

# SOIL SURVEY

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## Las Vegas and Eldorado Valleys Area Nevada

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This is the last Survey of the 1957 Series

UNITED STATES DEPARTMENT OF AGRICULTURE  
Soil Conservation Service  
In cooperation with  
THE UNIVERSITY OF NEVADA AGRICULTURAL EXPERIMENT STATION  
and  
UNITED STATES DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION, REGION 3

## HOW TO USE THIS SOIL SURVEY

**T**HIS SOIL SURVEY of the Las Vegas and Eldorado Valleys Area contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, or other structures; and in appraising the value of tracts of land for farms, industry, or recreation.

### Locating Soils

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

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

### Finding and Using Information

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

Individual colored maps showing the relative suitability or limitations of soils for many specific purposes can be developed by using the soil map and information in the text. Interpretations not included in the text can be developed by grouping the soils according to their suitability or limitations for a particular use.

Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

*Farmers and those who work with farmers* can learn about use and management of the soils in the soil descriptions and the capability groupings.

*Engineers and builders* will find under "Engineering Applications" tables that describe soil properties that affect engineering and show the relative suitability of the soils for specified engineering purposes.

*Scientists and others* can read about how the soils were formed and how they are classified in the section "Soil Formation and Soil Classification."

*Students, teachers, and others* will find information about soils and their management in various parts of the text.

*Newcomers in the Las Vegas and Eldorado Valleys 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 "General Nature of the Area."

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Fieldwork for this survey was completed in 1957. Unless otherwise indicated, all statements in this report refer to conditions in the county at the time the survey was in progress. This survey of the Las Vegas and Eldorado Valleys Area was made as part of the technical assistance furnished by the Soil Conservation Service to the Las Vegas Valley Soil Conservation District.

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# SOIL SURVEY OF LAS VEGAS AND ELDORADO VALLEYS AREA, NEVADA

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE UNIVERSITY OF NEVADA AGRICULTURAL EXPERIMENT STATION AND UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION, REGION 3

The Las Vegas and Eldorado Valleys Area is in Clark County, in the southernmost part of Nevada (fig. 1). Las Vegas Valley covers 350 square miles. Within the valley, but not surveyed, are the cities of Las Vegas, which is the county seat, North Las Vegas, and Henderson; Nellis

Air Force Base; and McCarran Airfield. Eldorado Valley covers 110 square miles. It is bordered on the northeast by Boulder City.

## General Nature of the Area

Relics and other evidence of primitive campsites indicate that the large springs in Las Vegas Valley were used as watering places long before the coming of the white man, in fact, even before the coming of the Basket Makers and, later, the Paiute and Shoshone Indians.

Spanish padres who explored this region about 1700 called the valley "Las Vegas," meaning "The Meadows." Wild grasses grew abundantly where the water supply was plentiful. Later visits were made by trappers, traders, and explorers, including Kit Carson and Gen. Fremont. The Fremont party camped in Las Vegas in 1844.

By 1855 the existence of water in Las Vegas Valley was well known, and Brigham Young assigned a party of thirty Mormon missionaries to colonize and develop the valley. An adobe fort and dwellings were built near the springs, the soil was tilled, and crops were grown to provide food for the settlers. In 1857 the Las Vegas mission was abandoned. After that, further use of ground water for agricultural purposes was made by the Stewart and Kyle ranches.

The State Land Act of 1885 offered tracts of 640 acres at \$1.25 per acre, with a down payment of 25 cents an acre and the balance to be paid in 25 years, at 6 percent interest. Farming then took on a permanent aspect. Small orchards were planted, and alfalfa was grown on some of the better soils. After the discovery of artesian water in 1906, alfalfa became the chief crop.

The population of the city of Las Vegas, according to the 1910 census, was 800, and probably a total of 1,000 people resided in Las Vegas Valley. By 1920 the population of the city had risen to 2,300 and that of the valley to 2,500. The population increased steadily after 1930, as a result of a growing tourist trade and the construction of Hoover Dam. According to the 1950 census, the population of the valley was 40,700. The population of the city of Las Vegas was 24,600 in 1950, and by 1955 it had increased to 45,000.

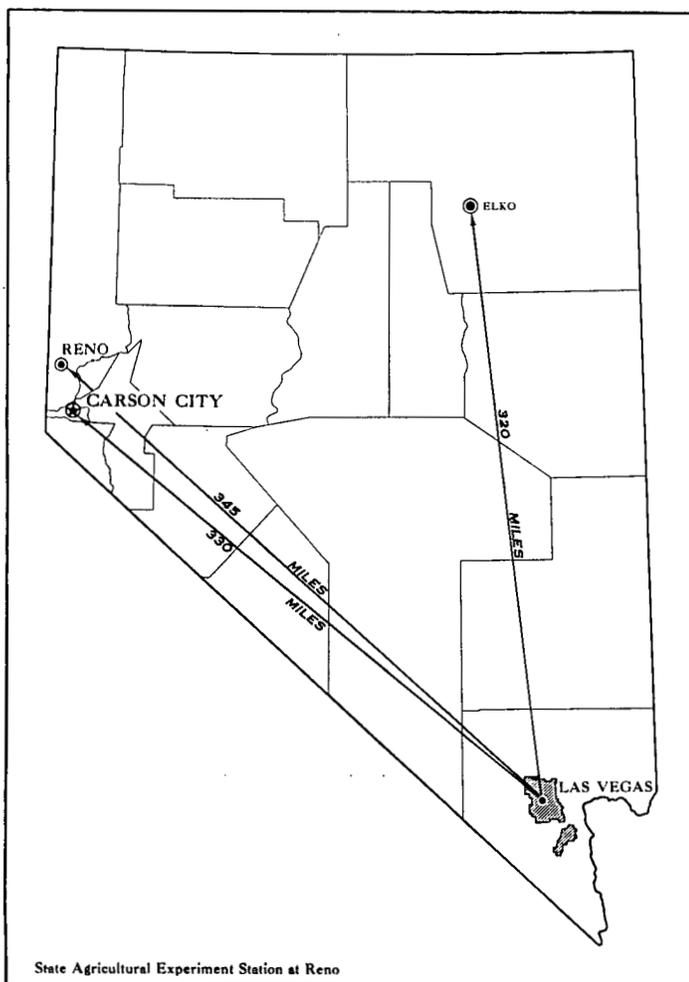


Figure 1.—Location of the Las Vegas and Eldorado Valleys Area in Nevada.

## Water Supply

The present water supply for the Area comes from ground water and from Lake Mead. There are no perennial streams in the valleys. Henderson and Boulder City are supplied from Lake Mead, through pipelines and pumping stations. Las Vegas is supplied from Lake Mead and from ground water. All other areas, including most of the ranches, are supplied from springs, flowing wells, and pumped wells. A few ranches are irrigated by sewage effluent from the Las Vegas Sewage Disposal Plant.

There are several perennial springs in the valley. Most of these discharge water from artesian aquifers, which probably lie along fault zones in the alluvial fill. The flow is fairly steady throughout the year and is modified only by pumping from nearby wells. Also, there are many small gravity springs, which originate near the base of fault scarps.

The best quality water is in the northern part of Las Vegas Valley, between Las Vegas and Tule Springs. Second in quality is water from wells in Paradise Valley. The poorest quality water comes from the vicinity of Pittman and Whitney and the Winterwood Ranch.

State regulations on the use of ground water currently restrict the extension of irrigation in Las Vegas Valley. Future development depends on securing an ample supply from a source outside the Area.

No source of surface water has been found in Eldorado Valley, and explorations for ground water have been unsuccessful.

Sewage effluent is an important, inexpensive source of irrigation water and one that has not been fully utilized. In 1954 the total flow was estimated to be 10,061 acre feet.<sup>1</sup> Increased amounts of water from this source can be expected as the population of Las Vegas increases. The Nevada State Department of Health has limited the use of this water to controlled irrigation of forage crops for livestock. Judging from the analysis<sup>2</sup> of a sample taken in 1954, the water appears to be of good quality.

## Vegetation

The vegetation in the valleys is typical of that found in hot desert areas of the Southwest. Generally, it consists of a sparse growth of stunted desert shrubs and grasses. There are no forests.

The vegetation on the Las Vegas Valley lowlands consists largely of phreatophytes. These are plants that send their roots down to the water table or to the overlying capillary fringe and thus obtain an adequate water supply. The most common of the phreatophytes are mesquite (*Prosopis sp.*), big saltbush (*Atriplex lentiformis*), cattle saltbush (*A. polycarpa*), iodinebush or pickleweed (*Allenrolfea occidentalis*), and rabbitbrush (*Chrysothamnus spp.*). Other common species that occur locally are arrowweed (*Pluchea sericea*), saltgrass (*Distichlis stricta*), and sacaton (*Sporobolus airoides*).

On the higher benches and alluvial fans in Las Vegas Valley, where ground water is at a greater depth, the

vegetation consists predominantly of creosotebush (*Larrea divaricata*) and white bur-sage (*Franseria dumosa*). Shadscale (*A. confertifolia*) and Mormon-tea (*Ephedra sp.*) also occur in these areas. Scattered stands of big galleta (*Hilaria rigida*) occur along drainageways. From the middle of the alluvial fans to the foothills, Spanish bayonet (*Yucca baccata*) and various species of cactus may be found.

In Eldorado Valley the vegetation consists predominantly of creosotebush and white bur-sage, but some desert saltbush and iodinebush grow near the playa. On some localized alluvial fans the vegetation consists predominantly of big galleta and a scattering of creosotebush. On one localized, nearly level alluvial fan the vegetation is predominantly woolly marigold (*Boileya plenirediate*). On the steeper parts of this fan, creosotebush is predominant, and woolly marigold is abundant but secondary.

## Transportation and Recreation

One of the main railroad lines between Los Angeles, Calif., and Salt Lake City, Utah, serves the city of Las Vegas. Branch lines serve Henderson, Nellis Air Force Base, the Lake Mead Ammunition Depot, and Boulder City. U.S. Highways No. 91, No. 93, No. 95, and No. 466 connect Las Vegas with markets and the principal cities in Nevada and in all adjoining States. U.S. Highways No. 93 and No. 466 serve Boulder City. Although many of the roads within the Area are paved or gravelled or otherwise maintained, some of the outlying parts of the survey Area are accessible only by ungraded roads and trails. Several major truck lines serve the Area. Three transcontinental airlines and two other airlines maintain daily service to Las Vegas.

Many types of recreational facilities are available. The Lake Mead Recreation Area provides fishing, boating, swimming, other water activities, camping, and picnicking. Also, Charleston Park, which is northwest of Las Vegas, affords good camping and picnicking facilities.

## Industry

The most important industry in Las Vegas Valley is that of furnishing services and entertainment to tourists.

Four companies are established in the Basic Magnesium Plant at Henderson. This plant produces quantities of chemicals, manganese for steel alloy, and flux for the steel industry of the west coast. Also, there are small manufacturing plants near the city of Las Vegas. Government facilities provide considerable employment.

## Agriculture

Only 1,580 acres was irrigated and farmed in Las Vegas Valley in 1954. More than 50 percent of this acreage was in alfalfa. As many as six cuttings a year were obtained. The alfalfa was baled and stacked and then either sold or fed to livestock.

Approximately 19 percent of the irrigated acreage in 1954 was in small grain, mainly barley, which is commonly grown as part of a rotation with alfalfa; 12 percent was used as pasture; about 10 percent was in corn, or sorghum, both of which are generally used as silage, although occasionally the sorghum is pastured; and less

<sup>1</sup>UNITED STATES BUREAU OF RECLAMATION. REPORT ON PRELIMINARY INVESTIGATION, LAS VEGAS PUMPING PROJECT. 160 pp. Nevada. 1955.

<sup>2</sup>UNITED STATES DEPARTMENT OF AGRICULTURE. REPORT OF WATER ANALYSIS. Agri. Research Serv., U. S. Salinity Lab., Rubidoux Unit. Analyzed by Hatcher and Keyes. 1954.

than 2 percent was planted to melons, nursery stock, and miscellaneous crops. There were a few pecan trees and fruit trees in the Area but no commercial orchards.

The acreage in irrigated crops has not changed significantly since 1954. Because of the rapid growth in population, the demand for subdivisions and homesites, and the increasingly higher cost of land, future development of commercial-sized farms is unlikely. Any new development of cropland is likely to be limited to small acreages that can be operated on a part-time basis.

The livestock are principally beef cattle. Generally, the cattle are grazed in adjacent mountain areas in summer and are fed or pastured on ranches in winter. Lack of a low-cost supply of feed limits the number of dairy cows. There are only a few in the valley. Work horses are used occasionally on some ranches, and a few saddle horses are kept for recreational purposes. There are practically no chickens.

## Climate

The Las Vegas and Eldorado Valleys Area is characterized by low humidity, abundant sunshine, mild winters, and hot dry summers. Freezing weather occurs frequently, but extremes of cold are rare. Snow falls nearly every year but seldom stays on the ground for more than a day or two. Table 1 gives temperature and precipitation data compiled from records of the weather bureau station at Las Vegas.

TABLE 1.—*Temperature and precipitation data*

[Data from station at Las Vegas, Nev. (elevation 2,162 feet).  
Based on a 22-year record through 1953]

Month	Temperature			Rainfall			Snow depth
	Average	Absolute maximum	Absolute minimum	Average	Driest year (1953)	Wettest year (1931)	
	°F.	°F.	°F.	In.	In.	In.	In.
January	45. 0	80	9	0. 52	0	0. 18	0. 45
February	50. 4	89	15	. 59	0	2. 71	0
March	56. 8	94	24	. 43	. 03	0	0
April	64. 2	102	30	. 23	0	. 01	0
May	71. 5	108	35	. 19	. 08	0	0
June	80. 4	114	45	. 15	0	. 36	0
July	86. 4	118	56	. 54	. 28	. 02	0
August	84. 8	115	46	. 60	. 03	2. 81	0
September	77. 0	110	39	. 37	0	0	0
October	65. 8	100	27	. 28	0	. 30	0
November	53. 8	89	20	. 31	. 18	1. 31	0
December	46. 2	82	13	. 41	0	. 89	. 41
Year	65. 2	118	9	4. 62	. 60	8. 59	. 86

The mean annual temperature at Las Vegas is 65.2° F.; the mean for the summer months is 83.9°. The absolute maximum recorded is 118°, and the absolute minimum is 9°. The growing season, or frost-free period, varies somewhat but is approximately 241 days. Generally, the first killing frost occurs early in November, and the last killing frost occurs in March.

The rainfall ordinarily is insufficient for the needs of any kind of farm crop. Most of the rain falls in winter. Rainfall in that season is usually gentle, and

little, if any, of the water runs off. In summer and early in fall, local thunderstorms and cloudbursts cause flash floods. Although large quantities of water fall during these storms, runoff is rapid and the soils seldom get wet to any appreciable depth. Erosion resulting from the highest intensity rains is severe.

Winds of high velocity occur frequently and at all times of the year but are most common in spring. The prevailing winds are from the north and northwest in winter and from the south in spring and summer. As they sweep through the valleys, these winds carry much sand and dust, and the hot drying winds in summer sometimes damage crops. Windbreaks are advisable.

## Physiography and Geology

The Las Vegas and Eldorado Valleys Area lies in the southwestern part of the Great Basin, within the Basin and Range physiographic province. Surrounding these low-lying, alluvium-filled valleys are sharp, rugged mountain ranges. Between the mountains and the nearly level basin lowlands is the gently sloping alluvial apron.

Las Vegas Valley extends in a northwest-southeast direction and drains toward the south through Las Vegas Wash into Lake Mead. On the west are the Spring Mountains, which consist mostly of well-consolidated sedimentary rocks and are more than 7,500 feet above sea level. The highest point in this range—Charleston Peak—is 11,910 feet high. On the north are the Pintwater, Desert, Sheep, and Las Vegas Mountains, which are less steep than the Spring Mountains and run north to south. On the east is Frenchman Mountain. It rises to an elevation of 4,000 feet, but toward the south, near Las Vegas Wash, its ridge drops off to about 2,500 feet. On the south are the River Mountains and the McCullough Range.

Eldorado Valley trends toward the southwest and has no outlet. It is bordered on the west by the McCullough Range, on the north by the River Mountains, and on the east by the Eldorado Mountains. All of these ranges are rugged, low-lying masses. Unlike other mountains in the Area, they consist predominantly of extrusive igneous rock.

The sedimentary formations in the mountain ranges consist mainly of limestone and mixtures of sandstone, shale, dolomite, and gypsum, and in places interbedded quartzite. These formations date from the Cambrian to the early Devonian periods of the early Paleozoic era to the Jurassic period of the Mesozoic era (4).<sup>3</sup> Volcanic activity was confined to the formation bordering the southern and eastern parts of Las Vegas Valley and to the formations bordering Eldorado Valley. Eruptions that resulted in basalt, rhyolite, and latite flows occurred during three periods of the Cenozoic era (4).

The alluvial apron is composed of many coalescing fans dissected by numerous drainage channels. The upper boundary, the average elevation of which is about 4,500 feet, is clearly defined by an abrupt change in slope and rock material. The lower boundary, the average elevation of which is about 2,500 feet above sea level, is obscure, for the change in slope and in the characteristics of the material is gradual. In its upper reaches, the allu-

<sup>3</sup> Italic numbers in parentheses refer to Literature Cited, p. 86.

vial apron is made up of poorly assorted gravelly, cobbly, and stony sand deposits, and it grades to finer materials as it nears the valley floor. Deposition started during the late Tertiary and Quaternary periods of the Cenozoic era (4) and is continuing today.

The basin lowlands are depositional areas of lake-laid silts and clays and younger alluvial deposits. Two periods of lake activity, one during the Miocene epoch and one during the Pleistocene (4), influenced the valley-filling process. Subsequent faulting of some of the lakebeds has resulted in the lowland's dominant landform. This landform consists of a series of scarps that range from a few feet to 150 feet in elevation. Easily eroded silt and clay beds of the Muddy Creek formation of Miocene age (4) are exposed on the faces of the scarps. The younger alluvial deposits have been transported predominantly by water and deposited on gently sloping alluvial fans and flood plains. Deposition of alluvium is continuing today. In places intermittent streams are cutting into the flood plains and forming alluvial terraces. Prominent in the landscape are numerous scattered sand dunes of varying sizes, a result of recent wind activity.

The Las Vegas and Eldorado Valleys Area includes the basin lowlands that are between elevations of 1,500 and 2,500 feet, and all other land in these valleys below an elevation of 2,500 feet except for military installations, municipalities, and game preserves.

## ***How This Soil Survey Was Made***

Soil scientists made this survey to learn what kinds of soils are in the Las Vegas and Eldorado Valleys 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; 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.

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

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

ture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man.

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

Some soil types vary so much in slope, degree of wetness, content of salts and alkali, 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, Glendale silt loam, slightly saline, is one of several phases of Glendale silt loam, a soil type that ranges from nonsaline to strongly saline.

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

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

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

In most areas surveyed there are tracts that are so rocky, so shallow, or so frequently worked by wind and water that they scarcely can be called soils. These tracts are shown on a soil map like other mapping units, but they are given descriptive names, such as Dune Land or Stony steep land, limestone, and are called land types rather than soils.

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

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to

be organized in such a way that it is readily useful to different groups of readers, among them farmers, ranchers, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in soil survey reports. The soil scientists set up trial groups based on the yield and practice tables and other data. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others; then they adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

## General Soil Map

The general soil map at the back of this report shows, in color, the soil associations in the Las Vegas and Eldorado Valleys 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 management of a farm or a field, because the soils in any one association ordinarily differ in slope, stoniness, drainage, and other characteristics that affect management.

There are 10 soil associations in the Las Vegas and Eldorado Valleys Area. Associations 1 and 10 are on or adjacent to the valley floors. They are level or nearly level and contain loamy soils that are well drained and moderately well drained. If they could be irrigated, these soils would have the highest agricultural potential of all the soils in the Area. Associations 6 and 8 provide good sites for nonagricultural and industrial development. They are nearly level to strongly sloping and contain gravelly, coarse-textured soils that are excessively drained to well drained and contain little or no sulfate. These soils are an excellent source of sand and gravel. Conversely, they are poor agricultural soils because of droughtiness. Association 5 contains little soil material and is too steep to be useful except as a recreational area or a wildlife refuge. Soil association 2 contains soils that are high in sulfate and susceptible to erosion. Associations 3, 4, 7, and 9 contain soils that for the most part are poor for agriculture but have distinctive features that make them suitable for other uses.

## Las Vegas Valley

Las Vegas Valley is the northern part of the Area surveyed. It is a trough that runs northwest-southeast and drains toward the south into Lake Mead. It is surrounded by steep, rugged mountain ranges. The valley covers 350 square miles. Most of it is privately owned. Only 1,580 acres is irrigated and cultivated.

### 1. Glendale-Land association

#### *Very deep loamy soils on nearly level flood plains*

This association occupies approximately 15 percent of Las Vegas Valley. One large area is in the east-central part of this valley, and two small areas occur in the northwestern and southwestern parts. The association consists predominantly of Glendale and Land soils but also includes Arden, Bluepoint, Carrizo, Gila, Grapevine, McCullough, and Paradise soils, and Dune Land.

Glendale soils, which make up approximately 60 percent of the association, are well drained. They are generally very deep, medium textured, strongly calcareous, low in organic-matter content, and moderately or moderately slowly permeable. Land soils, which make up approximately 20 percent of the association, are moderately well drained. They are very deep, medium textured and moderately fine textured, strongly calcareous, low in organic-matter content, unusually high in disseminated and fine crystalline salt and gypsum, and moderately slowly or slowly permeable.

The best agricultural soils in Las Vegas Valley, and most of the cultivated soils, are in this association. If irrigated and well managed, these soils are highly productive of all the crops locally grown. The acreage in farm crops can be expected to increase as the supply of irrigation water increases. No major increase in farm acreage can be expected, however, unless an ample and dependable supply of water is made available.

The vegetation on these soils is too sparse to support grazing. The present trend in land use is toward the development of small tracts for homesites. There has been little or no industrial development.

The drainage outlet of the valley is through this association. The channels are small. Consequently, the soils are often damaged by widespread inundation and deposition of sediments. Flood control should be considered if the trend toward homesite development continues.

### 2. Badland-Bracken-McCarran association

#### *Deep and very deep, loamy and gravelly, highly gypsiferous soils on nearly level to moderately sloping terraces and on eroded, moderately sloping to strongly sloping terrace escarpments*

This association occupies approximately 23 percent of Las Vegas Valley and occurs as scattered terraces and terrace escarpments in the eastern, south-central, central, and north-central parts. It consists predominantly of Badland, a miscellaneous land type, and Bracken and McCarran soils, but also includes Las Vegas, Spring, Bluepoint, Tonopah, and Jean soils and tracts of Riverwash and Dune Land.

Badland makes up approximately 35 percent of this association. It consists of severely eroded, highly gypsiferous, calcareous, lake-laid silts and clay. Bracken soils make up approximately 32 percent of the association. These soils are well drained, gravelly, moderately coarse textured, and high in crystalline gypsum. In most places they overlie loose gravel. McCarran soils, which also make up approximately 32 percent of the association, are moderately well drained, moderately coarse textured, highly gypsiferous, and calcareous.

This association is poorly suited to farming, but there are a few small, scattered ranches. The soils are slightly to severely eroded, are high in gypsum, and have other undesirable characteristics.

Fair to very poor sites for urban and industrial development occur on this association. The fair sites are on the more nearly level, slightly eroded parts of the association, and the very poor sites are on the steep, severely eroded parts. The sites that are potentially fair are readily accessible by rail and highway. Measures for flood control and erosion control will be needed if urban and industrial development continues.

The sulfate hazard to concrete is high throughout the association. Type 5 cement and high-density concrete should be used in all structures supported by these soils. Water-disposal systems should be carefully planned and designed to insure minimum leaching, because the soils are likely to subside, or settle, if the gypsum is completely or even partially removed.

### 3. *Cave-Goodsprings-Las Vegas association*

*Shallow and very shallow gravelly and loamy soils on nearly level and gently sloping terraces; commonly underlain by a hardpan or cemented gravel*

This association occupies approximately 35 percent of Las Vegas Valley and occurs as an almost continuous terrace along the western and northern parts. It consists predominantly of Cave, Goodsprings, and Las Vegas soils but also includes Skyhaven, Glendale, Tonopah, McCullough, and Arden soils, and tracts of Riverwash and Badland.

Cave soils make up approximately 35 percent of this association. These soils are shallow and very shallow and moderately coarse textured, and they overlie a thick, lime-indurated hardpan. Goodsprings soils make up approximately 30 percent of the association. They are shallow, gravelly, and moderately coarse textured and overlie gravel strongly cemented with lime. Las Vegas soils, which make up approximately 25 percent of the association, are shallow or very shallow and medium textured and overlie a thick, lime-indurated hardpan.

This association is best suited to nonfarm uses. All of the soils are well drained, but they have a predominantly shallow or very shallow root zone, are very low in water-holding capacity, and are susceptible to erosion.

Rail and highway facilities are available in parts of this association, and conditions are favorable for urban and industrial development. Homesite developments are likely if Las Vegas expands to the west. Flood-control and water-disposal systems should be considered if expansion continues.

The hardpan underlying these soils has only slight limitations as foundation-bearing material for most types of construction but hampers the installation of all underground facilities. This hardpan is too thick and too hard to be shattered by ordinary ripping equipment.

### 4. *Skyhaven-Spring-Gass association*

*Shallow to deep loamy and clayey soils on nearly level and gently sloping terraces; shallow soils underlain by a hardpan*

This association occupies approximately 5 percent of Las Vegas Valley. The largest area is in the central part

of the valley, and there are three smaller areas in the north-central and northeastern parts. The association consists predominantly of Skyhaven, Spring, and Gass soils but also includes Glendale, Cave, Casa Grande, and McCarran soils.

Skyhaven soils make up approximately 50 percent of this association. These soils are well drained, calcareous, and moderately fine textured and overlie a hard pan strongly cemented with lime. Spring soils, which make up approximately 37 percent of this association, are imperfectly drained, moderately fine textured, calcareous, and high in gypsum. Gass soils, which make up approximately 11 percent of the association, are moderately well drained, fine textured, and calcareous.

This association is best suited to nonfarm enterprises. Parts of it could be cultivated, but for the most part it has only poor to fair agricultural value. Only shallow-rooted, salt-tolerant crops should be planted on the acreages that are cultivated.

A large part of this association is in fringe areas and within the city limits of Las Vegas and North Las Vegas. It will most likely be the site of rural and light industrial developments as these cities expand. Flood-control and water-disposal systems should be considered along with further expansion of housing and industrial facilities.

The shrink-well potential is high and must be considered in structural designs. Wetting of these soils in summer and drying in winter is likely to cause buildings to heave and sag. The sulfate hazard to concrete is high.

### 5. *Stony steep land, basalt-Stony steep land, limestone, association*

*Very steep rocky mountains; little soil material*

This association occupies approximately 2 percent of Las Vegas Valley. It occurs as fringe areas along the eastern and southern edges of the survey Area.

This association is too steep to have any value for crops, and it supports little or no vegetation for grazing. It is best used for wildlife, for watershed projects, or as recreational areas.

### 6. *Tonopah-Pittman-Eastland-Jean association*

*Very deep to shallow gravelly sandy and gravelly loamy soils on nearly level to strongly sloping alluvial fans; shallow soils underlain by a hardpan*

This association occupies approximately 20 percent of Las Vegas Valley. It occurs as scattered spots on the alluvial apron that surrounds the valley. The association consists predominantly of Tonopah, Pittman, Eastland, and Jean soils but also includes McCarran and Las Vegas soils and tracts of Riverwash.

Tonopah soils make up approximately 37 percent of the association. They are very gravelly, coarse textured, calcareous, and excessively drained. Pittman soils, which also make up approximately 47 percent of the association, are gravelly, cobbly, stony, coarse textured, calcareous, and well drained. Eastland soils and Jean soils each make up approximately 13 percent of the association. Eastland soils are gravelly, moderately coarse textured, calcareous, and well drained. Jean soils are coarse textured, excessively drained, and moderately deep over gravel.

This association is best suited to nonfarm uses. The

soils are gravelly, cobbly, and droughty. They have only limited potential for farm crops, but they are suitable for orchard or vineyard crops that can tolerate excessive drainage. If these soils are to be used for farming, they need intensive measures that increase fertility and control erosion.

This association affords potentially good sites for homes and industries. Part of it is occupied by the city of Henderson and its allied chemical plants. Further expansion of residential and industrial sites can be expected. Flood-control and water-disposal systems should be installed to safeguard both the present and the future developments.

The soils in this association are a fair to good source of sand and gravel for concrete aggregate and have slight to moderate limitations as foundation-bearing material. There is essentially no sulfate hazard to concrete.

## Eldorado Valley

Eldorado Valley, the southern part of the area surveyed, covers 110 square miles. It is bordered by mountain ranges on three sides. Except for several mining claims, all of this valley is government owned. None of it is cultivated, because no water is available for irrigation.

### 7. Aztec-Cave association

*Deep to very shallow gravelly and sandy soils on nearly level to strongly sloping terraces; shallow soils underlain by a hardpan or cemented gravel*

This association occupies approximately 6 percent of Eldorado Valley and occurs in the northeastern part. It consists predominantly of Aztec, Cave, and Las Vegas soils but also includes Pittman and Bracken soils and tracts of Stony steep land, basalt.

Aztec soils make up approximately 40 percent of this association. They are gravelly, moderately coarse textured, somewhat excessively drained, and calcareous, and they contain a large amount of gypsum. Cave soils, which also make up approximately 40 percent of the association, are well drained, shallow or very shallow, gravelly, and moderately coarse textured. They overlie a thick, gravelly, lime-indurated hardpan.

The deep to very shallow soils of this association are low to very low in water-holding capacity. They are poorly suited or very poorly suited to farming but are well suited to residential and industrial development. Measures to control erosion should be considered before such development begins.

Much of the acreage has only slight limitations as foundation-bearing material to a depth of about 30 inches but very severe limitations below this depth. The rest is underlain by a thick, indurated hardpan that has only slight limitations. This hardpan will interfere with the installation of underground utilities. The sulfate hazard to concrete is high.

### 8. Carrizo-Tonopah-Pittman association

*Very deep to shallow gravelly and sandy soils on nearly level to strongly sloping terraces; shallow soils underlain by a hardpan or cemented gravel*

This association occupies approximately 33 percent of Eldorado Valley and occurs on the alluvial apron in the

southern and western parts. The association consists predominantly of Carrizo, Tonopah, and Pittman soils but also includes Vinton soils and Stony steep land, basalt.

Carrizo soils make up approximately 78 percent of the association. They are gravelly, coarse textured, excessively drained, slightly micaceous, and mildly calcareous. Tonopah soils, which make up approximately 12 percent of the association, are very gravelly, coarse textured, calcareous, and excessively drained. Pittman soils, which make up approximately 10 percent of this association, are gravelly, cobbly, stony, coarse textured, calcareous, and well drained.

The soils in this association are too gravelly or cobbly and too droughty to be used for farming, but they afford good sites for homes and for industrial development. Flood-control and water-disposal systems should be considered.

These soils are a fair to good source of sand and gravel for concrete aggregate and other uses. They also have slight to moderate limitations as foundation-bearing material. There is essentially no sulfate hazard to concrete.

### 9. Searchlight-Carrizo association

*Very deep gravelly loamy and gravelly sandy soils on gently sloping alluvial fans*

This association occupies approximately 32 percent of Eldorado Valley and occurs on the alluvial apron in the southeastern part. It consists predominantly of Searchlight and Carrizo soils but also includes tracts of Stony steep land, basalt.

Searchlight soils make up approximately 50 percent of the association. They are gravelly, moderately fine textured, calcareous, and well drained. Carrizo soils, which make up approximately 45 percent of the association, are very gravelly, coarse textured, slightly micaceous, mildly calcareous, and excessively drained.

This association provides fair to good sites for homes and for industrial development but is only fairly well suited or poorly suited to farming. The soils have a gravelly, coarse-textured surface layer and a moderate to low water-holding capacity.

The surface layer of these soils is generally too thin to be of engineering value. The subsoil of Searchlight soils has moderate limitations as foundation-bearing material and medium shrink-swell potential. The sulfate hazard to concrete is slight in this layer. Carrizo soils have slight limitations as foundation-bearing material and in most places are a very good source of sand and gravel.

### 10. Vinton-Ireteba-Knob Hill association

*Very deep sandy and loamy soils on nearly level and gently sloping flood plains and alluvial fans*

This association occupies approximately 29 percent of Eldorado Valley. It occurs in the central part of the valley and surrounds the playa. The association consists predominantly of Vinton, Ireteba, and Knob Hill soils but also includes Carrizo, Dry Lake, Kiup, Lairep, Laveldo, and Mead soils.

Vinton soils make up approximately 45 percent of this association. They are coarse textured, somewhat excessively drained, micaceous, and mildly calcareous. Ireteba soils, which make up approximately 15 percent of the association, are stratified, moderately coarse textured and

medium textured, and well drained. They contain lime accumulations just above the level of a past high water table. Knob Hill soils, which also make up approximately 15 percent of the association, are moderately coarse textured, somewhat excessively drained, and calcareous, and they have many soft lime nodules in the substratum.

The best soils for crops in Eldorado Valley are in this association. If irrigated and properly managed, these soils would be moderately to highly productive of all the crops locally grown. They could not be used intensively for farming, however, without an ample and dependable supply of irrigation water.

The vegetation is too sparse to support grazing. As yet, there has been no urban or industrial development. Flood control would be needed should such development begin. The drainage channels on this association are small. The soils receive a large amount of runoff from higher lying soils during convection storms in summer, and they often are damaged by widespread inundation and accompanying deposition of sediments.

## Use and Management of the Soils

The soils of the Las Vegas and Eldorado Valleys Area support little vegetation. Only 1,580 acres in this Area, all of it within Las Vegas Valley, is irrigated and used for cultivated crops. This section explains how the soils could be managed if irrigation water were available. It also gives estimated acre yields of principal crops on selected irrigated soils under two levels of management. The limitations of the soils are described in general, and then the soils that require similar management are grouped, each group is described, and suitable management practices are suggested.

### Crop Management

Most of the virgin soils in the Area are too low in both organic-matter content and in nitrogen content to be kept in good tilth and to produce crops. The supply of organic matter can be increased by growing a crop that produces an extensive root system and an abundance of foliage. To get maximum benefit, the entire crop should be returned to the soil. After this initial conditioning, good tilth can be maintained by including a high proportion of close-growing crops in the cropping system and returning residues and applying manure. Proper use of commercial fertilizer, especially nitrogen, helps to maintain tilth by increasing yields and thus increasing the amount of residue.

Because of their high lime content, most of the soils in the Area are also deficient in available phosphorus and in iron. The phosphorus deficiency results in poor growth and poor yields of most crops and particularly of alfalfa. The iron deficiency results in chlorosis, or yellowing of the leaves. It is noticeable in trees, shrubs, and crops throughout the Area and is most apparent where the soils are highly calcareous. The phosphorus deficiency can be alleviated by the use of phosphate fertilizer. The iron deficiency can be corrected by applying iron compounds (such as iron sulfate or iron chelate), or by using iron spray on the foliage. Heavy ap-

plications of phosphates are likely to be needed on newly cultivated soils.

Generally, tilled crops respond to applications of nitrogen and phosphorus fertilizers, which should be applied in the amounts indicated by soil tests.

### Salinity and Drainage

Most soils in arid regions contain soluble salts, and in places they contain strong concentrations of salts. Normally, these salts remain on or near the surface because low rainfall and rapid evapotranspiration prevent deep penetration of water and leaching. Concentrations of salts also form in areas where drainage is restricted by a high water table or by slow permeability.

Saline soils in the Las Vegas and Eldorado Valleys Area are classified as nonalkali, though in many the content of exchangeable sodium is greater than 15 percent of the cation-exchange capacity. The sodium does not adversely affect these soils if the soluble salts are removed, because gypsum is normally disseminated throughout the soil profile and is also present in all available irrigation water.

Saline phases of several of the soils have been mapped. The degree to which a soil is affected by salinity is determined by examining the vegetation, by observing the characteristics of the soils, and by making laboratory analyses of soil samples collected in the field.

Three classes of salinity are recognized in the survey Area. These classes are based on the percentage of salts in the surface layer and subsoil at the time of the survey. In the soils classified as *slightly saline*, the percentage of salts is 0.20 to 0.50. In the soils classified as *moderately saline*, the percentage is 0.50 to 0.70. In those classified as *strongly saline*, the percentage is greater than 0.70.

The effect of salts on plants depends on the kind of plant, its rooting habit and stage of growth, the kind of salts and the degree of concentration, the position of the salt concentration in the soil profile, the salt content of irrigation water, soil texture, drainage, and climate. A concentration of salts in the lower part of the subsoil is not likely to interfere with the growth of shallow-rooted plants, such as small grain and sorghum, but it may affect deep-rooted plants, such as alfalfa and fruit trees. The effect of salts is more serious if the soils are comparatively dry and the weather is hot and dry, because the accumulation of salts increases soil-moisture tension, thus making it more difficult for plants to extract moisture.

Irrigation water should be of the best quality available. Irrigating with saline water is likely to result in the further accumulation of salts in the soil.

Plants differ in their tolerance for salts (5). If the tolerance is low, yields are poor, even on slightly saline soils. If the tolerance is high, yields are ordinarily satisfactory on moderately saline soils. Few plants tolerate a strongly saline soil.

Adequate drainage is required to remove excess salts from a soil. The more saline the irrigation water is, the more water is needed for leaching salts from the root zone. Leaching requires good drainage, either natural or artificial. Once drainage is established, enough irrigation water can be applied to dissolve the salts and leach them through the soil into drainage outlets. Factors to be

considered in planning a system for leaching are soil characteristics, topography, and the amount of salts that needs to be removed from the soil.

Currently, drainage is a problem on approximately 7,000 acres in the Las Vegas and Eldorado Valleys Area. With the increased use of water for irrigation, drainage problems can be expected to develop on additional acreages.

Wetness in the soils in this survey Area is caused largely by leakage of ground water from artesian aquifers and by seepage from ditches, septic tanks, air conditioning units, and industrial tailing ponds. The soils most seriously affected by wetness are the Land, Glendale, Spring, and Paradise soils and others on low-lying flood plains and terraces. Artificial drainage is needed to prevent excessive accumulations of salts and to make these soils suitable mediums for the growth of plants. Plans for drainage should be based on detailed investigations.

### Capability Groups of Soils

The capability classification is a grouping of soils that shows, in a general way, how suitable soils are for most kinds of farming. It is a practical grouping based on the limitations of the soils, the risk of damage when they are used, and the way they respond to treatment.

In this system all the kinds of soil 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, II*e*. 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 interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the country, indicates that the chief limitation is climate that is too dry or too cold.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the 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, wildlife, recreation, or water supply.

Within the subclasses are the capability units, which are groups of soils 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.

In this report capability units are identified by numbers or letters that either indicate the chief limitation of the soils in the capability class and subclass or suggest other limitations, within the unit, in addition to the major limitation indicated by the subclass designation. The units in any given subclass may not be numbered consecutively, and the symbols are a key to some of the problems or limitations. The numbers and letters used to designate units are—

- A. Few or no limitations.
  1. Slope.
  2. Wetness because of a high water table.
  3. Slow permeability in the subsoil.
  4. Droughtiness caused by underlying rapidly permeable sand.
  5. Clayey texture.
  6. Excess salts or salts and alkali.
  7. Stones.
  8. Shallowness over hardpan or bedrock.
  9. Deficiencies or excesses of minerals.
- O. Loamy texture and susceptibility to wind erosion.
- L. Sandy texture.
- K. Insufficient rainfall for reseeding perennial grasses.

Two numbers, or a number and a letter, are used if the soils have more than one kind of limitation. For example, in capability unit III*w*-36 are slowly permeable soils (3) that are slightly affected by excess salts (6).

Soils are classified in capability classes, subclasses, and units according to the degree and kind of their permanent limitations, but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soil, and without consideration of possible but unlikely major reclamation projects.

The classification of the soils placed in capability classes I through IV in this survey Area represents what their uses and limitations would be if irrigation water were available, but no attempt has been made to evaluate the economic feasibility of providing the necessary water. The classification of the soils in capability classes VI through VII is based on the degree and kind of limitation for use as range. Such use is highly improbable because the current trend is toward nonfarming enterprises, but the system provides a basis for classifying similar soils in other areas.

The eight classes in the capability system and the subclasses in this survey Area are described in the list that follows.

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

(No subclasses)

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

Subclass II*e*. Soils subject to moderate erosion if they are not protected.

Subclass II*w*. Soils that have moderate limitations because of excess water.

Subclass II*s*. Soils that have moderate limitations of moisture capacity, tilth, or permeability.

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

Subclass IIIe. Soils subject to severe erosion if they are cultivated and not protected.

Subclass IIIw. Soils that have severe limitations because of excess water.

Subclass IIIs. Soils that have severe limitations because of moisture capacity, tilth, or permeability.

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 erosion if they are cultivated and not protected.

Subclass IVw. Soils that have very severe limitations for cultivation because of excess water.

Subclass IVs. Soils that have very severe limitations because of low moisture capacity or tilth.

Class V. Soils not likely to erode that have other limitations, impractical to remove without major reclamation, that limit their use largely to pasture or range, woodland, or wildlife food or cover. No soils in the Las Vegas and Eldorado Valleys Area are in class V.

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

Subclass VIw. Soils severely limited by excess water and generally unsuitable for cultivation.

Class VII. Soils that have very severe limitations that make them unsuitable for cultivation without major reclamation, and that restrict their use largely to grazing, woodland, or wildlife.

Subclass VIIw. Soils very severely limited by excess water.

Class VIII. Soils and landforms that have limitations that, without major reclamation, preclude their use for commercial production of plants and restrict their use to recreation, wildlife, water supply, or esthetic purposes.

Subclass VIIIe. Severely eroded land.

Subclass VIIIw. Low-lying, wet, salty soils that have little potential for production of vegetation.

Subclass IIIs. Rock or soils that have, under the existing climate, little potential for production of vegetation.

In the following pages each capability unit is described and suggestions are given on use and management of the soils of each unit.

#### **Capability unit I-A**

This unit consists of loamy, nearly level, light-colored soils on flood plains. These soils are well drained, friable, and more than 60 inches deep. They are high in fertility,<sup>4</sup> high in water-holding capacity, easy to work, and potentially highly productive. Permeability is moderately rapid to moderately slow in the subsoil and, in many of the soils, in the substratum also. It is slow where the material in the substratum is finer textured and stratified. Most of these soils are salt free. Some are slightly saline,

<sup>4</sup>Based on comparison with soils in other areas of the southwest. Virgin soils of desert areas are normally very low in organic matter, and nitrogen, and many are low in available phosphorus.

but they could be reclaimed readily once they were irrigated.

Alfalfa, barley, wheat, corn for silage, sorghum, cotton, radishes, onions, tomatoes, cantaloup, grapes, tree fruits, and pasture crops can be grown under irrigation. Rotate crops to include 2 years or more of soil-conditioning crops and not more than 3 successive years of row crops. Where maintaining tilth is a problem, it may be advantageous to plow under the last cutting of hay and to turn under a green-manure crop at least once during a 3-year period of row crops.

These soils need leveling before irrigation. Their water-holding capacity is more than 1.5 inches per foot of depth. If irrigation water becomes available, irrigate row crops by furrows; irrigate other crops by corrugations or by border flooding. Irrigation runs can be of moderate length and can be longer on loams and silt loams than on very fine sandy loams. There are no restrictions or limitations on the depth of cuts that can be made when leveling these soils.

#### **Capability unit IIe-4**

This unit consists of a loamy, gently sloping, light-colored soil that is well drained, friable, droughty, and more than 60 inches deep. This soil is moderate in fertility, easy to work, moderate in water-holding capacity, and potentially productive. Permeability is moderately rapid in the subsoil and very rapid in the substratum. This soil is moderately susceptible to water erosion. It does not contain a harmful accumulation of salts.

This soil occurs as such small areas that it cannot be managed separately. The management suggested for the soils of capability unit IVE-4 is applicable.

#### **Capability unit IIw-6**

This unit consists of light-colored and dark-colored, loamy, nearly level, friable, saline soils that are more than 60 inches deep. These soils are on flood plains in the trough of Las Vegas Valley or adjacent to springs and seeps. The depth to the water table fluctuates between 4 and 5 feet most of the year.

These soils are high in fertility, high in water-holding capacity, easy to work, and potentially productive of salt-tolerant crops. Permeability is moderately slow. In the Paradise soil it is slow below a depth of 30 inches. If these soils are irrigated, the salt content will decrease, but the water table will rise. Special measures for flood control are needed.

Unless leached, these saline soils are suitable only for salt-tolerant crops, which include grass, alfalfa, barley, and cotton. Maintain the stand of grass or alfalfa for at least 2 years, and then plant barley or cotton for not more than 3 years before reestablishing grass or alfalfa.

Larger amounts of water than are normally required would be needed to leach the excess salts from these soils. Then adequate drainage would be needed to help remove the salts, to keep the water table from rising when water is applied for leaching, and to lower the naturally high water table to a depth of more than 5 feet.

These soils need leveling before irrigation. If irrigation water becomes available, the irrigation requirements would be essentially the same as those for the soils in capability unit I-A, except that more water would be needed for leaching, and more frequent light irrigations

most likely would be needed to keep the salts diluted till crops were past the seedling stage. Irrigate row crops by furrows; irrigate other crops by corrugations or by border flooding. Irrigation runs can be of moderate length.

There are no restrictions on the depth of cuts that can be made when leveling these soils. Dikes and levees are needed for protection against flooding. Broad overland flows, rather than a concentrated flow in a single ditch, or even in several ditches, would lessen the destructive and erosive force of the water.

#### **Capability unit IIs-3**

This unit consists of a loamy, nearly level, light-colored soil on flood plains. This soil is very deep, friable, and well drained. It is underlain by slowly permeable clay at a depth between 28 and 48 inches. This soil is high in fertility, high in water-holding capacity, easy to work, and potentially productive. Permeability is moderate in the subsoil.

Alfalfa, barley, wheat, corn for silage, sorghum, cotton, radishes, onions, tomatoes, cantaloup, and pasture crops can be grown under irrigation. Rotate crops to include 2 years or more of soil-conditioning crops and not more than 3 successive years of row crops. Where maintaining tilth is a problem, it may be advantageous to plow under the last cutting of hay and to grow and turn under a green-manure crop at least once during a 3-year period of row crops.

This soil needs leveling before irrigation. Its water-holding capacity is more than 1.5 inches per foot of depth. If irrigation water becomes available, irrigate row crops by furrows; irrigate other crops by corrugations or by border flooding. Improper irrigation methods are likely to result in a perched water table. Cuts made in leveling should be no more than half the depth to the clay substratum.

#### **Capability unit IIs-4**

This unit consists of loamy, nearly level, light-colored soils on flood plains or alluvial fans. These soils are well drained, very friable, droughty, and more than 60 inches deep. They are moderate in fertility, moderate in water-holding capacity, easy to work, and potentially productive. Permeability ranges from moderate to very rapid.

Alfalfa, barley, wheat, corn for silage, sorghum, cotton, radishes, onions, tomatoes, cantaloup, grapes, tree fruits, and pasture crops can be grown under irrigation. Rotate crops to include 2 or more years of soil-conditioning crops and not more than 3 successive years of row crops. Where maintaining tilth is a problem, it may be advantageous to plow under the last cutting of hay and to grow and turn under a green-manure crop at least once during a 3-year period of row crops. Leave stubble standing for wind protection. Work residues into the surface layer, rather than turning them under.

These soils need leveling before irrigation. Their water-holding capacity is 1 inch to 1.5 inches per foot of depth. If irrigation water becomes available, irrigate row crops by furrows; irrigate other crops by corrugations or by border flooding. Short runs are advisable. There are no restrictions or limitations on the depth of cuts that can be made when leveling these soils. Windbreaks are needed along the southern edge of fields.

#### **Capability unit IIs-6**

This unit consists of loamy, nearly level, light-colored soils on flood plains where the water table is more than 10 feet below the surface. These soils are saline, friable, and more than 60 inches deep.

Soils of this group are high in fertility, high in water-holding capacity, easy to work, and potentially productive of salt-tolerant crops. Permeability is moderate or moderately slow. The salt content could be lowered by irrigation and leaching, but the water table most likely would rise to within 7 feet of the surface.

These saline soils are not suitable for any but salt-tolerant crops, which include grass, alfalfa, barley, and cotton. The surface layer needs to be leached before even these crops are planted. Maintain the stand of grass or alfalfa for at least 2 years, and then plant barley or cotton for more than 3 years before reestablishing grass or alfalfa. Where maintaining tilth is a problem, it may be advantageous to plow under the last cutting of hay and to grow and turn under a green-manure crop at least once during a 3-year period of cotton.

Large amounts of water need to be applied to leach the excess salts out of the surface layer. After the initial leaching, periodic heavy applications of water would likely be needed to keep the salinity at a low level. Drainage would be needed to remove excess salts and to keep the water table at a depth of more than 5 feet.

These soils need leveling before irrigation. If irrigation water becomes available, the irrigation requirements would be essentially the same as those of the soils in capability unit I-A, except that more water would be needed for leaching, and more frequent light irrigations most likely would be needed to keep the salts diluted till crops were past the seedling stage. Irrigate row crops by furrows; irrigate other crops by corrugations or by border flooding. Runs can be of moderate length and can be longer on silt loams than on very fine sandy loams. There are no restrictions on the depth of cuts that can be made when leveling these soils.

#### **Capability unit IIIe-4**

This unit consists of a loamy, moderately sloping, light-colored soil that is well drained, friable, droughty, and more than 60 inches deep. This soil is moderate in fertility, moderate in water-holding capacity, easy to work, and potentially productive. Permeability is moderately rapid in the subsoil and very rapid in the substratum. This soil is susceptible to water erosion. It does not contain a harmful accumulation of salts.

This soil occurs as such small areas that it cannot be managed separately. The management suggested for the soils of capability unit IVE-4 is applicable.

#### **Capability unit IIIw-36**

This unit consists of loamy, nearly level, light-colored soils on flood plains and terraces. These soils are slowly permeable, saline, friable, and more than 60 inches deep. They are high in fertility, high in water-holding capacity, easy to work, and fairly productive of salt-tolerant crops. Drainage is imperfect, moderately good, or good. Permeability is moderately slow to moderately rapid in the subsoil and slow in the substratum. Irrigation and leaching would lower the salt content but would cause the water table to rise.

These soils are not suitable for any but salt-tolerant crops, which include grass, alfalfa, barley, and cotton. Maintain the stand of grass or alfalfa for at least 2 years, and then plant barley or cotton for not more than 3 years before reestablishing grass or alfalfa. Where maintaining tilth is a problem, it may be advantageous to plow under the last cutting of hay and to grow and turn under a green-manure crop at least once during a 3-year period of cotton.

Large amounts of water would need to be applied to these soils to leach the excess salts out of the surface layer. Drainage would be needed to remove the excess salts and to keep the water table from rising when water is applied for leaching. Irrigation would probably result in a perched water table, because of the slowly permeable substratum.

These soils need leveling before irrigation. If irrigation water becomes available, irrigate row crops by furrows; irrigate other crops by corrugations or by border flooding. Additional applications of water, over and above crop needs, would likely be needed to control salinity in the upper part of the root zone. Irrigation runs can be of moderate length. Cuts made in leveling should be less than 18 inches deep, in order to leave enough space for roots above the slowly permeable material.

#### **Capability unit IIIw-4**

This unit consists of a gravelly, loamy, nearly level, light-colored soil that is droughty, friable, and more than 60 inches deep. This soil is on alluvial fans where it receives seepage from higher lying tailing ponds. The depth to the water table fluctuates between 4 and 5 feet during most of the growing season. This soil is moderate in fertility, moderate in water-holding capacity, and fairly productive. Permeability is rapid in the subsoil and moderate in the substratum. The gravel in the surface layer is not likely to interfere with cultivation. If exposed through leveling, the gravel in the subsoil will make cultivation difficult. Light smoothing may be needed. This soil does not contain a harmful accumulation of salts.

Under irrigation, alfalfa, barley, wheat, corn for silage, sorghum, radishes, onions, tomatoes, cantaloup, and pasture crops can be grown. Keep this soil in grass or cover crops for as long as practicable, and then in a row crop for no more than a year. Turn under the last cutting of hay. Leave stubble standing for wind protection. Work residues into the surface, rather than turning them under.

These soils have a water-holding capacity of 1 inch to 1.5 inches per foot of depth. If irrigation water becomes available, irrigate row crops by furrows; irrigate other crops by corrugations or by border flooding. Short runs are advisable. Cuts made in leveling should be less than 12 inches deep in order to avoid exposing the very gravelly underlying material. Windbreaks are needed along field boundaries.

#### **Capability unit IIIw-6**

This unit consists of a loamy, nearly level, light-colored soil that is friable, slightly wet, strongly saline, and more than 60 inches deep. This soil is on flood plains in the trough of Las Vegas Valley, where the depth to the water table fluctuates between 4 and 5 feet during most

of the year. This soil is high in fertility, high in water-holding capacity, and easy to work. It is fairly productive of salt-tolerant crops. Irrigation would lower the level of salinity.

This soil is not suitable for any but salt-tolerant crops, which include grass, alfalfa, barley, and cotton. Not even these crops should be planted, however, until the surface layer has been partly leached of salts. Where maintaining tilth is a problem, it may be advantageous to plow under the last cutting of hay and to grow and turn under a green-manure crop at least once during a 3-year period of row crops.

Large amounts of water would be needed to leach the excess salts from the surface layer. After the initial leaching, periodic heavy applications of water would likely be needed to keep the salinity at a low level. Drainage would be needed to help remove excess salts, to keep the water table from rising when water is applied for leaching, and to lower the naturally high water table.

This soil probably needs leveling before irrigation. If irrigation water becomes available, the irrigation requirements would be essentially the same as those of the soils in capability unit I-A, except that additional water for leaching would be needed, and more frequent light irrigations most likely would be needed to keep salinity at a low level until plants were past the seedling stage. Irrigate row crops by furrows; irrigate other crops by corrugations or by border flooding. Irrigation runs can be of moderate length. There are no restrictions on the depth of cuts that can be made when leveling this soil.

#### **Capability unit IIIs-13L**

This unit consists of a sandy, gently sloping, light-colored soil on terraces. This soil is slowly permeable, moderately well drained, very friable, and more than 60 inches deep. It is moderate in fertility and in water-holding capacity, easy to work, and potentially productive. Permeability is moderately rapid in the subsoil but slow in the substratum, which is weakly cemented with lime. Wind erosion is a hazard if the soil is left unprotected for long periods.

If irrigated, this soil is suited to alfalfa, barley, wheat, cotton, grass-legume pasture mixtures, and salt-tolerant row crops. If leached, it is also suited to corn for silage, sorghum, radishes, onions, tomatoes, cantaloup, grapes, and tree fruits. Leave stubble standing for wind protection. Work stubble into the surface, rather than turning it under.

Except for salt-tolerant crops, this soil would need to be leached. After the initial leaching, periodic heavy applications of water would likely be needed each year to keep the salinity at a low level. Drainage would be needed to help remove the excess salts and to keep the water table from rising when water is applied for leaching. Improper irrigation practices would likely result in a perched water table.

This soil needs leveling before irrigation. Its water-holding capacity is 1 inch to 1.3 inches per foot of depth. If irrigation water becomes available, irrigate row crops by furrows; irrigate other crops by corrugations or by border flooding. Sprinklers may also be used in places. Irrigation runs must be short. Cuts made in leveling should be less than half the depth to the lime-cemented

hardpan. Windbreaks all around a field would provide maximum protection against wind erosion. Plantings along only the southern edge of a field would provide some protection.

#### **Capability unit IIIs-3**

This unit consists of a gravelly, loamy, nearly level soil that is slowly permeable, very deep, friable, and well drained. This soil is weakly cemented with gypsum at a depth between 20 and 30 inches. It is moderate in fertility, moderate in water-holding capacity, easy to work, and fairly productive. Permeability is moderately rapid in the subsoil and slow in the upper part of the substratum.

Alfalfa, barley, wheat, corn for silage, sorghum, radishes, onions, tomatoes, cantaloup, and pasture crops can be grown under irrigation. Rotate crops to include 3 or more years of soil-conditioning crops and not more than 1 year of a row crop or grain. Leave stubble standing for wind protection. Work residues into the surface, rather than turning them under.

This soil needs leveling before irrigation. Its water-holding capacity is approximately 1 inch to 1.5 inches per foot of depth. If irrigation water becomes available, irrigate row crops by furrows; irrigate other crops by corrugations or by border flooding. Irrigation runs must be short. Improper irrigation methods are likely to result in a perched water table. Cuts made in leveling should be no more than half the depth to the hardpan. Windbreaks should be planted around the margins of fields, particularly along the southern edge.

#### **Capability unit IIIs-3L**

This unit consists of a sandy, nearly level, slowly permeable soil on flood plains and on toe slopes of alluvial fans adjacent to playas. This soil is very friable, is more than 60 inches deep, and overlies strata of fine-textured and moderately fine textured material. It is moderate in fertility, moderate in water-holding capacity, easy to work, and fairly productive. It is subject to wind erosion if left unprotected for long periods.

Alfalfa, barley, wheat, corn for silage, sorghum, radishes, onions, tomatoes, cantaloup, and pasture crops can be grown under irrigation. Keep this soil in grass or a cover crop as long as practicable and then in a row crop for no more than 1 year. Leave stubble standing for protection against wind erosion. Work residues into the surface, rather than turning them under.

This soil needs leveling before irrigation. Its water-holding capability is approximately 1.3 to 1.5 inches per foot of depth. If irrigation water becomes available, irrigate row crops by furrows; irrigate other crops by corrugations or by border flooding. Sprinklers may also be used in places. Irrigation runs should be short. Improper irrigation practices will likely result in salinity and a perched water table. Cuts made in leveling should be no more than half the depth to the clay substratum. Windbreaks all around a field would provide maximum protection against wind erosion. Plantings along only the southern edge of a field would provide some protection.

#### **Capability unit IIIs-4**

This unit consists of loamy, nearly level, droughty soils on flood plains. These soils are very deep, very

friable, and well drained or somewhat excessively drained. They are moderate in fertility, moderate to low in water-holding capacity, easy to work, and fairly productive. Unless protected, these soils are moderately susceptible to wind erosion.

Alfalfa, barley, wheat, corn for silage, sorghum, radishes, onions, tomatoes, cantaloup, grapes, tree fruits, and pasture crops can be grown under irrigation. Keep these soils in grass or a cover crop for as long as practicable, and then in a row crop for no more than 1 year.

These soils need leveling before irrigation. Their water-holding capacity is 1 inch to 1.3 inches per foot of depth. If irrigation water becomes available, irrigate row crops by furrows; irrigate other crops by corrugations or by border flooding. Irrigation runs should be short. The slightly saline soil would need larger amounts of water during the first two or three irrigations to leach the excess salts. After the initial leaching, periodic heavy applications of water would be needed to keep the salinity at a low level. The water table is no problem. There are no restrictions or limitations on the depth of cuts that can be made when leveling these soils. Windbreaks are needed along field boundaries, particularly along the southern edge.

#### **Capability unit IIIs-L**

This unit consists of a sandy, nearly level soil on flood plains and on the toe slopes of alluvial fans. This soil is very deep, is well drained, and overlies stratified, medium-textured and moderately coarse textured material. It is moderate in fertility, moderate in water-holding capacity, easy to work, and potentially productive. Permeability is rapid in the subsoil and moderate in the substratum. If left unprotected for long periods, this soil is moderately susceptible to erosion, particularly to wind erosion. It does not contain a harmful accumulation of salts.

Alfalfa, barley, wheat, corn for silage, sorghum, radishes, onions, tomatoes, cantaloup, grapes, tree fruits, and pasture crops can be grown under irrigation. Maintain grass or a cover crop for as long as practicable, and then grow row crops for no more than 1 year. Leave stubble standing for wind protection. Work residues into the surface, rather than turning them under.

This soil needs leveling before irrigation. Its water-holding capacity is approximately 1.3 to 1.5 inches per foot of depth. If irrigation water becomes available, irrigate row crops by furrows; irrigate other crops by corrugations or by border flooding. Sprinklers may also be used in places. Runs should be short. Improper irrigation would likely result in a temporary perched water table, which would limit the root zone. There are no restrictions or limitations on the depth of cuts that can be made when leveling this soil.

Windbreaks all around a field would provide maximum protection against wind erosion. Planting along only the southern edge would provide some protection.

#### **Capability unit IVe-4**

This unit consists of loamy, gently sloping and moderately sloping, light-colored soils on flood plains and alluvial fans. These soils are very deep, very droughty, very friable, well drained or somewhat excessively drained, and shallow to moderately deep (10 to 36

inches) over gravel. They are low in fertility and low in water-holding capacity, but they are easy to work and are fairly productive of drought-tolerant crops. Permeability is moderately rapid in the subsoil and very rapid in the substratum. The water table is no problem.

Alfalfa, barley, wheat, corn for silage, sorghum, radishes, onions, tomatoes, cantaloup, grapes, tree fruits, and pasture crops can be grown under irrigation. Rotate crops to include 3 or more years of soil-conditioning crops and not more than 1 year of a row crop. Leave stubble standing for wind protection. Work residues into the surface layer, rather than turning them under.

These soils need leveling before irrigation. Their water-holding capacity is 0.8 to 1 inch per foot of depth. If irrigation water becomes available, irrigate all crops by furrows, corrugations, or sprinklers. Furrows must run across the slope and must have a maximum gradient of 0.5 percent. Irrigation runs should be short. Only small areas are suitable for leveling. The depth of the cuts that can safely be made in leveling needs to be determined in the field. Windbreaks are needed along the southern edge of a field.

#### **Capability unit IVw-36**

This unit consists of loamy, nearly level soils that are deep and friable, are imperfectly drained, have a slowly permeable substratum, and are strongly saline. These soils are on flood plains in the main drainageway of Las Vegas Valley, where the depth to the water table fluctuates between 3 and 5 feet. These soils are easy to work when dry. Their natural fertility and their water-holding capacity are high. The erosion hazard is slight.

Unless leached, these strongly saline soils are suitable for only the most salt-tolerant crops, which include grass and barley. Maintain the stand of grass as long as possible, then plant barley for 1 or 2 years before reestablishing grass.

Because of their slow permeability, these soils probably cannot be reclaimed completely, but through leaching and drainage the salt content could be reduced enough that cotton and alfalfa would grow. After the salt content has been reduced, a suitable rotation would be 2 years of soil-conditioning crops and not more than 3 years of cotton. Where maintaining till is a problem, it may be advantageous to plow under the last cutting of hay and to grow and turn under a green-manure crop at least once during a 3-year period of row crops.

After the initial leaching, one or two heavy applications of water would likely be needed each year to keep the salinity at a low level. Drainage would be needed to help remove excess salts, to keep the water table from rising when water is applied for leaching, and to lower the naturally high water table.

These soils need leveling before irrigation. Their water-holding capacity is more than 1.5 inches per foot of depth. If irrigation water becomes available, either border flooding or, for row crops, furrow irrigation would be suitable. The frequency of irrigation and the amount of water needed each time would depend on the salt content. Runs could be 1,200 feet or more in length. Cuts made in leveling should be no more than half the depth to the water table. Included in this capability unit are spots where the depth to the water table fluctuates

between 6 and 9 feet. After irrigation, the water table in these places would probably rise to within 5 feet of the surface.

#### **Capability unit IVs-4L**

This unit consists of sandy, nearly level and gently sloping, light-colored soils on flood plains and alluvial fans. These soils are droughty, very friable or loose, excessively drained to well drained, and more than 60 inches deep. They are low or very low in fertility and low in water-holding capacity, but they are easy to work and are fairly productive. Permeability ranges from moderately slow to very rapid.

If left unprotected for long periods, these soils are moderately susceptible to wind erosion. They do not contain a harmful accumulation of salts, and the water table is not likely to rise if they are irrigated.

Alfalfa, barley, wheat, corn for silage, sorghum, radishes, onions, tomatoes, cantaloup, grapes, tree fruits, and pasture crops can be grown under irrigation. Deep-rooted crops are best suited. Keep these soils in soil-conditioning crops for as long as practicable and in row crops no more than 1 year. Leave stubble standing for protection against wind. Work residues into the surface layer, rather than turning them under.

These soils need leveling before irrigation. Their water-holding capacity is approximately 0.8 inch to 1.3 inches. Sprinkler irrigation would be best, but border flooding would be suitable for the nearly level soils. Irrigation runs must be short. There are no restrictions or limitations on the depth of cuts that can be made when leveling most of these soils. Cuts made in the soils underlain by hardpans should be more than half the depth to the pan. Windbreaks all around a field would provide maximum protection against wind erosion. Plantings along only the southern edge of a field would provide some protection.

#### **Capability unit VIw-36**

This unit consists of loamy, nearly level soils that are wet, slowly permeable, and saline. The salinity is the result of evaporation of the salt-laden ground water. These soils are on flood plains in the trough of Las Vegas Valley and on terraces adjacent to springs and seeps; in both positions the depth to the water table fluctuates between 2 and 4 feet during most of the year. These soils are light colored, friable, and more than 60 inches deep. They are high in fertility and are potentially productive of salt-tolerant plants.

Production of forage can be increased if the soils are irrigated by controlled flooding. Irrigation also helps to lower the salt content and to keep it low. Grazing should be restricted during irrigation, to prevent damage from trampling.

#### **Capability unit VIIw-6**

This unit consists of a medium-textured, nearly level, light-colored soil that is wet and strongly saline. This soil is saturated below a depth of 12 inches. It occurs in the main drainageway of Las Vegas Valley, where extremely salty ground water rises almost to the surface. During the winter months this soil is swampy. The vegetation is primarily phreatophytic but is stunted because

of the high salt content of the ground water. It affords limited grazing.

#### **Capability unit VIIIe-1**

The one land type in this unit consists of severely eroded material that varies in texture. It ranges from nearly level to steep. The slopes are complex, and the topography is rough. For all practical purposes, this land type is barren. The few desert shrubs that grow on it are stunted.

#### **Capability unit VIIIw-36**

This unit consists of clayey, nearly level soils that are well drained to imperfectly drained, slowly permeable, and strongly saline. These soils occur on alluvial fans and on lake bars, or embankments, adjacent to playas in Eldorado Valley. They are low to moderate in fertility and moderate in water-holding capacity. Runoff from higher lying soils results in a moderate erosion hazard. The vegetation is a sparse stand of stunted, salt-tolerant desert shrubs, which afford no grazing except in an occasional year when rainfall is above normal.

#### **Capability unit VIIIw-8**

The one land type in this unit consists of droughty material that is poorly sorted, stony, cobbly, gravelly, and sandy. This land type is nearly level to moderately sloping and occurs in drainage channels. It is overflowed frequently and consequently is subject to erosion and deposition. The vegetation is sparse and affords no grazing except in an occasional year when rainfall is above normal.

#### **Capability unit VIIIs-3**

This unit consists of nearly level to strongly sloping, light-colored soils on alluvial fans and terraces. These soils are slowly permeable and more than 20 inches deep. Most of them are well drained. Some are saline. Their fertility and water-holding capacity range from low to high, depending on the nature of the material in the subsoil and substratum. These soils support sparse desert vegetation, which affords no grazing except in an occasional year when rainfall is above normal. The erosion hazard is slight to severe.

#### **Capability unit VIIIs-7**

This unit consists of nearly level to steep, stony or cobbly soils on alluvial fans, terraces, and terrace breaks. These soils are deep and moderately well drained to excessively drained. They are very low to moderate in fertility and very low to moderate in water-holding capacity. They support only sparse stands of stunted desert shrubs, which afford no grazing except in an occasional year when rainfall is above normal. Permeability ranges from very rapid to slow. The slowly permeable soils are underlain by weakly to strongly gypsum-cemented or lime-cemented material. The erosion hazard is moderate to severe, depending on the slope.

#### **Capability unit VIIIs-78**

The two land types in this unit consist of steep to very steep mountainous rock outcrops and intervening areas

that contain little soil material. Surface runoff is very rapid. The vegetation is sparse and stunted.

#### **Capability unit VIIIs-8**

This unit consists of shallow and very shallow (less than 20 inches deep) soils on old terraces and alluvial fans. These soils are nearly level to strongly sloping, light colored, friable and very friable, and well drained. They are underlain by a dense, indurated lime hardpan. Some are saline. Fertility is low or very low. Permeability is rapid or moderate in the subsoil and very slow in the indurated substratum. The erosion hazard is moderate or severe, depending on the slope. These soils support only a sparse stand of stunted desert shrubs, which afford no grazing except in an occasional year when rainfall is above normal.

#### **Capability unit VIIIs-L**

This unit consists of sandy, nearly level or gently sloping, light-colored soils on alluvial fans, terraces, and flood plains. These soils are very friable, excessively drained, droughty, and more than 60 inches deep. Their fertility and water-holding capacity are low or very low. Permeability is very rapid. The erosion hazard is moderate. The vegetation consists of sparse stands of stunted desert shrubs, which afford no grazing except in an occasional year when rainfall is above normal.

### **Estimated Yields**

Table 2 lists average acre yields that can be expected on selected irrigated soils in the survey Area, under two levels of management. The estimates are based on yields that have been obtained on similar soils in the Moapa Valley, not on actual data for the soils of Las Vegas and Eldorado Valleys. In columns A are yields that can be expected under common, or prevailing, management. In columns B are yields that can be expected under the highest level of management that is now feasible. The estimates were prepared cooperatively by the Soil Conservation Service, the Nevada Agricultural Experiment Station, the Nevada Cooperative Extension Service, and the Bureau of Reclamation, United States Department of the Interior.

Several important limitations should be kept in mind when using table 2. First, the yield figures are estimates, or predictions, rather than proven facts, but they are considered reliable enough to be valuable. Second, the estimates are of average yields that may be expected over a period of many years; the yield in any one year may be higher or lower than this average. Third, there are variations in yields among areas of the same soil. Fourth, past management of a soil affects its immediate response to new management practices. Fifth, new crop varieties and improved farming practices are likely to increase yields in the future.

Under the A level of management, little fertilizer or barnyard manure is used and irrigation is inefficient. Under the B level, the practices suggested in the discussions of the capability units are followed; the soils are prepared carefully for irrigation, and irrigation water is applied uniformly, in sufficient amounts, and at the right time; and weeds and insect pests are controlled.

TABLE 2.—*Estimated average yield per acre*

[Yields in columns A are those obtained under ordinary management; yields in columns B are those to be expected

Map symbol	Soil	Alfalfa		Barley		Wheat	
		A	B	A	B	A	B
BcA	Bluepoint fine sandy loam, slightly saline, 0 to 2 percent slopes.....	<i>Tons</i> 4	<i>Tons</i> 6	<i>Bu.</i> 40	<i>Bu.</i> 65	<i>Bu.</i> 35	<i>Bu.</i> 50
BdB	Bluepoint loamy fine sand, hummocky.....	4	6	35	65	30	50
BkA	Bracken gravelly sandy loam, 0 to 2 percent slopes.....	4	6	40	65	35	50
Dk	Dry Lake loamy fine sand.....	4	6	35	65	30	50
Dm	Dry Lake sandy loam.....	5	6	35	50	40	60
EfA	Eastland gravelly fine sandy loam, secped, 0 to 2 percent slopes.....	4	6	35	65	30	50
EgB	Eastland gravelly loamy sand, 2 to 4 percent slopes.....	4	6	35	65	30	50
Gb	Glendale silt loam.....	6	9	50	75	40	60
Gc	Glendale silt loam, slightly wet, slightly saline.....	5	7	50	75	40	60
Gf	Glendale silt loam, slightly saline.....	6	9	50	75	40	60
GhA	Glendale silt loam, slightly saline, hummocky.....	6	9	50	75	40	60
Gm	Glendale silty clay loam, gypsiferous substrata, slightly saline.....	6	9	50	75	40	60
Gn	Glendale silty clay loam, slightly wet, slightly saline.....	5	7	50	75	40	60
Gp	Glendale silty clay loam, slightly saline.....	6	9	50	75	40	60
Gs	Glendale very fine sandy loam.....	6	9	50	75	40	60
Gt	Glendale very fine sandy loam, clay substrata.....	6	9	50	75	40	60
GyB	Grapevine loamy fine sand, slightly saline, 2 to 4 percent slopes.....	4	6	35	65	30	50
Ir	Ireteba fine sandy loam, slightly saline.....	6	9	50	75	40	60
It	Ireteba loam.....	4	9	50	75	40	60
JeB	Jean loamy fine sand, moderately deep over gravel, 2 to 4 percent slopes.....	4	6	40	65	35	50
KfB	Kiup loamy fine sand, 2 to 4 percent slopes.....	4	6	35	65	30	50
KhA	Knob Hill loamy fine sand, deep over gravel, 0 to 2 percent slopes.....	4	6	40	65	35	50
KnB	Knob Hill loamy sand, 2 to 4 percent slopes.....	4	6	35	65	30	50
La	Lairep loamy fine sand.....	4	6	35	65	30	50
Lf	Land silt loam, slightly saline.....	6	9	50	75	40	60
Lk	Land silty clay loam, slightly saline.....	6	9	50	75	40	60
MkA	McCullough fine sandy loam, 0 to 2 percent slopes.....	6	9	50	75	40	60
Pa	Paradise silt loam, drained, slightly saline.....	5	7	50	75	40	60
Sm	Spring clay loam, slightly saline.....	5	7	50	75	40	60
VsA	Vinton loamy sand, 0 to 2 percent slopes.....	4	6	35	65	30	50
VsB	Vinton loamy sand, 2 to 4 percent slopes.....	4	6	35	65	30	50
VtA	Vinton sandy loam, 0 to 2 percent slopes.....	4	6	40	65	35	50

<sup>1</sup> Animal units per month: the number of mature animals (cows, horses, or mules) that can graze 1 acre during the irrigation season

## Engineering Applications

This section contains information that will help engineers in selecting sites for buildings and other structures, in choosing locations for highways, in locating sand and gravel for use in construction, and in predicting problems in construction and maintenance. The information will be of use largely to engineers and others who have a working knowledge of the principles of soil mechanics and who have some familiarity with engineering groupings of soils. It has been developed largely from field observations and evaluations.

With the soil map for identification of soil areas, the engineering interpretations reported here can be useful for many purposes. It should be emphasized that these interpretations may not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and 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.

The characteristics of the soils in this survey Area are those generally associated with soils of arid regions.

Weathering of the constituent rocks and minerals has been slow, leaching of soluble salts is incomplete, the organic-matter content is low, and calcium and gypsum have concentrated in the subsurface layers.

For the most part, these soils overlie valley fill and alluvial fan deposits. The soils underlain by valley fill consist largely of fine-grained sand, silt, and clay. Those on alluvial fans consist of poorly sorted gravel, sand, and silt but are predominantly coarse textured. Lime-cemented strata are common in all of these soils. Only a small acreage occurs on flood plains. Most of this is in Las Vegas Wash and Paradise Valley in Las Vegas Valley and adjacent to the playa in Eldorado Valley. The soils on flood plains consist of material of many different textures and are generally stratified and saline.

Unless irrigated, most of the soils in the survey Area are dry below a depth of a few inches. Their behavior when saturated should be investigated thoroughly if they are to be used in foundations and embankments. Damage can be caused by settling resulting from the consolidation of fine sand, very fine sand, and silt, or by the swelling of normally dry clayey soils, unless these possibilities are anticipated and allowed for in design and construction.

Only a few soils in this Area are wet. The water in

of principal crops on selected irrigated soils

under the best management practical. Absence of yield indicates the crop is not commonly grown on the soil]

Corn for silage		Sorghum for silage		Radishes		Onions		Cantaloup		Pasture		Cotton	
A	B	A	B	A	B	A	B	A	B	A	B	A	B
Tons	Tons	Tons	Tons	Crates	Crates	Crates	Crates	Crates	Crates	A. U. M. <sup>1</sup>	A. U. M. <sup>1</sup>	Bales	Bales
12	18	15	20	210	500	210	450	225	400	0.6	1		
12	18	15	20							.6	1		
15	20	16	25	250	500	250	600	300	450	.6	1		
12	18	15	20	210	500	210	450	225	400	.6	1	1½	2
15	20	16	25	250	500	250	600	300	450	.5	.75		
12	18	15	20							1	2	1½	2
12	16	16	25							1	2	1½	2
15	20	16	25							1	2	1½	2
15	20	16	25							1	2	1½	2
12	16	16	25							1	2	1½	2
15	20	16	25							1	2	1½	2
15	20	16	25	250	500	250	600	300	450	1	2	1½	2
15	20	16	25	250	500	250	600	300	450	1	2	1½	2
12	18	15	20							.6	1		
15	20	16	25							1	2	1½	2
15	20	16	25	250	500	250	600	300	450	1	2	1½	2
12	18	15	20							.6	1		
12	18	15	20					225	400	.5	.75		
										.6	1		
										.5	.75		
										.75	1.25		
12	18	15	20							1	2	1½	2
15	20									1	2	1½	2
15	20									1	2	1½	2
15	20	16	25	250	500	250	600	300	450	1	2	1½	2
12	16									1	2	1½	2
12	16									1	2	1½	2
								225	400	.6	1		
								225	400	.5	.75		
12	18	15	20					225	400	.75	1.25		

without damage to the pasture.

these soils is largely leakage from underground aquifers and effluent from sewage and industrial plants. Low-lying soils on the flood plains and on some of the terraces may be wet for short periods after heavy rains because of slow infiltration and permeability. Also, some areas may be affected locally by irrigation. If the acreage under irrigation becomes more extensive, additional drainage problems should be anticipated.

Saline and gypsiferous soils occur throughout both Las Vegas and Eldorado Valleys. Consequently, sulfate concentrations are common. Concentrations of the sulfate ion, which is the principal constituent of the soil solution in these soils, generally exceed 1,500 to 2,000 parts per million. Engineers are aware that sulfates cause deterioration of hardened concrete. They should also become aware of the considerable soil shrink-swell caused by sulfate salts of sodium losing or adding water of crystallization as temperature changes.

**Engineering Classification Systems**

Two systems of classifying soils are in general use among engineers. One was developed by the American Association of State Highway Officials (AASHO) (1)

and the other, called the Unified system, Corps of Engineers, U. S. Army (7). Both are used in this report. These systems are based on the identification of soils in accordance with their texture, that is, the percentage of gravel, sand, and fines (silt and clay), and with their plasticity and compressibility characteristics as indicated by the liquid limit, plasticity index, and consistence; and with their behavior as engineering construction material.

In the AASHO system, soil material is classified in seven principal groups. The groups range from A-1, consisting of gravelly soils of high bearing capacity, to A-7, consisting of clayey soils having low strength when wet. Within each group the relative engineering value of the material is indicated by a group index number. The numbers range from 0 for the best material to 20 for the poorest. The group index number, if it has been determined, is shown in parentheses following the soil group symbol.

In the Unified system, soils are identified as coarse grained (8 classes), fine grained (6 classes), and highly organic (1 class). For example, SM and SC represent sand with fines of silt and clay of low liquid limit; MH and CH represent silt and clay of high liquid limit; and GP and GM represent gravel and gravel-sand mixtures.

Test data for selected soils are given in table 3.

TABLE 3.—Engineering

[Tests performed by Bureau of Public Roads (BPR) in accordance with standard

Soil name and location	Parent material	BPR report number	Depth	Horizon	Moisture-density data <sup>1</sup>	
					Maximum dry density	Optimum moisture
Goodsprings gravelly loamy fine sand: 1,300 feet E. and 100 feet N. of $\frac{1}{4}$ corner in SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 18, T. 22 S., R. 61 E.	Mixed; mainly sedimentary rocks and some basic igneous rocks.	S 31311	<i>Inches</i> 0-1	A1-----	<i>Lb. per cu. ft.</i> 125	<i>Percent</i> 9
		S 31312	3-8	B3ca-----	124	10
		S 31313	8-16	IIC1ca-----	119	13
300 feet N. and 30 feet W. of $\frac{1}{4}$ corner in SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 24, T. 22 S., R. 60 E.	Mixed; mainly sedimentary rocks and some igneous rocks.	S 31314	0-1	A1-----	125	10
		S 31315	4-9	B3ca-----	117	13
		S 31316	9-14	IIC1ca-----	121	12
McCarran fine sandy loam: 170 feet N. and 60 feet E. of center corner in SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 35, T. 21 S., R. 61 E.	Gypsiferous sands, silts, and clays.	S 31317	1-11	A12cs-----	100	23
		S 31318	11-17	IIC1cs-----	114	17
		S 31319	42-53	IIC5-----	102	22
120 feet N. and 300 feet W. of $\frac{1}{4}$ corner in SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 14, T. 22 S., R. 61 E.	Gypsiferous sands, silts, and clays.	S 31320	$\frac{1}{2}$ -14	A12cs-----	89	29
		S 31321	14-27	IIC1cs-----	83	36
		S 31322	27-36	IIC2cs-----	92	27

<sup>1</sup> Based on AASHO Designation: M 145-49(t).<sup>2</sup> Mechanical analysis according to AASHO Designation: T 88-57(t). 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

## Engineering Interpretations

In table 4 the material that makes up the important horizons of each soil in the survey Area is described in terms defined in the Unified system (?), and the horizons are classified for engineering purposes according to the Unified and the AASHO methods. The AASHO classification for many of the soils does not include a group index number, because the test data needed for calculating this number are not available.

Also given in table 4 are estimates of the suitability and limitations of the soils for specified engineering uses. More complete descriptions of soil profiles are given in the section "Descriptions of the Soils."

In the column showing permeability is an estimate, in inches per hour, of the rate at which water percolates through soil material that is not compacted.

The suitability ratings for road subgrade, road subbase, and road base are for soil material not subject to frost action. In areas where frost heaving is a problem, some soils would have ratings lower than the ratings shown in the table. Generally, coarse-grained soils are the best for subgrade, subbase, and base. Soils classified GW or A-1 are rated excellent for subgrade and subbase because they are sources of material that can be processed into crushed stone of high quality. These soils are rated good as base material. Suitability of the fine-grained soils for road subgrade is either fair or poor. These fine-grained soils are classified ML, CL, CH, or MH, and have an AASHO classification of A-4, A-5, A-6, or A-7. They are not suitable for road subbase and road base, because

they have one adverse property or more. These properties are moderate to high shrink-swell potential, moderate to high susceptibility to frost action, severely limited stability and bearing capacity, or slow internal drainage.

The ratings indicating suitability of the soils as sources of gravel and sand are based on laboratory data and field observation. Well-graded gravel and sand are classified GW and SW and are excellent sources of those materials. Poorly graded gravel and sand are classified GP and SP and are rated as good sources. Soil material that is less than 15 percent fine to coarse sand or gravel is not suitable as a source of sand or gravel.

The hazard of damage to concrete by sulfate depends on the amount of gypsum and other sulfate minerals in the soil. The amount has been determined by laboratory analysis and by field observation.

The shrink-swell potential indicates the volume change to be expected with a change in moisture content. In general, soils have a high shrink-swell potential if they are high in content of plastic fines and are classified MH or CH and A-7, or if they are high in content of organic matter and plastic fines, they are classified OH and A-7. They also have a high shrink-swell potential if they are very high in sodium sulfate content. Soils that have no shrink-swell potential are clean sands and gravels that are classified SP, GW, or GP and A-1.

The stability of soils in embankments depends largely on permeability, strength, and ease of compaction. Gravelly and sandy soils that have little or no fines and are classified GW, GP, SW, and SP are pervious to water, but they are stable and compactible; hence the

test data

procedures of the American Association of State Highway Officials (AASHO) (1)

Mechanical analyses <sup>2</sup>											Liquid limit	Plasticity index	Classification			
Estimated percentage discarded in field sampling—3 in. to 1 in.	Percentage passing sieve—						Percentage smaller than—						AASHO	Unified <sup>3</sup>		
	3-in.	¾-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.						
-----	-----	98	78	75	73	31	24	17	14	9	<sup>4</sup> NP	<sup>4</sup> NP	A-2-4(0)-----	SM.		
1	100	93	84	81	77	31	25	20	15	11			NP	NP	A-2-4(0)-----	SM.
-----	-----	84	70	65	60	27	24	19	15	10			NP	NP	A-2-4(0)-----	SM.
-----	-----	89	70	68	65	31	24	19	14	8	14	1	A-2-4(0)-----	SM.		
2	100	94	87	85	80	37	28	21	17	13	22	6	A-4(0)-----	SM-SC.		
-----	-----	83	55	47	42	20	15	12	10	8	22	5	A-1-b(0)-----	GM-GC.		
-----	-----	-----	-----	100	93	33	( <sup>5</sup> )	-----	-----	-----	NP	NP	A-2-4(0)-----	SM.		
-----	-----	-----	-----	100	98	46	( <sup>5</sup> )	-----	-----	-----	18	2	A-4(2)-----	SM.		
-----	-----	-----	-----	100	99	58	( <sup>5</sup> )	-----	-----	-----	51	31	A-7-6(14)-----	CH.		
-----	-----	96	96	96	91	63	( <sup>5</sup> )	-----	-----	-----	26	4	A-4(6)-----	ML-CL.		
-----	-----	-----	-----	100	92	55	( <sup>5</sup> )	-----	-----	-----	NP	NP	A-4(4)-----	ML.		
-----	-----	89	86	85	74	55	( <sup>5</sup> )	-----	-----	-----	52	27	A-7-6(12)-----	CH.		

than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes for soils.

<sup>3</sup> SCS and BPR have agreed to consider that all soils having plasticity indexes within two points of the A-line are to be given a borderline classification. Examples of borderline classification obtained by this use are ML-CL, SM-SC, and GM-GC.

<sup>4</sup> Nonplastic.

<sup>5</sup> No hydrometer test because of gypsum.

limitation is slight. Soils classified as CH are fairly stable if used in level areas, but they have detrimental shrinkage characteristics that may necessitate blanketing them or incorporating them in thin interior cores of embankments; hence, the limitation for these soils is severe. Soils containing a fairly large amount of organic matter and classified as OL, OH, and Pt are not commonly used in the construction of embankments.

The degree of limitation for use as foundations of embankments or structures depends largely on the strength and consolidation characteristics of the soil material and on the size and type of structure. In the construction of an embankment, a large amount of settling can safely be allowed if it is compensated for by overbuilding the embankment. In the construction of buildings, however, the amount of settling that can safely be allowed may be small because of the need to prevent overstressing the concrete or steel in the structure or the need to maintain an established grade. Gravel and gravelly soils classified GW, GP, GM, and GC generally undergo little consolidation under load. The limitation for these soils is slight. Soils classified MH and OL and some classified as CH are subject to a significant amount of settling. Thus, their limitation is severe.

The degree of limitation for use as septic tank fields is for the soil to a depth of 5 feet. Considered in making the estimates were texture, structure, permeability, depth to and thickness of slowly permeable layers, and tendency to swell when wet (6). There is no limitation if permeability is very rapid or rapid (5 or more inches per hour or 1 inch or more in 6 to 12 minutes) (6). The limitation

is slight if permeability is moderately rapid (2.5 to 5 inches per hour or 1 inch in 12 to 24 minutes (6)). The limitation is moderate if permeability is moderate (0.8 to 2.5 inches per hour or 1 inch in 24 to 75 minutes (6)); the suitability of such soils can be determined only by a field test. The limitation is severe if permeability is moderately slow or slow (less than 0.8 inch per hour or less than 1 inch in 75 minutes (6)). The nature of the material at a depth of more than 5 feet and the possible contamination of ground water where the rate of permeability exceeds 5 inches per hour were not considered in the ratings.

### Flood Control

Damage from runoff and flooding is negligible during most of the year in Las Vegas and Eldorado Valleys. In fall, winter, and spring, the rainfall normally is gentle, and most of it infiltrates. Intermittent runoff from surrounding mountainous areas generally is absorbed by the porous alluvial apron. During summer storms, flood damage is extensive and is most serious on the flood plains and low terraces where there are few or no drainage channels.

Information about runoff is essential to flood-control planning. In an engineering handbook<sup>5</sup> developed by hydrologists of the Soil Conservation Service, the Forest Service, and other agencies, the major soils of the United

<sup>5</sup>ENGINEERING HANDBOOK, HYDROLOGY, Supplement A, Sec. 4, Soil Conservation Service, USDA.

TABLE 4.—*Descriptions of soils*

[Based on data made available by L. W. Little

Map symbol	Soil	Description	Classification		Permeability
			Unified	AASHO	
AmB	Arden-McCullough fine sandy loams, 2 to 4 percent slopes.	Arden: 0 to 6 inches, sand-silt mixture; about 50 percent sub-angular fine sand to coarse sand; about 50 percent slightly plastic very fine sand and silt; low dry strength; slightly compact and dry in place; strongly calcareous; pH 8.4.	ML-----	A-4-----	<i>In. per hr.</i> 0.8 to 2
AmC	Arden-McCullough fine sandy loams, 4 to 8 percent slopes.	6 to 60 inches, gravel-sand mixture; about 65 percent poorly sorted, subrounded gravel up to 3 inches in diameter; about 33 percent fine sand and very fine sand; about 2 percent nonplastic silts; calcareous; some gypsum. McCullough: See description of McCullough fine sandy loam, 0 to 2 percent slopes (MkA).	GP-----	A-1-a----	>10
AzC	Aztec gravelly loamy sand, 2 to 8 percent slopes.	0 to 12 inches, sand-silt-gravel mixture; about 10 percent angular gravel up to 1 inch in diameter; about 50 percent angular medium sand and fine sand; about 40 percent nonplastic fines; low dry strength; strongly calcareous; pH 8.4.	SM-----	A-4-----	2.5 to 5
		12 to 30 inches, gravel-sand-silt mixture; about 55 percent angular gravel up to ¼ inch in diameter; about 25 percent angular coarse sand to fine sand; about 20 percent nonplastic fines; compact and lime cemented in place.	GM-----	A-2-4----	0.2 to 0.8
		30 to 60 inches, sand-silt-gypsum-gravel mixture; about 20 percent gravel; 60 percent medium sand and fine sand; 20 percent nonplastic fines and crystalline gypsum; gypsum cemented in place.	SM-----	A-4-----	0.2 to 0.8
Ba	Badland.	0 to 60 inches, stratified sand-silt mixture, silty clay, and clay; gypsiferous; calcareous; compact in place; lime-silica hardpan in places; eroded.	SC, CL, and CH.	A-2-6, A-6, and A-7-6.	<0.2
BcA	Bluepoint fine sandy loam, slightly saline, 0 to 2 percent slopes.	0 to 60 inches, sand-silt mixture; about 70 percent fine sand; 20 percent nonplastic fines; calcareous; dry and soft in place; pH 8.6. Slightly saline in places.	SM-----	A-2-4----	5 to 10
BdB	Bluepoint loamy fine sand, hummocky.				
BfE2	Bracken cobbly loam, 2 to 30 percent slopes, eroded.	0 to 3 inches, silt-gravel-cobblestone mixture; about 20 percent cobblestones and stones up to 12 inches in diameter; 5 percent gravel up to 3 inches in diameter; 20 percent fine sand; 55 percent slightly plastic fines; slight dry strength; some gypsum; dry and slightly hard in place; calcareous; pH 8.2.	ML-----	A-4-----	0.8 to 2.5
		3 to 15 inches, sand-silt-gravel mixture; about 10 percent gravel up to ¼ inch in diameter; 50 percent coarse sand to fine sand; 40 percent nonplastic fines; low dry strength; dry and soft in place; calcareous; gypsiferous.	SM-----	A-4-----	2.5 to 5.0
		15 to 60 inches, gypsum-sand-silt mixture; about 15 percent angular gravel; 25 percent coarse sand to fine sand; 60 percent nonplastic fines; mostly crystalline gypsum; dry and hard in place; slightly calcareous; pH 6.5.	ML-----	A-4-----	<0.2
BgC	Bracken gravelly fine sandy loam, 2 to 8 percent slopes.	0 to 14 inches, sand-silt-gravel mixture; about 20 percent angular gravel up to ¼ inch in diameter; 40 percent angular medium sand and fine sand; 40 percent slightly plastic fines; strongly calcareous; some gypsum; dry and soft in upper part and hard and weakly cemented with lime and gypsum in lower part.	ML or CL.	A-4-----	2.5 to 5
		14 to 60 inches, gravel-sand-silt-gypsum mixture; about 30 percent gravel up to ¼ inch in diameter; 40 percent sand, mostly angular fine sand; 30 percent slightly plastic fines of silt, sand, and gypsum; dry and hard in place.	SM or SC.	A-2-4----	<0.2

See footnotes at end of table.

and engineering interpretations

and the Nevada State Highway Department]

Suitability for—			Suitability as source of—		Sulfate hazard to concrete	Shrink-swell potential	Degree of limitation for—		
Subgrade <sup>1</sup>	Subbase	Base	Gravel	Sand			Embankments	Foundations	Septic tank field-(to a depth of 5 feet)
Fair <sup>2</sup> ----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	Low-----	Severe----	Severe-----	None.
Good <sup>2,3</sup> ---	Good----	Fair-----	Good----	Fair to unsuitable.	Severe---	None-----	Slight <sup>2,4</sup> ---	Slight-----	
Fair-----	Fair-----	Unsuitable.	Unsuitable.	Poor-----	Moderate.	Low-----	Moderate---	Moderate-----	Severe.
Good-----	Good-----	Fair-----	Fair-----	Poor-----	Severe---	Low-----	Moderate---	Slight-----	
Fair <sup>2</sup> ----	Fair-----	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	Low-----	Severe----	Severe-----	
Poor <sup>3</sup> ----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	Moderate to high.	Severe----	Moderate or severe, depending on density.	Severe.
Good-----	Fair-----	Poor-----	Unsuitable.	Poor-----	Severe---	Low-----	Moderate---	Severe-----	None.
Fair-----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	Low-----	Severe----	Severe-----	Severe.
Fair <sup>2</sup> ----	Poor-----	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	Low-----	Severe <sup>2</sup> ----	Severe <sup>2</sup> -----	
Fair <sup>2</sup> ----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	Low-----	Severe <sup>2</sup> ----	Severe <sup>2</sup> -----	
Fair-----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	Low-----	Severe----	Severe-----	Severe.
Fair <sup>2</sup> ----	Poor-----	Unsuitable.	Poor-----	Unsuitable.	Severe---	Low-----	Moderate <sup>2</sup> ---	Moderate <sup>2</sup> -----	

TABLE 4.—Descriptions of soils and

Map symbol	Soil	Description	Classification		Permeability
			Unified	AASHO	
BkA	Bracken gravelly sandy loam, 0 to 2 percent slopes.	0 to 18 inches, sand-silt-gravel mixture; about 20 percent angular and subangular gravel up to 1 inch in diameter; 40 percent angular medium sand and fine sand; 40 percent nonplastic fines, mostly silt and very fine sand; slight dry strength; loose to slightly compact and dry in place; strongly calcareous; some gypsum.	SM or ML.	A-4-----	<i>In. per hr.</i> 2.5 to 5
		18 to 28 inches, sand-silt-gravel mixture; about 20 percent angular lime-coated gravel up to 1½ inches in diameter; 30 percent fine sand; 50 percent fines, mostly disseminated lime and very fine sand; weakly cemented with gypsum; dry, compact, and hard in place.	ML-----	A-4-----	0.8 to 2.5
		28 to 40 inches+, sand-gravel-silt-gypsum mixture; about 20 percent gravel up to ¾ inch in diameter; 40 percent angular coarse sand to fine sand; 40 percent slightly plastic fines, mostly gypsum, silt, and very fine sands; cemented with gypsum; dry and hard in place.	SM or ML.	A-4-----	<0.2
BmD	Bracken loam, 2 to 15 percent slopes.	0 to 40 inches, silt-clay-gravel-gypsum mixture; about 5 percent angular gravel up to 1 inch in diameter; 30 percent fine sand, 65 percent slightly plastic fines; slight dry strength; dry and slightly hard in place; some gypsum; calcareous; weakly cemented in upper 10 inches with gypsum and lime.	CL-----	A-6-----	<0.2
BnD2	Bracken loamy sand, 2 to 15 percent slopes, eroded.	0 to 19 inches, sand-silt mixture; about 5 percent angular gravel; 65 percent medium sand and fine sand; 30 percent nonplastic fines; low dry strength; calcareous; dry and soft in upper part; dry and slightly hard in lower part.	SM-----	A-2-4----	2.5 to 5
		19 to 33 inches, gravel-sand-silt mixture; about 20 percent gravel up to 1 inch in diameter; 30 percent coarse sand to fine sand; 50 percent silt and nonplastic disseminated lime; dry and hard in place; weakly cemented with gypsum and lime; pH 8.7.	SM or ML.	A-4-----	<0.2
		33 to 60 inches, gravel-silt-gypsum mixture; about 50 percent angular gravel up to 1 inch in diameter; 20 percent medium sand and fine sand; 30 percent slightly plastic fines and gypsum; dry and slightly hard in place; calcareous; pH 9.4.	GM or GC.	A-2-4----	2.5 to 5
CaA	Carrizo gravelly loamy sand, 0 to 4 percent slopes.	0 to 10 inches, sand-silt-gravel mixture; about 25 percent angular gravel up to ¾ inch in diameter; 55 percent sand; 20 percent nonplastic fines; low dry strength; weakly calcareous; dry and soft in place; pH 8.4. In some areas this layer is 5 to 10 percent cobblestones.	SM-----	A-2-4----	5 to 10
		10 to 60 inches, gravel-sand mixture; about 60 percent subangular gravel up to 1½ inches in diameter; 35 percent coarse sand and angular and rounded medium sand; 5 percent nonplastic fines; low dry strength; slightly calcareous; dry and loose in place; pH 8.4; coarsely stratified.	GW or GP.	A-1-a----	>10
CcB	Carrizo stony sand, 0 to 4 percent slopes.	0 to 60 inches, gravel-sand-cobblestones mixture; about 10 percent cobblestones up to 12 inches in diameter; 35 percent angular gravel up to 3 inches in diameter; 50 percent angular coarse sand to fine sand; 5 percent nonplastic fines; weakly calcareous; dry and loose in place; pH 8.6. Material is stratified and contains some thin layers that are about 10 percent slightly plastic fines and are compact in place.	SW-----	A-1-b----	>10

See footnotes at end of table.

engineering interpretations—Continued

Suitability for—			Suitability as source of—		Sulfate hazard to concrete	Shrink-swell potential	Degree of limitation for—		
Subgrade <sup>1</sup>	Subbase	Base	Gravel	Sand			Embankments	Foundations	Septic tank field (to a depth of 5 feet)
Fair.....	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe...	Low.....	Severe.....	Severe.....	Severe.
Fair <sup>2</sup> .....	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe...	Low.....	Severe <sup>2</sup> .....	Moderate <sup>2</sup> .....	
Fair <sup>2</sup> .....	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe...	Low.....	Moderate <sup>2</sup> .....	Moderate <sup>2</sup> .....	
Poor <sup>2</sup> .....	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe...	Moderate.....	Moderate.....	Moderate.....	Severe.
Good.....	Fair.....	Poor.....	Unsuitable.	Poor.....	Severe...	Low.....	Moderate.....	Moderate.....	Severe.
Fair.....	Unsuitable.	Unsuitable.	Unsuitable.	Poor.....	Severe...	Low.....	Moderate.....	Moderate.....	
Good <sup>2</sup> .....	Fair <sup>2</sup> .....	Unsuitable.	Fair.....	Unsuitable.	Severe...	Low.....	Slight <sup>2</sup> .....	Slight <sup>2</sup> .....	
Good.....	Fair.....	Poor.....	Poor.....	Fair.....	None.....	Low.....	Moderate.....	Moderate.....	None.
Excellent. <sup>3</sup>	Good.....	Good.....	Good.....	Good.....	None.....	None.....	Slight.....	Slight.....	
Good <sup>3</sup> .....	Good.....	Poor.....	Fair.....	Good.....	None.....	None.....	Slight.....	Slight.....	None.

TABLE 4.—Descriptions of soils and

Map symbol	Soil	Description	Classification		Permeability
			Unified	AASHO	
CfB	Carrizo very fine sandy loam, 0 to 4 percent slopes.	0 to 12 inches, sand-silt mixture; about 40 percent fine sand; 60 percent nonplastic fines, mostly very fine sand and silt; calcareous; dry and soft in place; pH 8.8; generally 6 to 18 inches thick.	ML-----	A-4-----	<i>In. per hr.</i> 0.8 to 2.5
		12 to 60 inches, gravel-sand mixture; about 60 percent subangular gravel up to 3 inches in diameter; 35 percent medium sand and fine sand; 5 percent nonplastic fines; calcareous; dry and slightly compact in place; pH 8.8. Stratified gravel and sand in most places.	GP-----	A-1-a----	<10
Cg	Carrizo-Gila complex.	Carrizo: See description of Carrizo very fine sandy loam, 0 to 4 percent slopes (CfB).			
		Gila: 0 to 42 inches, sand-silt-gravel mixture; about 10 percent angular gravel up to 1 inch in diameter; 50 percent medium sand and fine sand; 40 percent nonplastic fines; strongly calcareous; dry and soft in place; pH 8.6; finely stratified; 15 to 50 inches thick.	ML-----	A-4-----	0.8 to 2.5
ChC2	Casa Grande clay loam, gypsiferous substrata, 0 to 8 percent slopes, eroded.	42 to 60 inches, gravel-sand mixture; about 65 percent angular gravel up to 2 inches in diameter; 30 percent medium sand and fine sand; 5 percent nonplastic fines; calcareous; dry and loose in place; pH 8.8.	GP-----	A-1-a----	>10
		0 to 32 inches, silt-clay mixture; about 5 percent hard angular limestone and chert gravel; about 25 percent subangular fine sand; about 70 percent plastic fines; high dry strength; blocky to subangular blocky and dry in place; strongly calcareous; pH 9.0 to 9.4.	CL-----	A-7-6----	0.2 to 0.8
CmD2	Cave fine sandy loam, 2 to 15 percent slopes, eroded.	32 to 60 inches, gravel-sand-gypsum mixture; about 50 percent subangular gravel up to ¼ inch in diameter; about 40 percent subangular and rounded coarse sand to fine sand; about 30 percent nonplastic fines and gypsum; cemented with gypsum; dry in place; pH 7.0.	SM-----	A-2-4----	<0.2
		0 to 12 inches, sand-silt mixture; 10 to 30 percent angular gravel; about 50 percent subangular medium sand and fine sand; about 40 percent slightly plastic fines; slight dry strength; slightly compact and dry in place; strongly calcareous; pH 8.8. In some areas this horizon has been removed by erosion. Below a depth of 12 inches is a 2- to 4-foot, indurated, gravelly lime hardpan; permeability in this hardpan is less than 0.2 inch per hour; except for foundations, material is unsuitable for engineering purposes.	SM or SC	A-4-----	2.5 to 5
CnB	Cave gravelly fine sandy loam, 0 to 4 percent slopes.				
CrA	Cave stony fine sandy loam, very shallow, 0 to 2 percent slopes.	0 to 8 inches, sand-silt mixture; as much as 25 percent stones; 10 percent gravel, mostly caliche fragments; 50 percent fine sand; 40 percent nonplastic fines; strongly calcareous; dry and slightly hard in place; pH 8.4. Below a depth of 8 inches is an indurated lime hardpan; except for foundations, the pan is unsuitable for engineering purposes.	SM-----	A-4-----	2.5 to 5
CsB	Cave loamy fine sand, shallow, 0 to 4 percent slopes.				
CvB	Cave loamy fine sand, very shallow, 0 to 4 percent slopes.	0 to 8 inches, sand-silt mixture; about 10 percent angular caliche fragments; 70 percent fine sand; 20 percent nonplastic fines; strongly calcareous; dry and soft in place; pH 8.6 to 8.8, severely eroded in places. Below a depth of 8 inches is a 20- to 48-inch indurated lime hardpan; permeability in this hardpan is less than 0.2 inch per hour; except for foundations, this material is unsuitable for engineering purposes.	SM-----	A-2-4----	2.5 to 5
CvD2	Cave loamy fine sand, very shallow, 2 to 15 percent slopes, eroded.				

See footnotes at end of table.

engineering interpretations—Continued

Suitability for—			Suitability as source of—		Sulfate hazard to concrete	Shrink-swell potential	Degree of limitation for—		
Subgrade <sup>1</sup>	Subbase	Base	Gravel	Sand			Embankments	Foundations	Septic tank field (to a depth of 5 feet)
Fair.....	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Slight.....	Low.....	Severe.....	Severe.....	None.
Good <sup>3</sup> .....	Good.....	Fair.....	Good.....	Good.....	Slight.....	None.....	Slight.....	Slight.....	
Fair <sup>3</sup> .....	Unsuitable.	Unsuitable.	Unsuitable.	Poor.....	Slight.....	Low.....	Severe.....	Severe.....	Slight.
Good.....	Good.....	Fair.....	Good.....	Good.....	Slight.....	None.....	Slight.....	Slight.....	
Poor.....	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe.....	Moderate to high.	Moderate to severe.	Slight to severe, depending on moisture content.	Severe.
Fair <sup>2</sup> .....	Fair <sup>2</sup> .....	Unsuitable.	Fair.....	Fair.....	Severe.....	Low.....	Moderate <sup>2</sup> .....	Slight <sup>2</sup> .....	
Fair.....	Poor.....	Unsuitable.	Unsuitable.	Unsuitable.	Slight.....	Low.....	Moderate.....	Moderate.....	Severe.
Fair.....	Poor.....	Unsuitable.	Unsuitable.	Unsuitable.	Slight.....	Low.....	Moderate.....	Moderate.....	Severe.
Fair.....	Poor.....	Unsuitable.	Unsuitable.	Unsuitable.	Slight.....	Low.....	Moderate.....	Moderate.....	Severe.

TABLE 4.—Descriptions of soils and

Map symbol	Soil	Description	Classification		Permeability
			Unified	AASHO	
Dk	Dry Lake loamy fine sand.	0 to 20 inches, sand; about 80 percent medium sand and fine sand; 20 percent nonplastic fines; slightly calcareous; dry and loose in place.	SM-----	A-1-6----	<i>In. per hr.</i> 5 to 10
		20 to 44 inches, sand-silt mixture; less than 1 percent gravel up to ¼ inch in diameter; about 60 percent medium sand and fine sand; 40 percent nonplastic fines; calcareous; dry and soft in place.	SM-----	A-2-4----	2.5 to 5
		44 to 66 inches, silt-clay mixture; about 10 percent fine sand; 90 percent slightly plastic fines; strongly calcareous; moist and firm in place; low bulk density.	ML or CL.	A-4 or A-6.	0.8 to 2.5
Dm	Dry Lake sandy loam.	0 to 10 inches, sand-silt mixture; about 10 percent angular gravel up to 1½ inches in diameter; 55 percent medium sand and fine sand; 35 percent nonplastic fines; calcareous; dry and slightly hard in place; pH 8.6.	SM-----	A-2-4----	2.5 to 5
		10 to 60 inches, stratified sand-silt mixture and nonplastic silt; calcareous; dry and slightly hard in place; pH 8.0 to 8.2. Silt strata are thin in most places.	SM or ML.	A-4-----	0.8 to 2.5
Du	Dune Land.	0 to 60 inches, fine sand; about 90 percent fine sand; 10 percent nonplastic fines; dry and loose in place; calcareous; some gypsum.	SP-SM---	A-3-----	>10
EFA	Eastland gravelly fine sandy loam, seeped, 0 to 2 percent slopes.	0 to 16 inches, sand-silt-gravel mixture; about 15 percent gravel up to ¼ inch in diameter; 55 percent coarse sand to fine sand; 30 percent nonplastic fines; low dry strength; calcareous; soft and dry in place; pH 8.2.	SM-----	A-2-4----	2.5 to 5
		16 to 60 inches, sand-silt-gravel mixture; about 25 percent gravel up to ¼ inch in diameter; 60 percent coarse sand to fine sand; 15 percent nonplastic fines; strongly calcareous; moist; hard in lower part because of weak lime cementation; stratified sandy and gravelly material in most places.	SM-----	A-2-4----	0.8 to 2.5
EgB	Eastland gravelly loamy sand, 2 to 4 percent slopes.	0 to 17 inches, gravel-sand-silt mixture; about 5 percent cobblestones and stones that range from 2 to 18 inches in diameter; 25 percent angular gravel up to 3 inches in diameter; 45 percent angular coarse sand to fine sand; 25 percent nonplastic fines; low dry strength; strongly calcareous; loose and dry in place. Content of cobbles varies from place to place.	SM-----	A-2-4----	5 to 10
		17 to 38 inches, gravel-sand-silt mixture; about 60 percent angular and subangular gravel up to 1 inch in diameter; 30 percent coarse sand to fine sand; 10 percent nonplastic fines; strongly calcareous; soft, loose, and dry in place. Stratified with some weakly lime-cemented layers.	GW-GM.	A-1-a----	5 to 10
		38 to 60 inches, sand-silt-gravel mixture; about 20 percent angular gravel; 50 percent sand, mostly medium and fine; 30 percent nonplastic fines; calcareous; soft, slightly compact, and dry in place. Stratified and variable in gravel and sand content.	SM or SW	A-2-4 or A-1-b.	0.8 to 2.5
GaA	Gass fine sandy loam, 0 to 2 percent slopes.	0 to 9 inches, sand-silt-gravel mixture; about 10 percent subangular gravel maximum 1 inch; 50 percent medium to fine sand; 40 percent nonplastic fines; strongly calcareous; dry and soft in place; pH 8.6.	SM-----	A-4-----	0.8 to 2.5
		9 to 60 inches, clay-gravel mixture; about 10 percent gravel, maximum size ¼ inch; 10 percent fine sand; 80 percent plastic fines with high dry strength; strongly calcareous; hard and dry in place; pH 8.6.	CH-----	A-7-6----	<0.2

See footnotes at end of table.

engineering interpretations—Continued

Suitability for—			Suitability as source of—		Sulfate hazard to concrete	Shrink-swell potential	Degree of limitation for—		
Subgrade <sup>1</sup>	Subbase	Base	Gravel	Sand			Embankments	Foundations	Septic tank field (to a depth of 5 feet)
Good	Fair	Poor	Unsuitable.	Poor	Slight	Low	Moderate	Severe; low density.	Severe.
Fair	Poor	Unsuitable.	Unsuitable.	Unsuitable.	Slight	Low	Moderate	Moderate	
Fair	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe	Moderate	Severe	Severe	
Good	Poor	Unsuitable.	Unsuitable.	Poor	Slight	Low	Moderate	Moderate	Severe.
Fair <sup>3</sup>	Unsuitable.	Unsuitable.	Unsuitable.	Poor	Moderate.	Low	Moderate <sup>5</sup>	Moderate	
Good	Fair	Poor	Unsuitable.	Poor	Moderate.	None	Slight	Severe; low density.	None.
Fair	Poor	Unsuitable.	Unsuitable.	Poor	Moderate.	Low	Moderate	Moderate	Moderate to severe.
Good <sup>3</sup>	Fair	Poor	Poor	Fair	Moderate to severe.	Low	Moderate	Moderate	
Good	Fair	Poor	Poor	Fair	Slight	Low	Moderate	Moderate	Moderate to severe.
Good <sup>3</sup>	Fair	Poor	Good	Fair	Slight	None	Slight	Slight	
Good <sup>3</sup>	Fair	Poor	Poor	Fair	Slight	Low	Moderate	Moderate	
Fair	Poor	Unsuitable.	Unsuitable.	Unsuitable.	Moderate.	Low	Moderate	Moderate	Severe.
Poor	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe	High	Moderate to severe.	Severe	

TABLE 4.—Descriptions of soils and

Map symbol	Soil	Description	Classification		Permeability
			Unified	AASHO	
Gb	Glendale silt loam.	0 to 60 inches, silt mixture; about 25 percent fine sand; 75 percent slightly plastic fines; strongly calcareous; dry and soft in place; pH 8.8 to 9.0. Nonsaline to strongly saline in upper part, strongly saline in lower part. In places material is stratified with thin layers of fine sand.	ML or CL	A-4-----	<i>In. per hr.</i> 0.2 to 0.8
Gc	Glendale silt loam, slightly wet, slightly saline.				
Ge	Glendale silt loam, moderately saline, overflowed.				
Gf	Glendale silt loam, slightly saline.				
GhA	Glendale silt loam, slightly saline, hummocky.				
Gk	Glendale silt loam, strongly saline.				
Gm	Glendale silty clay loam, gypsiferous substrata, slightly saline.	0 to 24 inches, silt-clay mixture; about 10 percent fine sand; 90 percent slightly plastic fines; medium dry strength; strongly calcareous; slightly saline; dry and compact in place; pH 8.6; 24 to 36 inches thick.	CL-----	A-7-5----	0.2 to 0.8
		24 to 52 inches, silt-clay mixture; about 10 percent fine sand; 90 percent plastic fines; calcareous; some gypsum; angular blocky to prismatic; dry and hard in place; pH 8.8. This layer is underlain by a moderately cemented lime and gypsum hardpan.	CH-----	A-7-6----	<0.2
Gn	Glendale silty clay loam, slightly wet, slightly saline.	0 to 14 inches, silt-clay mixture; about 10 percent fine sand; 90 percent slightly plastic fines; medium dry strength; strongly calcareous; slightly to strongly saline; moist and slightly compact in place; 10 to 30 inches thick.	CL-----	A-7-5----	0.2 to 0.8
Go	Glendale silty clay loam, slightly wet, strongly saline.	14 to 60 inches, silt, silt-clay mixture, and silt-sand mixture; coarsely stratified; strongly saline in lower part; strongly calcareous; moist and soft to slightly compact in place; pH 8.8; in places contains thin layers high in organic-matter content; these soils are slightly wet.	CL-----	A-6-----	0.2 to 0.8
Gp	Glendale silty clay loam, slightly saline.				
Gr	Glendale silty clay loam, strongly saline.				
Gs	Glendale very fine sandy loam.	0 to 60 inches, very fine sand-silt mixture; about 40 percent fine sand; 60 percent slightly plastic fines, mostly very fine sand and silt; strongly calcareous; dry and soft in place; pH 8.6 to 9.0. Thin strata of gravelly sand or silty soil in places; fine sand in lower part in some areas. Mapping unit Gu is moderately saline in upper part and strongly saline in lower part	ML-----	A-4-----	0.8 to 2.5
Gu	Glendale very fine sandy loam, moderately saline.				
Gt	Glendale very fine sandy loam, clay substrata.	0 to 14 inches, very fine sand-silt mixture; about 40 percent fine sand; 60 percent slightly plastic very fine sand and silt; calcareous; dry and soft in place; pH 8.6.	ML-----	A-4-----	0.8 to 2.5
		14 to 30 inches, silt-clay mixture; about 15 percent fine sand; 85 percent slightly plastic fines; slight dry strength; strongly calcareous; dry and compact in place; pH 8.8. 10 to 40 inches thick.	CL-----	A-6-----	0.2 to 0.8
		30 to 43 inches, silt-clay mixture; about 10 percent fine sand; 90 percent plastic fines; saline; calcareous; dry and compact in place; pH 8.8.	CH-----	A-7-6----	<0.2

See footnotes at end of table.

engineering interpretations—Continued

Suitability for—			Suitability as source of—		Sulfate hazard to concrete	Shrink-swell potential	Degree of limitation for—		
Subgrade <sup>1</sup>	Subbase	Base	Gravel	Sand			Embankments	Foundations	Septic tank field (to a depth of 5 feet)
Fair <sup>3</sup> ----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	Low to high, depending upon sodium sulfate concentration.	Severe-----	Severe-----	Severe.
Poor-----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	Moderate to high--	Moderate to severe.	Severe-----	Severe.
Poor-----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	High-----	Severe-----	Severe-----	
Poor-----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	Moderate to high--	Moderate to severe.	Severe-----	Severe.
Poor <sup>3</sup> ----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	Moderate to high, depending upon sodium sulfate concentration.	Moderate to severe.	Severe-----	
Poor <sup>3</sup> ----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	Low to high, depending upon sodium sulfate concentration.	Severe-----	Severe-----	Moderate.
Poor-----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	Low-----	Severe-----	Severe-----	Severe.
Poor-----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	Moderate to high, depending upon sodium sulfate concentration.	Moderate to severe.	Moderate-----	
Poor-----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	High-----	Moderate to severe.	Moderate-----	

TABLE 4.—Descriptions of soils and

Map symbol	Soil	Description	Classification		Permeability
			Unified	AASHO	
GvB	Goodsprings gravelly loamy fine sand, 2 to 4 percent slopes.	0 to 8 inches, gravel-sand-silt-clay mixture; about 15 percent subangular and angular gravel, up to 1½ inches in diameter; 50 percent coarse sand to fine sand; 35 percent slightly plastic fines; calcareous; dry and soft in place; pH 8.6.	SM-SC..	A-2 or A-4.	<i>In. per hr.</i> 2.5 to 5
		8 to 30 inches, gravel-sand-silt mixture; about 45 percent angular gravel; 35 percent coarse sand and medium sand; 20 percent slightly plastic fines; calcareous; dry and compact in place; pH 8.8; slightly to strongly lime cemented.	GM-GC..	A-1-b....	<0.2
		30 to 60 inches, gravel-sand-silt mixture; about 55 percent angular gravel; 35 percent coarse sand to fine sand; 10 percent nonplastic fines; calcareous; dry and hard in place; strongly lime cemented; pH 8.8. Underlain by stratified gravel-sand and lime-cemented layers.	GM.....	A-1-b....	<0.2
GwA	Grapevine loam, moderately saline, 0 to 2 percent slopes.	0 to 18 inches, silt-sand mixture; about 45 percent medium sand and fine sand; 55 percent slightly plastic fines; calcareous; dry and compact in place; slightly saline and gypsiferous; pH 8.6.	CL.....	A-6.....	0.8 to 2.5
		18 to 45 inches, silt-clay mixture; about 25 percent fine sand; 75 percent slightly plastic fines; calcareous; saline; gypsiferous; pH 8.6; dry, compact, and hard in place; weakly lime cemented.	CL.....	A-6.....	<0.2
		45 to 60 inches, sand-silt mixture; about 55 percent medium sand and fine sand; 45 percent slightly plastic fines; calcareous; gypsiferous; saline; dry and compact in place; pH 8.8.	SM or ML.	A-4.....	<0.2
GyB	Grapevine loamy fine sand, slightly saline, 2 to 4 percent slopes.	0 to 21 inches, sand-silt mixture; about 80 percent medium sand and fine sand; 20 percent nonplastic fines; calcareous; dry and soft in place; nonsaline; pH 8.4.	SM.....	A-2-4....	2.5 to 5
		21 to 45 inches, silt-clay mixture; about 25 percent fine sand; 75 percent slightly plastic fines; calcareous; saline; gypsiferous; pH 8.6; dry, compact, and hard in place; weakly lime cemented.	CL.....	A-6.....	<0.2
		45 to 60 inches, sand-silt mixture; about 55 percent medium sand and fine sand; 45 percent slightly plastic fines; calcareous; gypsiferous; saline; dry and compact in place; pH 8.8.	SM or ML.	A-4.....	<0.2
Ir	Ireteba fine sandy loam, slightly saline.	0 to 18 inches, sand-silt mixture; about 5 percent gravel up to 1 inch in diameter; 60 percent medium sand and fine sand; 35 percent nonplastic fines; calcareous; dry and soft in place; pH 8.2.	SM.....	A-2-4....	0.8 to 2.5
		18 to 34 inches, silt-sand mixture; about 25 percent fine sand; 75 percent slightly plastic fines; dry, compact, and hard in place; pH 8.2; saline.	ML or CL.	A-4.....	0.8 to 2.5
		34 to 54 inches, sand-silt mixture; about 70 percent coarse sand; 30 percent nonplastic fines; calcareous; dry and soft in place; pH 8.2; saline.	SM.....	A-2-4....	0.8 to 2.5
		54 to 60 inches, silt-sand mixture; about 25 percent fine sand; 75 percent slightly plastic fines; dry, compact, and hard in place; pH 8.2; saline.	ML or CL.	A-4.....	0.2 to 0.8

See footnotes at end of table.

engineering interpretations—Continued

Suitability for—			Suitability as source of—		Sulfate hazard to concrete	Shrink-swell potential	Degree of limitation for—		
Subgrade <sup>1</sup>	Subbase	Base	Gravel	Sand			Embankments	Foundations	Septic tank field (to a depth of 5 feet)
Fair.....	Poor.....	Unsuitable.	Unsuitable.	Poor.....	None.....	Low.....	Slight.....	Moderate.....	Severe.
Good.....	Fair.....	Poor.....	Fair.....	Fair.....	Slight.....	Low.....	Slight.....	Slight.....	
Good.....	Good.....	Fair.....	Good.....	Fair.....	Moderate.....	Low.....	Slight.....	Slight.....	
Poor.....	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe.....	Moderate to high, depending upon sodium sulfate concentration.	Severe.....	Moderate.....	Severe.
Poor.....	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe.....	Moderate to high, depending upon sodium sulfate concentration.	Severe.....	Moderate.....	
Fair.....	Unsuitable.	Unsuitable.	Unsuitable.	Poor.....	Severe.....	Low to high, depending upon sodium sulfate concentration.	Severe.....	Moderate.....	
Fair.....	Poor.....	Unsuitable.	Unsuitable.	Poor.....	Severe.....	Low to high, depending upon sodium sulfate concentration.	Moderate.....	Moderate.....	Severe.
Poor.....	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe.....	Moderate to high, depending upon sodium sulfate concentration.	Severe.....	Moderate.....	
Fair.....	Unsuitable.	Unsuitable.	Unsuitable.	Poor.....	Severe.....	Low to high, depending upon sodium sulfate concentration.	Severe.....	Moderate.....	
Fair.....	Poor.....	Unsuitable.	Unsuitable.	Poor.....	Severe.....	Low to high, depending upon sodium sulfate concentration.	Moderate.....	Moderate.....	Severe.
Fair.....	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe.....	Low to high, depending upon sodium sulfate concentration.	Severe.....	Moderate to severe.	
Fair.....	Poor.....	Unsuitable.	Unsuitable.	Poor.....	Severe.....	Low to high, depending upon sodium sulfate concentration.	Moderate.....	Moderate.....	
Fair.....	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe.....	Low to high, depending upon sodium sulfate concentration.	Severe.....	Moderate to severe.	

TABLE 4.—Descriptions of soils and

Map symbol	Soil	Description	Classification		Permeability
			Unified	AASHO	
It	Ireteba loam.	0 to 34 inches, silt-sand mixture; 40 percent fine sand; 60 percent slightly plastic fines; calcareous; dry and soft in place; pH 8.2; slightly saline.	ML or CL.	A-4-----	<i>In. per hr.</i> 0.8 to 2.5
		34 to 54 inches, sand-silt mixture; about 70 percent coarse sand to fine sand; 30 percent nonplastic fines; calcareous; dry and soft in place; pH 8.2; saline.	SM-----	A-2-4----	2.5 to 5
		54 to 60 inches, silt; about 10 percent fine sand; 90 percent slightly plastic fines; dry, compact, and hard in place; pH 8.2; saline.	ML or CL.	A-4-----	0.2 to 0.8
JeB	Jean loamy fine sand, moderately deep over gravel, 2 to 4 percent slopes.	0 to 8 inches, sand-gravel-silt mixture; about 10 percent angular gravel up to 1½ inches in diameter; 75 percent fine sand; 15 percent nonplastic fines; calcareous; dry and soft in place; pH 8.4.	SM-----	A-2-4----	5 to 10
		8 to 25 inches, gravel-sand-silt mixture; about 40 percent gravel up to 2 inches in diameter; 50 percent fine sand; 10 percent nonplastic fines; calcareous; dry and loose in place; pH 8.6.	SP-SM---	A-1-b----	5 to 10
		25 to 60 inches, gravel-sand mixture; about 60 percent angular gravel up to 3 inches in diameter; 35 percent fine sand; 5 percent nonplastic fines; calcareous; dry and loose in place; pH 8.8. Stratified gravel and sand.	GW or GP.	A-1-b----	>10
KfB	Kiup loamy fine sand, 2 to 4 percent slopes.	0 to 33 inches, sand-silt mixture; about 5 percent angular gravel up to 1 inch in diameter; 85 percent medium sand and fine sand; 10 percent nonplastic fines; low dry strength; weakly calcareous; dry and loose in place; pH 8.3.	SP-SM---	A-2-4----	5 to 10
		33 to 72 inches, gravel-silt-gypsum mixture; about 55 percent angular gravel up to ¾ inch in diameter; 15 percent coarse sand to fine sand; 30 percent nonplastic fines, mostly gypsum and lime; weakly lime and gypsum cemented; hard in place; grades to massive material that is more than 50 percent crystalline gypsum.	GM-----	A-2-4----	0.2 to 0.8
KhA	Knob Hill loamy fine sand, deep over gravel, 0 to 2 percent slopes.	0 to 19 inches, sand-silt-gravel mixture; about 3 to 5 percent angular gravel up to ¾ inch in diameter; 75 percent coarse sand to fine sand; 20 percent nonplastic fines; weakly calcareous; dry and soft in place; pH 8.2.	SM-----	A-1-b----	5 to 10
		19 to 38 inches, sand-silt-gravel mixture; about 10 percent angular gravel up to ¾ inch in diameter; 55 percent coarse sand to fine sand; 35 percent nonplastic fines; weakly lime cemented; dry and hard in place; pH 8.2.	SM-----	A-2 or A-4.	2.5 to 5
		38 to 60 inches, gravel-sand mixture; about 65 percent angular gravel up to 2 inches in diameter; 30 percent coarse sand to fine sand; 5 percent nonplastic fines; calcareous; dry and loose in place; pH 8.2.	GW-----	A-1-a----	5 to 10
KnB	Knob Hill loamy sand, 2 to 4 percent slopes.	0 to 23 inches, sand-silt-gravel mixture; about 30 percent angular gravel up to ¾ inch in diameter; 60 percent coarse sand to fine sand; 10 percent nonplastic fines; weakly calcareous; dry and soft in place; pH 8.2.	SM-----	A-1-b----	5 to 10
		23 to 37 inches, sand-silt-gravel mixture; about 15 percent angular gravel up to ¾ inch in diameter; 55 percent coarse sand to fine sand; 30 percent nonplastic fines; weakly lime cemented; dry and hard in place; pH 8.2.	SM-----	A-2-4----	2.5 to 5.0
		37 to 60 inches, sand-silt mixture; about 3 to 5 percent angular gravel up to ¾ inch in diameter; 80 percent coarse sand to fine sand; 15 percent nonplastic fines; calcareous; dry and loose in place; pH 8.2.	SM-----	A-2-4----	5 to 10

See footnotes at end of table.

engineering interpretations—Continued

Suitability for—			Suitability as source of—		Sulfate hazard to concrete	Shrink-swell potential	Degree of limitation for—		
Subgrade <sup>1</sup>	Subbase	Base	Gravel	Sand			Embankments	Foundations	Septic tank field (to a depth of 5 feet)
Poor	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe	Low to high, depending upon sodium sulfate concentration.	Severe	Severe	Severe.
Good	Poor	Unsuitable.	Unsuitable.	Unsuitable.	Severe	Low to high, depending upon sodium sulfate concentration.	Moderate	Moderate	
Fair	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe	Low to high, depending upon sodium sulfate concentration.	Severe	Moderate to severe.	
Good	Fair	Unsuitable.	Unsuitable.	Poor	None	Low	Moderate	Moderate	None.
Good	Fair	Poor	Fair	Poor	Slight	Low	Slight	Slight	
Good <sup>3</sup>	Good	Fair	Good	Poor	Slight	None	Slight	Slight	
Good	Fair	Poor	Unsuitable.	Fair	Moderate.	Low	Slight	Severe; low density.	Severe.
Good <sup>2</sup>	Poor <sup>2</sup>	Unsuitable.	Poor	Unsuitable.	Severe	Low	Severe	Slight <sup>2</sup>	
Good	Fair	Poor	Unsuitable.	Fair	Slight	Low	Slight	Moderate	None.
Good	Fair	Poor	Unsuitable.	Poor	Slight	Low	Moderate	Slight	
Good	Good	Good	Good	Fair	Slight	None	Slight	Slight	
Good	Fair	Poor	Poor	Fair	Slight	Low	Slight	Moderate	None.
Good	Fair	Poor	Unsuitable.	Poor	Slight	Low	Moderate	Slight	
Good	Fair	Poor	Unsuitable.	Good	Slight	Low	Slight	Moderate	

TABLE 4.—Descriptions of soils and

Map symbol	Soil	Description	Classification		Permeability
			Unified	AASHO	
La	Lairep loamy fine sand.	0 to 30 inches, sand-silt mixture; about 80 percent medium and fine sand; 20 percent nonplastic fines; calcareous; moist in lower part; pH 8.4; slightly saline.	SM-----	A-2-4----	<i>In. per hr.</i> 5 to 10
		30 to 60 inches, silt-clay mixture; about 5 percent fine sand; 95 percent plastic fines; strongly calcareous; large lime nodules; moist and compact in place; pH 8.8; saline.	CH-----	A-7-6----	<0.2
Lb	Land silt loam, slightly wet, strongly saline.	0 to 22 inches, silt; about 10 percent fine sand; 90 percent slightly plastic fines; calcareous; strongly saline; moist and slightly compact in place; pH 8.4. Many fine sand hummocks on surface of LcA.	ML or CL	A-4 or A-6.	0.2 to 0.8
LcA	Land silt loam, slightly wet, strongly saline, hummocky.	22 to 60 inches, silt; about 10 percent fine sand; 90 percent slightly plastic fines; calcareous; saline; gypsiferous; wet and slightly compact in place; pH 8.4. Thin strata of fine sand-silt and silt-clay mixtures in places. Mapping unit Lf moist in lower part.	ML or CL	A-4 or A-6.	<0.2
Ld	Land silt loam, wet, strongly saline.				
Lf	Land silt loam, slightly saline.				
Lg	Land silty clay loam, slightly wet, strongly saline.	0 to 8 inches, silt-clay mixture; about 10 percent fine sand; 90 percent plastic fines; strongly calcareous; strongly saline; moist and slightly hard.	CL-----	A-6-----	0.2 to 0.8
Lh	Land silty clay loam, wet, strongly saline.	8 to 27 inches, silt stratified with fine sand and some silt-clay mixture; strongly calcareous; gypsiferous; saline; moist and soft to slightly hard in place.	ML or CL	A-4 or A-6.	0.2 to 0.8
Lk	Land silty clay loam, slightly saline.	27 to 60 inches, silt-clay mixture; about 10 percent fine sand; 90 percent plastic fines; strongly calcareous; gypsiferous; saline; wet and compact in places; saturated or only moist in others.	CL-----	A-6-----	<0.2
Lm	Land silty clay loam, strongly saline.				
Ln	Land very fine sandy loam, wet, strongly saline.	0 to 9 inches, very fine sand-silt mixture; about 40 percent fine sand; 60 percent nonplastic fines, mostly very fine sand; calcareous; saturated; pH 8.2.	ML-----	A-4-----	0.8 to 2.5
		9 to 60 inches, finely stratified silt and sand-silt mixture; thin layers of highly organic material in places; calcareous; saturated.	ML-----	A-4-----	0.2 to 0.8
LoA	Las Vegas loam, shallow, slightly saline, gently undulating.	0 to 23 inches, silt-sand mixture; about 10 percent angular caliche fragments of variable size and shape; 30 percent fine sand; 60 percent slightly plastic fines; nonsaline to slightly saline; dry and slightly hard in place; strongly calcareous; pH 8.8. Below a depth of 23 inches is a 20- to 48-inch indurated lime hardpan; permeability in this hardpan is less than 0.2 inch per hour; except for foundations, this material is unsuitable for engineering purposes.	ML or CL	A-4-----	0.8 to 2.5
LpA	Las Vegas loam, shallow, 0 to 2 percent slopes.				
LsB2	Las Vegas loam, very shallow, 0 to 4 percent slopes, eroded.	0 to 8 inches, silt-sand mixture; about 10 percent angular caliche fragments; 30 percent fine sand; 60 percent slightly plastic fines; nonsaline to slightly saline; strongly calcareous; dry and slightly hard in place; pH 8.6; 2 to 10 inches thick. Below a depth of 8 inches is a 20- to 48-inch indurated lime hardpan; permeability in this hardpan is less than 0.2 inch per hour; except for foundations, this material is unsuitable for engineering purposes.	ML or CL	A-4-----	0.8 to 2.5
LtA	Las Vegas loam, very shallow, slightly saline, gently undulating.				
Lv2	Laveldo clay, eroded.	0 to 60 inches, stratified clay and silt-clay mixture; saline; gypsiferous; calcareous; plastic, moderately compact in place; many lime nodules in lower strata.	CL and CH.	A-6 and A-7-6.	<0.2
McB	McCarran clay loam, slightly saline, 0 to 4 percent slopes.	0 to 23 inches, silt-clay mixture; about 20 percent fine sand; 80 percent plastic fines; calcareous; saline; gypsiferous; dry and hard in place; pH 8.6.	CL or CH.	A-6 or A-7-6.	0.2 to 0.8
MdC	McCarran clay loam, scaped, slightly saline, 0 to 8 percent slopes.	23 to 60 inches, silt-clay-gypsum mixture; about 20 percent fine sand; 80 percent plastic fines; calcareous; high in gypsum; saline; dry and hard in place; pH 8.6. Grades to material lower in gypsum in lower part.	CL or CH.	A-6 or A-7-6.	<0.2

See footnotes at end of table.

engineering interpretations—Continued

Suitability for—			Suitability as source of—		Sulfate hazard to concrete	Shrink-swell potential	Degree of limitation for—		
Subgrade <sup>1</sup>	Subbase	Base	Gravel	Sand			Embankments	Foundations	Septic tank field (to a depth of 5 feet)
Good-----	Fair-----	Poor-----	Unsuitable.	Poor-----	Severe---	Low-----	Moderate---	Severe; low density.	Severe.
Poor-----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	High-----	Moderate---	Severe-----	
Fair-----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	High-----	Severe-----	Severe-----	Severe.
Fair <sup>3</sup> -----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	High-----	Severe-----	Severe-----	
Poor-----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	High-----	Severe-----	Severe-----	Severe.
Fair <sup>3</sup> -----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	High-----	Severe-----	Severe-----	
Poor-----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	High-----	Severe-----	Severe-----	
Poor-----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	High-----	Severe-----	Severe-----	Severe.
Poor <sup>3</sup> -----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	High-----	Severe-----	Severe-----	
Fair-----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Slight to moderate.	Moderate-----	Severe-----	Severe-----	Severe.
Fair-----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Slight to moderate.	Moderate-----	Severe-----	Severe-----	Severe.
Poor <sup>3</sup> -----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	Moderate to high--	Severe-----	Moderate to severe, depending on density.	Severe.
Poor <sup>2</sup> -----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	High-----	Severe <sup>2</sup> -----	Severe <sup>2</sup> -----	Severe.
Poor <sup>2</sup> -----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	High-----	Severe <sup>2</sup> -----	Severe <sup>2</sup> -----	

TABLE 4.—Descriptions of soils and

Map symbol	Soil	Description	Classification		Permeability
			Unified	AASHO	
MfB	McCarran fine sandy loam, 0 to 4 percent slopes.	0 to 28 inches, sand-silt mixture; about 60 percent fine sand; 40 percent slightly plastic fines; strongly calcareous; high in gypsum; dry and soft to slightly hard in place; pH 8.4.	SM or SC.	A-4-----	<i>In. per hr.</i> 0.8 to 2.5
MhA	McCarran fine sandy loam, hummocky.	28 to 48 inches +, silt-gypsum mixture; about 30 percent fine sand; 70 percent slightly plastic fines; 30 to 40 percent gypsum; pH 7.0; underlain in places by silt-clay mixture or firm hardpan weakly cemented with gypsum and lime.	ML or CL.	A-4 or A-6.	<0.2
MkA	McCullough fine sandy loam, 0 to 2 percent slopes.	0 to 26 inches, sand-silt mixture; about 30 percent subangular fine sand to coarse sand; about 70 percent slightly plastic fines, slight dry strength; slightly compact and dry in place; strongly calcareous; pH 8.4 to 9.0. Slightly stratified.	ML-----	A-4-----	0.8 to 2.5
		26 to 60 inches, sand-silt mixture; about 5 percent hard angular limestone and quartzite gravel; about 70 percent angular and subangular fine sand to coarse sand; about 25 percent nonplastic fines; low dry strength; slightly compact to loose in place; some gypsum; strongly calcareous; pH 8.0 to 8.2.	SM-----	A-2-4----	5.0 to 10
My	Mead clay.	0 to 60 inches, clay-silt mixture; about 10 percent fine sand; 90 percent plastic fines; massive to blocky in place; high dry strength and bulk density; saline; calcareous; pH 8.8 to 9.2. Thin sandy strata in some parts; 6-inch overwash of sand-silt mixture in some areas.	CH-----	A-7-6----	<0.2
Pa	Paradise silt loam, drained, slightly saline.	0 to 7 inches, silt; about 20 percent fine sand; 80 percent nonplastic fines; high in organic-matter content; strongly calcareous; slightly saline; pH 8.4; dry and soft; many roots.	OL-----	A-5-----	0.8 to 2.5
		7 to 31 inches, silt; about 20 percent fine sand; 80 percent slightly plastic fines; strongly calcareous; saline; pH 8.2.	ML or CL.	A-4-----	0.8 to 2.5
		31 to 52 inches+, silt; weakly lime cemented; very hard when dry; pH 8.6; 20 to 30 percent lime.	ML or CL.	A-4-----	<0.2
PmA	Pittman stony loam, 0 to 2 percent slopes.	0 to 5 inches, silt-sand-stone mixture; about 20 percent basalt cobbles; 25 percent medium sand and fine sand; 55 percent nonplastic fines; strongly calcareous; dry and hard in place.	ML-----	A-4-----	0.8 to 2.5
		5 to 24 inches, sand-silt-stone mixture; about 10 percent basalt stones; 20 percent angular gravel up to 3 inches in diameter; 40 percent medium sand and fine sand; 30 percent nonplastic fines; dry and strongly lime cemented; pH 8.6.	SM-----	A-2-4----	0.2 to 0.8
		24 to 40 inches, stratified sand-gravel-silt mixture; about 20 percent angular and subangular gravel up to 3 inches in diameter; few cobbles; 50 percent coarse sand to fine sand; 30 percent nonplastic fines; strongly calcareous; dry and soft in place; pH 8.2.	SM-----	A-2-4----	5 to 10

See footnotes at end of table.

engineering interpretations—Continued

Suitability for—			Suitability as source of—		Sulfate hazard to concrete	Shrink-swell potential	Degree of limitation for—		
Subgrade <sup>1</sup>	Subbase	Base	Gravel	Sand			Embankments	Foundations	Septic tank field (to a depth of 5 feet)
Poor <sup>2</sup> ---	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	Moderate to high, depending upon sodium sulfate concentration.	Moderate <sup>2</sup> --	Moderate <sup>2</sup> ----	Severe.
Poor <sup>2</sup> ---	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	Moderate to high, depending upon sodium sulfate concentration.	Severe <sup>2</sup> ---	Severe <sup>2</sup> -----	
Fair <sup>2</sup> ---	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	Low-----	Severe---	Severe-----	Moderate.
Fair <sup>2</sup> ---	Poor----	Unsuitable.	Unsuitable.	Fair----	Severe---	Low-----	Severe---	Slight-----	
Poor-----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	High-----	Moderate to severe.	Moderate to severe.	Severe.
Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	High-----	Severe---	Severe-----	Severe.
Poor-----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	Moderate to high, depending upon sodium sulfate concentration.	Severe---	Severe-----	
Poor-----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe---	Moderate to high, depending upon sodium sulfate concentration.	Severe---	Moderate-----	
Fair-----	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Slight---	Low-----	Severe---	Severe-----	Severe.
Fair-----	Poor----	Unsuitable.	Poor----	Poor----	Slight---	Low-----	Moderate---	Moderate to slight.	
Fair <sup>3</sup> ---	Poor----	Unsuitable.	Poor----	Poor----	Slight---	Low-----	Moderate---	Moderate-----	

TABLE 4.—Descriptions of soils and

Map symbol	Soil	Description	Classification		Permeability
			Unified	AASHO	
PnC	Pittman stony loamy sand, 0 to 15 percent slopes.	0 to 6 inches, sand-gravel-stone mixture; about 10 percent stones; 30 percent gravel; 45 percent coarse sand to fine sand; 15 percent nonplastic fines; strongly calcareous; dry and soft in place; pH 8.4.	SM-----	A-2-4----	<i>In. per hr.</i> 2.5 to 5
		6 to 46 inches, gravel-sand mixture; about 5 percent stones; 60 percent gravel up to 3 inches in diameter; 30 percent coarse sand to fine sand; 5 percent nonplastic fines; weakly lime cemented; dry and hard in place; pH 8.6.	GM-----	A-2-4----	0.2 to 0.8
		46 to 60 inches, gravel-sand mixture; about 60 percent gravel up to 3 inches in diameter; 35 percent coarse sand to fine sand; 5 percent nonplastic fines; calcareous; dry and loose in place; pH 8.4.	GW-----	A-1-a----	5 to 10
Rw	Riverwash.	0 to 60 inches, highly stratified cobblestones, gravel, and sand; highly variable.	GW, GP, or GM.	A-1-a or A-2-4.	>10
ScB	Searchlight-Carrizo gravelly loamy sands, 2 to 4 percent slopes.	Searchlight: 0 to 12 inches, gravel-sand-silt mixture; about 30 percent angular gravel up to ¼ inch in diameter; 60 percent angular coarse sand to fine sand; 10 percent nonplastic fines; low dry strength; slightly calcareous; loose and dry in place; pH 8.4.	SW or SM.	A-1-b----	5 to 10
		12 to 21 inches, gravel-sand-silt mixture; about 20 percent gravel; 60 percent angular coarse sand to fine sand; 20 percent slightly plastic fines; slight dry strength; slightly calcareous; slightly compact and dry in place; pH 8.4.	SM-----	A-2-4----	2.5 to 5
		21 to 46 inches, gravel-sand-silt-clay mixture; about 25 percent gravel; 45 percent angular coarse sand to fine sand; 30 percent plastic fines; high dry strength; slightly calcareous; compact and dry in place; pH 8.6 to 9.0. Thickness and amount of fines varies from place to place.	SC-----	A-2-6----	0.2 to 0.8
		46 to 60 inches, gravel-sand-silt mixture; about 45 percent angular gravel up to 3 inches in diameter; 45 percent angular coarse sand to fine sand; 10 percent nonplastic fines, low dry strength; calcareous; soft and dry in place; pH 8.4.	GM-SM--	A-1-a or A-1-b.	5 to 10
		Carrizo: See description of Carrizo gravelly loamy sand, 0 to 4 percent slopes (CaA).			
ShA	Skyhaven clay loam, 0 to 2 percent slopes.	0 to 9 inches, silt-clay mixture; about 5 percent gravel up to 1½ inches in diameter; 10 percent fine sand; 85 percent plastic fines; strongly calcareous; dry and hard in place; pH 8.8; saline with some gypsum; weakly cemented in lower part. Below a depth of 9 inches is an indurated lime hardpan; pH 9.0; except for foundations, the pan is unsuitable for engineering purposes.	CH-----	A-7-6----	<0.2
SkA	Skyhaven clay loam, strongly saline, 0 to 2 percent slopes.				
Sm	Spring clay loam, slightly saline.	0 to 60 inches, silt-clay mixture; about 20 percent fine sand; 80 percent plastic fines; compact and dry in place; much crystalline gypsum; saline; very weakly calcareous; pH 7.0. Underlain by strongly cemented lime hardpan in places; may also be saturated below 40 inches in places.	CH-----	A-7-6----	<0.2
Sn	Spring clay loam, wet, moderately saline.				
So	Stony steep land, basalt.	Mostly rock outcrop; thin mantle of soil in some areas.			
St	Stony steep land, limestone.	Material unsuitable for engineering purposes.			

See footnotes at end of table.

engineering interpretations—Continued

Suitability for—			Suitability as source of—		Sulfate hazard to concrete	Shrink-swell potential	Degree of limitation for—		
Subgrade <sup>1</sup>	Subbase	Base	Gravel	Sand			Embankments	Foundations	Septic tank field (to a depth of 5 feet)
Good.....	Fair.....	Poor.....	Fair.....	Fair.....	Slight.....	Low.....	Moderate.....	Moderate.....	Severe.
Good.....	Fair.....	Poor.....	Good.....	Fair.....	Slight.....	Low.....	Slight.....	Slight.....	
Good <sup>3</sup> .....	Good.....	Good.....	Good.....	Good.....	Slight.....	None.....	Slight.....	Slight.....	
Good <sup>3</sup> .....	Good.....	Fair.....	Good.....	Poor to fair.	None.....	None to low.....	Generally slight. <sup>4</sup>	Generally slight.	None to severe.
Good.....	Fair.....	Poor.....	Fair.....	Good.....	None.....	None to low.....	Slight.....	Slight.....	Moderate.
Good.....	Fair.....	Unsuitable.	Unsuitable.	Fair.....	None.....	Low.....	Moderate.....	Moderate.....	
Fair.....	Poor.....	Unsuitable.	Unsuitable.	Unsuitable.	Slight.....	Moderate.....	Moderate.....	Moderate.....	
Good.....	Fair.....	Poor.....	Good.....	Good.....	Slight.....	Low.....	Slight.....	Slight.....	
Poor.....	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe.....	High.....	Severe.....	Severe.....	Severe.
Poor.....	Unsuitable.	Unsuitable.	Unsuitable.	Unsuitable.	Severe.....	High.....	Severe.....	Moderate to severe.	Severe.

TABLE 4.—Descriptions of soils and

Map symbol	Soil	Description	Classification		Permeability
			Unified	AASHO	
TaA	Tonopah loamy fine sand, 0 to 2 percent slopes.	0 to 8 inches, sand-gravel-silt mixture; about 10 percent angular and subangular gravel up to 2 inches in diameter; 75 percent fine sand; 15 percent nonplastic fines; calcareous; dry and soft in place; pH 8.6.	SM-----	A-2-4----	<i>In. per hr.</i> 5 to 10
		8 to 60 inches, gravel-sand mixture; about 60 percent angular gravel up to 3 inches in diameter; 35 percent sand; 5 percent nonplastic fines; calcareous; dry and loose in place; pH 8.8. Stratified gravel and sand.	GW or GP.	A-1-a----	>10
TcC	Tonopah cobbly loamy sand, 2 to 8 percent slopes.	0 to 60 inches, gravel-sand mixture; about 5 percent cobbles; 55 percent angular and subangular gravel up to 3 inches in diameter; 35 percent coarse sand to fine sand; 5 percent nonplastic fines; strongly calcareous; dry and slightly compact in place; pH 8.6 to 9.0. Stratified gravel and sandy material in most places.	GW or Gp.	A-1-a----	>10
ThC	Tonopah stony loamy sand, 4 to 8 percent slopes.	0 to 16 inches, sand-gravel-stone-silt mixture; about 15 percent stones; about 25 percent hard angular gravel; 50 percent angular and subangular fine sand to coarse sand; about 10 percent nonplastic fines; low dry strength; loose in place; calcareous; pH 8.2 to 8.4.	SM-----	A-1-b----	5 to 10
		16 to 60 inches, gravel-sand mixture; about 70 percent angular gravel up to 3 inches in diameter; 28 percent coarse sand to fine sand; 2 percent nonplastic fines; calcareous; dry and soft in place. Stratified gravel and sandy material in most places.	GW-----	A-1-a----	>10
VsA	Vinton loamy sand, 0 to 2 percent slopes.	0 to 60 inches, sand-silt mixture; about 5 percent angular gravel up to ¼ inch in diameter; 70 percent medium sand and fine sand; 25 percent nonplastic fines; slightly calcareous; dry and soft in place; pH 8.8.	SM-----	A-2-4----	5 to 10
VsB	Vinton loamy sand, 2 to 4 percent slopes.				
VtA	Vinton sandy loam, 0 to 2 percent slopes.	0 to 18 inches, sand-silt mixture; about 5 percent angular gravel up to ¼ inch in diameter; 60 percent medium sand and fine sand; 35 percent nonplastic fines; low dry strength; weakly calcareous; dry and soft in place; pH 8.6.	SM-----	A-2-4----	2.5 to 5
		18 to 60 inches, sand-silt mixture; about 5 percent angular gravel up to ¼ inch in diameter; 70 percent medium sand and fine sand; 25 percent nonplastic fines; slightly calcareous; dry and soft in place; pH 8.8.	SM-----	A-2-4----	5 to 10

<sup>1</sup> Ratings based on assumptions that underground drainage will be provided to keep water table 3 or 4 feet below the road surface and that embankment of sufficient height to prevent flooding will be built.

<sup>2</sup> Applicable if material is not subject to change in density as a result of leaching of gypsum.

engineering interpretations—Continued

Suitability for—			Suitability as source of—		Sulfate hazard to concrete	Shrink-swell potential	Degree of limitation for—		
Subgrade <sup>1</sup>	Subbase	Base	Gravel	Sand			Embankments	Foundations	Septic tank field (to a depth of 5 feet)
Good.....	Fair.....	Unsuitable.	Poor.....	Fair.....	None.....	Low.....	Moderate...	Moderate.....	None.
Good <sup>3</sup> ...	Good.....	Fair.....	Good.....	Good.....	None.....	None.....	Slight.....	Slight.....	
Good <sup>3</sup> ...	Good.....	Fair.....	Good.....	Good.....	None.....	None.....	Slight.....	Slight.....	None.
Good.....	Fair.....	Poor.....	Poor.....	Fair.....	None.....	Low.....	Slight.....	Slight.....	None.
Good <sup>3</sup> ...	Good.....	Poor.....	Good.....	Fair.....	None.....	None.....	Slight.....	Slight.....	
Good.....	Fair.....	Poor.....	Unsuitable.	Fair.....	None.....	Low.....	Moderate...	Severe; low density.	Severe.
Good.....	Fair.....	Poor.....	Unsuitable.	Fair.....	None.....	Low.....	Moderate...	Moderate.....	None.
Good.....	Fair.....	Poor.....	Unsuitable.	Fair.....	None.....	Low.....	Moderate...	Severe; low density.	

<sup>3</sup> Stratified material; uniform subgrade is unlikely in cuts.

<sup>4</sup> Applicable only if material is well mixed.

States have been placed in four hydrologic groups. These groups are based on intake of water at the end of long-duration storms, after prior wetting and opportunity for swelling, without consideration of the protective effects of vegetation. The criteria for the four groups are as follows:

*Group A* consists of soils that have a high infiltration rate, even when thoroughly wetted; they are chiefly deep, well-drained or excessively drained sands or gravels. These soils have a high rate of water transmission and a low runoff potential.

*Group B* consists of soils that have a moderate infiltration rate when thoroughly wetted and that are chiefly moderately deep to deep, moderately well drained or well drained, and moderately fine textured to moderately coarse textured. These soils have a moderate rate of water transmission.

*Group C* consists of soils that have a slow rate of infiltration when thoroughly wetted, chiefly soils that have a layer that impedes downward movement of water and soils that are moderately fine textured or fine textured. These soils have a slow rate of transmission.

*Group D* consists of soils that have a very slow rate of infiltration when thoroughly wetted, chiefly clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious materials. These soils have a very slow rate of water transmission.

The hydrologic classification of the soils and land types of the Las Vegas and Eldorado Valleys Area is as follows:

<i>Group A</i> —	<i>Group C</i> —	<i>Group D</i> —
Carrizo	Aztec	Badland
Dune land	Eastland	Bracken
Jean	Gila	Casa Grande
Riverwash	Glendale	Cave
	Ireteba	Gass
<i>Group B</i> —	Lairep	Goodsprings
Arden	Land	Grapevine
Bluepoint	Paradise	Las Vegas
Dry Lake	Searchlight	Laveldo
Kiup		McCarran
Knob Hill		Mead
McCullough		Pittman
Tonopah		Skyhaven
Vinton		Spring
		Stony steep land, basalt
		Stony steep land, limestone

## Descriptions of the Soils

This section describes the soil series and mapping units of the Las Vegas and Eldorado Valleys Area. The approximate acreage and the proportionate extent of each mapping unit are given in table 5.

A general description of each soil series is given, and it is followed by brief descriptions of the mapping units in that series. For full information on any one mapping unit, it is necessary to read the description of the soil series as well as the description of the mapping unit.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of the description of each mapping unit is the capability unit in which the mapping unit has been placed. The page on which each capability unit is described can readily be found by referring to the "Guide to Mapping Units" at the back of the report.

Soil scientists, engineers, students, and others who want detailed descriptions of soil series should turn to the section "Soil Formation and Soil Classification." Many terms used in the soil descriptions and other sections of the report are defined in the Glossary.

Unless irrigated, the soils of the Las Vegas and Eldorado Valleys Area are not suitable for farming. Their potential for crop production under irrigation depends on the depth, the water-holding capacity, the fertility, and the drainage. Currently, only a small acreage is irrigated. Several small areas have fair value for use as range. Most of the vegetation is unsatisfactory as feed for livestock, and the small fraction that is satisfactory is too sparse and widely scattered to be of much use.

The suggestions for use and management in this section are based on the assumption that irrigation water will be made available. No attempt has been made to evaluate the feasibility of providing such water.

So long as irrigation water is not available, all of this Area, except acreages that have some value for grazing, should be considered for nonfarming enterprises. Information on some engineering properties of the soils and on the suitability of the soils for industrial and commercial purposes is included in the descriptions of the soils.

Conservation measures are needed in this Area. Measures to decrease the hazard of flash floods should be considered. Also, the soils that are susceptible to wind erosion should be protected, particularly if they are adjacent to urban and commercial developments.

## Arden Series

The Arden series consists of well-drained and somewhat excessively drained, moderately coarse textured soils that developed in alluvium derived from a variety of rocks, including limestone, sandstone, shale, and chert. These soils are on eroded valley plains, terraces, and fans in the southwestern part of Las Vegas Valley. They are associated with McCullough, Las Vegas, and Goodsprings soils. The vegetation consists chiefly of creosote-bush, white bur-sage, big galleta, and Mormon-tea. About 98 percent of the acreage is barren.

Arden soils are very deep and are calcareous throughout. In places they contain small amounts of gypsum. The surface soil is pink, is slightly hard, and has platy structure. The subsoil is pink or pinkish white; it is more reddish than the surface soil, is soft, and either has prismatic structure or is massive. The substratum is pinkish gray, loose, and single grained.

These soils are not used for farming. Large areas are used for homesites and for urban development.

In this Area, Arden soils are mapped as part of a complex with McCullough soils.

**Arden-McCullough fine sandy loams, 4 to 8 percent slopes (AmC).**—This complex consists about equally of Arden fine sandy loam and McCullough fine sandy loam.

TABLE 5.—Approximate acreage and proportionate extent of the soils

Soil	Area	Extent	Soil	Area	Extent
	<i>Acres</i>	<i>Percent</i>		<i>Acres</i>	<i>Percent</i>
Arden-McCullough fine sandy loams, 2 to 4 percent slopes.....	576	0.2	Grapevine loam, moderately saline, 0 to 2 percent slopes.....	67	( <sup>1</sup> )
Arden-McCullough fine sandy loams, 4 to 8 percent slopes.....	785	.3	Grapevine loamy fine sand, slightly saline, 2 to 4 percent slopes.....	391	0.1
Aztec gravelly loamy sand, 2 to 8 percent slopes.....	1,159	.4	Ireteba fine sandy loam, slightly saline.....	3,067	1.1
Badland.....	18,611	6.6	Ireteba loam.....	552	.2
Bluepoint fine sandy loam, slightly saline, 0 to 2 percent slopes.....	1,256	.4	Jean loamy fine sand, moderately deep over gravel, 2 to 4 percent slopes.....	6,415	2.3
Bluepoint loamy fine sand, hummocky.....	852	.3	Kiup loamy fine sand, 2 to 4 percent slopes.....	449	.2
Bracken cobbly loam, 2 to 30 percent slopes, eroded.....	2,145	.8	Knob Hill loamy fine sand, deep over gravel, 0 to 2 percent slopes.....	1,493	.5
Bracken gravelly fine sandy loam, 2 to 8 percent slopes.....	11,602	4.1	Knob Hill loamy sand, 2 to 4 percent slopes.....	1,739	.6
Bracken gravelly sandy loam, 0 to 2 percent slopes.....	496	.2	Lairep loamy fine sand.....	458	.2
Bracken loam, 2 to 15 percent slopes.....	602	.2	Land silt loam, slightly wet, strongly saline.....	292	.1
Bracken loamy sand, 2 to 15 percent slopes, eroded.....	260	.1	Land silt loam, slightly wet, strongly saline, hummocky.....	1,142	.4
Carrizo gravelly loamy sand, 0 to 4 percent slopes.....	17,122	6.1	Land silt loam, wet, strongly saline.....	1,513	.5
Carrizo stony sand, 0 to 4 percent slopes.....	10,014	3.5	Land silt loam, slightly saline.....	2,064	.7
Carrizo very fine sandy loam, 0 to 4 percent slopes.....	1,494	.5	Land silty clay loam, slightly wet, strongly saline.....	255	.1
Carrizo-Gila complex.....	238	.1	Land silty clay loam, wet, strongly saline.....	1,327	.5
Casa Grande clay loam, gypsiferous substrata, 0 to 8 percent slopes, eroded.....	2,589	.9	Land silty clay loam, slightly saline.....	721	.3
Cave fine sandy loam, 2 to 15 percent slopes, eroded.....	830	.3	Land silty clay loam, strongly saline.....	208	.1
Cave gravelly fine sandy loam, 0 to 4 percent slopes.....	12,235	4.3	Land very fine sandy loam, wet, strongly saline.....	414	.1
Cave stony fine sandy loam, very shallow, 0 to 2 percent slopes.....	603	.2	Las Vegas loam, shallow, slightly saline, gently undulating.....	459	.2
Cave loamy fine sand, shallow, 0 to 4 percent slopes.....	8,089	2.9	Las Vegas loam, shallow, 0 to 2 percent slopes.....	1,882	.7
Cave loamy fine sand, very shallow, 0 to 4 percent slopes.....	5,304	1.9	Las Vegas loam, very shallow, 0 to 4 percent slopes, eroded.....	2,250	.8
Cave loamy fine sand, very shallow, 2 to 15 percent slopes, eroded.....	225	.1	Las Vegas loam, very shallow, slightly saline, gently undulating.....	18,910	6.7
Dry Lake loamy fine sand.....	921	.3	Lavello clay, eroded.....	507	.2
Dry Lake sandy loam.....	515	.2	McCarran clay loam, slightly saline, 0 to 4 percent slopes.....	3,262	1.2
Dune Land.....	1,072	.4	McCarran clay loam, seeped, slightly saline, 0 to 8 percent slopes.....	96	( <sup>1</sup> )
Eastland gravelly fine sandy loam, seeped, 0 to 2 percent slopes.....	634	.2	McCarran fine sandy loam, 0 to 4 percent slopes.....	10,483	3.7
Eastland gravelly loamy sand, 2 to 4 percent slopes.....	5,466	1.9	McCarran fine sandy loam, hummocky.....	2,684	.9
Gass fine sandy loam, 0 to 2 percent slopes.....	424	.2	McCullough fine sandy loam, 0 to 2 percent slopes.....	92	( <sup>1</sup> )
Glendale silt loam.....	447	.2	Mead clay.....	1,075	.4
Glendale silt loam, slightly wet, slightly saline.....	469	.2	Paradise silt loam, drained, slightly saline.....	394	.1
Glendale silt loam, moderately saline, overflowed.....	225	.1	Pittman stony loam, 0 to 2 percent slopes.....	823	.3
Glendale silt loam, slightly saline.....	6,619	2.3	Pittman stony loamy sand, 0 to 15 percent slopes.....	17,369	6.2
Glendale silt loam, slightly saline, hummocky.....	437	.2	Riverwash.....	1,522	.5
Glendale silt loam, strongly saline.....	155	.1	Searchlight-Carrizo gravelly loamy sands, 2 to 4 percent slopes.....	16,452	5.8
Glendale silty clay loam, gypsiferous substrata, slightly saline.....	834	.3	Skyhaven clay loam, 0 to 2 percent slopes.....	454	.2
Glendale silty clay loam, slightly wet, slightly saline.....	146	.1	Skyhaven clay loam, strongly saline, 0 to 2 percent slopes.....	1,634	.6
Glendale silty clay loam, slightly wet, strongly saline.....	184	.1	Spring clay loam, slightly saline.....	1,286	.5
Glendale silty clay loam, slightly saline.....	291	.1	Spring clay loam, wet, moderately saline.....	172	.1
Glendale silty clay loam, strongly saline.....	286	.1	Stony steep land, basalt.....	2,254	.8
Glendale very fine sandy loam.....	1,497	.5	Stony steep land, limestone.....	3,488	1.2
Glendale very fine sandy loam, clay substrata.....	1,445	.5	Tonopah loamy fine sand, 0 to 2 percent slopes.....	405	.1
Glendale very fine sandy loam, moderately saline.....	515	.2	Tonopah cobbly loamy sand, 2 to 8 percent slopes.....	14,436	5.1
Goodsprings gravelly loamy fine sand, 2 to 4 percent slopes.....	24,881	8.8	Tonopah stony loamy sand, 4 to 8 percent slopes.....	2,531	.9
			Vinton loamy sand, 0 to 2 percent slopes.....	4,409	1.5
			Vinton loamy sand, 2 to 4 percent slopes.....	4,046	1.4
			Vinton sandy loam, 0 to 2 percent slopes.....	1,305	.5
			<b>Total.....</b>	<b>281,806</b>	<b>99.99</b>

<sup>1</sup> Less than 0.05 percent.

It occurs on undulating valley plains and alluvial fans in the southwestern part of Las Vegas Valley. The Arden soil generally occurs within larger areas of the McCullough soil. The main difference between the two soils is that the Arden soil is shallow over a gravelly substratum. Included in mapping are areas of Carrizo fine sandy loam.

Following is a representative profile of Arden fine sandy loam. A profile of McCullough fine sandy loam is described under the McCullough series.

Surface soil—

0 to 1 inch, pink fine sandy loam; moderate, medium, platy structure; slightly hard when dry, very friable when moist, few roots; pH 8.4.

Subsoil—

1 inch to 7 inches, pink fine sandy loam; weak, very coarse, prismatic structure; soft when dry, very friable when moist; few roots; pH 8.4.

7 to 16 inches, pinkish-white fine sandy loam; massive; slightly hard when dry, very friable when moist; few roots; pH 8.6.

Substratum—

16 to 42 inches+, pinkish-gray very gravelly fine sand; single grained; loose when dry or moist; pH 8.6.

The thickness of the solum ranges from 6 to 10 inches. The horizon of lime accumulation is just below the solum. The depth to the very gravelly substratum ranges from 10 to 30 inches.

Natural drainage is good to somewhat excessive, depending on the depth to gravel. Runoff is slow. Permeability is moderately rapid in the surface soil and subsoil and very rapid in the gravelly substratum. Both the water-holding capacity and the natural fertility are low. Runoff from higher lying soils causes a moderate erosion hazard.

The soils of this complex are not used for farming, but if irrigated by sprinkler, fertilized, and supplied with organic matter, they would be productive of most crops. The management would have to be that suited to the shallower Arden soil, for the soil pattern is such that neither soil could be managed separately. The leveling necessary for sprinkler irrigation would have to be restricted so that it would not expose large areas of the gravel that underlies the Arden soil. Wind erosion is a hazard if these soils are left without cover for prolonged periods.

The substratum of the Arden soil has slight limitations as foundation-bearing material and good value as subgrade material. It is good as a source of gravel and fair as a source of sand.

The McCullough soil has severe to slight limitations as foundation-bearing material and fair value as subgrade material. The substratum is fair as a source of sand. The sulfate hazard to concrete is severe. (Arden soil, capability unit IVE-4; McCullough soil, capability unit IIIe-4)

**Arden-McCullough fine sandy loams, 2 to 4 percent slopes (AmB).**—Except for slope, this complex is similar to Arden-McCullough fine sandy loams, 4 to 8 percent slopes. It is not used for cultivated crops, but if irrigated it would have the same potential for crop production and could be managed in the same way as that soil. It would be the easier of the two to irrigate because it is the less sloping. Runoff is slow, but the erosion hazard is moderate because of runoff from higher lying soils. (Arden soil, capability unit IVE-4; McCullough soil, capability unit IIe-4)

## Aztec Series

The Aztec series consists of somewhat excessively drained, moderately coarse textured, gravelly soils that formed in gypsiferous sediments derived from granodiorite, andesite, latite, shale, limestone, quartzite, and some sandstone. These soils occupy terraces in the northwestern part of Eldorado Valley. They are associated with Carrizo and Knob Hill soils. The vegetation consists chiefly of creosotebush, white bur-sage, cholla, and some big galleta. About 98 percent of the acreage is barren.

Aztec soils are very deep, calcareous, and high in gypsum. The surface soil is pale brown to very pale brown, is soft to slightly hard, and has platy or prismatic structure. The subsoil is slightly lighter colored than the surface soil and is soft to slightly hard and massive. The substratum is white to very pale brown, is very hard to slightly hard, and contains crystalline gypsum.

**Aztec gravelly loamy sand, 2 to 8 percent slopes (AzC).**—This soil occurs as a small area in the northeastern part of Eldorado Valley. It is dissected by many small drainage channels.

Representative profile:

Surface soil—

0 to 2 inches, a weak desert pavement of caliche fragments and pebbles overlies pale-brown gravelly loamy sand; weak, medium, platy structure; soft to slightly hard when dry, very friable when moist; pH 8.6.

2 to 4 inches, very pale brown gravelly sandy loam; very weak, coarse, prismatic structure; slightly hard when dry, very friable when moist; pH 8.4.

Subsoil—

4 to 12 inches, very pale brown very gravelly sandy loam; massive; soft to slightly hard when dry, very friable when moist; pH 8.4.

Substratum—

12 to 30 inches, white very gravelly sandy loam high in calcium carbonate and gypsum; massive; very hard when dry, firm when moist; pH 8.6.

30 to 60 inches, very pale brown gravelly loamy sand high in crystalline gypsum; massive; slightly hard when dry, very friable when moist; pH 7.8.

There is some variation in the depth to the lime and gypsum horizons, in the thickness of these horizons, and in the percentage of gravel in the profile.

Natural drainage is somewhat excessive, and runoff is slow. Permeability is rapid in the subsoil but moderately slow below this layer. The root zone is very deep. Both the water-holding capacity and the fertility are low. The erosion hazard is moderate.

This soil is not suitable for crops. It is generally not suitable as a source of gravel. It has moderate to slight limitations as foundation-bearing material to a depth of approximately 30 inches and severe limitations below this depth. The sulfate hazard to concrete is severe. (Capability unit VIIIs-3)

## Badland

**Badland (Ba)** consists of areas of rough, complex topography that has resulted from local geologic faulting, exposure of the Muddy Creek formation, and erosion of lake sediments that were deposited later. This land type occurs extensively in Las Vegas Valley, mainly near the city of Las Vegas, northwest of Las Vegas near Tule

Springs, and west and slightly north of Pittman. It is nearly level to strongly sloping and is severely eroded. It is associated with McCarran, Bracken, and Las Vegas soils.

The soil material consists of multicolored, calcareous, gypsiferous, stratified clay and silt and thin strata of sand. It ranges from very shallow to moderately deep. Natural drainage is good. Runoff is very rapid, and permeability is slow. The water-holding capacity and the natural fertility are very low. The erosion hazard is very severe.

Badland is not suited to cultivated crops. It supports very little vegetation, mostly creosotebush, white bur-sage, and shadscale. It is used to some extent for homesites but is not suitable for large-scale urban and industrial development. It has moderate to severe limitations as foundation-bearing material and is unsuitable as subgrade material. The shrink-swell potential is moderate to high. The sulfate hazard to concrete is severe. (Capability unit VIIIe-1)

### Bluepoint Series

The Bluepoint series consists of sandy, well-drained soils that formed in alluvium derived from a variety of rocks, including sandstone, shale, and limestone. These soils occur on alluvial flood plains and valley bottoms. They are commonly associated with Glendale and Land soils. The vegetation consists mainly of a good growth of creosotebush, white bur-sage, desert primrose, mesquite, saltgrass, and arrowweed. Approximately 85 percent of the acreage is barren.

Bluepoint soils are very deep, are calcareous, and contain varying amounts of soluble salts. The surface soil is reddish yellow, soft, and massive. The subsoil and substratum are similar to the surface soil.

These soils are mostly under natural vegetation, but where irrigation water is available, they are used for farm crops. Alfalfa, pasture crops, and small grain are grown.

**Bluepoint fine sandy loam, slightly saline, 0 to 2 percent slopes (BcA).**—This soil occurs in the trough of Las Vegas Valley. Generally, it is adjacent to drainage channels or washes and on flood plains at the mouth of washes.

Representative profile:

Surface soil—

0 to 7 inches, reddish-yellow fine sandy loam; massive; soft when dry, very friable when moist; pH 8.4.

Subsoil—

7 to 17 inches, reddish-yellow loamy fine sand; massive; soft when dry, very friable when moist; pH 8.4.

17 to 23 inches, reddish-yellow very gravelly fine sandy loam; single grained; loose when dry and when moist; pH 8.4.

23 to 36 inches, pink loamy fine sand; massive; soft when dry, very friable when moist; pH 8.4.

Substratum—

36 to 41 inches, pink fine sandy loam; massive; soft when dry, very friable when moist; pH 8.8.

41 to 60 inches +, reddish-yellow loamy fine sand; massive; soft when dry, very friable when moist; pH 8.8.

The surface soil is slightly saline. It ranges from loamy fine sand to fine sandy loam in texture. In places there is a gravelly horizon. The depth to this horizon varies.

Natural drainage is good. Runoff is very slow, and permeability is rapid. The root zone is very deep. Both the water-holding capacity and the inherent fertility are

moderate. Unless protected, this soil is moderately susceptible to erosion.

This soil is neither irrigated nor cultivated. If irrigated and properly managed, it would be productive of all crops climatically suited to the Area. It would need to be leveled before it could be irrigated. Deep cuts could be made. An initial leaching to remove the excess salts would be needed if salt-sensitive crops were to be grown. After the initial leaching, only enough water to wet the root zone would be needed during each irrigation. Too much water would leach away plant nutrients. Generous applications of nitrogen and phosphorus fertilizer would be required. Organic matter worked into the surface soil would maintain good tilth, stabilize the soil, and thus help to control erosion. Unless protected, this soil is subject to blowing.

This soil is suitable for urban development and to limited industrial development. It has severe limitations as foundation-bearing material, good value as subgrade material, fair value as subbase material, and poor value as base material. It is poor as a source of sand. The shrink-swell potential is low. The sulfate hazard to concrete is severe. (Capability unit IIIs-4)

**Bluepoint loamy fine sand, hummocky (BdB).**—As compared with Bluepoint fine sandy loam, slightly saline, 0 to 2 percent slopes, this soil has a coarser textured but nonsaline surface soil and hummocky, somewhat steeper slopes. Its water-holding capacity and inherent fertility are low.

Most of the acreage is neither irrigated nor cultivated. Where irrigation water is available, forage and grain crops do fairly well. Heavy applications of inorganic and organic fertilizers are needed to keep fertility at a satisfactory level. If cultivated, this soil is susceptible to wind erosion. Because of its low water-holding capacity, it would need frequent light irrigations. It would need to be leveled before it could be irrigated. The sulfate hazard to concrete is slight. (Capability unit IVs-4L)

### Bracken Series

The Bracken series consists of moderately well drained, gravelly, moderately coarse textured soils that formed in alluvium derived from gypsum, limestone, shale, sandstone, quartzite, and basalt. These soils occur on eroded and dissected terraces or valley fills. They are associated with McCarran and Spring soils. The vegetation consists chiefly of shadscale, creosotebush, white bur-sage, cat-claw, and Mormon-tea. About 98 percent of the acreage is barren.

Bracken soils are calcareous and contain a large amount of gypsum. The surface soil is very pale brown, is slightly hard, and either has platy structure or is massive. The subsoil is pinkish white to pink, hard to very hard, and massive. It contains finely disseminated gypsum. The substratum is white, hard, and massive and is high in content of finely divided crystalline gypsum.

These soils are not used for farming. In a few places they are used as sites for urban and industrial developments.

**Bracken gravelly fine sandy loam, 2 to 8 percent slopes (BgC).**—This soil is extensive along the western side of Las Vegas Valley north of the outlet of Las Vegas Wash.

Included in mapping are areas of Bracken loamy fine sand and Bracken very fine sandy loam.

Representative profile:

Surface soil—

0 to 2 inches, very pale brown gravelly fine sandy loam; moderate, medium, platy structure; slightly hard when dry, very friable when moist; pH 8.8.  
2 to 6 inches, similar to the layer above, but massive.

Subsoil—

6 to 14 inches, pinkish-white gravelly fine sandy loam and much crystalline gypsum; massive; very hard when dry, friable when moist; pH 8.4.  
14 to 20 inches, pink light gravelly fine sandy loam; contains less lime than the horizon above and less gypsum than the horizon below; massive; hard when dry, very friable when moist; pH 8.4.

Substratum—

20 to 60 inches +, white gravelly fine sandy loam and finely divided and weakly cemented crystalline gypsum; massive; very hard when dry, firm when moist, slightly sticky when wet; pH 7.4.

The range in the depth to the gypsum-cemented substratum is considerable, and also the range in the quantity of crystalline gypsum and gravel that occurs in the substratum. The depth ranges from 6 to 24 inches. Gypsum crystals are visible throughout the profile in some places, but only in the subsoil or substratum in other places. In spots the cementation is very weak and the substratum is 20 to 40 percent gravel.

Natural drainage is moderate. Runoff is slow to medium, depending on the slope. Permeability is moderately rapid as far down as the cemented horizon, is slow through this horizon, and is moderately rapid below. Both the water-holding capacity and the inherent fertility are moderate. The root zone is generally deep, but the depth varies, depending somewhat on the degree of cementation. The erosion hazard is moderate.

This soil is not suited to cultivation and irrigation. It is only fairly well suited or poorly suited to urban and industrial development. It is unsuitable to poor as a source of gravel. The subsoil and substratum have moderate to severe limitations as foundation-bearing material and fair value as subgrade material. The shrink-swell potential is low. The sulfate hazard to concrete is severe. (Capability unit VIIIs-3)

**Bracken cobbly loam, 2 to 30 percent slopes, eroded (BfE2).**—This soil is on eroded terraces and terrace side slopes. It is not suited to cultivation and irrigation. Runoff is rapid, and the erosion hazard is severe. This soil needs protection against erosion, but otherwise it can be used and managed in the same way as Bracken gravelly fine sandy loam, 2 to 8 percent slopes. Runoff should be carried across this soil by means of berms and shallow trenches. Then it should be allowed to spread over the adjacent less sloping soils. (Capability unit VIIIs-7)

**Bracken gravelly sandy loam, 0 to 2 percent slopes (BkA).**—This soil is similar to Bracken gravelly fine sandy loam, 2 to 8 percent slopes, except that its surface soil is coarser textured, it occurs on nearly level terrace tops, and it is generally slightly deeper (20 to 33 inches) to the weakly cemented gypsum. Runoff is slow.

This soil is not used for farming, but it could be used for most shallow-rooted crops that are climatically suited. If properly managed, it would be fairly productive of pasture crops, corn, and small grain. Supplemental fertilization, including nitrogen for grasses and phosphorus for legumes, would be advisable. Organic matter,

including barnyard manure and green-manure crops, would improve tilth and help to control erosion. Cuts made in leveling should allow sufficient depth for root development. (Capability unit IIIs-3)

**Bracken loam, 2 to 15 percent slopes (BmD).**—Except for texture and stronger slopes, this soil is similar to Bracken gravelly fine sandy loam, 2 to 8 percent slopes. It can be managed in much the same way as that soil. Runoff is slow to medium. The depth to the weakly cemented gypsum is generally less than 8 inches. Measures are needed to control runoff and thus lessen the hazard of erosion. Ditches and shallow ponds can be used effectively. (Capability unit VIIIs-3)

**Bracken loamy sand, 2 to 15 percent slopes, eroded (BnD2).**—Except for differences in texture and slope and in the degree of erosion, this soil is similar to Bracken gravelly fine sandy loam, 2 to 8 percent slopes. It can be managed in much the same way as that soil, but it needs to be protected against both wind and water erosion. Runoff is rapid, and the erosion hazard is severe. The natural vegetation should not be disturbed. Windbreaks would be advisable. Ditches and shallow ponds would slow down runoff. (Capability unit VIIIs-3)

## Carrizo Series

The Carrizo series consists of excessively drained, very gravelly, sandy soils that formed in alluvium derived predominantly from basalt, rhyolite, limestone, and quartzite. These soils are on alluvial fans and flood plains. They are associated with Vinton, Mead, Iretaba, Gila, Searchlight, and Knob Hill soils. The vegetation consists chiefly of creosotebush and white bur-sage. Approximately 98 percent of the acreage is barren.

Carrizo soils are calcareous and very deep. The surface soil is pale brown, single grained, and loose. The uppermost inch or two in many places has weak platy structure and is slightly hard. The subsoil and substratum are very pale brown to pale brown, loose, and single grained. Some stratification is common.

Most Carrizo soils are not suitable for farm crops. To a limited extent they can be used for grazing.

**Carrizo gravelly loamy sand, 0 to 4 percent slopes (CaA).**—This soil is extensive throughout Eldorado Valley.

Representative profile:

Surface soil—

0 to 1 inch, pale-brown sandy loam; weak, fine to medium, platy structure; slightly hard when dry, very friable when moist; slightly micaceous; pH 8.4.

1 inch to 10 inches, pale-brown gravelly loamy sand; single grained; loose when dry or moist; slightly micaceous; pH 8.2.

Subsoil and substratum—

10 to 60 inches, pale-brown or very pale brown very gravelly sand; single grained; loose when dry or moist; micaceous; pH 8.2. These layers are somewhat stratified.

Normally, the surface is covered with a weakly developed desert pavement. The color of this soil ranges from light yellowish brown to light brown. The gravel content ranges from 40 to 70 percent, the cobblestone content from 0 to 30 percent, and the stone content from 0 to 15 percent.

Natural drainage is excessive, though runoff is very slow. Infiltration and permeability are very rapid; little, if any, rainfall runs off, except during brief periods of

torrential storms. Both the water-holding capacity and the inherent fertility are very low. The erosion hazard is moderate because of runoff from higher lying soils.

This soil is not used for farming. It is so gravelly and so low in water-holding capacity that it is not suited to irrigation. It would be well suited to industrial and urban development if it were protected against the flooding that occurs during torrential storms. The subsoil and substratum have only slight limitations as foundation-bearing material and are good sources of sand and gravel. There is no sulfate hazard to concrete. (Capability unit VIII<sub>s</sub>-L)

**Carrizo stony sand, 0 to 4 percent slopes (CcB).**—This soil has many basalt stones on the surface and throughout the profile. It can be managed in much the same way as Carrizo gravelly loamy sand, 0 to 4 percent slopes. The subsoil and substratum are fair sources of gravel. (Capability unit VIII<sub>s</sub>-7)

**Carrizo very fine sandy loam, 0 to 4 percent slopes (CfB).**—This soil occurs in a drainageway in the north-central part of Las Vegas Valley. The surface soil is 5 to 12 inches thick. Some stratification is common in the subsoil and substratum. Runoff is slow, but the erosion hazard is moderate because of runoff from higher lying soils.

This soil can be used and managed in much the same way as Carrizo gravelly loamy sand, except that it needs to be protected from flooding. The substratum has only slight limitations as foundation-bearing material; it has good value as subgrade and subbase material; and it is a good source of sand and gravel. There is no shrink-swell potential in the substratum. The sulfate hazard to concrete is only slight. (Capability unit VIII<sub>s</sub>-L)

**Carrizo-Gila complex (Cg).**—This complex is along drainageways and channels in the central part of Las Vegas Valley. It is subject to periodic erosion and deposition. It is about 60 percent Carrizo very fine sandy loam and about 40 percent Gila very fine sandy loam.

Except for the surface soil, the profile of Carrizo very fine sandy loam is similar to the one described for Carrizo gravelly loamy sand, 0 to 4 percent slopes. The Carrizo soil in this complex has a slope range of 0 to 2 percent, an 8- to 20-inch surface layer (the average thickness is about 10 inches), and some stratification with finer textured material in the subsoil and substratum. Runoff is slow, but the erosion hazard is moderate because of runoff from higher lying soils. Channels may be needed to help control flooding, but otherwise this soil can be used and managed in much the same way as Carrizo gravelly loamy sand, 0 to 4 percent slopes.

The following is a representative profile of Gila very fine sandy loam.

Surface soil and subsoil—

- 0 to 42 inches, pink, stratified very fine sandy loam and fine sandy loam; massive; soft when dry, very friable when moist; pH 8.2.
- 42 to 60 inches +, pink, very gravelly sand; single grained; loose when dry or moist; pH 8.2.

The color ranges from pink to very pale brown. The depth to gravel ranges from about 20 inches to more than 60 inches but is most commonly between 40 and 48 inches. Differences in depth may be abrupt, and there is no definite pattern.

Natural drainage is good. Runoff is slow, and permeability is moderate in the subsoil and very rapid in the

substratum. Infiltration is moderate. The water-holding capacity is moderate, and natural fertility is high. The erosion hazard is moderate because of runoff from higher lying soils. The profile contains little gypsum.

The Gila soil could be irrigated and cultivated, but it occurs in such small areas that it has to be used and managed in the same way as Carrizo very fine sandy loam, 0 to 4 percent slopes. Hence, it is not used for farm crops.

The surface soil and subsoil of both parts of this complex have severe limitations as foundation-bearing material, have only fair value as subgrade material, and are generally poor as a source of sand and unsuitable as a source of gravel. The substratum has slight limitations as foundation-bearing material, has good value as subgrade and subbase material, and is a good source of sand and gravel. The sulfate hazard to concrete is slight. (Capability unit VIII<sub>s</sub>-L)

## Casa Grande Series

The Casa Grande series consists of well-drained, moderately fine textured soils that developed in alluvium derived from limestone, sandstone, shale, and quartzite. These soils are on old terraces or eroded valley plains in the northern part of Las Vegas Valley. They are associated with Las Vegas and Goodsprings soils. The landscape is one of low rolling ridges separated by broad shallow swales and shallow, intermittent drainage channels. The vegetation consists chiefly of creosotebush, shadscale, and desert holly. Big galleta is scattered along the drainage channels and low swales. The acreage is 98 or 99 percent barren.

Casa Grande soils are calcareous and saline. The surface soil is pink, is slightly hard, and has platy structure. The subsoil is yellowish red, light yellowish brown, or pink; it is slightly hard to hard; and it either has prismatic to subangular blocky structure or is massive. The substratum is white, massive, hard, gravelly material weakly cemented with gypsum.

**Casa Grande clay loam, gypsiferous substrata, 0 to 8 percent slopes, eroded (ChC2).**—This soil is northeast of the city of Las Vegas and west and northwest of Nellis Air Force Base.

Representative profile:

Surface soil—

- 0 to 2 inches, pink clay loam; moderate, medium, platy structure; slightly hard when dry, friable when moist; pH 9.0.

Subsoil—

- 2 to 12 inches, yellowish-red heavy clay loam; common, medium, prominent, white lime mottles; weak, medium to fine, prismatic structure; hard when dry, firm when moist; pH 9.0.
- 12 to 22 inches, light reddish-brown clay loam; common, large, prominent, white lime mottles on ped surfaces; moderate, medium, subangular blocky structure; slightly hard when dry, friable when moist; pH 9.4.
- 22 to 32 inches, pink light clay loam; massive; slightly hard when dry, friable when moist; some lime nodules; pH 9.4.

Substratum—

- 32 to 60 inches, white very gravelly sandy loam weakly cemented with gypsum; massive; hard when dry, firm when moist; pH 7.8.

The texture of the surface soil is either light clay loam or silty clay loam. The depth to the very gravelly horizon ranges from 22 to 40 inches.

Natural drainage is good. Runoff is medium to rapid, depending on the slope. Permeability is slow. The water-holding capacity is high, and the fertility is low. The root zone is deep. There are many shallow gullies.

Currently, this soil is not used for farming. It would not be suitable for irrigation, even if water were made available. The surface soil and subsoil are poor or unsuitable for more engineering purposes. The shrink-swell potential is moderate to high in these layers. The substratum is fair for most engineering purposes and has low shrink-swell potential. The sulfate hazard to concrete is severe. (Capability unit VIII<sub>s</sub>-3)

### Cave Series

The Cave series consists of well-drained, moderately coarse textured soils that have an indurated lime hardpan. These soils formed in alluvium derived mainly from limestone but partly from quartzite, rhyolite, and sandstone. They occupy terraces and alluvial fans, mainly in the western part of Las Vegas Valley. They are associated with Goodsprings and Las Vegas soils. The vegetation consists of creosotebush, white bur-sage, Spanish bayonet, and catclaw. About 99 percent of the acreage is barren.

Cave soils are shallow or very shallow and calcareous. In places they are covered with a well-developed desert pavement of gravel. The surface soil is pink, is slightly hard, and has platy structure. The subsoil is pink to reddish yellow, is slightly hard to soft, and either has prismatic structure or is massive. The substratum is an indurated lime hardpan.

These soils are not used for farming. They are unsuitable for most crops.

**Cave gravelly fine sandy loam, 0 to 4 percent slopes (CnB).**—This soil is extensive along the western side of Las Vegas Valley. It is covered with a well-developed desert pavement (fig. 2). Most of the gravel has a burnished desert varnish on its exposed side. There are many intermittent drainage channels, ranging from a few inches to 5 feet in depth.

Representative profile:

Surface soil—

0 to 2 inches, a well-developed desert pavement underlain by pink gravelly fine sandy loam; weak, coarse, platy structure; slightly hard when dry, friable when moist; pH 8.2.



Figure 2.—Characteristic desert pavement on Cave gravelly fine sandy loam.

Subsoil—

2 to 4 inches, pink gravelly fine sandy loam, slightly finer textured than the surface soil; very weak, coarse, prismatic structure breaking to moderate, medium, platy aggregates; slightly hard when dry, friable when moist; pH 8.3.

4 to 12 inches, pink light sandy loam; massive; soft when dry, very friable when moist; pH 8.6.

12 to 15 inches, reddish-yellow gravelly sandy loam; massive; soft when dry, very friable when moist; pH 8.8.

Substratum—

15 inches +, pinkish-white indurated lime hardpan; massive; pH 8.2.

The subsoil is pink, light reddish brown, or reddish yellow. The hardpan is at a depth of 10 to 22 inches (fig. 3) and contains a large amount of rounded and subrounded gravel.



Figure 3.—Profile of Cave gravelly fine sandy loam. Hammer is resting on indurated lime hardpan.

Natural drainage is good. Runoff is medium. Permeability is moderately rapid as far down as the pan but very slow through it. Both the water-holding capacity and the inherent fertility are very low. The erosion hazard is moderate.

This soil is not suitable for cultivation and irrigation because of its shallow root zone and very low water-holding capacity.

The surface soil and subsoil have moderate limitations as foundation-bearing material, but the substratum has only slight limitations. This soil has fair value as subgrade material, has poor value as subbase material, and is unsuitable for use as base material. The shrink-swell potential is low. The sulfate hazard to concrete is slight. (Capability unit VIII<sub>s</sub>-8)

**Cave fine sandy loam, 2 to 15 percent slopes, eroded (CmD2).**—This soil is similar to Cave gravelly fine sandy loam, 0 to 4 percent slopes. It can be managed in the same way as that soil but needs to be protected against

erosion. Runoff is rapid, and the erosion hazard is severe. In places the hardpan is exposed at the surface. Dikes or shallow trenches should be constructed to divert runoff from higher lying soils into natural drainageways or onto adjacent soils that are less sloping and have slower runoff. (Capability unit VIIIs-8)

**Cave stony fine sandy loam, very shallow, 0 to 2 percent slopes (CrA).**—For the most part, this soil can be managed in the same way as Cave gravelly fine sandy loam, 0 to 4 percent slopes. In most places the stones lack the desert varnish that is typical of that soil, and the subsoil is pink or white, lacking the reddish chromas. The root zone is 1 to 10 inches deep. The surface soil has moderate limitations as foundation-bearing material and has fair value as subgrade material. (Capability unit VIIIs-8)

**Cave loamy fine sand, shallow, 0 to 4 percent slopes (CsB).**—This soil lacks the gravel desert pavement that is typical of Cave gravelly fine sandy loam, 0 to 4 percent slopes. Consequently, it is subject to moderate wind erosion if the vegetation is disturbed. Ordinarily, the subsoil is pink or white. Included in mapping is a small area in the north-central part of the valley that has received deposits of wind- and water-eroded material carried from higher lying soils. In this area the depth to the hardpan is 20 to 28 inches.

This moderately deep inclusion is suitable for cultivation and irrigation of shallow-rooted crops. The rest of this soil can be used and managed in the same way as Cave gravelly fine sandy loam, 0 to 4 percent slopes. The surface soil has moderate limitations as foundation-bearing material, fair value as subgrade material, and poor value as subbase material. (Capability unit VIIIs-8)

**Cave loamy fine sand, very shallow, 0 to 4 percent slopes (CvB).**—This soil is similar to Cave gravelly fine sandy loam, 0 to 4 percent slopes, but is shallower and coarser textured. Ordinarily, the subsoil is pink or white. The root zone is 2 to 10 inches deep. Included in mapping is a small area of slightly saline soils.

For the most part, this soil can be used and managed in the same way as Cave gravelly fine sandy loam, 0 to 4 percent slopes. It needs to be protected against wind erosion. Tree plantings are advisable in urban areas. The roots should be planted below the pan.

The surface soil has moderate limitations as foundation-bearing material and fair value as subgrade material. (Capability unit VIIIs-8)

**Cave loamy fine sand, very shallow, 2 to 15 percent slopes, eroded (CvD2).**—This soil is coarser textured, is shallower, and has stronger slopes than Cave gravelly fine sandy loam, 0 to 4 percent slopes. The hazard of wind erosion is moderate if the vegetation is disturbed. Runoff is medium. The surface is rough, and there are many shallow gullies. The root zone is 0 to 10 inches deep.

This soil can be used and managed in the same way as Cave gravelly fine sandy loam, 0 to 4 percent slopes, except that it must be protected against erosion. Dikes or shallow ditches should be constructed so that runoff from higher lying soils can be diverted into natural channels or onto adjacent soils that are less sloping. The vegetation should not be disturbed.

The surface soil has only moderate limitations as foundation-bearing material and has fair value as subgrade material. (Capability unit VIIIs-8)

## Dry Lake Series

The Dry Lake series consists of well-drained, coarse-textured soils that are underlain by a moderately coarse textured buried soil. These soils formed in alluvium derived from a mixture of rocks, including granodiorite, quartzite, latite, basalt, and limestone. The buried soil has been affected by ground water high in lime. These soils are on flood plains and the lower margins of alluvial fans. They are associated with Carrizo and Vinton soils. The vegetation consists of an almost pure stand of galleta and scatterings of creosotebush. Approximately 85 to 90 percent of the acreage is barren.

Dry Lake soils are calcareous and very deep. The surface soil and subsoil are light brown, soft, and massive. The substratum is light brown to white, slightly hard or hard, and massive.

Currently, these soils are not used for farming.

**Dry Lake loamy fine sand (Dk).**—This soil is in the south-central part of Eldorado Valley, on flood plains and on toe slopes of alluvial fans, near the south end of the playa. Included in mapping are small areas of slightly saline soils.

Representative profile:

Surface soil—

0 to 6 inches, light-brown loamy fine sand; massive; soft when dry, very friable when moist; pH 8.4.

Subsoil—

6 to 20 inches, light-brown loamy fine sand; massive; soft when dry, very friable when moist; pH 8.4.

Substratum—

20 to 44 inches, light-brown fine sandy loam; massive; slightly hard when dry, very friable when moist; pH 8.4.

44 to 66 inches, white heavy silt loam; massive; hard when dry, friable when moist; contains common lime nodules  $\frac{1}{8}$  to  $\frac{1}{2}$  inch in diameter and  $\frac{1}{4}$  inch to 2 inches in length; pH 9.0.

The subsoil is somewhat stratified, but if this stratified material were mixed, it would be coarse textured. The substratum, or buried soil, is at a depth between 15 and 40 inches. It contains material that appears to have been laid down in a shallow lake or near the margin of a lake, and to have been modified by a high water table at some time in the past. In places there are iron mottles below a depth of 40 inches. The horizon of white lime ranges from 3 to 30 inches in thickness.

Natural drainage is good. Runoff is very slow, and permeability is rapid as far down as the substratum, and moderate below. The water-holding capacity and the inherent fertility are moderate. The erosion hazard is moderate because of runoff from higher lying soils. Wind erosion has made the surface hummocky.

If irrigation water were made available, this soil would be productive of crops. It would need to be leveled before it could be irrigated and would probably need an initial leaching to remove the excess salts. Applications of fertilizer would be advisable. Additions of organic matter would help to control wind erosion. Windbreaks might be needed. Channeling runoff to the playa would reduce the erosion hazard.

This soil is potentially good for homesites and for industrial development. The surface soil and subsoil have severe limitations as foundation-bearing material. These layers have good value as subgrade material and fair value as subbase material but are poor as base material. The shrink-swell potential is low. The sulfate hazard to

concrete is slight. The substratum has moderate to severe limitations as foundation-bearing material and fair value as subgrade material. It is unsuitable to poor as subbase and unsuitable as base material. The shrink-swell potential is low to moderate. (Capability unit IIIs-L)

**Dry Lake sandy loam (Dm).**—Except for texture, this soil is similar to Dry Lake loamy fine sand. It can be used and managed in much the same way as that soil. It is moderately susceptible to water erosion but only slightly susceptible to wind erosion. (Capability unit IIs-4)

## Dune Land

**Dune Land (Du)** consists of large dunes of pink, calcareous, wind-deposited fine sand. This land type occurs as small, scattered areas in Las Vegas Valley, mainly south of the city of Las Vegas, in Paradise Valley. It is associated with McCarran and Glendale soils. The slopes are moderate but complex.

Drainage is excessive. Runoff is slow, but permeability is very rapid. The water-holding capacity and the inherent fertility are low. The erosion hazard is severe if the vegetation is disturbed.

Dune Land is not suitable for farm crops, but it can be used as fill for lawns and flowerbeds. The vegetation consists chiefly of catchlaw, and the plant density is approximately 10 to 20 percent.

This land type has severe limitations as foundation-bearing material because of its low density. It is poor as a source of sand because the grains are of uniform size. The sulfate hazard to concrete is moderate. (Capability unit VIIIs-L)

## Eastland Series

The Eastland series consists of well-drained, crudely stratified, coarse-textured, gravelly and very gravelly soils. These soils formed in alluvium derived from a variety of rocks, including limestone, andesite, rhyolite, basalt, and quartzite. They are on alluvial fans and terraces and are associated with Pittman and Bracken soils. The vegetation consists chiefly of creosotebush and white bur-sage. About 99 percent of the acreage is barren.

Eastland soils are very deep, gravelly, and calcareous, and have a weakly lime cemented substratum. The surface soil is pink, soft, and massive. The subsoil is pink to light brown, stratified, slightly hard, and massive. The substratum is pink, very hard, massive, and weakly cemented with lime.

These soils are not used for farming. Part of their acreage is occupied by Henderson and its industrial center.

**Eastland gravelly loamy sand, 2 to 4 percent slopes (EgB).**—This soil occurs in the southeastern part of Las Vegas Valley, near Henderson.

Representative profile:

Surface soil—

0 to 17 inches, pink gravelly loamy sand; massive; soft when dry, very friable when moist; pH 8.4.

Subsoil—

17 to 26 inches, pink very gravelly sand; massive; slightly hard when dry, very friable when moist; pH 8.4.

26 to 38 inches, light-brown loamy sand; massive; slightly hard when dry, very friable when moist; pH 8.2.

Substratum—

38 to 52 inches, pink sandy loam; massive; very hard when dry, friable when moist; weakly lime cemented; pH 8.6.

52 to 60 inches +, pink gravelly loamy sand; massive; slightly hard when dry, very friable when moist; very weakly lime cemented; pH 8.2.

The chief variations are in the depth to the substratum and in the degree of cementation. The depth ranges from 36 to 54 inches. The degree of cementation is normally weak, but there are some thin, discontinuous strata that are strongly cemented.

Natural drainage is good. Runoff is slow. Permeability is rapid in the subsoil and moderate in the substratum. The water-holding capacity and the inherent fertility are low. The erosion hazard is moderate because of runoff from higher lying soils.

This soil is not used for farming, but if properly managed it should be fairly productive of crops. Only small quantities of irrigation water should be applied at a time. Too much water would cause a perched water table above the substratum and a waterlogged subsoil. Fertilizer, including nitrogen for nonlegumes and phosphorus for legumes, would be essential for good production. Additional organic matter would help to maintain tilth and control erosion. Measures would be needed to help control the runoff from higher lying soils and the subsequent erosion.

This soil is used extensively as sites for urban and industrial building in and around the city of Henderson. If properly irrigated and fertilized, it is well suited to the garden and ornamental plants and shade trees commonly grown in the Area.

This soil has moderate to slight limitations as foundation-bearing material and is poor to good as a source of gravel and sand. The shrink-swell potential is low, and the sulfate hazard to concrete is slight. (Capability unit IVs-4L)

**Eastland gravelly fine sandy loam, seeped, 0 to 2 percent slopes (EfA).**—This soil is similar to Eastland gravelly loamy sand, 2 to 4 percent slopes, but has a high water table. It is wet enough to have a moist surface soil in winter. The water-holding capacity and the inherent fertility are moderate. The water table has been caused by seepage from tailing ponds at the chemical plants near Henderson.

This soil is not used for farming, but if properly managed, it should be fairly productive of crops. Unless drained, however, it would not be suitable for deep-rooted crops, such as alfalfa. Adequate drainage would help maintain a favorable salt balance.

This soil has moderate limitations as foundation-bearing material. The sulfate hazard to concrete is moderate to severe in the subsoil and substratum. (Capability unit IIIw-4)

## Gass Series

The Gass series consists of moderately well drained, fine-textured soils that developed in alluvium derived from a variety of rocks, including limestone, shale, sandstone, quartzite, and volcanic ash. These soils are on terraces or fans. They are associated with Goodsprings and Las Vegas soils. The vegetative cover is sparse and stunted and consists mainly of shadscale, creosotebush,

and white bur-sage. About 99 percent of the acreage is barren.

Gass soils are calcareous and very deep. The surface soil is pink to reddish yellow, is soft to slightly hard when dry, and has platy or prismatic structure. The subsoil is light brown to reddish yellow, is hard to very hard, and has prismatic or subangular blocky structure. The substratum is pink, is very hard when dry, and has subangular blocky structure.

**Gass fine sandy loam, 0 to 2 percent slopes (GaA).**—This soil occurs as a small area north of Nellis Air Force Base in Las Vegas Valley.

Representative profile:

Surface soil—

0 to 1 inch, pink fine sandy loam; weak, coarse, platy structure; slightly hard when dry, very friable when moist; pH 8.6.

1 inch to 6 inches, reddish-yellow fine sandy loam; weak, very coarse, prismatic structure; soft when dry, very friable when moist; pH 8.8.

Subsoil—

6 to 9 inches, reddish-yellow fine gravelly loam (gravel consists of angular lime hardpan fragments); moderate, fine, subangular blocky structure; hard when dry, firm when moist; pH 8.8.

9 to 14 inches, light-brown gravelly clay or gravelly light clay; many, prominent, white lime flecks and mottles; strong, fine, subangular blocky structure; very hard when dry, very firm when moist; pH 8.6.

14 to 22 inches, light-brown clay; common, prominent, white lime mottles and some soft lime nodules; strong, fine, prismatic structure; very hard when dry, very firm when moist; pH 8.4.

Substratum—

22 to 60 inches +, pink clay; common, coarse, prominent, white lime mottles and splotches; moderate, medium, subangular blocky structure; very hard when dry, very firm when moist; pH 9.0.

The depth to the prismatic clay layer, which is in the lower part of the subsoil, ranges from 10 to 21 inches. In places a layer of gypsum occurs in the substratum.

Natural drainage is moderate, and runoff is slow. Permeability is very slow in the subsoil. The water-holding capacity and the inherent fertility are high. The erosion hazard is moderate.

This soil is not used for farming and is poorly suited to crops. Also, it is poorly suited to urban and industrial development. It has moderate to severe limitations as foundation-bearing material. The shrink-swell potential is high. The sulfate hazard to concrete is moderate in the surface soil and severe in the subsoil and substratum. (Capability unit VIII<sub>s</sub>-3)

## Gila Series

The Gila series consists of well-drained, stratified, medium-textured and moderately coarse textured soils. These soils formed in stream-laid material, including limestone, shale, sandstone, and quartzite. They occur on flood plains and are associated mainly with Carrizo and Glendale soils. Occasionally, during torrential rains, these soils receive thin deposits of alluvium washed from higher lying soils. The vegetation consists chiefly of desert sage, creosotebush, quailbush, and mesquite. The plant density varies from place to place because of local differences in moisture conditions but is usually between 5 and 15 percent.

Gila soils are ordinarily very deep and are calcareous throughout. The surface soil is pink to pale brown, soft, and massive. The subsoil is similar to the surface soil but is highly stratified. The substratum is similar in color but is loose and single grained. It contains small quantities of gypsum.

These soils are potentially good for irrigated cultivated crops, but in this Area they are mapped as part of a complex with Carrizo very fine sandy loam, 0 to 4 percent slopes, and consequently must be managed in the same way as the Carrizo soils. The Carrizo-Gila complex is described under the Carrizo series.

## Glendale Series

The Glendale series consists of well-drained, medium-textured soils that formed in stream-laid material, including limestone, shale, sandstone, and quartzite. These soils occur on flood plains and recent alluvial fans and are associated mainly with Bluepoint and Land soils. They are dissected by very shallow intermittent drainage channels. During torrential rains these soils receive thin deposits of alluvium washed from higher lying soils. The vegetation consists chiefly of iodinebush, desert sage, four-winged saltbush, quailbush, and mesquite. The composition and density of the vegetation vary considerably from place to place because of local differences in moisture conditions and salt content. The plant density ranges from 5 to 15 percent.

Glendale soils are very deep and are calcareous throughout. The surface soil is pink to very pale brown, is slightly hard, and has platy structure. The subsoil and substratum are similarly colored, slightly hard, and massive. These layers are stratified in places. The amount of soluble salts and the amount of gypsum vary.

For the most part, Glendale soils are not used for farming. Areas in which water is available are used for the production of alfalfa, pasture crops, corn, small grain, and miscellaneous crops, such as melons. Considerable urban development has taken place on Glendale soils east of Las Vegas and North Las Vegas, and between North Las Vegas and Nellis Air Force Base.

**Glendale silt loam, slightly saline (Gf).**—This soil occurs as large tracts in an area that extends along Las Vegas Wash from a point east of Las Vegas northeastward toward Nellis Air Force Base.

Representative profile:

Surface soil—

0 to 5 inches, pink silt loam; moderate, medium to coarse, platy structure; slightly hard when dry, friable when moist; pH 9.0.

Subsoil and substratum—

5 to 60 inches +, very similar to the surface soil, but stratified with either slightly finer textured or slightly coarser textured material; massive; pH 8.4.

The color ranges from pink to very pale brown. The texture of the strata in the subsoil and substratum ranges from fine sandy loam to light silty clay loam, and the strata vary in thickness and in amount of deposition. There is some mica in the profile and, in most places, some gypsum.

Natural drainage is good, runoff is slow, permeability is moderately slow, and infiltration is slow. Both the water-holding capacity and the natural fertility are high.

The erosion hazard is slight. The slight salinity limits the availability of water to plants and restricts the choice of crops.

Most of this soil is not used for farm crops. A small acreage is irrigated. Part of it is irrigated with water from deep wells and part with sewage effluent from the city of Las Vegas. Alfalfa, legume-grass crops for pasture, corn, small grain, tomatoes, and melons are well suited. Fertilizer, including nitrogen for nonlegumes and phosphorus for legumes, is advisable. The rate of infiltration increases from year to year if this soil is tilled and cropped and supplied with organic matter.

If well managed, this soil is not subject to erosion, but it is likely to blow if excessively dry. Fairly deep cuts can be made in leveling without decreasing overall productivity. Excess salts can be removed by an initial deep leaching, and the excess that accumulates during irrigation can be removed by occasional deep leachings. Adequate drainage is needed.

This soil is poor or unsuitable for most engineering purposes. The shrink-swell potential is low to high, depending upon the concentration of sodium sulfate salts. The sulfate hazard to concrete is severe. (Capability unit I-A)

**Glendale silt loam (Gb).**—This soil is similar to Glendale silt loam, slightly saline, except that it is free of excess salts in the surface layer. All of it is in natural vegetation, mostly desert sage. None of it is used for farm crops. If this soil were irrigated, it could be used and managed in much the same way as Glendale silt loam, slightly saline, except that initial leaching would not be needed. Periodic leaching would probably be advisable to remove excess salts that might accumulate during irrigation. Too much irrigation water would likely cause the water table to rise. (Capability unit I-A)

**Glendale silt loam, slightly wet, slightly saline (Gc).**—This soil is similar to Glendale silt loam, slightly saline, except that it is periodically saturated at a depth of 4 to 5 feet. It occurs near the trough of the valley along Las Vegas Wash, where the water table is fairly close to the surface. Mesquite is abundant.

This soil is not used for farming. It would need to be adequately drained before it could be used for crops. Drainage would lower the water table and provide an outlet for the removal of excess salts. If adequately drained, this soil could be used and managed in much the same way as Glendale silt loam, slightly saline. (Capability unit IIw-6)

**Glendale silt loam, moderately saline, overflowed (Ge).**—This soil is subject to overflow during flash floods in summer. Except for the hazard of overflow, the stronger concentrations of soluble salts in most places, and a somewhat greater degree of stratification in the subsoil and substratum, this soil is similar to Glendale silt loam, slightly saline. It can be used and managed in much the same way as that soil, except that it needs to be leached more deeply and protected against overflow.

This soil is not used for farm crops or for grazing. It would have to be leveled before it could be irrigated. Enlarging and centralizing the drainage channels would reduce the hazard of overflow. (Capability unit IIw-6)

**Glendale silt loam, slightly saline, hummocky (GhA).**—This soil is similar to Glendale silt loam, slightly saline, except that it is rough and hummocky and is crisscrossed

by many small gullies 1 to 1½ feet deep. The erosion hazard is moderate because of runoff from higher lying soils.

This soil is now in natural vegetation. None of it is used for farming. If leveled and protected from flooding, it could be used in much the same way as Glendale silt loam, slightly saline. (Capability unit I-A)

**Glendale silt loam, strongly saline (Gk).**—This soil contains strong salt concentrations that ordinarily increase slightly with depth. It is not used for farming. The natural vegetation is essentially undistributed. Except for needing extra amounts of water to leach the excess salts, this soil can be reclaimed, used, and managed in much the same way as Glendale silt loam, slightly saline. (Capability unit IIs-6)

**Glendale silty clay loam, gypsiferous substrata, slightly saline (Gm).**—Except for texture and a highly gypsiferous, slowly permeable buried soil in the substratum, this soil is similar to Glendale silt loam, slightly saline. For the most part, it can be used and managed in much the same way as that soil. The depth to the buried soil ranges from 30 to 48 inches.

This soil is in natural vegetation and is not used for farm crops. If it were irrigated, the amount of water applied at each irrigation would need to be carefully controlled. If too much is applied, a perched water table might form above the slowly permeable buried soil and cause waterlogging of the material above. The shrink-swell potential of the substratum is high. (Capability unit IIIw-36)

**Glendale silty clay loam, slightly wet, slightly saline (Gn).**—This soil is periodically saturated at a depth of 4 to 6 feet.

This soil is similar to Glendale silt loam, slightly saline. If adequately drained and leached, it can be used and managed in much the same way as that soil. Most of it is not used for farm crops. Only a small acreage is cultivated. (Capability unit IIw-6)

**Glendale silty clay loam, slightly wet, strongly saline (Go).**—Except for texture, periodic saturation at a depth of 4 to 5 feet, and a strong concentration of soluble salts, this soil is similar to Glendale silt loam, slightly saline. It occurs near the valley trough along Las Vegas Wash, where the water table is fairly near the surface.

This soil needs to be leached and drained before it can be used for farming. Most of it is not used for crops. A small acreage has been drained by a system of open ditches and is now cultivated. If leached, this soil can be used and managed in much the same way as Glendale silt loam, slightly saline. (Capability unit IIIw-6)

**Glendale silty clay loam, slightly saline (Gp).**—Except for texture, this soil is similar to Glendale silt loam, slightly saline, and it can be used in much the same way as that soil. Most of it is not used for crops. Of the small acreage that is irrigated and cultivated, part is irrigated with water from deep wells and part with sewage effluent from the city of Las Vegas. The shrink-swell potential of the surface soil, subsoil, and substratum is moderate to high, depending upon the sodium sulfate concentration. (Capability unit I-A)

**Glendale silty clay loam, strongly saline (Gr).**—Except for texture and degree of salinity, this soil is similar to Glendale silt loam, slightly saline. Most of it is in natural vegetation. Only a small acreage is irrigated. Except that larger amounts of water would be needed to leach out the excess salts, this soil can be reclaimed, used, and

managed in much the same way as Glendale silt loam, slightly saline. (Capability unit IIs-6)

**Glendale very fine sandy loam (Gs).**—This soil is similar to Glendale silt loam, slightly saline, but differs in texture and is free of excess salts. It is commonly stratified with very fine sandy loam and fine sandy loam. Infiltration is slightly more rapid than in the finer textured soil, and the water-holding capacity is slightly lower but is still high. Permeability is moderate. In a few places there is a gravelly or sandy substratum at a depth between 40 and 48 inches. Included in mapping are small areas that have a surface soil of fine sandy loam.

Part of the acreage is cultivated. For the most part, this soil can be used and managed in much the same way as Glendale silt loam, slightly saline, but it does not need to be leached, and the frequency of irrigation and the amount of water applied would be different because of the moderate permeability and the slightly lower water-holding capacity.

This soil is unsuitable as a source of sand or gravel. The sulfate hazard to concrete is severe. (Capability unit I-A)

**Glendale very fine sandy loam, clay substrata (Gt).**—This soil is similar to Glendale silt loam, slightly saline, but differs in texture, is nonsaline, and is underlain by compact clay that is high in lime and gypsum. The depth to this clay substratum is commonly about 36 inches but ranges from 28 to 48 inches within short distances.

The water-holding capacity and the inherent fertility are high. Permeability is slow in the clay substratum. Normally, the clay retards the downward movement of water and roots.

A small acreage is irrigated and is mostly in alfalfa and pasture crops. The rest of this soil is not farmed. Deep-rooted crops, such as alfalfa, are short lived because of the shallow root zone. The natural vegetation includes some creosotebush.

The clay substratum has moderate limitations as foundation-bearing material and is unsuitable as a source of sand and gravel. The shrink-swell potential is high. The sulfate hazard to concrete is severe. (Capability unit IIs-3)

**Glendale very fine sandy loam, moderately saline (Gu).**—Except for texture, a moderate amount of soluble salts, and moderate permeability, this soil is similar to Glendale silt loam, slightly saline. If leached of excess salts, it could be used in much the same way as that soil. It is not used for farm crops at the present time. The sulfate hazard to concrete is severe. (Capability unit IIs-6)

## Goodsprings Series

The Goodsprings series consists of well-drained, gravelly, moderately coarse textured soils that formed in alluvium derived from limestone, sandstone, and some quartzite. These soils are on alluvial fans. They are associated with Las Vegas and Tonopah soils. The vegetation is chiefly creosotebush and white bur-sage. About 98 percent of the acreage is barren.

Goodsprings soils are shallow, gravelly, and calcareous. The surface soil is pink or reddish yellow, is slightly hard, and has weak platy, prismatic, and subangular blocky structure. The subsoil is reddish yellow, hard or

very hard, massive, and weakly to strongly lime cemented. The substratum is light reddish brown, soft, and massive.

**Goodsprings gravelly loamy fine sand, 2 to 4 percent slopes (GvB).**—This soil occurs extensively along the west side of Las Vegas Valley and north of Nellis Air Force Base. Included in mapping are a few areas of indurated gravelly material.

Representative profile:

Surface soil—

0 to 1 inch, a moderately developed desert pavement underlain by pink gravelly loamy fine sand; weak, medium, platy structure; slightly hard when dry, very friable when moist; pH 8.4.

1 inch to 3 inches, reddish-yellow fine sandy loam; weak, coarse, prismatic structure; slightly hard when dry, friable when moist; pH 8.6.

3 to 8 inches, pink fine sandy loam; common, fine, distinct, white lime mottles; weak, coarse to medium, subangular blocky structure; slightly hard when dry, friable when moist; pH 8.8.

Subsoil—

8 to 16 inches, reddish-yellow very gravelly loam; massive; hard when dry, friable when moist; weakly lime cemented; pH 8.7.

16 to 30 inches, reddish-brown, massive, strongly lime-cemented, gravelly hardpan; pH 9.0.

Substratum—

30 to 60 inches +, light reddish-brown very gravelly loamy fine sand; massive; soft when dry, very friable when moist; a few, small, soft lime nodules; pH 8.6.

The depth to the lime-cemented subsoil ranges from 6 to 20 inches, and the degree of cementation ranges from weak to strong. The content of gravel is greatest on the higher and more sloping fans.

Natural drainage is good, and runoff is slow. Permeability is slow to very slow in the subsoil. The water-holding capacity and the fertility are very low. The root zone is shallow. The erosion hazard is moderate.

This soil is poorly suited to farm crops, and none of it is farmed. It is suitable for many engineering purposes and is used as a source of gravel and to a limited extent for homesites. The substratum has only slight limitations as foundation-bearing material and is a fair or good source of sand and gravel. The sulfate hazard to concrete is moderate. (Capability unit VIIIIs-3)

## Grapevine Series

The Grapevine series consists of moderately well drained, moderately coarse textured soils that formed in sediments derived from limestone, shale, sandstone, and highly gypsiferous material washed from Bracken and McCarran soils. These soils are on terraces. They are associated with Bracken and McCarran soils. The native vegetation consists chiefly of creosotebush, white bur-sage, and shadscale but includes some catclaw, which grows on small scattered sand dunes. Approximately 99 percent of the acreage is barren.

Grapevine soils are very deep, saline, and calcareous. The surface soil is pink, is soft, and has platy structure. The subsoil is reddish-yellow, is soft to slightly hard, and either has prismatic structure or is massive. The substratum is pink and contains white lime mottles that are massive, slightly hard to very hard, and weakly cemented.

For the most part, these soils are not used for farming. A small acreage is irrigated and is used for alfalfa or pasture crops in rotation with corn or small grain.

**Grapevine loamy fine sand, slightly saline, 2 to 4 percent slopes (GyB).**—This soil occurs as a small area in Las Vegas Valley.

Representative profile:

Surface soil—

0 to 2 inches, pink loamy fine sand; moderate, medium, platy structure; soft when dry, very friable when moist; pH 8.6.

Subsoil—

2 to 10 inches, reddish-yellow loamy fine sand; very weak, coarse, prismatic structure; soft when dry, very friable when moist; pH 8.4.

10 to 21 inches, reddish-yellow fine sandy loam; few, faint, pinkish-white lime mottles; massive; slightly hard when dry, friable when moist; pH 8.6.

Substratum—

21 to 45 inches, pink light clay loam (fine texture probably the result of finely divided lime); common, coarse, distinct, white lime mottles and soft lime nodules; massive; very hard when dry, firm when moist; pH 8.8.

45 to 60 inches +, pink fine sandy loam; few, medium, distinct, white lime mottles; massive; weakly cemented by lime and gypsum; slightly hard to hard when dry, very friable when moist; pH 8.8.

A weakly developed desert pavement covers most of this soil, but the pavement varies in degree of development, and in places there is none. The lime-cemented horizon is slightly hard to very hard. The depth to this horizon ranges from 30 to 48 inches. The amount of gypsum in the lime-cemented horizon and the underlying horizons varies.

Natural drainage is moderate, and runoff is slow. Permeability is moderately rapid in the subsoil but slow in the substratum. The water-holding capacity and the natural fertility are moderate. The erosion hazard is moderate.

Most of this soil is in natural vegetation. A small acreage is under irrigation and is mainly in alfalfa, pasture crops rotated with small grain, and corn for silage. If irrigated and properly managed, this soil would be well suited to crops. It would need applications of fertilizer and additions of organic matter, an initial deep leaching to remove excess salts, and then occasional leachings to control the accumulation of salts. Windbreaks would be advisable. The water table would most likely rise if too much water were applied during irrigation.

This soil has moderate limitations as foundation-bearing material and is unsuitable or poor as base or subbase material. The shrink-swell potential is low to high, depending upon the sodium sulfate concentration. The sulfate hazard to concrete is severe. (Capability unit IIIs-13L)

**Grapevine loam, moderately saline, 0 to 2 percent slopes (GwA).**—This soil is similar to Grapevine loamy fine sand, slightly saline, 2 to 4 percent slopes. It could be used in much the same way as that soil. It would need more leaching to remove the excess salts, but it would be less susceptible to erosion when irrigated and would need fewer irrigations than the more sloping phase. Permeability is moderate in the subsoil. The water-holding capacity and the fertility are high. The erosion hazard is only slight. (Capability unit IIIw-36)

## Ireteba Series

The Ireteba series consists of well-drained, stratified, medium-textured and moderately coarse textured soils

that formed in sediments derived from a mixture of igneous rocks, including rhyolite, latite, basalt, and tuff. These soils are in basins and on the lower margins of alluvial fans in Eldorado Valley. They are associated with Mead, Lavello, and Carrizo soils. The vegetation, chiefly creosotebush and desert sage, is sparse and stunted. Approximately 98 percent of the acreage is barren.

Ireteba soils are calcareous and very deep. The surface soil is pale brown, is soft to slightly hard, and has platy structure. The subsoil is light brown to very pale brown, is soft to very hard, and either has platy structure or is massive. The substratum is light brown to pinkish white, slightly hard to very hard, and massive.

These soils are not used for farm crops at the present time.

**Ireteba loam (lt).**—This soil is at the southern end of Eldorado Valley, adjacent to the playa.

Representative profile:

Surface soil—

0 to 12 inches, pale-brown loam; weak, medium to coarse, platy structure; soft to slightly hard when dry, friable when moist; pH 8.2.

Subsoil—

12 to 18 inches, light-brown fine sandy loam; weak, medium, platy structure; soft when dry, very friable when moist; pH 8.2.

18 to 34 inches, very pale brown loam or silt loam; massive; few, medium, faint, white lime veins; very hard when dry, friable when moist; pH 8.2.

Substratum—

34 to 54 inches, light-brown light fine sandy loam; massive; slightly hard when dry, very friable when moist; pH 8.2.

54 to 60 inches +, pinkish-white loam; massive; very hard when dry, firm when moist; pH 8.2.

There may be as many as three or four lime-cemented horizons within a 6-foot profile. Each of these ranges from 4 to 18 inches in thickness.

Natural drainage is good, and runoff is very slow. Permeability is generally moderate but in places is moderately slow to slow in the substratum. The water-holding capacity and the inherent fertility are high. The root zone is very deep. In places there are slight concentrations of soluble salts. The erosion hazard is slight, but erosion as well as deposition of material from higher lying soils is likely during severe thunderstorms.

If irrigation water were made available, crops could be grown. Nitrogen and phosphorus fertilizers and additional organic matter would be needed. Also, occasional leaching would be needed to control the accumulation of excess salts. In leveling, deep cuts would have to be avoided where the subsoil is weakly lime cemented.

This soil would have good potential for urban and industrial development if it were adequately drained and protected against flooding, runoff from higher lying soils, and subsequent deposition. It has severe to moderate limitations as foundation-bearing material and is poor as subgrade material. The shrink-swell potential is low to high, depending upon the sodium sulfate concentration. The sulfate hazard to concrete is severe. (Capability unit I-A)

**Ireteba fine sandy loam, slightly saline (lr).**—This soil occurs in Eldorado Valley, adjacent to the playa on the valley floor. It is similar to Ireteba loam but is slightly saline, slightly less fertile, and more readily permeable. If irrigated and leached of excess salts, it could be managed in much the same way as that soil. It has moderate to

severe limitations as foundation-bearing material. It is fair to good as subgrade material but is poor to unsuitable as subbase material. (Capability unit I-A)

### Jean Series

The Jean series consists of coarse-textured soils that formed in alluvium derived from limestone, sandstone, and quartzite. These soils are on alluvial fans in the southwestern part of Las Vegas Valley. They are associated with Goodsprings, Arden, McCullough, and Tonopah soils. The vegetation, chiefly creosotebush and white bur-sage, is sparse and stunted. Approximately 99 percent of the acreage is barren.

Jean soils are calcareous and are moderately deep over gravel. The surface soil is thin, pink, and soft, and has platy structure. The subsoil is light reddish brown, is soft, and has prismatic structure. The substratum is pink, soft, and massive.

**Jean loamy fine sand, moderately deep over gravel, 2 to 4 percent slopes (JeB).**—This soil occurs in the southwestern part of Las Vegas Valley.

Representative profile:

Surface soil—

0 to 1 inch, pink loamy fine sand; weak, medium, platy structure or massive; soft when dry, very friable when moist; pH 8.3.

Subsoil—

1 inch to 8 inches, light reddish-brown loamy fine sand; weak, very coarse, prismatic structure; soft when dry, very friable when moist; pH 8.4.

Substratum—

8 to 18 inches, pink loamy fine sand; massive; soft when dry, very friable when moist; pH 8.4.

18 to 25 inches, pink gravelly loamy sand; massive; soft when dry, very friable when moist; pH 8.6.

Unconformable material—

25 to 42 inches, stratified fine and medium gravel; single grained; loose when dry or moist; pH 8.4.

The surface soil has a thin overwash of gravelly loamy fine sand in some places. The color ranges from pink to light brown. The depth to the gravelly horizon ranges from approximately 16 to 30 inches.

Natural drainage is excessive. Runoff is very slow except during torrential rains. Permeability is rapid as far down as the gravel and very rapid below that depth. The water-holding capacity and the inherent fertility are low. The organic-matter content is very low. The erosion hazard is moderate; wind erosion is likely if the vegetation is removed.

If irrigation water were made available, this soil would be fairly well suited to crops. Because of its low water-holding capacity, it would need frequent, light irrigations. It would need to be leveled before it could be irrigated. Deep cuts, which would expose the gravel, would have to be avoided. Both organic and inorganic fertilizers would be advisable. Measures would be needed to control wind erosion and erosion caused by irrigation.

This soil has good potential for both urban and industrial development. It has slight to moderate limitations as foundation-bearing material. Generally, it is a good source of gravel. It is good as subgrade material, and the unconformable layer is good as subbase and fair as base material. There is generally no shrink-swell potential. The sulfate hazard to concrete is slight (Capability unit IVs-4L)

### Kiup Series

The Kiup series consists of well-drained, coarse-textured soils on alluvial fans. These soils overlie gypsiferous, very gravelly, medium-textured material derived from a mixture of rocks, including rhyolite, basalt, latite, granodiorite, quartzite, and limestone. They are associated with Carrizo and Mead soils. The vegetation consists chiefly of creosotebush, white bur-sage, cholla, dune primrose, and assorted annuals. The plant density ranges from 2 to 10 percent.

Kiup soils are calcareous and very deep. The surface soil is pale brown, is soft, and either has platy structure or is massive. The subsoil is similar in color and consistence but is massive. The substratum is very pale brown and white, very hard, and massive.

**Kiup loamy fine sand, 2 to 4 percent slopes (KfB).**—This soil is in Eldorado Valley.

Representative profile:

Surface soil—

0 to 10 inches, pale-brown loamy fine sand; platy structure in the uppermost 4 inches and massive below; soft when dry, very friable when moist; pH 8.3.

Subsoil—

10 to 33 inches, pale-brown loamy fine sand; massive; soft when dry, very friable when moist; pH 8.3.

Substratum—

33 to 61 inches, very pale brown very gravelly loam; massive; very hard when dry, firm to friable when moist; pH 8.7.

61 to 71 inches +, white crystalline gypsum; massive; very hard when dry, very firm when moist; pH 7.2.

In places the subsoil is stratified with slightly coarser textured or slightly finer textured material. The depth to the unconformable substratum ranges from 26 to 37 inches. Ordinarily, the substratum is weakly cemented, but in spots it is noncemented and the gravel has only coatings of gypsum and lime. The depth to the massive, crystalline gypsum ranges from 56 to 72 inches.

Natural drainage is good, and runoff is slow. Permeability is rapid in the subsoil and moderate to moderately slow in the substratum. The inherent fertility and the water-holding capacity are low. The hazard of erosion, particularly from wind, is moderate.

None of the acreage is cultivated or irrigated. The weakly cemented substratum would likely interfere with irrigation, but crops would do fairly well under irrigation, nevertheless. Deep-rooted crops would be best, because of the low water-holding capacity. Both organic and inorganic fertilizers would be needed. If cultivated, this soil would have to be protected against the wind. It should not be left without a cover for more than short periods.

This soil has good potential for urban development but only fair potential as industrial sites. The substratum has slight limitations as foundation-bearing material but is poor as a source of gravel. The sulfate hazard to concrete is moderate in the surface soil and subsoil but severe in the substratum. (Capability unit IVs-4L)

### Knob Hill Series

The Knob Hill series consists of somewhat excessively drained, moderately coarse textured soils on alluvial fans. These soils formed in sediments derived from a mixture of igneous and sedimentary rocks, including rhyolite,

granodiorite, latite, basalt, limestone, and quartzite. They are associated with Carrizo, Vinton, and Aztec soils. The vegetation consists chiefly of creosotebush and white bur-sage. Approximately 98 percent of the acreage is barren.

Knob Hill soils are very deep, are calcareous, and have a zone of lime accumulation. The surface soil is light brown, is soft, and has platy structure. The subsoil is light brown, soft, and massive. The substratum is pinkish gray to light brown, soft to slightly hard, and massive. The upper part of the substratum is weakly lime cemented.

These soils are not used for farm crops.

**Knob Hill loamy sand, 2 to 4 percent slopes (KnB).**—This soil occurs on an alluvial fan in the northeastern part of Eldorado Valley.

Representative profile:

Surface soil—

0 to 7 inches, light-brown loamy sand; weak, coarse, platy structure; soft when dry, very friable when moist; pH 8.3.

Subsoil—

7 to 23 inches, light-brown gravelly loamy sand to very gravelly loamy sand; massive; soft when dry, very friable when moist; pH 8.3.

Substratum—

23 to 37 inches, pinkish-gray gravelly fine sandy loam; few to common, medium, white lime nodules; massive; slightly hard when dry, friable when moist; pH 8.2.

37 to 60 inches +, light-brown loamy fine sand or loamy sand; massive; soft when dry, very friable when moist; pH 8.2.

The depth to the lime horizon ranges from 18 to 30 inches, and the thickness of that horizon from 12 to 30 inches. In consistence, the lime layer is slightly hard to hard.

Natural drainage is somewhat excessive. Runoff is slow. Permeability is rapid as far down as the lime horizon, moderately rapid through this horizon, and rapid below. The water-holding capacity and the fertility are low. The root zone is very deep. The hazard of wind and water erosion is moderate. The water erosion is caused by runoff from higher lying soils.

This soil is not farmed. If it were irrigated, it would be fairly well suited to crops. It would require frequent, light irrigations because of its low water-holding capacity. Applications of nitrogen and phosphorus and additions of organic matter would be advisable if crops were grown. This soil would be highly susceptible to water erosion if irrigated without proper care, and it would be susceptible to blowing if left even for a short time without a cover of vegetation.

This soil is poor to unsuitable as a source of gravel and poor to good as a source of sand. Its surface soil and substratum have moderate limitations as foundation-bearing material, and the subsoil has slight limitations. The sulfate hazard to concrete is low, and the shrink-swell potential is low. (Capability unit IVs-4L)

**Knob Hill loamy fine sand, deep over gravel, 0 to 2 percent slopes (KhA).**—This soil is underlain by loose gravel at a depth of about 38 inches. It could be used and managed in much the same way as Knob Hill loamy sand, 2 to 4 percent slopes, but would be easier to irrigate and less susceptible to erosion because it is less sloping. The substratum has only slight limitations as foundation-bearing material. It is good as a source of gravel and fair as a source of sand. (Capability unit IVs-4L)

## Lairep Series

The Lairep series consists of well-drained, coarse-textured soils that are moderately deep over stratified, fine textured and moderately fine textured material. These soils are on flood plains and on the toe slopes of alluvial fans adjacent to playas and are associated with Carrizo, Dry Lake, and Vinton soils. They developed mainly in material derived from rhyolite and other igneous flow rocks but partly in material derived from sedimentary rocks. At one time when drainage was poorer than it is now, the buried material was altered by ground water high in calcium carbonate. The vegetation consists of an almost pure stand of galleta and scatterings of creosotebush. About 85 to 90 percent of the acreage is barren.

Lairep soils are very deep and calcareous. The surface soil is very pale brown, soft, and massive. The subsoil is very pale brown and light yellowish brown, soft or slightly hard, and massive. The substratum is very pale brown, hard, and massive. In places these soils are slightly saline.

**Lairep loamy fine sand (La).**—This soil is in the north-central and south-central parts of Eldorado Valley, adjacent to the playa. The relief is somewhat hummocky.

Representative profile:

Surface soil—

0 to 6 inches, very pale brown loamy fine sand; massive; soft when dry, very friable when moist; pH 8.4.

Subsoil—

6 to 25 inches, very pale brown loamy fine sand; massive; soft when dry, very friable when moist; pH 8.4.

25 to 30 inches, light yellowish-brown fine sandy loam; massive; slightly hard when dry, very friable when moist; pH 8.4.

Substratum—

30 to 60 inches +, very pale brown, finely stratified clay and silty clay loam; massive; hard when dry, friable when moist; common, coarse (up to 2 inches in length), extremely hard lime concretions; pH 9.0.

Minor stratification with both coarser textured and slightly finer textured material may occur in the subsoil. The depth to the substratum ranges from 30 to 40 inches. The lime concretions range from common to many. In places there are soft nodules instead of concretions.

Natural drainage is good. Runoff is slow. Permeability is rapid in the surface soil and subsoil and slow in the substratum. The water-holding capacity and the inherent fertility are moderate. The erosion hazard is moderate.

If irrigated, this soil would be suitable for crops. It would need to be leveled before it could be irrigated. Also, it would need to be leached and drained to remove excess salts. Irrigation, unless the water is applied carefully, may result in a perched water table above the slowly permeable substratum. Applying both organic and inorganic fertilizers would improve tilth, insure vigorous plant growth, and help to control wind erosion.

This soil has fair to poor potential for homesites and for industrial development. The surface soil and subsoil have severe limitations as foundation-bearing material. They are good as subgrade material, fair as subbase material, and poor as base material. The shrink-swell potential is low. The sulfate hazard to concrete is severe. The substratum has severe limitations as foundation-bearing material. It is poor as subgrade material and is unsuitable as subbase and base material. The shrink-swell potential is high, and the sulfate hazard to concrete is severe. (Capability unit IIIs-3L)

## Land Series

The Land series consists of moderately well drained, medium-textured and moderately fine textured soils that formed in alluvium derived from shale, limestone, sandstone, crystalline quartz-bearing rocks, and old lake-laid deposits. These soils are on recent alluvial flood plains. They are associated mainly with Glendale, Spring, Bluepoint, Las Vegas, Bracken, and McCarran soils. The landscape is one of smooth to hummocky relief and very shallow intermittent drainageways. The vegetation consists chiefly of iodinebush, desert sage, quailbush, and mesquite. The plant composition varies, depending on the depth to the water table and the salt content of the soils. Approximately 80 to 95 percent of the acreage is barren.

Land soils are very deep, strongly calcareous, and high in disseminated and fine crystalline salt and gypsum. The surface soil is pink or pale brown, is slightly hard, and has platy structure. The subsoil is similar to the surface soil but either is massive or has granular structure and contains much crystalline salt and gypsum. The substratum is similar to the subsoil but in places lacks discernible quantities of salt and gypsum.

Most of these soils are under natural vegetation. Small acreages are irrigated and cultivated where water has been made available either by pumping or by natural flow from springs. Alfalfa, grass-legume mixtures, small grain, and other salt-tolerant crops do well under proper management. Suburban development has taken place east of Las Vegas, in Paradise Valley, and in Vegas Heights.

**Land silt loam, slightly saline (Lf).**—This soil is extensive along the floor of Las Vegas Valley in an area that extends from east of Las Vegas northward towards Nellis Air Force Base.

Representative profile:

Surface soil—

0 to 4 inches, pale-brown silt loam; moderate, medium, platy structure; slightly hard when dry, friable when moist; pH 8.4.

Subsoil—

4 to 12 inches, pale-brown silt loam; moderate, medium, platy structure; hard when dry, friable when moist; pH 8.4.

12 to 22 inches, light-brown silt loam; strong, very fine, granular structure; soft when dry, friable when moist; much finely disseminated gypsum; pH 8.0.

Substratum—

22 to 40 inches, pale-brown clay loam; moderate, very fine, granular structure; slightly hard when dry, friable when moist; pH 8.2.

40 to 60 inches +, pale-brown silty clay loam; massive; slightly hard when dry, friable when moist; pH 8.4.

This soil is predominantly pink to pale brown but in places is slightly redder or browner. The horizons in which appreciable quantities of gypsum have accumulated vary in thickness and occur at variable depths. The other horizons also vary somewhat in sequence, texture, and thickness.

Natural drainage is moderate, and runoff is slow. Permeability is moderately slow in the subsoil and slow in the substratum. The water-holding capacity and the inherent fertility are high. The root zone is very deep. The erosion hazard is slight.

This soil is neither cultivated nor irrigated. Most of it is under natural vegetation. It would need to be leveled before it could be irrigated. The cuts made in leveling could be of considerable depth. Deep leaching would be

needed to remove the excess salts, and because of the slowly permeable substratum, drainage would most likely be needed to prevent waterlogging. If leached of excess salts and adequately drained, this soil would be well suited to salt-tolerant crops. Unless leached, it would be suited only to crops that are highly tolerant of salts. Fertilizer and organic matter would be needed. The rate of infiltration would increase steadily if this soil were tilled and cropped and residues were mixed into the surface layer. Ordinarily, this soil is not subject to erosion but it is likely to blow if it becomes excessively dry.

This soil has poor potential for urban development and poor to fair potential for heavy industrial uses. It has severe limitations as foundation-bearing material. It is fair as subgrade material and unsuitable as subbase and base material. The shrink-swell potential is moderate to high, depending upon the sodium sulfate concentration. The sulfate hazard to concrete is severe. (Capability unit IIIw-36)

**Land silt loam, slightly wet, strongly saline (Lb).**—This soil has a water table that fluctuates between the depths of 36 and 60 inches. All of it is under natural vegetation. To make it suitable for any but the most salt-tolerant crops would require drainage and prolonged leaching to remove the excess salts. After leaching and drainage, this soil could be used in much the same way as Land silt loam, slightly saline. Open ditches would probably provide adequate drainage, but tile, though more costly to install, would be more efficient, would require less maintenance, and would remove no land from cultivation. (Capability unit IVw-36)

**Land silt loam, slightly wet, strongly saline, hummocky (LcA).**—This soil has a water table that fluctuates between the depths of 36 and 60 inches. All of it is under natural vegetation. To make it suitable for any but the most salt-tolerant crops would require drainage and prolonged leaching to remove excess salts. If drained and leached, this soil could be used in much the same way as Land silt loam, slightly saline. It would need to be leveled before it could be irrigated. Open ditches would probably provide adequate drainage, but tile, though more costly to install, would be more efficient, would require less maintenance, and would remove no land from cultivation. (Capability unit IVw-36)

**Land silt loam, wet, strongly saline (Ld).**—This soil occurs mainly in Paradise Valley, where faulting has allowed artesian water to seep upward and form a water table that fluctuates between the depths of 16 and 36 inches during most of the year. This soil is unsuitable for farm crops. No attempt should be made to cultivate it or to alter the vegetation. It is best used as native pasture. The forage is adequate for grazing but could be improved by water spreading. (Capability unit VIw-36)

**Land silty clay loam, slightly wet, strongly saline (Lg).**—This soil is periodically saturated at a depth of 3 to 4 feet. It is neither cultivated nor irrigated. To make it suitable for crops would require drainage and prolonged leaching to remove excess salts. Unless leached, it would be suited only to the most salt-tolerant crops. If drained and leached, it could be used in much the same way as Land silt loam, slightly saline. It has a somewhat slower water intake rate than the silt loam, because of its moderately fine texture. (Capability unit IVw-36)

**Land silty clay loam, wet, strongly saline (Lh).**—This soil occurs mainly in Las Vegas Wash. Excess water from the sewage disposal plant has seeped into the soil and raised the water table, and the soil is saturated at a depth of 2 to 3 feet. All of this soil is in natural vegetation. It is unsuitable for cultivation and is best used as native pasture. No attempt should be made to cultivate it or to alter the native vegetation. The forage is adequate for grazing but could be improved by water spreading. (Capability unit VIw-36)

**Land silty clay loam, slightly saline (Lk).**—This soil is slightly more difficult to manage than Land silt loam, slightly saline, because of its finer texture. It takes in water more slowly than the silt loam, and consequently leaching is slower. (Capability unit IIIw-36)

**Land silty clay loam, strongly saline (Lm).**—None of this soil is cultivated or irrigated. To make it suitable for crops would require intensive leaching and artificial drainage. Irrigation without drainage would be likely to cause waterlogging and further accumulation of salts. If leached and drained, this soil could be used and managed in much the same way as Land silt loam, slightly saline. In its natural condition, it is suited only to the most salt-tolerant crops. (Capability unit IVw-36)

**Land very fine sandy loam, wet, strongly saline (Ln).**—This soil occurs at the lower extremities of Las Vegas Wash, where a geologic barrier forces ground water upward into the soil profile. It is saturated below a depth of 12 inches during most of the year. In winter the water table is likely to rise to the surface, and the soil becomes swampy. It is unlikely that this soil could be leached of excess salts unless it is drained. The native vegetation should be maintained. Preferably, it should be used as food and cover for wildlife, but it would provide some forage for livestock. (Capability unit VIIw-6)

## Las Vegas Series

The Las Vegas series consists of well-drained, medium-textured soils that formed in alluvium derived mainly from limestone and partly from sandstone, shale, and quartzite. These soils are on alluvial fans and upland terraces and are dissected by numerous shallow washes. They are associated with Cave and Goodsprings soils. Erosion is slight to moderate. The vegetation consists chiefly of creosotebush and white bur-sage. Approximately 99 percent of the acreage is barren.

Las Vegas soils are calcareous and are shallow or very shallow over an indurated caliche hardpan. The surface soil is light gray, is soft, and has platy structure. The subsoil is white, is very hard, and either has platy structure or is massive. The substratum is a white, indurated caliche hardpan.

Generally, these soils are not used for farming. They are not suited to crops. A few small acreages are irrigated and used as pasture. A large area west and north-west of the city of Las Vegas has been used for homesites and for suburban development.

**Las Vegas loam, shallow, 0 to 2 percent slopes (LpA).**—This soil is in the northern part of Las Vegas Valley. Caliche fragments ranging from ½ inch to 3 inches in diameter are scattered on the surface.

### Representative profile:

#### Surface soil—

0 to 2 inches, light-gray loam; weak, medium, platy structure; soft when dry, friable when moist; pH 8.3.

#### Subsoil—

2 to 23 inches, white, gritty light clay loam; strong, medium, platy structure in upper 8 inches and massive below; very hard when dry, firm when moist; pH 8.6.

#### Substratum—

23 to 60 inches +, white, indurated calcium carbonate hardpan; massive; pH 8.7.

A weak to strong desert pavement is common. Colors range from pink to pale brown. The depth to the hardpan ranges from 10 to 23 inches. Some areas are slightly undulating.

Natural drainage is good. Runoff is slow. Permeability is moderate as far down as the pan and very slow through it. The fertility and the water-holding capacity are very low to low, depending on the depth to the hardpan. The root zone is shallow. The erosion hazard is moderate.

Except for a few small pasture acreages developed near homesites, this soil is not used for farming. It is not suitable for cultivated crops. This shallow soil needs to be protected against erosion; even a small loss of soil material would be serious.

This soil has good potential for homesites and for industrial development. The hardpan, however, interferes with construction of all underground facilities. Also, landscaping is a problem because of shallowness, very low water-holding capacity, and low inherent fertility.

The surface soil and subsoil have severe limitations as foundation-bearing material. These layers are fair as subgrade material but are not suitable as subbase and base material. The shrink-swell potential is moderate. The sulfate hazard to concrete is slight to moderate. (Capability unit VIIIs-8)

**Las Vegas loam, shallow, slightly saline, gently undulating (LoA).**—This soil is similar to Las Vegas loam, shallow, 0 to 2 percent slopes, and can be used and managed in much the same way as that soil. The root zone is 12 to 18 inches deep. Included in mapping is a small area near Tule Springs where the root zone is about 26 inches deep. In the surface layer, the sulfate hazard to concrete is moderate. (Capability unit VIIIs-8)

**Las Vegas loam, very shallow, 0 to 4 percent slopes, eroded (LsB2).**—This soil receives runoff from higher lying soils. It contains many shallow gullies and shows much evidence of sheet erosion. The root zone is only 2 to 10 inches deep. The water-holding capacity and the inherent fertility are very low.

This soil can be used in much the same way as Las Vegas loam, shallow, 0 to 2 percent slopes, but measures are needed to reduce the erosion hazard. Dikes would be advisable. Shallow ditches cut to the hardpan could be used to carry water to storm drains. The ditches should be of small capacity because large quantities of water would likely be difficult to handle. Vertical drains could be used to direct excess surface water into the material below the hardpan. (Capability unit VIIIs-8)

**Las Vegas loam, very shallow, slightly saline, gently undulating (LtA).**—This soil is much like Las Vegas loam, shallow, 0 to 2 percent slopes. The depth of its root zone is generally about 8 inches but ranges from 2 to 14 inches. The water-holding capacity and the inherent

fertility are very low. In the surface layer, the sulfate hazard to concrete is moderate. (Capability unit VIIIIs-8)

### Laveldo Series

The Laveldo series consists of well drained and moderately well drained, moderately fine textured soils that formed in alluvium derived from many kinds of rocks. These soils are on the lake bars or the embankments of Dry Lake in Eldorado Valley. They are associated with Mead and Ireteba soils. Calcium carbonate accumulated in the profile at some time in the past when these soils were more poorly drained than they are now. The vegetation consists of a very sparse stand of stunted creosotebush and white bur-sage. More than 99 percent of the acreage is barren.

Laveldo soils are very deep, calcareous, and high in soluble salts. The surface is covered with a weak erosion pavement that consists of hard lime fragments and nodules. The surface soil is pink to light reddish brown, is slightly hard, and has prismatic or platy structure. The subsoil is pink to light reddish brown, is slightly hard to soft, and either has prismatic structure or is massive. The substratum is pink to very pale brown, slightly hard, and massive.

**Laveldo clay, eroded (Lv2).**—This soil is in the central part of Eldorado Valley, adjacent to the playa. The surface is covered with a weak erosion pavement consisting of angular and subangular lime fragments that range up to about  $\frac{3}{8}$  inch in diameter and  $\frac{1}{2}$  to  $\frac{3}{4}$  inch in length.

Representative profile:

Surface soil—

0 to 2 inches, light reddish-brown clay; moderate, medium, prismatic structure; slightly hard when dry, very friable when moist; pH 9.0.

Subsoil—

2 to 4 inches, light reddish-brown clay; weak, medium, prismatic structure; slightly hard when dry, very friable when moist; pH 8.8.

4 to 8 inches, light reddish-brown light clay loam; common, fine and medium, distinct, white lime nodules; massive; soft when dry, very friable when moist; pH 8.0.

Substratum—

8 to 60 inches, very pale brown light clay loam; massive; slightly hard when dry, friable when moist; many hard to extremely hard, angular to subangular, white lime nodules and a few angular fragments of crystalline gypsum; pH 8.0.

In some places lime nodules are evenly distributed through the substratum. In other places the substratum consists of a few to several layers, and the content of nodules varies between 15 and 50 percent from layer to layer. A few nodules are as much as 2 inches in diameter.

Natural drainage is good or moderately good. Runoff and permeability are slow. The water-holding capacity and the inherent fertility are moderate. Erosion is moderate because this soil is susceptible to overflow caused by runoff from higher lying soils.

This soil is not suited to cultivation and irrigation because of its relief, its position adjacent to the playa, and its slow permeability. It has moderate to severe limitations as foundation-bearing material, depending on density. It is poor as subgrade material and is unsuitable as subbase and base material. The shrink-swell potential is moderate to high. The sulfate hazard to concrete is severe. (Capability unit VIIIw-36)

### McCarran Series

The McCarran series consists of moderately well drained, moderately coarse textured soils that formed in gypsiferous and calcareous lake sediments of the Muddy Creek formation. The parent material has undergone little change, but gypsum and salts have been leached from the surface soil and subsequently have been concentrated in the subsoil. These soils are on terraces, mainly in the south-central part of Las Vegas Valley. They are associated with Bracken and Spring soils. The vegetation consists chiefly of creosotebush, white bur-sage, shadscale, Mormon-tea, sandpaper plant, catclaw, iodinebush, and rabbitbrush. Approximately 98 percent of the acreage is barren.

McCarran soils are calcareous and contain a large amount of disseminated and crystalline gypsum. The surface soil is pink, is soft, and either has platy structure or is massive. The subsoil is soft to slightly hard, is massive, and contains much secondary gypsum. The substratum is a pink to pinkish-white mass of gypsum crystals; it is massive and is soft to very hard.

These soils are not used for farming. They are unsuited to most crops.

**McCarran fine sandy loam, hummocky (MhA).**—This soil occurs extensively south of the city of Las Vegas and as small areas elsewhere in Las Vegas Valley. Included in mapping are a few areas where the soils are slightly saline.

Representative profile:

Surface soil—

0 to  $\frac{1}{2}$  inch, pink fine sandy loam; weak, medium, platy structure; soft when dry, very friable when moist; pH 8.4.

$\frac{1}{2}$  inch to 8 inches, pink loamy fine sand; massive; soft when dry, very friable when moist; pH 8.4.

Subsoil—

8 to 15 inches, pink fine sandy loam; massive; soft to slightly hard when dry, friable when moist; common fine gypsum crystals; pH 8.4.

Substratum—

15 to 28 inches, pink fine sandy loam; massive; soft to slightly hard when dry, friable when moist; moderately high in gypsum; pH 8.2.

28 to 48 inches +, pinkish-white mass of gypsum crystals; massive; hard to very hard when dry, firm to very firm when moist; pH 7.0.

Gypsum occurs in all horizons but varies in amount and distribution. Normally, the depth to the substratum ranges from 10 to 24 inches, but in places it is less than 6 inches. In some areas there are outcrops of crusty, crystalline gypsum.

Natural drainage is moderately good. Runoff is very slow. Permeability is moderate as far down as the substratum and then slow through this layer. The water-holding capacity and the inherent fertility are moderate. The erosion hazard is moderate. The surface has been reworked by wind and is hummocky.

This soil is not used for farm crops. Its potential for production under cultivation and irrigation is very poor because of the large quantities of gypsum. It has poor potential for urban uses and fair potential for industrial uses, but the sulfate hazard to concrete is severe and structures must be designed accordingly. This soil has severe limitations as foundation-bearing material and is unsuitable as subgrade material. (Capability unit VIIIIs-3)

**McCarran clay loam, slightly saline, 0 to 4 percent slopes (McB).**—This soil can be used and managed in much the

same way as McCarran fine sandy loam, hummocky, except that the surface soil has a high shrink-swell potential. This limitation must be considered in building design. Runoff is slow, and the erosion hazard is slight. (Capability unit VIII<sub>s</sub>-3)

**McCarran clay loam, seeped, slightly saline, 0 to 8 percent slopes (M<sub>d</sub>C).**—This soil occurs on terraces and terrace breaks. It has a water table that is influenced by nearby springs and seeps and that fluctuates between the depths of 4 and 6 feet. The shrink-swell potential is high. Otherwise, this soil can be used and managed in much the same way as McCarran fine sandy loam, hummocky. Runoff is slow, and the erosion hazard is slight. (Capability unit VIII<sub>s</sub>-3)

**McCarran fine sandy loam, 0 to 4 percent slopes (M<sub>f</sub>B).**—This soil can be used and managed in much the same way as McCarran fine sandy loam, hummocky. Runoff is slow. (Capability unit VIII<sub>s</sub>-3)

### McCullough Series

The McCullough series consists of well-drained, moderately coarse textured soils that developed in alluvium derived from a mixture of sedimentary and metamorphic rocks, including sandstone, limestone, shale, and quartzite. These soils are on eroded plains, terraces, and fans. The vegetation consists of white bur-sage, creosotebush, and big galleta. About 98 percent of the acreage is barren.

McCullough soils are very deep and calcareous. The surface soil is pink, is slightly hard, and has platy structure. The subsoil is light reddish brown, is soft, and has prismatic structure. The substratum is pink, very pale brown, or reddish yellow, is hard to soft, and is massive.

These soils are not used for farming.

Some areas of McCullough soils are mapped as part of a complex with Arden soils.

**McCullough fine sandy loam, 0 to 2 percent slopes (M<sub>k</sub>A).**—This soil occurs on valley plains and alluvial fans in the southwestern part of Las Vegas Valley. Included in mapping are minor areas of the shallow Arden soils.

Representative profile:

Surface soil—

0 to 1½ inches, pink fine sandy loam; moderate, medium, platy structure; slightly hard when dry, friable when moist; no roots; pH 8.4.

Subsoil—

1½ to 8 inches, light reddish-brown fine sandy loam; very weak, coarse, prismatic structure breaking to very weak, coarse, platy; soft when dry, very friable when moist; few roots; pH 8.6.

Substratum—

8 to 17 inches, very pale brown loam to very fine sandy loam; weak, coarse, platy structure to massive; slightly hard when dry, very friable when moist; few roots; pH 8.8.

17 to 26 inches, pink loam; few, very fine, reddish-yellow iron mottles; very weak, coarse, platy structure; hard when dry, friable when moist; pH 8.8.

26 to 40 inches +, reddish-yellow loamy fine sand; massive; slightly hard to soft when dry, very friable when moist; few roots.

The solum ranges from 5 to 12 inches in thickness. Soft lime concretions may occur below the subsoil but are uncommon. Gravel or sand is at a depth of more than 36 inches.

Natural drainage is good. Runoff is very slow, and permeability is moderate. The water-holding capacity and the inherent fertility are moderate. The erosion hazard is moderate because of runoff from higher lying soils.

This soil is not used for cultivated crops. If irrigation water should become available, the soil could be managed in much the same way as Arden-McCullough fine sandy loams, 4 to 8 percent slopes, except that it would be best suited to border irrigation and the cuts made in leveling could be as much as 2 feet deep. (Capability unit II<sub>s</sub>-4)

### Mead Series

The Mead series consists of imperfectly drained, fine-textured soils derived from a mixture of rocks, including limestone, quartzite, basalt, latite, and shale. These soils are on the lower slopes of alluvial fans at the margin of the playa in Eldorado Valley. They are associated with Ireteba and Carrizo soils. The vegetation consists of a very sparse stand of desert sage and iodinebush. Approximately 99 percent of the acreage is barren.

Mead soils are calcareous and strongly saline. The surface soil is pale brown, hard, and massive. The subsoil is reddish brown to light brown, is hard, and has prismatic or subangular blocky structure. The substratum is pink or light reddish brown, is extremely hard to very hard, and either has subangular blocky structure or is massive.

**Mead clay (M<sub>y</sub>).**—This soil occurs as a small area adjacent to the playa in Eldorado Valley.

Representative profile:

Surface soil—

0 to 2 inches, pale-brown clay, massive; hard when dry, friable when moist; pH 9.2.

Subsoil—

2 to 6 inches, reddish-brown gravelly clay loam or clay; very weak, coarse, prismatic structure; hard when dry, friable when moist; pH 8.2.

6 to 14 inches, light-brown silty clay; moderate, fine, subangular blocky structure; hard when dry, firm when moist; pH 8.8.

Substratum—

14 to 27 inches, light reddish-brown clay; strong, fine, subangular blocky structure; extremely hard when dry, very firm when moist; pH 8.7.

27 to 31 inches, pink clay loam; massive; hard when dry, friable when moist; pH 8.6.

31 to 60 inches, light reddish-brown clay; massive; very hard when dry, very firm when moist; pH 8.6.

In places the surface is covered with a very weak desert pavement of coarse-textured material.

Natural drainage is imperfect. Runoff is very slow. Permeability is very slow in the subsoil and substratum. The water-holding capacity is moderate, and the fertility is low. The root zone is shallow or very shallow. The erosion hazard is moderate.

This soil is not suitable for cultivation and irrigation. It has moderate to severe limitations as foundation-bearing material and is poor as subgrade material. The shrink-swell potential is high. The sulfate hazard to concrete is severe. (Capability unit VIII<sub>w</sub>-36)

### Paradise Series

The Paradise series consists of imperfectly drained silty soils on flood plains. These soils formed in alluvium

derived from limestone, quartzite, and sandstone. Their substratum contains either a marly horizon or a discontinuous strongly lime-cemented horizon that formed as a result of the presence of lime-enriched ground water. These soils are associated with Land soils. The vegetation consists of saltgrass, wiregrass, alkali sacaton, and a few patches of mesquite. The plant density is approximately 30 to 50 percent.

Paradise soils are very deep, high in organic-matter content, slightly saline, and calcareous. The surface soil is dark gray or gray, is slightly hard to hard, and either has granular structure or is massive. The subsoil is light gray, slightly hard, and massive. The substratum is white, very hard, and massive, and it contains many lime concretions.

Some areas of these soils have been used to grow alfalfa, pasture crops, corn, and small grain. Currently, none of the acreage is used for crops.

**Paradise silt loam, drained, slightly saline (Pa).**—This soil occurs as a small area in the central part of Las Vegas Valley. It adjoins and extends into the city of Las Vegas.

Representative profile:

Surface soil—

0 to 2 inches, dark-gray silt loam; weak, medium to fine, granular structure; slightly hard when dry, friable when moist; pH 8.4.

2 to 7 inches, gray loam; massive; hard when dry, friable when moist; pH 8.4.

Subsoil—

7 to 14 inches, light-gray silt loam; massive; slightly hard when dry, friable when moist; pH 8.2.

14 to 31 inches, light-gray silt loam; massive; slightly hard when dry, friable when moist; pH 8.2.

Substratum—

31 to 52 inches +, white, weakly lime cemented silt loam; many extremely firm lime nodules; massive; very hard when dry, firm when moist; pH 8.4.

The thickness of the surface soil ranges from 2 to 12 inches, depending on the amount of leveling. The depth to the lime-cemented horizon ranges from 24 to more than 60 inches. This horizon is several feet thick in spots and is harder and more cemented with increasing depth.

The natural drainage was poor, but it has been improved by means of drainage ditches and by pumping ground water. Runoff is very slow. Permeability is medium as far down as the hardpan and slow through the pan. The inherent fertility and the water-holding capacity are high. The erosion hazard is slight.

For the most part, this soil is under natural vegetation. If irrigated and properly managed, it would be well suited to crops. It would need fertilizer containing nitrogen and phosphorus, even though its surface soil is high in organic matter. Also, it would need deep leaching and drainage to remove the excess salts. The slow permeability of the hardpan and the pressure of artesian water are likely to interfere with the installation of an artificial drainage system. Irrigation, unless carefully controlled, is likely to result in a perched water table above the hardpan, waterlogging of the soil above the hardpan, and accumulation of excess salts in the surface layer.

The surface soil and subsoil have severe to very severe limitations as foundation-bearing material; the substratum has moderate limitations. The shrink-swell potential

is moderate to high, depending on the sodium sulfate concentration. (Capability unit IIw-6)

## Pittman Series

The Pittman series consists of well-drained, very gravelly, coarse-textured soils derived from basalt, rhyolite, and limestone. These soils are on convex alluvial fans that are dissected by many shallow drainageways. They are associated with Eastland, Bracken, and Las Vegas soils. The vegetation consists chiefly of sparse stands of creosotebush and white bur-sage. Approximately 99 percent of the acreage is barren.

Pittman soils are very gravelly, stony, and calcareous. The surface soil is pinkish gray, is soft, and has either platy or granular structure. The subsoil is pinkish gray, soft to very hard, weakly to strongly lime cemented, and massive. The substratum is pinkish gray, loose, and single grained.

These soils are not cultivated, and they afford practically no grazing. They are not suited to cultivated crops. They are being used to some extent for urban development.

**Pittman stony loamy sand, 0 to 15 percent slopes (PnC).**—This soil occurs extensively in the southeastern part of Las Vegas Valley; it extends from Henderson several miles west along the south edge of the valley.

Representative profile:

Surface soil—

0 to 1 inch, pinkish-gray stony loamy sand; very weak, medium, platy structure; soft when dry, very friable when moist; pH 8.4.

1 inch to 6 inches, pinkish-gray very gravelly loamy sand; very weak, medium to fine, granular structure; soft when dry, very friable when moist; pH 8.4.

Subsoil—

6 to 26 inches, pinkish-gray very gravelly loamy sand; massive; soft when dry, very friable when moist; pH 8.6.

26 to 46 inches, pinkish-gray, weakly lime cemented, stony, very gravelly sandy loam; massive; very hard when dry, very firm when moist; pH 8.6.

Substratum—

46 to 60 inches +, pinkish-gray very gravelly sand; single grained; loose when dry or moist; pH 8.4.

A weak to strong desert pavement covers the surface. It consists of rounded to subrounded stones and cobblestones, some of which have a desert varnish. There is considerable range in the depth to the subsoil and in the degree of cementation and the thickness of this layer. The subsoil is weakly to strongly cemented and is 6 to 30 inches thick. The depth to the subsoil ranges from 18 to 26 inches. Some profiles contain several cemented horizons. Stones and cobblestones occur throughout the soil (fig. 4). All of the pebbles, stones, and cobblestones are lime coated.

Natural drainage is good. Runoff is slow to medium, depending on the slope. Permeability is moderate to slow in the limy subsoil but is very rapid both above and below the subsoil. The water-holding capacity and the inherent fertility are low. The erosion hazard is moderate.

This soil is not suited to farm crops, because of its coarse texture, stoniness, and slope. It has slight limitations as foundation-bearing material. It is good as a source of gravel and, in fact, is used extensively as a source of gravel for construction purposes. It is fair to



Figure 4.—Profile of Pittman stony loamy sand.

good as a source of sand. There is a low shrink-well potential or none, and there is a slight sulfate hazard to concrete. (Capability unit VIII<sub>s</sub>-7)

**Pittman stony loam, 0 to 2 percent slopes (PmA).**—This soil can be used and managed in much the same way as Pittman stony loamy sand, 0 to 15 percent slopes, except that the surface soil has severe limitations as foundation-bearing material and is unsuitable as a source of sand and gravel. Runoff is slow. (Capability unit VIII<sub>s</sub>-7)

### Riverwash

**Riverwash (Rw)** consists of excessively drained, undifferentiated, recently deposited stony, cobbly, and gravelly sandy material derived from a mixture of sedimentary, igneous, and metamorphic rocks. The material is deep, stratified, and calcareous. This land type occurs as small scattered areas on flood plains in Las Vegas Valley. It is subject to frequent deposition of fresh sediments. The vegetation consists chiefly of creosotebush, white bur-sage, and cactus. More than 99 percent of the acreage is barren.

Runoff is very slow, and permeability is very rapid. The water-holding capacity and the inherent fertility are low. The erosion hazard is moderate to severe because of runoff from higher lying soils.

This land type has no value for farming. It is a good to poor source of sand and a good source of gravel. It is good as subgrade and subbase material and fair as base material. There is a low shrink-swell potential or none, and there is no sulfate hazard to concrete. (Capability unit VIII<sub>w</sub>-F)

### Searchlight Series

The Searchlight series consists of well-drained, gravelly, coarse-textured soils over buried moderately fine textured soils that occur on alluvial fans. The parent material for Searchlight soils was derived from a variety of rocks, including limestone, quartzite, andesite, and latite. These soils are associated with Carrizo soils. They support a sparse stand of creosotebush and white bur-sage. About 98 percent of the acreage is barren.

Searchlight soils are calcareous and very deep. The surface soil is pinkish gray and light brown, loose and

soft, and single grained or massive. The subsoil is light brown and reddish brown, is very hard to slightly hard, and either is massive or has subangular blocky structure. The substratum is light brown, slightly hard, and massive.

In this Area, Searchlight soils are mapped as part of a complex with Carrizo soils.

**Searchlight-Carrizo gravelly loamy sands, 2 to 4 percent slopes (ScB).**—This complex is about 75 percent Searchlight gravelly loamy sand and about 25 percent Carrizo gravelly loamy sand. It occurs on broad alluvial fans at the southern end of Eldorado Valley. These soils are covered with a strongly developed erosion pavement that has no visible desert varnish. Carrizo soils occur as scattered small pockets, as slightly raised mounds, and as narrow, elongated areas along drainage channels on the alluvial fan.

Following is a representative profile of Searchlight gravelly loamy sand. A profile of Carrizo gravelly loamy sand is described under the Carrizo series.

#### Surface soil—

0 to 3 inches, pinkish-gray very gravelly sand; single grained; loose when dry or moist; pH 8.2.

3 to 9 inches, light-brown gravelly loamy sand; massive; soft when dry, very friable when moist; pH 8.4.

#### Subsoil—

9 to 12 inches, reddish-brown gravelly loamy sand; massive; slightly hard when dry, very friable when moist; pH 8.4.

12 to 21 inches, reddish-brown gravelly sandy loam; massive; hard when dry, friable when moist; pH 8.4.

21 to 40 inches, reddish-brown gravelly clay loam; moderate, fine, subangular blocky structure; very hard when dry, friable when moist; common, medium, distinct, pinkish-white lime stains; pH 8.4.

40 to 46 inches, light-brown very gravelly loam; massive; hard when dry, friable when moist; many, fine and medium, faint, pinkish-white lime stains; pH 9.0.

#### Substratum—

46 to 50 inches +, light-brown very gravelly loamy sand, massive; slightly hard when dry, very friable when moist; pH 8.4.

The depth to the subsoil ranges from 8 to 20 inches, and the depth to the gravelly clay loam ranges from 18 to 30 inches. The gravel content varies from layer to layer, ranging from 30 to 70 percent. If the material were mixed, the profile would be between 45 and 55 percent gravel. The depth to the substratum ranges from 40 to 48 inches.

Natural drainage is good. Runoff is slow. Permeability is rapid in the surface soil and substratum but is moderately slow in the subsoil. The water-holding capacity is low, and the inherent fertility is very low. The erosion hazard is moderate because of runoff from higher lying soils.

This soil is not used for cultivated crops, but it could be irrigated and cultivated. It would be best suited to deep-rooted orchard or vineyard crops. Heavy applications of organic matter, either animal manure or green manure, would improve tilth and reduce the hazard of erosion. Fertilizers containing nitrogen and phosphorus should be applied annually. Irrigation water would have to be carefully controlled, so that it would not cause erosion.

This soil has fair to good potential for industrial and urban development. The surface soil and the substratum are fair sources of gravel. The substratum is a good

source of gravel and sand. The subsoil has a moderate limitation as foundation-bearing material. The shrink-swell potential is moderate in the subsoil. The sulfate hazard to concrete is slight in the lower part of the subsoil and in the substratum. (Searchlight soil, capability unit IVs-4L; Carrizo soil, capability unit VIIIs-L)

### Skyhaven Series

The Skyhaven series consists of well-drained, moderately fine textured soils that formed in sediments derived mainly from sandstone, limestone, and quartzite. These soils are on remnants of stream terraces. They are associated with McCarran and Land soils. The vegetation is predominantly shadscale and iodinebush. Approximately 99 percent of the acreage is barren.

Skyhaven soils are shallow and calcareous. The surface soil is pink, is slightly hard, and has platy structure. The subsoil is light brown to brown, is hard to very hard, and has prismatic or subangular blocky structure. The substratum is a pink or pinkish-white, massive, indurated lime hardpan containing some gypsum crystals.

These soils are not used for farm crops. They are too shallow to be suitable for cultivation.

**Skyhaven clay loam, strongly saline, 0 to 2 percent slopes (SkA).**—This soil occurs as a small area northwest of Las Vegas, near Skyhaven Airport.

Representative profile:

Surface soil—

0 to  $\frac{1}{4}$  inch, pink clay loam; weak, fine, platy structure; slightly hard when dry, friable when moist; pH 8.4.

Subsoil—

$\frac{1}{4}$  inch to 4 inches, light-brown clay loam; many, fine, distinct, pink lime mottles; strong, medium, prismatic structure; very hard when dry, firm when moist; pH 8.8.

4 to 9 inches, brown silty clay; few, very fine, prominent, pink lime mottles; strong, fine, subangular blocky structure; hard when dry, firm when moist; pH 8.8.

Substratum—

9 to 29 inches, pink, strongly lime-cemented hardpan; massive; contains some gypsum crystals; pH 9.0.

29 to 46 inches +, pinkish-white indurated lime hardpan; massive; contains a small amount of gypsum crystals; pH 9.0.

The depth to the lime-cemented hardpan ranges from 8 to 19 inches, and the thickness of the pan from 36 to 72 inches. Some gypsum occurs throughout the profile.

Natural drainage is good. Runoff is slow, and infiltration is slow. Permeability is slow in the subsoil and very slow in the substratum. The water-holding capacity and the inherent fertility are very low. Severe salinity reduces the amount of moisture available to plants. The root zone is shallow. The erosion hazard is moderate.

This soil is unsuitable for cultivation and irrigation. It is also unsuitable as a source of sand and gravel. The surface soil and subsoil have severe limitations as foundation-bearing material. The shrink-swell potential is high, and the sulfate hazard to concrete is severe. (Capability unit VIIIs-8)

**Skyhaven clay loam, 0 to 2 percent slopes (ShA).**—This soil is similar to Skyhaven clay loam, strongly saline, 0 to 2 percent slopes, except that its surface soil is free of excessive amounts of soluble salts. It is not suitable for cultivation and irrigation. (Capability unit VIIIs-8)

### Spring Series

The Spring series consists of imperfectly drained, moderately fine textured soils derived from limestone, shale, and highly gypsiferous sediments of the Muddy Creek Formation. These soils are on valley fill adjacent to, but slightly above, Glendale and Land soils, which are on the more recent flood plains. Gypsum is leached downward through these soils and then is moved up toward the surface by the ground water. The vegetation includes shadscale, creosotebush, narrow-leaf saltbush, saltgrass, alkali sacaton, and iodinebush. Approximately 90 to 98 percent of the acreage is barren.

Spring soils are deep, calcareous, and gypsiferous. The surface soil is light reddish brown, is slightly hard, and either has subangular blocky structure or is massive. The subsoil is light reddish brown, is hard, and either has prismatic structure or is massive. The substratum is pink, hard, very high in gypsum content, and massive.

These soils are not used for farm crops. They are adjacent to the city of Las Vegas and consequently have been used for subdivisions and homesites.

**Spring clay loam, slightly saline (Sm).**—This soil occurs adjacent to and within the city of Las Vegas. Included in mapping are areas where the surface soil is silt loam and areas where the soils are strongly saline.

Representative profile:

Surface soil—

0 to 3 inches, light reddish-brown clay loam; weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist; pH 8.0.

3 to 5 inches, similar to the surface horizon, except massive.

Subsoil—

5 to 8 inches, light reddish-brown clay loam; moderate, coarse, prismatic structure; hard when dry, very friable when moist; few to common, very fine and fine gypsum crystals; pH 8.4.

8 to 10 inches, similar to upper part of subsoil, except massive.

Substratum—

10 to 21 inches, pink clay loam; massive; hard when dry, friable when moist; many, fine, white gypsum crystals; pH 7.8.

21 to 43 inches, pink light clay loam; massive; hard when dry, friable when moist; very high in gypsum; pH 7.0.

43 to 49 inches, pink silt loam; massive; hard when dry, friable when moist; common, fine, white gypsum crystals; pH 7.0.

49 to 69 inches +, pink silt loam; massive; slightly hard when dry, friable when moist; high in gypsum; pH 7.8.

The depth to the substratum ranges from 9 to 36 inches, and the thickness of that layer from 24 to more than 60 inches. The gypsum content of the substratum is moderate to very high.

Drainage is imperfect. Runoff is slow, and normal rainfall may pond before it is absorbed. Permeability is moderately slow as far down as the substratum and slow through this layer. The water table fluctuates between the depths of 6 and 8 feet because of nearby springs and seeps. The water-holding capacity and the inherent fertility are high. The erosion hazard is none to slight.

This soil is not used for crops. It is used to a limited extent for grazing, mostly for horses, and it is used extensively for urban and industrial development.

If properly managed, this soil would be productive of crops. It would need to be adequately drained and leached of excess salts. If drainage is established, the salts could be dissolved by ponding and leaching with a

large amount of irrigation water. Additional water would likely cause a rise in the water table and an increase in salinity. Drainage could be established at minimum cost by installing a system of open ditches. A tile drainage system would probably be more efficient than open ditches. It would be less costly to maintain and would not remove land from cultivation, but it would be more costly to install.

The rate of infiltration would increase from year to year if this soil were tilled and mixed with organic residues. Deep chiseling or subsoiling would help to increase permeability. Generous quantities of organic matter, both animal manure and green manure, would improve tilth. Inorganic fertilizers containing nitrogen and phosphorus would be advisable also.

This soil has severe to moderate limitations as foundation-bearing material. It is poor as subgrade material and is unsuitable as a source of sand and gravel. The shrink-swell potential is high, and the sulfate hazard to concrete is severe. (Capability unit IIIw-36)

**Spring clay loam, wet, moderately saline (Sn).**—Except for a higher water table, more restricted drainage, and a higher degree of salinity, this soil is similar to Spring clay loam, slightly saline. It is near springs and seeps and has a permanent high water table at a depth of 4 feet. Consequently, it is wet within 5 or 6 inches of the surface.

This soil is used to some extent for urban development. It affords a limited amount of grazing. If irrigation water should be made available, the soil could be used for pasture crops. It would need an extensive drainage system to eliminate the high water table and to help remove the excess salts. Without drainage, only salt-tolerant crops could be grown, and even these at some risk. Irrigation, unless very carefully controlled, is likely to cause an increase in salinity. (Capability unit VIw-36)

## Stony Steep Land

Stony steep land consists of mountainous areas of rock outcrops and little or no soil material. Weathering of the bedrock is slow, and the soil material erodes as fast as it forms. This land type is associated with Pittman and Braeken soils. It is not used for crops. The vegetation consists chiefly of sparse, stunted creosotebush and white bur-sage. More than 99 percent of the acreage is barren.

**Stony steep land, basalt (So).**—This land type occurs at the southern end of the survey Area, south of Henderson. The exposed bedrock is basalt. Runoff is very rapid.

This land type is not used for farming or for engineering purposes. It is best used for watershed purposes, for wildlife, or as recreational areas. (Capability unit VIIIs-78)

**Stony steep land, limestone (St).**—This land type occurs along the eastern edge of the survey Area. The exposed bedrock is predominantly limestone but includes strata of sandstone and quartzite. (Capability unit VIIIs-78)

## Tonopah Series

The Tonopah series consists of excessively drained, very gravelly and cobbly, coarse-textured soils that

formed in alluvium derived mainly from limestone and partly from sandstone and quartzite. These soils are on alluvial fans. They are associated with Goodsprings, Las Vegas, Cave, and Pittman soils. They developed under sparse vegetation, mainly creosotebush and white bur-sage. Approximately 99 percent of the acreage is barren.

Tonopah soils are very low in organic matter, very deep, and calcareous. The surface soil is light brown, is soft or slightly hard, and either has platy structure or is massive. The subsoil is light brown, very weakly lime cemented, soft, and massive. The substratum is light brown, loose, and single grained.

These soils are not suitable for farming. They are used extensively as a source of gravel.

**Tonopah cobbly loamy sand, 2 to 8 percent slopes (TcC).**—This soil occurs on gravelly alluvial fans along the northern, northwestern, and northeastern edges of Las Vegas Valley. The fans are dissected by many shallow drainageways that have been cut either by runoff from higher lying soils or by runoff on these soils during torrential rains.

Representative profile:

Surface soil—

0 to ½ inch, light-brown cobbly loamy sand; weak, medium, platy structure; soft when dry, very friable when moist; pH 8.4.

½ inch to 6 inches, light-brown cobbly and gravelly loamy sand; massive; slightly hard when dry, very friable when moist; pH 8.6.

6 to 22 inches, light-brown gravelly and cobbly sand; massive; soft when dry, very friable when moist; pH 8.7.

Subsoil—

22 to 33 inches, similar to the horizon above in color, texture, and structure, but contains a large quantity of disseminated and segregated lime; pH 8.9.

Substratum—

33 inches+, similar in color and texture to horizon above but contains much less segregated lime; single grained; loose when dry or moist; pH 8.6.

There is considerable range in the quantity of lime in the subsoil. In places the lime occurs as a coating on the underside of the gravel; in other places it weakly cements the gravel. Some profiles contain several lime-cemented horizons. This soil is at least 80 percent coarse fragments. The content of gravel, cobblestones, and stones varies considerably. The gravel content ranges from 40 to 70 percent, the cobblestone content from 10 to 15 percent, and the stone content from 0 to 20 percent.

Natural drainage is excessive. Runoff is slow, and permeability is very rapid. The water-holding capacity and the natural fertility are very low. The erosion hazard is moderate.

This soil is not suitable for cultivation and irrigation, because of its very low fertility and very low water-holding capacity, but it has good potential for urban and industrial development. It is a good source of gravel and sand for construction. It has only slight limitations as foundation-bearing material, is good as subgrade and subbase material, and is fair as base material. There is no sulfate hazard to concrete. (Capability unit VIIIs-7)

**Tonopah loamy fine sand, 0 to 2 percent slopes (TaA).**—This soil can be used and managed in much the same way as Tonopah cobbly loamy sand, 2 to 8 percent slopes.

The uppermost 8 inches of the surface soil has moderate limitations as foundation-bearing material, is unsuitable

as base material, and is a poor source of gravel. (Capability unit VIII<sub>s</sub>-L)

**Tonopah stony loamy sand, 4 to 8 percent slopes (ThC).**—This soil is similar to Tonopah cobbly loamy sand, 2 to 8 percent slopes, and can be used and managed in much the same way as that soil. (Capability unit VIII<sub>s</sub>-7)

### Vinton Series

The Vinton series consists of somewhat excessively drained, coarse-textured soils derived from a mixture of igneous and sedimentary rocks, including basalt, rhyolite, limestone, sandstone, and quartzite. These soils are on alluvial fans and flood plains that have been somewhat modified by wind erosion. They are associated with Carrizo and Knob Hill soils. The vegetation consists of a sparse stand of creosotebush and desert primrose. Approximately 99 percent of the acreage is barren.

These soils are very deep and mildly calcareous. The surface soil and subsoil are light brown, loose, and single grained. The substratum is reddish brown to light brown, soft, and massive.

These soils are not used for farm crops, but they have fair potential for cultivation and irrigation.

**Vinton loamy sand, 0 to 2 percent slopes (VsA).**—This soil occurs as an extensive area in the north-central part of Eldorado Valley. Included in mapping are areas where the surface soil is loamy fine sand.

Representative profile:

Surface soil and subsoil—

0 to 36 inches, light-brown loamy sand; single grained; loose when dry or moist; pH 8.4.

Substratum—

36 to 60 inches +, reddish-brown loamy fine sand; massive; soft when dry, very friable when moist; pH 8.8.

Colors slightly redder than those in this profile occur in places, particularly in the substratum.

Natural drainage is somewhat excessive. Rainfall is absorbed rapidly, and permeability is rapid. Little water runs off. The water-holding capacity and the natural fertility are low. The root zone is very deep. The hazard of wind erosion is moderate.

This soil is under natural vegetation; none of it is used for crops. If irrigated and properly managed, it would be fairly productive of crops. It would be best suited to deep-rooted crops, because of its low water-holding capacity. It would need both organic and inorganic fertilizers.

If cultivated, this soil would have to be protected against wind erosion. It should be covered with vegetation at all times unless it has been stabilized with organic matter.

This soil has good potential for urban development but is only fair for industrial sites. It has severe limitations as foundation-bearing material. It is good as subgrade material, fair as subbase material, and poor as base material. It is a fair source of sand. The shrink-swell potential is low, and there is no sulfate hazard to concrete. (Capability unit IV<sub>s</sub>-4L)

**Vinton loamy sand, 2 to 4 percent slopes (VsB).**—This soil is essentially like Vinton loamy sand, 0 to 2 percent slopes. It is neither cultivated nor irrigated. If irri-

gated, it would need more intensive management than the nearly level soil. (Capability unit IV<sub>s</sub>-4L)

**Vinton sandy loam, 0 to 2 percent slopes (VtA).**—This soil is moderately fertile and is somewhat less susceptible to erosion than Vinton loamy sand, 0 to 2 percent slopes. None of it is cultivated, but if properly managed it would be well suited to crops. The surface soil has moderate limitations as foundation-bearing material. (Capability unit III<sub>s</sub>-4)

## Soil Formation and Soil Classification

Las Vegas and Eldorado Valleys are in the Red Desert soil zone, which is characterized by a hot, arid climate and by sparse desert-shrub vegetation. The soils of these valleys, like those of other arid parts of the Southwest, have been little affected by leaching and consequently are high in bases and in soluble salts. They are lighter colored and lower in organic-matter content than the Sierozems and the Brown soils, which occur in areas that receive a little more rainfall, and they are slightly redder than the Desert soils, which occur in colder areas.

### Formation of the Soils

The characteristics of the soil at any given point are controlled by (1) the physical and chemical composition of the parent material, (2) the climate, (3) the relief, (4) biological forces, mainly vegetation, and (5) time. The nature of these factors as they occur in the Las Vegas and Eldorado Valleys Area, and the influence of each in soil formation, are described in the following subsections.

#### Parent material

The parent material of the soils in Las Vegas Valley was derived mainly from sedimentary rocks but partly from metamorphic rocks and partly from basic extrusive igneous rocks. Limestone was the dominant sedimentary rock. Others were sandstone, shale, dolomite, and gypsum. Quartzite, a metamorphic rock, was interbedded with the sedimentary rocks in places. Basalt, rhyolite, and latite were the dominant igneous rocks. A few soils, including the McCarran and Spring soils, developed from gypsiferous silt and clay sediments. Volcanic material had some influence on the soils in the southern and eastern parts of the valley, including the soils of the Pittman and Eastland series.

The parent material of the soils in Eldorado Valley was derived from the same kinds of rocks, but material derived from the igneous rocks was dominant.

Some of the effects of parent material on soil development are modified by the climate and accordingly are discussed in the subsection that deals with climate.

#### Climate

The climate of the Area is characterized by little precipitation, low humidity, abundant sunshine, and wide extremes in daily temperatures. Summers are long and hot, and winters are short and mild. Annual precipitation normally is less than 5 inches, and it is doubtful

that much more than that was usual at any time while the soils were forming. Many of the distinctive characteristics of the soils are attributable to the meager rainfall.

Incomplete leaching of soluble minerals is the most significant result of the arid climate. The depth to which soluble minerals are leached depends on the amount of water moving downward through a soil and on the texture, permeability, and water-holding capacity of the soil. Because the amount of rainfall is so small, shallow leaching is normal in this Area. Soils on the flood plains and on the lower parts of fans and terraces receive extra water as runoff from higher areas, and consequently they may be leached to a somewhat greater depth than soils that receive no water except rainfall. Also, soils that are coarse textured, rapidly permeable, and low in water-holding capacity generally are leached to a greater depth than coarse-textured soils that are more slowly permeable and have higher water-holding capacity.

If the parent material is high in lime, incomplete leaching results in calcification, which can be described as the translocation of calcium carbonate, through the percolation of surface water, from the upper horizons of a soil to some other horizon (3). In young soils, calcification may be evidenced by the presence of segregated lime, lime mottles, or lime coatings on gravel. In old soils, it may be evidenced by massive, indurated hardpans. Nodules and concretions of lime and weak to strong cementation with lime are evidence of intermediate degrees of calcification.

If the parent material was high in gypsum, a soil may have in the substratum an accumulation of gypsum that was leached from the surface layer. The Bracken, Aztec, McCarran, and Spring soils show evidence of translocation of gypsum.

Many soils of the Area have no textural B<sub>2</sub> horizon, partly because illuviation is limited by the meager rainfall, and partly because many of the soils were derived from limestone. Limestone does not produce clay minerals. Moreover, clay does not go into suspension in a solution in which calcium is the dominant cation. In such a solution, clay particles tend to adhere to other particles and form aggregates too large to move in suspension. The B<sub>2t</sub> horizons of the Casa Grande, Gass, and Skyhaven soils are believed to have formed when sodium rather than calcium was the dominant cation in the solution. If sodium is dominant, the clay particles tend to disperse and are readily transported in solution.

Some of the soils of the Area have, as a result of the alteration of sesquioxide minerals, a color B horizon of brighter chroma and redder hue than either the A or the C horizon. This alteration has taken place without significant illuviation but is associated with the development of prismatic structure. The illuvial B horizons of the Casa Grande, Gass, and Skyhaven soils also have a brighter chroma and a redder hue than the A or C horizon, probably because they were affected by alteration of sesquioxides as well as by illuviation.

A vesicular surface layer is another soil characteristic that is associated with an arid climate. The vesicles (round or egg-shaped cavities) are believed to have been formed by the expansion of trapped air.

The long periods of heat and sunshine cause organic matter to decompose rapidly and minerals to become oxidized and dehydrated. Stones, cobblestones, and pebbles

that are exposed for a long time acquire a dark-colored coating of oxidized iron and manganese minerals. This coating, which becomes almost black with age, is called desert varnish. The gravelly phases of the Cave series provide excellent examples of desert varnish.

### **Relief**

The three major physiographic features of the Las Vegas and Eldorado Valleys Area are alluvial fans, basin lowlands, and, in Las Vegas Valley, prominent scarps. Scattered sand dunes and terraces are included, and also a little mountainous terrain.

Alluvial fans make up about 60 percent of the acreage. Deposition of the gravelly and stony sediments of which these fans consist began during the Pliocene and Pleistocene periods (4) and still continues. Fans surround both valleys and are most prominent along the western and southern boundaries of Las Vegas Valley and the eastern, northern, and western boundaries of Eldorado Valley. They have nearly level to moderate slopes and smooth or gently convex relief, and they are dissected by numerous shallow drainage channels and a few broad, deep channels. Soils of the Cave, Carrizo, Goodsprings, Las Vegas, Tonopah, and several other series are on the alluvial fans.

The lower part of the alluvial fans merges with the basin lowlands, which constitute about 25 percent of the area surveyed. These are nearly level areas of recent alluvium and lake-laid silt and clay. They are in the east-central part of Las Vegas Valley and in the central part of Eldorado Valley. Soils of the Glendale, Land, Bluepoint, Dry Lake, Spring, Mead, Vinton, and other series are in the basins. Vegas Wash, the main drainage-way of Las Vegas Valley, is in the lowland part of that valley.

In the northwestern part of Las Vegas Valley, near Tule Springs, are exposed remnants of lake and playa deposits that date from the Pleistocene period (4). These deposits are mapped as Badland. No soils have developed from them, but material eroded from them has contributed to the parent material of soils in other parts of the Area.

The most conspicuous of the three major physiographic features, though it makes up only 10 percent of the Area, is a series of scarps, a few feet to nearly 150 feet high, in the south-central part of Las Vegas Valley. Exposed on the scarps are easily erodible Miocene lakebeds. This part of the Area is mapped as Badland.

Drainage is good or excessive over most of the Area, but there are some places near the low parts of Vegas Wash and some near seeps and springs where drainage is moderately good to poor. Soils of the Land, Spring, and Paradise series are among those that are moderately well drained to poorly drained.

### **Biological forces**

The vegetation consists of grass and desert shrubs. The excessively drained and well-drained soils normally have less than 5 percent plant cover, and the less well drained soils between 5 and 15 percent. This sparse cover contributes little organic matter to the soils, provides little shade, and affords little protection against erosion. High temperature, lack of organic matter, and, in the

more poorly drained soils, a high content of soluble salts make the soils poor habitats for micro-organisms.

**Time**

There are several ways in which differences in age are manifested in the soils of this Area.

The youngest soils, such as those of the Carrizo and Glendale series, have little or no profile development.

Soils that have been in the process of development a little longer begin to show evidence of profile development. Some have a weak A1 horizon, commonly not discernible by color, resulting from a slight increase in the organic-matter content of the surface layer. Soluble salts, gypsum, or calcium carbonate may have been leached from the upper horizons and precipitated to form a weak Csa, Ccs, or Cca horizon, at approximately the depth to which rainwater penetrates. Visible concentrations of salt or gypsum crystals, lime coatings on the underside of gravel, mottles and stains of lime, and, eventually, an increase in color value, are evidence that such horizons are forming. Alteration of sesquioxide minerals results in the formation of a color B2 horizon, and formation and illuviation of clay minerals in the formation of a B2t horizon. All or any of these horizons may develop. The Land, Spring, Tonopah, and McCullough soils are examples of soils that have weakly developed profiles.

In soils of intermediate age, horizonation is more pronounced. The content of salt, gypsum, and lime in the Csa, Ccs, and Cca horizons increases, and enough lime or gypsum may be translocated to cause cementation of the Ccs or Cca horizon. The clay content of the B2t horizon increases, and the structure of this horizon becomes stronger. The McCarran, Goodsprings, and Casa Grande soils are examples of soils at this stage of development.

The oldest soils of the Area have strongly developed profiles. The Las Vegas and Cave soils have indurated Ccam horizons several feet thick. In the Gass soils, the B2t horizon has a clay texture and strong structural development.

**Classification and Morphology of the Soils**

Two systems of natural classification of soils are now in general use in the United States. One of these is the 1938 system, proposed by Baldwin, Kellogg, and Thorp (2). The other, the Comprehensive System, 7th Approximation, was placed in general use by the Soil Conservation Service in 1965. In this report the soils are classified and described on the basis of the 1938 system, but they are listed by order, great group, and family, according to the Comprehensive System (see table 6).

TABLE 6.—Classification of soils in the Las Vegas and Eldorado Valleys Area according to Comprehensive System, 7th Approximation (1964)

Series	Family	Great group	Order
Arden.....	Sandy skeletal, mixed, thermic.....	Typic Camborthid.....	Aridisol.
Aztec.....	Loamy skeletal, mixed, thermic.....	Typic Calciorthid.....	Aridisol.
Bluepoint.....	Sandy, siliceous, nonacid, thermic.....	Typic Torripsamment.....	Entisol.
Bracken.....	Coarse loamy, sulfatic, thermic.....	Typic Calciorthid.....	Aridisol.
Carrizo.....	Sandy skeletal, mixed, nonacid, thermic.....	Typic Torripsamment.....	Entisol.
Casa Grande.....	Fine loamy, mixed, thermic.....	Typic Natrargid.....	Aridisol.
Cave.....	Coarse loamy, mixed, thermic.....	Petrocalcic Calciorthid.....	Aridisol.
Dry Lake.....	Sandy over fine loamy, mixed, calcareous, thermic.....	Typic Torrifluvent.....	Entisol.
Eastland.....	Sandy skeletal, mixed, thermic.....	Typic Calciorthid.....	Aridisol.
Gass.....	Fine, mixed, thermic.....	Typic Natrargid.....	Aridisol.
Gila.....	Coarse loamy, mixed, calcareous, thermic.....	Typic Torrifluvent.....	Entisol.
Glendale.....	Fine silty, mixed, calcareous, thermic.....	Typic Torrifluvent.....	Entisol.
Goodsprings.....	Coarse loamy, mixed, thermic.....	Typic Calciorthid.....	Aridisol.
Grapevine.....	Coarse loamy, mixed, thermic.....	Typic Calciorthid.....	Aridisol.
Ireteba.....	Coarse loamy, mixed, calcareous, thermic.....	Typic Torrifluvent.....	Entisol.
Jean.....	Sandy, mixed, nonacid, thermic.....	Typic Torripsamment.....	Entisol.
Kiup.....	Sandy, mixed, calcareous, thermic.....	Typic Torrifluvent.....	Entisol.
Knob Hill.....	Sandy, mixed, thermic.....	Typic Calciorthid.....	Aridisol.
Lairep.....	Sandy over fine, mixed, calcareous, thermic.....	Typic Torrifluvent.....	Entisol.
Land.....	Fine silty, mixed, thermic.....	Typic Salorthid.....	Aridisol.
Las Vegas.....	Fine loamy, carbonatic, thermic.....	Petrocalcic Calciorthid.....	Aridisol.
Laveldo.....	Fine loamy, carbonatic, thermic.....	Typic Calciorthid.....	Aridisol.
McCarran.....	Coarse loamy, sulfatic, thermic.....	Typic Calciorthid.....	Aridisol.
McCullough.....	Coarse loamy, mixed, thermic.....	Typic Camborthid.....	Aridisol.
Mead.....	Fine, mixed, calcareous, thermic.....	Typic Halaquept.....	Inceptisol.
Paradise.....	Coarse loamy, carbonatic, thermic.....	Typic Calciaquoll.....	Mollisol.
Pittman.....	Sandy skeletal, mixed, thermic.....	Typic Calciorthid.....	Aridisol.
Searchlight.....	Sandy over fine loamy, mixed, calcareous, thermic.....	Thapto Argidic Torriorthent.....	Entisol.
Skyhaven.....	Fine loamy, mixed, thermic.....	Petrocalcic Natrargid.....	Aridisol.
Spring.....	Fine loamy, sulfatic, thermic.....	Typic Calciorthid.....	Aridisol.
Tonopah.....	Sandy skeletal, carbonatic, thermic.....	Typic Calciorthid.....	Aridisol.
Vinton.....	Sandy, mixed, nonacid, thermic.....	Typic Torripsamment.....	Entisol.

The classification of soil series in the Las Vegas and Eldorado Valleys Area into orders and great soil groups, according to the 1938 system, is shown in the following tabulation.

Order and great soil group:	<i>Series</i>
Azonal—	
Alluvial -----	Bluepoint, Carrizo, Dry Lake, Gila, Glendale, Ireteba, Kiup, Lairep, Searchlight, Vinton.
Intrazonal—	
Calcsols -----	Aztec, Cave, Eastland, Knob Hill, Las Vegas, Pittman, Tonopah.
Solonchaks -----	Bracken, Land, Laveldo, McCarran, Mead, Paradise, Spring.
Zonal—	
Red Desert -----	Arden, Casa Grande, Gass, Goodsprings, Grapevine, Jean, McCullough, Skyhaven.

### Azonal soils

Azonal soils lack distinct, genetically related horizons because of their youth, resistant parent material, or steep topography. The azonal soils in the Las Vegas and Eldorado Valleys Area are in the Alluvial great soil group.

#### ALLUVIAL SOILS

Alluvial soils consist of transported and recently deposited alluvium. They are characterized by little or no modification of the original material by soil-forming processes.

The Alluvial soils in the Las Vegas and Eldorado Valleys Area occur on alluvial fans and on flood plains. The Alluvial soils on fans are excessively drained to well drained, gravelly, and coarse textured. Those on flood plains are well drained and somewhat excessively drained and are normally finer textured and less gravelly than the soils on fans. They may be slightly wet. Also, they may be affected by salinity to some degree.

Soils of the Carrizo, Searchlight, Glendale, Bluepoint, Dry Lake, Gila, Ireteba, Kiup, Lairep, and Vinton series represent the Alluvial great soil group in these valleys. The Carrizo and Searchlight soils are on alluvial fans, and the rest are on flood plains.

**ALLUVIAL SOILS ON FANS.**—In the following paragraphs are brief descriptions of two series typical of Alluvial soils on fans and a typical profile of each.

**Carrizo series.**—The Carrizo series consists of excessively drained, very gravelly, coarse-textured soils that developed in sandy alluvium washed from basalt, rhyolite, limestone, and quartzite. These soils formed under sparse vegetation on nearly level to gently sloping alluvial fans.

Typical profile of Carrizo gravelly loamy sand (virgin) located at the center of sec. 3, T. 24 S., R. 64 E., Mount Diablo base line and meridian in Eldorado Valley:

A1—0 to 1 inch, pale-brown (10YR 6/3) gravelly loamy sand, brown (10YR 5/3) when moist; weak, fine to medium, platy structure; slightly hard, very friable, nonsticky, nonplastic; few very fine roots; many very fine vesicular pores and few fine vesicular pores; slightly micaceous; strongly effervescent; pH<sub>s</sub> 8.4; abrupt, smooth boundary. 0 to 2 inches thick.

IIC1—1 inch to 10 inches, pale-brown (10YR 6/3) gravelly loamy sand, brown (10YR 5/3) when moist; single grained; loose when dry or moist, nonsticky, nonplastic; few very fine and fine roots; many very fine and fine interstitial pores; slightly micaceous; effervescent; pH<sub>s</sub> 8.2; clear, smooth boundary. 6 to 20 inches thick.

IIC2—10 to 60 inches, somewhat stratified, pale-brown and very pale brown (10YR 6/3 and 7/3) very gravelly sand, gravelly sand, and very gravelly loamy sand, brown (10YR 5/3) when moist; single grained; loose when dry or moist; few very fine and fine roots in the uppermost 36 inches, very few below; many very fine interstitial pores and few fine interstitial pores; slightly micaceous; effervescent; pH<sub>s</sub> 8.2.

About 20 percent of the surface is covered with a weakly developed desert pavement that consists of sub-rounded gravel, 1/8 inch to 2 inches in diameter; the rest of the surface is gravel free.

The control section consists of sand, coarse sand, and loamy sand. There is considerable variation in the amount of gravel and the number of cobblestones and stones from place to place and within the profile. The content of gravel ranges from 40 to 70 percent, the content of cobblestones from 0 to 30 percent, and the content of stones from 0 to 15 percent. In places where the control section is mixed, the content of coarse fragments ranges from 50 to 70 percent. Near the lower, nearly level parts of the fans, there may be some minor stratification (a layer generally less than 2 inches thick) of loamy fine sand, coarse sandy loam, and sandy loam in the upper 20 inches of the control section. The colors include hues of 10YR and 7.5YR, values of 6 and 7 when the material is dry and 5 and 4 when it is moist, and chromas of 3 and 4. The amount of lime in any one horizon is enough to make the material effervescent to strongly effervescent. The pH ranges from 8.0 to 8.6.

**Searchlight series.**—The Searchlight series consists of gravelly, coarse-textured soils, similar to Carrizo soils, over moderately fine textured buried soils. Searchlight soils are very deep, well-drained soils on gently sloping alluvial fans. They formed in alluvium washed from many different kinds of rocks.

Typical profile of Searchlight gravelly loamy sand (virgin) located 1,320 feet north of the southeast corner of sec. 28, T. 24 S., R. 63 E., in Eldorado Valley:

A1—0 to 3 inches, strongly developed erosion pavement, with no visible desert varnish, over pinkish-gray (7.5YR 6/2) very gravelly sand, brown (7.5YR 4/4) when moist; single grained; loose when dry or moist; few very fine roots; many very fine and fine interstitial pores; effervescent; pH<sub>s</sub> 8.2; abrupt, smooth boundary. 2 to 4 inches thick.

C1—3 to 9 inches, light-brown (7.5YR 6/4) gravelly loamy sand, brown (7.5YR 4/4) when moist; massive; soft, very friable, nonsticky, nonplastic; few very fine and fine roots; few fine tubular pores; strongly effervescent; pH<sub>s</sub> 8.4; abrupt, smooth boundary, 5 to 25 inches thick.

A1b—9 to 12 inches, reddish-brown (5YR 5/4) gravelly loamy sand, reddish brown (5YR 4/4) when moist; massive; slightly hard, very friable, nonsticky, nonplastic; few very fine and fine roots; common very fine tubular pores and few fine tubular pores; few thin clay bridges between sand grains; strongly effervescent; pH<sub>s</sub> 8.4; clear, wavy boundary. 0 to 4 inches thick.

B1b—12 to 21 inches, reddish-brown (5YR 5/4) gravelly sandy loam, reddish brown (5YR 4/4) when moist; massive; hard, friable, slightly sticky, slightly plastic; few very fine roots; common very fine tubular pores; many thin clay coatings and bridges on and between sand grains; strongly calcareous; pH<sub>5</sub> 8.4; clear, smooth boundary. 0 to 10 inches thick.

Batbca—21 to 40 inches, reddish-brown (5YR 5/4) gravelly clay loam, reddish brown (5YR 4/4) when moist; moderate, fine, subangular blocky structure; very hard, friable, sticky, plastic; no roots observed; few very fine tubular pores; many fine clay films and few moderately thick clay films on ped surfaces and in pores; strongly effervescent, but violently effervescent where common, medium, distinct, pinkish-white (7.5YR 8/2) lime stains occur; pH<sub>5</sub> 8.4; clear, wavy boundary. 16 to 22 inches thick.

IIB3bca—40 to 46 inches, light-brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 4/4) when moist; massive; hard, friable, slightly sticky, slightly plastic; few very fine and fine tubular pores; few thin clay bridges and coatings between and on sand grains; violently effervescent and contains many, fine and medium, faint, pinkish-white (7.5YR 8/2) lime stains and mottles; pH<sub>5</sub> 9.0; clear, wavy boundary. 4 to 10 inches thick.

IIIC1b—46 to 50 inches +, light-brown (7.5YR 6/4) very gravelly loamy sand, brown (7.5YR 4/4) when moist; massive; slightly hard, very friable, nonsticky, nonplastic; many very fine and fine interstitial pores; strongly effervescent; pH<sub>5</sub> 8.4.

The depth to the buried B2t horizon ranges from 18 to 30 inches. The texture of the overlying material is commonly gravelly loamy sand or gravelly loamy fine sand. The gravel content ranges from 30 to 70 percent, but if the material is mixed, it is between 45 and 55 percent. Color hues are 7.5YR and 10YR, values are 7 and 6 when the material is dry and 5 and 4 when it is moist, and chromas are 2 to 4. The lime content is such that the material is strongly or violently effervescent with 1N.HCL, except at the surface, where it may be only slightly effervescent. Color hues of the A1b and B1b horizons are 7.5YR and 5YR, values are 5 and 6 when the material is dry and 4 and 5 when it is moist, and chromas are 2 to 4. Either the A1b horizon or the B1b horizon, or both, may be missing. The texture of the B2b horizon is gravelly clay loam or gravelly sandy clay loam; the gravel content is 25 to 40 percent. The color of the buried B2b and B3b horizons includes values of 4 and 5 and chromas of 4 to 6. Soft lime segregations in the B2b and B3b horizons range from few to many and fine to coarse; most of these segregations are in the B3b horizon. The pH value of the buried soil increases with increasing depth and ranges from 8.4 to 9.0. The depth to the very gravelly, unconformable C material ranges from 40 to 48 inches.

**ALLUVIAL SOILS ON FLOOD PLAINS.**—In the following paragraphs are brief descriptions of eight soil series typical of Alluvial soils on flood plains and a typical profile of a soil of each series.

*Glendale series.*—The Glendale series consists of soils that developed in recent, slightly modified, stream-laid materials derived from many different kinds of rocks but predominantly from limestone. Glendale soils are very deep, stratified medium textured and moderately fine textured, well drained, and strongly calcareous.

Typical profile of Glendale silt loam (virgin), located approximately 320 feet south and 1,300 feet west of the east quarter corner of sec. 29, T. 20 S., R. 62 E., in Las Vegas Valley:

C1—0 to 2 inches, pink (7.5YR 7/4) very fine sandy loam, brown (7.5YR 5/4) when moist; moderate, medium, platy structure; slightly hard, very friable, nonsticky, nonplastic; abundant very fine roots; many very fine vesicular pores and common fine vesicular pores; violently effervescent; pH<sub>5</sub> 9.0; abrupt, smooth boundary. 1 inch to 3 inches thick.

C2—2 to 5 inches, pink (7.5YR 7/4) silt loam, brown (7.5YR 5/4) when moist; moderate, coarse, platy structure; slightly hard, friable, nonsticky, nonplastic; abundant very fine roots; common very fine and fine vesicular pores; violently effervescent; pH<sub>5</sub> 9.0; abrupt, smooth boundary. 2 to 5 inches thick.

C3—5 to 9 inches, pink (7.5YR 7/4) silt loam, brown (7.5YR 5/4) when moist; massive; slightly hard, friable, nonsticky, slightly plastic; plentiful very fine roots; common very fine tubular pores and few fine tubular pores; violently effervescent; pH<sub>5</sub> 8.8; smooth boundary. 3 to 7 inches thick.

C4—9 to 18 inches, very pale brown (10YR 7/4) silt loam, yellowish brown (10YR 5/4) when moist; massive; slightly hard, friable, nonsticky, nonplastic; plentiful very fine roots; common very fine tubular pores and few fine tubular pores; violently effervescent; pH<sub>5</sub> 8.4; abrupt, smooth boundary. 5 to 10 inches thick.

C5—18 to 32 inches, very pale brown (10YR 7/4) silt loam, yellowish brown (10YR 5/4) when moist; massive; slightly hard, friable, nonsticky, slightly plastic; plentiful very fine roots; few very fine and fine tubular pores; violently effervescent; pH<sub>5</sub> 8.4; abrupt, smooth boundary. 10 to 16 inches thick.

IIC6—32 to 43 inches, very pale brown (10YR 7/4) loam, yellowish brown (10YR 5/4) when moist, massive; slightly hard, friable, nonsticky, nonplastic; few very fine roots; common fine tubular pores; violently effervescent; pH<sub>5</sub> 8.4; abrupt, smooth boundary. 7 to 12 inches thick.

IIC7—43 to 60 inches +, very pale brown (10YR 7/4) loam, yellowish brown (10YR 5/4) when moist; massive; slightly hard, friable, nonsticky, nonplastic; few very fine roots; common fine tubular pores; violently effervescent; pH<sub>5</sub> 8.4.

The color of the profile includes hues of 7.5YR and 10YR, values of 7 and 6 when the material is dry and 5 and 4.5 when it is moist, and chromas of 3 to 5. The texture of the control section is predominantly silt loam. In places there are strata of loam and silty clay loam. Also, thin strata (less than 8 inches thick) of very fine sandy loam and fine sandy loam may be included. The lime content differs somewhat in different strata; it is generally slightly higher in strata where the clay content is higher. The calcium carbonate equivalent ranges from 15 to 40 percent. Segregated lime occurs in places, but most of the lime is well distributed. The pH<sub>5</sub> is predominantly between 8.0 and 8.4, but ranges to as high as 9.2, depending upon the distribution of exchangeable sodium. Fine salt and gypsum segregations may occur in any part of the profile, but generally occur only in the substratum. The calculated cation exchange capacity is ordinarily about 60 milliequivalents per 100 grams of clay, but it may be as much as 80 milliequivalents below a depth of 12 inches.

*Bluepoint series.*—The Bluepoint series consists of soils that are similar to Glendale soils, except that they are coarse textured and somewhat redder (5YR and 7.5YR hues) and were derived mainly from siliceous parent rocks. Bluepoint soils are very deep, well drained, and permeable. They may have been reworked by wind.

Typical profile of Bluepoint loamy fine sand (virgin) located 500 feet east of the northwest corner of sec. 16, T. 21 S., R. 62 E., in Las Vegas Valley:

- C1—0 to 17 inches, reddish-yellow (7.5YR 7/6) loamy fine sand, strong brown (7.5YR 5/6) when moist; massive; soft, very friable, nonsticky, nonplastic; plentiful very fine roots and few fine and medium roots; many very fine interstitial pores; violently effervescent;  $pH_5$  8.6; abrupt, wavy boundary. 6 to 24 inches thick.
- IIC2—17 to 23 inches, reddish-yellow (7.5YR 8/6) very gravelly fine sand, reddish yellow (7.5YR 6/6) when moist; single grained; loose when dry or moist; few very fine, fine, and medium roots; many very fine and fine interstitial pores; violently effervescent;  $pH_5$  8.4; abrupt, smooth boundary. 0 to 8 inches thick.
- IIIC3—23 to 36 inches, pink (7.5YR 8/4) loamy fine sand, light brown (7.5YR 6/4) when moist; massive; soft, very friable, nonsticky, nonplastic; few very fine and fine roots; many very fine interstitial pores; violently effervescent;  $pH_5$  8.6; clear, smooth boundary. 10 to 24 inches thick.
- IVC4—36 to 41 inches, pink (7.5YR 8/4) fine sandy loam, brown (7.5YR 5/4) when moist; massive; soft, very friable, nonsticky, nonplastic; few very fine roots; few very fine tubular pores and many very fine interstitial pores; violently effervescent;  $pH_5$  8.8; clear, smooth boundary. 0 to 8 inches thick.
- VC5—41 to 60 inches +, reddish-yellow (7.5YR 8/6) loamy fine sand, reddish yellow (7.5YR 6/6) when moist; massive; soft, very friable, nonsticky, nonplastic; few very fine roots; many very fine interstitial pores; violently effervescent;  $pH_5$  9.0.

The texture of the control section is predominantly loamy fine sand or loamy sand, but strata (less than 10 inches thick) of fine sandy loam, sandy loam, fine sand, or sand that may be gravelly or very gravelly are included. The color of the profile includes hues of 5YR and 7.5YR, values of 7 and 8 when the material is dry and 5 and 6 when it is moist, and chromas of 4 to 6. The lime content differs somewhat in different strata; it is generally slightly higher in strata where the clay content is higher. The  $pH_5$  is ordinarily between 8.0 and 8.6 but ranges to as high as 9.2, depending on the percentage of exchangeable sodium. Fine segregations of salt and gypsum may occur in any part of the profile but are uncommon.

*Dry Lake series.*—The Dry Lake series consists of soils that are similar to Glendale soils, except that they are coarse textured over stratified medium-textured and moderately coarse textured control sections. Dry Lake soils are very deep, well-drained soils that formed in alluvium derived from many different kinds of rocks. They were more poorly drained in the past than they are now, and lime has accumulated as a result of evaporation and precipitation.

Typical profile of Dry Lake loamy fine sand (virgin), located approximately a quarter of a mile south and 660 feet west of the east quarter corner of sec. 25, T. 24 S., R. 62 E., in Eldorado Valley:

- C1—0 to 6 inches, light-brown (7.5YR 6/4) loamy fine sand, dark brown (7.5YR 4/2) when moist; massive; soft, very friable, nonsticky, nonplastic; very few fine roots; many fine interstitial pores; noneffervescent;  $pH_5$  8.4; clear, smooth boundary. 5 to 10 inches thick.
- C2—6 to 20 inches, similar in color and consistence to C1 horizon but slightly finer textured; massive; soft, very friable; plentiful very fine and fine roots; slightly effervescent;  $pH_5$  8.4; abrupt, smooth boundary. 10 to 30 inches thick.

IIIC3—20 to 44 inches, light-brown (7.5YR 6/4) fine sandy loam, dark yellowish brown (10YR 4/4) when moist; massive; slightly hard, very friable, slightly sticky, slightly plastic; few very fine roots; many very fine interstitial pores; a few small rounded quartzite pebbles; strongly effervescent;  $pH_5$  8.4; abrupt, smooth boundary. 15 to 26 inches thick.

IIIC4ca—44 to 66 inches, white (10YR 8/2) heavy silt loam, pale brown (10YR 6/3) when moist; massive; hard, friable, slightly sticky, slightly plastic; no roots; common very fine tubular pores; violently effervescent; common lime carbonate nodules,  $\frac{1}{8}$  to  $\frac{1}{2}$  inch in diameter and  $\frac{1}{4}$  inch to 2 inches in length;  $pH_5$  9.0.

The color of the loamy fine sand horizons includes hues of 7.5YR and 10YR, values of 7 and 6 when the material is dry and of 5 and 4 when it is moist, and chromas of 3 and 4. The  $pH_5$  ranges from 8.0 to 8.5. The color of the unconformable underlying medium-textured material includes hues of 7.5YR and 10YR and values of 7 and 5.5 when the material is dry and 5 and 4 when it is moist, except in the Cca horizon, which has values of 8 and 7 when dry and 6 and 5 when moist. Chromas are 2 and 4 in both dry and moist material. The control section consists predominantly of loamy fine sand. It rests unconformably over stratified fine sandy loam, silt loam, very fine sandy loam, or loam, that, if mixed, would be more than 18 percent clay. The control section may include thin strata (less than 6 inches thick) of fine sand, sand, and light fine sandy loam. The material underlying the control section may be high in disseminated lime and nodular segregated lime, or it may consist of two or three such strata separated by alluvium that is low in lime. The thickness of the Cca horizon ranges from 3 to 30 inches. In places the profile has few to many, medium, distinct, reddish-brown (5YR 5/4) iron mottles below a depth of 40 inches.

*Gila series.*—The Gila series consists of soils that are similar to Glendale soils except in texture. The texture of the control section includes very fine sandy loam and fine sandy loam; the clay content is less than 18 percent. Gila soils are very deep, well drained, and moderately permeable.

Typical profile of Gila very fine sandy loam (virgin), located about 400 feet east of the west quarter corner of sec. 16, T. 21 S., R. 62 E., in Las Vegas Valley:

- C1—0 to 42 inches, pink (7.5YR 7/4), crudely stratified very fine sandy loam and fine sandy loam, brown (7.5YR 5/4) when moist; massive; soft, very friable, nonsticky, nonplastic; plentiful very fine roots in the uppermost 12 inches, few below, and few fine roots throughout; few very fine and fine tubular pores and many very fine interstitial pores; violently effervescent;  $pH_5$  8.2; abrupt, smooth boundary. 20 to 60 inches thick.
- IIC2—42 to 60 inches +, pink (7.5YR 7/4) very gravelly sand, light brown (7.5YR 6/4) when moist; single grained; loose when dry or moist; no roots apparent; many very fine and fine interstitial pores and few medium interstitial pores; violently effervescent;  $pH_5$  8.2.

The color of the soil profile includes hues of 7.5YR and 10YR, values of 7 and 6 when the material is dry and 5 and 4.5 when it is moist, and chromas of 3 to 5. The texture of the control section is predominantly very fine sandy loam, but strata of fine sandy loam and in places thin strata (less than 8 inches thick) of silt loam, loam, and loamy fine sand are included. The depth to the gravel substratum ranges from 20 to 60 inches within short distances but is most commonly between 40 and

48 inches. The lime content differs somewhat from one stratum to another. The calcium carbonate equivalent ranges from 15 to 40 percent. The  $pH_5$  is predominantly 8.0 to 8.4 but ranges up to 9.0. Some fine salt and gypsum segregations may occur in strata above the gravel.

*Ireteba series.*—The *Ireteba* series consists of soils that are similar to Glendale soils except for having distinct Cca horizons that appear to have been impregnated by lime precipitated from ground water. *Ireteba* soils are very deep, well-drained, stratified medium-textured and moderately coarse textured soils that developed in alluvium derived from many different kinds of rocks. They are in basins and on the nearly level lower margins of alluvial fans.

Typical profile of *Ireteba* loam (virgin), located approximately in the center of sec. 29, T. 24 S., R. 63 E., in Eldorado Valley:

- C1—0 to 12 inches, pale-brown (10YR 6/3) loam, brown (10YR 4/3) when moist; weak, medium to coarse, platy structure; soft to slightly hard, friable, slightly sticky, slightly plastic; few very fine and fine roots; common very fine tubular pores; violently effervescent;  $pH_5$  8.2; abrupt, smooth boundary. 6 to 15 inches thick.
- IIC2—12 to 18 inches, light-brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 4/4) when moist; weak, medium, platy structure; soft, very friable; few very fine roots; few very fine tubular pores; effervescent;  $pH_5$  8.2; abrupt, smooth boundary. 5 to 12 inches thick.
- IIIC3ca—18 to 34 inches, very pale brown (10YR 7/3) loam or silt loam, brown (10YR 5/3) when moist; few, medium, faint veins of white (10YR 8/1) lime; massive; very hard, friable, slightly sticky, slightly plastic; few very fine roots; few fine tubular pores; strongly effervescent; few, medium, faint filaments of white (10YR 8/1) lime;  $pH_5$  8.2; abrupt, smooth boundary. 10 to 18 inches thick.
- IVC4—34 to 54 inches, light-brown (7.5YR 6/4) light fine sandy loam, brown (7.5YR 5/4) when moist; massive; slightly hard, very friable, nonsticky, nonplastic; devoid of roots; few fine tubular pores; effervescent;  $pH_5$  8.2; abrupt, smooth boundary. 5 to 20 inches thick.
- VC5ca—54 to 60 inches +, pinkish-white (7.5YR 8/2) loam, light brown (7.5YR 6/4) when moist; massive; very hard, firm, slightly sticky, slightly plastic; devoid of roots; violently effervescent;  $pH_5$  8.2.

The color includes hues of 10YR and 7.5YR, values of 6 and 7 when the material is dry and 4 and 5 when it is moist, and chromas of 2 to 4. The texture of the control section varies; it is predominantly loam, fine sandy loam, or silt loam, but in places thin strata of finer or coarser textures are included. The clay content is less than 18 percent. There may be as many as three Cca horizons 4 to 15 inches thick below a depth of 15 inches. The calcium carbonate equivalent is generally less than 15 percent in the Cca horizons that are within 40 inches of the surface but may be as high as 25 percent in those below a depth of 40 inches. In the deeper horizons the color value is 8 when the material is dry and 6 when it is moist. The  $pH_5$  ranges from 8.0 to 8.6. Variable quantities of salt and gypsum occur throughout the profile.

*Kiup series.*—The *Kiup* series consists of soils that are somewhat similar to Glendale soils but are coarse textured and moderately deep and deep over buried, gypsiferous, very gravelly, medium-textured material. *Kiup* soils are well-drained soils that formed in alluvium derived from many different kinds of rocks. They are on slightly convex, very gently undulating to gently sloping alluvial fans.

Typical profile of *Kiup* loamy fine sand, located about 1,300 feet due north of the south quarter corner of sec. 17, T. 23 S., R. 64 E., in Eldorado Valley:

- C1—0 to 10 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 4/3) when moist; weak, medium, platy structure in the uppermost 4 inches and massive below; soft, very friable, nonsticky, nonplastic; few very fine and fine roots and few medium roots; many very fine interstitial pores; noneffervescent;  $pH_5$  8.3; clear, smooth boundary. 4 to 12 inches thick.
- C2—10 to 33 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 4/3) when moist; massive; soft, very friable, nonsticky, nonplastic; few very fine and fine roots; many very fine interstitial pores; few very fine and fine tubular pores; slightly effervescent;  $pH_5$  8.3; abrupt, smooth boundary. 16 to 30 inches thick.
- IICcsca—33 to 61 inches, very pale brown (10YR 7/4) very gravelly loam, yellowish brown (10YR 5/4) when moist; massive; very hard, firm, friable, nonsticky, slightly plastic; few very fine roots; many very fine and fine interstitial pores and common medium interstitial pores; weakly cemented by gypsum and lime; about 85 percent gravel averaging 1 inch in size; all gravel is lime coated; violently effervescent;  $pH_5$  8.7; gradual, wavy boundary. 21 to 39 inches thick.
- IIIC3cs—61 to 71 inches +, white (10YR 8/1) crystalline gypsum, light gray (10YR 7/2) when moist; massive; very hard, very firm, nonsticky, nonplastic; no roots observed; many very fine and fine interstitial pores; slightly effervescent;  $pH_5$  7.2.

The color of the soil profile includes hues of 10YR and 7.5YR and values of 6 and 7 when the material is dry and 4 and 5 when it is moist, except in the Ccs horizon, which has values of 8 and 7 when dry and 7 and 6 when moist. Chromas are 2 to 4 in both dry and moist material. The control section is predominantly loamy fine sand. It rests unconformably over weakly gypsum-cemented and lime-cemented very gravelly loam. The control section may include thin strata (less than 6 inches thick) of fine sand, sand, and light fine sandy loam. The unconformable underlying material is 50 to 90 percent gravel, and the rest of it is sandy loam, fine sandy loam, or loam. The clay content is less than 18 percent. The lime content of the profile is less than 15 percent. The depth to the IICcsca horizon ranges from 26 to 37 inches. Normally, this horizon is weakly cemented, but in some areas it has only coatings of gypsum and lime on the gravel. The consistence of the IICcsca horizon ranges from very hard to slightly hard and from firm to very friable. Gypsum crystals, up to 1/2 inch in size, are not uncommon. The depth to the IIIC3cs horizon ranges from 56 to 72 inches. In the IIIC3cs horizon, the  $pH_5$  ranges from 7.0 to 7.4; in the rest of the profile it ranges from 8.0 to 8.8.

*Lairep series.*—The *Lairep* series consists of soils that are similar to Glendale soils but are coarse textured over stratified fine textured and moderately fine textured material in the control section. *Lairep* soils are very deep, well-drained soils that developed in alluvium derived from many different kinds of rocks. They are on nearly level flood plains and on toe slopes of alluvial fans adjacent to playas.

Typical profile of *Lairep* loamy fine sand (virgin), located about 1,300 feet south and 660 feet west of the east quarter corner of sec. 25, T. 24 S., R. 62 E., in Eldorado Valley:

- C1—0 to 6 inches, very pale brown (10YR 7/3) loamy fine sand, brown (10YR 5/3) when moist; massive; soft, very friable, nonsticky, nonplastic; plentiful fine and

very fine roots; many very fine interstitial pores; strongly effervescent;  $pH_5$  8.4; clear, smooth boundary. 3 to 7 inches thick.

C2—6 to 25 inches, very pale brown (10YR 7/3) loamy fine sand, brown (10YR 5/3) when moist; massive; soft, very friable, nonsticky, nonplastic; plentiful very fine and few fine roots; many very fine interstitial pores; strongly effervescent;  $pH_5$  8.4; abrupt, smooth boundary. 10 to 20 inches thick.

IIC3—25 to 30 inches, light yellowish-brown (10YR 6/4) fine sandy loam, dark yellowish brown (10YR 4/4) when moist; massive; slightly hard, very friable, nonsticky, nonplastic; few very fine roots; common very fine tubular pores; violently effervescent;  $pH_5$  8.4; abrupt, smooth boundary. 0 to 12 inches thick.

IIIC4ca—30 to 60 inches +, very pale brown (10YR 8/3) finely stratified clay and silty clay loam, pale brown (10YR 6/3) when moist; massive; hard, friable, sticky and very sticky, plastic and very plastic; few very fine roots; few to common very fine tubular pores; common, coarse (up to 2 inches in length), extremely hard, lime concretions precipitated by ground water; violently effervescent;  $pH_5$  9.0.

The color of the soil profile includes hues of 10YR and 7.5YR and values of 7 and 6 when the material is dry and 5 and 4 when it is moist, except in the Cca horizon, which has values of 8 and 7 when dry and 6 and 5 when moist. Chromas are 3 and 4 in both dry and moist material. The control section is predominantly loamy fine sand. It rests unconformably over stratified clay and silty clay loam. Minor stratification in the overlying material may include strata (less than 6 inches thick) of fine sand, sand, and light fine sandy loam. The unconformable material horizon is normally well stratified, and may contain strata of fine sandy loam, very fine sandy loam, silt loam, and silty clay. The lime content of the Cca horizon ranges from 6 to 25 percent; that of the rest of the profile ranges from 1 to 10 percent. On flood plains, the Cca horizon normally has common to many, fine to medium lime segregations and possibly a few, fine, very hard lime nodules, and is less than 10 percent lime. On alluvial fans above playas, the Cca horizon contains much disseminated lime and common to many, medium to coarse, very hard to extremely hard lime nodules, and is more than 10 percent lime. The depth to the Cca horizon ranges from 30 to 40 inches. The  $pH_5$  ranges from 8.4 to 9.2 in the Cca horizon and from 8.0 to 8.6 in the rest of the profile.

*Vinton series.*—The Vinton series consists of soils that have a coarse-textured control section but are otherwise similar to Glendale soils. Vinton soils are deep, somewhat excessively drained soils that developed in sandy alluvium derived from a mixture of rocks including granodiorite, latite, basalt, quartzite, and limestone.

Typical profile of Vinton loamy sand, located at the south quarter corner of sec. 36, T. 23 S., R. 63 E., in Eldorado Valley:

C1—0 to 36 inches, light-brown (7.5YR 6/4) loamy sand, brown (7.5R 5/3) when moist; single grained; loose when dry or moist; few very fine and fine roots, but plentiful very fine roots in the uppermost 7 inches; many very fine interstitial pores; effervescent;  $pH_5$  8.4; clear, smooth boundary. 24 to 60 inches thick.

C2—36 to 60 inches +, reddish-brown (5YR 5/4) loamy fine sand, reddish brown (5YR 4/4) when moist; massive; soft, very friable, nonsticky, nonplastic; few very fine roots; many very fine interstitial pores; effervescent;  $pH_5$  8.8.

The texture of the control section is predominantly loamy sand, but in places it is loamy fine sand. Thin

strata (no more than 12 inches thick) of gravelly light sandy loam, fine sandy loam, gravelly loamy sand, sand, and fine sand are also included. The color of the soil profile above a depth of 30 inches includes hues of 7.5YR and 10YR, and below a depth of 30 inches the hue may be as red as 5YR; values are 7 to 5 where the material is dry and 6 to 4 when it is moist, and chromas are 2 to 4. The amount of lime varies. Some fine threadlike segregations of lime may occur below a depth of 36 inches, but they are rare and occur mostly in lower lying positions adjacent to playas. The  $pH_5$  ranges from 8.2 to 9.2.

### Intrazonal soils

Intrazonal soils have more or less well-developed profile characteristics that reflect the dominating influence of some local factor of relief or parent material over the normal effects of climate and vegetation. The intrazonal soils in the Las Vegas and Eldorado Valleys Area are in the Calcisol and Solonchak great soil groups.

#### CALCISOLS

Calcification is evident in Calcisols. These soils have an A horizon that varies in thickness and color, a prominent horizon of lime accumulation, and parent material that is high to very high in carbonates. The lime accumulation is the result of low rainfall and incomplete removal of lime from the profile. It may be in the form of lime coatings on gravel, of lime nodules, or of cementation of the soil particles or the gravel with lime. The zone of accumulation is at approximately the depth to which water penetrates. Generally, Calcisols have no B horizons, because of low rainfall and the resulting incomplete leaching and because the parent material is low in ferromagnesian minerals, which produce clay.

Soils of the Las Vegas, Aztec, Cave, Eastland, Knob Hill, Pittman, and Tonopah series represent Calcisols in these valleys.

*Las Vegas series.*—The Las Vegas series consists of well-drained Calcisols of maximal development. These soils developed in alluvium derived mainly from limestone and partly from sandstone and quartzite. They are on alluvial fans and upland terraces under a sparse stand of creosotebush, white bur-sage, and big galleta.

Typical profile of Las Vegas loam (virgin), located at the north quarter corner of sec. 34, T. 19 S., R. 61 E., Mount Diablo base line and meridian in Las Vegas Valley:

A1—0 to 2 inches, light gray (10YR 7/2) loam, pale brown (10YR 6/3) when moist; weak, medium, platy structure; soft, friable, slightly sticky, slightly plastic; devoid of roots; weakly vesicular; violently effervescent; calcareous;  $pH_5$  8.3; abrupt, smooth boundary. ½ inch to 2½ inches thick.

C1ca—2 to 23 inches, white (10YR 8/1) gritty light clay loam, very pale brown (10YR 7/3) when moist; strong, medium, platy structure in uppermost 2 to 10 inches, massive in lower part; very hard, firm, sticky, plastic; no roots or pores; violently effervescent;  $pH_5$  8.6; abrupt, smooth boundary. 5 to 24 inches thick.

C2cam—23 to 60 inches +, white (10YR 8/1), indurated calcium carbonate hardpan, very pale brown (10YR 7/3) when moist; massive; upper part is troweled and contains many extremely thin laminae;  $pH_5$  8.7.

An erosion pavement is common. Caliche fragments about ½ inch to 3 inches in diameter are thinly scattered

on the surface. In some places there are few pebbles, and in others pebbles cover most of the surface. The color of the soil profile includes hues of 10YR and 7.5YR. The color of the A1 horizon includes values of 7 and 6 when the material is dry and 6 and 5 when it is moist and chromas of 2 and 3. The color of the Cca and Ccam horizons includes values of 8 and 7 when the material is dry and 7 and 6.5 when it is moist, and chromas of 1 to 3. The texture of the soil material above the pan ranges from light clay loam to loam. This part of the profile contains gravel and cobblestones, originally part of the pan. Ordinarily these fragments make up less than 15 percent of the soil material, and in no place do they amount to more than 25 percent. In most places the depth to the Ccam horizon, or pan, is between 6 and 25 inches, but in areas along drainageways and below erodible terrace breaks where there are fresh deposits of alluvium, the depth may be as much as 30 inches. The thickness of the pan ranges from 18 to 60 inches. The material is massive, has many extremely thin laminae in the upper part, and in some places contains a few solution cavities. The calcium carbonate equivalent of the soil is more than 40 percent.

**Aztec series.**—The Aztec series consists of soils that are similar to Las Vegas soils but lack an indurated Ccam horizon. Aztec soils developed in very gravelly, moderately coarse textured alluvium that was moderately high in gypsum. They are deep and well drained and have a Ccacs horizon weakly cemented with lime and gypsum.

Typical profile of Aztec gravelly loamy sand (virgin), located near the center of sec. 23, T. 23 S., R. 64 E., Mount Diablo base line and meridian in Eldorado Valley:

- A1—0 to 2 inches, pale-brown (10YR 6/3) gravelly loamy sand, brown (10YR 5/3) when moist; weak, medium, platy structure; soft to slightly hard, very friable; very few roots; many fine and medium vesicular pores; violently effervescent; pH<sub>s</sub> 8.6; abrupt, smooth boundary. ½ inch to 2 inches thick.
- C1—2 to 4 inches, very pale brown (10YR 7/3) gravelly sandy loam, brown (10YR 5/3) when moist; very weak, coarse, prismatic structure; slightly hard, very friable; few roots; violently effervescent; pH<sub>s</sub> 8.4; abrupt, smooth boundary. 2 to 5 inches thick.
- C2—4 to 12 inches, very pale brown (10YR 7/3) very gravelly sandy loam, pale brown (10YR 6/3) when moist; massive; soft to slightly hard, very friable; roots plentiful; violently effervescent; pH<sub>s</sub> 8.4; clear, wavy boundary. 6 to 14 inches thick.
- C3cacs—12 to 30 inches, white (10YR 8/2) very gravelly sandy loam, light gray (10YR 7/2) when moist; high in calcium carbonate and gypsum; massive; very hard, firm; few roots; violently effervescent; pH<sub>s</sub> 8.6; clear, wavy boundary.
- C4cs—30 to 60 inches, very pale brown (10YR 7/3) gravelly loamy sand (about 10 to 15 percent gypsum); pale brown (10YR 6/3) when moist; massive; hard, friable, non-sticky, nonplastic; very few fine roots; many very fine and fine interstitial pores; violently effervescent; pH<sub>s</sub> 7.6.

The surface is covered with a weak desert pavement of caliche fragments, lime nodules, and pebbles.

The texture of the control section is predominantly very gravelly sandy loam. The gravel content is 60 to 80 percent. The gravel consists of angular and sub-rounded fragments of limestone, caliche, andesite, and quartzite. Also, there are a few cobblestones. Thin strata (less than 8 inches thick) of gravelly sandy loam, very gravelly loamy sand, and very gravelly loam occur in places. The color of the profile is mainly 10YR in hue

but includes some 7.5YR. The color values in the A1 horizon are 6 and 7 when the material is dry and 5 and 6 when it is moist, and the chromas are 2 to 4. The values in the Ccacs and Ccs horizons are 8 and 7 when the material is dry and 7 and 6 when it is moist, and the chromas are 1 to 3. The depth to the Ccacs horizon ranges from 10 to 18 inches. Cementation in this horizon is weak; the consistence is firm to very firm if the material is moist. Thin strata (½ inch to 2 inches thick) of strongly cemented material are common. The degree of cementation in the Ccs horizon ranges from noncemented with many fine gypsum crystals to weakly gypsum cemented. The consistence of this horizon ranges from slightly hard to hard in the noncemented material to very hard in the gypsum-cemented material. The calcium carbonate content of the profile ranges from 5 to 30 percent; it is highest in the Ccacs horizon and is 5 to 15 percent in the Ccs horizon. Much of the calcium is well disseminated or occurs as coating on gravel. The pH of the Ccs horizon ranges from 7.4 to 8.0.

**Cave series.**—The Cave series consists of soils that are moderately coarse textured over an indurated pan but are otherwise similar to Las Vegas soils. These soils are well drained, are shallow or very shallow, and have developed in alluvium derived mainly from limestone. They are on alluvial fans and terraces under a sparse stand of creosotebush and white bur-sage.

Typical profile of Cave gravelly fine sandy loam (virgin), located about 500 feet west of the south quarter corner of sec. 34, T. 20 S., R. 60 E., Mount Diablo base line and meridian in Las Vegas Valley:

- A1—0 to 2 inches, pink (7.5YR 7/4) gravelly fine sandy loam, brown (7.5YR 5/4) when moist; weak, coarse, platy structure; slightly hard, friable, nonsticky, nonplastic; devoid of roots; many fine and medium vesicular pores; violently effervescent; pH<sub>s</sub> 8.2; abrupt, smooth boundary. ½ inch to 3 inches thick.
- C1—2 to 4 inches, pink (7.5YR 7/4) gravelly fine sandy loam, slightly finer textured than that in A1 horizon, strong brown (7.5YR 4/6) when moist; very weak, coarse, prismatic structure breaking to moderate, medium, platy; slightly hard, friable, nonsticky, nonplastic; few very fine roots; many very fine interstitial pores; strongly effervescent; pH<sub>s</sub> 8.3; abrupt, smooth boundary. 2 to 5 inches thick.
- C2ca—4 to 12 inches, pink (7.5YR 7/4) light sandy loam, strong brown (7.5YR 5/6) when moist; massive; soft, very friable; few very fine roots; few fine tubular pores; many very fine interstitial pores; violently effervescent; pH<sub>s</sub> 8.6; gradual, smooth boundary. 5 to 10 inches thick.
- C3ca—12 to 15 inches, reddish-yellow (7.5YR 7/6) gravelly sandy loam, strong brown (7.5YR 5/6) when moist; massive; soft, very friable; few very fine roots; few fine tubular pores; many very fine interstitial pores; violently effervescent; pH<sub>s</sub> 8.8; abrupt, wavy boundary. 3 to 8 inches thick.
- C4cam—15 to 35 inches +, pinkish-white (7.5YR 8/2) when dry and when moist; indurated lime hardpan; massive; pH<sub>s</sub> 8.2.

A well-developed desert pavement of gravel 1 inch to 2 inches in diameter is common. In places it covers less than 15 percent of the surface; in other places it covers more than 85 percent of the surface and has desert varnish on the exposed side of the gravel. The color of the soil profile includes hues of 7.5YR and 10YR, except in the C1 horizon, where it includes hues of 7.5YR and 5YR. The color values in the A1 horizon are 7 and 6 when the material is dry and 4 and 5 when it is moist, and the chromas are 2 to 4. The color values in the C1

horizon are similar to those on the A1 horizon, but the chromas are 4 to 6. The color values in the Cca horizons are 7 and 8 when the material is dry and 5 and 6 when it is moist, and the chromas are 2 to 6. The brighter chromas occur in profiles that have a C1 horizon. The color of the Ccam horizon is similar to that of the Cca horizons, except that the Ccam horizon has chromas of 1 to 3. The texture of the soil material above the pan is sandy loam or fine sandy loam. This part of the profile is nongravelly in places, and in others it is 5 to 40 percent gravel consisting of limestone, quartzite, and pan fragments. The depth to the indurated Ccam horizon, or pan, is between 4 and 24 inches in most places. The thickness of the pan ranges from 24 to more than 60 inches. The pan is massive and has many thin laminae in the upper part. It contains gravel in some places.

*Eastland series.*—The Eastland series consists of soils that are similar to Las Vegas soils but have a crudely stratified, coarse-textured, gravelly or very gravelly coarse-textured control section and a weakly lime-cemented Cca horizon below a depth of 36 inches. Eastland soils are very deep, well-drained Calcisols that developed in sandy and gravelly alluvium derived from a mixture of rocks, including limestone, basalt, andesite, rhyolite, and quartzite. They are on nearly level to gently sloping alluvial fans and terraces under a sparse stand of creosotebush and white bur-sage.

Typical profile of Eastland gravelly loamy sand (virgin), located about 500 feet northeast of the west quarter corner of sec. 7, T. 22 S., R. 63 E., Mount Diablo base line and meridian in Las Vegas Valley:

- C1—0 to 17 inches, pink (7.5YR 7/4) gravelly loamy sand, brown (7.5YR 4/4) when moist; massive; soft, very friable, nonsticky, nonplastic; few very fine and fine roots; many very fine and fine tubular pores; the uppermost inch contains many fine vesicular pores and common medium vesicular pores and is somewhat finer textured than the lower part; about 35 percent gravel; violently effervescent; pH<sub>s</sub> 8.4; abrupt, smooth boundary. 4 to 18 inches thick.
- IIC2—17 to 26 inches, pink (7.5YR 7/4) very gravelly sand, brown (7.5YR 4/4) when moist; massive; slightly hard, very friable, nonsticky, nonplastic; few very fine roots; many very fine and fine interstitial pores; about 80 percent gravel; violently effervescent; pH<sub>s</sub> 8.4; abrupt, smooth boundary. 0 to 12 inches thick.
- IIIC3—26 to 38 inches, light-brown (7.5YR 6/4) loamy sand, brown (7.5YR 4/4) when moist; massive; slightly hard, very friable, nonsticky, nonplastic; few very fine roots; few very fine and fine tubular pores; violently effervescent; pH<sub>s</sub> 8.2; clear, wavy boundary. 6 to 18 inches thick.
- IVC4ca—38 to 52 inches, pink (7.5YR 8/4), weakly lime-cemented sandy loam, light brown (7.5YR 6/4) when moist; massive; very hard, friable, slightly plastic; no roots observed; few very fine tubular pores; violently effervescent; pH<sub>s</sub> 8.6; clear, wavy boundary. 10 to 20 inches thick.
- VC5ca—52 to 60 inches +, pink (7.5YR 8/4), very weakly lime-cemented gravelly loamy sand, light brown (7.5YR 6/4) when moist; massive; slightly hard, very friable, nonsticky, nonplastic; many very fine and fine interstitial pores; violently effervescent; pH<sub>s</sub> 8.2.

The surface is covered with a moderately developed erosion pavement of gravel ½ inch to 2 inches in diameter.

The texture of the control section is commonly crudely stratified loamy sand, gravelly loamy sand, and very gravelly loamy sand. Strata of very gravelly sandy loam,

sand, and gravelly sand may be included also. If the fine earth fraction were mixed, the texture would be loamy sand. The coarse fraction is as much as 50 to 80 percent. It is predominantly gravel, but in places as much as 10 percent of it consists of cobblestones. Except in the Cca horizon, the color of the soil profile includes values of 7 and 6 when the material is dry and 5 and 4 when it is moist and chromas of 3 to 5. The depth to the Cca horizon ranges from 36 to 54 inches, and the thickness of the horizon from 18 to 36 inches. The degree of cementation is weak and grades to very weak with increasing depth. In places there are strongly cemented, discontinuous lenses ½ inch to 4 inches thick. The consistency of the Cca horizon ranges from hard to very hard and friable in the upper part, and from slightly hard to hard and very friable in the lower part. The strongly cemented lenses are generally extremely hard and firm or very firm. The calcium carbonate equivalent is more than 10 percent. The pH<sub>s</sub> ranges from 8.0 to 8.8; it is highest in the Cca horizon.

*Knob Hill series.*—The Knob Hill series consists of soils that are similar to Las Vegas soils, except that they are somewhat excessively drained and have a stratified, gravelly loamy sand and gravelly sandy loam control section and a weakly lime-cemented Cca horizon. Knob Hill soils are deep Calcisols that developed in sandy and gravelly alluvium derived from a mixture of rocks, including rhyolite, granodiorite, latite, basalt, limestone, and quartzite. They are on nearly level and gently sloping alluvial fans.

Typical profile of Knob Hill loamy sand (virgin), located at the southwest corner of sec. 27, T. 23 S., R. 64 E., Mount Diablo base line and meridian in Eldorado Valley:

- A1—0 to 7 inches, light-brown (7.5YR 6/4) loamy sand, brown (7.5YR 4/2) when moist; weak, coarse, platy structure; soft, very friable; few fine roots; very porous; effervescent; pH<sub>s</sub> 8.3; clear, smooth boundary. 4 to 8 inches thick.
- IIC1—7 to 23 inches, light-brown (7.5YR 6/4) gravelly loamy sand to very gravelly sand, brown (7.5YR 4/2) when moist; massive; soft, very friable; few very fine roots; very porous; effervescent; pH<sub>s</sub> 8.3; clear, wavy boundary. 12 to 18 inches thick.
- IIIC2ca—23 to 37 inches, pinkish-gray (7.5YR 7/2) gravelly fine sandy loam, brown (7.5YR 5/2) when moist; few to common, medium, white (N 8/0) lime nodules or soft accumulations of secondary lime; massive; slightly hard, friable, nonsticky, slightly plastic; violently calcareous; pH<sub>s</sub> 8.2; clear, wavy boundary. 10 to 18 inches thick.
- IVC3—37 to 60 inches, light-brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 5/2) when moist; few pebbles; massive; soft, very friable; effervescent; pH<sub>s</sub> 8.2; pebbles completely coated with lime.

Stratification in the control section includes fine sandy loam, loamy sand, and loamy fine sand, modified by gravel. If these materials are mixed, the clay content is 5 to 13 percent. The gravel content is ordinarily between 20 and 40 percent, but some very gravelly strata may be included. The color of the soil includes hues of 7.5YR and 10YR. In all but the Cca horizon, the color values are 6 and 7 when the material is dry and 5 and 4 when it is moist, and the chromas are 4 to 2. In the Cca horizon, the values are one unit higher for both dry and moist material, and the chromas are 2 and 1. The calcium carbonate content is such that the A1 and C horizons above the Cca horizon are noncalcareous to moderately

calcareous, and the other C horizons are strongly calcareous. The  $pH_5$  ranges from 8.0 to 8.6. The Cca horizon is weakly cemented; when dry, it is slightly hard or hard. Soft to hard lime concretions occur in the softer Cca horizons, and the gravel, if any, is completely lime coated.

*Pittman series.*—The Pittman series consists of soils that are somewhat similar to Las Vegas soils but have a weakly to strongly lime-cemented, stony, and very gravelly Cca horizon. Pittman soils are well-drained, very gravelly, coarse-textured, medial Calcisols that developed on gently sloping, gravelly and stony alluvial fans. The parent rocks are predominantly basalt but include some rhyolite and limestone. The vegetation consists of a sparse stand of creosotebush, white bur-sage, and cholla.

Typical profile of Pittman stony loamy sand (virgin), located about 1,000 feet west of the southeast corner of sec. 9, T. 22 S., R. 62 E., Mount Diablo base line and meridian in Las Vegas Valley:

- A1—0 to 1 inch, pinkish-gray (7.5YR 6/2) stony loamy sand, brown (7.5YR 4/2) when moist; very weak, medium, platy structure; soft, very friable, nonsticky; practically devoid of roots; weakly vesicular; violently effervescent;  $pH_5$  8.4; abrupt, smooth boundary. ½ inch to 2 inches thick.
- IIAc—1 inch to 6 inches, pinkish-gray (7.5YR 6/2) very gravelly loamy sand, brown (7.5YR 4/2) when moist; very weak, medium to fine, granular structure; soft, very friable, nonsticky, nonplastic; few roots; violently effervescent;  $pH_5$  8.4; clear, smooth boundary. 2 to 7 inches thick.
- IIIC1ca—6 to 26 inches, pinkish-gray (7.5YR 6/2) very gravelly loamy sand, brown (7.5YR 5/2) when moist massive, or very weak, medium to fine, granular structure; soft, very friable, nonsticky; fine roots plentiful; porous; violently effervescent; much more lime than in the IIAc horizon;  $pH_5$  8.2; clear, wavy boundary. 14 to 22 inches thick.
- IIIC2ca—26 to 46 inches, pinkish-gray (7.5YR 7/2) stony and very gravelly sandy loam, brown (7.5YR 5/3) when moist; massive; very hard, firm; weakly lime cemented; very few roots; violently effervescent;  $pH_5$  8.6; clear, wavy boundary. 10 to 30 inches thick.
- IVC3ca—46 to 60 inches +, pinkish-gray (7.5YR 7/2) very gravelly sand, brown (7.5YR 5/3) when moist; single grain; soft, loose, nonsticky; few roots; very porous; violently effervescent; lime is disseminated and on the bottom of pebbles; very rapidly permeable;  $pH_5$  8.4.

The surface is covered with a strongly developed erosion pavement of gravel, cobblestones, and stones, mostly basalt fragments.

The texture of the control section is predominantly very gravelly loamy sand, gravelly and cobbly loamy sand, or gravelly, cobbly, and stony loamy sand. Strata of sand, loamy fine sand, or sandy loam may be included. The content of coarse fragments ranges from 60 to 90 percent. These fragments are predominantly gravel, but up to 30 percent are cobblestones or stones. Color hues are 7.5YR and 10YR. The values in the A1 horizon are 6 and 7 when the material is dry and 4 and 5 when it is moist, and the chromas are 2 to 4. Values in the C horizons are 6 to 8 when the material is dry and 5 to 7 when it is moist, and chromas are 2 to 4. The Cca horizons may include strata that are not cemented, but they always include at least one stratum that is either weakly or strongly cemented. When moist, the cemented horizon ranges from firm to very firm in consistence. It may include thin (less than 1 inch), discontinuous, ex-

tremely hard, extremely firm, indurated seams. The depth to the weakly or strongly lime-cemented horizon ranges from 18 to 26 inches. The lime content of the profile is more than 10 percent and is at least 5 percent higher in the Cca horizons than in the C horizon. The  $pH$  ranges from 8.0 to 8.8.

*Tonopah series.*—The Tonopah series consists of soils that are somewhat similar to Las Vegas soils but are excessively drained, have a very gravelly and cobbly, coarse-textured control section, and are noncemented in the Cca horizon. Tonopah soils are deep, minimal Calcisols that formed in gravelly and cobbly sandy alluvium derived mainly from limestone and partly from sandstone and quartzite. The calcium carbonate equivalent is more than 40 percent. These soils are on alluvial fans and support a sparse stand of creosotebush and white bur-sage.

Typical profile of Tonopah cobbly loamy sand (virgin), located about 1,500 feet south of the center of sec. 17, T. 19 S., R. 60 E., Mount Diablo base line and meridian in Las Vegas Valley:

- A1—0 to ½ inch, light-brown (7.5YR 6/4) cobbly loamy sand, brown (7.5YR 4/3) when moist; weak, medium, platy structure; very weak, vesicular material between pebbles; soft, very friable, nonsticky, nonplastic; no roots; violently effervescent;  $pH_5$  8.4; abrupt, smooth boundary. ¼ to 1 inch thick.
- C1—½ inch to 6 inches, light-brown (7.5YR 6/4) cobbly and gravelly loamy sand, brown (7.5YR 4/3) when moist; massive; slightly hard, very friable, nonsticky, nonplastic; few fine roots; very porous; violently effervescent;  $pH_5$  8.6; gradual, smooth boundary. 5 to 6 inches thick.
- C2—6 to 22 inches, light-brown (7.5YR 6/4) gravelly cobbly sand, brown (7.5YR 5/4) when moist; massive; soft, very friable; few fine roots; very porous; violently effervescent;  $pH_5$  8.7; clear, wavy boundary. 8 to 20 inches thick.
- C3ca—22 to 33 inches, similar to C2 horizon in color, texture, structure, and consistence but contains a larger quantity of disseminated and segregated lime; lime coats most of the pebbles and holds the soil and pebbles together; violently effervescent;  $pH_5$  8.9; clear, wavy boundary. 8 to 24 inches thick.
- C4—33 to 60 inches +, similar to C2 horizon in color, texture, and structure but contains much less segregated lime; single grained; loose, both when dry and when moist; very porous; violently effervescent;  $pH_5$  8.6.

The texture of the control section is gravelly, cobbly, and stony sand or loamy sand. The content of coarse fragments ranges from 80 to 98 percent. Gravel is predominant. The content of cobblestones is normally about 20 percent. The content of stones is usually no more than 15 percent, except on the higher part of the fans, where it may be as much as 30 percent. The Cca horizon is uncemented or weakly cemented; it is slightly hard in consistence when dry. All coarse fragments are lime coated, at least on the underside. This soil has a distinct Cca horizon within the uppermost 18 to 30 inches. Several additional Cca horizons, weakly to strongly cemented, may occur at varying depths below 30 inches, but these are not typical of the series.

#### SOLONCHAKS

Solonchaks have a strong concentration of soluble salts at or near the surface that result from evaporation of saline ground water. These soils occur on nearly level flood plains and lake bars, on toe slopes of alluvial fans, and on margins of playas. They formed under a sparse

cover of salt-tolerant grasses and shrubs, mostly in an arid, semiarid, or subhumid climate. Drainage was poor or imperfect during the period of soil formation but is now moderately good in some places.

Soils of the Land, Mead, Paradise, Laveldo, McCarran, Bracken, and Spring series represent Solonchaks in the Las Vegas and Eldorado Valleys. Only Land and Mead soils, however, are typical Solonchaks. The other soils, although classified as Solonchaks, differ significantly from the soils described as representative of this great soil group.

*Land series.*—The Land series consists of very deep, moderately well drained, stratified, moderately fine textured and medium-textured soils that have a prominent horizon of salt accumulation. These soils occur on nearly level flood plains under salt-tolerant vegetation. The parent material was derived from shale, limestone, sandstone, crystalline quartz-bearing rocks, and old lake-laid deposits.

Typical profile of Land silty clay loam (virgin), located at the west quarter corner of sec. 32, T. 20 S., R. 62 E., Mount Diablo base line and meridian in Las Vegas Valley:

A1—0 to 3 inches, pink (7.5YR 7/4) silty clay loam, brown (7.5YR 5/4) when moist; weak, medium to thick, platy structure; slightly hard, friable, sticky; few fine roots; many very fine vesicular pores, common fine vesicular pores, few medium vesicular pores, and few very fine tubular pores; violently effervescent;  $pH_5$  8.0; abrupt, smooth boundary. 1 inch to 5 inches thick.

IIC1sa—3 to 8 inches, white (10YR 8/1) fine sandy loam, pale brown (10YR 6/3) when moist; moderate, very fine, granular structure; soft, very friable; few fine roots; many very fine interstitial pores and a few fine tubular pores; extremely high in salt and contains many fine gypsum crystals; violently effervescent;  $pH_5$  8.0; abrupt, smooth boundary. 4 to 7 inches thick.

IIC2sa—8 to 14 inches, light-brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) when moist; massive; soft, very friable; few fine roots; few fine tubular pores; violently effervescent;  $pH_5$  8.0; abrupt, smooth boundary. 5 to 10 inches thick.

IIC3—14 to 27 inches, silt loam similar to IIC2sa horizon in color; massive; hard, friable, slightly sticky, non-plastic; few fine roots; few fine tubular pores; violently effervescent;  $pH_5$  8.0; clear, smooth boundary. 5 to 15 inches thick.

IVC4—27 to 34 inches, pink (7.5YR 7/4) light silty clay loam, brown (7.5YR 5/4) when moist; common, fine, prominent, white (7.5YR 8/0) flecks of gypsum; massive; slightly hard, friable, sticky, plastic; violently effervescent;  $pH_5$  8.2; clear, smooth boundary. 3 to 15 inches thick.

IVC5cs—34 to 60 inches +, pink (7.5YR 8/4) light silty clay loam, light brown (7.5YR 6/4) when moist; many, fine, distinct, white (N 8/0) flecks of gypsum; massive; hard, friable, sticky, plastic; violently effervescent;  $pH_5$  8.2.

The texture of the control section is predominantly silt loam or silty clay loam. The clay content is more than 17 percent. Strata less than 8 inches thick of fine sandy loam, very fine sandy loam, or silty clay are included. Color hues are 7.5YR and 10YR throughout the profile. The color values in the A1 horizon depend on the salt content, the plant density, and the organic-matter content. The values are 7 to 5 when the material is dry and 5 and 4 when it is moist. Chromas are 4 to 2 for both dry and moist material. The color in the upper part of the Csa horizon is normally white when the soil is dry and approaches the base color of the other C horizons when the soil is moist. The salt content in the Csa hori-

zon exceeds 2 percent, even if the soil is irrigated. The color values of the C horizon are normally 6 and 7 when the material is dry and 4 and 5 when it is moist. If there is an accumulation of gypsum or lime below a depth of 36 inches, the value is 8 if the material is dry and 6 if it is moist. If there is an accumulation of organic matter, a value of 5 can be expected for dry material. The soil is calcareous, but lime segregations are not an identifying characteristic. Gypsum segregations are common but also are not an identifying characteristic. The  $pH_5$  ranges from 7.6 to 9.0. Slightly and strongly saline phases occur. The soil names denoting salinity phases reflect conditions in the plow layer, or to a depth of 10 inches. The depth to the Csa horizon in the slightly saline phase is between 12 and 30 inches.

*Mead series.*—The Mead series consists of soils that have a fine-textured control section and are predominantly of 5YR hue but are otherwise similar to Land soils. Mead soils are deep, imperfectly drained Solonchaks that formed in alluvium derived from a mixture of igneous and sedimentary rocks. They occur on the toe slopes of alluvial fans and on the margins of playas under sparse, salt-tolerant vegetation.

Typical profile of Mead clay (virgin), located at the west quarter corner of sec. 15, T. 24 S., R. 63 E., Mount Diablo base line and meridian in Eldorado Valley:

A1—0 to 2 inches, pale-brown (10YR 6/3) clay, brown (10YR 4/3) when moist; massive; hard, friable, slightly sticky; no roots observed; many fine and medium vesicular pores; violently effervescent;  $pH_5$  9.2; abrupt, smooth boundary. ½ inch to 2½ inches thick.

IIC1—2 to 6 inches, reddish-brown (5YR 5/4) gravelly clay loam or clay, reddish brown (5YR 4/4) when moist; very weak, coarse, prismatic structure that breaks to weak, thick, platy; hard, friable, sticky; no roots observed; few very fine tubular pores; violently effervescent;  $pH_5$  8.2; abrupt, smooth boundary. 3 to 5 inches thick.

IIC2sa—6 to 14 inches, light-brown (7.5YR 6/4) silty clay, brown (7.5YR 4/4) when moist; moderate, fine, sub-angular blocky structure; hard, firm, very sticky, very plastic; no roots observed; many very fine interstitial pores; violently effervescent;  $pH_5$  8.8; clear, wavy boundary. 6 to 15 inches thick.

IVC3sa—14 to 27 inches, light reddish-brown (5YR 6/4) clay, reddish brown (5YR 4/3) when moist; strong, fine, sub-angular blocky structure; extremely hard, very firm, very sticky, very plastic; no roots observed; common very fine interstitial pores; violently effervescent;  $pH_5$  8.7; abrupt, irregular boundary. 10 to 20 inches thick.

VC4—27 to 31 inches, pink (5YR 7/3) clay loam, reddish brown (5YR 5/3) when moist; massive; hard, friable, sticky, plastic; no roots observed; many fine and very fine tubular pores; violently effervescent;  $pH_5$  8.6; abrupt, irregular boundary. 2 to 6 inches thick.

VIC5—31 to 60 inches, light reddish-brown (5YR 6/3) clay, reddish brown (5YR 4/3) when moist; massive; very hard, very firm, very sticky, very plastic; no roots observed; common very fine and fine tubular pores; violently effervescent;  $pH_5$  8.6.

The texture of the control section is predominantly clay or silty clay, but in places there are thin strata of clay loam or silty clay loam. The color of the A1 horizon includes hues of 10YR and 7.5YR, values of 6.5 and 5.5 when the material is dry and 4 and 5 when it is moist, and chromas of 2 to 4. The color in the rest of the profile includes hues of 5YR and 7.5YR, values of 6 and 7 when the material is dry and 4 and 5 when it is moist, and chromas of 4 and 3. In some places in the Csa hori-

zon the value is 8 when the material is dry. The structure of the Csa horizon is either granular or strong, very fine to fine, subangular blocky. The salt content of this horizon exceeds 2 percent, and there are visible salt crystals in many places. Gypsum segregations may be observed but are not characteristic. The pH ranges from 9.6 to 8.4. Below a depth of 20 inches, it normally decreases gradually.

**CALCIUM CARBONATE SOLONCHAKS.**—These soils resemble Calcisols. The zone of lime accumulation, however, does not result from calcification but from precipitation of lime by evaporation of lime-enriched ground water. Calcium Carbonate Solonchaks formed under poor drainage conditions but are now imperfectly drained to well drained. Normally, they have a dark-colored A1 horizon high in organic-matter content, because vegetation grew abundantly while the soils were poorly drained. The better drained soils lack the dark-colored A1 horizon and contain only small amounts of organic matter.

Soils of the Paradise and Laveldo series represent Calcium Carbonate Solonchaks in these valleys.

**Paradise series.**—The Paradise series consists of very deep, imperfectly drained, silty soils that developed under grass in areas adjacent to springs or seeps. These soils have a dark-colored A1 horizon over a white, marly, discontinuous, weakly to strongly lime-cemented, nodular Cca horizon.

Typical profile of Paradise silt loam (virgin), located about 1,200 feet southeast of the west quarter corner of sec. 25, T. 20 S., R. 61 E., Mount Diablo base line and meridian in Las Vegas Valley:

- A1—0 to 2 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) when moist; weak, medium and fine, granular structure; slightly hard, friable, slightly sticky, slightly plastic; abundant very fine and fine roots; many very fine interstitial pores; violently effervescent; pH<sub>s</sub> 8.4; abrupt, smooth boundary. 0 to 10 inches thick.
- A12—2 to 7 inches, gray (10YR 5/1) loam, very dark gray (10YR 3/1) when moist; massive; hard, friable, slightly sticky, slightly plastic; very fine and fine roots; common very fine and fine tubular pores; violently effervescent; pH<sub>s</sub> 8.4; gradual, smooth boundary. 2 to 12 inches thick.
- C1—7 to 14 inches, light-gray (10YR 7/1) silt loam, grayish brown (10YR 5/2) when moist; massive; slightly hard, friable, slightly sticky, slightly plastic; plentiful very fine roots and few fine roots; common very fine tubular pores and few fine tubular pores; violently effervescent; pH<sub>s</sub> 8.2; clear, smooth boundary. 0 to 8 inches thick.
- C2—14 to 31 inches, light-gray (10YR 7/1) silt loam, light brownish gray (10YR 6/2) when moist; massive; slightly hard, friable, slightly sticky, slightly plastic; plentiful very fine roots; common very fine tubular pores; violently effervescent; pH<sub>s</sub> 8.2; abrupt, wavy boundary. 12 to 24 inches thick.
- C3ca—31 to 50 inches +, white (10YR 8/1) silt loam, light brownish gray (10YR 6/2) when moist; massive; very hard, firm, slightly sticky, slightly plastic; few very fine roots; about 40 percent of this layer consists of extremely firm lime nodules  $\frac{1}{4}$  inch to about 1 inch in diameter and 2 to 3 inches in length; violently effervescent; pH<sub>s</sub> 8.4.

In a virgin soil the thickness of the A1 horizon ranges from 12 to 20 inches. In areas that have been leveled and cultivated, the thickness of this horizon ranges from 2 inches to more than 24 inches. The color values in the A1 horizon are 4 and 5 when the material is dry and 2 and 3 when it is moist, and the chromas are 1 and 2. The texture of the control section is silt loam; the clay content is 18 percent or more. Some stratification with loam or

silty clay loam is not uncommon. The color values of the Cca horizons are 8 and 7 when the material is dry and 7 and 6 when it is moist, and the chromas are 1 and 2. In places the A1 horizon is underlain by a Cca horizon that has a value of 5 when moist. The Cca horizon is a hard or slightly hard marly accumulation. In places it contains many, large, extremely firm nodules of lime or discontinuous strata of strongly lime-cemented material. The depth to these concretions or to the strongly cemented material ranges from 24 to more than 60 inches. The pH<sub>s</sub> ranges from 8.2 to 8.6.

**Laveldo series.**—The Laveldo series consists of soils that are somewhat similar to Paradise soils but have a lighter colored A1 horizon and are well drained or moderately well drained. Laveldo soils are deep, moderately fine textured Calcium Carbonate Solonchaks that formed on lake bars or embankments under a sparse stand of creosotebush and white bur-sage. The parent material was derived from a mixture of rocks. The characteristic lime nodules or concretions in these soils formed when there was water in the lake and the drainage was no better than imperfect.

Typical profile of Laveldo clay (virgin), located about 800 feet east of the northwest corner of sec. 3, T. 24 S., R. 63 E., Mount Diablo base line and meridian in Eldorado Valley:

- A1—0 to 2 inches, light reddish-brown (5YR 6/3) clay, reddish brown (5YR 4/4) when moist; moderate, medium, prismatic structure breaking to weak, thick and medium, platy; slightly hard, very friable, sticky, plastic; practically devoid of roots; many fine and medium vesicular pores; violently effervescent; pH<sub>s</sub> 9.0; abrupt, wavy boundary. 1 inch to 3 inches thick.
- C1—2 to 4 inches, light reddish-brown (5YR 6/4) clay, reddish brown (5YR 4/4) when moist; weak, medium, prismatic structure breaking to moderate, medium, platy; slightly hard, very friable, sticky, plastic, but plates are very hard and very firm; practically devoid of roots; common fine and medium vesicular pores within the platy material; many very fine and fine interstitial pores; violently effervescent; pH<sub>s</sub> 8.8; abrupt, wavy boundary. 2 to 4 inches thick.
- C2ca—4 to 8 inches, light reddish-brown (5YR 6/4) light clay loam, reddish brown (5YR 4/4) when moist; massive; soft, very friable, sticky, plastic; no roots observed; many very fine and fine interstitial pores; violently effervescent; common, fine and medium, distinct, white nodules of lime; pH<sub>s</sub> 8.0; abrupt, wavy boundary. 0 to 8 inches thick.
- C3ca—8 to 60 inches +, very pale brown (10YR 7/3) light clay loam, brown (7.5YR 5/3) when moist; massive; slightly hard, friable, sticky, plastic; no roots observed; few to common fine and very fine tubular pores; violently effervescent; many white (10YR 8/2), hard to extremely hard, angular or subangular nodules of lime and fragments of lime and a few angular fragments of crystalline gypsum that range up to about 1 inch in diameter; pH<sub>s</sub> 8.0.

The surface is covered with a weak erosion pavement of angular and subangular lime fragments and somewhat elongated lime nodules that range to about  $\frac{3}{8}$  inch in diameter and  $\frac{1}{2}$  to  $\frac{3}{4}$  inch in length. To a depth of 6 to 20 inches, the color includes hues of 5YR and 7.5YR, values of 5.5 to 7 when the material is dry and of 3.5 to 5 when it is moist, and chromas of 4 to 2. In the rest of the profile the color includes hues of 10YR and 7.5YR, values of 7 and 8 when the material is dry and 5 and 6 when it is moist, and chromas of 1 to 3. The texture of the control section is predominantly clay loam but is silty clay loam

in spots. The clay content is 24 to 35 percent, and the content of sand coarser than very fine sand is more than 15 percent. In some places minor stratification occurs in the control section. The depth to the Cca horizon ranges from 4 to 16 inches. Ordinarily, there is a thin, transitional Cca horizon, which contains few to many, fine to medium, very hard lime nodules, above a prominent Cca horizon. The prominent Cca horizon may be uniform in content of lime nodules, or it may consist of a few to several strata in which the content of nodules ranges from 15 to 50 percent. The nodules range from ½ inch to 2 inches in diameter, from ¾ inch to 3 inches in length, and from angular to subangular in shape. They have many surface irregularities and distinct branches. The pH<sub>s</sub> of the soil profile decreases with depth. It ranges from 9.0 to 9.6 in the A1 horizon and from 8.0 to 8.6 in the Cca horizon.

**Gypsic Solonchaks.**—These soils are similar to Calcisols and to Calcium Carbonate Solonchaks, except that gypsum, rather than calcium carbonate, has been redistributed in the profile. The redistribution is the result of the downward movement and subsequent concentration of gypsum, caused by rainfall, and of limited upward movement of gypsum-enriched ground water and precipitation of gypsum when the water evaporates. Gypsic Solonchaks developed from alluvium unusually high in gypsum. They occur on nearly level to moderately sloping terraces and on steep, eroded terrace breaks. They are moderately well drained and imperfectly drained, moderately coarse textured or moderately fine textured, gravelly or cobbly soils.

Soils of the McCarran, Bracken, and Spring series represent Gypsic Solonchaks in these valleys.

**McCarran series.**—The McCarran series consists of moderately coarse textured, moderately well drained soils that developed in sediments of the highly gypsiferous Muddy Creek formation. The parent material has undergone little change, but gypsum and salts have been leached from the surface layer and subsequently have accumulated in the subsoil and substratum. These soils occur on nearly level to moderately sloping terraces under a sparse stand of desert shrubs.

Typical profile of McCarran fine sandy loam (virgin), located about 500 feet north and 500 feet west of the southeast corner of sec. 24, T. 21 S., R. 61 E., Mount Diablo base line and meridian in Las Vegas Valley:

A11—0 to ½ inch, pink (7.5YR 7/4) fine sandy loam, light brown (7.5YR 6/4) when moist; weak, medium, platy structure; soft, very friable; few fine roots; weakly vesicular; strongly effervescent; pH<sub>s</sub> 8.4; abrupt, smooth boundary. ½ inch to 4 inches thick.

A12cs—½ inch to 8 inches, pink (7.5YR 7/4) loamy fine sand, light brown (7.5YR 6/4) when moist; massive; soft, very friable; plentiful fine roots; very porous; strongly effervescent; pH<sub>s</sub> 8.4; clear, smooth boundary. 0 to 18 inches thick.

IIC1cs—8 to 15 inches, pink (7.5YR 8/4) fine sandy loam, pink (7.5YR 7/4) when moist; common fine gypsum crystals and a few very hard, very fine, faint, white nodules of lime; massive; soft to slightly hard, friable; few very fine roots; very porous; violently effervescent; pH<sub>s</sub> 8.4; clear, wavy boundary. 5 to 15 inches thick.

IIC2cs—15 to 28 inches, pink (7.5YR 8/4) fine sandy loam, pink (7.5YR 7/4) when moist; massive; moderately high content of gypsum; soft to slightly hard, friable, slightly sticky, slightly plastic; few very fine roots; few to common very fine tubular pores; violently effervescent; pH<sub>s</sub> 8.2; abrupt, wavy boundary. 6 to 26 inches thick.

IIIC3cs—28 to 48 inches +, pinkish-white (7.5YR 8/2) mass of gypsum crystals that feel like loam, pink (7.5YR 7/4)

when moist; massive; hard to very hard, firm to very firm, nonsticky, slightly plastic; effervescent; pH<sub>s</sub> 7.0.

The texture of the control section is predominantly fine sandy loam. The clay content is less than 17 percent, and the gypsum content is very high. Minor stratification within sandy loam, loam, silt loam, and loamy fine sand occurs. The color hues are 7.5YR and 10YR. The values in the A1 horizon are 7 and 8 when the material is dry and 6 and 6.5 when it is moist. The chromas are 2 to 4. The lower part of the A1 horizon is generally massive, but in places it is weakly prismatic. The depth to the Ccs horizon ranges from ½ inch to 18 inches. The chromas in this horizon are 4 to 2. The consistence varies considerably, depending on the amount and form of the gypsum. The horizons that contain very small crystals are soft and very friable; others are weakly gypsum cemented, very hard, and very firm. The lime content of the Ccs horizon varies from low to very high. The pH<sub>s</sub> ranges from 7.0 to 8.4. The thickness ranges from 20 to more than 48 inches. Below a depth of 24 inches and underlying the Ccs horizon is unconformable, softly consolidated, valley-fill material of varying textures. This material is gypsiferous but contains at least 5 percent less gypsum than the Ccs horizon. It is normally hard or very hard and firm or very firm. The depth to this unconformable material ranges from 27 inches to more than 60 inches. Locally, a 6- to 14-inch indurated lime hardpan occurs below a depth of 36 inches in the substratum.

**Bracken series.**—The Bracken series consists of soils that are 20 to 40 percent gravel or cobblestones and are noncalcareous in the substratum but are otherwise similar to McCarran soils. Bracken soils are deep, moderately well drained, gravelly or cobbly, moderately coarse textured Gypsic Solonchaks that developed on dissected and eroded old terraces or valley fills under a sparse stand of desert shrubs. The parent rocks include gypsum, limestone, shale, sandstone, quartzite, and basalt.

Typical profile of Bracken gravelly fine sandy loam (virgin), located about 600 feet west of the center of sec. 34, T. 20 S., R. 62 E., Mount Diablo base line and meridian in Las Vegas Valley:

A11—0 to 2 inches, very pale brown (10YR 7/4) gravelly fine sandy loam; yellowish brown (10YR 5/4) when moist; moderate, medium, platy structure; slightly hard, very friable, nonsticky; few very fine roots; many fine vesicular pores and common medium vesicular pores; violently effervescent; pH<sub>s</sub> 8.8; abrupt, smooth boundary. ½ inch to 4 inches thick.

A12—2 to 6 inches, similar to the A11 horizon in color and texture; massive; slightly hard, very friable, slightly sticky; few very fine and fine roots; common very fine tubular pores and few fine tubular pores; violently effervescent; pH<sub>s</sub> 8.8; abrupt, wavy boundary. 0 to 7 inches thick.

C1csca—6 to 14 inches, pinkish-white (7.5YR 8/2) gravelly fine sandy loam, pink (7.5YR 7/4) when moist; massive; finely disseminated gypsum and calcium carbonate; very hard, friable, nonsticky, nonplastic; few very fine and fine tubular pores; violently effervescent; pH<sub>s</sub> 8.4; abrupt, wavy boundary. 5 to 10 inches thick.

C2cs—14 to 20 inches, pink (7.5YR 8/4) gravelly light fine sandy loam; pink (7.5YR 7/4) when moist; contains less lime than the C1csca horizon and less gypsum than the C3cs horizon; massive; hard, very friable; no roots observed; many very fine interstitial pores; strongly effervescent; pH<sub>s</sub> 8.4; abrupt, wavy boundary. 0 to 14 inches thick.

C3cs—20 to 60 inches +, white (10YR 8/1), weakly cemented gravelly fine sandy loam, light gray (10YR 7/1) when moist; contains finely divided crystalline gypsum; mas-

sive; very hard, firm, slightly sticky; common very fine and fine interstitial pores; effervescent in spots; pH<sub>5</sub> 7.4.

The texture of the control section is predominantly gravelly or cobbly fine sandy loam. The clay content is less than 17 percent. The content of gravel and cobblestones, which are subrounded and rounded fragments of limestone, basalt, and quartzite, ranges from 20 to 40 percent. A few stones occur also. In most places the soil contains both gravel and cobblestones. At the lower edges of the terraces, gravel is predominant, and at the higher elevations, cobblestones are predominant. Minor stratification with sandy loam, coarse sandy loam, loamy fine sand, or loamy sand occurs. The color in the profile includes hues of 10YR and 7.5YR. The color values in the A1 horizon are 7 and 7.5 when the material is dry and 5 and 6 when it is moist, and chromas are 4 to 2. In the Ccsca horizon and the upper part of the Ccs horizon, the chromas are 4 to 2, depending on the amount of lime and gypsum. If the chroma is 2, the material contains many, fine to coarse, colorless gypsum crystals. The pH<sub>5</sub> in the Ccsca horizon and the upper part of the Ccs horizon ranges from 7.8 to 8.6. In the lower part of the Ccs horizon, it ranges from 7.0 to 7.6. The lower part is generally noncalcareous but is effervescent in spots. The depth to the weakly cemented horizon ranges from 6 to 33 inches.

*Spring series.*—The Spring series consists of soils that are similar to McCarran soils, except that they have a moderately fine textured control section, are imperfectly drained, and are 5YR in hue. Spring soils are deep Gypsic Solonchaks that occur on nearly level alluvial terraces adjacent to, but slightly above, the more recent flood plains. The parent materials were derived from limestone and shale, and from the marly and gypsiferous Muddy Creek formation, which is of lacustrine origin. The Ccs horizon has formed as a result of the downward movement of gypsum through leaching and its upward movement and precipitation caused by a high water table.

Typical profile of Spring clay loam (virgin), located about 800 feet northwest of the southeast corner of sec. 36, T. 20 S., R. 61 E., Mount Diablo base line and meridian in Las Vegas Valley:

- A1—0 to 3 inches, light reddish-brown (5YR 6/4) clay loam, reddish brown (5YR 4/4) when moist; few, fine, prominent, white gypsum crystals; weak, medium, subangular blocky structure that breaks with slight pressure to weak, medium and fine, granular; slightly hard, very friable, sticky, plastic; few fine roots; few very fine tubular pores; many very fine interstitial pores; violently effervescent; pH<sub>5</sub> 8.0; abrupt, smooth boundary. 2 to 4 inches thick.
- C1—3 to 5 inches, similar to the A1 horizon, but is massive and contains plentiful fine roots. 2 to 4 inches thick.
- C2—5 to 8 inches, clay loam; similar to the A1 horizon in color, but contains few to common, prominent, very fine and fine, white gypsum crystals; moderate, coarse, prismatic structure; hard, very friable, sticky, plastic; plentiful fine roots; common very fine tubular pores; violently effervescent; pH<sub>5</sub> 8.4; abrupt, smooth boundary. 2 to 5 inches thick.
- C3—8 to 10 inches, similar to the C2 horizon but is massive. 2 to 4 inches thick.
- C4cs—10 to 21 inches, pink (5YR 7/3) clay loam, light reddish brown (5YR 6/4) when moist; many, fine, prominent, white gypsum crystals; massive; hard, friable, sticky, plastic; plentiful fine roots; common very fine and fine tubular pores; effervescent; pH<sub>5</sub> 7.8; clear, smooth boundary. 8 to 13 inches thick.
- C5cs—21 to 43 inches, pink (5YR 8/3) light clay loam, pink (5YR 7/3) when moist; massive; hard, friable, sticky,

plastic; few fine roots; few fine and very fine tubular pores; noneffervescent; very high in gypsum; pH<sub>5</sub> 7.0; clear, wavy boundary. 15 to 26 inches thick.

C6cs—43 to 49 inches, pink (5YR 7/3) silt loam, reddish brown (5YR 5/3) when moist; common, fine, distinct, white gypsum crystals; massive; hard, friable, nonsticky, slightly plastic; few fine roots; many very fine tubular pores and few fine tubular pores; noneffervescent; pH<sub>5</sub> 7.0; clear, wavy boundary. 5 to 15 inches thick.

C7—49 to 69 inches +, pink (5YR 7/4) silt loam high in content of gypsum; reddish brown (5YR 5/4) when moist; massive; slightly hard, friable, nonsticky, slightly plastic; no roots; few very fine tubular pores; strongly effervescent; pH<sub>5</sub> 7.8.

The texture of the control section is predominantly clay loam but is silty clay loam in places. Some minor stratification with silt loam, very fine sandy loam, or light clay occurs. The color hue is 5YR. The values in the A1 horizon are 5.5 and 7 when the material is dry and 4 and 5 when it is moist. The chroma are 3 and 4 in either moist or dry material. The depth to the uppermost Ccs horizon ranges from 8 to 30 inches. The thickness of the Ccs horizons ranges from 30 to 50 inches or more. The color values are 8 and 7 when the material is dry and 7 to 5 when it is moist, and the chromas are 3 and 2 in either moist or dry material. The consistence of the Ccs horizons ranges from slightly hard to very hard. Effervescence ranges from none to strong. The pH<sub>5</sub> values range from 7.0 to 7.8. In the C horizon, the color values are 7 and 6 when the material is dry and 6 and 5 when it is moist, and the chromas are 3.5 and 4.5 in either dry or moist material. The pH<sub>5</sub> ranges from 7.8 to 8.8.

### Zonal soils

Zonal soils are well developed and reflect the dominant influence of climate and living organisms, chiefly vegetation. The zonal soils in the Las Vegas and Eldorado Valleys Area are in the Red Desert great soil group.

#### RED DESERT SOILS

Red Desert soils form under a sparse cover of shrubs in a hot, arid climate. Because the amount of rainfall is small, weathering and leaching are limited and consequently a shallow solum is normal for these soils. Also, because the scant rainfall limits plant growth, the supply of nitrogen and organic matter is very low. The surface of these soils normally is protected by a desert pavement of gravel and cobblestones, some of which are coated with desert varnish. Except in eroded areas, there is a strongly vesicular A1 horizon that has thin platy structure. This horizon shows little, if any, color modification, because of very low organic-matter content. It is underlain by a thin color B2 horizon or by a textural B2t horizon. Varying degrees of calcification or accumulations of soluble salts may occur in the lower part of the B horizon, in the C horizon, or in both.

A B2 horizon typically forms through the accumulation of clay, iron, or aluminum, or the development of a blocky or prismatic structure, or a combination of these. A color B2 horizon forms if there is oxidation of iron from iron-bearing minerals and no noticeable clay accumulation. Oxidation imparts a redder color to this horizon than to other parts of the soil. It is accompanied by weak structural aggregation. A textural B2t horizon forms if clay has accumulated either through the formation of clay minerals in place or through eluviation. It is

likely that many of the textural B2t horizons formed when rainfall was higher than it is at present.

The age of a Red Desert soil is generally denoted by the development of the B horizon. Soils that have only a color and structural B2 horizon and a B2t horizon in which there has been only a slight increase in clay content through illuviation are considered youthful, or of minimal development. Conversely, soils that have a thick, fine-textured B2t horizon are the oldest and are of maximal development.

Soils of the Arden, Casa Grande, Gass, Goodsprings, Grapevine, Jean, McCullough, and Skyhaven series represent the Red Desert soils in these valleys. Arden, Grapevine, Jean, and McCullough soils, which have only a color or structural B2 horizon, are typical Red Desert soils of minimal development, as are Goodsprings soils, which have a textural B2t horizon. Casa Grande and Skyhaven soils are typical soils of medial development, and Gass soils are typical soils of maximal development.

**RED DESERT SOILS OF MINIMAL DEVELOPMENT.**—In the following paragraphs are brief descriptions of five series typical of this stage of development and a representative profile for each.

**McCullough series.**—The McCullough series consists of well-drained, moderately coarse textured Red Desert soils that developed in alluvium derived from sandstone, limestone, shale, and quartzite. These soils are on eroded valley plains, terraces, and fans. They support a sparse stand of desert shrubs. Typically, they have a thin A1 horizon, very low in organic-matter content, over a thin, prismatic, light reddish-brown B2 horizon.

Typical profile of McCullough fine sandy loam (virgin), located in the center of SE¼ sec. 6, T. 22 S., R. 61 E., Mount Diablo base line and meridian in Las Vegas Valley:

- A1—0 to 1½ inches, pink (7.5YR 7/4) fine sandy loam, brown (7.5YR 5/4) when moist; moderate, medium, platy structure; slightly hard, friable, nonsticky, nonplastic; no roots; strongly vesicular; violently effervescent; pH<sub>s</sub> 8.4; abrupt, smooth boundary. ½ inch to 3 inches thick.
- B2—1½ to 8 inches, light reddish-brown (5YR 6/4) fine sandy loam, yellowish red (5YR 4/6) when moist; very weak, coarse, prismatic structure that breaks to very weak, thick, platy; soft, very friable, nonsticky, nonplastic; few roots; violently effervescent; pH<sub>s</sub> 8.6; abrupt, smooth boundary. 5 to 10 inches thick.
- IIC1—8 to 17 inches, very pale brown (10YR 7/3) loam or very fine sandy loam, brown (10YR 5/3) when moist; few, medium, faint, white (10YR 8/2) lime mottles; massive, or weak, platy structure; slightly hard, very friable, nonsticky, nonplastic; few roots; violently effervescent; pH<sub>s</sub> 8.8; clear, wavy boundary. 6 to 12 inches thick.
- IIC2—17 to 26 inches, pink (7.5YR 8/4) loam, light brown (7.5YR 6/4) when moist; few, very fine, reddish-yellow (7.5YR 7/8 and 5YR 6/8) iron mottles; very weak, thick, platy structure; hard, friable, nonsticky, slightly plastic; few roots; violently effervescent; pH<sub>s</sub> 8.8; clear, wavy boundary. 6 to 14 inches thick.
- IIIC3—26 to 40 inches +, reddish-yellow (7.5YR 8/6) loamy fine sand, reddish yellow (7.5YR 6/6) when moist; massive; slightly hard to soft, very friable, nonsticky, nonplastic; few fine roots; violently effervescent; pH<sub>s</sub> 8.8.

The solum is 5 to 12 inches thick. The A1 horizon has color hues of 7.5YR and 10YR, values of 7 when dry and 5.5 and 4.5 when moist, and chromas of 3 and 4. It either has platy structure or is massive. The B2 horizon has color hues of 5YR and 7.5YR, values of 5 to 7 when dry and 4 and 5 when moist, and chromas of 4 to 6. The color

is at least one unit of hue and chroma redder than that of the A1 and C1 horizons. In texture, the B2 horizon ranges from sandy loam through fine sandy loam to light very fine sandy loam. It has very weak or weak, coarse or very coarse, prismatic structure. The structure is readily discernible in place. In consistence, this horizon ranges from soft to slightly hard. The C horizons have color hues of 7.5YR and 10YR, values of 7 and 8 when dry and 5 and 6 when moist, and chromas of 3 to 6. The C1 horizon, however, may not have a chroma of 6. These horizons range in texture from loam through very fine sandy loam and fine sandy loam to sandy loam. The clay content is less than 18 percent. Some thin strata of loamy fine sand may occur. The lime content is sufficient to make the material violently effervescent with 1 normal HCl. The pH<sub>s</sub> ranges from 8.0 to 8.8 and generally increases with depth. Some soft lime segregations may occur below the B2 horizon, but these are not typical of the series. Gravel or sand may occur at a depth of more than 36 inches.

**Arden series.**—The Arden series consists of soils that have a gravel stratum 10 to 36 inches below the surface but are otherwise similar to McCullough soils. Arden soils are well-drained and somewhat excessively drained Red Desert soils that developed in alluvium derived from limestone, sandstone, shale, and chert. They are on eroded valley plains, on terraces, and in broad shallow swales on fans. The vegetation consists of a sparse stand of creosotebush and white bur-sage. Typically, these soils have a thin A1 horizon very low in organic-matter content, a thin, prismatic reddish-brown B2 horizon, and a Cea horizon.

Typical profile of Arden fine sandy loam (virgin), located about 1,300 feet north and 25 feet east of the southwest corner of sec. 5, T. 22 S., R. 61 E., Mount Diablo base line and meridian in Las Vegas Valley:

- A1—0 to 1 inch, pink (7.5YR 7/4) fine sandy loam, strong brown (7.5YR 5/6) when moist; moderate, medium, platy structure; slightly hard, very friable, nonsticky, nonplastic; few very fine roots; many fine vesicular pores and common medium vesicular pores; violently effervescent; pH<sub>s</sub> 8.4; abrupt, smooth boundary. ½ inch to 3 inches thick.
- B2—1 inch to 7 inches, pink (5YR 7/4) fine sandy loam, yellowish red (5YR 5/6) when moist; weak, very coarse, prismatic structure; soft, very friable, nonsticky, nonplastic; few very fine and fine roots; few fine tubular pores; violently effervescent; pH<sub>s</sub> 8.4; clear, smooth boundary. 5 to 9 inches thick.
- C1ca—7 to 16 inches, pinkish-white (7.5YR 8/2) fine sandy loam, pink (7.5YR 7/4) when moist; massive; slightly hard, very friable, nonsticky, slightly plastic; few very fine and fine roots; few very fine and fine tubular pores; violently effervescent; lime is disseminated; pH<sub>s</sub> 8.6; abrupt, smooth boundary. 0 to 20 inches thick.
- IIC2—16 to 42 inches +, pinkish-gray (7.5YR 7/2) very gravelly fine sand, pinkish gray (7.5YR 6/2) when moist; single grained; loose when dry and moist; few very fine roots in upper part; many fine to medium open pores; about 97 to 99 percent rounded gravel ¼ inch to 1½ inches in diameter; violently effervescent; thin coat of lime on lower sides of some gravel in upper part; pH<sub>s</sub> 8.6.

The solum is 6 to 10 inches thick. The A1 horizon has color hues of 7.5YR and 10YR and chromas of 3 and 4 when dry and 4 to 6 when moist. It either has platy structure or is massive. The B2 horizon has color hues of 5YR and 7.5YR, values of 7 and 6 when dry and 5 and 4 when moist, and chromas of 4 to 6. The color is always at least one unit of hue redder or two units of chroma higher

than that of the A1 and C1 horizons. The B2 horizon has coarse and very coarse structure that is easily observable in place, but much of the soil material is unaggregated if displaced. The Cca horizon, which contains much disseminated lime or common to many soft segregations of lime, has color hues of 7.5YR and 10YR and values of 7 when dry and 5 and 6 when moist. In texture, the A1, B2, and Cca horizons are ordinarily fine sandy loam but in places are sandy loam. The Cca horizon in places contains thin strata of loamy fine sand or light very fine sandy loam. Some gravel occurs either on the surface or within the profile, but it does not exceed 15 percent. The depth to unconformable gravel ranges from 10 to 36 inches.

*Grapevine series.*—The Grapevine series consists of soils that are similar to McCullough soils but are moderately well drained and have a coarse-textured B2 horizon and a nodular Cca horizon. Grapevine soils are deep, minimal Red Desert soils that appear to have developed under imperfect or restricted drainage. They developed on terraces in alluvium derived from limestone, shale, sandstone, and highly gypsiferous material washed from Bracken and McCarran soils. The vegetation consists of a sparse stand of creosotebush, shadscale, and white bursage. Normally these soils have a thin A1 horizon very low in organic-matter content, a thin, prismatic, reddish-yellow B2 horizon, and a nodular Cca horizon.

Typical profile of Grapevine loamy fine sand (virgin), located about 500 feet south of the northeast corner of sec. 11, T. 22 S., R. 61 E., Mount Diablo base line and meridian in Las Vegas Valley:

- A1—0 to 2 inches, pink (7.5YR 7/4) loamy fine sand, brown (7.5YR 5/4) when moist; moderate, medium, platy structure; soft, very friable, nonsticky, nonplastic; few very fine roots; common very fine and fine vesicular pores; strongly effervescent; pH<sub>s</sub> 8.6; abrupt, smooth boundary. ½ inch to 2 inches thick.
- B2—2 to 10 inches, reddish-yellow (7.5YR 7/6) loamy fine sand, strong brown (7.5YR 5/6) when moist; very weak, thick, prismatic structure; soft, very friable, nonsticky, nonplastic; few fine roots; few fine tubular pores and many very fine interstitial pores; violently effervescent; pH<sub>s</sub> 8.4; abrupt, wavy boundary. 6 to 10 inches thick.
- IIC1ca—10 to 21 inches, reddish-yellow (7.5YR 7/6) fine sandy loam, light brown (7.5YR 6/4) when moist; few, fine, faint, pinkish-white (7.5YR 8/2) lime mottles; massive; slightly hard, friable, nonsticky, nonplastic; plentiful fine roots; common fine tubular pores; violently effervescent; pH<sub>s</sub> 8.6; abrupt, wavy boundary. 8 to 13 inches thick.
- IIIC2ca—21 to 45 inches, pink (7.5YR 8/4) light clay loam, pink (7.5YR 7/4) when moist; common, coarse, distinct, white (N 8/0) lime mottles and some soft lime nodules; the amount of clay-size lime is so high that the texture is light clay loam; massive; very hard, firm, slightly sticky, slightly plastic; few very fine roots; few very fine tubular pores; violently effervescent; pH<sub>s</sub> 8.8; abrupt, wavy boundary. 15 to 25 inches thick.
- IIVC3cacs—45 to 60 inches, pink (7.5YR 8/4) fine sandy loam, light brown (7.5YR 6/4) when moist; weakly lime and gypsum cemented; few, medium, distinct, pinkish-white (7.5YR 8/2) lime mottles; massive; slightly hard to hard, very friable, nonsticky, nonplastic; devoid of roots; common very fine interstitial pores; violently effervescent; pH<sub>s</sub> 8.8.

The solum is 5 to 12 inches thick. The A1 horizon has color hues of 7.5YR and 10YR, values of 7 and 6 when dry and 5 and 4 when moist, and chromas of 4 and 3. It either has weak to moderate, medium to thin, platy structure or is massive. The B2 horizon has color hues

of 7.5YR and 5YR, values of 7 and 6 when dry and 5 and 4 when moist, and chromas of 7 to 5. The color is at least one unit of chroma higher than that of the A1 or C1 horizons. In texture, the B2 horizon is either loamy fine sand or loamy sand. It has very weak or weak, coarse or very coarse, prismatic structure. The C horizons have color hues of 7.5YR and 10YR, values of 7 and 8 when dry and 6 and 7 when moist, and chromas of 6 to 4. Any one of the C horizons may have enough disseminated lime in spots to impart a chroma as low as 2. The C1ca horizon has few to common, fine to medium segregations of lime, which normally increase in size and in degree of cementation with increasing depth. A weak, lime- and gypsum-cemented Ccacs horizon is common but is normally below a depth of 30 inches. In many places this horizon contains gypsum crystals. In some spots it lacks gypsum, and in others it is marly and uncemented. The control section, when mixed, is less than 18 percent clay. The pH<sub>s</sub> is variable and has no distinct trend. It ranges from 8.2 to 8.8.

*Goodsprings series.*—The Goodsprings series consists of minimal Red Desert soils that, unlike McCullough soils, have been in place long enough to have formed a textural B2t horizon as a result of redistribution of clay through illuviation. Goodsprings soils are well drained and moderately coarse textured. They developed in alluvium derived from a mixture of rocks, including limestone and sandstone and some quartzite. They occur under sparse desert vegetation on nearly level to gently sloping alluvial fans. Normally, these soils have a thin A1 horizon that contains very little organic matter, a thin, reddish-yellow, prismatic B2t horizon, and a strongly lime-cemented Ccam horizon.

Typical profile of Goodsprings gravelly loamy fine sand (virgin), located about 1,300 feet east and 100 feet north of the west quarter corner of sec. 18, T. 22 S., R. 61 E., Mount Diablo base line and meridian in Las Vegas Valley:

- A1—0 to 1 inch, pink (7.5YR 7/4) gravelly loamy fine sand, strong brown (7.5YR 5/6) when moist; weak, medium, platy structure; slightly hard, very friable, nonsticky, nonplastic; few very fine roots; weakly vesicular; strongly effervescent; pH<sub>s</sub> 8.4; abrupt, smooth boundary. ½ inch to 2 inches thick.
- B2—1 inch to 3 inches, reddish-yellow (5YR 7/6) fine sandy loam, yellowish red (5YR 5/6) when moist; weak, coarse, prismatic structure; slightly hard, friable, nonsticky, nonplastic; common thin clay films in pores; few fine roots; common fine tubular pores; strongly effervescent; pH<sub>s</sub> 8.6; abrupt, wavy boundary. 2 to 6 inches thick.
- B3tea—3 to 8 inches, pink (5YR 8/4) fine sandy loam, light reddish brown (5YR 6/4) when moist; common, fine, distinct, white lime mottles; weak, coarse to medium, subangular blocky structure; slightly hard, friable, nonsticky, nonplastic; roots plentiful; porous; violently effervescent; pH<sub>s</sub> 8.8; clear, wavy boundary; some lime-coated pebbles. 4 to 9 inches thick.
- IIC1ca—8 to 16 inches, reddish-yellow (7.5YR 7/6), weakly lime cemented very gravelly loam, strong brown (7.5YR 5/6) when moist; massive; hard, friable, slightly sticky, slightly plastic; few fine roots; violently effervescent; pH<sub>s</sub> 8.7; clear, wavy boundary. 6 to 15 inches thick.
- IIC2cam—16 to 30 inches, light reddish-brown (5YR 6/3), strongly lime cemented hardpan of very gravelly sandy loam texture, reddish brown (5YR 4/4) when moist; massive; very hard, very firm, slightly sticky; violently effervescent; pH<sub>s</sub> 9.0; lime-coated pebbles are pink (7.5YR 8/4) when dry or moist; clear, wavy boundary. 15 to 25 inches thick.

IIC3—30 to 60 inches, light reddish-brown (5YR 6/3) very gravelly loamy fine sand, reddish brown (5YR 5/4) when moist; massive; soft, very friable, nonsticky, nonplastic; devoid of roots; violently effervescent; a few small soft nodules of lime and some finely disseminated lime carbonate;  $pH_5$  8.6.

In spots, a weak to strong desert pavement covers the surface, but few, if any, pebbles have a desert varnish. The solum is 7 to 11 inches thick and is about 15 percent, but not more than 35 percent, gravel. The A1 horizon has color values of 5 and 6 when moist and chromas of 3 to 6. It may be weakly or moderately vesicular. The B2t horizon has color values of 7 and 6 when dry and 5 and 4 when moist and chromas of 4 to 6. The color is at least one unit of hue redder and two units of chroma brighter than that of the A1 and C1 horizons. The B2t horizon has structure that is readily discernible in place, but much of the material is unaggregated if displaced. The lime content increases gradually from the B2t horizon to the Ccam horizon and is at least 60 percent more in the Ccam horizon than in the next underlying horizon. The Ccam horizon may occur at a depth of 14 to 20 inches. It has color hues of 7.5YR and 5YR, values of 6 to 8 when dry and 4 to 7 when moist, and chromas of 3 to 6. Its color depends on the lime content. The IIC horizons are 50 to 85 percent gravel.

*Jean series.*—The Jean series consists of soils that are similar to McCullough soils, except that they have a coarse-textured B2 horizon and are shallow to moderately deep over gravel. Jean soils are excessively drained, minimal Red Desert soils that developed under sparse desert vegetation on gently sloping alluvial fans. Their parent material was derived from mixed rocks, including sandstone, limestone, and quartzite. Normally, these soils have a thin A1 horizon containing very little organic matter, a light reddish-brown, prismatic B2 horizon, and a Cca horizon.

Typical profile of Jean loamy fine sand (virgin), located at the west quarter corner of sec. 7, T. 22 S., R. 60 E., Mount Diablo base line and meridian in Las Vegas Valley:

- A1—0 to 1 inch, pink (7.5YR 7/3) loamy fine sand, brown (7.5YR 5/3) when moist; weak, medium, platy structure or massive; soft, very friable, nonsticky, nonplastic; devoid of roots; many very fine and fine vesicles and a few medium vesicles; violently effervescent;  $pH_5$  8.3; abrupt, smooth boundary.  $\frac{1}{2}$  inch to  $1\frac{1}{2}$  inches thick.
- B2—1 inch to 8 inches, light reddish-brown (5YR 6/4) loamy fine sand, reddish brown (5YR 5/4) when moist; weak, very coarse, prismatic structure; soft, very friable, nonsticky, nonplastic; plentiful very fine roots; common very fine tubular pores; violently effervescent;  $pH_5$  8.4; clear, smooth boundary. 5 to 8 inches thick.
- C1—8 to 18 inches, pink (7.5YR 7/4) loamy fine sand that is about 10 percent small subangular pebbles, brown (7.5YR 5/3) when moist; massive; soft, very friable, nonsticky, nonplastic; few very fine roots; very porous; violently effervescent; very thin film of lime on lower sides of pebbles;  $pH_5$  8.4; clear, smooth boundary. 8 to 12 inches thick.
- IIC2ca—18 to 25 inches, pink (7.5YR 7/4) gravelly loamy sand, light brown (7.5YR 6/4) when moist; massive; soft, very friable, nonsticky, nonplastic; no roots; very porous; about 40 percent fine subrounded and rounded gravel; violently effervescent; thin lime crust on lower sides of pebbles;  $pH_5$  8.6; clear, smooth boundary. 3 to 10 inches thick.
- IIC3—25 to 42 inches +, stratified fine and medium gravel; color determined by mineralogical composition; loose when dry or moist; very porous; violently effervescent;  $pH_5$  8.4.

The solum is 5 to 9 inches thick. The A1 horizon has color hues of 7.5YR and 10YR, values of 7.5 and 6.5 when dry and 5 and 6 when moist, and chromas of 2 to 4. In texture, this horizon ranges from fine sand through loamy fine sand to fine sandy loam. The number of vesicular pores depends on the texture; none occur in the coarsest textured soils. The B2 horizon has color hues of 5YR and 7.5YR, values of 6 and 5 when dry and 5 and 4 when moist, and chromas of 4 to 6. The color is always one unit of hue redder or one unit of chroma higher than that of the A1 and C1 horizons. The B2 horizon has structure that is easily observable in place, but much of the material is unaggregated if disturbed. A Cca horizon, consisting of soft lime segregations or of thin lime coatings on the lower sides of pebbles, occurs in the C, the IIC, or the IIC horizon, generally at a depth of 14 to 20 inches. The unconformable IIC material is between 16 and 30 inches below the surface. It consists of stratified clean gravel or very gravelly sand; the gravel content is 90 to 100 percent.

**RED DESERT SOILS OF MEDIAL DEVELOPMENT.**—In the following paragraphs are brief descriptions of two series typical of this stage of development and a representative profile of each.

*Skyhaven series.*—The Skyhaven series consists of well-drained, moderately fine textured soils that developed in alluvium derived from sandstone, limestone, and quartzite and from gypsiferous, calcareous, lacustrine material. These soils occur under sparse desert vegetation on remnants of stream terraces. Normally, they have a thin, light-colored A1 horizon very low in organic-matter content, a thin B2t horizon, and an indurated Ccam horizon.

Typical profile of Skyhaven clay loam (virgin), located at the north quarter corner of sec. 7, T. 20 S., R. 61 E., Mount Diablo base line and meridian in Las Vegas Valley:

- A1—0 to  $\frac{1}{4}$  inch, pink (7.5YR 7/4) clay loam, brown (7.5YR 5/4) when moist; weak, thin, platy structure; slightly hard, friable, slightly sticky, plastic; devoid of roots; common very fine and fine vesicular pores; violently effervescent;  $pH_5$  8.4; abrupt, smooth boundary.  $\frac{1}{2}$  inch to 2 inches thick.
- B2tca— $\frac{1}{4}$  inch to 4 inches, light-brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) when moist; many, fine, distinct, pink (7.5YR 8/4) lime mottles; strong, medium, prismatic structure; very hard, firm, slightly sticky, plastic; few very fine and fine roots; common very fine tubular pores and few fine tubular pores; common thin clay films on ped faces and in pores; violently effervescent;  $pH_5$  8.8; abrupt, smooth boundary. 3 to 13 inches thick.
- B22tca—4 to 9 inches, brown (7.5YR 5/4) silty clay, brown (7.5YR 4/4) when moist; common, very fine, prominent, white lime mottles; strong, fine, subangular blocky structure; hard, firm, sticky, plastic; plentiful very fine and few fine roots; common moderately thick clay films and few thin clay films on ped faces and in pores; common very fine tubular pores; violently effervescent;  $pH_5$  8.8; clear, wavy boundary. 4 to 8 inches thick.
- C1caes—9 to 29 inches, pink (7.5YR 8/4), strongly lime cemented hardpan, pink (7.5YR 7/4) when moist; massive; very hard, very firm, nonsticky, nonplastic; few very fine and fine roots to a depth of about 18 inches, none below; few very fine tubular pores; common gypsum crystals; violently effervescent;  $pH_5$  9.0; abrupt, wavy boundary. 15 to 30 inches thick.
- C2cam—29 to 46 inches +, pinkish-white (7.5YR 8/2), indurated lime hardpan, pink (7.5YR 8/4) when moist; massive; extremely hard, extremely firm; devoid of

roots; few very fine interstitial pores; laminar capping along upper boundary; contains small amount of gypsum crystals along fractures; violently effervescent;  $pH_5$  9.0.

In spots, the surface is covered with a weak to moderate gravel pavement. The solum is 8 to 19 inches thick. The A1 horizon has color hues of 7.5YR and 10YR, values of 6.5 and 7.5 when dry and 5.5 and 6.5 when moist, and chromas of 4 and 3. It either has weak to moderate, thin to medium, platy structure or is massive. Ordinarily, this horizon contains common to many, very fine to coarse, vesicular pores. The B2t horizon has color hues of 7.5YR and 5YR, values of 6 and 5 when dry and 5 and 4 when moist, and chromas of 4 to 6. In texture, it is commonly clay loam but ranges from clay loam through silty clay loam to silty clay and light clay. When this material is mixed, the clay content is between 30 and 35 percent. The B2t horizon normally has strong to moderate, medium to fine, prismatic structure, and strong to moderate, very fine to medium, subangular blocky structure in the lower part. This horizon commonly contains lime mottles of various sizes, and it may also have salt and gypsum crystals in the lower part. The indurated Ccam horizon is at a depth of 14 to 31 inches. The indurated Cca horizon contains continuous laminated strata. The upper part contains large amounts of gypsum and is likely to be strongly cemented. Also, there are gypsum crystals in cracks and crevices. The  $pH_5$  ranges from 8.2 to 9.2, and there is no definite trend. Saline phases have been recognized.

*Casa Grande series.*—The Casa Grande series consists of soils that are similar to Skyhaven soils but lack an indurated Ccam horizon and have an unconformable horizon that is weakly cemented with gypsum. Casa Grande soils are well-drained, moderately fine textured, medial Red Desert soils that developed in alluvium derived from limestone, shale, quartzite, and sandstone. These soils occur under a sparse stand of desert shrubs on eroded valley plains and terraces. They typically have a thin A1 horizon very low in organic-matter content, a B2t horizon, and a Cca horizon.

Typical profile of Casa Grande clay loam (virgin), located at the center of sec. 25, T. 19 S., R. 61 E., Mount Diablo base line and Meridian in Las Vegas Valley:

A1—0 to 2 inches, pink (7.5YR 7/4) clay loam, brown (7.5YR 5/4) when moist; moderate, medium, platy structure; slightly hard, friable, sticky, plastic; devoid of roots; many fine and medium vesicular pores; violently effervescent;  $pH_5$  9.0; abrupt, smooth boundary.  $\frac{1}{2}$  inch to 3 inches thick.

B21tca—2 to 12 inches, yellowish-red (5YR 5/6) clay loam, yellowish red (5YR 4/6) when moist; common, medium, prominent, white (5YR 8/1) lime mottles; weak, medium to fine, prismatic structure breaking to moderate, fine and very fine, subangular blocky; hard, firm, sticky, plastic; few very fine roots; few very fine tubular pores; common thin clay films on ped faces and in pores; violently effervescent;  $pH_5$  9.0; abrupt, wavy boundary. 6 to 14 inches thick.

B22tca—12 to 22 inches, light reddish-brown (5YR 6/4) clay loam, reddish brown (5YR 5/4) when moist; common, large, prominent, white (7.5YR 8/2) lime mottles on ped surfaces; moderate, medium, subangular blocky structure; slightly hard, friable, sticky, plastic; few fine roots; common very fine tubular pores; common thin clay films on ped faces and in pores; violently effervescent; few, small, very hard lime nodules;  $pH_5$  9.4; clear, wavy boundary. 8 to 12 inches thick.

C1ca—22 to 32 inches, pink (7.5YR 8/4) light clay loam, light brown (7.5YR 6/4) when moist; massive; slightly

hard, friable, slightly sticky, plastic; no roots observed; common very fine tubular pores; violently effervescent; much segregated lime and common soft lime nodules;  $pH_5$  9.4; clear, wavy boundary. 8 to 15 inches thick.

IIC2cs—32 to 60 inches +, white (10YR 8/1) very gravelly sandy loam, very pale brown (10YR 8/3) when moist; weakly cemented with gypsum; massive; hard, firm, nonsticky, nonplastic; no roots observed; many fine interstitial pores; noneffervescent in matrix, but violently effervescent in spots;  $pH_5$  7.8.

The solum is 15 to 26 inches thick. The A1 horizon has color hues of 7.5YR and 10YR, values of 7 and 6 when dry and 5 and 4 when moist, and chromas of 4 and 3. It either has moderate to weak, medium to thin, platy structure or is massive. This horizon has many to common, very fine to medium vesicular pores. The B2t horizon has color hues of 5YR and 7.5YR, values of 5 and 6 when dry and 4 and 5 when moist, and chromas of 6 to 4. In texture, it is predominantly clay loam; the clay content is less than 35 percent. In structure, the B2t horizon is weak to moderate, medium to fine, prismatic, at least in the upper part, but if the material is displaced, the structure is moderate to strong, medium to very fine, subangular blocky. This horizon contains some lime mottles and may contain a few salt crystals. A Cca horizon occurs just below the B2t horizon. It may consist of disseminated lime with many to common, medium to coarse lime mottles and soft nodules, or of a large amount of segregated lime, which imparts a color value of 8 when the material is dry and 6 and 7 when it is moist. In spots, the Cca horizon is weakly cemented and is hard when dry and firm when moist. The unconformable IICcs horizon is between 22 and 40 inches below the surface and is 50 to 75 percent gravel. Normally, it is weakly cemented with gypsum, but in places there are only coatings of gypsum on the gravel or bridges of gypsum holding the pebbles together. The IICcs horizon is variable in lime content, ranging from noneffervescent in the matrix to strongly effervescent. There are always some lime segregations. The  $pH_5$  value ranges from 8.6 to 9.2 in the A1 horizon and from 8.8 to 9.6 in the B2t and Cca horizons and is less than 8.2 in the IICcs horizon.

RED DESERT SOILS OF MAXIMAL DEVELOPMENT.—A brief description of one series typical of this stage of development and a typical profile are given in the following paragraphs.

*Gass series.*—The Gass series consists of very deep, moderately well drained, fine-textured Red Desert soils that developed under a very sparse stand of stunted desert shrubs on nearly level to gently sloping terraces and fans. The parent material was derived from shale, sandstone, limestone, quartzite, and volcanic ash. Normally, these soils have an A1 horizon very low in organic-matter content and a thick B2t horizon.

Typical profile of Gass fine sandy loam (virgin), located about 300 feet east of the south quarter corner of sec. 28, T. 19 S., R. 62 E., Mount Diablo base line and meridian in Las Vegas Valley:

A11—0 to 1 inch, pink (7.5YR 7/4) fine sandy loam, brown (7.5YR 5/4) when moist; weak, thick, platy structure; slightly hard, very friable; no roots observed; many very fine vesicular pores and common fine vesicular pores; effervescent;  $pH_5$  8.6; abrupt, smooth boundary.  $\frac{1}{2}$  inch to 2 inches thick.

A12—1 inch to 6 inches, reddish-yellow (7.5YR 7/6) fine sandy loam, strong brown (7.5YR 5/6) when moist; weak, very coarse, prismatic structure; soft, very friable,

nonsticky, nonplastic; few fine roots; few fine tubular pores; strongly effervescent; pH<sub>s</sub> 8.8; abrupt, smooth boundary. 0 to 7 inches thick.

IIB1t—6 to 9 inches, reddish-yellow (7.5YR 6/6) fine gravelly loam, strong brown (7.5YR 5/6) when moist; moderate, fine, subangular blocky structure; hard, firm, slightly sticky, slightly plastic; few fine roots; few fine tubular pores; few thin clay films on ped faces and in pores; gravel consists of angular lime hardpan fragments; strongly effervescent; pH<sub>s</sub> 8.8; abrupt, smooth boundary. 3 to 15 inches thick.

IIB21tea—9 to 14 inches, light-brown (7.5YR 6/4) gravelly clay or light clay, strong brown (7.5YR 5/6) when moist; common, medium, prominent, white (N 8/0) lime flecks and mottles; strong, fine, subangular blocky structure; very hard, very firm, very sticky, plastic; few fine roots; few fine tubular pores, many thin clay films on ped faces and in pores; strongly effervescent in matrix; pH<sub>s</sub> 8.6; abrupt, smooth boundary. 4 to 8 inches thick.

IIB22tea—14 to 22 inches, light-brown (7.5YR 6/4) clay, brown (7.5YR 5/4) when moist; common, coarse, prominent, white (N 8/0) lime mottles and some soft nodules; strong, fine, prismatic structure; very hard, very firm, very sticky, very plastic; few fine roots; few fine tubular pores; thin continuous clay films on ped faces and in pores; strongly effervescent in matrix; pH<sub>s</sub> 8.4; abrupt, smooth boundary. 6 to 11 inches thick.

IIB23tea—22 to 60 inches, pink (7.5YR 8/4) clay, brown (7.5YR 5/4) when moist; common, coarse, prominent, white (N 8/0) lime mottles and splotches; moderate, medium, subangular blocky structure; very hard, very firm, very sticky, very plastic; few fine roots; few fine tubular pores; many thin clay films on ped faces and in pores; violently effervescent; pH<sub>s</sub> 9.0.

The solum is more than 60 inches thick. The A1 horizon has color hues of 7.5YR and 10YR, values of 7 and 6 when dry and 5.5 and 4.5 when moist, and chromas of

TABLE 7.—Mechanical data for selected soils

Soil type and location of sample	Horizon	Sample number	Depth	Particle size distribution									
				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.)	Silt (0.05-0.002 mm.)	Clay (less than 0.002 mm.)	International classification		Particles more than 2 mm.
				Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	
Glendale silt loam: Approximately 320 feet south and 1,300 feet west of the east quarter corner of sec. 29, T. 20 S., R. 62 E., Las Vegas Valley.	C1-----	5659	0 to 2	0	0.2	0.2	2.4	28.6	59.1	9.5	66.9	22.8	0
	C2-----	5660	2 to 5	0	.2	.2	2.8	22.0	62.4	12.4	48.8	38.0	0
	C3-----	5661	5 to 9	0	.2	.2	2.5	19.7	61.8	15.6	49.7	34.0	0
	C4-----	5662	9 to 18	0	.1	.1	1.4	33.3	56.3	8.8	74.9	15.9	0
	C5-----	5663	18 to 32	0	.1	.1	2.5	23.4	53.6	20.3	49.5	20.8	0
	IIC6-----	5664	32 to 43	0	.1	.1	5.6	25.6	48.2	20.4	55.0	24.2	0
	IIC7-----	5665	43 to 60+	0	.1	.2	8.8	30.4	43.9	16.6	61.4	21.0	0
Goodsprings gravelly loamy fine sand: Approximately 1,300 feet east and 100 feet north of the west quarter corner of sec. 18, T. 22 S., R. 61 E., Las Vegas Valley.	A1-----	5640	0 to 1	1.0	1.4	5.6	40.0	20.1	17.5	14.4	49.8	12.6	28
	B2t-----	5641	1 to 4	1.3	1.9	6.6	43.8	17.9	11.1	17.4	48.6	6.8	13
	B3tea-----	5642	4 to 9	2.6	2.8	7.0	39.5	17.2	16.0	14.9	47.5	8.4	33
	IIC1ca-----	5643	9 to 14	5.3	4.3	8.4	38.0	13.9	16.4	13.7	42.3	9.2	58
	IIC2cam-----	5644	14+	14.3	7.5	9.8	39.7	9.1	10.7	8.9	35.5	5.6	82
McCarran fine sandy loam: Approximately 120 feet north and 300 feet west of the east quarter corner of sec. 14, T. 22 S., R. 61 E., Las Vegas Valley.	A11-----	5653	0 to 1/2	( <sup>1</sup> )	( <sup>1</sup> )	( <sup>1</sup> )	( <sup>1</sup> )	( <sup>1</sup> )	( <sup>1</sup> )	( <sup>1</sup> )	( <sup>1</sup> )	( <sup>1</sup> )	3
	A12cs-----	5654	1/2 to 14	-----	-----	-----	-----	-----	-----	-----	-----	-----	5
	IIC1cs-----	5655	14 to 27	-----	-----	-----	-----	-----	-----	-----	-----	-----	1
	IIC2cs-----	5656	27 to 36	-----	-----	-----	-----	-----	-----	-----	-----	-----	16
	IIC3cs-----	5657	36 to 47	-----	-----	-----	-----	-----	-----	-----	-----	-----	6
Mead clay: At the west quarter corner of sec. 15, T. 24 S., R. 63 E., Eldorado Valley.	A1-----	5678	0 to 2	4.5	5.2	7.1	23.8	17.3	20.0	22.1	41.8	11.8	20
	IIC1-----	5679	2 to 5	.6	2.1	3.4	12.4	14.0	26.2	41.3	32.3	16.5	1
	IIC2sa-----	5680	5 to 9	.1	.7	1.1	5.2	12.5	33.8	46.6	28.0	22.2	1
	IIC3sa-----	5681	9 to 16	.1	.2	.3	3.3	14.2	37.4	44.5	30.4	24.0	11
	IIC4-----	5682	16 to 36	0	.4	.7	3.2	8.8	41.9	45.0	25.3	27.8	16
IIC5-----	5683	36 to 60+	.1	0	.2	2.7	8.1	40.7	48.2	25.1	26.1	0	

<sup>1</sup> Particle size distribution not reported. Samples stirred twice with 1,000 millimeters of water, but most samples gave indication of flocculation from gypsum after treatment.

3 to 6. If there are two or more strata, only the lowest part has chromas of 5 and 6. In structure, this horizon is either very weak to weak, coarse to very coarse, prismatic or weak to moderate, thin to thick, platy. The A11 horizon has weak to moderate, thin to thick, platy structure. It has vesicular pores. The texture of the B1t horizon ranges from loam through sandy clay loam to light clay loam. This horizon may contain gravel. The B2t horizon has color hues of 7.5YR and 5YR, values of 6 and 7 when dry and 5 and 6 when moist, and chromas of 4 to 6. When dry, the lower part of this horizon may have a value as high as 8, because of the amount of segregated lime. The B2t horizon has strong to moderate, fine to medium, prismatic or subangular blocky structure. In some places it breaks from weak prismatic structure to subangular

blocky. Lime segregations and mottles that range from coarse to medium in size and from common to many in number occur on the faces of all peds and in the interiors of some. The pH<sub>s</sub> is predominantly between 8.2 and 8.8 but it may be as high as 9.2 in the lower part of the B2t horizon.

### Laboratory Data

Tables 7, 8, and 9 give data obtained by mechanical and chemical analyses of selected soils of the Las Vegas and Eldorado Valleys Area. The samples were analyzed at the Soil Survey Laboratory, Soil Conservation Service, Riverside, Calif.

TABLE 8.—Physical and chemical data for selected soils

[Dashes indicate values not determined]

Soil type and location of sample	Horizon	Sample number	Depth	Reaction		Or-ganic carbon	Nitro-gen	C/N ratio	Moisture held at tension of—			Mois-ture at saturation
				Satu-rated paste	1:10				1/10 at-mos-phere	1/3 at-mos-phere	15 at-mos-pheres	
			<i>m.</i>	<i>pH</i>	<i>pH</i>	<i>Pct.</i>	<i>Pct.</i>		<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>
Glendale silt loam: Approximately 320 feet south and 1,300 feet west of the east quarter corner of sec. 29, T. 20 S., R. 62 E., Las Vegas Valley.	C1-----	5659	0 to 2	8.3	9.4	0.62	0.040	15.5	-----	-----	6.1	29.6
	C2-----	5660	2 to 5	8.8	9.8	.47	.043	10.9	-----	-----	6.2	28.7
	C3-----	5661	5 to 9	9.1	10.1	.45	.048	9.4	-----	-----	7.4	29.6
	C4-----	5662	9 to 18	8.9	9.9	.36	-----	-----	-----	-----	5.6	30.9
	C5-----	5663	18 to 32	7.9	9.1	.45	-----	-----	-----	-----	8.4	32.3
	IIC6-----	5664	32 to 43	8.5	9.0	.32	-----	-----	-----	-----	8.6	32.0
	IIC7-----	5665	43 to 60	8.8	9.2	.35	-----	-----	-----	-----	7.7	32.0
Goodsprings gravelly loamy fine sand: Approximately 1,300 feet east and 100 feet north of the west quarter corner of sec. 18, T. 22 S., R. 61 E., Las Vegas Valley.	A1-----	5640	0 to 1	7.5	9.0	.12	.016	-----	14.8	10.7	4.6	17.3
	B2t-----	5641	1 to 4	8.4	9.1	.09	.012	-----	14.3	10.7	5.5	21.1
	B3tea-----	5642	4 to 9	8.5	9.1	.10	.013	-----	25.1	17.7	5.6	37.1
	IIC1ca-----	5643	9 to 14	8.5	9.0	.12	-----	-----	22.8	17.0	6.0	35.8
	IIC2cam-----	5644	14 to 14+	8.5	9.2	.09	-----	-----	12.4	9.4	3.7	-----
McCarran fine sandy loam: Approximately 120 feet north and 300 feet west of the east quarter corner of sec. 14, T. 22 S., R. 61 E., Las Vegas Valley.	A11-----	5653	0 to 1/2	7.9	8.0	.52	.056	9.3	-----	-----	7.7	36.4
	A12cs-----	5654	1/2 to 14	8.0	8.0	.10	.023	-----	-----	-----	26.6	78.2
	IIC1cs-----	5655	14 to 27	8.1	8.3	.17	-----	-----	-----	-----	26.1	65.7
	IIC2cs-----	5656	27 to 36	8.3	8.4	.18	-----	-----	-----	-----	24.5	78.4
	IIC3cs-----	5657	36 to 47	8.3	8.6	.28	-----	-----	-----	-----	23.7	83.2
Mead clay: At the west quarter corner of sec. 15, T. 24 S., R. 63 E., Eldorado Valley.	A1-----	5678	0 to 2	7.9	9.2	.29	.013	22.3	-----	-----	9.0	24.2
	IIC1-----	5679	2 to 5	7.9	8.7	.32	.027	13.3	-----	-----	16.6	37.4
	IIC2sa-----	5680	5 to 9	7.8	8.6	.28	.028	10.0	-----	-----	15.7	45.8
	IIC3sa-----	5681	9 to 16	7.8	8.7	.26	-----	-----	-----	-----	16.4	51.3
	IIC4-----	5682	16 to 36	8.2	8.9	.26	-----	-----	-----	-----	18.5	56.3
IIC5-----	5683	36 to 60	8.5	9.2	.24	-----	-----	-----	-----	20.5	58.9	

TABLE 9.—Chemical data for selected soils

[Dashes indicate values not determined]

Soil type and location of sample	Horizon	Sample number	Depth	Electrical conductivity (EeX 10 <sup>3</sup> )	CaCO <sub>3</sub> equivalent	Gyp-sum <sup>1</sup>	Cation exchange capacity	Extractable cations		Exchangeable Na	Saturation extract (soluble)		
								Na	K		Na	K	Ca and Mg
			In.	Mmhos. per cm. at 25° C.	Pct.	Meg. per 100 gm.	Meg. per 100 gm.	Meg. per 100 gm.	Pct.	Meg. per l.	Meg. per l.	Meg. per l.	
Glendale silt loam: Approximately 320 feet south and 1,300 feet west of the east quarter corner of sec. 29, T. 20 S., R. 62 E., Las Vegas Valley.	C1-----	5659	0 to 2	3.0	38	0	10.7	1.2	1.9	11	20.2	3.0	8.6
	C2-----	5660	2 to 5	2.9	40	0	12.4	1.8	3.5	15	20.6	3.6	4.1
	C3-----	5661	5 to 9	20.1	39	0	14.0	6.9	5.1	49	212.0	21.4	3.9
	C4-----	5662	9 to 18	34.8	35	0	9.5	6.2	3.7	65	390.0	24.9	24.2
	C5-----	5663	18 to 32	43.5	35	6.3	13.5	6.7	3.3	50	520.0	24.2	89.2
	IIC6-----	5664	32 to 43	37.0	38	10.1	12.3	6.2	2.2	50	430.0	15.3	72.8
	IIC7-----	5665	43 to 60+	30.0	38	6.1	11.6	5.6	1.8	48	350.0	7.7	63.2
Goodsprings gravelly loamy fine sand: Approximately 1,300 feet east and 100 feet north of the west quarter corner of sec. 18, T. 22 S., R. 61 E., Las Vegas Valley.	A1-----	5640	0 to 1	.58	15	0	7.5	.1	.8	1	.9	.4	4.3
	B2t-----	5641	1 to 4	.50	11	0	11.0	.1	.9	1	.8	.3	3.6
	B3tea-----	5642	4 to 9	.34	16	0	8.1	.1	.8	1	.4	.3	2.4
	IIC1ca-----	5643	9 to 14	.44	20	0	3.7	.1	.6	3	.6	.3	3.0
	IIC2cam-----	5644	14+	-----	35	0	3.6	2.1	2.3	3	-----	-----	-----
McCarran fine sandy loam: Approximately 120 feet north and 300 feet west of the east quarter corner of sec. 14, T. 22 S., R. 61 E., Las Vegas Valley.	A11-----	5653	0 to ½	3.3	19	58.0	9.4	.5	.4	5	3.6	.9	40.0
	A12es-----	5654	½ to 14	2.9	<0.5	424.0	10.0	.1	.1	1	1.0	.4	36.7
	IIC1es-----	5655	14 to 27	11.3	5	404.0	10.5	1.1	.3	10	63.0	2.7	46.8
	IIC2es-----	5656	27 to 36	20.6	26	74.0	20.9	3.6	.9	17	180.0	7.4	66.3
	IIC3es-----	5657	36 to 47	28.4	38	74.0	17.6	3.4	1.2	19	254.0	9.1	80.6
Mead clay: At the west quarter corner of sec. 15, T. 24 S., R. 63 E., Eldorado Valley.	A1-----	5678	0 to 2	114.3	5	0	20.1	11.8	1.7	59	162.0	9.2	119.6
	IIC1-----	5679	2 to 5	114.6	8	2.6	29.2	12.0	1.7	41	162.0	5.4	125.3
	IIC2sa-----	5680	5 to 9	99.0	10	12.4	31.5	19.0	1.4	60	109.0	2.9	133.4
	IIC3sa-----	5681	9 to 16	77.7	11	13.0	30.4	21.4	1.4	70	89.0	2.6	83.2
	IIC4-----	5682	16 to 36	74.3	11	19.0	32.0	21.1	1.6	66	86.5	3.4	61.6
IIC5-----	5683	36 to 60+	68.0	10	<1.0	32.0	8.3	2.1	26	86.5	4.0	48.1	

<sup>1</sup> To convert to percent of gypsum by weight, multiply number of milliequivalents by 0.0861.<sup>2</sup> NH<sub>4</sub>Ac extractable. A value of 0.1 indicates electrical conductivity is very low.

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## Glossary

- Acree-foot.** The quantity of water that will cover 1 acre to a depth of 1 foot.
- Acree-inch.** The quantity of water that will cover 1 acre to a depth of 1 inch.
- Aquifer.** A porous soil or geological formation that yields ground water to wells and springs.
- Calcareous soil.** A soil containing enough calcium carbonate to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.
- Cation-exchange capacity.** The milliequivalents of cations per 100 grams of soil that can be held by surface forces and that can be replaced by other cations. The term as applied to soils is synonymous with base-exchange capacity, but more precise in its meaning.
- 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.
- Control section.** That part of a soil profile containing the horizons that determine the placement of the soil in the new system of soil classification. Generally, these horizons are between a depth of 10 inches and a depth of 40 inches.
- Eluviation.** The movement of material from one place to another within the soil, in either true solution or colloidal suspension. Soil horizons that have lost material through eluviation are said to be eluvial; those that have received material are illuvial.
- Evapotranspiration.** The loss of water from a soil by evaporation and plant transpiration.
- Fault, rock.** A fracture along which there has been differential movement.
- Field moisture capacity.** The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has been allowed to drain away; the field moisture content 2 or 3 days after a soaking rain; also called normal field capacity, normal moisture capacity, or capillary capacity.
- Flood plain.** Nearly level land consisting of stream sediment that borders a stream and is subject to flooding unless protected artificially.
- Ground water.** Water that fills all the unblocked pores of underlying material below the water table, which is the upper limit of saturation.
- Hardpan.** A hardened or cemented soil horizon, or layer. The soil material may be sandy or clayey, and it may be cemented by iron oxide, silica, calcium carbonate, or other substances.
- Horizon, soil.** A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes.
- Illuviation.** The accumulation of material in a soil horizon through the deposition of suspended mineral and organic matter removed from horizons above. Since part of the fine clay in the B horizon (or subsoil) of many soils has moved into the B horizon from the A horizon above, the B horizon is called an illuvial horizon.
- Infiltration rate.** The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. It may be limited either by the infiltration capacity of the soil or by the rate at which water is applied to the surface soil.
- Lacustrine deposit.** Material deposited in lake water and exposed by lowering of the water table or elevation of the land.
- Leaching.** The removal of soluble material from soils or from other soil material by percolating water.
- Liquid limit.** The moisture content at which a soil passes from a plastic to a liquid state. In engineering, a high liquid limit indicates that the soil has a high content of clay and a low capacity for supporting loads.
- Morphology, soil.** The makeup of the soil, including the texture, structure, consistence, color, and other physical, chemical, mineralogical, and biological properties of the various horizons of the soil profile.
- Permeability.** The quality that enables water or air to move through the soil. Terms used to describe permeability are as follows: *very slow*, *slow*, *moderately slow*, *moderate*, *moderately rapid*, *rapid*, and *very rapid*.
- pH value.** A numerical means for designating relatively weak acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.
- Plasticity index.** The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.
- Structure, soil.** The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).
- Subsoil.** Technically, the B horizon; roughly, the part of the profile below plow depth.
- Substratum.** Any layer lying beneath the solum, or true soil.
- Terrace.** An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.
- 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."
- Wilting point.** The moisture content of soil, on an oven-dry basis, at which plants (specifically sunflower) wilt so much that they do not recover when placed in a dark, humid atmosphere.



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