amount of residue that is needed to provide protection varies according to the surface texture of the soil. Soils that have a coarse-textured surface layer, such as Pedrick loamy fine sand, need more crop residue to protect them than do soils that have a medium-textured surface layer, such as Witt loam, 0 to 1 percent slopes.

Cropping systems.—Cropping systems are used to improve or maintain tilth; to limit erosion; to help control weeds, insects, and disease; and to bring the best cash return. A cropping system consists of a sequence of crops in which soil-improving crops balance soil-depleting crops. The frequency of growing soil-improving crops depends on the severity of the erosion hazard and the limitations of the soil. A deep, loamy soil, such as Clovis loam, 0 to 5 percent slopes, does not need a soil-improving crop in the rotation as often as a deep, sandy soil, such as Pedrick loamy fine sand. Grasses and such legumes as alfalfa and sweetclover are soil-improving crops. They should be fertilized and the residue incorporated into the soil in the last year of the rotation. Small grains and sorghum can be used as soil-improving crops if large amounts of residue are returned to the soil, if nitrogen is added to hasten decomposition, and if large amounts of residue are turned under.

Cover crops are close-growing crops that are grown between seasons of regular crops, primarily for soil protection and improvement. They are most commonly grown on the coarser textured soils, such as Willard fine sandy loam. The main cover crops are small grains, vetch, winter peas, and sweetclover.

Fertilization.—Irrigated crops need commercial fertilizer or barnyard manure. Most soils in this Area are deficient in nitrogen and phosphorus. They generally have enough potash for plant growth, but more potash is often applied to improve the keeping quality of truck crops. The amount and kind of fertilizer to be applied should be determined by soil tests. Barnyard manure improves the condition of the soil and provides nutrients that plants need. It is in short supply in the Torrance Area, but some is available from dairies and feedlots.

Manzano soils on flood plains are the most fertile of the irrigated soils in the Area. Willard soils have a naturally high content of potash but a low content of nitrogen and phosphate. The coarser textured soils, such as those of the Pedrick, Ildefonso, and Willard series, benefit most from additions of barnyard manure because they are low in inherent fertility.

Areas from which part or all of the topsoil has been removed by leveling should receive heavy applications of barnyard manure, or else they should be well fertilized and planted to a soil-improving crop the first year after leveling.

Minimum tillage.—Minimum tillage is important in the Torrance Area. Excessive tillage breaks down soil structure, compacts the soil, and reduces pore space. The surface then tends to puddle and crust and to take in less water and air, and plant growth is retarded. Tilling the soils when the moisture content is too high causes surface compaction, particularly if the surface layer is loam or clay loam, such as that of Witt clay loam, 0 to 1 percent slopes, eroded. Surface compaction can be avoided by reducing the number of tillage operations, by not tilling when the soil is wet, and by varying the depth of tillage to reduce the probability of formation of a plowpan.

Management of irrigated soils by capability units

The capability classification of an irrigated soil in the Torrance Area differs from the capability classification of the same soil when it is used for dryland. For this reason, two sets of capability units are described. One set describes the capability of the soils when they are irrigated, and the other set describes the capability of the soils when used for dryland.

The classes, subclasses, and capability units recognized for irrigated soils are described in the following outline. Then, the irrigated capability units of the Area are discussed, and suggestions for the use and management of the soils are given. To find the capability classification of any given soil, refer to the Guide to Mapping Units.

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

- Subclass IIe. Soils that are subject to severe wind or water erosion if they are cultivated and not protected.
  - Unit IIe-1. Deep and moderately deep, well-drained, medium-textured and moderately fine textured, nearly level soils that have a high-lime layer in the substratum.
- Subclass IIew. Soils that are subject to severe wind or water erosion and overflow damage.
  - Unit IIew-1. Deep and moderately deep, fertile, well-drained, medium-textured, nearly level soils in swales and on flood plains.

Class III. Soils that have severe limitations that reduce the choice of plants, or require special conservation practices, or both.
- Subclass IIIe. Soils that are subject to severe wind or water erosion if they are cultivated and not protected.
  - Unit IIIe-1. Deep, well-drained, medium-textured and moderately fine textured, gently sloping soils that have a high-lime layer in the substratum.
  - Unit IIIe-6. Deep and moderately deep, limy, well-drained, medium-textured and moderately coarse textured, nearly level to gently sloping soils.
- Subclass IIIs. Soils that have severe limitations because they occur over lacustrine sediments or because they are moderately alkaline.
  - Unit IIIs-1. Shallow and moderately deep, well-drained, medium-textured and moderately coarse textured, nearly level soils over lake sediments.
  - Unit IIIs-4. Deep, medium-textured, nearly level, moderately alkaline soils on lake terraces.

Class IV. Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.
- Subclass IVe. Soils that are subject to very severe wind or water erosion if they are cultivated and not protected.
  - Unit IVe-1. Deep and moderately deep, limy, well-drained, medium-textured and moderately coarse textured, gently sloping to moderately sloping soils.
  - Unit IVe-2. Moderately deep, coarse-textured, nearly level and hummocky soils overlying lake sediments.
- Subclass IVs. Soils that have very severe limitations because they are very shallow and severely eroded and because they overlie lacustrine sediments.
  - Unit IVs-2. Very shallow, medium-textured, level to nearly level, eroded soils overlying lake sediments.

IRRIGATED CAPABILITY UNIT IIe-1

This unit consists of deep and moderately deep, well-drained, upland soils of the Clovis, Harvey, and Witt series. These are medium-textured and moderately fine textured soils that have a high-lime layer in the substratum. They make up about 20 percent of the irrigated acreage. Only those areas where the slope is 1 percent or less are assigned to this capability unit.

These soils are moderately fertile, and they hold a good supply of moisture for crops. They are subject to severe wind erosion unless adequate crop residue is left on the surface. The plow layer of the Witt clay loam is easily compacted and tends to crust over more readily than that of the other soils.

These soils are suited to all of the crops generally grown in this Area. Alfalfa, potatoes, pinto beans, and corn for silage are the main crops. Truck crops, such as lettuce, carrots, onions, and tomatoes, are well suited, but they are not grown extensively, because there is not enough demand.

In managing the soils of this capability unit, it is necessary to use irrigation water efficiently, to maintain fertility of the soil, and to keep crop residue on the surface for protection against erosion. Tillage that roughens the surface and brings up clods is a common practice if the amount of crop residue is not adequate. Crop rotations that include a high-residue crop, such as small grain, 1 year out of 3 will improve the soil and limit erosion. Clean-tilled crops, such as potatoes or pinto beans, can be grown 2 years in succession without depleting the fertility of the soil or increasing the erosion hazard. Growing alfalfa or perennial grasses in a long-term rotation will improve tilth and permeability. Barnyard manure or commercial fertilizer is usually needed to maintain productivity.

Both sprinkler irrigation and surface irrigation are suitable, but evaporation losses are normally less if surface irrigation is used. Underground pipelines or concrete-lined ditches reduce loss of water and cut irrigation costs. Land leveling where needed will also reduce costs.

IRRIGATED CAPABILITY UNIT IIew-1

This unit consists of deep and moderately deep, fertile, well-drained soils of the Manzano series. These soils are medium textured and nearly level. They occur in swales and on flood plains.

These are the most fertile and productive irrigated soils in the survey Area. They have a high content of organic matter. They are permeable to roots, air, and water, and their water-storage capacity is high. Internal drainage is medium to slow. In places the surface layer is clay loam that is easily compacted when moist and has a tendency to crust over when wet.

Manzano loam, 0 to 1 percent slopes, is flooded once or twice a year, but Manzano loam, saline substratum, 0 to 1 percent slopes, is flooded only about once in 5 years. Water erosion does more damage to these soils than wind erosion. Headcutting occurs in areas where the water flows swiftly, and sedimentation occurs in areas where the water flows slowly. Close-growing crops are more seriously damaged than tall crops, such as corn and grain sorghum. Overflow that occurs about the time crops need irrigating is beneficial.

All of the crops suited to this Area are grown on these soils. Alfalfa and silage corn (fig. 28) are the principal crops. Alfalfa is often damaged by overflow when the hay is down or in bales drying in the field before stacking. Pinto beans are often damaged while lying in windrows and stacks before being threshed. In years when rainfall is above normal, close-growing crops are likely to fail.

A cropping system in which a soil-improving crop, such as alfalfa, is grown half the time helps to maintain fertility and productivity and keeps soil loss to a minimum. Two years of corn grown for silage should be followed by 2 years of small grain, and the residue from the grain should be turned under to add organic matter and improve tilth. Pinto beans, potatoes, and sugar beets do not leave enough residue for control of erosion. If these crops are grown, tillage methods that leave the surface cloddy and rough should be used.

Diversions can be used in places for protection from runoff, particularly on Manzano loam, saline substratum, 0 to 1 percent slopes.

Both sprinkler irrigation and surface irrigation are suitable, but surface irrigation is the more common. Concrete-

Figure 28.—Corn on Manzano loam, 0 to 1 percent slopes. The surface soil has crusted and cracked upon drying.

lined ditches or underground pipes reduce loss of water through evaporation and seepage and thus cut irrigation costs. Land leveling is advisable for areas that are rough or too steep to be irrigated efficiently.

IRRIGATED CAPABILITY UNIT IIIe-1

This unit consists of deep, well-drained, gently sloping soils of the Witt series. These soils are medium textured and have a high-lime layer in the substratum.

The Witt loam in this unit is subject to severe wind and water erosion if it is not protected with adequate plant cover. It is moderate in fertility and in organic-matter content. Tillage is easy, but deep tillage should be avoided because it will bring up the finer textured subsoil and increase the clay content of the plow layer. The increased clay content makes the soil less permeable and harder to till.

The Witt clay loam is eroded. The surface layer and, in places, part of the subsoil have been lost through erosion. This soil is low in fertility and low in organic-matter content. It is hard to till, and the surface layer crusts over easily upon wetting. It absorbs water slowly and is easily compacted. Controlling wind and water erosion is the main problem in managing this soil.

These soils will compact if they are tilled or grazed when too wet. Compaction destroys the structure and retards penetration of roots and movement of air and water; it also makes plowing more difficult. Permeability is moderate to slow, and moisture-storage capacity is high.

All of the locally adapted crops are grown on these soils. Alfalfa, corn, potatoes, and pinto beans are the most common crops.

A cropping system in which soil-improvement crops and high-residue crops are grown half the time will improve tilth, lessen the erosion hazard, increase fertility, and improve the water-intake rate. Crop residue left on the soil after harvest adds organic matter and makes the soil more friable and less subject to compaction and erosion.

A common rotation consists of 5 years of alfalfa, 2 years of corn, and 1 year of potatoes. Alfalfa is often planted with a nurse crop of oats for protection against soil blowing. The oats will also break the soil crust, should one form before the alfalfa sprouts.

Tillage should leave the soil rough, for protection during the windy season. Soil that has been leveled and is being prepared for planting can be protected against blowing by being kept moist. The risk of water erosion can be reduced by irrigating on the contour with small heads of water.

Leveling in preparation for irrigation is a common practice. Cuts made in leveling should not be so deep that they reach the limy substratum. At least 8 inches of soil suitable for tillage should remain after the cuts are made. Whether the soils are leveled or not, the use of commercial fertilizer and heavy applications of barnyard manure will increase fertility. Plowing under green-manure crops, such as sweetclover or alfalfa, improves the physical condition of these soils. Concrete-lined ditches or underground pipes reduce water loss and thus cut irrigation costs. Both sprinkler irrigation and surface irrigation are suitable, but surface irrigation is the more common.

IRRIGATED CAPABILITY UNIT IIIe-6

This unit consists of deep and moderately deep, well-drained, friable, limy, upland soils of the Harvey and Ildefonso series. These soils are medium textured and moderately coarse textured. Only those areas where the slope is 2 percent or less are assigned to this capability unit.

These soils are easily eroded by wind unless an adequate protective cover is kept on the surface during the windy season. They are subject to water erosion if large heads of irrigation water are used.

These soils absorb water readily, and they have a moderate to high capacity to store moisture for plants. They are easily tilled, but most plant roots are confined to the less limy upper layers. Fertility is low, and the organic-matter content is low.

Alfalfa, corn, sorghum, and barley are suitable crops. For control of erosion, a high-residue crop, such as barley, should be grown 2 years out of 3. Perennial grasses and legumes grown for pasture in long rotations protect the soils from erosion and improve fertility. Green-manure crops and heavy applications of barnyard manure increase fertility and add organic matter. Clean-tilled crops seldom leave enough residue for protection against erosion. Tillage that leaves the soil rough and cloddy is advisable.

Both sprinkler and surface irrigation are suitable, but surface irrigation is the more common. Underground pipe or concrete-lined ditches reduce loss of water through evaporation and increase the acreage that can be irrigated with a given amount of water, and thus cut irrigation costs. Land smoothing is needed in areas that are too rough to be irrigated efficiently. These soils hold about 1½ to 2 inches of water per foot.

IRRIGATED CAPABILITY UNIT IIIs-1

This unit consists of nearly level, shallow and moderately deep, well-drained, limy soils of the Willard series. These soils are medium textured and moderately coarse textured. They overlie lake sediments in the lake basins. They make up about 18 percent of the irrigated acreage.

These soils are subject to severe wind erosion when not protected with adequate cover. They are easily tilled and readily permeable to roots, air, and water. They are low in fertility and in organic-matter content and are droughty. The depth to lacustrine sediments ranges from about 10 inches to 30 inches but is most commonly about 16 inches.

Crops that grow well in mildly to moderately alkaline soils are suitable. Alfalfa, corn, sugar beets, irrigated pasture, and small grains are the main crops. Pinto beans, potatoes, and other truck crops are not suited. An example of a suitable crop rotation is 6 years of alfalfa, followed by 2 years of corn, then 1 year of barley. One year of sugar beets can be grown instead of the corn. Crop residue should be mixed with the surface soil to make it resistant to erosion and to increase fertility. If there is not enough crop residue, the soils should be tilled deeply enough to bring up clods. Irrigated pasture of alfalfa or yellow clover, orchardgrass, and smooth bromegrass is a good soil-improving mixture. Pastures should be fenced into three or more areas to allow rotation of grazing.

Concrete-lined ditches, underground pipe, or portable pipe should be used with all types of irrigation systems. Some areas have to be leveled before they can be irrigated efficiently.

IRRIGATED CAPABILITY UNIT IIIs-4

Harvey loam, alkali, is the only soil in this capability unit. It is a deep, medium-textured, nearly level soil on lake terraces. In most places it is moderately alkaline, but in many areas southwest of Estancia it is strongly alkaline. This soil makes up about 8 percent of the irrigated acreage.

This soil is subject to wind erosion if it is not protected with adequate plant cover. It absorbs moisture at a slow to moderate rate; internal drainage is slow to moderate. It compacts easily and is often difficult to plow. The surface layer tends to run together and to crust over after being irrigated. In some areas the surface layer is fine sandy loam, and in these areas the soil is normally less alkaline and more permeable to roots, air, and water. The water table is sometimes within 5 feet of the surface.

Only alkali-tolerant crops, such as alfalfa, barley, sugar beets, and corn, are grown on this soil. Irrigated pasture is also well suited.

This soil needs to be leveled before it is irrigated. It should be leached every year before planting time unless the crop is a perennial, and then a leaching irrigation should be applied in spring before time for growth to begin. Chemical amendments, such as gypsum, sulfur, or sulfuric acid, may improve this soil, but they should be applied to small test areas before they are applied to whole fields. If chemicals are used, they should be applied before the leaching irrigation. Heavy applications of barnyard manure improve tilth and permeability. Deep chiseling might improve internal drainage. Growing deep-rooted and fibrous-rooted crops improves the physical condition of this soil.

A crop rotation consisting of 6 years of irrigated pasture (alfalfa or yellow clover, orchardgrass, and smooth bromegrass), followed by 2 years of barley and 1 year each of corn and sugar beets improves the soil and keeps wind erosion to a minimum. For additional soil improvement, the irrigated pasture plants could be turned under as a green-manure crop in the sixth year.

Surface irrigation is the best method for use on this soil. Concrete-lined ditches or underground pipes reduce loss of water through seepage and evaporation.

IRRIGATED CAPABILITY UNIT IVe-1

This unit consists of deep and moderately deep, well-drained, limy, upland soils of the Harvey and Ildefonso series. These soils are medium textured and moderately coarse textured. The Harvey soils in this unit have a slope range of 1 to 3 percent, and the Ildefonso soils have a slope range of 2 to 5 percent.

These soils absorb water readily, and they have a moderate to high capacity to store moisture. They are droughty, however, because they have a high content of lime and because the Ildefonso soil contains gravel. They are low in fertility and low in content of organic matter. They are readily penetrated by plant roots, but most roots are confined to the less limy upper layers. They compact easily, especially if they are tilled or trampled by livestock when wet. They are subject to severe wind and water erosion.

Alfalfa, irrigated pasture, and small grains are suitable crops. Low-residue row crops are less dependable and should be grown not more than 1 year in 3. Long-time rotations that include legumes and perennial grasses will increase fertility, maintain the organic-matter content, and improve tilth. When small grains are grown in the rotation, the residue should be left on the surface for protection against wind erosion. Tillage should leave the soils rough and cloddy so they will be resistant to erosion.

These soils can be irrigated on the contour with furrows, but they can be irrigated more efficiently if leveled. Cuts deep enough to expose the high-lime layer should be avoided. Normally, cuts of 8 to 10 inches leave enough soil material above the high-lime layer for tillage and plant growth. After leveling, the application of 10 tons of barnyard manure per acre will increase productivity. All crops should be fertilized in accordance with results of soil tests and according to the needs of the crop to be grown. Deep chiseling may be necessary to keep compaction to a minimum.

These soils can be irrigated with sprinklers, but care must be taken to avoid excessive runoff, which would cause erosion. Portable pipe, concrete-lined ditches, or underground pipe will reduce loss of water and cut irrigation costs.

IRRIGATED CAPABILITY UNIT IVe-2

This unit consists of moderately deep, coarse-textured, nearly level and hummocky soils of the Pedrick series. These soils formed over lake sediments.

These soils are subject to severe wind erosion because they are coarse textured and unstable. They are easily tilled and are readily penetrated by plant roots. They absorb water rapidly, but they have a low capacity to store it. Internal drainage is rapid. Fertility and the organic-matter content are very low.

The kinds of crops that can be grown on these soils are limited. Growing high-residue crops, such as small grains, year after year or in rotation with irrigated pasture, provides the best protection against wind erosion. The residue also increases fertility and maintains the organic-matter content. Returning crop residue to the soil after harvest is another way to control erosion. Tillage that roughens the soil can be resorted to if the soils start to blow.

These soils are suited only to sprinkler irrigation. Portable pipe or underground pipe is essential for efficient irrigation.

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IRRIGATED CAPABILITY UNIT IVs-2

Willard loam, eroded, is the only soil in this capability unit. It is a very shallow, medium-textured, level to nearly level soil that has been severely eroded by wind. Limy, saline lake sediments are at or near the surface.

This soil is easily tilled and is permeable to roots, air, and water. It is low in fertility and low in organic-matter content. It tends to crust over after being irrigated. The lake sediments hold a moderate supply of moisture for crops, but plants have difficulty absorbing the water if the content of soluble salts is high.

Salt-tolerant crops, such as alfalfa, barley, sugar beets, and corn, are best suited. Irrigated pasture of alfalfa or yellow clover, orchardgrass, and bromegrass is also well suited. A crop rotation that consists of 2 years of legumes or irrigated pasture followed by 1 year of small grain checks erosion, increases fertility, and maintains the organic-matter content. Crop residue should be incorporated into the soil or left on the surface to provide protection against wind erosion. Heavy applications of barnyard manure, along with commercial fertilizer, increase productivity. Shallow tillage is desirable because of the underlying saline sediments. Leaching irrigations before planting help to reduce the salt content.

If surface irrigation is used, this soil may need smoothing. Sprinkler irrigation is suitable also. Concrete pipe, underground pipe, and portable pipe are needed for efficient irrigation.

Estimated yields of irrigated crops

The estimates of yields given in table 7 are averages that can be expected over a period of years. These estimates are based on results of research and on information obtained in interviews with farmers and other informed persons.

The table shows estimates under two levels of management. The figures in columns A represent yields that can be expected under an average level of management. Those in columns B represent yields that can be expected under a high level of management.

Under an average level of management, one or more of the following is assumed—

1. A conservation cropping system is not followed.
2. Suitable crops are not planted at the proper time or at the proper planting rates.
3. Fertilizer is not applied or is applied irregularly.
4. Crop residue is not properly managed.
5. The soils are tilled or grazed or crops are harvested when the soil is wet enough to compact excessively.
6. Control of insect pests, plant diseases, and weeds is inconsistent and not timely.
7. The length and slope of the irrigation run is not correct for applying irrigation water.
8. Irrigation water is not conserved.
9. Irrigation is erratic and untimely.
10. Harvesting is not properly done nor properly timed.

Under a high level of management, all of the following are assumed—

1. Conservation cropping systems are followed that include crops that produce a large amount of residue and crops that improve the soil.
2. Suitable crop varieties are selected, and seed is planted at the proper time and at the correct rates.
3. The right kind of fertilizer is applied in proper amounts and at the proper time.

TABLE 7.—*Estimated average yields per acre of principal irrigated crops under two levels of management*

[Yields in columns A are to be expected under an average level of management; yields in columns B can be obtained under a high level of management. Only the soils used to a significant extent for the specified crops are listed. Dashed lines indicate the crop is generally not suited to the soil]

Soil	Alfalfa		Corn for silage		Corn for grain		Potatoes		Sugar beets		Pinto beans		Barley		Wheat	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Tons	*Tons*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Cwt.*	*Cwt.*	*Tons*	*Tons*	*Cwt.*	*Cwt.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Clovis loam, 0 to 5 percent slopes	3	5	14	18	35	55	175	215	10	14	11	15	45	55	25	50
Harvey loam, 0 to 1 percent slopes	3	5	10	15	30	45	160	200	8	12	8	12	25	50	20	40
Harvey loam, 1 to 9 percent slopes	2	4	8	13	25	35	----	----	----	----	5	9	15	30	15	30
Harvey loam, alkali	2	4	7	12	20	35	----	----	7	11	----	----	25	45	15	25
Ildefonso fine sandy loam, 0 to 2 percent slopes	3	5	12	15	30	50	140	180	8	12	8	12	25	50	20	40
Ildefonso fine sandy loam, 0 to 5 percent slopes	2	4	8	13	20	35	----	----	----	----	6	10	20	35	15	30
Manzano loam, 0 to 1 percent slopes	4	6	15	21	45	65	190	240	13	18	12	18	45	65	35	55
Manzano loam, saline substratum, 0 to 1 percent slopes	4	6	15	21	45	65	190	240	13	18	12	18	45	65	35	55
Pedrick loamy fine sand	2	4	6	10	15	30	----	----	----	----	----	----	20	40	15	25
Pedrick loamy fine sand, hummocky	----	----	----	----	----	----	----	----	----	----	----	----	15	30	10	20
Willard fine sandy loam	3	6	10	16	30	50	----	----	9	13	8	12	40	55	25	40
Willard loam	3	5	12	16	30	50	150	210	9	13	8	12	40	55	25	45
Willard loam, eroded	2	4	8	12	20	35	----	----	8	12	----	----	25	50	15	30
Witt loam, 0 to 1 percent slopes	4	6	14	20	40	60	180	240	12	16	12	16	40	60	30	55
Witt loam, 1 to 6 percent slopes	3	5	13	17	35	55	175	200	9	13	10	14	30	55	25	45
Witt clay loam, 0 to 1 percent slopes, eroded	3	5	14	18	35	55	175	215	10	14	11	15	40	55	25	50
Witt clay loam, 1 to 6 percent slopes, eroded	2	4	11	14	30	55	170	195	8	13	8	12	25	50	25	40
Witt-Harvey loams, 0 to 3 percent slopes	3	5	12	18	35	55	165	200	9	14	10	14	30	55	25	45

4. The soils are tilled carefully at the right time and with the right kinds of implements so that crop residue is utilized, weeds are controlled, and excessive compaction is prevented.
5. Insect pests and plant diseases are controlled by chemicals and proper management.
6. Length and slope of irrigation runs are suitable.
7. Irrigation water is applied in accordance with crop needs and at proper times.
8. Crops are harvested at the proper times and with equipment that is properly operated.

Yields may change in the future as a result of the development of new crop varieties that will tolerate the diseases and insect pests common in the Area and that are adapted to the short growing season. Yields higher than the estimates given in columns B are not uncommon in favorable seasons.

Soils used only for range are not listed in table 7. Some irrigated soils are not listed, because the irrigated acreage is small.

Use of the Soils for Timberland[5]

This section presents information about the suitability of the soils for production of timber and other wood products. In the Torrance Area the soils that support commercial timber and woodland are mainly those at the higher elevations, where the environment is favorable for trees. Only those soils within forested and wooded areas are discussed in this section.

Most of the timbered lands have been cut over, and the present stands consist of saplings, poles, and scattered sawtimber-size trees. Poles and posts can be harvested, and diseased trees and risk trees salvaged. There are also small, isolated pockets of mature timber left from the original stands. Pulpwood could be produced if a market for it developed.

Ponderosa pine, Douglas-fir, white fir, and limber pine are the commercial timber species in this Area. Ponderosa pine is dominant and makes up most of the merchantable timber. White fir and limber pine are minor species; they presently have less commercial value than either ponderosa pine or Douglas-fir.

In this Area ponderosa pine grows best at elevations of 7,000 to 8,500 feet. In the upper part of this range, it grows well on Capillo, Jekley, Tecolote, and Tampico soils (fig. 29) and on Stony alluvial land. In the lower part, it grows best on Crest, Fortwingate, Wilcoxson, Pino, and Fuera soils.

At elevations of 7,800 to 9,000 feet, the tree cover generally changes to a mixed stand of Douglas-fir, white fir, and ponderosa pine. In places, however, there are nearly pure stands of Douglas-fir and white fir. The elevation range for fir appears to be 7,800 to 9,000 feet. Soils of the Capillo, Crest, Jekley, Mirabal, Tecolote, and Supervisor series support substantial stands of fir. Aspect also has a strong influence on the growth of fir. In the main part of the ponderosa pine zone, at elevations of 7,500 to 8,000 feet, fir grows on north-facing slopes and in canyon bottoms. At elevations of 8,500 to 10,000 feet, fir grows on slopes of all aspects.

[5] By DARWIN B. CREZEE, forester, and JOHN A. WILLIAMS, soil scientist, U.S. Forest Service, Albuquerque.

Figure 29.—**Ponderosa pine and Douglas-fir on Tampico loam.**

At elevations of 6,000 to 7,000 feet, the tree cover is mostly pinyon pine and juniper. These species are common also on south-facing slopes at elevations as high as 8,000 feet. Of the two species, juniper is dominant.

Pinyon and juniper trees grow best on the following soils: Bernal-Travessilla fine sandy loams; Chupadera loamy fine sand, 5 to 15 percent slopes; Laporte-Rock outcrop complex; Penistaja fine sandy loam, 1 to 6 percent slopes; Penistaja loamy fine sand, hummocky, 1 to 8 percent slopes; Pinata-Stroupe stony loams, 20 to 50 percent slopes; Pinon channery loam, 3 to 20 percent slopes; Trail loamy fine sand, 5 to 10 percent slopes; and Turkeysprings stony loam, 20 to 50 percent slopes.

Juniper is abundant on Penistaja and Trail soils. The trees reach a height of 20 to 25 feet on Trail loamy fine sand, 5 to 10 percent slopes, as compared to a general average of 15 feet. Thick, vigorous stands of pinyon grow on Pinata-Stroupe stony loams, 20 to 50 percent slopes. Pinyon grows much taller on Turkeysprings stony loam, 20 to 50 percent slopes.

Pinyon and juniper have commercial value as fenceposts, mine props, and stulls. Both species have value as fuel wood. The pinyon trees produce edible nuts, and they also make good Christmas trees. These two species are also often used as ornamentals in landscaping.

Timber suitability groups

Table 8 groups the forest soils in order of their estimated relative suitability for timber. Ratings are given for five groups of soils. The soils in group 1 are those that are the most productive of ponderosa pine, and those in group 5, the least. The soils in group 1 produce trees that are of good quality, have good form, and are fast growing. Those in group 5 produce trees that grow slowly and have poor form. The site index is the average height of the dominant and codominant trees at 100 years of age.

Table 8 shows the estimated suitability for Douglas-fir and white fir, where such information applies to particular soils. The ratings for fir are given as high and medium. These ratings are not based on site index, but on field observations and experience of soil scientists, forest rangers, and forest technicians. The timber suitability groups described in the table apply only to this survey Area.

Table 8 also gives ratings for plant competition, equipment limitations, and the erosion hazard.

Windthrow is not a significant hazard in this Area. Some damage may occur if high-velocity winds strike timbered areas at a time when the soils are saturated. Trees on shallow soils are the most susceptible. The windthrow hazard is not rated in the table.

Plant competition.—When a site has been disturbed by fire, cutting, or other factors, undesirable species of brush, trees, and other plants are apt to invade. Such competition hinders the establishment and growth of desirable tree species.

A rating of *slight* indicates that invasion by undesirable species will have little effect on growth of desirable timber species. A rating of *moderate* indicates that competition will not seriously affect establishment of adequate stands of timber. A rating of *severe* indicates that competition is strong and interferes with natural regeneration. If seedlings are planted, the competing species must be controlled.

In the Torrance Area, oak brush is the chief source of competition. Thick stands grow up on burned or heavily cutover areas of Capillo, Jekley, Tecolote, and Supervisor soils.

Table 8.—*Timber suitability groups of forest soils*

Group and soils	Site index [1]	Species suitability	Suitability for—		Plant competition	Equipment limitations	Erosion hazard
			Ponderosa pine	Douglas-fir and white fir			
Group 1: Deep, medium-textured, somewhat stony soils on gently sloping to moderately sloping alluvial bottoms. These soils are well drained and moderately permeable. (Ta)	70+	Ponderosa pine, Douglas-fir, and white fir.	High	High	Moderate	Slight	Moderate to severe.
Group 2: Moderately deep, medium-textured and moderately fine textured soils on steep, north-facing canyon side slopes. These soils are well drained and are usually moist. Permeability is not restricted. (Ca, Je, Sr, Tg)	60 to 69	Douglas-fir and white fir.	Moderately high.	High; medium on Tg.	Severe	Severe	Severe.
Group 3: Shallow to moderately deep, medium-textured soils on gently sloping to very steep, mountainous terrain. These soils are well drained and moderately permeable. Some of them are stony. (Fo, Fr, Oa, Pr, Pv, Pw, Wf)	50 to 59	Ponderosa pine.	Moderate		Moderate	Slight to severe.	Moderate to severe.
Group 4: Shallow to deep, stony, medium-textured and coarse-textured soils on moderately sloping to very steep, mountainous terrain. These soils are well drained and are moderately to moderately rapidly permeable. Many of them have a southern aspect. (Ct, Fu, Mh, Ml, Ps, Sn, Tf, We, Wg)	40 to 49	Ponderosa pine.	Low		Moderate	Moderate to severe.	Moderate to severe.
Group 5: Shallow and deep, medium-textured and coarse-textured soils in fringe zone between pine and other woodland below elevations of about 7,000 feet. The slopes are moderate to very steep. (Cm Og)	39 or less	Ponderosa pine.	Very low		Slight	Slight to moderate.	Severe.

[1] Based on site index values for ponderosa pine (*10*).

EQUIPMENT LIMITATIONS.—Some soil characteristics and topographic features restrict or prevent the use of equipment commonly used in timber management or in tree harvesting. The chief factors affecting use of equipment on the soils of the survey Area are slope, susceptibility to erosion, and stoniness.

A rating of *slight* indicates that there is no special problem in use of equipment. A rating of *moderate* indicates that not all types of equipment can be used and that the location and construction of haul roads, skid roads, landings, and the like must take into account the hazard of erosion. A rating of *severe* indicates that the type of equipment that can be used is limited and special logging methods may have to be used. It also indicates that use of equipment can cause serious damage to the structure and stability of the soil.

For a short period after frost leaves the ground in spring, and occasionally during the summer rainy season, all of the timbered soils are too soft and wet to support equipment.

EROSION HAZARD.—The erosion hazard is rated according to inherent soil characteristics, such as slope, surface cover of stones and cobblestones, and aspect. Ratings of *slight*, *moderate*, and *severe* are used to indicate susceptibility to erosion if the soil is disturbed or if it lacks a protective cover of vegetation.

A rating of *slight* indicates that only a small loss of soil occurs where there has been disturbance or depletion of the plant cover. A *moderate* rating indicates that disturbance of the surface layer and loss of protective vegetation will result in conditions conducive to erosion. Careful planning and construction of roads, skid trails, and landings are necessary to prevent soil loss. A *severe* rating indicates that the soils are subject to serious erosion loss. Harvesting must be done carefully, and special logging methods that minimize soil disturbance are advisable. All roads and skid trails must be carefully located and constructed. They must be adequately drained to control excessive runoff. After logging has been completed, the roads must be seeded to reduce runoff and curb erosion.

Forest management

Forest management includes protection against fire, insects, and disease; thinning and pruning to improve the quality of the stands; reforestation; and good management of the watershed.

The national forest timberland in the Area is under sustained-yield management. Fire protection is provided through a system of lookouts and fire guards and through practices that reduce the fire hazard. Proper silvicultural practices and direct-control methods provide protection against insects and disease. Pruning, precommercial thinning, and commercial cutting improve the quality of the timber and increase the growth potential. Erosion control practices are needed in areas used for commercial production of trees. These practices include protecting skid trails, roads, and log landings by constructing water bars, cross-ditching, seeding to grass, and scattering slash in the disturbed areas.

A well-managed forest provides protection against erosion. Litter and humus absorb water, the tree root channels increase the porosity of the soil, and the dense network of surface roots helps to bind the soil. Also, forest litter absorbs the impact of rainfall and thus prevents damage to the soil.

Reforestation is achieved by natural regeneration and by direct planting and seeding. Regeneration as used here means the capacity for natural replacement or natural reforestation of timber species. Most of the timbered soils have moderate capacity for regeneration, but several have better than average capacity. The soils that have the best capacity for regeneration of ponderosa pine are Fuera cobbly loam, 5 to 20 percent slopes; Fuera cobbly loam, 20 to 60 percent slopes; Pinata stony loam, 25 to 50 percent north slopes; Pinata stony loam, 20 to 60 percent south slopes; Pino loam, loamy substratum, 3 to 12 percent slopes; Pino silt loam, 2 to 30 percent slopes; and Wilcoxson stony loam, 5 to 20 percent slopes.

The soils that have the best capacity for regeneration of fir are Capillo loam, 15 to 50 percent slopes; Jekley silty clay loam, 20 to 40 percent slopes; and Supervisor loam, 40 to 80 percent slopes.

Use of the Soils for Wildlife [6]

Both game species and nongame species of wildlife find habitats in the Torrance Area. Big-game species are mule deer, pronghorn antelope, black bear, and Merriam's turkey. These species are concentrated mainly at the higher elevations. Small-game species of the lowlands are mourning dove, scaled quail, and various kinds of waterfowl.

Nongame species of the mountains include turkey vultures, golden eagles, cliff swallows, ravens, pinon jays, western robins, western bluebirds, mountain bluebirds, and several kinds of sparrows. Coyotes and bobcats are also numerous.

Nongame wildlife of the foothills, grasslands, and farmlands include kangaroo rats of several species, prairie dogs, pocket mice, plains jackrabbits, cottontail rabbits, pocket gophers, skunks, porcupines, badgers, and various kinds of snakes, including rattlesnakes. There are also prairie falcons, sparrow hawks, red-tailed hawks, Cooper's hawks, marsh hawks, western kingbirds, horned larks, ravens, and several kinds of warblers.

The nature, quality, and abundance of wildlife habitats are directly affected by the use of the land for farming, for the production of wood crops, and for the production of forage.

The 11 soil associations in the Torrance Area have been placed in five wildlife groups. Each of these groups has similar wildlife populations and has about the same potential for wildlife habitat. These groupings can be useful in broad land-use planning and in the acquisition of land for wildlife management.

WILDLIFE SUITABILITY GROUP 1

This group consists of the Washoe-Ildefonso association, the Salas-Rock outcrops and slides association, and the Wilcoxson-Supervisor-Pino association, which are in the mountainous, rocky, western and southern parts of the survey Area. The slopes are gently sloping to very steep. The vegetation consists of forest and an understory of short and mid, cool-season grasses and oak brush and other shrubs.

[6] By JOHN FARLEY, wildlife biologist, Soil Conservation Service.

Rocky Mountain mule deer is the most important game species. All of the soils provide year-round habitats for deer. The slope aspect affects daily and seasonal use, because winter snow and summer heat are factors in the deer's choice of habitat.

Black bear are native to the Manzano Mountains, but they are scarce now, even though supplemental plantings have been recently made for their benefit. Wildlife observers estimate the present population of black bear at only about ten head.

Merriam's turkey (fig. 30) finds habitats in both the Manzano Mountains and the Gallinas Mountains but is more abundant in the Manzano Mountains. The turkey population was hard hit by the severe drought of the 1950's, during which both food and water were scarce. The turkey population has increased some in recent years, but it is unlikely that turkeys will ever again be numerous. Urban developments are spreading into the Manzano Mountains, and Merriam's turkey are not tolerant of close association with people.

Mourning dove also inhabit these mountainous areas, but they are not numerous.

Figure 30.—**Merriam's turkey in a stand of upland aspen. (Photo by New Mexico Department of Game and Fish.)**

Tajique Creek, in the Manzano Mountains, is stocked several times each year with catchable-size trout. It is the only public fishing ground of consequence on the soils of this wildlife group. There are a few private ponds that are stocked and managed as trout fisheries.

WILDLIFE SUITABILITY GROUP 2

This group consists of the Witt-Wilcoxson-Turkeysprings association and the Penistaja-Steep rock land association, which are on foothills and uplands in the western, southern, and eastern parts of the survey Area. The slopes are nearly level to very steep. The vegetation consists of moderate to heavy stands of pinyon and juniper and an understory of short and mid grasses and cactus.

A substantial number of Rocky Mountain mule deer characterizes this group. The tract near the eastern slopes of the Manzano Mountains is a winter range for deer. Tracts in the eastern part of the survey Area provide year-round habitat.

This group supports the major breeding population of mourning dove in the survey Area. Scaled quail are moderately abundant near small cultivated fields in the western part of the Area.

Manzano Lake, near the village of Manzano, is stocked by the New Mexico Department of Game and Fish and managed as a public trout fishery. This lake, owned by the Manzano Water Users Association, is about 3 acres in size.

WILDLIFE SUITABILITY GROUP 3

This group consists of the Witt-Harvey-Manzano association and the Willard-Ildefonso-Karde association, which are on uplands and in swales in the western and southern parts of the Area and on plains and hills of lake basins. The slopes are nearly level to strongly sloping. The vegetation consists mainly of short and mid grasses, cactus, and snakeweed. Much of the irrigated cropland in the Area is in this group. Small grains, row crops, alfalfa, and truck crops are the principal irrigated crops.

Mourning dove are numerous in summer and early in fall. The breeding population is large in some years, and in fall the population is swelled by migrating birds.

Scaled quail occur in small numbers, but the habitat is not especially favorable. Quail are most numerous in the irrigated areas.

In years when precipitation is above normal, migrating waterfowl and shorebirds frequent stock ponds and irrigation storage reservoirs.

A number of the storage reservoirs are stocked with bass, bluegill, and channel catfish. Where the water temperature is favorable, the reservoirs are stocked with trout. These are private fisheries.

WILDLIFE SUITABILITY GROUP 4

This group consists of the Clovis-Otero-Rock land association, the Tapia-Dean-Pastura association, and the La Fonda-Alicia-Rock outcrop association, which are in the eastern part of the survey Area, in the Pedernal Hills and the uplands to the east and south of these hills. A small area west of the town of Mountainair is included. The soils are loamy and generally nearly level to strongly sloping. The vegetation consists mostly of short and mid grasses, cactus, snakeweed, and scattered pinyon and juniper.

The presence of North American pronghorn antelope in the Pedernal Hills is the distinguishing feature of this group. The range vegetation, the topography, and the elevation of less than 7,500 feet provide a favorable environment for pronghorns. Management in recent years has been directed toward encouraging an increase in the antelope population. There are small numbers of mourning dove, scaled quail, and migrating waterfowl in areas where food and water are plentiful.

WILDLIFE SUITABILITY GROUP 5

This group consists of the Otero-Palma-Trail association, which is in the southern part of the Area, on the Chupadera Mesa and stretching eastward to Pino Hill. The relief is undulating to hummocky. The native vegetation consists of moderate to heavy stands of pinyon and juniper and an understory of short, mid, and tall grasses, cactus, and weeds. Some areas have been cleared.

This group provides the best habitat in the survey Area for scaled quail (fig. 31). Range in fair to poor condition is the best year-round source of food for these birds. Food for doves is abundant, also, in years when rainfall is normal or above. In such years, the peak population of migrating doves is large. The habitat is also favorable for Rocky Mountain mule deer.

Engineering Uses of the Soils [7]

Some soil properties are of special interest to engineers because they affect the construction and maintenance of roads, airports, building foundations, pipelines, drainage systems, facilities for water storage, erosion control structures, sewage disposal systems, irrigation systems, and related structures. The soil properties most important to engineers are permeability, shear strength, compaction, shrink-swell characteristics, water-holding capacity, grain size, plasticity, and soil reaction. Also important are topography, depth to bedrock or caliche, and depth to the water table.

Figure 31.—Scaled quail in its natural habitat. (Photo by New Mexico Department of Game and Fish.)

[7] By NORMAN L. WELBORN and THEODORE C. PATTERSON, engineers, Soil Conservation Service.

The characteristics of the soils in the Torrance Area are described in detail in the section "Descriptions of the Soils." Those characteristics that affect engineering are interpreted in this section for engineers and others concerned with use of soil as a construction material.

With the use of the soil map for indentification, the engineering interpretations reported here can be useful for many purposes. It should be emphasized that they do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads or excavations deeper than the depths of layers here reported. Even in these situations, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

Information in this report can be used to—

1. Make preliminary estimates of the engineering properties of soils for use in planning irrigation systems, farm ponds, field terraces and diversion terraces, and agricultural drainage systems.
2. Make preliminary evaluations that will aid in selecting locations for highways, airports, pipelines, and cables, and in planning detailed surveys of the soils at the selected locations.
3. Locate probable sources of sand, gravel, and construction material.
4. Make studies that will aid in selecting and developing sites for industrial, business, residential, and recreational uses.
5. Supplement information obtained from published maps, reports, and aerial photographs, for the purpose of making maps and reports that can be used readily by engineers.
6. Develop other preliminary estimates for construction purposes pertinent to the particular area.

Much of the information in this section is presented in tables. Only the data in table 9 are from actual laboratory tests. The estimates in table 10 and the interpretations in table 11 are based on data shown in table 9 and on other data compiled for the soil survey.

Some of the terms used in this publication have a special meaning to soil scientists that may not be familiar to engineers. The Glossary defines many such terms as they are used in soil science.

Engineering classification systems

In this section, soils are classified according to the system used by the American Association of State Highway Officials (AASHO) (*1*), according to the Unified system developed by the Corps of Engineers, U.S. Army (*18*), and according to the textural classification used by scientists of the U.S. Department of Agriculture.

The AASHO system classifies the soils according to their engineering properties, based on field performance of soils in highways. In this system soil materials are classified in seven basic groups, designated A–1 through A–7. The best soils for road subgrade—gravelly soils of high bearing capacity—are classified as A–1; the next best, A–2; and so on to the poorest, which are classified as A–7.

The Unified system is based on the identification of soils according to particle size, plasticity, and liquid limit. In the Unified system SW and SP are clean sands; SM and SC are sands with nonplastic or plastic fines; GM and GC indicate that the coarse fraction is mainly gravel;

ML and CL are nonplastic or plastic, fine-grained materials with low liquid limit; and MH and CH are primarily nonplastic or plastic, fine-grained materials with high liquid limit. If soils are on the borderline between two classifications, a joint classification symbol is used, for example, ML–CL.

The textural classification used by the Department of Agriculture depends on the proportional amounts of sand, silt, and clay particles.

Engineering test data

Table 9 gives data obtained by laboratory testing of samples of several soils of the Area and engineering classifications of these soils, based on the laboratory data. The soils tested were sampled at one or more locations. The engineering properties of a soil at a specific location are indicated by these test data, but variations in properties can be expected at other locations. Even for those soils sampled in more than one location, the test data probably do not show the maximum range in characteristics that affect engineering.

For detailed descriptions of the profiles sampled, see the section "Genesis, Classification, and Morphology of the Soils."

Estimated properties of the soils

Table 10 gives some of the characteristics of the soils of the Torrance Area that are significant in engineering.

TABLE 9.—*Engineeering test data*

[Tests performed by New Mexico State Highway Department, Materials and Testing Division, Santa Fe]

Soil name and location	Parent material	New Mexico report No.	Depth from surface	Horizon	Percentage passing sieve[1]— No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Liquid limit	Plasticity index	Classification AASHO	Unified
Clovis loam: In road cut near NE. corner of sec. 31, T. 7 N., R. 12 E. (modal).	Mixed alluvium from quartzite, limestone, gneiss, schist, and igneous rocks.	16–1715	*Inches* 0–5	A1	100	99	64	*Percent* (2)	(3)	A–4(6)	ML
		16–1716	8–16	B2t	100	99	70	31	10	A–4(7)	ML–CL
		16–1717	36–60	C2ca	100	94	48	22	6	A–4(3)	SM–SC
NW¼NW¼NW¼ sec. 21, T. 2 N., R. 7 E. (modal).	Mixed alluvium from quartzite, schist, gneiss, igneous rocks, and limestone.	58–19561	0–7	A1	100	99	83	(3)	(3)	A–4(8)	ML
		58–19562	7–17	B2t	100	98	81	35	17	A–6(11)	CL
		58–19563	34–41	A1bca	100	98	84	27	6	A–4(8)	ML–CL
Harvey loam: SW¼SW¼SW¼ sec. 33, T. 7 N., R. 8 E. (modal).	Mixed alluvium from quartzite, schist, gneiss, igneous rocks, and limestone.	16–1709	2–13	A1	100	98	79	28	7	A–4(8)	ML–CL
		16–1710	13–25	AC	100	98	80	34	11	A–6(8)	ML–CL
		16–1711	34–42	C1ca	100	98	76	29	10	A–4(8)	CL
Ildefonso fine sandy loam: Bench between shoreline terraces, SE¼NE¼ sec. 33, T. 7 N., R. 8 E. (modal).	Mixed shoreline terrace deposits.	16–1706	0–8	Ap	100	91	61	21	4	A–4(5)	ML–CL
		16–1707	9–13	AC	[4] 85	72	42	24	7	A–4(1)	SM–SC
		16–1708	19–26	C2ca	[5] 72	55	24	21	6	A–2–4(0)	SM–SC
Otero loamy fine sand: NW¼SW¼SE¼ sec. 34, T. 1 N., R. 8 E. (modal).	Mixed wind-reworked alluvium.	58–19558	0–4	A11	100	99	18	(3)	(3)	A–2–4(0)	SM
		58–19559	4–15	A12	100	97	18	(3)	(3)	A–2–4(0)	SM
		58–19560	15–32	AC	100	95	24	(3)	(3)	A–2–4(0)	SM
Pedrick loamy fine sand: NE¼NE¼NE¼ sec. 1, T. 4 N., R. 8 E. (modal).	Wind-reworked sandy alluvium from mixed materials.	58–19564	0–4	A1	100	99	32	(3)	(3)	A–2–4(0)	SM
		58–19565	4–17	AC	100	99	31	(3)	(3)	A–2–4(0)	SM
		58–19566	21–35	IIC1	100	99	57	(3)	(3)	A–4(4)	ML

See footnotes at end of table.

TABLE 9.—*Engineering test data*—Continued

Soil name and location	Parent material	New Mexico report No.	Depth from surface	Horizon	Percentage passing sieve [1]—			Liquid limit	Plasticity index	Classification	
					No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)			AASHO	Unified
Penistaja fine sandy loam:			*Inches*					*Percent*			
60 feet south of cattleguard, NW¼SW¼ sec. 14, T. 3 N., R. 8 E. (modal).	Mixed alluvium, primarily from sandstone and limestone.	61–1712	0–4	A1	100	99	55	[2]	[3]	A–4(4)	ML
		61–1713	12–20	B2t	100	99	76	27	9	A–4(8)	CL
		61–1714	52–62	Cca	100	98	45	20	5	A–4(2)	SM–SC
Tapia loam: SW¼SW¼SW¼ sec. 9, T. 3 N., R. 12 E. (nonmodal).	Mixed alluvium from quartzite, schist, gneiss, igneous rocks, and limestone.	16–1718	0–5	A1	100	99	78	27	9	A–4(8)	CL
		16–1719	8–12	B21t	100	99	81	41	16	A–7–6(11)	ML–CL
		16–1720	33–48	Cca	[6] 78	62	37	32	8	A–4(0)	SM–SC
Willard loam: NW¼NW¼NW¼ sec. 12, T. 6 N., R. 8 E. (modal).	Lacustrine sediments.	58–19576	8–11	AC	100	99	73	33	13	A–6(9)	CL
		58–19577	18–26	Cca	100	99	81	35	17	A–6(11)	CL
		58–19578	26–36	IIC	100	99	84	38	20	A–6(12)	CL
Willard loam: NE¼NE¼NE¼ sec. 36, T. 8 N., R. 8 E. (modal).	Lacustrine sediments.	58–19573	9–15	AC	100	98	64	[3]	[3]	A–4(6)	ML
		58–19574	20–28	C2	100	99	71	[3]	[3]	A–4(7)	ML
		58–19575	32–41	IIIC	100	99	96	44	19	A–7–6(12)	ML–CL
Witt loam: NW¼NW¼SW¼ sec. 13, T. 9 N., R. 7 E. (modal).	Alluvium from quartzite, schist, gneiss, igneous rocks, and limestone.	58–19570	11–17	B3	100	98	84	35	11	A–6(8)	ML–CL
		58–19571	17–26	B31ca	100	97	78	34	13	A–6(9)	CL
		58–19572	32–42	C1ca	100	86	71	36	10	A–4(7)	ML–CL
Witt loam: SW¼NE¼NW¼ sec. 16, T. 5 N., R. 6 E. (nonmodal).	Alluvium from quartzite, schist, gneiss, igneous rocks, and limestone.	58–19579	3–8	B1	100	97	75	[3]	[3]	A–4(8)	ML
		58–19580	12–22	B3	100	94	72	35	14	A–6(9)	CL
		58–19581	29–37	B21tbca	100	98	72	34	14	A–6(9)	CL

[1] Analysis according to AASHO Designation: T 88–57 (*1*). Results by 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 use in naming textural classes for soils.

[2] Sandy.

[3] Nonplastic.

[4] 98 percent passed the ¾-inch sieve; 90 percent passed the No. 4 sieve.

[5] 96 percent passed the ¾-inch sieve; 79 percent passed the No. 4 sieve.

[6] 97 percent passed the ¾-inch sieve; 88 percent passed the No. 4 sieve.

The information in the table was based on data compiled for the soil survey, on test data shown in table 9, and on knowledge of the individual soils of the Area.

The three columns under the heading "Classification" show soil texture as it is classified both by soil scientists and by engineers.

The estimated percentages of soil material passing sieves No. 4, No. 10, and No. 200 reflect the normal range for the series. Since the grain-size distribution of any soil varies considerably, it should not be assumed that the range shown in the table will be applicable to all samples of a specific soil, nor that the engineering classification will invariably be as shown.

The rates of permeability given in table 10 are based on the movement of water through the soil in its undisturbed state. The rates depend largely on the texture and structure of the soil.

Available moisture capacity is the approximate amount of capillary water in the soil at field capacity. It is measured in inches of water per inch of soil depth. When the

TABLE 10.—*Estimated*

[Dashed lines indicate that properties are too variable for reliable estimates to be made. Estimated properties of soils mapped

Soil series and map symbols	Depth from surface	Classification		
		USDA texture	Unified	AASHO
	Inches			
Alicia: Al	0–6	Loam	ML–CL	A–4
	6–27	Clay loam	CL	A–6
	27–60	Loam	ML–CL	A–4
Badland: Ba	------	------	------	------
Bernal: Bs, Bt. For Slickspot in Bs, see Slickspot. For Travessilla soil in Bt, see Travessilla series.	0–3	Fine sandy loam	ML	A–4
	3–12	Sandy clay loam	ML–CL	A–4
	12	Sandstone bedrock.		
Blown-out land: Bu	------	------	------	------
Capillo: Ca	0–3	Loam	ML–CL	A–4
	3–30	Clay loam to clay	CH	A–7
	30–60	Silty clay	CH	A–7
Carnero: Ce	0–3	Loam	ML	A–4
	3–19	Clay loam	CL	A–6
	19–32	Light clay loam	CL–ML	A–6
	32	Sandstone bedrock.		
Chilton: Cg, Cl. For La Fonda soil in Cl, see La Fonda series.	0–9	Gravelly loam	SM	A–4
	9–20	Gravelly loam	GM	A–2
Chupadera: Cm	0–16	Loamy fine sand	SM	A–4
	16–24	Fine sandy loam	SM	A–4
	24	Fractured limestone bedrock.		
Clovis: Cn, Co, Cp, Cs. For Dean soil in Cp, see Dean series. For Scholle soil in Cs, see Scholle (Sc).	0–5	Loam	ML–CL	A–4
	5–22	Clay loam	CL	A–6
	22–60	Loam to clay loam	ML–CL	A–4
Crest: Ct	0–6	Stony loam	GM	A–4
	6–24	Very stony clay	CH–MH	A–7
	24–26	Limestone bedrock.		
Dean: De	0–7	Loam	ML–CL	A–4
	7–36	Gravelly loam	GM	A–4
Duncan: Du	0–4	Loam	ML–CL	A–4
	4–20	Heavy clay loam to loam	CL	A–6
	20–60	Clay loam	CL	A–6
Encierro: Ec	0–5	Channery loam	ML–CL	A–4
	5–9	Stony light clay	GC	A–6
	9–48	Rock, clay, and stony loam.		
	48–60	Hard sandstone.		
Erramouspe: Er	0–5	Stony loam	GM	A–4
	5–35	Clay loam	CL	A–6
	35	Felsite bedrock.		

engineering properties

as complexes, undifferentiated units, or associations are given under the series name of the individual components]

Percentage passing sieve—			Permeability	Available moisture capacity	Reaction	Salinity	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*	*pH*		
	100	82–92	0.63–2.0	0.17	7.4–7.8	None	Low.
	100	85–95	0.20–0.63	.17	7.9–8.4	None	Moderate.
	100	82–92	0.63–2.0	.17	7.9–8.4	None	Low.
	100	75–85	0.63–2.0	.15	6.6–7.3	None	Low.
	100	82–92	0.20–0.63	.17	6.6–7.3	None	Moderate.
86–96	85–95	60–70	0.63–2.0	.17	6.6–7.3	None	Low to moderate.
86–96	85–95	75–85	<0.05–0.63	.17	6.6–7.8	None	High.
76–86	75–85	69–79	<0.05–0.20	.17	7.4–8.4	None	High.
90–100	90–100	64–74	0.63–2.0	.13	6.6–7.3	None	Low.
95–100	90–100	70–80	0.20–0.63	.16	7.4–8.4	None	Moderate.
95–100	90–100	65–75	0.20–0.63	.16	7.9–8.4	None	Moderate.
65–75	63–73	36–46	2.0–6.3	.13	7.9–8.4	None	Low.
35–45	33–43	21–31	2.0–6.3	.08	7.9–8.4	None	Low.
100	94–100	39–49	2.0–6.3	.15	7.4–7.8	None	Low.
75–85	73–83	40–50	2.0–6.3	.13	7.9–8.4	None	Low.
	100	70–80	0.20–0.63	.17	6.6–7.3	None	Moderate.
	100	70–80	0.20–0.63	.17	6.6–8.4	None	Moderate to high.
	100	60–70	0.20–0.63	.17	7.9–8.4	None	Moderate.
67–77	60–70	41–50	0.20–0.63	.10	6.6–7.3	None	Low to moderate.
65–75	60–70	50–59	0.05–0.20	.12	6.6–7.3	None	Moderate.
	100	73–83	0.63–2.0	.17	7.9–8.4	None	Low.
50–60	45–55	33–43	0.63–2.0	.17	7.9–8.4	None	Low.
	100	83–93	0.63–2.0	.17	8.5–9.0	Slight to moderate	Moderate.
	100	87–97	0.20–0.63	.17	9.0	Severe	High.
	100	89–99	0.20–0.63	.17	8.5–9.0	Severe	Moderate.
73–83	71–81	60–70	0.63–2.0	.13	7.9–8.4	None	Moderate.
55–65	50–60	40–50	0.20–0.63	.13	7.9–8.4	None	Moderate.
50–60	50–60	40–50	0.63–2.0	.08	7.4–7.8	None	Low.
	100	75–85	0.20–0.63	.17	7.4–7.8	None	Moderate.

TABLE 10.—*Estimated engineering*

Soil series and map symbols	Depth from surface	Classification		
		USDA texture	Unified	AASHO
	Inches			
Fortwingate:				
Fo	0–11	Stony loam	GM-GC	A-4
	11–30	Stony clay loam	CH	A-7
	30	Sandstone bedrock.		
Fuera:				
Fr, Fu	0–11	Cobbly loam to fine sandy loam	GM	A-2
	11–48	Clay and stony silty clay	CH	A-7
	48–60	Heavy clay loam	CL	A-6
Gypsum land				
Hagerman:				
Ha, Hd	0–3	Fine sandy loam	ML	A-4
For Dean soil in Hd, see Dean series.	3–30	Sandy clay loam	ML-CL	A-4
	30	Sandstone bedrock.		
Harvey:				
He, Hf, Hh, Hm	0–11	Loam	ML-CL	A-4
For Dean soil in Hh and Hm, see Dean series.	11–60	Loam	ML-CL	A-4
Hg	0–13	Loam	ML-CL	A-4
	13–60	Clay loam	CL	A-6
Hassell:				
Hs	0–3	Loam	ML-CL	A-4
	3–16	Clay loam	CL	A-6
	16–28	Loam	ML-CL	A-4
	28–38	Silty clay loam	CH	A-7
	38–42	Weathered shale.		
Ignacio:				
Ig	0–14	Fine sandy loam	ML	A-4
	14–25	Fine sandy loam	ML	A-4
	25	Sandstone bedrock.		
Ildefonso:				
Ih, Ik	0–10	Fine sandy loam	ML	A-4
	10–36	Gravelly fine sandy loam	SM	A-2
Im	0–8	Loamy fine sand	SM	A-4
	8–60	Gravelly fine sandy loam	SM	A-4
Is	0–6	Stony sandy loam	GM	A-4
	6–13	Sandy loam	SM	A-4
	13–48	Gravelly loam	GM	A-4
Jekley:				
Je	0–24	Silty clay loam	CL	A-7
	24–46	Silty clay	CH	A-7
	46–60	Partly weathered shale.		
Karde:				
Ka, Kd	0–5	Loam	ML-CL	A-4
For Willard soil in Kd, see Willard (Wm).	5–60	Silt loam	ML-CL	A-4
Keeh:				
Kg	0–4	Gravelly loam	SM	A-4
	4–16	Clay loam	CL	A-7
	16	Gneiss bedrock.		
Kim:				
Ko, Kp, Kw	0–38	Loam	ML-CL	A-4
For Otero soil in Ko, see Otero series. For Pastura soil in Ko and Kp, see Pastura series. For Tapia soil in Kp, see Tapia series. For Pinon soil in Kw, see Pinon series. For Witt soil in Kw, see Witt series.				

properties—Continued

Percentage passing sieve—			Permeability	Available moisture capacity	Reaction	Salinity	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*	*pH*		
59–69	55–65	42–52	0. 63–2. 0	. 09	6. 6–7. 8	None	Low.
70–80	65–75	59–69	0. 20–2. 0	. 13	7. 4–8. 4	None	Moderate.
66–76	65–75	30–40	0. 63–2. 0	. 10	6. 6–7. 3	None	Low.
58–68	55–65	50–60	0. 20–0. 63	. 17	6. 6–7. 3	None	High.
----------	100	75–85	0. 20–0. 63	. 17	7. 4–7. 8	None	Moderate.
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----------	100	58–68	0. 63–2. 0	. 15	6. 6–7. 3	None	Low.
----------	100	59–69	0. 63–2. 0	. 17	7. 4–8. 4	None	Moderate.
----------	100	79–89	0. 63–2. 0	. 17	7. 9–8. 4	None	Low.
----------	100	79–89	0. 63–2. 0	. 17	7. 9–8. 4	None	Low.
----------	100	65–75	0. 63–2. 0	. 17	7. 9–8. 4	None	Low to moderate.
----------	100	70–80	0. 20–0. 63	. 17	8. 5–9. 0	Slight	Moderate.
----------	100	64–74	0. 63–2. 0	. 17	7. 9–8. 4	None	Moderate.
----------	100	69–79	0. 20–0. 63	. 17	7. 9–8. 4	None	Moderate to high.
----------	100	78–88	0. 63–2. 0	. 17	8. 5–9. 0	None	Moderate.
----------	100	80–90	0. 20–0. 63	. 17	8. 5–9. 0	Slight	Moderate to high.
----------	100	55–65	0. 63–6. 3	. 15	6. 6–7. 3	None	Low.
----------	100	61–71	0. 63–6. 3	. 15	7. 9–8. 4	None	Low.
91–100	84–94	50+	0. 63–2. 0	. 15	7. 9–8. 4	None	Low.
73–83	67–77	27–37	2. 0–6. 3	. 13	7. 9–8. 4	None	Low.
----------	100	37–47	2. 0–6. 3	. 08	7. 4–8. 4	None	Low.
70–80	65–75	37–47	0. 63–2. 0	. 13	7. 9–8. 4	None	Low.
55–65	30–40	30–40	2. 0–6. 3	. 08	7. 9–8. 4	None	Low.
75–85	70–80	40–50	0. 63–2. 0	. 15	7. 9–8. 4	None	Low.
55–65	45–55	30–40	2. 0–6. 3	. 08	7. 9–8. 4	None	Low.
----------	100	86–96	0. 05–0. 63	. 17	6. 6–7. 3	None	Moderate.
----------	100	84–94	0. 05–0. 20	. 17	6. 6–7. 8	None	High.
----------	100	90–100	0. 63–2. 0	. 17	7. 9–8. 4	Moderate	Low.
----------	100	91–100	0. 20–2. 0	. 17	7. 9–8. 4	Severe	Low.
73–83	70–80	40–50	0. 63–2. 0	. 15	7. 4–7. 8	None	Low.
88–98	85–95	73–83	0. 20–6. 3	. 17	7. 9–8. 4	None	Moderate.
----------	100	82–92	0. 63–2. 0	. 17	7. 9–8. 4	None	Low.

TABLE 10.—*Estimated engineering*

Soil series and map symbols	Depth from surface	Classification		
		USDA texture	Unified	AASHO
	Inches			
La Fonda:				
La, Lm, Lo. For Alicia soil in Lm, see Alicia series. For Rock outcrop in Lo, see Rock outcrops and slides.	0–8	Loam	ML–CL	A–4
	8–18	Heavy loam	CL	A–6
	18–60	Loam	ML–CL	A–4
Lg	0–21	Loam	ML–CL	A–4
	21–30	Fine sandy loam	ML	A–4
	30–42	Gravelly sandy loam	GC	A–6 to A–7
Laporte:				
Lp. For Rock outcrop in Lp, see Rock outcrops and slides.	0–11	Stony loam	GM	A–1
Manzano:				
Ma, Mb	0–13	Loam	ML–CL	A–4
	13–41	Light clay loam	CL	A–6
Mc	0–7	Loam	ML–CL	A–4
	7–25	Clay loam	CL	A–6 to A–7
	25–60	Loamy lacustrine sediments.		
Mirabal:				
Mh, Ml	0–21	Stony sandy loam	GM	A–1
	21–39	Schist bedrock.		
Moriarty:				
Mm, Mo	0–8	Clay loam	CL	A–6
	8–60	Clay	CH	A–7
Osha:				
Oa, Og	0–18	Gravelly loam	GM–GC	A–2
	18–32	Gravelly coarse sandy loam	GM	A–2
	32–50	Very gravelly heavy sandy loam	GM	A–2
	50	Granite bedrock.		
Otero:				
Op, Or. For Palma soil in Op and Or, see Palma series.	0–40	Fine sandy loam	ML	A–4
Palma	0–6	Fine sandy loam	ML	A–4
	6–19	Heavy fine sandy loam	ML–CL	A–4
	19–60	Fine sandy loam	ML	A–4
Pastura:				
Pa, Pb	0–10	Loam	ML–CL	A–4
	10–24	Indurated caliche.		
Pedrick:				
Pd, Pe	0–21	Loamy fine sand to sandy loam	ML	A–4
	21–35	Heavy fine sandy loam	ML	A–4
	35–56	Loamy lacustrine deposits.		
Penistaja:				
Pf, Pg, Pn, Po. For Dean soil in Pn and Po, see Dean series.	0–5	Fine sandy loam	ML	A–4
	5–29	Sandy clay loam	CL	A–6
	29–60	Fine sandy loam	ML	A–4
Ph	0–10	Loamy fine sand	SM	A–4
	10–60	Light sandy clay loam and fine sandy loam.	SM	A–4
Pm	0–23	Sandy clay loam	SC	A–4
	23–60	Fine sandy loam	SM	A–4
Pinata:				
Pr, Ps, Pt, Pu. For Stroupe soil in Pt and Pu, see Stroupe series.	0–10	Stony loam	GM	A–4
	10–45	Stony clay	GC	A–6
	45	Felsite bedrock.		

properties—Continued

Percentage passing sieve—			Permeability	Available moisture capacity	Reaction	Salinity	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*	*pH*		
	100	78–88	0. 63–2. 0	. 17	7. 4–8. 4	None	Low.
	100	82–92	0. 63–2. 0	. 17	7. 9–8. 4	None	Moderate.
	100	75–85	0. 63–2. 0	. 17	7. 9–8. 4	None	Low.
	100	75–85	0. 63–2. 0	. 17	7. 9–8. 4	None	Moderate.
75–85	75–85	60–70	0. 63–2. 0	. 17	7. 9–8. 4	None	Low.
60–70	60–70	45–55	0. 63–2. 0	. 15	7. 9–9. 0	None	Low.
29–39	28–38	23–33	0. 63–6. 3	. 14	7. 9–8. 4	None	Low.
	100	80–90	0. 63–2. 0	. 17	6. 6–7. 3	None	Low to moderate.
	100	90–95	0. 05–0. 63	. 17	7. 4–8. 4	None	Moderate.
	100	60–75	0. 63–2. 0	. 17	6. 6–7. 3	None	Low to moderate.
	100	70–80	0. 20–0. 63	. 17	6. 6–7. 8	Slight	Moderate.
56–66	55–65	25–35	2. 0–6. 3	. 07	6. 6–7. 3	None	Low.
	100	90–99	0. 20–2. 0	. 17	7. 4–7. 8	None	Moderate.
	100	95–100	0. 05–0. 63	. 17	7. 4–8. 4	Slight	High.
60–70	55–65	26–36	0. 63–2. 0	. 08	6. 6–7. 3	None	Low.
45–55	40–50	10–20	2. 0–6. 3	. 03	6. 6–7. 3	None	Low.
32–42	25–35	13–23	0. 20–6. 3	. 05	6. 6–7. 3	None	Low.
	100	50–60	2. 0–6. 3	. 13	7. 9–8. 4	None	Low.
	100	51–61	2. 0–6. 3	. 15	6. 6–7. 3	None	Low.
	100	61–71	0. 63–6. 3	. 17	6. 6–7. 3	None	Low.
	100	57–67	2. 0–6. 3	. 15	7. 9–8. 4	None	Low.
88–98	85–95	63–73	0. 63–2. 0	. 17	7. 9–8. 4	None	Low.
	100	57–67	2. 0–6. 3	. 08	7. 9–8. 4	None	Low.
	100	56–66	0. 63–2. 0	. 10	7. 9–8. 4	None to slight	Low.
	100	55–65	0. 63–2. 0	. 10	6. 6–7. 3	None	Low.
	100	58–68	0. 63–2. 0	. 10	6. 6–8. 4	None	Moderate.
	100	51–61	0. 63–2. 0	. 10	7. 9–8. 4	None	Low.
	100	45–60	2. 0–6. 3	. 08	6. 6–7. 3	None	Low.
	100	40–55	0. 63–6. 3	. 10	7. 9–8. 4	None	Low.
	100	35–55	0. 63–2. 0	. 10	6. 6–8. 4	None	Moderate.
	100	40–55	2. 0–6. 3	. 08	7. 9–8. 4	None	Low.
67–77	65–75	41–50	0. 63–2. 0	. 10	6. 6–7. 3	None	Moderate.
56–66	45–55	34–44	<0. 05	. 09	6. 6–7. 3	None	High.

TABLE 10.—*Estimated engineering*

Soil series and map symbols	Depth from surface	Classification		
		USDA texture	Unified	AASHO
	Inches			
Pino:				
Pv	0–6	Loam and very fine sandy loam	ML–CL	A–4
	6–36	Clay loam	CL	A–6
Pw	0–10	Silt loam	ML–CL	A–6
	10–18	Clay loam	CL	A–6
	18–44	Clay	CH	A–7
	44	Limestone bedrock.		
Pinon:				
Px	0–18	Channery loam	ML–CL	A–6
	18–20	Limestone bedrock.		
Prewitt:				
Pz	0–8	Heavy loam	ML–CL	A–4 to A–6
For Manzano soil in Pz, see Manzano series.	8–60	Light clay loam	CL	A–6
Rance:				
Rg	0–26	Silt loam	ML–CL	A–6
For Gypsum land in Rg, see Gypsum land.	26–60	Gypsiferous material.		
Rock land:				
Rk				
Rock outcrop-Pinon-La Fonda complex:				
Rp				
For Pinon soil in Rp, see Pinon series.				
For La Fonda soil in Rp, see La Fonda series.				
Rock outcrops and slides:				
Rs				
Salas:				
Sa	0–6	Stony loam	GM	A–4
	6–31	Clay loam	GC	A–6
	31–33	Schist bedrock.		
Scholle:				
Sc	0–5	Gravelly loam	CL	A–4
	5–15	Gravelly clay loam	CL	A–4
	15–60	Calcareous gravelly loam	CL	A–4
Sh	0–4	Loam	ML–CL	A–4
	4–17	Clay loam	CL	A–6
	17–29	Gravelly clay loam	CL	A–6
Slickspot				
Steep rock land:				
Sm				
Stony alluvial land:				
Sn				
Stony steep land:				
So				
Stroupe:				
Sp	0–7	Stony loam	GM	A–4
	7–20	Stony clay	GC	A–4
	20–24	Felsite bedrock.		
Supervisor:				
Sr	0–13	Loam	ML–CL	A–4
	13–30	Stony loam	GC	A–4
	30–49	Schist bedrock.		

properties—Continued

Percentage passing sieve—			Permeability	Available moisture capacity	Reaction	Salinity	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*	*pH*		
----	100	60-75	0.63-2.0	.17	6.1-7.3	None	Low.
----	100	70-80	0.20-2.0	.17	7.4-7.8	None	Moderate.
90-100	90-100	66-76	0.63-2.0	.16	6.6-7.3	None	Moderate.
91-100	90-100	81-91	0.05-2.0	.16	6.1-6.5	None	High.
91-100	90-100	73-83	<0.20	.17	6.6-7.3	None	High.
77-87	75-85	61-71	0.63-2.0	.16	7.9-8.4	None	Low.
----	100	82-92	0.63-2.0	.17	7.4-7.8	None	Low to moderate.
----	100	89-99	0.20-2.0	.17	7.4-8.4	None	Moderate.
----	100	80-90	0.20-2.0	.17	7.9-8.4	Slight to moderate	Low to moderate.
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57-67	55-65	37-47	0.63-2.0	.09	6.6-7.3	None	Low.
45-50	42-52	40-50	0.05-0.63	.08	6.6-7.8	None	Moderate.
77-87	75-85	67-77	0.63-2.0	.17	6.6-7.3	None	Low.
67-77	65-75	60-70	0.20-2.0	.17	7.4-8.4	None	Moderate.
77-87	75-85	67-77	0.63-2.0	.17	7.9-8.4	None	Low.
----	100	60-75	0.63-2.0	.17	6.6-7.3	None	Low.
----	100	70-80	0.63-2.0	.17	7.4-7.8	None	Moderate.
60-70	55-65	55-65	0.63-2.0	.15	7.4-7.8	None	Low.
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48-58	45-55	31-41	0.63-2.0	.07	6.6-7.8	None	Low.
57-67	55-65	46-56	0.05-0.63	.10	7.4-8.4	None	Moderate to high.
80-85	79-89	56-66	0.63-2.0	.15	6.6-7.3	None	Moderate.
57-67	55-65	39-49	0.63-2.0	.09	4.5-5.5	None	Low to moderate.

TABLE 10.—*Estimated engineering*

Soil series and map symbols	Depth from surface	Classification		
		USDA texture	Unified	AASHO
	Inches			
Tampico:				
Ta	0–19	Loam	ML–CL	A–4
	19–38	Gravelly heavy loam	CL	A–4
	38–60	Gravelly clay loam	CL	A–4
Tapia:				
Tc, Td, Te. For Dean soil in Td and Te, see Dean series.	0–3	Loam	ML–CL	A–4
	3–15	Clay loam	CL	A–4
	15–21	Gravelly light clay loam	CL	A–4
	21	Indurated caliche.		
Tecolote:				
Tf	0–20	Stony loam and very fine sandy loam	GM	A–4
	20–35	Stony very fine sandy loam and clay loam.		
	35–50	Stony clay loam	GM	A–1
Tg	0–26	Stony loam to stony very fine sandy loam.	GM	A–4
	26–50	Stony clay loam	GC	A–2
Tesajo:				
Th	0–21	Gravelly sandy loam to gravelly coarse sandy loam.	GM	A–2
	21–45	Very gravelly sandy loam	GW	A–1
Trail:				
Tm	0–7	Loamy fine sand	SM	A–4
	7–60	Fine sand	SM	A–4
Travessilla	0–2	Fine sandy loam	ML	A–4
	2–6	Loam	ML–CL	A–4
	6	Sandstone bedrock.		
Turkeysprings:				
Tn	0–2	Stony loam	GM	A–2
	2–9	Stony clay loam	GM	A–2
	9–16	Stony clay	CH	A–7
	16–24	Stony silty clay loam	ML–CL	A–6
	24–36	Stony silt loam	ML	A–6
	36–42	Limestone bedrock.		
Washoe:				
Wa	0–5	Cobbly loam	GM	A–2
	5–35	Very gravelly clay loam	ML–CL	A–2 to A–4
Wb	0–6	Gravelly loam	ML–CL	A–4
	6–44	Very gravelly clay loam	GC	A–4
	44–60	Very gravelly loam	GC	A–2
Wilcoxson:				
Wc	0–9	Clay loam	CL	A–6
	9–37	Clay	CH	A–7
	37–42	Silty clay loam	CL–CH	A–6 to A–7
Wd	0–10	Loam	ML–CL	A–4
	10–21	Clay loam	CL	A–6
	21–46	Clay	CH	A–7
We	0–2	Stony loam	ML–CL	A–4
	2–16	Clay	CH	A–7
	16	Weathered limestone.		
Wf, Wg	0–2	Stony loam	GM	A–4
	2–24	Stony clay	GC	A–6
	24–30	Limestone bedrock.		

properties—Continued

Percentage passing sieve—			Permeability	Available moisture capacity	Reaction	Salinity	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*	*pH*		
	100	81-91	0.63-2.0	.17	6.6-7.3	None	Moderate.
77-87	75-85	70-80	0.20-2.0	.15	6.6-7.3	None	Moderate.
81-91	80-90	59-69	0.20-2.0	.15	7.4-7.8	None	Moderate.
95-100	95-100	83-93	0.63-2.0	.17	6.6-7.3	None	Low to moderate.
95-100	95-100	80-90	0.05-2.0	.17	6.6-7.3	None	Moderate.
77-87	75-85	65-75	0.20-2.0	.15	7.9-8.4	None	Low.
56-66	55-65	32-42	0.63-6.3	.07	6.6-7.3	None	Low.
26-36	25-35	19-29	0.05-0.63	.06	6.6-7.8	None	Moderate.
65-75	65-75	45-55	0.63-2.0	.17	6.6-7.8	None	Low.
35-45	35-45	25-35	0.20-0.63	.13	6.6-7.8	None	Moderate.
42-52	35-45	26-36	0.63-6.3	.06	6.6-7.3	None	Low.
18-28	5-15	5-10	>6.3	.01	6.6-7.3	None	Low.
	100	45-50	>6.3	.07	7.4-7.8	None	Low.
	100	35-45	>6.3	.07	7.4-7.8	None	Low.
	100	58-68	0.63-2.0	.15	6.6-7.3	None	Low.
	100	70-80	0.63-2.0	.17	6.6-7.3	None	Low.
50-60	45-55	40-50	0.20-2.0	.08	7.9-8.4	None	Low to moderate.
50-60	45-55	40-50	0.05-2.0	.08	7.9-8.4	None	Moderate.
67-77	65-75	51-61	<0.20	.15	7.9-8.4	None	High.
57-67	55-65	51-61	0.05-0.63	.13	7.9-8.4	None	Moderate.
57-67	55-65	51-61	0.20-2.0	.13	7.9-8.4	None	Low to moderate.
70-80	70-80	45-55	0.63-2.0	.17	6.6-7.3	None	Low.
70-80	70-80	50-60	0.20-2.0	.15	7.3-7.8	None	Moderate.
75-85	73-83	67-77	0.63-2.0	.15	6.6-7.3	None	Low.
40-50	35-45	32-42	0.20-2.0	.15	6.6-7.8	None	Moderate.
35-45	25-35	22-32	0.63-6.3	.10	6.6-7.3	None	Low.
	100	77-87	0.20-0.63	.17	7.4-7.8	None	Moderate to high.
	100	77-87	0.05-0.63	.19	7.4-8.4	None	High.
	100	89-99	0.05-2.0	.17	8.5-9.0	None	High.
	100	60-75	0.20-2.0	.17	6.6-7.3	None	Low.
	100	70-80	0.20-0.63	.17	7.4-7.8	None	Moderate.
	100	75-95	0.05-0.63	.17	7.9-8.4	None	High.
75-85	75-85	55-65	0.20-2.0	.15	6.6-7.3	None	Low.
	100	77-87	0.05-0.63	.19	7.4-8.4	None	High.
75-85	75-85	55-65	0.20-2.0	.15	6.6-7.3	None	Low.
75-85	75-85	63-73	0.05-0.63	.16	7.4-8.4	None	Moderate to high.

TABLE 10.—*Estimated engineering*

Soil series and map symbols	Depth from surface	Classification		
		USDA texture	Unified	AASHO
	Inches			
Willard:				
Wh	0–10	Fine sandy loam	ML	A–4
	10–24	Loam	CL	A–6
	24–60	Lacustrine deposits.		
Wk	0–11	Loam	CL–ML	A–4
	11–26	Clay loam	CL	A–6
	26–60	Clayey lacustrine material.		
Wl	0–4	Loam	CL	A–6
	4–60	Lacustrine sediments.		
Wm	0–5	Loam	ML–CL	A–4
	5–17	Light clay loam	CL	A–6
	17–60	Lacustrine sediments.		
Witt:				
Wn, Wp, Ws, Wt. For Harvey soil in Ws and Wt, see Harvey series. For Pinon soil in Wt, see Pinon series.	0–5	Loam	ML–CL	A–4
	5–47	Clay loam	CL	A–4
	47–60	Loam	ML–CL	A–4
Wo, Wr	0–40	Clay loam	CL	A–4
	40–52	Loam	ML–CL	A–4

soil is air dry, this amount of water will wet the soil material to a depth of 1 inch without deeper percolation.

Reaction refers to the degree of acidity or alkalinity of a soil, expressed in pH values. A soil having a pH value of 7 is neutral in reaction. In the Torrance Area, the soils at the lower elevations are mostly neutral or alkaline, and those at the higher elevations are neutral or acid.

Salinity affects not only the suitability of a soil for crops, but also its stability when used as a construction material and its corrosiveness to other materials. Estimates of salinity are based on estimates of electrical conductivity of saturated soil extract, which is expressed in millimhos per centimeter at 25° C. In table 10, salinity is rated as *none* if conductivity is estimated as less than 2.0 millimhos per centimeter. It is rated as *slight* if conductivity is estimated as 2.0 to 4.0 millimhos per centimeter, as *moderate* if conductivity is estimated as 4.0 to 8.0 millimhos per centimeter, and as *severe* if conductivity is estimated as 8.0 to 16.0 millimhos per centimeter.

TABLE 11.—

Soil series and map symbols	Suitability as a source of—				Dikes and levees	Terraces and diversions [1]	Farm ponds and irrigation reservoirs	
	Topsoil	Sand and gravel	Road subgrade	Road fill			Reservoir areas	Embankments
Alicia: Al	Good to a depth of 6 inches; fair from 6 inches to 3 feet.	Unsuitable	Fair	Fair	Good stability if compacted when wet.	Should be placed when soil is damp.	Moderate permeability.	Good stability if compacted when wet.
Badland: Ba	Unsuitable	Unsuitable	Fair; high shear strength.	Unsuitable	Topography; feasible only in level areas.	Not applicable	Slow permeability.	Shale in some areas.
Bernal: Bs, Bt. For Slickspot part of Bs, see Slickspot. For Travessilla soil in Bt, see Travessilla series.	Unsuitable	Unsuitable	Fair	Fair to good	Limited quantity of soil material.	Not applicable, because of shallowness.	Rock at a depth of 12 inches.	Limited quantity of soil material.

See footnotes at end of table.

properties—Continued

Percentage passing sieve— No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)	Permeability	Available moisture capacity	Reaction	Salinity	Shrink-swell potential
			Inches per hour	*Inches per inch of soil*	*pH*		
----------	100	55–65	0. 63–6. 3	. 15	7. 9–8. 4	None	Low.
----------	100	75–85	0. 20–6. 3	. 17	7. 9–8. 4	Slight	Low.
----------	100	50–60	0. 63–2. 0	. 17	7. 9–8. 4	None	Low.
----------	100	75–85	0. 20–0. 63	. 17	7. 9–8. 4	Slight	Moderate.
----------	100	75–85	0. 20–6. 3	. 17	7. 9–8. 4	Moderate	Low.
100	100	60–75	0. 63–2. 0	. 17	7. 9–8. 4	Moderate	Low.
100	100	70–80	0. 20–0. 63	. 17	7. 9–8. 4	Severe	Moderate.
----------	100	88–98	0. 63–2. 0	. 17	6. 6–7. 3	None	Moderate.
----------	100	83–93	0. 20–0. 63	. 17	6. 6–8. 4	None	Moderate to high.
----------	100	86–96	0. 63–2. 0	. 17	7. 9–8. 4	None	Moderate.
100	100	70–80	0. 20–0. 63	. 17	6. 6–8. 4	None	Moderate to high.
100	100	60–75	0. 63–2. 0	. 17	7. 9–8. 4	None	Moderate.

Shrink-swell potential is an indication of the volume change to be expected when the moisture content of the soil material changes. In general, soils classified as CH and A–7 have a high shrink-swell potential. Clean, structureless sands and gravel and most other nonplastic or slightly plastic soils have a low shrink-swell potential.

Engineering interpretations

Table 11 gives estimates of the suitability of the soils for specified uses and describes some of the characteristics of the soils that affect the design, construction, and maintenance of engineering structures.

The ratings of the soils as a source of topsoil are based on use of the soil as topdressing on road slopes and dams. A good rating is given to a soil, such as Manzano loam, that is fertile and tillable and generally not subject to erosion. Soils are rated poor or unsuitable if they are lacking in plant nutrients, are hard to work, or are erodible. The soils are also rated as a source of sand and gravel.

Engineering interpretations

Irrigation	Waterways	Range pitting and chiseling	Building foundations [2]	Stock water pipelines	Degree of limitation for— Sewage disposal fields	Recreation areas	Homesites: Cabins	Homesites: Residences	Hydrologic soil group
Moderate permeability; fair water-holding capacity.	Erodibility until cover is established.	Fair water-holding capacity.	Low shrink-swell potential; fair bearing capacity.	Necessary depth easily reached; no rock problem.	Slight	Slight	Slight	Slight	C
Steep topography; rock formations; low fertility.	Not applicable	Rock outcrops; slow permeability.	High shrink-swell potential, except on rock outcrops.	Rock outcrops	Severe: slow permeability; sandstone outcrops.	Moderate: steep, broken topography.	Moderate: steep, broken topography.	Severe: poor foundation material; poor field for septic tanks.	D
Rock at a depth of 12 inches.	Rock at a depth of 12 inches.	Rock at a depth of 12 inches.	Good bearing capacity on rock.	Rock at a depth of 12 inches.	Severe: rock at a depth of 12 inches.	Slight	Slight	Moderate: poor field for septic tanks; hazard of severe wind erosion.	D

TABLE 11.—*Engineering*

Soil series and map symbols	Suitability as a source of—				Dikes and levees	Terraces and diversions [1]	Farm ponds and irrigation reservoirs	
	Topsoil	Sand and gravel	Road subgrade	Road fill			Reservoir areas	Embankments
Blown-out land: Bu	Unsuitable	Unsuitable	Fair to poor	Fair in sandy areas.	Fair compaction characteristics, but erodible after construction.	Not needed, because water erosion is not a problem.	Moderate permeability.	Fair compaction characteristics; moderate permeability.
Capillo: Ca	Fair	Unsuitable	Fair	Poor	Steep topography.	Steep topography.	Slow permeability; rock limits depth of excavation for ponds.	Good embankment material if compacted when wet.
Carnero: Ce	Fair	Unsuitable	Poor to a depth of 20 inches; good below 20 inches.	Poor to fair to a depth of 20 inches; good below 20 inches.	Fair to good stability.	Rocks in soil material.	Bedrock at a depth of 30 inches.	Fair to good stability; rocks help stability.
Chilton: Cg, Cl For La Fonda soil in Cl, see La Fonda series.	Poor	Good for gravel.	Good	Good	Very pervious because of gravel.	Gravel in soil material.	Rapid permeability.	Rapid permeability.
Chupadera: Cm	Poor	Poor	Fair	Fair	Poor stability	Not needed, because runoff is slow.	Rapid seepage	Poor stability
Clovis: Cn, Co, Cp, Cs For Dean soil in Cp, see Dean series. For Scholle soil in Cs, see Scholle Sc.	Fair	Unsuitable	Fair	Fair	Compacts easily.	Not needed	Moderate permeability.	Compacts easily, but remains permeable.
Crest: Ct	Poor	Unsuitable	Good below the topmost 6 inches.	Good	Shallow soil limits availability of material.	Not applicable, because of position.	Shallow to bedrock.	Amount of soil limited.
Dean: De	Poor	Poor; mostly caliche.	Poor in topmost 7 inches; good below 7 inches.	Poor in topmost 7 inches; good below 7 inches.	Not stable when wet.	Hard caliche near surface.	Moderate permeability.	Not stable when wet.
Duncan: Du	Unsuitable	Unsuitable	Poor; high shrink-swell potential.	Unsuitable	High shrink-swell potential; cracks when dry.	Not applicable; nearly level.	Cemented hardpan at a depth of 20 inches.	Cracks when dry and is consequently subject to piping.
Encierro: Ec	Poor	Unsuitable	Fair to poor	Unsuitable	Limited amount of soil, but rocky enough to make stable dikes.	Not applicable	Shallow to fractured bedrock.	Limited amount of soil, but rocks make embankments stable.

See footnotes at end of table.

interpretations—Continued

Irrigation	Waterways	Range pitting and chiseling	Building foundations [2]	Stock water pipelines	Degree of limitation for— Sewage disposal fields	Recreation areas	Homesites: Cabins	Homesites: Residences	Hydrologic soil group
Low fertility and low organic-matter content; moderate intake rate.	Cover difficult to establish.	Not needed, because terrain is flat and water soaks in.	Fair bearing capacity.	No limitations.	Moderate: slow to moderate permeability.	Severe: no vegetation.	Severe: no vegetation; severe hazard of wind erosion.	Severe: low fertility; plant cover is hard to establish.	D
Steep topography.	Erodibility when bare.	Not applicable: forested.	High shrink-swell potential.	Weathered rock prevents reaching adequate installation depth in places.	Severe: perched water table.	Moderate: steep topography.	Slight	Moderate: water supply doubtful because topography is steep.	D
Unsuitable, because of rocks in soil material.	Too rocky to establish cover.	Feasible only on milder slopes.	Good bearing capacity.	Too rocky for installation of plastic pipelines.	Severe: bedrock at a depth of 30 inches.	Slight	Slight	Moderate: poor potential for septic tanks.	D
Low water-holding capacity.	Not applicable, because of gravel.	Low water-holding capacity; high intake rate.	Low shrink-swell potential; fair bearing capacity.	Some extremely gravelly areas, which require bedding.	Slight	Moderate: not much plant cover.	Slight	Slight	B
Low water-holding capacity.	Not necessary, because runoff is slow.	High intake rate.	Low shrink-swell potential; good bearing capacity.	Features favorable to a depth of 24 inches.	Severe: rock near surface.	Slight	Slight	Slight	C
Moderate fertility and organic-matter content.	Highly erodible until cover is established.	Good water-holding capacity.	Moderate to high shrink-swell potential.	No adverse features.	Slight	Slight	Slight	Slight	C
Shallow; too steep.	Not applicable	Not applicable; soil too shallow.	Good bearing capacity at a depth of 24 inches.	Soil too shallow and too stony.	Severe: bedrock at a depth of 24 inches.	Slight	Slight	Moderate: topography too steep.	D
Low-water holding capacity.	Hard to establish grass cover.	Absorbs water readily, but has low water-holding capacity.	Low shrink-swell potential.	Hard caliche in places.	Slight	Moderate: vegetation is hard to maintain.	Slight	Slight	C
High salt content.	Not applicable	Slow intake rate.	High shrink-swell potential.	Hard to install below a depth of 20 inches.	Severe: soil is saturated during rainy season.	Severe: high water table in wet weather.	Severe: high water table in wet weather.	Severe: high water table in wet weather.	D
Low water-holding capacity; shallow soil.	Not applicable	Low water-holding capacity.	Good bearing capacity; moderate shrink-swell potential.	Too rocky for plastic lines; shallow to bedrock.	Moderate: can drain through fractured bedrock.	Moderate: too rocky.	Moderate: too rocky; sparse vegetation.	Severe: rocky; sparse vegetation.	D

TABLE 11.—*Engineering*

Soil series and map symbols	Suitability as a source of—				Dikes and levees	Terraces and diversions [1]	Farm ponds and irrigation reservoirs	
	Topsoil	Sand and gravel	Road subgrade	Road fill			Reservoir areas	Embankments
Erramouspe: Er	Poor	Unsuitable	Good	Fair to a depth of 5 inches; poor from 5 inches to 35 inches.	Rocky, but stable.	Not applicable	Rock at a depth of 36 inches.	Good stability because of rocks.
Fortwingate: Fo	Poor	Unsuitable	Fair	Fair in topmost 11 inches; poor below 11 inches.	Good stability	Not applicable	Slow permeability; rock at a depth of 30 inches.	Good stability because of rocks.
Fuera: Fr, Fu	Poor	Unsuitable; mostly coarse material.	Good to a depth of 11 inches; poor to very poor below 11 inches.	Good to a depth of 11 inches.	Cobblestones make good pervious blanket.	Not applicable	Slow seepage; rock at a depth of 5 feet.	Good stability with cobblestones as riprap.
Gypsum land	Poor	Unsuitable	Fair to poor	Unsuitable	Unstable	Not applicable	Gypsum at a depth of 4 to 12 inches.	Unstable
Hagerman: Ha, Hd. For Dean soil in Hd, see Dean series.	Poor	Unsuitable	Fair	Poor	Stable if compacted when wet.	Not applicable	Moderate permeability; rock at a depth of 30 inches.	Stable if compacted when wet.
Harvey: He, Hf, Hh, Hm. For Dean soil in Hh and Hm, see Dean series.	Poor	Unsuitable	Fair	Poor	Stable if compacted when wet.	Erodibility without plant cover.	Moderate permeability.	Stable if compacted when wet.
Hg	Poor	Unsuitable	Poor	Unsuitable	Unstable when wet.	Erodibility without plant cover.	Moderate permeability.	Unstable when wet.
Hassell: Hs	Fair	Unsuitable	Fair	Unsuitable	Must be compacted when wet.	Not applicable	Moderate permeablity.	Must be compacted when wet.
Ignacio: Ig	Poor	Unsuitable	Poor	Unsuitable	Subject to wind and water erosion; rock at a depth of 25 inches.	Not applicable	Rock at a depth of 25 inches.	Unstable when wet; subject to wind erosion when dry.
Ildefonso: Ih, Ik	Poor	Good in many areas; some areas are well graded; suitable for use in masonry.	Fair at a depth of 10 inches to 36 inches or more; gravelly stratum.	Unsuitable	Unstable; easily compacted when moist.	Subject of wind and water erosion.	Rapid seepage	Unstable; easily compacted when moist.

See footnotes at end of table.

interpretations—Continued

Irrigation	Waterways	Range pitting and chiseling	Building foundations [2]	Stock water pipelines	Degree of limitation for— Sewage disposal fields	Recreation areas	Homesites: Cabins	Homesites: Residences	Hydrologic soil group
Steep; rocky	Not applicable	Soil takes water readily and has good water-holding capacity.	Good bearing capacity.	Too rocky for plastic lines.	Moderate: rock at a depth of 36 inches.	Moderate: too steep.	Moderate: too steep.	Severe: too steep.	C
Steep; rocky	Not applicable	Too stony; high water-holding capacity.	High bearing capacity.	Too rocky; bedrock at a depth of 30 inches.	Severe: rock at a depth of 30 inches.	Moderate: steep slopes; rocky.	Moderate: steep; rocky.	Severe: steep; rocky.	C
Not applicable	Not applicable	Good water-holding capacity; subsoil is slowly permeable.	Moderate to high shrink-swell potential.	May be too cobbly for plastic lines.	Severe: slow permeability.	Slight	Slight	Severe: poor field fo: septic tanks.	C
Not applicable	Not applicable	Excessive gypsum.	Good bearing capacity.	Severe: rock at a depth of 4 to 12 inches.	Moderate: gypsum at a depth of 4 to 12 inches.	Severe: sparse vegetation; hazard of wind erosion.	Moderate: sparse vegetation.	Severe: poor foundation material; hazard of wind erosion; low fertility.	C
Not applicable	Not applicable	Medium water-holding capacity.	Moderate shrink-swell potential.	No limitations above bedrock.	Severe: rock at depth of 30 inches.	Slight	Slight	Slight	C
Good water-holding capacity; roots confined to less limy strata.	Moderate erodibility.	Soil takes water rapidly and has high water-holding capacity.	Low shrink-swell potential.	All features favorable.	Slight	Slight	Slight	Slight	B
Soil suited to salt-tolerant crops only.	Hard to produce cover.	Good water-holding capacity.	Moderate shrink-swell potential; low bearing capacity when wet.	All features favorable.	Moderate: high water table at times.	Moderate: poor cover.	Moderate: high water table at times.	Moderate: high water table at times.	C
Not applicable	Not applicable	High water-holding capacity.	Moderate to high shrink-swell potential.	All features favorable.	Moderate: slowly permeable subsoil.	Slight	Slight	Moderate: topography undesirable.	C
Not applicable	Not applicable	Low water-holding capacity.	Low shrink-swell potential; rock at a depth of 25 inches.	Rock at a depth of 25 inches.	Moderate: shallow to porous bedrock.	Moderate: hazard of severe wind erosion.	Moderate: hazard of severe wind erosion.	Moderate: hazard of severe wind erosion.	C
Erodibility; low water-holding capacity.	Erodibility without cover; cover hard to establish.	Low water-holding capacity.	Low shrink-swell potential; fair bearing capacity.	May need bedding in gravelly areas.	Slight	Moderate: hazard of severe wind erosion.	Slight	Slight	C

TABLE 11.—*Engineering*

Soil series and map symbols	Suitability as a source of—				Dikes and levees	Terraces and diversions [1]	Farm ponds and irrigation reservoirs	
	Topsoil	Sand and gravel	Road subgrade	Road fill			Reservoir areas	Embankments
Ildefonso—Cont.								
Im	Poor	Fair to good below a depth of 20 inches; in some places material is suitable for use in masonry.	Fair	Unsuitable	Unstable	Not applicable	Rapid seepage	Unstable
Is	Poor	Poor; mixed stone and coarse sand.	Fair to good	Good	Not enough binder in gravel.	Not applicable	Rapid seepage	Not enough binder in gravel.
Jekley:								
Je	Fair to good	Unsuitable	Poor	Poor	Hard to compact adequately, but makes good dikes.	Not applicable	Little or no seepage.	Hard to compact adequately.
Karde:								
Ka, Kd For Willard soil in Kd, see Willard (Wm).	Poor	Unsuitable	Poor	Unsuitable	Unstable	Not applicable	Moderate seepage.	Unstable
Kech: Kg	Poor	Poor; poorly graded.	Fair	Good	Soil is limited; rock at a depth of 16 inches.	Not applicable	Rock at a depth of 16 inches.	Soil is limited in quantity; rock at a depth of 16 inches.
Kim: Ko, Kp, Kw For Otero soil in Ko, see Otero series. For Pastura soil in Ko and Kp, see Pastura series. For Tapia soil in Kp, see Tapia series. For Pinon soil in Kw, see Pinon series. For Witt soil in Kw, see Witt series.	Poor	Unsuitable	Fair	Poor	Fairly stable; medium to high compressibility.	Not applicable	Moderate seepage; bedrock at a depth of 40 inches in places.	Fairly stable; low to moderate permeability when compacted.
La Fonda: La, Lg, Lm, Lo For Alicia soil in Lm, see Alicia series. For Rock outcrop part of Lo, see Rock outcrops and slides.	Fair	Unsuitable in areas of La, Lm, and Lo; fair below a depth of 2 feet in areas of Lg.	Poor to fair	Poor	Slakes when wet.	Not applicable	Moderate seepage.	Fairly stable; medium to high compressibility.
Laporte: Lp For Rock outcrop part of Lp see Rock outcrops and slides.	Unsuitable	Unsuitable	Good	Good	Fill material limited.	Not applicable	Shallow to bedrock.	Limited fill material.
Manzano: Ma, Mb	Good	Unsuitable	Fair	Unsuitable	Medium to high compressibility.	All features favorable.	Moderate permeability.	Fair to good stability.
Mc	Good in topmost 7 inches.	Unsuitable	Fair	Unsuitable	Medium to high compressibility.	All features favorable.	Moderate permeability.	Fair to good stability.

See footnotes at end of table.

interpretations—Continued

Irrigation	Waterways	Range pitting and chiseling	Building foundations [2]	Stock water pipelines	Degree of limitation for— Sewage disposal fields	Recreation areas	Homesites: Cabins	Homesites: Residences	Hydrologic soil group
Erodibility; low water-holding capacity.	Not applicable	Low water-holding capacity.	Good bearing capacity; low shrink-swell potential.	May need bedding in extremely gravelly areas.	Slight	Moderate: hazard of severe wind erosion.	Slight	Slight	B
Not applicable	Not applicable	High natural intake rate; low water-holding capacity.	Low shrink-swell potential; good bearing capacity.	Too rocky for plastic lines.	Slight	Severe: gullied and eroded.	Moderate: badly eroded.	Severe: badly eroded.	C
Not applicable	Not applicable	High water-holding capacity; seals easily.	High shrink-swell potential.	All features favorable.	Moderate: slowly permeable.	Moderate: topography too steep.	Slight	Severe: too steep.	D
Not applicable	Not applicable	Not applicable because of saline characteristics.	Low shrink-swell potential.	All features favorable.	Moderate: moderately permeable.	Moderate: saline soil.	Moderate: saline soil.	Moderate: saline soil.	C
Not applicable	Not applicable	Not applicable; gravelly and rocky at a depth of 16 inches.	Low shrink-swell potential.	Rock at a depth of 16 inches.	Severe: rock at a depth of 16 inches.	Moderate: not much cover, because soil is shallow.	Moderate: not much cover, because soil is shallow.	Severe: poor field for septic tanks.	D
Not applicable	Not applicable	Good water-holding capacity.	Low shrink-swell potential.	All features favorable above 40 inches.	Moderate: rock or caliche at a depth of 40 inches in places.	Moderate: sparse vegetation because of gravel.	Moderate: sparse vegetation because of gravel.	Slight	C
Not applicable	Not applicable	All features favorable.	Low to moderate shrink-swell potential.	All features favorable.	Moderate: moderate permeability.	Moderate: low fertility and organic-matter content.	Moderate: low fertility and organic-matter content.	Slight	C
Not applicable	Not applicable	Shallow to rock	Low shrink-swell potential.	Too rocky for plastic lines.	Severe: shallow to rock.	Moderate: rocky surface.	Slight	Severe: poor potential for septic tanks.	D
Moderate intake rate; high water-holding capacity.	Highly erodible until cover is established.	Good intake rate in natural state.	Moderate shrink-swell potential.	All features favorable.	Slight	Moderate: gullied in places; subject to flooding.	Moderate: subject to flooding.	Moderate: subject to flooding.	B
Moderate intake rate; high water-holding capacity.	Highly erodible until cover is established.	High water-holding capacity.	Moderate shrink-swell potential.	All features favorable.	Slight	Moderate: subject to flooding.	Moderate: subject to flooding.	Moderate: subject to flooding.	B

TABLE 11.—*Engineering*

Soil series and map symbols	Suitability as a source of—				Dikes and levees	Terraces and diversions [1]	Farm ponds and irrigation reservoirs	
	Topsoil	Sand and gravel	Road subgrade	Road fill			Reservoir areas	Embankments
Mirabal: Mh, Ml	Poor	Unsuitable	Good	Good	Poor resistance to piping.	Not applicable	Shallow to bedrock.	Limited soil material.
Moriarty: Mm, Mo	Unsuitable	Unsuitable	Poor	Unsuitable	Fair stability; difficult to compact.	Not applicable	All features favorable.	Fair stability; difficult to compact.
Osha: Oa, Og	Poor	Fair for gravel	Good	Good	Soil binder limited; gravelly.	Not applicable	Rapid seepage; rock at a depth of 4 feet.	Soil binder limited; gravelly.
Otero: Op, Or For Palma soil in Op and Or, see Palma series.	Poor	Unsuitable in uneroded areas; fair in eroded areas.	Fair	Unsuitable	Poor stability	Not applicable	Moderate to rapid seepage.	Poor stability
Palma	Poor	Unsuitable in uneroded areas; fair in eroded areas.	Poor to fair	Unsuitable	Poor stability	Not applicable	Rapid seepage.	Poor stability
Pastura: Pa, Pb	Poor	Unsuitable; mostly caliche gravel.	Poor	Fair	Fair to good stability.	Not applicable	Weakly cemented caliche at a depth of 2 feet.	Fair compaction characteristics.
Pedrick: Pd, Pe	Poor	Unsuitable; fair for sand in eroded areas.	Fair	Poor	Poor stability	Erodibility and poor stability.	Rapid seepage.	Unstable; poor resistance to piping.
Penistaja: Pf, Pg, Pn, Po For Dean Soil in Pn and Po, see Dean series.	Poor	Unsuitable	Fair	Poor; not well graded.	Poor stability	Erodibility without protection.	Moderate seepage.	Poor stability; poor compaction characteristics.
Ph	Poor	Unsuitable	Fair to good	Fair	Poor stability	Not applicable	Rapid to moderate seepage.	Unstable; poor piping resistance.
Pm	Poor	Unsuitable	Poor	Unsuitable	Slow permeability when compacted.	Not applicable	Moderate to slow seepage.	Slow permeability when compacted.
Pinata: Pr, Ps, Pt, Pu For Stroupe soil in Pt and Pu, see Stroupe series.	Unsuitable	Unsuitable	Fair	Poor	Fair stability; soil material limited.	Not applicable	Shallow to rock	Soil material limited.
Pino: Pv	Fair	Unsuitable	Poor to fair	Unsuitable	Fair to good stability.	Not applicable	Moderate seepage.	Good stability if compacted when wet.
Pw	Good	Unsuitable	Poor to fair	Poor	Fair stability	Not applicable	Rock at a depth of 4 feet.	Fair stability

See footnotes at end of table.

interpretations—Continued

Irrigation	Waterways	Range pitting and chiseling	Building foundations [2]	Stock water pipelines	Degree of limitation for—				Hydrologic soil group
					Sewage disposal fields	Recreation areas	Homesites		
							Cabins	Residences	
Not applicable	Not applicable	Not applicable	Low shrink-swell potential; good bearing capacity.	Too rocky	Severe: shallow to rock.	Moderate: steep topography.	Moderate: steep topography.	Severe: steep topography.	D
Not applicable	Not applicable	Good water-holding capacity; slow intake rate.	High shrink-swell potential; high compressibility.	All features favorable.	Severe: poorly drained.	Moderate: subject to flooding.	Moderate: subject to flooding.	Severe: subject to flooding.	D
Not applicable	Not applicable	Low water-holding capacity.	Good bearing capacity; low shrink-swell potential.	Too gravelly for plastic lines.	Severe: rock at a depth of 4 feet.	Moderate: steep topography.	Moderate: steep topography.	Severe: steep topography.	D
Not applicable	Not applicable	Moderate water-holding capacity; takes water rapidly.	Fair bearing capacity.	All features favorable.	Slight	Moderate: erodible.	Moderate: erodible.	Slight	C
Not applicable	Not applicable	Takes water rapidly.	Fair bearing capacity.	All features favorable.	Slight	Moderate: hard to maintain cover.	Moderate: difficult to maintain cover.	Moderate: difficult to maintain cover.	C
Not applicable	Not applicable	Low water-holding capacity; slow intake rate.	High bearing capacity on the caliche.	Difficult to excavate because of caliche.	Severe: caliche prevents drainage.	Severe: shallow soil; low fertility.	Severe: shallow soil; low fertility.	Severe: shallow soil; low fertility.	C
High intake rate; difficult to irrigate by surface method; low water-holding capacity.	Erodible and difficult to vegetate.	Takes water readily.	Medium bearing capacity; low shrink-swell potential.	All features favorable.	Slight	Moderate: fine-textured soil is erodible.	Moderate: fine-textured soil is very erodible.	Moderate: fine-textured soil is very erodible.	C
Not applicable	Erodible and difficult to vegetate.	Moderate water-holding capacity.	Fair bearing capacity; low shrink-swell potential.	All features favorable.	Slight	Slight	Slight	Slight	B
Not applicable	Not applicable	Rapid intake rate.	Low shrink-swell potential.	All features favorable.	Slight	Moderate: subject to wind erosion.	Moderate: subject to wind erosion.	Moderate: subject to wind erosion.	B
Not applicable	Not applicable	Slow water intake rate.	Moderate shrink-swell potential.	All features favorable.	Moderate: moderate permeability.	Slight	Slight	Slight	B
Not applicable	Not applicable	Too rocky; low water-holding capacity.	High shrink-swell potential.	Too rocky; shallow to bedrock.	Severe: shallow to rock.	Moderate: steep topography.	Moderate: steep topography.	Moderate: steep topography.	D
Not applicable	Not applicable	Rapid intake rate.	Medium shrink-swell potential.	Hardpan at a depth of 2 feet in places.	Moderate: moderate seepage.	Slight	Slight	Slight	D
Not applicable	Not applicable	Surface absorbs water readily.	High shrink-swell potential.	All features favorable above 4 feet.	Severe: rock at a depth of 4 feet.	Slight	Slight	Moderate: rock at a depth of 4 feet.	C

TABLE 11.—*Engineering*

Soil series and map symbols	Suitability as a source of—				Dikes and levees	Terraces and diversions [1]	Farm ponds and irrigation reservoirs	
	Topsoil	Sand and gravel	Road subgrade	Road fill			Reservoir areas	Embankments
Pinon: Px	Poor	Unsuitable	Fair to good	Good below a depth of 18 inches.	Soil material limited.	Not applicable	Shallow to rock	Soil material limited.
Prewitt: Pz. For Manzano soil, see Manzano series.	Good	Unsuitable	Fair	Unsuitable	Fair to good stability.	Not applicable	Moderate seepage.	Fair to good stability.
Rance: Rg. For Gypsum land part of Rg, see Gypsum land.	Fair	Unsuitable	Poor	Unsuitable	Slakes easily	Not applicable	Rapid seepage	Slakes easily
Rock land: Rk	Unsuitable	Good for crushed rock.	Good when crushed.	Fair when crushed.	Soil material limited.	Not applicable	Rock at the surface.	Soil material limited.
Rock outcrops and slides: Rs	Unsuitable	Good for crushed rock.	Good when crushed.	Fair when crushed.	Soil material limited.	Not applicable	Rock at the surface.	Soil material limited.
Salas: Sa	Poor	Unsuitable	Good	Poor	Soil material limited.	Not applicable	Shallow to bedrock.	Soil material limited.
Scholle: Sc	Fair	Fair; poorly graded gravel.	Fair	Poor	Fair to good stability.	Not applicable	Moderate seepage.	Fair to good stability.
Sh	Fair	Fair below a depth of 15 inches; poorly graded.	Poor	Unsuitable	Fair to good stability.	Not applicable	Moderate seepage.	Fair to good stability.
Slickspot	Unsuitable	Unsuitable	Unsuitable	Unsuitable	High shrink-swell potential.	Not applicable	Sandstone at a depth of 10 inches.	Clay has high shrink-swell potential.
Steep rock land: Sm	Unsuitable	Fair: mostly coarse gravel.	Good	Fair	Soil material limited.	Not applicable	Rock at the surface.	Soil material limited.
Stony alluvial land: Sn	Poor	Unsuitable	Fair	Fair	Soil material limited.	Not applicable	Rapid seepage	Soil material limited.
Stony steep land: So	Poor	Unsuitable	Fair	Fair	Soil material limited.	Not applicable	Rapid seepage	Soil material limited.
Stroupe: Sp	Unsuitable	Unsuitable	Good	Fair	Fair to poor stability.	Not applicable	Rock at a depth of 20 inches.	Fair to poor stability.
Supervisor: Sr	Fair	Unsuitable	Good	Fair to good	Too steep	Not applicable	Shallow to bedrock.	Topography too steep.
Tampico: Ta	Good	Unsuitable to a depth of 24 inches; fair below 24 inches; poorly graded.	Poor to fair	Unsuitable	Good stability if compacted when wet.	Not applicable	Moderate seepage.	Good stability

See footnotes at end of table.

interpretations—Continued

Irrigation	Waterways	Range pitting and chiseling	Building foundations [2]	Stock water pipelines	Degree of limitation for—				Hydrologic soil group
					Sewage disposal fields	Recreation areas	Homesites		
							Cabins	Residences	
Not applicable	Not applicable	Too rocky	Good bearing capacity; low shrink-swell potential.	Too rocky	Severe: shallow to bedrock.	Moderate: steep; not much grass cover.	Moderate: steep; little grass cover.	Severe: poor potential for septic tanks.	D
Not applicable	Not applicable	Moderate intake rate.	Moderate shrink-swell potential.	All features favorable.	Moderate: moderate permeability.	Severe: subject to annual flooding.	Severe: subject to annual flooding.	Severe: subject to annual flooding.	B
Not applicable	Not applicable	Moderate intake rate.	Poor bearing capacity when wet.	All features favorable.	Moderate: moderate permeability.	Moderate: little cover.	Moderate: little cover.	Moderate: little cover.	C
Not applicable	Not applicable	Rock at surface	Excellent bearing capacity.	Rock at surface	Severe: rock at surface.	Moderate: all rock.	Moderate: all rock.	Severe: all rock.	C
Not applicable	Not applicable	Too rocky	Excellent bearing capacity.	Too rocky	Severe: too rocky.	Severe: rocky and steep.	Severe: rocky and steep.	Severe: rocky and steep.	D
Not applicable	Not applicable	Too rocky	Excellent bearing capacity.	Too rocky for installation.	Severe: shallow to bedrock.	Severe: rocky and steep.	Severe: rocky and steep.	Severe: rocky and steep.	C
Not applicable	Not applicable	Fair water-holding capacity.	Moderate to low shrink-swell potential.	May need bedding in some areas.	Moderate: moderate permeability.	Slight	Slight	Slight	C
Not applicable	Not applicable	Moderate water holding capacity.	Moderate shrink-swell potential.	All features favorable.	Moderate: moderate permeability.	Slight	Slight	Slight	C
Not applicable	Not applicable	Rock at a depth of 10 inches; very slowly permeable.	Excellent if the surface is clay.	Sandstone at a depth of 10 inches.	Severe: rock at depth of 10 inches.	Severe: nearly barren of vegetation; hazard of wind erosion; affected by alkali.	Moderate: slickspots are small.	Severe: difficult to establish vegetation; affected by alkali.	D
Not applicable	Not applicable	Rock at surface	Excellent bearing capacity.	Too rocky for installation.	Severe: rock at surface.	Severe: steep and rocky.	Severe: steep and rocky.	Severe: steep and rocky.	D
Not applicable	Not applicable	High intake rate in natural state.	Fair bearing capacity.	Too rocky for plastic lines.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	D
Not applicable	Not applicable	Not enough soil material.	Fair bearing capacity.	Too rocky for plastic lines.	Severe: steep	Severe: steep and rocky.	Severe: steep and rocky.	Severe: steep and rocky.	D
Not applicable	Not applicable	Low water-holding capacity.	Moderate shrink-swell potential.	Too rocky for plastic lines.	Severe: rock at a depth of 20 inches.	Severe: steep and rocky.	Severe: steep and rocky.	Severe: steep and rocky.	C
Not applicable	Not applicable	Topography too steep.	Low shrink-swell potential.	Shallow to bedrock.	Severe: shallow to bedrock.	Severe: too steep.	Severe: too steep.	Severe: too steep.	C
Not applicable	Not applicable	Absorbs water readily.	High water table in places.	All features favorable.	Moderate: high water table in places.	Slight	Slight	Slight	B

TABLE 11.—*Engineering*

Soil series and map symbols	Suitability as a source of—				Dikes and levees	Terraces and diversions [1]	Farm ponds and irrigation reservoirs	
	Topsoil	Sand and gravel	Road subgrade	Road fill			Reservoir areas	Embankments
Tapia: Tc, Td, Te. For Dean part of Td and Te, see Dean series.	Fair	Unsuitable	Fair	Unsuitable	Fair stability	Not applicable	Caliche at a depth of about 20 inches.	Fair stability; moderate permeability when compacted.
Tecolote: Tf, Tg	Poor	Unsuitable	Fair	Poor	Fair stability; soil material limited in some areas.	Not applicable	Shallow to bedrock.	Fair stability
Tesajo: Th	Poor	Good; poorly graded.	Good	Good	Good stability	Not applicable	Very rapid seepage.	Good stability if compacted when wet.
Trail: Tm	Poor	Fair; well-graded fine sand.	Fair to good	Fair	Poor resistance to piping.	Not applicable	Very rapid seepage.	Poor resistance to piping.
Travessilla	Poor	Unsuitable	Poor	Unsuitable	Moderate stability; soil material limited.	Not applicable	Rock at a depth of 6 inches.	Soil material limited.
Turkeysprings: Tn	Poor	Unsuitable	Poor	Unsuitable	Fair stability; fair compaction characteristics.	Not applicable	Shallow to rock.	Fair stability; fair compaction characteristics.
Washoe:								
Wa	Unsuitable	Good for gravel and cobblestones; poorly graded.	Good	Poor	Fair stability	Not applicable	Moderate permeability.	Fair stability
Wb	Poor	Good for gravel; poorly graded.	Good	Fair	Fair stability	Not applicable	Moderate permeability.	Fair stability
Wilcoxson:								
Wc	Fair	Unsuitable	Fair	Poor	Fair to good stability.	All features favorable.	Slow seepage; rock at a depth of 40 inches in some areas.	Fair to good stability.
Wd	Good	Unsuitable	Fair	Poor	Fair stability if compacted when wet.	All features favorable.	Moderate seepage.	Fair stability if compacted when wet.
We, Wf, Wg	Poor	Unsuitable	Fair	Poor	Good stability	Not applicable	Shallow to rock	Good stability
Willard:								
Wh	Poor	Unsuitable	Fair	Unsuitable	Fair to poor stability in suface layer.	Easily eroded	Rapid seepage	Poor stability
Wk, Wl	Fair	Unsuitable	Fair	Poor	Fair stability if compacted when wet.	Subject to wind erosion if bare.	Moderate seepage.	Fair stability if compacted when wet.

See footnotes at end of table.

interpretations—Continued

Irrigation	Waterways	Range pitting and chiseling	Building foundations [2]	Stock water pipelines	Degree of limitation for—				Hydrologic soil group
					Sewage disposal fields	Recreation areas	Homesites		
							Cabins	Residences	
Not applicable	Not applicable	Low to moderate water-holding capacity.	Moderate shrink-swell potential.	Caliche limits depth.	Severe: caliche prevents drainage.	Moderate: hazard of severe wind erosion.	Moderate: hazard of severe wind erosion.	Moderate: hazard of severe wind erosion.	C
Not applicable	Not applicable	Low water-holding capacity.	Moderate shrink-swell potential.	Too stony for plastic lines.	Severe: moderate permeability; bedrock at a depth of 40 inches.	Severe: steep topography.	Severe: steep topography.	Severe: steep topography.	C
Not applicable	Not applicable	Rapid intake rate.	Low shrink-swell potential.	May need bedding in some places.	Slight	Moderate: droughty soils.	Moderate: droughty soils.	Severe: droughty soils.	C
Not applicable	Not applicable	Rapid intake rate.	Low shrink-swell potential.	All features favorable.	Slight	Moderate: wind-eroded area.	Moderate: wind-eroded area.	Severe: wind-eroded area.	A
Not applicable	Not applicable	Rock at a depth of 6 inches.	Excellent bearing capacity.	Rock at a depth of 6 inches.	Severe: rock at a depth of 6 inches.	Moderate: rocky.	Moderate: rocky; not much cover.	Severe: poor potential for septic tanks.	D
Not applicable	Not applicable	Topography too steep.	Good bearing capacity; low shrink-swell potential.	Too stony for plastic lines.	Severe: shallow to rock.	Moderate: steep topography.	Moderate: steep topography.	Severe: steep topography.	D
Not applicable	Not applicable	Rocky; takes water well.	Low to moderate shrink-swell potential.	Too rocky for plastic lines.	Moderate: moderate permeability.	Slight	Slight	Moderate: severe erosion when bare.	D
Not applicable	Not applicable	Rocky; takes water well.	High bearing capacity.	May need bedding in places.	Slight	Slight	Slight	Slight	D
Not applicable	Hard to vegetate because of clay.	High water-holding capacity.	High shrink-swell potential.	All features favorable, except where bedrock is near surface.	Severe: slow permeability.	Slight	Slight	Moderate: slowly permeable soil.	D
Moderate intake rate; high water-holding capacity.	Hard to vegetate.	High water-holding capacity.	Moderate shrink-swell potential.	All features favorable.	Moderate: moderate permeability.	Slight	Slight	Slight	D
Not applicable	Not applicable	Shallow to bedrock.	Moderate shrink-swell potential; rock at a depth of 24 inches.	Stony and shallow to bedrock.	Severe: shallow to bedrock.	Slight	Slight	Moderate: shallow to bedrock.	D
Low fertility and low organic-matter content.	Extreme erodibility.	Takes water rapidly.	Subsurface has moderate shrink-swell potential.	All features favorable.	Slight	Moderate: subject to severe wind and water erosion.	Moderate: subject to severe wind and water erosion.	Moderate: subject to severe wind and water erosion.	B
Low fertility, but responds well to fertilizer.	Erodible, but suitable after cover is established.	Deep chiseling increases intake rate.	Moderate shrink-swell potential.	All features favorable.	Moderate: moderate seepage.	Moderate: erodible without good cover.	Moderate: erodible without good cover.	Moderate: erodible without good cover.	C

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TABLE 11.—*Engineering*

Soil series and map symbols	Suitability as a source of—				Dikes and levees	Terraces and diversions [1]	Farm ponds and irrigation reservoirs	
	Topsoil	Sand and gravel	Road subgrade	Road fill			Reservoir areas	Embankments
Willard—Continued								
Wm	Poor	Unsuitable	Poor to fair	Unsuitable	Stable when compacted.	Erodible when bare.	Seepage water is saline.	Stable when compacted.
Witt: Wn, Wp, Ws, Wt. For Harvey soil in Ws and Wt, see Harvey series.	Good	Unsuitable	Poor to fair	Unsuitable	Easily compacted.	Features favorable; subject to wind erosion.	Slow seepage	Easily compacted.
Wo, Wr	Fair	Unsuitable	Poor to fair	Unsuitable	Easily compacted; fair stability.	All features favorable.	Slow to moderate seepage.	Easily compacted; fair stability.

[1] Terraces applicable only for soils that are suitable for dryland farming in climatic zone 4.

The ratings of the soils for use in road subgrade are based on the estimated classification of the soil material. Soils that have high plasticity or a layer of highly plastic clay have impeded internal drainage and poor stability when wet. Such soils are rated poor or unsuitable. Sandy soils and gravelly soils are rated good because they have high bearing capacity and low shrink-swell potential.

The suitability of soils for road fill depends on the texture of the material and the natural water content. Compaction characteristics, erodibility, depth to bedrock, and presence of rock within the normal depth of road excavation are features that were considered in determining suitability. Highly plastic soil materials that have high natural water content are rated poor or unsuitable in the table. Soils that have a high content of silt and fine sand are rated poor to fair as road fill because they are difficult to compact, slow to revegetate, and easily eroded on steep embankments.

Soil features significant in construction of dikes and levees are stability of the soil when wet and the workability of the soil in construction operations. Soil features significant in construction of terraces and diversions are erodibility, workability, and wet stability.

The characteristics of the soils that affect suitability for constructing farm ponds and irrigation reservoirs are the amount of seepage to be expected and the depth to an inhibiting layer or to bedrock. The characteristics considered in determining suitability of the soils for embankment structures are the same as those for dikes and levees.

The factors that affect irrigation are depth of tillable soil, texture, permeability, water-holding capacity, soil reaction, internal drainage, and topography. Availability of suitable irrigation water is not considered. The factors that affect use of soils as waterways are slope, erosion hazard, and the ease or difficulty of establishing vegetation.

Characteristics considered in rating soils as to suitability for building foundations are bearing capacity, shrink-swell potential, and shear strength. Characteristics considered in rating soils as to suitability for installation of stock water pipelines are the depth of soil and the presence or absence of rocks or stones in the soil.

Suitability of the soils for sewage disposal fields is shown in the table in terms of the degree of limitation for such use. A rating of slight indicates no unfavorable features. Points considered are permeability, ground-water level, topography, overflow hazard, depth to impervious material, and the possibility of polluting the water supply.

Suitability of the soils for recreation areas and homesites is also shown in the table in terms of the degree of limitation for such use. Factors considered in establishing the ratings are topography, drainage, vegetation, accessibility, soil texture, shrink-swell potential, soil salinity and alkalinity, and depth to parent material.

The soils are classified in the table according to their hydrologic group. The soils in group A have a high intake rate and consequently the least potential for runoff. The soils in group D have a low intake rate and consequently the highest potential for runoff.

Genesis, Classification, and Morphology of the Soils

This section presents the outstanding morphologic characteristics of the soils of the Torrance Area and relates them to the factors of soil formation. Physical and chemical data for many of the soils are limited, and the discussion of soil genesis and morphology is correspondingly incomplete. The first part of the section deals with the factors of soil formation, the second with the classification of the soils, and the third with the morphology of the soils.

Factors of Soil Formation

The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material accumulated and has existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time these forces have been active.

interpretations—Continued

Irrigation	Waterways	Range pitting and chiseling	Building foundations [2]	Stock water pipelines	Degree of limitation for—				Hydrologic soil group
					Sewage disposal fields	Recreation areas	Homesites		
							Cabins	Residences	
High salinity	Hard to vegetate.	High water table in places.	High shrink-swell potential.	Feasible for plastic; corrosive to metal.	Severe: slow internal drainage.	Severe: saline soil prevents desirable co.er.	Severe: saline water from wells.	Severe: saline water from wells.	C
High water-holding capacity.	Subject to wind erosion when bare.	All features favorable.	Moderate to high shrink-swell potential.	All features favorable.	Moderate: moderate permeability.	Slight	Slight	Slight	C
High water-holding capacity.	Difficult to vegetate.	All features favorable.	High shrink-swell potential.	All features favorable.	Moderate: slow permeability.	Slight	Slight	Slight	C

[2] Engineers and others should not apply specific values to the estimates given for bearing capacity of soils.

Climate and vegetation are the active factors of soil genesis. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body with genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent material also affects the kind of profile that can be formed and, in extreme cases, determines it almost entirely. Finally, time is needed for the development of distinct horizons.

The factors of soil genesis are so closely interrelated that few generalizations can be made regarding the effect of any one factor because the effect of each is modified by the other four. Many of the processes of soil development are unknown.

Parent material

The soils of the Torrance Area developed in or were derived from several kinds of parent material—bedrock, valley fill sediments, lacustrine sediments, alluvium, silty loess, and eolian sand.

Soils that developed in material weathered from bedrock occur throughout the Area but mostly in the mountains and foothills of the western and southern parts. Soils at the higher elevations in the Manzano Mountains and the Pedernal Hills developed mainly in material weathered from Precambrian crystalline igneous rocks and metamorphic rocks, including granite, schist, gneiss, and quartzite (fig. 32). Precambrian rocks are beneath the surface in nearly all parts of the Torrance Area.

The Sandia formation and the Madera formation of Pennsylvanian age and the Bursum formation of Permian age crop out near the northern crest of the Manzano Mountains and in the northern foothills. These formations dip eastward; they underlie the valley fill sediments of the Estancia Valley. They consist mostly of coarse-grained sandstone and limestone. Capillo, Turkeysprings, and Wilcoxson soils are common in this area.

Soils at the higher elevations of the Gallinas Mountains developed mainly in material weathered from felsite and sandstone. These acid parent materials are weathering into soils such as those of the Pinata, Stroupe, Tecolote, Erramouspe, and Fortwingate series.

Soils that developed in material weathered from the red beds of the Abo and Yeso formations of Permian age occur in the southern foothills of the Manzano Mountains, near the base of the Chupadera Mesa escarpment and along the margins of the Encino and Pinos Wells Lake Basins. These red-bed materials slake readily when they become wet and are easily eroded. Shale, fine-grained sandstone, siltstone, and gypsum are common rocks of these formations (fig. 33). Encierro, Hassell, Alicia, Rance, and La Fonda soils developed in material weathered from the red beds.

In the eastern part of the Area the bedrock is mainly Glorieta sandstone, a member of the San Andres formation, of Permian age. Glorieta sandstone also crops out along the escarpment of the Chupadera Mesa in the southern part of the Area. Hagerman, Bernal, and Travessilla soils developed in material weathered from this sandstone.

On most of the Chupadera Mesa and in the area around Clines Corners, Glorieta sandstone is overlain by Chupadera limestone, also a member of the San Andres formation (fig. 34). The calcareous and shallow Pinon, Laporte, and Chupadera soils formed in material weathered from this limestone.

Badland, which occurs in the northeastern part of the Area, is associated with the Dockum group, of Triassic age. The Dockum group consists mostly of red-bed shale and sandstone that weathers rapidly and is easily eroded.

Scholle and Chilton soils developed in what appear to be Ogallala pediment deposits of Pliocene or Pleistocene age. These deposits occur in the southwestern part of the Area, west of the town of Mountainair and near the eastern boundary of the Torrance Area.

Valley fill sediments on piedmont fans, probably of the Upper Santa Fe group of late Pliocene and Pleistocene age, occur on the uplands east of the Manzano Mountains and on the uplands surrounding the Gallinas Mountains. A special study,[8] conducted while the soil survey was in progress, indicated that these sediments were derived

[8] SHUMAN, ROBERT C., soil scientist, Soil Conservation Service. SOILS AND GEOMORPHIC SURFACES OF WESTERN TORRANCE AREA. Condensation of an unpublished M.S. thesis.

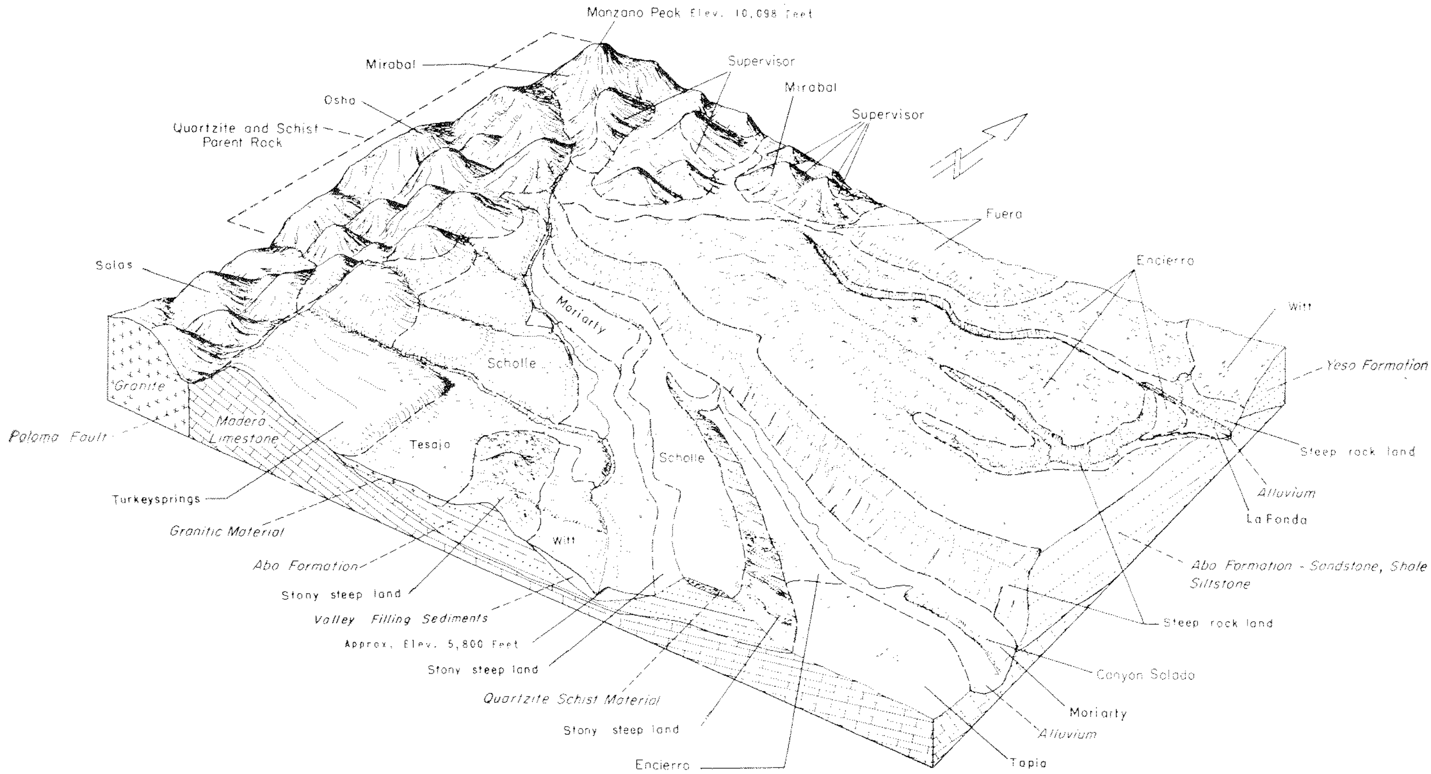

***Figure 32.*—Relationship of soil series to parent material in the Manzano Mountains.**

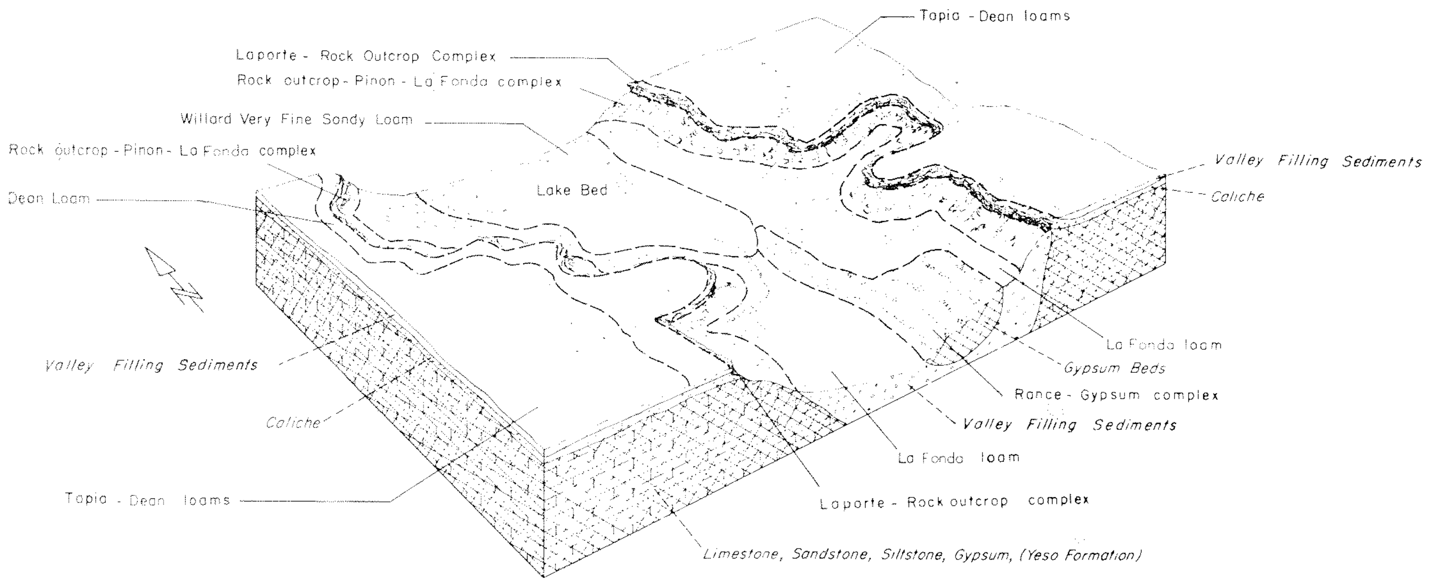

***Figure 33.*—Relationship of soil series to parent material in the area of the Pinos Wells Lake Basin.**

mainly from mixed parent rocks, including limestone from the Madera formation and from Precambrian gneiss, schist, carboniferous limestone, sandstone, and shale. The study was made to determine the relationship of soils and geomorphic surfaces in the Chinchonte Arroyo area. This arroyo is a major tributary that carries sediments to the Lake Estancia Basin. Four geomorphic surfaces were mapped (fig. 35).

Valley fill sediments of the late Pliocene and Pleistocene epochs apparently were washed down from the mountains during the period when the mountains were being uplifted and then deposited as broad, gently sloping fans. Apparently, the mountains have been uplifted several times, and after each uplift a fresh mantle of alluvium was deposited over the older material. Enough time elapsed between each uplift and subsequent alluviation to permit

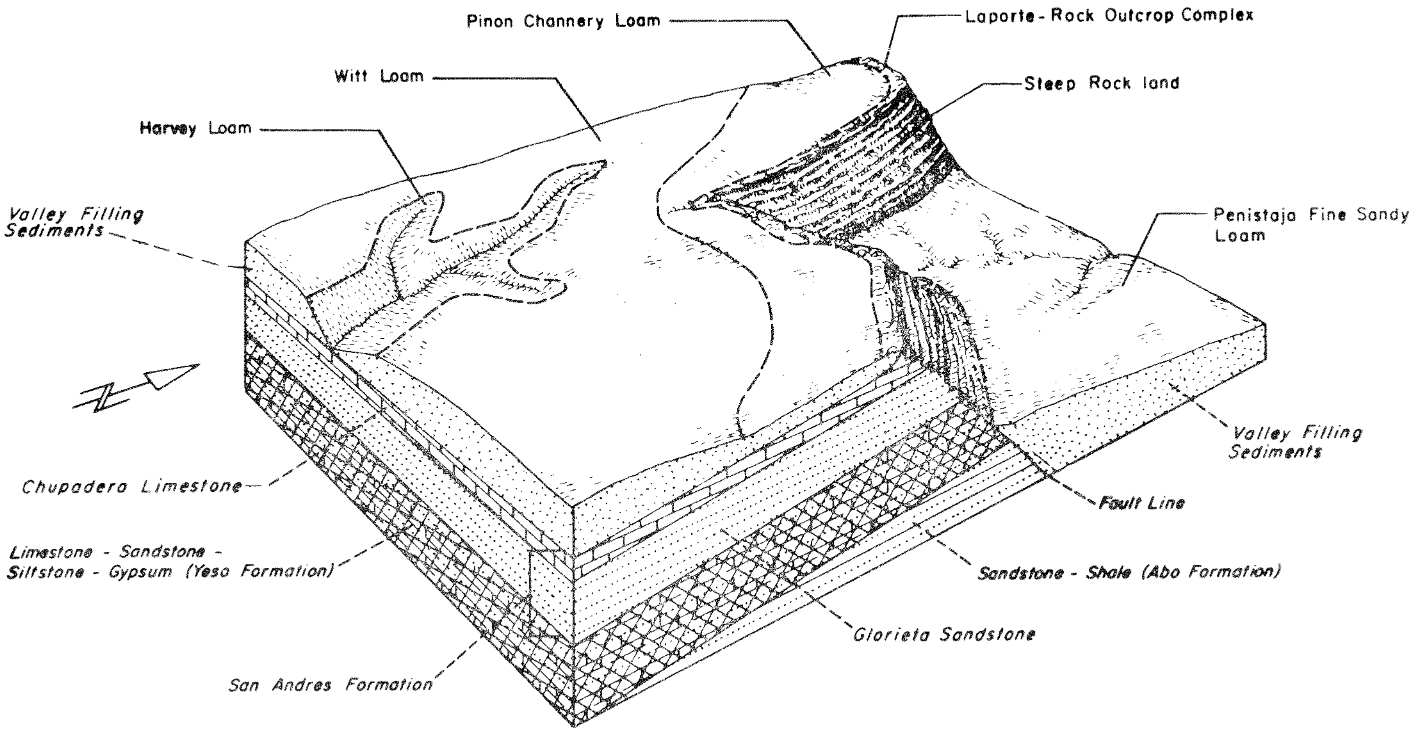

Figure 34.—Relationship of soil series to parent material in areas of the Chupadera Mesa.

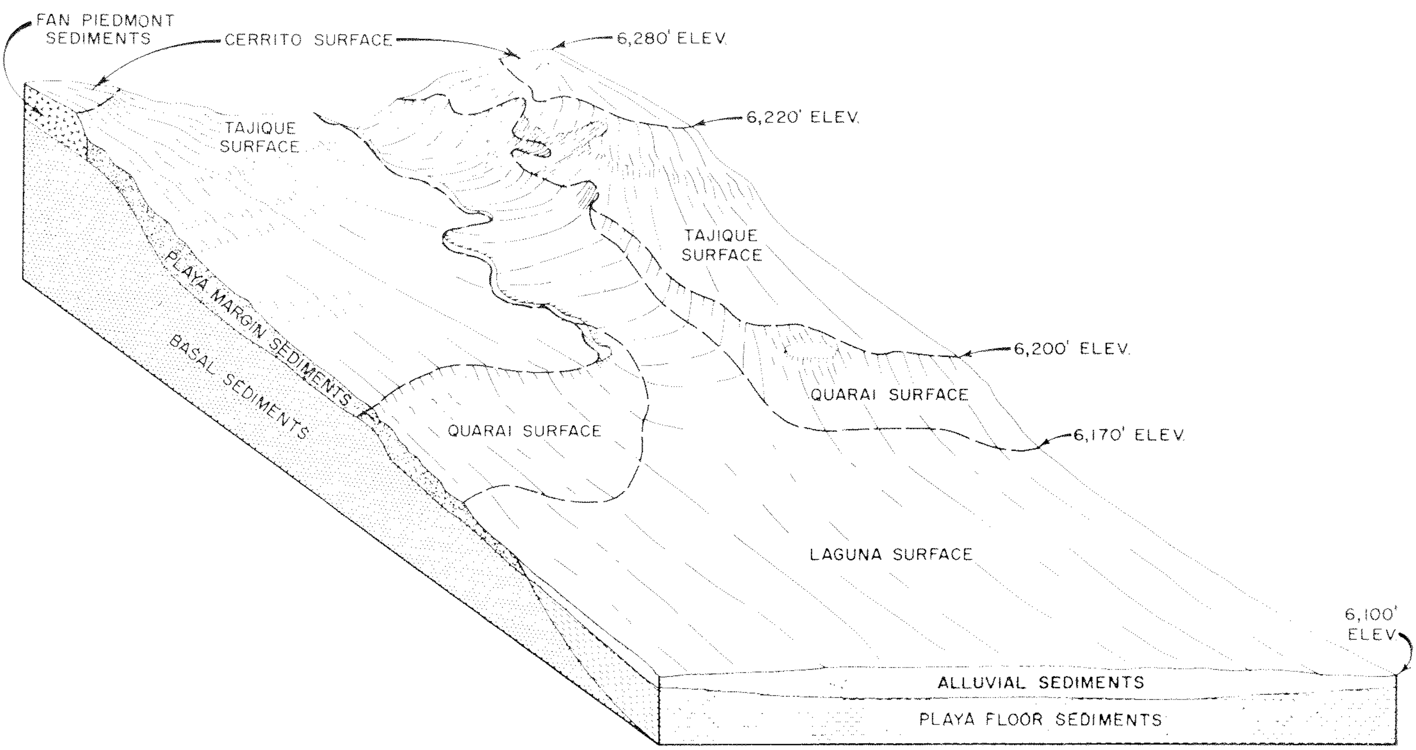

Figure 35.—Sedimentary deposits and geomorphic surfaces of the lower part of Chinchonte Arroyo.

soil to develop. This is substantiated by the many well-developed buried profiles discernible in soils of the Witt, Clovis, Alicia, and Penistaja series.

Deposits of caliche occur in nearly all parts of the survey Area but are more common in the southeastern and northeastern parts. These limy materials were apparently deposited by ground water; the overlying soil material is not thick enough to have supplied so much calcium carbonate. Soils of the Pastura, Tapia, and Dean series developed on these deposits.

Willard, Ildefonso, and Pedrick soils occur in lake basins of the Torrance Area. They developed in stratified lacustrine sediments of Pleistocene age. These sediments are high in content of lime, gypsum, and soluble salts. They are stratified with gravel, sand, silt, and clay. In places the water table keeps the sediments wet for long periods. The soils that develop from them are limy and light colored, and, in places, they contain harmful amounts of soluble salts. The lacustrine sediments were carried by runoff water flowing down the arroyos into the enclosed basins, and later settled out of the saline lake water. The salts were left behind after the water evaporated.

The arroyos and flood plains are filled with deep, dark-colored, floodwater sediments of relatively recent age. This alluvium ranges from clay to sand and is stratified in places. It is high in organic-matter content and in fertility. Where these arroyos terminate in lake basins, the alluvium is deposited over the lacustrine sediments as broad, nearly level fans. Some fresh material is still being deposited in many of the arroyos and on flood plains. Soils of the Manzano, Moriarty, and Prewitt series are the major soils that developed in this kind of alluvium.

Loess deposits of Pleistocene age are not extensive in this survey Area. They occur in all of the lake basins on the leeward side of playas. These playa lakes are remnants of larger lakes; they occur in the lower part of the lake basins. They are frequently filled with runoff water and remain wet for long periods. When the surface dries out, a thin, salty, friable crust forms. This crust is easily eroded. Wind whips it off the lake bottoms and deposits it on the leeward side of dunes and low ridges. Soils of the Karde series developed in this silty, saline loess.

The shallow and deep, sandy soils on the uplands in the southern part of the Area developed in eolian sands that were blown in from the sandhills southwest of the Area. This belt of eolian sand is 1 to 4 miles wide and extends in a northeasterly direction from Gran Quivira nearly to the village of Pinos Wells. Soils of the Otero, Palma, and Trail series formed in these sandy eolian deposits. In some places the sands are still unstable, and active dunes are present. Several other isolated areas of eolian sands occur in the central and eastern parts of the Area.

Climate

The climate of the Torrance Area is continental and is typical of that of intermountain valleys of the southern regions of the Rocky Mountains. It is characterized by abundant sunshine, low relative humidity, erratic rainfall, and wide variation in daily and seasonal temperatures.

Winters are long and cold, and summers are short and mild. Spring winds cause excessive loss of soil moisture needed for plant growth and soil development. In winter the nighttime temperature falls below freezing, but there is considerable daytime warming. This alternate freezing and thawing makes the soils more friable and better aerated and also hastens structural development. If the soil is moist, frost penetrates to a depth of 2 feet in some years. Much of the winter moisture is lost through evaporation and runoff if the soils freeze before arrival of the winter snows. Evaporation losses are greatest at the lower elevations because of the warmer daytime temperatures and the exposure of the soils to prevailing winds.

Rainfall in the mountainous areas is about one and a half times as much as that at the lower elevations. The higher rainfall, the lower daytime temperatures, and the lower evaporation rates have resulted in the soils in mountainous areas being more deeply leached of lime and colloids. Plant cover is thicker in the area of higher rainfall, and consequently, larger quantities of organic matter are added to the soil. This improves the rate of water and air intake. Temperature is most important in the development of forest soils, because it controls the rate at which snow melts, the rate of evaporation, the rate of plant growth, and the activity of animal life in the soil.

It is unlikely that the soils at the lower elevations developed under the present-day type of climate. The strength of the soil structure, the leaching of colloids, and the depth to which lime has been leached indicate that many of the soils developed in a time of greater rainfall.

Other evidences of wetter climatic periods in the past are the stairstep beach lines around the Estancia, Encino, and Pinos Wells Lake Basins. Other factors being equal, twice as much precipitation as is now normal would be needed to keep Estancia Lake at the level of its uppermost shoreline (*8*). The wetter periods corresponded to glacial advances in the North, and the drier periods corresponded to glacial retreats (*2*). The water near the center of the lake, at its highest level, was about 110 to 120 feet deep.[9]

Plant and animal life

Trees and shrubs, grasses and other herbaceous plants, micro-organisms, earthworms, gophers, rats, prairie dogs, and various other forms of plant and animal life are active factors in soil formation.

The soils of the Torrance Area formed under three general types of vegetation—mixed short, mid, and tall grasses; scrub trees and short, mid, and tall grasses; and mixed conifers and shrubs. These three vegetative types are closely related to elevation. The mixed grasses type, which is the most extensive, is mainly at an elevation of less than 6,500 feet; the scrub tree and mixed grasses type, at an elevation of between 6,500 and 7,300 feet; and the mixed conifers and shrubs type at an elevation of more than 7,300 feet. There is considerable overlap, but generally the divisions are apparent. Vegetation is less abundant at the lower elevations because precipitation is less plentiful.

Organic matter is added to the soil in the form of needles, leaves, twigs, roots, and entire plants. Most of it is incorporated into the A horizon, where it is acted upon by micro-organisms, earthworms, and other forms of life, and by chemicals. The darkness of color of the A horizon is directly related to the amount of organic matter in the soil and is a factor in soil classification.

[9] HARBOUR, J. MICROSTRATIGRAPHIC AND SEDIMENTARY STUDIES OF AN EARLY-MAN SITE NEAR LUCY, NEW MEXICO. Unpublished M.S. thesis, University of New Mexico. 111 pages. 1958.

In the Torrance Area, prairie dogs and kangaroo rats have greatly altered soil characteristics. These animals dig underground tunnels, and in doing so mix the soil from various horizons and bring soil from the lower horizons to the surface. The kangaroo rats especially like the well-drained, well-developed, medium-textured, wooded soils that have a limy layer below the surface. They burrow in the shade of the pinyon and juniper trees and bring much of the lime to the surface, where it is mixed with the original surface layer and subsoil. As a result, the soil structure is destroyed, and color, texture, and other morphological characteristics are sufficiently changed in some places to affect the classification of the soil.

Man has also greatly altered soil characteristics. He broke out thousands of acres of productive grassland and planted cultivated crops. When drought set in, he abandoned most of the fields and left them to blow. The soils deteriorated in fertility, structure, and other characteristics.

In places man has clean tilled the soil and plowed under plant residue, thereby accelerating runoff and erosion. He has depleted the soil of nutrients by farming without fertilizing and rotating crops. Man has allowed overgrazing of rangeland, which has compacted the soil and left it exposed to hot, dry, erosive winds, again increasing the amount of water lost through runoff. He overharvested the forests and carelessly set fires, which resulted in excessive soil loss and slower soil development.

In other places man has hastened soil development and improved fertility by irrigating, fertilizing, leveling, mulching, and planting soil-conserving grasses and legumes. Whatever man does to the soil affects its development in some way.

Relief and drainage

The effects of climate and vegetation, as factors in soil formation, are modified to varying degrees by relief. If other factors are about equal, runoff is rapid on steep slopes and slow on level areas. If runoff is rapid, little water enters the soil, plants do not grow vigorously, and soil formation proceeds slowly; soil horizons are thin and indistinct; and, unless a good plant cover is maintained, erosion may progress as fast as soil development.

The relief in the Torrance Area ranges from level in the lake basins to very steep on mountain slopes. It has been a more important factor in soil formation at the higher elevations than at the lower elevations.

Soils on the northern and eastern slopes of mountainous areas are deeper, darker colored, and more strongly developed than soils on the southern and western slopes. They are protected from prevailing winds and from direct rays of the sun. Winter snows melt more slowly, and the soils absorb and retain more moisture. The kind and amount of vegetation is different from that on the southern and western exposures.

Soils on the southern and western slopes are less strongly developed and less deeply leached of lime and colloids than soils on northern and eastern slopes. They are droughty and are subject to wind erosion. The vegetation is more sparse, and the plants are stunted.

In the lake basins, runoff is slow, internal drainage is impeded, and in places the water table is near the surface. Soluble salts rise through the soils by capillary action, and evaporation builds up salt deposits at the surface. This makes the soils saline and alkali.

Time

The length of time needed for a soil to form depends on the nature of the parent material, the climate, plant growth and animal activity, and relief and drainage. The degree of profile development depends on the intensity of the different soil-forming factors and on the length of time they have been active.

A soil is young, or immature, if the soil-forming factors have not been active long enough for the soil to be in equilibrium with its environment. A soil is mature, or old, if it has been in place for a long time and has approached equilibrium.

Soils of the Trail, Otero, Willard, Ildefonso, Dean, and Pastura series are young, or immature. They show little or no profile development and very little leaching of soil colloids. Soils of the Manzano series, which occur in swales and on flood plains, are fairly young. They show some profile development. In places new material is still being deposited.

Soils of the Witt, Alicia, and Wilcoxson series are old, or mature. They have a thick, well-developed profile. These soils occur on nearly level to moderately sloping uplands, mainly in the western part of the Area. Many of these mature soils are underlain by a buried soil that is older and more mature than the soil now at the surface.

Both young and old soils occur in the mountainous regions. Soils of the Tampico series are examples of immature soils of the Alluvial great soil group. Generally, the more mature of the mountainous soils occur on the eastern and southern slopes. Soils of the Wilcoxson and Pinata series are examples of mature mountainous soils that occur extensively in the Torrance Area.

Classification of the Soils

Two systems of classifying soils have been used in the United States in recent years. One system was adopted in 1938 (*4, 15*) and later revised. In this system there are six categories. Beginning with the most inclusive, the six categories are the order, the suborder, the great soil group, the family, the series, and the type. Only four of the categories—the order, the great soil group, the series, and the type—have been widely used. There are three orders: the zonal, the intrazonal, and the azonal. All three are represented in the Torrance Area. Ten of the great soil groups are represented.

A comprehensive system of soil classification was adopted for general use by the National Cooperative Soil Survey in 1965 and supplemented in March 1967. This system is under continual study, and readers interested in the development of the system should refer to the latest literature available (*13, 17*).

Table 12 shows the classification of each of the soil series represented in the Torrance Area according to the 1938 system, and also the order, subgroup and great group, and the family according to the comprehensive system. Placement of some of the soil series in the comprehensive system of classification, particularly in families, may change as more precise information becomes available.

The discussion that follows relates to the orders and great soil groups of the 1938 system.

TABLE 12.—*Classification of soil series of the Torrance Area*

Series	Classification according to 1938 system		Classification according to comprehensive system		
	Order	Great soil group	Order	Subgroup and great group	Family
Alicia	Zonal	Reddish Brown	Aridisol	Ustollic Camborthid	Fine-silty, mixed, mesic.
Bernal	Zonal	Reddish Brown	Mollisol	Lithic Argiustoll	Loamy, mixed, mesic.
Capillo	Zonal	Chestnut	Mollisol	Typic Argiboroll	Fine, mixed, frigid.
Carnero	Zonal	Reddish Chestnut	Mollisol	Typic Argiustoll	Fine-loamy, mixed, mesic.
Chilton	Azonal	Regosol	Entisol	Ustic Torriorthent	Loamy-skeletal, mixed, calcareous, mesic.
Chupadera	Azonal	Regosol	Aridisol	Ustollic Calciorthid	Coarse-loamy, mixed, mesic.
Clovis	Zonal	Reddish Chestnut	Aridisol	Ustollic Haplargid	Fine-loamy, mixed, mesic.
Crest	Zonal	Gray Wooded	Alfisol	Typic Eutroboralf	Clayey, skeletal, mixed, frigid.
Dean	Intrazonal	Calcisol	Aridisol	Ustollic Calciorthid	Fine, carbonatic, mesic.
Duncan	Intrazonal	Solonetz	Aridisol	Typic Nadurargid	Fine, mixed, thermic.
Encierro	Zonal	Reddish Chestnut	Mollisol	Lithic Argiustoll	Clayey, mixed, mesic.
Erramouspe	Zonal	Chernozem	Alfisol	Typic Haplustalf	Fine, mixed, mesic.
Fortwingate	Zonal	Gray Wooded	Alfisol	Hapludic Eutroboralf	Fine, montmorillonitic, frigid.
Fuera	Zonal	Gray Wooded	Alfisol	Typic Haplustalf	Fine, mixed, frigid.
Hagerman	Zonal	Reddish Brown	Aridisol	Ustollic Haplargid	Fine-loamy, mixed, mesic.
Harvey	Intrazonal	Calcisol	Aridisol	Ustollic Calciorthid	Fine-loamy, mixed, mesic.
Hassell	Zonal	Reddish Chestnut	Aridisol	Ustollic Haplargid	Fine, mixed, mesic.
Ignacio	Zonal	Reddish Brown	Aridisol	Ustollic Camborthid	Coarse-loamy, mixed, mesic.
Ildefonso	Intrazonal	Calcisol	Aridisol	Ustollic Calciorthid	Loamy-skeletal, mixed, mesic.
Jekley	Zonal	Gray Wooded	Mollisol	Typic Argiboroll	Fine-silty, mixed, frigid.
Karde	Azonal	Regosol	Entisol	Ustic Torriorthent	Fine, carbonatic, mesic.
Keeh	Zonal	Reddish Brown	Aridisol	Lithic Ustollic Haplargid	Loamy, mixed, mesic.
Kim	Azonal	Regosol	Mollisol	Entic Haplustoll	Fine-loamy, mixed, calcareous, mesic.
La Fonda	Zonal	Reddish Chestnut	Aridisol	Ustollic Camborthid	Fine-loamy, mixed, mesic.
Laporte	Azonal	Lithosol	Mollisol	Aridic Lithic Haplustoll	Fine-loamy, mixed, mesic.
Manzano	Zonal	Chestnut	Mollisol	Cumulic Haplustoll	Fine-loamy, mixed, mesic.
Mirabal	Azonal	Lithosol	Entisol	Typic Ustorthent	Loamy-skeletal, mixed, nonacid, frigid.
Moriarty	Azonal	Regosol	Vertisol	Typic Torrert	Fine, mixed, mesic.
Osha	Zonal	Gray Wooded	Mollisol	Typic Paleboroll	Loamy- skeletal, mixed, frigid.
Otero	Azonal	Regosol	Entisol	Typic Haplorthent	Coarse-loamy, mixed, calcareous, mesic.
Palma	Zonal	Reddish Brown	Aridisol	Ustollic Haplargid	Coarse-loamy, mixed, mesic.
Pastura	Azonal	Lithosol	Aridisol	Ustollic Paleorthid	Loamy, mixed, mesic, shallow.
Pedrick	Azonal	Regosol	Entisol	Ustollic Torriorthent	Coarse-loamy, mixed, calcareous, mesic.
Penistaja	Zonal	Reddish Brown	Aridisol	Ustollic Haplargid	Fine-loamy, mixed, mesic.
Pinata	Zonal	Gray Wooded	Alfisol	Udic Haplustalf	Clayey, skeletal, mixed, frigid.
Pino	Zonal	Chestnut	Mollisol	Typic Argiboroll	Fine, mixed frigid.
Pinon	Intrazonal	Calcisol	Aridisol	Lithic Mollic Calciorthid	Loamy, mixed, mesic.
Prewitt	Azonal	Alluvial	Mollisol	Fluventic Haplustoll	Fine-loamy, mixed, mesic.
Rance	Intrazonal	Calcisol	Entisol	Ustic Torriorthent	Fine-silty, mixed, gypsic, calcareous, mesic.
Salas	Zonal	Reddish Chestnut	Mollisol	Udic Argiustoll	Fine-loamy, mixed, mesic.
Scholle	Zonal	Reddish Brown	Aridisol	Ustollic Haplargid	Fine-loamy, mixed, mesic.
Stroupe	Zonal	Chestnut	Mollisol	Typic Argiustoll	Clayey-skeletal, mixed, frigid.
Supervisor	Azonal	Regosol	Mollisol	Typic Cryoboroll	Loamy-skeletal, mixed, frigid.
Tampico	Azonal	Alluvial	Mollisol	Typic Cryoboroll	Fine-loamy, mixed, frigid.
Tapia	Zonal	Reddish Brown	Aridisol	Ustollic Haplargid	Fine-loamy, mixed, mesic.
Tecolote	Zonal	Gray Wooded	Alfisol	Typic Eutroboralf	Loamy-skeletal, mixed, frigid.
Tesajo	Azonal	Regosol	Mollisol	Cumulic Haplustoll	Loamy-skeletal, mixed, mesic.
Trail	Azonal	Alluvial	Entisol	Typic Normipsamment	Sandy, mixed, nonacid, mesic.
Travessilla	Azonal	Lithosol	Entisol	Lithic Ustic Torriorthent	Loamy, mixed, calcareous, mesic.
Turkeysprings	Zonal	Chestnut	Mollisol	Typic Argiboroll	Fine, mixed, frigid.
Washoe	Zonal	Reddish Brown	Aridisol	Ustollic Haplargid	Loamy-skeletal, mixed, mesic.
Wilcoxson	Zonal	Chestnut	Mollisol	Typic Argiboroll	Fine, mixed, frigid.
Willard	Azonal	Regosol	Entisol	Ustollic Calciorthent	Fine, carbonatic, mesic.
Witt	Zonal	Reddish Brown	Aridisol	Ustollic Haplargid	Fine-silty, mixed, mesic.

Zonal order

The zonal order consists of soils that have evident, genetically related horizons that reflect the predominant influence of climate and living organisms, mainly vegetation, in their formation. The zonal soils in this Area are in the Reddish Brown, Reddish Chestnut, Chestnut, Chernozem, and Gray Wooded great soil groups. The soils at the lower elevations developed in valley fill under mixed short, mid, and tall grasses. Those at the higher elevations developed in material weathered from bedrock under a cover of mixed conifers.

REDDISH BROWN SOILS

In this Area the Reddish Brown great soil group is represented by the Alicia, Bernal, Hagerman, Ignacio, Kech, Palma, Penistaja, Scholle, Tapia, Washoe, and Witt series. Soils of these series are on nearly level to strongly sloping uplands and on moderately steep to steep piedmont fans in the foothills. They are well drained.

Alicia, Palma, Penistaja, Scholle, Tapia, and Witt soils developed in calcareous piedmont fan deposits on uplands. Washoe soils developed in similar, but noncalcareous, material. Scholle and Washoe soils developed in gravelly material, and the others in loamy material. Bernal, Hagerman, and Ignacio soils developed in residuum from acid sandstone bedrock, mainly of the Glorieta formation. Kech soils developed in residuum from mixed, acid igneous rocks and from schist, gneiss, quartzite, and limestone.

These soils formed in a semiarid climate and under a cover of mixed short, mid, and tall grasses, mainly blue grama, side-oats grama, galleta, western wheatgrass, and little bluestem. At elevations above 6,400 feet, the vegetation consists mainly of light to moderate stands of pinyon and juniper.

The soils of this great soil group commonly have an A1 horizon of brown loam or fine sandy loam, 3 to 6 inches thick, that has moderate granular structure. This horizon is leached of calcium carbonate. The B2t horizon is normally brown or light-brown clay loam or sandy clay loam that has weak to moderate prismatic structure breaking to moderate to strong, subangular blocky. The upper part of the B2t horizon is commonly leached of calcium carbonate. In many places the C horizon is lighter colored, loamy, and structureless. It contains concentrations of calcium carbonate.

Kech, Scholle, and Washoe soils are more than 15 percent gravel throughout the solum. Ignacio and Palma soils are coarser textured than is typical of this great soil group, and they are also less strongly developed. Soils of the Tapia series are the only Reddish Brown soils of this Area that have a semi-indurated C horizon. The thickness of the solum ranges from 12 inches in the Bernal soils to 47 inches in the Witt soils. The average thickness is 26 inches.

REDDISH CHESTNUT SOILS

In this Area the Reddish Chestnut great soil group is represented by the Carnero, Clovis, Encierro, Hassell, La Fonda, and Salas series. Soils of these series are on uplands and mountain slopes. They are nearly level to very steep. They are well drained.

Soils of the Carnero, Clovis, Hassell, and La Fonda series developed in calcareous piedmont fan deposits. Soils of the Encierro series formed in material weathered from Permian red-bed sandstone, and soils of the Salas series developed in material weathered from acid schist bedrock.

Most of these soils formed under mixed short, mid, and tall grasses, mostly blue grama, side-oats grama, western wheatgrass, and little bluestem. In some places the vegetation consisted of light stands of pinyon and juniper. The Salas soils formed under grasses and moderate to heavy stands of pinyon and juniper.

These soils have a brown to reddish-brown, loamy A1 horizon, 2 to 6 inches thick, that has moderate granular structure. The A1 horizon of all except Hassell and La Fonda soils is leached of calcium carbonate. The B2t horizon is light reddish-brown, brown, or reddish-brown heavy loam or clay loam that has weak to moderate prismatic structure breaking to weak to moderate subangular blocky. In most of the soils, the B2t horizon is leached of lime in the upper part. The C horizon is commonly lighter colored, coarser textured, and more alkaline. The thickness of the solum ranges from 9 inches in the Encierro soils to 31 inches in the Salas soils. It is most commonly about 20 inches. Soils of the Salas series have stones in the profile.

CHESTNUT SOILS

In this Area the Chestnut great soil group is represented by the Capillo, Manzano, Pino, Stroupe, Turkeysprings, and Wilcoxson series. These soils are well drained.

Soils of the Manzano series are in swales and on flood plains at the lower elevations. They formed in relatively recent loamy alluvium of mixed origin. Soils of the Capillo, Pino, Turkeysprings, and Wilcoxson series occur in the foothills and on mountains in the western part of the Torrance Area. They developed in residuum weathered from limestone and calcareous shale. Soils of the Stroupe series occur on mountains in the southern part of the Torrance Area. They developed in material weathered from acid sandstone and felsite.

The soils in this great soil group formed under several different types of vegetation. Capillo and Pino soils and some of the Wilcoxson soils formed under coniferous forest, mainly ponderosa pine, Douglas-fir, and white fir, with a ground cover of short, mid, and tall, cool-season grasses. Stroupe and Turkeysprings soils, and some of the Wilcoxson soils, formed under sparse to thick stands of pinyon and juniper, with a ground cover of short, mid, and tall grasses. Manzano soils formed mainly under a ground cover of short and mid grasses, mostly blue grama, side-oats grama, western wheatgrass, and vine-mesquite.

With the exception of Manzano, Stroupe, and some of the Wilcoxson soils, these soils have a thin mineral layer of decomposing forest litter on the surface. The A horizon is commonly dark-brown or dark grayish-brown loam or silt loam 3 to 10 inches thick. This horizon commonly has moderate granular structure. It is leached of calcium carbonate. The B2 horizon is brown to dark grayish-brown clay with weak to moderate prismatic structure breaking to moderate or strong subangular and angular blocky structure. The soils are commonly leached of calcium carbonate in the upper part. In many places the C horizon is lighter colored and coarser textured than the B horizon, and it contains variable concentrations of calcium carbonate. The thickness of the solum ranges from 24 inches in Turkeysprings soils to 37 inches in Wilcoxson soils. It is most commonly about 30 inches. Pino soils are free of calcium carbonate throughout the profile. They intergrade to the Chernozem great soil group. Manzano soils are the most youthful in this group. Their profile is coarser textured and less well developed than that of other soils in the group. Stroupe, Turkeysprings, and some of the Wilcoxson soils are stony.

CHERNOZEMS

In the Torrance Area the Chernozem great soil group is represented by soils of the Erramouspe series. These soils are well drained. They developed in a cooler and more moist climate than soils of the Chestnut group, and they have a nearly black surface horizon.

Erramouspe soils occur on southern and western slopes of the Gallinas Mountains. They formed in material weathered from felsite. They developed under thick stands of scrub pinyon and juniper and mixed short, mid, and tall grasses.

A thin organic horizon at the surface is common, but this horizon is not continuous. Normally, Erramouspe soils have a very dark gray A1 horizon that is rich in humus and is about 5 inches thick. This horizon grades into a B2t horizon of reddish-brown clay loam that has moderate angular and subangular blocky structure. Felsite bedrock is at a depth of about 3 feet. In most places the solum is leached free of calcium carbonate, and it is not uncommon for the entire profile to be free of calcium carbonate.

GRAY WOODED SOILS

In the Torrance Area the Gray Wooded great soil group is represented by the Crest, Fortwingate, Fuera, Jekley, Osha, Pinata, and Tecolote series. These soils occur on mountain crests and side slopes. They are moderately sloping to very steep. All are well drained except Fuera soils, which are moderately well drained.

The soils of this great soil group developed mainly in noncalcareous residuum or piedmont fan deposits. Pinata, Tecolote, and Fortwingate soils occur in the Gallinas Mountains. Pinata and Tecolote soils developed in material weathered from felsite, and Fortwingate soils developed in material weathered from sandstone. Crest, Fuera, Jekley, and Osha soils occur in the Manzano Mountains. Crest soils developed in material weathered from limestone. Fuera soils, which are on piedmont fans, developed in material weathered from schist and quartzite. Jekley soils developed in material weathered from red-bed sandstone and shale, and Osha soils developed partly in residuum weathered from igneous rock and schist and partly in piedmont fan deposits.

These soils formed in a subhumid climate under dominantly coniferous forest, mainly ponderosa pine, Douglas-fir, white fir, and alligator juniper. The ground cover was a mixture of short, mid, and tall, cool-season grasses.

Generally, these soils have a thin, patchy layer of decomposing litter over a thin A1 horizon of dark-colored stony loam that has moderate granular or crumb structure. Below the A1 horizon is a leached or eluviated A2 horizon of light-colored stony loam that tongues into the underlying B2t horizon in many places. The B2t horizon is reddish brown, is moderately fine textured to fine textured, and has moderate angular and subangular blocky structure. These horizons contain stones or gravel in many places. They commonly tongue into fractures in the underlying bedrock. With the exception of Fortwingate soils, which have a weak ca horizon in the lower part of the B2t horizon, these soils are free of calcium carbonate. Fortwingate soils do not have an A1 horizon, and the litter rests directly on the A2 horizon. Osha soils intergrade to Chernozems. The range in depth to parent material is from about 24 inches to 50 inches, and the depth is most commonly about 42 inches.

Intrazonal order

The intrazonal order consists of soils that reflect the dominant influence of a local factor of relief or parent material over the normal effects of climate and living organisms. In the Torrance Area the intrazonal order is represented by the Calcisol and Solonetz great soil groups. Soils in the Calcisol great soil group have a horizon that is 15 percent or more calcium carbonate. Calcisols occur on crests, side slopes of ridges, lake terraces, and level to gently sloping uplands. Only one member of the Solonetz great soil group, the Duncan series, is represented. These are saline and alkali soils that have impeded internal drainage. The only Duncan soil mapped in the Area is on nearly level terraces in lake basins.

CALCISOLS

In this Area the Calcisol great soil group is represented by soils of the Dean, Harvey, Ildefonso, Pinon, and Rance series. These soils are well drained. They developed from material influenced dominantly by limestone. They range in thickness from about 7 inches to more than 30 inches. Their profiles show evidence of translocation of calcium carbonate; they have a ca horizon that is 15 percent or more calcium carbonate.

With the exception of Pinon soils, the soils in this great soil group formed under mixed short and mid grasses, mainly blue grama, side-oats grama, galleta, and sand dropseed. Pinon soils formed under a dense cover of pinyon and juniper. The climate is semiarid.

Dean soils, which are in the eastern part of the Area, developed in material weathered from caliche. Harvey soils, which occur throughout the Area, formed in calcareous, loamy piedmont fan deposits. Ildefonso soils, which are along the margins of lake basins, developed in gravelly, calcareous shoreline deposits. Pinon soils, which occur throughout the Area, formed in calcareous, loamy residuum weathered from limestone bedrock. Rance soils developed in calcareous, gypsiferous piedmont deposits washed from the red beds of the southern and eastern parts of the Torrance Area.

The soils of this great soil group have a light-colored, calcareous A1 horizon that has weak or moderate granular structure. The C horizon is even lighter colored, contains more calcium carbonate, and is massive or has weak, subangular blocky structure.

The resistant parent material and the semiarid climate have had a stronger influence than the other factors of soil formation, and soil development has been restricted. Pinon soils have a darker colored A1 horizon than the other soils in this group and show a little evidence of translocation of clay. These soils appear to be intergrading to the Chestnut great soil group.

SOLONETZ SOILS

In the Torrance Area, the Solonetz great soil group is represented by soils of the Duncan series. These soils are poorly drained. They have a fluctuating water table that is near the surface in wet seasons and normally is within 3 to 5 feet of the surface in dry seasons.

Duncan soils occur on lake terraces in the Estancia Lake Basin. They formed in stratified saline and alkaline lacustrine sediments. They developed in a semiarid climate under short and mid grasses that are salt- or alkali-tolerant, mainly saltgrass and alkali sacaton.

These soils normally have an A2 horizon of strongly alkaline, brown loam that has moderate granular structure. This horizon is about 4 inches thick and rests abruptly on a B2h horizon of dark-brown heavy clay loam, about 4 inches thick, that is high in content of humus and is also strongly alkaline. The B2t horizon is very strongly alkaline, brown heavy clay loam, about 7 inches thick, that has moderate prismatic structure and moderate to strong angular and subangular blocky structure. It contains some soluble salts. A B3 horizon, about 5 inches thick, of very pale brown loam that has weak subangular blocky structure, rests abruptly on the C1cam horizon, which is a white, massive, lime-cemented pan in the substratum. This horizon is very strongly alkaline. It is about 11 inches thick and overlies a more friable C2ca horizon that is high in content of soluble salts.

Azonal order

The azonal order consists of soils that lack distinct, genetically related horizons, commonly because of youth, resistant parent material, or steep topography. In the Torrance Area the order is represented by the Regosol, Lithosol, and Alluvial great soil groups. The soils occur on ridgetops, on side slopes of ridges, on lake terraces, on flood plains, and in swales.

REGOSOLS

In the Torrance Area the Regosol great soil group is represented by soils of the Chilton, Chupadera, Karde, Kim, Moriarty, Otero, Pedrick, Supervisor, Tesajo, and Willard series. With the exception of the Supervisor soils, these soils developed in a semiarid climate under mixed short, mid, and tall grasses, mainly blue grama, side-oats grama, and little bluestem. Karde soils formed mainly under alkali sacaton. Supervisor soils, which are on very steep slopes in the Manzano Mountains, developed under coniferous forest, mainly Douglas-fir, white fir, and ponderosa pine.

With the exception of Chupadera and Supervisor, the soils in this great soil group developed from thick, unconsolidated material, such as piedmont fan deposits, lacustrine lake sediments, alluvium, loess, and eolian sand. Chupadera soils developed in thin, unconsolidated material over limestone. They are shallow to moderately deep. Supervisor soils developed in residuum from quartzite and schist.

Chilton and Tesajo soils, which occur mainly in the southern and western foothills of the Manzano Mountains, developed in gravelly piedmont fan deposits of mixed origin. Chilton soils are calcareous and alkaline. Tesajo soils are noncalcareous or neutral to slightly acid, and they have a much thicker A horizon than Chilton soils. Chupadera, Otero, and Pedrick soils, which are in the southern and eastern parts of the Area, developed in deposits of calcareous, eolian, wind-reworked sand. Otero soils are deep over mixed piedmont deposits. Karde soils, which are on the leeward sides of playa lakes within lake basins, formed in deep, silty, saline loess. Kim soils, which are on fans in the eastern part of the Area, formed in calcareous, loamy piedmont deposits. Moriarty soils, which are in swales and on flood plains in the western part of the Area, developed in fine-textured alluvium, mainly of red-bed origin. Willard soils, which are in lake basins, developed in loamy, calcareous, saline and nonsaline, stratified lacustrine lake sediments.

With the exception of Supervisor soils, these soils normally have a thin, light-brown or brown, weak to moderate granular A horizon over a lighter colored, massive, or weak subangular blocky C horizon that grades into the parent material. Supervisor soils have a thin mantle of decomposing forest litter on the surface. They have a darker colored surface horizon than is typical; they appear to be intergrading to the Brown Forest great soil group.

LITHOSOLS

In this Area the Lithosol great soil group is represented by the Laporte, Mirabal, Pastura, and Travessilla series. Soil development has been restricted because of steep slopes or resistant parent material, or both. All except the Mirabal soils are well drained. Mirabal soils are well drained to somewhat excessively drained.

With the exception of Mirabal soils, these soils developed in a semiarid climate at the lower elevations under mixed short, mid, and tall grasses. Blue grama, black grama, side-oats grama, needle-and-thread, and New Mexico feathergrass are most common. Pinyon and juniper grow on the Laporte and Travessilla soils. Mirabal soils occur in a cool, subhumid environment at the higher elevations. They formed under mixed conifers and mixed short and mid, cool-season grasses.

Laporte, Pastura, and Travessilla soils have a thin, darkened, loamy A1 horizon that has weak or moderate granular structure and a weakly developed or structureless C horizon. Bedrock is within 12 inches of the surface in many places, and outcrops are common. Laporte soils developed in residuum from limestone, Pastura soils developed in residuum from caliche, and Travessilla soils developed in residuum from acid sandstone. Mirabal soils developed in residuum from schist and quartzite. They have a thicker and darker colored A1 horizon than other soils in this great soil group and appear to be intergrading to the Gray Wooded great soil group.

ALLUVIAL SOILS

In this Area the Alluvial great soil group is represented by soils of the Prewitt and Tampico series, which developed in loamy alluvium, and by soils of the Trail series, which developed in wind-reworked, sandy eolian deposits.

Prewitt soils occur in swales and on flood plains at the lower elevations in the eastern and southern parts of the Torrance Area. They are calcareous, well drained, and fertile. They formed in a semiarid climate under short and mid grasses, mainly blue grama, side-oats grama, and western wheatgrass. They have a brown, loamy A1 horizon that has weak granular structure. This horizon grades to a massive C horizon of brown light clay loam.

Tampico soils occur in swales and on flood plains at the higher elevations. They are noncalcareous, well drained, and fertile. They developed in a cool, subhumid climate under coniferous forest of ponderosa pine, Douglas-fir, and white fir and a ground cover of short and mid, cool-season grasses. They have a thick, grayish-brown, loamy A1 horizon that has weak, subangular blocky and crumb structure. This horizon grades to a massive C horizon of reddish-brown gravelly clay loam.

Trail soils occur as hummocky areas in the southern part of the Torrance Area. They are noncalcareous and somewhat excessively drained. They developed in noncalcareous, sandy eolian deposits derived mainly from quartzite. They formed in a semiarid climate under a dense cover of pinyon and juniper and mixed short, mid, and tall grasses, mainly blue grama, side-oats grama, sand dropseed, and big and little bluestem. They have an A1 horizon of pale-brown loamy fine sand that grades to brown or strong-brown fine sand. The A1 horizon is single grain.

Prewitt and Tampico soils lack distinct, genetically related horizons because they are young and have not been in place long enough to be affected by soil-forming processes other than accumulation of organic matter and weak structural development of the surface horizon. Trail soils show little soil development, mainly because the parent material was resistant and the soils have been in place a relatively short time. Only small amounts of organic matter have accumulated in the surface layer of these soils.

Morphology of the Soils

In this section are descriptions of all of the soil series represented in the county. Generally, the descriptions give the natural drainage, texture, parent material, alkalinity or acidity, and the general location of the soils. Associated series are named and significant contrasts between the series are stated. A representative profile is described in detail, and the range in significant characteristics is given.

Description of the individual soils in the Torrance Area are given in the section "Descriptions of the Soils."

Alicia series

The Alicia series consists of deep, well-drained, reddish-brown soils. These soils are calcareous and medium textured. They developed in medium-textured to moderately fine textured, calcareous piedmont deposits derived from igneous rock and mixed materials of Jurassic, Triassic, and Permian age. They occur in the foothills on the eastern slopes of the Manzano Mountains and on nearly level to gently sloping fans near the Pedernal Hills in the eastern part of the survey Area. Elevations range from 6,000 to 7,500 feet.

Alicia soils have a finer textured B2 horizon than La Fonda soils. They are more reddish than Witt soils, and lack the textural B2t horizon of those soils. They have a coarser texture B horizon than Hassell soils.

Typical profile of Alicia loam, NE¼ sec. 20, T. 7 N., R. 10 E.

A1—0 to 6 inches, reddish-brown (5YR 5/3) loam, dark reddish brown (5YR 3/4) when moist; weak, medium, platy structure in the uppermost 3 inches; moderate, very fine and fine, granular structure in lower part; slightly hard when dry, very friable when moist; weakly calcareous; clear boundary.

B1—6 to 12 inches, reddish-brown (5YR 5/3) clay loam, dark reddish brown (5YR 4/3) when moist; weak to moderate, fine, prismatic structure breaking to moderate, fine, subangular blocky; hard when dry, very friable when moist; weakly calcareous; clear boundary.

B2—12 to 20 inches, reddish-brown (5YR 5/3) clay loam, reddish brown (5YR 4/3) when moist; moderate, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard when dry, very friable when moist; strongly calcareous; very few clay films; gradual boundary.

B3—20 to 27 inches, reddish-brown (5YR 5/3) clay loam, reddish brown (5YR 4/3) when moist; weak, medium and fine, subangular blocky structure; hard when dry, very friable when moist; strongly calcareous; lime is disseminated and in scattered seams and specks; gradual boundary.

C1ca—27 to 40 inches, light reddish-brown (5YR 6/3) loam, reddish brown (5YR 5/3) when moist; weak, medium, subangular blocky structure; hard when dry, very friable when moist; strongly calcareous; calcium carbonate is disseminated and in fine, rounded, soft masses; clear boundary.

C2ca—40 to 60 inches, light reddish-brown (5YR 6/3) loam, reddish brown (5YR 5/3) when moist; massive; soft when dry, very friable when moist; strongly calcareous; this horizon contains less lime than the C1ca horizon.

The texture of the A1 horizon ranges from loam to fine sandy loam. The color ranges from 5YR to 7.5YR in hue, from 4 to 5.5 in value when dry and from 2 to 3.5 when moist, and from 2 to 4 in chroma. The thickness ranges from 3 to 9 inches. The texture of the B horizon ranges from heavy loam or silt loam to clay loam or silty clay loam. The color of the B horizon ranges from 5YR to 7.5YR in hue, from 4 to 6 in value when dry and from 3 to 5 when moist, and from 3 to 4 in chroma. The thickness of the B horizon ranges from 20 to 40 inches. The texture of the C horizon ranges from loam or silt loam to clay loam or silty clay loam, and the color ranges from 2.5YR to 7.5YR in hue, from 4 to 6 in value when dry and from 3 to 5 when moist, and from 3 to 5 in chroma. Buried horizons occur below a depth of 20 inches in some profiles. In places these soils are noncalcareous to a depth of about 15 inches.

Bernal series

The Bernal series consists of shallow, well-drained, medium-textured to moderately fine textured, brown soils. These soils are noncalcareous. They developed in residuum weathered from moderately coarse grained, noncalcareous sandstone bedrock. They occur throughout the Area on ridgetops and escarpments at elevations of about 6,000 to 7,000 feet.

Bernal soils are deeper than Travessilla soils and have a B2t horizon, which is lacking in those soils. They are shallower than Hagerman soils and lack a ca horizon, which Hagerman soils have. They differ from Laporte soils in being noncalcareous, in having a B2t horizon, and in having formed in material weathered from sandstone rather than limestone. Bernal soils are unlike Penistaja soils in being shallow and in lacking a ca horizon.

Typical profile of Bernal fine sandy loam, SW¼NE¼SW¼ sec. 15, T. 9 N., R. 13 E.

A1—0 to 3 inches, brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) when moist; moderate, very fine, granular structure; soft when dry, very friable when moist; noncalcareous; clear boundary.

B1—3 to 7 inches, brown (7.5YR 4/3) sandy clay loam, dark brown (7.5YR 3/3) when moist; moderate, medium, subangular blocky structure breaking to moderate, fine, granular; hard when dry, very friable when moist; noncalcareous; patchy clay films; clear boundary.

B2t—7 to 12 inches, reddish-brown (5YR 5/3) heavy sandy clay loam, reddish brown (5YR 4/3) when moist; moderate, medium, prismatic structure breaking to moderate, fine, angular and subangular blocky; hard when dry, friable when moist; noncalcareous; continuous clay films; abrupt boundary.

R—12 inches +, noncalcareous sandstone bedrock with few fractures.

The texture of the A horizon ranges from loam to fine sandy loam. The color ranges from 7.5YR to 10YR in hue, from 3 to 5.5 in value when dry and from 2 to 3.5 when moist, and from 2 to 4 in chroma. The thickness ranges from 2 to 6 inches. The texture of the B horizon ranges from loam or sandy clay loam to clay loam. The color of the B horizon ranges from brown to dark brown or dark reddish brown. The thickness ranges from 6 to 14 inches. In some places the lower part of the B horizon is weakly calcareous. A few small sandstone pebbles occur in some profiles.

Capillo series

The Capillo series consists of deep, well-drained, very dark brown soils. These soils are neutral to mildly alkaline and are medium textured. They have fine-textured B2t horizons. They developed in residuum weathered from limestone, sandstone, and shale of the Madera formation. They are on strongly sloping to very steep, north- or east-facing mountain slopes in the western part of the Torrance Area. Elevations range from 7,400 to 8,300 feet.

Capillo soils are more deeply leached of calcium carbonate than Wilcoxson soils. They are deeper than Supervisor soils, and they have a textural B2t horizon. They also differ from Supervisor soils in being alkaline and in having developed in material weathered from sedimentary rock. They are shallower than Pino soils, and have a thinner A horizon. They are browner and finer textured than Turkeysprings soils and are noncalcareous.

Typical profile of Capillo loam, NE¼ sec. 15, T. 5 N., R. 5 E.

O1—2 inches to 0, decomposing needles, bark, and twigs; pH 7.0.

A1—0 to 3 inches, very dark brown (10YR 2/2) loam, black (10YR 2/1) when moist; weak, thin, platy structure; soft when dry, very friable when moist; noncalcareous; pH 6.6; clear boundary.

B1—3 to 6 inches, very dark grayish-brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) when moist; moderate, fine, granular structure; hard when dry, very friable when moist; noncalcareous; pH 6.8; clear boundary.

B21t—6 to 11 inches, dark grayish-brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) when moist; strong, fine, blocky structure; very hard when dry, firm when moist; noncalcareous; pH 7.6; continuous clay films; gradual boundary.

B22t—11 to 21 inches, dark yellowish-brown (10YR 4/4) clay, dark yellowish brown (10YR 3/4) when moist; moderate, medium, blocky structure; extremely hard when dry, firm when moist; noncalcareous; pH 7.0; continuous clay films; clear boundary.

B3—21 to 30 inches, yellowish-brown (10YR 5/4) clay, dark yellowish brown (10YR 4/4) when moist; weak, fine, blocky structure; very hard when dry, firm when moist; noncalcareous; pH 7.2; few patchy clay films; gradual boundary.

C1—30 to 40 inches, light yellowish-brown (10YR 6/4) silty clay, yellowish brown (10YR 5/4) to dark yellowish brown (10YR 4/4) when moist; weak, fine, blocky structure; hard when dry, friable when moist; noncalcareous; pH 7.4; abrupt, wavy boundary.

C2—40 to 60 inches +, partly weathered interbedded shale, limestone, and sandstone; noncalcareous in upper part and strongly calcareous in lower part; pH 7.6 to 8.2.

The decomposing litter ranges in thickness from 1 to 3 inches. The texture of the A horizon is loam, silt loam, or light clay loam. In most places the color is very dark brown or black. The thickness ranges from 3 to 10 inches. The texture of the B2t horizons ranges from heavy clay loam to silty clay or clay. The color ranges from 7.5YR to 10YR in hue, from 4 to 5 in value when dry and from 3 to 5 when moist, and from 3 to 5 in chroma. The thickness ranges from 20 to 50 inches. In most places the parent material is lighter colored and coarser textured than the B horizon. It is partly weathered in the upper part and becomes massive and more alkaline with depth. In some places there are a few flat limestone rocks on the surface and in the upper part of the profile.

Carnero series

The Carnero series consists of moderately deep to deep, well-drained, medium-textured, brown soils. These soils are noncalcareous. They are neutral to mildly alkaline. They developed in calcareous, medium-textured to moderately fine textured piedmont fan deposits washed from sandstone, limestone, and igneous rock. They are gently sloping to moderately sloping. They occur at elevations of 6,500 to 7,000 feet on upland ridge crests in the southern part of the Torrance Area.

Carnero soils are deeper and more alkaline than Bernal soils. They normally have ca horizons, which Bernal soils lack. They differ from Harvey soils in having a textural B2t horizon. Carnero soils have a darker colored surface layer than Hagerman soils and a less sandy B horizon.

Typical profile of Carnero loam, NE¼ sec. 20, T. 1 S., R. 12 E.

A1—0 to 3 inches, brown (7.5YR 5/3) loam, dark brown (7.5YR 3/3) when moist; weak, fine, subangular blocky structure breaking to moderate, very fine, granular; soft when dry, very friable when moist; noncalcareous; pH 7.0; about 15 percent of this horizon is gravel; clear boundary.

B1—3 to 6 inches, reddish-brown (5YR 4/3) light clay loam, dark reddish brown (5YR 3/4) when moist; moderate, medium, subangular blocky structure; hard when dry, very friable when moist; noncalcareous; pH 7.6; thin, patchy clay films; about 10 percent of this horizon is gravel; clear boundary.

B2t—6 to 12 inches, reddish-brown (5YR 5/4) clay loam, dark reddish brown (5YR 3/4) when moist; weak, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard when dry, friable when moist; noncalcareous; pH 7.6; thin, patchy clay films on all ped faces; about 10 percent of this horizon is gravel; gradual, wavy boundary.

B3ca—12 to 19 inches, brown (7.5YR 5/4) light clay loam, dark brown (7.5YR 4/4) when moist; weak, medium, subangular blocky structure; hard when dry, very friable when moist; strongly calcareous; pH 8.4; thin, patchy clay films on all ped faces; this is a weak ca horizon with calcium carbonate occurring as soft masses and as thin seams and streaks; gradual, wavy boundary.

Cca—19 to 32 inches, reddish-brown (5YR 5/4) light clay loam, reddish brown (5YR 4/4) when moist; moderate, medium, subangular blocky structure; very hard when dry, friable when moist; strongly calcareous; pH 8.2; this is a weak to moderate ca horizon with calcium carbonate occurring as soft masses and as thin seams; abrupt boundary.

R—32 inches +, lime-coated sandstone bedrock.

The texture of the A1 horizon ranges from loam or gravelly loam to fine sandy loam. The color ranges from 7.5YR to 10YR in hue, from 4 to 5.5 in value when dry and from 2 to 3.5 when moist, and from 1.5 to 3 in chroma. The thickness of this horizon ranges from 3 to 8 inches. The texture of the B horizon ranges from clay loam to heavy clay loam or gravelly clay loam. The color ranges from 5YR to 7.5YR in hue, from 4 to 6 in value when dry and from 3 to 5 when moist, and from 2 to 4 in chroma. The thickness ranges from 15 to 35 inches. A buried B horizon occurs in some profiles. The solum is calcareous in many places. The ca horizon is weak to moderate. The content of gravel in the solum ranges from 5 to 30 percent.

Chilton series

The Chilton series consists of brown, well-drained, calcareous soils. These soils are gravelly and medium textured. They developed in very gravelly, medium-textured, calcareous, piedmont fan sediments derived from sandstone, quartzite, schist, gneiss, limestone, and igneous rock. They occur on shoulders and side slopes of ridges in the southwestern and eastern parts of the Area. Elevations range from 5,800 to 6,800 feet.

Chilton soils have a more gravelly surface horizon than Scholle soils. They differ from those soils in being calcareous and in lacking a B2t horizon. They are calcareous and have a ca horizon, which the Washoe soils lack. Washoe soils have a B2t horizon. Chilton soils differ from La Fonda soils in being gravelly and in lacking B2 horizons.

Typical profile of Chilton gravelly loam, near the north quarter corner of sec. 31, T. 3 N., R. 6 E.

A1—0 to 9 inches, brown (7.5YR 5/2) gravelly loam, dark brown (7.5YR 4/2) when moist; weak to moderate, very fine, granular structure; soft when dry, very friable when moist; strongly calcareous; pH 8.2; approximately 30 percent of this horizon is gravel; gradual boundary.

Cca—9 to 15 inches, light-brown (7.5YR 6/4) gravelly loam, brown (7.5YR 5/4) when moist; massive; soft when dry, very friable when moist; strongly calcareous; pH 8.4; moderate ca horizon in which calcium carbonate occurs as small concretions and as coatings on the gravel; approximately 50 percent is gravel; gradual, wavy boundary.

C—15 to 20 inches +, light-brown (7.5YR 6/4) gravelly loam, brown (7.5YR 5/4) when moist; massive; soft when dry, very friable when moist; strongly calcareous; pH 8.4; some accumulated calcium carbonate, but much less than in the Cca horizon; approximately 60 percent is gravel; becomes less gravelly and more reddish in color with depth.

The texture of the A horizon ranges from gravelly loam to gravelly fine sandy loam. The color ranges from 10YR to 7.5YR in hue, from 4 to 6 in value when dry and from 3 to 5 when moist, and from 2 to 4 in chroma. The thickness ranges from 4 to 10 inches. The A horizon generally is thicker in less sloping areas. The gravel content of the A horizon ranges from 20 to 80 percent. The color of the C horizon ranges from 10YR to 5YR in hue, from 5 to 8 in value when dry and from 4 to 6 when moist, and from 2 to 4 in chroma. The gravel content of the C horizon ranges from 40 to 85 percent in the upper part and from 15 to 60 percent in the lower part. Most profiles have a weak or moderate ca horizon.

Chupadera series

The Chupadera series consists of shallow to moderately deep, excessively drained, brown soils. These soils are calcareous and coarse textured. They developed partly from eolian sand of mixed origin and partly in residuum from limestone bedrock. They occur on crests and side slopes of ridges in the southern part of the Area. Elevations range from 6,200 to 6,500 feet.

Chupadera soils differ from Palma soils in being shallow to moderately deep over bedrock and in lacking a B2t horizon. They differ from Trail and Otero soils in being shallow to moderately deep over bedrock and in being finer textured in their C horizon. Chupadera soils lack the strong ca horizon of Pinon soils and are coarser textured than those soils.

Typical profile of Chupadera loamy fine sand, 50 feet north of State Highway 10, SE¼SE¼ sec. 35, T. 1 N., R. 8 E.

A1—0 to 6 inches, brown (10YR 5/3) loamy fine sand, dark brown (10YR 3/3) when moist; weak, very fine, granular structure; soft when dry, very friable when moist; weakly calcareous; few limestone fragments on the surface; clear boundary.

AC—6 to 16 inches, brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) when moist; very weak, medium, subangular blocky structure breaking to weak, very fine, granular; soft when dry, very friable when moist; weakly calcareous; clear, smooth boundary.

Cca—16 to 24 inches, light brownish-gray (10YR 6/2) fine sandy loam, grayish brown (10YR 4/2) when moist; very weak, medium, subangular blocky structure breaking to weak, fine, granular; soft when dry, very friable when moist; strongly calcareous; weak ca horizon in which calcium carbonate occurs in finely divided forms and as small concretions; channery fragments of limestone make up approximately 10 percent of the upper part and 30 percent of the lower part; gradual, irregular boundary.

Rca—24 inches +, partly fractured, grayish limestone bedrock; small amount of soil material similar to that of the Cca horizon in the fractures.

The A horizon ranges from 6 to 12 inches in thickness. The texture ranges from fine sandy loam to loamy fine sand. The color of the A and AC horizons ranges from 7.5YR to 10YR in hue, from 4 to 6 in value when dry and from 2 to 4 when moist, and from 2 to 4 in chroma. In some places the A horizon is noncalcareous. The C horizon ranges from 4 to 15 inches in thickness. The texture is heavy fine sandy loam, channery fine sandy loam, or loamy fine sand. The color of the Cca horizon is similar to that of the overlying horizons in hue and chroma, but it is 1 to 2 units lighter in value. In some places, this horizon lacks channery fragments of limestone. Limestone crops out in places.

Clovis series

The Clovis series consists of moderately deep to deep, well-drained, brown soils. These soils are noncalcareous and medium textured. They are mildly to moderately alkaline. They developed in calcareous, medium-textured to moderately fine textured piedmont deposits derived from quartzite, limestone, gneiss, schist, and igneous rock. They occur on upland fans in most parts of the Torrance Area. Elevations range from 5,700 to 7,000 feet.

Clovis soils are similar to Witt soils. They differ from those soils in having a strong ca horizon within 36 inches of the surface and in having a thinner solum. They are deeper than Scholle soils and have a thicker B horizon and a less gravelly substratum. Caliche fragments make up less than 15 percent of the Cca horizon of these soils, but they make up 20 to 50 percent of the lower part of the profile of Tapia soils. Clovis soils lack a cemented ca horizon, which Tapia soils have.

Typical profile of Clovis loam, in a road cut near the northeast corner of sec. 31, T. 7 N., R. 12 E.

A1—0 to 5 inches, brown (7.5YR 5/3) loam, dark brown (7.5YR 4/3) when moist; strong, very fine, granular structure; soft when dry, very friable when moist; noncalcareous; clear boundary.

B1—5 to 8 inches, brown (7.5YR 5/3) loam, dark brown (7.5YR 4/3) when moist; moderate, fine and medium, subangular blocky structure; slightly hard when dry, very friable when moist; noncalcareous; clear boundary.

B2t—8 to 16 inches, brown (7.5YR 5/3) clay loam, dark brown (7.5YR 4/3) when moist; moderate, fine, prismatic structure breaking to moderate, fine, subangular blocky; hard when dry, friable when moist; noncalcareous; thin, continuous clay films; clear boundary.

B3ca—16 to 22 inches, light-brown (7.5YR 6/4) light clay loam, brown (7.5YR 5/4) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; strongly calcareous; weak ca horizon in which calcium carbonate occurs as soft concretions; thin, continuous clay films; gradual, wavy boundary.

C1ca—22 to 30 inches, light-brown (7.5YR 6/4) light clay loam, brown (7.5YR 5/4) when moist; massive or very weak, coarse, subangular blocky structure; very hard when dry, friable when moist; strongly calcareous; moderate ca horizon in which calcium carbonate occurs as soft concretions and as thin seams; about 5 percent is gravel; gradual, wavy boundary.

C2ca—30 to 60 inches, pink (7.5YR 8/3) loam, light brown (7.5YR 6/4) when moist; massive; very hard when dry, friable when moist; very strongly calcareous; strong ca horizon in which calcium carbonate occurs in finely divided forms; about 10 percent of this horizon is gravel.

The A horizon ranges from 3 to 6 inches in thickness. The texture ranges from loam to fine sandy loam. The color ranges from 7.5YR to 10YR in hue, from 5 to 6 in value when dry and from 3 to 4 when moist, and from 2 to 4 in chroma. The B horizon ranges from 8 to 23 inches in thickness. The texture ranges from heavy loam to clay loam. The color ranges from 5YR to 7.5YR in hue, from 5 to 6 in value when dry and from 4 to 5 when moist, and from 2 to 4 in chroma. The texture of the C horizon is loam or clay loam. The color ranges from 7.5YR to 10YR in hue, from 6 to 8 in value when dry and from 4 to 6 when moist, and from 3 to 5 in chroma. Most horizons contain a few small pebbles, but no profile is more than 15 percent gravel. In some places a buried profile occurs below a depth of 5 feet. Only a few profiles are noncalcareous below a depth of 20 inches.

Crest series

The Crest series consists of moderately deep and deep, well-drained, very dark gray, gravelly soils. These soils are neutral to mildly alkaline and medium textured. They developed in moderately fine textured to fine textured, neutral to mildly alkaline residuum weathered from limestone. They are moderately sloping to very steep and occur on side slopes in the Manzano Mountains. Elevations range from 7,500 to 8,800 feet.

Crest soils have a finer textured B2t horizon than Fort-wingate soils, which developed in residuum weathered from sandstone. Crest soils lack the ca horizon common in Wilcoxson soils. They are finer textured than Supervisor soils and have a B2t horizon and an A2 horizon, which are uncommon in Supervisor soils. Crest soils are redder in the B2t horizon than Capillo soils, and they have an A2 horizon, which is not typical of Capillo soils.

Typical profile of Crest stony loam, NE¼NE¼ sec. 27, T. 7 N., R. 5 E.

O1—4 to 3 inches, undecomposed organic material, mainly leaves, twigs, bark, and needles.

O2—3 inches to 0, undecomposed forest litter consisting of leaves, needles, twigs, and bark.

A1—0 to 2 inches, very dark gray (10YR 3/1) stony loam, black (10YR 2/1) when moist; moderate, fine, crumb structure; soft when dry, very friable when moist; pH 7.2; about 20 percent is stones; abrupt boundary.

A2—2 to 6 inches, light brownish-gray (10YR 6/2) stony silt loam, dark grayish brown (10YR 4/2) when moist; moderate, fine, crumb structure; soft when dry, very friable when moist; pH 7.2; about 20 percent is stones; clear boundary.

B&A—6 to 10 inches, brown (7.5YR 5/3) stony clay loam, dark brown (7.5YR 4/3) when moist; about 25 percent consists of material from the A2 horizon tonguing into this horizon; moderate, fine, subangular blocky structure; very hard when dry, firm when moist; pH 7.2; about 25 to 40 percent stones; gradual boundary.

B2t—10 to 24 inches, reddish-brown (5YR 5/4) very stony clay, reddish brown (5YR 4/4) when moist; moderate, medium, subangular blocky structure; extremely hard when dry, firm when moist; thin, continuous clay films; pH 7.4; about 55 percent stones; clear boundary.

R—24 to 26 inches +, weakly fractured limestone bedrock; material from the B2t horizon in the fractures.

The thickness of the organic matter on the surface ranges from 1 to 4 inches. The texture of the A1 and A2 horizons is stony loam or stony silt loam. The A1 horizon ranges from 0 to 2 inches in thickness. The color of the A2 horizon ranges from 10YR to 7.5YR in hue, from 5 to 7 in value when dry and from 4 to 5 when moist, and from 2 to 3 in chroma. The thickness of the A2 horizon ranges from 4 to 6 inches. The B2t horizon is normally about 12 to 37 inches of stony clay with about 4 to 15 inches of transitional material above it. The color of the B2t horizon ranges from 2.5YR to 5YR in hue, from 5 to 6 in value when dry and from 4 to 5 when moist, and from 2 to 4 in chroma. The stone content ranges from 15 to 40 percent in the A horizon and from 30 to 70 percent in the B horizon.

Dean series

The Dean series consists of very shallow to shallow, well-drained, light-colored soils. These soils are calcareous and medium textured to moderately coarse textured. They are moderately alkaline. They developed in medium-textured, highly calcareous piedmont deposits derived from limestone, quartzite, schist, gneiss, and igneous rocks. Dean soils are characterized by a thin A horizon and by prominent calcium carbonate horizons. They occur mainly in the eastern part of the Torrance Area but to a minor extent in the western part. Elevations range from 5,500 to 6,500 feet.

Dean soils have a less limy surface layer and less strongly cemented ca horizons than Pastura soils. They differ from Harvey soils in having a thinner and more alkaline A horizon and in being less than 16 inches deep to a prominent lime zone. Dean soils are lighter colored than Tapia soils and lack the textural B2t horizon of those soils.

Typical profile of Dean loam, 1 to 9 percent slopes, near the center of sec. 28, T. 5 N., R. 11 E.

A1—0 to 3 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; weak, fine, crumb structure; soft when dry, very friable when moist; strongly calcareous; pH 8.2; moderate number of small, hard caliche pebbles on the surface; clear boundary.

AC—3 to 7 inches, light brownish-gray (10YR 6/2) loam, brown (10YR 5/3) when moist; weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist; strongly calcareous; pH 8.4; gradual boundary.

C1ca—7 to 23 inches, light-gray (10YR 7/2) gravelly loam, brown (10YR 5/3) when moist; massive; hard when dry, friable when moist; very strongly calcareous; pH 8.4; strong ca horizon in which calcium carbonate occurs in finely divided forms, as soft concretions, and as semihard caliche fragments; the uppermost few inches are weakly cemented; diffuse boundary.

C2ca—23 to 36 inches +, very pale brown (10YR 8/3) gravelly loam, brown (10YR 5/3) when moist; massive; hard when dry, friable when moist; very strongly calcareous; pH 8.4; strong ca horizon but slightly less so than the C1ca horizon; lime occurs mostly in finely divided forms and as soft concretions; the amount of lime decreases with depth.

The texture of the A1 and AC horizons is loam, gravelly loam, or fine sandy loam. The color ranges from 7.5YR to 10YR in hue, from 6 to 7 in value when dry and from 4 to 5 when moist, and from 2 to 3 in chroma. The thickness ranges from 5 to 16 inches. The texture of the ca horizons is loam, gravelly loam, or gravelly light clay loam. The color ranges from 7.5YR to 10YR in hue, from 6 to 8 in value when dry and from 5 to 6 when moist, and from 2 to 4 in chroma. The upper part of the ca horizon is not cemented in all places. This horizon can be broken with a spade, and more friable material can be reached. The abundance of caliche pebbles on the surface reflects the degree of wind erosion or of rodent activity.

Duncan series

The Duncan series consists of shallow to moderately deep, brown, poorly drained soils. These are medium-textured soils on level to nearly level lake terraces. They are calcareous, moderately to strongly saline, and strongly to very strongly alkaline. They developed in calcareous, strongly to very strongly alkaline, medium-textured and moderately fine textured, stratified lacustrine lake sediments. These sediments were derived from mixed parent material—quartzite, schist, gneiss, limestone, and igneous rocks. The parent material contained varying amounts of lime, iron, and soluble salts. These soils normally have a high water table and are characterized by the high content of humus in their B2h horizon and by the lime-cemented pan in the substratum. They occur in the western part of the Estancia Lake Basin. Elevations are about 6,100 to 6,200 feet.

Duncan soils are more alkaline than Harvey soils, and they have a darker colored surface horizon. They have a B2h horizon and a cemented pan in the substratum, which Harvey soils generally lack. They differ from Willard soils in being more alkaline and in having a B2h horizon, a B2t horizon, and a cemented Ccam horizon.

Typical profile of Duncan loam, NW¼NE¼ sec. 14, T. 6 N., R. 8 E.

A2—0 to 4 inches, brown (10YR 5/3) loam, dark brown (10YR 4/3) when moist; moderate, very fine, granular structure; soft when dry, very friable when moist; weakly calcareous; pH 8.6; abrupt boundary.

B2h—4 to 8 inches, dark-brown (10YR 3/3) heavy clay loam, very dark brown (10YR 2/3) when moist; strong, very fine, subangular blocky structure; hard when dry, very friable when moist; noncalcareous to weakly calcareous; pH 8.8; patchy clay films; clear boundary.

B2t—8 to 15 inches, brown (7.5YR 5/3) heavy clay loam, dark brown (7.5YR 4/2) when moist; moderate, coarse, prismatic structure breaking to moderate and strong, coarse, angular and subangular blocky; very hard when dry, firm when moist; weakly calcareous; pH 9.6; continuous clay films; soluble salts occur as soft concretions and as thin seams; clear boundary.

B3—15 to 20 inches, very pale brown (10YR 7/3) loam, pale brown (10YR 6/3) when moist; weak, medium, subangular blocky structure; very hard when dry, firm when moist; weakly calcareous; pH 9.2; patchy clay films; soluble salts occur as soft concretions and in finely divided forms; abrupt boundary.

C1cam—20 to 31 inches, white (10YR 8/1), lime-cemented pan; gray (2.5Y 6/1) when moist; massive; extremely hard when dry, extremely firm when moist; very strongly calcareous; pH 9.2; soluble in cold hydrochloric acid; clear boundary.

C2ca—31 to 60 inches, white (2.5Y 8/0) clay loam, white (2.5Y 8/0) when moist; massive; very hard when dry, firm when moist; strongly calcareous; pH 8.6; strong ca horizon in which soluble salts and calcium carbonate occur as soft concretions, as thin seams, and in finely divided forms; often wet because of the water table.

In places a thin A1 horizon is present. The texture of the A horizon ranges from loam to clay loam. The color ranges from 5 to 6 in value when dry and from 3 to 4 when moist, and from 2 to 4 in chroma. The thickness ranges from 2 to 6 inches. The texture of the B horizon ranges from clay loam to clay. The color ranges from 7.5YR to 10YR in hue, from 4 to 7 in value when dry and from 3 to 5 when moist, and from 2 to 4 in chroma. The thickness ranges from 8 to 16 inches. The texture of the C horizon ranges from loam to heavy clay loam. The color ranges from 7.5YR to 2.5Y in hue, from 6 to 8 in value when dry and from 5 to 7 when moist, and from 0 to 2 in chroma. The cemented pan ranges from 4 to 15 inches in thickness. In many profiles the C horizon is mottled with reddish and yellowish colors and with white and olive and contains concretions of iron and manganese. In places salt crystals occur on the surface. In some areas the upper part of the solum is noncalcareous.

Encierro series

The Encierro series consists of brown, shallow, well-drained, medium-textured soils. These are calcareous, moderately to strongly alkaline soils. They developed in residuum weathered from fine-grained sandstone and shale. They occur on upland slopes in the foothills of the western part of the Torrance Area. Elevations range from 6,300 to 7,000 feet.

Encierro soils are shallower than Hassell soils and have less lime accumulation in the substratum. They differ from Tapia soils in lacking a strong ca horizon. Tapia soils developed in material weathered from limestone. Encierro soils have a finer textured B2t horizon than Bernal soils.

Typical profile of Encierro channery loam, in an open pit in the SW¼ sec. 11, T. 3 N., R. 5 E.

A1—0 to 2 inches, brown or dark-brown (7.5YR 4/4) channery loam, dark brown (7.5YR 3/2) when moist; weak, thin, platy structure breaking to weak, fine, granular; soft when dry, very friable when moist; noncalcareous or weakly calcareous; pH 8.2; channery fragments make up approximately 50 percent of this horizon; 30 percent of the surface is covered with stones; clear boundary.

B1—2 to 5 inches, reddish-brown (5YR 4/3) channery loam, dark reddish brown (5YR 3/3) when moist; weak, fine, subangular blocky structure breaking to moderate, fine, granular; slightly hard when dry, very friable when moist; weakly calcareous; pH 8.2; channery fragments make up approximately 50 percent of this horizon; clear boundary.

B2t—5 to 9 inches, reddish-brown (5YR 4/3) stony light clay, dark reddish brown (5YR 3/3) when moist; moderate, medium, subangular blocky structure; very hard when dry, friable when moist; noncalcareous to weakly calcareous; pH 8.2; thin, continuous clay films; stones make up approximately 50 percent of this horizon; abrupt, irregular boundary.

R&B2t—9 to 25 inches, fractured bedrock; soil in fractures; soil is reddish-brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) when moist; moderate, fine, subangular blocky structure; very hard when dry, firm when moist; weakly calcareous; pH 8.2; continuous clay films; about 90 percent lime-coated standstone rock; abrupt, irregular boundary.

R&Cca—25 to 48 inches, pink (5YR 7/4) stony loam, reddish yellow (5YR 6/6) when moist; weak, fine, subangular blocky structure; soft when dry, very friable when moist; very strongly calcareous; pH 8.8; weak to moderate ca horizon in which calcium carbonate occurs as soft concretions and as thin seams; 40 to 50 percent is rock; abrupt, irregular boundary.

R—48 to 60 inches +, reddish-brown or dark reddish-brown sandstone bedrock of the Abo Formation; hard; massive.

The texture of the A horizon is loam, channery loam, or stony loam. The color ranges from 5YR to 7.5YR in hue, from 4 to 5.5 in value when dry and from 2 to 3.5 when moist, and from 2 to 4 in chroma. The thickness ranges from 2 to 3 inches. The B horizon ranges from channery loam or stony clay loam to channery or stony clay in texture. The thickness above the bedrock ranges from 5 to 20 inches. The color ranges from 2.5YR to 5YR in hue, from 4 to 5 in value when dry and from 3 to 4 when moist, and from 3 to 5 in chroma. The bedrock is not fractured in all places. The thickness of the solum above the bedrock ranges from 6 to 25 inches. The solum is noncalcareous in some places. Stone and channery fragments cover 30 to 80 percent of the surface.

Erramouspe series

The Erramouspe series consists of moderately deep to deep, well-drained, very dark colored soils. These soils are stony and medium textured. They are noncalcareous though mildly alkaline. They developed in place in material weathered from felsite. They occur on south- and west-facing, very steep mountain slopes in the southern part of the Torrance Area. Elevations range from 6,600 to 7,600 feet.

Erramouspe soils are less stony than Tecolote soils and have a thicker, darker colored A1 horizon than those soils. They lack an A2 horizon, which Tecolote soils have, and their B2t horizon is finer textured than that of Tecolote soils.

Typical profile of Erramouspe stony loam, NW¼ sec. 5, T. 1 S., R. 11 E.

O1—2 inches to 0, partly decomposed leaves, needles, and twigs.

A1—0 to 5 inches, very dark gray (10YR 3/1) stony loam, black (10YR 2/1) when moist; moderate, fine, crumb structure; soft when dry, very friable when moist; noncalcareous; pH 7.8; approximately 20 percent of the surface is covered with rock; clear boundary.

B1—5 to 9 inches, brown (7.5YR 5/2) clay loam, dark brown (7.5YR 4/2) when moist; moderate, fine, crumb structure; slightly hard when dry, very friable when moist; noncalcareous; pH 7.6; thin, patchy clay films on vertical faces; clear boundary.

B2t—9 to 35 inches, reddish-brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) when moist; moderate, medium, angular and subangular blocky structure; hard when dry, very friable when moist; noncalcareous; pH 7.6; thin, patchy clay films on all faces; abrupt, smooth boundary.

R—35 inches +, felsite bedrock that is partly weathered in the upper part.

The texture of the A1 horizon ranges from stony loam to stony sandy clay loam. The color ranges from 7.5YR to 10YR in hue, from 3 to 4 in value when dry and from 1 to 2 when moist, and from 0 to 1.5 in chroma. The thickness ranges from 3 to 8 inches. The B horizon ranges from clay loam or stony clay loam to clay or stony clay in texture. The color ranges from 2.5YR to 5YR in hue, from 4 to 5 in value when dry and from 3 to 4 when moist, and from 2 to 4 in chroma. The thickness ranges from 16 to 32 inches. Stones make up 20 to 60 percent of the surface horizon and 2 to 20 percent of the B horizon. The depth to bedrock is less than 50 inches. A zone of lime occurs at a depth of about 35 inches in some places.

Fortwingate series

The Fortwingate series consists of light-colored, well-drained, moderately deep to deep, stony soils. These soils are noncalcareous, mildly alkaline to moderately alkaline, and medium textured. They developed in residuum weathered from sandstone. They occur on moderate to very steep, north- and east-facing mountain slopes in the southern part of the survey Area. Elevations range from 7,000 to 7,800 feet.

Fortwingate soils are on opposite slopes from Stroupe soils. They are deeper and less stony than those soils and have an A2 horizon, which Stroupe soils lack. They have a coarser textured B2t horizon than Crest soils, which developed in material weathered from limestone.

Typical profile of Fortwingate stony loam, SW¼ sec. 17, T. 1 S., R. 12 E.

O1—2 inches to 1 inch, loose, undecomposed leaves, needles, and twigs.

O2—1 inch to 0, decomposed forest litter.

A2—0 to 6 inches, light-gray (10YR 7/2) stony loam, grayish brown (10YR 5/2) when moist; weak, thin, platy structure breaking to moderate, very fine, granular; soft when dry, very friable when moist; noncalcareous; pH 7.6; approximately 50 percent stones; clear boundary.

A2&B2t—6 to 11 inches, brown (10YR 5/3) stony heavy loam, dark brown (10YR 4/3) when moist; streaks of brown (7.5YR 5/4), dark brown (7.5YR 4/4) when moist; weak to moderate, medium, subangular blocky structure; slightly hard when dry, very friable when moist; noncalcareous; pH 7.2; thin streaks and fragments of clay; vesicular; approximately 40 percent stones; clear boundary.

B2t—11 to 25 inches, reddish-brown (5YR 4/4) stony heavy clay loam, reddish brown (5YR 4/4) when moist; moderate, medium, blocky structure; extremely hard when dry, very firm when moist; noncalcareous; pH 7.6; continuous clay films; approximately 20 percent stones; gradual, wavy boundary.

B2tca—25 to 30 inches, reddish-brown (5YR 4/4) stony heavy clay loam, reddish brown (5YR 4/4) when moist; moderate, medium, angular blocky structure; extremely hard when dry, very firm when moist; slightly calcareous; pH 8.0; weak ca horizon in which calcium carbonate occurs as soft concretions and as thin seams; approximately 20 percent stones; abrupt boundary.

R—30 inches +, fractured, reddish-brown sandstone bedrock.

The texture of the A horizon ranges from stony loam to stony sandy clay loam. The color ranges from 7.5YR to 10YR in hue, from 5 to 7 in value when dry and from 3 to 5 when moist, and from 2 to 4 in chroma. The thickness ranges from 6 to 20 inches. Some profiles have a thin A1 horizon. The texture of the subsoil ranges from stony light clay loam to stony heavy clay loam. The color ranges from 2.5YR to 7.5YR in hue, from 5 to 6 in value when dry and from 3 to 4 when moist, and from 3 to 5 in chroma. The thickness ranges from 10 to 25 inches. Stone and gravel make up 20 to 60 percent of the surface horizon and 15 to 80 percent of the B horizon. In most places fractures in the bedrock are filled with material from the horizon above.

Fuera series

The Fuera series consists of deep, moderately well drained, very dark grayish-brown soils. These soils are cobbly and medium textured. They are neutral to medium acid. They developed in stony, noncalcareous, fine-textured sediments on piedmont alluvial fans on north- and east-facing slopes. Their parent material was derived from schist and quartzite. They occur on moderately sloping uplands and very steep canyon side slopes in the Manzano Mountains. Elevations range from 7,000 to 8,000 feet.

Fuera soils are darker colored and less alkaline than Witt soils and are finer textured in the B2t horizon. They are cobbly and have an A2 horizon, which is uncommon in the Witt soils. They differ from Pino soils in being browner and cobbly and in having an A2 horizon. Fuera soils are deeper than Jekley soils and lack the reddish hues common in those soils. They also differ from Jekley soils in being cobbly.

Typical profile of Fuera cobbly loam, SE¼ sec. 3, T. 4 N., R. 5 E.

O1—2 inches to 0, undecomposed and partly decomposed forest litter; pH 6.2; abrupt boundary.

A1—0 to 2 inches, very dark grayish-brown (10YR 3/2) cobbly loam, very dark brown (10YR 2/2) when moist; moderate, thin, platy structure breaking to moderate, fine, crumb; soft when dry, very friable when moist; noncalcareous; pH 6.6; about 40 percent cobblestones; clear, wavy boundary.

A2—2 to 11 inches, light-gray (10YR 7/2) cobbly fine sandy loam, dark grayish brown (10YR 4/2) when moist; moderate, fine, granular structure; slightly hard when dry, very friable when moist; noncalcareous; pH 6.4; abrupt, wavy boundary.

B2t—11 to 32 inches, yellowish-brown (10YR 5/4) clay, dark yellowish brown (10YR 4/4) when moist; moderate, fine, blocky structure; very hard when dry, firm when moist; noncalcareous; pH 6.4; continuous clay films; clear boundary.

B3—32 to 48 inches, pale-brown (10YR 6/3) stony silty clay, brown (10YR 5/3) when moist; moderate, fine, blocky structure; hard when dry, friable when moist; noncalcareous; pH 7.2; patchy clay films; some light olive-brown mottles; clear boundary.

C—48 inches +, pale-brown (10YR 6/3) heavy clay loam, brown (10YR 5/3) when moist; massive; very hard when dry, firm when moist; pH 7.6; grades to weathered schist bedrock at a depth of about 60 inches.

The texture of the A1 horizon ranges from cobbly or stony loam to cobbly or stony fine sandy loam. The color is within the 10YR hue. It ranges from 3 to 4 in value when dry and from 1 to 2 when moist, and from 1.5 to 3 in chroma. The litter on the surface is 1 to 4 inches thick. The thickness of the A1 horizon ranges from 1 to 3 inches. The texture of the A2 horizon ranges from cobbly or gravelly loam to cobbly or gravelly sandy loam. The color is within the 10YR hue. It ranges from 6 to 8 in value when dry and from 4 to 6 when moist, and from 1.5

to 3 in chroma. The thickness of the A2 horizon ranges from 5 to 12 inches. In most places the B horizon is stony or gravelly clay or stony or gravelly silty clay. The color ranges from 7.5YR to 10YR in hue, from 5 to 6 in value when dry and from 4 to 5 when moist, and from 3 to 5 in chroma. The thickness ranges from 20 to 45 inches. Stones, cobblestones, and gravel make up 15 to 50 percent of the A horizon, 5 to 30 percent of the upper part of the B horizon, and 40 to 90 percent of the lower part of the B horizon. The stronger slopes are stonier than the more nearly level areas.

Hagerman series

The Hagerman series consists of moderately deep to deep, well-drained, brown soils. These soils are noncalcareous and medium-textured to moderately coarse textured. They are mildly to moderately alkaline. They developed partly in locally transported material derived from quartzite, sandstone, and limestone and partly in residuum from sandstone bedrock. They are mainly in the northeastern part of the Area. Elevations are 6,400 to 7,200 feet. The topography is nearly level to moderately sloping or rolling.

Hagerman soils are similar to Bernal soils, but they are deeper and have a horizon of calcium carbonate accumulation above the bedrock. They are shallower than Penistaja soils. They differ from Dean soils in being deeper and darker colored, in being noncalcareous in the upper part, and in having a textural B2t horizon.

Typical profile of Hagerman fine sandy loam, SE¼SW¼NE¼ sec. 10, T. 8 N., R. 14 E.

A1—0 to 3 inches, brown (7.5YR 5/3) fine sandy loam, dark brown (7.5YR 4/3) when moist; weak, thin, platy structure breaking to moderate, very fine, granular; slightly hard when dry, very friable when moist; noncalcareous; pH 7.2; clear boundary.

B1—3 to 7 inches, reddish-brown (5YR 5/3) light sandy clay loam, reddish brown (5YR 4/3) when moist; weak, very coarse, prismatic structure breaking to moderate, medium, subangular blocky; hard when dry, very friable when moist; noncalcareous; pH 7.4; clear boundary.

B2t—7 to 22 inches, reddish-brown (5YR 5/3) heavy sandy clay loam, reddish brown (5YR 4/3) when moist; moderate, very coarse, prismatic structure breaking to moderate to strong, fine, subangular blocky; very hard when dry, friable when moist; noncalcareous; nearly continuous clay films; gradual, wavy boundary.

B3ca—22 to 27 inches, reddish-brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) when moist; weak, very coarse, prismatic structure breaking to weak, medium, subangular blocky; very hard when dry, friable when moist; weakly calcareous; pH 8.0; weak ca horizon in which calcium carbonate occurs as soft concretions and as thin seams; patchy clay films; gradual, wavy boundary.

Cca—27 to 30 inches, light-brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 5/4) when moist; massive; very hard when dry, friable when moist; very strongly calcareous; pH 8.4; moderate ca horizon in which calcium carbonate occurs mostly as thin seams; abrupt boundary.

R—30 inches +, yellowish-red sandstone bedrock; massive; noncalcareous; partly weathered in the upper part.

The texture of the A1 horizon ranges from loam to fine sandy loam. The color ranges from 7.5YR to 10YR in hue, from 5 to 6 in value when dry and from 3 to 4 when moist, and from 2 to 4 in chroma. The thickness ranges from 2 to 4 inches. The texture of the B horizon ranges from sandy clay loam to heavy sandy clay loam, and the thickness from 10 to 26 inches. The color ranges from 5YR to 7.5YR in hue, from 5 to 6 in value when dry and from 4 to 5 when moist, and from 3 to 4 in chroma. In most places the Cca horizon is lighter colored than the B horizon. It is a weak to strong ca horizon. In some places the profile is noncalcareous to a depth of 3 feet. The depth to bedrock ranges from 20 to 48 inches.

Harvey series

The Harvey series consists of deep, light-brown, well-drained soils. These soils are moderately to strongly alkaline and medium textured to moderately coarse textured. They developed in piedmont deposits derived from limestone, schist, gneiss, quartzite, and igneous rock. These soils occur throughout the Area on level to nearly level lake terraces and nearly level to strongly sloping crests and side slopes of upland fans. Elevations range from 6,000 to 7,000 feet.

Harvey soils are lighter colored than Witt soils. They are calcareous and lack the textural B2t horizon common in Witt soils. They differ from Clovis soils in being calcareous and lighter colored and in lacking a B2t horizon. They have a thicker surface horizon than Dean soils and a less limy, less strongly cemented substratum. They are limy and lighter colored than Manzano soils, and they lack a B2 horizon.

Typical profile of Harvey loam, in a pit, SW¼NE¼ sec. 18, T. 9 N., R. 10 E.

A1—0 to 6 inches, light-brown (7.5YR 6/3) light loam, dark brown (7.5YR 4/3) when moist; moderate, very fine, granular structure; soft when dry, very friable when moist; strongly calcareous; clear boundary.

AC—6 to 11 inches, light-brown (7.5YR 6/3) loam, dark brown (7.5YR 4/3) when moist; very weak, medium, subangular blocky structure breaking to moderate, fine, granular; soft when dry, very friable when moist; strongly calcareous; gradual, smooth boundary.

C1ca—11 to 16 inches, pink (7.5YR 7/3) loam, brown (7.5YR 5/3) when moist; weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist; very strongly calcareous; weak ca horizon in which calcium carbonate occurs as soft concretions and in finely divided forms; clear boundary.

C2ca—16 to 31 inches, pink (7.5YR 7/4) loam, light brown (7.5YR 6/4) when moist; massive, or very weak, medium, subangular blocky structure; hard when dry, very friable when moist; very strongly calcareous; strong ca horizon in which calcium carbonate occurs as soft concretions and in finely divided forms; some indurated caliche pebbles; diffuse boundary.

C3ca—31 to 60 inches +, light-brown (7.5YR 6/4) loam, brown (7.5YR 5/4) when moist; massive; hard when dry, very friable when moist; very strongly calcareous; strong ca horizon but less so than the C2ca horizon.

The texture of the A horizon ranges from loam to fine sandy loam. The color ranges from 7.5YR to 10YR in hue, from 5 to 7 in value when dry and from 3 to 5 when moist, and from 2 to 4 in chroma. The thickness of the A1 and AC horizons ranges from 7 to 13 inches. The texture of the Cca horizons ranges from loam to clay loam. The color ranges from slightly redder than 7.5YR to 10YR in hue, from 6 to 8 in value when dry and from 4 to 6 when moist, and from 3 to 5 in chroma. The ca horizons range from weak to strong. Thin, patchy clay films occur in some profiles. In some places the surface horizon is noncalcareous. Paleosols and pockets of gravel occur in the lower strata in places.

Hassell series

The Hassell series consists of deep, well-drained, dark-brown soils. These soils are calcareous and medium textured. They developed in piedmont deposits derived from red-bed shale, sandstone, and limestone. They are moderately to strongly alkaline. They occur on uplands in the southwestern part of the Area. Elevations range from 5,900 to 6,400 feet.

Hassell soils are similar to Encierro soils in color and in parent material but are deeper and have little or no rock in the profile. They are darker colored and deeper than Tapia soils and lack a strong ca horizon, which Tapia soils have.

Typical profile of Hassell loam, SE¼ sec. 11, T. 3 N., R. 5 E.

A1—0 to 3 inches, dark-brown (7.5YR 4/4) loam, dark brown (7.5YR 3/3) when moist; weak, thin, platy structure breaking to moderate, fine, granular; soft when dry, very friable when moist; weakly calcareous; pH 8.2; clear boundary.

B1—3 to 6 inches, reddish-brown (5YR 4/3) light clay loam, dark reddish brown (5YR 3/3) when moist; weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist; weakly calcareous; pH 8.2; clear boundary.

B2t—6 to 16 inches, reddish-brown (5YR 4/3) heavy clay loam, dark reddish brown (5YR 3/3) when moist; moderate, medium, subangular blocky structure; hard when dry, friable when moist; weakly calcareous; pH 8.2; few clay films; clear, wavy boundary.

C1ca—16 to 28 inches, pink (5YR 7/3) loam, reddish brown (5YR 5/3) when moist; massive; soft when dry, very friable when moist; very strongly calcareous; pH 8.6; weak or moderate ca horizon in which calcium carbonate occurs as soft concretions and as thin seams; clear, wavy boundary.

C2—28 to 38 inches, weak-red (2.5YR 5/2) silty clay loam, dusky red (2.5YR 3/2) when moist; massive; hard when dry, friable when moist; very strongly calcareous; pH 8.5; clear, wavy boundary.

R—38 to 42 inches +, weak-red to dusky-red, partly weathered shale; massive; very strongly calcareous; pH 8.8.

The texture of the A1 horizon ranges from light loam to heavy loam. The color ranges from 5YR to 7.5YR in hue, from 4 to 5.5 in value when dry and from 2 to 3.5 when moist, and from 2 to 4 in chroma. The thickness ranges from 3 to 6 inches. The texture of the B2t horizon ranges from heavy clay loam to clay. The color ranges from 2.5YR to 5YR in hue, from 4 to 6 in value when dry and from 3 to 5 when moist, and from 2 to 4 in chroma. The thickness ranges from 10 to 20 inches. The texture of the C horizon ranges from loam to silty clay loam or clay loam. The color ranges from pink or light reddish brown to dusky red or dark reddish brown. The A horizon and the upper part of the B horizon are noncalcareous in some places. The content of gravel and stones in the profile ranges from none to 10 percent. The depth to bedrock ranges from 30 to 50 inches.

Ignacio series

The Ignacio series consists of brown, well-drained soils. These soils are moderately coarse textured and moderately deep over bedrock. They are noncalcareous and mildly alkaline. They developed partly in material weathered from sandstone bedrock and partly in mixed piedmont deposits derived from schist, gneiss, igneous rock, and limestone. They occur on upland fans in the eastern part of the Area. Elevations range from 6,000 to 6,400 feet.

Ignacio soils are deeper than Bernal soils. They are more weakly developed and coarser textured in the B horizon than those soils. They differ from Tapia soils in being coarser textured in the surface layer and the subsoil, in lacking a moderate or strong ca horizon, and in overlying sandstone bedrock. They are similar to Palma soils but are less reddish, lack a B2t horizon, and are less than 40 inches deep over bedrock.

Typical profile of Ignacio fine sandy loam, SW¼SW¼NW¼ sec. 21, T. 5 N., R. 15 E.

A1—0 to 4 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) when moist; moderate, very fine, granular structure; soft when dry, very friable when moist; noncalcareous; pH 7.4; clear boundary.

B2—4 to 16 inches, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) when moist; weak, medium, prismatic structure breaking to weak, medium, subangular blocky; slightly hard when dry, very friable when moist; noncalcareous; pH 7.6; gradual, wavy boundary.

Cca—16 to 25 inches, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) when moist; massive; slightly hard when dry, very friable when moist; weakly calcareous; weak ca horizon in which calcium carbonate occurs as soft concretions; abrupt boundary.

R—25 inches +, reddish-yellow, lime-coated sandstone bedrock of the Glorieta formation; noncalcareous interior.

The texture of the A horizon ranges from fine sandy loam to loamy fine sand. The color ranges from 7.5YR to 10YR in hue, from 5 to 7 in value when dry and from 3 to 5 when moist, and from 2 to 4 in chroma. The thickness ranges from 4 to 6 inches. The texture of the B2 and Cca horizons ranges from light loam to light fine sandy loam. The color is within the 7.5YR hue. It ranges from 5 to 6 in value when dry and from 4 to 5 when moist, and from 3 to 6 in chroma. The B2 horizon ranges from 5 to 18 inches in thickness, and the Cca horizon from 2 to 12 inches. The solum is weakly calcareous or noncalcareous, and a ca horizon is lacking in some profiles. The thickness of the solum ranges from 12 to 30 inches. The depth to bedrock is less than 40 inches.

Ildefonso series

The Ildefonso series consists of brown, well-drained, shallow and moderately deep soils (fig. 36) on lake shorelines and piedmont fans. These soils are calcareous and moderately to strongly alkaline. They are moderately coarse textured and coarse textured. Soils of this series developed in mixed gravelly deposits derived from limestone, quartzite, schist, gneiss, and igneous rock. They occur along the margins of Estancia, Encino, and Pinos Wells Lake Basins and on western slopes of the Manzano Mountains, generally as terraces or fans. They are level to very strongly sloping. Elevations range from 5,800 to 6,200 feet.

Ildefonso soils are calcareous and are lighter colored than Witt soils, and they lack the B2t horizons of those soils. They have a gravelly substratum, which Witt soils lack. They differ from Harvey and Willard soils in having a gravelly substratum. Ildefonso soils are less gravelly than Tesajo soils, and they have a strong ca horizon, which is uncommon in those soils.

Typical profile of Ildefonso fine sandy loam, NE¼NE¼ sec. 33, T. 6 N., R. 8 E.

A1—0 to 5 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) when moist; weak, very fine, granular structure; soft when dry, very friable when moist; strongly calcareous; pH 8.2; clear boundary.

AC—5 to 10 inches, pale-brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) when moist; very weak, medium, subangular blocky structure breaking to weak, very fine, granular; slightly hard when dry, very friable when moist; strongly calcareous; pH 8.2; gradual boundary.

C1ca—10 to 19 inches, pale-brown (10YR 6/3) gravelly fine sandy loam, dark brown (10YR 4/3) when moist; very weak, medium, subangular blocky structure breaking to weak, very fine, granular; slightly hard when dry, very friable when moist; very strongly calcareous; pH 8.4; weak or moderate ca horizon with lime occurring as soft concretions and in finely divided forms; gradual boundary.

C2ca—19 to 36 inches +, very pale brown (10YR 7/3) gravelly fine sandy loam, light yellowish brown (10YR 6/4) when moist; massive; hard when dry, friable when moist; very strongly calcareous; pH 8.4; this is a moderate to strong ca horizon with calcium carbonate occurring as soft concretions and in finely divided forms; approximately 30 to 40 percent is gravel.

Figure 36.—**Profile of an Ildefonso soil. In this soil the basal sediments underlying the Playa Margin sediments show strong prismatic and blocky structure.**

The texture of the A1 and AC horizons ranges from very fine sandy loam to loamy fine sand. The color ranges from 7.5YR to 10YR in hue, from 5.5 to 7 in value when dry and from 3.5 to 5 when moist, and from 2 to 4 in chroma. The thickness of these layers ranges from 8 to 16 inches. The texture of the Cca horizons ranges from loam or gravelly loam to fine sandy loam, gravelly fine sandy loam, or fine sand. The color ranges from 7.5YR to 10YR in hue, from 6 to 8 in value when dry and from 4 to 6 when moist, and from 2 to 5 in chroma. The surface horizon is noncalcareous in some places. The gravel and stone content ranges from 0 to 20 percent in the surface horizon and from 15 to 90 percent in the substratum; in the control section it is less than 50 percent. In most places the steeper soils contain more gravel and lime than less sloping soils. Strata of nearly clean gravel and sand occur in the substratum in many places. The thickness of these strata ranges from 4 inches to 10 feet or more. The ca horizons are strong and in places are cemented in the upper few inches. The clay content of the control section ranges from 5 to 27 percent.

Jekley series

Soils in the Jekley series are moderately deep to deep, reddish, well drained, and moderately fine textured. They are noncalcareous and neutral to mildly alkaline. They developed in residuum weathered from sandstone and shale of the Abo formation. They occur on north-facing slopes on very strongly sloping to very steep canyon side slopes in the western part of the Torrance Area. Elevations range from 7,200 to 8,000 feet.

Jekley soils are redder and less stony than Fuera soils, and their A horizon is finer textured. They are darker colored than Supervisor soils and have much less stone in the profile. They have an A2 horizon and a B2t horizon, which Supervisor soils generally lack. Jekley soils developed mainly in parent material weathered from red beds. Fuera and Supervisor soils developed mainly in material weathered from schist, quartzite, and igneous rock.

Typical profile of Jekley silty clay loam, SW¼NE¼ SW¼ sec. 35, T. 5 N., R. 5 E.

O1—1 inch to 0, undecomposed and partly decomposed organic litter; abrupt boundary.

A1—0 to 5 inches, dusky-red to weak-red (2.5YR 3/2) silty clay loam, dusky red (2.5YR 3/2) when moist; strong, fine, granular structure; soft when dry, very friable when moist; noncalcareous; pH 6.8; clear boundary.

A2—5 to 11 inches, weak-red (2.5YR 4/2) silty clay loam, dark reddish brown (2.5YR 3/3) when moist; moderate, fine, subangular blocky structure; hard when dry, very friable when moist; noncalcareous; pH 7.0; clear boundary.

B21t—11 to 24 inches, dark reddish-brown (2.5YR 3/3) silty clay loam, dark reddish brown (2.5YR 2/3) when moist; moderate, fine, subangular blocky structure; very hard when dry, friable when moist; noncalcareous; pH 6.8; thin, patchy clay films; few sandstone fragments; clear boundary.

B22t—24 to 37 inches, weak-red (10R 5/3) silty clay, weak red (10R 4/3) when moist; moderate, medium, subangular blocky structure; very hard when dry, friable when moist; noncalcareous; pH 6.8; thin, continuous clay films; few sandstone fragments; gradual, wavy boundary.

B3—37 to 46 inches, weak-red (10R 5/3) silty clay, weak red (10R 4/3) when moist; weak, medium, subangular blocky structure; very hard when dry, friable when moist; noncalcareous; pH 7.6; thin, patchy clay films; some slickensides; few sandstone fragments; gradual, wavy boundary.

R—46 to 60 inches +, partly weathered shale similar in color to the B3 horizon.

The texture of the A horizon ranges from fine sandy loam to clay loam or silty clay loam. The color ranges from 2.5YR to 7.5YR in hue, from 3 to 5 in value when dry and from 2 to 4 when moist, and from 2 to 4 in chroma. The thickness ranges from 5 to 13 inches. The texture of the B horizon ranges from sandy clay loam to silty clay or clay. The color ranges from 10R to 5YR in hue, from 3 to 5 in value when dry and from 2 to 4 when moist, and from 2 to 4 in chroma. The thickness of the solum ranges from 30 to 60 inches. The gravel and stone content ranges from about 5 to 20 percent.

Karde series

Soils in the Karde series are deep, light colored, well drained, and medium textured. They are calcareous, moderately saline, and moderately to strongly alkaline. They developed in loess dunes on the leeward side of salt lakes. The loess originated in lacustrine sediments derived from limestone, quartzite, schist, gneiss, igneous rock, sandstone, and shale. Wind erosion removed the sediments from lakebeds and deposited them on the eastern and northeastern sides of the salt lakes. Karde soils occur in all the lake basins in the eastern two-thirds of the Area. Elevations are about 6,100 feet.

Karde soils are lighter colored than Willard soils. Calcium carbonate makes up more than 40 percent of the uppermost 40 inches of the profile.

Typical profile of Karde loam, saline, near the center of sec. 7, T. 4 N., R. 10 E.

A1—0 to 5 inches, light-gray (2.5Y 7/2) loam, light brownish gray (2.5Y 6/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; strongly calcareous; gradual boundary.

C1—5 to 24 inches, pale-yellow (5Y 7/3) silt loam or loam, pale olive (5Y 6/3) when moist; massive to very weak, coarse, subangular blocky structure; hard when dry, very friable when moist; very strongly calcareous; some visible lime and soluble salts; gradual boundary.

C2—24 to 60 inches +, pale-yellow (5Y 7/3) silt loam or loam, pale olive (5Y 6/3) when moist; massive; hard when dry, very friable when moist; very strongly calcareous; visible salts occur as thin seams and streaks.

The texture of the surface layer is loam, silt loam, or very fine sandy loam. The color ranges from 10YR to 2.5Y in hue, from 5 to 7 in value when dry and from 4 to 6 when moist, and from 2 to 4 in chroma. The thickness of the surface horizon ranges from 3 to 8 inches. In most places this horizon is thicker on the flanks of dunes and thinner on the crests. The texture of the C horizon is loam, silt loam, or light clay loam. The color ranges from 10YR to 5Y in hue, from 6 to 8 in value when dry and from 5 to 7 when moist, and from 1 to 3 in chroma. Chloride salts are not visible in all profiles.

Kech series

This series consists of shallow, well-drained, pale-brown soils on convex ridge crests and on side slopes of ridges. These soils are gravelly and medium textured. They are noncalcareous, though mildly alkaline to moderately alkaline. They developed in residuum weathered from calcareous, medium-textured to moderately fine textured material derived from granite, schist, gneiss, quartzite, and limestone. They occur mainly in the Pedernal Hills in the eastern part of the Area. Elevations are 6,200 to 6,600 feet.

Kech soils occur in association with Rock land and with soils of the Clovis series. They differ from Clovis soils in being shallow and gravelly.

Typical profile of Kech gravelly loam, SE¼SE¼SE¼ sec. 21, T. 6 N., R. 12 E.

A1—0 to 4 inches, pale-brown (10YR 6/3) gravelly loam, dark brown (10YR 4/3) when moist; moderate, medium and fine, granular structure; soft when dry, very friable when moist; noncalcareous; pH 7.8; about 30 percent gravel; clear boundary.

B2t—4 to 10 inches, brown (7.5YR 5/3) clay loam, dark brown (7.5YR 4/3) when moist; weak to moderate, coarse, prismatic structure breaking to moderate, medium, subangular blocky; hard when dry, very friable when moist; noncalcareous; pH 7.6; patchy clay films; few pebbles; clear boundary.

B3ca—10 to 16 inches, light-brown (7.5YR 6/3) light clay loam, brown (7.5YR 5/3) when moist; moderate, medium, subangular blocky structure; hard when dry, very friable when moist; very strongly calcareous; pH 8.2; moderate to strong ca horizon in which calcium carbonate occurs in finely divided forms and as soft concretions; patchy clay films; the lower part contains some fractured, partly weathered, lime-coated gneiss bedrock; diffuse boundary.

R—16 inches +, unweathered or slightly weathered gneiss bedrock.

The texture of the A1 horizon ranges from gravelly loam to gravelly fine sandy loam. The color ranges from 7.5YR to 10YR in hue, from 5 to 7 in value when dry and from 3 to 5 when moist, and from 2 to 3 in chroma. This horizon is calcareous in some places. It ranges from 3 to 5 inches in thickness. The texture of the B horizon ranges from heavy loam to clay loam or gravelly clay loam. In most places the color is darker in the upper part. It ranges from 7.5YR to 5YR in hue, from 5 to 6 in value when dry and from 4 to 5 when moist, and from 2 to 4 in chroma. The upper part is calcareous in some places. The thickness of the B horizon ranges from 9 to 20 inches. Gravel makes up 15 to 50 percent of the surface layer and 2 to 20 percent of the subsoil. These soils are locally stony. The depth to bedrock is normally less than 20 inches.

Kim series

The Kim series consists of deep, grayish-brown, well-drained soils. These soils are calcareous and medium textured. They developed in medium-textured, calcareous piedmont deposits derived from limestone, sandstone, gneiss, schist, and igneous rock. They occur on gently sloping to strongly sloping fans and side slopes of ridges in the eastern part of the survey Area. Elevations range from 5,500 to 6,500 feet.

In the Torrance Area Kim soils are mapped only with other soils. They differ from Pinon soils in lacking a strong ca horizon and in being deeper to bedrock. Kim soils lack the strongly cemented ca horizon of Pastura soils. They differ from Tapia soils in being calcareous in the surface layer and in lacking a B2t horizon. Kim soils are calcareous and lighter colored than Witt soils and lack the B2t horizon common in those soils. They differ from Otero soils in being finer textured and darker in color.

Typical profile of Kim loam, NW¼SE¼ sec. 4, T. 8 N., R. 14 E.

A1—0 to 4 inches, grayish-brown (10YR 5/2) loam, dark brown (10YR 3/3) when moist; moderate, very fine, granular structure; slightly hard when dry, very friable when moist; strongly calcareous; few, small, hard concretions of calcium carbonate; many worm casts; clear boundary.

AC—4 to 11 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; slightly hard when dry, very friable when moist; strongly calcareous; few, small, hard concretions of calcium carbonate; many worm casts; clear boundary.

C—11 to 16 inches, pale-brown (10YR 6/3) loam, dark brown (10YR 4/3) when moist; moderate, fine, granular structure; hard when dry, very friable when moist; strongly calcareous; few, small, hard concretions of calcium carbonate; gradual boundary.

Cca—16 to 38 inches +, light yellowish-brown (10YR 6/4) loam, dark yellowish brown (10YR 4/4) when moist; very weak, medium, subangular blocky structure; hard when dry, very friable when moist; very strongly calcareous; this is a weak to moderate ca horizon with calcium carbonate occurring as hard concretions and as thin seams.

The texture of the A and AC horizons is loam, gravelly loam, or fine sandy loam. The color ranges from 10YR to 7.5YR in hue, from 5 to 6 in value when dry and from 3 to 4 when moist, and from 2 to 3 in chroma. The thickness ranges from 10 to 18 inches. The texture of the Cca horizon ranges from loam to clay loam. The color ranges from 2.5Y to 10YR in hue. The ca horizon is normally weak or moderate but is strong in some places. In places a buried soil and limestone bedrock occur below a depth of 40 inches. Caliche pebbles make up as much as 15 percent of the A horizon in some profiles.

La Fonda series

The La Fonda series consists of deep, well-drained, reddish-brown soils. These soils are calcareous and medium textured. They developed in medium-textured to moderately fine textured, calcareous piedmont deposits derived from mixed red-bed shale, sandstone, limestone, and gypsum. They occur on upland fans and alluvial bottom lands in nearly all parts of the Torrance Area. Elevations are 5,800 to 6,700 feet.

La Fonda soils are darker colored and less limy than Chilton soils. They differ from those soils in having a B2 horizon and little or no gravel in the solum. They are darker colored than Rance soils and have a B horizon. They contain much less gypsum than Rance soils. La Fonda soils are calcareous and are lighter colored and coarser textured than Alicia soils.

Typical profile of La Fonda loam, near the center of NE¼ sec. 11, T. 3 N., R. 6 E.

A1—0 to 4 inches, reddish-brown (5YR 5/3) loam, dark reddish brown (5YR 3/3) when moist; moderate, thin, platy structure breaking to moderate, very fine, granular; soft when dry, very friable when moist; weakly calcareous; clear boundary.

B1—4 to 8 inches, reddish-brown (5YR 5/4) loam, dark reddish brown (5YR 3/4) when moist; weak, coarse, subangular blocky structure; slightly hard when dry, very friable when moist; strongly calcareous; patchy clay films; clear boundary.

B2—8 to 18 inches, reddish-brown (5YR 5/4) heavy loam, reddish brown (5YR 4/4) when moist; weak, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard when dry, friable when moist; strongly calcareous; patchy clay films; gradual boundary.

B3ca—18 to 23 inches, light reddish-brown (5YR 6/4) loam, reddish brown (5YR 4/4) when moist; weak, coarse, prismatic structure breaking to weak, coarse, subangular blocky; hard when dry, friable when moist; very strongly calcareous; weak ca horizon in which calcium carbonate occurs as soft concretions and as thin seams; patchy clay films; gradual boundary.

Cca—23 to 35 inches, light reddish-brown (5YR 6/4) loam, reddish brown (5YR 4/4) when moist; massive; hard when dry, friable when moist; very strongly calcareous; weak ca horizon in which calcium carbonate occurs as soft concretions and as thin seams; diffuse boundary.

C—35 to 60 inches +, light reddish-brown (5YR 6/4) loam, reddish brown (5YR 4/4) when moist; massive; slightly hard when dry, very friable when moist; strongly calcareous.

The texture of the A1 horizon ranges from loam to fine sandy loam. The color ranges from 5YR to 7.5YR in hue, from 4 to 5.5 in value when dry and from 2 to 3.5 when moist, and from 2 to 3 in chroma. The thickness ranges from 4 to 6 inches. The texture of the B horizon ranges from loam or gravelly loam to light clay loam. The color ranges from 2.5YR to 5YR in hue, from 4 to 5 in value when dry and from 3 to 5 when moist, and from 3 to 4 in chroma. The thickness ranges from 11 to 24 inches. The ca horizons are weak to moderate. These soils are noncalcareous to a depth of 10 inches in some profiles. In many areas on flood plains, the substratum contains gravel and cobblestones. Bedrock is at a depth of 50 inches in places.

Laporte series

The Laporte series consists of stony, shallow and very shallow, well-drained, grayish-brown soils. These soils are calcareous, moderately alkaline, and medium textured. They developed in residuum weathered from limestone bedrock. They occur on nearly level to very strongly sloping foothill crests and side slopes. Elevations range from 6,200 to 7,500 feet.

In most places Laporte soils are shallower than Pinon soils and lack the strong ca horizon typical of those soils. They are shallower and lighter colored than Wilcoxson soils and lack the fine-textured B2t horizon common in those soils. They differ from Hagerman soils in being calcareous and lighter colored and in lacking a B2t horizon. Laporte soils are shallower and darker colored than Harvey soils and contain less lime than those soils.

Typical profile of Laporte stony loam, in a road cut, SE¼ sec. 30, T. 1 N., R. 13 E.

A1—0 to 7 inches, grayish-brown (10YR 5/2) stony loam, very dark grayish brown (10YR 3/2) when moist; strong, very fine, granular structure; soft when dry, very friable when moist; strongly calcareous; pH 8.2; approximately 65 percent stones; gradual boundary.

Cca—7 to 11 inches, very pale brown (10YR 7/3) stony loam, brown (10YR 5/3) when moist; moderate, medium, granular structure; soft when dry, very friable when moist; very strongly calcareous; pH 8.4; weak to moderate ca horizon in which calcium carbonate occurs as soft concretions and as thin seams; approximately 70 percent of this horizon is stones; abrupt, irregular boundary.

R—11 inches +, massive, grayish, lime-coated limestone bedrock; few fractures.

The texture of the surface layer ranges from stony loam or loam to silt loam. The color is within the 10YR hue. It ranges from 4 to 5.5 in value when dry and from 2 to 3.5 when moist, and from 1.5 to 3 in chroma. The thickness of the A horizon ranges from 7 to 11 inches. The Cca horizon is stony in places. Its texture ranges from loam to light clay loam. The color ranges from 7.5YR to 10YR in hue, from 5 to 7 in value when dry and from 4 to 6 when moist, and from 2 to 4 in chroma. The thickness ranges from 4 to 11 inches. Gravel and stones make up 5 to 75 percent of the regolith. Rock outcrops occupy 15 to 80 percent of the surface.

Manzano series

The Manzano series consists of moderately deep to deep, well-drained, grayish-brown soils. These soils are medium textured and moderately fine textured and mildly to moderately alkaline. They developed in calcareous alluvium derived from igneous rock, schist, gneiss, felsite, and limestone. In many places the parent material is stratified. Fine, medium, and moderately fine textured material predominates. These soils occur throughout the Area in swales and on flood plains. Elevations range from 5,800 to 7,200 feet.

Manzano soils are associated with Moriarty soils and occur in similar positions. They are browner and coarser textured than those soils. They are darker colored, less limy, and more fertile than Harvey soils, and they have a B2 horizon, which those soils lack. They are deeper than Willard soils and are darker colored and more fertile. They are darker colored and deeper than Prewitt soils, and they have a B2 horizon, which is uncommon in Prewitt soils.

Typical profile of Manzano loam, SW¼SW¼SE¼ sec. 23, T. 9 N., R. 8 E.

A1—0 to 9 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; slightly hard when dry, very friable when moist; noncalcareous; the upper 2 or 3 inches consists of recent deposits and is lighter in color and calcareous in many places; clear boundary.

A3—9 to 13 inches, dark-brown (10YR 4/3) heavy loam, dark brown (10YR 3/3) when moist; weak to moderate, medium, subangular blocky structure breaking to moderate, medium, granular; hard when dry, friable when moist; noncalcareous; clear boundary.

B2—13 to 23 inches, dark grayish-brown (10YR 4/2) light clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, prismatic structure breaking to moderate, fine, subangular blocky; hard when dry, friable when moist; weakly calcareous; patchy clay films; gradual boundary.

B3ca—23 to 31 inches, grayish-brown (10YR 5/2) light clay loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; very strongly calcareous; weak ca horizon in which calcium carbonate occurs as thin seams; gradual boundary.

Cca—31 to 41 inches +, brown (10YR 5/3) light clay loam, dark brown (10YR 4/3) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; very strongly calcareous; weak ca horizon in which calcium carbonate occurs as soft concretions and as thin seams; gradual, smooth boundary.

The texture of the A horizon ranges from light loam to clay loam or silty clay loam. The color ranges from 7.5YR to 10YR in hue, from 4 to 5 in value when dry and from 2 to 3 when moist, and from 2 to 4 in chroma. The thickness of the A horizon ranges from 10 to 20 inches. The texture of the B horizon ranges from heavy loam to clay loam. The color ranges from 7.5YR to 10YR in hue, from 4 to 5.5 in value when dry and from 3 to 5.5 when moist, and from 1 to 3 in chroma. The thickness ranges from 16 to 50 inches. The texture of the C horizon is loam, heavy loam, sandy clay loam, clay loam, or silty clay loam. The color ranges from 5YR to 10YR in hue. The calcium carbonate horizons are weak to moderate. In many places the solum is calcareous throughout. Recent deposits range up to 12 inches in thickness. Concretions of soluble salts are common in the substratum in areas where these soils adjoin lake basins.

Mirabal series

The Mirabal series consists of stony, shallow to moderately deep, well-drained to somewhat excessively drained, dark grayish-brown soils. These soils are noncalcareous and medium acid to neutral. They are moderately coarse textured and coarse textured. They developed in residuum weathered from schist and quartzite bedrock. They occur on the south side of very steep mountain slopes in the western part of the Area. Elevations range from 7,800 to 9,200 feet.

Mirabal soils are on opposite slopes from Supervisor soils. They are stonier than those soils, coarser textured, and more alkaline in their C horizon. They are coarser textured and less alkaline than Wilcoxson soils and lack the B2t horizon common in those soils. Mirabal soils are browner and coarser textured than Salas soils and lack the B2t horizon of those soils.

Typical profile of Mirabal stony sandy loam, NE¼ sec. 21, T. 5 N., R. 5 E.

O1—2 inches to 0, partly decomposed forest leaf litter; pH 6.4; 25 to 45 percent stones; abrupt boundary.

A11—0 to 5 inches, dark grayish-brown (10YR 4/2) stony sandy loam, very dark brown (10YR 2/2) when moist; weak, fine, crumb structure; soft when dry, very friable when moist; noncalcareous; pH 6.6; 25 to 45 percent stones; clear boundary.

A12—5 to 9 inches, grayish-brown (10YR 5/2) stony sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, crumb structure; soft when dry, very friable when moist; noncalcareous; pH 6.8; 25 to 45 percent stones; gradual boundary.

A2 or C—9 to 21 inches, pale-brown (10YR 6/3) stony sandy loam, dark brown (10YR 4/3) when moist; massive; soft when dry, very friable when moist; noncalcareous; pH 7.0; about 60 percent stones; clear, irregular boundary.

R—21 to 39 inches +, light yellowish-brown, partly weathered schist bedrock in upper part, grading to unweathered rock in lower part; noncalcareous; pH 7.2.

The texture of the A horizon ranges from stony loam to stony sandy loam. The color is within the hue 10YR. It ranges from 4 to 5 in value when dry and from 2 to 3 when moist, and from 1.5 to 3 in chroma. The thickness ranges from 4 to 10 inches. The texture of the A2 or C horizon ranges from gravelly or stony loam to stony sandy loam. The color ranges from 7.5YR to 10YR in hue, from 5 to 6 in value when dry and from 3.5 to 5 when moist, and from 2 to 4 in chroma. The thickness ranges from 4 to 20 inches. In most places the parent material is partly weathered and fractured in the upper part. The stone and gravel content ranges from 20 to 50 percent in the upper part to 40 to 90 percent in the lower part. The depth to unweathered bedrock is generally more than 30 inches.

Moriarty series

The Moriarty series consists of deep, dark reddish-gray, moderately well drained, moderately fine textured soils. These soils developed in calcareous, fine-textured alluvial sediments derived mainly from red-bed shale and sandstone but with a minor influence from schist, quartzite, gneiss, igneous rock, and limestone. They occur as level to moderately sloping, flood plain terraces along streams in the western and southern parts of the Area. Elevations range from 6,100 to 6,800 feet.

Moriarty soils are finer textured and more reddish than the associated Manzano soils, and they have slower internal drainage than those soils. They are darker colored, finer textured, and less limy than La Fonda soils. They are deeper, darker colored, and finer textured than Hassell soils and have less lime in their substratum.

Typical profile of Moriarty clay loam, in a gully cut, NW¼SW¼SW¼ sec. 20, T. 5 N., R. 8 E.

A11—0 to 8 inches, dark reddish-gray (5YR 4/2) clay loam, dark reddish brown (5YR 3/2) when moist; weak to moderate, medium and coarse, granular structure; hard when dry, friable when moist; weakly calcareous; about 3 inches of recent accumulation at the surface; clear boundary.

A12—8 to 17 inches, dark reddish-gray (5YR 4/2) clay, dark reddish brown (5YR 3/2) when moist; moderate, fine, blocky structure; very hard when dry, firm when moist; weakly calcareous; gradual boundary.

AC—17 to 33 inches, reddish-brown (5YR 5/3) clay, dark reddish gray (5YR 4/2) when moist; weak, very coarse, prismatic structure breaking to strong, medium and coarse, blocky; extremely hard when dry, extremely firm when moist; weakly calcareous; many slickensides; gradual boundary.

C—33 to 44 inches, dark reddish-gray (5YR 4/2) clay, dark reddish brown (5YR 3/2) when moist; reddish-brown (5YR 4/4) mottles; weak, coarse, subangular blocky structure; extremely hard when dry, extremely firm when moist; strongly calcareous; few slickensides; gradual boundary.

Cca—44 to 60 inches +, reddish-gray (5YR 5/2) clay, dark reddish gray (5YR 4/2) when moist; reddish-brown (5YR 4/4) mottles; massive, or very weak, coarse, subangular blocky structure; very hard when dry, very firm when moist; very strongly calcareous; weak ca horizon in which calcium carbonate occurs as soft concretions.

The texture of the A horizon ranges from silty clay loam to clay loam. The color ranges from 2.5YR to 5YR in hue, from 3 to 5.5 in value when dry and from 2 to 3.5 when moist, and from 2 to 4 in chroma. The thickness ranges from 2 to 10 inches. The texture of the AC horizon ranges from heavy silty clay loam or silty clay to clay. The color ranges from 2.5YR to 5YR in hue, from 5 to 6 in value when dry and from 4 to 5 when moist, and from 2 to 4 in chroma. The thickness ranges from 12 to 20 inches. The C horizon is similar in color and texture to the AC horizon. It is mottled in many places. In places there is some gravel on the surface and in the substratum. Recent deposits on the surface range up to 8 inches in thickness. The A horizon and the upper part of the AC horizon are noncalcareous in some places. The Cca horizon is weak in most places but is moderate in some places.

Osha series

The Osha series consists of moderately deep to deep, well-drained, grayish-brown soils. These soils are gravelly and medium textured and are neutral to mildly alkaline.

They developed partly in residuum and partly in piedmont fan sediments derived from schist and igneous rock. They are on ridge crests and very steep canyon side slopes in the Manzano Mountains, mainly on western and southern slopes but less extensively on eastern slopes. Elevations range from 6,500 to 8,500 feet.

Osha soils are at higher elevations than Salas soils. They are coarser textured than those soils and have an A2 horizon, which is uncommon in Salas soils. Osha soils are deeper than Mirabal soils. They have a more prominent A2 horizon than those soils and have a B2t horizon, which Mirabal soils lack.

Typical profile of Osha gravelly loam, within the Cibola National Forest, SW¼ sec. 23, T. 7 N., R. 5 E.

O1—3 inches to 0, undecomposed and partly decomposed leaves, needles, and twigs.

A11—0 to 11 inches, grayish-brown (10YR 5/2) gravelly loam, very dark brown (10YR 2/2) when moist; fine granular structure in uppermost few inches; very weak, fine, subangular blocky structure in lower part; slightly hard when dry, very friable when moist; noncalcareous; pH 7.0; about 30 percent small gravel; gradual boundary.

A12—11 to 18 inches, brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) when moist; weak, fine, subangular blocky structure breaking to weak to moderate, medium, granular; slightly hard when dry, very friable when moist; noncalcareous; pH 6.8; about 40 percent gravel; gradual, wavy boundary.

A2—18 to 32 inches, pale-brown (10YR 6/3) gravelly coarse sandy loam, brown (10YR 5/3) when moist; very weak, fine, subangular blocky structure breaking to weak to moderate, medium, granular; slightly hard when dry, very friable when moist; noncalcareous; pH 6.6; about 40 percent gravel; lower part mixed with material from the B2t horizon; gradual, wavy boundary.

B2t—32 to 50 inches, brown (10YR 5/3) very gravelly heavy sandy loam, dark brown (10YR 4/3) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; noncalcareous; pH 6.2; thin, continuous clay films; about 80 percent gravel; gradual boundary.

R—50 inches +, weakly fractured granite bedrock; some finer material like that in the B2t horizon penetrating into the cracks.

The texture of the A1 horizon ranges from gravelly loam to gravelly fine sandy loam. The color ranges from 10YR to 7.5YR in hue, from 3 to 5.5 in value when dry and from 2 to 3.5 when moist, and from 1.5 to 3 in chroma. The thickness ranges from 8 to 20 inches. The texture of the A2 horizon ranges from gravelly loam to gravelly coarse sandy loam. The color ranges from 7.5YR to 10YR in hue, from 6 to 7 in value when dry and from 5 to 6 when moist, and from 2 to 4 in chroma. The thickness ranges from 12 to 16 inches. The texture of the B2t horizon ranges from gravelly loam to gravelly sandy clay loam. The color ranges from 7.5YR to 10YR in hue, from 5 to 6 in value when dry and from 4 to 5 when moist, and from 2 to 4 in chroma. The organic layer on the surface ranges from 1 to 5 inches in thickness. The gravel content ranges from 25 to 50 percent in the A horizon and from 30 to 90 percent in the B horizon. Stones make up as much as 10 percent of the surface horizon. The reaction of the solum ranges from slightly acid to mildly alkaline.

Otero series

The Otero series consists of light-brown, somewhat excessively drained, nearly level to strongly sloping soils on uplands. These soils are mildly to moderately alkaline and moderately coarse textured to coarse textured. They developed in calcareous, medium-textured and moderately coarse textured piedmont deposits derived from quartzite, schist, gneiss, igneous rock, and limestone. They have been partly reworked by wind, and the topography is undulating in many places. They occur in the eastern and southern parts of the Area at elevations of 6,000 to 7,000 feet.

Otero soils are lighter colored and coarser textured than Clovis soils, and they lack the B2t horizons common in those soils. They have less gravel in the substratum than Ildefonso soils, and they lack a strong ca horizon, which Ildefonso soils have. Otero soils are similar to Palma soils, but lack the weak textural B2t horizon that those soils have.

Typical profile of Otero fine sandy loam, SE¼NE¼NE¼ sec. 11, T. 6 N., R. 11 E.

A1—0 to 6 inches, light-brown (7.5YR 6/3) fine sandy loam, dark brown (7.5YR 4/3) when moist; moderate, very fine, granular structure; soft when dry, very friable when moist; strongly calcareous; clear boundary.

AC—6 to 17 inches, light-brown (7.5YR 6/3) fine sandy loam, dark brown (7.5YR 4/3) when moist; weak, coarse, subangular blocky structure breaking to moderate, fine, granular; slightly hard when dry, very friable when moist; strongly calcareous; gradual boundary.

C1ca—17 to 28 inches, light-brown (7.5YR 6/4) fine sandy loam, dark brown (7.5YR 4/4) when moist; massive; slightly hard when dry, very friable when moist; very strongly calcareous; weak ca horizon in which calcium carbonate occurs as soft concretions and as thin seams; gradual, wavy boundary.

C2ca—28 to 40 inches +, very pale brown (10YR 7/3) fine sandy loam, yellowish brown (10YR 5/4) when moist; massive; slightly hard when dry, very friable when moist; very strongly calcareous; moderate ca horizon in which calcium carbonate occurs in finely divided forms, as soft concretions, and as thin seams.

The texture of the A horizon ranges from fine sandy loam to loamy fine sand. The color ranges from 7.5YR to 10YR in hue, from 5 to 7 in value when dry and from 3 to 5 when moist, and from 2 to 3 in chroma. The thickness of the A1 and AC horizons ranges from 10 to 17 inches. The texture of the C horizon ranges from light loam or light sandy clay loam to sandy loam. The lower part generally contains more clay than the upper part. The color ranges from 7.5YR to 10YR in hue, from 6 to 8 in value when dry and from 4 to 6 when moist, and from 3 to 5 in chroma. In places there are buried horizons below a depth of 30 inches. Pebbles occur in many profiles. In some areas these soils are noncalcareous to a depth of 10 inches.

Palma series

The Palma series consists of deep, brown, well-drained, nearly level to strongly sloping soils on uplands. These soils are mildly to moderately alkaline and moderately coarse textured to coarse textured. They developed in calcareous, moderately coarse textured piedmont sediments and wind-reworked deposits derived from quartzite, schist, gneiss, igneous rock, and limestone. They occur in the eastern and southern parts of the Area at elevations of 6,000 to 7,000 feet.

Palma soils are coarser textured in the B2t horizon than Clovis soils and lack the strong ca horizon common in those soils. They are darker colored and deeper than Dean soils, are less limy, and have a B2t horizon, which Dean soils lack. They are more reddish than Otero soils, which also lack a B2t horizon.

Typical profile of Palma fine sandy loam, SE¼NE¼SW¼ sec. 16, T. 8 N., R. 10 E.

A1—0 to 3 inches, brown (7.5YR 5/3) fine sandy loam, dark brown (7.5YR 4/3) when moist; strong, very fine, granular structure; soft when dry, very friable when moist; noncalcareous; clear boundary.

A3—3 to 6 inches, reddish-brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) when moist; moderate, medium, granular structure; slightly hard when dry, very friable when moist; noncalcareous; clear boundary.

B2t—6 to 19 inches, reddish-brown (5YR 5/4) heavy fine sandy loam, reddish brown (5YR 4/4) when moist; weak to moderate, very coarse, prismatic structure breaking to moderate, coarse, subangular blocky; hard when dry, friable when moist; noncalcareous; thin, patchy clay films; gradual, wavy boundary.

B3ca—19 to 23 inches, light reddish-brown (5YR 6/4) fine sandy loam, reddish brown (5YR 5/4) when moist; weak, coarse, subangular blocky structure; hard when dry, friable when moist; thin, patchy clay films; strongly calcareous; weak ca horizon in which calcium carbonate occurs in finely divided forms; gradual boundary.

Cca—23 to 36 inches, light reddish-brown (5YR 6/4) fine sandy loam, reddish brown (5YR 5/4) when moist; massive; hard when dry, very friable when moist; very strongly calcareous; moderate ca horizon in which calcium carbonate occurs in finely divided forms; gradual boundary.

C—36 to 60 inches, light reddish-brown (5YR 6/4) fine sandy loam, reddish brown (5YR 5/4) when moist; massive; hard when dry, very friable when moist; very strongly calcareous; weak ca horizon in which calcium carbonate occurs in finely divided forms.

The texture of the A horizon ranges from fine sandy loam to loamy fine sand. The color ranges from 7.5YR to 5YR in hue, from 5 to 6 in value when dry and from 4 to 5 when moist, and from 2 to 4 in chroma. The thickness ranges from 3 to 9 inches. The texture of the B horizon ranges from fine sandy loam to sandy clay loam. The color ranges from 5YR to 7.5YR in hue, from 5 to 7 in value when dry and from 4 to 6 when moist, and from 3 to 5 in chroma. The thickness ranges from 9 to 21 inches. The texture of the C horizon ranges from loam to fine sandy loam, and the color ranges from 5YR to 7.5YR in hue. The Cca horizon ranges from weak to strong and is weakly indurated in some places. The A horizon is weakly calcareous in some places. In a few areas Palma soils are underlain by sandstone bedrock, generally at a depth of more than 40 inches.

Pastura series

The Pastura series consists of shallow to very shallow, light brownish-gray, well-drained soils. These soils are medium textured, highly calcareous, and moderately alkaline. They developed in residuum weathered from medium-textured, calcareous, hard caliche. They occur on nearly level to very strongly sloping crests and side slopes of ridges in the eastern part of the Area.

Pastura soils are shallower than the associated Dean soils, and they have a thicker, more strongly cemented ca horizon than those soils. They differ from Harvey soils in being shallower and lighter colored and in having a strongly cemented ca horizon. They have a thinner, lighter colored A1 horizon than Kim soils, and they have a strongly cemented ca horizon, which is uncommon in those soils.

Typical profile of Pastura loam, SE¼NW¼NW¼ sec. 24, T. 9 N., R. 14 E.

A1—0 to 3 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; strong, very fine, granular structure; soft when dry, very friable when moist; strongly calcareous; pH 8.2; about 5 percent caliche fragments; clear boundary.

C—3 to 10 inches, pale-brown (10YR 6/3) loam, brown (10YR 4/3) when moist; weak, fine, subangular blocky structure; slightly hard when dry, very friable when moist; very strongly calcareous; pH 8.4; about 10 percent caliche fragments; abrupt boundary.

Ccam—10 inches +, pinkish-white (7.5YR 8/2) to very pale brown (10YR 8/3) indurated caliche that has a laminal upper surface; grades to weakly cemented caliche at a depth of about 24 inches.

The texture of the A1 horizon ranges from loam or gravelly loam to fine sandy loam. The color is within the 10YR hue. It ranges from 5 to 7 in value when dry and from 3 to 5 when moist, and from 2 to 4 in chroma. The thickness ranges from 2 to 6 inches. In most places the texture of the C horizon is loam or gravelly loam. The color ranges from 7.5YR to 10YR in hue, from 6 to 8 in value when dry and from 4 to 6 when moist, and from 2 to 4 in chroma. The thickness ranges from 4 to 12 inches. The Ccam horizon, or parent material, is fractured and partly weathered in the upper part. The content of caliche gravel or fragments ranges from 0 to 30 percent in the A horizon and from 5 to 50 percent in the C horizon. Typically, the depth to indurated caliche is less than 12 inches, but it ranges from 6 to 18 inches.

Pedrick series

The Pedrick series consists of moderately deep to deep, well-drained, pale-brown soils. These soils are mildly to strongly alkaline and calcareous. They are moderately coarse textured to coarse textured. They developed in medium-textured to moderately coarse textured, calcareous, eolian deposits and in stratified lacustrine sediments of mixed origin. They occur on level to nearly level, gently undulating terraces in the lake basins of the Torrance Area. Elevations range from 6,000 to 6,200 feet.

Pedrick soils are coarser textured than the associated Willard soils. They are similar to Ildefonso soils but lack the gravelly subsurface horizons of those soils.

Typical profile of Pedrick loamy fine sand, NE¼NE¼ NE¼ sec. 1, T. 4 N., R. 8 E.

A11—0 to 4 inches, pale-brown (10YR 6/3) loamy fine sand, dark brown (10YR 4/3) when moist; single grain; soft when dry, very friable when moist; strongly calcareous; clear boundary.

A12—4 to 17 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) when moist; single grain; soft when dry, very friable when moist; strongly calcareous; clear boundary.

C—17 to 21 inches, pale-brown (10YR 6/3) light fine sandy loam, brown (10YR 5/3) when moist; single grain or weak, fine, granular structure; soft when dry, very friable when moist; strongly calcareous; clear boundary.

Cca—21 to 35 inches, very pale brown (10YR 7/3) heavy fine sandy loam, pale brown (10YR 6/3) when moist; very weak, medium, subangular blocky structure; hard when dry, very friable when moist; very strongly calcareous; moderate ca horizon in which calcium carbonate occurs in finely divided forms and as thin seams; clear boundary.

IIC—35 to 56 inches, white (10YR 8/1) loam, light gray (10YR 7/1) when moist; yellow (10YR 7/8) and yellowish-brown (10YR 5/8) mottles; massive; slightly hard when dry, friable when moist; very strongly calcareous; few iron manganese concretions; gradual boundary.

IIIC—56 inches +, light-gray (5Y 7/2) silty clay, light olive gray (5Y 6/2) when moist; yellowish-brown (10YR 5/8) mottles; massive; hard when dry, friable when moist; very strongly calcareous; few iron manganese concretions.

The texture of the A horizon ranges from fine sandy loam to loamy fine sand. The color ranges from 7.5YR to 10YR in hue, from 5 to 6 in value when dry and from 3 to 4 when moist, and from 2 to 4 in chroma. The thickness ranges from 10 to 20 inches. The texture of the C horizon ranges from very fine sandy loam to sandy loam. The color ranges from 7.5YR to 2.5Y in hue, from 5 to 7 in value when dry and from 4 to 6 when moist, and from 3 to 5 in chroma. The thickness of the soil over lacustrine deposits ranges from 15 to 40 inches. The surface horizon is noncalcareous in some profiles. The ca horizons are generally weak to moderate but are strong in some localities.

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The IIC horizon and the IIIC horizon are stratified in many places and are variable in color and texture. These horizons contain varying amounts of salts, lime, and iron.

Penistaja series

The Penistaja series consists of deep, well-drained, brown soils on upland piedmont fans. These soils are noncalcareous and mildly to moderately alkaline. They are medium textured to coarse textured. They developed in medium-textured to moderately coarse textured, calcareous fan and eolian deposits derived from quartzite, limestone, schist, gneiss, and igneous rock. They occur mainly in the southern and eastern parts of the Area at elevations of 6,100 to 7,000 feet.

Penistaja soils are coarser textured than Witt soils. They are deeper than Bernal soils and Hagerman soils.

Typical profile of Penistaja fine sandy loam, NW¼ SW¼ sec. 14, T. 3 N., R. 8 E.

A1—0 to 5 inches, brown (7.5YR 5/3) fine sandy loam, dark brown (7.5YR 4/3) when moist; moderate, very fine, granular structure; soft when dry, very friable when moist; noncalcareous; clear boundary.

B1—5 to 11 inches, brown (7.5YR 5/3) sandy clay loam, dark brown (7.5YR 4/3) when moist; weak, coarse, prismatic structure breaking to moderate, medium, subangular blocky; hard when dry, very friable when moist; noncalcareous; patchy clay films; clear boundary.

B2t—11 to 17 inches, light-brown (7.5YR 6/3) heavy sandy clay loam, brown (7.5YR 5/3) when moist; weak, coarse, prismatic structure breaking to moderate, fine, subangular blocky; very hard when dry, friable when moist; noncalcareous; nearly continuous clay films; clear boundary.

B3ca—17 to 29 inches, brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) when moist; moderate, fine and medium, subangular blocky structure; very hard when dry, friable when moist; strongly calcareous; weak ca horizon in which calcium carbonate occurs as soft concretions and as thin seams; few sandstone pebbles; patchy clay films; gradual boundary.

C1ca—29 to 53 inches, reddish-brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) when moist; weak, medium, subangular blocky structure; hard when dry, very friable when moist; strongly calcareous; weak ca horizon in which calcium carbonate occurs as soft concretions and as thin seams; gradual boundary.

C2ca—53 to 60 inches +, light reddish-brown (5YR 6/4) fine sandy loam, reddish brown (5YR 5/4) when moist; massive; very hard when dry, friable when moist; very strongly calcareous; moderate ca horizon in which calcium carbonate occurs in finely divided forms.

The texture of the A horizon ranges from loamy fine sand to sandy clay loam. The color ranges from 7.5YR to 10YR in hue, from 5 to 6 in value when dry and from 3 to 4 when moist, and from 3 to 4 in chroma. The thickness ranges from 3 to 10 inches. The texture of the B2t horizon ranges from heavy fine sandy loam to heavy sandy clay loam. The color ranges from 5YR to 7.5YR in hue, from 5 to 6 in value when dry and from 3 to 4 when moist, and from 3 to 4 in chroma. In some places these soils are calcareous in the surface layer, and in other places they are noncalcareous through the B2t horizon. Sandstone bedrock occurs below a depth of 40 inches in places.

Pinata series

The Pinata series consists of stony, moderately deep to deep, well-drained, very dark grayish-brown soils. These soils are medium textured, noncalcareous, and moderately acid to mildly alkaline. They developed in residuum weathered from felsite and sandstone. They are strongly sloping to very steep and occur on northern, southern, and eastern slopes in the southern part of the Area. Elevations range from 6,800 to 8,800 feet.

Pinata soils are stonier than Fortwingate soils, and they lack a ca horizon, which those soils have. They have a leached A2 horizon, which is uncommon in Wilcoxson soils, and they lack a ca horizon, which those soils have. They are finer textured than Supervisor soils, and they have a textural B2t horizon and a leached A2 horizon, which those soils lack. Pinata soils differ from Capillo soils in being stony and redder and in having an A2 horizon.

Typical profile of Pinata stony loam, SE¼ sec. 31, T. 1 S., R. 12 E.

O1—2 inches to 0, undecomposed and partly decomposed leaves, needles, and twigs.

A1—0 to 3 inches, very dark grayish-brown (10YR 3/2) stony loam, very dark brown (10YR 2/2) when moist; strong, fine, crumb structure; soft when dry, very friable when moist; noncalcareous; pH 6.8; approximately 30 percent stones; clear boundary.

A2—3 to 10 inches, pinkish-gray (7.5YR 6/2) stony loam, brown (7.5YR 5/3) when moist; weak to moderate, thin, platy structure breaking to moderate, very fine, granular; soft when dry, very friable when moist; noncalcareous; pH 6.6; approximately 30 percent stones; clear, wavy boundary.

B2t—10 to 30 inches, reddish-brown (5YR 5/3) stony clay, reddish-brown (5YR 4/3) when moist; moderate, medium, subangular blocky structure; very hard when dry, very firm when moist; noncalcareous; pH 6.8; thin, continuous clay films; approximately 50 percent stones; gradual, wavy boundary.

B3—30 to 45 inches, light reddish-brown (5YR 6/3) stony clay, reddish-brown (5YR 5/3) when moist; weak, medium, subangular blocky structure; very hard when dry, very firm when moist; noncalcareous; pH 6.8; thin, nearly continuous clay films; approximately 50 percent stones; gradual, wavy boundary.

R—45 inches +, partly weathered felsite bedrock; a few fractures in the upper part.

The thickness of the organic litter on the surface ranges from 1 to 4 inches. The texture of the A1 horizon ranges from stony loam to stony silt loam or stony fine sandy loam. The color ranges from 7.5YR to 10YR in hue, from 3 to 5.5 in value when dry and from 2 to 3.5 when moist, and from 2 to 4 in chroma. The thickness ranges from 0 to 5 inches. The leached A2 horizon consists of loam, stony loam, or stony silt loam. Its color ranges from 7.5YR to 10YR in hue, from 5 to 7 in value when dry and from 4 to 6 when moist, and from 2 to 4 in chroma. This horizon ranges from 5 to 9 inches in thickness. The texture of the B2t horizon ranges from gravelly clay loam to stony clay or gravelly clay. The color ranges from 5YR to 7.5YR in hue, from 5 to 7 in value when dry and from 4 to 6 when moist, and from 2 to 4 in chroma. The B horizon ranges from 25 to 41 inches in thickness. In most places the solum is more than 20 inches thick. Stones make up 15 to 40 percent of the A horizon and 40 to 80 percent of the B horizon.

Pino series

The Pino series consists of dark-brown, moderately deep to deep, moderately well drained, medium-textured soils. These soils are slightly acid to mildly alkaline and noncalcareous. They developed in residuum weathered from interbedded shale and limestone. They occur at elevations of 7,400 to 7,800 feet on convex ridgetops in the foothills in the western part of the Torrance Area. The soils are gently sloping to very strongly sloping and have an eastern aspect.

Pino soils are browner and less alkaline than Wilcoxson soils and do not have accumulated lime in the profile, as those soils do. They have a thicker, lighter colored A1 horizon than Capillo soils and lack the sandstone component in their parent material that those soils have.

Typical profile of Pino silt loam, SE¼NE¼ sec. 35, T. 7 N., R. 5 E.

O1—2 inches to 0, undecomposed and partly decomposed forest litter.

A1—0 to 10 inches, brown (7.5YR 5/2) silt loam, dark brown (7.5YR 3/2) when moist; weak, medium, subangular blocky structure breaking to moderate, fine, crumb; slightly hard when dry, very friable when moist; noncalcareous; pH 6.8; clear boundary.

B1—10 to 18 inches, brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) when moist; moderate to strong, medium, angular and subangular blocky structure; very hard when dry, friable when moist; noncalcareous; pH 6.5; thin, patchy clay films; clear boundary.

B2t—18 to 25 inches, brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) when moist; moderate, medium, prismatic structure breaking to moderate to strong, medium, blocky; very hard when dry, friable when moist; noncalcareous; pH 6.8; medium, continuous clay films; gradual boundary.

B3—25 to 32 inches, light yellowish-brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) when moist; weak, medium, prismatic structure breaking to weak, medium, subangular blocky; extremely hard when dry, firm when moist; noncalcareous; pH 6.8; thin, patchy clay films; gradual boundary.

C—32 to 44 inches, pale-yellow (5Y 7/3) clay, pale olive (5Y 6/3) when moist; mottled with olive yellow (2.5Y 6/6) when dry and with light olive brown (2.5Y 5/6) when moist; massive; extremely hard when dry, firm when moist; noncalcareous; pH 7.0; abrupt boundary.

R—44 inches +, massive limestone bedrock.

The texture of the A horizon ranges from loam or silt loam to sandy clay loam. The color ranges from 7.5YR to 10YR in hue, from 4 to 5.5 in value when dry and from 2 to 3.5 when moist, and from 1.5 to 3 in chroma. The thickness ranges from 6 to 12 inches. The organic layer on the surface is 1 to 4 inches thick. The texture of the B2t horizon ranges from heavy clay loam to clay. The color ranges from 7.5YR to 10YR in hue, from 5 to 6 in value when dry and from 4 to 5 when moist, and from 3 to 5 in chroma. In most places the C horizon is clay, mottled with olive or yellow in hues of 10YR to 5Y. A few pebbles and stones occur in the profile in some places. The thickness of the solum ranges from 20 to 40 inches. The depth to bedrock is less than 60 inches in most places.

Pinon series

The Pinon series consists of brown, shallow, medium-textured soils. These soils are calcareous and mildly to moderately alkaline. They developed in medium-textured, calcareous residuum weathered from limestone bedrock. They occur at elevations of 6,300 to 7,000 feet on convex, gently sloping to very strongly sloping crests and side slopes of ridges in all parts of the Torrance Area.

Pinon soils are similar to Laporte soils but are lighter colored and have a strong ca horizon. They differ from Harvey soils in being shallow over bedrock. Pinon soils differ from Kim soils in having bedrock within 20 inches of the surface and in having a strong ca horizon, which is uncommon in Kim soils.

Typical profile of Pinon channery loam, NE¼NW¼ sec. 15, T. 2 N., R. 7 E.

A1—0 to 6 inches, brown (7.5YR 5/3) channery loam, dark brown (7.5YR 3/3) when moist; moderate, very fine, granular structure; soft when dry, very friable when moist; strongly calcareous; pH 8.0; about 40 percent channery fragments of limestone; clear boundary.

C1ca—6 to 10 inches, light-brown (7.5YR 6/3) channery loam, brown (7.5YR 5/3) when moist; very weak, fine, subangular blocky structure; slightly hard when dry, very friable when moist; very strongly calcareous; pH 8.2; moderate to strong ca horizon in which calcium carbonate occurs as concretions, as thin seams, and in finely divided forms; clear boundary.

C2ca—10 to 18 inches, pinkish-white (7.5YR 8/2) channery loam, pinkish gray (7.5YR 7/2) when moist; massive; slightly hard when dry, very friable when moist; very strongly calcareous; pH 8.4; strong ca horizon in which calcium carbonate occurs as finely divided forms; abrupt boundary.

R—18 to 20 inches +, massive, partly weathered, fractured limestone bedrock coated with a layer of calcium carbonate.

The texture of the A1 horizon is loam, channery loam, or fine sandy loam. The color ranges from 7.5YR to 10YR in hue, from 4 to 5.5 in value when dry and from 2 to 3.5 when moist, and from 2 to 4 in chroma. The thickness ranges from 3 to 6 inches. The texture of the C horizon ranges from loam, stony loam, or channery loam to light clay loam or channery light clay loam. The color ranges from 7.5YR to 10YR in hue, from 6 to 8 in value when dry and from 4 to 6 when moist, and from 2 to 4 in chroma. The thickness ranges from 4 to 14 inches. In some areas indurated caliche occurs in the substratum. Limestone outcrops cover less than 15 percent of the surface.

Prewitt series

The Prewitt series consists of deep, well-drained, brown soils. These are youthful soils that developed in calcareous, medium-textured and moderately fine textured alluvium derived from limestone, sandstone, igneous rock, and red-bed material. They are calcareous and medium textured. They occur in swales and on flood plains in nearly all parts of the Area. They are nearly level to moderately sloping. Elevations range from 5,800 to 6,500 feet.

Prewitt soils are closely related to Manzano soils, but they are more youthful than those soils, are calcareous throughout the profile, and lack a B2 horizon, which those soils have. They are darker colored than La Fonda soils and lack the B2 horizon common in those soils.

Typical profile of Prewitt loam, in the northeast corner of NW¼ sec. 23, T. 3 N., R. 6 E.

A1—0 to 8 inches, brown (7.5YR 5/3) loam, dark brown (7.5YR 3/3) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; weakly calcareous; clear boundary.

AC—8 to 18 inches, brown (7.5YR 5/4) light clay loam, dark brown (7.5YR 3/4) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; weakly calcareous; clear boundary.

C—18 to 60 inches, brown (7.5YR 5/4) light clay loam, dark brown (7.5YR 4/4) when moist; massive; hard when dry, friable when moist; strongly calcareous; few soft concretions of calcium carbonate in the lower part.

The texture of the A horizon is loam, silt loam, or very fine sandy loam. In places there is as much as 8 inches of recent overburden on the surface. The color of the A horizon ranges from 7.5YR to 5YR in hue, from 4 to 5.5 in value when dry and from 2 to 3.5 when moist, and from 2 to 3 in chroma. The thickness ranges from 4 to 10 inches. In most places the C horizon is loam to clay loam, stratified in places with layers of coarser and finer material. The color ranges from 5YR to 10YR in hue. Soft concretions of soluble salts occur in the lower strata in places.

Rance series

The Rance series consists of shallow and moderately deep, well-drained, medium-textured, light brownish-gray soils. These soils are calcareous and mildly to strongly alkaline. They developed in medium-textured, calcareous, gypsiferous piedmont deposits derived from red-bed material containing gypsum, quartzite, siltstone, and limestone. They are on level to gently sloping uplands, mainly in the southeastern and southwestern parts of the Area.

In the Torrance Area, Rance soils are mapped only as a complex with Gypsum land. They are shallower and lighter colored than La Fonda soils and are less strongly developed than those soils. Also, they are underlain by gypsum, which is uncommon in La Fonda soils.

Typical profile of Rance silt loam, SE¼SW¼NW¼ sec. 18, T. 4 N., R. 15 E.

A1—0 to 3 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; strong, very fine, granular structure; soft when dry, very friable when moist; strongly calcareous; clear boundary.

AC—3 to 13 inches, pale-brown (10YR 6/3) silt loam, dark brown (10YR 4/3) when moist; weak, medium, subangular blocky structure breaking to moderate, fine, granular; slightly hard when dry, very friable when moist; very strongly calcareous; gradual boundary.

C1—13 to 26 inches, pale-brown (10YR 6/3) silt loam, dark brown (10YR 4/3) when moist; massive; slightly hard when dry, very friable when moist; very strongly calcareous; few very fine crystals of calcium sulfate; clear boundary.

C2—26 inches +, white (10YR 8/2), silty, gypsiferous material, light gray (10YR 7/2) when moist; structureless; soft when dry, very friable when moist; probably 60 percent calcium sulfate; very strongly calcareous.

The texture of the A1 and AC horizons ranges from silt loam to fine sandy loam. The color ranges from 7.5YR to 2.5Y in hue, from 6 to 7 in value when dry and from 3 to 5 when moist, and from 2 to 4 in chroma. The thickness ranges from 8 to 20 inches. The texture of the C horizon ranges from loam or silt loam to light clay loam. The color ranges from 7.5YR to 2.5Y in hue, from 6 to 8 in value when dry and from 4 to 7 when moist, and from 2 to 4 in chroma. The depth to the C2 horizon ranges from 15 to 35 inches. The content of calcium sulfate ranges from 20 to 90 percent.

Salas series

This series consists of moderately deep to deep, dark-brown, well-drained soils. These soils are noncalcareous and neutral to mildly alkaline. They are medium textured. They developed in residuum weathered from schist, gneiss, and igneous rock. They occur on very strongly sloping to very steep western slopes of the Manzano Mountains. Elevations range from 6,200 to 7,500 feet.

Salas soils have a textural B2t horizon, which is uncommon in Mirabal soils. They lack the A2 horizon common in Osha soils and are finer textured in their B2t horizon than those soils.

Typical profile of Salas stony loam, NW¼ sec. 6, T. 5 N., R. 5 E.

A1—0 to 6 inches, dark-brown (7.5YR 4/2) stony loam, dark brown (7.5YR 3/2) when moist; moderate, fine, granular structure; soft when dry, friable when moist; noncalcareous; pH 7.0; approximately 30 percent stones; clear boundary.

B1—6 to 12 inches, reddish-brown (5YR 4/3) stony light clay loam, dark reddish brown (5YR 3/3) when moist; moderate, medium, subangular blocky structure; hard when dry, friable when moist; few, thin, patchy clay films on vertical faces of peds; noncalcareous; pH 7.4; approximately 30 percent stones; clear boundary.

B2t—12 to 23 inches, reddish-brown (5YR 5/3) stony silty clay loam, reddish brown (5YR 4/3) when moist; moderate, fine, subangular blocky structure; very hard when dry, firm when moist; thin, continuous clay films; noncalcareous; pH 7.2; about 30 percent stones; gradual boundary.

B3—23 to 31 inches, reddish-brown (5YR 5/4) stony clay loam, reddish brown (5YR 4/4) when moist; weak, fine, subangular blocky structure; hard when dry, friable when moist; thin, patchy clay films on all ped faces; noncalcareous; pH 7.4; approximately 30 percent stones; clear, wavy boundary.

R—31 to 33 inches +, light olive-gray schist bedrock; strong plate cleavage; massive.

The texture of the A1 horizon ranges from stony sandy loam to stony loam. The color ranges from 7.5YR to 10YR in hue, from 3 to 5.5 in value when dry and from 2 to 3.5 when moist, and from 1.5 to 3 in chroma. The thickness ranges from 5 to 10 inches. The B2t horizon ranges in texture from stony light clay loam or stony silty clay loam to stony clay loam. The color ranges from 2.5YR to 7.5YR in hue, from 4 to 6 in value when dry and from 3 to 5 when moist, and from 2 to 4 in chroma. The thickness ranges from 6 to 18 inches. Stones and gravel make up 20 to 70 percent of the profile. The B horizon is generally less stony than the A1 horizon. The depth to bedrock ranges from 20 to 50 inches.

Scholle series

This series consists of shallow to moderately deep, brown, well-drained, medium-textured soils on nearly level to strongly sloping fans. These soils are mildly to moderately alkaline. They developed in gravelly, medium-textured to moderately fine textured, calcareous, fan piedmont sediments derived mainly from quartzite, schist, gneiss, igneous rock, and limestone. They occur in the southwestern and eastern parts of the Area on slopes facing all directions. Elevations range from 6,000 to 6,800 feet.

Scholle soils occur mainly in association with Chilton soils. They differ from those soils in having a textural B2t horizon, in being noncalcareous, and in having less gravel in the profile. They are shallower to the strong ca horizon than Witt soils and contain more gravel than those soils.

Typical profile of Scholle gravelly loam, NW¼NW¼ sec. 14, T. 3 N., R. 6 E.

A1—0 to 5 inches, brown (7.5YR 5/3) gravelly loam, dark brown (7.5YR 4/3) when moist; moderate, fine, subangular blocky structure (uppermost 2 inches is moderate, fine, granular); soft when dry, very friable when moist; noncalcareous; about 20 percent gravel; clear boundary.

B2t—5 to 12 inches, reddish-brown (5YR 5/4) gravelly clay loam, reddish brown (5YR 4/4) when moist; weak, fine, prismatic structure breaking to moderate, fine, subangular blocky; hard when dry, friable when moist; noncalcareous to very weakly calcareous; patchy clay films; about 20 percent gravel; clear, wavy boundary.

B3ca—12 to 15 inches, light-brown (7.5YR 6/3) gravelly clay loam, brown (7.5YR 5/3) when moist; moderate to strong, very fine, subangular blocky structure; slightly hard when dry, very friable when moist; very strongly calcareous; moderate ca horizon in which calcium carbonate occurs as soft concretions; patchy clay films; about 35 percent gravel; gradual, wavy boundary.

C1ca—15 to 24 inches, pinkish-white (7.5YR 8/2) gravelly loam, pinkish gray (7.5YR 6/2) when moist; massive; slightly hard when dry, very friable when moist; very strongly calcareous; strong ca horizon in which calcium carbonate occurs in finely divided forms; about 30 percent gravel; gradual, wavy boundary.

C2ca—24 to 60 inches +, pink (5YR 7/4) gravelly loam, light reddish brown (5YR 6/4) when moist; massive; slightly hard when dry, very friable when moist; very strongly calcareous; moderate ca horizon in which calcium carbonate occurs in finely divided forms and as soft concretions; about 20 percent gravel.

The texture of the A horizon ranges from loam or gravelly loam to fine sandy loam. The color ranges from 7.5YR to 10YR in hue, from 5 to 6 in value when dry and from 3 to 5.5 when moist, and from 2 to 4 in chroma. The thickness ranges from 4 to 8 inches. The texture of the B2t horizon ranges from heavy loam or gravelly heavy loam to clay loam or gravelly clay loam. The color ranges from 5YR to 7.5YR in hue, from 5 to 6 in value when dry and from 4 to 5 when moist, and from 3 to 5 in chroma. The thickness ranges from 6 to 16 inches. In most places the texture of the C horizon is loam, gravelly loam, or gravelly clay loam. The color ranges from 5YR to 7.5YR in hue, from 6 to 8 in value when dry and from 5 to 7 when moist, and from 3 to 5 in chroma. The gravel content ranges from 5 to 30 percent in the surface horizon and from 15 to 60 percent in the subsoil and substratum. These soils are normally noncalcareous to a depth of 6 or 8 inches, but in some areas they are calcareous throughout. The depth to the strong ca horizon ranges from 15 to 36 inches.

Stroupe series

This series consists of dark-brown, moderately deep, well-drained, medium-textured, very stony soils. These soils are noncalcareous and neutral to moderately alkaline. They developed in residuum weathered from sandstone and felsite. They occur on moderately sloping to very steep, west- and south-facing slopes of the Gallinas Mountains in the southern part of the Area. Elevations range from 6,800 to 7,800 feet.

Stroupe soils are stony and are shallower than Tecolote soils. They lack the thick A2 horizon of those soils and are finer textured in the B2t horizon. They are browner, shallower, and more stony than Wilcoxson soils. They are shallower than Pinata soils and more alkaline, and they lack an A2 horizon, which those soils have.

Typical profile of Stroupe stony loam, NW¼ sec. 31, T. 1 N., R. 12 E.

A1—0 to 4 inches, dark-brown (7.5YR 4/3) stony loam, dark brown (7.5YR 3/3) when moist; moderate, fine, granular structure; soft when dry, very friable when moist; noncalcareous; pH 7.2; about 85 percent stones; clear boundary.

B1—4 to 7 inches, dark-brown (7.5YR 4/3) stony loam, dark brown (7.5YR 4/3) when moist; moderate, fine, subangular blocky structure; hard when dry, very friable when moist; noncalcareous; pH 7.4; thin, patchy clay films; about 25 percent stones; clear boundary.

B2t—7 to 12 inches, brown (7.5YR 5/4) stony clay, dark brown (7.5YR 4/4) when moist; weak, fine, prismatic structure breaking to moderate, fine, subangular blocky; hard when dry, friable when moist; noncalcareous; pH 7.6; thin, continuous clay films; about 30 percent stones; gradual, wavy boundary.

B3ca—12 to 20 inches, brown (7.5YR 5/4) stony clay, dark brown (7.5YR 4/4) when moist; weak to moderate, fine, subangular blocky structure; hard when dry, very friable when moist; weakly calcareous; pH 8.0; weak ca horizon in which calcium carbonate occurs as soft concretions and as thin seams; thin, patchy clay films; about 85 percent of this horizon is stones; gradual boundary.

C—20 to 24 inches +, partly weathered, fractured felsite bedrock; material from the B3ca horizon in fractures.

The texture of the A horizon ranges from stony loam to stony sandy clay loam. The color ranges from 7.5YR to 10YR in hue, from 4 to 5.5 in value when dry and from 2 to 3.5 when moist, and from 2 to 4 in chroma. The thickness ranges from 3 to 7 inches. The texture of the B2t horizon ranges from heavy clay loam to clay. The color ranges from 5YR to 7.5YR in hue, from 5 to 7 in value when dry and from 4 to 6 when moist, and from 3 to 5 in chroma. The C horizon tongues into the rock. Its color and texture are similar to that of the B horizon. Stones, cobblestones, and gravel make up 30 to 90 percent of the A horizon, 15 to 35 percent of the upper part of the B horizon, and 50 to 95 percent of the lower part of the B horizon and of the C horizon. The depth to bedrock ranges from 20 to 40 inches.

Supervisor series

This series consists of dark grayish-brown, moderately deep, well-drained, medium-textured soils. These soils are very strongly acid to neutral. They developed in residuum weathered from schist and quartzite bedrock. They occur on north- and east-facing, very steep canyon side slopes in the Manzano Mountains. Elevations range from 7,500 to 8,000 feet. The vegetation consists of mixed conifers.

Supervisor soils occur on opposite slopes from Mirabal soils. They are less stony, finer textured, and more acid than those soils, and they have a thicker A horizon. They lack the textural B2t horizon that is common in Capillo soils.

Typical profile of Supervisor loam, NE¼ sec. 21, T. 5 N., R. 5 E.

O1—3 inches to 0, undecomposed and partly decomposed leaves, needles, and twigs.

A1—0 to 13 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) when moist; weak, medium, granular structure; soft when dry, very friable when moist; noncalcareous; pH 6.8; about 10 percent of this horizon is stones; gradual boundary.

AC—13 to 26 inches, grayish-brown (10YR 5/2) stony loam, dark brown (10YR 3/3) when moist; very weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist; noncalcareous; pH 4.8; about 40 to 50 percent stones; gradual boundary.

C—26 to 30 inches, very pale brown (10YR 7/4) stony loam, dark yellowish brown (10YR 4/4) when moist; very weak, medium, subangular blocky structure; soft when dry, very friable when moist; noncalcareous; pH 5.2; considerable mica; about 80 percent stones; clear, irregular boundary.

R—30 to 49 inches +, very pale brown, hard schist bedrock.

In most places the A horizon is loam, stony loam, or silt loam. The color ranges from 10YR to 7.5YR in hue, from 3 to 5 in value when dry and from 2 to 3 when moist, and from 2 to 4 in chroma. The thickness ranges from 8 to 15 inches. The surface litter is 1 to 4 inches thick. In most places the C horizon is stony loam or stony silt loam. The color ranges from 7.5YR to 10YR in hue, from 5 to 7 in value when dry and from 3 to 5 when moist, and from 2 to 4 in chroma. The stone content increases with depth and makes up 10 to 25 percent of the A horizon and 30 to 90 percent of the C horizon. The depth to bedrock is normally less than 30 inches.

Tampico series

This series consists of deep, grayish-brown, well-drained, medium-textured soils. These soils are noncalcareous. They developed in gravelly, medium-textured, neutral to alkaline alluvium derived from felsite, sandstone, limestone, shale, and schist. They occur in narrow, high mountain valleys in the Manzano and Gallinas Mountains. Elevations range from 7,200 to 8,000 feet.

Tampico soils occur in a cooler, wetter climate than Manzano and Prewitt soils. They are more deeply leached of carbonates than those soils, and they contain more rock in the lower horizons.

Typical profile of Tampico loam, in the NW¼SW¼ sec. 24, T. 1 S., R. 11 E.

A1—0 to 19 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure breaking to weak, fine, crumb; slightly hard when dry, very friable when moist; pH 6.8; gradual boundary.

AC—19 to 38 inches, brown (7.5YR 5/3) gravelly heavy loam, dark brown (7.5YR 4/3) when moist; moderate, medium and coarse, subangular blocky structure; hard when dry, friable when moist; neutral; pH 7.0; about 20 percent gravel; gradual boundary.

C—38 to 60 inches +, reddish-brown (5YR 5/4) gravelly clay loam, reddish brown (5YR 4/4) when moist; massive; very hard when dry, firm when moist; mildly alkaline; pH 7.4; about 35 percent gravel.

The texture of the A1 horizon is loam, gravelly loam, silt loam, or gravelly silt loam. The color ranges from 10YR to 7.5YR in hue, from 4 to 5.5 in value when dry and from 2 to 3.5 when moist, and from 2 to 4 in chroma. The thickness ranges from 10 to 30 inches. The texture of the C horizon ranges from gravelly loam to gravelly heavy clay loam. The color ranges from 10YR to 5YR in hue, from 5 to 7 in value when dry and from 3 to 5 when moist, and from 2 to 4 in chroma. The content of coarse fragments in the lower horizons does not exceed 40 percent.

Tapia series

The Tapia series consists of shallow to moderately deep, light-brown, well-drained, medium-textured soils. These soils are noncalcareous and mildly to moderately alkaline. They developed in calcareous, medium-textured to moderately fine textured piedmont fan deposits derived from limestone, quartzite, schist, gneiss, and igneous rock. They occur on nearly level to moderately sloping uplands in the western and eastern parts of the Area. Elevations range from 5,800 to 7,000 feet.

Tapia soils are shallower over indurated caliche than Witt soils. They are browner than Hassell soils, have an indurated ca horizon, and show little or no influence of red-bed parent materials. Tapia soils are normally noncalcareous in the upper part and have a textural B2t horizon, which is uncommon in Dean and Pinon soils.

Typical profile of Tapia loam, near the center of NW1/4 sec. 1, T. 4 N., R. 7 E.

A1—0 to 3 inches, brown (7.5YR 5/3) loam, dark brown (7.5YR 3/3) when moist; moderate, very fine, granular structure; soft when dry, very friable when moist; noncalcareous; clear boundary.

B1—3 to 6 inches, brown (7.5YR 5/4) light clay loam, dark brown (7.5YR 4/4) when moist; weak, fine, subangular blocky structure; slightly hard when dry, very friable when moist; noncalcareous; patchy clay films; clear boundary.

B2t—6 to 15 inches, light-brown (7.5YR 6/4) clay loam, brown (7.5YR 4/4) when moist; weak, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard when dry, friable when moist; noncalcareous; few hard concretions of calcium carbonate in the lower part; nearly continuous clay films; clear boundary.

B3ca—15 to 21 inches, light-brown (7.5YR 6/4) gravelly light clay loam, brown (7.5YR 5/4) when moist; weak, medium, subangular blocky structure; extremely hard when dry, friable when moist; very strongly calcareous; ca horizon in which calcium carbonate occurs as hard concretions and in finely divided forms; many fragments of caliche; clear boundary.

IICca—21 inches +, white, weakly fractured, indurated caliche; massive; few fine particles in fractures.

In most places the texture of the A horizon is loam or light loam. The color ranges from 7.5YR to 10YR in hue, from 5 to 6 in value when dry and from 3 to 5 when moist, and from 2 to 4 in chroma. The thickness ranges from 3 to 6 inches. The texture of the B horizon ranges from light clay loam to heavy clay loam. The color ranges from 5YR to 7.5YR in hue, from 5.5 to 7 in value when dry and from 4 to 6 when moist, and from 3 to 5 in chroma. The thickness of the solum ranges from 12 to 35 inches. The texture of the C horizon is loam, gravelly loam, light clay loam, clay loam, or gravelly clay loam. The color ranges from 7.5YR to 10YR in hue, from 6 to 8 in value when dry and from 5 to 7 when moist, and from 2 to 4 in chroma. In most places the indurated layer is less than 10 inches thick, grading to softer material with depth. Caliche gravel makes up 20 to 50 percent of the lower horizons. In places these soils are calcareous in the A and B horizons.

Tecolote series

This series consists of deep, well-drained, gray soils on strongly sloping to very steep mountain side slopes. These soils are stony and medium textured and are neutral to mildly alkaline. They developed in residuum or in locally transported material weathered from felsite. They occur on south- and north-facing slopes in the Gallinas Mountains. Elevations range from 7,000 to 8,000 feet.

Tecolote soils are coarser textured than Crest soils and have a much thicker A2 horizon. They are coarser textured in their B horizon and have a thicker A2 horizon than Pinata soils. They have an A2 horizon, which is uncommon in Erramouspe soils.

Typical profile of Tecolote stony loam, SE1/4NE1/4 sec. 9, T. 1 S., R. 11 E.

O1—3 inches to 0, undecomposed and partly decomposed leaves, needles, and twigs.

A1—0 to 3 inches, gray (10YR 5/1) stony loam, very dark gray (10YR 3/1) when moist; moderate to strong, fine, crumb structure; soft when dry, very friable when moist; noncalcareous; pH 6.6; about 30 percent stones; gradual boundary.

A2—3 to 20 inches, pinkish-white (7.5YR 8/2) stony very fine sandy loam, pinkish gray (7.5YR 6/2) when moist; weak, fine, subangular blocky structure breaking to moderate, very fine, granular; soft when dry, very friable when moist; noncalcareous; pH 7.4; vesicular; about 30 percent stones; gradual, wavy boundary.

A2 & B2t—20 to 35 inches, pinkish-white (7.5YR 8/2) stony very fine sandy loam, pinkish gray (7.5YR 6/2) when moist, with aggregates of reddish-brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) when moist; weak, fine, subangular blocky structure breaking to moderate, fine, granular; slightly hard when dry, very friable when moist; noncalcareous; pH 6.6; vesicular; clay flows in channels and nodules; about 60 percent stones; gradual, wavy boundary.

B2t—35 to 50 inches +, reddish-brown (5YR 5/4) stony clay loam, reddish brown (5YR 4/4) when moist; moderate, fine, subangular blocky structure; hard when dry, friable when moist; noncalcareous; pH 6.4; thin, continuous clay films; about 60 percent stones.

The texture of the A1 horizon ranges from stony fine sandy loam to stony silt loam. The color ranges from 7.5YR to 10YR in hue, from 5 to 6 in value when dry and from 2 to 4 when moist, and from 1 to 2 in chroma. The thickness ranges from 0 to 4 inches. The surface litter is patchy and as much as 4 inches in thickness. The A2 horizon ranges from stony fine sandy loam to stony loam in texture. The color ranges from 7.5YR to 10YR in hue, from 7 to 8 in value when dry and from 5 to 6 when moist, and from 2 to 3 in chroma. The thickness ranges from 12 to 20 inches. The texture of the B horizon ranges from stony sandy clay loam to stony heavy clay loam. The color ranges from 5YR to 7.5YR in hue, from 5 to 6 in value when dry and from 4 to 5 when moist, and from 3 to 5 in chroma. Stones, cobblestones, and gravel make up 20 to 60 percent of the A horizon and 40 to 80 percent of the B horizon. In most places the depth to bedrock is more than 40 inches.

Tesajo series

The Tesajo series consists of deep, well-drained, grayish-brown, gravelly soils on piedmont fans on western slopes of the Manzano Mountains. These soils are noncalcareous and mildly to moderately alkaline. They are coarse textured. They developed in coarse-textured fan deposits derived from mixed schist and igneous rocks. They occur on gently sloping to strongly sloping uplands at elevations of 5,600 to 6,000 feet.

Tesajo soils are coarser textured and more gravelly than Chilton soils, and they lack the strong ca horizon common in those soils. They lack the distinct textural B2t horizon of Washoe soils. They are noncalcareous and are coarser textured than Ildefonso soils, and they lack the strong ca horizon common in those soils.

Typical profile of Tesajo gravelly sandy loam, SE¼ sec. 6, T. 7 N., R. 4 E.

A1—0 to 21 inches, brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 3/3) when moist; weak, fine, subangular blocky structure breaking to moderate, coarse, granular; slightly hard when dry, very friable when moist; noncalcareous; pH 6.8; approximately 60 percent fine granite gravel; gradual, wavy boundary.

C—21 to 45 inches +, pale-brown (10YR 6/3) very gravelly sandy loam, dark brown (10YR 4/3) when moist; massive, or weak, fine, subangular blocky structure; slightly hard when dry, very friable when moist; noncalcareous; pH 7.2; approximately 90 percent fine gravel and a few coarse pebbles.

The texture of the A horizon ranges from gravelly loam to gravelly coarse sandy loam. The color is within the hue 10YR. It ranges from 4 to 5.5 in value when dry and from 2 to 3.5 when moist, and from 1.5 to 3 in chroma. The thickness ranges from 16 to 30 inches. The texture of the C horizon ranges from gravelly loam to gravelly coarse sandy loam. The color ranges from 7.5YR to 10YR in hue. The gravel content ranges from 30 to 70 percent in the A horizon and from 50 to 95 percent in the C horizon. The lower part of the profile is slightly calcareous in some places.

Trail series

The Trail series consists of pale-brown, somewhat excessively drained, coarse-textured soils on moderately to strongly sloping, hummocky uplands. These soils are noncalcareous and mildly to moderately alkaline. They developed in calcareous, coarse-textured, wind-reworked alluvial material derived from quartzite and limestone. They occur in the southern part of the Area at elevations of 6,200 to 6,500 feet.

Trail soils are noncalcareous and are deeper than Chupadera soils, and they are coarser textured in the C horizon than those soils. They lack the textural B2t horizon common in Palma soils. Trail soils are weakly developed and lack the textural B2t horizon of Penistaja soils. They are coarser textured than Otero soils and lack the ca horizon common in those soils.

Typical profile of Trail loamy fine sand, SE¼ sec. 26, T. 2 N., R. 10 E.

A1—0 to 7 inches, pale-brown (10YR 6/3) loamy fine sand, dark brown (10YR 4/3) when moist; single grain; loose when dry or moist; noncalcareous; pH 7.6; gradual, wavy boundary.

C—7 to 60 inches, brown or strong-brown (7.5YR 5/5) fine sand, brown to dark brown (7.5YR 4/4) when moist; single grain; soft when dry, very friable when moist; noncalcareous; pH 7.8; few pebbles in the lower part.

The texture of the A horizon ranges from heavy loamy fine sand to fine sand. The color ranges from 7.5YR to 10YR in hue, from 5.5 to 7 in value when dry and from 3.5 to 5 when moist, and from 3 to 5 in chroma. The thickness ranges from 5 to 12 inches. The texture of the C horizon ranges from loamy fine sand to fine sand. The color ranges from 5YR to 7.5YR in hue. In many areas the lower part of the substratum is calcareous. The soil is normally leached free of calcium carbonate to a depth of more than 20 inches.

Travessilla series

This series consists of very shallow, brown, well-drained soils on nearly level to moderately sloping upland ridgetops. These soils are noncalcareous and mildly to moderately alkaline. They are medium textured to moderately coarse textured. They developed in residuum weathered from moderately coarse grained, noncalcareous sandstone bedrock of the Glorieta formation. They occur in all parts of the Area except the northwest part. Elevations range from 6,000 to 7,000 feet.

Travessilla soils differ from Bernal soils in being very shallow and in lacking a textural B2t horizon.

Typical profile of Travessilla fine sandy loam, SW¼NE¼SW¼ sec. 15, T. 9 N., R. 13 E.

A1—0 to 2 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) when moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; few small sandstone pebbles; clear boundary.

C—2 to 6 inches, brown (7.5YR 5/3) light loam, dark brown (7.5YR 3/2) when moist; weak, medium, subangular blocky structure breaking to moderate, fine, granular; slightly hard when dry, very friable when moist; noncalcareous; few small sandstone pebbles; abrupt, irregular boundary.

R—6 inches +, yellowish-red sandstone bedrock; massive; noncalcareous; some fractures.

The texture of the A1 and C horizons ranges from loam to fine sandy loam. The color ranges from 7.5YR to 10YR in hue, from 5 to 6 in value when dry and from 3 to 5 when moist, and from 2 to 3 in chroma. The thickness of the solum normally ranges from 4 to 8 inches, but in a few areas it is as much as 15 inches. In places a thin layer of needles and twigs is on the surface. Stones and outcrops cover 10 to 25 percent of the surface.

Turkeysprings series

The Turkeysprings series consists of stony, moderately deep to deep, well-drained, medium-textured, dark grayish-brown soils on strongly sloping to very steep canyon side slopes. These soils are calcareous and mildly to moderately alkaline. They developed in residuum weathered from limestone bedrock of the Madera formation. They occur mainly on south-facing slopes of the eastern foothills of the Manzano Mountains. Elevations range from 6,400 to 7,000 feet.

In many places Turkeysprings soils are on opposite slopes from Wilcoxson soils. They are stonier and generally shallower than those soils and are less strongly developed. They also differ from those soils in having a calcareous surface horizon. They are deeper than Laporte soils and have a textural B2t horizon, which is uncommon in those soils. Turkeysprings soils are stony and are shallower than Witt soils, and they have a fine-textured B2t horizon, which is uncommon in those soils.

Typical profile of Turkeysprings stony loam, SW¼ sec. 23, T. 7 N., R. 6 E.

O1—1 inch to 0, decomposing leaves, needles, and twigs; abrupt boundary.

A1—0 to 2 inches, dark grayish-brown (10YR 4/2) stony loam, very dark brown (10YR 2/2) when moist; moderate, fine and medium, crumb structure; soft when dry, very friable when moist; weakly calcareous; pH 8.0; approximately 30 percent stones; clear boundary.

A3—2 to 9 inches, dark grayish-brown (10YR 4/2) stony clay loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, subangular blocky structure breaking to moderate, medium, granular; slightly hard when dry, friable when moist; weakly calcareous; pH 8.0; approximately 40 percent stones; clear boundary.

B2t—9 to 16 inches, brown (7.5YR 5/2) stony clay, dark brown (7.5YR 4/2) when moist; weak, fine, subangular blocky structure; very hard when dry, firm when moist; strongly calcareous; pH 8.0; patchy clay films; approximately 40 percent stones; clear, wavy boundary.

B3ca—16 to 24 inches, pale-brown (10YR 6/3) stony silty clay loam, dark brown (10YR 4/3) when moist; very weak, fine, subangular blocky structure; hard when dry, friable when moist; very strongly calcareous; pH 8.2; weak ca horizon in which calcium carbonate occurs as thin seams; patchy clay films; approximately 40 percent stones; clear, wavy boundary.

Cca—24 to 36 inches, very pale brown (10YR 7/3) stony silt loam, brown (10YR 5/3) when moist; massive; soft when dry, very friable when moist; very strongly calcareous; pH 8.4; weak or moderate ca horizon in which calcium carbonate occurs as thin seams; approximately 80 percent stones; abrupt, wavy boundary.

R—36 to 42 inches +, light brownish-gray limestone bedrock, partly weathered in the upper part; massive.

The texture of the A horizon ranges from stony loam to stony clay loam. The color is within the 10YR hue. It ranges from 4 to 5 in value when dry and from 2 to 3 when moist, and from 1.5 to 3 in chroma. The thickness ranges from 4 to 10 inches. The texture of the B2t horizon ranges from stony heavy clay loam to stony clay. The color ranges from 7.5YR to 10YR in hue, from 5 to 6 in value when dry and from 3 to 5 when moist, and from 2 to 4 in chroma. The thickness ranges from 8 to 15 inches. The C horizon is lighter colored and coarser textured than the B horizon and contains more stones. The ca horizons range from weak to strong. The stone content ranges from 20 to 40 percent in the A and B horizons and from 40 to 80 percent in the C horizon.

Washoe series

The Washoe series consists of deep, light brownish-gray, well-drained, medium-textured, gravelly soils. These soils are noncalcareous and neutral to mildly alkaline. They developed in noncalcareous, moderately fine textured fan piedmont sediments derived from quartzite, schist, gneiss, shale, igneous rocks, and limestone. They occur in the western part of the Area on eastern and southeastern foot slopes of the Manzano Mountains. Elevations range from 7,000 to 8,000 feet.

Washoe soils are gravelly throughout the profile; they lack the ca horizons common in Witt soils. They differ from Scholle soils in lacking a ca horizon and in having a thicker, finer textured B2t horizon than those soils. Washoe soils are noncalcareous and darker colored than Chilton soils, and they have a textural B2t horizon.

Typical profile of Washoe gravelly loam, in a gravel pit near the east quarter corner of sec. 4, T. 5 N., R. 6 E.

A1—0 to 6 inches, light brownish-gray (10YR 6/2) gravelly loam, dark grayish brown (10YR 4/2) when moist; weak, thin, platy structure breaking to moderate, fine, granular; soft when dry, very friable when moist; noncalcareous; approximately 25 percent gravel; clear boundary.

B1—6 to 9 inches, brown (7.5YR 5/3) gravelly light clay loam, dark brown (7.5YR 4/3) when moist; weak, fine, subangular blocky structure; hard when dry, very friable when moist; noncalcareous; pH 7.2; patchy clay films; approximately 20 percent gravel; clear boundary.

B2t—9 to 25 inches, reddish-brown (5YR 5/4) very gravelly clay loam, reddish brown (5YR 4/4) when moist; moderate, fine, angular and subangular blocky structure; hard when dry, very friable when moist; noncalcareous; pH 7.4; continuous clay films; approximately 60 percent gravel; gradual boundary.

B3—25 to 44 inches, reddish-yellow (7.5YR 6/6) very gravelly clay loam, strong brown (7.5YR 5/6) when moist; weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist; noncalcareous; pH 7.6; patchy clay films; approximately 70 percent gravel; gradual boundary.

C—44 to 60 inches +, brown to strong-brown (7.5YR 5/5) very gravelly loam, dark brown to strong brown (7.5YR 4/5) when moist; massive; slightly hard when dry, very friable when moist; noncalcareous; approximately 75 percent gravel.

The texture of the A horizon ranges from gravelly very fine sandy loam to gravelly heavy loam. The color ranges from 7.5YR to 10YR in hue, from 5 to 7 in value when dry and from 3 to 5 when moist, and from 1.5 to 3 in chroma. The thickness ranges from 3 to 8 inches. The texture of the B2t horizon ranges from gravelly light clay loam to gravelly heavy clay loam. The color ranges from 5YR to 7.5YR in hue, from 5 to 6 in value when dry and from 4 to 5 when moist, and from 3 to 5 in chroma. The thickness of the solum ranges from 15 to 50 inches. The lower part is weakly calcareous in some places. In most places the C horizon is lighter colored and coarser textured than the overlying horizons and contains more gravel. The gravel content ranges from 15 to 40 percent in the surface horizon and from 30 to 70 percent in the subsoil and substratum. A thin layer of decomposing litter is on the surface in some places.

Wilcoxson series

This series consists of moderately deep to deep, dark-brown, well-drained, medium-textured to moderately fine textured soils on nearly level to strongly sloping uplands and on very steep mountain slopes. These soils are mildly to strongly alkaline. They developed in residuum weathered from limestone. They occur in the western and southern parts of the Area, on slopes of all aspects, at elevations ranging from 6,500 to 8,000 feet.

Wilcoxson soils are similar to Turkeysprings soils but are finer textured, less stony, and generally deeper. Also, they are noncalcareous in the surface horizon. They are more alkaline than Pinata soils and have a ca horizon, which those soils lack. Wilcoxson soils are deeper than Laporte soils and have a textural B2t horizon, which is uncommon in those soils.

Typical profile of Wilcoxson clay loam, SW¼ sec. 23, T. 7 N., R. 6 E.

A1—0 to 2 inches, dark-brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) when moist; weak, thin, platy structure breaking to moderate, fine, granular; hard when dry, very friable when moist; noncalcareous; pH 7.3; clear boundary.

A3—2 to 9 inches, dark-brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/4) when moist; moderate, medium, granular structure; hard when dry, friable when moist; noncalcareous; pH 7.4; clear boundary.

B21t—9 to 14 inches, reddish-brown (5YR 5/3) clay, dark reddish brown (5YR 3/3) when moist; weak to moderate, medium, subangular blocky structure; very hard when dry, firm when moist; weakly calcareous; pH 7.6; continuous clay films; clear boundary.

B22t—14 to 20 inches, reddish-brown (5YR 5/4) clay, reddish brown (5YR 4/4) when moist; strong, coarse, subangular blocky structure; very hard when dry, firm when moist; strongly calcareous; pH 8.2; continuous clay films; clear boundary.

B3—20 to 37 inches, reddish-brown (5YR 5/4) clay, reddish brown (5YR 4/4) when moist; weak, coarse, subangular blocky structure; very hard when dry, firm when moist; strongly calcareous; pH 8.2; nearly continuous clay films; few pebbles; clear boundary.

Cca—37 to 42 inches +, pinkish-white (5YR 8/2) silty clay loam, reddish gray (5YR 5/2) when moist; massive; hard when dry, friable when moist; very strongly calcareous; pH 8.6; moderate to strong ca horizon in which calcium carbonate occurs mostly in finely divided forms.

The texture of the A horizon ranges from loam or stony loam to clay loam or stony clay loam. The color ranges from 7.5YR to 10YR in hue, from 3 to 5 in value when dry and from 2 to 3.5 when moist, and from 2 to 4 in chroma. The thickness ranges from 4 to 12 inches. As much as 5 inches of decomposing litter is on the surface in places. The texture of the B2t horizon range from heavy silty clay loam or stony heavy silty clay loam to heavy clay or stony clay. The color ranges from 5YR to 7.5YR in hue, from 5 to 6 in value when dry and from 3 to 5 when moist, and from 2 to 4 in chroma. The thickness of the solum ranges from 20 to 50 inches. The texture of the C horizon ranges from loam or stony loam to clay loam or stony clay loam. The color ranges from 2.5YR to 2.5Y in hue. Stone and gravel do not occur in all profiles. These soils are noncalcareous to a depth of 30 inches in places.

Willard series

The Willard series consists of shallow and moderately deep, light brownish-gray, well-drained soils. These soils are calcareous and mildly to strongly alkaline. They are medium textured and moderately coarse textured. They developed in calcareous, medium-textured and moderately fine textured lacustrine lake deposits derived from quartzite, schist, gneiss, igneous rock, and limestone. They occur mainly on level to nearly level lake terraces in the Estancia, Encino, and Pinos Wells Lake Basins at elevations of 5,800 to 6,200 feet.

Willard soils are finer textured and less alkaline than Pedrick soils. They lack the gravelly substratum and the strong ca horizon common in Ildefonso soils. They differ from Harvey soils in not having a strong ca horizon and in having developed in lacustrine deposits rather than piedmont fan sediments.

Typical profile of Willard loam, NW¼NW¼NW¼ sec. 12, T. 6 N., R. 8 E.

A1—0 to 8 inches, light brownish-gray (10YR 6/2) loam or very fine sandy loam, dark grayish brown (10YR 4/2) when moist; very weak, medium, subangular blocky structure breaking to moderate, very fine, granular; slightly hard when dry, very friable when moist; strongly calcareous; clear boundary.

AC—8 to 11 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; very strongly calcareous; thin, patchy clay films on vertical faces; gradual boundary.

C—11 to 18 inches, pale-brown (10YR 6/3) clay loam, brown (10YR 5/3) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; very strongly calcareous; thin, patchy clay films on vertical faces; gradual boundary.

Cca—18 to 26 inches, light yellowish-brown (2.5Y 6/3) light clay loam, light olive brown (2.5Y 5/3) when moist; weak to moderate, fine, subangular blocky structure; hard when dry, friable when moist; very strongly calcareous; weak ca horizon in which calcium carbonate occurs as small soft concretions; the structure is typical of the parent sediments.

IIC—26 inches +, stratified yellowish, olive, and grayish, calcareous lacustrine sediments, mainly of clay loam texture.

The texture of the A horizon ranges from loam to fine sandy loam. The color is within the 10YR hue. It ranges from 5 to 6 in value when dry and from 3.5 to 5 when moist, and from 2 to 4 in chroma. The thickness of the A horizon ranges from 4 to 15 inches. The texture of the AC horizon ranges from heavy fine sandy loam to clay loam. The color ranges from 10YR to 2.5Y in hue, from 5 to 7 in value when dry and from 4 to 6 when moist, and from 2 to 4 in chroma. The thickness ranges from 3 to 8 inches. The texture of the C horizon ranges from loam or silt loam to clay or silty clay. The color ranges from 10YR to 5Y in hue. The wide color range results from gleying and concentration of salts, lime, and iron. In many places the lower part of the C horizon is stratified with sand, silt, and clay and is sometimes mottled because of a fluctuating water table and restricted internal drainage. In places these soils are noncalcareous to a depth of about 8 inches.

Witt series

The Witt series consists of deep, well-drained, brown soils on nearly level to strongly sloping uplands. These soils are moderately fine textured to moderately coarse textured. They developed in calcareous, medium-textured to moderately fine textured piedmont deposits derived from quartzite, schist, gneiss, igneous rock, and limestone. They occur in the western part of the Area at elevations of 6,200 to 7,000 feet.

Witt soils are noncalcareous and are darker colored than Harvey soils (fig. 37, p. 140). They have a textural B2t horizon, which is uncommon in those soils. They differ from Alicia soils in having a strong ca horizon and in having a B2t horizon. Witt soils are deeper over a strong ca horizon than Clovis soils.

Typical profile of Witt loam, northeast corner of NW¼SE¼ sec. 20, T. 6 N., R. 8 E.

A1—0 to 5 inches, brown (7.5YR 5/3) loam, dark brown (7.5YR 4/3) when moist; weak, thick, platy structure breaking to weak, very fine, granular; soft when dry, very friable when moist; noncalcareous; about 1 inch of recent deposition on the surface; gradual boundary.

B21t—5 to 13 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) when moist; weak to moderate, medium, prismatic structure breaking to moderate to strong, coarse, granular; hard when dry, friable when moist; noncalcareous; continuous clay films; clear boundary.

B22t—13 to 21 inches, dark-brown (7.5YR 4/2) heavy clay loam, dark brown (7.5YR 3/2) when moist; weak to moderate, medium and coarse, prismatic structure breaking to moderate to strong, fine, blocky; very hard when dry, firm when moist; noncalcareous; continuous clay films; gradual boundary.

B3ca—21 to 47 inches, brown (7.5YR 5/4) light clay loam, dark brown (7.5YR 3/4) when moist; weak to moderate, medium and coarse, subangular blocky structure; very hard when dry, firm when moist; strongly calcareous; weak ca horizon in which calcium carbonate occurs as small soft concretions and in finely divided forms; patchy clay films; gradual boundary.

Cca—47 to 60 inches, pinkish-white (7.5YR 8/2) loam, pinkish gray (7.5YR 7/2) when moist; massive; hard when dry, friable when moist; very strongly calcareous; strong ca horizon in which calcium carbonate occurs as soft concretions and in finely divided forms.

The texture of the A horizon ranges from loam to fine sandy loam. The color ranges from 7.5YR to 10YR in hue, from 5 to 7 in value when dry and from 3 to 5 when moist, and from 2 to 4 in chroma. The thickness ranges from 4 to 7 inches. The texture of the B2t horizon ranges from light clay loam to heavy clay loam. The color ranges from 5YR to 7.5YR in hue, from 5 to 6 in value when dry and from 3 to 5 when moist, and from 2 to 4 in chroma. The thickness of the B2t horizon ranges from 16 to 32 inches. The texture of the C horizon ranges from loam to clay loam. The color ranges from a hue of 5YR to a hue slightly yellower than 7.5YR. The upper part of the profile is calcareous in some places. Weakly cemented ca horizons occur in some profiles. The thickness of the solum ranges from 30 to more than 60 inches. Buried soils with similar characteristics are common.

Laboratory Data

Data obtained by mechanical and chemical analysis of 11 selected soils in the Torrance Area are given in table 13. Such data are useful to soil scientists in classifying soils and in developing concepts of soil genesis. They are also helpful for estimating rate of water intake, water-holding capacity, alkalinity, organic-matter content, fertility, erodibility, and other properties significant in soil management. Profiles of the soils listed in the table are described in the following pages.

308-922—69——10

TABLE 13.—*Analytical*

[Analyses made at Soil Survey Laboratory, Soil Conservation Service,

Soil type, location of sample, and sample number	Horizon	Depth	Texture	Particle size distribution					
				Larger than 2 mm.	Very coarse sand (2–1 mm.)	Coarse sand (1–0.5 mm.)	Medium sand (0.5–0.25 mm.)	Fine sand (0.25–0.10 mm.)	Very fine sand (0.10–0.05 mm.)
		In.		*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Clovis loam (modal) (Location: NW¼NW¼NW¼ sec. 21, T. 2 N., R. 7 E.; sample No. S58NM-29-2-1 to 2-9; laboratory No. 568-576)	A1	0–7	Loam	0	0.1	0.5	0.4	5.5	27.2
	B2t	7–17	Clay loam	0	.1	.2	.2	6.4	24.9
	B3ca	17–23	Clay loam	0	.1	.4	.3	8.2	27.4
	C1ca	23–28	Clay loam	0	4.6	5.4	3.0	7.5	18.4
	C2ca	28–34	Loam	0	.8	2.0	1.4	5.5	20.3
	A1bca	34–41	Loam	0	1.6	1.0	.8	5.6	21.2
	B2tbca	41–46	Clay loam	0	.5	.6	.4	2.8	19.8
	B3bca	46–65	Silt loam	0	.2	.8	.6	3.3	18.5
	Cb	65–77							
Harvey loam (modal) (Location: SW¼SW¼SW¼ sec. 33, T. 7 N., R. 8 E.; sample No. S60NM-29-13-1 to 13-7; laboratory No. 772-779)	A	0–2							
	A1	2–13	Loam	0	1.0	1.5	1.1	12.0	19.1
	AC	13–25	Clay loam	0	.3	1.4	1.3	9.0	25.1
	C	25–34	Clay loam or loam	0	.8	1.6	1.7	10.7	24.6
	C1ca	34–42	Clay loam	0	.4	.9	1.1	11.4	27.8
	C2ca	42–50	Sandy clay loam	0	.3	1.1	1.4	15.4	33.0
	C3ca	50–62	Sandy clay loam	0	1.1	1.4	1.2	11.5	34.1
	B2bca	62	Sandy clay loam	0	4.0	4.3	2.2	12.4	29.3
Ildefonso fine sandy loam (modal) (Location: Lake shoreline terrace in SW¼SW¼ sec. 3, T. 6 N., R. 8 E.; sample No. S60NM-29-10-1 to 10-8; laboratory No. 749-756)	A1	1½–8	Sandy loam	14.4	9.2	16.2	14.6	11.0	18.5
	AC	8–14	Sandy loam	12.8	6.7	16.4	15.3	11.4	17.0
	C1ca	14–20	Gravelly sandy loam	42.7	10.3	19.9	20.3	13.7	8.9
	C2ca	20–30	Loamy coarse sand	13.6	13.6	26.6	17.4	12.1	10.3
	IIC	30–32	Clay loam or loam	0	2.5	7.4	3.7	9.2	22.2
	B2b1ca	32–36	Silty clay loam	0	.9	1.0	1.4	5.6	7.3
	B2b2ca	36–45	Silty clay loam or silty clay.	0	.1	.5	.7	3.4	5.1
	B2b3ca	45–49							
	B3bca	49–59	Clay loam	0	0	.5	.7	5.4	22.1
Ildefonso fine sandy loam (modal) (Location: Bench between shoreline terraces in SE¼NE¼ sec. 33, T. 7 N., R. 8 E.; sample No. S60NM-29-12-1 to 12-7; laboratory No. 765-771)	Ap	0–8	Fine sandy loam or very fine sandy loam.	11.6	5.0	11.5	10.8	18.2	30.3
	A1	8–9	Fine sandy loam	11.1	3.2	9.3	10.8	18.7	26.8
	AC	9–13	Fine sandy loam or gravelly fine sandy loam.	15.0	4.6	9.8	12.0	21.0	20.5
	C1ca	13–19	Gravelly sandy loam.	33.4	6.4	11.5	14.3	24.0	8.0
	C2ca	19–26	Gravelly coarse sandy loam.	36.1	8.4	18.0	14.5	23.4	9.4
	IIC	26–35	Loam	0	2.6	7.6	6.3	10.9	14.7
	IIIC	35–46	Gravelly coarse sandy loam.	20.7	10.3	20.9	12.1	13.9	17.4
	IVC	46–48							
	VC	48–60							
Otero loamy fine sand (nonmodal) (Location: NW¼SW¼SE¼ sec. 34, T. 1 N., R. 8 E.; sample No. S58NM-29-1a-1 to 1a-9; laboratory No. 559-567)	A11	0–4	Loamy fine sand	0	.2	1.8	8.4	58.5	17.2
	A12	4–15	Loamy fine sand	0	.1	2.2	8.5	58.2	12.1
	AC	15–32	Fine sandy loam	0	.3	2.8	10.0	53.6	11.0
	C1ca	32–38	Fine sandy loam	0	.2	2.4	7.6	46.6	17.0
	C2ca	38–42	Fine sandy loam	0	.4	2.4	8.2	49.4	18.1
	C	42–52	Loamy fine sand	0	.2	2.7	9.6	54.1	16.1
	IIC1	52–63	Fine sand	0	3.2	10.0	17.5	51.0	8.5
	IIC2	63–78	Fine sand		.1	4.5	12.5	65.5	10.8
	IIIC	78	Fine sand						

See footnote at end of table.

data for selected soils

University Park, N. Mex. Dashes indicate value was not determined]

Particle size distribution—Continued		Chemical analysis										
Silt (0.05–0.002 mm.)	Clay (<0.002 mm.)	Reaction (saturated paste)	Organic matter: Organic carbon	Organic matter: Nitrogen	Estimated salt content[1]	Electrical conductivity (Ecx10³)	$CaCO_3$ equivalent	Cation-exchange capacity	Extractable cations: Ca	Extractable cations: Mg	Extractable cations: Na	Extractable cations: K
Pct.	*Pct.*	*pH*	*Pct.*	*Pct.*	*Pct.*	*Mmhos. per cm.*	*Pct.*	*Meq./100 gm. of soil*	*Meq./100 gm. of soil*	*Meq./100 gm. of soil*	*Meq./100 gm. of soil*	*Meq./100 gm. of soil*
44. 6	21. 7	—	0. 63	0. 136	0. 12	0. 9	0. 7	—	12. 2	2. 8	0. 5	1. 5
33. 8	34. 4	—	. 39	. 094	. 11	1. 0	1. 5	—	18. 0	5. 6	. 6	. 7
28. 1	35. 5	—	. 32	. 087	. 07	. 9	3. 8	—	22. 6	11. 9	. 7	. 5
31. 4	29. 7	—	. 20	. 046	. 11	. 6	42. 9	—	—	—	. 7	. 3
45. 4	24. 6	—	. 12	. 040	. 11	1. 1	19. 5	—	28. 1	7. 0	. 9	. 4
44. 7	25. 1	—	. 10	. 037	. 13	1. 1	18. 2	—	25. 6	—	1. 0	. 4
42. 8	33. 1	—	. 05	. 034	. 15	1. 2	6. 4	—	25. 6	9. 9	1. 9	. 5
55. 1	21. 5	—	—	—	—	—	—	—	—	—	—	—
45. 9	19. 4	7. 8	1. 03	. 098	—	—	12. 1	25. 7	—	—	—	—
32. 7	30. 2	7. 8	. 61	. 064	—	—	28. 2	26. 7	—	—	—	—
33. 0	27. 6	7. 9	. 43	. 045	—	—	28. 4	24. 8	—	—	—	—
24. 4	34. 0	8. 0	. 24	. 024	—	—	40. 5	19. 7	—	—	—	—
19. 3	29. 5	7. 9	. 15	. 012	—	—	31. 2	18. 9	—	—	—	—
21. 4	29. 3	7. 8	. 12	. 014	—	—	30. 4	12. 7	—	—	—	—
19. 9	27. 9	7. 8	. 07	. 010	—	—	27. 9	18. 5	—	—	—	—
17. 0	13. 5	7. 5	. 76	. 084	—	—	4. 9	—	—	—	—	—
18. 1	15. 1	7. 4	. 77	. 355	—	—	9. 8	—	—	—	—	—
15. 7	11. 2	7. 4	. 66	. 092	—	—	16. 3	—	—	—	—	—
11. 9	8. 1	7. 6	. 24	. 036	—	—	12. 1	—	—	—	—	—
27. 2	27. 8	7. 5	. 23	. 033	—	—	20. 5	—	—	—	—	—
53. 0	30. 8	7. 5	. 17	. 022	—	—	43. 7	—	—	—	—	—
51. 1	39. 1	7. 5	. 09	. 016	—	—	38. 8	—	—	—	—	—
32. 9	38. 4	7. 3	. 05	0. 09	—	—	13. 6	—	—	—	—	—
13. 7	10. 5	8. 2	. 35	. 041	—	—	2. 3	14. 7	—	—	—	—
19. 1	12. 1	8. 1	. 48	. 061	—	—	5. 8	15. 1	—	—	—	—
19. 0	13. 1	8. 3	. 48	. 069	—	—	11. 3	16. 3	—	—	—	—
22. 4	13. 4	8. 4	. 53	. 067	—	—	15. 6	14. 5	—	—	—	—
16. 5	9. 8	8. 4	. 25	. 028	—	—	17. 3	9. 3	—	—	—	—
38. 6	19. 3	7. 9	. 25	. 031	—	—	24. 7	19. 2	—	—	—	—
15. 5	9. 9	8. 0	. 19	. 017	—	—	11. 5	13. 6	—	—	—	—
6. 3	7. 6	—	. 25	—	<. 02	1. 0	—	—	14. 1	. 8	. 9	. 4
11. 8	7. 1	—	. 20	—	<. 02	. 9	—	—	19. 2	1. 0	. 8	. 2
11. 8	10. 5	—	. 12	. 035	<. 02	. 9	—	—	17. 6	—	. 9	. 2
11. 7	14. 5	—	. 10	—	. 07	1. 0	—	—	22. 1	2. 1	. 9	. 2
10. 6	10. 9	—	. 08	. 030	. 05	1. 0	—	—	—	4. 3	1. 0	. 2
7. 7	9. 6	—	. 07	. 026	<. 02	1. 0	—	—	23. 8	—	. 6	. 2
0	9. 8	—	. 04	. 031	<. 02	. 9	—	—	21. 0	—	. 5	. 1
1. 6	4. 8	—	. 04	. 028	. 09	. 4	—	—	12. 6	. 9	. 5	. 1

TABLE 13.—*Analytical data for*

Soil type, location of sample, and sample number	Horizon	Depth	Texture	Particle size distribution					
				Larger than 2 mm.	Very coarse sand (2–1 mm.)	Coarse sand (1–0.5 mm.)	Medium sand (0.5–0.25 mm.)	Fine sand (0.25–0.10 mm.)	Very fine sand (0.10–0.05 mm.)
		In.		*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Pedrick loamy fine sand (modal) (Location: NE¼NE¼NE¼ sec. 1, T. 4 N., R. 8 E.; sample No. S58NM–29–3–1 to 3–5; laboratory No. 577–581)	A1	0–4	Loamy fine sand	0	0	0.2	4.6	32.8	47.4
	AC	4–17	Very fine sandy loam	0	0	.2	4.7	34.2	36.8
	C	17–21	Very fine sandy loam	0	.1	.3	4.0	29.6	33.7
	IIC1	21–35	Very fine sandy loam	0	.1	.5	3.2	24.3	27.0
	IIC2	35–56	Loam	0	--------	.4	1.6	12.8	31.6
	IIC3	56	--------	--------	--------	--------	--------	--------	--------
Penistaja fine sandy loam (modal) (Location: 60 feet southeast of cattle guard in NW¼SW¼ sec. 14, T. 3 N., R. 8 E.; sample No. S60NM–29–15–1 to 15–6; laboratory No. 823–828)	A1	0–4	Fine sandy loam	0	.2	.9	3.5	35.7	24.3
	B1	4–12	Sandy clay loam	0	0	.4	3.3	34.5	19.8
	B2t	12–20	Sandy clay loam	0	.1	.5	2.7	30.3	20.3
	B31ca	20–31	Sandy clay loam	0	.4	.8	2.9	31.9	18.9
	B32ca	31–52	Sandy clay loam	0	.3	.8	3.6	39.9	20.8
	Cca	52–62	Sandy clay loam or fine sandy loam.	0	.7	1.8	3.9	42.7	17.8
Tapia loam (nonmodal) (Location: SW¼SW¼SW¼ sec. 9, T. 3 N., R. 12 E.; sample No. S60NM–29–17–1 to 17–7; laboratory No. 836–842)	A1	0–5	Clay loam	0	.3	1.1	2.9	15.6	9.8
	B1	5–8	Clay loam	0	.2	.8	2.4	13.3	9.4
	B21t	8–12	Clay or clay loam	0	.3	.9	2.3	12.0	9.9
	B22t	12–18	Clay loam	0	.2	.8	2.2	12.7	16.5
	B31ca	18–23	Clay loam	0	.2	.8	2.4	14.0	17.1
	B32ca	23–33	Clay loam	0	.4	1.5	3.5	18.8	18.7
	Cca	33–48	Sandy loam	0	10.6	12.8	9.4	21.9	14.7
Willard loam (modal) (Location: NE¼NE¼NE¼ sec. 36, T. 8 N., R. 8 E.; Sample No. S58 NM–29–6–1 to 6–8; laboratory No. 592–599)	A11	0–4	Very fine sandy loam	0	.3	1.7	1.0	10.1	52.6
	A12	4–9	Very fine sandy loam	0	0	1.3	.6	9.6	56.1
	AC	9–15	Very fine sandy loam	0	.2	1.0	.9	8.3	55.2
	C1	15–20	Very fine sandy loam or loam.	0	0	.4	.5	10.0	38.2
	C2	20–28	--------	--------	--------	.3	.3	7.5	--------
	IIC	28–32	Silt loam	0	0	0	.2	3.5	14.0
	IIIC	32–41	Silty clay loam	0	0	.2	.4	3.0	12.0
	IVC	41–55	Silty clay	0	0	.4	.8	4.0	7.1
Witt loam (modal) (Location: NE¼SE¼NE¼ sec. 4, T. 6 N., R. 8 E.; sample No. S60NM–29–14–1 to 14–11; laboratory No. 780–790)	A11	0–2	Loam	0	<.1	.4	.4	3.2	42.4
	A12	2–6	Loam	0	.1	.6	.8	7.3	33.6
	B21t	6–12	Clay or clay loam	0	.1	.5	.8	5.1	23.4
	B22t	12–17	Clay loam	0	.1	.4	.5	4.3	21.7
	B31ca	17–23	Silty clay loam	0	.4	.6	.5	4.9	12.7
	B32ca	23–32	Clay loam	0	.6	1.0	.8	7.0	15.0
	C1ca	32–43	Clay loam	0	3.6	4.0	2.3	9.4	11.8
	C2ca	43–53	Clay loam	0	4.2	4.8	3.8	11.3	16.4
	B21bca	53–62	Silty clay loam	0	.3	.8	.8	3.7	14.1
	B22bca	62–71	Clay loam	0	.4	.6	.9	5.0	19.1
	IIB2tbca	71–84	Silty clay	0	.1	<.1	.1	.5	5.0
Witt loam (nonmodal) (Location: SW¼NE¼NW¼ sec. 16, T. 5 N., R. 6 E.; sample No. S58NM–29–8–1 to 8–9; laboratory No. 608–616)	A1	0–3	Loam	0	.2	.9	.8	6.8	37.2
	B1	3–8	Loam	0	.2	.8	.6	7.5	30.7
	B2t	8–12	Clay loam	0	.3	.7	.5	5.0	24.5
	B3	12–22	Silty clay loam	0	.3	.6	.5	4.8	13.3
	A1bca	22–29	Loam	0	1.1	1.0	.8	8.2	19.6
	B21tbca	29–37	Clay loam	0	1.1	1.1	1.0	8.8	23.7
	B22tb	37–47	Clay loam	0	.6	.6	.3	5.2	26.3
	B3bca	47–62	Clay loam	0	.3	.5	.6	8.8	30.8
	Cbca	62–84	Sandy clay loam	0	1.0	1.4	1.1	9.1	34.0

Bureau of Soils cup.

selected soils—Continued

Particle size distribution—Continued		Chemical analysis											
Silt (0.05–0.002 mm.)	Clay (<0.002 mm.)	Reaction (saturated paste)	Organic matter		Estimated salt content[1]	Electrical conductivity (Ecx10³)	$CaCO_3$ equivalent	Cation-exchange capacity	Extractable cations			
			Organic carbon	Nitrogen					Ca	Mg	Na	K
Pct.	*Pct.*	*pH*	*Pct.*	*Pct.*	*Pct.*	*Mmhos. per cm.*	*Pct.*	*Meq./100 gm. of soil*	*Meq./100 gm. of soil*	*Meq./100 gm. of soil*	*Meq./100 gm. of soil*	*Meq./100 gm. of soil*
8.2	6.8	----	.24	.051	.05	1.1	----	----	18.3	1.9	0.6	0.6
16.9	7.2	----	.23	.058	<.02	.9	----	----	21.3	2.0	.7	.3
20.5	11.8	----	.21	.060	<.02	.9	----	----	21.9	2.4	.6	.2
31.8	13.1	----	.21	.066	<.02	.8	----	----	20.6	5.2	.6	.2
38.1	15.5	----	.15	.035	.07	1.4	----	----	22.9	----	.8	.2
17.3	18.1	7.4	1.02	.066	----	----	.2	9.4	5.3	1.0	.4	1.0
17.1	24.9	7.0	.72	.067	----	----	0	14.4	8.7	2.3	.9	.4
14.1	32.0	7.2	.45	.072	----	----	.2	16.4	8.7	3.1	.5	.5
17.7	27.4	7.9	.42	.047	----	----	.2	14.6	9.5	3.8	1.0	.6
10.9	23.7	8.0	.24	.042	----	----	.3	14.0	13.1	3.7	1.1	.3
12.2	20.9	8.0	.15	.021	----	----	13.7	8.9	27.2	2.4	1.3	.3
31.8	38.5	7.4	1.54	.124	----	----	.4	19.5	21.6	4.8	.5	1.1
35.3	38.6	7.6	1.40	.124	----	----	----	24.0	20.3	2.0	.9	.7
33.8	40.8	7.4	.99	.073	----	----	.3	24.5	19.8	7.3	1.2	.7
30.4	37.2	7.8	.79	.079	----	----	2.8	22.6	38.2	5.6	1.4	1.2
33.5	32.0	8.2	.53	.087	----	----	3.6	19.8	37.3	6.7	1.9	1.0
29.0	28.1	8.1	.38	.087	----	----	4.4	17.0	40.0	5.8	2.7	1.0
16.3	14.3	7.4	.42	.017	----	----	35.5	10.6	40.3	3.8	5.0	1.0
26.2	8.1	----	.46	.092	.05	1.1	10.1	----	29.6	----	.4	.4
22.2	10.2	----	.46	.094	.05	.9	12.2	----	30.6	14.3	.4	.2
24.7	9.7	----	.47	.079	.02	.9	15.8	----	30.7	13.0	.4	.2
42.4	8.5	----	.31	.062	<.02	.9	17.2	----	17.4	12.5	.4	.2
----	9.0	----	.21	.042	<.02	1.0	15.4	----	28.9	12.6	.5	.2
58.4	23.9	----	.21	.050	.10	1.5	32.8	----	29.4	13.5	1.5	.4
45.6	38.8	----	.30	.016	.14	4.0	51.9	----	15.8	13.0	2.9	.4
43.7	44.0	----	.26	.057	.17	10.0	62.6	----	18.0	14.2	3.6	.3
34.9	18.7	7.9	1.31	.101	----	----	1.0	----	----	----	----	----
38.1	19.5	7.7	.81	.078	----	----	.4	----	----	----	----	----
29.7	40.4	7.4	1.07	.115	----	----	.3	----	----	----	----	----
37.5	35.5	7.9	.92	.102	----	----	3.7	----	----	----	----	----
50.7	30.2	8.0	.53	.064	----	----	5.6	----	----	----	----	----
47.1	28.5	8.1	.31	.041	----	----	4.7	----	----	----	----	----
39.4	29.5	8.0	.42	.040	----	----	39.4	----	----	----	----	----
29.2	30.3	7.8	.53	.027	----	----	50.9	----	----	----	----	----
48.1	32.2	8.0	.15	.014	----	----	50.8	----	----	----	----	----
41.5	32.5	8.1	.01	.008	----	----	39.5	----	----	----	----	----
48.9	45.4	7.9	.01	.013	----	----	39.1	----	----	----	----	----
39.5	14.6	----	.49	----	----	----	.2	----	8.0	2.3	.6	.4
36.1	24.1	----	.46	----	----	----	.2	----	10.3	3.1	.3	.4
40.0	29.0	----	.36	----	----	----	.2	----	12.8	3.9	.5	.4
51.6	28.9	----	.30	----	----	----	.4	----	14.0	3.9	.4	.3
43.6	25.7	----	.17	----	----	----	1.2	----	28.7	3.9	.5	.3
30.2	34.1	----	.17	----	----	----	1.2	----	28.7	4.6	.8	.4
30.3	36.7	----	.12	----	----	----	.8	----	26.8	5.9	1.3	.5
20.9	38.1	----	.05	----	----	----	1.4	----	23.1	5.2	1.4	.6
20.5	32.9	----	.04	----	----	----	5.6	----	----	----	----	----

Figure 37.—Profile of Witt and Harvey soils. The Witt soil is at the right. The Harvey soil is on the truncated slope at the left.

Field and laboratory methods

The samples used to obtain the data in table 13 were collected from carefully selected pits. Material larger than 2 millimeters in size, if any, was determined. All material passing a 2-millimeter sieve is reported on an ovendry basis with organic matter and soluble salts removed. The percentage figures are the percentages of material passing the 2-millimeter sieve.

Methods of the Soil Survey Laboratory were used to obtain most of the physical data. Particle size distribution was determined by the pipette method (*6*, *7*, *11*). The reaction of the saturated paste was measured with a glass electrode. Organic carbon was determined by a modification of the Walkley-Black wet-combustion method (*12*). A 77-percent recovery factor for this method was used. Nitrogen was determined by methods of analysis of the Association of Official Agricultural Chemists (*3*). The calcium carbonate equivalent was determined by a modified procedure of acid neutralization (*16*). The cation-exchange capacity was determined by flame photometric determination of adsorbed sodium (*16*). Extractable cations were extracted with 1 normal ammonium acetate (*12*). Calcium was precipitated as calcium oxalate and titrated with permanganate. Magnesium was precipitated as magnesium-ammonium phosphate, dissolved in sulfuric acid, then titrated with sodium hydroxide. Sodium and potassium were determined with the Perkin-Elmer flame photometer. The methods of the U.S. Salinity Laboratory were used to obtain the saturation extract (*16*).

Profiles of soils analyzed

Profiles of the soils listed in table 13 are described in the following pages. Two profiles representing the Ildefonso series and three representing the Witt series are described in order to show the range in profile characteristics.

CLOVIS LOAM (modal).—The profile described is in the NW¼NW¼NW¼ sec. 21, T. 2 N., R. 7 E. The soil is well drained. It formed in mixed piedmont deposits washed from quartzite, schist, gneiss, igneous rock, and limestone. The site is in an area of native range, on gently sloping upland fans.

A1—0 to 7 inches, dark-brown (10YR 4/3) loam, dark brown (10YR 3/3) when moist; weak, fine, crumb structure; slightly hard when dry, very friable when moist, sticky when wet; noncalcareous; clear boundary.

B2t—7 to 17 inches, dark-brown (7.5YR 3/4) clay loam, dark brown (7.5YR 3/4) when moist; weak, coarse, prismatic structure breaking to moderate, fine and medium, subangular blocky; very hard when dry, firm when moist, very sticky when wet; noncalcareous; continuous clay films; clear boundary.

B3ca—17 to 23 inches, brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) when moist; weak, fine and medium, subangular blocky structure; very hard when dry, firm when moist, very sticky when wet; very strongly calcareous; calcium carbonate occurs as soft concretions; continuous clay films; abrupt, irregular boundary.

C1ca—23 to 28 inches, pinkish-white (7.5YR 8/2) loam, brown (7.5YR 5/4) when moist; massive; very hard when dry, firm when moist, slightly sticky when wet; very strongly calcareous; calcium carbonate occurs in finely divided forms; clear, irregular boundary.

C2ca—28 to 34 inches, pinkish-white (7.5YR 8/2) loam, brown (7.5YR 5/4) when moist; massive; hard when dry, friable when moist, slightly sticky when wet; very strongly calcareous; calcium carbonate occurs in finely divided forms; clear boundary.

A1bca—34 to 41 inches, brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) when moist; massive to weak, medium, subangular blocky structure; hard when dry, friable when moist, slightly sticky when wet; very strongly calcareous; ped faces coated with calcium carbonate; clear boundary.

B2tbca—41 to 46 inches, light-brown (7.5YR 6/4) clay loam, dark brown (7.5YR 4/4) when moist; weak, fine and medium, subangular blocky structure; hard when dry, very friable when moist, sticky when wet; very strongly calcareous; calcium carbonate occurs as thin seams; interior of peds is noncalcareous; patchy clay films; iron manganese stains; clear boundary.

B3bca—46 to 65 inches, brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) when moist; weak, fine and medium, subangular blocky structure; hard when dry, very friable when moist, sticky when wet; very strongly calcareous; calcium carbonate occurs as thin seams; interior of peds is noncalcareous; patchy clay films; iron manganese stains; clear boundary.

Cb—65 to 77 inches +, brown (7.5YR 5/4) loam, reddish brown (5YR 4/4) when moist; massive; slightly hard when dry, very friable when moist, slightly sticky when wet; weakly calcareous.

Harvey loam (modal).—The profile described is in the SW¼SW¼SW¼ sec. 33, T. 7 N., R. 8 E. The soil is well drained. It formed in mixed piedmont deposits washed from quartzite, schist, gneiss, igneous rock, and limestone. Plant roots are abundant to a depth of 50 inches, and there are a few below this depth. The krotovinas in the C1ca horizon are old rodent burrows filled with soil from overlying horizons. The site is in an area of native range on side slopes of upland ridges, bordering a drainage channel.

A—0 to 2 inches (overwash), brown to dark-brown (7.5YR 4/3) loam, dark brown (7.5YR 4/3) when moist; weak, medium, platy structure breaking to weak, very fine, granular; soft when dry, very friable when moist, nonsticky when wet; strongly calcareous; abrupt boundary.

A1—2 to 13 inches, brown (7.5YR 5/4) loam, dark brown (7.5YR 4/3) when moist; weak, fine, granular structure; soft when dry, very friable when moist, slightly sticky when wet; strongly calcareous; abrupt, wavy boundary.

AC—13 to 25 inches, light-brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) when moist; weak, medium to coarse, subangular blocky structure; slightly hard when dry, very friable when moist, sticky when wet; very strongly calcareous; clear, irregular boundary.

C—25 to 34 inches, light-brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) when moist; massive; slightly hard when dry, very friable when moist, sticky when wet; very strongly calcareous; abrupt, wavy boundary.

C1ca—34 to 42 inches, pinkish-white (7.5YR 8/2) clay loam, light brown (7.5YR 6/4) when moist; massive; hard when dry, friable when moist, sticky when wet; few krotovinas; very strongly calcareous; calcium carbonate occurs mostly in finely divided forms; clear, wavy boundary.

C2ca—42 to 50 inches, pink (7.5YR 7/4) clay loam, light brown (7.5YR 6/4) when moist; massive; hard when dry, friable when moist, sticky when wet; numerous root channels; very strongly calcareous; calcium carbonate occurs in finely divided forms and as soft concretions; clear, wavy boundary.

C3ca—50 to 62 inches, light-brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) when moist; massive; very hard when dry, friable when moist, sticky when wet; very strongly calcareous; calcium carbonate occurs in finely divided forms and as soft concretions; clear, wavy boundary.

B2bca—62 inches +, light-brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) when moist; weak, fine, subangular blocky structure; hard when dry, friable when moist, sticky when wet; very strongly calcareous; many soft calcium carbonate concretions.

Ildefonso fine sandy loam (modal).—The profile described is in the SW¼SW¼ sec. 3, T. 6 N., R. 8 E. The soil is well drained. It formed in mixed lacustrine shoreline deposits. Plant roots are abundant to a depth of 30 inches; a few reach a depth of 32 inches, but there are none below that depth. The site is in an area of native range on convex lake shoreline terraces.

A—0 to 1½ inches (overwash), brown (10YR 5/3) loam, dark brown (10YR 4/3) when moist; weak, thin, platy structure breaking to weak, very fine, granular; slightly hard when dry, very friable when moist, nonsticky when wet; weakly calcareous; few waterworn pebbles; abrupt boundary.

A1—1½ to 8 inches, grayish-brown (10YR 5/2) gravelly fine sandy loam, dark brown (10YR 3/3) when moist; weak, very fine, granular structure; slightly hard when dry, very friable when moist, nonsticky when wet; strongly calcareous; few waterworn pebbles; gradual, wavy boundary.

AC—8 to 14 inches, light brownish-gray (10YR 6/2) gravelly fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, fine, granular structure; hard when dry, very friable when moist, slightly sticky when wet; very strongly calcareous; few waterworn pebbles; clear, wavy boundary.

C1ca—14 to 20 inches, light brownish-gray (10YR 6/2) gravelly fine sandy loam, dark grayish brown (10YR 4/2) when moist; single grain; hard when dry, very friable when moist, nonsticky when wet; very strongly calcareous; calcium carbonate occurs mostly in finely divided forms; many waterworn pebbles; clear, wavy boundary.

C2ca—20 to 30 inches, light brownish-gray (10YR 6/2) coarse sandy loam, dark grayish brown (10YR 4/2) when moist; single grain; slightly hard when dry, very friable when moist, nonsticky when wet; very strongly calcareous; calcium carbonate occurs mostly in finely divided forms; many pockets of sand and gravel; abrupt, wavy boundary.

IIC—30 to 32 inches, light brownish-gray (2.5Y 6/2) silty clay loam, light olive brown (2.5Y 5/4) when moist; massive; hard when dry, firm when moist, sticky when wet; very strongly calcareous; iron manganese stains; abrupt, wavy boundary.

B2b1ca—32 to 36 inches, pink (5YR 8/3) silty clay loam, light reddish brown (5YR 6/3) when moist; moderate, fine, subangular blocky structure; hard when dry, friable when moist, sticky when wet; very strongly calcareous; calcium carbonate occurs as soft concretions and thin seams; patchy clay films; abrupt, wavy boundary.

B2b2ca—36 to 45 inches, light reddish-brown (5YR 6/3) clay, reddish brown (5YR 5/3) when moist; strong, fine, blocky structure; very hard when dry, firm when moist, sticky when wet; very strongly calcareous; calcium carbonate occurs as seams and streaks and as soft concretions; continuous clay films; iron manganese stains; abrupt, wavy boundary.

B2b3ca—45 to 49 inches, pinkish-gray (5YR 7/2) silty clay loam, pink (5YR 7/4) when moist; moderate, fine, subangular blocky structure; hard when dry, friable when moist, sticky when wet; very strongly calcareous; calcium carbonate occurs mostly as soft concretions; continuous clay films; abrupt, wavy boundary.

B3bca—49 to 59 inches, light reddish-brown (5YR 6/3) clay, reddish brown (5YR 5/4) when moist; moderate, medium, subangular blocky structure; very hard when dry, firm when moist, sticky when wet; very strongly calcareous; calcium carbonate occurs mostly as thin seams and streaks; patchy clay films; iron maganese stains.

Ildefonso fine sandy loam (modal).—The profile described is in the SE¼NE¼ sec. 33, T. 7 N., R. 8 E. The soil is well drained. It formed in mixed shoreline terrace deposits. The site is an abandoned cultivated field on a bench between nearly level shoreline terraces.

Ap—0 to 8 inches, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/3) when moist; weak, fine, granular structure; soft when dry, very friable when moist, nonsticky when wet; few waterworn pebbles; strongly calcareous; abrupt boundary.

A1—8 to 9 inches, pinkish-gray (7.5YR 6/2) fine sandy loam, dark brown (7.5YR 4/2) when moist; moderate, fine, granular structure; slightly hard when dry, very friable when moist, slightly sticky when wet; few waterworn pebbles; strongly calcareous; abrupt, wavy boundary.

AC—9 to 13 inches, brown (10YR 5/3) sandy loam, dark brown (7.5YR 4/3) when moist; moderate, fine, granular structure; slightly hard when dry, very friable when moist, slightly sticky when wet; about 15 percent is gravel; very strongly calcareous; clear, wavy boundary.

C1ca—13 to 19 inches, light brownish-gray (10YR 6/2) gravelly sandy loam, brown (10YR 5/3) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist, nonsticky when wet; many waterworn pebbles; very strongly calcareous; calcium carbonate occurs mostly in finely divided forms; clear, wavy boundary.

C2ca—19 to 26 inches, pale-brown (10YR 6/3) gravelly sandy loam, brown (10YR 5/3) when moist; weak, fine, granular structure breaking to single grain; slightly hard when dry, very friable when moist, nonsticky when wet; many waterworn pebbles; very strongly calcareous; calcium carbonate occurs mostly in finely divided forms; diffuse, wavy boundary.

IIC—26 to 35 inches, very pale brown (10YR 7/3) silty clay loam, light yellowish brown (10YR 6/4) when moist; massive, breaking to weak, fine, granular structure; hard when dry, very friable when moist, sticky when wet; iron manganese stains; very strongly calcareous; calcium carbonate occurs mostly as soft concretions; clear, wavy boundary.

IIIC—35 to 46 inches, pale-brown (10YR 6/3) coarse sandy loam, dark yellowish brown (10YR 4/4) when moist; single grain; slightly hard when dry, very friable when moist, nonsticky when wet; iron manganese stains; few waterworn pebbles; very strongly calcareous; abrupt, wavy boundary.

IVC—46 to 48 inches, light-brown (7.5YR 6/4) gravelly clay loam, brown (7.5YR 5/4) when moist; massive; hard when dry, very friable when moist, sticky when wet; many waterworn pebbles; iron manganese stains; very strongly calcareous; calcium carbonate occurs mostly as soft concretions; abrupt, wavy boundary.

VC—48 to 60 inches +, light-brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) when moist; massive; hard when dry, very friable when moist, sticky when wet; iron manganese stains; few waterworn pebbles; very strongly calcareous; calcium carbonate occurs mostly as soft concretions.

OTERO LOAMY FINE SAND (nonmodal).—The profile described is in the NW¼SW¼SE¼ sec. 34, T. 1 N., R. 8 E. The soil is well drained to somewhat excessively drained. It formed in wind-reworked, mixed piedmont fan deposits. The site is in an area of native range on side slopes of rolling, wooded hills.

A11—0 to 4 inches, brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) when moist; weak, fine, crumb structure; soft when dry, very friable when moist, nonsticky when wet; weakly calcareous; clear boundary.

A12—4 to 15 inches, brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) when moist; weak, fine, crumb structure; slightly hard when dry, very friable when moist, slightly sticky when wet; strongly calcareous; a little caliche gravel; clear boundary.

AC—15 to 32 inches, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) when moist; massive; slightly hard when dry, very friable when moist, slightly sticky when wet; strongly calcareous; a little caliche gravel; gradual boundary.

C1ca—32 to 38 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) when moist; weak, medium to coarse, subangular blocky structure; hard when dry, very friable when moist, slightly sticky when wet; strongly calcareous; few caliche pebbles; calcium carbonate coatings on ped faces and in root channels; clear boundary.

C2ca—38 to 42 inches, brown (7.5YR 5/4) heavy sandy loam, dark brown (7.5YR 4/4) when moist; weak, medium to coarse, subangular blocky structure; hard when dry, friable when moist, sticky when wet; strongly calcareous; few caliche pebbles; calcium carbonate coatings on ped faces and in root channels; clear boundary.

C3—42 to 52 inches, brown (7.5YR 5/4) loamy fine sand, dark brown (7.5YR 4/4) when moist; massive; slightly hard when dry, very friable when moist, slightly sticky when wet; strongly calcareous; few caliche pebbles; clear boundary.

IIC4—52 to 63 inches, brown (7.5YR 5/4) fine sand, dark brown (7.5YR 4/4) when moist; single grain; soft when dry, very friable when moist, nonsticky when wet; strongly calcareous; numerous waterworn lime-coated pebbles; clear boundary.

IIC2—63 to 78 inches, brown (7.5YR 5/4) fine sand, dark brown (7.5YR 4/4) when moist; single grain; soft when dry, very friable when moist, nonsticky when wet; weakly calcareous; clear boundary.

IIIC—78 inches +, yellowish-red (5YR 5/6) fine sand, yellowish red (5YR 4/6) when moist; single grain; slightly hard when dry, very friable when moist, nonsticky when wet; weakly calcareous.

PEDRICK LOAMY FINE SAND (modal).—The profile described is in the NE¼NE¼NE¼ sec. 1, T. 4 N., R. 8 E. The soil is well drained. It formed in wind-reworked, mixed sandy alluvium. The IIC horizons are generally stratified and contain varying concentrations of lime, iron, and salts, which partly accounts for the mottled colors. The material in the IIC horizons consists of lacustrine sediments, deposited before the lake dried up. The site is in an area of native range on a slightly undulating lakebed terrace.

A1—0 to 4 inches, pale-brown (10YR 6/3) loamy fine sand, dark brown (10YR 4/3) when moist; single grain; loose when dry, loose when moist, nonsticky when wet; strongly calcareous; clear boundary.

AC—4 to 17 inches, brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) when moist; single grain or weak, granular structure; soft when dry, very friable when moist, nonsticky when wet; strongly calcareous; clear boundary.

C—17 to 21 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) when moist; single grain or moderate, granular structure; soft when dry, very friable when moist, nonsticky when wet; strongly calcareous; clear boundary.

IIC1—21 to 35 inches, very pale brown (10YR 7/3) fine sandy loam or sandy clay loam, pale brown (10YR 6/3) when moist; very weak, medium, subangular blocky structure; hard when dry, very friable when moist, slightly sticky when wet; very strongly calcareous; clear boundary.

IIC2—35 to 56 inches, white (10YR 8/1) heavy clay loam, light gray (10YR 7/1) when moist, mottled with brownish yellow (10YR 6/8) when dry, yellowish brown (10YR 5/8) when moist; massive; slightly hard when dry, friable when moist, sticky when wet; very strongly calcareous; iron manganese stains; clear boundary.

IIC3—56 inches +, light-gray (5Y 7/2) silty clay, light olive gray (5Y 6/2) when moist, mottled with yellowish brown (10YR 5/8) when dry, strong brown (7.5YR 5/6) when moist; massive; hard when dry, friable when moist, sticky when wet; very strongly calcareous; iron manganese stains.

PENISTAJA FINE SANDY LOAM (modal).—The profile described is in the NW¼SW¼ sec. 14, T. 3 N., R. 8 E. The soil is well drained. It formed in mixed piedmont fan deposits washed mainly from sandstone and limestone. Plant roots are abundant to a depth of 31 inches, and there are a few below that depth. The site is in an area of native range on moderately sloping upland fans.

A1—0 to 4 inches, brown (10YR 5/3) fine sandy loam, dark yellowish brown (10YR 3/4) when moist; weak, fine, granular structure; soft when dry, very friable when moist, nonsticky when wet; noncalcareous; clear boundary.

B1—4 to 12 inches, dark-brown (7.5YR 4/4) sandy clay loam, dark brown (7.5YR 4/4) when moist; weak, medium and coarse, prismatic structure breaking to weak, medium, subangular blocky; hard when dry, friable when moist, slightly sticky when wet; patchy clay films; noncalcareous; clear boundary.

B2t—12 to 20 inches, brown (7.5YR 5/4) heavy sandy clay loam, dark brown (7.5YR 3/4) when moist; weak, coarse, prismatic structure breaking to moderate, fine and medium, subangular blocky; very hard when dry, very firm when moist, slightly sticky when wet; continuous clay films; noncalcareous; clear, wavy boundary.

B31ca—20 to 31 inches, brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist, sticky when wet; patchy clay films; strongly calcareous; calcium carbonate occurs as thin seams and as soft concretions; gradual boundary.

B32ca—31 to 52 inches, strong-brown (7.5YR 5/6) light sandy clay loam, strong brown (7.5YR 4/6) when moist; weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist, slightly sticky when wet; patchy clay films; strongly calcareous; calcium carbonate occurs mostly as soft concretions; few krotovinas; gradual boundary.

Cca—52 to 62 inches +, pinkish-gray (5YR 7/2) fine sandy loam, light brown (7.5YR 6/4) when moist; massive; hard when dry, friable when moist, slightly sticky when wet; very strongly calcareous; calcium carbonate occurs mostly in finely divided forms.

TAPIA LOAM (nonmodal).—The profile described is in the SW¼SW¼SW¼ sec. 9, T. 3 N., R. 12 E. The soil is well drained. It formed in mixed piedmont fan deposits from quartzite, schist, gneiss, igneous rock, and limestone. Plant roots are abundant to a depth of 23 inches, and there are a few below that depth. The site is in an area of native range on gently sloping upland fans.

A1—0 to 5 inches, brown (10YR 5/3) loam, dark yellowish brown (10YR 3/4) when moist; weak, very fine, granular structure; slightly hard when dry, very friable when moist, slightly sticky when wet; noncalcareous; clear boundary.

B1—5 to 8 inches, dark-brown (10YR 4/3) clay loam, dark yellowish brown (10YR 3/4) when moist; weak, fine, subangular blocky structure breaking to moderate, fine, granular; slightly hard when dry, very friable when moist, sticky when wet; noncalcareous; abrupt boundary.

B21t—8 to 12 inches, dark-brown (7.5YR 4/3) heavy clay loam, dark brown (7.5YR 3/3) when moist; weak, fine, prismatic structure breaking to moderate, fine and medium, subangular blocky; hard when dry, firm when moist, sticky when wet; continuous clay films; noncalcareous; clear boundary.

B22t—12 to 18 inches, brown (10YR 5/3) heavy clay loam, dark brown (10YR 4/3) when moist; weak, medium, prismatic structure breaking to moderate, fine and medium, subangular blocky; very hard when dry, firm when moist, sticky when wet; continuous clay films; weakly calcareous; clear boundary.

B31ca—18 to 23 inches, brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) when moist; weak, medium and coarse, prismatic structure breaking to weak, fine and medium, subangular blocky; very hard when dry, firm when moist, sticky when wet; patchy clay films; very strongly calcareous; few soft calcium carbonate concretions; clear, wavy boundary.

B32ca—23 to 33 inches, light-brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) when moist; weak, medium and coarse, prismatic structure breaking to weak, fine and medium, subangular blocky; very hard when dry, firm when moist, sticky when wet; patchy clay films; few krotovinas; very strongly calcareous; many semihard calcium carbonate concretions; gradual, wavy boundary.

Cca—33 to 48 inches +, white (10YR 8/1) loam, very pale brown (10YR 7/3) when moist; massive; hard when dry, friable when moist, slightly sticky when wet; few krotovinas; few waterworn pebbles; uppermost 3 inches cemented; very strongly calcareous; partly indurated caliche.

WILLARD LOAM (modal).—The profile described is in the NE¼NE¼NE¼ sec. 36, T. 8 N., R. 8 E. The soil is well drained. It formed in lacustrine sediments, and the structure of the lower three horizons is characteristic of soils formed in this kind of material. The site is in an area of native range on a nearly level lake terrace.

A11—0 to 4 inches, pale-brown (10YR 6/3) very fine sandy loam, dark yellowish brown (10YR 4/4) when moist; weak, fine, granular structure; soft when dry, very friable when moist, slightly sticky when wet; very strongly calcareous; clear boundary.

A12—4 to 9 inches, pale-brown (10YR 6/3) very fine sandy loam, dark grayish brown (10YR 4/2) when moist; massive or weak, fine, granular structure; soft when dry, very friable when moist, slightly sticky when wet; very strongly calcareous; clear boundary.

AC—9 to 15 inches, pale-brown (10YR 6/3) very fine sandy loam, brown (10YR 5/3) when moist; massive, or weak, fine, granular structure; soft when dry, very friable when moist, slightly sticky when wet; very strongly calcareous; clear boundary.

C1—15 to 20 inches, pale-yellow (2.5Y 7/4) fine sandy loam, light yellowish brown (2.5Y 6/4) when moist; massive; soft when dry, very friable when moist, slightly sticky when wet; very strongly calcareous; clear, irregular boundary.

C2—20 to 28 inches, pale-yellow (2.5Y 7/4) fine sandy loam, light yellowish brown (2.5Y 6/4) when moist; massive, or weak, coarse, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; very strongly calcareous; abrupt, irregular boundary.

IIC—28 to 32 inches, white (2.5Y 8/2) to pale-yellow (2.5Y 8/4) silty clay loam, light gray (2.5Y 7/2) to pale yellow (2.5Y 7/4) when moist, mottled with olive yellow (2.5Y 6/8) when dry, light olive brown (2.5Y 5/6) when moist; weak, fine and medium, prismatic structure breaking to weak, medium, subangular blocky; hard when dry, friable when moist, slightly sticky when wet; very strongly calcareous; iron manganese stains; clear, irregular boundary.

IIIC—32 to 41 inches, white (2.5Y 8/0 to 8/2) silty clay loam, light gray (2.5Y 7/2) when moist; weak, fine and medium, subangular blocky structure; slightly hard when dry, friable when moist, very sticky when wet; very strongly calcareous; clear, irregular boundary.

IVC—41 to 55 inches +, white (2.5Y N 8/0) stratified silty clay, silt loam, and silty clay loam that is light gray (2.5Y 7/2) when moist; mottled with light gray (2.5Y 7/2) when dry, light brownish gray (2.5Y 6/2) when moist; massive; soft to very hard when dry, friable to firm when moist, very sticky when wet; very strongly calcareous; many soft concretions of calcium sulfate; calcium carbonate occurs in finely divided forms; iron manganese stains.

WITT LOAM (modal).—The profile described is in the NE¼SE¼NE¼ sec. 4, T. 6 N., R. 8 E. The soil is well drained. It formed in mixed piedmont fan deposits washed from quartzite, schist, gneiss, igneous rock, and limestone. Plant roots are abundant to a depth of 32 inches, and there are a few below that depth. The site is in an area of native range on nearly level upland ridge crests (elevation 6,200 feet).

A11—0 to 2 inches, brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) when moist; weak, medium, platy structure breaking to weak, very fine, granular; soft when dry, very friable when moist, slightly sticky when wet; noncalcareous; abrupt boundary.

A12—2 to 6 inches, brown (7.5YR 5/4) heavy loam, dark brown (7.5YR 3/4) when moist; weak, thick, platy structure breaking to moderate, fine, granular; soft when dry, very friable when moist, slightly sticky when wet; noncalcareous; clear boundary.

B21t—6 to 12 inches, dark-brown (7.5YR 4/3) clay loam, dark reddish brown (5YR 3/4) when moist; weak, medium, prismatic structure breaking to moderate, medium, subangular blocky and moderate, fine, granular; hard when dry, very friable when moist, sticky when wet; noncalcareous; continuous clay films; clear, wavy boundary.

B22t—12 to 17 inches, brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/3) when moist; weak, medium, prismatic structure breaking to moderate, medium, subangular blocky; hard when dry, very friable when moist, sticky when wet; weakly calcareous; continuous clay films; clear, wavy boundary.

B31ca—17 to 23 inches, brown (7.5YR 5/4) light clay loam, dark brown (7.5YR 4/3) when moist; weak, medium, prismatic structure breaking to weak, medium, subangular blocky; very hard when dry, friable when moist, slightly sticky when wet; very strongly calcareous; many soft concretions of calcium carbonate; nearly continuous clay films; clear, wavy boundary.

B32ca—23 to 32 inches, brown (7.5YR 5/4) heavy loam, dark brown (7.5YR 4/4) when moist; weak, medium, prismatic structure breaking to weak, medium and coarse, subangular blocky; very hard when dry, firm when moist, slightly sticky when wet; very strongly calcareous; calcium carbonate occurs as thin seams and as soft concretions; patchy clay films; clear, wavy boundary.

Cca—32 to 53 inches, white (7.5YR N 8/0) heavy loam, light brown (7.5YR 6/4) when moist; massive; hard when dry, very friable when moist, slightly sticky when wet; very strongly calcareous; calcium carbonate occurs in finely divided forms; gradual, wavy boundary. (This horizon was analyzed in two parts.)

B21bca—53 to 62 inches, pinkish-white (7.5YR 8/2) heavy loam, light brown (7.5YR 6/4) when moist; massive to weak, medium, granular structure; hard when dry, very friable when moist, slightly sticky when wet; very strongly calcareous; calcium carbonate occurs as soft concretions; iron manganese stains; gradual, wavy boundary.

B22bca—62 to 71 inches, pinkish-gray (7.5YR 7/2) heavy loam, brown (7.5YR 5/4) when moist; massive to weak, medium, granular structure; very hard when dry, firm when moist, slightly sticky when wet; very strongly calcareous; few soft calcium carbonate concretions; few iron manganese stains; abrupt, wavy boundary.

IIB2tbca—71 to 84 inches, reddish-brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) when moist; moderate, fine, subangular blocky structure; very hard when dry, firm when moist, sticky when wet; weakly calcareous; patchy clay films; some iron maganese stains; vertical pockets of massive caliche that is white (5YR 8/1) to pinkish gray (5YR 7/2) when moist and is hard when dry, very friable when moist, and slightly sticky when wet.

WITT LOAM (modal).—The profile described is in the NW¼NW¼SW¼ sec. 13, T. 9 N., R. 7 E. The soil is well drained. It formed in mixed piedmont fan deposits washed from quartzite, schist, gneiss, igneous rock, and limestone. The site is in an area of native range on gently sloping upland fans.

A1—0 to 3 inches, brown (10YR 5/3) loam, dark brown (10YR 4/3) when moist; weak, thin to medium, platy structure breaking to weak, fine, granular; soft when dry, very friable when moist, slightly sticky when wet; noncalcareous; clear boundary.

B21t—3 to 7 inches, dark-brown (7.5YR 4/4) heavy loam, dark brown (7.5YR 3/4) when moist; moderate, coarse, prismatic structure breaking to weak, fine to medium, subangular blocky; slightly hard when dry, very friable when moist, sticky when wet; patchy clay films; noncalcareous; clear boundary.

B22t—7 to 11 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) when moist; moderate, coarse, prismatic structure breaking to moderate, fine to medium, angular and subangular blocky; very hard when dry, friable when moist, sticky when wet; continuous clay films; noncalcareous; clear boundary.

B3—11 to 17 inches, brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) when moist; weak, coarse, prismatic structure breaking to weak, fine to medium, subangular blocky; very hard when dry, friable when moist, sticky when wet; continuous clay films; noncalcareous; clear boundary.

B31ca—17 to 26 inches, reddish-brown (5YR 5/4) loam, reddish brown (5YR 4/4) when moist; weak, medium, subangular blocky structure; very hard when dry, friable when moist, slightly sticky when wet; lime coatings on ped faces; nearly continuous clay films; weakly calcareous; clear boundary.

B32ca—26 to 32 inches, reddish-brown (5YR 5/4) loam, reddish brown (5YR 4/4) when moist; massive, or weak, coarse, subangular blocky structure; very hard when dry, friable when moist, slightly sticky when wet; lime coatings on ped faces; few lime concretions; patchy clay films; weakly calcareous; clear boundary.

C1ca—32 to 42 inches, pinkish-white (5YR 8/2) loam, pinkish gray (5YR 7/2) when moist; massive; hard when dry, friable when moist, nonsticky when wet; lime occurs in finely divided forms; very strongly calcareous; clear, wavy boundary.

C2ca—42 to 53 inches +, pinkish-gray (5YR 7/2) loam, light reddish brown (5YR 6/4) when moist; massive; slightly hard when dry, very friable when moist, nonsticky when wet; lime occurs in finely divided forms; very strongly calcareous.

WITT LOAM (nonmodal).—The profile described is in the SW¼NE¼NW¼ sec. 16, T. 5 N., R. 6 E. The soil is well drained. It formed in piedmont fan deposits washed from quartzite, schist, gneiss, igneous rock, and limestone. The site is in an area of native range on upland fans in the foothills of the Manzano Mountains (elevation 7,200 feet).

A1—0 to 3 inches, brown (7.5YR 5/4) loam, dark brown (7.5YR 4/2) when moist; weak, thin, platy structure breaking to weak, fine, granular; slightly hard when dry, very friable when moist, slightly sticky when wet; noncalcareous; clear boundary.

B1—3 to 8 inches, reddish-brown (5YR 4/4) light sandy clay loam, dark reddish brown (5YR 3/4) when moist; weak, fine and medium, prismatic structure breaking to weak, fine and medium, subangular blocky; hard when dry, very friable when moist, slightly sticky when wet; noncalcareous; patchy clay films; clear boundary.

B2t—8 to 12 inches, dark reddish-brown (5YR 3/3) clay loam, dark reddish brown (5YR 3/3) when moist; weak, fine and medium, prismatic structure breaking to moderate, fine and medium, angular and subangular blocky; very hard when dry, firm when moist, sticky when wet; noncalcareous; continuous clay films; clear boundary.

B3—12 to 22 inches, reddish-brown (5YR 4/4) silty clay loam, reddish brown (5YR 4/3) when moist; moderate, medium, angular and subangular blocky structure; very hard when dry, friable when moist, slightly sticky when wet; noncalcareous; continuous clay films; abrupt, wavy boundary.

A1bca—22 to 29 inches, brown (7.5YR 5/4) heavy loam, dark brown (7.5YR 4/4) when moist; weak, fine and medium, subangular blocky structure; very hard when dry, friable when moist, slightly sticky when wet; strongly calcareous; calcium carbonate occurs as thin seams; patchy clay films; clear boundary.

B21tbca—29 to 37 inches, reddish-brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) when moist; moderate, fine and medium, angular and subangular blocky structure; hard when dry, friable when moist, slightly sticky when wet; strongly calcareous; calcium carbonate occurs as thin seams; patchy clay films; gradual boundary.

B22tb—37 to 47 inches, reddish-brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) when moist; moderate, fine and medium, angular and subangular blocky structure; hard when dry, very friable when moist, slightly sticky when wet; calcareous; noncalcareous inside peds; patchy clay films; iron manganese and organic stains; a thin layer of waterworn gravel occurs above this horizon in opposite end of pit; clear boundary.

B3bca—47 to 62 inches, yellowish-red (5YR 5/6) clay loam, yellowish red (5YR 4/6) when moist; moderate, fine and medium, angular and subangular blocky structure; hard when dry, very friable when moist, sticky when wet; calcareous; noncalcareous inside peds; patchy clay films; iron manganese and organic stains; calcium carbonate occurs as soft concretions; clear boundary.

Cbca—62 to 84 inches, reddish-yellow (5YR 6/8) clay loam, yellowish red (5YR 5/8) when moist; mottled with pinkish white (5YR 8/2) to pink (5YR 8/3) when moist; massive, or weak, fine and medium, subangular blocky structure; hard when dry, friable when moist, slightly sticky when wet; very strongly calcareous; calcium carbonate occurs in finely divided forms and as soft concretions; patchy clay films.

Additional Facts About the Area

This section gives general facts about the Torrance Area. It briefly discusses the history and development of the Area, ranching and farming, and other subjects of general interest. The agricultural statistics used are from the Bureau of the Census.

History and development

The early inhabitants of the Torrance Area were Pueblo Indians. When explorers visited the Area in the 16th century, they found the Indians living in "many-storied houses" along the eastern side of the Sierra Morena Mountains, now called the Manzano Mountains. Early in the 17th century, Spanish missionaries founded mission churches near Abo, Punta de Aqua, Manzano, and Tajique.

The Indians raised turkeys and cultivated maize, beans, and gourds on soils mapped in this survey as the Witt-Wilcoxson-Turkeysprings association. They were a peace-loving people and were not prepared to defend themselves against the roving bands who attacked time after time until the Pueblos eventually fled across the Rio Grande. They returned to the area around Manzano early in the 18th century and began rebuilding their homes.

White settlers began arriving in the 18th century. They were mostly sheep ranchers, and their flocks roamed freely. The sheepmen were gradually displaced by homeseekers early in the 19th century. Some of the settlers established sawmills in the Manzano and Gallinas Mountains and cut lumber from logs harvested mainly from Tampico soils of the mountain valleys, for use in building homes, barns, and corrals. Remnants of some of these sawmills can still be found along the major roads leading into the mountains.

Before the coming of the railroads, the salt lakes in the Willard-Ildefonso-Karde association provided most of the salt supply for northern New Mexico. The salt was carried in wagons to Santa Fe and nearby points, where it was traded for grain and other supplies. Some of the salt was transported south into Mexico. The evaporation beds used for collecting the salt are still discernible at La Salina Grant, east of Willard.

Torrance County was organized in January 1905 from parts of Valencia, Lincoln, Socorro, and Bernalillo Counties. A modern courthouse was constructed in Estancia, the county seat, in 1910.

The population of Torrance County grew rapidly with the coming of the railroads, and by 1910 had reached a peak of 10,119. It has gradually decreased since that time to the 1960 census figure of 6,497.

Ranching and farming

The Torrance Area is primarily agricultural. The 1964 Census of Agriculture showed 293 farms in Torrance County. Most of these are operated by their owners. The average size of the farms is about 4,600 acres. There were 103 miscellaneous and unclassified farms. The other farms were classified as follows:

Type	*No. of farms*
Cash-grain	12
Cotton	1
Field crops other than cotton	3
General	16
Dairy	16
Livestock other than dairy	142
Livestock ranches	132

The production of livestock, mainly beef cattle and sheep, is the major enterprise in Torrance County. Hereford and Angus are the common breeds of beef animals, and Holstein the most common dairy breed. The 1964 census shows 26,214 cattle and calves in the county, 620 milk cows, and 22,667 sheep and lambs. Quarter horses and thoroughbreds are common.

The acreage of the principal crops grown in Torrance County in 1964 is given in the following list.

Crop	*Acres*
Alfalfa or alfalfa mixtures	2,976
Wheat, winter	580
Corn for silage	1,068
Corn for grain	864
Beans	802
Potatoes, Irish	558
Sorghum for grain	369
Sorghum for silage	40
Barley	45

Alfalfa is the major crop. Most of it is grown on soils of the Manzano, Willard, and Witt series. Some is grown in irrigated pastures with a mixture of orchardgrass and bromegrass. Most is cut and baled for hay. Some dairymen chop alfalfa for silage or feed it freshly chopped from the field.

Winter wheat is suited to the Witt, Manzano, Clovis, Penistaja, Wilcoxson, and Alicia soils, and there is usually enough winter moisture to get the stand established. Some spring wheat is grown, but it is difficult to establish stands because rainfall is low in spring and the winds are strong. The acreage of wheat has decreased by about 90 percent since 1950. Most of the wheat crop is grown without irrigation.

The acreage of corn grown for silage and grain decreased during the late 1940's and early 1950's. In recent years the acreage has been increased because dairying has increased and more feed is needed for cattle. Corn is grown for silage on irrigated soils of the Witt, Manzano, and Willard series. Corn grown for grain is produced on both irrigated and unirrigated soils of the Witt, Manzano, Willard, and Wilcoxson series.

Pinto beans were once the principal cash crop grown on soils of the Witt-Harvey-Manzano association and the Witt-Wilcoxson-Turkeysprings association, but low rainfall, crop disease, and insects have forced farmers to reduce the acreage, and pinto beans are now of only minor importance. In recent years most unirrigated areas have been reseeded to native grasses. Some areas of Witt and Alicia soils in the foothills of the Manzano Mountains are used for pinto beans, wheat, corn, and sorghum.

Irrigation was attempted as early as 1906, but it was not until the drought of the 1930's that serious interest in irrigation developed. Many wells have been drilled since that time, and the major part of the farming area of the Witt-Harvey-Manzano association is now irrigated. There were 67 irrigated farms in Torrance County in 1964, all in the west-central part of the Area and near the western edge of the Willard-Ildefonso-Karde association. The average size of these farms is 136 acres. Alfalfa, corn, potatoes, and pinto beans are the main irrigated crops. Most of the irrigation water comes from wells. A few small fields near Manzano are irrigated from a spring-fed lake.

Potatoes and sugar beets are grown under irrigation, mostly under contract with a processing company. Red and white potatoes are commonly grown on Witt and Manzano soils. Sugar beets are grown mainly on the more alkaline areas of Willard soils and on Manzano and Witt soils. Other truck crops, such as onions, lettuce, and carrots, are suitable for the soils of this Area, but the small demand does not warrant their production.

Sorghum is produced for grain, silage, and bundle feed. Most of the grain and bundle feed is produced on Manzano soils without irrigation, but sorghum for silage is grown on irrigated soils, mainly those of the Manzano, Willard, and Witt series. The growing season is often too short for good yields of grain; yields of sorghum grown for silage are often less than yields of corn.

Barley is grown mostly under irrigation on areas of Willard and Manzano soils and is used for feed and as a cash crop. The acreage is small.

Industry, transportation, and markets

The Torrance Area has few industries and none that employ large numbers of workers. There is a cement-processing plant, a garment factory, a feed mill, and plants where beans and potatoes are cleaned and sacked for marketing.

Gravel, mainly for use in road and highway construction, is excavated from areas of Ildefonso and Dean soils. Logging companies harvest timber, mostly diseased and mature trees, from the mountainous areas. Posts and firewood are cut from stands of pinyon, juniper, and oak, mainly on Pinon and Laporte soils, for local consumption or for marketing nearby.

The Area has good transportation. Two railroads and three bus lines are operated. Good Federal and State highways provide access to all communities.

Livestock is trucked to Albuquerque, 40 miles northwest of Estancia, for auction or is shipped by rail or truck to markets at Clovis. Milk is collected daily from dairy farms and trucked to Albuquerque and Santa Fe for processing. Sugar beets are shipped by rail from Moriarty to markets in Colorado. Wheat is marketed in Mountainair and Estancia. Most of the hay, corn, and sorghum crop is processed by a feed mill at Estancia, mainly for use within the Area. Soils of the Witt-Harvey-Manzano association and the Willard-Ildefonso-Karde association, which produce most of the farm products, are convenient to transportation and marketing facilities.

Ground water

The recharge of ground water in the Torrance Area results partly from local precipitation and partly from runoff from the Manzano and Gallinas Mountains and from the Pedernal Hills. The effect of local precipitation is generally slight, especially at the lower elevations, because most of the rainfall evaporates or is used by plants. Runoff from the mountains is the more important source.

The amount of ground water and its quality vary considerably from one place to another.

In the Manzano Mountains and the Pedernal Hills and in areas around Lobo Hill and Chameleon Hill, the Precambrian rocks are a source of small to moderate quantities of water. In some of the adjacent areas, the water-bearing strata are Precambrian rocks overlain by Permian rocks (*14*).

The principal aquifer underlying the Witt-Wilcoxson-Turkeysprings association, in the northern part of the Manzano Mountains and eastward to the Estancia Lake Basin, is the upper arkosic limestone member of the Madera formation. This aquifer is a source of water of satisfactory quality for livestock and for domestic wells.

In the area south of Manzano and north of the Chupadera Mesa, between the Manzano Mountains and the Estancia Lake Basin, the Abo formation supplies water suitable for livestock and for domestic wells.

The Yeso formation, which overlies the Abo formation, is the principal aquifer in about half of the Torrance Area. It occurs mainly in areas of the La Fonda-Alicia-Rock outcrop association and is a source of water for stock wells throughout most of the outcrop area. It is also a source of water for public-supply wells near Mountainair and for irrigation wells in a small area south of Lobo Hill. Because of its chemical quality, the water from most wells tapping the Yeso formation is undesirable for drinking or irrigation, but it is usable for watering livestock. The Glorieta sandstone member of the San Andres formation, which overlies the Yeso formation in an area north of Moriarty, is a source of irrigation water in that area.

In the northeastern corner of the Torrance Area, beds of the Dockum group bear water of good quality at depths of less than 300 feet. The valley-fill deposits west of the Estancia Lake Basin, underlying areas of the Witt-Harvey-Manzano association and the Witt-Wilcoxson-Turkeysprings association, furnish water for irrigation and other purposes in the west-central part of the Area. Most of these wells range from 100 to 300 feet in depth. The nonpumping water levels in most of the irrigation wells range from 10 to 150 feet, and in most of the stock-water wells, from 10 to 250 feet.

Generally, water from wells west of State Highway 41 is chemically satisfactory for drinking, for watering domestic livestock, and for irrigation. In areas east of the Highway, in the Willard-Ildefonso-Karde association and particularly in the vicinity of the playa lakes, the water is generally undesirable or unsatisfactory for drinking, for most domestic uses, and for irrigation, but it is satisfactory for watering livestock.

The igneous and metamorphic rocks underlying the Pedernal Hills are the water-bearing strata that supply water for livestock and domestic wells in the Clovis-Otero-Rock land association. Wells in this area range from 53 to 405 feet in depth, and water levels range from 34 to 360 feet below the surface. Chemically, the water is generally satisfactory for livestock, for irrigation, and for most domestic uses, but in places it is undesirable for drinking. Obtaining good water is more difficult in this part of the Torrance Area than in any other.

In the eastern uplands the Yeso formation is the principal aquifer. The depth of the wells in these areas ranges from 75 to 3,600 feet, and water levels range from 72 to 940 feet. In chemical quality, the water varies widely; the worst is unsatisfactory for drinking and for most domestic purposes but is satisfactory for watering livestock and for irrigation. The yield is sufficient to supply windmills.

The Yeso formation is also the principal aquifer underlying the northern end of the Chupadera Mesa. Wells range from 250 to about 970 feet in depth, and water levels range from 200 to about 750 feet. Chemically, the water is not satisfactory for drinking or domestic use, but it is suitable for watering livestock.

The principal aquifers underlying the Encino Lake Basin are Precambrian rocks in the western part of the Basin and the Yeso formation in the other parts. Wells furnish water for livestock, for domestic purposes, and for railroad supply. The depth of the wells ranges from 24 to 640 feet, and water levels range from 18 to 540 feet. Chemically, the water is satisfactory for livestock, but it is not satisfactory in all places for drinking, for domestic use, or for irrigation.

Recreation

The Forest Service has developed several areas in the Wilcoxson-Supervisor-Pino association for camp grounds and picnic facilities. The more important of these are Fourth of July Springs along the Tajique-Torreon loop road, the Capillo campgrounds, the Red Canyon campgrounds in the Manzano Mountains, and the Red Cloud Canyon campgrounds in the Gallinas Mountains. Roads to these areas are well maintained.

Manzano Lake (fig. 38), near the community of Manzano, is open to fishermen the year around, as is Tajique Creek, west of the community of Tajique. These waters are stocked with trout several times a year by the New Mexico Department of Game and Fish.

Deer are numerous in the Torrance Area. Soil associations 3, 5, and 9 in the Corona area of the Gallinas Mountains are popular hunting grounds for local and out-of-State hunters. Soil associations 2, 3, and 4 in the foothills of the Manzano Mountains are also popular. There are good populations of mourning doves and plains jackrabbits. In most years there are enough wild turkeys in the mountainous areas for hunting. Sparse populations of antelope roam the soils of the Clovis-Otero-Rock land association, but hunting permits are seldom issued.

Figure 38.—Manzano Lake, fed by spring water and stocked with trout.

Ruins of many Indian dwellings and villages are preserved in the Torrance Area. The Gran Quivira Ruins (fig. 39), about 25 miles south of Mountainair on State Highway 10, have been designated as a National Monument. The National Park Service maintains a museum on the site, as well as campgrounds nearby. It supervises all excavations in the area surrounding the ruins. Thousands of visitors come each year.

The Abo Ruins, about 9 miles southwest of Mountainair on U.S. Highway 60, and the Quarai Ruins, about 8 miles north of Mountainair on State Highway 10, have been designated as State Monuments. These monuments also attract many visitors each year.

Two fire lookout stations, one on Capillo Peak in the Manzano Mountains and one on Gallinas Peak in the Gallinas Mountains, are manned during the fire hazard season, usually in June, July, and August. These lookout stations are open to the public when they are staffed. They provide exceptional views of scenic areas. The stations are accessible by good roads.

Figure 39.—Part of the Gran Quivira National Monument. This structure is one of the "many-storied houses" occupied by Pueblo Indians in the early 1600's. The soils surrounding the ruins are of the Chupadera and Otero series.

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Glossary

Air-dry. To dry or dehumidify forage or hay by means of natural air movement, often in the open.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil that 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 crop plants is retarded.

Aspect. The direction toward which a slope faces. Synonym: exposure.

Caliche. A more or less cemented deposit of calcium carbonate in many soils of warm-temperate areas, as in the Southwestern States. The material may consist of soft, thin layers in the soil or of hard, thick beds just beneath the solum, or it may be exposed at the surface by erosion.

Chiseling. Breaking or loosening subsoil with a chisel cultivator or chisel plow.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

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—

Loose.—Noncoherent; will not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect downslope areas from the effects of such runoff.

Emergency tillage. Cultivation by listing, chiseling, pitting, basin listing, or other means to roughen the soil surface for temporary control of wind erosion.

Eolian soil material. Soil parent material accumulated through wind action; commonly refers to sandy material in dunes.

Erosion. The wearing away of the land surface by wind, running water, and other geological agents.

Fallow. Cropland left idle in order to restore productivity, mainly through accumulation of water, nutrients, or both. The soil ordinarily is tilled for at least one growing season to control weeds and to aid in the decomposition of plant residue.

Half-shrub. A perennial plant having stems that are more or less woody at the base.

Headcut. A vertical cut caused by water erosion at the head of a gully.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons.

O horizon. The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residue.

A horizon. The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of the following: soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon. The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused by (1) accumulation of clay, sesquioxides, humus, or some combination of these; (2) prismatic or blocky structure; (3) redder or stronger colors than the A horizon; or (4) some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon. The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer. Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

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.*

Leached soil. A soil in which most of the soluble materials have been removed from the entire profile or have been removed from one part of the profile and have accumulated in another part.

Listing. The opening of a furrow several inches deep with an implement that throws the soil to either side.

Loess. A fine-grained eolian deposit consisting dominantly of silt-size particles.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

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	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline.	9.1 and higher
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3		

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.

Saline-alkali soil. A soil that contains a harmful concentration of salts and exchangeable sodium; or one that contains harmful salts and is strongly alkaline in reaction; or one that contains harmful salts and exchangeable sodium and is strongly alkaline in reaction. The harmful substances are in such a location in the soil that growth of most crop plants is less than normal.

Sand. As a soil separate, individual rock or mineral fragments ranging from 0.05 millimeter 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.

Slickspots. Small areas that are slick when wet because they contain excess exchangeable sodium, or alkali.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that 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 a 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 characteristic of the soil are largely confined to the solum.

Stratified. Composed of, or arranged in, strata, or layers, such as stratified alluvium. The term is confined to geological material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

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 either (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Substratum. Any layer beneath the solum, or true soil.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. 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 specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Weathering. All physical and chemical changes produced in rocks at or near the earth's surface by atmospheric agents. These changes result in more or less complete disintegration and decomposition of the rock.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit in the section "Descriptions of the Soils," beginning on page 14, and the description of the series in the section "Morphology of the Soils," beginning on page 114. Additional information is given in tables as follows:

Acreage and extent: table 4, page 14.
Estimated yields (dryland): table 6, page 67.
Estimated yields (irrigated): table 7, page 72.
Engineering uses of soils: table 9, page 78; table 10, page 80; and table 11, page 90.
Analytical data for selected soils: table 13, page 136.

Dashed lines indicate that the soil was not assigned to a group in that particular classification.

Map symbol	Mapping unit	Described on page	Capability unit: Dryland: Climate zone 4	Page	Capability unit: Dryland: Climate zone 5	Page	Capability unit: Irrigated: Symbol	Page	Range site: Name	Page	Timber suitability group: Number	Page
Al	Alicia loam, 1 to 6 percent slopes--------------	15	IVe-3	62	VIs-2	64	------	--	Loamy	57	--	--
Ba	Badland---------------------------------------	16										
	Shale and sandstone areas------------------	--	------	--	VIIIs-1	66	------	--	Hills	57	--	--
	Soil areas------------------------------------	--	------	--	VIIe-1	65	------	--	Hills	57	--	--
Bs	Bernal-Slickspot complex----------------------	16	------	--	VIs-4	65	------	--	Loamy	57	--	--
Bt	Bernal-Travessilla fine sandy loams------------	16										
	Bernal soil------------------------------------	--	VIIs-1	66	VIIs-1	66	------	--	Loamy	57	--	--
	Travessilla soil------------------------------	--	VIIs-1	66	VIIs-1	66	------	--	Shallow Sandstone	58	--	--
Bu	Blown-out land--------------------------------	17	VIs-3	65	VIs-3	65	------	--	Salt Flats	58	--	--
Ca	Capillo loam, 15 to 50 percent slopes-----------	17	VIIe-5	65	------	--	------	--	----------------	--	2	74
Ce	Carnero loam, 3 to 8 percent slopes------------	17	------	--	VIs-4	65	------	--	Loamy	57	--	--
Cg	Chilton gravelly loam--------------------------	18	VIs-1	64	VIs-1	64	------	--	Shallow	58	--	--
Cl	Chilton-La Fonda complex, 1 to 9 percent slopes--	18										
	Chilton soil----------------------------------	--	------	--	VIs-1	64	------	--	Shallow	58	--	--
	La Fonda soil---------------------------------	--	------	--	VIs-1	64	------	--	Loamy	57	--	--
Cm	Chupadero loamy fine sand, 5 to 15 percent slopes--	18	VIe-1	63	VIe-1	63	------	--	Sandy	58	5	74
Cn	Clovis loam, 0 to 5 percent slopes-------------	19	IVe-3	62	VIc-1	63	------	--	Loamy	57	--	--
	Where slope is 1 percent or less-----------	--	------	--	------	--	IIe-1	69	----------------	--	--	--
Co	Clovis soils, 0 to 5 percent slopes, eroded-----	19	VIc-1	63	VIc-1	63	------	--	Loamy	57	--	--
Cp	Clovis-Dean loams, 0 to 5 percent slopes--------	20										
	Clovis soil-----------------------------------	--	------	--	VIc-1	63	------	--	Loamy	57	--	--
	Dean soil-------------------------------------	--	------	--	VIe-2	64	------	--	Limy	57	--	--
Cs	Clovis and Scholle soils----------------------	20										
	Clovis soil-----------------------------------	--	------	--	VIc-1	63	------	--	Loamy	57	--	--
	Scholle soil----------------------------------	--	------	--	VIs-1	64	------	--	Shallow	58	--	--
Ct	Crest stony loam, 5 to 50 percent slopes--------	20	VIIe-7	66	------	--	------	--	----------------	--	4	74
De	Dean loam, 1 to 9 percent slopes---------------	21	------	--	VIe-2	64	------	--	Limy	57	--	--
Du	Duncan loam, dark variant----------------------	21	------	--	VIs-3	65	------	--	Salt Flats	58	--	--
Ec	Encierro channery loam, 1 to 9 percent slopes---	21	VIs-1	64	VIs-1	64	------	--	Shallow	58	--	--
Er	Erramouspe stony loam, 30 to 60 percent slopes--	21	VIIe-2	65	------	--	------	--	Mountain Shale	57	--	--
Fo	Fortwingate stony loam, 5 to 40 percent slopes--	22	VIIe-6	65	------	--	------	--	----------------	--	3	74
Fr	Fuera cobbly loam, 5 to 20 percent slopes-------	22	VIIe-6	65	------	--	------	--	----------------	--	3	74
Fu	Fuera cobbly loam, 20 to 60 percent slopes------	22	VIIe-7	66	------	--	------	--	----------------	--	4	74
Ha	Hagerman fine sandy loam, 1 to 5 percent slopes--	22	------	--	VIs-4	65	------	--	Loamy	57	--	--
Hd	Hagerman-Dean complex, 1 to 5 percent slopes----	23										
	Hagerman soil---------------------------------	--	------	--	VIs-4	65	------	--	Loamy	57	--	--
	Dean soil-------------------------------------	--	------	--	VIs-4	65	------	--	Limy	57	--	--
He	Harvey loam, 0 to 1 percent slopes-------------	23	VIe-2	64	VIe-2	64	IIIe-6	70	Limy	57	--	--
Hf	Harvey loam, 1 to 9 percent slopes-------------	23	VIe-2	64	VIe-2	64	------	--	Limy	57	--	--
	Where slope is 1 to 3 percent-------------	--	------	--	------	--	IVe-1	71	----------------	--	--	--
Hg	Harvey loam, alkali----------------------------	24	------	--	VIs-3	65	IIIs-4	71	Salt Flats	58	--	--
Hh	Harvey-Dean loams, 1 to 9 percent slopes--------	24	VIe-2	64	VIe-2	64	------	--	Limy	57	--	--
Hm	Harvey and Dean soils, eroded------------------	24	VIe-2	64	VIe-2	64	------	--	Limy	57	--	--
Hs	Hassel loam, 2 to 5 percent slopes-------------	25	VIs-2	64	VIs-2	64	------	--	Loamy	57	--	--
Ig	Ignacio fine sandy loam, 1 to 5 percent slopes--	25	------	--	VIe-1	63	------	--	Sandy	58	--	--
Ih	Ildefonso fine sandy loam, 0 to 2 percent slopes--	25	VIe-2	64	VIe-2	64	IIIe-6	70	Limy	57	--	--
Ik	Ildefonso fine sandy loam, 0 to 5 percent slopes--	25	------	--	VIe-2	64	------	--	Limy	57	--	--
	Where slope is 2 percent or less-----------	--	------	--	------	--	IIIe-6	70	----------------	--	--	--
	Where slope is more than 2 percent---------	--	------	--	------	--	IVe-1	71	----------------	--	--	--
Im	Ildefonso loamy fine sand, 0 to 5 percent slopes--	26	------	--	VIe-1	63	------	--	Sandy	58	--	--
Is	Ildefonso stony sandy loam, 10 to 30 percent slopes--	26	VIIs-3	66	VIIs-3	66	------	--	Hills	57	--	--
Je	Jeckley silty clay loam, 20 to 40 percent slopes--	26	VIIe-5	65	------	--	------	--	----------------	--	2	74
Ka	Karde loam, saline-----------------------------	26	------	--	VIIs-4	66	------	--	Salt Flats	58	--	--
Kd	Karde-Willard loams, saline--------------------	27										
	Karde soil------------------------------------	--	------	--	VIIs-4	66	------	--	Salt Flats	58	--	--
	Willard soil----------------------------------	--	------	--	VIs-3	65	------	--	Salt Flats	58	--	--
Kg	Kech gravelly loam, 1 to 9 percent slopes-------	27	------	--	VIs-1	64	------	--	Shallow	58	--	--
Ko	Kim-Otero-Pastura complex----------------------	27										
	Kim soil--------------------------------------	--	------	--	VIc-1	63	------	--	Loamy	57	--	--
	Otero soil------------------------------------	--	------	--	VIe-1	63	------	--	Sandy	58	--	--
	Pastura soil----------------------------------	--	------	--	VIIs-1	66	------	--	Shallow	58	--	--
Kp	Kim-Pastura-Tapia loams------------------------	28										
	Kim soil--------------------------------------	--	------	--	VIc-1	63	------	--	Loamy	57	--	--
	Pastura soil----------------------------------	--	------	--	VIIs-1	66	------	--	Shallow	58	--	--
	Tapia soil------------------------------------	--	------	--	VIs-4	65	------	--	Loamy	57	--	--
Kw	Kim-Pinon-Witt loams---------------------------	28										
	Kim soil--------------------------------------	--	------	--	VIc-1	63	------	--	Loamy	57	--	--
	Pinon soil------------------------------------	--	------	--	VIIs-1	66	------	--	Shallow	58	--	--
	Witt soil-------------------------------------	--	------	--	VIc-1	63	------	--	Loamy	57	--	--
La	La Fonda loam, 1 to 9 percent slopes------------	29	VIc-1	63	VIc-1	63	------	--	Loamy	57	--	--
Lg	La Fonda loam, gravelly substratum, 2 to 8 percent slopes-------------------------------	29	VIew-2	64	VIew-2	64	------	--	Bottomland	56	--	--
Lm	La Fonda-Alicia loams, 1 to 9 percent slopes----	29	------	--	VIc-1	63	------	--	Loamy	57	--	--
Lo	La Fonda-Rock outcrop complex------------------	30										
	La Fonda soil---------------------------------	--	VIIs-1	66	VIIs-1	66	------	--	Loamy	57	--	--
	Rock outcrop----------------------------------	--	VIIs-1	66	VIIs-1	66	------	--	Shallow Sandstone	58	--	--
Lp	Laporte-Rock outcrop complex-------------------	30	VIIs-3	66	VIIs-3	66	------	--	Hills	57	--	--
Ma	Manzano loam, 0 to 1 percent slopes------------	31	IVew-1	63	VIew-2	64	IIew-1	69	Bottomland	56	--	--
Mb	Manzano loam, 1 to 5 percent slopes------------	31	IVew-1	63	VIew-2	64	------	--	Bottomland	56	--	--
Mc	Manzano loam, saline substratum, 0 to 1 percent slopes--	32	------	--	VIs-4	65	IIew-1	69	Loamy	57	--	--
Mh	Mirabal stony sandy loam, high elevation, 10 to 70 percent slopes------------------------------	32	VIIe-7	66	------	--	------	--	----------------	--	4	74
Ml	Mirabal stony sandy loam, 40 to 80 percent slopes--	32	VIIe-7	66	------	--	------	--	----------------	--	4	74
Mm	Moriarty clay loam, 0 to 1 percent slopes-------	32	VIew-1	64	VIew-1	64	------	--	Salty Bottomland	58	--	--
Mo	Moriarty clay loam, 2 to 6 percent slopes-------	33	VIew-1	64	VIew-1	64	------	--	Salty Bottomland	58	--	--

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GUIDE TO MAPPING UNITS--CONTINUED

Map symbol	Mapping unit	Described on page	Capability unit: Dryland, Climate zone 4	Page	Capability unit: Dryland, Climate zone 5	Page	Capability unit: Irrigated, Symbol	Page	Range site: Name	Page	Timber suitability group: Number	Page
Oa	Osha gravelly loam, 10 to 50 percent slopes	33	VIIe-6	65	------	--	------	--	----------------	--	3	74
Og	Osha gravelly loam, calcareous variant, 20 to 80 percent slopes	33	VIIe-2	65	VIIe-2	65	------	--	Mountain Shale	57	5	74
Op	Otero and Palma soils	33	VIe-1	63	VIe-1	63	------	--	Sandy	58	--	--
Or	Otero and Palma soils, hummocky	34	------	--	VIe-1	63	------	--	Sandy	58	--	--
Pa	Pastura loam, 1 to 9 percent slopes	35	VIIs-1	66	VIIs-1	66	------	--	Shallow	58	--	--
Pb	Pastura loam, 9 to 25 percent slopes	35	VIIs-1	66	VIIs-1	66	------	--	Shallow	58	--	--
Pd	Pedrick loamy fine sand	35	VIe-1	63	VIe-1	63	IVe-2	71	Sandy	58	--	--
Pe	Pedrick loamy fine sand, hummocky	36	------	--	VIe-1	63	IVe-2	71	Sandy	58	--	--
Pf	Penistaja fine sandy loam, 0 to 1 percent slopes	36	IVe-4	63	VIe-1	63	------	--	Loamy	57	--	--
Pg	Penistaja fine sandy loam, 1 to 6 percent slopes	36	IVe-4	63	VIe-1	63	------	--	Loamy	57	--	--
Ph	Penistaja loamy fine sand, hummocky, 1 to 8 percent slopes	36	------	--	VIe-1	63	------	--	Sandy	58	--	--
Pm	Penistaja sandy clay loam, 1 to 6 percent slopes, eroded	37	IVe-4	63	VIc-1	63	------	--	Loamy	57	--	--
Pn	Penistaja-Dean complex, 1 to 5 percent slopes	37										
	Penistaja soil	--	------	--	VIe-1	63	------	--	Loamy	57	--	--
	Dean soil	--	------	--	VIe-2	64	------	--	Limy	57	--	--
Po	Penistaja-Dean fine sandy loams, 1 to 5 percent slopes	38										
	Penistaja soil	--	------	--	VIe-2	64	------	--	Loamy	57	--	--
	Dean soil	--	------	--	VIe-2	64	------	--	Limy	57	--	--
Pr	Pinata stony loam, 25 to 50 percent north slopes	38	VIIe-6	65	------	--	------	--	----------------	--	3	74
Ps	Pinata stony loam, 20 to 60 percent south slopes	38	VIIe-7	66	------	--	------	--	----------------	--	4	74
Pt	Pinata-Stroupe stony loams, 5 to 20 percent slopes	39	VIIs-3	66	------	--	------	--	Hills	57	--	--
Pu	Pinata-Stroupe stony loams, 20 to 50 percent slopes	39	VIIe-2	65	------	--	------	--	Mountain Shale	57	--	--
Pv	Pino loam, loamy substratum, 3 to 12 percent slopes	39	VIIe-6	65	------	--	------	--	----------------	--	3	74
Pw	Pino silt loam, 2 to 30 percent slopes	40	VIIe-6	65	------	--	------	--	----------------	--	3	74
Px	Pinon channery loam, 3 to 20 percent slopes	40	VIIs-1	66	VIIs-1	66	------	--	Shallow	58	--	--
Pz	Prewitt and Manzano soils	40	IVew-1	63	VIew-1	64	------	--	Bottomland	56	--	--
Rg	Rance-Gypsum land complex	41										
	Rance soil	--	VIIs-2	66	VIIs-2	66	------	--	Loamy	57	--	--
	Gypsum land	--	VIIs-2	66	VIIs-2	66	------	--	Gyp Flats	57	--	--
Rk	Rock land	41	------	--	VIIs-1	66	------	--	Shallow	58	--	--
Rp	Rock outcrop-Pinon-La Fonda complex	42										
	Rock outcrop	--	VIIe-1	65	VIIe-1	65	------	--	Breaks	56	--	--
	Pinon soil	--	VIIe-1	65	VIIe-1	65	------	--	Shallow	58	--	--
	La Fonda soil	--	VIIe-1	65	VIIe-1	65	------	--	Loamy	57	--	--
Rs	Rock outcrops and slides	42	VIIIs-1	66	------	--	------	--	----------------	--	--	--
Sa	Salas stony loam, 30 to 70 percent slopes	42	VIIe-2	65	VIIe-2	65	------	--	Mountain Shale	57	--	--
Sc	Scholle gravelly loam, 1 to 9 percent slopes	43	VIs-1	64	VIs-1	64	------	--	Shallow	58	--	--
Sh	Scholle loam, 1 to 5 percent slopes	43	VIs-1	64	VIs-1	64	------	--	Loamy	57	--	--

Map symbol	Mapping unit	Described on page	Capability unit: Dryland, Climate zone 4	Page	Capability unit: Dryland, Climate zone 5	Page	Capability unit: Irrigated, Symbol	Page	Range site: Name	Page	Timber suitability group: Number	Page
Sm	Steep rock land	43	VIIe-3	65	VIIe-3	65	------	--	Breaks	56	--	--
Sn	Stony alluvial land	44	VIIe-7	66	------	--	------	--	----------------	--	4	74
So	Stony steep land	44	VIIs-3	66	VIIs-3	66	------	--	Hills	57	--	--
Sp	Stroupe stony loam, 15 to 70 percent slopes	44	VIIe-2	65	------	--	------	--	Mountain Shale	57	--	--
Sr	Supervisor loam, 40 to 80 percent slopes	44	VIIe-5	65	------	--	------	--	----------------	--	2	74
Ta	Tampico loam	45	VIew-3	64	------	--	------	--	----------------	--	1	74
Tc	Tapia loam, 0 to 5 percent slopes	45	VIs-4	65	VIs-4	65	------	--	Loamy	57	--	--
Td	Tapia-Dean loams, 0 to 5 percent slopes	45										
	Tapia soil	--	------	--	VIs-4	65	------	--	Loamy	57	--	--
	Dean soil	--	------	--	VIe-2	64	------	--	Limy	57	--	--
Te	Tapia and Dean soils, eroded	46										
	Tapia soil	--	VIs-4	65	VIs-4	65	------	--	Loamy	57	--	--
	Dean soil	--	VIe-2	64	VIe-2	64	------	--	Limy	57	--	--
Tf	Tecolote stony loam, 20 to 70 percent slopes	46	VIIe-7	66	------	--	------	--	----------------	--	4	74
Tg	Tecolote stony loam, thick surface variant, 20 to 70 percent slopes	46	VIIe-5	65	------	--	------	--	----------------	--	2	74
Th	Tesajo gravelly sandy loam, 2 to 15 percent slopes	47	VIs-1	64	VIs-1	64	------	--	Shallow	58	--	--
Tm	Trail loamy fine sand, 5 to 10 percent slopes	47	VIIe-4	65	VIIe-4	65	------	--	Deep Sand	57	--	--
Tn	Turkeysprings stony loam, 20 to 50 percent slopes	47	VIIe-2	65	VIIe-2	65	------	--	Mountain Shale	57	--	--
Wa	Washoe cobbly loam, 9 to 25 percent slopes	48	VIIs-3	66	------	--	------	--	Hills	57	--	--
Wb	Washoe gravelly loam, 1 to 9 percent slopes	48	VIs-1	64	------	--	------	--	Shallow	58	--	--
Wc	Wilcoxson clay loam, 2 to 10 percent slopes	48	VIs-2	64	------	--	------	--	Clayey	56	--	--
Wd	Wilcoxson loam, thick surface, 1 to 6 percent slopes	49	IVe-3	62	VIs-2	64	------	--	Loamy	57	--	--
We	Wilcoxson stony loam, 5 to 20 percent slopes	49	VIIe-7	66	------	--	------	--	----------------	--	4	74
Wf	Wilcoxson stony loam, 20 to 50 percent north slopes	49	VIIe-6	65	------	--	------	--	----------------	--	3	74
Wg	Wilcoxson stony loam, 15 to 45 percent south slopes	49	VIIe-7	66	------	--	------	--	----------------	--	4	74
Wh	Willard fine sandy loam	51	------	--	VIe-2	64	IIIs-1	70	Limy	57	--	--
Wk	Willard loam	50	------	--	VIe-2	64	IIIs-1	70	Limy	57	--	--
Wl	Willard loam, eroded	50	VIs-3	65	VIs-3	65	IVs-2	72	Salt Flats	58	--	--
Wm	Willard loam, strongly saline	51	------	--	VIs-3	65	------	--	Salt Flats	58	--	--
Wn	Witt loam, 0 to 1 percent slopes	51	IVe-3	62	VIc-1	63	IIe-1	69	Loamy	57	--	--
Wo	Witt clay loam, 0 to 1 percent slopes, eroded	52	IVe-3	62	VIc-1	63	IIe-1	69	Loamy	57	--	--
Wp	Witt loam, 1 to 6 percent slopes	52	IVe-3	62	VIc-1	63	------	--	Loamy	57	--	--
	Where slope is 3 percent or less	--	------	--	------	--	IIIe-1	70	----------------	--	--	--
Wr	Witt clay loam, 1 to 6 percent slopes, eroded	52	IVe-3	62	VIc-1	63	------	--	Loamy	57	--	--
	Where slope is 3 percent or less	--	------	--	------	--	IIIe-1	70	----------------	--	--	--
Ws	Witt-Harvey loams, 0 to 3 percent slopes	53										
	Where slope is 1 percent or less	--	------	--	------	--	IIe-1	69	----------------	--	--	--
	Witt soil	--	IVe-3	62	VIc-1	63	------	--	Loamy	57	--	--
	Harvey soil	--	IVe-3	62	VIc-1	63	------	--	Limy	57	--	--
Wt	Witt-Harvey-Pinon loams, 1 to 9 percent slopes	53										
	Witt soil (slope of 6 percent or less)	--	IVe-3	62	VIc-1	63	------	--	Loamy	57	--	--
	Harvey soil	--	VIe-2	64	VIe-2	64	------	--	Limy	57	--	--
	Pinon soil	--	VIIs-1	66	VIIs-1	66	------	--	Shallow	58	--	--

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